UNDERSTANDING CARBON LOCK-IN OF ENERGY AND INFORMATION SYSTEMS THROUGH POWER/IGNORANCE

THEORIZING TWO CASE STUDIES OF POTENTIAL ENERGY SYSTEM FLEXIBILITY FROM A NEW ECONOMICS PERSPECTIVE – WITH AN AFTERWORD ON POWER/IGNORANCE IN THE CORONAVIRUS RECESSION

BY
KIRSTEN SOPHIE HASBERG

DISSERTATION SUBMITTED 2020

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Dissertation submitted May 2020

Thesis submitted:	May 4th 2020
Date of viva:	June 10, 2020
PhD counselor:	Professor Frede Hvelplund Aalborg University
PhD committee:	Professor Inge Røpke Aalborg University (chair)
	Professor Dominic Boyer Rice University
	Professor Catherine Mitchell University of Exeter
PhD Series:	Technical Faculty of IT & Design, Aalborg University
Department:	Department of Planning

ISSN (online): 2446- 1628
ISBN (online): 978-87-7210-638-0

Published by:
Aalborg University Press
Skjernvej 4A, 2nd floor
DK – 9220 Aalborg Ø
Phone: +45 99407140
aauf@forlag.aau.dk
forlag.aau.dk

Dedicated to the memory of

Hermann Scheer (1944 - 2010)
Renewable energy visionary and Member of the German Bundestag,
in gratitude of inspiration and encouragement.

CV

Kirsten Sophie Hasberg earned a Master of Science degree in Economics from the University of Copenhagen in 2009. She has more than 10 years of experience in the Danish and German energy sectors, including employment with the Danish Transmission System Operator Energinet and with parliamentary groups of the Danish Folketing and the German Bundestag. As an independent consultant, she has advised organizations like Siemens Transmission, Mercedes Benz R&D North America, as well as the Danish District Heating Association, and evaluated grant applications for the European Horizon 2020 program and the Irish Disruptive Technologies Innovation Fund. From 2016 to 2018, she played an active role in the Berlin blockchain-in-energy startup scene. Her teaching portfolio includes energy transition-related courses at the University of Kassel in Germany and the University of Roskilde in Denmark, as well as an information systems-related module on Digital Technology and New Business Models at the IT-University of Copenhagen. As a science communicator, she engages in art/science crossovers and has co-produced podcasts, a documentary film, and music. Most recently, she co-performed a climate lecture concert at the Roskilde Festival 2019. From 2017 to 2020, she was a PhD fellow of the Sustainable Energy Planning research group at Aalborg University in Copenhagen, where she took part in the Energy Collective research project lead by the Technical University of Denmark, out of which this PhD dissertation has emerged.

ENGLISH SUMMARY

The global use of fossil fuels and their corresponding greenhouse gas emissions are continuously increasing. All the while, the cost of renewable energy systems is plunging. Knowledge about climate change mitigation policies is also ubiquitous. *How can we understand this carbon lock-in*? I argue that this is a question for new economics combining insights of ecological and institutional economics. In two case studies I apply insider research as a phronetic (or problem and practice-oriented) approach to social science. I examine how carbon lock-in takes place in the thought collectives of information and energy infrastructure in the making. Case study A examines the approval process around the Danish-British electric interconnector project Viking Link. Case study B looks at the pursuit of peer-to-peer electricity trading enabled by the information technology blockchain. The two cases represent ideal-typical ways of creating flexibility in the energy system: Fluctuating renewable electricity can be integrated via local and intersectoral exchange or via cross-border electricity trade.

In both case studies infrastructure, understood in a socio-material sense, acts as stored power (as in the French *pouvoir* or the German *Macht*, not as electrical power). It gives rise to novel forms of Foucauldian biopower: infopower, the power inherent to information systems, and energopower, the power inherent to energy systems. I argue that power interlocks with ignorance and becomes *power/ignorance*. This neologism is derived from the hyphenated Foucauldian term *power-knowledge*. Two elements contribute to this interdependence: In the blockchain case sociotechnical imaginaries in the form of techno-utopian visions of desired futures make it possible to ignore questions of governance and power. In the Viking Link case calculative devices like the current way of doing cost-benefit analysis act as performative tools of the discipline of mainstream economics. They determine what is to be included in and excluded from analysis. These sociotechnical veils of power/ignorance turn transition processes against themselves; to use a Derridean term, they become *autoimmune*.

Trying to remove ignorance alone does not transform power/ignorance. Transforming power/ignorance and understanding the energy transition as a *turning* in Heidegger's sense can unlock carbon lock-in. Policy reforms can support such ex-novation: In the electricity sector, principles of sufficiency, subsidiarity, and system cost orientation can replace the current ruleset regarding the regulation of the Danish Transmission System Operator Energinet. In the field of economics, research policy can help alleviate the carbon lock-in of economic thinking. Further research is needed in relation to the data ethics of the energy transition, in order to prevent autoimmune processes from turning smart energy systems into surveillance energy systems. Lastly, in the outlook, I apply the power/ignorance concept to understand the current Coronavirus recession.

TABLE OF CONTENTS

CHAPTER 3. FROM OLD TO NEW ECONOMICS

> We as researchers can influence the reality we study through our choice of theories and methods. Our work is not just epistemological (i.e., the way we know things), but also ontological (i.e., what things are). This creates tremendous ethical responsibilities for researchers (Barad 2007) in that the theoretical-methodological approaches we adopt, create worlds. This makes the decision to adopt a given theoretical lens […] a high-stakes game. (Schultze 2017: 61)

3.1. OLD PARADIGM ECONOMICS

As the arrival story of the preface on page vii suggests, how we define economics is by no means uncontroversial. On the contrary, the mainstream economic thought collective defines its field by exclusion of certain approaches and individuals, thereby exerting hegemonic power over the term economics itself.[77] In this section, I term the current economic thinking *old paradigm economics*, following Edward Fullbrook (2013). It is also often termed neoclassical economics, mainstream economics, orthodox economics, or neoliberal economics.[78] The more general problems of monodisciplinarity discussed in section 2.1 like self-referentiality are especially pronounced in economics, "where a handful of US elite university departments are bestowed with a level of economic, social, institutional and cultural capital (in a Bourdieuian sense) […] [delivering supplies to the] peculiar 'market for economic ideas' […] (see Heise 2019b)" (Heise 2019a: 6).[79]

The research questions regarding carbon lock-in posed in this PhD dissertation (see section 1.2) deal with how power and ignorance shape carbon lock-in and what kinds of practices of unseeing and fact-making devices allow existing infopower and

[77] An up-to-date example is the current verbal bashing of the German professor of energy economics and sustainability Claudia Kemfert who is being marginalized as "not worthy of this discipline" because her conclusions resemble those that renewable energy system engineers have been making for years (see for example (K. Hansen, Mathiesen & Skov 2019)), namely that a transition to 100% renewable energy system is possible and economically feasible in Germany. For the press coverage, see Fell (2020); Götze & Joeres (2020); Kemfert (2020), and Kersting & Stratmann (2020).

[78] I follow the critique of Colander (2000) and avoid the term neoclassical economics; as well as the term "neoliberal thought collective, as argued in the critique of Cahill & Humphrys (2019).

[79] See for example Aistleitner, Kapeller & Steinerberger (2019) for a comparison of citation patterns in economics, and Gibson (2018) for how these citations are concentrated on a few postal codes.

energopower structures to be sustained. They cannot be elucidated by a classical economic approach (which is my educational background)—not even by the sub-disciplines of energy and information economics—because the questions I am asking relate to the workings of power that the discipline of economics in its old paradigm version is rarely interested in: "the most commonplace features of neo-classical and neo-Keynesian economics are the assumptions by which power, and therewith political content, is removed from the subject" (Galbraith 1973: 2). In sum, mainstream economics doesn't work for sustainable transitions (Göpel 2016). More concretely and related to carbon lock-in, the current mainstream understanding of economics is not compatible with the natural science-based calls for climate change action (UNEP 2018). Still, the Bank of Sweden awarded their prize in the memory of Alfred Nobel to Nordhaus in 2018 (KVA 2018)[80]. His work has contributed to carbon lock-in and climate inaction by modelling global average temperature rises as being, more or less, a question of slightly more or less economic growth in the long term perspective (Bichler & Nitzan 2018), contributing to "climate change trivialization" as (Voldsgaard 2020) calls it.[81] Galbraith therefore calls for the emancipation of the economic discipline: "For the economist there can be no doubt as to where this task begins. It is with the emancipation of economic belief" (Galbraith 1973: 11). One such emancipatory movement is new economics, which can be understood as the creation of a new field growing out of institutional and ecological economics (with inspiration from fields like Science and Technology studies and political economy).

Where does old economics leave heterodox economic approaches to sustainability and power, like mine? As the name suggests, heterodox means "not conforming with accepted or orthodox standards or beliefs" (OED 2020f); economic alternatives are negatively defined, up against orthodox, the right (from Greek *orthos*) opinion (from Greek *doxa*) (OED 2020i). This bears little of the emancipatory potential that Galbraith called for (see above). Heterodox economists can either take the space left next to the old paradigm economics and, in the name of plurality, be tolerated as a mere hyphen or modifier economics[82] like environmental or gender economics that do not threaten the mainstream. Alternatively, heterodox economic perspectives can give in to the hegemonizing of economics altogether and abandon the term economics in our name (and, for example, frame our work as being inside the fields of organization or management studies, social science energy research, or sustainable transition studies). Another way of giving our work a home is by turning economics into an adjective and adding another discipline, as in economic sociology or economic

[80] For a critique regarding the 2019 awards, see Kvangraven (2020).

[81] See Hasberg (2008) regarding one of the fundamental problems of Nordhaus' approach, the rate of discounting.

[82] A subfield of economics with a particular interest in a specific empirical field. The term is borrowed from the more common expression "hyphen sociologies", used about empirically (and interdisciplinarity) oriented sub-disciplines of sociology.

anthropology.[83] However, this does not directly interfere with old paradigm economics, as these disciplines have now placed themselves outside of the economic thought collective. But as the Nordhaus Nobel Prize example above shows, leaving economics to old paradigm economists is simply not an option if we want to take our natural science colleagues seriously. To summarize in the language of old paradigm economics: "We believe that economics has been trapped in a suboptimal equilibrium in which much of its research efforts are not directed towards the most pressing social needs" (Collander et al. 2009: 264).[84] And just as "a 16-year-old Swedish schoolgirl shames us by asking 'Where are the adults?'" (Thunberg 2019, cited in Galvin 2020), I find myself asking: Where are the—new—economists?

I do not take the inability of old paradigm economics to answer my research questions as a reason to leave the field of economics altogether, but to redefine economics itself. While I do borrow concepts from organization studies, Science and Technology studies, and energy social science research, among other fields, I fundamentally define my work as being part of the discipline concerned with the "provisioning and appropriation" (Røpke 2020) of, in my case, energy, and thus, as part of new economics, which I consider in the next section.

New economics follows the field creation-approach to coping with the research constraints of old economics.[85] "Scholars are interested in integrating different disciplines; they are not restricted to a limited set of disciplinary approaches for scientific problem-solving" (Woiwode & Froese 2020: 10). Of the four categories of strategies to overcome interdisciplinary challenges presented by Woiwode & Froese (2020), only field-creation is path-breaking and characterized by the restoration of "a choice situation – the insertion of at least one alternative course of action" (Sydow et al. 2009:14, cited in Woiwode & Froese 2020). The term "choice situation" refers to a concept similar to "choice awareness" (H. Lund 2000), which denotes the awareness of alternative energy system pathways. In relation to economic scholarship, choice situation means being aware of alternative research pathways. Thus, field-creating interdisciplinary researchers "attempt to shape institutional, social and technical facets […]" (Garud & Karnøe 2001:7, cited in Woiwode & Froese 2020). In sum, field creation in the context of economics can be understood as "thinking without [the] banister" (Arendt 2006) of the existing economic disciplinarity.

[83] This is absolutely not to say that there is something wrong with the fields mentioned, as they provide immensely valuable work to the understanding of, indeed, questions like carbon lock-in.

[84] It is beyond the scope of this introduction to go into further detail with (criticisms of) old paradigm economics; see instead the section on "Motivations for a new economics" in Røpke (2020) for a summary.

[85] The niche-seeking through special issue publishing discussed in the previous section (2.3) can "be the starting point of new fields" (Woiwode & Froese 2020: 10).

3.2. NEW ECONOMICS

This section is inspired by Inge Røpke's "Econ 101" (2020) on how to teach a new economics (without necessarily referring to old economics)[86] and Arild Vatn's (2020) expanded research program for ecological economics. It seeks to provide an answer to the question posed in the introduction to this chapter on page 31: What field am I in?

The carrying capacity of the atmosphere of Earth is one of the biophysical limits that is currently being exceeded, as explained in the introduction; a topic that ecological economics regards as fundamental to its approach to economic issues. On the other hand, the term lock-in stems from (old) institutional economics, which takes interest in the institutional embeddedness and path dependency of the economy. Institutions are here understood as the "integrated systems of rules that structure social interactions" (Hodgson 2006: 2). Hence, questions of fossil fuel path dependency and carbon lock-in of my PhD research belong to an emerging field of "ecological-institutional economics" (Söderbaum 2019: 194), which Røpke (2020) terms *new economics*.

3.2.1. APPROACH

A new economic paradigm (Fullbrook 2013) must constitute a fundamental alternative to old paradigm economics.[87] Similar approaches have also been called "post-autistic economics" (Fullbrook 2002), economics for a warming world (Ackerman 2007), transformative economics (Schneidewind et al. 2016), and donut economics (Raworth 2017). New economics takes its inspiration from institutional economics (Vatn 2018; 2020) and ecological economics (Røpke 2020). Integrating ecological issues in institutional economics, for example by fusing energy system research and institutional economics (Hvelplund 2005), is not new; integrating social, institutional and power issues in ecological economics is not new either (Jacobs 1996; Gale 1998; Shi 2004: 28). But naming the resulting work simply as new economics is. Written without an adjective as a modifier and without quotation marks, it aims at representing the new paradigm as non-exotic and independent from old paradigm economics, which Røpke (2020) emphasizes as important. Rather, it seeks to answer questions regarding the "provisioning and appropriation […] [of] the real cake" (Røpke 2020: 7). The real cake is "a 'pile' of products and services provided during a

[86] See Graupe (2012a; 2012b; 2013) regarding economics education and its function as a rite of passage.

[87] Economists themselves, in practice, can be crossing over from old to new paradigm economics in their work or evolve from emphasizing one paradigm to emphasizing the other. For example, the former chairman of the Danish economic council, Peter Birch Sørensen, is now putting forward arguments as to why not to deplete the oil and gas from the Danish North Sea (Nielsen & Bahn 2019) on the basis of a Norwegian economic study (Fæhn et al. 2017).

year, which is called 'real' to emphasize that it is not measured in money or any other unit of value" (Røpke 2020: 7). There is a fundamental interest of new economics in the materiality of the economy (see also Chapter 5 on new materialism): Supply and demand are not just two curves that intersect as Inge Røpke emphasizes (2020: 6). They are governed by materialities researched in fields like industrial economics, not by the assumed production functions of old paradigm economics.

The primary difference between new and old paradigm economics is that new economics rests on an understanding of the biophysical basis on which humanity and hence its economy rests[88]; whereas old paradigm economics disregards this biophysical basis by treating it as instrumental to human economic growth. Thus, old paradigm economics could also be termed "fossil economics". New economics is thus an "economic perspective that can be applied to the study of a biophysical and social whole" (Røpke 2020: 5). It must necessarily be about degrowth, as the biophysical limits are currently being overstepped (Kallis, Kerschner & Martinez-Alier 2012).

3.2.2. FOUNDING FIELDS: INSTITUTIONAL AND ECOLOGICAL ECONOMICS

New economics, in contrast to its mothering and fathering disciplines of different heterodox economic directions, among them ecological economics and institutional economics[89], differs from them by no longer necessarily studying the interrelationship between economic systems and ecosystems (Costanza 1989) on the one hand or that between the economy and "integrated systems of rules that structure social

[88] I avoid phrasing this relationship as an embeddedness of the economy in the biosphere because I share Inge Røpke's objections to the term. She explains: "In my opinion, attempting to capture this broad range of aspects through the idea of embeddedness, whereby the economy is pictured as a specific sphere that is embedded in society, which is then embedded in the biosphere, is problematic. This illustration suggests that the economy can be de-limited in an ontological sense and that the biosphere and society are surroundings or frameworks. Instead, the idea of embeddedness could be replaced by the idea of economics as a specific perspective on the totality of human life with the purpose of highlighting provisioning. In this way, it is emphasized that economic issues are always essentially biophysical, technical and social. At the same time, this view emphasizes the need for openness to insights that are achieved through other perspectives on the totality because they are often relevant for the practices of provisioning" (Røpke 2020: 5).

[89] I here primarily mean old, or historical institutional economics (Granovetter 1985; Hodgson 1988; 2006), not new institutional economics (Coase 1937; Williamson 1985). "New institutional economists deviate from neoclassical economics mainly by including information and transaction costs. [...] Classical institutional economics emphasizes the role of culture and social processes and sees humans as socially constructed, and in this way it goes beyond new institutional economics" (Vatn 2018: 6). For further reflections regarding old vs. new institutional economics, see Appendix D.

interactions" (Hodgson 2006: 2) on the other. Just as mainstream economics assumes the unlimitedness of the biosphere, new economics takes the insights from institutional and ecological economic disciplines regarding the limited biophysical basis and the constraining effects of institutions as given, in order to orient itself towards concrete questions.

While old paradigm economics is based on the instrumental ethic of utilitarianism (Arler 2006), the natural science basis leads new economics to a fundamental ethical and normative imperative, which Hermann Scheer (2010), with a pun, called the "energ-ethic imperative": Do not destroy the planet. In this way, new economics may be seen as a re-orientation towards the original meaning of the Greek word *oikonomia*: It means stewardship or management of household, that is, taking care of, or looking after, the home. For Aristotle, *oikonomia* was significantly different from *chrematike*, whose definition is much closer to what we consider economic activity today: *Oikonomia* is about unlimited wealth-getting (Arler 2006: 7).

New economics is interested in many areas of human activity that contribute to the provisioning and appropriation sustaining human life: Energy systems, pension schemes, school payments—in short, all the topics that current economists put under scrutiny and make policy recommendations about. For example, an economics of labor and care would research new forms of organizing work and care in line with the biophysical limits (Antal 2018; Frey 2019); housing economics would do likewise and deal with the provisioning and appropriation of housing (Stratford 2020). In the same way, research into the areas of energy and information systems would focus on how these systems in their current and envisioned future forms can be sustained by the biosphere and thus meaningfully contribute to human well-being on earth (Røpke 2012). New economics is thus interested in promoting an energy transition that diverts from the current path of treating nature, with the words of Martin Heidegger, as a "standing reserve" (see section 5.2.1 on Heidegger's energy ontologies). The insights from especially old institutional economics mean that new economists acknowledge that institutions and power structures significantly influence and constrain human activity and see it as their task to strive for justice (Faber 2008).

3.2.3. RELATIONSHIP TO OTHER FIELDS

The new economics "gaze" cuts across traditional natural, social, and human sciences (Røpke 2020: 5) and therefore borrows concepts from these three different knowledge domains. For example, the natural sciences are useful to understand the biophysical basis, social sciences shed light on institutions (Vatn 2020), and the humanities are home to ethics and (techno)anthropology[90]. Therefore, it is in its nature inter- and

[90] Techno-anthropology focuses on relations between technology, humans, and society. As it is provocatively argued in one of the chapters of the anthology *What is Techno-Anthropology?*, all anthropology should be called techno-anthropology (Birkbak 2013).

transdisciplinary. This is not just a collaboration that cuts across disciplinary boundaries, but across ontological and epistemological ones (for an introduction and discussion of these terms and my use of them, see Chapter 5 and 6). The natural sciences operate on a positivistic ontological and epistemological basis; a model that old paradigm economics seeks to emulate (see Flyvbjerg's "physics envy" in section 3.2.4 below). New economics is also inspired by the natural sciences, but in a different way: The natural science insights regarding our habitat form the knowledge base for a new economics. The biosphere is limited and the biophysical basis for human activity is constrained. Interdisciplinarity is an important way in which new economics enables the economic discipline to move beyond the mono-disciplinarity of old paradigm economics: I am in need of both natural, social, and human sciences to be able to answer the research questions posed in section 1.2. Without this three-dimensional interdisciplinarity of new economics, I cannot find the answers to the problems I seek to understand; they remain outside my cognition context. In my work, I borrow concepts from all three dimensions, including philosophy, science and technology studies, (critical) organization studies, and sociology.

Following Hvelplund (2005: 54), the thought collective of new economics is dispersed across different actors and institutions. Within academia, it can be found in heterogenous disciplines like, for example, environmental science, sustainability transformation research, and energy planning; it is also present in NGOs, action groups, and in some ministries of energy or the enviroment, as well as in environmental protection agencies. The institutional dispersion of colleagues doing similar work means that I have chosen a niche-seeking approach to publishing by seeking out special issues (see section 2.3 above).

3.2.4. METHODS AND RELATIONSHIP TO REAL-WORLD PHENOMENA

Old paradigm economics has been jokingly defined as "economics is what economists do," a phrase attributed to the Canadian economist Jacob Viner. This is true in the sense that old paradigm economics is methodologically defined (Skarbek 2020)—that is, defined by the application of a positivist worldview in combination with mostly quantitative methods—more than by its object of study (which can be anything from sports to energy systems to music and housing). I use the following definition of positivism: "(a) there is an objective external reality awaiting discovery and dissection by science; (b) scientific method gives privileged access to reality; (c) language provides a transparent medium for categorization, measurement and representation; (d) the observer scientist occupies a position outside and objective reality from which he (rarely she) develops and validates robust theories about reality" (Adler et al. (2007: 157, cited in Hartz 2011: 217)). Rodrik (2015) even claims that the economics profession "is unforgiving of those who violate the way work in the discipline is done" (Rodrik (2015: 199, cited in Skarbek 2020: 3) and "this sentiment might well apply to engaging with qualitative evidence" (Skarbek 2020: 3). The arrival story in the preface can be seen as an example of such unforgivingness. This is not to say that quantitative

methods are problematic in themselves or cannot be useful—rather, it is a problem that it is a methodological preference, not the problem at hand, that defines what research approach is used.

While old paradigm economics is defined via method, "methods could never substitute for rational dialogue and virtuous judgment" (Arler 2006: 7). Instead, Faber (2008) asserts the importance of practical wisdom, or phronesis, to ecological economics—a term Aristotle used to define economic rationality (C. U. Becker 2016). Phronesis is also the term that Flyvbjerg (2001) utilizes as he makes the case for *Making Social Science Matter* (Flyvbjerg 2001a). Flyvbjerg tried to cure social science from its "physics envy" (Flyvbjerg 2001b: 1), and what he perceived as its emulation of positivism[91] and the natural and technical sciences. Similarly to Flyvbjerg, Schumacher critiques the "physics envy" of social science with the words: "The maps produced by modern materialistic Scientism [which Schumacher explains as "the rigorous application of the scientific method to all subjects and disciplines"] leaves all the questions that really matter unanswered; more than that, they deny the validity of the questions" (Schumacher 1977: 3–5).

He argues for the societal immersion of the scholar in what he calls phronetic social science to produce change. A new economics thus borrows from both ecological economics and from phronetic social science and takes interest in concrete problems. Methodologically, close-up studies (Alvesson 2003), institutional ethnography (D. E. Smith 2007). or the three-step approach of concrete institutional economics (Hvelplund & Djørup 2017) that involves "the socio-anthropological method of going close" (Hvelplund et al. 2019: 168) are useful to a new economics. The economist must approach questions like an anthropologist and "challenge the idea that the organization of society is 'natural' and given" (Røpke 2020: 7). This suggests a reflexive praxis; new economics thus brings the reflexive turn to economics. Based on its phronetic interest in economic reality, new economics must also engage in theorizing (Swedberg 2017). After debunking economics comes theory (re)building, because "theory construction will produce a structure isomorphic with the scientific structure producing it" (Galtung 1977: 29, cited in Hvelplund 2005: 16). Therefore, new economics will build different theories than old paradigm economics. Theorizing is an important step beyond playing close attention to reality. Otherwise, an "unwillingness to abstract from and go beyond one's data leads to pure narrative" (Hirsch, Michaels & Friedman 1987: 333).

3.2.5. GOALS

Old paradigm economics seeks to identify so-called optimal solutions, proverbially summarized as Adam Smith's invisible hand of the "free market," which is a market

[91] For a brief summary of logical positivism, see Chapter 6.

model under certain strong assumptions, including perfect competition (Hvelplund 2005). This is for example done using computable general equilibrium models like the *Danish Rational Economic Agents Model* (DREAM). New economics recognizes that real markets do "not fulfil the institutional preconditions of the 'free market' of the textbooks. […] The strongest actors on an oligopolistic 'real market' use the ideology of the 'free market' to argue for no public regulation, without removing their own private regulation of the market" (H. Lund & Hvelplund 2012: 194). This private regulation of the market can also be called "*regulatory capture*, which I return to in Chapter 8 on policy. Therefore, "markets have to be consciously constructed to serve sustainability purposes and influence the direction of technical change" (Røpke 2020: 11). New economics, therefore, is a "science of potentiality"[92] (Schneidewind 2017) that aims at pointing out and assessing alternatives, as opposed to the prescriptive optimization approach of old paradigm economics (Lund et al. 2017).[93]

The "arithmomania" of economics (Georgescu-Roegen 1979: 323) is also problematized by Ludwik Fleck as the "worship of number"[1] (Fleck 1935: 189), in the translation of Fred Bradley and Thaddeus J. Trenn termed the "reverence for number and form" (Fleck 1979: 144). Renata Salecl also addresses this "obsession with predicting and forecasting things that are rather random, like the market" (Salecl 2012: min. 44). It is important that the problem lies not with mathematics or modelling itself. There are plenty of heterodox economic schools of thought, like the system dynamics of Jay Forrester (Saeed 2014), a branch of operations research (Filho 2017: 95). Rather, the question is what mathematics and models are used for. Paul Pfleiderer (2020) calls models that act to distort policy processes "chameleons because they change colors in order to avoid having their assumptions subjected to appropriate scrutiny" (2020: 81) In that sense, economics is similar to the natural science described by Ludwick Fleck that has "a particular inclination to objectivize the thought structures [Denkgebilde] that it has created" (Fleck 1979: 144).

3.2.6. RELATIONSHIP TO POLICY MAKERS

Crucially, the new economist must—like their mainstream counterpart—engage in policy recommendations and not be sidelined by old paradigm economists. This is a crucial difference to many other social scientists, possibly especially those identifying with a critical position, if one takes the following quote at face value: "Critical academics have been busily worrying about epistemology while Seattle was burning" (Parker 2002: 125). Frede Hvelplund & Søren Djørup (2017: 1219) address a similar problem among transitions theorists who, albeit doing important interdisciplinary

[92] Own translation of the German "Möglichkeitswissenschaft".

[93] For a comparison of the AAU Institute of Planning approach and the University of Copenhagen Institute of Economics approach to socio-economic cost-benefit analysis also mentioned in the preface, see (Hasberg 2007).

research by addressing "the relationship between social science and technological questions, […] seldom link these concepts to concrete policy recommendations." Hirsch et al. (1987) explain that sociologists, despite a desire for impact, "often are policy outsiders, preferring to define the problems and debunk nearly all solutions" (Hirsch et al. 1987: 324); they "analyze critically, sometimes rouse and stir, but they rarely venture to propose fixes and remedies," Marion Fourcade et al. (2015: 109) add. With its policy recommendations, while being concrete, new economics must address fundamentals—not just produce "knowledge around the edges of the gigantic crisis unfolding before us" (Galvin 2020: 1). Paraphrasing John Myles (2003: 511), someone has got to do the heavy lifting.

Anticipating the discussion of ontological conceptions of energy transition in Chapter 5, the narrow definition of key terms of energy transition like flexibility[94], discussed by Stanley Blue, Elizabeth Shove, and Peter Forman (2020) highlights "a much wider failure - especially within engineering and economics - to engage with insights from the social sciences." This is "also symptomatic of another failure, this time within the social sciences, to [...] argue for the practical significance of [...] a thoroughly social understanding" of flexibilities specifically in the case of Blue et al., and the energy transition more generally (Blue et al. 2020: 13). The policy interventions of a new economics need to reflect the interdisciplinarity discussed in section 3.2.3., because, as Royston & Selby (2019) show, a compartmentalization of policy advice is insufficient in addressing challenges like energy transition.

3.2.7. WHAT DOES NEW ECONOMICS DO?

As the opening quote of Chapter 3 by Ulrike Schultze shows, the choice of what field I am in is important, because disciplines are performative.[95] Schultze (2017) asks what kind of world we want to make with our theories. "Performativity makes […] [the] forceful claim […] that our instrument-dependent practices that present reality in a certain way, actually produce the world" (2017: 61).

New materialism (see Chapter 5), framed as an ontological turn in philosophy, has been taken up in Science and Technology studies (STS) where actor-network-theory suggests that not only humans carry agency; objects do, too. This perspective is suitable for exploring, for example, smart homes as non-human actors (Gram-Hanssen 2019) and will arguably only become more important as the so-called internet of things (IOT) develops. One important concept derived from actor-network-theory are

[94] See also *Energy Fables: Challenging Ideas in the Energy Sector* by Jenny Rinkinen, Elizabeth Shove, and Jacopo Torriti (2019) for other examples of the discursive power of key conceptualizations.

[95] See Hasberg (2020a) in Appendix J for a discussion of the term *performativity* in relation to economics, as well as section 5.1. for an introduction to new materialisms.

calculative devices, that is, performative tools of economic and energy system modelling (Callon & Muniesa 2005; Bertelsen et al. 2020). In the Viking Link article (Hasberg 2020a, see Appendix J), I show how calculative devices of old economics exert infopower (Koopman 2019b) by fastening information into pre-defined formats that make the information economically knowable.[96]

> As Timothy Mitchell (2007: 248) emphasizes, instead of just ascertaining that the calculative devices of old paradigm economics is performative, it is "useful to consider what kind of world the (mis)representation helps to organize." When we acknowledge that economic concepts shapes reality and we can understand economic thinking as way of "organizing sociotechnical practices, such as markets, […] the narrowness of neoclassical economics […] serves a purpose" (Mitchell 2007: 244). However, "the question of which theory or model finally prevails and 'performs' reality […] constitutes a research puzzle in its own right," as Stefan Aykut (2019: 15) writes. In "Cents and Sensibility," Marion Fourcade (2011) answers this puzzle by showing "that the mere availability of certain economic technologies does not guarantee their performative effects for the simple reasons that these technologies may not muster enough institutional and political support or that they may not resonate enough with the cultural claims they are supposed to represent" (2011: 1725). In Price and Prejudice, she asserts: "Economic methods are performative, but with qualifications; both whether and how they "perform" their world is determined, in part, through the intervention of politics. (Fourcade 2011b: 15). In other words, the performative effects must fall on fruitful ground. Ray Galvin (2020: 6) comes to a similar conclusion, arguing that economics is performative when it serves the interests of those in power. (Hasberg 2020a: no page)

With reference to Heise's "market for economic ideas" (2019a: 6) (see also page 41) one could say that there is demand for the performativity of old economics by those who are powerful. This demand keeps the supply of old paradigm economics going. Critiquing the performativity of old paradigm economics is in itself is not enough: Therefore, new economists are not only engaged in a critique of old paradigm economic theory, but also in the critique of the "concrete interests that are served by that discipline" (Gale 1998: 137, cited in Shi 2004).

As my research on Viking Link shows (Hasberg 2020a, see Appendix J), the relationship between criticizing old paradigm economics and criticizing those in

[96] "I use the term *performativity of economics* specifically about the infopower (Koopman 2019b) inherent to calculative devices of old paradigm economics. These calculative devices can be economic models or methodologies like cost-benefit analysis as defined by the Ministry of Finance in Denmark that function as informational infrastructures to which infopower is inherent" (Hasberg 2020a: no page).

power is one that goes both ways: By critiquing old paradigm economics, the calculative devices of those in power are weakened; by critiquing those in power, the demand for calculative tools of old paradigm economics declines. Thus, when Røpke (2020) calls for a new economics that aims at promoting "a different performativity of economics – one that implies a strong call for just sustainability transitions and empowers environmental justice movements" (Røpke, 2020: 11), she calls for the production of new type of "foreknowledge" (Aykut 2019: 16) that can challenge established practices. Concretely, this means that an active strategy of new economics intervention can be both to criticize a concrete actor and its decision-making, and at the same time critique the discipline of old economics. At best, both are done in the form of recommending concrete policy measures.[97] Often, paying attention to "infra-critique" (Schick & Gad 2015: 53, referencing Verran 2014), that is, critique that is *already* present inside of a thought collective researched, can be a fruitful way of identifying ideas for change. In the case of Energinet, the Smart Energy System thought collective is present as a sub-thought collective *inside* Energinet (see Appendix F). Chances are that it knows very well which policy changes would be needed. These views can be given a voice through the outside intervention of the researcher.

Table 3-1 summarizes the ideal-type new economics paradigm and how it relates to my research questions and chosen research approach.

[97] This is what the SEP group has done in the case of Viking Link (and in relation to Danish energy planning across the past decades; see for example Lund 2000).

Table 3-1 Ideal-type new economics and its applicability to my research problems

	New economics	Relation to my research questions
Approach	New economics deals with the "provisioning and appropriation […] [of] the real cake" (Røpke 2020: 7). Both quantitative and qualitative methods are used, dependent on the **research problem**.	**My research problem** asks how power and ignorance shape carbon lock-in. These questions require a close-up approach to be answerable.
Founding fields	(old) institutional and ecological economics and ecological economics. Treats markets and "**the economy as a subset of the planet and of its biosphere**" (Fullbrook 2013: 129). New economics is thus **positivist** in its reliance on natural science basis and **normative** in its conclusion that human action should take place within biospheric limits, and be just.	My development of the power/ignorance framework of the two case studies is clearly indebted to an **old institutional economics thinking regarding power.** The 'Corona crisis' afterword is a particularly clear example of how the **economy is a subset of the biosphere**.
Relationship to other fields	New economics cuts across traditional natural, social and human sciences (Røpke 2020: 5). Scholars are interested in integrating different disciplines" (Woiwode & Froese 2020: 10) and **borrow concepts** from other fields.	examples of **borrowed concepts used** are power (humanities), Smart Energy Systems (engineering) and calculative devices (science and technology studies).
Methods and relationship to real-world phenomena	Priority is given to the **real-world phenomena** which are studied in various forms, e.g. using practice thory (Christensen & Røpke 2010), phronetic social science (Flyvbjerg, 2001), or ethnographic approaches etc. **Theorization** is based on that reality (Swedberg 2017).	I use the **real-world phenomena** of Viking Link and blockchain-in-energy as case studies and chose ethnographic insider research as a method. This is the starting point for the development of my power/ignorance framework.
Goals	New economics is a "science of potentiality" (Schneidewind 2017) that aims at pointing out and assessing **alternative pathways** based on an understanding of "the real cake" (Røpke 2020: 7) and it's biophysical limits.	In asking why carbon lock-in persists, I assess why the **alternative pathways** towards renewable energy systems are not taken.
Relationship to policy makers	New economics seeks to be an active player in society by making **policy recommendations**.	the power/ignorance framework forms the basis for the **policy recommendations** given in Section 8.
What does new economics do?	New economics critiques both old paradigm economics and the power structures that benefit from old paradigm economics. It aims at establishing a different performativity (Røpke 2020: 4).	I critically adress both the **infopower of calculative devices** of old paradigm economics, and the **energopower of incumbent energy players**.

Source: Own work inspired by Røpke (2020) and Fullbrook (2013)

To summarize section 3.2 on new economics: Hvelplund (2005: 47) states that "when the empirical reality changes in fundamental ways, a historical need for a fundamental change of thought arises."[98] Such is the case of carbon lock-in, which reveals that existing economic thinking cannot solve the problems of the Anthropocene. The existing cognition context "becomes too narrow"[99] (Hvelplund 2005: 50), especially within scholarly fields like economics where "scientists have acted as contented prisoners of their own theories […] [,] paradigms, and disciplinary matrices"[100] (Outhwaite 2007: 22 with reference to Kuhn 1962, cited in Hvelplund 2005: 50). Hvelplund concludes that the "next step is to localize the conditions […] that determine the possibility space of thoughts"[101] (Hvelplund 2005: 47) and then to "twist oneself free of these thought prisons"[102] (Hvelplund 2005: 76, with reference to Foucault 1966).[103] This is what I have aimed at doing by situating my research within the field of new economics. Frede Hvelplund argues that we must "establish processes that make it possible for people […] to think the societally necessary new thoughts" (2005: 47)[104]. I consider the reformation of the field of economics to be such a process; new economics is a "more spacious thought prison/cognition context"[105] (Hvelplund 2005: 50) compared to old paradigm economics.

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[98] Own translation from Danish: "Når den empiriske virkelighed ændrer sig på så fundamentale områder, er der også et historisk behov for at ændre tænkningen fundamentalt."

[99] Own translation from Danish: "[…] bliver for snæver."

[100] Videnskabsmænd [har] i historiens løb i langt højere grad […] handlet som tilfredse fanger af deres egne teorier […] [,] paradigmer og disciplinmatricer" (Outhwaite 2007: 22).

[101] Own translation from Danish: "Det næste skridt kan så være at lokalisere disse forhold […] der fastlægger tankernes mulighedsrum."

[102] Own translation from Danish: " […] vriste sig ud af et for snævert tankefængsel."

[103] The term *thought prison* may originate from the expression *prison-house of language*, a common mistranslation of Nietzsche: The original German phrase "Wir hören auf zu denken, wenn wir es nicht in dem sprachlichen Zwange tun wollen," written between 1885-87 (Nietzsche 2005: 193–194) has been translated into English as "We have to cease to think if we refuse to do so in the prison-house of language," as used by for example Jameson (1972). For further detail regarding the translation of this phrase, see Behler (1998: 142).

[104] Own translation from Danish: "[…] og etablere en proces, hvor det muliggøres at folk og grupper af mennesker tænker de for samfundet nødvendige nye tanker."

[105] Own translation from Danish: "[…] rummeligere teorifængsel/- erkendelsesunivers."