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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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.

DANSK RESUME

Den globale anvendelse af fossile brændsler og deres tilsvarende drivhusgasudledning øges kontinuerligt. Samtidigt falder omkostningerne ved vedvarende energisystemer. Viden om, hvilke tiltag der er nødvendige for at afbøde klimaforandringer, er også allestedsnærværende. *Hvordan kan vi forstå denne fossile stiafhængighed?* Jeg hævder, at dette er et spørgsmål for ny økonomi, der kombinerer indsigter fra økologisk og institutionel økonomi. I to casestudier anvender jeg insiderforskning som en phronetisk – det vil sige en problem- og praksisorienteret – tilgang til samfundsvidenskab. Jeg undersøger, hvordan den fossile stiafhængighed foregår inden for de tankekollektiver, hvorudfra ny informations- og energiinfrastruktur opstår. Casestudie A undersøger godkendelsesprocessen omkring den dansk-britiske eltransmissionsforbindelse Viking Link. Casestudie B ser på muligheden for peer-to-peer-handel med elektricitet, altså direkte alle-til-alle-handel, ved hjælp af informationsteknologien blockchain. De to cases repræsenterer to idealtypiske måder at opnå fleksibilitet i elsystemet på: Fluktuerende vedvarende strøm kan integreres via lokal udveksling på tværs af energisektorer eller via elhandel over landegrænser.

I begge casestudier fungerer infrastruktur, her forstået på en socio-materiel måde, som magtlager. Den baner vejen for nye former for foucaultsk biomagt, nemlig informations- og energimagt, dvs. den iboende magt i henholdsvis informations- og energisystemer. Jeg viser, at magt låses sammen med ikke-viden og bliver til makkerparret *magt/ikke-viden*. Denne sproglige nydannelse er afledt af det foucaultske bindestregsudtryk magt-viden. To elementer bidrager til denne indbyrdes afhængighed: I blockchain-casen muliggør socio-tekniske forestillinger, dvs. tekno-utopiske visioner om ønskede fremtider, at ignorere spørgsmål om styringsformer og magt. I Viking Link-sagen agerer beregningsapparater, for eksempel den nuværende måde at udføre samfundsøkonomiske analyser på, som performative mainstreamøkonomiske værktøjer. De bestemmer, hvad der indgår i og hvad der skal udelades af analyser. Disse socio-tekniske slør af magt/ikke-viden vender forandringsprocesser mod sig selv; udtrykt med Derrida bliver de autoimmune.

Forsøg på at fjerne ikke-viden alene forandrer ikke makkerparret magt/ikke-viden. At omforme magt/ikke-viden og at betragte energiomstillingen som en omstilling i heideggersk forstand kan bidrage til at forlade den fossile sti. Politiske reformer kan støtte en sådan ex-novation: I elsektoren kan nye principper om tilstrækkelighed, subsidiaritet og systemomkostningsorientering erstatte de nuværende regelsæt. Inden for faget økonomi kan forskningspolitiske tiltag afhjælpe den økonomiske tænknings fossile fastlåsthed. Yderligere forskning er nødvendig i forhold til energiomstillingens dataetik for at forhindre, at autoimmune processer omdanner integrerede energisystemer til overvågnings-energisystemer. Afslutningsvist anvender jeg makkerparret magt/ikke-viden til at forstå den aktuelle Corona-recession I perspektiverings-kapitlet.

PREFACE: AN ARRIVAL STORY[1]

In 2006, I almost failed my bachelor thesis at the Institute of Economics of the University of Copenhagen (Hasberg 2006). My work dealt with how a cognition context[2] (Hvelplund 2005)—a school of thought or thought style (Fleck 1979)—affects the economic analysis of renewable energy transitions. At the oral exam, the external examiner burst out: "This is not a bachelor thesis, this is a political manifesto!"[3]

Why was my writing so clearly controversial at the Institute of Economics in 2006? A bit of context: The Danish center-right government of prime minister Fogh Rasmussen had systematically discontinued renewable energy and other green policies in 2002. In its view, policies supporting wind power or public transport distort markets (NOAH-Trafik 2002; Bach Mortensen 2018). The supporters of this economic cognition context included the Institute of Economics (where I was enrolled) and the Danish Ministries of Finance and Transport. As a prior permanent secretary of the latter, my examiner had spent much of his career making sure that ministers and environmental concerns did not get in the way of civil servants and their transportation models (Ellegaard & Boddum 1999; Dahlin 2000; Rehling 2000; NOAH-Trafik 2002).

I, in contrast, had based my work on the thought style represented by research groups at the Institute of Planning at Aalborg University (AAU), among others (Hvelplund 2005: 54). Regarding energy policy, this way of thinking uses the normative goal of 100% renewable energy systems as a basis for energy planning, instead of performing an optimization exercise to identify and attain an imagined market equilibrium. Seeing AAU and Frede Hvelplund referenced made the examiner erupt. From the

[1] An arrival story is a tool in ethnographic writing introducing how the author came to study the field, or topic, at hand. This "'I was there' element" (Herndl 1991: 325) is used to "give authenticity to the findings" (Aull Davies 2012: 11) and to establish "a particular kind of subjectivity of the ethnographer, which establishes her as able to know and speak about her object" (Beaulieu 2004: 152).

[2] Following Hvelplund (2005), a structured way of seeing the world, like a map that serves a specific purpose. See also Chapter 6.

[3] Own translation from Danish: "Din opgave er ikke en akademisk opgave, det er et politisk manifest!" All quotes are from a complaint that I filed with the Institute of Economics shortly after the exam.

point of view of the latter, the former is "not a real economist as he hasn't been in touch with other economists for years."[4]

The examiner criticized my work by suggesting that if I had wanted to write about faith and conviction, then I should hand in my thesis at the department of theology—which shouldn't even be a university department, in the first place,[5] he added.

My bachelor thesis included a case study of the Energy Year 2006 of the Danish Engineer's Association (H. Lund & Mathiesen 2006). Hundreds of collaborating engineers laid the groundwork for the so-called Smart Energy Systems approach of the Sustainable Energy Planning Group at AAU, focused on linking electricity, heating, and transport systems to integrate variable renewable energy. I concluded that such an approach represented a "homeless cognition context" (Hasberg 2006: 6, citing Hvelplund 2005): It was not yet institutionalized in the dominant school of economic thought. Unfortunately, my external examiner belonged to just that school. I had (not entirely unwittingly) stepped into a minefield of disciplinary conflict, reflecting divergent approaches to economics. The course of the exam itself had confirmed my conclusion, so to speak.

My bachelor counselor managed to keep the examiner from failing me entirely; I got away with the lowest passing grade. Had it been my master's thesis – it would have prevented me from ever pursuing a PhD.

Power in the energy sector is not just a concept; to me, it is an embodied experience. Maybe this explains why you are holding a cover essay on power struggles of the energy transition in your hands today.

Kirsten Hasberg,
Gödöllő, Hungary,
May 4th, 2020

[4] Own translation from Danish: "Frede Hvelplund er jo ikke en rigtig økonom, han har jo ikke haft kontakt med andre økonomer i årevis."

[5] Own translation from Danish: "Hvis du vil skrive om tro og overbevisning, så kan du aflevere din opgave på teologi, som i øvrigt er et fag der slet ikke burde være på universitetet" (from exam complaint).

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LIST OF PAPERS

Along with this cover essay, the papers Hasberg (2019c), Hasberg (2020b) and Hasberg (2020a) comprise my PhD dissertation.

- Hasberg (2019c): From Foucauldian biopower to infopower and energopower: A review of Colin Koopman's and Dominic Boyer's novel conceptualizations of power. *Le foucaldien* 5(1). 1–16. DOI: https://doi.org/10.16995/lefou.70

- Hasberg (2020b): [in preparation] Power struggles on the blockchain and the sociotechnical veil of ignorance: From de- to recentralization. In Morten Knudsen, Tore Bakken, & Justine Grønbæk Pors (eds.), *Organized ignorance: The practices and politics of the organisation of ignorance [special issue]. ephemera*.

- Hasberg (2020a): [revised for resubmission] Constructing the interconnector Viking Link: How calculative devices and thought collectives constitute and reinforce energopower. In Guido Erreygers, Marion Gaspard, & Antoine Missemer (eds.), *Facts in Environmental and Energy Economics: Models and Practices, Past and Present [special issue]. Œconomia*.

This PhD thesis is based on two case studies: The interconnector Viking Link (case A) and blockchain technology in the energy sector (case B). The function of this cover essay is to tie together the three papers and to answer the main research question regarding carbon lock-in (see section 1.2). Two sub-questions in relation to case A and case B are answered in Hasberg (2020a) and Hasberg (2020b). Hasberg (2019c) sets the foundations by reviewing key concepts of power applied across all publications. In addition, I have (co)-written two additional publications:

- Hasberg (2019d): Vom Verteilnetz zum Netz des Zusammenspiels: Zur neuen Rolle von Verteilnetzen in Energiesystemen in Dänemark und Deutschland. *Zeitschrift für neues Energierecht*, *23*(5), 417–422.

- Hasberg et al. (2018): Hasberg, Kirsten Sophie, Brian Vad Mathiesen, Henrik Lund, & Søren Djørup. 2018, May 17. Ein Kabel für deutschen Kohlestrom. *Tagesspiegel Energie & Klima Background.*

These articles are written in German and are therefore not part of the PhD thesis. Nevertheless, the policy chapter 8 of this cover essay is based on insights from Hasberg (2019b), and Hasberg et al. (2018) is the basis for Hasberg (2020a).

CHAPTER 1. EXTENDED INTRODUCTION

Over the past half a century, the scientific body of knowledge regarding anthropogenic climate change has solidified (Le Treut et al. 2007). At the same time the global use of fossil fuels is increasing, as shown in Figure 1-1, and with it carbon emissions continue to accelerate global warming (Ritchie & Roser 2020). All the while the cost of renewable energy is plunging below that of fossil and nuclear, both as levelized cost of electricity (LCOE) (IRENA 2019b)[6] and as system costs (Brown et al. 2018). *Knowledge* about renewable energy systems is ubiquitous (Mathiesen, Lund, Connolly, et al. 2015). We also know what policies are needed overall (IRENA, OECD/IEA & REN21 2018; I. M. Otto et al. 2019), and regarding specific areas like energy markets or concrete national actions. However, implementation remains extremely slow. For example, making the energy system flexible through the integration of electricity and heating through household and utility scale heat pumps[7] has been a topic of Danish energy policy for the past 40 years, but regulatory incentives are lacking still today—for example, Frede Hvelplund (1982) and Claire Bergaentzlé et al. (2019) call for similar grid tariff reforms, almost 40 years apart. "It's been a long time coming," as Aretha Franklin sang[8]—but a change doesn't seem to be coming. As Figure 1-1, shows, the expansion of renewables has just been icing on the cake: It has not changed our accelerating depletion of fossil fuels, and the exponentially growing impact on the planet.[9]

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[6] Levelized cost of electricity is a measure of long-run total cost of electricity generation. "The method of Levelized Cost of Electricity (LCOE) allows a comparison of power plants with different generating and cost structures. The LCOE results from the comparison of all costs, which arise throughout the lifetime of the power plant for the construction and operating of the plant, with the sum of the generated amount of energy throughout the life cycle. The calculation can be conducted either on the basis of the net present value method (NPV) or the so-called annuity method. When applying the net present value method, the expenses for the investment, as well as the payment flows of revenues and expenditures during the plant's lifetime, are calculated by discounting related to a shared reference date. For this purpose, the present values of all expenses are divided by the present value of electricity generation" (Kost et al. 2018: 29). For a discussion of discounting practices, see (Hasberg 2008).

[7] That is, the integration of electricity and heating beyond combined heat and power (CHP).

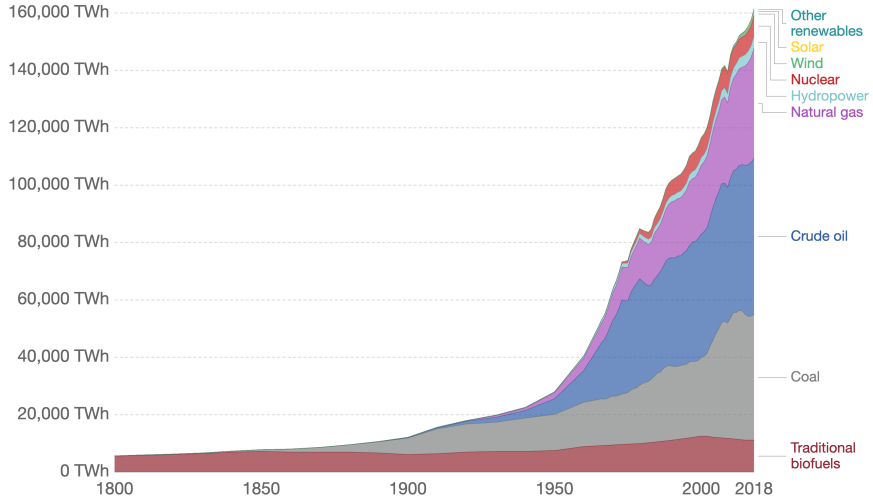
[8] With the words of Sam Cooke, 1964.

[9] The current mass extinction (Ceballos, Ehrlich & Dirzo 2017) demonstrates this "Great Acceleration" (Steinberg 2019) dramatically.

1.1. CARBON LOCK-IN

In contrast to the reality of climate change outlined above, global renewable energy investment slowed down in 2018 (Zhai & Lee 2019). Most nations invest less than 1% of their Gross Domestic Product (GDP) in renewable energy systems (Ritchie & Roser 2017). This is not only due to falling technology costs (IRENA 2019b); the growth of installed renewable energy capacity[10] also stalled in 2018 (IEA News 2019). Framing renewables as costly and aesthetically negative has lowered their perceived desirability (Bach Mortensen 2018: Chapter 7).

Figure 1-1 Global primary energy consumption in terawatt-hours (TWh) per year



Note: Source: Ritchie & Roser (2018) based on data from BP (2019) and Smil (2017).

As a response, governments around the world have phased out successful feed-in tariff schemes like the German Erneuerbare Energien Gesetz (EEG) and the Danish Public Service Obligation (PSO) (Morris & Jungjohann 2016; Cointe & Nadaï 2018).[11] Although many citizens want to engage in the energy transition, national policy

[10] Capacity is defined as the maximum electric output an installation can produce under specific conditions, measured in multiples of watts like gigawatts (GW) or terawatts (TW), that is, units of electric power.

[11] The move from feed-in tariffs to auction schemes in Germany in 2016 and worldwide followed from a push of policy entrepreneurship from the side of the European Commission (Boasson 2019). State aid guidelines (Kahles & Pause 2019) aided the switch to auction instruments (Fitch-Roy, Benson & Woodman 2019). Following Leiren & Reimer (2018), auctioning controls renewable energy development and protects profits of fossil energy interest groups.

barriers prevent widespread local adoption: In Germany, measures like the 1000 meter distance regulation for onshore wind turbines and the 52 Gigawatt (GW) limitation of solar photovoltaics (PV) have brought installations to a halt and the solar and wind industries to tumble (Oei et al. 2020). Denmark has set a halving of the number of onshore wind turbines as an energy policy goal (Bach Mortensen 2018; Regeringen 2018a). Feed-in tariffs for household wind turbines have been abandoned (Regeringen 2018a: 6), and policy changes have also affected solar photovoltaic (PV) home systems negatively, as the stand-still in the installed solar capacity in Denmark shows (Mathiesen et al. 2017: 78). The scientific community in the form of Scientists for Future (Hagedorn et al. 2019), Economists for Future (E4F 2020) and the signatories of the Danish Climate Call[12] (Friis Lund et al. 2018) warn against maldevelopments. But action is lacking. At the same time, subsidies to fossil fuels continue. Globally, fossil energy subsidies remain large. According to estimates by the International Monetary Fund, they amount to 4.7 trillion USD or 6.3 % of global GDP in 2015 (Coady et al. 2019). This does not include subsidies to nuclear power projects like the Hungarian Paks II (Antal 2019) or the British Hinkley Point, two examples of nuclear power plants currently under construction in Europe. Hinkley point alone will receive an estimated 1.6 billion EUR annually for 35 years through a feed-in tariff-like electricity price guarantee (EnergyBrainpool 2015; Greenpeace Energy 2016).

The phase-out of coal does not necessarily mean the end of subsidy payments either: Germany has pledged a total of 40 billion EUR until 2038 as compensation payments to the coal industry regions (Bundesregierung 2020), adding to the existing fossil fuel subsidies of 46 billion EUR annually (Zerzawy & Fiedler 2017). Whether Denmark will phase out the exploration of oil and gas from the North Sea is a decision that is presently being deferred (Berlingske 2020). At the European level, infrastructure subsidies are handed out via the Projects of Common Interest (PCI) list, containing both natural gas pipelines and electric interconnectors (European Commission 2019; Hvelplund, Djørup & Sperling 2019). Sectoral integration options are not funded, although the Clean Energy for All Europeans package intends to support renewable energy communities (REScoop.EU 2017; 2019). In addition to this bleak energy sector outlook, there is a lack of transition in other sectors like transport and food systems, too. We are literally "eating fossil fuels" (Røpke et al. 2017: 8).[13]

[12] Own translation of the Danish term "klimaopråb."

[13] Own translation from Danish: "Man kan på en måde sige, at vi i dag spiser fossile brændsler" (Røpke et al. 2017). Regarding the links between the food and energy transitions, see Friis & Becker (2020) and Ernährungsrat Berlin (2017) as examples of the political demands that a transition of the food system entails.

In the following, both infrastructure and technology are understood in a socio-material way: Infrastructure, both in relation to energy and information, is meant in the sense of Susan Leigh Star and Karen Ruhleder (1996) and is characterized by:

- *Embeddedness.* Infrastructure is 'sunk' into […] social arrangements and technologies;

- *Transparency.* Infrastructure […] does not have to be reinvented […] for each task […];

- *Reach or scope*. This may be either spatial or temporal […];

- *Learned as part of membership*. The taken-for-grantedness of artifacts and organizational arrangements is a *sine qua non* of membership in a community of practice (Lave & Wenger 1991) [like the Fleckian thought collective, see Chapter 6}

- *Links with conventions of practice*. Infrastructure both shapes and is shaped by conventions of a community of practice, e.g. the ways that cycles of day-night work are affected by and affect electrical power rates and needs […];

- *Embodiment of standards*. […] Infrastructure takes on transparency by plugging into other infrastructures and tools in a standardized fashion;

- *Built on an installed base*. Infrastructure […] wrestles with the "inertia of the installed base" and inherits strengths and limitations from that installed base (Monteiro, Hanseth & Hatling 1994) […]; new systems are designed for backward compatibility;

- *Becomes visible upon breakdown*. The normally invisible quality of working infrastructure becomes visible when it breaks; the server is down, […] there is a power blackout.
  (Leigh Star & Ruhleder 1996: 113, italics in original)

A last point is added by Susan Leigh Star in 1999:

- *Is fixed in modular increments, not all at once or globally*. Because infrastructure is big, layered, and complex […] it is never [only] changed from above [my addition]. Changes take time and negotiation […]. Nobody is really in charge of infrastructure.
  (Leigh Star 1999: 382)

The last point may be especially provocative to those who see themselves as in charge for infrastructure.

I use the socio-material definition of technology of Gabrielle Hecht, "broadly includ[ing] artifacts as well as non-physical, systematic methods of making or doing things" (2009: 15).[14]

1.2. RESEARCH QUESTIONS AND RESULTS

How can we understand this current carbon lock-in?[15] We did not, as Unruh titled his 2002 paper, escape carbon lock-in (Unruh 2002). On a global scale, we are rather experiencing an energy non-transformation and "sustained non-sustainability"[16] (Blühdorn et al. 2020). This constitutes a "climate policy paradox" (Unruh & Carrillo-Hermosilla 2006: 1185). I seek to understand this situation taking place as humanity is facing the consequences (UNEP 2018) of the *pyrocene* (Pyne 2019), a term denoting the twofold age of fire that we are in: that of burning fossil fuels and of raging wildfires, as examples of catastrophic natural phenomena attributable to climate change (Oldenborgh et al. 2020). In short, "let's focus more on negative trends," as Miklós Antal et al. (2020: 1) prompt. Why do we have carbon lock-in? How do we have carbon lock-in? I want to put mechanisms of carbon lock-in under the magnifying glass and ask how they happen in practice. We need close-up studies and theorization that "help us understand why humanity continues to plunge toward climate catastrophe despite heightened scientific knowledge and moral awareness" (Galvin 2020: 1). Why, and through what mechanisms, are endeavors bringing the energy transition to a halt instead of to fruition?

What must be understood today are not transformation processes, but rather, the elusiveness of these. What must be understood is not action, but inaction. It is not *knowledge* that must be explained, but the *ignorance* of knowledge. By ignorance, I mean the making invisible of knowledge that Ludwik Fleck (1979) has termed "harmony of delusion" (Fleck 1979: 27), a phenomenon that takes place inside thought collectives, communities of practice that exchange ideas and develop a shared thought style or world view. In addition to looking at ignorance in the face of abundant knowledge, another obvious analytical lens is that of power. The climate crisis is not a tragedy of the commons, as Hardin is often paraphrased, when climate change is explained as market failure. Instead, it is a "tragedy of the few" (Scavenius 2016), that is, a tragedy caused by a relatively small group of powerful economic actors. "It is simply not possible to think about [energy] technologies independently of their

[14] For a specification of the different socio-material components that technology consists of, see Jens Müller, Arne Remmen, & Per Christensen (1984), who define technology as consisting of knowledge, technique, organization, and product; as well as Frede Hvelplund (2005: 11) who adds profit as a fifth component.

[15] Carbon lock-in is here understood as being composed of both (a) infrastructural and technological, (b) institutional, and (c) behavioral components (Seto et al. 2016).

[16] Own translation from German "Nachhaltige nicht-Nachhaltigkeit" (Blühdorn et al. 2020).

economic form", Christine Blättler (2016: 82) argues. "Inequality thus forms the basis for provision systems that enable rich people's appropriation of large amounts of biophysical resources" (Røpke 2019: 6, with reference to Fuchs et al. 2016). Therefore, I ask the overarching research question, pertaining to this cover essay:

How do power and ignorance shape carbon lock-in?

I consider power as a force of "distributed agency" (Garud & Karnøe 2003) that is embedded in materiality.[17] Two forms of infrastructured power are in focus: *Energopower*, a term coined by Dominic Boyer (2019) that can be understood as the power inherent to fossil energy infrastructures; and *infopower*, a neologism[18] of Colin Koopman (2019), denoting the power inherent to information systems.[19] In my first publication, "From Foucauldian biopower to infopower and energopower," I have reviewed these concepts in more detail:

> In *How we Became our Data*, Colin Koopman traces the origins of today's information society back to its origins a century ago, making the point that we are not just represented, but performatively shaped by our data. *Energopolitics – Wind and Power in the Anthropocene* by Dominic Boyer explores the power struggles surrounding renewable energy development in Mexico and shows how it is possible to continue the extractive logic of fossil fuels with renewable energy. Both coin neologisms inspired by the Foucauldian term biopower: energopower (Boyer 2019) and infopower (Koopman 2019b).
> Hasberg (2019a: abstract)

The term *power/ignorance* (see Chapter 7), as a derivative of the Foucauldian term *power-knowledge*, is my analytical lens to grasp the mechanisms behind carbon lock-in: Thought collectives and the physical realm interact to produce what is to be known (facts) and what is to be ignored (see Chapter 6). These facts form the basis of decision-making and performatively shape artefacts like those of the two case studies. Performativity is the effect of a certain practice, for example economics, or of certain categorizations, for example binary gender, on society at large. In this cover essay, it is especially used to consider how the old economic paradigm influences more than passively describes the social world. The term is also used about material performativity, that is, that not only actors, but also things, perform actions and

[17] On new materialism, see section 5.1.

[18] A newly coined word or expression sometimes based on the pattern of existing terms.

[19] Infopower applies both to information systems understood as information and communication technologies (ICTs), and to other forms of information systems, such as *calculative devices*, that is, tools of economic assessment that format our thinking.

"matter comes to matter" (Barad 2003).[20] In my two case study publications, I take a close-up look at two types of potential electricity exchange as a means of energy system flexibility: case study A, a Danish-British interconnector project Viking Link (Hasberg 2020a), and case study B regarding the pursuit of using blockchain technology, an information infrastructure, for local peer-to-peer electricity trading (Hasberg 2020b). The case studies illustrate how processes that are initiated as transformations end up producing more of the same. They are thus examples of carbon lock-in at a concrete, project-level. In the following, I introduce the two cases and my findings, starting with case B as in **b**lockchain, because it is my primary case. Nevertheless, I have named it case study B because it fits the initialism and the paper citation Hasberg (2020b).

1.2.1. CASE B: POWER STRUGGLES ON THE BLOCKCHAIN

Blockchain is a distributed ledger technology based on peer-to-peer information networks, cryptography, and game theory (Voshmgir & Kalinov 2017).[21] It held the promise of enabling peer-to-peer trade, that is, direct exchange between parties without an intermediary, also called a third party. Trust in the intermediary would be replaced by trust in information technology, the blockchain itself (The Economist 2015). Such disintermediation, that is, removal of the need for mediated exchange, could challenge today's major digital businesses based on platformization, the establishing of closed information architectures in consortia of energy incumbents. As an active partaker in the blockchain-in-energy thought collective between 2016 and 2018, I therefore described blockchain technology as "disrupting the disruptors" (Hasberg 2017).

My initial hypothesis regarding the use of blockchain technology in the energy sector was that it would be the missing link in the transition to 100% renewable energy systems (Sagmeister 2017); a missing link between the decreased costs of renewable energy systems described above and the foot-dragging realization of Smart Energy Systems.[22] In brief anticipation of section 5.2.2 on the nature of renewable energy systems, the missing link can be thought of in the following way: Today, it is not possible to exchange—to sell or share—electricity via a public grid in a local area in either Denmark or Germany. The technological vision of blockchain has perpetuated the calls for giving *prosumers* who are both a

[20] See section 5.1 for an introduction to new materialism, and section 3.2.7 as well as Hasberg (2020a, section 2.4) in Appendix J for a broader review of the term *performativity* in relation to economics.

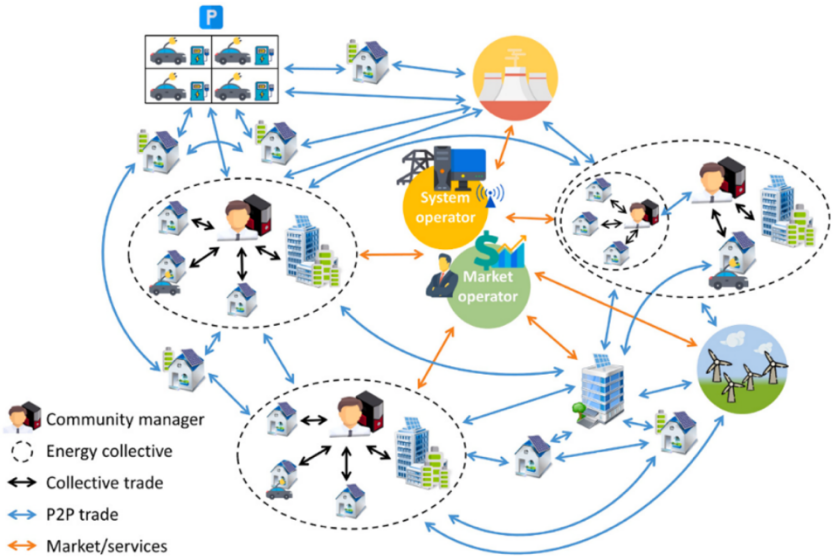
[21] For a non-technical introduction to cryptography, see Singh (2011).

[22] For a definition and discussion of energy exchange in renewables-based electricity markets, see section 5.2.2.

> consumer and producers of energy the possibility to sell their electricity in order to recuperate investments in renewable energy installations. (Hasberg 2020b)

Such a vision of peer-to-peer markets has been put forward in the Energy Collective Project (Sousa et al. 2019).[23] The vision of peer-to-peer markets as shown in Figure 1-2 illustrates what such a vision could entail. It shows peer-to-peer trading between prosumers and consumers. These can be both cooperative groups or individual units like households, industrial units, or cross-sectoral consumers. The latter group includes heat systems, electricity-based transportation systems like electric cars, or electro-fuel-based heavy transportation systems as envisioned in the Smart Energy Systems approach (see section 5.2.3).

Figure 1-2 A peer-to-peer electricity market design



Source: Sousa et al. (2019); conceptualization based on Parag & Sovacool (2016). Re-use conforms to STM Association guidelines (STM 2014).

> Recent review publications on blockchain in the energy sector seem to confirm my missing link hypothesis: "If the goal is to develop a transparent, secure and disintermediated exchange of goods, electricity seems to be the ideal type of asset to be managed through the blockchain

[23] Also known as microgrids, this topic has been actively discussed in electronic and telecommunications systems research for the past 15 years, see for example Rusitschka, Gerdes and Eger (2009) and Werth, Kitamura and Tanaka (2015).

> technology" (Di Silvestre et al. 2020: 15). "Peer-to-peer trading […] is an application domain where blockchain-enabled systems would fit most naturally […]. [Blockchain-based] peer-to-peer trading can be seen as a truly decentralised form of an energy market" (Andoni et al. 2019: 154). "Blockchain will play [a] vital role in the evolution of the IoE [Internet of Energy] market as distributed renewable resources and smart grid network are being deployed and used" (Miglani et al. 2020: 395). "Clearly, a blockchain-based electricity sector would not only change the role of prosumers towards active market participants, but also requires developing solutions for decentralised responsibilities of supply and system operation" (Diestelmeier 2019: 195). "Blockchain in the energy sector […] may contribute to digitalization, decentralization and decarbonization in the future" (Ahl et al. 2020: 8). (Hasberg 2020b)

Most of these article also recognize the regulatory barriers: "current regulation does not allow to run local peer-to-peer energy markets in most countries" (Mengelkamp et al. 2018). These scholarly articles express findings similar to earlier consulting reports and popular writing on the topic (Tapscott & Tapscott 2016; VZ NRW & PWC 2016; BDEW 2017) to some of which I have contributed (Voshmgir 2016; Haleakala-Stiftung 2017; Reetz 2017; 2019; IRENA 2019a).

> However, four years after entering the blockchain-in-energy thought collective, I have changed my hypothesis:
>
> > The real missing link is the societal embeddedness[24] of blockchain—both regarding the past and the future. Where did blockchain technology come from, what are the societal visions that it fuels, and, most importantly, how do the power struggles regarding the peer-to-peer electricity market promises outlined above unfold? [As the works cited above show, many believe that] we are dealing with a fundamental societal transformation—however, [the use of] blockchain technology [in the energy sector] has largely remained a topic of computer science and engineering. Putting it into the context of overall societal transition doesn't just fail—it's largely missing. [Case B of] my PhD thesis aims at closing that gap.
> > Notes, February 2018, Appendix D.
>
> The energy sector hype around blockchain technology is most likely neither living up to its promises of decentralizing governance structures, nor facilitating distributed renewable energy exchange locally, nor shifting

[24] Embeddedness is here understood both in relation to societal structures and to the nature of renewable energy (see Chapter 5).

> power balances. Therefore, I ask research question B, pertaining to case study B (Hasberg 2020b):
>
> *What kinds of practices of unseeing inside blockchain-in-energy thought collectives allow existing infopower and energopower structures to prevail?*
>
> Unseeing is here meant as to "know what not to know" (B. Otto, Pors & Johnsen 2019: 98)—both consciously and unconsciously, actively and passively. (Hasberg 2020b)

I have put thought collective*s* in plural in research question B above, as each startup in the blockchain-and-energy space can be considered its own thought collective, strongly overlapping with others, but still distinct. I will return to Flecks conception of multiple thought collective memberships in section 6.3.

My findings, as expressed in the abstract of Hasberg (2020b), are the following:

> The emergence of blockchains, a distributed ledger technology based on peer-to-peer networks, cryptography, and game theory came along with a re-invigoration of decentralization imaginaries of the internet in general and of the energy sector specifically. I show how this thought collective put forward visions of spatial, economic, and power decentralization but ended up replicating the centralization it originally set out to challenge. These insights are based on insider research in the blockchain-in-energy community around Berlin in the years 2016-2018.
> I argue that the recentralization can be understood through the workings of power/ignorance, a derivative of the Foucauldian power-knowledge, denoting the intertwined relationship between infrastructured power and ignorance, that which is not to be known. The sociotechnical imaginaries act as a veil of ignorance and foster an ignorance towards questions of power. This creates a power vacuum that helps to bring about new centralized *infopower* structures of blockchain governance. At the same time, it maintains existing *energopower* structures of energy incumbents […]. Decentralization displays *autoimmunity*[25] and remains elusive.
> Hasberg (2020b: abstract)

[25] *Autoimmunity* is a Derridian term denoting self-destruction of systems. Derived from the biological notion of autoimmunity, meaning the attack of body cells by the body's own immune system.

1.2.2. CASE A: CONSTRUCTING VIKING LINK

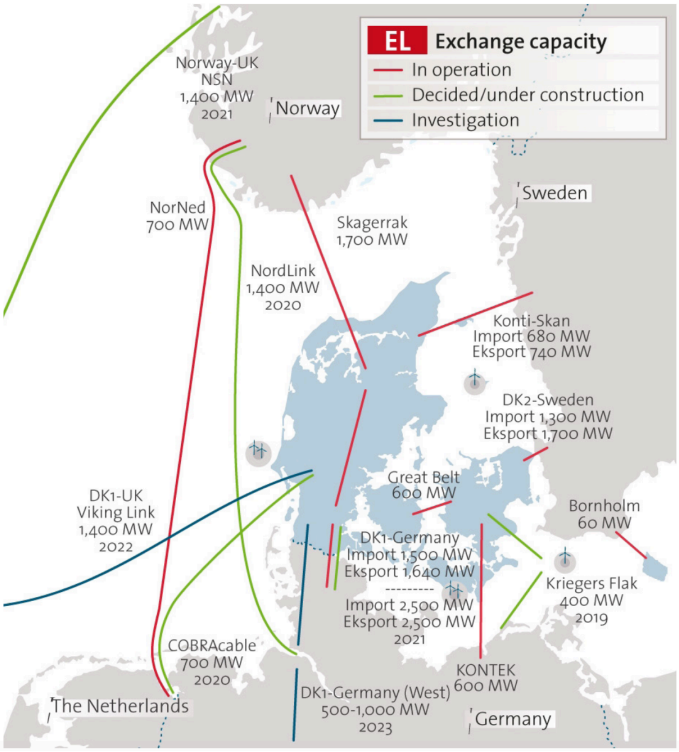
At the other end of the spectrum for energy system flexibilities[26] is international electricity exchange. Viking Link is such a planned facilitator of trade, connecting the British and the Danish electricity markets, as shown in Figure 1-3. As a PhD fellow of the Sustainable Energy Planning (SEP) research group at AAU, I became part of the Smart Energy Systems thought collective.[27] When I joined the research group in mid-2017, it was engaged in a debate about the Viking Link interconnector. Like blockchain in energy, Viking Link, too, entails a promise of being the "missing link" of the energy transition. The interconnector is an artefact of the Supergrid thought community,[28] which aims at solving the problem of flexibility within the electricity sector, without giving up its energopower.

Figure 1-3 Some interconnectors of Denmark and neighboring countries

[26] That interconnection is able to perform the task of integrating renewables is a fact of the Supergrid thought collective, which is contested by the Smart Energy Systems thought collective.

[27] See section 5.2.3 regarding the Smart Energy Systems (SES) approach, and Appendix E for reflections on the SES thought collective as represented by the SEP group at AAU.

[28] See Appendix J (Hasberg 2020a) as well as Appendix F regarding details on the Supergrid thought collective as represented in the Viking Link debate.



Note: The map includes Vikning Link (which is delayed several years compared to the finalization date of 2022 stated on the map), but omits links under consideration: DKE - PL1, DKE-DE (Kontek2) as well as the North Sea Wind Power Hub. Source: Energinet and Danish Energy Agency (2018), Baltic InteGrid (2019), and ENTSO-E (2019). Reproduced in Hasberg 2020a.

This is to be achieved through international interconnection. Thus, this thought style is firmly rooted at the European level and receives funding via the PCI list first mentioned in section 1.1. Viking Link promises to integrate fluctuating wind power by transferring electricity from one country to another during hours of high wind. However, seen from a Smart Energy Systems perspective Viking Link does not seem to be neither useful on the road towards achieving a 100% renewable energy system, nor worth the electricity consumer's money as it lowers the value of sectoral integration and does not solve the problem of fluctuating renewable electricity sources (Mathiesen, Lund & Djørup 2018). However, Viking Link is being constructed, despite the fact that it will most likely not benefit the green energy transition, but benefit continental European coal producers instead (Mathiesen et al. 2018; Hasberg 2020a). Therefore, I ask research question A, pertaining to case study A (Hasberg 2020a).

> *How does cost-benefit analysis[29] as a calculative device reinforce energopower in times of energy transition, leading to the construction of Viking Link?*

My findings, as expressed in the abstract, are the following:

> In the recent case of Viking Link, a planned Danish-British interconnector, the group has proposed a significantly alternative valuation compared to that of the Danish Transmission System Operator Energinet and the Danish authorities. While the latter claim that Viking Link is imperative to green transition (termed Supergrid thought style), the former argue that there are better flexibility options available (termed Smart Energy System thought style). Through an empirical assessment of the cost-benefit analysis and of a parliamentary hearing regarding Viking Link, this paper sheds light on the power struggles inherent to these processes. It shows how energopower, that is, the political power inherent to energy infrastructures, is reinforced through the infopower, that is, the power exercised through the work of data formatting, inherent to cost-benefit analysis. The cost-benefit analysis, as a calculative device, limits the potential valuations of Viking Link and hence restricts decision-making. Very literally, this interplay shapes reality: Viking Link has entered the construction phase.
> Hasberg (2020a: abstract)

To summarize the two cases: In the Viking Link case A, cost-benefit calculations in the style of old paradigm economics define what can be known and what is ignored. The decision-making process ignores Smart Energy System scenarios casting doubt on the greenness of the interconnector. The Smart Energy System scenarios do not fit into the calculative device of the cost-benefit analysis. Viking Link thus ends up contributing to a transition in the wrong direction.

In the blockchain case B, visions of spatial, economic, and power decentralization lead to a blindness towards practical questions of governance. Through platformization, the thought collective ends up replicating the centralization it originally set out to challenge.

How did I arrive at these conclusions? Is it possible to theorize the results from two individual case studies to arrive at a more general response to the overarching research question? This is the task of this cover essay. While the individual papers on Viking link and blockchain-in-energy (Hasberg 2020a; 2020b) are based on research

[29] Other factors apart from the cost-benefit analysis play a decisive role regarding the actions taken by Energinet, for example, the fundamental principles of electricity regulation that are the basis of grid tariff design. This aspect is not part of the Viking Link article, but is addressed in Chapter 8 on policy in this cover essay.

questions A and B, this cover essay takes its starting point in the overarching research question.

1.3. WHY STUDY ENERGY AND INFORMATION SYSTEMS IN PARALLEL?

The two cases A and B, while both related to energy provision, are fundamental representatives of power struggles within two different sectoral transitions: the energy transition and the digital transformation. Why study these two sectors in parallel? Because the energy transition and the digital revolution are linked in three fundamental ways:[30]

1. *Power for data*: The increasing use of data increases electricity consumption (Røpke 2012; Morley, Widdicks & Hazas 2018; Cisco 2020). This aspect is addressed in Case A with respect to the question of how the purposefully wasteful electricity consumption of the proof-of-work consensus mechanism[31] of most blockchains could be ignored by most blockchain-in-energy thought collectives.
2. *Data for power:* The fact that information systems are co-constitutive of energy systems, particularly renewable ones, means that information technology is increasingly needed in managing these systems, as I detail in Chapter 5.
3. *Power over data:* Following from (2), the power struggles that take place and receive increasing attention in the information sector also apply to the energy sector. I return to the problematic (lack of) data ethics in the energy sector in section 8.5 as a future research topic.

Furthermore, the information and energy sectors share the fundamental nature of being dominated by infrastructures as defined by Susan Leigh Star in section 1.1. This entails that they are subject to infrastructured forms of power, as outlined in the quote from Hasberg (2019c) on infopower and energopower above. Additionally, the role of faith in technology as a form of constructed fact (Fleck 1979) or sociotechnical

[30] Thanks to Tina Barroso for co-coining this taxonomy, first used in Hasberg (2019a).

[31] "Proof of work is an economic measure to deter denial of service attacks and other service abuses such as spam on a network by requiring some work from the service requester, usually meaning processing time by a computer. […] This idea is also known as a CPU cost function, client puzzle, computational puzzle or CPU pricing function" (Voshmgir & Kalinov 2017: 19). Proof-of-Work was first developed by Cynthia Dwork & Noni Naor (1993). Proof-of-work is the consensus mechanism used by both the bitcoin blockchain and the Ethereum blockchain as of January 2020. Ethereum is planning a transition to a different (and less energy consuming) consensus mechanism, *proof-of-stake*.

imaginary (Jasanoff 2015) plays a significant role in both sectors, as I show in Hasberg (2020a) and (2020b). I return to this topic in Chapter 6.

The information and energy sectors also display a number of parallel developments that make them similar in terms of being analytical objects of my research.[32] In the following sections I address the parallels in terms of cost structures (1.3.1), thought styles (1.3.2), and how decentralization is understood in the two sectors.[33]

1.3.1. PARALLELS IN COST STRUCTURES

With energy transition in the energy sector and digital transformation in the information sector, both total cost structures, as well as marginal cost structures, have changed. I address these two components in turn: Firstly, the information and energy sectors share significant cost reductions experienced along with digital transformation in the case of the former and energy transition in the case of the latter. Information technology and renewable energy technology have come down significantly in cost over the recent decades. This reduction in total costs has taken place though an intertwined interactive process involving technological advances, policy instruments driving this development, and popular demand, the latter both reacting to, and initiating, the two formers. In information systems, this exponential cost reduction is known as Moore's law.[34] This price decrease has enabled decentralization in the sense that, if not everybody, then at least many more than previously can be producers: In the case of the energy sector, renewable energy technology has enabled many more to become producers of electricity, either through home systems or via cooperative ownership; in the case of information systems, the internet has enabled many to be not only consumers of, but also producers of web content like texts and videos. The phrase from Jay Rosen's blogpost-turned-internet-meme from 2006 sums it up: The new providers are "the people formerly known as the audience" (Rosen 2006).

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[32] This taxonomy is based on a talk given at the 100% Renewables conference in San Francisco (Hasberg 2013).

[33] A significant difference between information and energy systems is their nature: The variability of renewable energy means that balancing the energy system is a topic of concern, as detailed in Chapter 5. The equivalent task in information systems known as Internet load balancing takes place through TCP (Transmission Control Protocol) congestion control. Balancing information is less of an issue in information systems than in the energy system.

[34] Moore's law is the observation that the number of transistors in an integrated circuit doubles about every two years, that is, exhibits exponential development. Named after Gordon Moore, co-founder of the Intel Corporation. It might be a more correct description to talk about the exponential *part* of a logistic curve, that is, an S-curve, as J. P. Hansen, Narbel, & Aksnes (2017) do in relation to installed capacity growth of renewable energy.

Secondly, both digital products and intermittent renewable energy generation exhibit near-zero short-run marginal costs, which therefore differ significantly from the levelized costs of energy (LCOE, see footnote 6). Short-run marginal costs measure the cost of producing an additional unit in the short run.[35] "From an economic perspective, the replacement of fuels with wind and solar energy is a substitution of short-term fuel costs with long-term capital costs" (Djørup, Thellufsen & Sorknæs 2018: 149). This substitution process has taken place within digitization as well. The production of journalism, as one example from the information realm, has difficulty recovering long-run total costs under current market mechanisms. As cost structures and value chains[36] change, so do business models. Legacy markets worked for print journalism and for fossil electricity with positive short-term marginal costs, but do not provide sufficient incentives for the provision of information and energy goods with zero short-term marginal costs. In the energy sector, this is known as the missing money problem on wholesale electricity markets, which I come back to in 5.2.5.

In the information sector of digital products with zero short-term marginal costs, the missing money problem and current market regimes have turned into winner-takes-all-markets. How did this happen? Intermediaries like Google, Apple, Facebook, and Amazon (GAFAs) run on platform business models (Osterwalder & Pigneur 2010) that connect suppliers and buyers with each other. When introduced in the 2000s, GAFAs were disruptive to incumbents in the sense introduced by Bower & Christensen (1995): By first taking a foothold at the low end of a market and then moving upmarket, they displaced established incumbents—think Airbnb versus hotels for hospitality or Netflix versus Blockbuster for home cinema. Aided by network effects[37] and favorable regulatory regimes (Rahman & Thelen 2019), intermediaries established closed information architectures and quickly became the "crowd-sourced monopolies" (Balaram 2016) of "crowd-based capitalism" (Sundararajan 2016). As winners, they *take it all* in the sense that GAFAS have locked-in their customer base due to the high switching costs that come with demand-side network effects. This makes it disproportionately difficult to compete in the markets of GAFA's. The disruptors of the '00s have become the powerful incumbents of the '20s—think of the chances of starting an alternative to Amazon, for instance. While the money is still missing for the provisioning of the fundamental information good (online journalism,

[35] I make the standard microeconomic assumption that short run is defined as the time period when at least one input factor of production is fixed, and the long run is correspondingly defined as a time period where all input factors are by definition variable

[36] For more on the changing value chains and cost structures in the energy sector, see Hvelplund (2001: Ch. 5, p. 43–74).

[37] Also known as positive network externalities or demand-side economies of scale, denoting a situation where every additional user of a system increases the value of the product or service offered; the typical textbook example used to be the wired telephone monopoly system: The larger the network, the more value it offers to users. Platform business models are all built on network effects.

in this example), platform business models have re-enabled the reaping of supernormal profits[38] for the platform (quasi-)monopolists. Infrastructure (in the case of energy, the electric grids) and platforms (in the case of information goods) have become the cash cows in both sectors. Plantin et al. (2018) talk about the *platformization* of infrastructure and the *infrastructuralization* of platforms:

> Platformization entails moving away from published URIs [Uniform Resource Identifier][39] and open HTTP [Hypertext Transfer Protocol] transactions in favor of closed apps that undertake hidden transactions with Facebook through a Facebook-controlled API [Application Programming Interface]. (Plantin et al. 2018, paraphrasing Helmond 2015)

The keyword among the technical terms in the quote above is that platformization shifts content from the open internet towards walled gardens. Infrastructuralization on the other hand is the continuous practice of making and maintaining infrastructure, which is also expressed in the use of infrastructur*ing* as a verb (Niewöhner 2014; Karasti & Blomberg 2018).

1.3.2. TREE VERSUS MESH NETWORK PARADIGMS

The energy and information sectors share similar tensions between two different grid or network paradigms. Although these grid paradigms are not singular, but rather representative of a continuum of positions, I use two network paradigms as ideal types[40] to structure my account in the following. With a neutral descriptive naming, they can be called *tree* and *mesh* network paradigms shown in *Figure 1-4* and Figure 1-5. Following the terminology of network topology, the dots are called nodes and the lines are called links or edges.[41] The green nodes represent either a delivering actor, in information systems called a server, in energy systems called a producer. The red nodes represent receivers, called clients in information systems or consumers in energy systems. I do not use the terms *centralized* and *decentralized* to name the network paradigms, as these terms are loaded with connotations that I aim at disentangling in the following Figure 1-6. I use Thomas Kuhn's term *paradigm* (1962)

[38] Supernormal profit is profit above what can be accrued on a fully competitive textbook market. Fully competitive markets under certain (strong) assumptions do only just keep businesses afloat and return a profit equivalent to the market interest rate.

[39] An URI is the address of web content as defined by the standardization organization of the internet, the Internet Society (ISOC).

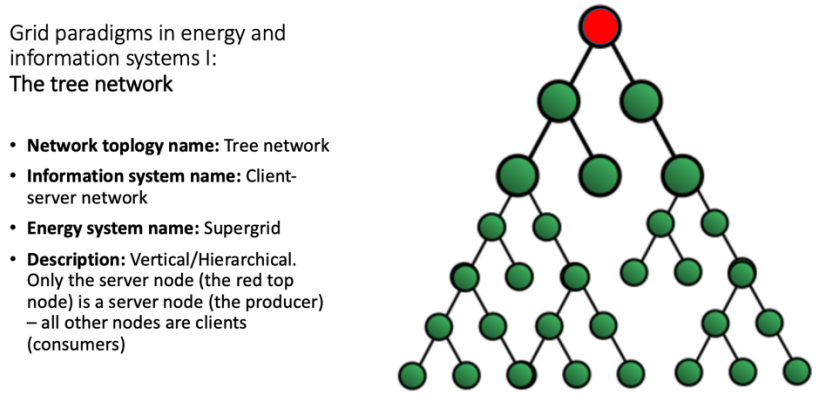
[40] An ideal type, a concept developed by the German sociologist Max Weber, denotes "constructed ideal used to approximate reality by selecting and accentuating certain elements" (EB 2018a).

[41] For the network topology background of these terms, see Filho (2017: 76).

to differentiate it from *real existing* thought styles and thought collectives discussed in Chapter 6.

The tree network paradigm in *Figure 1-4* is characterized by a vertical or hierarchal structure with only the top node acting as producer at all times.

Figure 1-4 Ideal-type illustration of tree network paradigm

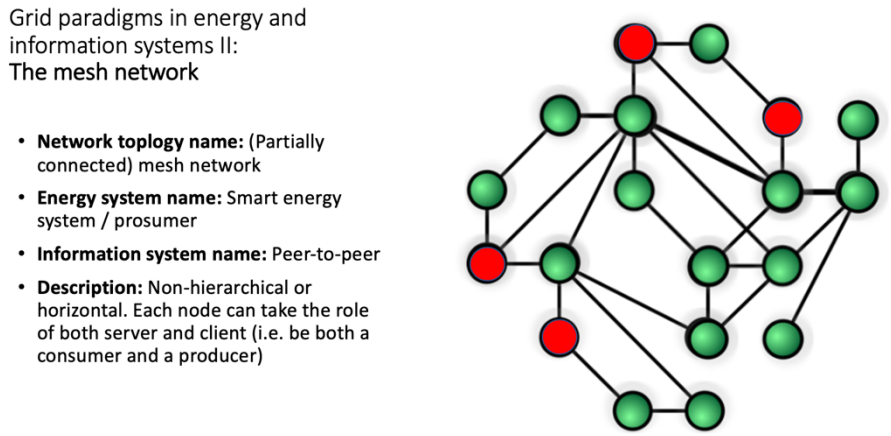


Source: Wikimedia Commons (2008) and own illustration (Hasberg 2019d). The red node denotes a server, or producer, the green node denotes a client, or consumer.

The characteristic of the mesh network paradigm in Figure 1-5 is its non-hierarchical, horizontal, or lateral structure. Not all nodes are connected to each other, hence it is not a full, but a partial mesh network. At any given time, each node is either a consumer (client) or producer (server). Over time, however, they can switch roles, denoted as prosumerism in the energy sector.

In information systems, sometimes also in energy systems as in Figure 1-2 above, this type of grid is denoted peer-to-peer network. In the energy sector, we could call it a Smart Energy System characterized by renewable energy and sectoral interconnection between electricity, heating, and transport (for a definition, see 5.2.3).

Figure 1-5 Ideal-type illustration of the mesh network grid paradigm



Source: Wikimedia Commons (2006; 2008) and own illustration (Hasberg 2019d). The red node denotes a server, or producer, the green node denotes a client, or consumer, at any given point in time. In the mesh network paradigm, the nodes can change roles over time. In the energy system, this concept is known as the prosumer.

These grid paradigms have emerged from the analysis of the Supergrid vs. Smart Energy System conflict of the Viking Link case A (Hasberg 2020a) and the client-server vs. peer-to-peer conflict in the blockchain case B (Hasberg 2020b). The two different network paradigms are building blocks for my conceptualization of decentralization in section 1.3.3 below; I also return to the network paradigms in Chapter 8 on policy.

1.3.3. THREE DIMENSIONS OF (DE)CENTRALIZATION IN ENERGY & INFORMATION SYSTEMS

Although the grid paradigms take a starting point in the physical topology of a network, the meaning of the topology goes beyond that of a physical infrastructure and includes political and cultural aspects. As the tree versus mesh network paradigm shows, a contested notion of (de)centralization is shared among the two sectors. Early adaptors within the energy and information sectors share a passion for decentralization that has driven much of the respective transformation processes.

In the information sector, blockchain technology grew out of a reaction against data centralization (Hellegren 2017), an attitude that the crypto-community shares with early internet activists (see for example (Schildt & Siegfried 2009a: 423) on the German Chaos Computer Club. Jan-Felix Schrape (2019b) sketches out this elusive quest decentralization in information systems. By linking the history of the internet, the hippie movement, and today's blockchain hype, he shows how attempts at

decentralization end in demise. He sees this to be caused by the logic of "digital utopianism" (Dickel & Schrape 2017) that results in "patterns of complexity reduction" (Schrape 2019b: 36). Considering the histories of the internet, (Rosenzweig 1998; Graves 2011; Naughton 2016; Tréguer 2017), history teaches us that the struggle between decentralization and centralization is ongoing. The movement towards centralization is not inevitable, or, to cite Rosenzweig 1998, "the road toward monopolization and centralized control is not preordained" (1998: 1551) although today's concentration in information systems would support such a view.

Similarly, the history of the energy transition, and in Denmark, particularly that of wind power, can be read as a struggle over (de)centralization (Wistoft, Thorndahl & Petersen 1991; Beuse et al. 2000; Garud & Karnøe 2003; van der Vleuten & Raven 2005; Maegaard, Krenz & Palz 2013) (for green movements and wind power from a German perspective, see (Schildt & Siegfried 2009b: 369 ff)., and Heymann 1995, respectively). Energy transition movements of the 1970s and 80s were in part a reaction against centralized nuclear power. In Denmark, the organization for renewable energy (OVE – Organisationen for Vedvarende Energi) and the Danish anti-nuclear organization (OOA – Organisationen til Oplysning om Atomkraft) were at the forefront of the green movement (Bach Mortensen 2018, Chapter 3; Meyer 2020; Rüdiger 2020).

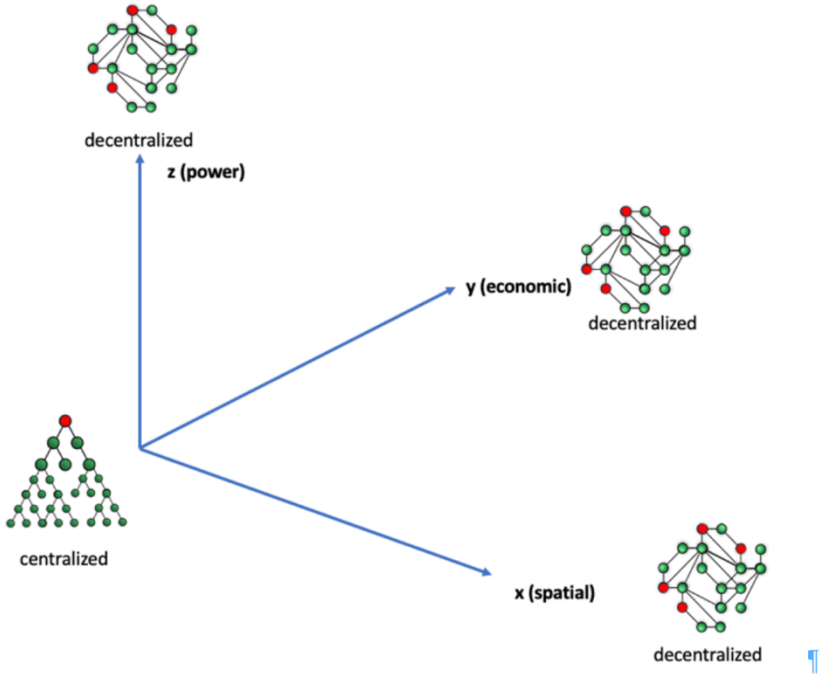
However, what is meant by decentralization is not always clear, neither in the information sector, nor in the energy sector. With reference to different frameworks and typologies regarding decentralization of the energy transition (Funcke & Bauknecht 2016; Brisbois 2019; Thombs 2019), Emily Judson et al. (2020) argue that "decentralisation is often symbolic, as much a narrative shorthand for the direction in which the energy system is (or should) be heading and the values that it ought to embody, as it is a descriptive or analytical device", and that "it can an have multiple interpretations, depending on what is decentralising – energy hardware, ownership, knowledge, socio-political power, decision-making authority, economic market share and so on" (Judson et al. 2020: 2).[42] The use the term decentralization in the information sector is similar to the use that Judson et al. (2020) find in the energy sector. As Schneider (2019) asserts with respect to information systems, "even the most apparently decentralized systems have shown the capacity to produce economically and structurally centralized outcomes" (2019: 1). My research confirms this: It shows is that blockchain ledgers and renewable energy systems may be spatially and economically decentralized. However, if power is (re)centralized, this centralization dominates the spatial and economic decentralization. In both the energy

[42] The situation is similar regarding the concept of democracy as used in the information and the energy sectors. As Mirowski writes, "one can observe the sadly empty notion of 'democracy' that equates a greater quantity of people enrolled in minor (and unremunerated) support roles with a higher degree of democratic participation, when, in fact, they primarily serve as the passive reserve army of labor in the marketplace of ideas (Mirowski 2018: 177).

and information sectors, power structures are an important determinant of decentralization-recentralization outcomes. Therefore, power is one of three dimensions of decentralization, as shown in Figure 1-6.

While a review of the use of the term decentralization in both information and energy is beyond the scope of this introductory chapter (see instead Judson et al. 2020: Section 2 for energy, and Schrape 2019b and 2019a for information), I offer a novel taxonomy of decentralization based on my findings in case A and case B (Hasberg 2020a, 2020b). I use the taxonomy to understand why backlashes to decentralization efforts seem to come as a surprise in both sectors, and how we can explain continuous cyclic decentralization-recentralization struggles. I distinguish between three dimensions of decentralization in the following: The spatial (x), the economic (y), and the power dimensions as shown in Figure 1-6. They are key to understanding the power struggles between the mesh network and the tree network thought styles that are taking place in both sectors.

Figure 1-6 Three dimensions of decentralization in energy and information systems



Note: Centralization is defined as higher towards the intersection of the three axes x, y, and z, while decentralization increases outward on the axes. Source: Own illustration and (Wikimedia Commons 2006; 2008).

In both sectors, the technology development outlined above in section 1.3.1 has contributed to decentralization in the sense that access barriers to becoming a prosumer in both information and energy systems have been lowered. However, this development has been followed by a perceived by re-centralization as expressed in recent concerns regarding data oligopolies in the information sector; and as an increasing use of renewable energy technology within the frameworks of the fossil market structures, as outlined in the introduction (for example the Danish political goal of less onshore wind in Denmark.)

This seemingly contradictory development of digital and renewable energy technologies in their respective sectors—that of technology-induced increased decentralization *and* simultaneous re-centralization—arises because only two dimensions of decentralization are considered, while the third dimension is frequently ignored.

- The x-axis in Figure 1-6 denotes the spatial dimension of decentralization, with increasing decentralization outwards, indicated by a high density of suppliers within a given area. Energy systems examples include rooftop solar (spatially decentralized generation) vs. coal power plants (spatially centralized generation). Information systems examples include hotels (spatially centralized) vs. individual apartments for rent (spatially distributed); as well as public network TV shows (spatially centralized generation) vs. YouTube Channels (spatially decentralized generation).

- The y-axis denotes the economic dimension of decentralization, with increasing decentralization upwards. The definition follows the economic notion of atomized vs. centralized market structures from competition economics; decentralization is indicated by many suppliers, whereas centralization signifies oligopolistic or monopolistic supply structures. Hence, by definition, market power decreases upward on the scale, because the number of suppliers increases. Generally speaking, technology development has increased decentralization both in terms of dimensions x and y (this argument is supported through a comparison of digital and renewable technologies regarding their cost structures and historical development).

- The third dimension of decentralization is described by the z-axis, which denotes increasing decentralization of power, or the institutional dimension of decentralization. I use the concepts of infopower and energopower to unpack this third dimension. One way of exerting control over the third dimension of decentralization is through market rules, which happen both in the energy and information sectors (for example, the market rules of the electricity wholesale market; the market rules of platforms like Airbnb). To provide an example from energy, centralized control over regulatory affairs

has halted decentralized solar and wind development in Germany. Although decentralization in terms of dimension x and y was high, dimension z remained relatively centralized and has pushed back both dimension x and y towards more centralization. Similarly, in information systems, the governance over the bitcoin blockchain (dimension z) remained centralized, so although dimensions x and y were decentralized at the outset, they became increasingly re-centralized over time; the centralized control (z) pushed back both the spatial (x) and the economic (y) dimensions towards centralization—i.e. the hidden institutional logics of dimension z are pushing back the more readily observable dimensions x and y.

In the remainder of this introduction, I explain the structure of this cover essay.

1.4. FUNCTION OF THIS COVER ESSAY

My illustration in Figure 1-7 borrows from the notion of Ragnhild Laird Iversen (2019), who describes cover essays as "a roof or cover, lifting the articles into a higher unit." It shows that the foundation of the PhD dissertation is the book review in Hasberg (2019c). It functions as a first step of conceptual work that is continued in this cover essay as it deals with the two concepts of power in energy and information systems by Colin Koopman (2019) and Dominic Boyer (2019) on which I base my work. The case studies on Viking Link and blockchain-in-energy in Hasberg (2020a) and Hasberg (2020b) are the pillars of the house, and the synthesis and theorization presented in this cover essay is the roof.

A *cover essay*, extended summary, integrative chapter, or synthesis as it is sometimes called, is a relatively recent format that has arisen as many academic fields are moving from the more traditional format of the book-length, monographic PhD dissertation towards dissertations by publication.[43] The assessment criteria applicable to PhD monographs apply to cover essays as well (AAU Engineering 2019). There are no separate criteria regarding the cover essay that it can be evaluated against.[44] I therefore reviewed cover essays published at my Faculty of IT and Design (TECH) during my time at AAU[45] and consulted guidelines of other universities or faculties (Haara &

[43] For an extended discussion of this development, see section 2.3.

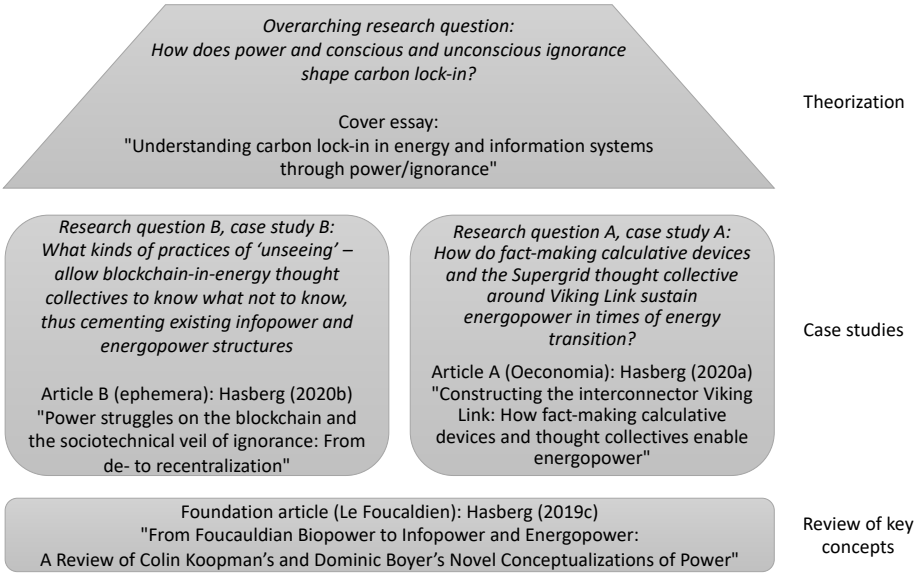
[44] Personal communication, Kristian Østergaard Sørensen, AAU PhD office, December 18, 2019.

[45] I reviewed both cover essays of the AAU Faculty of IT and Design (TECH) and AAU Engineering and Science (ENG) (until 2016, the TEK-NAT Faculty) as they follow identical evaluation criteria (AAU Engineering 2019). I found that the style of the cover essay is strongly discipline-dependent: From a 7-page introduction to three publications on electricity markets (Hjorth 2019), a 30-page introduction and summary on blockchain use in smart grids (Danzi 2019) to an integrative cover essay of more than 100 pages on strategic energy planning (Jensen 2019). The cover essays varied as to whether they provided an

Smith 2011; Rienecker & Jørgensen 2013; Nikander & Piattoeva 2017; AAU 2018; Velnić 2018; Iversen 2019).

A line of weaving idioms can anecdotally summarize my findings. In Nordic languages, the cover essay is itself named with a textile metaphor: *Kappe* in Danish and Norwegian, or *kappa* in Swedish means cape or mantle. It dresses up research for its final presentation, with the purpose to emphasize the red—or golden—thread, as Pirjo Nikander & Nelli Piattoeva (2017) state in their London School of Economics (LSE) blog post. By interweaving the research presented in the publications into one text(ile), it ties up any loose ends, demonstrating that, in spite of their differences, the articles of the dissertation are cut from the same cloth. The cover essay "[ties] together the theoretical and methodological choices made throughout" (Nikander & Piattoeva 2017). Like backtracking Ariadne's thread, it reveals the turns taken.

Figure 1-7 Overview of the papers of the PhD dissertation



Note: The lower box represents Hasberg (2019c), the two middle boxes represent the case studies A and B reported in Hasberg (2020a) and Hasberg (2020b) and the roof represents this text, the cover essay.

introduction to or a synthesis of the papers they were wrapping. Furthermore, those methodologically closest to my approach published their findings as monographs (Mortensen, 2018; Pihl, 2019).

I have arrived at the following stated aim and function of this cover essay. A cover essay "plays a key role in the PhD examination process" (Nikander & Piattoeva 2017) by:

1. *zooming out* to the broader significance: It is a "meta-text" that is "treating the publications as data" and taking a reflective stance (Nikander & Piattoeva 2017).

2. *theorizing* by going "beyond the theoretical basis of the individual articles. [The cover essay] contributes to creating a connection between findings that may invite discussions at a more theory-driven level […] in the light of methodical, epistemological and theoretical issues"[46] (Haara & Smith 2011).

More specifically, a cover essay:

3. uses tables and visualizations to compare, contrast, and summarize the findings of the publications (Nikander & Piattoeva 2017), and

4. does not follow a prescribed structure, but is structured so as to "present the research work in the best possible way"[47] (Haara & Smith 2011).

1.4.1. READING GUIDE

This introductory chapter has *zoomed out* to the overarching problem of carbon lock-in and summarized the findings of case studies A and B. Section A contains the Chapters 2, 3, and 4 and reflects on research organization and methods; section B encompasses the Chapters 5, 6, and 7, presents philosophical reflections along ontological and epistemological lines, and *theorizes* the findings from case studies A and B, in the form of the power/ignorance concept derived from the two case studies. Section C draws up policy perspectives in Chapter 8. The afterword contains an application of the power/ignorance concept to the current Coronavirus crisis. Throughout, where possible, I have aimed at providing figures or tables that act to summarize and condense the points of the written text. I have chosen this structure of the cover essay, which unlike the standard IMRAD[48] structure starts out with presenting the findings in this first chapter. The three articles in Appendix H (Hasberg

[46] Own translation from Norwegian: "Kappen kan dermed bidra til å skape en sammenheng mellom funn som kan invitere til drøftinger på et mer teoridrivende nivå […] i lys av metodiske, vitenskapsteoretiske og teoretiske problemstillinger" som "går utover teorigrunnlaget for den enkelte artikkel."

[47] Own translation from Norwegian: "(…) som skal til for at du skal få kappen til å fremstille ditt forskningsarbeid på beste måte."

[48] Introduction, Methods, Results, and Discussion; a common structure of scientific papers.

2019c on energopower and infopower), Appendix I (Hasberg 2020b on blockchain), and Appendix J (Hasberg 2020a on Viking Link) can advantageously be read after Section A of the cover essay, before proceeding to sections B and C.

Interdisciplinary research requires fundamental mutual understanding and respect between disciplines, across epistemological and ontological boundaries. When communicating findings, writing to an interdisciplinary readership requires more explanation of concepts and terms; what is a basic concept for one discipline is foreign to the other. The translation work required can seem daunting when spanning information systems and energy systems as objects considered with social science and the humanities as the methodological and theoretical lenses. Also, when working close-up with empirical cases, many specific terms of that field are encountered which may be unknown outside that specific field, such as *biopower*, *unbundling,* or *zoonotic*. Therefore, I have collected an alphabetical list of more than 300 terms and abbreviations used in this cover essay as well as in the three appended articles; although I have striven to include their definition in a footnote where the term appears the first time, please refer to Appendix A when encountering unfamiliar expressions. Over the past 30 years, scientific writing has become increasingly difficult to read (Hayes 1992). My aim is to keep the readability index[49] within an acceptable range to counterbalance that trend. There is enough complexity with the research content; the communication of it should not obscure it further.

Appendix B contains a list of contacts while Appendix C contains the retrospective field notes regarding Hasberg (2020b) on blockchain in the energy sector. As I will discuss in detail in Chapter 4, this field work was undercover. Therefore, the retrospective field notes and the list of contacts are confidential and are only available to the PhD assessment committee. Appendix D contains field notes regarding the overall research process. Where quotes from the field notes are included in this cover essay and in the blockchain-in-energy article (Hasberg 2020b), any identifying information has been removed and replaced by […]. Field note quotes are also used to document my choice of research approaches, and to express reflections of my academic path, not only as a documentation of the field work as such. Appendices E, F, and G contain supplementary information regarding Hasberg (2020a) on the Viking Link interconnector. As I apply the terms Smart Energy System thought collective and Supergrid thought collective, Appendices E and F respectively reflect on these two. Appendix G contains a transcript in Danish, of which the main quotes are included in English in Appendix F. The Appendixes H, I, and J contain the three articles Hasberg (2019c) published in *Le foucaldien*, Hasberg (2020b) on blockchain technology submitted to *ephemera*, and Hasberg (2020a) on Viking link under revision for *Oeconomia*. They follow the formatting and reference styles of the respective publishers.

[49] LIX (from Swedish: läsbarhetsindex).

1.4.2. WRITING STYLE

Choices of style and voice in this cover essay merit a few words, too. Reading ethnographic works has impacted my use of language so that it differs from the style typically found in social science works and has more narrative qualities, because I, knowingly and unknowingly, "mimic that writing" (Vrasti 2010: 87). "If interdisciplinarity is about defying discursive boundaries to create a more comprehensive understanding of social reality, then we should start with challenging the literary conventions for representing that reality" (Vrasti 2010: 87). For example, *I* have decided not to apply a passive voice in my writing as to make a point out of displaying, not disguising, the choices and judgements that I as an author continuously make. Donna Haraway's "god-trick of seeing everything from nowhere" (1988: 581) may still be the voice of choice for more positivistically oriented researchers and outlets because it "gives research an air of unbiased and objective knowledge attained from a privileged external position" (Birkbak, Petersen & Jensen 2015: 268). When dealing with research questions like those outlined in section 1.2, however, it is my conviction that an active voice is the better choice, because knowledge is always situated, as Haraway (1988) phrases it.[50] Using an active voice is thus a way of walking my talk about avoiding the impersonality of *das Man,* a Heideggerian term denoting the power inherent to the generic everybody and nobody that the use of passive voice gives rise to (see section 6.5).

Although AAU TECH recommends following the *Publication Manual of the American Psychological Association* (APA 2020) and I follow its general style guidelines. However, I have chosen to follow the citation style of the Open Access linguistics journal Glossa that uses full names in the bibliography (Paul & Wyngaerd 2015). Displaying first names along with last names in the list of references is recommended by Barbara Czarniawska & Guje Sevón (2018). In their paper "Gendered references in organization studies," they show that women authors are systematically underrecognized. Scholarly referencing is—still—a man's world, as James Brown sang in 1966 with the words of Betty Jean Newsome. "Full first names in reference lists (and in the text, when appropriate) […] might enhance the proper recognition of research conducted by women" (2018: 1,8). It can also help prevent gender misattributions in citations due to gender-science stereotypes in readers, as analyzed by Michał Krawczyk (2017). With first names as a proxy for gender, I as an author can assess my own writing regarding gender bias in citations—without first names, this is impossible.

[50] See Chapter 4 for further reflections on methods.

SECTION A: REFLECTIONS ON RESEARCH ORGANIZATION

Research organization influences research findings. The purpose of this section is therefore to reflect on the research process and show what conscious choices I have made along the way. In Chapter 2, I first discuss disciplinary boundaries and thought constraints of mono-, inter-, and transdisciplinary approaches. Chapter 3 discusses new economics, a new field of heterodox economics, as a scholarly *home* of my work. Lastly, I reflect on choices of methods and methodological challenges in Chapter 4.

CHAPTER 2. MONO-, INTER-, AND TRANSDISCIPLINARITY

> At first, not having a *disciplinary home* led me to believe that my approach was just truly interdisciplinary [or] multidisciplinary […], [that is] *beyond disciplines*. After all, how could I otherwise explain that I would be interested—and taking courses—in cryptography, together with bachelor students of computer science degrees, in microeconomics with master students of an economics department, in energy market policy with a bunch of researchers and PhDs from both economics and engineering backgrounds, and then, going to research conferences on the design of 100% renewable energy systems? When my counselor talks about "homeless cognition contexts" […] (Hvelplund, 2005), this had to be what he meant. I did feel homeless—or at home everywhere, depending on my daily constitution. On which one of the many cognition contexts would I be able to build the house that was to become my PhD dissertation […]?
> Notes, February 2018, Appendix D

As this introductory quote illustrates, this chapter deals with finding "epistemic living spaces" (Felt et al. 2013: 514), that is, constructing an academic space for myself in between or beyond disciplines.

2.1. MONO-DISCIPLINARY RESEARCH ORGANISATION

The advantage of disciplines in organizing research is that many discussions become unnecessary, time is freed up energy for other things. As Pim Klaassen explains:

> Everything from the choice of objects of investigation to the ways in which the results of research are written and published is covered by the concept, including all that happens in between. Therefore, people who belong to the same [thought] collective will generally not disagree on which methods and which research technologies to use for arriving at the truth about the objects of interest—better still, the material, technological and hands-on, practical experience of those educated in or socialized into a particular collective are all aspects of [thought] style too.
> Klaassen (2014: 42)

Ludwik Fleck, an early philosopher of science and microbiologist whose main work on the *Genesis and Development of a Scientific Fact* stems from central Europe in the

interwar period, described disciplines as *thought collectives*[51]. Without disciplines, "things can be seen almost arbitrarily in this light or that" (Fleck 1979: 92). Paraphrasing Fleck, Barbara Herrnstein Smith writes that, "in the absence of the habits of style-directed perception gained by disciplinary training and experience, a researcher's observations in the conduct of an investigation are vague and uncertain" (Herrnstein Smith 2006: 59).

A closer look at the etymology of the term discipline can help clarify the meaning of the root of the word: Discipline is derived from Latin *disciplina* (instruction), *discipulus* (pupil), and *discere* (to learn) (OED 2020d).[52] The English adjective disciplin*ary* originates from the Latin adjective *discipinarius* (OED 2020c). Usually, the English suffix[53] *-ary* and the Latin suffix *-arius* express pertinence to the root word (P. Smith 2017: 96). Think of image – imagin*ary* or family – famili*ary*. In the case of discipline, -arius has the specific meaning of "enforcing discipline," originally with reference to church order (OED 2020c). One can also find this meaning of force inside the word discipline by tracing the Latin discere (to learn) further back in time: Discere can be seen as a derivative of the Proto-Indo-European root *dek-*[54] meaning 'cause to accept' (AHD 2020: Section 5).[55] Thus, what we today perceive as two distinct meanings of discipline is actually one. Below, I list the two meanings of discipline and show how power is immanent to both:

1. Discipline as "the practice of training people to obey rules or a code of behaviour, using punishment to correct disobedience" (OED 2020d). Foucault (1995) wrote at length about the fundamental importance discipline to the development of the role of the state and perceived discipline as the "medical and political correlative" to "plague as a form [...] of disorder" (Foucault 1995: 198).

[51] While I do apply the term thought collective in this chapter, a thorough walk-through of Ludwik Fleck's epistemology follows in Chapter 6.

[52] There is disagreement among linguists regarding the connection of 'discipline' and 'discere'. For example, the Danish dictionary DDO (2019) disputes this derivation.

[53] A syllable "added at the end of a word to form a derivative" (OED 2020l).

[54] 'dek-' turned into 'discere' via reduplication, that is, a doubling of the word, so that 'dek-' became '*di-dk-ske-' (AHD 2020).

[55] Another strand of explanation for the meaning of discipline as a coercive force which does not depend on going back to the Proto-Indo-European root 'dek-' is the following: Disciplinary (Latin: disciplinarius) conditions were needed to create suitable circumstances for the instruction (Latin: disciplina) of students (Latin: discipulus). Discipline as force is thus seen as a precondition for the learning of a scholarly discipline.

2. Discipline as a "branch of instruction or education" (Etymonline 2020a) that its followers (the pupils, or, with a biblical term, disciples) have been *caused to accept*. A discipline thus involves an actor; the borders of a discipline are not natural delimitations, but an active act of limiting knowledge and causing that knowledge to be accepted. The enforcement of the borders of a discipline is both passed on and recreated by each generation of scholars through education.

To recreate a sensibility for the power inherent to a scholarly discipline (2), I apply the *-ary* suffix that, as shown above, refers to enforcement. By talking about disciplin*arity,*[56] also when referring to mono-disciplin*arities*, I want to "challenge the idea that the organization of [a discipline] is 'natural' and given," as Inge Røpke (2020: 7) states. She refers to the German playwright Berthold Brecht's technique of *Verfremdung*, that is, method of estrangement or defamiliarization[57] (which Røpke mentions in relation to the didactics of economics). My use of the *-arity* suffix is to remind myself and the reader of the making of a discipline as an active coercive process, because disciplin*arity* is not commonly used about mono-disciplines.[58] Simply calling single scholarly subjects *disciplines* gives them an aura of familiarity, which the suffix aims at breaking. It neglects that disciplin*arities* require actors that actively create the acceptance of knowledge. As a form of knowledge infrastructure, then, scholarly disciplinarities can be perceived as a form of *stored power,*[59] as Birte Förster (2020) argues. An academic disciplin*arity* is thus a carrier of infopower (Koopman 2019b), as I also show in the case of Viking Link (Hasberg 2020a), where the disciplinarity of old paradigm economics through the method of cost-benefit analysis plays the role of enforcing a certain worldview. In the following, I quote from Jay Bernstein (2014), who brings the implications of disciplinarity to the point, providing context for the arrival story of the preface and to the following section on interdisciplinarity:

> [D]isciplinarity [...] may be defined as the compartmentalization of scholarly research, labor, and communication into bureaucratic units. […]

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[56] The *-arity* suffix is composed of two suffixes: *-ar(y)*, as discussed above, and *-ity*; the latter just turns an adjective into a verb.

[57] Estrangement is a key element of Brecht's epic theatre (1991), developed on the brink of World War II. "Der Zweck dieser Technik des Verfremdungseffeks [ist] es, dem Zuschauer eine untersuchende, kritische Haltung gegenüber dem darzustellenden Vorgang zu verleihen" (Brecht 1981: 187).

[58] Actually, only *interdisciplinary* is defined as "relating to more than one branch of knowledge" in the Oxford English dictionary (OED 2020g) while *disciplinary* in the sense of relating to one branch of knowledge does not have an entry. The Oxford English Dictionary only defines 'disciplinary' as related to the meaning of discipline (1), that is, "obeying rules" (OED 2020c).

[59] Own translation from German "Machtspeicher."

> Education scholar Janet G. Donald (1995: 7) asserts that "the method by which knowledge is arrived at in a discipline [...] and the truth criteria employed in that process are essential to the definition of the discipline." […] These disciplines maintain their legitimacy through inertia and may not be fit to tackle problems that have recently arrived on the horizon (Wallerstein 2004). The major mode of adaptation of disciplines is subdivision into smaller specialties (Becher 1989) […] "[W]ithin a discipline[,] meaning is conserved" (Finkenthal 2001: 4-5). One's overall way of thinking is constrained by what Finkenthal (2001: 3) calls disciplinarian thinking. Disciplinarian thinking can lead to disciplines becoming "[…] largely 'walled off' from connections to and feedback from outsiders" (Kline 1995: 1998). This enclosure leads to a sense of territoriality about which topics and approaches are the rightful property of a discipline […]. Success and recognition depend on achievements pertinent to the goals and values of one's own discipline as defined by core texts […] by professors at major Ph.D.-granting universities. […] Disciplinarity […] lends one an affiliation at a deeper level of identity as a scholar (see Messer-Davidow et al., 1993). […] Disciplinary thinking can become pervasive when one starts viewing and speaking about everyday matters in terms of disciplinary concepts and priorities. (Bernstein 2014: 248, italics added)

2.2. INTER- AND TRANSDISCIPLINARY RESEARCH ORGANIZATION

Because of the risk of self-enclosure in disciplines discussed in section 2.1 above, Petter Næss (2010) warns against "the dangerous climate of disciplinary tunnel vision." Nevertheless, crossing disciplinary borders in one way or the other can be difficult to handle institutionally, in spite of its stated desirability. If the prefix[60] *inter-* means between and *trans-* means beyond, what is inter-disciplinary, then? Moving between two disciplinary thought prisons?[61] Transdisciplin*arity*[62], then, must be the active creation of knowledge beyond the boundaries of single scholarly disciplin*arities*. A working definition of transdisciplinarity useful in this cover essay is the following: Transdisciplinarity is the crossing of disciplinary boundaries by one single researcher (me). This is different from a more collaborative definition, where individual researchers might rather want to retain their disciplinary identity while working together, preserving a disciplinary division of work. Although I prefer the

[60] A syllable "placed at the beginning of a word to adjust or qualify its meaning" (OED 2020j).

[61] See footnote 103 and *cognition context* in the dictionary of terms in Appendix A.

[62] See Wittmayer & Hölscher (2016).

term transdisciplinarity, I use the two prefixes inter- and trans- interchangeably, as interdisciplinarity is in wider use[63]. For example, Hendrik Woiwode & Anna Froese (2020)—whose taxonomy of overcoming problems of working across scholarly fields I apply in the following—define *inter*disciplinarity by paraphrasing Goethe's *Faust* in their paper title "Two hearts beating in a research centers' chest."[64] My working definition of crossing disciplinary boundaries is then: (At least) two hearts beat in an inter- or transdisciplinary researcher. Examples of such researchers in the field of Science and Technology studies are described by Niewöhner, taking a starting point in Ludwik Fleck, whose combination of a natural science background and his interest in the philosophy of science was of advantage to his work *Genesis and Development of a Scientific Fact* (see Chapter 6). Jörg Niewöhner (2012) asserts that

> until this day, the research field [of Science and Technology Studies] has benefitted from female (and rarely male) scholars with double training [Doppelausbildung]. Especially the intersection of feminist anthropology and science studies has proved to be fruitful. Donna Haraway, Karen Barad, Margaret Lock are prominent representatives of this direction with natural science educational backgrounds.[65] (2012: 66)

As a PhD candidate, assuming time and resources are constrained, the time which can be committed to a single disciplinary element of an interdisciplinary dissertation is shorter than for monodisciplinary ones. This may result in PhD researchers pursuing only the trodden paths of "disciplinary innovation" and refrain from engaging "with unfamiliar disciplines' knowledge stocks" (Woiwode & Froese 2020: 5). Another strategy according to Woiwode & Froese (2020) may be to pursue strategic compliance, a form of self-censoring by adapting to monodisciplinary demands. Attempting niche-seeking by not adhering to these demands is another possibility. However, carving out a niche requires the development of an identity as a researcher, but the "culture of temporary project-based employment (…) can interrupt or disrupt

[63] A subject area can also be expressed with an entirely different term: The Germanic *Fach*, from which the Danish *fag* is derived, means 'something joined' or 'bonded together' (Danish: 'noget sammenføjet') (DDO 2018b). Thus, the Danish term used for interdisciplinarity, "tværfaglighed", means 'across something joined'. This has a different taste than interdisciplinarity, because there is no coercive force connected with the term "fag."

[64] "Zwei Seelen wohnen, ach! in meiner Brust!" (von Goethe: 1808, Line 1112).

[65] Own translation from German: "das Forschungsfeld [=Science and Technology Studies] hat bis heute immer wieder in entscheidenden Momenten seiner Entwicklung von Wissenschaftlerinnen (seltener Wissenschaftlern) mit Doppelausbildung profitiert. Gerade das Schnittfeld von feministischer Anthropologie und Wissenschaftsforschung hat sich hier als fruchtbar erwiesen: Donna Haraway, Karen Barad, Margaret Lock sind prominente Vertreterinnen dieser Richtung mit ursprünglich naturwissenschaftlicher Ausbildung."

the intellectual strand of early career researchers identity-trajectories as academics" (Enright & Facer 2017: 623, citing McAlpine 2010). This

> precarity arises at a time of declining state funding of universities around the world, increasing reliance on international audit as a means of accountability and the growth of a competitive market ethos that positions academics in individualised and competitive relations with each other for increasingly scarce secure forms of employment as well as the proliferation of temporary, 'adjunct', and casualised employment. (Enright & Facer 2017: 623)

A further problem is that cross-disciplinary social science research that collaborates closely with natural or engineering sciences, which both information and energy systems social science research do, may find that social sciences or humanities are frequently "conceptualized as the junior partner; the leading role remains with science and engineering" (Felt 2014: 385, cited in Wagner 2016). Andrew Barry et al. (2008) critique that the social sciences and humanities are being subjected to the existing market logics in the name of interdisciplinarity. Giulia Sonetti et al. (2020) also attest to the instrumental use of social sciences and humanities in interdisciplinary energy research, which is ultimately also a consequence of funding policies (Overland & Sovacool 2020).[66] In sum, power relations in inter- and transdisciplinary research play a role across all three phases of research, from developing the project and framing the research problem, over co-producing knowledge, to bringing results to fruition, as Livia Fritz and Franziska Meinherz (2020) attest.

Nowotny et al. (2003) coined the term *mode 2 knowledge creation* for applied, interdisciplinary research in teams. This form of interdisciplinarity is subject to disciplinary measures of interdisciplinarity itself; therefore Jörg Niewöhner (2016: 15) calls it the "regime of the inter-". It is characterized by a "research to invoice"-style (Henriksen 2019: 6) of "commercialized research" (Nowotny et al. 2003: 181) that I discuss in more detail in the next section.

2.3. NICHE-SEEKING AS A STRATEGY TO OVERCOME PROBLEMS OF INTERDISCIPLINARITY

The interdisciplinary nature of my research questions requires thorough consideration of the research outlets chosen. "When a research activity involves multiple disciplines, there is not a well-defined community of practitioners who are all expected to be equally capable of critically scrutinizing new results [...] [causing] an inherent tension

[66] The field of Wagner (2016) is sport studies, which crosses medicine and social science; Barry et al. (2008) arrive at their conclusions by studying interdisciplinary climate change research and ethnographic information systems research; and Sonetti et al. (2020) study interdisciplinary energy research.

[…] between interdisciplinarity and quality control" (Hanne Andersen 2016: 7). It is thus important to identify suitable publication outlets, because being scrutinized on mono-disciplinary grounds might lead to rejection.

Many academic fields are moving from the more traditional format of the book-length PhD dissertation, also denoted as PhD monograph, towards paper-based dissertations, also called compilation thesis or dissertation by publication.[67] This section explains why I have chosen a paper-based format as opposed to a more traditional book-length thesis. The PhD school of the Technical Faculty of IT and Design at Aalborg University (AAU TECH) recommends writing paper-based PhD dissertations,[68] and so does the Sustainable Energy Planning research group (H. Lund 2020). In addition to concerns regarding research visibility, this is due to the Danish performance-based model of research funding distribution, the Bibliographic Research Indicator (BFI). It rewards Danish universities for peer-reviewed papers, but not for book-length dissertations (UFM 2019: 12). The BFI system was introduced in 2009, in the wake of fundamental Danish university reforms that Lars Bo Henriksen summarizes in the following way: "In 2003 a new university law abolished the century old collegial management system and replaced it with new system with a board of directors appointed by the ministry" (2019: 6). This resulted in the departure from the modern university based on Humboldtian principles with "free research, unity of research and teaching and govern[ment] by the professors in a kind of democratic manner" (Henriksen 2019: 8). It is superseded by "the post-modern university [governed by] new public management (NPM)[69]-inspired machine bureaucracy" (Henriksen 2019: 8) which uses the BFI and the international Hirsch (or simply h) index (AAU 2020a) as tools for managing the *production* of knowledge at the "project university" (Scavenius 2019).[70] Martin Heidegger also criticized the activities of what Lars Bo Henriksen terms the post-modern university and Theresa Scavenius calls the project university. In the 1938 essay *The Age of the World Picture* (Heidegger 1977a) he writes: "The scholar disappears. He [sic] is succeeded by the research man who is engaged in research projects. […] he is constantly on the move. He negotiates at meetings and collects information at congresses. He contracts for commissions with publishers. The latter now determine along with him which books must be written"

[67] In the following, I will use the terms paper-based vs. book-length dissertation or thesis.

[68] "The faculty recommends that PhD theses are written as a collection of papers with an introductory and overview part plus a number of publications. If the monograph format is chosen, the thesis is still frequently based on a number of scientific papers" (Phd.tech.aau.dk 2018).

[69] According to (Hood 1991), NPM emerged from a marriage of new institutional economics and the scientific management movement, also known as Taylorism.

[70] Regarding the consequences this has on students, see Priestley (2018).

(Heidegger 1977a: 125).[71] Alvesalo-Kuusi & Whyte (2018) show how research funding bodies and corporate interests take influence by setting research agendas.

Formally, it is up to PhD fellow themselves—influenced by the culture of their research groups—to choose whether they write a book-length PhD dissertation or a paper-based one. The turn to dissertation by publication can both be understood as an "innovative approach to social science research, as well as an operationalization of the doctoral student" (O'Keeffe 2019: 1). Choosing to go for a thesis by publication therefore means to be confronted with these institutionalized calculative devices of academic life like the BFI-indicator and the h-index mentioned above, which govern the publish-or-perish publication game. Interdisciplinary researchers especially experience a tension between their research and the frequently mono-disciplinary quality-criteria that reviewers apply during peer-review. These criteria, "shaped by specific paradigms, and ontological and epistemological orientations of disciplinary communities […] thus become benchmarks of […] research activities" (Woiwode & Froese 2020). Ultimately, these calculative practices reduce academic quality (Binswanger 2014).

Another problematic part of the publishing game is that women are more likely to encounter discrimination: "Excellence in research is related to different constructions of masculinity"[72] (Salminen-Karlsson, Wolffram & Almgren 2018: 52), and women tend to be held to higher standards in peer review (Hengel 2020). Homophily[73] in coauthoring may impact visibility, and hence careers, negatively (Sarsons 2017; King et al. 2017; Ghiasi et al. 2018). Still, gender equality efforts are likely to encounter resistance at universities (Powell, Ah-King & Hussénius 2018).[74]

In the light of these aggravating problems, I have chosen a combined format of a paper-based and a monographic PhD dissertation. "[A dissertation by publication] suited my multidisciplinary research topic and approach to research and assisted the flexibility and creativity of my research" (O'Keeffe 2019), but the short format of the papers was limiting in terms of the ideas and connections that I wanted to develop. Therefore, I have written both a cover essay in the style of a monography, as well as

[71] For the problematic history of this Heidegger essay, see Kellerer (2011; 2014) who documents how Heidegger in the post-war years tries to edit out his Nazi sympathies from *The Age of the World Picture*. For an introduction to Heidegger's energy ontologies, see Chapter 5.

[72] Similar effects have been found in the energy sector: Nader (1981) describes how a transition to renewable energy is considered feminine, deemed soft and hence devalued.

[73] Also known as the Huey, Dewey, and Louie effect, a Danishism ("rip-rap-rup-effekt") referring to the fact that people tend to associate with those similar to themselves (in this case, in terms of gender).

[74] —just as efforts to reduce the gender gap in the private sector can end up reinforcing gender discrimination because they fail to address underlying issues (Ely & Padavic 2020).

papers for journals. In my choice of journals, I have aimed at special issues or conference paper series, which is a typical strategy of interdisciplinary scholars, described by Hendrik Woiwode and Anna Froese (2020) as niche-seeking. They explain that "scholars employ niche-seeking for finding new ways" (Woiwode & Froese 2020: 9), for example by choosing special issues as a preferred publication channel. Although there may also be shady practices associated with special issues (Wagner 2016), special issue-publishing has had a positive effect on my research, as call texts have aided the focusing of articles. Furthermore, I felt motivated by the implied concrete readership that special issues or conference papers promise. It gave me the possibility of writing with dedication for a given issue of a journal, with the added benefit that the pre-screening process of abstracts by special issue editors meant that I had the feeling that this dedication was mutual. I have matched the unconventionality of choosing (retrospective) insider research as a method (see Chapter 4) with a more conventional IMRAD-style structure for both of my articles Hasberg 2020a and 2020b. The more conventional writing format is intended to provide readers (outside ethnography) with some kind of familiarity and hence, trust.

The choice of writing a dissertation by publication also confronted me with the paradoxical requirement of open access publishing (UFM 2018; AAU 2019), while the BFI and the h-index favor the brand-value and familiarity of so-called high ranking journals (Serenko & Bontis 2011; Moriarty 2016). The beneficiaries of these contradictory demands are large academic publishing houses, who engage in the practice of *double dipping*: The publisher earns twice, as university libraries pay subscriptions while university institutes pay Author Processing Charges (APC) to allow individual articles to be accessible without a paywall (Mittermaier 2015; Björk 2017). Like in other parts of the so-called sharing economy, the free labor of scholars is used to "crowd-source platform monopoly power" (Balaram 2016: 6). Working with similar questions of power and platforms in my research, although in other sectors, sensitized me to the importance of not contributing to these processes; rather, I wanted to support cooperative models of scholarly publishing (Crow 2006) run by new university presses, professional societies, or university institutes. I have therefore chosen to submit articles to open access (OA) journals that neither charge authors nor readers and allow authors full copyright retention or grant equivalent rights.[75] Ultimately, non-APC open-access is fundamentally an ethical question and an act of removing discrimination towards "those without financial means or without certain kinds of institutional and national affiliations" as Cymene Howe emphasizes (Vieira & Kipphut-Smith 2019: 56).

Overall, my publication choices reflect my preference for "curiosity-driven, uncertainty-acknowledging" research (Alvesson 2013: 82) with the goal of becoming

[75] It is important to highlight that open access *with* author processing charges, is not opening up scholarship, but rather platform-enclosing it, leading to a platform capitalism in academia that Mirowski (2018) warns against.

an independent researcher (Gardner 2008) who has "something [interesting] to say" (Alvesson 2013). I actively considered journals at home in different disciplines as I find it important that interdisciplinary research puts its work to display in the windows of the fields that it borrows from. In sum, I have submitted the case study on blockchain-in-energy (Hasberg, 2020a) to a special issue on *The Practices and Politics of the Organisation of Ignorance* of the journal *ephemera - theory and politics of organization*; the Viking Link case study (Hasberg, 2020b) is under revision for a special issue on *Facts in Environmental and Energy Economics: Models and Practices, Past and Present* of the French-English bilingual journal *Œconomia – History / Methodology / Philosophy*. A double book review on the concepts of infopower and energopower (Hasberg 2019c), has been published by the *Open Access Journal for Research along Foucauldian Lines, Le foucaldien*. Also, my preliminary policy perspectives are available in German in an energy law practitioners journal, *ZNER – Zeitschrift für neues Energierecht* (Hasberg 2019d). All of these are open access without fees to either authors or readers and have granted me the retention of copyright.[76]

[76] In the case of ZNER, the open access has been negotiated on an individual basis.

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."

CHAPTER 4. METHODOLOGICAL REFLECTIONS

Chapter 4 deals with questions of insider research (see definition in section 4.2) as an ethnographic method, *and* with the question of how I have utilized field work to give the interpretations presented in section B, Hasberg (2020a), and Hasberg (2020b). Thus, I depart from

> [the] 'hierarchy of purity' (Gupta & Ferguson 1997: 12) between fieldwork and interpretation suggest[ing] that knowledge production is a linear and deliberate trajectory from ignorance to enlightenment, from raw data to theoretical conclusion. In reality, […] the answers to our questions rarely await us 'in the field'. Often we return home more confused than we were in the first place. (Vrasti 2010: 84)[106]

Wanda Vrasti's call to "stop worrying about methodology" (Vrasti 2010: 79) echoes the criticisms voiced by Paul Feyerabend (1975; 1986) in *Against Method* and by John Law (2004) in *After Method.* As the latter emphasizes, he "would like to divest concern with method of its inheritance of hygiene. [Law] want[s] to move from the moralist idea that if only you do your methods properly, you will lead a healthy research life" (2004: 9). Instead of method as a "bankable guarantee" (Law 2004: 9), this chapter provides a methodography: It is more an ex-post explication of how I got to my findings rather than an ex-ante prescriptive methodology. The term methodography (Greiffenhagen, Mair & Sharrock 2015; 2016) is derived from the Greek met-hodos-graphia. It describes, '*graphia,*' the pursuit of, '*met,'* the (knowledge) path, '*hodos*.' Methodography, in a way, works like an Ariadne's thread[107] in that it back-tracks the research path. Methodography as a form of reflexivity can be productive in many disciplines, including the emerging field of new economics. From section 4.2, I define and discuss the concrete method I have used, insider research. I understand it as one way of doing *phronetic* social science already discussed in Chapter 3, which I revisit in the following section. With case B on blockchain being my primary case, the methodological considerations in this chapter are skewed towards that case.

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[106] Treating theory and method as interrelated and inseparable elements of research means that I revisit this question in Chapter 7 on theorization.

[107] From Greek mythology. Refers to a life-saving thread that Ariadne gave Theseus that enabled him to find his way out of a labyrinth by back-tracking the way he came in (OED 2020a).

4.1. PHRONETIC SOCIAL SCIENCE

As emphasized in section 3.2.4, new economics is interested in problem- and practice-oriented research. Such is the phronetic approach of Bent Flyvbjerg (2001a), whose principal task is

> to clarify values, interests, and power relations in planning as a basis for praxis. The point of departure for such research can be summarized in four value-rational questions:
>
> (1) Where are we going?
> (2) Who gains and who loses, and by which mechanisms of power?
> (3) Is this development desirable?
> (4) What, if anything, should we do about it? (Flyvbjerg 2004: 289–290)

I have sketched out where we are going (1) and whether this is desirable (3) on a more general level in the introduction, and more specifically with respect to the two case studies in Hasberg (2020a) and (2020b). I return to my conceptualization of power, the subject of Flyvbjerg's question (2), in Chapter 7 and discuss (4) in Chapter 8 on policy.

In an anthology edited by Flyvbjerg et al., Virginia Eubanks (2012) emphasizes the close links between phronetic social science, feminist epistemology, and sociology of knowledge. She states that "phronesis is useful because it gives us permission to finally abandon the failed project of producing a social science focused on universal truth, broad generalizability, prediction and a stance of disinterested neutrality" (2012: 228). Thereby, Eubanks echoes Donna Haraway's (1988) rejection of the voice "from nowhere" (1988: 581) as discussed in section 1.4.2. Or as Christian Lund phrases it: "Scholarly inquiry *is* not objective; we *have* objectives with our research" (2014: 226, my italics). Anticipating Chapter 6, the practice-orientation of Flyvbjerg is well in line with the constructivist epistemology of Ludwik Fleck, whose work lends itself to concrete analysis of cases, as it emerged from his experience as a microbiologist. As Pim Klaassen (2014) argues:

> Rather than considering […] the objects of scientific research […] from the safe haven of one's armchair – in other words, engaging in "an epistemology of the imagination" (Fleck 1979: 21), analysts of science are encouraged to get their boots dirty, to engage, either historically or contemporaneously and in any case comparatively, with scientific practices as actually performed. (2014: 33)

4.2. (RETROSPECTIVE) INSIDER RESEARCH

[Parts of this section are quoted or paraphrased from Hasberg (2020b)]

> Some research problems don't present themselves readily; they are high, foggy mountains to climb. This means that these research fields exhibit high entry barriers and the research problems that can be found inside are obscure and unclear when seen from a distance. Anecdotal evidence might be abundant, suggesting that something interesting is going on inside a certain field, for example, inside board rooms, expert councils and hacker chatrooms. However, no validated primary sources exist, not to mention aggregated survey data. This leaves these areas of research as obvious opportunities of "studying up" ethnographically (Nader 1972: 284). According to Jörg Niewöhner, however, ethnographers rarely study the "ideological Other, e.g. investment bankers, law firms, or the military. [This leads to a] bias that is hard to justify" (Niewöhner 2016: 10). Researchers are faced with two solutions: Either, climb another mountain.[108] Or, look deeply in the methodological toolbox to find suitable equipment. One of the methodologies from the bottom of that toolbox is retrospective insider research. I define retrospective insider research by the following characteristics: self-ethnographic (1), serendipitous (2), retrospective (3), and covert (4). (Hasberg 2020b)

Retrospective could be bracketed in the above quote, because only the blockchain research was retrospective, while the Viking link research was 'in-time'. In the next three subsections (4.2.1, 4.2.2, and 4.2.3), I go through each element in turn. I then turn to the concrete research contexts in 4.3 and reflect on the anxieties that come with the chosen method. Before ending this methodography by summing up the ethical dilemmas and advantages that come with my methodological choices in 4.6, I offer some more speculative reflections on parallels between moving across borders of thought collectives and across those of languages.

4.2.1. SELF-ETHNOGRAPHIC: BEING AN INSIDER

When researchers examine their own home field, this is called self-ethnography[109] (Alvesson 2003), at-home (or home culture) ethnography (Vickers 2018), insider research (Brannick & Coghlan 2007) (the term that I have chosen to use), or even "writing espionage" as Young (1991) called his work according to Brannick & Coghlan (2007: 71). Note the difference between self- and autoethnographic: While sometimes used interchangeably—which is the reason I prefer to use the term insider

[108] What Jörg Niewöhner calls "Sympathie-Sampling" in German (Niewöhner 2017).

[109] I use the term ethnography in reference to method, not as a term denoting the final written product.

research, as it is less ambiguous—I differentiate the term *autoethnography* from self-ethnography: "In doing self-ethnography I study what others do, and what these doings and sayings could have as meaning. In auto-ethnography I study what I do, and the meaning I believe my doings and sayings have" (Eriksson 2010: 93, see also Humphreys 2005). As Mats Alvesson (2003) describes, self-ethnography comes with a different set of challenges:

> While conventional ethnography is basically a matter of the stranger entering a setting and "breaking in", trying to create knowledge through understanding the natives from their point of view or their reading of acts, words and material used, self-ethnography is more of a struggle of 'breaking out' from the taken for grantedness of a particular framework and of creating knowledge through trying to interpret the acts, words and material used by oneself and one's fellow organizational members from a certain distance. In the first case, we have the researcher as a burglar, in the second as a run-away. (Alvesson 2003: 176)

Anticipating section 4.2.2, Jeffrey W. Riemer (1977) includes an element of chance in his definition of self-ethnographic research by referring to unintended or opportunistic self-ethnographic field work that takes advantage of (1) unique circumstances or timely events, (2) familiar situations, and (3) special expertise. Especially in relation to the being an insider, he writes:

> Many sociologists [and researchers in general] possess special skills and knowledge aside from their sociological expertise. Some have taken advantage of this in their research endeavors. This coupling of expertise has resulted in some of the more interesting and illuminating case studies. Ned Polsky's research on pool hustlers and Howard Becker's [H. S. Becker 1963] research on jazz musicians exemplify this research strategy. (Riemer 1977: 472)

In both case studies A and B, I have taken advantage of unique circumstances regarding my experience as a blockchain-in-energy insider, of my familiarity with the Smart Energy Systems concept, of my knowledge as a former employee of Energinet and also of my special expertise regarding old paradigm economics as a former economics student at the University of Copenhagen. It helps to have been through the "mainstream brainwashing machinery" (Røpke 2020: 4) when critiquing the epistemology of old paradigm economics.

4.2.2. SERENDIPITY: COUNTING ON EPHIPHANIES

As Louis Pasteur is quoted to have said, chance favors the prepared mind.[110] Serendipity,[111] then, is a "contingent mix of insight coupled with chance" (G. A. Fine & Deegan 1996: 3). Ann Fujii uses the term "accidental ethnography" about "paying systematic attention to the unplanned moments" (Fujii 2015: 525). This preparedness or systematism, however, also functions as a lens: I can only discover what I am prepared to discover. Gary Alan Fine and James G. Deegan distinguish between three types of serendipity: "Temporal serendipity (happening upon a dramatic instance), serendipity relations (the unplanned building of social networks), and analytic serendipity (discovering concepts or theories that produce compelling claims)" (G. A. Fine & Deegan 1996: 7). In my research, I have made use of all three: For example, being part of the blockchain thought collective is both a temporal and a relational serendipity. The discovery of Fleck's epistemology (Chapter 6) can be said to be an analytic serendipity, as I came across it while reading up on something else. Wanda Vrasti uses the term *improvisation* regarding these types of epiphanies, and writes:

> Improvisation has nothing to do with "weak" research design or self-indulgent solipsism. Rather, it is an exercise in being truthful about the distance we travel from research questions to finished manuscript: nothing can be left out of our ethnography without taking something away from theory. Also, improvisation is not a matter of giving up on textual authority. Much to the contrary, a text that is aware of "the subtle forms of knowledge found in ineffable moments of intuition and epiphany" (Behar 2003: 23) only acquires a more credible voice. (Vrasti 2010: 84)

To a certain extent, epiphanies are so inherent to ethnographic method that they are part of its core definition. As Bob Simpson observes, "you don't do fieldwork, it does you" (2011: 126)—just as "you don't really choose ethnography, it choses you," as Bud Goodall Jr. (2000) writes.

4.2.3. RETROSPECTIVE AND COVERT RESEARCH

Sónia Vespeira De Almeida coined the term *retrospective ethnography* in Portuguese in 2007; in her English-language article with Sónia Ferreira, she writes: "By 'retrospective ethnography' we understand a theoretical and methodological process

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[110] The full quote of Louis Pasteur (1822–1895) in French is: "Dans les champs de l'observation le hasard ne favorise que les esprits prepares."

[111] The three Princes of Serendip, the title of a fairy tale from Sri Lanka, then known as Serendip, inspired Horace Walpole, an English novelist, to coin the term serendipity. In a letter in 1754, he referred to the tale in which the heroes 'were always making discoveries, by accidents and sagacity, of things they were not in quest of'" (G. A. Fine & Deegan 1996: 2) (OED 2020k)

that allows the intensive study of a specific past event and its present reverberations" (Ferreira & De Almeida 2017: 208).[112]

Julia Elyachar's use of the term comes even closer to what I entail it to mean: In her paper on the 1982 Latin American debt crisis, she uses her own experience—thirty years prior—as an assistant at the Federal Reserve Bank in New York (Elyachar 2013). By this definition, then, retrospective research is always covert: Julia Elyachar did not know that she would use her field experience decades later, much as I did not know that I would do a PhD on blockchain when I joined a blockchain-in-energy crowd in Berlin in 2016. This gives retrospective research an "innocent" version of covert research,[113] where the researcher is undercover because they themselves do not yet know that they are researching.

4.3. RESEARCH CONTEXT

[Parts of this section are quoted or paraphrased from Hasberg (2020b)]

My research is based on retrospective insider research with the blockchain-in-energy thought collective in the years 2016–2018 and my position as an insider of the Sustainable Energy Planning group (SEP) at Aalborg University involved in the Viking Link debate in the years 2017–2019. The shift between the two thought collectives involved a geographic shift between Copenhagen and Berlin. Although, according to Fleck, one can be an insider of several thought collectives at the same time, becoming an insider of the Smart Energy System thought collective involved gradually becoming an outsider to the blockchain-in-energy thought collective, as Figure 4-1 shows. My time in the field of blockchain and energy based out of Berlin took place between spring 2016 and the end of 2017, although ties of collaboration to the field exist until today. The primary location was Berlin, but included visits in Vienna, Budapest, New York, Copenhagen, and Nairobi. The details of my insider research are confidential and described in the List of informants for case B in Appendix B and in the research note on the blockchain-in-energy thought collective in Appendix C. I have not at any point held any cryptocurrency myself.

The following arrival story into blockchain-in-energy field shows my starting position as an insider of the thought collective, before "breaking out," as Mats Alvesson (2003: 176) cited above calls it:

[112] Bill Maurer also uses the term in 2016 in an analysis of financial regulation. With it, he does not refer to method, but rather uses it as an allegoric description of regulation itself, which he terms "retrospective ethnography of potential" (Maurer 2016: 313).

[113] See also Covert Research: The Art, Politics and Ethics of Undercover Fieldwork by David Calvey (2017).

> I came across the term "blockchain" for the first time in the beginning of 2016. At the time, I was doing some part-time teaching at the IT-university of Copenhagen, and a colleague there posted an article of his on LinkedIn – it was about blockchain technology. I got interested. I was also working as an independent consultant out of Berlin, and some of my clients were conference organizers. When I was talking to one of them, I mentioned my newly found interest in this weird thing called blockchain (these were still the days where people would ask: Is that some kind of tool for blogging?). Two months later, we organized the first German conference on blockchain on energy: I did the content, they organized the logistics. At the time, there were only a handful people interested in the topic, but somehow, they were all circling around Berlin, and when speakers heard who else was coming, they all joined in. We ended up having what was already then, but especially in hindsight, a very high-level speaker list of pioneers in the field.
>
> To me, blockchain in energy was a way of reviving what I had seen languish over the past decade, namely the decentralization and democratization as "by-products" of the energy transition. [...]. I myself became the promoter of the happy message that "blockchain would solve our problems of the energy transition" From retrospective field notes, December 2018 (Notes, December 2018, Appendix C)

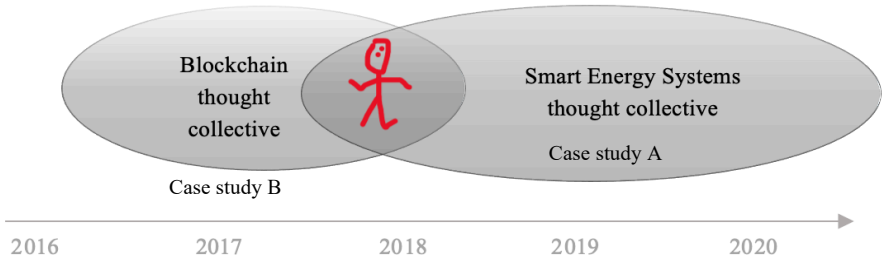
With reference to the documentary filmmaker Henry Breitrose, one could be tempted to describe the ethnographic participant observer as the proverbial "fly on the wall" and contrast that with the observant participant of insider research as a "fly in the soup" (Breitrose 1986:47, cited in Baily 1989: 11). But as Frede Hvelplund (personal communication) rightly points out, a fly in soup is dead. Rather, then, I use a team sports analogy: If insider research is equivalent to being a player in the field, the two cases differ methodologically with respect to which team I research: In case B, I have researched my own team, the blockchain-in-energy thought collective. In case A, I have researched the opposite team: While being part of the Smart Energy Systems thought collective, my research scrutinized the Supergrid thought collective. In both cases, being a field player allows close-up studies that would not otherwise be possible. Fleck even uses team sports to define the importance of the thought collective:

> If the individual may be compared to a soccer player and the thought collective to the soccer team trained for cooperation, then cognition would be the progress of the game. Can an adequate report of this progress be

> made by examining the individual kicks one by one? The whole game would lose its meaning completely.[114] (Fleck 1979: 46)

In Figure 4-1 I have marked myself as a red drawing. The two circles show the two different thought collectives that I did field work within on a time scale: the blockchain-in-energy case study B and the Viking Link case study A.

Figure 4-1 Being an insider in two different thought collectives over the PhD period



Note: The red figure represents the author. Source: Own illustration

The following quote from my field notes shows how the transfer from one thought collective to the other came with "role conflict" and how I was rolled into "loyalty tugs, behavioral claims, and identification dilemmas" (Brannick & Coghlan 2007: 70) that stemmed from the change from being blockchain insider to now being an academic:

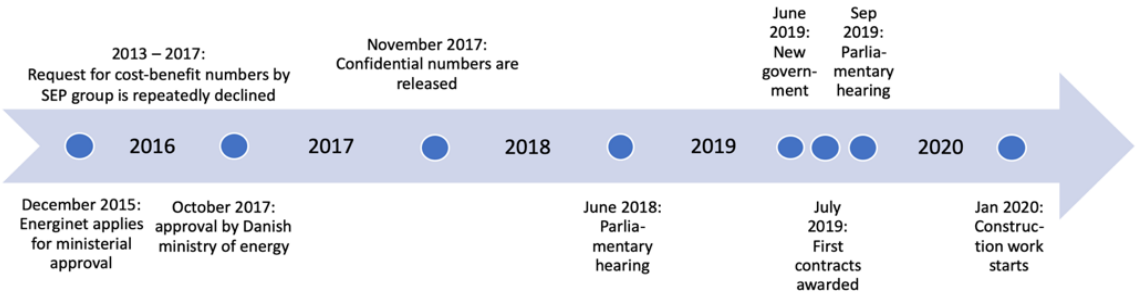
> My first encounter with academic work on blockchain was when a [blockchain thought collective acquaintance and] university professor […] requested me as a reviewer of [their] article on blockchain in energy. […]. [They] had pre-written my reviewer statement the way [they] wanted it [in an email to me]. As […] said, it would be "extremely important" […] to get a positive review in this very competitive journal. I discussed matters with my research group leader, wrote a review, and submitted it as if I had not seen [the] email and [their] attempt at bribing me. "Wow, so this is what I came to academia for?" I thought. (Notes, December 2018, Appendix C)

I have included a temporal scale in Figure 4-1 and the following Figure 4-3 and Figure 4-2 as well because neglecting to do so "obscure[s] much of the contextual information, […] and neglects 'the conjectural nature of all ethnography' (De Pina-

[114] Original German: "Das Individuum ist dem einzelnen Fußballspieler vergleichbar, das Denkkollektiv der auf Zusammenarbeit eingedrillten Fußballmannschaft, das Erkennen dem Spiel- verlaufe. Vermag und darf man diesen Verlauf nur vom Standpunkte einzelner Fußstöße aus untersuchen? Man verlöre allen Sinn des Spieles!" (Fleck 1935: 62, cited in Niewöhner 2012: 68).

Cabral 2000: 347)" (Ferreira & De Almeida 2017: 209). Figure 4-3 shows the timeline regarding the Viking Link decision-making process. When comparing Figure 4-3 and Figure 4-1, it becomes clear that I made use of "timely events" (Riemer 1977, cited above), as the release of confidential numbers in November 2017 that colleagues in the SEP group had been working towards since 2013 happened shortly after I became part of the group. The parliamentary hearing, on which I base my Supergrid thought collective analysis in Appendix F, took place in September 2019—after first construction contracts had been awarded.

Figure 4-2 Timeline over the Viking Link decision making



Source: Own illustration based on Hasberg (2020a). The timeline shows how the initial cost-benefit analysis of Viking Link had already been made in 2013. A version from 2015 was used to gain ministerial approval in 2017, only after which the confidential numbers of the cost-benefit analysis were released. In June 2019, a change of government from center-right (Cabinet of Lars Løkke Rasmussen III) to center-left (Cabinet of Mette Frederiksen I) took place. First construction contracts were awarded in July 2019, before a parliamentary hearing was postponed due to the parliamentary elections could be rescheduled. The new minister was called in a hearing in September 2019, which did not change the decision regarding Viking Link.

An important piece of contextual information regarding case B is the hype cycle that blockchain technology went through while I was a PhD fellow. As shown in Figure 4-3, Gartner's hype cycle can be neatly drawn on top of the valuation of one cryptocurrency as expressed in the price of the cryptocurrency Ether in US Dollars. The *hype cycle* displayed as the red line in Figure 4-3 is a term coined by the consultancy Gartner, denoting a cycle that they see technological development to be following. ETH is shorthand for Ether, the cryptocurrency of the Ethereum blockchain network, which is displayed as the blue line in Figure 4-3. Ethereum is the largest blockchain network after the Bitcoin blockchain and was founded by Vitalik Buterin in 2013 (Buterin 2014). Sometimes cryptocurrencies are also called altcoins, short for alternative coin, because they are considered as alternatives to Bitcoin, which was the first cryptocurrency. Cryptocurrencies are traded on exchanges; just like electricity exchanges, these are marketplaces for trading where value is expressed in exchange currencies like USD. The data source Etherscan is a BlockExplorer, a search engine

for transactions on the Ethereum blockchain. Figure 4-3 shows that the Ethereum bubble[115] burst on January 13, 2018, shortly after the Bitcoin bubble.

Figure 4-1 Ether Price in USD overlaid with the Gartner hype cycle

Source: Etherscan.io and own illustration. The blue axis measures the value of the cryptocurrency Ether as expressed in USD. The red axis is the scale of expectations as used by the Gartner hype cycle. As the red line roughly follows the blue, the cryptocurrency Ether has followed the Gartner hype cycle in its boom and bust phases

Comparing Figure 4-3 and Figure 4-1 makes clear that my research took place in times of large turmoil and strongly changing attitudes within the blockchain community in general and the blockchain-in-energy thought collective specifically. I describe this special situation in my notes:

> How to understand a technology-in-the-making, during a period in time of extreme increase in popular attention due to speculation (or: increase in speculation due to popular attention), a speculation which is completely detached from any technical or philosophical understanding of blockchain technology, its origins and potential? […] Simultaneously to my considerations and search for methodological and theoretical networks, the "bitcoin hype" exploded. [...] It is blurring the picture, but also making the relevance of a broader social science cognition context even more acute, because it magnifies power struggles in the field that cannot be explained by microeconomic or transaction cost theory. (From Notes, February 2018, Appendix D)

[115] For an ethnography of the DAO (Distributed Autonomous Organization) hack, see DuPont (2017) and also Voshmgir (2017).

4.4. ANXIETIES OF RETROSPECTIVE INSIDER RESEARCH

[Parts of this section are quoted or paraphrased from Hasberg (2020b)]

The anxieties of working with retrospective insider research are manifold:

- *The anxiety of too strong a dissonance with the field*: What will happen "when they [the thought collectives in the field] read what [I] write" as Caroline Brettell (1993) asks in the title of her book. Will I "[…] face at best disappointment or at worst potentially damaging reprisals if [my] conclusions do not match the perceptions and/or expectations of [my] informants," as Tara Schwegler (2009:12) phrases it? These anxieties are of course connected to the power issues of "studying up" (Nader 1972).
- *The anxiety of too strong a consonance with the field*: How will my work be different to the work already done in the field? Do I have anything to add to what is already known by the field (Boyer 2008, cited in Niewöhner 2016: 2)? In short, will my thesis look any different to the consulting reports on blockchain in the energy sector? "Is this research?" as Kelly Guyotte & Nicola Sochacka (2016: 1) ask.
- *The anxiety of too strong consonance, revisited*: On the other side, there is the research community as a peer group. Towards that group, there is the anxiety of having been just a collaborator to the research field in the negative sense,[116] that is, the risk of having fraternized with the field, glossing over what is considered to be trivial knowledge within the field with an air of academic *truth*.
- Adding to these anxieties related to field work are those *towards the mono-disciplines* that interdisciplinary research borrows from, and academia as such: Have I used their concepts the way the mono-disciplines intended them to be used or have I overstepped certain unwritten rules of mono-disciplines that I was unaware of? In short, am I a "'good' qualitative researcher" (Pagan 2019: 75)?

Jörg Niewöhner (2016) describes and addresses some of the anxieties listed above. Regarding the second point, he argues that it is a certain *reflexivity* that the researcher adds to the field. This is a "reflexivity grounded in mobility as German sociologist Stefan Hirschauer [2008] argues: mobility between theories, fields, colleagues, institutions, thought styles and ways of worlding,[117] if you will" (Niewöhner 2016: 5).

[116] What Niewöhner (2017: 00:21:45) calls "das Risiko des Kollaborateurs."

[117] The use of world as a verb occurs in Heidegger's work: Heidegger uses "welten", "to world" in the expression "die Welt welten und walten lassen" (Heidegger 1995: 44), to let the world world and prevail." (own translation). "Worlding" is also used by Anna Tsing (Tsing 2011), which is from where Niewöhner borrows the term.

Borrowing different theoretical concepts from different disciplines (as discussed in section 3.2.3) is part of this mobility, which is especially important among sustainability researchers. According to (Knaggård, Ness & Harnesk 2018: 3) who study the interdisciplinarity of the sustainability research group LUCID[118] in Lund, Sweden, Sue Wilkinson (1988) delineates three forms of reflexivity: personal, functional, and disciplinary, of which "disciplinary reflexivity is a deep form of reflexivity, and therefore, more unusual" (Knaggård et al. 2018: 5). They conclude that it is crucial for sustainability researchers to be "deeply reflexive about the function of academic boundaries. It is this awareness that enables them to construct an academic identity entirely beyond boundaries" (Knaggård et al. 2018: 1, see also section 2.3). The mobility between thought collectives has also given rise to reflections on a group level in relation to the thought collectives of which I have been a part. See Appendix C for reflections regarding the blockchain-energy thought collective, and Appendix D regarding my situatedness in the SEP group at Aalborg University.[119]

These anxieties above have real and personal consequences. I did have "feel-bad moments" (Sohl 2018) when I thought of what some of my peers inside the blockchain-in-energy thought collective would think about me if they read my paper Hasberg (2020b). I have ceased contact with some of the people who would otherwise have remained acquaintances—especially those who haven't noticed my change of environment and asked whether I'll come back and work for energy-blockchain startups when done with the PhD. The precarious employment situation in academia (see section 2.2) does not help me in maintaining a steadfast position dissonant to the dominant blockchain thought collective, either (or the dominant economic thought collective, for that matter).

4.4.1. FINDING THE RIGHT DISTANCE/PROXIMITY

As Jörg Niewöhner remarks, "a 'native'-like knowledge of the field of examination is only an advantage if one is able to separate the different perspectives clearly and turn

[118] Abbreviation of the Lund University Centre of Excellence for Integration of the Social and Natural Dimensions of Sustainability (LUCID).

[119] For similar self-reflections of interdisciplinary research groups in the field of sustainable development, see Nastar, Boda & Olsson (2018) who reflect on the Lund University Centre of Excellence for Integration of the Social and Natural Dimensions of Sustainability (LUCID). In addition, the IRI-THESYS where I was a guest researcher has documented reflections on the interdisciplinary nature of their research group in Otero et al. (2017).

them into an advantage analytically"[120] (2012: 66). This "struggle with closeness and closure" that Alvesson (2003: 167) addresses has more recently also been addressed as "critical proximity" (a pun on the proverbial critical distance) as Bruno Latour (2005:1, cited in Birkbak et al. 2015: 266) calls it. Christopher Gad and Britt Winthereik assert that "the critic is an integrated part of what is criticized"[121] (2016: 353). This is true for both my Viking Link and blockchain research (Hasberg 2020a, 2020b): As Figure 4-1 shows, I am inside the thought collectives in both cases, albeit critiquing the Supergrid thought collective from the standpoint of the Smart Energy Systems thought collective in the case of Viking Link, as the sports analogy on page 58 explains.

I set out to study transition processes *within* thought collectives in cases A and B. However, I ended up concluding that power/ignorance ensures lock-in rather than transition. The transition, however, that *did* take place, was that of myself, from being an insider to the field to becoming an outsider. Therefore, the meaning of *within* is twofold:[122] On the one hand, it signifies the power struggles going on *within* the field, behind the scenes, partly in the invisible, revealing themselves only in moments of epiphany. But on the other hand, it also expresses the transition *within* me as a researcher, from my role as insider to outsider, taking place during co-laboration[123] *with* and *in* the field. At the outset of my PhD studies, I sought theoretical guidance in my economics background and considered Transaction Cost Economics (Coase 1937; Williamson 1985) as an analytical framework for understanding blockchain technology (which was initially my only case study), under the hypothesis that blockchains were fundamentally about facilitating transactions. Progressing through the studies, I have myself gone through a transition, resulting in the current methodological positioning described in this methodography. Guided by the question: How to do social science research on blockchain? (see also Appendix D) and the incessant question of a colleague: "What did you *actually* do in Berlin?", I realized the usefulness of my experience as an insider to the blockchain field. From there, I

[120] Own translation from German: "Allerdings muss angemerkt werden, dass die Kenntnis des zu untersuchenden Feldes als quasi »Eingeborene« nur dann von Vorteil ist, wenn die betroffene Person die unterschiedlichen Perspektiven klar zu trennen und analytisch zu ihrem Vorteil zu wenden versteht."

[121] Own translation from Danish: "I begge eksempler er kritikeren en integreret del af det, der kritiseres."

[122] I thank Tim Moss, IRI-THESys, for fruitful discussions resulting in this double entendre.

[123] Co-laboration is a "third mode" (Niewöhner 2016: 2) of field collaboration denoting "temporary joint epistemic work (…) without telos" (2016: 10) but of an experimental and reflexive character. As a concept, co-laboration shares the search for a new understanding of field work with what Dominic Boyer (2014b: 20), with reference to Hadi Deeb and George Marcus (2011) calls para-sites of field work, or Bruno Latour calls critical proximity as mentioned above.

increasingly focused on power struggles and the methodological implications of a *messy* reality, as John Law (2004) emphasized in the subtitle of *After Method*.

On a last note, the experience of distance and proximity in field work is gendered, as Karen Ross (2015) notes: It does matter what the gender of the researcher is. Both in the very male-dominated fields of energy and of blockchain technology, this matters in terms of field work. For illustration purposes, I have included some field notes reflecting examples of the gendered nature of field work at the end of Appendix E. The point that Ross makes is the following: The typical field work instruction of creating proximity by lowering the power distance assumes a setting where the researcher is of a higher standing that those studied. However, as a woman, it may be necessary to do exactly the opposite: To increase the power distance by emphasizing in what ways one is of a superior position, in order to level out the assumed inferior position that one's gender ascribes to one. In a sense, I have unconsciously done so and this may have helped in getting access to vital information and informants.

4.4.2. HANDLING THE LACK OF FIELD NOTES

In case B, unrecorded confidential conversations with key players were the primary way of collecting narratives from the blockchain-in-energy thought collectives. Persons and locations are listed in the confidential Appendix B. The retrospective nature of my research in case B as described in 4.2.3 by definition means that I did not make dedicated field notes during my time in the field, only handwritten notes that I take in notebooks at meetings and for personal reflections. To speak with reference the Grimm brothers' fairy tale figures Hansel and Gretel, the breadcrumbs on my research path have not been eaten by birds—I hadn't even thrown them. Head notes and hand-written notes from the time in the field were turned into field notes when I realized their relevance for my academic work during my research stay in Berlin in the winter of 2018/2019. I compiled them in three different note documents from February 2018, March 2018, and December 2018 that are attached in Appendices C, D, and E.

I have used triangulation to handle lack of field notes and to improve my understanding of case B. According to Martyn Hammersley and Paul Atkinson (2007), cited in Uwe Flick (2007: 3), there are several types of triangulation:

- *Data-source triangulation* is the contrasting of information "deriving from different phases of the fieldwork, different points in the temporal cycles occurring in the setting, or the accounts of different participants" (Hammersley & Atkinson 2007: 183). These different data sources were my participation in different working groups, conferences, and workshops that are listed in the Supervisor Statement attached to this dissertation, in addition to the wide range of data sources listed in Appendix B.

- *Technique or methodic triangulation:* I contrasted the insider research method with desk research. This way, narratives from the field were compared with news articles, tweets, and the writings of other scholars on blockchain and energy. I have referred to these sources where I have made direct use of them.
- *Theoretical triangulation* means to "approach[] data with multiple perspectives and hypotheses in mind" (Hammersley & Atkinson 2007: 165, with reference to Denzin 1989). I have made use of different theoretical lenses throughout my research; what is presented here as the end result does not include the many detours taken. For example, my initial theoretical lens regarding blockchain technology was transaction cost economics, as documented in Appendix D and cited above.

Hence, insider research in my understanding is not used to produce an ethnography (here used in the meaning of the written monographic product), but rather to generate and adapt research hypotheses that can then be laid out for further scrutiny by comparing and contrasting theoretical concepts, research by other scholars, using different methods, and using research from other fields. Triangulation can help check for bias and improve the credibility of research. Retrospectively writing down field notes serves the goal of improving transparency and accountability. However, the notion that field notes are somehow the data that form the basis of subsequent interpretation is flawed:

> Every time researchers choose a word, or a sentence structure, every time they use active or passive voice, or direct or indirect reporting of speech, every time they use a known narrative structure, researchers create the very evidence they will later use as 'proof' of their interpretations. The concept of "raw data" is therefore 'half-baked.' (Kouritzin 2002: 133)

And, as Barbara Herrnstein Smith firmly asserts, "Fleck's point here, once again, is that there are no pure observations, complete descriptions, or 'raw' data." (2006: 60) Lisa Gitelman confirms this in the title of her anthology *"Raw Data" Is an Oxymoron.* Data are always already cooked and never entirely raw (Bowker 2005, cited in Gitelman & Jackson 2013: 2).

4.4.3. MY OWN HARMONIES OF DELUSION

Ludwik Fleck calls for a "comparative epistemology" (Fleck 1979: 28), that is, becoming aware of one's own way of knowing by comparing it to that of other. Jörg Niewöhner summarizes:

> Now, the task of researchers is to dissolve the harmony of delusions. Especially when exploring current topics this is difficult especially because it dupes researchers themselves are duped by the harmony of

> delusion. This is especially the case when they only move within one field.[124] (Niewöhner 2012: 71)

Did I really twist myself free of my own thought prisons (Hvelplund 2005, see Footnote 104) and my own "taken-for-granted understandings of the social world under scrutiny" (Van Maanen, 1979: 547 cited in Humphreys 2005: 855)? Or did I, in breaking with one convention, just follow another, namely that of how to break a convention, what Heidegger calls the tyranny or dictatorship of *das Man* (see section 6.5)? Like in music and art, you can only break the rules if you know them. *Das Man* determines how we ought to break out of the norm.

In the nature of things, I cannot reflect on my "unknown unknowns," to use the Rumsfeldian expression (Rumsfeld 2002; McGoey 2012: 7). Nevertheless, I can state that I have worked towards uncovering what I am unaware of by reflecting *around* the known limits of the thought collectives that I moved within: My discipline of training, my research group of hosting, and the blockchain startup scene in Berlin. Did I in some way "cherry-pick" my case studies to reverse-engineer a particular point, to use the words of Pfleiderer (2020)? Possibly, that was my intention initially, as I joined a research project that wanted to show how well the use of blockchain technology could be applied to local peer-to-peer trading. However, my conclusions regarding that case turned out to be the opposite of my initial hypothesis. Did I cherry-pick the Viking Link case to prove a particular point? As I stumbled upon it through the work of my research group, it caught my interest because I had worked at Energinet (which is also disclosed in the article Hasberg 2020) itself. In the Viking Link case, my conclusion remained unchanged from the initial hypothesis and the findings of my colleagues.

4.5. SPECULATIONS: CROSSING DISCIPLINES, CROSSING LANGUAGES

In this section; I want to extend some more speculative reflections on the interlinkage of interdisciplinarity and interculturality. Why have I chosen work that contains frequent disciplinary switches? I am doing not only interdisciplinary research (as discussed in section 2.2) but the "translation work" required in moving from insider to outsider in self-ethnography. The insider-outsider transition inherent to ethnographic research is similar to the boundary work of crossing disciplinarily lines when working transdisciplinarily. Why have I chosen to do both? According to Knaggård et al. (2018: 3), Darbellay (2015: 205) even uses the vocabulary of cultural and language migration in characterizing interdisciplinary researchers with a

[124] Own translation from German: "Aufgabe […] [der Forscher] es nun, diese Harmonie der Täuschungen aufzulösen […]. Gerade bei der Untersuchung aktueller Themen ist dies vor allem deswegen schwierig, weil die Harmonie der Täuschung die Untersuchenden schnell selbst hinter das Licht führt. Vor allem dann, wenn sie sich nur in einem Feld bewegen."

disciplinary background who have become increasingly interdisciplinary as a "migrant" researchers. In the case of economics, Steffestun & Graupe (2020) show how restrictive language contributes to the monodisciplinarity and encourages us to "break the silence of the text books."[125] So it stands to reason to explore further the connection between crossing linguistic borders and crossing disciplinary borders.

I wonder whether this choice (a choice insofar as it is a choice at all, as the quote of Bud Goodall Jr. in section 4.2.2 asserts) of doing transdisciplinary research *and* choosing ethnographic insider research as a method is to some extent connected to my own biography of growing up trilingually. As the (weak) linguistic relativity theory asserts, language influences thoughts and decisions. As Guy Deutscher (2010) expresses it, the world looks different in different languages. My hypothesis is that switching between thought collectives, like those of disciplines, is similar to switching between languages, continuously translating. Experience in crossing language borders may help in crossing disciplinary borders.

According to Ellen Bialystok et al. (2009: 97), Elizabeth Peal and Wallace Lambert (1962) were among the first to question the negative view of bilingualism, which was until then perceived as a "handicap for children" (Bialystok et al. 2009: 97). Vivian Cook's concept of "multicompetence" defined as "the compound state of a mind with two grammars" (Cook 1991, cited in Cook 2018: para. 1), revolutionized this understanding, because it conceived the multilingual mind as different from that of monolinguals. "By looking at the whole learner's mind, multi-competence opened up reverse transfer from the second language to the first" (Cook 2018: Effects Section). Multilinguals have a range of functions for language unknown to monolinguals: Cognitive flexibility, "the bilingual advantage in switching between two mental sets" (Ikizer & Ramírez-Esparza 2018: 957), also called "task switching" (Bialystok et al. 2009: 102) or "codeswitching" (Cook 2018: Multicompetence Section), are the linguistic concepts for the brain processes that take place when crossing boundaries between languages. Divergent thinking, a quality in creativity, is also characteristic of multilinguals. "The greater divergent thinking performance of multilinguals could be linked to the fact that they perceive the world through the amalgam of two different conceptual prisms and view events with a wider range of enriched experiences" (Dewaele 2016: 11). Recently, "social flexibility, [that is,] the ability to switch with ease between different social environments and accurately assess cues in social interactions" (Ikizer & Ramírez-Esparza 2018: 966) has been added to the cognitive abilities of bilinguals. Dewaele and van Oudenhoven (2009) show that Third-Culture

[125] Own translation of the German phrase "das Schweigen der Lehrbücher" (Steffestun & Graupe 2020).

Kids, a distinct subgroup of bilinguals,[126] score higher on the personality traits[127] of open-mindedness and cultural empathy, which should come in handy in an interdisciplinary setting or when switching between thought collectives as part of field work.

I suggest that interdisciplinary research can learn from this revolution in linguistics: Linguistics has stopped treating bilinguals as a defective native speaker but instead started to recognize the cognitive and social flexibility that comes with being able to switch between linguistic thought collectives, to use the Fleckian term. In the same way, we can learn to see interdisciplinarity as an asset, and not as a defect for a monodisciplinary researcher. Just like multilingualism changes the relationship to the first language(s), the reflexivity attained through interdisciplinary research changes the relationship to the home discipline(s).

In anticipation of Chapter 6 on the epistemology of Ludwik Fleck, a closer look at his biography is an example of such a coincidence between multilingualism, multiculturalism, and transdisciplinarity. The European medical doctor and microbiologist Ludwik Fleck (1896-1961) was born to Polish-Jewish parents in the city named Lwów in Polish, Lemberg in German, and L'viv in Ukrainian. Today the most Western city of Ukraine, when Fleck grew up it was the most Eastern city of the Austrian-Hungarian Habsburg monarchy and had been an East-West melting pot since the early Middle Ages (Lagzi 2014). Together with Krakow, Lwòw was the "political, cultural and intellectual center[]" (Markiewicz 1986: 227) of the province of Galicia in the Austro-Hungarian empire. "Besides the Polish majority, [there were] Ukrainians, Germans, Jews, Armenians and representatives of other nationalities" like Austrians, Czech, Slovaks, Hungarians, and Roma. Wladyslaw Markiewicz (1986) continues:

> The ethnic-religious groups within the population varied with respect to their customs, cultural value systems, political attitudes, aspirations, etc. This found expression in the variety of cultural and intellectual life, the architecture, the specific dialect and even the sense of humor. Without exaggeration, one can categorize the moral and cultural visage of the city as being unusual and unique. Each of the significant nationalities created

[126] Third Culture Kids (TCK) have been raised in a culture other than that of the country of origin of their parents and typically don't feel that they fully belong to any one culture, but appropriate traits of all the cultures that they are raised in. As I was raised in Denmark by a Hungarian mother and a German father, I belong in this category myself.

[127] The concept of personality traits is fraught with infopower as Koopman (2019a) shows, and must hence be taken with a grain of salt.

> its own cultural organizations, theatre, education organization, publishing houses, scientific societies, etc. (1986: 227)

One can imagine that Fleck had plenty of opportunity to observe different thought styles, and also plenty of opportunity for "getting his boots dirty" as Pim Klaassen (2014: 33) calls the movement between thought collectives of both language, culture, and discipline.

> The fact that Fleck was a non-philosopher was not altogether a disadvantage for the development of his thought. [...] he had no commitment to affirming its value as a specific intellectual enterprise. [...] he had the advantage of a certain kind of intellectual freedom and, with it, the possibility or even likelihood of a certain kind of radical originality. (Herrnstein Smith 2006: 73)

While Fleck was working across disciplinary fields, the world was moving in the other direction. There was a "growing division and to varying extents antagonism between the empirical sciences and classic humanistic disciplines, both as cognitive styles and as institutional projects" (Herrnstein Smith 2006: 74–75).

Another biographical fact of my own, that of being a woman, may also contribute to my choice of crossing disciplinary boundaries. As I have cited Jörg Niewöhner in section 2.2, more women than men in Science and Technology studies have crossed disciplinary boundaries in a similar way to Ludwik Fleck. As discussed in section 2.3, disciplinary and gender constraints can interact and turn the core of established research fields into male domains, creating particularly unwelcome environments for women. Isabelle Stengers and Vinciane Despret (2014) elaborate on the outsider position of women in academia (in their case, focusing on philosophy) and point out by writing in the voice of traditional male philosophers: "You [as a woman] are welcome, for we [the traditional male philosophers] are 'democrats', but on our terms, so that nothing changes. You are welcome as long as you don't make a fuss" (2014: 17). However, "not being meant by tradition can have something liberating"[128] as Juliane Rebentisch asserts in Burgemann and Schönfelder (2019). Not feeling at home in their disciplinary home draws women across disciplinary boundaries.

Working at the margins of disciplines—be it because of gender or aided by the multicompetence of multilingualism and multiculturalism—may have contributed to my choice of case studies, the choice of methods, and the fundamental choice of interdisciplinarity. I have been an insider to the fields of study in case studies A and B, but an outsider to the intellectual tradition whose tools I've started using (ethnography, philosophy of science, and science and technology studies). Much of that methodological inspiration has come from my research stay at the

[128] Own translation from German: "(…) der Umstand, nicht von der Tradition gemeint zu sein, [kann auch] etwas Befreiendes haben."

Interdisciplinary Research Institute for the Transformation of Human-Environment Systems at the Humboldt University Berlin (IRI-THESYS), and through the neighboring groups of techno-anthropology and participation (TAPAR) as well as the Special Interest Group on Valuation, both at the Institute of Planning at Aalborg University Copenhagen.

4.6. SUMMING UP RETROSPECTIVE INSIDER RESEARCH: DRAWBACKS AND ADVANTAGES

In this chapter, I have aimed to be explicit about how I got to my findings, that is, to describe the way up the mountain, to return to the opening allegory in section 4.2. As shown in this section, retrospective insider research is wrought with choices and anxieties. These downsides can be alleviated via a large degree of reflexivity in handling the tensions between credibility, confidentiality, and transparency. Some of the core issues of ethnographic methods that exist both with and without complete sets of field notes, with and without being insider, being retrospective and covert: these cannot remove my own harmonies of delusion.

Insider research is able to provide insights otherwise inaccessible through other methods. It is thus a particularly useful method for "studying up". It uncovers things "in time"—that is, as they are happening. To achieve a similar level of insight would be unimaginable with other methods such as structured interviews, or even overt ethnography. For example, a longitudinal study using repeated questionnaires or structured interviews to identify attitudes of members of the blockchain/energy thought collective towards questions of power over time would prove difficult, both because the questions to be asked cannot necessarily be formulated at the outset of the research (or will at least change significantly over the course of the study), and because self-reported answers will contain response bias. As Alvesson and Sköldberg (2000: 131) emphasize: "We can hardly go around asking people about their psychic prisons or false consciousness or communicative distortions and so on."

The phronetic third question of Bent Flyvbjerg in section 4.1 "Is this development desirable?") has generally been understood as "desirable for society" and, thus, taking a critical stance towards those in power. However, it is worth being aware of the important point that Anne Alvesalo-Kuusi and David Whyte (2018) make:

> The "interests of society" or the "public interest" are not politically or socially neutral terms. Indeed, many of us work in contexts in which the notion of the "public interest" is changing fast. In most advanced capitalist states, the private interests of corporations are increasingly being represented by governments and policy makers as the same thing as the public interest. (2018: 144)

In addition to that, Alvesalo-Kuusi and Whyte (2018) "question the proposition that elites and the organisations they work for should be given the same protections as vulnerable research participants" (2018: 147) and therefore call for a new conception of social science research ethics when studying the powerful: It should be the societal interest that guides ethics. As they write:

> If we return to our example of the researcher seeking to understand how corporate executive legitimise environmental pollution, the research itself seeks to understand how elites systematically engage in deception. In such a context, does this mean we can legitimately develop a new set of research practices that are themselves deceptive? What might this mean for an ethical approach to research? (Alvesalo-Kuusi & Whyte 2018: 142)

Their example is quite close to the Viking Link case A. In future research, it is thus worth considering ethical dilemmas in the new light that Alvesalo-Kuusi and Whyte suggest. In that light, the advantages of retrospective insider research clearly outweigh the downsides, at least when used as a method to study the powerful who are otherwise inaccessible with other methods. Teresa Brannick and David Coghlan (2007) come to similar conclusions. In their paper "In defense of being 'native': The case for insider academic research," Teresa Brannick and David Coghlan (2007) highlight the difficulties, but also the advantages, of insider research. They confirm some of my anxieties listed in section 4.4, but nevertheless conclude that

> insider research [...] is not only valid and useful but also provides important knowledge about what organizations are really like, which traditional approaches may not be able to uncover. In our view, insider research is not problematic in itself and is respectable research in whatever paradigm it is undertaken. (Brannick & Coghlan 2007: 72)

In my concrete case, using retrospective insider research means that I have been able to develop the power/ignorance concept presented in Chapter 7. Without the position as an insider, and with the proximity that comes with not disclosing (and in my case, initially not having) a research intent, I would not have been able to get the insights of fellow participants in the field that would have led me to look closer at the construction of facts and ignorance, and the role of power therein. Yet, access to these thought collectives is indispensable when researching carbon lock-in, because the action is "in what we might call infrastructural practices and debates, i.e. highly technical, scientific, legal and economic debates and processes that are rarely accessed [by outsiders like] anthropologists" (Niewöhner 2016: 14)

SECTION B: PHILOSOPHICAL REFLECTIONS

Both case A on Viking Link and case B on blockchain technology essentially deal with how we come to know what we believe to be true, and how this knowledge then guides action and manifests in reality—in the form of an overseas cable between Denmark and Britain, and as investments in blockchain technology. This section, therefore, discusses ontology, the nature of reality in Chapter 5, and epistemology, that is the theory of knowledge, in Chapter 6, which is of relevance to the way I put concepts to work in Chapter 7.

CHAPTER 5. FOSSIL VERSUS RENEWABLE ENERGOMATERIALISMS

This chapter introduces the ontological[129] differences between fossil-nuclear and renewable energy systems, discussing the notions of *flexibility* and the concept of *Smart Energy Systems* in light of Heidegger's philosophy of (energy and information) technology. Fossil-nuclear energy systems are here understood as based on coal, fossil gas, and nuclear energy carriers, while renewable energy systems are based primarily on electricity as an energy carrier of fluctuating renewable energy sources like wind and sunlight, with the addition of storable energy carriers, like biomass, biogas, different forms of pumped hydro power, and geothermal energy.

From a technical viewpoint, it is self-evident to the degree of being trivial that renewable and fossil energy systems are different in nature. In fossil systems, energy is storable, and production[130] of energy (to some degree) therefore follows human demand. In renewable energy systems, this relationship is turned upside down: Because solar irradiation and especially wind patterns, although they may be meteorologically be predicted, are beyond the control of humans, the production of energy follows nature's supply. This difference becomes especially important in renewables-based energy systems. The concept of Smart Energy Systems (as defined in the next section 5.2.2) of the Sustainable Energy Planning group at Aalborg University conceptualizes how a 100% renewable energy system can be achieved, when only some components of the system are storable.

If the difference between fossil-nuclear and renewable energy is obvious to the point of banality, why devote an entire chapter to it? Because I read Heidegger's *The Question Concerning Technology* (Heidegger 1977b) as an early work on what is today called *new materialism*, which I introduce in the following section. Heidegger writes about materiality with a specificity to energy systems that is rarely encountered in philosophical writings. This is the reason for using the term *energomaterialism*[131] coined by Andreas Folkers (2017: 32) in the title.

[129] Ontology is derived from Greek, literally meaning 'speaking about' (-logy) 'being' (-onto).

[130] Or more correctly, conversion.

[131] Own translation from German: "Energomaterialismus."

5.1. NEW MATERIALISM

New materialism, sometimes also framed as an *ontological* or *material turn*, has brought renewed interest to things[132] and infrastructure (see definition in section 1.1) in the humanities and social sciences. It is born out of the (to engineers not quite revolutionary) realization that we're "living in a material world" as Madonna sang in 1980. The newness of new materialism consists of a *re*turn to matter (Whatmore 2006, emphasis by Forman 2020: Section 2.4)[133] after phases of historical materialism à la Karl Marx (Forman 2020: Section 2.3). Peter Forman defines *new materialisms* as "a body of scholarship in which the 'vibrant' or 'vital' materialities of things has been emphasised, primarily in response to the prioritisation of discourse during the cultural turn"[134] (Forman 2020: Section 1). Historical materialism was "concern[ed] with 'structural' or 'macro-level' forces deriving from the social relations of production; power was conceptualized as a top-down phenomenon, exerted by a dominant social class over an oppressed class of working people" (Fox & Alldred 2019: 2). This is in contrast to new materialism—or reflecting the heterogeneity of the field, new materialism*s*—which "extend[s] […] the concept of agency and power to non-human[s]" (Lemke 2015: 4). In the term *new materialisms*, the social is tacitly included. In that sense, the term is "unhelpful in that it implies an exclusive interest in matter and materiality, despite its advocates remaining interested in life, bodies, knowledge, systems of meaning, and affects" (Forman 2020: Section 2.2.). In the words of Karen Barad, "reality is not composed of things-in-themselves or things-behind-phenomena but 'things'-in-phenomena" (2003: 817). New materialist thinking

[132] Coming from Danish, it is particularly easy to read the term thing as an assemblage (Deleuze & Guattari 1980)—without taking the "detour" via French, but in keeping the etymology of the word in mind instead. 'Thing' is derived from Proto-Germanic '*thinga-' , meaning 'assembly' (Etymonline 2020c), as still used today in the Danish term 'folketing', denoting the Danish parliament. This etymology is also acknowledged by Latour (2005b) with the words: "As every reader of Heidegger knows, or as every glance at an English dictionary under the heading 'Thing' will certify, the old word 'Thing' or 'Ding' designated originally a certain type of archaic assembly" (Latour 2005b: 12). Latour refers to Heidegger's understanding of thing as "that which is present" (Heidegger 1971b: 174) ["das Anwesende" (Heidegger 2000b:177)]. He too adds the etymological explanation: "To be sure, the Old High German word thing means a gathering, and specifically a gathering to deliberate on a matter under discussion, a contested matter" (Heidegger 1971b: 172) ["Wohl bedeutet das althochdeutsche Wort thing die Versammlung und zwar die Versammlung zur Verhandlung einer in Rede stehenden Angelegenheit, eines Streitfalles" (Heidegger 2000b:176)].

[133] The following quotes from Forman (2020) and Fox & Alldred (2019) are from a preprints published online. References to Forman (2020) therefore contain section numbers, not page numbers, while those to Fox & Alldred (2019) refer to the page numbers of the preprint PDF.

[134] The cultural turn is here understood as "a movement towards idealist ontologies and constructivist epistemologies [and away from] realist ontologies and positivist epistemologies. […] To differing degrees, these new perspectives took the broadly phenomenological approach that, if a real world did exist at all, it was impossible to ever know of its existence with any certainty or objectivity. (Forman 2020: Section 2.3).

opposes dualisms like the nature-culture or mind-matter divide, including the division between ontology and epistemology. New materialist epistemologies are thus onto-epistemologies: Producing knowledge while reality "kicks back" (Barad 1998: 112). They share a "concern for the performative role of materials and in the constitution of social life"[135] (Forman 2020: Section 2). The socio-material perspectives of new materialisms are a "shift from an ontology of being to an ontology of becoming" (Hultin 2019: 92). In other words, world (as well as infrastructure) is also a verb: "The world worlds" [my italics; "die Welt welte[t]" (Heidegger 1995: 44, see also Footnote 119).

"Energy is a central theme of new materialism"[136] (Folkers 2017: 32) and the infrastructur*ing* of energy infrastructure has gained particular attention in the social sciences and humanities recently (Niewöhner 2015; Karasti & Blomberg 2018; Abram et al. 2019). Heidegger's energomaterial understanding of the 'essence' of technology addresses just that. Yet

> the position of Heidegger in respect to the ontological turn is actually puzzling. […] Yet, browsing the post-constructionist literature, Heidegger appears rather marginal, and often criticized. For example, Latour is rather ambivalent about Heidegger, without properly engaging with him. […] turning to feminist new materialism, the situation does not basically change. […] A few quotations can be found […] in Jane Bennett's *Vibrant Matter* (2010) […]. Heidegger, however, is hardly ever mentioned in major works of […] Karen Barad, Donna Haraway and others. This does not mean that Heidegger's critique of Western dualism and essentialism is irrelevant to the post-constructionist's case. […] I am familiar with just one attempt to use extensively Heidegger in regard to the current relationship between humans and nature, namely Ruth Irwin's Heidegger, Politics and Climate Change (2008). (Pellizzoni 2016: 150)

As the above quote shows, Heidegger's thinking on technology, and particularly on renewable energy, is not widely enrolled nor discussed in what Pellizzoni calls the "post-constructionist literature" in the quote above, nor in the field of energy transition research. In fact, by critics, Heidegger's work on technology has frequently been received as romantic back-to-the-Black-Forest[137] kind of thinking (see for example

[135] See Hasberg (2020a, section 2.4) in Appendix J for a review of the term performativity in relation to economics.

[136] Own translation from German: "Energie ist ein zentrales Thema des neuen Materialismus."

[137] The Black Forest (Schwarzwald) in south-western Baden-Württemberg, the birthplace of Heidegger.

(Poschardt 2011) and technology-fearing Luddism.[138] It may thus constitute a "homeless cognition context" with the words of Hvelplund (2005), confirming what Ludwik Fleck (see Chapter 6) showed: That there must be a thought collective interested in receiving a thought. Otherwise, an idea has a hard time surviving. I will return to the work of Ruth Irwin at the end of this chapter.

5.1.1. THE (NEW) MATERIALITY OF POWER

My fundamental understanding of power and its material embeddedness is expressed by Gailing and Moss (2016a):

> Materialities are congealed forms of social relations in the sense that materiality is the outcome of the impact of powerful institutions and actors. Here, it should be noted that power relations between materiality and society are not one-directional: (...) Powerful actors create materialities, but materialities restrict the scope of action of actors. (Gailing & Moss 2016b: 117)

According to Gabrielle Hecht, technopolitics is "the strategic practice of designing or using technology [understood in a socio-material sense] to constitute, embody, or enact political goals" (2009: 15). Similarly, infrastructure can be seen as *stored power* (Förster 2020). An example is provided by Anne Neumann et al. (2020) who show that large-scale energy infrastructure investments with lifespans over decades both politically and materially block the path towards a more decentralized renewable energy system. Information infrastructures, including models and methodologies, are also a way of *storing* power.

Why have I chosen energopower (Boyer 2019), the power inherent to fossil energy infrastructures, and infopower (Koopman 2019b), the power inherent to information systems, as analytic lenses? Aren't there plenty of power concepts available for understanding power in the energy and information sector? On the energy side, these include concepts of hierarchical, elite, and corporate power of incumbents (Beder 2014; Stirling 2014; Fix, Bichler & Nitzan 2019; Sovacool & Brisbois 2019); power understood as Foucauldian governmentality and depolitization (Bues & Gailing 2016); ownership as a form of power (Moss, Becker & Naumann 2015; Gorroño-Albizu, Sperling & Djørup 2019; Hvelplund & Djørup 2019); power as a form of evil (Galvin 2020) and gendered power struggles (Nader 1981; Allen, Lyons & Stephens 2019). Notions of democracy play a key role across all these conceptualizations of power, and even more explicitly so in Timothy Mitchell's (2009) *Carbon Democracy* on the relationship between infrastructured fossil power and democracy. Similarly,

[138] From Luddite (derogatory), "a person opposed to new technology […] Perhaps named after Ned Ludd, a participant in the destruction of machinery of English workers, especially in cotton and woolen mills, that they believed was threatening their jobs (1811–16)" (OED 2020h).

various conceptualizations of energy democracy pick up on this relationship between energy and social (infra)structure (M. J. Burke & Stephens 2018; Szulecki 2018; van Veelen & van der Horst 2018).

Similarly, there are a number of relevant conceptualizations of power in information systems, most recently and notably Shoshana Zuboff (2015, 2019) with *Surveillance Capitalism*. Just as in the energy sector, the changing nature of democracy in the information society is the subject of theorizations (Hofmann 2017; 2019) and visions of how to redistribute power (Balaram 2016; Bauwens 2016; Scholz & Schneider 2016). In addition to these sector-specific concepts, power is also conceptualized in relation to infrastructure and how it reinforces or reproduces existing political or economic power relations (Mcfarlane & Rutherford 2008; Bridge, Özkaynak & Turhan 2018). Neither of these concepts can *"pretend to model the absolute truth of power"* (Boyer 2014a: 325).

I have chosen energopower and infopower because these terms have a focus on materiality (see 5.1) and thus include an infrastructural perspective:

> Infopower acts by fastening information into infrastructures which path-dependently reproduce whatever injustices were molded into the earliest data sheets. Inspired by this insight, energopower could be understood as the fastening of energy into infrastructures (which are, today, fossil infrastructures), path-dependently reproducing the problematics of the fossil era. (Hasberg 2019c)

The terms are an example of "practical theory" (Lewin 1951) because they are both sector-specific but share their Foucauldian origin, which makes them applicable to the analysis of two sectors in parallel: I apply infopower to the power of (new) data infrastructures of blockchains, and energopower for the (old) power of existing energy incumbents, affecting the governance structures of blockchains. By focusing on the materiality of power, I want to avoid "explaining power with power" and rather "escort the powers back to the galleries and networks from where they came" (Latour, cited in Metzger, Soneryd & Tamm Hallström 2017). This material focus of infopower and energopower can be seen as inherent to the concept they are derived from; Foucauldian biopower (Lemke 2015). Biopower originates in the first volume of Foucault's history of sexuality, *The Will to Knowledge* (Foucault 1978), where it meant the rule over bodies. Counterintuitively, it is mostly in *Security, Territory, Population* that Foucault develops the concepts of biopower and biopolitics (Foucault 2007) while *The Birth of Biopolitics* (Foucault 2008) deals with questions of neoliberalism and the market as a site of veridiction (Dean 2014: 6). Debates over whether Foucault endorses neoliberalism have been centered around *The Birth of Biopolitics*. See for example Newheiser (2016: 11) for a rejection of that claim.

I follow the interpretation of Lemke (2015) who argues that biopower, in Foucault's later use of the word, includes the "government of things," not only that of bodies, as Foucault himself stresses the "intrication of men and things" (Foucault 2007: 135).

5.2. THE QUESTION CONCERNING ENERGY TECHNOLOGY

Our energy system forms the basis of economic activity, as especially ecological economics has made clear (see section 3.2.2). The nature of this system, that is, it's ontology, has significant influence on our relationship to nature and ultimately on our relationship to ourselves. This is the core argument in Heidegger's work from 1954, *The Question Concerning Technology* (Heidegger 1977b; 2000c). The choice between fossil and renewable energy permeates the essay, and "it all hinges on an aspect that is mostly overlooked by philosophers but all the more present among electrical engineers: Storability"[139] (Folkers 2017: 41). Heidegger's argument centers around the lack of storability of renewable energies like wind and sun versus the storability of fossil and "old" renewable[140] forms of energy like coal, nuclear, and large hydropower.

The reason to bring Heidegger's *The Question Concerning Technology* into my argument in this cover essay are two anticipations that I read out of it: *Firstly*, in anticipation of the ontological turn in modern, especially feminist philosophy (of science) introduced in section 5.1, Heidegger emphasizes the interwovenness of the material and the social. *Secondly*, Heidegger anticipates the argument of ecological economics that the economy is dependent on, the biosphere (see section 3.2). As Wolfgang Friedrich Lutz writes, "we could superficially conclude that Heidegger—would he still be among us—would be an advocate of decentralized energy supply and of renewable energies"[141] (Lutz 2011: 15–16). But Heidegger's argument is not primarily concerned with the biophysical limits that today's use of fossil fuels is transgressing. Instead, Heidegger argues that the nature of the energy system—fluctuating renewable or storable fossil—has a decisive impact on our Being[142] as humans.

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[139] Own translation from German: "Alles hängt an einem von Philosoph_innen zumeist überlesenen und den Elektroingenieur_innen dafür umso präsenteren Aspekt, den Heidegger anspricht: Speicherbarkeit."

[140] Like in Heidegger's thinking, many renewable energy statistics exclude large hydro. The renewable energy category without large hydro is then often termed "new" renewable energy, as large hydro is considered an "old" form of renewable energy.

[141] Own translation from German: "Wir könnten oberflächlich darauf schließen, dass Heidegger – würde er noch unter uns weilen – ein Verfechter der dezentralen Energieversorgung und der erneuerbaren Energien sein würde."

[142] Being is a key term in Heideggerian philosophy, and often capitalized in English translations.

Before starting out, a biographical note on Heidegger is needed: Partly, the critique of Heidegger has also been fueled by the fact "that Heidegger was a Nazi and […] held anti-Semitic views […]" (Malpas 2016: 3). The discussion of how to separate the life and work of creators like artists and philosophers is an important discussion. In the wake of #metoo,[143] and after it became clear that important characters of German cultural life identified with Nazism and prior antisemitic movements (like the painter Emil Nolde, the composer Richard Wagner,[144] and indeed, Martin Heidegger's *Black Notebooks* released in 2014) (Farin & Malpas 2016), the question is: Is it possible to use the work of a Nazi like Heidegger or a rapist like American film producer Harvey Weinstein?

Without minimizing Heidegger's politics, I contend that his concepts offer a valuable contribution to my thinking on energy. Heidegger's analysis of the fundamentally different nature of renewable and fossil energy is remarkable and to the point. Heidegger is frequently cited for his view that "the essence of technology is by no means anything technological"[145] (Heidegger 1977b: 4). What this means is that Heidegger is interested in how technologies interfere with our relationship to nature, and ultimately, with our relationship to ourselves, as stated in the introduction to this chapter. Heidegger uses new constructs of language to prove his point, but the use of neologisms characteristic of his work makes the task of translators particularly difficult. He builds up a conceptual universe around two German word roots, 'bergen' and 'stellen.' Instead of relying on the extensive range of English translations, I want to summarize Heidegger's thinking on technology by using an etymological approach to these two roots:

- 'bergen' originally means 'bring into the safety' of a castle, 'Burg', on a hill or mountain, 'Berg.' Heidegger often uses this root with a negative prefix like 'ent-' in 'entbergen', transporting the meaning 'to bring something forth' by taking it away from its safe heaven,[146] also translated as 'revealing'.
- 'stellen' means 'to put in place' or 'to construct'. It is the root of the German 'herstellen', to produce, and 'darstellen', to perform. The root is used in Heidegger's key concept of 'Ge-stell' which is a neologism quite detached

[143] #metoo is an international movement denouncing sexual assault, rape, and harassment. The #metoo hashtag went viral after the sexual abuse cases of filmmaker Harvey Weinstein became public in 2017.

[144] As exemplified in Wagner's discrediting of Felix Mendelssohn-Bartholdy.

[145] German original: "So ist denn auch das Wesen der Technik ganz und gar nichts Technisches."

[146] 'Entbergen' is translated as 'revealing,' 'bringing-forth,' and 'unconcealment.'

> from its German meaning 'scaffold' or 'frame.' For Heidegger it means 'what is produced' or 'what is performed.'[147]

Heidegger's core argument is that what he calls modern technology—fossil, nuclear, and old renewable energy technologies, according to the taxonomy above—is a 'Ge-stell' of production that forcefully brings forth ('entbergen') energy from nature and in so doing turns nature into 'Bestand', an asset, stock, or standing-reserve in the translation of William Lovitt. This is different from renewable energy that lets nature reveal itself through its fluctuating nature, which Heidegger describes as withdrawal.

In the following subsections, I combine Heidegger's energy ontologies and apply them to the transition from a non-intermittent fossil-nuclear to an intermittent renewable energy system. I show how the role of three components change: That of (a) generation, (b) information and communication, and (c), that of storage and flexibility. While (a) covers the primary energy carriers in the two ideal-type[148] energy systems, and (b) is dealt with in section 5.2.4, it is component (c) that represents the standing-reserve of Heidegger that he perceived as crucial to understanding "modern" fossil-nuclear technology. To further specify (c), I use the definition of Blue et al. (2020: 3) who operate with three types of flexibility, of which storage is one. Blue et al. write that flexibility is:

> [c1] a quality or property of the energy system as a whole;
> [c2] a commodity that can be bought and sold, and
> [c3] […] specific measures, instruments, or techniques such as storage or demand-side management. (Blue et al. 2020: 3)

To these, I add a fourth type:

> [c4] interconnection.

With this understanding of flexibility, the Viking Link case study A and the blockchain peer-to-peer energy exchange case study B (see Appendix I and J) serve similar functions in an energy system: In very different ways, they aim at providing flexibility and can therefore be considered as two very different ideal types of flexibility. In Figure 5-1 and Figure 5-2, the three categories (a), (b), and (c) are depicted on the left. I show how the three categories interact to maintain an uninterrupted supply of electricity, visually illustrated as an intersecting demand and supply curve on the right.

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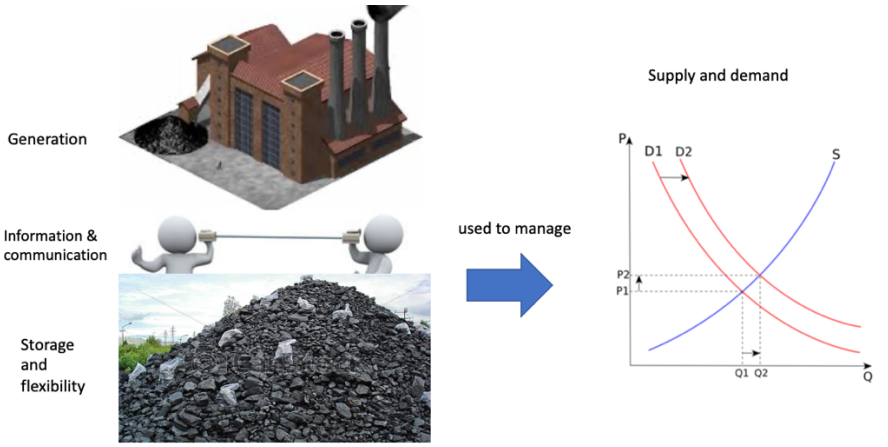
[147] "Das Wort 'stellen' meint im Titel Ge-stell nicht nur das Herausfordern, es soll zugleich den Anklang an ein anderes 'Stellen' bewahren, aus dem es abstammt, nämlich an jenes Her- und Dar-stellen" (Heidegger 2000c: 21).

[148] See Footnote 40 or the Dictionary of terms in Appendix A for an explanation of the term "ideal type.

5.2.1. FOSSIL ENERGY AS A STANDING RESERVE

Figure 5-1 Balancing supply & demand in the non-intermittent fossil energy system



Source: Adaption of figure published in Hasberg (2019a); image sources: Clipart (2020); csp_MikhailT (2020); DLPNG (2020), and private.

In a fossil energy system, it is the storability of fossil energy carriers that makes supply and demand meet. As mentioned above, supply is demand-driven, and the storability of fossil energy means that adjusting to daily, weekly, and seasonal variations in demand is physically and socio-technically possible. Communication and information do play a role in the fossil energy system, but it is minor and monodirectional: The telephones in the control centers of transmission grid operators in the monopoly era come to mind, calling the coal power plant to add one more shovel of coal.

> Modern technology […] puts to nature the unreasonable demand that it supply energy that can be extracted and stored as such. […] The coal that has been hauled out […] It is stockpiled; that is, it is on call, ready to deliver the sun's warmth that is stored in it. (Heidegger 1977b: 14–15)

On the right-hand side, Figure 5-1 shows the electricity market in the standing-reserve ontology. Today, trade of electricity takes place at centralized electricity exchanges like the Nord Pool[149] electricity market or the EPEX Spot market of European Energy

[149] The Nordic electricity exchange in Lysaker, Norway, operating on Nordic, Baltic, and, since 2019, in continental European and British markets (until January 2016, Nord Pool Spot). It is owned by a group of Nordic and Baltic Transmission System Operators.

Exchange (EEX).[150] There, electricity is traded "like biscuits"[151] meaning that it is traded like any other storable commodity on a global market.

The problem with the standing-reserve approach to nature is that ultimately, this process turns ourselves into a standing-reserve, as today's terminology of "human resources" and "investing into friendships" vividly exemplify. I will return to the parallels between the consumption of self and the consumption of nature as a standing reserve in section 7.3.2.

> [When] man […] is nothing but the orderer of the standing-reserve, […] [he walks on][152] the very brink of a precipitous fall; that is, he comes to the point where he himself will have to be taken as standing-reserve. Meanwhile man, precisely as the one so threatened, exalts himself to the posture of lord of the earth. (Heidegger 1977b: 27)[153]

This quote shows that Heidegger predicted that environmental destruction ultimately leads to human self-destruction: We consume ourselves, as Renata Salecl (2013a: 99) points out with reference to Jacques Lacan; or with a Derridean term, we turn autoimmune in the sense that we attack and destroy ourselves "in [a] quasi-*suicidal* fashion" (Borradori 2003: 94, emphasis in original).

Heidegger argues against technological determinism, the concept of perceiving technology as something neutral, today frequently expressed as *technology neutrality*:

> Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something *neutral*; for this conception

[150] European Energy Exchange in Leipzig, Germany. Together with the French Powernext, EEX operates EPEX Spot, an electricity exchange located in Paris, trading power from Continental Western Europe and Britain and expected to open business to Nordic and Baltic markets in 2020.

[151] A metaphor of Frede Hvelplund, personal communication, March 2020.

[152] The original translation by William Lovitt states "he comes to," not "he walks on." This must be based on a grammatical translation of a dative in the original German translated into an accusative in English: Man does not walk towards the brink but is already there and walks on the brink.

[153] German original: "Sobald […] der Mensch […] nur noch der Besteller des Bestandes ist, — geht der Mensch am äußersten Rand des Absturzes, dorthin nämlich, wo er selber nur noch als Bestand genommen werden soll. Indessen spreizt sich gerade der so bedrohte Mensch in die Gestalt des Herrn der Erde auf" (Heidegger 2000c: 27–28).

> of it, to which today we particularly like to do homage, makes us utterly blind to the essence of technology. (Heidegger 1977b: 4)[154]

He also argues against TINA-thinking[155] regarding technology, the notion that "technology is the fate of our age, where 'fate' means the inevitability of an unalterable course. (Heidegger 1977b: 25)[156] Apart from energy examples, Heidegger also mentions how nature spots are turned into touristic assets—what we today call the experience economy (Pine II & Gilmore 1998)[157].

Our way of turning nature into a productive stock is "danger in the highest sense" (1977b: 28) ["im höchsten Sinne Gefahr" (2000c: 29)]. Standing at this perilous "brink" (1977b: 27) is the Faustian (von Goethe 1808)[158] moment in Heidegger's *The Question Concerning Technology*. And exactly at this point of no return, the point where there is no hope anymore—there is hope. Heidegger's *deus ex machina*[159] comes along in the form of an opening line from a Hölderlin poem:

> But where danger is, grows the saving power also[160]
> (Hölderlin 1953: 191, lines 3–4, English translation from Heidegger 1977b).

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[154] Original German: "Am ärgsten sind wir jedoch der Technik ausgeliefert, wenn wir sie als etwas Neutrales betrachten; denn diese Vorstellung, der man heute besonders gern huldigt, macht uns vollends blind gegen das Wesen der Technik" (Heidegger 2000c: 9).

[155] TINA is the abbreviation of there-is-no-alternative, a slogan originally used by the British conservative prime minister Margaret Thatcher (1925-2013), used to define the market capitalism as the only viable form of societal organization.

[156] German original: "[…] die Technik sei das Schicksal unseres Zeitalters, wobei Schicksal meint: das Unausweichliche eines unabänderlichen Verlaufs" (Heidegger 2000c: 26).

[157] "Der Rhein bleibt doch, wird man entgegnen, Strom der Landschaft. Mag sein, aber wie? Nicht anders denn als bestellbares Objekt der Besichtigung durch eine Reisegesellschaft, die eine Urlaubsindustrie dorthin bestellt hat" (Heidegger 2000c: 17).

[158] Less known is the "Hungarian Faust" *Tragedy of Man* (Madách 2000) from 1861 which also features the paradoxical situation of possibility which reveals itself only in a moment where no possibilities are left (Hasberg 2002). The Danish philosopher Søren Kierkegaard termed the leap of faith in such paradoxical situations the "teleological suspension of the ethical" (Kierkegaard 2006: 46). According to Derrida, "the teleological suspension of the ethical is no suspension at all, but rather the underlying structure of all ethical obligation" (Graybill 2013: 115). For Derrida, all ethical obligation is thus paradoxical: Forgiveness only makes sense in the face of a situation you cannot forgive. Otherwise, it is not forgiveness, he argues.

[159] Latin for 'god from the machinery,' "an unexpected power or event saving a seemingly hopeless situation" (Oxford English Dictionary).

[160] "Wo aber Gefahr ist, da wächst das Rettende auch" (Hölderlin 1953: 191, line 3–4).

Heidegger uses Friedrich Hölderlin's "Patmos" hymn from 1803 to describe how there is a chance for transformation inherent to the fossil energy lock-in. This means that at the moment of highest danger, when there is no way out—just then, there is a way out. This presence of possibility where there is no possibility is paradoxical. Heidegger explains what the "saving power" inherent to the highest danger entails that there is a possibility of a *turning* in a Heideggerian sense, (1977c), a *Kehre* (1976). Heidegger urges us to practice *Gelassenheit*, a mode of letting-be, in our relationship to technology and nature, and to cease playing the role of the "orderer of the standing-reserve" (Heidegger 1977b: 27). I return to what this might mean for the energy transition and for carbon lock-in in section 7.4.

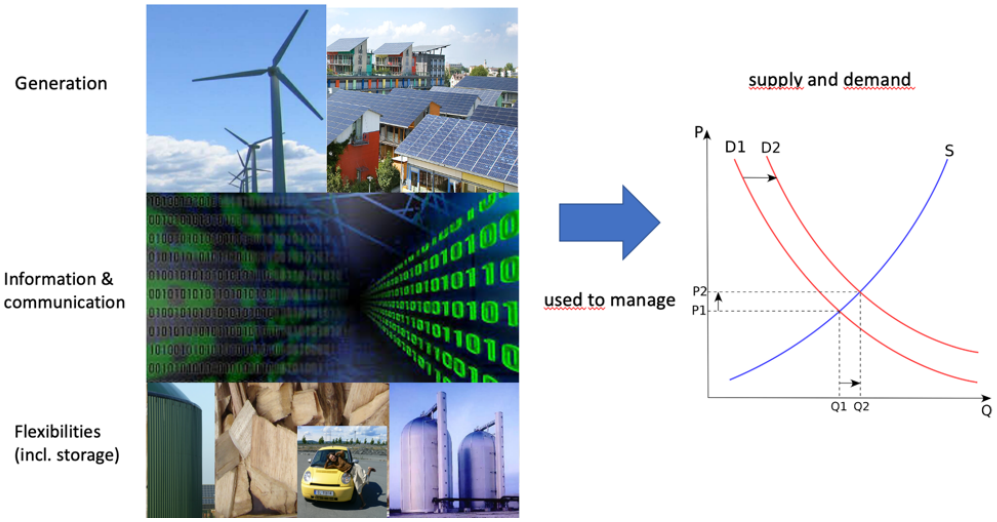
5.2.2. RENEWABLE ENERGY SYSTEMS AS WITHDRAWAL

Heidegger sees the intermittency of renewables as a quality, a constant reminder to humans of our place in the biosphere:

> But does this not hold true for the old windmill as well? No. Its sails do indeed turn in the wind; they are left entirely to the wind's blowing. But the windmill does not unlock energy from the air currents in order to store it. (Heidegger 1977b: 14–15)

Thus, the fluctuations, by Heidegger denoted as withdrawal, becomes a quality, not a deficiency, of renewable energies.

Figure 5-2 Balancing supply & demand in the intermittent Smart Energy System



Source: Adaption of figure published in Hasberg (2019a). Image sources: dbdh.dk (2013); Disch (2020); Gerlach (2020); Lignum Group (2020) and private (2005).

5.2.3. THE SMART ENERGY SYSTEMS APPROACH TO 100% RENEWABLE ENERGY[161]

Figure 5-2, shows a Smart Energy System, defined as

> an approach to 100 % renewable energy systems […] in which smart electricity, thermal and gas grids are combined with storage technologies and coordinated to identify synergies between them in order to achieve an optimal solution for each individual sector as well as for the overall energy system. (H. Lund, Østergaard, et al. 2017: 560)

'Smart' thus denotes the extensive use of intersectoral flexibilities. In a Danish and German context, with little geothermal and pumped hydro power, this means that sun and wind should be the primary sources of energy. All the while, biomass is limited, but storable. As a fundamental strategy, then, Smart Energy Systems must use the fluctuating sources of sun and wind to cover the energy needed for electricity, heating, and mobility, while biomass must be reserved for times of back-up and as seasonal storage (Maegaard, Kruse & Hasberg 2010).

The flexibilities of a Smart Energy System are shown in the lower part of the image patchwork. They consist of renewable energy that is storable as such, that is, biomass and biogas (shown as wood chips and as a biogas plant), as well as flexibility through integration towards district heating systems (shown as two utility-scale hot water storage tanks), and the transportation sector (shown as an electric car, in this case, the (now bankrupted) Think City electric car. These forms of flexibility/storage are examples of a larger palette of options including "electrochemical (batteries), thermodynamic (storage heaters, boiler tanks), gravitational (hydropower), inertial (flywheels), and conversion (electricity being used to make storable products such as hydrogen or methane)" (Blue et al. 2020: 6–7). *Electrofuels* are the newest addition to the flexibility component of the Smart Energy System concept. They are defined as synthetic fuels, for example methane or hydrogen, produced from renewable electricity (Ridjan, Mathiesen & Connolly 2016; Korberg, Skov & Mathiesen 2020). Because the synthetic fuel can take several forms, the process is described as power-to-X. Some of these forms of flexibility and storage intersect with the flexibility notion of "demand-side management (DSM) […] [including] real-time pricing, automatic switching, and simply encouraging households or organisations to use energy at off-peak times" (2020: 7). For example, the battery of an electric car is both a storage medium and an DSM actor.

In the Smart Energy System approach, it is sectoral integration that makes the balance of supply and demand possible on a hardware level. The "glue" that sticks the sectors together is information and communication technologies, which play a much more

[161] Section 1.2.1 introduced one aspect of renewable energy systems: The vision of peer-to-peer trading.

central role in the Smart Energy System in comparison to the nuclear-fossil one in Figure 5-1: Information and communication technologies and the data flows within them make balancing supply and demand possible.

Blue, Shove, and Forman (2020) show that dominant discourses of flexibility are performative,[162] that is, "real in their effects" (2020: 3), "because they justify and legitimise investment in technologies of certain size and capacity, they embed and materialise future expectations, based on current patterns of demand" (Blue et al. 2020: 8). They describe how the current use of the term flexibility obscures flexibility as such. Mostly, flexibility is denoted as a capacity in GW, not in relation the actual time shifting needed. This "purified" construction of flexibility is a precursor to turning it into a market-tradeable good, the authors argue. "Flexibility as the commodified potential to shift the timing of energy-use and energy supply" (Blue et al. 2020: 3). This way, the authors share Heidegger's critique: "opportunities for modifying demand are treated, and therefore, identified and acted upon as if they could be turned up and down, just like sources of [fossil] energy supply" (Blue et al. 2020: 5). These are the questions that Heidegger and Blue et al. urge us to take up instead of assuming them away. From a Heideggerian perspective, putting the everyday practices back into the notion of flexibility would be to allow the possibility of treating nature—and thus ourselves—as something else than mere *standing reserve*.

Although *both* the hardware of flexibility *and* information and its communication play key roles in renewable energy systems, the research foci remain fragmented: More technically oriented research tends to overlook the sectoral integration aspect (which was the cause for the development of the SES concept in the SEP group in the first place). A recent example is the use of the smart energy systems concept in relation to ICT-use in the energy sector, but leaving out the sectoral integration approach (Motlagh et al. 2020: 16, Figure 5). At the same time, social science research on smart cities and smart grids focuses on the flows of data as the defining feature of *smartness*, while leaving the hardware out of the analysis (see for example Klauser, Paasche & Söderström 2014; and Bauriedl & Strüver 2018). The opposite is the case with the Smart Energy Systems (SES) approach: The seminal papers on Smart Energy Systems barely mention, or don't mention at all, ICT as part of the SES concept (H. Lund et al. 2014; H. Lund, Østergaard, et al. 2017). Only the introduction to Smart Energy Systems of Susana Paardekooper, Rasmus Lund, and Henrik Lund (2019) explicitly mentions ICT as part of the definition, stating that the three types of grids mentioned in the definition above "form the backbone of a smart energy system and allow the integration of the operation across the different energy sectors *through ICT*" (2019: 232, my italics).

[162] See section 3.2.7 on new economics and section 5.1 on new materialism.

In sum, both the typical social science approach as well as the Smart Energy Systems approach leave either a hardware gap or an information gap in the analysis. The Smart Energy Systems approach has energy flows and the hardware of sectoral integration at the core of its analysis; data systems are, if at all, considered by their function, as they are assumed to make plain the way for interactions between, for instance, wind turbines connected to the electricity grid and electric boilers connected to the district heating networks via (price) signals. The flow of data itself, however, and the power structures inherent to it are not problematized in the current conceptualization of Smart Energy Systems.

The Smart Energy Systems approach of the SEP group focusing on sectoral integration could be expanded to explicitly address information systems as well, for example by using the term Smart Energy-Information System. This would emphasize the *combined* focus on (a) generation, (b) information and communication, and (c) flexibilities as illustrated in the Figure 5-1 and Figure 5-2 above. This would make the role of information explicit, while not neglecting the importance of sectoral integration that is at the core of the Smart Energy Systems approach.

5.2.4. INFOPOWER IN ENERGY SYSTEMS

As argued above, a transition towards intermittent renewable energy systems means that information and communication play an increasingly important role. These technologies have also been treated by Heidegger as early as 1956 in his lecture *The Principle of Ground* (1974), as Andreas Folkers shows (2017: 48). To Heidegger, information is a way of securing the "standing reserve":

> The guiding word for [securing] […] contemporary existence [is]: Information. [...] The definition of language as information first of all provides the sufficient ground for the construction of thinking machines and for the building of *large calculators*. […] As reporting, in-formation [hypen in original] is already also the organization which places man, all objects and constructions [Bestände], into one *form* that suffices in order to assure the domination of man over the entire earth, and even beyond this planet. (Heidegger 1974: 216, emphasis mine)[163]

The parallel to Heidegger's description of fossil energy is striking. It is reminiscent of the parallel between infopower and energopower that I have discussed in Hasberg

[163] "Das Leitwort für die Grundhaltung des heutigen Daseins lautet: Information. […] Denn die Bestimmung der Sprache als Information verschafft allererst den zureichenden Grund für die Konstruktion der Denkmaschinen und für den Bau der Großrechenanlagen. […]. Die Information ist als Benachrichtigung auch schon die Einrichtung, die den Menschen, alle Gestände und Bestände in eine Form stellt, die zureicht, um die Herrschaft des Menschen über das Ganze der Erde und sogar über das Außerhalb dieses Planeten sicherzustellen" (Heidegger 1997: 171 ff), partly cited in Folkers (2017: 48)

(2019c). To recap by following Heidegger's etymological method set out in the quote above, "the Latin verb informare […] literally means "to put into shape, to form, to mould" (Introna 2002: 232). It was initially used about instruction, making the knower fit into the mold of knowledge. This way, 'information' has a similar connotation to power as the etymology of the word discipline explored in section 2.1. This is the infopower of in-form-ation that Koopman (2019b) emphasizes in *How We Became Our Data*. "Information has a powerful ontological function, that of making us controllable" (Folkers 2017: 48),[164] echoing Shoshanna Zuboff (2015), who asserts that we are not users of technology, but used by it. Control over information in the renewable energy system therefore takes a similar role as control over storage in the fossil energy system. The latter has been extensively documented in *Carbon Democracy* by Timothy Mitchell (2009). The consequence of the co-constitution of Smart Energy Systems and information systems is that not only energopower but also infopower play a significant and increasingly important role in energy systems. Beyond uncovering this relationship however, surveillance in and data ethics of energy systems have not been the focus in my PhD research. I come back to the future research perspectives in this regard in section 8.5.

5.2.5. ELECTRICITY MARKETS TRANSITIONS

The fundamentally different nature—the different ontologies—of fluctuating renewable and storable fossil energy means that current aims of transitioning energy systems run into severe problems when trying to fit renewables into current systems. Intermittent renewable energy generation exhibit near-zero (short-term) marginal costs, but certainly positive levelized cost of energy (LCOE) as also mentioned in section 1.3.1. This creates a so-called missing money problem. More specifically, in the renewable energy sector, this problem is due to the merit-order effect at the electricity exchange: Renewable electricity like wind and solar is not storable without significant losses, of both economic and electrical nature. But because supply bids are ordered according to their short-term marginal costs (the *merit* ordering), the electricity price is driven towards zero in hours with large shares of renewable electricity production, resulting in a dilemma:

> The incentive to invest in additional renewable installations decreases with increasing market penetration in [the current market structure]. That is, the higher the share of renewables, the less profitable is the installation (of any generating capacity, not only renewable). […] A paradox situation results: With the current market structure, renewables are dependent on support schemes, also in the long run. This is contrary to conventional wisdom,

[164] "Vielmehr hat [Information] eine machtvolle ontologische Funktion. […] Sie 'in- formiert' das Seiende auf eine Weise, die es kontrollierbar macht" (Folkers 2017: 48).

> where learning curves and technological development result in increasing competitiveness over time. (Hasberg et al. 2010: 2)

Independently of the emergence of blockchain technology, there have been calls for electricity market reforms as part of wider energy market reforms to align with the new reality of Smart Energy Systems (Hvelplund 2006; Ecofys & Fraunhofer IWES 2017; Ropenus 2017; Mitridati, Kazempour & Pinson 2020; Sorknæs et al. 2020). This is especially important in the post-feed-in tariff energy regimes of Denmark and Germany (see also footnote 11); however, current electricity taxes, grid tariffs, and market participation rules prevent this (Hvelplund & Djørup 2017; Hvelplund, Østergaard & Meyer 2017; Sandberg et al. 2019).

> Smart energy systems require different electricity markets than the traditional fuel-based systems. Currently, electricity markets are in most cases based on a short-term marginal cost approach. This makes sense in a fuel-based energy systems where the supply costs are more closely linked to the short-term marginal costs (e.g., fuel costs), […] [but] the current electricity market structure is not able to financially sustain the amounts of wind power necessary for the transition to a 100% renewable energy system. (Djørup et al. 2018: 149)

Whether renewables are implemented in a fossil energy ontology, or a renewable energy ontology, matters. "Smart markets" (Sorknæs et al. 2020), as the conceptual development of new market structures suitable for fluctuating renewable energies is named, and local ownership (Moss et al. 2015; Hvelplund & Djørup 2019) are needed to supersede the current market and ownership structures. As argued in Hvelplund, Möller, and Sperling (2013), The long-term goal of smart markets and local ownership is to increase the value of renewable electricity by creating demand for it, by making it possible to buy and consume electricity locally and across sectors. By increasing its value, smart markets make it attractive to invest in renewable energy again, also in a post-feed in tariff regimes.

5.3. LINKING THE ECONOMIC SYSTEM AND THE ENERGY SYSTEM WITH HEIDEGGER

In the concluding section of this chapter, I use *The Question Concerning Technology* to understand the link between the fossil fuel use and the instrumental view of nature in old paradigm economics on the one hand, and the interlinkage of a new economics paradigm and sustainable renewable energy use on the other hand. Heidegger's critique of technique can also be read as a parallel to Marx's critique of Kapital (Blättler 2016), and thus, as a critique of economic systems. From a Heideggerian perspective, the question becomes "what sort of relationships to the earth and world does a technology enable?" (Deluca 2005: 78).

In *Figure 5-3*, I display two ideal-type relationships between the dominant energy paradigm and the dominant economic paradigm. The figure shows a link between the dominant economic paradigm and the dominant energy system. In the case of fossil energy and the old economics paradigm in the first row, the market structures and the fossil energy system are compatible with each other. Both are bound to a belief in unbounded availability. Fossil energy use is clearly at the core of the instrumentalization[165] of the biosphere that ecological economics criticizes. The instrumental view of nature of old paradigm economics and fossil fuel use mutually reinforce each other. On the other hand, an intermittent renewable energy system is, as explained above, incompatible with the market structures of old paradigm economics. It is instead compatible with a new economics understanding.

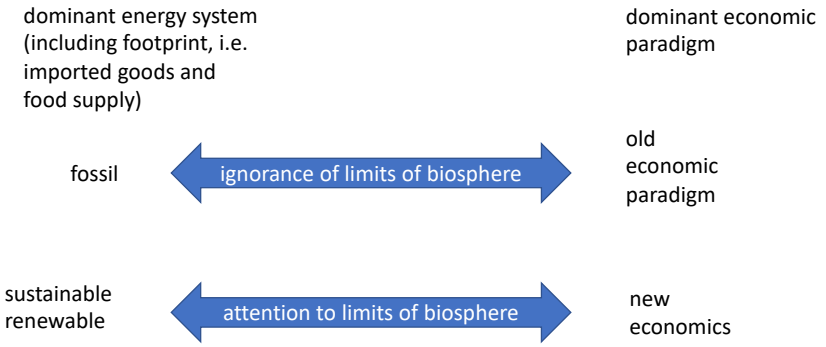
Sustainable, renewable energies[166] bear the *potential* to be interlinked with new economics paradigm in a similar way (this is not to say that unsustainable renewable energy use does not exist—it certainly does; hence the term *potential*). Understood this way, a transition to renewable energy systems must go hand in hand with a reformed economic understanding (Seidl & Zahrnt 2017), departing from the standing reserve as a mode of existence. Or to say it with the words of Ruth Irwin:

> The fossil-based industrialization and consumption are proving to be so toxic that as a modus operandii they have to change fundamentally. Heidegger asks questions of the modern paradigm that may allow us to transcend the technological alienation that industrial production and modern philosophy, as its cultural superstructure, have created. (Irwin 2010: 28)

[165] Instrumentalization is also the term used by Shoshanna Zuboff (2018). She cites Filippi & Loveluck (2016) and states: "[...] machine solutions [as the bitcoin blockchain] both express and contribute to the general erosion of the social fabric in ways that are both consistent with instrumentarianism and further pave the way for its success" Zuboff (2018: no page). Instrumentarianism, or instrumentarian power, is Zuboff's term for power that "can know and modify the behavior of individuals, groups and populations in the service of surveillance capital" (2018: no page).

[166] I use "sustainable renewable" to emphasize that it does not include, for example, extensive use of biomass, which is unsustainable.

Figure 5-3 Interlinkage between the energy systems and the economic paradigms.



Note: The fossil energy system is interlinked with the old energy paradigm and an instrumental understanding of humans, ignoring the limits of the biosphere; the sustainable renewable energy system is interlinked to a new economic paradigm that pays attention to the limits of the biosphere.

Heidegger's fossil and renewable energy ontologies, as well as their linkage to old and new paradigm economics, make clear what Einstein is frequently cited for[167]: Solutions cannot emerge from within the thought styles that have created the problem. The different nature of fossil and renewable systems laid out in this chapter must be recognized: "Emphasizing the nature of 'green' energies as one of withdrawal or even finality could […] very well contribute to scrutinizing certain expectations towards new energy carriers and thereby question their inscription into the dispositif[168] of contemporary capitalism"[169] (Folkers 2017: 51). Such scrutiny requires a change of thinking, which is the topic of the next chapter. In Chapter 7, I return to how Heidegger's philosophy of technology can help reconceptualize the energy transition

[167] "Die Probleme, die es in der Welt gibt, können nicht mit den gleichen Denkweisen gelöst werden, die sie geschaffen haben" (Einstein, cited in Scheer 2000).

[168] A Foucauldian term denoting structures of power-knowledge.

[169] Own translation from German: "Die Betonung des Entzugscharakters, ja der Endlichkeit 'grüner' Energien kann […] sehr wohl dazu beitragen, gewisse Erwartungshaltungen an die neuen Energieträger und damit die Einschreibung der Energiewende in das Dispositiv des kontemporären Kapitalismus zu hinterfragen."

CHAPTER 6. FLECK'S CONSTRUCTIVIST EPISTEMOLOGY

My research questions in section 1.2 are closely related to fundamental problems of epistemology,[170] or theory of knowledge. How are the facts that carbon lock-in is based on and justified by *constructed*? What determines which knowledge is turned into action (and which is turned into non-knowledge, or ignorance)? In an age of post-truth and fake news, it might be provocative to take a constructivist epistemological stance of seeing facts and knowledge as constructs of thought collectives.[171] One can imagine how controversial this must have been in the 20s and 30s of the last century when the Polish-Jewish microbiologist Ludwik Fleck developed his ideas (see also the biographical note on Fleck in section 4.5). This chapter presents and discusses his work.

6.1. THE GENESIS OF FLECK'S *GENESIS*

The history of the book itself seems to prove its thesis: Thought collectives co-constitute facts and ideas need thought collectives to flourish—and conversely, in the unfortunate case of Fleck's work itself, an idea without a thought collective withers away. Barbara Herrnstein Smith summarizes Fleck's findings regarding the concept of syphilis with the words: "The acceptance of a theory (...) depends on the extent to which it can be linked to ideas already established in the relevant community within a more general intellectual and cultural, including technological, context" (Herrnstein Smith 2006: 64). In the same vein, Marilyn Strathern talks of knowledge only being interesting "if others can invent around it" (Strathern 2002, cited in Niewöhner 2012: 68).

Genesis and Development of a Scientific Fact (1979) was originally published in German in 1935 as *Die Entstehung und Entwicklung einer wissenschaftlichen*

[170] Epistemology is derived from the ancient Greek *episteme*, meaning 'knowledge,' and the suffix '-ology,' derived from Greek '-logia', meaning 'to speak, tell.' Hence epistemology means 'speaking about knowledge.' Epistemology therefore includes the ontology of knowledge, that is, the speaking about (-logy) the being (-onto) of knowledge.

[171] For a debate regarding the responsibility of Science and Technology studies in the age of post-truth, and in that sense, Fleck's conception of the construction of facts, see (Fuller 2017; Sismondo 2017a; 2017b).

Tatsache – Einführung in die Lehre vom Denkstil und Denkkollektiv.[172] Conceiving of facts as *emerging* and *developing*, not simply *being* while awaiting scientific disclosure, was radical—especially at a time of logical positivism. Fleck himself wrote *Genesis* as a statement against the logical positivism of the Viennese circle (which is also where neoclassical utilitarian economics stems from, see Punzo [1991]). The book was published in Basel, Switzerland: Supposedly, as "darkness had begun to descend on Europe […] no German publisher […] was willing to put out a book written by a Jew" (Rapoport 2005). His work was not recognized during his lifetime, although he lived on after World War II, surviving the Nazi concentration camps by joining laboratory work on a fake typhus[173] vaccine, sabotaging the effort to vaccinate German soldiers at the Eastern front while saving his own life and that of his wife and son (Rapoport 2005). Fleck's thinking wasn't rediscovered until the 1960s when Thomas Kuhn stated that Fleck had "anticipate[d] many of my own ideas" (Kuhn 1962: vii). The Fleck-Kuhn link is telling; the Kuhnian notion of paradigm (shift) is very close to that of the Fleckian thought collective. However,

> Perhaps because Kuhn failed to quote Fleck specifically anywhere else in his book, Fleck's work still went largely unnoticed until 1977 when W[ilhelm] Baldamus, a German refugee and retired professor of philosophy in Birmingham (U.K.), stimulated his student T[homas] Schnelle to systematically research Fleck's biography and bibliography (R. S. Cohen & Schnelle 1986). (Eichmann 2008: 27)

Thus, more years elapsed before Fleck's work was finally translated into English almost two decades after his death, in 1979.

> According to Barbara Herrnstein Smith, Ludwik Fleck can be read as a "protoconstructivist" (2018: 10) who anticipated "the contemporary understanding of science as a social process" (Peine 2011: 490). Fleck emphasizes the social element in the construction of facts: A thought collective develops a certain thought style, defined as "[the readiness for] directed perception, with corresponding mental and objective assimilation of what has been so perceived" (Fleck 1979: 99). In the same way, Bruno Latour names Fleck "the founder of sociology of science" (Latour 2013: 112), Jörg Niewöhner (2012) calls him a "bedrock of Science and Technology Studies"[174] (2012: 66), and Klaassen (2014: 32) states that

[172] Own translation into English of the German original title: *Emergence and Development of a Scholarly Fact – Introduction to the Theory of Thought Style and Thought Collective.* Notice the difference to the English translation from 1979: It completely omits the subtitle mentioning thought collectives and thought styles.

[173] In German, even named after Ludwik Fleck and called *Fleckfieber*.

[174] Own translation from German: "Urgestein der Science and Technology Studies."

> Fleck is an "icon" in STS. Nevertheless, the foundational moment of science studies is often considered to be the laboratory studies of Bruno Latour and Steve Woolgar, first published in *Laboratory Life* (1986) in the same year that Fleck's English translation appeared and whose subtitle, *The Construction of a Scientific Fact*, even seems to paraphrase the title of Fleck's (1979). (Hasberg 2020a: no page)

In the second edition of *Laboratory Life*, a footnote in the added postscript does recognize Fleck's work as *laboratory studies* preceding Latour and Woolgar's: "Fleck's (1979) account […] is now widely acknowledged to have predated this trend [of laboratory studies], having been originally published in German in 1935" (1986: Note 2, page 286). Still, Fleck's name is not mentioned at a typical site of recognition like the *laboratory studies* entry in a handbook of Science and Technology Studies (Knorr-Cetina 1995). As Barbara Herrnstein Smith dryly states with reference to another of Bruno Latour's works considered to be a milestone of laboratory studies: "Latour's *Pasteurization of France* [1988], which recounts the formation, triumph and dissemination of the microbe theory of disease, could be read as an epic – or mock-epic[175] – extension of Fleck's narrative of the Wassermann Reaction" (2006: 53). (The Wassermann reaction, an antibody test for syphilis, is the primary case study of Fleck 1979). At last, in *Reassembling the Social*, Latour dedicates three-page text box to Fleck (2013: 212–214).

Being a microbiologist also made Fleck an outsider to the realm of philosophy. The (non-)reception of his work confirmed his theories. He was outside of the thought collective of history and philosophy of science:

> Some answers to these questions are suggested by Fleck's intellectual and professional biography, which has implications both for the character – or, indeed, style – of his thought and also for its fortunes in the relevant collectives. [...] Fleck was an amateur and outsider in epistemology and the history and philosophy of science. (Herrnstein Smith 2006: 70)

Recently, scholars have operationalized and further developed Flecks approach: Dieter Plehwe (2009) applies Fleck to identify historical neoliberalist thought collectives of the Mont Pèlerin Society; Katja Sabisch (2017) develops a distinct "thought style analysis" methodology, and Arne Heise (2019a) specifically applies the Fleckian concept of harmony of delusion to a case regarding the effect of minimum wages on unemployment, showing the resilience of neoclassical thought collectives on economic policy.

[175] A mock-epic is "a form of satire that adapts the elevated heroic style of the classical epic poem to a trivial subject" (EB 2018b).

6.2. THOUGHT COLLECTIVES AS FUNDAMENTAL BUILDING BLOCKS OF FACTS

What is a fact? As Latour scornfully states, "positivists were not very inspired when they chose 'facts' as their elementary building blocks to build their cathedral of certainty" (Latour 2013: 112). He refers to the etymology of the noun 'fact.' The word originates from Latin factum, the past participle of facere 'do' (OED 2020e). Facts were literally "thing done" (Etymonline 2020b).[176] According to Latour, this etymology should "ma[k]e [positivists] shudder" (2013: 112). If facts are manu-fact-ured, then there must be factors other than an observer and the observed interacting: "Cognition must not be construed as only a dual relation between the knowing subject and the object to be known. The existing fund of knowledge must be a third partner in this relation as a basic factor of all new knowledge" (Fleck 1979: 179, cited in Herrnstein Smith 2006: 63). That "third party" in the making of facts is the thought collective. A thought collective is a community of practice that exchanges ideas and develops a shared thought style of which the individual is "never, or hardly ever, conscious of" (Fleck 1979: 42). As Fleck asserts, this is not something bad to be eradicated:

> But those who consider social dependence a necessary evil and an unfortunate human inadequacy which ought to be overcome fail to realize that without social conditioning no cognition is even possible. Indeed, the very word "cognition" acquires meaning only in connection with a thought collective.[177] (Fleck 1979: 43)

This is not to downplay the role of "reality": To Fleck, there are always three factors involved in the making of a fact: "the individual, the collective, and objective reality (that which is to be known)" (Fleck 1979: 40). (Hasberg 2020a: no page)

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[176] The main modern sense of "thing known to be true" […] and "real state of things (as distinguished from a statement of belief)" […] is from the 1630s, from the notion of "something that has actually occurred." (Etymonline 2020b).

[177] German original: "Wer aber die soziale Bedingtheit für ein malum necessarium, für eine leider existierende menschliche Unzulänglichkeit ansieht, die zu bekämpfen Pflicht ist, verkennt, dass ohne soziale Bedingtheit überhaupt kein Erkennen möglich sei, ja, dass das Wort ›Erkennen‹ nur im Zusammenhang mit einem Denkkollektiv Bedeutung erhalte" (Fleck 1935: 59, cited in Niewöhner 2012: 68).

Fleck uses a map allegory to explain how facts make sense only in relation to their thought collective:

> The statement, "Someone recognizes something," whether it be a relation, a fact, or an object, is therefore incomplete. It is no more meaningful as it stands than the statements, "This book is larger," or "Town A is situated to the left of town B." Something is still missing, namely the addition, "than that book," to the second statement, and either, "to someone standing on the road between towns A and B while facing north," or "to someone walking on the road from town C to town B," to the third statement. The relative terms "larger" and "left" acquire a definite meaning only in conjunction with their *appropriate* components.
> Analogously, the statement, "Someone recognizes something," demands some such supplement as, "on the basis of a certain fund of knowledge," or, better, "as a member of a certain cultural environment," and, best, "in a particular thought style, in a particular thought collective." (Fleck 1979: 38, my italics)

The above quote shows that it is important to put problems into their *appropriate* context (see also section 8.1 on appropriate cognition contexts).

What is going on inside a thought collective? "Fleck introduces a vivid metaphor from musical improvisation. […] Like the uncertain and scattered opening riffs of an improvisatory jazz group, the early experiments performed by Wassermann and his associates initiated a process of selective production and mutual attunement" (Herrnstein Smith 2006: 60, with reference to Fleck 1979: 86).

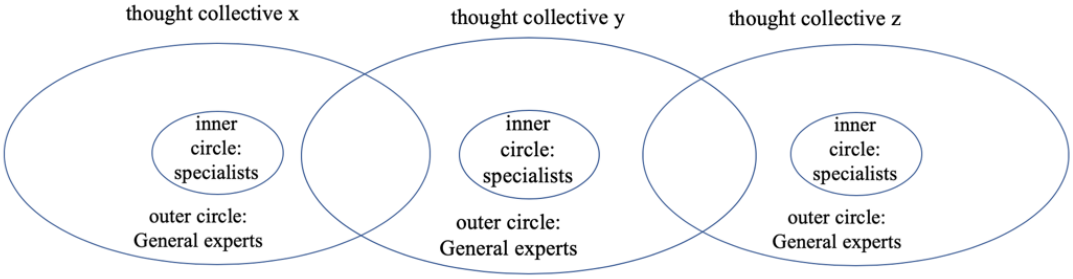
A few words regarding the naming of Fleck's concepts: Pim Klaassen notes that Flecks concepts of thought collective and thought style could possibly be better expressed simply as *style* and *collective*, because they "encompass so much beyond thought or thinking" (Klaassen 2014: 42). Mary Douglas (Douglas 1986: 16) argues that *thought collective* could better be expressed as *thought world*. Regarding the choice of terminology, Barbara Herrnstein Smith states: "The term 'thought styles' is somewhat awkward and perhaps naïve sounding in English. Related but more familiar and perhaps more sophisticated sounding notions include 'discourses', 'regimes of truth', 'language games' and, of course, 'paradigms'" (2006: 58–59). To Herrnstein Smith's list, I'd add the term "cognition context" of Hvelplund (2005) as introduced in the preface to describe phenomena; Karin Knorr-Cetina (1999) coined the term "epistemic cultures," Lave and Wenger (1991) popularized the term "communities of practice," while Mary Douglas (2011) talks about "how institutions think." The concept of *discourse coalitions* (Buschmann & Oels 2019; Funcke & Ruppert-Winkel 2020) also serves a similar function to the Fleckian thought styles of thought collectives.

In both case study A and B, thought collectives are stabilized through sociotechnical imaginaries, which are "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of form of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff 2015: 6). The techno-utopian visions of decentralization in the blockchain thought collective are an example of such a sociotechnical imaginary, as are the Supergrid visions of the European umbrella association for transmission system operators, ENTSO-E, in case study A.

6.3. EXOTERIC AND ESOTERIC CIRCLES

Fleck details his notion of the thought collective by dividing it into *exoteric* (outer) and *esoteric* (inner) circles. For simplicity, I don't use Fleck's terminology but have re-named them "inner" and "outer circle" in Figure 6-1.

Figure 6-1 Inner and outer circles of thought collectives



Source: Own illustration based on Fleck (1979), inspired by (Fagan 2009: 274, Figure 1).

With the inner and outer circles, Fleck introduces a form of power struggle inside thought collectives. As the following quote expresses, this can be an important cue as to why the unlocking of carbon lock-in is related to democracy, which I return to Chapter 7.

> The esoteric [inner] circles thus each enter into a relation with their exoteric [outer] circles known in sociology as the relation of the elite to the masses. If the masses occupy a stronger position, a democratic tendency will be impressed upon this relation. The elite panders, as it were, to public opinion and strives to preserve the confidence of the masses […] Then secretiveness and dogmatism dominate the life of the thought collective. This is the situation of religious thought collectives. The first, or democratic, form must lead to the development of ideas and to progress, the second possibly to conservatism and rigidity. (Fleck 1979: 105–106)

It is important to emphasize that one can be a member of several thought collectives and move between them, like a *boundary object* to use the terminology of Bowker & Leigh Star (1999). I have shown this as overlapping thought collectives in Figure 6-1.

This overlapping means that a thought collective can make use of facts stemming from the common set of facts that it shares with a neighboring or larger thought collective. In the Viking Link case, this is done by using facts like "wind energy is desirable" which is more broadly accepted—with the words of Fleck, accepted in several thought collectives—than the fact that "interconnectors are a necessity" which belongs to the Supergrid thought collective. That way, more palatable facts can be used as a fig leaf. [178]

6.4. HOW DO FACTS EVOLVE OVER TIME?

While Thomas Kuhn conceives of intellectual development as normal and post-normal science that evolve in phases of revolutionary paradigm shifts, Barbara Herrnstein Smith notes that "unlike Kuhn and to some extent Foucault, Fleck does not invoke radical discontinuities – 'revolutions' or 'ruptures' – in his accounts of intellectual history" (2006: 65). Instead of paradigm shifts, Fleck uses the term *Widerstandsaviso*[179] to describe how a new fact is initiated. In the English translation, this is denoted as a *signal of resistance* (Graf & Mutter 2006). To Jörg Niewöhner, "a *Widerstandsaviso* is a point of resistance that arises from 'reality' within the practices of a thought collective. It is the world kicking back, in today's STS parlance" (2016: 17), a first hunch that something is about to happen which the existing knowledge cannot grasp (Niewöhner 2012: 69):

> This is how a fact arises. At first there is a signal of resistance [Widerstandsaviso] in the chaotic initial thinking, then a definite thought constraint, and finally a form to be directly perceived. A fact always occurs in the context of the history of thought and is always the result of a definite thought style. [180] (Fleck 1979: 95)

Fleck continuously emphasizes the role of the thought collective: A fact must fall on the fruitful ground, that is, it "must be in harmony with the prevailing thought style and aligned with the intellectual interests and other goals – for example, technological projects – of the relevant community" (Herrnstein Smith 2006: 50) in order to become more than just a signal of resistance.

This way, Fleck shares Hvelplund's objection to Kuhn's paradigm shift regarding its applicability in the social sciences. Hvelplund shows that there is no "automatic drive"

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[178] Thank you to Frede Hvelplund for this point.

[179] According to Niewöhner (2016) "there is some debate as to the origin of the word 'aviso'. I like best the etymology from vulgar latin mihivisum est = it occurs to me" (Niewöhner 2016: Note 68).

[180] German original: "So entsteht die Tatsache: zuerst ein Widerstandsaviso im chaotischen anfänglichen Denken, dann ein bestimmter Denkzwang, schließlich eine unmittelbar wahrzunehmende Gestalt. Und sie ist immer ein Ereignis denkgeschichtlicher Zusammenhänge, immer ein Ergebnis bestimmten Denkstiles."

that ensures a shift from one paradigm to the next in the social science, no mechanism that makes old theories wither away when they are no longer valid and overthrown by new insights, as Kuhn's paradigm shift seems to imply. To Hvelplund, this is because reality has a harder time "kicking back" in social sciences than in natural sciences, to paraphrase Barad.[181] Without this kicking back, the thought style of a thought collective stands unchallenged.

6.5. HARMONY OF DELUSION AND HEIDEGGER'S *DAS MAN*

When the thought style becomes second-nature and exerts an "absolutely compulsive force upon his thinking [...] with which it is not possible to be at variance" (Fleck 1979: 41), it is prone to *harmony of delusion*. This harmony enabling the tenacity of systems of opinion [Beharrungstendenz der Meinungssysteme**]** is enabled by what Fleck calls a harmony of delusions:[182]

> Once a structurally complete and closed system of opinions consisting of many details and relations has been formed, it offers enduring resistance to anything that contradicts it: […] (1) A contradiction to the system appears unthinkable. (2) What does not fit into the system remains unseen; (3) alternatively, if it is noticed either it is kept secret or (4) laborious efforts are made to explain an exception in terms that do not contradict the system. (5) Despite the legitimate claims of contradictory views, one tends to see, describe, or even illustrate those circumstances, which corroborate current views and thereby give them substance. (Fleck 1979: 27)

Heidegger's counterpart to Flecks harmony of delusion is the concept of *das Man*[183] developed in *Being and Time* (1962) published in 1927, at the time of Ludwik Fleck.

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[181] "Kuhns opfattelse af, at der er et indbygget drive, som automatisk sikrer skiftet fra perioder med normalvidenskab til perioder med omfattende paradigmeskift, udviklet på basis af naturvidenskabelige eksempler, kan ikke overføres til samfundsvidenskaberne" (Hvelplund 2005: 52).

[182] I use my own translation delusions rather than "'illusions' as in the English translation from 1979. For problems of translation in Fleck, see Graf and Mutter (2006) as well as Jarnicki (2016).

[183] Writing *Man* with a capital M denotes its nominalization, that is, the turning into a noun, of the uncapitalized German 'man', meaning a generalized persona, frequently translated into English as "the they" or "the one." I leave the term untranslated and when quoting from English translations, I reinsert *das Man*, as I think the original term conveys more meaning than its attempted translation. *Das Man* are habits, values, and social norms. They determine what and how *one* sees and is therefore related to the concept of knowledge and ignorance. The masculine connotation and indeed etymology of *Man* does not stand in the way of its meaning. At the time of writing, a male gaze was, and to a certain extent today still is, the norm. In sum, these are the reasons for using the untranslated term.

Das Man is no one and everyone at the same time, and Heidegger describes its prescriptive voice as a tyranny or dictatorship:[184]

> In utilizing public means of transport and in making use of information services such as the newspaper, every Other is like the next. This Being-with-one-another dissolves one's own Dasein completely into the kind of Being of "the Others", in such a way, indeed, that the Others, as distinguishable and explicit, vanish more and more. In this inconspicuousness and unascertainability, the real dictatorship of *das Man* is unfolded. We take pleasure and enjoy ourselves as [one] take[s] pleasure; we read, see, and judge about literature and art as [one] see[s] and judge[s]; likewise we [withdraw] from the "great mass" as [one] [withdraws]; we find "shocking" what [one] find[s] shocking. *Das Man* which is nothing definite, and which all are, though not as the sum, prescribes the kind of Being of everydayness.[185]
> (Heidegger 1962: 164, with my changes to the translation)

Thought collectives also serve as a form of complexity reduction, just like Heidegger's *Das Man*. Das Man is not only tyranny, but also a help to everyday life: It is through the norms of "what one does" that we can function—without that, we would suffer from personality disorders (Should I really put on my pants before leaving the house? Why put on my clothes in this order and not in the opposite?).

> [Das Man] is there alongside everywhere, but in such a manner that it has always stolen away whenever Dasein presses for a decision. Yet because [das Man] presents every judgment and decision as its own, it deprives the particular Dasein of its answerability. […] It can be answerable for everything most easily, because it is not someone who needs to vouch for anything. It "was" always [das Man] who did it, and yet it can be said that it has been "no one". In Dasein's everydayness the agency through which most things come about is one of which we must say that "it was no one". Thus the particular Dasein in its everydayness is disburdened by [das Man] […]. And because [das Man] constantly accommodates the particular

[184] German original: "Herrschaft."

[185] German original: "In der Benutzung öffentlicher Verkehrsmittel, in der Verwendung des Nachrichtenwesens (Zeitung) ist jeder Andere wie der Andere. Dieses Miteinandersein löst das eigene Dasein völlig in die Seinsart 'der Anderen' auf, so zwar, daß die Anderen in ihrer Unterschiedlichkeit und Ausdrücklichkeit noch mehr verschwinden. In dieser Unauffälligkeit und Nichtfeststellbarkeit entfaltet das Man seine eigentliche Diktatur. Wir genießen und vergnügen uns, wie man genießt; wir lesen, sehen und urteilen über Literatur und Kunst, wie man sieht und urteilt; wir ziehen uns aber auch vom 'großen Haufen' zurück, wie man sich zurückzieht; wir finden empörend, was man empörend findet. Das Man, das kein bestimmtes ist und das Alle, obzwar nicht als Summe, sind, schreibt die Seinsart der Alltäglichkeit vor" (Heidegger 1967: 126–127).

> Dasein by disburdening it of its Being, [das Man] retains and enhances its stubborn dominion. Everyone is the other, and no one is himself.[186] (Heidegger 1962: 165, with my changes to the translation)

6.6. LINKING EPISTEMOLOGY AND ONTOLOGY

In sum, Section B has presented Martin Heidegger's energomaterialism (Chapter 5) and Ludwik Fleck's constructivist epistemology (Chapter 6). Are their approaches compatible?[187] I argue, yes.

> Although Ludwik Fleck emphasizes the social element in the construction of facts with his concept of the thought collective, Fleck was certainly not a pure social constructionist as Barbara Herrnstein Smith (2006) emphasizes. Therefore, Fleck's work is not conflicting with, but rather compatible to, other socio-material (or material-semiotic) approaches like new materialisms or actor-network theory. They share an "onto-epistemology" (Barad 2007), that is, a rejection of dualisms like the nature-culture divide and that between the theory of knowledge (epistemology) and what there is to know (ontology). Therefore, [both Heidegger and] Fleck [are] compatible with later socio-material conceptualizations like the term *calculative device* of Fabian Muniesa and Michel Callon (2005) and the infrastructured info- and energopower of Koopman (2019) and Boyer (2019). They all emphasize the importance of materiality as well as power relations. (Hasberg 2020a: no page)

In sum, Heidegger can be read as one of the philosophical pioneers of *technology studies*, while Fleck is a pioneer of *science studies*—thus, together contributing to today's *Science and Technology Studies*, which, as I have argued in section 3.2.3, is a source of inspiration for new economics.

There are concrete examples of the Heidegger-Fleck compatibility: Barbara Herrnstein Smith (2006) shows that Heidegger's criticisms of science mentioned in

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[186] German original: "Das Man ist überall dabei, doch so, daß es sich auch schon immer davongeschlichen hat, wo das Dasein auf Entscheidung drängt. Weil das Man jedoch alles Urteilen und Entscheiden vorgibt, nimmt es dem jeweiligen Dasein die Verantwortlichkeit ab. [...]. Es kann am leichtesten alles verantworten, weil keiner es ist, der für etwas einzustehen braucht. Das Man 'war' es immer und doch kann gesagt werden, 'keiner' ist es gewesen. […] Das Man entlastet so das jeweilige Dasein in seiner Alltäglichkeit. [...] Und weil das Man mit der Seinsentlastung dem jeweiligen Dasein ständig entgegenkommt, behält es und verfestigt es seine hartnäckige Herrschaft. [...] Jeder ist der Andere und Keiner er selbst" (Heidegger 1967: 127–128).

[187] See also Tom Børsen (2020) and Lars Botin (2020) for links between postphenomenology and critical constructivism, especially in relation to techno-anthropology.

section 2.3 are similar to those of Flecks (2006: 78, Note 12). Heidegger stated his criticism in 1938 and Fleck published in 1935, both in German, but there is no evidence that Fleck and Heidegger knew of each other's work (2006: 80, Note 39). Ruth Irwin also makes this connection between a Fleckian line of thought in Heidegger's philosophy of technology, and its applicability to today's climate change: "Most science accumulates 'facts' that reinforce the worldview of the things in a way that is already at hand. Thus, vast quantities of data can reinforce an existing conceptual apparatus and get no closer to understanding how that paradigm limits understanding in crucial, if subtle ways" (Irwin 2010: 21)

CHAPTER 7. CONCLUSIONS: THE POWER/IGNORANCE CONCEPT

In the first subsection of this chapter, I discuss the problem of theorizing. In 7.2, I turn to the power/ignorance concept as a major result arising from case studies A and B. In 7.3, I discuss the question of breaking or transforming the power/ignorance that keeps us from unlocking carbon lock-in. This question remains largely open.

7.1. THE PROBLEM OF THEORIZING

As discussed in Chapter 4, I understand theory and method as inseparably interrelated. Creating a new concept is an act of theorizing (Swedberg 2017), categorizing (Grodal, Anteby & Holm 2020), and, when based on case studies, a way of answering the question: "Of what is this a case?" (C. Lund 2014: 224). I perceive theorizing as the back and forth between the conceptual and concrete levels. This up-down movement is dual: It is both between the empirical and the theoretical, and between the concrete and the abstract. Howard Becker emphasizes the former: "[…] my favorite way of developing concepts is in a continuous dialogue with empirical data." (1998: 109). Swedberg exemplifies the latter: "A good exercise for theorizers is running up and down, in your mind, from what is specific to what is general and back up" (2017: 195). I as a researcher, and the thought collectives I am part of, are continuously part of this exercise. Even when I recognize patterns across case studies, these are not independent from me as a researcher, but are theoretical constructions that I produce through interaction with reality and with the thought collectives I belong to, as Fleck has emphasized (see Chapter 6). Van Maanen (2011) goes as far as calling theory choices "the rabbits we pull out of our hats" (Van Maanen 2011: 158).

If "there is nothing so practical as a good theory" (Lewin 1951: 169), what is a good theory, then? Latour uses what he calls the "Stengers-Despret falsification principle" to answer this question. Named after two philosophers of science, Isabelle Stengers and Vinciane Despret, Latour differentiates between good and bad generalizations in the following way: "The good [generalizations] are those that allow for the connection of widely different phenomena […]" (Latour 2004: 220). This resonates with the conjunctive theorizing of Tsoukas (2017). In the new journal *Organization Theory*, (Cloutier & Langley 2020) present a taxonomy of four different types of process theorization. Since my theorization is concerned with transformation *processes*, it is by definition included in their conceptualization. Most fittingly, their fourth category is "conjunctive theorizing" in the sense of Haridimos Tsoukas, seeking "to make connections between diverse elements […] of concepts normally used in a compartmentalized manner" (Tsoukas 2017: 132). My theorization in the following section can therefore be considered an attempt at conjunctive theorizing.

7.2. WHAT IS IGNORANCE?

Colloquially, ignorance, that is, non-knowledge, is understood as a state before knowledge. Ignorance is the focus area of the emergent field of ignorance—or agnotology—studies (McGoey 2012), a lens of inquiry that is increasingly applied to energy questions (Horta & Gross 2018). Knowledge and ignorance go hand in hand: There is always a production of ignorance when there is production of knowledge. Like a light in the darkness of ignorance, knowledge illuminates some parts but let's other parts fall into even darker shadows. In cases A and B, however, it is the creation of an ignorance in a situation of abundant knowledge that must be understood and explained. Where do dark spots in full daylight come from?

Such ignorance can be understood though Frede Hvelplund's concept of inadequate knowledge (although such [in]adequateness is, as always, in the eye of the beholder). This conceptualization of ignorance is close to Fleck's "harmony of delusion" and Heidegger's "*das Man*" (see section 6.5), because it results from being locked in to an epistemological prison (see also 8.1 for a discussion of the concept of adequate cognition contexts). Like in the phrase "Let them eat cake" attributed to Marie Antoinette as an answer to the problem that peasants had no bread to eat, inadequate knowledge is knowledge that is not helpful in order to grasp a problem:

In her forthcoming book, *A Passion for Ignorance* (2020), the Slovenian philosopher Renata Salecl's explains that the role of ignorance is accelerating in the Anthropocene. She writes:

> The passion for ignorance is now appearing on a variety of levels. In spite of the continuing economic crises, most countries are behaving as if it is just a bad dream from which they will eventually wake up and then everything will be as usual. With the ongoing ecological problems that are becoming more and more alarming, we are behaving as if nothing really has to change. […] This kind of ignorance, paradoxically, can contribute to the illusionary feeling of all-powerfulness. (Salecl 2013a: 101–102)

In one of her talks on ignorance (Salecl 2013b: min. 14:40) Salecl refers to an episode of the cartoon "The Simpsons" from 2009, where the daughter of the family, Lisa Simpson, is prescribed the drug *Ignorital* (Oliver & Wilmore 2009b) to treat her "environment-related despair" (Oliver & Wilmore 2009a). The schoolgirl is suffering from depression ever since realizing how her hometown Springfield would look in 50 years due to climate change. Curiously, Lisa's talk to her classmates in Springfield is surprisingly close to Greta Thunberg's recent speech at the United Nations in both style and content (Guardian News 2019). This scene from the Simpsons shows that maintaining carbon lock-in requires a lot from us on a psychological and sociological level. Living with harmonies of delusion is not "free," so to speak, but also has human costs in the here and now.

It is notoriously difficult to distinguish different forms of ignorance. In the following, I will illustrate the slipperiness of ignorance with some examples. The poem "The Impossible Fact" ["Die unmögliche Tatsache" 1909], a gallows song of the German lyricist Christian Morgenstern (1964), has attained proverbial character in German because it mocks the bureaucrat's adherence to legal reasoning, ignoring reality. The bureaucrat named Palmström, who has been run over by a car in a street where cars were not permitted,

> comes to the conclusion:
> His mishap was an illusion,
> for, he reasons pointedly,
> that which must not, cannot be[188]

Is Palmström's ignorance conscious or unconscious? Although injured, he is so convinced of the rule of law that he would rather believe that he is mistaken about being hit by a car, rather than admitting that a driver has broken the law. What the psychologist might term denial has a conscious and active element of repression, but also an unconscious element ensuring that no cognitive dissonance[189] arises—a process that is not conscious or intentional. It is difficult to distinguish active and intentional or conscious ignorance from passive, unintentional, or unconscious ignorance, as soon as ignorance is not perceived as taking place at an individual level, but at the level of a thought collective.

Open secrets are a good example of how ignorance might simultaneously be conscious, unconscious, active, and passive at the level of a thought collective. At the car manufacturer Volkswagen, the use of software to manipulate the results of cars in emissions test can be understood as such an open secret. Is it a case of active or passive, conscious or unconscious ignorance of the inherent criminality of the endeavor? At the level of individual actors, it might be possible to distinguish this. But at the level of the thought collective, the responsibility for ignorance sneaks off, like Heidegger's *das Man*. Even if the conscious-unconscious division is meant to entail that conscious ignorance comes with feelings of guilt, the thought collective can help alleviate that, too. According to Salecl, belonging to a group reduces the anxiety and guilt and gives illusion of security (Salecl 2013b).

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[188] German original: "Und er kommt zu dem Ergebnis: / Nur ein Traum war das Erlebnis. / Weil, so schließt er messerscharf, / nicht sein kann, was nicht sein darf."

[189] In psychology, cognitive dissonance occurs when an individual holds contradictory beliefs, ideas, or values, or when actions are contradictory to beliefs held. Cognitive dissonance can be resolved by changing your mind or by deeming that which gives rise to the dissonance as wrong. Then, the dissonance is turned into cognitive consonance.

7.2.1. TRUST, IGNORANCE, AND FAITH IN TECHNOLOGY

Ignorance also takes a special role in relation to technology, namely in the form of faith in technology. It plays a particularly large role in the case study B on blockchain, where decentralization is a question of faith rather than a "descriptive device" (Judson et al. 2020: 2). In case A on Viking Link, faith takes the form of a fundamental belief in the benefits of international trade. It is thus more directed towards an economic concept entangled in a physical technological artefact than towards a technology per se. Fleck recognizes this almost religious dimension that emerges from the workings of a thought collective:

> The initiation into any thought style, which also includes the introduction to science, is epistemologically analogous to the initiations we know from ethnology and the history of civilization. Their effect is not merely formal. The Holy Ghost as it were descending upon the novice, who will now be able to see what has hitherto been invisible to him. Such is the result of the assimilation of a thought style. (Fleck 1979: 104)

The notion of faith as a form of non-knowledge stems from Georg Simmel's *Philosophy of Money* (2011: 393), where trust implies a "quasireligious faith" (2011: 178, cited in Büscher & Sumpf 2015: 5) "which is both less and more than knowledge" (Simmel 2011: 178). Knudsen, Bakken, and Pors (2020) understand this trust as a form of ignorance, half-way between knowledge and non-knowledge. Trust in technology as a link between technology and ideology has been critically commented upon by scholars: A critic of blockchain technology, Jon Baldwin (2018), sees the "bitcoin discourse […] [as] an expression of the Californian Ideology, which itself often conceals a right-wing agenda." Gerardo del Cerro Santamaría (2019) sees megaprojects like Viking Link as an "infrastructure of neoliberalism, […] inherently tied to the logic of growth, development, wealth creation, competitiveness and prosperity" (2019: 283).[190] Likewise:

> Louis Althusser pointed out that ideology [that is, the consumerist ideology of late capitalism] functions in such a way that it creates a *veil of obviousness* (Althusser 1971). This operation has been very strong in recent years since questioning where capitalism is going and whether there is an alternative to the organization of society as we know it has been almost nonexistent in the public sphere. (Salecl 2013a)

[190] The history of nuclear power is a good example of how trust in technology and faith in socio-technical imaginaries preceded the material construction of nuclear power plants: "In the late-1940s, civil nuclear energy, still not yet either a technical or commercial reality, started to become discursively constructed in the public realm as the mirror-image twin of nuclear weapons" (Trischler & Bud 2018: 196). Today's pro-nuclear thought collectives not only share the techno-optimistic worldview of the crypto scene that Baldwin criticizes in the quote above. The cyberlibertarian roots of parts of the crypto community are comparable to the corporate libertarian stance of the current pro-nuclear revival.

7.3. DEFINING POWER/IGNORANCE

> Based on the above discussion of the concept of ignorance, I now turn to my own neologism, power/ignorance. Power/ignorance is derived from the hyphenated Foucauldian term power-knowledge, a Foucauldian neologism signifying that power and knowledge are co-constitutive.[191] The most important part of the term is the forward-slash that links the two aspects, alluding to the inherent inextricability. Power/ignorance has previously been used by Andrew Mathews (2005) in an article about forest fires in Mexico, and indirectly by David Graeber (2006) in a lecture on power, ignorance, and stupidity in bureaucratic procedure. In the following, I explain the notion of power/ignorance with a literary analogy: *The Emperor's New Clothes* by the Danish author Hans Christian Andersen, written in 1837 and translated by Jean Hersholt in 1949 (Hans Christian Andersen 1949).[192] It is inspired by a Spanish fable, *El Conde Lucanor,* by Juan Manuel written in 1335 (Bredsdorff 1975). Andersen's fairy tale tells the story of an emperor who is betrayed by two weavers who sell non-existent garments to him, which they claim become "invisible to anyone who was unfit for his office, or who was unusually stupid" (Hans Christian Andersen 1949) Because everybody is afraid to lose face and pretends to see the garments, the emperor ends up walking (half) naked through the streets, only to be "revealed" by a child screaming, "He hasn't got anything on!" (1949). (Hasberg 2020b)

There are several possible interpretations of the story that explain the relationship between power and ignorance. One reading illustrates my understanding of the intertwined nature of power and ignorance: The drama of *The Emperor's New Clothes* unfolds from the first sentence: The emperor "(…) spent all his money on being well dressed" (Hans Christian Andersen 1949) and spends his time in his dressing room rather than in Council. Translated to modern times, taxpayer's money is diverted, and personal enrichment overrules the duties of the office; a case of bad governance. Also, the tale does not even attempt to create any whodunit-style tension of the plot. Even before the two charlatans are described as weavers, Andersen plainly states that they are "swindlers." These "merchants of doubt" (Oreskes & Conway 2010) are lobbyists, experts, consultants, or salespeople with their own (economic) interests, who promise

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[191] While the forward-slash is most used in English, Foucault himself wrote pouvoir-savoir, using a hyphen in French. I follow the English language version and use a forward-slash in power/ignorance. The slash does not absolutely signify that power and ignorance are interchangeable (which could be a problematic misinterpretation of using a slash); rather, they are intertwined. See Kelly (2009: 169, note 12) on the origins of hyphen versus slash controversy in translating Foucault.

[192] In the following, I do not reference page numbers as I have used the version published online by the Hans Christian Andersen Centre, University of Southern Denmark.

to make those in (symbolic) power "look good" figuratively, and, indeed, literally in the case of Andersen (1837). The tale shows how a harmony of delusion is established: "One saw no more than another, but they all joined the Emperor in exclaiming, 'Oh! It's *very* pretty'" (Hans Christian Andersen 1949). It is the one with no social status to lose who can tell "truth." "'But he hasn't got anything on," a little child says. This leads to a revolutionary moment; the people unite against those in power: "But he hasn't got anything on!" the whole town cried out at last. Thus, the morality of the story seems to be: Speak truth to power! It will dismantle power. It is a romanticized conception of the whistleblower, showing that we as readers have "a fantasy-desire for the kind of truth that can be revealed" (Robbins 2003: 660).

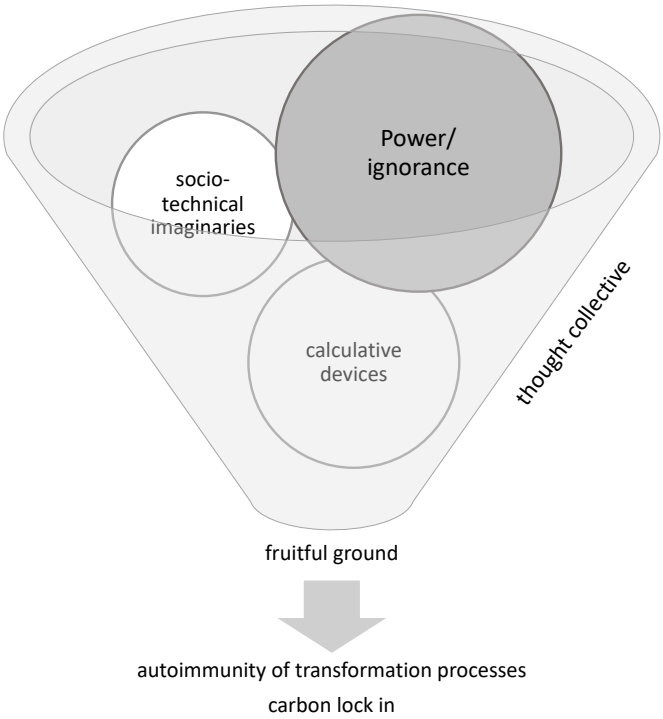
However, this is not the end of the story. It goes on: "The Emperor shivered, for he suspected they were right. But he thought, 'This procession has got to go on.' So he walked more proudly than ever, as his noblemen held high the train that wasn't there at all" (Hans Christian Andersen 1949).[193] The show must go on and business as usual continues. We can imagine that the inhabitants go home, now one step closer to political disillusionment. Neither the emperor nor the swindlers have to face any consequences for their deeds. Read this way, the tale is a critique of criticism (Derrida cited in Robbins 2003): Critiquing by speaking truth to power does not necessarily have any substantial consequences; the tale is "an acknowledgement of the potential limitations of speaking the truth" (Ness 2017). It doesn't disable power or result in policy changes. On the contrary, it forces those in power to remain in their positions even more steadfastly, "more proudly than ever" (Hans Christian Andersen 1949). The cognitive dissonance between the real and perceived state of the world is dissolved by fortifying the harmony of delusions in the present and delaying action into the future. Furthermore, it portrays those in power as mere marionettes of "swindlers" who act behind the scenes and whose fate (and fortune) is not even reported at the end of the tale. It is almost Kafkaesque in its absurdity because the financial interests that are really in power remain in the dark, and the real problem, namely the diversion of public funds to swindlers, is overshadowed by the front stage performance (in the sense of Erving Goffman (DeRoche & DeRoche 2010) of walking naked in the street. This reading thus entails an—admittedly—very bleak outlook to the relationship between power and ignorance. Ignorance enables power and power enables ignorance—but speaking truth to power will not change anything. This suggests that there must be something apart from ignorance and power that helps to produce path-dependent continuation of business as usual. Ignorance is only mediator of power (an enabler of power, or enabled by power). Because ignorance is not the cause of power, power cannot be broken by removing ignorance.

[193] It is worth noting that this ending where the child speaks out was added later by the author. Earlier drafts ended with the emperor successfully displaying his new garments to the people (H. C. Andersen 2015).

7.3.1. THE POWER/IGNORANCE FUNNEL

Figure 7.1 shows how power/ignorance, sociotechnical imaginaries and/or calculative devices interact inside a thought collective, creating a sociotechnical veil of ignorance.[194] It requires *fruitful ground*, that is, must create resonance outside the thought collective, in order to prevail. This fruitful ground is the powerful few as expressed in the term "the tragedy of the few" (Scavenius 2016) also mentioned in the introduction, who benefit from carbon lock-in. Transformation processes turn out to be non-transformation, because societal transformation processes are turned against themselves; with a Derridean term, they become *autoimmune*, a term that I return to in detail below.

Figure 7-1 The power/ignorance funnel



Note 1 The funnel itself represents a thought collective. Inside it, power/ignorance is upheld and reinforced by different elements that may differ from case to case. Socio-technical imaginaries and calculative devices are elements that play a key role in cases A and B.

[194] I use the term "veil of ignorance" in a different meaning than Rawls (Blackburn 2008).

Regarding case study B, the power/ignorance funnel in Figure 7-1 shows that the practice of unseeing takes place inside thought collectives, where calculative devices and socio-technical imaginaries interact. Sociotechnical imaginaries of spatial, economic, and indeed power decentralization lead to a blindness towards practical questions of governance. This make the ignorance of power itself possible. Through platformization, the establishing of closed information architectures in consortia of energy incumbents, thought collectives end up replicating the centralization it originally set out to challenge. That is why the "technology of decentralization" ends up cementing existing infopower and energopower structures.

In the Viking Link case A, the calculative device of the cost-benefit analysis sustains power by legitimizing the ignorance of alternatives. Cost-benefit calculations define what can be known and what ignored. Alternative scenarios casting doubt on the "greenness" of the Viking Link do not fit into the calculative device and are thus ignored in the decision-making process. The calculative device is able to reinforce energopower because it interacts with the socio-technical imaginaries of the Supergrid thought collective. This is what ultimately leads to the construction of Viking Link. The interconnector is built and will act as a foot-dragging element of energy transition.

My constructivist-materialist positioning introduced in Chapters 5 and 6 entails that there is no one single entity to pass the buck to. In describing power as "asymmetrically structured agency" Stirling argues that "the implicated forms of agency are not singular and controlling, but complex and multidimensional" (2014: 84). In relation to the two cases, this means that the harmonies of delusion that the thought collectives display, both in the realm of blockchain and in the world of Viking Link, are like *das Man*: Every time one thinks that someone responsible has been found, this responsibility crumbles. With Heidegger's words: "It 'was' always [das Man] who did it, and yet it can be said that it has been 'no one'" (Heidegger 1962: 165).

The cases, are, however, different when one considers who the autoimmunity affects: In the blockchain case, the autoimmunity turns against that which large parts of the inner circle of the blockchain thought collective strived towards initially: A more democratic way of organizing information systems. This, of course, has overall societal implications, as the blockchain-in-energy community has not been able to deliver that missing link to the energy transition that some—I at least—were hoping that it would: A solution for the post-feed-in tariff regime of financing renewable energy installations. In the case of Viking Link, the autoimmunity turns against the body of society in its totality. The harmony of delusion of the Supergrid thought collective, as exemplified in the transcript of the public hearing on Viking Link from September 2019 in Appendices F and G, does not primarily or doesn't at all harm the involved actors, but rather impacts the overall societal aim of transforming energy systems towards sustainability, on both sides of the English Channel.

The illustration does not contain any arrows inside the thought collective, because the interaction between the elements does not follow causal mechanisms. Rather, socio-technical imaginaries and calculative devices interact with and in the thought collective in various ways that enable the power/ignorance nexus to function. The choice of a funnel as a figure is hence to show that cause and effect are blurred inside the thought collective, which is the funnel itself. Rather, power, ignorance, sociotechnical imaginaries, and calculative devices are separated out for analytical purposes.

Another way of illustrating what happens inside thought collectives is shown in Table 7-1. It is inspired by a quote by Andrew Feenberg. In *Technosystem* (2017), he writes: "[V]alues are the facts of the future. […]. Technologies are the crystallized expression of those values" (Feenberg 2017: 132, cited in Botin 2020). If values are the "facts of the future," then facts can be perceived as stored values. These facts shape decision-making and are thereby reinforced—in socio-material technologies or infrastructures. Ultimately, infrastructure acts as stored power—for example, the infopower of information systems or the energopower of energy systems.

Table 7-1 Comparing case A and case B

	Constructivist hypothesis: Imaginaries and values shape facts		**Performativity hypothesis: Facts shape reality**	
	Socio-technical imaginaries (Jasanoff) / Values (Feenberg)	**Facts (Fleck)**	**Technologies / Infrastructures (Leigh Star)**	**Infrastructured power (Boyer; Koopman; Förster)**
Case A	Trade is good	Calculative devices show: Viking Link is socio-economically beneficial	Viking Link in integration with the overall transmission grid	Energopower of the Supergrid
Case B	Blockchain technology leads to decentralization, which is good	Removing the intermediary leads to democratization	Blockchain information infrastructure controlled by few key players	Infopower of "surveillance capitalism" (Zuboff)

Note: The table is an example of how sociotechnical imaginaries, values, facts, infrastructure, and power/ignorance interact inside the thought collective, illustrated as the tunnel above. These interactions are not linear or sequential although the format of a table might suggest that.

Table 7-1 shows how socio-technical imaginaries or values interact inside thought collectives, in a first step, creating facts. I call this the constructivist hypothesis. These facts form the basis of decision-making and thus, in a second step, result in manifestations in reality. I call this the performativity hypothesis.

7.3.2. THE PARADOX OF AUTOIMMUNITY

The term autoimmunity refers to biological processes of self-destruction where white blood cells, instead of attacking outside intruders, attack the body's own cells, causing

inflammation. Therefore, these diseases are also called autoimmune inflammatory diseases. In medicine, an increasing range of diseases, including diabetes, are understood as autoimmune and part of larger syndrome complexes. The cause is generally unknown, but genetic and environmental contributions to triggering the abnormal immune response are recognized (Costenbader et al. 2012).

Derrida's use of the word autoimmunity is considered as a further development of his concept of *deconstruction*. In an interview, he uses to concept to understand US American reactions after 9/11 as "a risk that democracy generates for and poses to itself" (Johnson 2012: 4). In an interview of Giovanna Borradori (2003) with Jacques Derrida, he describes his notion of autoimmune processes:

> An autoimmunitary [sic] process is that strange behavior where a living being, in quasi-suicidal fashion, 'itself' works to destroy its own protection, to immunize itself against its 'own' immunity.[195] (2003: 94)
> […]
> We must recognize that defenses and all the forms of what is called, with two equally problematic words, the 'war on terrorism' work to regenerate, in the short or long term, the causes of the evil they claim to eradicate. (Borradori 2003: 100)

Derrida's use of the term autoimmunity is similar to Heidegger's conceptualization of self-consumption as the ultimate consequence of an instrumental relationship to nature. According to Heidegger, we ourselves become a *standing reserve*; we are consuming ourselves in the same way that we are hauling coal out from the ground (see Chapter 5). This motif is also present in Renata Salecl's philosophy; with reference to the French psychoanalyst Jacques Lacan, she points out that

> the idea of self-destruction is very much aligned with how capitalism functions. [...] [We] not only work longer hours and consume more and more [...], at some point, in a paradoxical way, [we] start consuming [our]selves [...] [on] various paths of self-destruction. (Salecl 2013a: 99)

She mentions workaholism, anorexia, and self-cutting as examples as examples of this self-destruction. Autoimmune processes can therefore be understood as a form of death processes. With reference to George Devereux (neé György Dobó), the German critical economist Lars Hochmann describes old paradigm economics as a way of thinking that "kills off" [abtötend], both literally and figuratively (Hochmann 2018). The great mass extinction mentioned in the introduction (and the Coronavirus disease

[195] Derrida's medical comparison is limping: As noted above, autoimmunity does not mean that immune cells attack themselves, as the quote from Derrida seems to imply. It is not the protection, that is, the immune system, that is destroyed, but other healthy cells of the body.

in the Afterword) stands in a new light when understood as literal results of an autoimmune, or death, process.

Rinkinen, Shove, and Torriti (2019: 1) observe a similar autoimmunity or circular movement regarding energy policy: "Energy research and energy-related policy making are informed by terms, ideas and stories that reproduce certain ways of thinking about problems and responses." Or as Andy Stirling puts it: "History provides many examples where ostensibly revolutionary efforts to overturn incumbency simply reproduce it in another form – often more entrenched" (Stirling 2014: 84). Autoimmunity is a paradox: It confirms that the proverbial road to hell is laid out with good intentions, that is, what is thought to be good turns out to be bad. Heidegger's *turning* [Kehre], briefly introduced in Chapter 5, is paradoxical in an inverse way, because it entails that there is a *saving power* inherent to the *highest danger*. In the moment of no hope, there is hope. I return to the concept of turning in the following section.

7.4. RENEWABLE ENERGY: STANDING RESERVE OR A TURNING?

As shown in Chapter 5, renewables offer a different mode of existence—a different ontology. However, "our current thinking about sustainable energy technology operates squarely within the logic of Enframing" [Gestell] (Mahoney 2019: 123). Is renewable energy just a new standing-reserve? "Sustainable energy technology—as we currently conceive of it—risks furthering the exploitative logic of modern technology" (Mahoney 2019: 121). This is what Dominic Boyer (2019) and Cymene Howe (2019) showed in the case of wind power in the Isthmus of Tehuantepec[196] in Mexico, where "wind power [is left] in the thrall of finance capital, state biopolitics, and energopolitics" (Boyer 2019: 24, cited in Hasberg 2019c: 8). That an unsustainable path can be laid out with the proverbial good intentions of sustainable energy is also recognized by others: Hvelplund (2013) terms this the "blind alley […] [of] 'black wind power,'" characterized by a top-down planning and a Supergrid, high-voltage interconnection approach to managing fluctuations. With reference to the French and German experience, Stefan Aykut and Aurélien Evrard (2017) describe it as a "transition so that nothing changes" (2017: 17).

As introduced in Chapter 5, our treatment of nature and ourselves as a *standing reserve* entails the *highest danger* to Heidegger. But paradoxically, this highest danger entails the possibility of a turning—falling off the cliff is not a determined fate when walking on the edge. This turning entails a different relationship to Earth and to technology, which Heidegger expresses as dwelling [wohnen] and letting-be

[196] The narrow and windy strip of land between the Gulf of Mexico and the Pacific Ocean.

[Gelassenheit]. *Dwelling*[197] is described as being "a staying with things"[198] (Heidegger 1971a: Section I). *Letting-be* [Gelassenheit] is "an attitude of simultaneous yes and no to the technical world"[199] (1959: 25). It by no means means "'resignation and passivity' as Feenberg rather polemically translates the term at one point (Feenberg 1999: 184)" (Thomson 2000: 208). Instead, "Heidegger meant that there is an opening in 'letting be,' which exactly points at active and engaging decision-making in relation to how and why we should appropriate new technologies" (Botin 2020: 5). From Heidegger's perspective, choosing a renewable path is to let it be—but from today's perspective, that is actually the path that requires more action, as not doing anything will allow us to remain on a fossil path.

Currently, the Supergrid thought style regarding the energy transition is to solve fluctuations through "time-space compression" as David Harvey calls it (Kivisto 2012): With batteries (time) and with interconnectors (space), "all distances in time and space are shrinking"[200] (Heidegger 1971b: 163 cited in Folkers 2017: 44).

Changing behavioral patterns, along with sectoral integration, can be understood as a more conscious living with fluctuations. Heidegger's would be a living in *Gelassenheit*, in letting-be-ness, not in the sense of passivity, but in the sense of accepting and accommodating the fluctuating nature of renewable energy. This is in contrast to the Supergrid thought style that imagines a renewable system just as the current one, with added interconnection to compresses space and large-scale storage to compresses time in order to avoid system change. But avoiding the system change is to treat renewable energy as a standing reserve.

Instead of taking for granted "what is enough supply, how this is defined, and what counts as reliable" (Blue et al. 2020: Reifying flexibility Section), Peter Forman and Elizabeth Shove argue for a completely revised notion of what flexibility might mean:

> In the longer-run, making greater use of renewable energy and doing so as effectively as possible depends on reconfiguring the detail and timing of what people do. This might involve reintroducing seasonal variations in consumption and production or reconnecting societal and natural rhythms

[197] Dwelling is a concept that Heidegger unfolds in *Buidling Dwellling Thinking* (Heidegger 1971a) [*Bauen Wohnen Denken* (Heidegger 2000a)] in which he puts forward an almost Christian-democratic thinking of preserving the integrity of Creation.

[198] German original: "Das Wohnen ist vielmehr immer schon ein Aufenthalt bei den Dingen" (Heidegger 2000a: 153).

[199] Own translation of "Ich möchte diese Haltung des gleichzeitigen Ja und Nein zur technischen Welt mit einem alten Wort nennen: die Gelassenheit zu den Dingen."

[200] "Alle Entfernungen in der Zeit und im Raum schrumpfen ein" (Heidegger 2000b: 167).

> including those of heat and light. (Forman and Shove 2019: Reimagining flexibility Section)

Or put more bluntly: "Perhaps our futurity will only be illuminated and air-conditioned in an intermittent, flickering way" (Boyer 2020: 23).

> Instead of situating power production in remote, out-of-sight locations or utilizing technology to distance us from the natural environment, more decentralized and localized energy production would reveal more directly the process by which natural phenomena are converted into energy. […] Integrating ourselves into the natural environment in such a manner could help us to fully practice Heidegger's concept of dwelling. (Mahoney 2019: 128)

Why don't we like to go away from baseload? Because it forces us to recognize that we are not, and should not be, rulers of nature and "the orderer of the standing-reserve (Heidegger 1977b: 27). With reference to Sigmund Freuds psychoanalysis, Boyer (2020) argues that departing from baseload forces us to recognise the fluctuating forces of energy inside us: "Baseload thinking naturalises a situation of endless constant electrical supply equilibrated to endless constant demand" (Boyer 2020: 13).[201]

Conceptualizing the energy transition as a turning in a Heideggerian sense entails not only a change to our energy system. It means to undo ourselves from being mere human resources, a standing reserve, but also from being. The "back-to-nature"-call of Heidegger, if there should be one, is more of an inner calling than a return to the Black Forest.

7.5. TRANSFORMING POWER/IGNORANCE: A QUESTION UNANSWERED

How may the power/ignorance that keeps us from achieving a turning in the Heideggerian sense be transformed? The case studies are, unfortunately, of little guidance in how to achieve this. Rather, they are cautious tales both of the attempt at reforming from within by "speaking truth to power" in case A, or wanting to replace the system with an entirely different one, as in case B. From a transition point of view,

[201] Salecl's arguments resonate well with those of Dominic Boyer, and both of them refer to psychoanalysis, "since psychoanalysis is the only domain of social theory that addresses desire as a political force" (Boyer 2020: 1). "I argue that the relationship of electricity and modernity fundamentally involves the problem of desire—specifically the desires for modern luxury and convenience and freedom from onerous labour, but also the irrational utopian desire of endless economic growth and wealth generation and the repetition compulsion of investment in fossil fuels despite signs of global warming and ecological disruption multiply" (Boyer 2020).

both cases are failed, as they turn transition processes against themselves (see section 7.3.1).

A deconstructive reading of H. C. Andersen that historicizes *The Emperor's New Clothes* reveals that whether power/ignorance is positive or negative depends on which status quo it maintains; which path the lock-in preserves. In such a reading, the tale portrays the peaceful democratic revolution that took place just few years after it was published. There is a tacit collusion between people and ruler: If the ruler voluntarily refrains from exerting power (by being interested only in fashion, not showing up in council), then the people will create a thriving town where "life was always gay" and not reveal publicly what everybody knows: That the emperor has no power anymore, but has become a symbolic figure which only functions as a point of gathering of the people (Robbins 2003). This would mean that the most important sentence is that which claims the well-being of the town, and the emperor's ignorance to political matters in this light is thus positive. This interpretation is aided by the original ending of the fairy tale, which H. C. Andersen changed into to the final published ending after the manuscript had been sent to the publisher. In the original version, H. C. Andersen ends the tale *without* the boy's cry, completely changing the message. Instead of being humiliated and revealed, the emperor—as well as the people—are contented: "'I must wear that suit every time I join the procession or attend the Council!' said the Emperor; and the whole town talked about his splendid new clothes (H. C. Andersen 2015).[202] When real power is removed, symbolic power can persist through tacit collusion and act as the glue of society, as long as the "weavers" don't bankrupt the society. Keeping the weavers in check, then, emerges as a fundamentally important task.

The real people in power are not mentioned in the fairy tale. The dismantling of power has taken place in a different way. The city is to some extent "powerless" in a positive sense—at least we are not told who actually rules the town (as the emperor clearly doesn't). Or in other words: There is no need to speak truth to a ruler that doesn't exert any power anyways (but spends all day in the dressing room). "Andersen's tale (...) might also be real as an exploration of a constitutional monarchy in which the public conspires to preserve the myth of monarchial fitness" (Robbins 2003). "Both spectacle and spectator maintain the mutual pretense of the parade and the social and political structure perseveres" (Carson 2013: 20). In this reading, power/ignorance is not "removed," but rather, their function is transformed, because both power and ignorance perform important social functions of organizing the social. Did Hans Christian Andersen dupe us, the readers? Are we subject to a harmony of delusion that leads us to believe that the tale encourages us to speak truth to power, as my interpretation first interpretation concluded?

[202] Danish original: "Den Dragt maa jeg rigtig have paa hver Gang jeg gaaer i Procession eller træder op i Folkeforsamling!" sagde Keiseren; og hele Byen talte om hans prægtige nye Klæder" (H. C. Andersen 2015).

Can we really consider "transformation from the inside" as an answer to the carbon dictatorship of *das Man*? My own experience is bleak, both regarding changing systems from within (while working at Energinet) and from without (as a startup'er in the blockchain-in-energy community). The question of how to achieve socio-material change may be an unanswerable paradox. The case studies show that no matter whether change is attempted from the inside or outside of existing paradigms, controlling the weavers remains the most important task. In policy language, the work of the weavers is called "regulatory capture." Therefore, policy action counteracting such regulatory capture is the topic of Chapter 8.

Although the case studies in themselves have not given an answer to the question of how to unlock carbon-lock in and how to transform power/ignorance, the research path taken in this monographic essay gives some indications as to where to look.

Frede Hvelplund (2011) suggests that policy processes can be understood as the interplay of dependent and independent actors, denoted as lobbyists, where dependent actors have a direct economic interest in the outcome of the policy process while independent actors do not. He argues that in an *innovative democracy* process, the influence from independent actors carries "at least the same weight in the political process as the influence from the dependent" (Hvelplund 2011: 101). These two spheres can be compared to Fleck's conceptualization of the inner and the outer circle of a thought collective. In order to make a thought collective less prone to harmony of delusion, the outer circle must be strengthened. When the (exoteric) circle of a thought collective is stronger than it's inner (esoteric) circle, we get a more democratic of fact-making (see 6.3), because the outer circle keeps the weavers in check, to speak in the metaphor of H. C. Andersen. Both speaking truth to power, symbolized by the boys cry, and transitions from within, as implied in the deconstructive reading of *The Emperor's New Clothes*, are needed in combination.

A stronger connection between the inner and the outer circle of fact-making also means that the world of science and the world of politics must move closer together. As Bruno Latour argues:

> facts and opinions are already mixed up and they will be even more mixed up in the future. What we need is not to try isolating once again the world of science and the world of politics —how can we even imagine keeping such a program in operation in the time of the anthropocene, that mix up of all mix ups?— […] Instead of trying to distinguish what can no longer be distinguished, ask these key questions: what world is it that you are assembling, with which people do you align yourselves, with what entities are you proposing to live? (Latour 2011: 7)

Such a fact-making in a manner of *dialogue or deliberation* (H. Lund, Arler, et al. 2017) is an a fact-making worth striving for.

SECTION C: ESCAPING LOCK-IN BY TRANSFORMING POWER/IGNORANCE

CHAPTER 8. POLICY CONSIDERATIONS

An important function of the cover essay, in addition to "dressing up" the research as described in the introductory section 1.4, is to give it shoes—that is, to combine in-depth research with concrete and actionable points that make it applicable to real-world problems. This function is fulfilled by this policy chapter. In 8.1, I discuss the making of policy recommendations as such. In section 8.2, I discuss policy measures that can be taken to reduce the regulatory capture that the Danish TSO Energinet is exerting. Section 8.3 contains research policy considerations that could strengthen a new economics, and lastly 8.4 points towards future research in the area of data ethics for the energy transition.

8.1. AN ADEQUATE COGNITION CONTEXT FOR POLICY MATTERS

Sticking to the ambition that I formulated for a new economics, namely to be vocal on policy recommendations, this policy chapter cannot be lacking. But before embarking on the policy recommendations as such, I want to revisit Fleck and return to the comparison of a thought collective to a map. Like Schumacher and Fleck (see section 6.2.1), Hvelplund (2005) also uses a map metaphor to explain his concept of *adequate cognition contexts*.

> Let's take a look at a map example. There are detailed maps and overview maps, hiking maps and bicycle maps, maps with and without contour lines, maps indicating historical sights and maps indicating scenic points of interest, etc. Maps can be categorized. And it is important to have a hiking map when hiking, a biking map when biking, and a map of historical attractions if that is what one is interested in. The map must be appropriate / adequate for the given person, or group of people, and the purpose(s) of the trip. All maps are not equally good; the good map is the one that is

> appropriate (adequate) to the person (organization) and the purpose of that person (organization).[203] (Hvelplund 2005: 75)

In this cover essay, I have aimed at creating what I perceive as an adequate cognition context for the two case studies in Hasberg (2020a) and Hasberg (2020b). To stay with the metaphor, I have developed a mental map consisting of the ontology of Heidegger, the epistemology of Fleck, and my own power/ignorance concept. This helicopter-level understanding enables me to notice the conditions that constrain and shape the actions taken by actors in the field.

In addition to being aware of what map one is handling, Hvelplund (2001b) emphasizes the importance of being concrete and action-oriented, that is, to zoom back in once the map has been drawn. I consider that the move of zooming out and zooming in—of landing the "thought helicopter", if you will—are two moves that belong together. It is the helicopter perspective makes it possible to identify the relevant policy areas in the first place. Zooming out is thus not just an intellectual exercise, but a practical necessity. Returning to the ground means to return to a concrete level of abstraction where actionable policy intervention can take place. However, as I discussed in Chapter 2, increasing specialization in research organization to a certain degree pulls apart the task of flying the helicopter and landing it. The compartmentalization of language and terminology of different fields adds to this barrier: The language of policy is typically different from that of Heidegger, Fleck, and Foucault. Although I do build on the insights that the field work of cases A and B have provided, and the power/ignorance framework is at the back of my mind while writing policy recommendations, the language of the policy section is different than that of earlier chapters. Policy recommendations must be readable to an audience that is unfamiliar with the above-mentioned concepts of Heidegger, Fleck, and Foucault. Thus, policy recommendations, like interdisciplinary research, involve the act of translation. In this chapter, I translate *power/knowledge* into *regulatory capture* as it covers much of the same meaning and is at the same time in much wider use in policy circles. Also, a term like *calculative device* is not used in a policy context, while mainstream and *heterodox, or plural, economics* are known terms that denote alternative calculative regimes.

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[203] Own translation from Danish: "Lad os se på et landkorteksempel. Der findes detailkort og oversigtskort, vandrekort og cykelkort, kort med og uden højdekurver, kort der angiver historiske seværdigheder og kort der angiver naturmæssige interessante steder, etc. Landkort kan kategoriseres. Og det er vigtigt, at man har et vandrekort med på vandreturen, et cykelkort på cykelturen og et kort med historiske seværdigheder, hvis det er det man er interesseret i. Kortet eller kortsamlingen skal være passende/adækvat til den givne person, eller gruppe af personer, og den/de formål der er med turen. Alle kort er ikke lige gode, og det gode kort er det, der er passende (adækvat) til personen (organisationen) og personens (organisationens) formål" (Hvelplund 2005: 75). See also Hvelplund (2001b).

Thus, the task of this policy section is to suggest concrete and actionable policy interventions. In section 8.2 I show how concrete policy changes regarding the financing of Energinet can contribute to reducing the reinforcing of carbon-lock in that Viking Link is an example of. However, "energy policies] [...] address only a tiny part of what matters for energy demand" (Royston & Selby 2019: 114). [204] Therefore, I have added policy considerations outside of the energy sector in section 8.3. It deals with how research policy reforms can help reduce the grip of old paradigm economics.

The following policy recommendations all have in common that they aim at transforming power/ignorance as discussed in the previous chapter. It is important to underline that the recommendations *rest upon* a rebalancing of the inner and outer circles of policy making thought collectives, as emphasized in Chapter 7. Such rebalancing increases democratic control over energy and information systems, as discussed in Chapter 7.

8.2. ENERGY POLICY CONSIDERATIONS: REGULATING ENERGINET

Parts of this section are based on Hasberg (2019d): Vom Verteilnetz zum Netz des Zusammenspiels. Zur neuen Rolle von Verteilnetzen in erneuerbaren Energiesystemen in Dänemark und Deutschland. *Zeitschrift Für Neues Energierecht* (5) 417–422,

which has been presented as Hasberg (2019b): From distribution to interaction grid. Fundamental questions on the role of and tariff design in distribution networks of 100% renewable energy systems. A framework for evaluating grid tariff policy proposals? [conference presentation]. In *5th International Conference on Smart Energy Systems in Copenhagen, 10–11 September 2019*, Copenhagen.

This section explores a problem articulated by Hvelplund et al. (2019):

> The main investment, operation and management actions of Energinet.dk are dealing with power grids, but not by supporting and building infrastructures that support 'free trade' across the borders of various sectors, as between, for instance, heat and electricity. […] Therefore, new legislation for Energinet.dk is needed that not only creates a network for trading electricity, but also opens the door for free trading between the heat and the electricity sectors. (Hvelplund et al. 2019: 173)

[204] Ilona Otto et al. (2019) gives an overview of the spectrum of policy areas that matter for carbon lock-in. Some of the most important recommendations address ending fossil fuel subsidies (Erickson et al. 2020) and divesting from fossil assets (influencemap.org 2019).

8.2.1. ENERGINET EXERTING REGULATORY CAPTURE

Regulatory capture describes "the process through which regulated monopolies end up manipulating the state agencies that [were designed to] control them" (Dal Bó 2006), cited in Payne (2018). It is also denoted as "incumbent capture" (Lockwood, Mitchell & Hoggett 2019: 9). Capture can also take more subtle forms, via the formation or influence of public opinion: Fossil energy companies have been known to fund climate denialism by (Grasso 2019), as recently uncovered with the Dutch Shell papers (van Beek et al. 2020) and the US Exxon papers (Supran & Oreskes 2017). When influence is achieved via the use of social media advertising, more recently also supported by tweet bots (Marlow, Miller & Roberts 2020), Lock and Ludolph (2020) denote it as "organizational propaganda." Regulatory capture can also utilize consumers to put forward interests of incumbents: Both in the energy and information sector, astroturfing[205] corporate entities in disguise as grassroot organizations (Beder 2014), or the "tacit allegiance of consumers […] can prove a formidable source of opposition to regulations" (Culpepper & Thelen 2020).

In the case of Energinet, regulatory capture has been investigated over recent years. A report regarding the regulation of Energinet (Implement 2016) based on the work of a public utility regulation committee (Udvalg for el-reguleringseftersynet 2014) points out a range of weaknesses of the current regulation of Energinet and confirms regulatory capture. The report asserts that regulation is informal, characterized by information asymmetry to the advantage of Energinet. In sum, the report concludes that the current regulation incentivizes overinvestment and enables market distortion (Implement 2016, 15).

The concept of state-owned multinationals refers to the process by which national natural monopolies transition into multinational companies (Clifton, Díaz-Fuentes & Revuelta 2010; Clifton, Comín & Díaz-Fuentes 2011) through the process of internationalization. A more precise term is *state-owned natural monopolist/multinational,* because it indicates the hybrid nature, combining the risk-reduction features of the state-owned monopolist and the international opportunities of the multinational. Grid monopolies—whose customers' payments are determined by a regulatory authority—are such a financial structure that makes an entity quasi-state-owned in the terminology of Judith Clifton, Francisco Comín, and Daniel Díaz-Fuentes. Künneke (1999) raises the question regarding how natural the monopoly of electricity networks really is. With the energy transition, more and more economically viable distributed alternatives emerge to cables generally speaking, drawing the status of the natural monopolist into question (as discussed in Hasberg 2019a). That

[205] "The deceptive practice of presenting an orchestrated marketing or public relations campaign in the guise of unsolicited comments from members of the public. From AstroTurf, a trademark name of an artificial grass surface used for sports fields. the idea being that such a campaign is an artificial version of a grassroots campaign" (OED 2020b).

Energinet is not a natural monopolist, but a multinational enterprise active in the European market for interconnectors is shown in section 2.2.1 and is supported by TINA-thinking of the Supergrid thought collective. As the Danish Minister of Climate and Energy, Dan Jørgensen puts it during the public parliamentary hearing on Viking Link in September 2019: "It is not like the cable wouldn't be built if Denmark wouldn't do it. […] *It would be built somewhere else*"[206] (see Appendix F, Discursive depolitization Section). This competitive attitude is also asserted by (Energinet (2017b): "The biggest gains accrue to the first connections." The fact that the 'business case' was kept confidential (not only estimates for individual elements of the construction costs, which, if public, could influence the bidding on the construction tenders) further suggests that Energinet is acting in international competition, not as a natural monopolist. In a European perspective, in addition to being part of a European network of TSO's, Energinet is also competitor to the other European TSOs; a situation of *coopetition*, that is, both cooperation and competition. Energinet wants to secure that the arbitrage rents accrue to Energinet, and not to competing TSOs and their cables.

Aharoni (2018: 21) describes how regulatory capture is a feature of state-owned multinationals: "The result is that the controllers are to a large extent the captive audience of the managers on important issues." This is in line with recent research stating that natural monopolies on their way to becoming multinationals benefit from domestic policies protecting their ability to reap the monopoly benefits at home while entering into fierce competition internationally: Regulatory capture can be seen as a form of state protection in the period of transformation from natural domestic monopolist to the hybrid *state-owned natural monopolist/multinational*, a set-up that is "even more likely to emerge in industries such as networks, owing to historical links and strategic interests [providing firms] with monopoly rents, useful when undertaking risky international operations" (Clifton et al. 2010: 992). As Musacchio and Lazzarini (2018) state, state-owned multinationals are more willing to take risks than comparable private multinationals, because the natural-monopoly part of the venture acts as a form of insurance against losses. This is confirmed by figures presented in the Implement report. "Energinet.dk has a very low degree of equity financing compared to other TSOs"[207] with an equity ratio of 15%, in comparison to another state-owned TSO, the Norwegian Statnett, with 28% (Implement 2016, 12, own translation). The equity ratio is a typical measure of the investment risk that a company takes. Overinvestments are a result of such systematic underestimation of risk. In the case of Energinet interconnectors, the market risk, that is, the risk that arbitrage rents decrease over time because other cables, or sectoral integration, cuts

[206] The neologism 'business case' for cost-benefit-analysis used by Energinet seems like another indicator of this public-private role confusion.

[207] Danish original: "Energinet.dk har en meget lav grad af egenfinansiering sammenlignet med øvrige TSO'er."

away market shares, is systematically underestimated because such risk is borne by the electricity consumers in Denmark, who are the customers of the natural monopoly (Implement 2016, 15).

The tendency to overinvest has also been pointed out by Energinet employees who acted as whistleblowers as early as 2011: "At a department seminar in the summer of 2010, a manager stated that his section was now geared to handle Energinet capital investments of the size of 1½-2 billion DKK annually, and if the Grid Development department would not propose projects of this size, his section would have to find the projects themselves" (Confidential authors 2011, own translation). This is equivalent to what Musacchio and Lazzarini (2018: 267) describe as "managerial hubris": "if there are principal-agent problems, like weak monitoring, this could allow state-owned multinationals managers to have significant discretion to pursue internationalization agendas following managerial hubris."

This is precisely the kind of regulatory capture that takes place when Energinet advises the authority that is also supposed to control the TSO, that is, the Ministry of Energy, Climate and Utilities, and its sub-entity, the Danish Energy Authority. "Energinet delivers a significant contributions to the analyses that result in decision-making (...) regarding grid expansion" (Implement 2016, 16, own translation). "It is difficult for the Energy Authority to recommend the rejection of an approval to the Minister" because projects have reached a very mature stage before approval is requested (2016: 14). Regulatory capture therefore short circuits regulatory oversight and hence, the democratic control over the interconnector decision-making process. In other words: Viking Link competes against other interconnectors of Energinet, like the Cobra cable between Denmark and the Netherlands which entered into operation this year (see Figure 1-3). Such so-called cannibalization remains underrecognized in risk assessments. Consumers pays the costs of such cannibalization as they bear the risk of the project. To paraphrase Thatcher inversely: With interconnectors, the problem seems to be that you don't run out of other people's money.

At the European level, lobby groups like "Friends of the Sustainable Grid" (formerly "Friends of the Supergrid"), the former "North Seas Countries Offshore Grid Initiative" (NSCOGI 2016) and the "Global Energy Interconnection Development and Cooperation Organization" contribute to solidifying the Supergrid thought collective internationally (GEIDCO 2020). The current strategy paper of Energinet, "Energy across borders" (Energinet 2017a), is focused on constructing interconnectors, which is in line with the EU interconnection targets that have been raised from 10 percent by 2020 to 15 percent by 2030 of installed electricity generation capacity. These targets are based on the recommendations of the Expert Group on electricity interconnection in 2017 (CEG 2017; 2019) of which the lobby group "Friends of the Sustainable Grid" is part (Transparency Register 2019).

That Energinet is a natural-monopoly-turned-multinational means that the regulation of Energinet should be fundamentally different. In the following, I briefly sketch out regulatory implications based on the analysis of Viking Link in this article, which simultaneously points towards knowledge gaps in need of further research

8.2.2. FROM CABLE LAYER TO BUYER OF FLEXIBILITIES

Even though a cost-effectiveness analysis would instill a different perspective, it would on its own hardly change the problematic investment behavior of Energinet sketched out in this article. To ensure equal consideration of interconnectors and flexibility options and to avoid the market distortion effect of Energinet selecting cable infrastructure by default without considering other flexibility options, the revenue cap regulation of Energinet must be changed. For example, one could imagine tenders for flexibility, where aggregators pooling different flexibility options enter into a long-term contractual relationship with Energinet, thus providing an alternative cost-and-benefit profile that can be compared to the construction of an interconnector. Furthermore, flexibility market reforms must be seen in conjunction with the ongoing Danish work towards grid tariff reform (KEFM 2019a). Today's fundamental principles of grid tariffs still fit an energy system with centralized fossil generation and need to be adjusted to a Smart Energy System future by re-interpreting the cost-orientation principle as a principle of lowest system costs; replacing the waterfall and stamp principles (Danish: vandfaldsprincip) that currently creates a copper plate assumption acting as a subsidy to interconnectors. An alternative could be grid tariffs based on a subsidiarity principle. Furthermore, ownership unbundling (Ropenus & Grenaa Jensen 2009) must be ensured to avoid vertical re-integration of networks, generation, and flexibility.

These policy recommendations on a transmission level are equivalent to the changes needed on the distribution level, where local flexibility markets with the distribution grid operator as a buyer could also enable sectoral integration and a change in the role of the distribution grid towards an interaction grid.[208] Although there are many challenges ahead regarding the construction of flexibility markets, like ensuring sufficient liquidity and preventing increase-decrease gaming (Ecofys & Fraunhofer IWES 2017: 102), these policy measures could be a move towards institutionalizing the Smart Energy Systems thought style already present at Energinet. Anchoring it in the revenue cap regulation and grid tariff principles would turn the transmission system operator into a Smart Energy System operator.

Today, the electricity regulation in Denmark and Germany is based on the following principles 1 to 5:

[208] For an elaboration of this argument, see Hasberg (2019a).

(1) Waterfall principle: The waterfall principle entails that the consumer pays for electricity transmission and distribution from the highest voltage level to the lowest. The highest voltage level is implicitly assumed as the level of generation. (Danish: vandfaldsprincip; German: Kostenwälzungsprinzip)

(2) Cost-orientation principle: The consumer is by definition seen as the incurrer of costs in electricity transmission and distribution, not the producer. (Danish: omkostningsægthed; German: Verursacherprinzip)

(3) Revenue cap regulation, that is, the rules turning the grid cost into grid fees (German: Anreizregulierung, Danish: indtægtsrammeregulering)

(4) Stamp principle: The consumer has to pay the same grid fee no matter where the electricity comes from. In German, this is expressed as the principle of "one stamp for all of Europe"

(5) Marriage between Standard load profiles and baseload: (Danish: Skabelonafregning, German: Standardlastprofil, SLP). Standard load profiles are used as a "production plan" in baseload-driven energy systems

These principles are all closely related to two fundamental questions we need to ask of regulation: Firstly, "does it facilitate a Smart Energy System?" as summarized in table 7. Secondly, regarding the different activities in energy systems, we need to ask whose task they are; specifically, whether they are a natural monopoly activity or not. As it turns out, the scope of natural grid monopolies is reduced in the transition to renewable energy systems (Künneke 1999). As there are many ways to provide the flexibility that has until now been provided by grids, only the existing, historical grid can be said to be a natural monopoly. The functionality of every new bit of grid could, to a certain extent, be provided by other means and, therefore, the grid (beyond connecting new actors) is no longer a natural monopoly. This is crucial for the reform of the revenue cap regulation, turning grid operators into buyers of flexibility instead of builders of cables (and thereby, paving the way for so-called flexibility markets). Energinet could be turned into a buyer of flexibilities instead of a builder of cables, which is also being demanded by "The Free Energy Companies"[209] (Miller 2020: 5) and is discussed in more detail in (Hasberg 2019d).

[209] "Free" denotes that the member companies are unbundled from grid ownership. The organization is equivalent to that of the European umbrella organization European Energy Retailers. Similar recommendations at a European level are made by European level (SmartEn 2019).

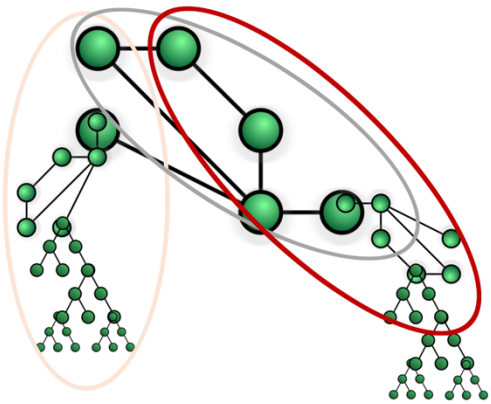
Table 8-1 Evaluation of current electricity regulation principles

	(1) Waterfall principle	(2) Cost orientation principle	(2) Revenue cap regulation	(4) "Stamp" principle	(5) Marriage between Standard load profile (SLP) / baseload
Problems	leads to over-investment in transmission capacity (and, possibly, underinvestment at distribution level	Is inherently conservative because of the built-in path dependence	allows for supernormal profits	can be considered as a form of consumer subsidy for remote production that leads to expansion of the natural monopoly.	Keeps load profiles that are useful to create demand for baseload, even when real loads differ from this pattern
Does it facilitate a Smart Energy System?	No. The highest voltage level is the default level of origin by definition.	No. It seems that by definition, the „cause" of costs can only be newcomers to the system, that is, new producers or new prosumers	No. Flexibilities cannot be bought, but only be built This leads to a "copper only" strategy.	No, because local production is not „rewarded" / lower transportation costs of combined local production and consumption is not reflected. Combination of this principle with the (1) discriminates producers at distribution level	No. With SLP, Consumers /prosumers cannot chose a non-baseload-supporting electricity subscription (In DK now: Flexafregning)

Source: Derived from (Hasberg 2019d).

Figure 8-1 and Figure 8-2 apply a combination of the mesh and the tree grid paradigms that I introduced in section 1.3.2.Figure 8-1 shows how the cost orientation principle, waterfall principle, the stamp principle, and the standard load profile principle interact to finance the current centrally organized electricity networks: A consumer pays for all voltage levels from their connection point to highest voltage level. The circles indicate the "distance paid" when connected at low voltage (beige), at medium voltage level (red), and at high voltage (grey).

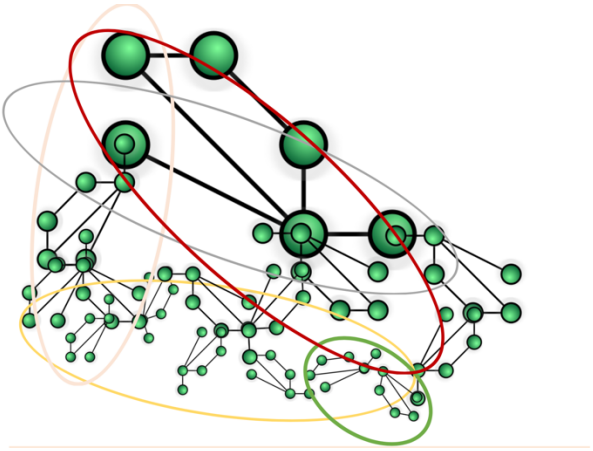
Figure 8-1 Ideal-type grid fees in a Supergrid electricity network.



Source: (Hasberg 2019d) *Wikimedia Commons (2006, 2008) and own illustration*

Figure 8-2 illustrates how grid payments could be organized according to new principles. Replacing both the stamp and the waterfall principle by a "subsidiarity principle" (Hvelplund et al. 2013) would entail that the pricing of the grid is dependent of the distance (similar suggestions are also made by (Graichen 2017), denoted as "electricity price regions [Strompreisregionen]. The lines of different colors in Figure 8-2 indicate that electricity can both be bought locally and over long distances, but this is then reflected in the grid tariff paid, as a type of road pricing for electricity.

Figure 8-2 Ideal-type grid fees in a Smart Energy System electricity network



Source: Hasberg (2019d), Wikimedia Commons (2006, 2008) and own illustration

As Hvelplund et al. (2019) assert, "Power transmission tariffs should be dependent on the degree to which a consumer uses the transmission system." In sum, new principles could lessen the power/ignorance that current energy sector regulation regimes exert, causing carbon lock-in. This would enable an

> equal playing field between long distance power transmission systems and local integration of fluctuating renewable energy in smart energy systems […]. This requires new grid tariffs that do not favour investments in the long distance transmission systems, and tax and tariff structures that do not hinder the integration of heat and electricity production. (Hvelplund et al. 2017: 577)

8.3. SOME RESEARCH POLICY CONSIDERATIONS REGARDING ECONOMICS

The changes suggested in 8.3. need support from outside the energy sector. Such support could come from a new economics. Research policy is therefore the second policy area that I consider.

As shown particularly in the Viking Link article (Hasberg2020b), the calculative devices of old paradigm economics significantly contribute to carbon lock-in. The infopower they exert means that only a certain type of perspective is represent-able before large infrastructure investment decisions are made. Calculative devices reinforce socio-technical imaginaries of prosperity through growth and trade. The conclusions they produce fall on fruitful ground, that is, are well received, because they support the interests of the few, but powerful, as Theresa Scavenius expresses it with her rephrasing of Hardin (Scavenius 2016). Thus, economics itself, as a thought collective, is a site of power/ignorance: In both cases A and B, economics plays a decisive role in establishing carbon lock-in. In the blockchain case, it is Austrian economics and new institutional economics, while in the case of Viking Link, it is the calculative device of the cost-benefit analysis.

Calculative devices are a decisive policy factor in energy policy. They affect the level and type of energy consumption via many of the adjacent policy areas. For example, the preface provides a good example of how transport policies significantly affect energy policies, and that socio-technical imaginaries and calculative devices interlock to produce the perpetuum mobile of carbon lock-in. Thought collectives typically have para-religious traits, so from a Fleckian constructivist perspective, the remark of the external examiner regarding "conviction and faith" was indeed not out of context. He was a member of the individual mobility by car[210] thought collective, "without which you couldn't work at the Ministry of Transport" (NOAH-Trafik 2002; Næss et al. 2009: 150), as he had been cited as saying to a Danish newspaper *Aktuelt* in 1996. As emphasized earlier in the preface, he saw it as his task to keep the models of the transport ministry of out of the reach of political influence. Hence clearly, the strong socio-technical imaginaries of the thought collective, as well as their calculative devices, interlock to produce transport policies that favor individual mobility by car. These kinds of relationships between the calculative devices of old paradigm economics and socio-technical imaginaries of faith in technology and growth exist in many other sectors, including agriculture and food, urban and regional planning, labor (Frey 2019) and labor mobility, leisure and travel. One way of unravelling them, besides working on the socio-technical imaginaries at a societal level as addressed in the conclusions of Chapter 7, is to address the calculative devices of economics. As detailed in section 3.2, a new economics could provide a different type of performativity, that is, influence reality in a different way than the current dominant

[210] Own translation from Danish: "privatbillisme."

paradigm of mainstream economics. Therefore, this section addresses how a change in economic thinking can be aided through policy measures. I understand this as the field of research policy, that is, policies regarding university and research funding.

Other educational levels are also involved in the production of economic thinking that shapes lock-in, as Eaton and Day (2019) emphasize with their term petro-pedagogy. Just as newer kindergarten books represent different views regarding gender and race than those 50 years ago, it would be important to address what views regarding the energy system are communicated to children of all ages; however, the ideas in this section are primarily concerned with higher education, resting on a certain "trickle-down" economics belief that reforms at universities will spread new economic thinking to public administration and, that way, to a multitude of sectors. I will consider the use of research/higher education policy in creating new calculative devices through reforming the economics discipline.

To repeat a point made in section 3.2, Why doesn't economics change? Because it serves a purpose: "a set of instruments of calculation and other technical devices, whose strength lies not in their representation of an external reality, but in their usefulness for organizing sociotechnical practices, such as markets. The narrowness of neoclassical economics then serves a purpose" (Mitchell, 2007: 244 cited in Røpke 2020). There is demand for old paradigm economics from "those in power" (Galvin 2020); it is thus not only old paradigm economics itself, but also, the demand for it (Fix et al. 2019). Clearly, then, we have a chicken-and-egg problem of which I only address one specific element: The role of universities in the (re)production of the old economic paradigm.

Organizations like "Economists for Future" in support of "Fridays for Future" initiated by Greta Thunberg (E4F 2020), as well as "Rethinking Economics" (2020) demand a transformation towards a new economics in line with that detailed in section 3.2: An economics that acknowledges the role of values and perspectives (no such thing as a view from nowhere) and that of the performativity of economics, and strives towards a different impact of the field of economics on the world. But this new economics is still an "institutionally homeless cognition context" (Hvelplund 2005), and therefore, research policy is required to shape such a home for it.

- "University social responsibility" (Söderbaum 2018): "Also universities need to be scrutinized in relation to sustainable development and democracy as a way to restore the integrity of the discipline." (Söderbaum 2018: 265).

- Research ethics: "Our key task as researchers of power is not to seek to further our narrow institutional or profession interests but the wider collective interest" (Alvesalo-Kuusi & Whyte 2018: 148). And as Stirling adds: "If social research is to claim any alignment with these goals, then democracy itself – in all its many plural, ambiguous and uncertain forms – is

not only a central analytical focus but a pivotal normative commitment" (Stirling 2014).

- explicitly support new economics in research funding schemes; Funding bodies: explicitly supporting a new, ecological-institutional approach

- Valuing and promoting academic freedom, for example via the academic freedom index (Kinzelbach et al. 2020) as a relevant metric, which is currently not included in university rankings.

- Establishing open access, non-APC journals for a new, ecological-institutional approach to economics, for example by turning paywalled journals into journals published by professional societies (Padula et al. 2017; Hartley et al. 2019).[211] Related to this point is the reformation of performance metrics that make a cultivation of a "slow science" possible (Berkowitz & Delacour 2020)

- Uni-versi-ties: Return to the cultivation of polymath minds: Considering the proverbial jokes about experts who end up knowing everything about nothing and generalists who know nothing about everything (Quoteinvestigator 2020), university education has certainly been skewed increasingly to the former.
  "We are often unaware of (or not encouraged to articulate) our basic epistemological or ontological upbringing and assumptions" (Van Maanen, Sørensen & Mitchell 2007: 1147). Therefore, we should start articulating our epistemological and ontological stand—also when this stand is positivist—thereby recognizing that other positions exist.
- Encourage and cultivate "self-correction" in academia (Rohrer et al. 2018), thereby loosening up the strong ties to thought collectives.

The measures suggested here would not only benefit the research world as such, but have a performative effect in support of the energy measures suggested in 8.2.

8.4. FUTURE RESEARCH: DATA ETHICS OF THE ENERGY TRANSITION

My research started out as an exploration of blockchain technology as a solution both to the lacking electricity market reform, and to the increasing data surveillance by quasi-monopolists. However, as shown in Hasberg (2020b), the results were sobering;

[211] For disciplinary differences regarding the adoption of open access, see Severin et al. (2018).

blockchain did not bring a more responsible way of handling data. As I discuss in the afterword, questions of data surveillance are becoming even more pressing in the light of Coronavirus surveillance apps (Muller et al. 2020; Birkholm 2020). Therefore, future research tasks point towards a second round of emphasis on the interlinkages between energy and information systems, in a new light.

The Danish rollout of smart meters is an example of how infopower enters the energy sector. In the name "*societal interests*" (ENS 2018), smart meter data has been linked to data of social authorities to surveil unemployed citizens without the consent of the households (Olesen & Keiding 2018; Mortensen 2019).

Yet, as Alvesalo-Kuusi and Whyte (2018: 144) assert, the

> "interests of society" or the "public interest" are not politically or socially neutral terms. Indeed, many of us work in contexts in which the notion of the "public interest" is changing fast. In most advanced capitalist states, the private interests of corporations are increasingly being represented by governments and policy makers as the same thing as the public interest. (2018: 144)

Therefore, data ethics of the energy transition are future research questions of crucial importance for a livable planet, both from an energopolitical and from an infopolitical perspective.

EXTENDED AFTERWORD: POWER/IGNORANCE IN THE CORONAVIRUS RECESSION[212]

Part of practicing phronetic social science is to be attentive to serendipity that delivers research objects of interest to us, as discussed in Chapter 4. To paraphrase John Lennon, phronetic research is what happens to you while you're busy making other plans.[213] During the final writing phase of my PhD—while more or less voluntarily self-quarantined at my mother's place in Hungary, initially only to get some writing done—a novel type of a zoonotic influenza A virus, the SARS-CoV-2 Coronavirus, spread worldwide following an epidemic outbreak in Wuhan in the province of Hubei, China. Probably arriving in Europe in January 2020 with the first confirmed European cases and deaths reported in February 2020, the spread has transformed the continent to a place of both short- and long-term policy action, adding detrimental human, social, and economic consequences to the health effects of the virus itself. The Coronavirus *pandemic* (more on this term later) and the harsh disciplinary measures taken to contain it seem to be an example of the definite return of Foucauldian biopower. Public authorities close and re-open schools, workplaces, borders, shops, and restaurants and even give detailed directions regarding everything from who Danes should have sex with (a permanent partner being best, The Local 2020)[214] and how to eat ice cream in Lower Saxony, Germany (only licking briefly, but *not* eating, within 50 meters of the ice cream parlor (niedersachsen.de 2020: Section "Gilt dieser…").[215] Though at the time of writing the spread of the virus was still continuing and its long-term impacts yet to be seen, there are three fundamental reasons why it is

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[212] This afterword is in preparation as:

Hasberg, Kirsten Sophie. 2021. [in preparation] Power/ignorance of the Coronavirus recession and the autoimmunity of pandemic mitigation measures. In Samantha Vanderslott, Matthias Gross, & Katharina T. Paul (eds.), *Institutionalized ignorance in policy & regulation [special issue]. Science as Culture*.

[213] "Life is what happens to you while you're busy making other plans" is a quote from the song "Beautiful Boy (Darling Boy)," released 1980.

[214] "Sex is good, sex is healthy […]especially with a permanent partner", the head of the Danish Health Authority, Søren Brostrøm, said (English translation by The Local 2020).

[215] German original: "Bei der Anwendung der Verordnung darf insofern pragmatisch vorgegangen werden, als durch erstes rasches Lecken an einer Eiskugel während des zügigen Sichentfernens von der Eisdiele ein Heruntertropfen des Eises auf Kleidung oder Fußboden verhindert werden darf. Für den Verzehr des Resteises gilt jedoch der Abstand von 50 Metern."

of importance to take a closer look at the virus outbreak, the containment measures taken, and the recession in its aftermath:

1. As emphasized in Chapter 8, there are many policy areas besides energy policy that affect energy consumption and, thus, carbon lock-in. One of them is our current global way of organizing the production and consumption of goods: globalization. However, I have not dealt with such structural questions of energy consumption like the "long distance society" (Schreiner & Mattioli 2020), which both contributes to and is affected by the viral outbreak. This is one of the problems of working *close up,* as I have done in both case studies A and B of my PhD research. Additionally, I have focused on the electricity sector only, but such a sectoral perspective is partial at best. When moving inside a narrow energy policy thought collective only, I risk losing sight of wider societal structures that keep carbon lock-in in place. The Coronavirus crisis is therefore an invitation to address these underlying drivers of carbon lock-in that have come up short in my work so far. Furthermore, as a *new economist*, as laid out in Chapter 3, I am committed to delivering policy relevant input voice regarding ongoing economic developments.

2. In addition to the close connection to energy consumption and environmental issues, as outlined above and which I return to in the chapter, the outbreak of the novel Coronavirus vividly illustrates the pressing need for a data ethics of the energy transition mentioned as a future area of research in section 8.4, as the virus outbreak is used to legitimize mass surveillance (Muller et al. 2020; Evers 2020; Birkholm 2020).

3. Primarily, however, this afterword aims at testing the power/ignorance concept developed in Chapter 7 on the case of Coronavirus mitigation measures. My overarching research questions in section 1.2 dealt with inaction, but the Coronavirus's spread has spurred the globe into frantic action. The COVID-19 pandemic could therefore be seen as contradictory to my power/ignorance thesis of how transformation processes end up producing nothing but their own autoimmunity and carbon lock-in. Is my power/ignorance framework also applicable when we talk about society-wide, even worldwide processes, or is it limited to studying "small cases" such as a cable (Viking Link) or a new digital technology (blockchain)?

In this afterword, it is primarily the third aspect I consider. The first sections of the afterword introduce the novel Coronavirus, its origins and its spreading. In the latter sections, I return to the power/ignorance funnel. I argue that the *Coronavirus recession* in the aftermath of the viral infection, as it will probably be called in hindsight, and the measures taken to counteract it, are formidable examples of the workings of power/ignorance, and how measures taken might turn against themselves,

that is, display autoimmunity—also in the case of a global pandemic-induced recession. In the following, I will elaborate on this statement with an in-depth, albeit preliminary, analysis of the causes of and induced actions due to COVID-19.

CORONA AND PRECAUTION

The measures taken to control the spread of COVID-19 might *seem* exaggerated because they seem to follow a precautionary principle (UN 1992).[216] Such a principle is not being followed in the case of fossil energy use and its related problems like air pollution that causes death by respiratory disease, just like COVID-19. The strict lockdown measures are of a biopolitical nature; state power is used to control bodies. However, their severity seem inconsistent in the sense that the argument of protecting the population, especially the weak and the old, is not in line with our ordinary actions regarding protection of vulnerable groups from other respiratory health risks (Rose 2020). Whether the measures taken are suitable in their type, timing, and extent can only be decided in hindsight—at the time of writing, we still do not know what the case fatality rate (CFR), that is, the mortality, of COVID-19 is. In other words, we lack important data in order to estimate how big a share of the population would be impacted by long-term health implications or death if nothing was done. For example, we do not know if everyone is susceptible to the virus, or whether herd immunity, that is, immunity at population scale (P. Fine, Eames & Heymann 2011), could be achieved already when less than the majority of the population has developed antibodies to the virus because some may hold "partial immunity [due to] possible antibody cross-reactivity […] from previous infections with the common seasonal coronaviruses" (Kwok et al. 2020). The shift from a containment to a "flatten-the-curve" strategy in most countries means that efforts focus on avoiding health care system breakdown: The lockdown serves to avoid too many becoming seriously ill at the same time. The long-term outlook is that COVID-19 will come into contact with large parts of the population and (asymptotically) infect those susceptible. Possibly, it will become part of seasonal flu (Wieler 2020); at the time of writing, predictions indicate that a vaccine might be available within the next year (Hollingsworth et al. 2011; Anderson et al. 2020).

How did new economics' precautionary principle (also strongly advocated by ecological economics) all of a sudden "spread like a virus" into mainstream political positions in the case of Coronavirus? "It is tempting to ask what the world would feel like had governments responded to other global health disasters – gender-based violence, climate change, war, poverty, HIV/AIDS, or hunger – with such vigor," as medical anthropologists Leonore Manderson & Susan Levine (2020: 2) state. Are we

[216] In the Declaration of the United Nations Earth Summit in 1992 in Rio de Janeiro, the precautionary principle is defined in the following way: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (UN, 1992). The term possibly originates from German 'Vorsorge,' pre-care.

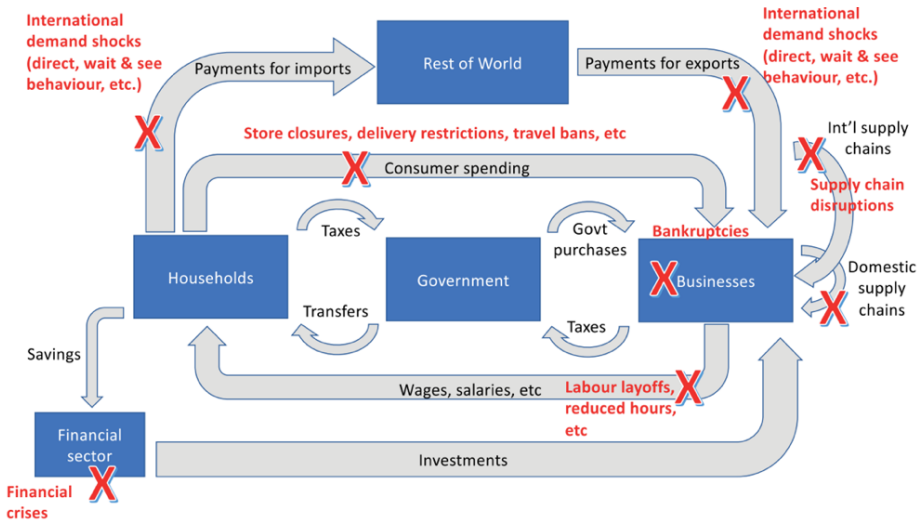
really experiencing a regime change where all of a sudden, people's health and lives matter? Specifically, how can we make sense of a circumstance in which, seemingly, both risk perception and response in the case of the Coronavirus are *very different* compared to the risks of climate change and other risks associated with fossil fuel use. How is this possible? Further, are there chances that we *learn from the COVID-19 pandemic* and continue reducing our environmental impact in the long run?

In order to understand risk perception and the measures taken, I first deal with what could be called short term *biopolitical* measures taken to limit the spread of COVID-19. Then, I look at long-term economic measures and whether these may result in more, not fewer, zoonic pandemics in the future, creating repeated biopolitical repercussions. But first, how did the Coronavirus disease break out and what were routes of spreading?

WHAT IS COVID-19 AND HOW DID IT SPREAD TO EUROPE?

In the times of COVID-19, effort of experts in fields as diverse as virology, epidemiology, public health, social behavior, psychology, and economics are required. But, despite the need for such transdisciplinary approaches "to deal with concatenating global problems, barriers between scientific disciplines, a 'silo mentality', persist and undercut our capacity to respond to emerging threats" (Price-Smith 2008: 1678, in a review of Kimball 2016). An example of such silo mentality is old paradigm economics that positions events such as pandemics as exogenous to the economy (Bofinger et al. 2020; Mckibbin et al. 2020; OECD 2020b; R. Baldwin & Weder di Mauro 2020a; 2020b; Gopinath 2020). As *Figure 9-1* illustrates, COVID-19 is treated as an exogenous shock to the economic flow, causing three types of disruption: (1) "the purely medical shocks – workers in their sickbeds aren't producing GDP"; (2) the "economic impacts of containment measures"; and (3), "the expectation shocks" (R. Baldwin & Weder di Mauro 2020b: 10). Since humans in this mode of thinking are also just a resource of the economy, it confirms Heidegger's notion of humans as *standing reserve* [Gestell], that is, as stored production capacity (Heidegger 1977b).

Figure 9-1 COVID-19s multiple strikes in the circular flow of income diagram



Source: R. Baldwin & Weder di Mauro (2020b: 10). Reprinted with permission.

In *Figure 9-1*, the red crosses mark where the three types of economic shocks from COVID-19 hit. However, in the case of a zoonotic virus, this old economics approach is misleading. After all, the virus emerged exactly because the human economy is inseparable from the biosphere. A new economics approach seeks a natural science basis for the understanding of economics. Therefore, it is important to understand the cause of COVID-19 before prescribing economic measures to counteract its impact.

Coronaviruses are "a group of Ribonucleic acid (RNA)[217] viruses[218] that circulate in animals and humans. In humans, they can cause respiratory disease" (Ross, 2020: Coronavirus). CoVs have "a crown-like appearance under an electron microscope (coronam is the Latin term for crown)" (Cascella et al., 2020: Etiology Section). Although from a different family of viruses than influenza, the symptoms in humans are similar. The pandemic outbreak of "severe acute respiratory syndrome coronavirus 2" (SARS-CoV-2), the full name of the novel virus causing Coronavirus disease

[217] A type of genetic material.

[218] A type of germ or microbe. "Viruses are not considered alive because they don't have the tools they need to replicate on their own. The flu, COVID-19, Zika and Ebola are all caused by viruses. Viruses cannot be treated with antibiotics" (E. Ross 2020).

(COVID-19),[219] is at the time of writing believed to be zoonotic,[220] as "bats appear to be the reservoir of COVID-19 virus" (WHO 2020c). COVID-19 causes almost symptomless (asymptotic) infections among younger healthy individuals—which could be 50–90% of all infected (RKI 2020; Cedrone 2020; repubblica.it 2020), but relatively high case fatality rates (CFR) (>2% of *diagnosed* cases) among people with existing (chronic) diseases, particularly the elderly. COVID-19 is particularly associated to comorbidities, a medical term for the co-occurrence of more than one health condition in one person: For example, smokers are more receptive to the impacts of Coronavirus due to their pre-damaged lungs (UCSF 2020). This also applies to similar damages of the lungs due to other particle matter (PM) in the lungs—namely air pollution (Passarini et al. 2020; Wu et al. 2020; Setti et al. 2020).

Epidemiologists operate with two key terms in relation to epidemics: *Spark risk* is the likelihood of a potentially pandemic virus to arise, for example via "spillover" from animals to humans (Quammen 2012)[221] in the cases of zoonotic viruses, while *spread risk* denotes how likely a virus is to diffuse broadly through human populations. Closer proximity between animals closer and humans, for example, in the slum suburbs of megacities, increases the spark risk, that is, the likelihood of transfer of viruses from animals to humans. Deforestation, habitat destruction, dense livestock production systems, and climate change exacerbate the emergence of pandemics through spillover (WHO 2018b; Bhushan 2020; Scott 2020; Shah 2020). Therefore, zoonotic diseases are on the rise (K. E. Jones et al. 2008). Bhushan (2020) writes: "It is, therefore, not surprising that all the global outbreaks in recent history—Severe acute respiratory syndrome (SARS)[222] the Zika virus, and the Middle East respiratory syndrome (MERS)—are zoonotic diseases; these viruses have moved from animals to humans" (Bhushan 2020).

Seen in this light, a pandemic is an externalized cost of our current economic system:

> The private decision to convert land at the edges of wildlife refugia may, for example, be driven by relative land prices, property rights and land access regimes, alternative employment opportunities, agricultural product markets and so on. The private decision to import risk materials similarly reflects relative product prices, shipping costs, exchange rates and the like. In all such cases, the risk to society depends on a private

[219] Viruses and the diseases caused by them have different names, as the WHO explains (WHO 2020b).

[220] "A disease that infects humans but originally came from other animals. (…) Some zoonotic diseases, such as Zika and malaria, cannot be passed from person to person without an animal host" (E. Ross 2020).

[221] See also *Big Farms Big Flu* (Wallace 2016).

[222] See also Wilder-Smith, Chiew & Lee (2020).

> calculus—whether the private benefits of a risky activity outweigh the private costs. (Perrings, Levin & Daszak 2018: 242)

COVID-19, similar to other coronaviruses like SARS and MERS, is believed to originate from bats (Ye et al. 2020); bats are a common virus host (de Jong et al. 2011; Schneeberger & Voigt 2015; Fan et al. 2019) and are considered a "reservoir" of coronaviruses (Fan et al. 2019), which then pass via host animals such as livestock to infect humans (K. G. Andersen et al. 2020). The host animal linking bats and humans in the case of COVID-19 is still unknown. In the case of MERS, these were dromedary camels (Cabalion et al. 2018). This spark risk combines with the spread risk which is increasing with globalization and urbanization, that is, the inter-connectivity between (mega)cities. The "threat of ecological destruction has long been a problem, but the alienation afforded by industrial production has allowed most of us to ignore the problematic and reside smugly within the illusion of mastery over nature" (Irwin 2010: 27).

In the following, I take a closer look at how this might have worked out in the particular case of transmitting COVID-19 from Hubei to Northern Italy. COVID-19 was first identified in late 2019 (hence its name) in Wuhan in the province of Hubei, China, a manufacturing hub of the global economy in the areas of automobile, iron and steel, petrochemical, food processing, equipment manufacturing, electronic information, and textile (Fei & van de Bovenkamp 2015), hence sometimes referred to as the "Chicago of China." "Fashion and the apparel industry are traditional industries in Wuhan. Wuhan houses the largest garment production and distribution centers in Central China, owing to its well-established garment sales network and unique geographical location" (Fei & van de Bovenkamp 2015). From there, it spread following the expected logistic[223] pattern of viral transmission[224] with a doubling time of *confirmed* cases of between two and ten days (OurWorldInData.org 2020) (although this may say more about testing regimes than about the actual state of affairs). While the COVID-19 cases under treatment in China peaked around mid-February 2020, the center of the outbreak moved to Northern Italy in Europe, where clusters of cases were detected in the Lombardy region (Wikipedia 2020c) in mid-February. John Hopkins University has become the global source for updated numbers regarding confirmed cases and deaths. There is no unified way of defining Coronavirus deaths. Some countries do post-mortem testing and account for all deaths with a positive test as Corona deaths, in spite of comorbidities (JHU 2020). Case fatality rates are notoriously difficult to determine (Battegay et al. 2020) as they are most likely overestimated by orders of magnitude due to the chosen testing

[223] Also called epidemic curve; an S-shaped curve which looks like an exponential curve at the outset but flattens out as the total population size is reached. Important: virus spread is not exponential (Sanderson 2020; R. Baldwin 2020).

[224] The medical term for passing on the virus between humans.

strategies[225] of only testing individuals with significant symptoms that many countries (except Korea and Iceland) have reverted to in the initial months of the outbreak. In the case of COVID-19, it is especially true that "there is no such thing as raw data" (Gitelman & Jackson 2013).

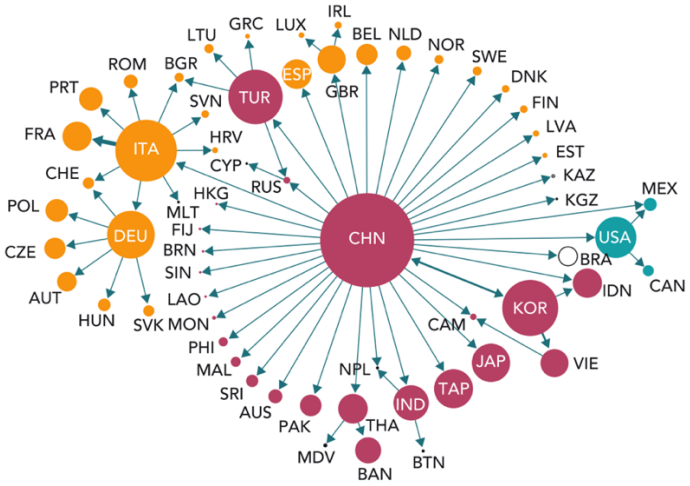
The overall case fatality rate may be somewhere between 0.25% and 3.0% of *diagnosed* cases (Wilson et al. 2020) across age groups. This is significantly higher than the common seasonal flu, and at the same time, COVID-19 is believed to be more communicable if it is assumed that no immunity exists in populations and 60–70% could therefore be infected over the course of some years (FAZ 2020). Thus, even case fatality rates of below 1%, as in Korea, would cause the death[226] of a significant number of individuals if 60–70% of the globe were to be infected, which is considered to be the level of infected individuals needed reach herd immunity (Wieler 2020).

Infections probably arrived in Europe via multiple networks of transmission. Based on incubation times and the time of first deaths in Italy, the virus was most likely around from early January, long before it was detected. The Lombardy region, particularly the provinces of Lodi, Cremona, and Bergamo have the highest case rates in Italy as of March 20, 2020 (Beige 2020c; Wikipedia 2020c, based on protezionecivile.gov.it 2020); these provinces are part of the Po plain, one of Europe's largest industrial clusters (Harrison 1997). Apart from the fact that Italy has one of the oldest populations in Europe, which can explain part of the higher case fatality rate compared to other European countries, Wuhan, or Korea, international supply-chains can contribute to understanding the heavy toll of the virus particularly in Italy: In the global supply chains, for example in textile, Italy acts as a subcontractor to China that is the center of fast fashion supplies of "the Western world" (Johanson, Smyth & French 2009; Lan & Zhu 2014; Ceccagno 2015). More than 300,000 Chinese citizens live in Italy, not counting illegal migrant workers (Wikipedia 2020a, based on Istat 2014). Most of them are employed in or entrepreneurs of the garment sector (Ceccagno 2003), where they produce "made in Italy" clothes in the textile industrial cluster of the Po plain (Chen 2015). Figure *Figure 9*-2 shows the strong Italy-China connection in the textile industry.

[225] Testing strategies are notoriously difficult to formulate—how to test during the period of time where distribution is growing significantly, and tests cannot follow that growth because testing resources are limited? The problem also arises that testing might give the impression that the peak of daily new infections is reached; instead, it might rather be the limit of testing capacities that is reached. See also (Beige 2020b).

[226] total, not annual, if compared to deaths from air pollution – I will get into this in more detail on the following pages

Figure 9-2 Interconnected hubs in the world's supply chain for textiles.

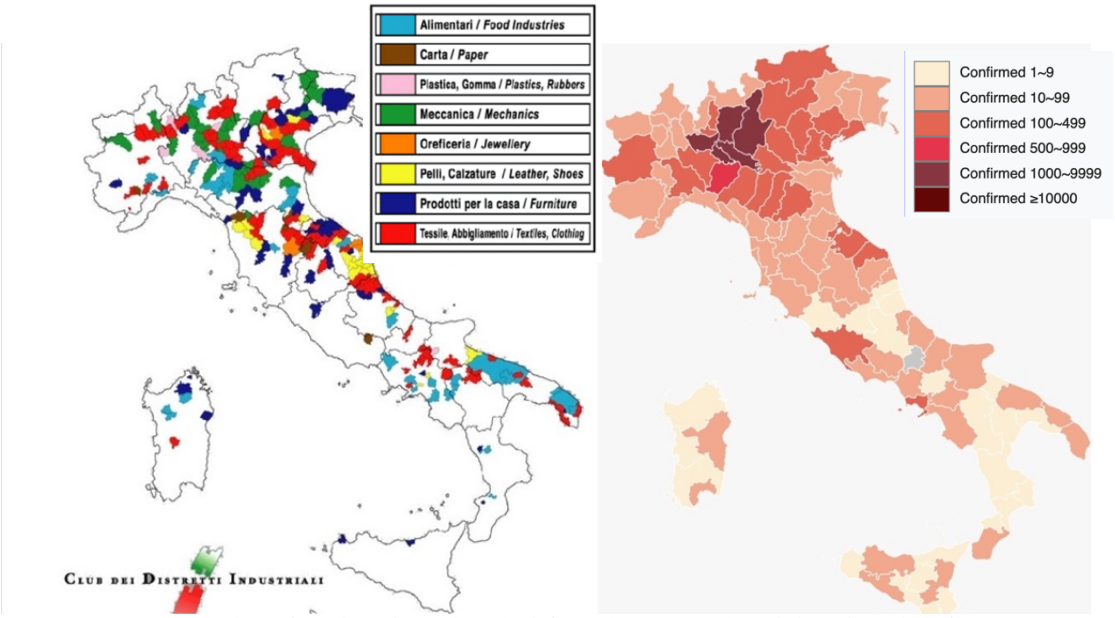


Source (R. Baldwin & Tomiura 2020: 63) reprinted from (Li, Meng & Wang 2019: 28) p. 28 based on (Meng et al. 2019). CC BY 4.0.

It is well-known that (textile) trade routes and pandemics go together,[227] also historically. It is believed that the Black Death originated in or near China. It then followed the Silk Road throughout the Middle East, "eventually entering Europe through trade routes from Italy" (Clamp 2020). Trade routes are infrastructures not only of goods, but of pandemics too (Kimball 2016). With its key role historically in trade routes, Italy also has a long history of experience with handling epidemics. Literary examples point towards Italy, too: The German writer Thomas Mann named cholera the "death from Venice" and the Danish author I. P. Jacobsen wrote about "the plague in Bergamo" (cited in J. R. Christensen 2015). Even the word 'quarantine' "comes from Italian 'quarantino' derived from 'quaranta' which means forty (Sehdev 2002). It refers to the number of days that ships were quarantined in order to fight pandemics, especially in Mediterranean seaports. Figure 9-3 shows reported cases of COVID-19 as of mid-March and the industrial clusters of Italy. The concentration of industries in the Po plain of Lombardy in Northern Italy corresponds to the regions with the highest registered cases of COVID-19.

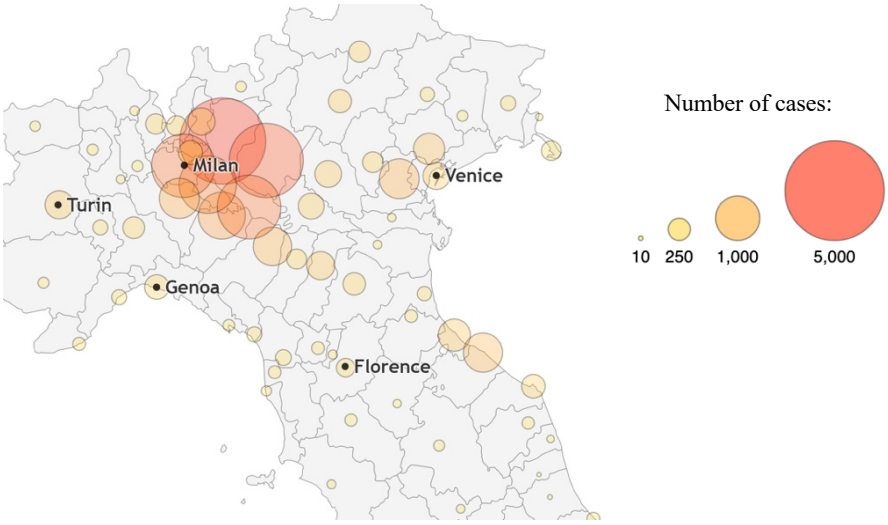
[227] Following the textile industry supply chains is also in line with the outbreak in Romania. More than one million Romanian citizens work in Italy (Gherasim 2020), a circumstance which is eased by the comparably low language barriers compared to other Eastern European countries because of the Roman origin of Romanian.

Figure 9-3 Italian industrial clusters 2001, & Covid19 confirmed by 14.03.2020.



Source: Beige (2020f) and Barberis (2009) (left map); Facquis (2020) based on data from protezionecivile.gov.it, (2020) (right map).

Figure 9-4 Spread of COVID-19 in Italy



The map shows the spread from the industrial cluster of the Po plain East and South East of Milan along trade routes to Venice and the port of Ancona as of March 15, 2020. Color indicates the number of cases. Source: Ashkenas (2020) and Beige (2020e); Data source: Dipartimento della Protezione Civile.

Figure 9-4 shows a map of Northern Italy. "Three dynamic patterns emerge: (1) local growth within region around the origin, the province of Lodi [south-east] of Milan (2) spread towards the [south east] along autostrada A35 to Modena & Bologna (3) spread towards the [East] along autostrada E35 to Padua & Venice" (Beige 2020a). From an old economics perspective, Coronavirus may be exogenous—but looking at these links, it is endogenous, that is, immanent to the system. It is an "infection of global supply chains" (Beige 2020a), or an example of what Anna Tsing calls "supply chain capitalism" (Tsing 2009: 148).

The Coronavirus has acted as a shock to supply chains, ringing true the words of Inge Røpke to "never draw an intersection between two curves [as a new economist]" (Røpke 2020: 6, cited in section 3.2.1.). Indeed, it is the materiality of supply chains that makes the supply and demand curve intersect—if at all. In the Coronavirus crisis this means: Never assume that supply chains work seamlessly. They can be the source of disturbance, as they have been at the outbreak of COVID-19 and continue to be as the lockdown measures disturb everything from toilet paper to food supplies (Torero 2020).

How did the virus reach the sensitive elderly in Italy? Apart from the fact that the business structure of Northern Italy is to a certain extent family-based (Harrison 1997), one possible pattern of transmission is that of intergenerational co-living, which is very common in Italy (Manacorda & Moretti 2006). At the same time, Italy has one of the highest overcrowding rates[228] of the OECD (OECD 2020a), which arguably increases intergenerational at-home transmission and, thereby, the case fatality rate. This suggests that the virus first spread unnoticed among the younger, working population (asymptomatically, that is, not showing any, or not many, symptoms) working in the Po Plain industries, who then went home to smaller towns with high concentrations of elderly people, where they infected their parents and grandparents (Bayer & Kuhn 2020). Dowd et al. (2020: 1) call this "the social connectedness of older and younger generations." The WHO confirms that quarantines in Italy could have acted as "additional sources of contamination and dissemination of the disease" (WHO 2020a), because the outbreak peaked before it was even detected (Cereda et al. 2020). The genetic composition of SARS-CoV-2 may also have contributed to the severe impact on Italy, compared to Germany, where the virus is also believed to have arrived in January 2020, directly from China via employees of the company Webasto that has offices in Munich as well as Wuhan. One

[228] This indicator follows the EU-wide agreed definition of overcrowding (Eurostat, 2016): "A household is considered overcrowded if it does not have at its disposal a minimum number of rooms equal to: one room for the household; one room per adult couple in the household; one room for each single person aged 18 and over; one room per pair of single persons of the same sex between 12 and 17 years of age; one room for each single person between 12 and 17 years of age and not included in the previous category; one room per pair of children under 12 years" (OECD 2019).

speculation is that there are two genetic strands: one Type S "silent" form, which is benign in the working population, hence notoriously difficult to detect and therefore lethal for the vulnerable and elderly with comorbidities, while the more aggressive type L is more easily detected also among the younger population and, therefore, easier to contain (Koyama, Platt & Parida 2020). Italy may have (had) a large amount of infected people in the working population without symptoms, which is confirmed by the case of the town Vo' where full population testing has been done (Cedrone 2020; repubblica.it 2020). In summary, a preliminary summary of the spread factors of COVID-19 are:

(1) global supply routes of tier suppliers (in the case of Italy, tier suppliers of the textile industry;
(2) frontline workers in the "offline economy" (i.e. logistics);
(3) Intrafamily intergenerational transmission (Beige 2020g);
(4) "EasyJet" flight routes like skiing holidays to Tirol that spread COVID-19 to, for example, Denmark.

THE SOCIO-MATERIAL PRODUCTION OF RISK

The measures taken to dampen the spread of the Coronavirus outbreak pose the question: If such radical measures that were deemed impossible for decades are possible in response to Coronavirus[229], why not with climate change? Fossil fuel use is today the single highest health risk factor, globally accounting for more than 5 million statistical lives lost[230] annually (Lelieveld et al. 2020), equivalent to around 10% of all annual deaths[231]. Like Coronavirus disease (COVID-19), air pollution due to fossil fuel use enters the body via the respiratory system. As noted above, COVID-19 cases are comorbid with existing respiratory diseases. Seemingly, the best way to avoid death from Coronavirus is to avoid respiratory diseases—which is equivalent to ensuring cleaner air, by stopping the burning of fossil fuels.

The discrepancy between action in the two cases is usually explained psychologically: "When mortality is attributed to a risk factor such as air pollution, the relationship is statistical but not distinctive (unlike car accidents where excess mortality relates to persons who can be identified" (Lelieveld et al. 2020). Deaths due to fossil fuel use cannot be compared to because they are statistical lives, not "real lives" with names

[229] Just to mention a few, people now actually stay at home instead of going to the office when sick instead of coming to the office to prove their protestant work ethic (Weber 2016); videoconferencing is taking over travelling, and sneezing into your sleeve and washing hands have become common sense.

[230] Also called excess or premature mortality, a number determined using dose-response functions.

[231] Based on 2015 numbers: 54 million died in 2015 (Ritchie 2019). Regarding death of fossil fuel use, see also EEA (2019); Sundheds- og Omsorgsforvaltningen (2020); OurWorldInData.org (2007); Lelieveld et al. (2020).

and death certificates, and as climate change impacts seem distant in time and space for many in the developed world, we perceive them differently from "immediate deaths" from an infectious disease. While these mechanisms certainly play a significant role, they cannot exclusively account for the inaction in regard to energy transition and climate change issues: The psychological immediacy of someone dying in a wildfire in Australia caused by climate change as attested by attribution science (Oldenborgh et al. 2020)—although the person does not have "climate change" stated on their death certificate—should be just as immediate as the psychological effect of a family member dying of Coronavirus. Still, wildfires have not caused Australia to implement significant policy changes. Therefore, the action gap still remains: *Why is Coronavirus, more than other problems, a reason to for biopolitical short term measures and expansionary fiscal policy long term measures? Why is Coronavirus's risk perceived so much more seriously than other dangers?*

In the case of Coronavirus disease, risk is constructed through the "standard narrative" of a pandemic. I have added footnotes to the following "generic plague narrative" of J. R. Christensen (2015):

> The numbers of deaths are stated, the source of the pestilence is given, symptoms of the plague are described[232] […] People fear infection[233], and they distrust other people as they are regarded as bearers of contagion[234], and so are animals[235] and travelers[236]. Travelling is regarded as danger. On the other hand, people themselves seek to escape from the plague, but official measures mean that they can be incarcerated in their own homes. Other official, administrative measures are part of the formula, but it may also be the case that the public administration fails and society as a whole may collapse[237]. The fatal seriousness of the plague epidemic is stressed in

[232] The symptoms as described by the WHO are repeated on all communication channels.

[233] As expressed by bulk-buying of toilet paper, pasta tinned foods, and disinfectants.

[234] Racism rises due to COVID-19 (Zheng, Goh & Wen 2020).

[235] Animals play a central role in COVID-19 narratives: COVID-19 is most probably zoonotic and is genetically liked to bats: "The genetic sequence of the COVID-19 virus is similar to a coronavirus found in bats, so that may be where this disease originated" (WHO 2020c; E. Ross 2020); the first registered outbreak of COVID-19 is associated with a so-called wet market in Wuhan, the Huanan Seafood Wholesale market (WHO 2020c; Wikipedia 2020b); pets can be infected with COVID-19 (Sit 2020); pets are being abandoned and die in China due to COVID-19 (Kim 2020).

[236] As exemplified by border closings of the European union and the closing of Schengen borders within the EU, even though this is not in line with IHR regulations (Habibi et al. 2020)

[237] As it happened in Italian prisons (Hume 2020).

> descriptions of how cures do not work[238], and the final and terminal icon of the plague narrative formula is the mass grave or the pit.[239]
> (2015: 27)

As detailed in Chapter 6, scientific knowledge is co-constructed in an interaction between the material, the researcher, and the thought collective, and this goes for the assessment of health risks as well. What would the protoconstructivist Fleck, who specialized in infectious diseases, make of Coronavirus? Exactly that: the disease is constructed, and that these constructs are performative, that is, real in their effects on the world. This does not make a disease any less "real," but its reality is conditioned. In the case of syphilis, Fleck's case study, many of the same factors as those at play today interact in the construction of the disease entity. In the following narration of Barbara Herrnstein Smith, I have italicized these parallels.

> The Wassermann Reaction, he [Fleck] insists, is certainly a scientific fact; But that fact would never have been discovered if the *European public had not been so anxious* about syphilis; and they would not have been so anxious about the disease were it not for its ancient religious- metaphoric-emotional status […]. (Fleck notes that *tuberculosis, which claimed many more victims at the time, did not receive nearly as much attention*.) Nor would the reaction have been discovered if Wassermann, working in a state-supported research institute in Germany, had not been *pressured by a minister of health* who, aware of recent advances in experimental biology in France, was conscious of national honour. These *historically conditioned cultural anxieties and political concerns* operated together to make the sea*rch for a diagnostic test* for syphilis a significant scientific project in Germany at the beginning of the twentieth century. They also operated to provide a high degree of *public energy, popular interest and institutional support for its intensive pursuit*. […] To acknowledge, trace and specify the inevitable and indeed crucial operation of cultural, social and political forces in the development of scientific knowledge is not to claim (or charge or concede) that science is fundamentally biased, corrupt or in the service of power – though, of course, the effects of such forces are not always intellectually or socially benign either. (Herrnstein Smith 2006: 62, my italics)

How are pandemic narrative instituted practically? This can be understood by taking a closer look at short term measures, their origin, and legitimization: On March 11, the WHO declared that COVID-19 is now a pandemic (WHO 2020e). This was only possible because of an updated definition of what the term pandemic means, which

[238] For Coronavirus disease, there is no vaccine (Spinney 2020).

[239] As reported from both Iran (Borger 2020), Italy (Jankowicz 2020), and New York.

happened just before the H1N1[240] virus outbreak ten years ago. According to the latest definition, "an influenza pandemic occurs when an influenza A virus to which most humans have little or no existing immunity acquires the ability to cause sustained human-to-human transmission leading to community-wide outbreaks. Such a virus has the potential to spread rapidly worldwide, causing a pandemic" (WHO 2017). In this new definition, lethality no longer plays any role. Thus, virus infections with case fatality rates below one can also be counted as pandemics. This also explains why the term was used rather as a coercive measure urging countries to take stronger biopolitical actions on March 11: "We are deeply concerned both by the alarming levels of spread and severity, and by *the alarming levels of inaction*. We have therefore made the assessment that COVID-19 can be characterized as a pandemic" (WHO 2020e, my italics).

The WHO also makes recommendations regarding measures to be taken and co-develops national pandemic plans (WHO 2017; 2018a)—therefore, these are close to identical all over the world. These consist of hygienic measures[241] and some measures that are the same as against climate change: Travel less (do videoconferencing); work less (be at home with your children); stay at home (social distancing[242]), and, hence, consume less (especially cultural consumption that takes place in large groups). "If a State decides not to comply with the regulations or the guidelines, it might incur in reputational costs that may affect its relations with other States" (Villarreal 2016: 111). At the time of writing, this is observable in the case of Sweden, a country that has taken a different path. Nations that do not close schools are hence perceived as countries that "don't comply" and are criticized for taking "risky" road—this is the reputational costs that Villarreal talks about. These measures are perceived as "technical," as (Villarreal 2016) explains: "The issues that are labeled as 'technical' may enjoy legitimacy if they are decided in accordance with certain scientific standards and expert knowledge, even though they are not always the result of, and at times not even compatible with, democratic consensus, transparency, accountability and other elements that contribute to political legitimacy" (Villarreal 2016: 114).

An example of how risk is created in Denmark is the press conference of the Danish prime minister Mette Frederiksen, dressed in black, on March 11, 2020

[240] For more on the H1N1 decision of the WHO, see Dawood et al. (2012); Hanrieder & Kreuder-Sonnen (2014); Hanrieder (2020).

[241] Also effective against the spread of the "normal" seasonal influenza: frequent and thorough hand washing; staying at home when sick; sneezing and coughing protocols; and taking a bike, not public transport, in peak hours.

[242] "A preventive measure that encourages avoiding large crowds or small gatherings in tight places, keeping a distance from others and, for those with underlying health conditions, staying home" (E. Ross 2020: Social distancing).

(Statsministeriet 2020) when she announced "the lockdown of Denmark." The image of the head of Danish police Thorkild Fogde and the prime minister next to each other gives the session an aura of post-terror attack severity. In other regions, similar framing could be observed: As the French prime minister Emmanuel Macron said: "Nous sommes on guerre"—we are at war (LeHuffPost 2020). The German finance minister talked about the "bazooka" against Coronavirus (taz.de 2020).[243] A political commentator called the Danish actions regarding Corona a "militarization of Danish politics" (Mogensen 2020). Ludwik Fleck "notes that older views and metaphors of warfare in regard to disease and the body – 'invasion', 'attack', 'defence', and so forth, [...] [are] a relic […] of archaic ideas of demon-possession" (Herrnstein Smith 2006: 71).

Nations compete to be perceived as the most action-taking, similarly to the situation in the wake of terrorist attacks. Short-term measures are seen to be rather a symbolic action in the sense of Murray Edelman (1971). One such measure are border closures that countries must report and justify towards the WHO as the organization does not recommend them. In the case of Denmark, the minister of health reported following the advice of the European Centre for Disease Prevention and Control (ECDC) who in fact never recommended border closures (ECDC 2020; Heunicke 2020; Dahlin & Andersen 2020). The Danish prime minister was criticized for the closing of the borders by professor of public health, Lone Simonsen, by a former civil servant of the Danish health authority, Else Smith, and by the current head of the Danish health agency, Søren Brostrøm (Pagh-Schlegel 2020; Rasmussen 2020; Wang 2020) who pointed towards the lacking evidence for the effectiveness of border closures. The response of the Danish prime minister Mette Frederiksen was: "If we await evidence-based knowledge in relation to corona, we will simply be too late,"[244] (Ritzau 2020).

Villarreal (2016) criticizes the democratic deficit; D. Cohen & Carter (2010) show how the WHO pandemic decision-making organs are subject to corporate capture; Gostin, Sridhar, and Hougendobler (2015) describe the WHO as a "normative agency endowed with unprecedented constitutional powers"; Doshi (2011) uses the term "virus-centric thinking" about the WHO and writes: "Virus-centric thinking may heavily influence pandemic influenza planning because of the considerable weight of expert opinion. Disease experts are not necessarily competent to judge a disease's *relative importance* against competing health priorities" (Doshi 2011, my italics). The WHO was also criticized by the Council of Europe (Flynn 2010): The parliamentary assembly was "particularly troubled by some of the consequences of decisions taken and advice given leading to distortion of priorities of public health services across Europe, waste of large sums of public money, and also unjustified scares and fears

[243] For more war-related quotes from politicians regarding the pandemic, see Mudde (2020).

[244] "Hvis vi skal afvente evidensbaseret viden i forhold til Corona, så kommer vi ganske enkelt for sent, siger statsminister Mette Frederiksen" (Ritzau 2020).

about health risks faced by the European public at large." Virus-centric thinking means that no socioeconomic assessment of saving lives has been made.

Also in the Coronavirus crisis, the dominance of epidemiologists and virologists seem to inform the (initial) basis for decision-making. While I have no objections to their expertise, it seems that the lack of other advice results in policy-making that underrecognizes the side effects of the containment measures themselves. While this could sound like a call for classical cost-benefit analysis as it is performed by health economics as, for example, the *Financial Times* demand for a Chief Economist of the World Health Organization exemplifies (Donelly & Kickbusch 2019), it is not necessarily a simple reduction to economic calculation that is needed to broaden the scope of considerations. In a Fleckian phrasing, a strengthening of the outer circle of the thought collective is needed in order to revitalize the political decision-making process.

Coronavirus reconfirms the social science and humanities versus natural science and economics policy recommendation gap: Although Taster (2020) calls for social scientists to be "awake," social science has remained largely silent and/or unheard: "It might be that not many want to hear us [social scientists] out. We tend to make things more complicated. But we should keep trying because this is exactly what they are" (Beyer 2020). In the meantime, economists have already published a long list of reports containing policy recommendations, natural science publishers have removed their paywalls to make the stock of natural science research on COVID-19 growing daily publicly available, and Twitter is home to active discussions. Just as in Chapter 2 where I described the instrumentalization of the social sciences in interdisciplinary research, Hayley MacGregor notes:

> This outbreak has again revealed the tendency for shoe-horning of social science into significant but narrow operational questions related to how to enable containment, enforce behavioural change and adherence to public health messaging, and counteract 'misinformation' in risk communication. […] The danger is that the 'draconian' public health containment response becomes the unquestioned default reaction to this uncertainty, & that the difficult issues related to the social and ethical implications and trade-offs will receive inadequate reflection & scrutiny. (MacGregor 2020)

What prevents the focus on supply-chains as a cause of the crisis are the International Health Regulations (IHR 2005), a legally binding instrument of international law (WHO 2008): "The IHR (2005) seek to limit the public health measures taken in response to disease spread to those 'that are commensurate with and restricted to public health risks, and *which avoid unnecessary interference with international traffic and trade*'" (WHO 2017: 11). This quote suggest that it is the protection of "the economy" that is at center stage (here understood in the old economics paradigm sense of the word). This is also reinforced by the actors that the WHO draws upon: As the head of the WHO said on March 11: "We're working with the World Economic Forum

(WEF) and the International Chambers of Commerce (ICC) to engage the private sector" (WEF 2020; WHO 2020d). TRAC (2000) criticizes the UN as "tangled up in" corporate interest. The problematics of the International Chamber of Commerce and the World Economic Forum are well-known (Skodvin & Skjærset 2003; Carroll & Sapinski 2010; Garsten & Sörbom 2018). These cooperation partners indicate that decision-making is done inside the old paradigm economics thought collective.

Thus, the risk perception that urges action in the case of Coronavirus is the same risk perception that prevents action in the case of climate change. Although resulting in different actions, the underlying logic seems to be the protection of economic systems as we know them.

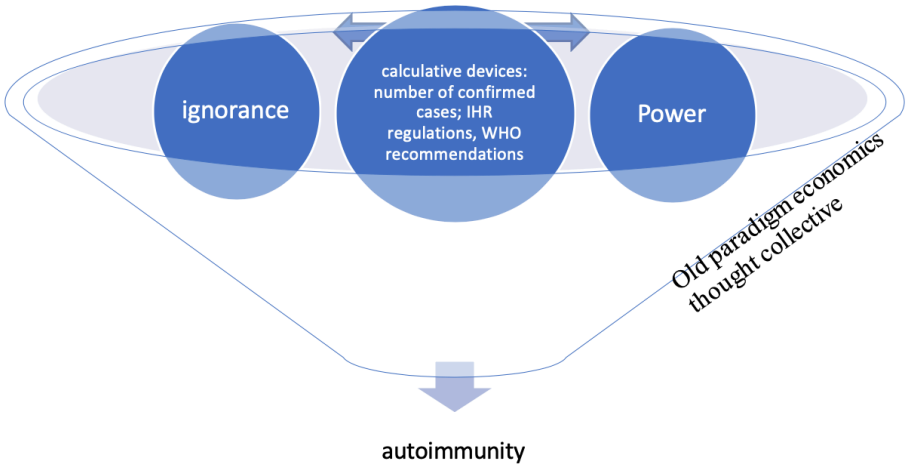
To conclude, virus-centric policy advice and a competition among states leading to symbolic actions beyond evidence-based measures create an acute perception of risk. Importantly, this construction of risk works so well because it is a risk *to the economy* that is mitigated. It enables the ignorance of the supply-chain origin of COVID-19. As shown in *Figure 9-5*, the calculative devices, a term I here use to describe both the reported numbers of COVID-19 cases and deaths, as well as the regulatory regimes of IHR and WHO, reinforce power/ignorance: The result is that the underlying causes of the pandemic are not recognized.

Because both COVID-19 and climate change mitigation measures are perceived as risks towards the global economy in its current form, taking severe action against COVID-19 and inaction against climate change are not contradictions, but in line with a perception of risk *as the risk towards the economy*, not as risks towards humanity.

Thus, we can conclude that global emergencies do matter—if they are compatible with, i.e. fall on the fruitful ground of, pre-existing interests. This reconfirms the urgent need for re-democratizing our institutions.[245] Thus, when old paradigm economic interests and the interests of human health are aligned, as in the case of COVID-19 short-term measures, it may *seem* like the precautionary principle is back; however, when one looks at the measures to counter the Coronavirus recession, it becomes clear that there is no such change in policy.

[245] I have not looked into the links between Italian mafia structures and the textile industry, but have come across some indications of such a link: Harrison (1997) describes a world where big business dictates the Italian textile industry and exploit tier suppliers. This process is aided by the Camorra mafia, as Saviano (2006, "The System" Chapter) describes: "The workforce in clan operations is highly skilled, with decades of experience under Italy's and Europe's most important designers. The same hands that once worked under the table for the big labels now work for the clans […] Which means that the clothes made by the clans aren't typical counterfeit goods…but rather a sort of true fake. All that's missing is the final step: the brand name, the official authorization from the motherhouse."

Figure 9-5 Power/ignorance in times of a pandemic



Pandemic-governing and risk-defining calculative devices reinforce the link between power and ignorance. The resulting long-term economic measures lead to autoimmunity: They pave the way to higher, not lower, risk of pandemics in the future.

POWER/IGNORANCE IN THE CASE OF CORONA

In my PhD research, I have hardly dealt with the original concept of biopower, but instead focused on the derived neologisms of infopower and energopower. The biopolitics and biopower that may have seemed like an exotic historical concepts to me at first have been turned into embodied experiences during with the disciplinary measures of the Coronavirus crisis. Biopower originates in the first volume of Foucault's history of sexuality *The Will to Knowledge* (Foucault 1978), where it denotes the rule over bodies, for example, in the sense of birth control or rules about abortion and sterilization.[246] Following Sarasin (2020), Foucault based his theorization of power on three different pandemics:

[246] Counterintuitively, it is mostly in *Security, Territory, Population* that Foucault develops the concepts of biopower and biopolitics (Foucault 2007) while "The Birth of Biopolitics" (Foucault 2008) deals with questions of neoliberalism and the market as a site of veridiction (Dean 2014: 6). Debates over whether Foucault endorses neoliberalism have been centered around "The Birth of Biopolitics"; for Newheiser (2016: 11) though, *The Birth of Biopolitics* (Foucault 2008) presents neoliberalism itself as a paradigmatic case of biopolitics.

1. The concept of Sovereign power was based on lepra, conceptualized as a form of Stigma-power where power separates the healthy from the ill. Developed in *Madness and Civilization* (Foucault 1965)

2. The concept of disciplinary power was based on the plague, developed in *Discipline and Punish* (Foucault 1995). As Michel Foucault expresses it, the plague summoned the model of disciplining:[247] "The moment of the plague is one of an exhaustive sectioning (quadrillage) of the population by political power, the capillary ramifications of which constantly reach the grain of individuals themselves, their time, habitat, localization, and bodies" (Foucault, 2003: 47). "Each individual is fixed in his place. And, if he moves, he does so at the risk of his life, contagion or punishment." (Foucault 1995: 195)

3. The concept of neoliberal power/governmentality was based on smallpox, developed in *Security, Territory, Population* (Foucault 2007).

These concepts have all contributed to the conceptualization of biopower. The infrastructural understanding of power that I have applied in case studies A and B is derived from a socio-material understanding. If power is stored in infrastructure, then those moving things along with infrastructure are certainly part of power structures—what is called logistical power by Gregson, Crang, and Antonopoulos (2017). Indeed, the emphasis of new materialism on non-human actors is particularly relevant in the case of a virus, which is not only not human, but is not even considered a living being.[248]

Mistakenly, the COVID-19 situation is perceived as a "rule of science" which should also apply in the case of climate change (Lau 2020). Although it may seem like that is the case in the short run, it is not the case in the long run, where measures taken are likely to result in more, not fewer, zoonotic pandemics (apart from the fact that there is, especially in a Fleckian constructivist perspective, never such a thing as "the science") (Bacevic 2020).

The power/ignorance framework seems applicable to the novel Coronavirus and the mitigation measures taken, because:

[247] "the plague gave rise to disciplinary projects" (Foucault, 1995:198); German translation: "(…) hat die Pest das Modell der Disziplinierung herbeigerufen" (Foucault, 1994: 252).

[248] "Viruses are not considered alive because they don't have the tools they need to replicate on their own. The flu, COVID-19, Zika and Ebola are all caused by viruses. Viruses cannot be treated with antibiotics" (Ross, 2020).

(1) Mechanisms enable certain aspects the Coronavirus to be seen (and others to be ignored);
(2) Power structures enable (in some places, strict and fast) reactions to it;
(3) The old paradigm economics thought collective carries this power/ignorance; and
(4) Calculative devices (numbers) and sociotechnical imaginaries (fear) seem to play a significant role in assisting power/ignorance.

One could perceive the tools of the World Health Organization for the governance of pandemics as calculative devices, as they define risk and measure impacts and set standards for procedures of testing regimes and other procedures. The role of calculative devices is omnipresent (numbers of tests taken, number of people tested positive, fatalities, numbers of intensive care beds in hospitals, number of respirators, numbers of facemasks, and liters of hand sanitizer are the important numbers at play; together with stock exchange developments, interest rates, and consumption and trade indices. The fear of what could happen can be understood as a sort of sociotechnical imaginary of negative expectations. In this way, the thought collective produces both a risk perception, as well as the measures to be taken against this risk. If the framework of the power/ignorance funnel fits, then the result is not a long-term improvement of the situation, but the autoimmunity of the measures taken: The actions taken become a springboard for a new wave of exactly that thing. Power/ignorance acts as a vehicle to promote a more-of-the-same tactic to overcome the Coronavirus recession. Such autoimmunity could for example emerge from an combination of low oil prices and "exacerbated […] competition in slowly recovering tourism markets, lead[ing] to price-driven competition specifically in the most energy-intense tourism subsectors, aviation and cruises" (Gössling et al. 2020: 14).

As shown in Chapter 7, power and ignorance are inseparably interlinked, and power cannot be removed just by removing ignorance. A death certificate stating the cause of death as "particle pollution from diesel exhaust" could be the ultimate calculative regime that would change our perceptions—but it wouldn't necessarily change action, as it doesn't change power. It is an irony that Coronavirus slows the economy in the most climate-friendly way. This will only get better, so to speak, when they get worse again (more air pollution deaths again). Instead, the pandemic-governing and risk-defining calculative devices coordinated by the World Health Organization interact with an old paradigm economics thought style present in both national and supranational governance bodies to produce power/ignorance.

LONG-TERM ECONOMIC STIMULI IN THE WRONG DIRECTION

When the social construction of risk is successful—Agamben (2020) talks about the invention of an epidemic, for example—it has severe economic and social implications because of spirals of negative expectations. Oil prices have crashed,

reaching even negative prices in April 2020, stock markets have broken down, and crypto-markets have also crashed (Bitcoin fell to half of its value on February 12, 2020). The economic impact of COVID-19 has already been enormous—in part, because many economies were already moving towards a recession before the virus outbreak. Hence, the COVID-19 shock was the final push and a shock to both the demand and supply side.

> The Corona recession is an unforeseen event that is impacting the profitability, and hence the risk profile, of Viking Link as the power prices in Britain have dramatically fallen during lockdown (Ambrose 2020; Mathiesen 2020). Jordà, Singh, and Taylor (2020) find that in the aftermath of pandemics, investment opportunities are depressed due to an excess capital stock—and that this effect could sustain for decades. That sets capital stock investments like Viking Link in a new light: Even using the criticized mainstream economic cost benefit calculation does not return such a good investment opportunity now, if reassessed, as it did before the Coronavirus crisis. Viking Link risks becoming a stranded asset (Hasberg 2020a)

Many voices call for Coronavirus to mark a fundamental change in economic policy making and societal development (Bär & Runkel 2020; Birol 2020; Dixson-Declève et al. 2020; Göpel 2020; Brian Vad Mathiesen in Hannestad 2020; Mazzucato 2020; Rockström 2020). Just as in the wake of the financial crisis, they call for not "letting a crisis go to waste," seeking to use it to steer society onto a more sustainable path (Kemfert 2009; H. Lund & Hvelplund 2012; Latour 2020)[249]. But this doesn't seem likely, based on first indications at the time of writing. "If the virus leads to a full-blown global pandemic and economic crash, it could easily drain money and political will from climate efforts" (Temple 2020). We could end up in a situation with "revenge pollution," as Li Shuo, a senior climate policy adviser for Greenpeace East Asia, calls it in Wright (2020). In old paradigm economics, things only turn good when the air quality turns bad again, as we return to "business as usual" (MacFarlane 2020). This is despite the fact that, possibly, as many as 50,000 statistical lives were saved in China (M. Burke 2020) due to reduced air pollution caused by Coronavirus containment measures; pollution also plummeted in the Lombardia region (Mooney et al. 2020).

Strong lobby efforts are exerted by the "fossil fuel, motor, aviation, farming, plastic and timber sectors" (Carrington 2020; Hurowitz 2020; Corporate Europe Observatory 2020) and by tech companies (Field 2020) who have benefitted from the increased digitization during the pandemic. At EU level, car makers are exerting pressure against stricter carbon emission rules for vehicles (Balser, Michael & Beisel 2020), and agricultural business lobby for softer pesticide restriction due to COVID19 by

[249] See also Røpke (2016) who calls for an ecological macroeconomics as crisis response.

delaying the so called "Farm to fork strategy" (EEB et al. 2020). Old economics paradigm advise on how to save firms from insolvency dominates in advisory bodies, as documented by the non-governmental organization LobbyControl in the case of Germany (Sinn 2020; Lange 2020).

As a result, fossil bailouts are ubiquitous: Sweden is supporting it's airline (SVT 2020), Norway it's oil industry (Exarheas), and the US it's fracking industry (Siegel 2020; Deaton 2020) and Germany it's car industry (LobbyControl 2020).[250] At the same time, in Germany, regulation making the growth of renewables impossible has been kept in place: the wind turbine distance regulation and photovoltaics 52 GW maximum installed capacity rule continues (BEE 2020). Power/ignorance seems to be inducing long-term measures against the coronavirus recession that will result in autoimmunity, that is, an even stronger persistence of carbon lock-in. The economic measures to alleviate the Coronavirus crisis will lead to more, not fewer, pandemics in the future. This is the reversal of cause and effect: Fighting a problem with what caused it in the first place. The situation is similar to the yoyo-effect of dieting, where there are short-term measurable results, but in the long term, its impact is harmful and the weight lost will be more than gained again, preparing for yet another round of dieting.

DATA ETHICS AND A RE-DEMOCRATIZATION OF DECISION PROCESSES

As already discussed in the concluding section of the cover essay, the power/ignorance mechanism requires re-democratization of decision-making processes. This is in particular true in the case of zoonotic virus pandemics like COVID-19, where we have seen frequent use of biopolitical measures, both the ones induced by epidemiological evidence, and particularly those beyond, like border closures (Igum Rasmussen & Bredsdorff 2020), and hasty law-making without the full information of the parliament, as happened in Denmark (Löfgren 2020; Kildegaard & Borre 2020; Skovgaard Andersen 2020; Dahlin 2020a; 2020b). While measures are taken on the basis of health, the hasty adoption of biopolitical measures without recourse to democratic processes could likewise harm democracy (Rose 2020; Schlott 2020). In China, the surveillance capitalism of Coronavirus is likely to fortify the linkages between health and environmental governance and surveillance already established (Kostka, Zhang & Shin 2020). In the US, monitoring wearables communicating health data to insurers could become a reality (Perakslis & Coravos 2019) legitimized by the *extraordinary times*, a term that is repeated when democratic processes are short-circuited in the name of pandemic mitigation. In both Denmark and Hungary, punishments for various crimes have been increased; the production of

[250] Hildegaard Müller (2020), president of the German Association of the Automotive Industry, has called for state support measures that may be implemented after a summit of the German government and the automobile manufacturers on May 5th, 2020.

so-called fake news about Coronavirus is now a more severe crime (Danish Parliament 2020; Hungarian Parliament 2020). For example, closing down a website in Denmark now doesn't require a court order (Marcher Hansen 2020), and "Scaremongering" about COVID19 can be punished with years of jail in Hungary (Polyák 2020). Amat et al. (2020: 25) summarize how the pandemic might endanger democracy:

> the [pandemic] shock opens a window of opportunity for would-be authoritarian leaders and institutions to seize and centralize power, limit checks and balances and increase population control and surveillance. In the first stage they will not encounter resistance from the public [this is the result of Amat et al., based on survey data from March 2020], and then the authoritarian turn may outlast the pandemic[]. (2020: 25)

THE SOCIAL DOWNSIDE: PAYING THE PRICE OF COVID-19 MEASURES

Who are the ones suffering the consequences of the virus and not necessarily benefitting from the economic measures taken? Under COVID-19, it remains true that inequality kills (O. Jones 2020). The homeless are criminalized during lockdowns if they are found in the streets, and their usual food supplies may no longer be able to provide food (Tsai & Wilson 2020; Tafel Deutschland 2020). In Italy, a riot in prisons in response to tightened regulations led to the death of seven prisoners (Lazzerini & Putoto 2020; Hume 2020). In the refugee camp Moria on Lesbos with more than 20,000 people, the first COVID-19 infections have been registered (Iacobucci 2020) yet no evacuation is planned, and the entire EU has closed its borders towards non-EU citizens. An outbreak in the Rohingya refugee camp in Bangladesh's Kutupalong-Balukhali site with more than 1 million inhabitants would have serious impact (Truelove et al. 2020; Vince 2020). Coronavirus attacks the workers of the "offline economy" as (Beige 2020a) puts it. This may remain difficult to detect during the outbreak, because "tourists go to the doctor, supply chain workers don't" (Beige 2020h). Gig economy workers do not have the luxury of self-isolating (Ongweso & Koebler 2020; Ustek-Spilda et al. 2020), and neither do people driving buses, working in supermarkets, cleaning, or caring: They cannot "work from home." There is a high concentration of migrant labor in logistics (Cuppini et al. 2014: 11). Excessive fear, stigmatization, and xenophobia are likewise psychological effects of pandemics (Taylor 2019). Coronavirus shows that the work of the "service class" has until now been unnoticed while well-functioning; but upon breakdown, it is noticed, like infrastructure (Leigh Star 1999: 381). Andreas Reckwitz even calls jobs like cashiers in supermarkets "infrastructure jobs"[251] (Piorkowski 2020).

[251] Own translation from German: "Infrastrukturberufe."

Madhav et al. (2017: Spread Risk Section) note that "collectively, all these factors suggest that marginalized populations, including refugees and people living in urban slums and informal settlements, likely face elevated risks of morbidity and mortality during a pandemic." Like other economic crises (Kantola & Lombardo 2017) this too, has gendered consequences: In Germany, 24 male and 2 female scholars recommend that daycare stays closed until the end of August 2020 (Leopoldina 2020); 34 female scholars responded with why that was a bad idea (Allmendinger et al. 2020). Women bear the workload of self-quarantine due to COVID-19, as they remain the primary caretakers, both of children and of the elderly in Western heterosexual couples. Now, predominantly women have to coordinate home-schooling while continuing to work from home (Wenham et al. 2020).[252] In *The Atlantic*, Susan Lewis (2020) titles: "The Coronavirus is a disaster for feminism." In China, where data is already available, quarantines have meant a rise in domestic violence, and NGOs warn against similar developments in Europe, for example in Denmark (Kretschmer 2020; Brock & Jessen 2020).

In a way, COVID-19 shows how we are reaching the biophysical limits of growth, what Beige (2020d) calls "an overstretching of the capitalist infrastructure." "We can't operate without a physical world" (Beige 2020f), but it seems that, until recently, we had forgotten that our garments need to be produced, our food delivered, our shops kept open, and indeed, that our ill, old, and vulnerable be treated using capacity that, like firefighters, should ideally sit idle most of the time. The online world had forgotten about the offline one. Again, it is power/ignorance that makes sure we fail to diagnose the problem. Therefore, the old paradigm economics prescribes more-of-the-same as the cure to the Coronavirus recession. However, "you would need the sort of systemic overhaul that would result in real policies that could stimulate economies from the ground up. For the present, wash your hands, don't touch your face, and hold your breath" (Prins 2020).

A "social recession," a term coined by writer Ezra Klein (2020), is a significant *unintended consequence* of COVID-19 in the sense of Ulrich Beck (U. Beck 1686). It may exacerbate the existing loneliness, particularly for elderly and ill (Larsson, Rämgård & Bolmsjö 2017; Banerjee et al. 2020; NAS 2020), although "we don't know the dose-response rate for loneliness and isolation" according Paula Perissinotto

[252] The regulation of Aalborg University (Jørgensen 2020) during COVID-19 reflects how the average employee in research, as many other professional fields, is based on a non-child-caring stereotype, what Salminen-Karlsson et al. (2018) call a "construction of masculinity" (2018: 57) as discussed in section 2.3. In such a perspective, having childcare responsibilities is treated as a special case, even in the extraordinary situation when both schools and daycare institutions are closed: "Employees should, as far as possible, work the usual hourly rate if sufficient tasks may be solved from home," as Aalborg University writes to their employees. "Should challenges occur in relation to working at home, such as caring for children, employees must discuss with their immediate manager how the work can be organised in a flexible way, so that both children and work can be looked after" (Jørgensen 2020).

(in Klein 2020). If pandemics become more common, or of long duration as expected with the COVID-19 pandemic (Wieler 2020), will social distancing protocols stay in place? One can legitimately ask if four months in isolation as suggested for British seniors (Sparrow 2020) is a worthy life for anyone—but particularly somebody above the age of 70 with pre-existing diseases. Dying in loneliness (not necessarily of Coronavirus, but due to old age and pre-existing conditions) is already on the rise globally.

As the Danish philosopher Anders Fogh Jensen (2011; 2020) argues, pandemics measures generally and the Coronavirus measures specifically reduce our concept of life to mere extension of life [livsforlængelse] and survival [overlevelse], turning us into "zombies that are too alive to die and too dead to live" ["Ellers bliver vi til zombies, der er for levende til at dø og for døde til at leve"] (Fogh Jensen 2020: Introduction Setion]. For example, you can cross an EU border to go to work, but not to see your family member. Our being is reduced to mere productivity, making us evermore a standing reserve in a Heideggerian sense. Even our protocols of dying in dignity and making room for the mourning of those bereaved are disrupted by the disciplinary measures of biopower during pandemics: The ill cannot be visited, burials cannot take place (Amante, Hafezi & Choi 2020).[253] How ironic, given that those people who want to mourn are most likely those who passed on the disease to the elderly and vulnerable in the first place (through intergenerational transmission, as suggested above). They are most likely already immune to the SARS-CoV-2. If we do not return to real-life social routines but remain "online" and physically-socially distanced,

> life will become 'hearthed' or 'homeized' (we already need to start thinking up neologisms). Schools too will disappear with the use of devices like Skype, students will be able to attend their teachers' lessons from home. This generalized seclusion caused by the epidemic (or rather, by attempts to prevent it) will become our habitual way of life. (Benvenuto 2020)

[253] On a side note: Could it be that the difficulty in recognizing the finitude of planetary resources and the finitude of our own lives somehow go hand in hand? Over-treatment of chronically seriously ill, and/or very old patients (Lenzer 2012; Zilberberg & Shorr 2012) seems to be a problem in Western societies: "Physicians are trained to believe that staving off death, even if only for days, is their overriding mission, and all available technology should be employed to achieve that goal." (Lenzer 2012). "Letting people die" is described as inhumane—although, death could also be seen as a "merciful angel," as Noonan (2013) writes about the notion of a "good death" in palliative care: "If there can be no more good in life, then best that it end peacefully."

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APPENDICES

The Appendices B, C, D, E, F and G contain supplementary material which supports the argument of the body text of this cover essay and the three articles and provides documentation of the research process. The Appendices H, I and J contain the three articles that this cover essay is based on.

Appendix A. Dictionary of terms

In the following, OED indicates that the definition is cited from Oxford English Dictionary for Mac OS, Version 2.3.0. Underlined words mean that the word has an entry in this dictionary.

AAU	Aalborg University, Denmark.
AAU TECH	Technical Faculty of IT and Design, Aalborg University.
Actor-network-theory (ANT)	A social theory and method typically attributed to the Science and Technology scholars Michel Callon, Bruno Latour and John Law. It emphasizes that neither the social nor the material is hierarchized over the other. Therefore, it is also called a material-semiotic approach as it perceives networks as relations between both things and symbols.
aggregator	New actor that pools smaller consumers and producers and markets their power or flexibility on (local) power and flexibility markets. For example, aggregators could pool local district heating plants and sell their flexibility to a distribution grid operator or buy electricity for them in windy hours.
algorithm	A set of well-defined, sequential instructions for problem solving, usually as part of a computer code.
ANCAP	Anarcho-capitalism. A political philosophy built on a belief in market fundamentalism and the elimination of state power. See also crypto anarchism.
anthropocene	Current geological age during which human activity is the dominant influence the planet. Combination of 'anthropo-,' of a human being, and '-cene', from Greek 'kainos,' meaning 'recent,' used in designations of geological epochs.
APC	Author Processing Charges that academic publishing houses ask scholars to pay in order to make their work open access.
arbitrage	Trading across a price differential, that is, between a higher priced and a lower priced area, leading to a convergence of prices in the two areas. See also price discrimination (third degree).

arbitrage rent	Gains of arbitrage. Also called congestion rent when referred to congestion rent. Danishism: bottleneck gains, from Danish: 'flaskehalsindtægter.'
Ariadne's thread	From Greek mythology. Refers to a life-saving thread that Ariadne gave. Theseus which enabled him to find his way out of a labyrinth by back tracking the way he came in, using the thread (OED).
arrival story	A tool in ethnographic writing introducing how the author came to study the field, or topic, at hand. This "'I was there' element" (Herndl 1991: 325) is used to "give authenticity to the findings" (Aull Davies 2012: 11) and to establish "a particular kind of subjectivity of the ethnographer, which establishes her as able to know and speak about her object" (Beaulieu 2004: 152).
astroturfing	The deceptive practice of presenting an orchestrated marketing or public relations campaign in the guise of unsolicited comments from members of the public. From AstroTurf, a trademark name of an artificial grass surface used for sports fields. the idea being that such a campaign is an artificial version of a grassroots campaign. (OED).
asymptomatic	An infection without symptoms (Ross 2020).
attribution science	The new science of attributing weather phenomena to climate change (Otto 2020).
Austrian economics	An economic school of thought within neoclassical economics emphasizing methodological individualism and market fundamentalist arguments. Sees economic dynamics as evolutionary processes leading to the survival of the fittest" (economic actors).
auto-ethnography	When researchers study what they themselves do, and the meaning they believe their doings and sayings have (Eriksson 2010: 93). See also self-ethnography.
Autoimmunity	A Derridian term denoting self-destruction of systems. Derived from the biological notion of autoimmunity, meaning the attack of body cells by the body's own immune system.

Balmorel	An energy system model used by the Danish Energy authority.
Baseload	Used as shorthand for baseload electricity or its generation units. Characteristic of baseload is that generators cannot change their power output quickly or in response to changes in demand.
BAU	Business-as-usual scenario used in cost-benefit-analysis.
BFI	Bibliometric Research Indicator (BFI), from Danish: 'bibliometrisk forskningsindikator'
BID	Better Investment Decisions, is the energy system model used by Energinet.
Big Four	In a German context, denoting the four large utilities in Germany EON, ENBW, Vattenfall and RWE.
Big Oil	Large oil companies, typically including BP, Chevron Corporation, Eni, ExxonMobil, Royal Dutch Shell, and Total.
Big Tech	Large digital technology companies, typically Google, Apple, Facebook as Amazon (GAFA).
biopower	A Foucauldian notion of power denoting the subjugation of bodies and populations to state power (Foucault 2008).
bit	The smallest unit of information storage. The bit stores information as a 0 or 1.
Bitcoin	Cryptocurrency launched in 2009 based on the whitepaper by Satoshi Nakamoto.
bitcoin blockchain	The blockchain network on which the bitcoin cryptocurrency runs
block	Group or package of bits of data on a blockchain.
block size	The size, in bits, of a block of a blockchain. Has been subject to severe controversy in the bitcoin community, leading to a fork.

Blockchain technology	Distributed ledger technology based on peer-to-peer networks, cryptography and game theory.
Bobchain	As a pun on the term blockchain, a satirical depiction of our current centralized information infrastructure. Bob, along with Alice, are names typically used by computer scientists to refer to a generic actor instead of simply using the letters A and B.
bot	Shorthand for social bot, derived from robot. Originally denoting a machine resembling a human, the term 'bot' is used about automated social media posts that are generated by a piece of software (see code).
bottleneck (electricity)	Point in electricity system that is not a copper plate, that is, where the electric capacity of the grid cannot accommodate indefinite amounts of electricity transmission.
bottleneck (information systems)	As in electric network planning, a bottleneck occurs when a node, for example in a client-server system, is overloaded and cannot handle all requests. Peer-to-peer systems avoid bottlenecks because information can be re-routed.
bottleneck gains	Danishism denoting the arbitrage rents gained from cross-border trade. From Danish: 'flaskehalsindtægter.'
Brexit	Britain's exit from the European Union.
BTC	Shorthand for Bitcoin, used on cryptocurrency exchanges in the same way as USD is used on currency exchanges.
business case	Used by Energinet instead of 'cost-benefit analysis.' A business case normally denotes a business-economic calculation showing whether a new product or line of business is potentially profitable.
calculative device	A term coined by Callon and Muniesa (2005) denoting performative tools of (economic) modelling and assessment.
cannibalization	Cannibalization refers the fact that a new interconnector between two price zones reduces the congestion revenues of pre-existing interconnectors across the same price zones.

capacity	Capacity is defined as the maximum electric output an installation can produce under specific conditions, measured in multiples of watts like gigawatts (GW) or terawatts (TW), that is, units of electric power.
carbon democracy	A concept of Timothy Mitchell denoting the “political machinery that emerged to govern the age of fossil fuels” (Mitchell 2009: 401).
cash cow	A (part of) business that provides a steady turnover and profit.
CBA	See cost-benefit analysis.
CC BY 4.0.	Creative Commons BY license version 4.0., giving permission to use, distribute, and reproduce work in any medium, provided the source and authors are credited.
CFR	Case fatality rate (CFR), " The number of sick people who die from a specific disease. You calculate case fatality ratio by taking the number of people who have died from a disease and dividing it by the number of people who got that disease." (Ross, 2020). The number may be overestimated if many cases are asymptomatic and go unnoticed. It may also be underestimated, as it takes some time for people to die. To make clear that CFR sometimes is built on diagnosed cases only, the term "diagnosed fatality ratio" could be used instead, and be contrasted to "infected fatality ratio" as the share of all infections, including asymptomatic ones, that die of the infection.
CGE	Computable General Equilibrium model like the Danish Rational Economic Agents Model (DREAM)
chain, hash chain	cryptographic link between groups of data on a blockchain.
CHP	combined heat and power: An energy plant that uses fuel to produce both electricity and heat. Contrast this to power plants producing power only, wasting the excess heat.
chrematike	a Greek term used by Aristotle to denote the art of wealth-getting. See also oikonomia.

Citizen Energy Community (CEC)	One of two definitions of energy communities in the final European Clean Energy Package, the other being renewable energy community. CEC stems from the recast electricity market Directive. Both terms are open to interpretation and transposition into national law will be critical for their final meaning.
Clean Energy Package	the full name of this legislative package of the European Union is called "Clean Energy for All Europeans." Includes proposed frameworks regarding Citizen Energy Communities.
client	In network topology, the consumer in a communication system that requests and receives data. See also client-server-principle.
client-server-principle	An organizing principle of internet communication where the client, a service requester as for example a smartphone, calls up the server, the service provider; contrasted by the peer-to-peer-principle.
CMI	Communication, Media and Information technologies; a section of Aalborg University under the Department of Electronic Systems.
co-constitute	Constructed or shaped by more than one (f)actor.
co-laboration	Co-laboration is a "third way" of field collaboration denoting "temporary joint epistemic work (…) without telos" (Niewöhner 2016) that is, without necessarily sharing the same epistemological goal, but of an experimental and reflexive character.
Cobra cable	Dutch-Danish electricity interconnector that entered into operation in 2019.
code (verb)	In cryptography, a concept similar to but distinct from cypher. Popular use today is as a synonym to programming, as in 'writing code.'

cognition context	A term used in Hvelplund (2005) to denote a structured way of seeing the world. The cognition context can be compared to a map; it is a type of abstraction of the world that we use to orient ourselves in the world. Different cognition contexts—like different maps—are useful for different purposes. Hvelplund talks about the adequacy of cognition contexts in relation to societal interests. It is important to be aware of the limits of one's own cognition context and attuned to societal perspectives in order to attain a societally adequate cognition context.
cognitive dissonance	In psychology, cognitive dissonance occurs when an individual holds contradictory beliefs, ideas or values, or when actions are contradictory to beliefs held. Cognitive dissonance can be resolved by changing your mind or by deeming that which gives rise to the dissonance as wrong. Then, the dissonance is turned into cognitive *consonance*.
comorbidity	The co-occurrence of more than one health condition in one person, either independently of each other, or where one contributes to the other. Is also used about more general health characteristics as tobacco use. For example, the comorbidity (that is, the simultaneous occurrence of) both asthma and tobacco use in serious COVID-19 patients seem to be high as COVID-19 attacks the lungs which are pre-damaged by these comorbidities more severely.
conceptual paper	According to Gilson and Goldberg (2015) a conceptual paper seeks to bridge existing theories in interesting ways or to link work across disciplines. Unlike a theory paper, conceptual pieces need not propose new theory at the construct level.
concrete institutional economics	"a three step, interdisciplinary theoretical approach that encompasses technical systems analysis, context specific and action adequate analysis of institutional conditions, and the development of concrete and context specific policy scenarios" (Hvelplund and Djørup 2017).
congestion rent	See arbitrage rent.

Consensus mechanism	"Proof of work is an economic measure to deter denial of service (DoS) attacks and other service abuses such as spam on a network by requiring some work from the service requester, usually meaning processing time by a computer. […] This idea is also known as a CPU cost function, client puzzle, computational puzzle or CPU pricing function" (Voshmgir & Kalinov 2017: 19). Proof-of-Work was first developed by (Dwork & Naor 1993). Proof-of-work is the consensus mechanism used by both the bitcoin blockchain and the Ethereum blockchain as of January 2020. Ethereum is planning a transition to a different (and less energy consuming) consensus mechanism, proof-of-stake.
consortium (block)chains	Contrasted to the *ideal type* of public blockchains, consortium blockchains are controlled by a group of identified companies, usually organized as a consortium. Sometimes also called enterprise blockchain. It is disputed whether such blockchains can be referred to as such, as they are centralized; rather, they should be called distributed ledgers (see also DLT).
consumer pays principle	A principle of electricity regulation. The consumer is by definition seen as the cause of costs in electricity transmission and distribution, not the producer. The English phrasing borrows from the notion of 'the polluter pays'-principle from economics, which aims at attributing costs to its causation. Since this is currently the consumer in both Denmark and Germany, (Danish: omkostningsægthed, German: Verursacherprinzip). The German term can also be translated as "Cost (incurring) principle."
Corona	Shorthand for Coronavirus disease, COVID-19.
Coronavirus (CoV)	"A group of RNA viruses that circulate in animals and humans. In humans, they can cause respiratory disease" (Ross, 2020). CoVs have "a crown-like appearance under an electron microscope (coronam is the Latin term for crown)" (Cascella et al., 2020). Coronavirus is from a different family of virus than influenza virus, even though the symptoms may be similar.

cost orientation principle	Principle of electricity sector regulation, more frequently known as consumer pays principle. From Danish: omkostningsægthed
Cost-benefit analysis	A tool of mainstream economics that seeks to decide whether a project is preferable to status quo by weighing its discounted future benefits against its immediate investment costs.
cost-effectiveness analysis	Compares how different projects can achieve the same goal by ranking them and then selects the one that does so most cost efficiently. An alternative approach to cost-benefit-analysis, which compares only business-as-usual to one project scenario.
cover essay	Also known as extended summary, integrative chapter or synthesis or 'kappe' in Danish. In PhD dissertations by publication, the cover essay performs the task of synthesizing and theorizing the individual publications.
COVID-19	Coronavirus disease, caused by the virus SARS-CoV-2.
cryptanalysis	Breaking encryption.
crypto community	The (mostly online) community interested in cryptocurrencies, and, typically, crypt-anarchism and other parts of crypto culture.
crypto anarchism	Anarchism practiced in cyberspace using cryptographic tools to uphold anonymity and prevent intervention from state power. Term coined in the 1988 "crypto anarchist manifesto."
crypto bubble	Term used to denote the rise and fall of the value of cryptocurrencies on crypto exchanges, following a pattern comparable to other financial bubbles driven by exceeding and imploding expectations (see figure 4.1 of the cover essay).
crypto economics	A combination of cryptography and economics where the economic school of thought is mostly transaction cost economics and Austrian economics. Crypto economics is interested in, among other things, mechanism design, a

	subfield of industrial economics related to game theory, and tokenization.
cryptocurrency	Cryptocurrencies are used as rewards to miners who sustain a blockchain (see also consensus mechanism and token). Sometimes cryptocurrencies are also called altcoin, short for alternative coin, because they are alternatives to the bitcoin, which was the first cryptocurrency. Cryptocurrencies are traded on crypto exchanges.
cryptography	A field of computer science and mathematics dealing with writing and solving code.
CSL	Citation Style Language, a program language used in reference managing software.
CSO	Civil Society Organization.
cyberliberitarianism	A discourse that claims that the internet should a space of individual liberty, characterized by freedom from especially government interference. The slogan "information wants to be free" is widely associated with cyber-libertarianism.
cyberpunk	A dystopian futuristic science-fiction genre. A classic is the film *Blade Runner* (1982) or *The Matrix* (1999).
cyborg	"A cyborg is a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction" (Haraway 1985: 65). Cyborg play a key role in different sub-genres of science fiction, like cyberpunk.
cypher	A cipher (or cypher) is an algorithm for performing encryption (coding) or decryption (decoding).
cypherpunk	Political activism advocating widespread and strong use of cryptography. Also the title of a book by Julian Assange.
DAG	Directed Acyclic Graph, a concept in graph theory.
Danishism	An English word loaned or derived from Danish.

DAO	Decentralized Autonomous Organization, a governance form for company-like entities on the blockchain.
dApp	Distributed application. As opposed to current apps, which are then understood as 'cApps', that is, centralized apps.
data cooperativism	Cooperative structures of data management or ownership; similar to the notion of platform cooperativism, a term coined by Trebor Scholz.
data democracy	An ideal type of information system governance that entails a democratic control of information systems. It can, but must not, be related to specific types of infrastructural design.
de-politization	Foucauldian term denoting the shifting "between spheres of deliberation (...) opening up or closing down possibilities of agency" (Bues and Gailing 2016).
Decentralization (in energy and information systems)	Decentralization is understood along three dimensions: Spatial, economic and power decentralization. Systems can thus be spatially decentralized (= distributed), economically dispersed among many actors, and control can be exerted by few or many actors.
Democratization	Contested term sometimes used about market expansion, increase of users, or, more in line with the term democracy, about democratic participation and governance processes.
DESERTEC	Megaproject vision of the 2000s that put forward the idea of producing solar electricity in the deserts of Sahara with the aim of transfer the electricity to Europe via high-voltage interconnectors.
disciplinarity	compared to the word discipline, 'disciplinarity' highlights the process of causing knowledge to be accepted, as in discipline (1)
discipline (1)	An area of knowledge that its followers (the pupils, or, with a biblical term, disciples) have been 'caused to accept.'
discipline (2)	The practice of training people to obey rules or a code of behavior, using punishment to correct disobedience (OED)

DIST	Center for Design, Innovation and Sustainable Transition at the Department of Planning of Aalborg University
DKK	Danish kroner
DLT	Distributed Ledger Technology. An umbrella term for both public and consortium blockchains (see also ledger).
DONG	Company name, abbreviation of 'Dansk Olie og NaturGas' (Danish Oil and Natural Gas). From 2006 merged with a number of electric utilities and renamed DONG Energy; today Ørsted.
Dose-response relationship	Also exposure–response relationship. Used to establish the statistical lives lost due to the exposure to a given environmental chemical (=dose), for example, air pollution, after a certain exposure time.
double dipping	A term used to describe a practice of academic publishers who earn twice on the same content as university libraries pay subscriptions while institutes pay for open access for the articles written by their employees via Author Processing Charges (APC).
DTU	Technical University of Denmark (Danmarks Tekniske Universitet).
ECDC	European Centre for Disease Prevention and Control.
ecological economics	The study of the interrelationship between ecosystems and economic systems.
EEG	Erneuerbare-Energien-Gesetz, German feed-in tariff established in 2000.
EEX	European Energy Exchange in Leipzig, Germany. Together with the French Powernext, EEX operates EPEX Spot, an electricity exchange located in Paris, trading power from Continental Western Europe and Britain and expected to open business to Nordic and Baltic markets in 2020
Electrofuels	Electrofuels are the newest addition to the Smart Energy System concept (Ridjan, Mathiesen & Connolly 2016; Korberg, Skov & Mathiesen 2020). They are synthetic fuels,

	for example methane or hydrogen, produced from renewable electricity. Because the synthetic fuel can take several forms, the process is described as power-to-X.
encryption	The process of turning plaintext into cyphertext, that is, obscuring a message to make it unreadable without a decryption key.
endogenous	system-immanent
Energinet	Danish state-owned Transmission System operator (until 2017, Energinet.dk)
energopower	The power inherent to fossil energy infrastructure, a neologism based on the Foucauldian term biopower.
Energy democracy	An ideal-type form of energy system governance that entails a democratic control of energy systems. It is correlated with a more mesh network type infrastructure rather than a hierarchical grid topology. It is often, but not always, related to specific types of cooperative ownership, implying a notion of collective and not only individual solutions. Furthermore, it involves a normative aim at a transition towards 100% renewable energy across sectors. Although it typically goes hand in hand with an economic, spatial and power decentralization, it is not to be confused with or reduced to either one dimension of decentralization.
EnergyPlan	Energy System model developed and used by the SEP group.
ENTSO-E	European Network of Electricity Transmission System Operators.
epiphany	An expression of Greek and biblical origin denoting revelation and enlightenment.
epistemic, epistemology	Also theory of knowledge; the way we know things. Derived from Greek episteme, meaning knowledge, and the suffix '-ology', derived from Greek '-logia', meaning 'to speak, tell' about, in this case, knowledge.

ESMT	European School of Management and Technology in Berlin, a business school, founded in 2002. The Berlin campus is hosted in the former State Council Building (Staatsratsgebäude), the domicile of the collective head of state of the German Democratic Republic (GDR) from 1964 to 1990.
ETH	Shorthand for Ether, used on cryptocurrency exchanges.
Ether	the cryptocurrency of the Ethereum blockchain network.
Ethereum	The largest blockchain network after bitcoin. Differentiates itself from bitcoin by enabling smart contracts. Founded by Vitalik Buterin in 2013 (Buterin 2014).
ETS	European Trading Scheme for CO2 quotas.
EU	European Union.
EUR	Euro (currency).
EURELECTRIC	The Union of the Electricity Industry at European level.
Eurosolar	A German-based renewable energy NGO founded by Hermann Scheer and Irm Scheer-Pontenagel, advocating for a decentralized approach to the transition to 100 % renewable energy.
exchange	A marketplace for trading. Used about cryptocurrency exchanges and electricity exchanges alike.
Exnovation	A deliberate organizational process of removing and replacing the old; as opposed to innovation.
exogenous	Of external cause or origin
fastening	"Fastening denotes how formats of data both "tie us down and speed us up" (Koopman 2019) as informational persons. Infopower acts by fastening information into infrastructures which path-dependently reproduce whatever injustices were molded into the earliest data sheets. Inspired by this insight, energopower could be understood as the fastening of energy into infrastructures (which are, today, fossil infrastructures),

	path-dependently reproducing the problematics of the fossil era" (Hasberg 2019c).
feed-in tariff	A guaranteed remuneration for (mostly) renewable electricity that is supplied, or fed in, to a distribution grid. The height of the remuneration is regulated and fixed per kWh.
Flexibility (in energy systems)	Blue et al. (2020: 3) operate with three types of flexibility in energy systems to which I add a fourth element. Thereby, flexibility can be: [1] a quality or property of the energy system as a whole; [2] a commodity that can be bought and sold, and [3] […] specific measures, instruments, or techniques such as storage or demand-side management. [4] interconnection.
fly on the wall	Expression from documentary film maker (name) for the observatory role of the filmmaker in documentary films.
FOMO	Fear-of-missing-out.
fork (verb)	The splitting up of a blockchain ledger into several parts. Used as a "dissensus mechanism" to solve disputes.
game theory	A subfield of microeconomic theory dealing with incentives.
gas (in crypto)	Currency expressing the cost of a transaction on Ethereum. See also transaction cost.
GDP	Gross Domestic Product.
graph (theory)	in mathematical expression for that which is more commonly called network (theory). Graphs consist of nodes that are connected to each other by links (also called edges) and thus depict pairwise relationships. Applied graph theory is called network topology.

GW	gigawatt, 1000 megawatt
h-index	Hirsch index, a publication performance index.
H1N1	A zoonotic subtype of *influenza A* virus that caused the swine flu pandemic in 2009. The letters stand for haemagglutinin and neuraminidase, two components of the virus. The virus is a novel form of the one that caused the Spanish flu outbreak in 1918. The case fatality rate is lower than that of COVID-19. The pandemic spread mostly in the Americas, South East Asia and Africa and affected children and younger people. The death toll of the 2009-2010 pandemic is estimated to be between 151.700 and 575.400 individuals globally (Dawood et al., 2012).
H5N1	A subtype of the influenza A virus called avian influenza or popularly, bird flu.
hackathon	Event where new applications are developed within a short, limited time frame. combination of hack and marathon.
Harmony of delusion	A concept of Ludwik Fleck that he defines in the following way: "(1) A contradiction to the system appears unthinkable. (2) What does not fit into the system remains unseen; (3) alternatively, if it is noticed either it is kept secret or (4) laborious efforts are made to explain an exception in terms that do not contradict the system. (5) Despite the legitimate claims of contradictory views, one tends to see, describe, or even illustrate those circumstances, which corroborate current views and thereby give them substance" (Fleck 1979: 27). Translated from German: "Harmonie der Täuschungen."
hash function, cryptographic hash function, hashing	"A mathematical algorithm that maps data of arbitrary size (often called message) to a bit string of a fixed size (the "hash value", "hash", or "message digest"). It is a one-way function, that is, a function which is practically infeasible to invert" (Wikipedia).

hegemony	Hegemony is a political concept from Gramsci denoting an ideological position that comes to dominate "to prevail, to gain the upper hand, to propagate itself throughout society—bringing about not only a unison of economic and political aims, but also intellectual and moral unity, […] thus creating the hegemony of a fundamental social group over a series of subordinate groups" (Gramsci et al., 1971: 181–182) cited in Spash 2020).
heterodox economics	Opposed to mainstream economics. Heterodox means "not conforming with accepted or orthodox standards or beliefs" (OED) and is opposed to orthodox economics. Ecological economics is an example of a heterodox economics school of thought.
historicize	interpret in historical context; the opposite of presentism.
horizontal integration	A term in business economics, denoting the integration along the value chain, i.e. from production over distribution to end-consumer sales.
Hubei	A province in China with the capital Wuhan; a manufacturing hub of the global economy in the areas of automobile, iron and steel, petrochemical, food processing, equipment manufacturing, electronic information and textile.
hype cycle	A term coined by the consultancy Gartner denoting a cycle that technological development follows.
ICC	International Chamber of Commerce
ICO	Initial Coin Offering, a type of blockchain-based crowdfunding or crowd investing tool where tokens are issued for sale. The term is a modification of 'Initial Public Offering', that is, offering stocks of a company on a stock exchange for the first time.
ICT	Information and communication technology
IDA Energy Year 2006	a collaborative effort to develop a 100% renewable energy scenario for Denmark initiated by the Danish Engineer's Association (IDA - Ingeniørforeningen i Danmark) (Lund and Mathiesen, 2006)

ideal-typical	An ideal-type, a concept developed by the German sociologist Max Weber, denotes "a constructed ideal used to approximate reality by selecting and accentuating certain elements" (Britannica.com 2018).
identity	identity can be anonymous or pseudonomous
idiot	Deleuzian, Dostojewskian or Stengers-type idiot
IEA	International Energy Agency
IEA	International Energy Agency
ignorance	The active or passive, conscoius or unconscious making unknown of sth.
IHR	International Health Regulations from 2005. A legally binding instrument of international law (WHO, 2008)
IMF	International Monetary Fund
imponderabilia	A combination of the terms imponderable 'something that cannot be guessed or calculated because it is completely unknown' (OED), and memorabilia, collectibles of remembrance.
IMRAD	Introduction, Methods, Results, and Discussion; a common structure of scientific papers.
inc-dec game	increase-decrease game (for example, in electricity markets)
infopower	The power inherent to information infrastructure, a neologism based on the Foucauldian term biopower.
infra-critique	A term coined by Verran (2014) to denote critique that is already present inside of a thought collective researched, which Verran encourages the researcher to make use of on their own critique.
institutional economics	see new institutional economics, concrete institutional economics or old institutional economics
integrated utility	A horizontally integrated provider of energy

inter-disciplinarity	A working definition of the interdisciplinary scholar makes use of a German idiomized phrase from Goethe's Faust: (at least) two (disciplinary) hearts beat in an interdisciplinary researcher's chest (Woiwode and Froese, 2020).
intermittency	The variability, that is, weather-dependent stochastic nature, of certain types of renewable energy sources like wind and sun. See also flexibility.
Internet	Computer communication network governed by the TCP/IP protocol
internet meme	An image, video, piece of text, etc., typically humorous in nature, that is copied and spread rapidly by Internet users, often with slight variations (OED).
Intheoreum	A tongue-in-cheek name for an imaginary blockchain network, an internet meme of blockchain developers turning the decentralization argument for blockchain technology on its head and mockingly calling centralized solutions the Bobchain.
invisible hand	An idiomatic expression in economics with reference to Adam Smith who in *The Theory of Moral Sentiments* (1759) denoting how self-interest leads to a socio-economic optimum. A dominant thought style of neoclassical economics.
IoE	Internet of Energy. The abbreviation is also used to denote the Internet of Everything. Both are derivatives of IoT, the Internet of Things.
IREMB	Innovative Re-Making of markets, a project at the Department of Planning, AAU TECH.
IRENA	International Renewable Energy Agency, an international organization working to promote renewable energy, co-initiated by Hermann Scheer.
IRI-THESys	Interdisciplinary Research Institute for the Transformation of Human-Environment Systems at the Humboldt University Berlin.

kW	Kilowatt = 1000 Watt. The capacity of a cable or installation. See also GW
kWh	Kilowatthour = Kilowatt multiplied by time. The produced or consumed energy over time.
layer	In information systems, used to conceptualize a hierarchy of different components of a full system, for example denoted the (bottom) hardware layer, the (intermediate) protocol layer and the (top) application layer.
LCOE	Levelized Cost of Energy. "The LCOE of a given technology is the ratio of lifetime costs to lifetime electricity generation, both of which are discounted back to a common year using a discount rate that reflects the average cost of capital" (IRENA, 2019).
ledger	used as an umbrella term for both public and consortium blockchains. Literal meaning: a book of recorded transactions.
libertarian	Apolitical philosophy characterized by minimal state intervention both regarding individual freedoms and markets (see market fundamentalism).
lightning network	An additional protocol layer of blockchain technologies designed to improve performance and scalability.
lock-in	A term from institutional economics, denoting that (the institutional configurations of) history constrain(s) the present. See also path dependency.
logistic curve	Also called epidemic curve; an S-shaped curve which looks like an exponential curve at the outset but flattens out as the total population size is reached. Important: virus spread is not exponential (Baldwin, 2020; Sanderson, 2020).
long run	A time period where all input factors of production are variable.
LUCID	Lund University Centre of Excellence for Integration of the Social and Natural Dimensions of Sustainability at the University of Lund, Sweden.

luddism	From Luddite (derogatory), a person opposed to new technology […] Perhaps named after Ned Ludd, a participant in the destruction of machinery of English workers, especially in cotton and woolen mills, that they believed was threatening their jobs (1811–16). (OED)
mainstream economics	also called neoclassical or orthodox economics; see old paradigm economics.
marginal cost of public funds	Also known as the deadweight loss of taxation or excess burden of taxation or tax distortion loss, a literal translation of the Danish term "skatteforvridningstab." In cost-benefit analysis, this factor increases the investment costs of tax financed projects to reflect the assumed dynamic costs of taxation; it is currently set to 10 % (Finansministeriet 2017). "As the name suggests, the excess burden principle is founded on the idea that there is an excess burden of taxation—in welfare terms—beyond the taxation itself. In that way, financing projects through taxation implies a welfare cost. The excess burden reflects an economic deadweight loss [similar to the deadweight loss illustrated in Figure 4] which is assumed to appear when taxes are added in the market economy. […] Even if one accepts the condition that private companies are held accountable for the state's tax revenue, it is difficult to accept that the postulated need of increasing the taxation elsewhere in the economy would necessarily create a greater distortion [than not collecting the tax]." (Djørup 2020: 7, 8)
market fundamentalism	A strong belief in that the invisible hand of the so-called free market or laissez-faire capitalism (mostly not taking into account corporate power).
Merit-order effect	A rationale of operation in current wholesale electricity markets. Supply bids are ordered according to their short-term marginal costs (the *merit* ordering). This ordering exerts a downward push on the electricity market price at any given instant with large shares of renewable electricity production, because the short-term marginal cost of fluctuating renewable electricity is close to zero.

Mesh network	In network topology, a mesh network its characterized by the non-hierarchical, horizontal, or lateral way of connecting nodes with each other.
methodography	An ex-post explication of how a researcher got to their findings (as compared to an ex-ante prescriptive methodology). The term is derived from Greek and can be broken down into met-hodos-graphia: It describes (graphia) the pursuit of (met) the (knowledge) path (hodos).
metonym	A word used as a substitute for something else with which it is closely associated (OED). For example, "Slotsholmen" is a metonym for the Danish public administration.
metoo	Metoo is an international movement denouncing sexual assault, rape, and harassment. The #metoo hashtag went viral after the sexual abuse cases of filmmaker Harvey Weinstein became public in 2017
Middle East respiratory syndrome (MERS)	A disease caused by the MERS coronavirus (MERS CoV), a zoonotic virus derived from bats and transmitted via camels. An outbreak occured in South Korea in 2015 and in 2018 in and around Saudi Arabia. It has till date caused around 800 deaths.
mode 2 knowledge creation	Applied, interdisciplinary research in teams (Nowotny et al., 2003)
modifier	A word, especially an adjective or noun used attributively, that restricts or adds to the sense of a head noun (OED)
Moore's law	The observation that the number of transistors in an integrated circuit doubles about every two years, that is, exhibits exponential development. Named after Gordon Moore, co-founder of the Intel Corporation.
MW	1000 kilowatt (kW)
neoclassical economics	See old paradigm economics.
neologism	A newly coined word or expression, sometimes based on the pattern of existing terms, like infopower and energopower.

Network	In network topology of communication or electrical networks and in mathematical graph theory, a network consists of links (also called edges) and nodes.
network effect	Also known as positive network externalities or demand-side economies of scale, denoting a situation where every additional user of a system increases the value of the product or service offered; the typical textbook example used to be the wired telephone monopoly system: The larger the network, the more value it offers to users. Platform business models are all built on network effects.
network topology	The organization of applied networks like communication networks or electricity grids. Networks consist of nodes that are connected to each other by links (also called edges). The underlying mathematical theory is called graph theory.
new economics	A new economic paradigm combining the insights of the heterodox economics schools of ecological and institutional economic perspectives seeking to replace the old paradigm economics.
new materialism	Peter Forman defines new materialisms as "a body of scholarship in which the 'vibrant' or 'vital' materialities of things has been emphasised, primarily in response to the prioritisation of discourse during the cultural turn" (Forman 2020: Section 1).
new paradigm economics	See new economics.
NGO	Non-Governmental Organization. See also CSO.
node	a term from network topology denoting an actor in a network (for example, a client, or a server; transferred to energy networks, the nodes are either consumers or producers at a given point in time
Non-transformation	The lack of energy transition, that is, the continous increase of fossil fuel use and corresponding emission of greenhouse gasses

Nord Pool	The Nordic electricity exchange in Lysaker, Norway. (until January 2016, Nord Pool Spot) operating on Nordic, Baltic and since 2019, in continental European and British markets. It is owned by a group of Nordic and Baltic Transmission System Operators
not-for-profit ownership	German: Daseinsvorsorge, Rekommunalisierung; Danish: hvile-i-sig-selv princip, forbrugereje. These terms are used when not-for-profit ownership is being practices or considered
NPM	New Public Management. According to Hood (1991), it emerged as a marriage of new institutional economics and the scientific management movement, also known as Taylorism.
OA	Open access
Ofgem	British regulator: The Office of Gas and Electricity Markets.
oikonomia	Ancient Greek term denoting stewardship or management of household, used by Aristotle along chrematike in his early philosophy of economics.
old paradigm economics	A term coined by Fullbrook (2013), denoting the current economic thinking. It is also often termed neoclassical economics, mainstream economics or orthodox economics. See also new economics
ontology	Ontology, derived from Greek speaking about (-logy) being (-onto). Epistemology thus includes the ontology of knowledge, that is, the speaking about the being of knowledge.
ontology (dis-ambiguation)	In information systems, a way of mapping a knowledge domain, similar to a knowledge graph.
oracle (in crypto)	Input data to a blockchain transaction, for example weather data from a third-party source.
Ørsted, Orsted	Named after H. C. Ørsted. Danish state-owned power plant owner and operator and offshore wind developer. Formerly DONG.

orthodox economics	Mainstream economic thinking. The term originates from Greek and means the right (orthos) opinion (doxa). See old paradigm economics.
P2P, peer-to-peer	A term from network topology denoting a non-hierarchical network configuration where each node can take the role of both server and client. Translated to energy system, each actor in the grid can be both a prosumer and a producer (a prosumer).
Pandemic	"An epidemic that has spread to multiple continents. On March 11, after extensive COVID-19 spread on multiple continents, the WHO officially declared the coronavirus outbreak a global pandemic." (Ross, 2020). The official definition of the WHO is "an influenza pandemic occurs when an influenza A virus to which most humans have little or no existing immunity acquires the ability to cause sustained human-to-human transmission leading to community-wide outbreaks. Such a virus has the potential to spread rapidly worldwide, causing a pandemic" (WHO, 2017).
Pareto efficiency	A distribution of wealth where there is no alternative distribution that would make some people better off without making someone worse off; attributed to Italian economist Vilfred Pareto.
particulate matter	Abbreviated PM; particle pollution in the air. Particulate matter is typically accounted for with respect to their size: PM10 is particulate matter 10 micrometers or less in diameter, PM2.5 is particulate matter 2.5 micrometers or less in diameter.
Path creation	A counter-concept to path dependency attributed to Garud and Karnøe (2001).
Path dependency	A concept from old institutional economics (historical institutionalism) denoting that 'history matters.'
PCI-list	List of 'Projects of Common Interest,' a list of European electricity and gas infrastructure projects that are receiving EU funding.

peer-to-peer	Interaction between equals; non-hierarchical interaction in a mesh network.
performative, performativity	The effect of a certain practice, for example economics, or of certain categorizations, for example binary gender, on society at large. Especially used about how economics influences more than passively describes the social world. The term is also used about material performativity, that is, that not only actors, but also things, perform actions and 'matter comes to matter' (Barad). See also actor-network theory.
permissioned	Used about consortium blockchains, as contrasted with permissionless, public blockchains.
phronesis	Ancient Greek term meaning practical wisdom.
phronetic social science	A term coined by Bent Flyvbjerg in his seminal book *Making Social Science Matter*, arguing for the societal immersion of the researcher with the purpose of producing societal change.
Platform cooperativism	See data cooperativism
platformization	The establishing of closed information architectures as in for example done by Facebook and other GAFAs.
Po plain	An industrial area in Northern Italy around the river Po.
POC	Proof-of-concept, a term used about pilot cases or demonstration projects in the blockchain-energy thought collective.
Power	Understood as infrastructured power, that is, with particular emphasis on the materiality of power. Power can thus be exerted by things as well as actors. See also infopower and energopower.
power-knowledge	A Foucauldian neologism signifying that power and knowledge are co-constitutive. The most important part of the term is the hyphen that links the two aspects, alluding to their inherent inextricability. While Foucault's original

	spelling is hyphenated, the backslash use has become commonplace in English: Power/knowledge.
power/ignorance	A neologism derived from the hyphenated Foucauldian term power-knowledge denoting the intertwined relationship between conscious and unconscious ignorance and power. Ignorance can enable power and/or power can enable ignorance. Removing ignorance does not necessarily disable power.
PPA	power purchase agreements, a type of long-term electricity trading contract.
precautionary principle	In the Rio Declaration that resulted from the United Nations Earth Summit in 1992 in Rio de Janeiro, the precautionary principle is defined in the following way: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (UN, 1992). The term possibly originated from the German 'Vorsorge', literally 'pre-care.'
prefix	A syllable placed at the beginning of a word to adjust or qualify its meaning (OED).
price discrimination	A concept from microeconomic theory, differentiating between first, second- and third-degree price discrimination.
prosumer	An actor that is both a consumer and producer (of energy). Equivalent to a peer in a peer-to-peer information network topology.
protocol (1)	A set of rules governing the exchange or transmission of data between devices (OED).
protocol (2)	The accepted or established code of procedure or behavior in any group, organization, or situation (OED). For example, hand-washing protocol, mask wearing protocols or social distancing protocols have come into place during the COVID-19 outbreak.

PSO	Danish feed-in tariff and surcharge. Shorthand for Public Service Obligation.
PV	Photovoltaic, that is, an electricity-generating solar installation.
Pyrocene	A term denoting the twofold age of fire that we are in: That of burning fossil fuels and burning of wildfires (Pyne, 2019), see also attribution science.
Radius	Distribution grid operator in the Greater Copenhagen Area. Until 2018, Dong Energy Distribution.
Ramses	Ramses and Balmorel are the models used by the Danish Energy Authority.
rate of discounting	An interest rate used in cost-benefit analysis to discount future values to the present. There is disagreement over the size of the rate of discounting and what it reflects (for example, individual impatience or a societal valuation of the present over the future).
Regulatory capture	Regulatory capture describes how "organized interest groups successfully act to vindicate their goals through government policy at the expense of the public interest" Payne (2018). More specifically in the energy sector, regulatory capture describes "the process through which regulated monopolies end up manipulating the state agencies that [we]re [designed] to control them" Payne (2018).
Renewable Energy Community	One of two definitions of energy communities in the final European Clean Energy Package. This term stems from the recast renewable energy directive (RED II). See also citizen energy community. Both terms are open to interpretation and transposition into national law will be critical for their final meaning.
respiratory disease	"Illness with symptoms in the lungs, throat, and airways" (Ross, 2020).
Retrospective insider research	Defined as research that is self-ethnographic (1), serendipitous (2), retrospective (3) and covert (4).

RNA	"Ribonucleic acid; a type of genetic material. Humans, plants, animals, bacteria and some viruses have both DNA and RNA. (...) Coronavirus is an RNA virus or ribovirus, which means that drugs that treat it need to somehow block the virus' RNA from invading our cells" (Ross, 2020).
RWE	German Utility (until 1990 Rheinisch-Westfälisches Elektrizitätswerk) with headquarters in Essen.
SARS-CoV-2	Severe Acute Respiratory Syndrome CoronaVirus 2, a novel virus causing COVID-19.
Satoshi Nakamoto	A person or group of authors that wrote the Bitcoin whitepaper. Satoshi disappeared from online debate fora shortly after the launch of Bitcoin.
Seasonal influenza	Seasonal influenza is mostly caused by influenza virus A (strands B, C, and D exist as well). The WHO estimates that it causes about 290.000 to 650.000 worldwide respiratory deaths annually.
self-ethnography	When researchers examine their own home field, this is called self-ethnography (Alvesson 2003), at-home (or home culture) ethnography (Vickers 2018) or insider research (Brannick & Coghlan 2007). See also auto-ethnography.
sensitivity analysis	Recalculation of a cost-benefit-analysis using different assumptions. Assumptions are changed one at a time, to see how *sensitive* the result is to these changes. If the conclusion, i.e. the net present value does not change significantly, the cost-benefit-analysis is said to be robust.
SEP group	Sustainable Energy Planning group at AAU.
SEPM	Sustainable Energy Planning and Management, a Master's program at Aalborg University.
serendipity	Serendipity is a term derived from *The three Princes of Serendip*, the title of a fairy tale from Sri Lanka, then known as Serendip. It inspired Horace Walpole, an English novelist, to coin the term serendipity. In a letter in 1754, he referred to the tale in which the heroes "were always making

	discoveries, by accidents and sagacity, of things they were not in quest of" (OED).
server	In network topology, of a communication system, the server is the node that provides data. See also client-server-principle.
Severe acute respiratory syndrome (SARS)	A disease caused by the SARS Coronavirus (SARS CoV), a virus of zoonotic origin, identified in 2003. The outbreak centered in China, Taiwan, Hong Kong, Singapore, and Toronto, Canada. was contained within eight months in 2003 resulted in around 800 deaths globally (Wilder-Smith et al., 2020).
Shellpapers	Revelation of how the oil company Royal Dutch Shell supported climate denialism, uncovered in 2020.
Short run	A microeconomic term denoting a time period where not all input factors of production are variable, but some input factors are fixed. These costs are also called sunk costs.
short-run marginal costs	A measure of the cost of producing an additional unit in the short run. I make the standard microeconomic assumption that short run is defined as the time period when at least one input factor of production is fixed, and the long run is correspondingly defined as a time period where all input factors are by definition variable.
simultaneity	Occurrence at the same time
smart contract	Piece of code that executes automatically when certain conditions are fulfilled.
Smart Energy System	An approach to energy system planning based on sectoral integration and the use of renewable energy, defined as an "approach in which smart electricity, thermal and gas grids are combined with storage technologies" (Lund et al. 2017). Coined by the Sustainable Energy Planning (SEP) research group at AAU TECH.

social distancing	"A preventive measure that encourages avoiding large crowds or small gatherings in tight places, keeping a distance from others and, for those with underlying health conditions, staying home" (Ross, 2020).
Sociotechnical imaginary	Sociotechnical imaginaries are "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of form of social life and social order attainable through, and supportive of, advances in science and technology." (Sheila Jasanoff, 2015).
solar punk	A new stream of literature and art imagining sustainable futures, inspired from steampunk and cyberpunk.
spark risk	In epidemiology, a term denoting the likelihood of a potentially pandemic virus to arise, for example, by spreading from animals to humans (zoonotic viruses).
spread risk	In epidemiology, a term denoting how likely a virus is to diffuse broadly through human populations. For example, global supply chains increase the spread risk.
stack	Technology stack, understood as a stack of layers like the internet layer, the blockchain layer and the application layer.
Stamp principle	The consumer has to pay the same grid fee no matter where the electricity comes from. In German, this is expressed as the principle of "one stamp for all of Europe."
standard load profile (SLP)	(skabelonafregning in Danish; standarlastprofil (SLP) in German). A way of billing end customers in electricity systems, assuming that their consumption profile over the hours of the day follows a standardized assumption. Used as a "production plan" in baseload-driven energy systems.
Statistical life lost	Also called premature mortality or excess mortality. A statistical measure that is established using dose-response functions. "When mortality is attributed to a risk factor such as air pollution, the relationship is statistical but not distinctive (unlike car accidents where excess mortality relates to persons who can be identified" (Lelieveld et al., 2020).

STM Association	International Association of Science, Technology and Medicine Publishers.
stranded asset	Assets that have been written down prematurely, for example, a Volkswagen with a tinkered engine or a coal mine in the case of coal phase out.
STS	Science and Technology Studies. Sometimes also Science, Technology and Society Studies.
subsidiarity	As decentralized as possible, as centralized as necessary. Derived from Catholic social teaching.
suffix	A syllable added at the end of a word to form a derivative (OED).
sunk cost	Fixed investment costs that cannot be recovered.
Supergrid	The Supergrid approach is defined as "a system characterised by highly centralised renewable electricity production and large-scale transmission over long distances, spanning across continents or even the entire globe (Funcke & Bauknecht 2016) (Battaglini et al. 2009). The rationale behind such a 'Super-grid' is to make efficient use of unevenly distributed renewable energy resources, connect them to load centres, and handle large-scale penetration of variable energy sources, while avoiding the need for storage or demand flexibility (Blarke & Jenkins, 2013; Liu 2015)" (Hojčková et al: 76-77).
SUSCI	Sustainable Cities, a master's program at Aalborg University Copenhagen.
sustainable renewable energy	Renewable energies within the biophysical limits—that is, in combination with reducing overall energy consumption and limiting the use of biomass.
TAPAR	Techno-Anthropology and Participation (TAPAR) is an interdisciplinary research group at the Department of Planning at AAU TECH focusing on relations between technology, humans, and society.

TCP/IP	Transmission Control Protocol / Internet Protocol: a set of rules governing the format of data sent over the Internet or other network (OED).
techno-utopianism	Short for technological utopianism. The belief in that technological change will bring about a utopian, that is, an ideal state of society.
Third Culture Kid	People raised in a culture other than that of the country of origin of their parents.
Thought collective	A community that exchanges ideas and develops a shared thought style of which the individual is "never, or hardly ever, conscious of" (Fleck 1979: 42). Thought collectives have inner and outer circles, and it is possible for individuals to belong to several thought collectives at the same time, which is how knowledge and ideas permeate from one thought collective to the other.
Thought style	A thought collective develops a certain thought style, defined as "[the readiness for] directed perception, with corresponding mental and objective assimilation of what has been so perceived" (Fleck 1979, 99).
tier supplier	subcontractor or sub supplier.
TINA-thinking	Abbreviation of there-is-no-alternative, a slogan originally used by the British conservative prime minister Margaret Thatcher, used to define the market capitalism as the only viable form of societal organization.
token	Tokens represent a cryptocurrency that is added to an existing infrastructure.
Tragedy caused by the few	An adaption of "tragedy of the few" coined by Scavenius (2016) denoting that climate crisis is caused by a lack of democratic decision-making and strong corporate powers exerting regulatory capture. Refers to "the tragedy of the commons," a term used in environmental economics to denote that environmental probles are like over-grazing, and that they can be solved by privatization of a common resource.

transaction cost (in cryptography)	The cost of one transaction on a blockchain, that is, sending funds from one wallet to another. The cost can be expressed in the cryptocurrency of the blockchain and in gas.
transaction cost (in economics)	Transaction cost is a theoretical concept used in new institutional economics originating from Coase.
Trans-disciplinarity	The active creation of knowledge beyond the boundaries of single scholarly disciplinarities.
Transmission (in biology)	"The spread of disease. A disease can be transmitted from person to person, from person to animal to person or by the environment (...) Coronaviruses are transmitted in respiratory droplets, which are drops of water and mucus that come out of our lungs when we cough and sneeze. They can also contaminate door handles and surfaces" (Ross, 2020).
Transmission (of electricity)	The transportation of electricity at high voltage levels via the transmission grid, operated by a transmission system operator (TSO).
transparency	Surveillance or openness.
Tree network	A term from network topology denoting a hierarchical network structure. Named so because the visual representation looks like an (upside-down) tree.
troll	A person who makes a deliberately offensive or provocative online post (OED). Can be a bot.
trustless, trust-free	Term used in the crypto community. A system is trustless when trust in an organizational entity with "trust in code," that is, trust in the governance structures that device the rules of a blockchain system.
TSO	Transmission system operator responsible for the transmission of electricity at high voltage level. See also Energinet.
tWh	Terawatthours. Thousand kilowatt hours (see kWh)
Twitter	Social media platform characterized by its character limit

TYNDP	Ten-Year-Development-Plan of ENTSO-E
UN	United Nations
unbundling	The splitting up of energy production and energy transportation.
URI	Uniform Resource Identifier. URLs, that is Uniform Resource Locators, are URIs.
USD	United States Dollar.
USP	Unique selling point or Unique selling proposition, a feature or characteristic of a product, service, etc. that distinguishes it from others of a similar nature and makes it more appealing (OED).
valuation studies	A subfield of science and technology studies dealing with the performativity of economics.
VAT	Value-added tax
Verfremdungs-effekt	Method of estrangement or defamiliarization. The Verfremdungseffekt is a key element of German playwright Bertolt Brecht's epic theatre, developed on the brink of World War II in Brecht (1991). "Der Zweck dieser Technik des Verfremdungseffeks [ist] es, dem Zuschauer eine untersuchende, kritische Haltung gegenüber dem darzustellenden Vorgang zu verleihen" (Brecht 1981: 187).
view or voice from nowhere	A term coined by Haraway (1988) to denote that the researcher is always entangled in the research object and there can therefore not be a view, or voice, from nowhere. Also used to criticize passive voice in research writing, and a lack of reflexivity more generally.
Viking Link	A 760-kilometer Danish-British interconnector project. It is set out to connect the two countries electrically by 2023, at an estimated cost of 1,5 billion Euro for the Danish share alone (EFKM 2018a, referenced in Hasberg 2020a).
virus	A type of germ or microbe. Viruses are not considered alive because they don't have the tools they need to replicate on their own. The flu, COVID-19, Zika and Ebola are all caused

	by viruses. Viruses cannot be treated with antibiotics" (Ross, 2020).
Vitalik Buterin	Founder of the Ethereum blockchain.
wallet	Similar to a bank account, a location for holding cryptocurrencies. "A Bitcoin wallet is a piece of software that stores the user's private keys. Your bitcoin wallet allows you to access your Bitcoin" (Voshmgir & Kalinov 2017).
waterfall principle (disambiguation)	A software development model which is considered outdated as it starts with a specification and works linearly and sequentially onwards. Contrasted by agile development characterized by continuous iteration.
Waterfall principle (energy)	The waterfall principle entails that the consumer pays for electricity transmission and distribution from the highest voltage level to the lowest. The highest voltage level is implicitly assumed as the level of generation. Danish: vandfaldsprincip; German: Kostenwälzungsprinzip.
web	The world wide web - see Internet.
Web3	Also known as the semantic web or web 3.0. A machine-readable internet. Sometimes blockchain technology is understood as part of a wider Web3 development.
WEC	World Economic Forum
welfare economics	A microeconomic market allocation theory.
wet market	A wet market is a market selling fresh meat, fish, produce, and other perishable goods as distinguished from "dry markets" which sell durable goods (Wikipedia). The Huanan Seafood Wholesale market is a wet market that has been associated with the Wuhan outbreak of COVID-19.
whitepaper (in the crypto community)	A first non-technical description of a new blockchain project.

WHO	The World Health Organization within the United Nations, headquartered in Geneva and with several additional centers, including Copenhagen.
wholesale electricity price	The price of electricity on the electricity exchange, without grid tarifs, taxes, VAT or any other levies.
worlding	The use of world as a verb occurs in Heidegger's work: Heidegger uses 'welten,' 'to world' in the expression "die Welt welten und walten lassen" (Heidegger 1995: 44), "to let the world world and prevail." The term 'worlding' is also used by Anna Tsing (2011).
Wuhan	The capital of the province Hubei in China with 11 million inhabitants, sometimes referred to as the "Chicago of China" because it is an industrial center.
Zoonotic	"A disease that infects humans but originally came from other animals. (…) Some zoonotic diseases, such as Zika and malaria, cannot be passed from person to person without an animal host" (Ross, 2020).

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