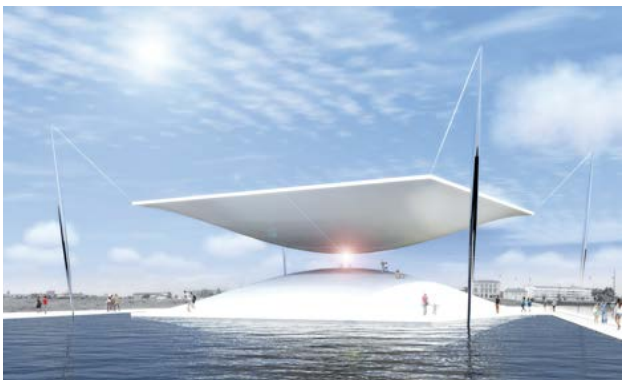
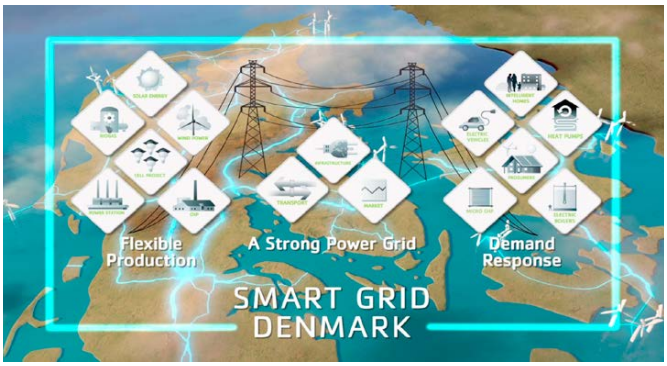
Composing for Energy Engagement
– studies in sm/art infrastructures





PhD Dissertation by Lea Schick
IT University of Copenhagen, June 2015
Supervised by: Brit Ross Winthereik & Randi Markussen
Assessment committee: Noortje Marres, Ramia Mazé and Mark Elam

Composing for Energy Engagements

– studies in sm/art infrastructures

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Submitted June 2015, Defended November 2nd 2015

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Credits for cover photos:

- Nuage Vert 2008 by HeHe
- The Solar Hourglass by Santiago Muros Cortés, 1st Place Winner to the 2014 Land Art Generator Initiative Copenhagen Design Competition
- Energy Duck by Hareth Pochee, Adam Khan, Louis Leger, Patrick Fryer, submission for the 2014 Land Art Generator Initiative Copenhagen Design Competition
- Still from Film: Smart Grid Denmark by Energinet.dk
- Natural Fuse 2008 by Usman Haque Design

Contact: leaschick@itu.dk

Preface

The content for this PhD thesis was conducted at the IT University of Copenhagen between September 2010 and June 2015. From April 1st 2013 to January 1st 2014 the PhD period was interrupted as I was employed temporarily in another project at the IT University (see page 81). From January to April 2013 I was visiting Lancaster University and supervised by Lucy Suchman. The PhD has not been part of any research project, but was funded by the IT University as a so-called 'free PhD', meaning that the subject and content have been developed entirely by the PhD candidate. During the PhD I have been based in the research group *Technologies in Practice* and I was part of funding the strategic research area *Energy Futures.* The thesis has been supervised by Brit Ross Winthereik & Randi Markussen.

This is a paper-based PhD thesis. The papers, included in the end of this document, constitute the main analytical part of the dissertation. The overview presented in the first part of the thesis is intended to provide an introduction to the issues of research, the empirical field, as well as sketching out the theoretical and analytical framework through which the papers have emerged. The second part consists of four academic papers and two shorter texts (all referred to as papers). The papers are listed chronologically in the order of writing, but can be read in any order the reader wish.

Overview of papers and status of publications:

Paper 1: *Powering Ecological Futures*

By: Lea Schick & Anne Sophie Witzke
Short-paper. Published online for the conference *ISEA, Istanbul 2011*
It was reviewed (not blind peer review) and published through the *Leonardo Electronic Almanac*.
Online at: https://isea2011.sabanciuniv.edu/paper/powering-ecological-futures

Paper 2: *Innovating Relations – or Why Smart Grid Is Not Too Complex for the Public*

By: Lea Schick & Brit Ross Winthereik
Peer-reviewed journal article. Published 2013
Science & Technology Studies 26(3):82–102.
Special issue: *Energy Systems and Infrastructures in Society*

Paper 3: *Flexible and Inflexible Energy Engagements – a study of the Danish Smart Grid Strategy*

By: Lea Schick & Christopher Gad
Peer-reviewed journal article. Published 2015, online first
Energy Research & Social Science
Special Issue: *Smart Grid and the Social Sciences*.

Paper 4: *Making Energy Infrastructure: Tactical Oscillations and Cosmopolitics*

By: Lea Schick & Brit Ross Winthereik
Peer-reviewed journal article: accepted, forthcoming January 2016.
Science as Culture, Special Issue: *Infrastructuring Environments*.

Paper 5: *Generating Futures: LAGI as an Imaginatorium*

By: Lea Schick & Anne Sophie Witzke
Short book essay. Published 2014.
New Energies: Land Art Generator Initiative, Copenhagen, edited by Elizabeth Monoian and Robert Ferry. (Prestel). Pp. 50–51.

Paper 6: *Environmental Entanglements - art, natures and technology*

Symposium description.
Place: Royal Academy of Science and Letters, Copenhagen
Date: October 27.-29. 2014

Acknowledgements

A dear colleague once told me that writing a PhD dissertation is not an individual undertaking, but a collaborative task shared among colleagues. This certainly has been the case for me. The following acknowledgements aim to make visible at least parts of the hidden and significant network of actors, who have, one way or the other, helped this dissertation find its form. However, let me start with the more visible part by thanking my co-authors. Anne Sophie, Brit and Christopher thank you for sharing your knowledge and experience and for letting me *think with you*. Also, great thanks to reviewers and colleagues for commenting and bringing new perspectives to our thoughts.

The German name for supervisor is 'Doktormutter.' I have been so incredibly gifted to have two absolutely amazing 'mothers', who have been so much more than supervisors to me. Brit and Randi, you have indeed been mentors in the broadest sense of the word – as scholars, as colleagues, as friends, and as fellow feminists. Randi, my great PhD-Grandmother, thank you sincerely for believing in me from the very beginning and all the way to the through. Thanks for amazing dinner discussions and for inspiring and encouraging me with your ever-positive disposition. Thank you Brit, for taking me under your wing and for making me fly wild in our endless discussions during which I am sure we both got some extra grey hairs. Thank you for generously sharing your knowledge, your network, and not least your wonderful Swedish sanctuary. And, most of all, thank you for 'taming' my wild associations and for insisting on 'closing down down down', without which this dissertation would never had come to an end.

Furthermore, I owe great thanks to my 'academic family' – the TIP (Technologies in Practice) research group – for their encouragement and support. A very special thanks to Christopher Gad for always having the time and energy for talks, jokes and beers, and for always caring to explain complex concepts and theories to me. Casper Bruun Jensen, despite of being located on the other side of the planet you are probably the one who knows this dissertation best besides (maybe) me. Thank you for 'editing' in the absolutely broadest meaning of the word. Your changes, suggestions, and comments have improved the dissertation immensely. Also, great thanks to other 'tipsters,' Marisa, Steffen, Mark, Irina, Laura, Ingmar, and Rachel for inspiring 'STS salons', productive 'shut up and write' sessions, and fun board gaming nights.

During my time in TIP we were lucky to have wonderful guests visiting. Thank you Helen Verran, Adrian Mckenzie, John Law and Lucy Suchman for generously commenting on my work in progress. And thank you Lucy for hosting me at Lancaster University. Without my fellow PhD students, James, Louise, Signe, Antonia, Naja, Karen, Sebastian, Line the process of doing a PhD would never have been so rewarding and so much fun. Especially, I am indebted to my two joyful office mates, Anne Katrine and Marie. Thank you for listening to loose ideas and firm frustrations and for making me laugh at even the worst days.

A great thanks goes to everyone involved in the *LAGI2014* project. Especially, I would like to thank Elizabeth Monoian, Robert Ferry, Else Marie Bukdahl, Trine Plambech, Anne Sophie Witzke (again), Ida Egedal Henriksson, Gry Krogager Lund, Stine Kondrup, Annelie Jepsen, Mikkel Svane-Petersen, Rina Bjørn, Mie Weile, Mette Hermannsen, Philippe Bonnet, and Natalie Mossin for making the project flourish with me.

Though time spend with friends and family has lately been (way too) scarce, getting though these years would not have been possible without your support and your ability to make me (occasionally) forget about work. Thank you Line for following me through every scary loop of this roller-coaster ride – no matter how dizzy and confused I got you helped me to stay on track and could always explain exactly what my dissertation was about – both to others me! Thank you Kira for refreshing and reassuring sauna talks about PhD-life. 'Urkoner' and 'Thurø-piger,' thank you for providing a safe haven. Thanks Nynne and Cecilie for housing, talking, and holidays. And thanks, Namaste, my yoga teacher, who literally stretched me through this PhD.

Not least am I unconditionally grateful to my wonderful family. Thank you Sister for making sure I did not starve (or lived solely on junk food) and thank you for dog walks and pep talks when my brain stopped working. And thank you Mom for patiently listening to my endless moaning and for understanding my continuous postponement of our holiday – now it's time to go!

Lea Schick,
IT University, June 22, 2015

Abstract

Rising energy consumption, access to fossil fuels, and not least climate issues have put energy infrastructures on the agenda in many parts of the world. How to redesign electricity infrastructures in ways that ensure stable, affordable and 'clean' energy production? Denmark has set the ambitious goal to show the world that it is possible to replace all fossil fuels (including for transport and heating) with renewable energy, primarily wind, and thus become CO_2–neutral before 2050. An integral part of a 'green transition' in Demark, and in many other countries, is a so-called smart grid, which can handle distributed energy production and ensure 'flexible electricity consumption'. The smart energy infrastructure should ensure that electricity is consumed as the wind blows and it thus designates new forms of involvement of end users. Whereas the current electricity infrastructure has been carefully designed to be invisible, unnoticed, and un-engaging, a green transition will most likely make energy more visible and one of the major challenges proves to be how to re-design for more and for 'the right' kinds of energy engagement. This challenge is not only taken up by engineers and policy planers, but also by artists and designers.

This thesis investigates different experimental cases within Danish smart grid planning and within art and design. Each case raises the issue of engagement differently. Grounded in science and technology studies (STS) energy engagement is here taken to be a dynamic and changeable 'thing' emerging through socio-technical relations and infrastructural environments. As the different cases 'compose' relations between people, energy, infrastructures, and environmental issues differently, they make possible specific kinds of engagement and not others. It is the specific compositions of energy engagement and their potentiality that is central to this dissertation.

In concert with a growing body of literature within social science and humanities the dissertation seeks to expand approaches to energy that mainly focus on its technological and economic aspects. Instead, passing through the notion of engagement the dissertation is concerned with broadening our analytical and practical understanding of energy. Taking seriously the urgent need for radical energy transitions the main contribution of the dissertation is to describe and analyze and to move between various attempts to 'speed up' and 'slow down' reasoning in cases of composing energy infrastructures. The dissertation highlights how energy can engage both engineers and artists, and illustrates the importance of keeping very different actors in the picture if the goal is to stay open and experimental with regards to which kinds of future energy engagements and sm/art infrastructures are possible and desirable.

Table of Contents

Part 1

Dissertation Framework

1. Introduction

> The government will make Danish society future proof by establishing a green growth economy and by converting to an energy and transport system based on 100% renewable energy by 2050. Such an enormous conversion is a huge task, so we must start right now.
>
> (*Our Energy Future*, Ministry of Climate, Energy and Building, 2011)

> It is time to compose—in all the meanings of the word, including to compose with, that is to compromise, to care, to move slowly, with caution and precaution. That's quite a new set of skills to learn: imagine that, innovating as never before but with precaution!
>
> (*Attempt at a Compoisitionist Manifesto*, Bruno Latour 2010:487)

In many parts of the world, energy infrastructures are in urgent need of innovative redesign towards less CO_2 intensive solutions. As for Denmark, the country has set out on a mission to show the world that it *is* indeed possible to make a complete conversion of the current electricity infrastructure to renewable energy no later than 2035. The ambition is furthermore to replace all fossils-based energy with clean electricity by 2050. This major innovation task would ensure 'green growth' and, not least, place Denmark as a world leader of clean energy technologies. Politicians tend to emphasize that the transition to a carbon-neutral energy future will *not* compromise living standards (KEBMIN 2011b, 2013a). Yet, it is more realistic to assume that such profound infrastructural redesigns will likely influence large parts of the society. With 35 years to make a complete energy transition these ambitious goals place Danish politicians, infrastructure planners, and engineers in a race against time. With reference to the French philosopher of science and technology Bruno Latour, we can say that it is indeed time to innovate like never before.

Modern infrastructures in general, and the electricity grid in particular, are vital to, even constitutive of, much of everyday life in industrialized parts of the world. Yet, infrastructures operate mostly as invisible and naturalized backgrounds about which the general public needs not to care. In fact, the electricity infrastructure has been so carefully designed to be invisible, unnoticed, and un-engaging, that it is presently very challenging to re-design for more public visibility and engagement. This dissertation deals with that challenge: the making visible of energy. More specifically, it deals with how different experimental projects across the fields of infrastructure planning and the arts are trying to make energy a topic of public engagement in new ways. It also deals with how people are assigned and/or take on new roles in relation to energy and the environment as part of these processes.

This dissertation explores the Danish energy transition by focusing specifically on the innovations and forms of policy planning that have been taken place in relation to a new intelligent electricity infrastructure, better known as *the smart grid*. Parts of my fieldwork were carried out with a national Smart Grid Network appointed by the Minister of Climate and Energy in 2010. Over a three year period, the network developed a national *Smart Grid Strategy* (KEBMIN 2013b). According to the Ministry of Climate Energy and Building,[1] the smart grid is an integral and necessary part of the Danish transition to renewable energy. Because wind and sun are intermittent and fluctuating energy sources, electricity consumption needs to be made 'flexible' so that it can follow production. Said differently, we need to use electricity when the wind blows and the sun shines. According to the Danish Smart Grid Strategy: "the development of a smart grid depends primarily on whether consumers see a value in making their flexible consumption available" (Ibid.). Here we see new roles and capacities being ascribed to consumers who are expected to become 'more involved' in their energy consumption in new and only vaguely defined ways. Not least, smart grid is presented as an opportunity for "consumers to become involved actively in the green transition and it allows for the development of a host of new services for the more high-tech consumers" (Ibid.). Such new relations between people and energy are among the topics I explore below.

[1] The Ministry of Climate and Energy was in 2011 changed to the Ministry of Climate Energy and Building. The Danish abbreviation of the ministry is KEBMIN (Klima-, Energi-, og Bygningsministeriet http://www.kebmin.dk/), and this is used for all reports published from the ministry.

The task of *re*-infrastructuring for a CO_2 neutral society is of course rather daunting: we might imagine that it would pose great challenges to technical innovation. Yet, among infrastructure developers in Denmark the general opinion seems to be that the technological solutions by and large already exist. As far as they are concerned, the more difficult challenges take organizational, political, and social form; they concern questions such as which institutions and actors to include, and how to distribute roles and responsibilities among them (DanGrid 2012:11). One of the major puzzles is how to make 'ordinary people' engaged in the 'right' way – how to turn them into 'flexible smart grid consumers'. Furthermore, the thousands of wind turbines currently being erected in the Danish landscapes have provoked, and will most likely continue to provoke, public reactions to the increasing visibility of energy production.

As the roles that people can and do take in relation to energy have multiplied, infrastructure planners and engineers see a surging interest including social science and humanities in transition processes (e.g. Horizon2020 Vilnius Declaration 2013; Sovacool 2014). Simultaneously, and not at all surprisingly, an increasing number of social scientists are engaging with a variety of social, political and ethical issues around energy (e.g. Chilvers and Pallett 2015; Miller *et al.* 2013; Sylvast *et al.* 2013; Urry 2014). Responding to dominant and quite narrow techno-economic approaches to energy consumption and infrastructure development, social scientists now argue for multiplying and nuancing notions of energy. They also advocate the deployment of perspectives capable of taking into account forms of human action and motivation. As I discuss in chapter three, these efforts can be generally described as a shared endeavor to widen the imaginary scope of energy innovation, and to expand the range of disciplines and actors included into the development of future energy systems. With this dissertation I join this venture, as I explore the arts as a field for studying and experimenting with energy and energy engagement. Having constructed my research field across art and infrastructure planning, the thesis investigates two cases of smart grid planning and two cases of art projects related to energy and engagement.

The majority of social science and energy researchers argue that in order to design good new energy systems it is important to begin with the examination of existing practices of domestic energy consumption, and to inquire about what people already *do* and what they *care about* in relation to

energy. No matter how important this approach is, my ambition with this thesis is something different. In brief: I am more interested in what people *may* come to do and what they *can be brought to* care about. Rather than looking at energy engagement as an actually existing form – what there is – I am thus interested in looking at energy as potentiality – what it may become (Gabrys 2014; Stengers 2003).

Thus, I explore questions that include: How are people imagined to participate in (new) ways in future energy systems? Which technologies, incentives, and other kinds of values are imagined to and can potentially foster energy engagement? Which roles may environmental issues play in relation to the involvement of people? In short: how can energy engagement be composed and recomposed?

In line with science and technology studies (STS), I approach infrastructures as complex socio-technical systems configured by and co-constructing human practices and matters of concern (Bijker and Law 1992; Edwards 2003; Hughes 1993; Star and Bowker 2002). More specifically, I am inspired by a particular wing within STS that is concerned with emergent infrastructures and technologies as ontological and world-shaping actors (e.g. Jensen 2010; Latour 2008, 2010; Marres 2012; Watts 2007, see chapter four). From this position, I see the re-design and re-composition of existing energy infrastructures as holding potentials for the re-design of energy practices and energy engagements.

In the four different cases analyzed below, people are brought into relations with new technologies, infrastructures, energies (in different forms and shapes), and with various configurations of environmental issues. I see these as experimental 'compositions', which may or may not give rise to new engagements with energy. Now, returning to the opening quote by Latour, if infrastructure development holds potentials for recomposing energy engagements and environmental relations, then we can start to see why it is important *not only* to innovate as never before, *but also* to 'slow down' and innovate with precaution (Latour 2010; Stengers 2005). It may seem odd to advocate for a 'slowing down' in a time where we are, some would argue, in an urgent need of an even faster transition. However, the call for hesitation and precaution that I here take from Latour and the Belgian philosopher of science Isabelle Stengers is not counter to a progressive and enduring transition, but it resists taking for granted what *needs* to be done and what *can* be done. A slow

innovation is one that carefully interrogates thinkable and unthinkable ways 'forward'. Throughout this dissertation I attempt retaining this ambivalent tension between slow precaution and profound progressivity. It is from within the space of this tension that I explore the potentials of new infrastructural compositions for energy engagement.

Reading Guidelines: presenting papers and chapters

The dissertation consists of two parts. **Part One** provides an introduction to the issues of research and the empirical field and sketches out the theoretical and analytical framework based on which the paper have been written.

Part Two consists of four main papers (a short paper and three peer-reviewed journal papers) and two shorter texts (an essay and a symposium description). For the sake of simplification, I refer to all of the texts as papers. In general, the thesis provides a journey into different worlds in which energy engagements are imagined and made. In the four main papers I analyze four different cases – two cases within smart grid planning and two cases of art projects.

In **paper one**, *Powering Ecological Futures* (2011), I analyze two artworks: *Natural Fuse* by Usman Haque and *Nuage Vert* by the artist duo HeHe. **Paper two**, *Innovating Relations – or Why Smart Grid Is Not Too Complex for the Public* (2013), offers an ethnographic study of a smart grid innovation delegation trip to Germany. Through document readings and interviews, I continue to analyze the work of a Danish national Smart Grid Network in **paper three**. Finally, in **paper four,** I analyze the process of implementing the art project *Land Art Generator Initiative* (*LAGI*) in Copenhagen in 2014. In this process, I worked as the main project manager, which gave me the chance to not 'only study' art and energy, but also to intervene practically in the field (see more on this process in chapter five and six).

The research conducted for this dissertation has been experimental in several ways. It has been an experiment in studying and acting across different disciplinary fields not often combined. And it has been an experiment in simultaneously researching *and* intervening in the field. Finally, have I attempted

to talk to different audiences, fellow scholars, artist, politicians, engineers, and various publics. In order to reflect the diversity of my actual research engagements, I have chosen to include a short essay written for a book published as part of the *LAGI* project. Thus, **paper five** was an exercise in non-academic writing. And **paper six** is a description from the symposium "*Environmental Entanglements - Art, Natures and Technology"*, which I was organizing (October 2014). Whereas the first four papers are more classical contributions to be found in an article based PhD, I have chosen to include the last two 'papers' in the dissertation – rather than attaching them as appendix – in order to stay true to a general argument I will make through the dissertation, namely not to distinguish between what counts as 'real' or 'primary' – in this case academic – knowledge. I see all six papers as essential parts of my knowledge-making practices and thus as vital for the dissertation in general. Résumés of the papers, along with more reflections on the process and format of making a paper based PhD, can be found in chapter six.

Given that the papers are written *with* different co-authors, *for* different journals, special issues, and other purposes, and not least *at* specific moments throughout the research process, they are very different in style and form. Therefore, the purpose of **Part One** is to articulate a common framework through which the papers can be read. In **chapter two,** I introduce the general challenges of energy transitions. Here I present the Danish energy vision and I explain the basic workings of the smart grid. In **chapter three,** I provide a literature review of the relevant research on smart grid and other forms of energy engagement. As the literature, especially on smart grid, is mostly written within the past few years, and thus did not exist prior to my own project, this outline serves the double purpose of examining a new and emergent research field and of placing my own research in relation to it.

In **chapter four,** I sketch out the philosophical and analytical landscape, which inspired and guided my research. In contrast to the more eclectic bodies of theory presented in the articles, I have deliberately written this section as a narrative, which takes the reader on an intellectual journey through selected works of the French philosopher of science and technology Bruno Latour. As I explain, this journey – including Latour's meetings with the German philosopher Peter Sloterdijk and the Belgian philosopher of science Isabelle Stengers – inspired me to study the *potentiality* of energy and to construct my empirical field across art and infrastructure planning. In **chapter five,** I present the

empirical material of the four different cases followed by a few methodological reflections. In **chapter six** I provide résumés of the individual papers. Simultaneously, relating the articles to the general framework, this chapter also serves the purpose to sum up the main arguments and contributions of the thesis. The paper résumés thus form the foundation for a few ending reflections in **chapter seven**.

On this note, let's begin with an introduction to the transitions and challenges faced by current electricity infrastructure.

2. Energy In Transition

In the following, I introduce the Danish energy system and current visions and plans for a low-carbon energy future. As I discuss these visions for an intelligent infrastructure and 100% renewable energy I also examine ways in which they entail new ways of engaging with electricity.

Electricity systems are critical infrastructures for modern society (e.g Hughes 1993). A tremendous amount of work goes into planning, maintaining and developing electricity grids in order to ensure stable electricity at an affordable price. At the same time, energy consumption is rising in many countries, and thus changes to electricity infrastructures are planned and implemented around the world. Whereas many developing countries are still rolling out national energy systems or local micro-grids, here I am concerned with the Danish system, which already has a long legacy. Thus, when I refer to electricity infrastructures in the following, my discussion is restricted to the kind of energy systems operating in most industrialized countries.

Current electricity infrastructures face several challenges. For one thing, the increase in electricity consumption – especially during peak-hours – pose problems for the capacity of the existing power cables in many countries, Denmark included. One prevalent answer to this challenge is to advocate for energy reductions, expansions of the existing copper cables, and management of energy demand. But there are other challenges, such as energy security and the fluctuating, but generally ricing, prices of fossil fuels. Political conflicts in recent years (i.e. in Ukraine, Russia and concerning the geopolitical race to the North Pole), as well as concerns about the finite nature of fossil fuels, have motivated many countries to plan for more energy independency. Not least, the rising attention to CO_2 emission and global warming over the past decades has put pressure on fossil-based electricity systems. Electricity production currently is the biggest source of CO_2 emissions (32%).[2] Countries around the world are thus seeking to find alternative, low-carbon (or carbon-neutral) energy sources for electricity production, though arguably not fast enough.

The professor of science and technology studies (STS), Sheila Jasanoff (2013) has shown that, 'socio-technical imaginaries and national energy policies'

[2] http://www.epa.gov/climatechange/ghgemissions/sources/electricity.html

diverge from country to country. Depending on different social and political notions on risk, and on varied interpretations of the benefits of energy, that is, countries create different visions and generate different answers to the question of what is entailed by more environmentally friendly electricity infrastructures. Some countries hold nuclear power to be the best solution for a low-carbon energy future, while other countries praise a green solution centered on bio-fuels. Yet others work towards an energy future based on wind and other renewable energy sources. Common to must energy imaginaries and policies, however, is the premise that new energy systems must not decrease living standards. The excruciatingly slow and reluctant process of these energy transitions is often accompanied by a high degree of hype, promoting hopes for a better, greener and richer future. Below I describe the Danish national energy strategy, which is regularly presented as the most ambitious climate strategy in the world (KEBMIN 2011b).

The Danish Climate and Energy Vision

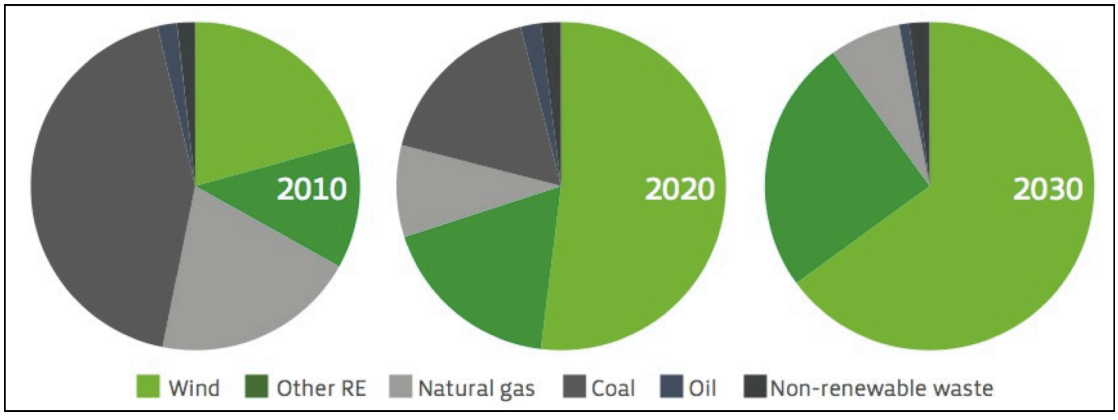
In 2010, the year after Copenhagen hosted COP15, the Danish Commission on Climate Change Policy published the document "Green Energy – The road to a Danish Energy System without fossil fuels" (Klimakommisionen 2010). The document outlines how Denmark can replace all energy sources with renewable energy and become CO_2-neutral before 2050. This plan was followed by a number of climate and energy plans since, including "Our Energy Future" in 2011 (KEBMIN 2011b). In March 2012 the Danish Government passed an important energy legislation, covering the energy transition from 2012-2020. The agreement was supported by all Danish parties (Danish Government 2012). In the Danish government, energy and climate management is the responsibility of the Ministry of Climate, Energy and Building (KEBMIN).

As mentioned, the green transition in Denmark includes electrification of sectors such as the transport and heating. This will cause an estimated energy increase of around 100%, which should all be covered by renewable energy, wind being the main source. Today, around 40% of electricity consumption is covered by renewable energy. By 2020, this number should be increased to 50%, and by 2035 all current electricity should be covered by renewables (KEBMIN 2013a).

The national climate plan emphasizes that its ambitious goals are in line with the recommendations made by IPCC (Intergovernmental Panel on Climate Change) and with the EU goals of reducing CO_2 emissions by 80-95% before 2050. Denmark has set as its goal to be a pioneering country, showing the world that "it is possible to reduce [CO_2] emissions significantly. And we shall show that the green transition can be reconciled with sustained economic growth and welfare" (KEBMIN 2013a:10). Climate and energy plans stress that the green transition will prove to be the cheapest way to sustain current standards of living. The report *Our Energy Future* recommends three key initiatives to phase out fossil fuels completely: energy efficiency, electrification of other energy sources, and expanding the supply from renewables (KEBMIN 2011b:7).

The Danish Energy System

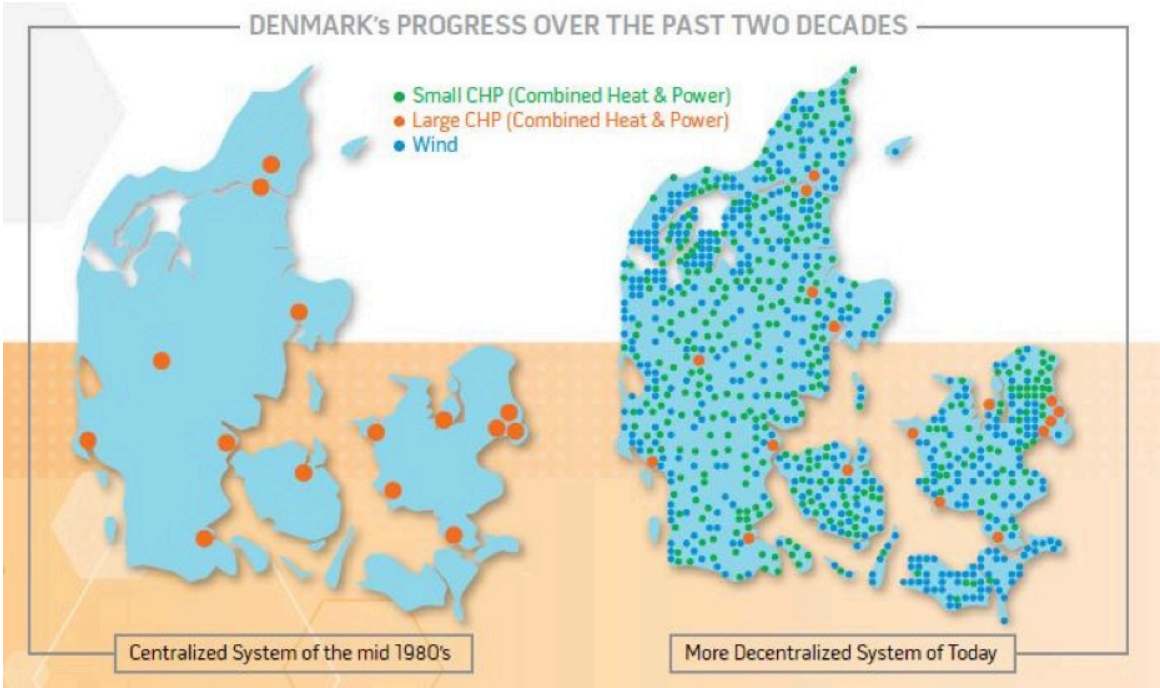
In 2014, 39,1% of the national electricity consumption in Denmark was covered by wind.[3] Solar energy covered 1,5% of the overall electricity consumption. Around 40% of the electricity came from coal. The remaining electricity is based on oil, natural gas, bio fuels, and waste-to-energy incineration. Denmark furthermore has plans for scaling up the use of wave energy, and a national test center for wave energy has been set up. Over the longer run, solar and wave energy is meant to play an increasingly significant role in the energy system (KEBMIN 2011b:11).



Electricity production by energy source: Our Energy Future (KEBMIN 2011:20)

[3] http://energinet.dk/EN/El/Nyheder/Sider/Vindmoeller-slog-rekord-i-2014.aspx

On average, a Danish household consumes around 4 MWh a year, and the average emission of CO_2 per inhabitant is 7.6 tons.[4] Denmark has a well-developed district heating infrastructure, a combined heat and power system (CHP), which covers 2/3 of the population. This system is regarded as an important actor in the transition to renewable energy, among other things because it can function as storage for wind energy.[5] An important part of the energy plan is to create synergy between the different infrastructures (transport, agriculture, heating, water, electricity) making them work as back-ups for one another (Frank Elefsen, ElForsk 2012). Households not covered by district heating mostly have oil-burners, but a law has been passed for phasing them out before 2050. They are meant to be replaced by electrical heat pumps. With the rapid emergence of private solar panels (around 90.000 home-owners), land and offshore wind farms and the many CHP power plants, over the two past decades the Danish energy system has undergone a drastic change. Today it is one of the world's most distributed energy systems.



Distributed system: Development of Danish power system. Frank Elefsen (Danish Technological Institute), power point presentation, Munich 2012

[4] http://www.ens.dk/info/tal-kort/statistik-nogletal/nogletal/danske-nogletal
[5] http://www.fjernvarme.info/Forside.187.aspx

The Danish transmission grid (high-voltage energy system) is operated by Energinet.dk, a non-profit enterprise owned by the Ministry of Climate, Energy and Building. The grid is one of the most stable energy supply systems in the world, having seen no blackouts in the transmission grid since one occurred in the eastern part of Denmark and southern Sweden in 2003. An important part of the stabile power supply is that Denmark is closely linked to the other Scandinavian and the Baltic countries, and to Germany and UK through the electricity trade market Nord Pool Spot, which is Europe's largest market for electricity. This features as an important component in the future smart grid, because electricity can be ex- and important according to demand.

Around 70 grid managers take care of the distribution to consumers (middle-voltage). It is this distribution grid that is now stressed during peak-hours. Until 2003, the company DONG (primarily owned by the state) had a monopoly on electricity production. A liberalization of the energy system is ongoing, and today Danish consumers can choose between 50 utility companies. Yet, since the monopoly was broken only around 12% of domestic consumers have chosen to change supplier (interview, Dansk Energi, November 2013). A newly established DataHub collects all energy consumption data and it should function as a portal for consumers providing them an overview of they consumption and making it easier to change provider.[6] It is the hope that consumers will in the future make more use of a liberalized energy market, thus changing provider responding to supply and demand. Today, there is however little economic incentive to change utility company, because the prices do not vary substantially (Elpristavlen). The main reason for consumers to change provider today is environmental, as a number of utility companies offer wind energy.

Due to high energy taxes, covering around 90% of the electricity price, Denmark has the highest household electricity prices in the world (Eurostat 2012). In spite of the price-level, however, the level of energy poverty is relatively low in Denmark and it is rarely discussed in Danish energy politics. In general, indeed, electricity supply and energy security is not something that people pay much attention to in their everyday life. Nonetheless, wind power appears to have become part of the Danish national identity.

[6] http://www.energinet.dk/da/el/Datahub/Sider/DataHub.aspx

Wind Energy in Denmark

Due to a very strong anti-nuclear movement in the 1970s, Denmark has no nuclear power. During the 70s oil crisis, attention instead turned to the development of wind energy (Kruse and Maegaard 2002). Tax legislations favored locally, community-owned windmills, which gave rise to the now famous Danish model of mill cooperatives (guilds).

> The many cooperatives turned wind power into 'the People's project,' and by the end of the 1980s, some 3.000 privately owned wind turbines had been installed (Karnøe 2014:36)

These cooperatives were very important for creating the success story of Danish wind energy (Garud and Karnøe 2003). Later, however, tax regulations were changed and today large investors own many of the wind farms.

By January 2015, Denmark has a total of 4753 on-shore and 519 offshore wind turbines.[7] Windmills 'decorate' large parts of the Danish landscape. With both Vestas and Siemens Wind Power placed in Denmark, wind turbines are an important part of Danish export and identity. A new test center for large wind turbines Østerild, was opened in the north of Jutland in 2012. Here the world's tallest (222 meter) and most powerful wind turbines (8 MW) are now tested and the center is an important part of the Government's strategy to make Denmark into an innovation center for 'green technologies' (KEBMIN 2011b).

Though the population is generally supportive of renewable energy, both the test center and the rising numbers of wind turbines have led to local, public resistance and protests. The so-called Not In My BackYard (NIMBY) also exists in Denmark, and lately there have been dicussions in the media around the placing of on-shore wind turbines.[8] Without doubt, it will be a challenge to find locations for the 1.800 MW of wind power, which must be added to the system over the coming 5 years (KEBMIN 2013a). The Nature Agency, an administrative department under the Ministry of Environment, is responsible for the siting of on-shore wind turbines. The agency runs a number of initiatives in order to "involve citizens in the process of planning while they are still able to effect the

[7] http://www.ens.dk/en/supply/renewable-energy/wind-power/facts-about-wind-power/facts-numbers
[8] http://www.vesthimmerlandsavis.dk/index.php?id=95&no_cache=1&tx_ttnews%5Btt_news%5D=15698 http://www.information.dk/463918 http://www.bt.dk/danmark/modstanden-mod-kaempevindmoeller-vokser

decision."[9] Meanwhile various organizations (public and NGOs) for and against wind participate in the debate about the co-existence of people and wind turbines.

Smart Grid – managing fluctuating energy

The rising amount of wind energy in the grid pose further challenges, which according to the Danish government (and to energy infrastructure developers in many other countries), is likely to make energy increasingly *visible* in peoples' everyday lives. Thus, the government emphasizes that:

> Fifty percent of wind energy in the electricity system is a challenge for security of supply, but it can be managed, if at the same time Denmark moves towards a more intelligent energy system with flexible electricity consumption (KEBMIN 2011b:20)

In Denmark, the making of an intelligent energy system – smart grid – is seen as prerequisite to achieving 100 % renewable energy. The particular challenge of using wind, sun and other renewable energy sources is that they are intermittent and fluctuating. Stated simply: there is energy when the sun shines and the wind blows. In contrast with fossil fuels, which allow energy production to be fitted to demand, renewable energy requires a reversal. In the future, that is, electricity consumption must *follow* production. Energy storage in such large amounts is yet regarded as too expansive and thus not a viable solution (Dansk Energi and Energinet.dk 2010).

In 2010 The Danish Energy Association, Dansk Energi, and the national transmission system operator (TSO), Energinet.dk, in 2010 conducted a cost-benefit analysis, which concluded that:

> Smart Grid is the most effective and cheapest way to improve the electricity grid making it able to handle the challenges of the future (Dansk Energi and Energinet.dk 2010:5).

[9] See Nature Agency on citizen involvement in wind turbine placing http://naturstyrelsen.dk/planlaegning/planlaegning-i-det-aabne-land/vindmoeller/borgerinddragelse/

Based on this analysis, the Minister of Climate and Energy, Lykke Friis, appointed a Smart Grid Network with the mandate to offer recommendations on how to built the future Danish smart grid. The Smart Grid Network included actors from universities, utility companies, grid managers, technology developers, public and private institutions, industry and private businesses.[10] This followed a general Danish tendency, according to which infrastructural development happens in close collaboration between government, academia and industry. The distinction between public and private is in Denmark somewhat less clear than in many other countries. Alongside its general focus on exporting clean tech and energy technologies (in 2013 energy technologies accounted for 10,8% of the combined goods export),[11] the Danish government and industry also aims to become a world leader in smart grid technologies. In 2011, the report *Denmark: a European Smart Grid Hub* mapped all Danish smart grid competences and projects (CCC 2011). According to a similar mapping of European smart grid projects made in 2014, Denmark is the country in EU with the highest investment in smart grid projects (Catalin *et al.* 2014:10).

Over the course of three years, the Smart Grid Network and its key actors published a number of reports offering recommendations and possible solutions for the future smart grid (DanGrid 2012; Energinet.dk 2011; KEBMIN 2011a, 2012, see more in chapter five page 77). Based on this work, the Ministry of Climate, Energy and Building published the national *Smart Grid Strategy* in May 2013. The strategy was aiming to set

> the course for development of a smart grid which can make this green transition cheaper, provide savings on electricity bills and help promote new services and products to the benefit of consumers (KEBMIN 2013b).

The strategy served the purpose of creating a shared roadmap for Danish smart grid actors. At the launch of one of the reports, the new Minister of Energy, Climate and Building Martin Lidegaard (successor of Lykke Friis) announced that:

[10] The original policy document from 2010 lists 26 experts but new members joined and some left the network.

[11] Denmark is primarily known for export of wind turbines from Vestas and Siemens Wind Power https://stateofgreen.com/en/news/danish-export-boom-in-green-energy-technologies

> Smart grid development can go in so many different ways. With this work we have a shared strategy, which ensures that all actors work on the same project. This will save money and time. With this strategy we have paved the way for a smart grid future (Smart Grid event, Danish Architecture Centre, May 2012)

In paper 3, I provide an analysis of the work conducted by the national Smart Grid Network. In paper 2, I compare a Danish smart grid diagram with a related German vision. Hence, I am not presently going into details with the Danish smart grid system but I instead introduce some of the common functions, ideas and implications of smart grid. This presentation is based on three years of fieldwork (see chapter 5), on the secondary literature on smart grid (outlined in chapter 3), and on information from the EU Commission's Smart Grid Task Force (Catalin *et al.* 2014; EU 2011). In accordance with the emphasis of the overall dissertation, this discussion also stresses the envisioned role of the consumer.

The concepts of 'smart grid', 'smart energy', or 'intelligent electricity infrastructure' increasingly guide energy visions. They are, for example, important areas of investment in innovation and funding programs such as Horizon 2020[12] and the US Government Recovery Act.[13] Yet, although the concept of smart grid is used by many different actors, presumably referring to the same thing, smart grids look quite different depending on where one looks. Configurations of smart grids depend, for instance, on whether a country has nuclear and/or hydropower. They also depend on privacy protection laws and degrees of privatization of infrastructures (EU 2011). In spite of these differences, the following description paints a picture of some general, commonly shared ideas. In other words, I begin by describing smart grid *as if* it was a singular object, thus not accounting for the uncertainty, instability, and variable ontological status of smart grid (Jensen 2010, see also paper 2). However, the aim of the present description is simply to offer an overview of the general visions and operations of the smart grid.

As outlined above, current western electricity systems are faced with various technological, environmental, social and regulatory challenges. In this context, smart grid presents a promising solution to these uncertain and challenging energy futures (Verbong *et al.* 2013:121). The current electricity grid

[12] http://ec.europa.eu/programmes/horizon2020/en/h2020-section/secure-clean-and-efficient-energy
[13] http://energy.gov/oe/information-center/recovery-act
https://www.smartgrid.gov/the_smart_grid#smart_grid

was developed over a century ago. It provides a one-way delivery of electricity *from* production *to* consumers, whose only interaction with the utility companies is to pay the bill. This system is now seen as 'outdated,' both because its capacity does not match rising energy demands and because it was not built to handle distributed electricity production from a variety of energy sources.

The 'smart' grid is often presented as an 'upgraded' version of the 'old-fashioned' and 'dumb' grid. Its 'smartness' consists in augmenting the existing infrastructure with layers of information technology, which will transform the grid by making it 'two-way,' such that both electricity and information can be exchanged between consumers and system operators. Further, instead of enlarging the existing copper cables, smart grid aims to ensure that they are intelligently utilized. In the power grid, demand and supply has to be constantly balanced in order to avoid blackouts. Demand side management intends to ensure that energy demand is transferred to times where there is a surplus of electricity, which is thus also cheaper. The main idea is thus that energy demand must be measured and controlled on a second-to-second basis, making it adaptable to the current grid load. In a Danish context smart grid is thus described as the glue that connects a distributed and diverse energy infrastructure.

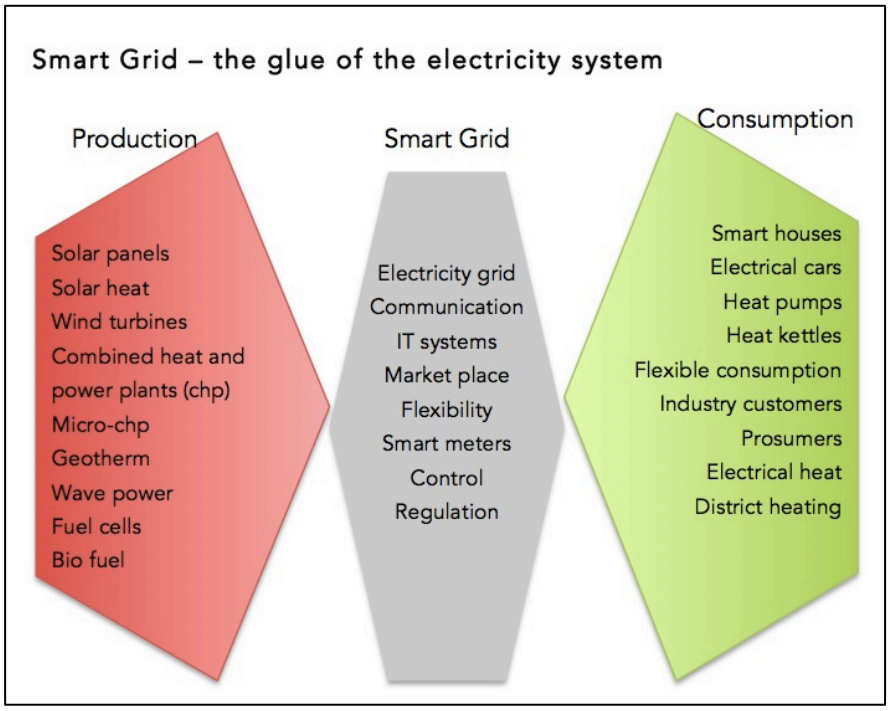


Illustration of Danish Smart Grid[14]

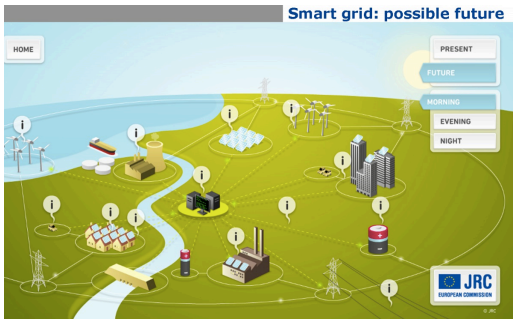
[14] From the webpage of Minister of Climate, Energy, and Building. My translation. Original version: http://www.kebmin.dk//klima-energi-bygningspolitik/dansk-klima-energi-bygningspolitik/energiforsyning-effektivitet/smart

Moving electricity demand away from peak-hours will ease the pressure on the grid; in turn allowing for larger shares of renewable energy. This depends on creating 'grid flexibility' (EU 2012); that is, making electricity *consumption* flexible. This adjustment can happen either by making consumers to turn on and off their electrical devices or by implementing automatic systems reacting to price signals. Either way, electricity consumption can be utilized as a balancing mechanism for grid managers:

> The implementation of more active transmission, distribution and supply systems in the form of Smart Grids is central to the development of the internal market for energy. The drive for lower-carbon generation, combined with greatly improved efficiency on the demand side, will motivate consumers towards greater interaction with the energy supply system (EU 2012:1)

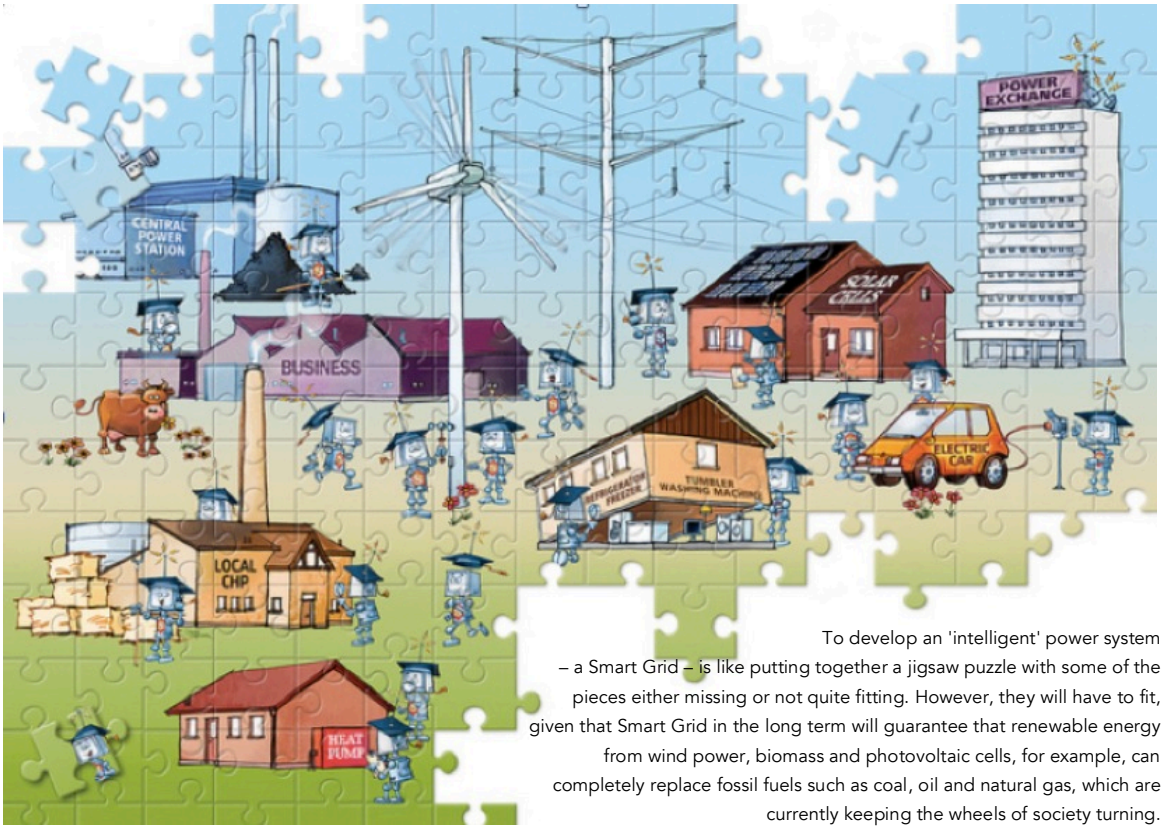
As this brief description suggests, the smart grid is a complex system comprised by lots of actors. A partial list might include information technologies and power cables, control operation rooms, aggregators, energy data bases, distributed energy resources (DER), heat pumps, electrical vehicles, smart meters, flexibility products, home automation systems, smart houses, industry, standardized IT protocols, IT security systems, hourly settlement and flexible tariffs, new flexibility markets, private solar panels, wind turbines, storage units, transnational energy highways, consumers, costumers and, indeed, 'prosumers' (see page 23).

Below I show three different visualizations of smart grids:



EU model for Smart Grid
http://ses.jrc.ec.europa.eu/we-nutshell

US Government model for Smart Grid
https://www.smartgrid.gov/the_smart_grid/smart_grid



Danish depiction of smart grid from Denmark Opts for smart Grid (DanGrid 2012)

As the quote accompanying the last picture describes, the difficult thing is to figure out just how these heterogeneous actors should be connected and, not least, how to distribute roles and responsibilities between them (DanGrid 2012; EU 2011). Among the more puzzling actors are the consumer and the domestic household. According to the EU Commission's Smart Grid Task Force

> "As far as smart grids demonstration and deployment are concerned, key obstacles and challenges still appear to be at the social and regulatory levels (rather than technical constraints) … the way the smart consumer will act in the future electricity grid is still surrounded by uncertainty and researchers are developing tools and approaches to better understand the role of the future electricity prosumer" (Catalin *et al.* 2014:11,98).

Also in Denmark smart grid developers often emphasize that most of the technical innovations already exist, whereas the real difficulty is how to 'correctly' engage consumers (see more in paper three). In spite of the uncertainty surrounding the role of consumers, most smart grid visions consistently emphasize the need for a more active consumer. This is a consumer that will

interact with the grid and utilities in new ways, and who, in general, will be more engaged in energy consumption and, possibly, production.

> The development of a smart grid depends primarily on whether consumers see a value in making their flexible consumption available. There are several ways to encourage consumers to do so. Firstly, consumers want a financial incentive, however flexible electricity consumption also makes it possible for consumers to become involved actively in the green transition and it allows for the development of a host of new services for the more high-tech consumers. (KEBMIN 2013c)

This quote, from the Danish *Smart Grid Strategy* (2013), nicely exhibits the role of the consumer: 'to deliver flexible consumption', and the dominating incentives imagined to make people participate in the hoped for ways. Whereas financial incentives are prevalent in many strategies *(Strengers 2013; Verbong et al*. 2013), the increased level of consumer involvement is also often presented as an *opportunity* for people to participate in environmental transitions.

Delivering flexible consumption can happen either "through customers *or* appliances connected to the power system changing their behavior – as and when requested – to fulfill the needs of the power system" (KEBMIN 2013c). In spite of the emphasis on green consumers, however, the 'active' customer choosing to turn on and off devices according to wind and sun and grid load tends to fade into the background. He or she is 'out-battled' by the promising new technologies imagined and planned to emerge with the new infrastructures. An integral part of the future 'flexible' consumer is the 'smart house' and the various products and services it will equip him or her with. The idea of the smart house first emerged in the 60s (Strengers 2013; Taylor *et al*. 2006). In a smart grid context, the smart home refers to houses with smart meters, energy management systems (also often called 'home automation'), and smart grid ready appliances (Nyborg 2015). The most important domestic smart grid technology, which has already moved into many homes today, is the smart meter.[15] Smart meters enable 'flexible prices,' so-called time of use (ToU) prices and tariffs. Via digital infrastructure these meters send energy consumption data to the distribution system operators (DSO). The management of data and

15. 75% of Danish homes have smart meters installed today (January 2015) and the European Task Force for Smart Grid foresees a 80% rollout of Smart Meters in Europe by 2020 (Ctalan *et al*. 2012. p. 2).

privacy protection varies from country to country. In several places, they have caused controversies and even led to anti-smart meter movements (Krishnamurti *et al*. 2012). Probably due to a generally strong confidence in the Danish state authorities, and to the fact that the Danish state already collects much information about its citizens, however, there has not been much discussion about privacy issues in Denmark. Since 2014, all energy consumption data has been collected in a DataHub managed by the national TSO, Energinet.dk.

According to many smart grid visions, 'smart grid ready' products will inhabit future smart homes. These are products capable of reacting to changing prices and/or able to be controlled automatically from remote sites. Examples of such products include refrigerators, freezers, and washing machines; however the two most important technologies are heat pumps and electrical vehicles (EV). Because heat-pumps and EVs both use large amounts of energy,[16] they are particularly promising for activating flexibility: houses can be heated and cars charged during the night and outside of peak hours.

The control of home appliances can either happen manually, through programmed energy management systems, or through contract-based demand and response. Contract-based demand response entails that the customer hands over control of their device to a contractor, a so-called 'aggregator' (a grid manager or third party business, see more in paper three). Based on a predefined agreement, a service plan, the contractor then controls the appliances remotely. According to the aggregator model, as it is called in the Danish smart grid strategy, large amounts of heat pumps and EVs can thus function as 'storage capacity' and regulation mechanisms for grid managers.

Many smart grid strategies envision a future where such systems will function efficiently and automatically without consumers even noticing. However, alongside the automated systems, smart grid visions also often emphasize that smart grid technologies such as interfaces for energy visualization (either web based or on separate home displays) and energy management systems will enable individual consumers to become more aware of, and take increasing charge over, their energy consumption. It is believed that smart grid technologies will empower consumers by making their invisible energy consumption visible and manageable. Various services and apps, for example, can provide consumers with new and easier ways to interact with their home

16 An average Danish home with either an EV or a heat pump will have its yearly energy consumption doubled.

appliances even when they are away from home. Aside from activating flexible electricity consumption to the benefit of the grid, smart grid technologies should thus also 'make life easier' for people, helping them use less energy, and save money on the electricity bill (KEBMIN 2013b).

Another way in which some consumers are intended to become 'active' parts of the grid is through installment of solar panels, house wind turbines, and/or micro-CHP systems (Micro combined heat and power)[17], all of which can turn private households into producers of electricity. One reason why a new two-way grid is needed is precisely to enable electricity to flow *from consumers* to grids. The term 'prosumers' – a combination of producers and consumers – is commonly used to describe this new role (Catalin *et al.* 2014; Energinet.dk 2011; EU 2012; US Government web). The term prosumer originates from the Internet and Web 2.0 where consumers can produce and upload information and entertainment. The former Minister of Climate and Energy, Lykke Friis used this analogy as she launched the Smart Grid Network:

> The Internet has a younger brother. This is how the intelligent power grid could be popularly perceived. Just as the Internet revolutionized the way we communicate, the intelligent power grid will change the way we use electricity. In some years, it will seem completely natural to have our appliances constantly online, checking the actual price of electricity and starting the washing machine when the price is low (Energinet.dk 2011:3)

As part of the general digitization of society, smart grids are furthermore integral, infrastructural, foundations for wider strategies to create so-called smart cities (CCC 2012; Geisler 2013; Strengers 2013).[18] Smart cities, are places where ever-more information and data is digitalized, rendering it amenable to new and 'intelligent' forms of management and control. I will not delve further into this concept here. Yet, what is important to notice is that both smart cities and smart grids are infused with promises to empower and engage people by giving them

[17] A micro-CHP is a small personal power plant the size of a refrigerator. Using fuel cells it transforms electricity into hydrogen or natural gas when electricity is cheap and then back into electricity when it is beneficiary to sell electricity back to the system.

[18] See for example: Copenhagen: http://www.copcap.com/~/media/Copenhagen%20Capacity/PDF%20Publications/SPI%20PDFs/Executive%20summary%20-%20Smart%20City.ashx Australia: http://www.smartgridsmartcity.com.au/ Amsterdam: http://amsterdamsmartcity.com/projects EU Commission: https://eu-smartcities.eu/

more information and providing new ways of interacting with infrastructures – all of which is seen to facilitate citizen participation in environmental concerns.

Energy and Engagement

As is hopefully clear from my description above, the transition to renewable energy and smart grid depends on the emergence of new relations between people (consumers, humans, citizens) and energy. The visions and kinds of policy planning I have presented tender to a future in which energy will be a more visible part of everyday life. This prominence may show in as different ways as new forms of renewable energy technologies co-inhabiting land- and seascapes and mundane interactions with electricity and energy in the home.

Out of the nine Key Recommendations handed over to the Danish government by the national Smart Grid Network, the seventh is titled *Strengthen consumer engagement* (KEBMIN 2011a:25). This recommendation points out that Danish consumers have very little knowledge of energy and therefore:

> Electricity customers' engagement should be strengthened by increasing their awareness and knowledge about the Smart Grid. This should be done through the launch of education and information initiatives about the Smart Grid. ... It is important to ensure that terms such as "Smart Grid", "flexible consumption" and "demand response" gradually become more widely recognised in society, in the relevant industries and among electricity customers. (KEBMIN 2011a:25)

As we have seen, 'people' are mostly discursively constructed as 'consumers' or 'customers' in smart grid visions and energy plans. However, as the quote above implies engaging people is also a matter of educating citizens and creating public awareness. By the time of writing yet very few people have heard about smart grid in Denmark, and when the public *is* reacting to energy production and infrastructures their engagements often take the form of protests against wind turbines or other infrastructural developments. More dramatically, in February 2014 the public mobilized on a large scale against the decision of the Danish government to sell 19% stakes of the national utility company DONG to

the US investment bank *Goldman Sachs*. This nearly toppled the already shaky government coalition and caused a large cabinet reshuffle.[19]

Whereas *these* forms of public engagement are routinely depicted by political commenters and journalists as 'negative reactions' detrimental to infrastructure development, the challenge for infrastructure planners is to find ways to engage people in energy infrastructures in what they view as positive and productive ways.

How to engage people in energy and in infrastructure development is indeed a topic not only at the core of the present dissertation, but it has also in the recent years sparked a growing interest social science. In the next chapter I review selected parts of this literature, specifically concerned with how to engage people in energy futures.

[19] 200.000 people (out of a population of 5,6 million) signed protests against the sale, and thousands went to the streets protesting. The sale of the DONG was lead by the governing party, the Social Democrats and the Minister of Finance Bjarne Corydon. Immediately the sale one of the parliament parties, Socialist People's Party (SF) left the government. The sale is still today criticized widely in the Danish media and in the public for being undemocratic. See e.g. The Economist: http://www.economist.com/blogs/charlemagne/2014/01/danish-politics

3. Energy and Social Science

The development and management of electricity infrastructures has primarily been a task for engineers, economists, and, more generally, people with technical training. However, as I described in the previous chapter, ongoing challenges and changes relating to energy systems have sparked a call for social science and humanities – SSH, as it is shortened in the EU Horizon2020 funding scheme – to also get involved in the work of developing (new) infrastructures (EU 2013). Indeed, energy systems, and what is often referred to as the 'energy trilemma' of global climate change, energy security, and socio-economic inequalities (Chilvers and Pallett 2015:2), have become 'hot' topics in the social science and, particularly, among STS scholars. Thus, a number of special issues around energy, infrastructures, and social dimensions have been published within the last two years. "Energy In Society: Energy Systems And Infrastructures In Society" was published as a three volume special issue of *Science & Technology Studies* (Sylvast *et al.* 2013, 2014a, 2014b, paper two was published here); *Theory, Culture & Society* published a special issue with the very similar title: "Energy & Society" (Urry 2014). And "Smart Metering and Society" was a 2014 special issue in the journal *Technology Analysis & Strategic Management* (van der Horst *et al.* 2014). In the introduction to yet another special issue "The Social Dimension of Energy Transitions" in *Science as Culture*[20] the editors write:

> Energy is a harbinger for a new era in human history. We are now moving from an era of constructing large-scale technologies to one of re-constructing complex, socio-technological systems […] This transition will challenge engineers, societies, policy-makers, and the social and policy sciences to develop new approaches to innovation that integrate both technological and human dimensions together. (Miller et al. 2013)

These many recent contributions span a wide variety of issues and empirical subjects. One might point to studies of (conflicting) visions and imaginaries (e.g. Jasanoff and Kim 2013; Nyborg and Røpke 2011; Sovacool and Brossmann

[20] *Science as Culture* is currently working on a special issue on "Infrastructuring Environments" in which paper four will be published.

2013); socio-technical transition theories (e.g. Araújo 2014; Geels 2010; Ngar-yin Mah *et al.* 2012; Späth and Rohracher 2010); adoption of renewable energy technologies (e.g. Batel and Devine-Wright 2014; Schelly 2014; Wüstenhagen, *et al.* 2007); issues around social justice and energy poverty (e.g. Bazilian *et al.* 2014; Middlemiss and Gillard 2015); liberalization and privatization of energy markets (e.g. Hall *et al.* 2005; Hawkey and Webb 2014; Yatchew 2014); management of electricity and consumption data (e.g. Kotlowski 2007; Silvast and Virtanen 2014); and innovation and user-involvement (e.g. Hyysalo *et al.* 2013; Nyborg, forthcoming).

Energy consumption and energy behavior has become areas of special interest to many social scientists (e.g. Ghanem and Mander 2014; Moezzi and Janda 2014; Stern 2014; Strengers 2013; Verbong, *et al.* 2013). This includes case studies of technologies involved in making energy feedback and awareness (e.g. Darby 2010; Hargreaves, *et al.* 2010; Pierce and Paulos 2010); studies of energy practices in the home and in workplaces (e.g. Palm and Darby 2014; Shove and Walker 2014; Stern 2014); and studies of how energy consumption is translated into environmental practice (e.g. Falkner 2014; Gjefsen 2013; Hobman and Frederiks 2014; Marres 2011).

Furthermore, new journal called *Energy Research & Social Science* was launched in 2014. In the inaugural article, "What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda" (2014b), the chief editor Benjamin Sovacool presented a thorough review of the existing literature on energy, including no less than 4.444 articles from three of the major energy journals.[21] He showed that these articles predominantly focused on technological fixes and the economic dimensions of energy. Sketching a number of problems and short-comings with such techno-centric approaches, Sovacool noted that they are nevertheless central to decision- and policy-makers, who therefore often make plans based on inadequate understanding of the real issues, which in turn often leads to unsuccessful infrastructure development. Accordingly, he states:

> Energy studies must become more socially oriented, interdisciplinary and heterogeneous. … A broader pool of expertise is needed (Sovacool 2014a)

[21] The Energy Journal, Energy Policy, and Electricity Journal. All articles are published from 1999 to 2013 (Sovacool 2014, p. 2).

A main agenda – both in this new journal and more generally across the special issues listed above – is thus to widen the narrow techno-economic approach to energy and to offer more nuanced, multifaceted accounts, both of what energy *is* and what it might *become*. Approaching energy infrastructures as socio-technical systems (Bijker, *et al.* 1987; Bijker and Law 1992; Hughes 1993, more on this in chapter four page 49), several social studies in STS have aimed to broaden the range of materials, practices, and issues included in energy infrastructures. These studies typically point to the political, ethical, and social issues embedded in, and emerging from, new infrastructural arrangements. Such multifaceted, trans-disciplinary approaches to energy have the shared premise that adding human, social, and environmental dimensions to the study of energy infrastructures may create a basis for better, and more integrated, energy planning and development (Miller et al. 2013; Sovacool et al. 2015; Spreng 2014).

Below I discuss selected parts of the existing literature: first on public involvement in renewable energy and infrastructure development, and second on smart grid users and energy consumption. The novelty of the field means that most of the studies presented have been conducted simultaneously with my research. Indeed, I have only come across many of the articles after finishing most of the papers. For this reason, the discussion below does not function as a conventional literature review of a preexisting body of research, based *on which* and *in relation to which* I have structured my own study. My drawing together this review serves instead to show how other researchers with other approaches are currently working on similar issues. In this sense, the key purpose of the review is to map a very new and still emergent field, and to place my approach in relation to this. Doing so, I do not, of course, claim to make an exhaustive and impartial presentation. Instead, the literature has been specifically picked in relation to the particular issues central to the papers that make up Part Two of the dissertation. The review furthermore helps me describe my approach to energy as potentiality.

Public engagement in infrastructure development

As long as electricity infrastructures are centralized and largely invisible, little need has been felt to involve the general public in their development and management. During the past century, power plants were increasingly moved away from residential areas. Aside from electricity poles and cables traversing the landscapes, most people only notice the electricity system when they pay the bill or when it occasionally breaks down (Bowker 1995; Burgess and Nye 2008; Edwards 2003; Hargreaves *et al*. 2010; Nye 1992, see more chapter four on page 49). Within this system, electricity users have primarily been granted the role of 'passive' consumers. The relatively 'simple' relationship between suppliers and consumers – a one way connection – has meant that the innovations pertaining to energy systems have been dominated by professionals with technical expertise (Cotton and Devine-Wright 2010).

However, as described in chapter two, with the rise of distributed energy resources such as wind turbines, solar panels, and hydraulic fracturing (fracking), energy infrastructures are becoming more visible to the public. As Jason Chilvers and Helen Pallett write, energy transitions "have multiplied the roles that publics can and do take up in relation to energy" (2015:1). Along with rising attention paid by publics to infrastructures – often taking the form of protests against new renewable energy technologies (RET) – the need to find new ways of involving citizens in infrastructure planning are gaining recognition. Public protests are often regarded as 'negative' and as 'slowing down' (if not completely capsizing) infrastructure development projects. As an alternative, policy planners are increasingly engaging in dialogue with the citizens through public campaigns or by organizing for example citizen involvement workshops. A spin-off of these developments, is the rise to a growing academic field studying and themselves engaging in initiatives for better understanding and mobilizing energy publics (e.g. Chilvers and Pallett 2015; Lezaun and Soneryd 2007).

Initiatives for 'public understanding of science (PUS) and later 'public engagement with science' (PES) are diverse (Horst and Michael 2011; Michael 2009). Since the 1980s STS scholars have argued against simplified understandings of relations between experts and publics, critiquing the 'diffusion model' underlining that information are simply transported from experts to lay-persons (Irwin 2002; Wynne 1982, 1992, 1993). Such sturdies have

showed how many government and policy initiatives subscribe to the 'information deficit model' believing that if only people are informed they will be less skeptical (Maranta et al. 2003; Wynne 1991, 1992). As Matthew Cotton and Patrick Devine-Wright argues:

> Within science and technology policy, the practice of involving public and stakeholder actors in decision-making processes has arisen primarily as a means to ameliorate the public scepticism, cynicism, and mistrust (Cotton and Devine-Wright 2010:19)

Instead, STS scholars have argued for a more complex and dynamic understandings of relations between experts and publics as co-emergent (Jensen 2005; Wynne 1992, 1993). In aiming to provide different and more diverse accounts of protesters than simply unsatisfied 'neighbors,' the well-known topic of 'NIMBYism' has been particularly central for such alternative perspectives on the public-policy interface (Delicado *et al.* 2014; Walker *et al.* 2010). Simplistically, NIMBYism is often described as a 'gap' between global top-down approaches to green transitions and local bottom-up protest against particular initiatives. Offering a review of the many different theoretical attempts to better understand public responses to RET, Susan Batel and Patrick Devine-Wright (2014) describes RET as a complex matter of social change:

> …this is crucial for the deployment of RET to happen in a sustainable democratic way, one that recognises and incorporates all the diverse, conflicting and variegated existent representations, identities and discourses of renewable energy (Batel and Devine-Wright 2014:11).

Cotton and Devine-Wright examine a number infrastructure innovation processes and show that even when such projects attempt to include publics as 'stakeholders,' they often fail to take into account their heterogeneous character. Thus, they argue, publics are deliberatively limited to the role of 'customers,' which implies inclusion only at a stage 'downstream' in the innovation process, where they are not given any real decision influence. Along with many others, Cotton and Devine-Wright further argue for the importance of bringing "public involvement in technology policy issues 'upstream' in the development process" (Cotton and Devine-Wright 2010:19). This matters, because it means that public

concerns around ethical and social issues can be heard before the technologies becomes stabilized or "blackboxed" (Law and Hassard 1999).

Understanding how technical experts imagine and construct publics is crucial in order to to understand the variable forms of public engagements. Maranta *et al*. (2003), for example, argue that experts tend to construct publics as 'imagined lay persons.' Not only does this construction produce enduring divisions between 'experts' and 'lay persons,' but this homogenization is also misleading for people who try to communicate differently with, or design differently for, particular publics (for more on this issue see paper 2).

In social and political science, and in particular in STS, a growing critique has emerged of the existing literature, especially the literature on policy making, for having "a simplistic view on energy publics" (Chilvers and Pallett 2015:2). Recapitulating the general PUS insights, the general problem is that these discourses tend to imagine publics as preexisting entities located in an abstract 'public space,' simply awaiting mobilization by experts. Instead, constructivist approaches in STS argue that publics are actively brought into being with and around particular energy materialities and emerging issues of public concern, as diverse as the building of large wind mills, fracking, or the implications of smart meter energy data for privacy (e.g. Lezaun and Soneryd 2007; Mahony, *et al*. 2010; Marres and Lezaun 2011; Marres 2005, 2012). This constructivist re-orientation entails a radical rethinking of energy publics, seeing them as emergent and co-produced with different social, technical and political arrangements. A workshop report on the making of energy publics[22] summarizes this point:

> [M]ost existing ways of knowing, doing and governing energy publics fail to properly account for how publics are actively constructed and shaped by – and in turn shape – the various material settings, technologies, infrastructures, issues, participatory procedures, and political philosophies with which they are associated. Rather than existing as fixed entities waiting to be discovered by social scientists, energy publics are seen to be co-produced through the mutual constitution of social, political and technical orders in the performance of experiments and practices at particular sites and the more durable relations between citizens,

[22] I participated in the workshop "Making Energy Publics" (April 3rd 2014, London). The presentations and discussions at this workshop have been a great inspiration for my further research.

> technoscience and the state held together in wider assemblages, institutions and political cultures (Chilvers and Pallett 2015:2).

To sum up, what I have wanted to highlight here, is a sense of public engagement with energy as a set of dynamic and heterogeneous practices. As I discuss at the end of this chapter, these points are essential for understanding the potentiality of energy engagement. I will now turn to studies concerned with the construction of smart grid 'consumers'.

Smart Grid and Electricity Users

The diverse ways in which publics, people, users, or consumers are imagined and constructed through smart grid visions and demonstration projects have become an important topic for social scientists (Goulden *et al*. 2014; Nyborg and Røpke 2013; Stern 2014; Strengers 2013; Verbong *et al.* 2013). The majority of these studies share a critique of the techno-economic approach informing most of these imaginaries. Mithra Moezzi and Kathryn B. Janda (2014), for example, argue that energy visions and policy planning are usually presented as matters of 'untapped technological and behavioral potentials.' If the right technological solutions are implemented, the argument goes, it will be possible to conserve energy and to change people's behavior. In their review of different disciplinary approaches to energy research and development Moezzi and Janda show that next after technological and economic approaches comes 'behavioral economics' (Ibid.).

Most smart grid systems are indeed infused with energy awareness technologies, most prominently smart meters and energy visualization devices. These information technologies also build on logics from the 'information deficit model' as their inventors typically believe that more information about energy consumption will 'necessarily' make consumers interested, thus effecting changes in energy consumption behavior (Darby 2010; Hargreaves *et al*. 2010; Palm and Darby 2014; Pierce *et al*. 2008). Through mechanisms of 'nudging' and other kinds of technological tweaks, behavioral economics claims to change consumer's energy behavior, making it 'match' the needs of the technological systems. This is indeed also the proposed method in the Danish *Smart Grid Strategy* (KEBMIN 2013b). The problem is that most studies show that people

often 'fail' (or refuse) to use the technologies 'right' in spite of being 'nudged.' Even when the technologies *are* used right, they often do not have the intended effects, or those effects wear off over time (Hargreaves, *et al*. 2013; Marres 2012b; Nyborg and Røpke 2013). All of which suggests a certain mismatch between the users that engineers, economists and behavioral scientists imagine to design for and those actually existing.

Yolande Stengers' new book "Smart Energy Technologies in Everyday Life. Smart Utopia?" (2013) has already become a 'classic' within smart grid research. Based on a study of over 50 different smart grid visions she argues that:

> The ultimate consumer emerges from these reports as a rational and rationalizing Resource Man. He is imagined in the image of his utopian masterminds – engineers, economists and behavioural scientists – and is positioned as an efficient and well-informed micro-resource manager who exercises control and choice over his consumption and energy options (Strengers 2013:34)

The Resource Man is a utility-maximizing and tech-savvy man who is imagined to be 'interested in his own energy data, understand it, and is willing to change behavior in order to save money on the electricity bill. Strengers' picture of the future 'smart consumer' mirrors the findings of many other studies and the Resource Man has become a prevalent figure for critique among social scientists studying smart grid (Chilvers and Pallett 2015; Ghanem and Mander 2014; van der Horst *et al.* 2014; Pullinger *et al.* 2014). Designed in the self-image of engineers, the Resource Man constitutes a minority of the population – if he even exists.

Strengers argues that smart grid visions often build on ideas of 'smart utopia' – a rather hoary imaginary according to which technologies are smoothly integrated in everyday life where they result in more comfortable, less labour-intensive, more informed, and less stressed lifestyles – while simultaneously solving problems of climate change and energy scarcity. As STS researches have long argued, however, technologies in practice are seldom as frictionless as imagined, they are often used in unintended ways, and even if they solve some problems they tend to create others in turn (Akrich 1992; Jensen 2010; Markussen 1995; Suchman 1987, 2007).

For her analysis, Strengers draws on STS literature on the performativity of materiality (Latour, Law and Haraway in Strengers 2013:6), but her main theoretical and methodological point of departure is 'social practice theory'.[23] In this she is not alone, for 'social practice theory', originally formulated originally by Elizabeth Shove (Shove and Walker 2014; Shove 2003a, 2010), has become one of the approaches most used in inquiries into energy consumption and sustainable behavior. In order to challenge the dominating techno-economic approaches social practice theory insists on the importance of studying practices of everyday life. Accordingly, these studies show how energy consumption is much less a matter of simple, rational choice than it is a complex practice involving a heterogeneous set of actors, discourses, routines and habits (Goulden *et al.* 2014; Nyborg and Røpke 2013; Shove *et al.* 2012; Shove 2003b).

In contrast, the Resource Man is presented as living in a vacuum detached from and unaffected by such complexities. For example, this vision has no way of accounting for a heterogeneous family where unruly teenagers leave their television on all night, or where the well-being of pets and babies matter more than saving money (Nyborg 2015; Strengers 2013).

Practice theory presents a critique of approaches to energy demand issues that assume an individualistic model of attitudes and choice. Instead social practice theory emphasizes that energy consumption is indeed a *social* practice; one that takes place not only among different family members, but also across humans, technologies, discourses, and around clusters of meanings around energy (Ibid.; Hargreaves *et al.* 2010; Haunstrup Christensen *et al.* 2013; Jensen, *et al.* 2009).

Also building on practice theory, Grégoire Wallenborn and Harold Wilhite have criticized techno-economic approaches as well as social science research for an excessive focus on "mental states, meaning, cognition, and rational choice" (2014:1). Developing an alternative "theory of body and consumption" (Ibid.), these authors explore the diverse ways in which bodies co-evolve with practices of energy consumption (for example in practices of transportation, cleaning, preparing and eating food, or achieving comfort). Wallenborn and Wilhite propose to view infrastructures and energy technologies as "body

[23] 'Practice theory' and STS overlaps in many ways. But, especially if we look to specific parts of STS concerned with the ontological emergence of 'reality' there are also significant analytical, methodological and, not least, ontological differences. Here I do not discuss these differences in detail, but only present the most important practice theory studies within smart grid by way of contrast with the approach I develop in chapter four. For a detailed discussion on practice theory and STS see Gad and Jensen 2014.

accessories" and argue, accordingly, that bodies and their complex relationships to energy consumption and other environmental practices should be part of the narratives and visions of energy transitions.

Finally, a number of studies show that smart technologies often have 'rebound effects,' leading not to less energy intensive practices and lifestyles but rather to *more* intensive forms of usage (Jensen *et al.* 2009; Røpke *et al.* 2010; Sovacool *et al.* 2015). As Strengers writes, the Recourse Man and his 'smart life stile' is "inadvertently enrolled in consuming more resources" (2013:157).

New Ontologies for Energy Users

When people do not use the (smart) technologies as intended, engineers and economists tend to place the problem with people, rather than question their own models (Moezzi and Janda 2014:33). 'Social science', primarily in the form of behavioral science, is thus called upon in order to make people comply with the models. This has lead to a critique, not only of people being instrumentalized to fit to a technological system, but also of the increasing instrumentalization of the social science (Moezzi and Janda 2014; Sovacool 2014b; Strengers 2013). Aiming to revert this trend, social practice researchers argue that engineers and economists should instead learn from social science; in particular by taking everyday practice as a methodological and analytical point of departure. Among other things, this would entail recognizing the materiality and different forms of knowledge that are already involved in 'practices-that-use-energy.' It would also involve a sustained effort to reimagine and develop smart energy technologies in better sync with the peoples' everyday lives (Nyborg 2015; Shove and Walker 2014; Strengers 2013). In summary, therefore, practice theory proposes to widen the narrow 'smart ontology' of engineers and economists by introducing an alternative:

> ontology of everyday practice [which] proposes that change takes place in and through householders' participation in everyday practices. Change occurs when the elements of practice (meanings, materials, skills) realign in one practice or across a bundle or complex of practices" (Strengers 2013:159)

When Strengers calls the work of the smart grid developers a "self-reproducing smart ontology, (Ibid.) it is precisely because engineers and economists fail to see other realities and potential futures than the ones in which social change is mobilized through technological solutions:

> as the provision of data and technology are the only means by which Resource Man is understood to operate and change, this vision simultaneously excludes all other ways in which practices are already and always changing, as well as a range of other possibilities for intervening in these processes of change (Strengers 2013:157)

A similar argument has been made by Sophie Nyborg and Inge Røpke in a study of a major Danish smart grid test project, *eFlex*. These authors show how envisioning and testing smart grid technologies is simultaneously a matter of constructing a particular kind of user who, in turn, 'needs' the proposed technological solutions (Nyborg and Røpke 2013). The making of smart grid is thus simultaneously about the making of a particular needs and particular users.

Many recent articles have engaged with the politics of envisioning and designing for particular smart grid users in similarly critical terms (ibid., Goulden *et al.* 2014; Strengers 2013; Verbong *et al.* 2013). Whereas most visions propose that smart grid technologies enable people to play more active roles, and hold potential for them to relate differently to energy, the literature in contrast shows that smart grid visions routinely sustain and reproduce the figure of the neo-liberal consumer exclusively motivated by economic incentives. In these visions, electricity remains a commodity and the 'users' or 'people' are defined narrowly and passively as consumers. As Goulden *et al.* write: "the user of the smart grid remains essentially dumb" (2014:28). While awareness technologies should leave consumers with a sense of 'empowerment' and a feeling of 'doing-something,' several studies further emphasize that in practice little seems to be actually changing in the relation between consumers, infrastructures and grid managers (Goulden *et al.* 2014; Strengers 2013; Verbong *et al.* 2013). The STS scholar Noortje Marres has labeled such forms of inconsequential pseudo-participation as the 'change of no change' (Marres 2011:517).

As is also the case with the Danish Smart Grid Vision, energy consumption is often co-articulated as possible ways of 'being green' and 'helping the earth' (Hinchliffe 1996). Whereas environmental effects of energy consumption have been rendered as invisible as possible for everyday

consumers, through smart grid and energy visualization technologies private energy consumption is being reconfigured into environmental practice (Shove 2010; Slocum 2004; Wood and Newborough 2003). Through new technologies daily routines like cooking, washing, and cleaning are being 're-composed' as practices of 'environmental participation' (Marres 2012a:66). This tendency has indeed led to wider critique of how global problems are being translated into individualized responsibility enacted through everyday practices and consumption (Hargreaves 2014; Stern 2014; Strengers 2013; Wallenborn and Wilhite 2014).

In her recent doctoral thesis on the role of smart homes in Danish smart grid visions, Sophie Nyborg argues that:

> the smart grid is not a 'neutral technology', but indeed a political phenomenon, which can for instance also be seen as part of a broader political ideology of assigning responsibility for combatting climate change to the individual and his or her consumer choices (Nyborg 2015:9)

On a similar note, Moezzi and Janda argue, that individualizing responsibility for as well balancing the grid as 'saving the planet', is a way of obscuring attention to higher-level, more effective actions. It is a means for re-distributing responsibility away from infrastructure planning and policy makers and instead placing it with private consumers (Moezzi and Janda 2014:34). As I will describe further in chapter four such attempts to make people involved in environmental issues often take as a starting point that people are not particularly engaged and that they cannot be made engaged in environmental issues. Not least do they presume that people will only participate if it is made easy for them (Marres 2011, 2012, see more page 49).

Thus, social science studies have shown, how smart grid ontologies provides narrow framings for what 'consumers' are and can be, not least, what may be relevant to them. And it is against this backdrop that social scientists are now experimenting with new roles and spaces to be inhabited by people. In their study of 'community energy schemes' and 'microgeneration technologies' (solar panels, heat pumps, micro CHPs), for example, Goulden *et al.* (2014) advocate for a shift away from conceptualizing end-users as passive and 'dumb' consumers to more active 'energy citizens.' Building on Devine-Wright's (2007) concept of 'energy citizens' they argue:

> In contrast with the consumer, for whom energy is simply a good to be expended in pursuit of personal goals, the energy citizen engages with energy as a meaningful part of their practices (Goulden *et al.* 2014:24)

Their data shows that people who produce their own energy become more aware not only of their energy production but also of their energy consumption, and that they are also much more likely to change their own energy behavior (for a similar point see paper three). Goulden *et al*. thus argue that ownership and trust are important elements in the potential creation of more engaged energy citizens.

Also concerned with how people may take on different and more active roles in smart grids, Nyborg (forthcoming) shows end-users to be creative innovators. Doing so, she argues that so-called lead users can be particularly valuable and generative for innovative practices around smart grids. A similar point is made by Hyysalo *et al*. (2013), who show that citizens are indeed engaged in their own energy consumption as they make inventive modifications to their heat pumps.

To sum up, across the literature on smart grid and engagement there is a general critique of the way smart grid is enacted as the only possible solution and of the narrow picture of energy users as passive and generally unengaged 'consumers.' In various ways, social scientist attempt to widen and diversify this simplified figure by showing that 'it' does indeed contain many more capacities and potentialities than those crystallized in the image of the "Resource Man." This literature opens up for ways of viewing energy and environmental engagement as happening in a wider register than only through economic incentives.

From Individual Consumption to Social Potential

Among the existing research in energy and environmental engagement, there is a prevalent focus on domestic homes and individualized consumption patterns. Indeed this was also where my research interest was originally located: how to make people more aware of relations between everyday consumption and environmental issues. Over time, however, I became increasingly interested in engagement as something that can also happen in settings outside the home – as part of social and cultural life. The last selection of literature focuses on precisely this issue.

In particular, I am interested in Mithra Moezzi and Katryn B. Janda's recent article on what they call the 'social potential' (2014). In this article, part of the inaugural volume of *Energy Research & Social Science*, the authors outline 12 major disciplines and research fields dealing with energy (including social psychology, architecture, political science, STS, user-centered design, etc.). They go on to show how different disciplines frame 'the problem of energy' differently.

> Each domain invites a particular narrative, or set of narratives, about why energy use is as it is, what should be changed, and how these changes should be pursued (Moezzi and Janda 2014:32)

Moezzi and Janda's point is that different narratives make some solutions possible, while rendering others invisible or unthinkable. Akin to Marres and Strengers, they are particularly interested in narratives that go beyond individual consumption, domestic energy use, and 'people as self-interested consumers' (Moezzi and Janda 2014:35). Yet, in contrast with 'social practice theory' they want to shift attention away from private homes, relocating energy engagement to broader spheres of social and cultural life. Also, they are less concerned with what people *do in present* than with what people *might do in the future*. Like Goulden *at al,*. Moezzi and Janda criticize the way 'citizens' and 'consumers' are often conflated and argue instead for studies of how citizens are engaged in energy through social contexts such as 'citizen science projects', 'community building' and other participatory forms.

In order to describe such forms of participation they develop the notion of 'social potential.' They argue that greater collaboration between citizens and various institutional and organizational actors opens up for such potentials, by

making possible co-production of knowledge, and by bridging between top-down and bottom-up approaches. Social potential is thus about looking to social groups and social relations as valuable assets, rather than as instruments of policy making, or causes of energy use problems (Moezzi and Janda 2014:35). Moezzi and Janda argue that:

> This complementary concept could ideally stimulate developing new perspectives, tools and frameworks that invite a more active engagement of people—as building users, as architects, or in any number of other professions, as citizens—in helping define and address energy problems. The concept of social potential … shifts attention from emphasizing converting what individuals do, buy, or install to a potentially more creative and contextual orientation that recognizes the importance of social relationships in creating use and in changing it (Moezzi and Janda 2014:38)

However difficult it may be to take 'social potentials' into account in policy planning, Moezzi and Janda insist on their importance for infrastructure development and policy planning. What is required is to 'expand the space for imagining change' (Moezzi and Janda 2014:35). Towards the end of her book, Strengers similarly suggests to turn to "concepts of culture, ethics, ritual or routine" (Strengers 2013:159) in order to challenge the 'smart utopia'.

Whereas Moezzi and Janda primarily focus on 'professional' and institutional actors as facilitators of social potential, the present research project looks to yet other places, such as public artworks, as settings where engagement in energy and potential socio-technical change may happen.

Potentiality of Energy Engagement

In Sovacool's inaugural article, where he sketched out new agendas for social science in energy research he argued that "social science, humanities and *the arts* are marginalized in energy research" (2014a: 529, my emphasis). Since then more than 100 articles have been published within the short lifetime of the journal (one and a half years), his call for engagement has clearly been heard. Yet none of these are concerned with the role of arts in energy research, and I have not been able to detect any articles in the energy focused journals, which

deals with arts. Yet, among artists and designers (particularly within 'speculative design' which can be described as an experimental intersection between art and design, see more page 64) there has in the recent decade been an increasing interest in energy and infrastructure art (Bergström et al. 2009; Boucher *et al.* 2010; Gustafsson and Gyllenswärd 2005; Holmes 2007; Mazé and Redström 2008). Just as social scientists have recently seen an interest in the potential role of art in making energy futures come to life (Domínguez Rubio and Fogué 2013; Gabrys 2014; Marres 2013). This literature will be presented throughout the next chapter (and I engage with it in more detail in paper four), where I will further explicate how my engagement with the arts is closely linked to, what I will below describe as an approach to energy as potentiality rather than as an actuality.

First, I will sum up the literature above by discussing the role of the social scientist and thereby place and define my approach to energy. Certain shared threads emerge across the bodies of research I have discussed above. In particular, there is a shared project of widening the narrow techno-economic ontology informing and forming large parts of infrastructural research and policy planning. Calling attention to how energy production and consumption appears in private and public life, as matters of sociotechnical practices, imaginaries, and environmental concerns, the literature adds a variety of dimensions to energy. Criticizing simplistic and reductionist models and approaches to energy, scholarship in both the social science and the humanities endeavor to contextualize, relativize, particularize, diversify, problematize, in short, complexify (Ang 2011) what energy really *is*. As Strengers write, "researchers play a critical role in reproducing the smart ontology, as well as disrupting and imagining alternatives" (Strengers 2013:162).

On this basis, research in social science and humanities aspire to a much more pro-active role in the development of energy futures and other socio-technical developments. As we have seen, this entails inclusion in innovation processes not only as solvers of problems already defined by politicians, economists, and engineers, but also 'upstream' where the problems are defined in the first place. In short, this is a matter of bringing social science theories and methods to the table of environmental innovation as devices for critically scrutinizing the ethical, political, and societal implications related to particular problematizations (such as smart grid visions), and of using such analyses to redefine those problematizations (for this point see e.g. Asdal and Marres 2014; Gabrys 2014; Hargreaves 2014; Sovacool et al. 2015; Urry 2014).

This dissertation both endorses and participates in such endeavors. It explores new roles for social science, humanities and the arts in relation to energy infrastructures, and it seeks to widen the narrow ontological space in which such energy futures is and can be imagined and made. Even so, my approach also differs somewhat from most of the existing studies. The central difference is that I am less concerned with what energy *is* and *means* to people today than I am with questions around what energy and engagement in energy may *become*. Said differently, I am more interested in the *potentiality* of energy than in its *actualities* (Gabrys 2014). Although I find the various practice studies describing how people live with energy both relevant and important, and whereas I agree with the ambition to develop infrastructures that support these existing practices, I am also concerned that they run the risk of *reproducing existing concerns and modes of living* (however unsustainable).

In brief, the problem is that by focusing on how people interact with electricity one is led towards a relatively stable and inherently *conservative* idea of what engages people: namely the everyday, business as usual. In contrast, I am concerned with engagement as a dynamic and malleable 'thing' emerging across heterogeneous socio-technical environments and practices. Taking a more future-oriented approach, I explore potentials for reimagining and redesigning energy engagements. Is it possible, I ask, that proposals for new energy environments hold potentials for the actual remaking of forms of living with, caring about, and engaging with energy? I am curious to which kinds of engagements are composed for, and how engagements could potentially be composed otherwise.

In order to really ask such questions and in order to understand the ontological implications of viewing energy engagement as potentiality I will now take a step 'back' and present some of the philosophical thoughts, which have made this view on energy possible.

4. Framing Theoretical and Analytical Landscapes

In this chapter I outline the theoretical and conceptual inspirations having guided my research. This discussion covers both the way I have constructed my field across art and energy planning and the way I have approached the empirical material. Central to this story is the French philosopher of science and technology Bruno Latour. Perhaps the best way to describe the landscape I want to sketch out is by way of a selected intellectual journey through Latour's voluminous and wide-ranging writings – it goes without saying that many other trajectories could also have been taken.

On the particular 'voyage' I am going to present, Latour 'meets' two other important characters, the German philosopher Peter Sloterdijk and the Belgian philosopher of science Isabelle Stengers.[24] Along the journey, Latour also finds himself confronted with the demand of responding to the threats of ecological crisis and global warming. And he engages increasingly with the discipline of arts as an experimental practice for new ecological politics.

The narrative of the chapter moves from a relatively intimate relation between humans and objects, to a scaled-up discussion of the relations between humans, infrastructures, and natures. It ends with a particular definition of globalization, cosmos, and the 'common world,' for which a new cosmopolitics is needed. The story is meant to convey simultaneously a sense of urgency and the necessity to 'slow down reasoning' in a situation in which, as Latour argues, we may need to redesign the entire 'fabric of our collective lives' (2008b, 2010a).

I have divided the journey into several 'acts'. Each act ends with a presentation of research within social science, design, and arts that has employed and worked with the here outlined philosophical thoughts. In the first part, I introduce the basics of actor-network theory (ANT) with particular emphasis on the way in which this 'theory' views nonhuman agency. This 'object-oriented' approach is further developed and connected to environmental issues by way of the sociologist Noortje Marres' concept of

[24] Stengers has been an important inspiration for Latour through much of his academic career, whereas Sloterdijk only appears in his later writings. Many other people have also been important to Latour's intellectual journey, most noticeably Albert Whitehead, Michel Serres, Gilles Deleuze, and Gabriel Tarde, however I won't focus on these connections.

'material participation.' The second part presents Latour's description of the 'Modern Constitution' and how it is challenged by hybrids including manmade climate change. This section ends by specifying infrastructures as important actors in making and maintaining the modernist settlement. The third part presents Sloterdijk's thoughts on 'connected spheres' and 'co-fragility.' I describe how these thoughts have inspired Latour's 'steps toward a philosophy of design' and his 'attempt at a compositionist manifesto.' This section ends with an introduction to scholars, designers and artists who work with alternating future imaginaries. The last part introduces Stengers' concept of 'cosmopolitics.' It ends by summarizing how this intellectual voyage has inspired and affected my own research.

The 'fictional' vocabulary chosen for this introduction does not only serve the purpose of (hopefully) capturing the reader, it also reflects an important intellectual project of Latour's; namely blurring the boundaries between 'facts' and 'fiction', between 'presentation' and 'representation', between 'constructed' and 'real', and not least between 'matters of fact' and 'matters of concern' (see e.g. Latour 1988, 1993, 1999b, 2004b, 2004e, 2010c).

Reassembling Collectives of Humans and Nonhumans

Latour is by far most famous for the actor-network theory (ANT), which he created with John Law and Michel Callon in the early 1980s. However, my aim here is not to provide a full account of ANT. What I want to convey, instead, is a sense of how the design of things – objects, technologies, infrastructures – matter, not only for the way we are in the world, but also for the way we relate to and participate in social and environmental issues. In general, this constructivist and object-oriented approach aims to avoid essentialist explanations of innovation and knowledge-making. There are no essence to these kinds of enterprises for the simple, yet profound, reason that all 'things' and events are made out of complex socio-technical networks (Latour 1988a, 1996).

Latour's studies of engineers made important contributions to the early social studies of technology. Around the same time as the development of ANT, for example, the tradition known as SCOT (social construction of technology), showed that technologies are not only results of rational decisions and scientific

facts (Bijker *et al.* 1987). Instead, social constructivism emphasized that technologies are results of the social and cultural networks the engineers are part of. Like anthropologists going to far away lands to study the religious rituals and cultural practices found there, Latour, along with many other ANT and STS scholars, have studied scientists in their labs, and engineers developing new technologies, thus showing how their material instruments, disciplinary backgrounds, and not least their cultural values and 'beliefs,' matter for the knowledge they produce and the technologies they design. Latour, for example, has emphasized the concern, or even love, engineers invest in making new technologies; dimensions as important, he suggested, as the political and economic negotiations that are also indispensable for assembling new things (Latour 1976, 1986, 1996).

When new technologies come to the market and meet their users the immense network of negotiations and decisions that went into shaping the particular outcome are often black-boxed and made invisible (Jensen 2010; Latour 1999b; Law and Hassard 1999). The better technologies work, and the more naturalized parts of everyday life they become, the less we tend to question how they came about. Thus, it is often only upon breakdown that we start asking whose fault it was and which political and economic design decisions that lead to the failure, and, not least, how the design could have been done differently (Bijker and Law 1992). Thus, for example, few people think about how mundane things like light bulbs and switches were first constructed or about what politics went into making them. Opening the black-boxes of mundane artifacts and studying the socio-technical and political processes of 'assembling' and 'stabilizing' technologies have thus become pivotal to ANT and STS inquiry, and many scholars have followed designers and engineers in order to study technologies-in-the-making (Bijker *et al.* 1987; Hughes 1993; Jensen 2010; Latour 1988a; Suchman 1987, 2000).

The focus on the politics of technologies and objects, however, does not stop at the moment where they are supposedly stabilized and black-boxed. Indeed, Latour, along with other STS scholars, has argued that objects or technologies are not simply shaped by politics and human passion; they are *themselves political agents* (Latour 1992; Winner 1980). With this provocative starting point, Latour began a decade long effort to overcome the traditional distinction between active human subjects and passive material objects (Blok and Jensen 2011). As Latour argued in his famous 1992 article "Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts," everyday objects

such as seatbelts, speed bumps, and door-closers have agency. Human actions and responsibilities are 'translated' and 'delegated' to nonhumans that, in turn, act in and on the world, allowing people to do certain things and not others. Inscribed with meaning and action (Akrich 1992), technologies thus work as moral actors and they can discriminate against particular people or actions. In this view, then, action and agency are distributed, produced, and reproduced across collectives of humans and nonhumans (Latour 1992, 2005b). Making a similar argument, the anthropologist of technology Lucy Suchman has written:

> Agency on this view is rather an effect or outcome, generated through specific configurations of human and nonhuman entities (Suchman 2007:261)

Suchman describes the relationship between people and technology as a matter of 'human-machine reconfigurations' and she insists (like Latour and others) that humans and technology continuously reconfigure one another (see also, Oudshoorn and Pinch 2003; Oudshoorn *et al.* 2004; Woolgar 1991). All entities – human and nonhuman, animate and inanimate – thus receive equal treatment and have symmetrical ontological status. From this point of view, talking about something as purely human or purely technical makes little sense.[25] Yet, as I will discuss later, people are indeed part of and change with their technological environments (see page 57).

ANT, and much STS scholarship, argues for a break with metaphysics and suggests instead an (object oriented) 'ontology' in which objects are not subordinated representatives of some given 'real' but constitutive of what is real (Jensen 2010; Latour 2005b; Mol 2003). Socio-material compositions of societies are thus viewed as dynamic and generative of 'socio-ontological change' (Marres 2012a:102).

If one follows this line of thought, the analysis of people and society needs to take into account the vast nonhuman world of technologies and objects that take part in shaping both (Bijker and Law 1992). Rather than dividing the world into people and sociality on one side (a subject for sociologists to care about), and nonhumans and objects on the other (a subjects for engineers, physicists, and natural scientist), Latour (2005b) argued for using the shared term 'collectives' to cover both 'sides.' The collective, in this view, is

[25] The hybridity between humans and technology has been widely discussed and further developed within STS and beyond – most famously through Donna Haraway's cyborg figure (1999)

made by different ways of connecting, and thus collecting, various heterogeneous actors. Latour argued for the abandonment of terms like 'society' and 'the social' because they – like the term 'nature' – function as descriptive and analytical 'shortcuts,' which explain away specific ways of being, doing, and relating as preexisting and unchangeable. Instead he asks:

> … what sort of collective life and what sort of knowledge is to be gathered by sociologists of associations once modernizing has been thrown into doubt while the task of finding the ways to cohabit remains more important than ever? (Latour 2005b:16)

Inspired by Latour I approach processes of redesigning electricity infrastructures as a matter of assembling new energy collectives of humans and nonhumans. If one aims to reassemble collectives, Latour suggests that the last thing one would do is to "limit in advance the shape, size, heterogeneity, and combination of associations" involved (2005b:11). With the notion of collectives I thus attempt to keep open the variety of entities and relations, which might be seen as, or brought into, future smart energy collectives. With this, admittedly, rather simplified introduction to an extensive and heterogeneous field I wish to set the scene for a world in which neither technologies nor humans are stabile and fixed entities, but rather come into being with one another.

Before returning to Latour and his Modern Constitution, I will make a short introduction to Noortje Marres' work on technologies as devices of material engagement and environmental participation.

Material Engagement and Relations of Relevance

Building her theory of 'material participation' explicitly on Latour's object-oriented approach, Noortje Marres (2012a) explores how domestic technologies such as smart meters, eco-showers, and heat-pumps work as devices for 'environmental participation.' Like several other ANT/STS scholars, she argues that it is not possible to determine precisely where nonhuman objects or human subjects start and end (Marres 2012a:34). Instead, with a reference to Stengers' cosmopolitics, she argues that objects can 'disturb, provoke and suggest' things

and issues, and therefore play important roles in staging political events (Ibid., see more on page 66).

Marres argues that smart meters and other 'carbon accounting technologies,' as she calls them, "enable a politics of 'co-articulation'" (Marres 2012:26, a concept she borrows from Callon 2009). Due to the way (some) smart meters simultaneously display KwH, the economic cost of energy, and CO_2 emissions, they redefine everyday energy consumption as environmental practices. At the same time, they create "multiple, diverging co-articulations of economy, politics and innovation" of electricity infrastructures (Marres 2011: 515). Since technologies are designed to articulate and make some relations visible (while rendering others invisible) they are part in defining what appears as relevant to people and what does not. For example, when new technologies inhabit the home and become part of everyday life, environmental engagement can be located in household practices, and thereby create distinctive material forms of engagement.

> Sustainable living experiments [smart meters, eco-showers, heat-pumps, etc.] can be understood as attempts to explicate the normative capacities of things, as they provide demonstrations of their powers of engagement. … These public experiments in living with smart meters, then, do not just confer powers of engagement onto the experimental device of the smart meter, but also onto environments, things and substances. They turn familiar surroundings into engaging environments, demonstrating that the socio-material arrangements of the home can do the work of engaging people (Marres 2012:95+96).

Marres describes these technologies as devices that enable certain modes of material participation potentially making people engaged in particular matters of environmental concerns. However, if people are to participate in particular issues, these issues have to be made relevant to them. Distinguishing her object-oriented approach from more instrumentalist approaches (most noticeably behavioral economics, see page 32) Marres argues that a technology in itself does not have this power to engage people. However, 'problems of relevance' or 'relevance relations' can emerge (or fail to emerge) 'in-between' mediated human and nonhuman actors (consumers, domestic technologies, grids, etc.) (Marres 2012a:145). When this happens, such arrangements can participate in a process of 'relevancing' and thus making particular registers of engagement and modes of participation emerge. Through socio-material

relations new matters of concerns and problems of relevance *may* thus be articulated:

> To consider problems of relevance is to resist the assumption that issues and issue communities are somehow objectively given, and the only thing lacking is adequate political *representation*. … To adopt a pragmatist sensitivity to problems of relevance is, then, to adopt a political ontology that does not assume the separation between *de facto* and *de jure* forms of issue involvement, but instead conceives of issue specification as a wider material, technical, political and social process (Marres 2012a:53)

In this situation, what counts as relevant matters of concern to people can neither be (pre)defined, nor created (with certainty) through one specific technology or by supplying people with one form of knowledge. This changes the problem from being one of 'information deficit' – if only they knew, they would care – and away from 'nudging technologies', and instead specifies it as a problem of designing relations of relevance.

As mentioned in chapter three, Marres is critical to the way in which environmental engagement and participation is often articulated as a fairly easy task, demanding minimal effort of people while allowing them to save money. This understanding, she argues, makes environmental participation appear 'doable' to people without really challenging or changing their everyday activities (Marres 2011, 2012a:60–81). In turn, this has 'particular normative implications' (2012:68) because it reconstitutes and strengthens a reality in which people only engage with environmental issues if and when it is made easy for them.

> Everyday technologies of carbon accounting codify participation in distinctively liberal terms, namely in terms of the *effort* invested in its performance. This codification of public engagement evokes classic liberal ideals of participation, such as the ideal of 'involvement made easy', which … is frequently mobilized in the specification of environmental engagement in material terms (Marres 2012a:62)

This does not only give the consumer a somewhat false ideas about doing something important, but it also reproduces figurations of 'people' as generally uninterested in the environment and thus draws attention away from other forms

of involvement where people are genuinely engaged and invest much more in environmental issues. Attempting to make different realities visible, Marres writes about settings of environmental participation where economic registers do not necessarily dominate and where people get engaged in much more demanding ways, costly in terms of money, time and hard labor (Marres 2011, 2012a:72–75). Returning to ANT, Marres argues, that the work of strengthening and weakening some socio-technical realities over others (both the work of engineers and policy planners and also her own academic work) is a work of doing 'ontological politics' (Law 2004; Mol 1999 in Marres 2012:100-3).

With a strong interest in political science, Marres' intellectual project is slightly different than mine. Whereas she aims to widen the notion of what counts as public engagement to also include material forms of participation, what I take from her object-oriented approach is a view on the construction of new energy infrastructures as a matter of articulating new matters of concern and designing new relations of relevance.

From this ontological perspective, it is indeed insufficient to design for what people are already concerned with (supposedly money and comfort). I instead suggest asking 'how it is possible to design for the emergence of new and different relations of relevance and matters of concern?' Or, in Marres words: "What is it possible to make relevant?" (Marres 2012:145). This re-defines the task of infrastructure developers from making technological systems that 'solve' specified preexisting problems (energy efficiency and low-carbon energy production) and to subsequently make people comply with these systems, to a task of designing and redesigning relations of relevance and matters of concern in a mode that might be called normative experimentation. Furthermore it also points to my own role in seeking and writing out new possible relations of relevance (more on this role in chapter five, page 71).

In the next section, I return to Latour's writings on 'nature' and modernity on order to criticize the idea of nature as something existing 'out there' in separation from 'society'. This takes us closer to the role infrastructures have played (and still play) in the production of nature(s).

The Modern Constitution and Ecological Hybrids

Following his famous laboratory study of *science in action* (Latour and Woolgar 1986; Latour 1988), Latour published his immensely influential book *We Have Never Been Modern* in 1993. In this volume, he described the 'modern project' as a failed attempt to organize the world around a primordial division between Nature and Society. This division shapes the entirety of what he called the Modern Constitution.

Specifically, Latour argued that the idea of a pre-existing nature 'out there,' for which it is the task of the scientist to function as a neutral spokesperson, is a construction made and maintained by the moderns. Showing that scientific 'facts' are always constructed through processes of mediation and translation through various human interests and nonhuman technologies, Latour instead argued that 'matters of fact' are always intricately entwined with the 'matters of concerns' of the scientists that (re-)present them. In this sense 'nature' must be understood as a product of scientific practices rather than what causes them (Blok & Elgaard Jensen 2009: 9). This entails letting go of the idea of Nature with a capital N and instead conceiving natures in plural (Latour 2004b).

Scientific knowledge is constructed and maintained through complex processes including scientists and their various instruments and infrastructures for knowledge-making. The more 'factual' knowledge seems, the more thoroughly it has been constructed. An important dimension of Latour's project can therefore be described in terms of a break with the opposition between what is 'real' and what is 'constructed.' He often uses the formulation that the more, and better, something is constructed the more it is real.

Latour described modern science as a failed attempt to purify science from values, politics, and matters of concern. Rather than purification, what has really happened over the last three centuries is that matters of fact have become ever more entangled with politics, ethics, and values. The claim that 'we have never been modern' thus refers to the ways in which the moderns misunderstood their own practices. While they thought they operated in the pure realm of science, they were instead involved in constructing ever more complex hybrids between things (Latour 2009).

The idea of progressive modernity itself depends on a purified understanding that never really existed. Latour's descriptive, theoretical, and normative projects thus have the shared starting point that we must learn to

take into account how such things as nature, politics, technology, economy, society, humans and nonhumans are co-constituted. Only in this way might we stand a chance of re-constituting and re-composing these relations. As I described above, collectives are gatherings of humans and objects but we can now see that they are more than that. According to Latour, 'natures,' too must be seen as emergent socio-material collectives (Latour 2004b).

Accordingly, one dimension of reassembling collectives thus involves the political action of figuring out which social and natural, human and nonhuman actors should be taken into account and included in the collective. For this reason, Latour's intellectual project might be summarized as an attempt to 'ecologize our collective lives' (Latour 1998), which means to develop a new a-modern politics for reassembling hybrid nature-society collectives. This politics, which he has referred to as 'ecological politics' and as 'cosmopolitical' (to be explained on page 66), entails becoming better at taking into account the endless, proliferating entanglements between nature and society. Such a politics, he presently argues, has become even more urgent with the ecological crisis (Latour 2004b, 2008, 2011b).

Manmade climate change is a very evocative and illustrative example of the problem with a fundamental distinction 'the natural' and 'the social'; the 'constructed' and the 'real'. In a global situation, which is often described as 'the anthropocene' – a geological term for an epoch where human activity profoundly changes the Earth's ecosystems (Crutzen and Stoermer 2000) – humans, their technologies and 'nature' cannot be separated: they co-constitute each other's conditions and existences.

During the last decade, Latour has been increasingly concerned with global warming and this preoccupation has been important for his engagements with the arts: *Anthropocene Monument*[26] was indeed the title of Latour's latest curated art exhibition. Launching his new *education program on Art and Politics*, Latour said that the idea of Nature as the sublime outside finally evaporates when humans understand that they have become "a collective *giant* that, in terms of terawatts, has scaled up so much that it has become the main geological force shaping the Earth" (Latour 2011b:3; I will return to Latour's engagement with the arts and this education program later, page 63).

[26] The exhibition took place in Paris in October 2014 and was curated together Bronislaw Szerszynski http://www.lesabattoirs.org/en/evenements/anthropocene-monument-un-colloque-performance

As part of his efforts to come to terms with climate change, James Lovelock's Gaia figure has become something of a main protagonist in Latour's recent writings (Latour 2010a, 2011b, 2013, 2014). Personally, I remain rather skeptical towards Latour's use of Gaia as a picture of our planetary situation. In my view, contemporary ecological thinking is better served by Latour's deployment of Stengers' 'cosmopolitics' and Sloterdijk's 'spherology.' However, before delving further into these philosophies, I will first present infrastructures as key actors in constituting and maintaining the modernist settlement.

The Unbearable Modernity of Infrastructures[27]

What does it mean to be living in a modern society? Modern countries – as we tend to call industrialized countries – are in many regards characterized by well functioning and smoothly running infrastructures. Roads, sewer systems, public transportation, water supply, power grids, and ICT infrastructures function as the invisible woodwork of society, as Geoff Bowker and Susan Leigh Star have famously formulated it (2000:34). As naturalized backgrounds they are constitutive of modern lifestyles. When infrastructures work well, as they mostly do, the moderns feel safe and at home. Correlatively, when traveling to other parts of the world, what is often noticed is the lack of, or difference, in infrastructures (Edwards 2003:189).

Re-conceptualizing infrastructures as complex socio-technical networks and heterogeneous assemblages, a growing number of studies have investigated the politics of infrastructures (Edwards *et al.* 2009; Jensen and Winthereik 2013; Larkin 2013; Mackenzie 2005; Star 1999). Thus, infrastructures have gradually come to be seen as 'political machines' (Barry 2001, 2013). As Casper Bruun Jensen and Brit Ross Winthereik write, infrastructures are much more than merely technological systems that connect people, for they script particular ways of being, doing, and knowing. Moreover, they suggest, "infrastructures must be studied for their ontological, world-shaping implications. Emerging infrastructures articulate particular ontologies" (Jensen and Winthereik 2013:10; see also Jensen 2010).

[27] I have borrowed this playful title from Brian Larkin's (2013) "The Politics and Poetics of Infrastructure."

The historian of technology, Paul Edwards, characterizes modern infrastructures "as basic to modernity as lived reality".

> Modern infrastructures are the invisible background, the substrate or support, the technocultural/natural environment, of modernity (Edwards, 2003:191).

Edwards describes how modern infrastructures enable spatial and temporal control over the natural environment, allowing us to regulate indoor temperatures, see at night, obtain water at will, move around at high speed, and communicate instantaneously. Infrastructures furthermore 'protect' the moderns from nature by creating technologically mediated environments:

> Infrastructures constitute an artificial environment, channeling and/or reproducing those properties of the natural environment that we find most useful and comfortable; providing others that the natural environment cannot; and eliminating features we find dangerous, uncomfortable, or merely inconvenient (Edwards, 2003:189).

Infrastructures thus, so Edwards tells us, are responsible for creating a sense of stability in society. They are also central actors in creating a fundamental separation between 'society' as a safe place and 'nature' as an unruly place *out-there*. Because infrastructures constitute nature as other to society and technology, they are, as Edwards also argues, central to the creation and maintenance of Latour's 'modernist settlement' (Edwards 2003:189, on this point see also: Jensen & Winthereik 2013:10, Larkin 2013:2).

> infrastructures simultaneously shape and are shaped by — in other words, co-construct — the condition of modernity. … To be modern is to live within and by means of infrastructures, and therefore to inhabit, uneasily, the intersection of these multiple scales (Edwards 2003:186).

At once connecting and disconnecting, infrastructures allow people to live as individual households and in a collective society. Since infrastructures are indeed complex entanglements of technology, nature and society – Latour's definition of 'collectives' seems to fit well. This definition only becomes more pertinent as the environmental effects of keeping infrastructures running

become more and more present. Because most infrastructures are built of and also run on natural resources, they have also been important actors in constituting nature as a commodity, to be exploited.

Constituting the invisible and naturalized backgrounds of our lives, infrastructures seem as 'natural' – or even more so – than 'nature'. Thus, Geoff Bowker propose to view infrastructures as 'second nature' (Bowker 1995). Designed to be as invisible as possible under normal circumstances, is only upon breakdown we tend to really pay attention to them. At this point they become problems for experts to solve (Bowker and Star 2000; Star and Ruhleder 1996). On a similar note, the sociologist Jennifer Gabrys writes:

> The intangibility and yet constant availability of energy is something that has been designed into modern systems (…) where the invisibility of energy is a design strategy that has been so successful it has contributed to unsustainable everyday practices (Gabrys 2014: 2098)

Indeed, it is because infrastructures have been designed to be invisible and thus not as matters of concern that it now proves rather difficult re-designing them to become visible and covey matters of concern.

In a recent article, the sociologist Fernando Domínguez Rubio and the architect Uriel Fogué (2013) have described infrastructures as black-boxed 'matters of fact'. Inspired by Latour and Marres, they argue that, removed from public life, and made into something that people need not care about, infrastructures have been de-politicized. The many political, economic and social negotiations going into the design of infrastructures are thoroughly hidden for people and buried under ground in a "subpolitical world" (Domínguez Rubio and Fogué 2013:1039).

Through architecture and design, Domínguez Rubio and Fogué thus argue for making infrastructures more visible in public space and to design them in ways that convey their invisible infrastructural workings and open the political design decisions for public debate. Their aim, that is, is to make infrastructures *public*, as Latour and Peter Weibel have described in their catalogue text for the art exhibition *Making Things Public* (2005a, see more page 67). Such a 'publicization of infrastructures', as Domínguez Rubio and Fogué call it, is

> aimed at replacing the traditional understanding of infrastructural and natural processes as 'matters of fact' located outside the realm of public discussion with an understating that deals with them as *matters of public concern*; that is, as subjects open to public scrutiny, discussion and accountability … As we claim, the political valence of design does not reside in its ability to spatialize and materialize political programs and ideologies, but in its capacity to generate spaces of political discussion and civic engagement (Domínguez Rubio and Fogué 2013:1040)

Domínguez Rubio and Fogué are skeptical of the conventional ways in which design is used as tools for changing people's consciousness and behavior (exemplified by behavioral economics, see page 32). Instead, they argue, the power of architectural design is to enable new spaces for political participation and engagement and to propose new models for cohabitation of humans, infrastructures and natures.[28] The example that Domínguez Rubio and Fogué provide as an example of an infrastructural redesign is an idea for an architectural construction placed in an urban public square, capable of generating electricity through solar panels. Because the sculpture visualizes environmental effects and (some of) the politics designed into it, Domínguez Rubio and Fogué argue that it offers an alternative to the 'modernist' way of designing. By visualizing connections and 'inverting infrastructures'[29] the sculpture participates in making a new 'urban political ecology' (Domínguez Rubio and Fogué 2013:1039; for 'urban political ecology' see also: Blok 2013; Hodson and Marvin 2009). As I discuss in more detail in paper one, this notion of political ecology, or, rather, the action of *ecologizing*, can indeed be seen as instantiating a deeply Latourian (e.g. 1998, 2008a) effort to create new and a-modern principles for designing new infrastructural collectives. Latour's attempts towards a 'philosophy of design' are developed in a meeting with Sloterdijk, which is the center of the next section.

[28] In a forthcoming article Marres makes a similar argument as she analyzes the public art installation *Nuage Vert* and argue that it makes explicit existing controversies around energy and sustainable city development.

[29] Domínguez Rubio and Fogué do not refer to anybody when deploying the concept of 'infrastructure inversion', but Bowker and Star (2000: 34) have developed precisely this concept as a research strategy for "learning to look closely at technologies and arrangements which, by design and by habit, tend to fade into the woodwork". See also Jensen (2010, chapter 8).

Designing and Composing

In a number of recent papers, Latour (2004a, 2004d, 2007, 2008b, 2009, 2011a) has developed his thoughts in conversation with Peter Sloterdijk's grandiose trilogy *Sphären*[30] (Spheres) (2004c, 2008, 2010b).[31] Indeed, Latour has compared actor-network theory with Sloterdijk's 'spherology' and gone so far as to claim that he has 'always been a "spherologist"' (2009:139).

In a keynote lecture for a *Networks of Design* meeting of the *Design History Society* at Cornwall 2008, Latour argued that Sloterdijk's thoughts are helpful for taking "a few steps towards a philosophy of design" (2008b).[32] Such steps are necessary because the ecological crisis has rendered manifest that the very "fabric of our lives", that is "our collective life on earth" is in urgent need of a *redesign* (Ibid.:7). This includes the way climate science is conducted, the way political systems are designed, and the ways in which we create cities, infrastructures and 'natural' landscapes. Such re-design, Latour argues, has to be done: "with a completely different notion of what it is to *make* something … it is to be carried through with exactly the opposite of revolutionary and modernizing attitudes" (Ibid.: 6-7). Indeed, he goes as far as to say that modernism is not a period in history, but a 'design style' (Latour, 2008a:9). Dispensing with the words of making and constructing, he argues that the benefit of the term 'design' is that it entails 'precaution' and 'carefulness'.

Based on Sloterdijk's historical account of modern architecture, including green houses, shopping malls, modern apartment complexes, air-conditioning systems, artificial bio-spheres, weather-control systems, and space ships, Latour argues that "dasein ist design".[33] The implication of this play on words, which inscribes design into the Heideggerian vocabulary of 'being in the world,' is that our very being is enmeshed with the 'umwelt',[34] the surroundings in which we dwell. Following Sloterdijk, Latour asserts that:

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[30] So far, only the two first volumes are translated into English, *Blasen* (Bubbles 2011) and *Globen* (Globes 2014).

[31] Peter Sloterdijk is a very controversial thinker and his thoughts are debated heavily in the German media. Indeed, I am also very skeptical of parts of authorship and public announcements. Here I only engage with the *Sphären* trilogy.

[32] The speech has later been published in the anthology *In Medias Res – Sloterdijk's spherological poetis of being* (Schinkel and Noordegraaf-Eelens 2011)

[33] He takes the phrase from another Sloterdijk-inspired thinker, the Dutch philosopher Henk Oosterling.

[34] Both Sloterdijk and Latour take the notion of 'umwelt' from Jakob von Üexkull (1921), who first explicated the idea that the *oikos*, the environment in which organisms live, is constitutive of their very being.

> To define humans is to define the envelopes, the life support systems, the Umwelt that make it possible for them to breathe (Latour 2008:8, see also Sloterdijk 2004:249).

Sloterdijk argues that to understand the current predicament of humankind one needs to ask what kinds of spheres they build and inhabit. One also needs to query how people come to understand themselves and their relations to the environments they have constructed. Taking the reader through approximately 2500 years of architectural history, Sloterdijk argues that humans have gone from living in microspheres (so-called primitive societies), to living in a macrosphere (during the time of big monotheistic religions). Presently, he argues, we live in plural spheres – what he calls foam.[35] These different times, he argues, are characterized by different architectural styles. Pre-modern architecture such as cathedrals, domes, and churches were characterized by a weltanschauung (world view) of the metaphysical Globe. Their presupposition was that we all lived under the same sky, in *one* ordered and unified cosmos[36] (Sloterdijk 1999). With modernity, this all-encompassing globe has imploded, Sloterdijk argues, and today we no longer live on a shared globe but rather in many isolated and connected bubbles, as Sloterdijk describes the modernist style of designing apartment blocks. For this style he uses the image of foam (Sloterdijk 2004:501-654). Each individual apartment operates as a private micro-sphere because the people living in them can create their own air-condition (cooling/heating), their own light, their own meals, and moreover, through information and communication channels have access to the whole world. In a word, modern people can live under their own private sky.[37] Thanks to various forms of infrastructures – or technological prostheses, as Sloterdijk calls them – people can thus live in 'isolation' from one another. This is why apartments and their infrastructures are also described as 'technological immune systems' (2004:534), which Latour translates as 'life support systems' (see quote above).

Nevertheless, any sphere is always connected, through architecture and infrastructures, to others. Sounds and smells, for example, may seep through the

[35] Each book describes each one of these epochs. Foam (Schäume) is the name of the third book.
[36] This sense of cosmos is the one we know from the philosophy of Immanuel Kant. It is quite different from the cosmos in cosmopolitics, to which I will soon turn.
[37] Sloterdijk's ideas of bubbles are inspired by the architectural constructions of Buckminster Fuller, who designed domes to live in, which provide people with their 'own private sky' or sphere (Sloterdijk 2004;477-500, see also Krausse & Lichtenstein 2001).

walls between apartments (membranes between bubbles). This is why Sloterdijk describes apartment buildings as 'connected isolations' (foam) and the condition of living in them as a 'co-isolated existence' (Sloterdijk 2004:568). However, the connectedness of spheres does not stop with the neighbors, for all spheres are indeed connected through a 'planetary foam' to which there is no 'outside.'

As in foam, when one bubble changes it affects the others. Thus, fuelling private spheres with light, heat and air-conditioning systems does indeed affect other spheres on the planet. Even the global atmosphere, which has often been (and still often is) seen as an 'outside,' or merely as a dumping ground, is changing character due to CO_2 emissions and global warming. The atmosphere has become just another bubble in the planetary foam, and this bubble is literally changing due to the maintenance of western technological immune systems. There is no outside. The rising awareness of manmade climate change is a painful realization of this 'co-habitation' and 'co-fragility,' as Sloterdijk calls it (2004:255 and 577). It is this image of global foam and the co-existence and co-fragility, which has captured Latour, and me too, as a powerful image for grapping with the complexity of the current environmental situation, often called climate change.

I am now getting closer to an understanding of why Latour has compared his actor-network theory with Sloterdijk's spherology (2009, 2010b). Both theories describe a world in which everything is connected and where actors and networks (umwelt) co-constitute one another. Latour says that the two models –networks and spheres – are two ways of interpreting globalization and the relation between humans and their environments (Latour 2009). He goes on to describe the difference he perceives between networks and spheres in the following way:

> Unlike networks, spheres are not anemic, not just points and links, but complex ecosystems in which forms of life define their "immunity" by devising protective walls and inventing elaborate systems of air conditioning. Inside those artificial spheres of existence, through a process Sloterdijk calls "anthropotechnics," humans are born and raised. … while networks are good at describing long-distance and unexpected connections starting from local points, spheres are useful for describing local, fragile, and complex "atmospheric conditions" —another of Sloterdijk's terms (Latour 2011a:1)

Latour argues that Tomas Saraceno's art installation of suspended spheres in networks, has the capacity to convey a sense of such atmospheric co-fragility (Ibid.).[38]

Tomas Saraceno, Biospheres 2009
National Gallery of Denmark

What I find appealing about Sloterdijk's picture of foam is its direct translation into architecture, energy consumption, design and engineering of infrastructures, and environmental issues. In my view, his ideas of 'connected isolations' and co-fragility convey, with particular vividness, one of the main complexities, I have identified in my own empirical material on the redesign of electricity infrastructures and in the literature review above: namely the complex relations between individuality and collectivity. Energy infrastructures are simultaneously devices for individualization *and* links between inhabitants and extended collectives of nonhuman (technological and 'natural') entities. So what does it mean to design for connected individuality? Doing so, calls for a new politics.

Quoting Sloterdijk's statement that: "Politics, from now on, will be a section of the technology of climate-control," Latour claims that "air-condition is our new political fate" (Latour 2004a). Politics becomes a matter of designing the technologies that 'condition' various 'spheres' including their mutual relations. In a paper that also connects Sloterdijk's foam theory with Latour's cosmopolitics, the philosopher Marie-Eve Morin writes that "Politics will thus become a matter of arranging and assembling spaces … [which] is an affair of designers and architects" (Morin 2009:68).[39] Because we have designed and engineered ourselves into the ecological crisis, the only way out of it, says Latour, is through re-designing the 'natural' and built environment (Latour 2008). This is a reassembling and a re-composition of nature-society collectives'

[38] Latour wrote the exhibition catalogue text for Saraceno's exhibition (Latour 2011a).

[39] Morin also explicates some important ontological differences between Sloterdijk's and Latour's notions of the globe. This distinction would be crucial if my aim here was the philosophical comparison of the two thinkers. Since it is not, I simply point the reader to her text (Morin 2009:69).

Inspired by Latour and Sloterdijk's conceptualizations of the relationality of infrastructures, humans, and environmental issues, I have examined the ongoing redesign of electricity infrastructures as a practice of reassembling collectives in ways that highlight hybrid issues and entanglements, and the ways in which the design efforts try to take them into account. This is, indeed, a highly political matter of redesigning the 'umwelt' in which we live, thereby potentially re-constituting our very being – 'dasein'.

As the observations of Latour and Sloterdijk make clear, such redesign has to be conducted with a sensitivity to material 'co-habitation' and 'co-fragility' in mind. When Latour prefers the verb 'designing' instead of 'making' or 'constructing', it is because the term evokes the question whether something is designed well or badly (Latour, 2008a: 5):

> This is of great importance because if you begin to redesign cities, landscapes, natural parks, societies, as well as genes, brains and chips, no designer will be allowed to hide behind the old protection of matters of fact. No designer will be able to claim: "I am just stating what exists", or "I am simply drawing the consequences of the laws of nature", or "I am simply reading the bottom line". By expanding design so that it is relevant everywhere, designers take up the mantle of morality as well (Latour, 2008a: 6)

When asking whether a 'thing' or an infrastructure is designed well or badly, the designers (including engineers, policy-makers, and knowledge-makers) need to carefully explore how it might affect other (atmo-)spheres. Latour proposes to conceptualize such processes of making or designing new collectives as creative efforts to 'compose the common world' (Latour 2010a). I will later explain more in detail how Latour's notion of a 'common world' does not entail a reversal to any pre-given or universal 'cosmos' (see cosmopolitics page 66), but here I will linger with his notion of 'composing' or 'composition', which I am also inspired by in the title of my dissertation.

In a number of texts Latour conceptualizes the practice of 'designing', 'assembling', and 'constructing' collectives with the creative practice of 'composing' and 'making compositions'. To compose, for example a piece of music, is a creative play of putting bits and pieces together and carefully deciding when they work well together. Composition, Latour states,

> underlines that things have to be put together (Latin componere) while retaining their heterogeneity. Also, it is connected with composure; it has clear roots in art, painting, music, theater, dance, and thus is associated with choreography and scenography; it is not too far from "compromise" and "compromising," retaining a certain diplomatic and prudential flavor. Speaking of flavor, it carries with it the pungent but ecologically correct smell of "compost," itself due to the active "de-composition" of many invisible agents. … Above all, a composition can *fail* and thus retains what is most important in the notion of *constructivism* (a label which I could have used as well, had it not been already taken by art history). It thus draws attention away from the irrelevant difference between what is constructed and what is not constructed, toward the crucial difference between what is *well* or *badly* constructed, *well* or *badly* composed. What is to be composed may, at any point, be *de*composed (Latour, 2010a: 474)

Climate change is living proof, Latour says, that pretty much everything: cities, landscapes, brains, natures, and the atmosphere, are in urgent need of re-composition. Addressing global warming, Latour describes the 'common world' as one in which many entities – human and nonhuman – coexist, and in which evermore entities – including 'invisible agents' and 'unheard voices' – must be taken into account when experimenting with new emergent compositions. Latour proclaims that "composition may become a plausible alternative to modernization" (Latour 2011a:6). He sees composition as different from modernization because composition is not about purifying, but about connecting. It is not a 'fast movement forward' but a precautious and creative process of carefully investigating the actors and relations that make up a given issue and of putting them together in the best possible way (see page 70). Even so, composition and design never happen from scratch. Since anything that has been designed or composed can also be re-designed and re-composed (Latour 2008, 2010a). Thus, argues Latour, composition embeds a critique of Modernity's strong belief in linear progression towards a somewhat determined future, achieved through a process of innovation. Instead, he argues, there is "no future but many prospects" (Latour, 2010a:485).

In the next section I will present literature concerned with prospecting different futures, but first I will specify my selection of title. When I have chosen to call the dissertation "Composing for Energy Engagement" it is in order to indicate that energy engagement – or rather the 'lack' of engagement with

energy – is not a pre-given and stabile thing, but it has been composed and can thus be re-composed. When I find the word 'composing' more appealing than 'designing', it is not only due to its artistic and ecological flavors (see quote above), but also because it entails an uncertainty, which is often lost when we talk about design. In the design discipline (where I was originally trained) there tend to be a strong belief in the possibility to actually 'design eco life styles,' 'design behavioral change' or even 'massive change.'[40] By exchanging design with compose I attempt to be more humble and underline that even if one strives to compose *for* energy engagement, there is no guaranty that engagement will be achieved, nor that it will lead to more sustainable lifestyles. The composer is trying her best, but it is up to the audiences (in plural) to judge how it works.

Futures, Imaginaries and Interventions

The imaginary of techno-scientific knowledge-making as naturally evolving linear progression has been widely criticized. Researchers have shown that the realities of innovation are much more complex and rambunctious than the classical (still widely used) innovation diffusion model (Jensen 2010; Latour 1988:132; Verran and Winthereik, forthcoming). Innovation and future-making processes are indeed contested. They happen through material, rhetorical, and organizational alignments and negations by different voices that vie for ascendancy (Jensen 2011). This is why Nik Brown, Brian Rappert, and Andrew Webster argue in the introduction to their anthology *Contested Futures* that:

> When the future can no longer be expected to follow on neatly from the past, then imaginative means must be employed (Brown *et al.* 2000:8).

Imaginaries, expectations, and narratives about potentials and risks matters for which futures are granted as possible and desirable (Ibid.; Adam and Groves 2007; Jasanoff and Kim 2013). Given that cultural imaginaries are important for prospecting alternative futures, the question thus become what sorts of cultural

[40] Massive Change was the name of a Canadian design program in Bruce Mau's design studio. On their web site they proclaim "Is not about the world of design. It's about the design of the world." http://www.brucemaudesign.com/work?project_id=24

work is necessary to make new futures cohere? (Rosenberg and Harding 2009).

As I have described in the previous chapter, discourses around smart grid futures are, not surprisingly, permeated by narratives about 'smartness' and 'a smarter planet,' [41] which makes it difficult to see other imaginaries and thus, by implication, works to marginalize alternative future directions (Moezzi and Janda 2014; Strengers 2013).

In her PhD thesis on future-making in the telecom industry, anthropologist Laura Watts argued that futures are simultaneously 'imagined and made':

> as the social and the material have agency, so too does the imaginary: the fantasies of technological desire, the science fictions, the expectations for the future in the mobile telecoms industry have effects on what is imagined for the future, what is considered possible, and what is therefore made (Watts 2007:13).

Watts focused specifically on how the landscapes and geographical places in which innovation happens matters for the outcome (Watts 2007, 2014, see also Suchman 2011). Just as important, of course, is the question of which actors and disciplines are heard and included in innovation. This obliges asking questions about the stories, problems, needs, expectations, and realities that are taken into account, when futures are imagined and made.

STS scholars have taken upon them the job of giving voices to marginalized actors in order to identify openings and generate practices from which alternative futures can emerge or at least enter into conversation with the existing discussions (Barry and Born 2013; Brown *et al.* 2000; Watts 2007, 2014). On this topic, participatory design, interaction design, and initiatives engaging publics and users in design processes, too, have done important work. These studies tell stories about energy futures in which people play other and more integral roles than merely 'consumers' (Binder *et al.* 2008; Ehn *et al.* 2014; Michael 2000; Wilkie and Michael 2009). One design and research group at Goldsmith University, for example, investigates the co-design of potential energy communities. By designing speculative objects and placing them in social situations, their research aim is:

[41] As IBM has famously termed their project: http://www.ibm.com/smarterplanet/us/en/overview/ideas/

> to engender creative discussion and debate around matters of trust, responsibility and community ownership of energy demand reduction (Boucher *et al.* 2010)

Speculative design is less concerned with designing finished and 'useful' objects than in using design objects as means for exploring and discussing potentially alternative futures. For this reason, speculative design deploys methods such as 'design fictions' and 'cultural probes' in order to create 'projected realities' through which futures can be imagined, rehearsed, and debated (Basar 2009; Boehner *et al.* 2014; Dunne and Raby 2013; van Mensvoort and Grievink 2012). In a project called *Switch!*, for example, a design research team from the *Interactive Institute* in Stockholm has explored "how design can be engaged in staging potential scenarios, narratives and debates" (Mazé and Redström 2008:55, see also Bergström *et al.* 2009). Concerned with energy and sustainability, the project designed a series of critical interventions in public space and in people's homes in order to expose and discuss the values already designed into energy ecologies. The broader aim was to explore possibilities for re-designing ecologies for alternative energy futures. Similar to my research, their approach to energy infrastructures as socio-technical ecologies, and their view of design as a practice for making and remaking norms and values, was inspired by Latour. Describing design not merely as a matter of problem-solving but as an important part of staging alternative problems, they too reference Isabelle Stengers:

> As an "art of staging," design might meet sustainability in "problem-finding" within existing and emerging paradigms, opening up questions to an expanded range of interests and stakeholders. Critical practice might be brought to bear on sustainable design not as simplification but diversification of the ways in which we might understand the challenges at hand (Mazé and Redström 2008:68)

This description of speculative design mirrors, in many ways, Kathryn Yusoff and Jennifer Gabrys' (2011) presentation of the ability of art – specifically art dealing with climate change – to transport people into imagined futures from which both present and potential futures can be materially experienced and critically discussed. Also inspired by Stengers, Yusoff and Gabrys have argued that creative practices stage 'political scenes' for 'collective experiments' that challenge the division between nature and culture:

> Arts and sciences collaborations both in historic and contemporary contexts have at turns addressed two-cultures issues, cultivated spaces of technological innovation, sought strategies for artful application of science and technology, and provided new terms for imagining socio-cultural and environmental issues. (Gabrys and Yusoff 2012:11)

Besides challenging the modern constitution (division between nature and society), these authors furthermore argue that the greatest potential of the arts is to challenge dominating neo-liberal approaches to the environment and sustainable transitions (Yusoff and Gabrys 2011:4). Such challenge takes the form of interventions in the present in ways that may invoke "imaginative possibilities to becomes otherwise" and to set unthought-of futures in motion (Ibid.:5). While some of these artworks function as what I will soon call 'spaces for hesitation', others seek to provide concrete solutions for different ways of living.

In my research I have been interested in both solutions-based art practices (see paper four) and in art practices that seek to stage the problems differently (see paper one and four). In my papers on art as well as in the ones on smart grid development (paper two and three) my aim has been to intervene in the existing discussions about energy engagement and to provide alternative perspectives on potential energy futures.

Before I present my empirical material, I end this journey through Latour's thinking by presenting his meeting with Isabelle Stengers and, especially, her definition of 'cosmopolitics' (Stengers 2003, 2005).

Experiments in Arts and Cosmopolitics

Over the past decade, Latour's interests in ecological issues, the arts and possibilities to articulate new and a-modern politics have gone hand in hand. Thus he has recently launched a new education program at the *Sciences Po* called *Experimental Program in Arts and Politics* (SPEAP). In the opening speech, Latour argued for "composing the common world through arts and politics" (2011b). As mentioned in his most recent art exhibition he invited artists to propose monuments for the anthropocene (see page 52). And in the art

exhibition *Making Things Public: Atmospheres of Democracy* (2005) [42] he explored how arts has the ability to render otherwise hidden politics and invisible connections visible and thus open them for public debate. As I have already indicated this perspective on arts has inspired both artist, designers and social scientists working in the intersection between art, ecology and politics (Marres forthcoming; Domínguez Rubio and Fogué 2013; Gabrys and Yusoff 2012; Gabrys 2014; Yusoff and Gabrys 2011). It was also in the catalogue for this exhibition that Isabelle Stengers' short and famous text "The Cosmopolitical Proposal" (2005) was published, and it is no doubt due to this publication that Stengers has since been so widely taken up by arts and speculative design (Gabrys 2014; Mazé and Redström 2008; Michael 2011, 2012).

Especially since the 2000s, Latour has increasingly referred to Isabelle Stengers' concept of 'cosmopolitics' as a possible ecological politics that "does not rely on the 'first modernity' dream of an already existing common Sphere" (Latour 2004d:462; 2011a). As we recall, Sloterdijk's sphere analysis begins with the implosion of the unitary 'globe'. However, Stengers' use of the pre-fix, 'cosmo-' does not mean that she is pulling us back towards such an all-encompassing idea. Instead, Stengers' effort is an explicit attempt to free the cosmos from any universalistic basis:

> … the idea is precisely to slow down the construction of this common world, to create a space for hesitation regarding what it means to say "good". … The cosmopolitical proposal has nothing to do with the miracle of decisions that "put everyone into agreement" (Stengers 2005:995,1003)

Combining cosmos with politics, Stengers emphasizes that what counts as cosmos is subject to ongoing negotiation. As Latour writes:

> The presence of *politics* in *cosmopolitics* resists the tendency of *cosmos* to mean a finite list of entities that must be taken into account. *Cosmos* protects against the premature closure of *politics*, and *politics* against the premature closure of *cosmos* (Latour 2004c:454)

[42] "Making Things Public: Atmospheres of Democracy" Zentrum für Kunst und Medien. Co-curated with Peter Weibel, 2005. http://www.bruno-latour.fr/node/333

To clarify any confusion between Stengers' cosmopolitics[43] and that of Ulrich Beck's, who follows Kant in speaking of 'cosmopolitanism' and the 'cosmopolitans', Latour argues that 'citizens of the world' now have to give up a dream of all inhabiting one stable 'same world.' Instead, they need to take on the daunting task of re-composing the world and imagining alternative ways of rearranging the space in which they will come to dwell (Ibid.:457). Indeed, it is only *because* there is no Nature (in singular) and no given 'truth' that it is possible to talk about cosmopolitics.

Stengers has written extensively on 'cosmopolitics', especially in her seven volume French series of the same name (Stengers 2010, 2011). This endeavor was dedicated specifically to the production of natural science. In these books, cosmopolitical practice refers to an invention of 'another science' – a slow science, which does not take any preconceptions for granted and do not come to hasty conclusions about which "processes, practices, experiences, ways of knowledge and values that make up our common world" (Stengers 2012). Here, it is relevant to notice that Stengers focuses on natural science and never engages with innovation and technology development, except in order to dismiss it as 'knowledge economy,' which she views as the very anti-thesis of science. Thus, there can be no issue of a smooth translation of her cosmopolitics into the realm of infrastructure innovation. In this thesis, however, I am primarily inspired by Latour's adoption of her concept as a means for redesigning and recomposing the build environment in a more precautious way (Latour 2008, 2010a). All of which is to say that my presentation is by no means exhaustive, and to explain why I engage directly with only a few of her primary writings (Stengers 2003, 2005, 2012).

However, Stengers' project also arises from a deeply felt ecological concern. Thus, she argues that due to global warming there is an urgent need for a kind of science capable of taking into account the messiness and political aspects of science.[44] As noted, cosmopolitics can be described as a means for slowing down dominating ways of knowing, creating a space for carefully scrutinizing possible alternatives to what is taken for granted. The cosmopolitical proposal, therefore, is not about providing clear answers and guidelines. Instead it aims to shifting perspectives:

[43] Stengers denies any relation between her use of cosmopolitics and that of Kant (Stengers 2005:994).
[44] Stengers and Latour's intellectual exchanges goes back long before 'cosmopolitics'. For example Latour has written the foreword to Stengers book *Power and Invention: Situating Science* (1997).

> How can we present a proposal intended not to say what is, or what ought to be, but to provoke thought, a proposal that requires no other verification than the way in which it is able to "slow down" reasoning and create an opportunity to arouse a slightly different awareness of the problems and situations mobilizing us? (Stengers 2005: 994)

Cosmopolitics, in this sense, refers to the articulations of multiple and so far unknown worlds. Scrutinizing possible worlds one can take no shortcuts. When assembling any new collectives one cannot know in advance neither which entities (human and nonhuman) should be included, nor which requirements and obligations their inclusion will bring along. Cosmopolitics is thus first and foremost about hesitating and slowing down – is about questioning and challenging what there *is*. This is why Stengers distinguishes between 'recognizing' (what we already know) and 'thinking' (where we can discover something new). The central emphasis is on what she calls ecology of practices:

> ecology of practices does not have any ambition to describe practices 'as they are'; it resists the master word of a progress that would justify their destruction. It aims at the construction of new 'practical identities' for practices, that is, new possibilities for them to be present, or in other words to connect. It thus does not approach practices as they are–physics as we know it, for instance–but as they may become (Stengers 2003:186).

To make new knowledge appear, we need to give to the situation 'tools for thinking'; that is tools that have the power 'to make us think' and not just recognize (Ibid.:185). Stengers therefore describes the cosmopolitical proposal as a skillful art of "designing a political scene" in which collective thinking can proceed "in the presence of" actors who are otherwise disqualified and thus excluded from the "common account" (Stengers 2005:1002).

Accordingly, the composition of collectives is a matter of experimenting with new possible 'propositions'. Both Stengers and Latour adopt the term propositions from the philosopher Alfred. North Whitehead. Centrally, a proposition is not merely a linguistic construction, but instead "the engagement of a certain type of world in a certain type of collective" (Latour 1997:7). In other words, what is proposed are specific ways of making social, material, 'natural' actors relate to one another; forms of re-composing heterogeneous entities

differently. This requires an open imagination and consistent experimentation to think and compose new relations *with others*.

Inspired by these thoughts I have explored the different infrastructural compositions – both ones proposed by the smart grid developers and the ones proposed by artists and designers – as propositions for future energy collectives. In the various cases I study (see more in the following chapter) the variety of social, technical and 'natural' actors are brought into relations with one another and thus propose and compose certain 'common' worlds.

However, if these do all count as propositions, how then do we evaluate cosmopolitical propositions? While propositions are not judged on the basis of their truth or falsity, this does not mean they are all equally good. Instead, propositions can be more or less *well-articulated* (Blok and Jensen 2011:83; Jensen 2003). A well-articulated proposition is one where the protagonist has done a thorough (and thus often slow) job of figuring out the basis on which any actor or issue should be in- or excluded in each particular case. Because there exist no given truth or general principle to rely on, the job of figuring out whom, what, and how it something included is indeed a political task to decide. A well-articulated proposition is one where its protagonist has explored a variety of possible connections, and on this basis has decided upon the, at hand, best composition. In doing so, a good proposition may push its own limits for what counts as relevant for the issue at hand (Stengers 2003, 2005). But a good cosmopolitical proposition is not only one that challenges the existing reality (what is commonly acceptable as 'real' and possible') and does difference by proposing new and 'unthinkable' propositions, it is *also* a matter of 'diplomacy'; which means doing difference with a sensitivity to and a respect for what currently counts as 'real.' The art of diplomatic challenge is not about proposing something completely detached from the relevant practice only to ask the practitioner "why don't you just agree with this or that proposal" (Stengers 2003:193). A good cosmopolitical proposal is one, instead, which takes its point of departure in a reality already in place and tries to shift this reality slightly.

> Approaching a practice then means approaching it as it diverges, that is, feeling its borders, experimenting with the questions which practitioners may accept as relevant, even if they are not their own questions, rather than posing insulting questions that would lead them to mobilise and transform the border into a defense against

> their outside. … This achievement is what I describe as a cosmopolitical event (Stengers 2003:184).

For example when approaching a research field one needs to understand which issues are already relevant for the practitioners and base one's intervention on this knowledge. As Latour also wrote about the art of composing, the diplomat needs to be willing to make compromises and to find some kind of common ground. Not a common ground based on agreement, but a ground from which both parties can return to their fields and still be accepted (Stengers 2003:194).

As I approach my empirical field, I discuss in which ways the different cases both challenge and relate to the existing 'reality' as they explore and propose new energy collectives. I do not see the propositions made by artist and designers and those made by engineers and smart grid planners as intrinsically distinct from one another, but I attempt to see them as part one and the same project, namely to explore and propose future energy collectives, and to do so in ways that compose for new modes of energy engagement. This does however not mean that I do not recognize the important difference between the disciplines in the sense that the artist are not hold accountable for their propositions the same way as engineers and policy planners (at least to some extend) are.

Furthermore, I have attempted to include my own practice in the same project. It is thus not my intention to take a position 'outside' these propositions from where I can 'judge' them and decide whether or not they do good or bad cosmopolitics. Even though I do, to some extend, 'evaluate' and discuss the different cases' cosmopolitical potentials (especially in paper four), I also see my own work as part of 'an ecology of practice' attempting to propose new energy collectives. I am indeed very sympathetic towards both the art projects and the smart grid planning, and thus 'debunking' or criticizing any of these endeavors have never been my intention. Instead, in the following papers, I am attempting to do diplomatic analyses taking the point of departure in questions and concerns already present in the field. On this basis, I am trying to push the borders by emphasizing possible shifts, which may 'arouse a slightly different awareness of the problems and situations mobilizing' as well the smart grid developers as artists and designers. In this dissertation I have set out to explore how artists and smart grid planners engage in a cosmopolitics of energy engagement; one centered on potentials for re-compositions of alternative

energy collectives. But while I am *studying* other actors' practices it is my hope that my endeavors may come to *intervene* or maybe rather *take part in* what could be conceptualized as collective 'ecologies of practices' for a cosmopolitics of energy engagement (for more in this diplomatic and interventionist role of the researcher see next chapter, page 84).

I am not alone on this endeavor for 'a cosmopolitics of energy'. In a very recent paper Jennifer Gabrys (2014) analyzes three artworks concerned with energy[45] and she argues that they:

> demonstrate how the materialities of energy emerge within distinct cosmopolitical arrangements that are generative of distinct types of participants and publics. … In this sense, they assemble a cosmopolitical array of participants and design political scenes that slow down thinking about what the performance of environmental change in relation to energy may involve. … [They] present renewed opportunities for developing speculative and interventionist practices in relation to the cosmopolitics of energy. (Gabrys 2014:2106)

When I came across Gabrys' wonderful paper, it was with an ambivalent feeling of excitement (I am not alone with this idea) and resentment (someone said it before me!). However, needless perhaps to say, doing energy cosmopolitics is an ongoing and complex endeavor, and there is certainly room for more than one experiment. Thus, I am now happy to see my project as part of a larger pursuit to explore new ways of doing cosmopolitics of energy and engagement.

Whereas Gabrys' argument in many regards resembles mine and her paper has indeed been very valuable for me to sharpen my approach, there are also numerous specific, contextual differences between my study and that of Gabrys'. Most noticeably is that Gabrys is only analyzing artworks – what she refers to as creative practices[46] – and argue that they can function as 'hesitating practices' for reflecting on the collective energy crisis, and that they can make new energy potentialities emerge. I have attempted to *bring together* both projects from the arts and from infrastructure planning in order to see them as

[45] One of the artworks is *Nuage Vert*, which I have also analyzed in paper one.

[46] Since the art projects that I am working with are somewhat hybrids between art, design and architecture, I did consider referring to them as 'creative practices'. However, this would have created a distinction between the art practices as creative and thus indicated that the smart grid projects were *not* creative.

part of a 'shared' cosmopolitics of energy engagement.[47] Thus, constructing my empirical field across arts and smart grid development, I hope that both 'worlds' may come to work as 'tools for thinking' about what energy engagement is and what it may potentially become.

With this dissertation I want to highlight the importance of keeping very different actors in the picture if the goal is to stay open and experimental with regards to which kinds of future energy engagements are possible and desirable. On this note, I close this intellectual journey with the Latour quote with which I also opened the dissertation:

> It is time to compose—in all the meanings of the word, including to compose with, that is to compromise, to care, to move slowly, with caution and precaution. That's quite a new set of skills to learn: imagine that, innovating as never before but with precaution!' (Latour 2010a:487)

Taking seriously the urgent need for radical energy transitions the purpose of my dissertation is to describe and analyze and to move between various attempts to 'speed up' and 'slow down' reasoning in cases of composing energy infrastructures. In doing so, it is my hope that this dissertation offers some modest contributions to the development of such skills of composition.

[47] In doing so I have attempted to 'resist' a classical notion of art as having a somewhat privileged position 'outside' of society, from where it can function as trickster or as critical 'commentator.'

5. Introducing and Constructing the Field

In an attempt to attain diverse perspectives on potentialities of energy engagement and on future infrastructural compositions, I have constructed my research field (Amit 2000) across various projects of smart grid planning and artistic practices. The empirical material derives from four different cases. Rather than trying to compose one coherent story in which I have had complete 'control' over the selection of these materials, I emphasize in the following the rather rambunctious and 'coincidental' aspects of the research process. This is not, of course, to say that it has been entirely chaotic, or that my interests have not guided me in particular directions. Yet, it is true to say that the empirical material for the individual cases presented itself to me in ways that I had not planned or anticipated.

As the cases ended up being rather different from each other, I used different methods generating and sorting the material: artwork analysis (paper one), ethnography (paper two), document reading and interviews (paper three), and auto-ethnography (paper four). In other words, instead of approaching the empirical material with a particular and pre-defined method, the methodologies, as well at the analytical concepts employed, have emerged in relation to the specifics of the empirical materials (Gad and Ribes 2014; Law 2004; Lury and Wakeford 2014). Coming from a background in arts and design, I did not have much preliminary training in social science methods. That meant that I entered the field with relatively few predefined ideas about 'what to do' and 'how to do it'. Accordingly, my journey through the different cases was also a learning process. Thus, encountering new empirical fields involved 'becoming an ethnographer', learning how to make interviews and read policy documents (paper three), experimenting with the crafting of 'thick' ethnographic descriptions (paper two), and, not least, figuring out how to sort and make sense of the somewhat 'too rich' auto-ethnographic material (paper four). For these reasons, collaborations with co-authors with finely honed social scientific skills have been very important.

Because I have constructed my field across arts and infrastructure planning, I have worked at the edges of, and in-between, different disciplinary and methodological 'worlds'. Moving between the different cases and exploring the borderlands between empirical and methodological approaches

continuously threw up questions of what it is possible to do with which methods and materials. As I will discuss below, the various cases have indeed posed quite different methodological and analytical challenges. Rather than eradicating such differences, I emphasize that these challenges are essential to keep in mind when reading the papers as part of the combined thesis.

Even though I have here presented my research as a matter of moving between different empirical cases and, thus also, disciplinary 'worlds', I would also like to stress that I do not see these worlds as altogether distinct from one another, and certainly not as having a hierarchical relation. Instead, symmetrically, I analyze the four cases as illustrative of different experiments in assembling energy collectives and composing for energy engagement (see also page 71). Each of four articles contains its own section on empirical material and methods, so here I provide simply an overview of the quantity and the quality of the material. Furthermore, I describe how I encountered the various cases, thus offering an account of my methodological and empirical journey. I end the chapter with a few reflections on my 'normative' intentions, interventions and the implications of constructing the field across worlds that do not normally meet.

Case 1: Analysis of Artworks

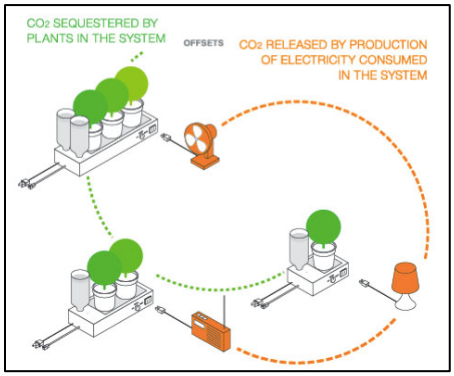
My research was originally sparked by an interest in how new technologies were employed, or imagined to be employed, in order to foster sustainable lifestyles and make people more aware of, and engaged in, environmental issues. The specific focus of energy came only later. With a background in arts and design, I was particularly interested in how these domains would be part of various experiments with new solutions for low-carbon life styles.

For this reason, the first phase of my research consisted of an inquiry into existing art projects and other creative practices that employed new technologies in order involve people in environmental issues. At this point I was investigating projects in the broad realm of environmental issues. Because I was working closely together with a fellow PhD student, Anne Sophie Witzke (co-author of paper one, five and six), whose subject was artistic practices relating to air and climate change, we examined a variety of artworks working with air and air-conditioning. As I describe later, we co-authored a Danish book chapter, in

which we analyzed how four artworks constituted 'atmospheric constellations' (Schick and Witzke 2014a, see page 86). Since two of the artworks were located at the intersection of air and energy production/consumption, we also co-authored a short paper focusing more specifically on energy and infrastructures. The two artworks in question were:

- *Nuage Vert* (2008) by artist duo HeHe (Helen Evans and Heiko Hansen)
- *Natural Fuse* (2008) by Usman Haque

Nuage Vert was a public installation that took place over one week in in Helsinki. The artists collaborated with the local power plant and got access to the data of power production. The data was translated into a green cloud (nuage vert), which was projected onto the vapor from the power plant's chimney. The cloud changed size reacting to the amount of power produced.



Natural Fuse was a network installation, where participants could bring a small part of the network home. This part consisted of a plant, an interactive flowerpot, and a lamp, fan or radio. The domestic units were connected through the Internet, and the installation functioned as a game where the participants worked to achieve a collective balance between electricity consumption and CO_2 off-sets. These works are discussed in more detail in paper one.

We chose these specific artworks for several reasons. First, obviously, they were about energy and air. Second, they were both placed outside the traditional museum space – *Nuage Vert* in the sky and *Natural Fuse* in people's homes – and they were interactive installations involving participation of people or publics. Third, both installations were situated in an interdisciplinary field somewhere between art, design, and science. Finally, the choices were motivated by our interest in the conceptual frameworks of Bruno Latour and

Peter Sloterdijk. We found the artworks helpful for articulating some of the political complexities that they were grappling with. Instead of making traditional aesthetic analyses, we thus took the artworks to be indicative of wider societal situations; doing so, we analyzed how they explicated particular matters of concern. Given this concern, we did not aspire to place the works in an art-historical context. Nor did we take them to exemplify specific artistic trends or styles. In other words, our analyses have to be seen as partial perspectives: we are primarily interested in the quality of the artworks as comments on, and interventions into, entanglements of air, electricity, and environmental issues.

Unfortunately, we did not have the chance to experience the installations live. For this reason, the materials analyzed were photographic and textual representations. I had the opportunity to talk with Usman Haque at a conference, but this conversation did not change the analysis. Later, we invited Helen Evans and Heiko Hansen (HeHe) to a conference (see paper six). Conversation with these artists turned out to be very important for paper four, and for my general reflections on art and energy.

Case 2: Danish Smart Grid Network

Settling on energy as the main focus of my research happened around half a year into the PhD project. At this point, I learned that the Danish Ministry of Climate and Energy had appointed a group of experts to come up with suggestions for a 'smart grid'. The way in which people were imagined to change their everyday practices in order to allow for a grid running on 100% renewable energy, made the 'smart grid' seem an ideal case to me. However, I was more interested in the general vision of potential future consumers than in investigating the specific nitty-gritty of specific projects, actors or knowledge-making practices. Hence, I chose not to follow particular projects, but instead to study the collected work of the Smart Grid Network as they formulated a general vision for Danish smart grid (as described in chapter two).

I followed this work over the course of the three years in which the Network existed. I did so by subscribing to newsletters and follow media coverage of smart grid. I also attended various conferences, events and public meetings, primarily intended for experts and professionals within energy development to discuss problems and solutions. An important part of the

empirical material also consisted of seven key reports published during this period by the Ministry of Climate, Energy and Building, and by other key organizations represented in the network. These reports are listed below.

- *Smart Grid i Danmark* (2010) Published by Energinet.dk and The Danish Energy Association (Danish only).
- *Denmark Opts for Smart Grid*. (2011) Published by Energinet.dk.
- *MAIN REPORT: The Smart Grid Network's Recommendations* (2011) Published by The Ministry of Climate, Energy and Building.
- *Smart Grid Netværkets Arbejde - Sammenfatning og Anbefalinger* (2012) Published by The Ministry of Climate, Energy and Building .
- *Smart Grid Anbefalinger - Status på Smart Grid-Netværkets Arbejde* (2012) Published by The Ministry of Climate, Energy and Building (Danish only).
- *Smart Grid in Denmark 2.0 - Implementation Of Three Key Recommendations From The Smart Grid Network* (2012) Published by Energinet.dk and The Danish Energy Association.
- *Smart Grid Strategi* (2013) Published by The Ministry of Climate, Energy and Building. (Danish with UK Summary)

Inspired by science and technology studies discussions of how to read policy documents (Gad 2010; Jensen and Lauritsen 2005) I read these reports closely, not with the purpose of criticizing them, but rather with the aim of finding openings for infra-reflexivity and infra-critique (Latour 1988b; Verran 2014, see more in paper three).

After reading the reports I conducted three semi-structured interviews (Kvale 2009). Their purpose was to gain further knowledge on the role of the consumer, an entity gradually written out of the reports (see chapter two). I wanted to find out why the expectations to the involvement of consumers had decreased and also to acquire more insight into how actors involved in the Smart Grid Network saw the role of the user. The three interviewees were thus chosen because they held key positions in the smart grid network. The first was a government official from the Ministry of Climate, Energy and Building with

responsibility for the Smart Grid Network. The second was head of the Danish Alliance for Intelligent Energy, a sub-section of the Dansih Energy Association. The third was head of research and development at the national transmission system operator.

Interviews:

- Hans Martin Kühl, Special Advisor to the Minister of Climate and Energy. Interview at the Danish Ministry of Climate and Energy November 12th 2013.

- Morten Baadsgaard Trolle, Head of The Alliance for Intelligent Energy. Interview at Danish Energy Association. November 4nd 2013.

- Kim Behnke, Head of Head of R&D at Energinet.dk. Phone Interview November 2th 2013.

Getting access to the field was generally easy and all three interviewees, whom I contacted per email, were immediately interested in doing the interviews. Here it might perhaps be relevant to note that Denmark is a small country with a famously 'flat' hierarchy. Moreover, smart grid is a an emergent and relatively delimited field, which means not only that people tend to know each other, but also that they were generally interested in all the other actors working on 'the same project'. I had previously heard two of the interviewees speak at events but I did not know them personally.

All three interviews were rather casual and conversational. As they unfolded, it became clear that the reason these people were interested in talking to me was exactly because they also found the concern with 'consumers' to be problematic. Indeed, as I discuss in paper three, the initial interview roles tended to shift slightly, because the interviewees were interested in me not only as an interviewer, but also as a supposed expert in consumers.

The material from the Smart Grid Network is analyzed primarily in paper three, while the reports have also been used as background material for the analysis of a smart grid innovation delegation trip analyzed in paper two.

Case 3: Innovation Delegation Trip

Through a newsletter, I was invited to participate in a two and a half days 'innovation delegation trip' to Munich, Germany. The trip was organized by the Innovation Center Denmark, which is an initiative by the Danish Ministry of Foreign Affairs.[48] The theme of this particular trip was *Smart Green Homes.* Nine companies and institutions participated. They comprised a mix of businesses developing smart grid technologies and public research institutions. The aim was to create dialogue, share knowledge, and initiate partnerships between Danish and German smart grid developers. The Danish delegation visited five German knowledge institutions as well as key industrial players including Siemens and Fraunhofer institute.[49] At each visit, all Danish participants presented their knowledge to the hosts and vice versa.

Data generation throughout the field trip took the form of participant observation. Since I had joined the trip on equal terms with the other participants, I also had to present my research to the German institutions. Simultaneously, of course, I was observing. Each night at the hotel I wrote field notes (Emerson *et al.* 2011; Hammersley and Atkinson 2007; Spradley 1980). Along with other materials collected during the trip – such as brochures and power point slides – these field notes functioned as the main empirical material for paper two.

During this fieldwork, I thus had a double role as both ethnographer and participant. By the other participants, however, I was perceived simply as 'part of the group' and not as an observer. This double role, and the form of the trip itself, which included dinners as well as many opportunities for informal conversations, gave access to a particular form of data. Simultaneously, it effectuated a blurring between my positions as observer of the field and participant in it. This blurring was intensified in the last empirical case.

[48] Denmark has four innovation centers around the world (Shanghai, Hong Kong, Silicon Valley and Munich) aiming at strengthening collaborations between Danish and international businesses.
[49] The other three were: Stadtwerke München, B.A.U.M. Consult GmbH (heading the national smart grid project EEnergy in Germany), and Munich CleanTech Network.

Case 4: Auto-ethnographic study of the implementation of an art project

The last part of my empirical material was not collected intentionally as empirical material. Nor was it originally part of my PhD research. As part of my interest in the intersection between art and energy, I was acquainted with the art project Land Art Generator Initiative.[50] Land Art Generator Initiative (LAGI) is a biannual ideas competition, which invites artists, architects, engineers, designers and others to submit ideas for site-specific, large-scale, public artworks that have the added function of producing clean, renewable energy to the electricity grid.[51] LAGI took place in Dubai and Abu Dhabi in 2010 and in New York City in 2012.

Due to my interest in art projects dealing with energy, I had invited the artists behind *LAGI* to Denmark to participate in a panel session on arts and environmental issues organized for the conference *Design and Displacement* (4S/EASST, Copenhagen 2012). In collaboration with Anne Sophie Witzke from Aarhus University and Trine Plambech from the Alexandra Institute, we decided to organize a workshop about *LAGI* while the artists were in the country. This event took place at the IT University of Copenhagen on October 15th 2012. Aside from the *LAGI* founders, who presented their project, we had invited the Nature Agency, an administrative body under the Ministry of Environment, to present their initiatives with public involvement in renewable energy (see also chapter two, page 14). We had also invited a group of professionals and civil servants within energy, arts, architecture and city planning. During this workshop emerged a great interest in bringing *LAGI* to Denmark.

The IT University saw an interest in hosting *LAGI* as part of a strategy to promote a new strategic research area called *Energy Futures*.[52] For this reason, the university offered me to take a nine-month leave of absence from my PhD, in order to be employed as full time project manager for *LAGI2014*. For the nine months I thus stayed at the university, but worked on *LAGI* instead of my PhD. My own decision to take on this task was based on a wish to gain experience with practical work at the intersection of art and energy. I did not, however, think of my work with *LAGI* as part of my fieldwork.

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[50] I first met the founders and director of LAGI at a conference in Istanbul in 2011.

[51] *Land Art Generator Initiative*: http://landartgenerator.org/

[52] Energy Futures: http://energyfutures.itu.dk/

From April 1st to December 31st 2013, I worked as project manager and collaborated with the US-based founders of *LAGI*. The work consisted of fundraising, making partnerships, finding a site for the competition, identifying an exhibition venue, assembling a jury, and mobilizing support from experts and politicians in support of the competition. When the project was launched on January 1st 2014 my employment ended and I returned to my research position. [53] However, later that year I organized a symposium called *Environmental Entanglements – Art, Natures and Technology*, as part of the *LAGI2014* project (see paper six).

Since I did not view my project management work as empirical material I did not take any systematic notes during the period. Only after returning to my PhD position did I begin to think about using the knowledge and experiences gained during this process as part of my dissertation. Eventually, I collected a set of materials for the auto-ethnography found in paper four. These materials included e-mails and various notes, funding applications, material for the web, along with media coverage, an external evaluation report,[54] and, of course, my general impressions and memories.

As discussed in paper four, my involvement with *LAGI2014* went considerably beyond classical ethnographic engagement of participation and observation (Hammersley and Atkinson 2007; O'Reilly 2011). As the conventional and useful ethnographic tool of 'estrangement' (Zuiderent-Jerak and Jensen 2007; Zuiderent 2002) was not available to me, the work of 'removing' myself from the empirical material in which I was undeniably a key actor was far from easy. In order to achieve the necessary distance, numerous discussions with colleagues have been essential. Similarly, the organization of several events conducted in relation to *LAGI2014* helped me see the project from other, external, perspectives. [55] Not least, have the comments from

[53] Subsequently, the IT University employed a new local project manager, with whom I had close contact throughout the project. *LAGI2014* ended with the ending of the exhibition November 7th 2014.
[54] Region Capital, who funded most of *LAGI2014*, required an external evaluation report, which was made by the consultancy firm Smith working with innovation in the building sector http://smithinnovation.dk/
[55] Besides the academic symposium described in paper six, I was also part of organizing the public event *Pynt eller Politik?* (Decoration or Politics?), in which politicians, city developers, architects, activists, researchers, and artist were brought together to discuss "whether arts and architecture can enhance the green transition". The event was organized in collaboration with a major Danish newspaper (Dagbladet Information) as part of their series of public events discussing green transitions in Denmark. http://voresomstilling.dk/artikel/pynt-eller-politik-kan-kunst-og-arkitektur-fremme-den-gr%C3%B8nne-omstilling/590

reviewers and the various rewritings of the article been part of the process of distancing myself from the material.

From a practical point of view, the project management process was indeed important, as it gave me access to a variety of key actors within arts and culture, energy planning and development, and not least key politicians, whom I would not otherwise have had access to. Moreover, engaging in project management to make *LAGI2014* come to life in a Danish context (by mobilizing the necessary financial support and partnerships) gave me the opportunity to practically intervene in my field of study – the intersection between art and infrastructure planning. Through this process I gained invaluable insight into what it takes to work across art and energy planning – and what doesn't work.

Practically intervening in one's research field is, of course, not a new idea within arts, design, or more practice-based forms of research (Bergström et al. 2009; Boehner et al. 2014; Frayling 1994). However, within social science there has in the past few years been an increasing interest in material devices as tools for actively intervening in the field. Design and employment of services, technologies, probes, and creative objects are used to make otherwise invisible things visible, to engage publics in research, to gain access to new forms of knowledge-making, and to construct the field in different ways by using objects as mediators (Lury and Wakeford 2014; Watts 2007, Winthereik forthcoming). Indeed, it would be quite interesting to further investigate 'project management' as a practice of knowledge-making and a form of research intervention.
However, this lies outside the scope of this thesis.

A notion of methodological experimentation and intervention emerges from the realization that methods are much more than 'just' tools for ordering the empirical world 'out-there.' As sociologist John Law has written, method practices "also help to *produce* the reality that they understand" (Law 2004:5, see also Lury and Wakeford 2014, Winthereik forthcoming). For example, what we choose to do research on, how we choose to construct our field, which 'methods' we choose to employ, and not least how we (more or less) actively choose to intervene in the field are indeed normative choices. They matter not only for the way we come to see the world, but due to their potential effects on the construction of new futures (Adam and Groves 2007; Haraway 1994; Jensen 2010; Mol 2003). By constructing my field across art and smart grid planning, I

see myself as participating in the carving out of alternative directions for future energy engagements (as also explained in the previous chapter page 71).

Indeed, John Law ends his book *After Methods* by arguing that one of the many realms often excluded from conventional methods of finding truths is aesthetics.[56] This is, he says, due to the 'modern settlement' that dissociates facts and truth from aesthetics. However, says Law, once we do away with the modern settlement:

> Beauties will need to live alongside truths, and alongside politics too. As I have noted above, they are, in any case, multiple in their enactments and forms. But their blanket absence from the processes of crafting realities is not a good. It works to exclude ontic/epistemic aesthetic imaginaries (Law 2004:150).

Bringing arts and infrastructure planning together I attempt to intervene in the field, and this is also why I nowhere attempt to hide my own interest in the subject matter at hand. Far from being a "distant observer watching disinterestedly", I see my work as aligned with what Latour describes as the "new *diplomatic* role of the social scientist", which implies "a mixture of research and normative intervention" (Latour 2004c:451).

My engagement with the different cases is guided by my concern with environmental issues and my strong aspiration to go beyond and to widen the dominating techno-economic approaches to energy. In the next chapter, I introduce the six papers, which, in spite of their profound differences, share an aim of challenging and hopefully multiplying the ways in which energy infrastructures and energy engagement can be imagined and composed.

[56] Law's notion of aesthetics is wider than, but does include, the discipline of arts.

6. Introducing papers: Processes and Contributions

Due to the somewhat 'odd' form of an article based PhD dissertation, this chapter serves the ambiguous double purpose of closing down the first part of the thesis and opening up the second. I offer an introduction to the content and main arguments of the individual papers. Simultaneously, I sum up the findings and contributions of the overall thesis. In this way, the presentation relates to the dissertation framework and specifies the paper's contributions to the thesis. These 'preliminary conclusions' constitute the basis for the concluding perspectives of chapter seven.

As already explicated, the articles are very different both in terms of form, style and arguments. This is not only due to the different case materials analyzed, but also a consequence of the form of an article-based dissertation. Before continuing with the paper introductions I will therefore make a few (meta)reflections on the character, process and premises of making a paper-based PhD dissertation. I do so because, in my view, article-based dissertations tend to neglect, or underestimate, the importance of the form and 'infrastructure' of articles themselves. Yet these forms matter a great deal for the knowledge-making process and for the content of such dissertations, including this one.

For one thing, all of the papers are results of collaborative work, and thus my co-authors have been integral to the shaping of perspectives and arguments. Moreover, the articles have been framed and formed through the contexts of the particular journals (and special issues) for which they were written. The review processes (for paper two and four[57]) have thus influenced the direction of arguments, not least by opening the door to new analytical and theoretical frameworks, which have subsequently re-oriented my research.

One particularly important aspect of writing an article-based PhD concerns the temporality of article writing, which cannot be detached from the diversity of the outcome. Thus, knowing about the process and trajectory of

[57] Paper one was not peer-reviewed and paper three has not yet been revised according to the reviewers' comments.

writing the thesis is crucial for understanding the unfolding of the argument itself. In contrast with monograph chapters, which can be retrofitted to match a general argument, or be 'updated' according to the authors' academic development, the articles stabilize as finished products, reflecting their own position in the temporality of the research project. To reflect that process, and my own academic journey from a background in arts and design into new empirical and analytical approaches to social studies of technology and innovation, I have chosen to list the papers in a roughly chronological order.[58]

For that reason, I end each resume with a short reflection on how the findings helped me get the field into view in particular ways, and how they took my research in certain directions. For the reason just outlined, it is relatively difficult to construct one coherent story when doing an article based PhD. Though I will outline some general perspectives and partial conclusions across the different papers (in chapter seven), I do not wish to claim for the papers a false sense of unity. Given that this is a retrospective endeavor and because the resumes also serve the purpose of summing up the contributions of the collected thesis, I have chosen to introduce the papers in the past tense.

Paper 1: *Powering Ecological Futures*

Co-authored with Anne Sophie Witzke
Published June 2011 online for conference *ISEA*

This is a short paper written for a conference on electronic arts. We were interested in how artists and designers were employing digital networked technologies, sensors, and visualization devices in order to make tangible and explicit some of the complex entanglements between modern life-styles and environmental issues are often hidden from plain view. We also wanted to explore how such materializations could be seen as directing the attention of the public to issues of energy consumption and ecological problems. The paper combines two different PhD research topics ('energy' and 'air') by looking at energy infrastructures as air-conditioning technologies. In our analysis, we showed how the two artworks *Nuage Vert* and *Natural Fuse* made explicit that

[58] Paper three and four are, due to the review process of paper four written somewhat simultaneously. Paper 5 is written before three and four, but because it is an essay, and not a journal article, I have chosen to place it later.

air and CO_2 emissions have presently become a fundamental concern to power supply systems.

The starting point of the analysis was the philosophical ideas of Latour and Sloterdijk (as outlined in chapter four).[59] Seeing the artworks as material openings into currently 'black-boxed' electricity infrastructures, we argued that the artworks made visible a variety of hidden connections and causal effects, thereby drawing attention to silenced matters of concern. We further argued that both installations explicated how the air-conditioning of our private houses or spheres is not as isolated as we may think, and thus made tangible some of the complex causalities of the current ecological crisis.

In different ways both artworks reworked relations between individual energy consumptions and 'energy commons'.[60] *Nuage Vert* functioned as a 'collective smart meter' that visualized the combined consumption of a surrounding residential area.[61] In this way, *Nuage Vert* connected the question of individual energy consumption to a collective infrastructure and to shared atmosphere. Similarly, *Natural Fuse* made an energy collective by including plants, technologies, and CO_2 quota into the network equation of energy consumption. It furthermore experimented with relations between 'selfish' and unrestricted over-consumption and a collective balance in the energy system. Making the effects of excessive energy consumption 'painfully' visible through dying plants in the home environments, we described *Natural Fuse* as an experiment in 'new structures of participation'.

Functioning as experiments that related energy, air, humans, plants, technologies, infrastructures, and collectivities in new ways, we argued that *Nuage Vert* and *Natural Fuse* encouraged discussions on how it is possible to ecologize (as oppose to 'modernize') energy systems. Both artworks maintained

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[59] I will leave out most literary references in this section because it is in the individual papers or have been explained in the previous chapters.

[60] We did not elaborate specifically on the notion of 'energy commons', but Usman Haque has described *Natural Fuse* as a network "structuring participation for an energy commons" (2011), and Gabrys has later described *Nuage Vert* as an event that created an energy commons (2014:2103). I would have been interested to explore this notion further, but this will have to wait to a later occasion. The concept of energy commons has been discussed by a few researchers in relation to equal access to natural recourses for energy production (van der Horst and Vermeylen 2008; Mediaalternatives 2015), and as means for building communal ownership and new energy communities (Byrne et al. 2009; Elworthy 2011). A discussion of an energy commons can of course not be taken without relating back to Garrett Hardin's classical text "The Tragedy of the Commons" (1968).

[61] We later learned from Noortje Marres' (forthcoming) analysis of *Nuage Vert* that it did not in reality work as a collective smart meter because the power plant was not only producing electricity to the residential area, but was part of the Nordic electricity grid Nord Pol. Therefore, it was not possible to make a direct link between electricity consumed and produced in one local area.

a certain ambiguity and reflexivity, and they did not propose any concrete solutions. Instead, we argued, they worked as material articulations of the complexity and ambiguities of an ecological future. Based on these articulations we suggested that one of the most important roles for art in relation to energy and environmental issues is to make visible that 'there is no easy energy future'.

This article was written before I was familiar with the thought of Isabelle Stengers. Even so, our description of the artworks is indeed closely related to Stengers' and Latour's ideas on cosmopolitics. In many ways it also resembles Jennifer Gabrys' (2014) description of art practices as 'spaces for hesitation' and as contributing to 'a cosmopolitics of energy'.

In fact, the paper is a condensed and somewhat modified version of a longer Danish article, which we were writing simultaneously for an anthology on climate and humans (eds. Sørensen and Eskjær 2014). In this article, called "Atmospheric Constellation – the Art of Ecologizing" (Schick and Witzke 2014) we offered a historical discussion of how the tradition of the eco-art of the 1960s are currently cross-breeding with newer digital art in what we describe as 'digital eco-art'. Aside from *Nuage Vert* and *Natural Fuse* we analyzed two additional artworks, *Pigeon Blog* (2006-2008) by Beatriz da Costa[62] and *Environmental Health Clinique* (2007-) by Natalie Jeremijenko. In the Danish version, we focused more on 'art and science' and 'micro-science/citizen-science' and on related ideas of 'democratizing science' through art (see e.g. Born and Barry 2013). We also explored how the artworks involved publics and created possibilities for people to participate and take action in relation to concrete environmental issues.

I chose not to include the longer Danish article because it did not focus explicitly on energy, however the historical roots of the artworks, and the emergence of new forms of digital eco-art is worth bearing in mind in what follows. Moreover, the Danish article played with Latour's notion of the 'parliament of things,' describing the artworks as 'parliaments of air', and argued that the artists "gave life and materiality to Latour's otherwise rather abstract conception" (Schick and Witzke 2014a:100). This is relevant to note because the 'parliament of things' is, alongside 'political ecology' and 'cosmopolitics,' yet another of Latour's concepts for an a-modern and more ecological politics. However, as my research progressed, I became rather skeptical towards this

[62] For analyses of Pigeon Blog see: da Costa and Philip (2008) and Born and Barry (2013).

notion and I gradually shifted focus towards 'cosmopolitics'. However, the idea of 'things' and 'thinginess' stuck with me and was also employed in paper two.. One thing I want to bring along from the Danish article is a description of the artworks as 'experimental compositions'. We described this kind of art as a 'compositional aesthetics' (Schick and Witzke 2014a:101). Whereas these concepts did not seem central to me at the time, Latour's concept of 'composition' has later become central to my research. After reading chapter four, it should be clear why I find them worthy of mention here.

My explorations of these artworks took place prior to my research on smart grid development and the attendant analytical and conceptual journey into STS inspired ideas of infrastructures as socio-technical assemblages (see page 53). However, these artistic and experimental compositions of energy collectives were formative of the perspective and sensitivity with which I subsequently approached for the study of smart grids.

Paper 2: *Innovating Relations – or Why Smart Grid Is Not Too Complex for the Public*

Co-authored with Brit Winthereik

Published 2013 in *Science & Technology Studies*, special issue: *Energy Systems and Infrastructures in Society*

In this article, we analyzed the aforementioned Innovation Delegation Trip to Germany. Based on an STS approach to technologies and infrastructures in-the-making, we approached smart grid as a 'partially existing object' to highlight its uncertain ontological status. Thus, we saw smart grid development as a process of assembling a 'thing,' in a Latourian understanding of the word. We analyzed how smart grid gradually emerged and transformed through the interactions of participating 'experts' and the various objects included in the delegation trip. The trip, we argued, could be seen as an attempt to define the problem of smart grid, and to cast the actors invited to join in the innovation of energy futures.

In particular we analyzed and compared illustrations of two future smart grids (one Danish, one German). We analyzed these illustrations as ways of performing and (hopefully, in the eyes of their makers) making particular futures 'gain reality'. We also showed that both models – one more than the other – relied on quite technocratic assumptions, since their starting point was the

perception that smart grids are *too complicated* for laypeople to understand. Thus we showed how, during the delegation trip, smart grid innovation was constructed as a problem with political, legal, ethical concerns that it was mainly up to experts to solve.

In particular, consumers – the imagined future inhabitants of smart grids – were constructed as problematic 'aliens.' This led the participating experts to call for yet other experts with specialist knowledge on 'humans.' In contrast, however important it was for the smart grid developers to 'engage consumers', everyday people and publics were not invited into the 'smart grid family' (as one informant termed it). Building on this metaphor, we argued for the need to extend invitations to new actors into this family. Inspired by Noortje Marres' (2005) argument that publics emerge exactly when problems become *too complex* and where the experts do *not* have the answers or clear definitions, we also proposed to embrace the public *as* a problem.

This article was written and published at a point where the rapidly evolving social science on smart grid research (introduced chapter three) was still in its very early states. Hopefully, the paper has contributed to this emergent field. In relation to the combined thesis, the most important point is that the analysis made visible that smart grid innovation is not only about solving a problem waiting to be solved, but just as much a matter of opening up an imaginative space of potentialities into which different matters of concerns and new 'family members' might be added. Such support of the potentialities of other 'alien' forms of energy engagement is akin to what I have later come to think of as a matter 'designing the political scene' for smart grid innovation.

Paper 3: *Flexible and Inflexible Energy Engagements – a study of the Danish Smart Grid Strategy.*

Co-authored with Christopher Gad

Accepted for *Energy Research & Social Science*, special issue on *Smart Grid and the Social Sciences*

This paper analyzed the writings of the national *Smart Grid Network*. Our readings of the smart grid reports focused on the figure of the 'flexible electricity consumer.' The analysis showed that the Danish Smart Grid Vision relies on a narrow, techno-centric and rather 'inflexible' consumer figuration. The majority of the existing social science research on smart grids critiques such

narrowly framed visions. Often it proposes alternative approaches fetched from practices and theory external to the field. In contrast, we showed that potentials for critique and different modes of engagement and flexibility could also be located *internally* in the Smart Grid Network. Paying attention to different stories told by interviewees – about solar panel owners and about a smart grid island community – we showed particular forms of 'infra-critique' and 'infra-reflexivity' to emerge from within. Taking these stories as generative openings, we argued that infra-reflexivity opens up to more flexible and reflexive conceptions of the 'flexible electricity consumer' as well as more open-ended and flexible relations between 'the technical' and 'the social.'

As a contribution to the social science smart grid literature, we argued that social inquiry ought to become better at learning from ongoing practices of reflexivity and critique in the field. We also argued for a more dynamic understanding of 'the social' and 'the technical' as entangled in energy collectives. Instead of critiquing the field from an 'outside position', we attempted to approach the field "as it diverges, that is, feeling its borders, experimenting with the questions which practitioners may accept as relevant" (Stengers 2003:184). In this sense, this article can be seen as an experiment in doing diplomatic, cosmopolitical research, even though we do not use Stengers in the article.

This article was written roughly two years after paper two; a point I mention for two reasons. The first is that an extensive body of literature on smart grids had been published by social scientists in the interim. In relation to collected thesis, an important contribution of the paper is thus to locate and specify the distinctiveness of my approach to smart grids. Moreover, the empirical field of Danish smart grid development had slowly changed during the period. Thus, I had witnessed the 'more active consumer' being gradually written out of the smart grid collective and replaced by technological solutions. This is why one aim of the article was to search for other potentials for engaging people in energy. This article helped me to shift my perspective away from engagement as something happening primarily in domestic settings and through individual consumption, and to start looking at energy engagement in public space. Which is the theme of the next paper.

Paper 4: *Making Energy Infrastructure: Tactical Oscillations and Cosmopolitics*

Co-authored with Brit Ross Winthereik

Will be published January 2016 in *Science as Culture*, special issue on *Infrastructuring Environments*

In this paper we were concerned with the role(s) art may play in the process of engaging publics in energy and in *re*imagining and *re*making environmental infrastructures. The empirical case is the process of implementing the *Land Art Generator Initiative* in Copenhagen (*LAGI2014*). Through an auto-ethnographic analysis of my work as project manger (see page 82) we showed that *LAGI2014* was successful in mobilizing the necessary financial and political support largely due to its hybridity and flexibility. We analyzed this hybridity and flexibility as a series of *tactical oscillations* between different modes of being. Thus, we showed how the project oscillated between presenting itself as part of existing policy initiatives and as posing alternatives to them; between being situated in a pragmatic present and in an unprecedented future; between being tied to the specific site of the competition and belonging to no place in particular; and not least between being predominantly an art project and primarily an infrastructure development project. Through these oscillations *LAGI2014* performed what we called a 'smooth politics', that is a consensus-seeking politics that attempted to render any potential controversies invisible.

While these oscillations and their smooth politics ensured the practical success of the project, they also meant, we argued, that the project failed to really mobilize any general public. Based on the existing literature on arts, publics, and cosmopolitics we thus argued that *LAGI2014* missed out on opportunities to turn energy and infrastructure design into a truly contentious public issue. Performing the future as (only) somewhat alternative to what presently exists, *LAGI2014* did not really create a space for hesitation and cosmopolitical discussion. We argued that making more space for hesitation by not shying away from controversies might have engendered more participation. Yet, paradoxically, this would likely also have reduced the attention and participation of the politicians and decision makers that supported the project.

Most existing literature about art, energy, and infrastructure development highlights the ability of art to create spaces for hesitation (Gabrys 2014), providing radical alternatives (Yusoff and Gabrys 2011), and to make controversies visible and open for debate (Marres, forthcoming). Working as project manager of *LAGI2014*, and later reflecting academically on the

experience, made me see the political potentials of arts as somewhat different than those already described. In order to be heard and to be able to intervene in political and professional life, a smooth politics indeed appeared very effective. Rather than valuing one political strategy over the other, we thus ended the article by suggesting that both artists and social scientists might benefit from working actively with political strategies that oscillate between 'hesitating' and 'sliding'; between 'smoothening' and 'making controversial.'

The contribution of this paper to the combined thesis lies in its widening of the imaginary roles that art may have, or come to have, in relation to energy engagement and infrastructure development. Analyzing *LAGI2014* in relation to the existing literature allowed me to see art both as practices for reflections and for action. This mirrored the kind of double movement between 'a sense of urgency' and 'a need to slow down'; between 'hesitating' and 'acting', which I have tried to articulate during the first half of this thesis.

Paper 5: *Generating Futures: LAGI as an Imaginatorium*

Co-authored with Anne Sophie Witzke

Published 2014 in book: *New Energies: Land Art Generator Initiative, Copenhagen*.

This paper is a two-page essay written for the book published for *LAGI2014*. This was a glossy coffee table book presenting the 60 best ideas from the competition. The book included ten related essays, including this one.

The essay was written prior to the previous paper. In contrast with paper four, which concentrated on the process of implementing *LAGI2014*, this essay focused on the outcome. We did not, however, engage with the individual submissions (the essay was written before we had even seen the submission for *LAGI2014*). Instead, we were concerned with the multiplicity of ideas generated trough *LAGI* (400 ideas from the 2010 and 2012 competitions and eventually 300 for *LAGI2014*). We also played with the name of the competition, arguing that *Land Art Generator Initiative* was a conceptual apparatus that enabled the ongoing production of ideas for site-specific artworks. We further suggested that the *generation* of imaginaries extended to the audience. When the many ideas generated through *LAGI* are presented alongside one another – in the book, in the exhibitions, and in the website portfolio – an imaginative space unfolds, we suggested, in-between the creative scenarios. This is a space, in which the spectator is invited to imagine alternative landscapes of energy

generation. We coined this space an 'imaginatorium' – a space that sparks the imagination of the viewer. Rather boldly, we argued that because *LAGI* was functioning as an imaginatorium it could potentially expand the space in which energy futures can be imagined and made. *LAGI* can therefore engage the public in rethinking infrastructures and thus "envision the world as a more fascinating, manifold, and environmentally sound place to live" (Schick and Witzke 2014b:51).

This essay was an exercise in writing for a non-academic audience, so rather than structuring it according to academic norms, we deliberately 'joined' the enthusiastic and optimistic tone of the *LAGI* discourse. However, this was not purely a matter of volition. Because we were both actively involved in the organization of *LAGI2014* it was not actually possible for us to write a critical text. I have nevertheless chosen to include the essay here for two reasons. First because, as I have already written, I want the thesis to reflect the variety of academic and non-academic work I have engaged in through the PhD project. And, second, because the relation between this essay and paper four reflects a shift in my own engagement with *LAGI* – from being a very enthusiastic insider to becoming a somewhat distanced and more critical *partial* outsider.

Paper 6: Symposium description: "*Environmental Entanglements - Art, Natures and Technology*"

Co-written with co-organizers: Else Marie Bukdahl, Anne Sophie Witzke, Line Marie Thorsen.

Towards the end of my PhD project, I was the main organizer of a symposium entitled *Environmental Entanglements – Art, Natures and Technology*. In collaboration with Anne Sophie Witzke, I defined the theme of the symposium, applied for the funding, invited speakers and organized the event.

I have chosen to include the symposium description with the thesis, not only to exhibit the variety of work in which I have been engaged, but also because it contains the kind of general introduction to the intersection between art, climate issues and technology, which I find otherwise missing from my dissertation (see page 88). It is not based on carefully analyzed examples and discussions of the literature, however, it clearly outlines my (and our) STS inspired approach to art. Thus, the text describes a variety of ways in which artists engage with the phenomena of climate change, environmental issues, and *re*-infrastructuring. Aside from the overall symposium description it also

contains short introductions to each of the four panel sessions: 'Natures', 'Sensing Change and Mediating Climates', 'Publics, Participation and Politics', and 'Rethinking Infrastructures'.

Hopefully, the introductions above have made clear how my research has gradually been woven at the intersection between social science, infrastructures, and arts. Though I have ordered the papers chronologically, they may be read differently. And just as there is no single sequence in which the papers should be read, they also do not cohere into one single, general argument. Whereas each paper (especially the four main papers) makes their own contributions, in the last chapter, ending the first part of the thesis, I will contemplate on some more general insights and perspectives.

7. A Few Perspectives

As I am composing this final chapter of my PhD dissertation, Denmark is headed for a parliamentary election (June 18th), which may have important ramifications for the country's progressive energy and climate politics and for the re-design of energy infrastructures in Denmark.[63] I have here presented the Danish climate and energy plan, as it is, very visionary and ambitious. However, alongside the confident and idealistic politics a so-called 'politics of necessity' is simultaneously growing a stronghold in the political vocabulary. Strong voices on both sides of the political spectrum are thus proclaiming a 'need to be realistic' about what can be achieved in terms of transiting to a fossil free society.[64] In Denmark as elsewhere such political rhetoric is often consolidated with references to economic crises, risky financial markets for renewable energy technology, and the observation that even if Denmark takes the lead in a green transition, there is no guarantee that other and more CO_2 intensive countries will follow. On the one side Denmark adheres to be a pioneer country, and on the other side there are doubts to whether this will really make any difference on a global scale.

In this dissertation I have argued against this presumed politics of necessity and its self-defined "realism". From a cosmopolitical perspective, the argument of a 'politics of necessity' operates as a 'short-cut' for action (or non-action) as it rhetorically pre-empts any political and ideological negotiations. Moreover, 'realistic' politics fails to see reality – both technological reality and the 'reality' of public engagement – as ontologically emergent. And, of course, as the classical point of feminist theory and practice argues, it altogether fails to consider 'whose reality' it represents.

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[63] According to the Danish professor Inge Røpke, who is doing research on energy planning, a shift from the current center-left to a center-right government will be fatal for the climate and energy politics. Several parties in the right-wing wish to cut back on or entirely stop the transition to renewable energy (interview with Røpke in *Dagbladet Information* May 28 2015, Bax Lindhardt).

[64] Though the governing party, *The Social Democrats,* was sealing the ambitious climate and energy deal in 2012, the party and especially the Minister of Finance Bjarne Corydon now emphasize that it is important to listen to the right-winged parties for "a more realistic climate politics", where coal is part of the answer (see Jyllandposten 2015). Corydon was heading the sale of 19% of the shares of the national electricity grid to Goldman Sacs in 2014 (see page 24).

What I have argued is, however, *not* a call to be *un*realistic. Instead, it is a call to widen the notion of environmental realities, by rendering them dynamic, and by experimenting with ways of accounting for and intervening in energy realities *as emergent processes* rather than static structures or immobile surroundings. Hence, I have argued for recognizing *re*-infrastructuring as creative practices that hold potentials for emergence of other kinds of energy realities.

My remise has thus been that to infrastructure only for 'what there *is*' and what *already* counts as relevant to (some) people, prematurely closes down the space for imagining other possible worlds. Indeed, because such a politics has no way of being mindful of the potentials of new compositions – it fails to engage in a cosmopolitics of energy.

Rather than being in opposition to existing political initiatives to convert the entirety of energy infrastructures in Denmark, my research journey was guided by a significant degree of sympathy. In my own work, I wanted to help develop 'a new set of skills' for 'innovating as never before but with precaution' (introduction quote, Latour 2010). Perhaps it would thus be appropriate at present to display a list of ten 'skills' – ten solutions for how to get people engaged in energy.

However, this is not where I intend to end. Rather than coming up with solutions, my aim has been to approach the fields as they diverge and, doing so, help shift perspectives. Through the various cases at hand, I have explored varied notions of energy engagement and different approaches to what might mobilize people and make them engage in energy matters. In this process, the field(s) – art and smart grid policy planning – have also shifted my own research perspectives.

I began with an interest in how new technologies could foster greater involvement in energy and environmental issues and how they could help change behavior towards more sustainable lifestyles. Whereas I was initially concerned with the engagement of individuals in energy, I gradually shifted perspective to looking at engagement as an outcome of socially configured fields of action, which happened not only in domestic settings, but also in broader arenas of public and cultural life. During my three years of research with and on the Danish Smart Grid Network, I saw experts gradually lose hope in the possibility of changing consumers' individual behavior and domestic practices. This was mainly because they realized that the usual tool, economic incentive, would not do the job. The Smart Grid Network's shifting focus was mirrored by

the emerging field of social science energy research, which explicated the difficulties, if not critical short-comings, of working with energy behavioral change at an individual level. However, I also experienced a kind of 'energy engagement' among the experts akin to Latour's infra-reflexivity. This became generative for my thinking about energy engagement on a more collective and communal level – and for involving experts differently than as outsiders or distant observers to the problem. Through the art projects, I further came to see the potential for fostering energy engagement through public art and cultural events. Artworks, along with a variety of other public and cultural events, may constitute efficacious spaces for turning relations between energy and environmental issues into matters of collective concern. Maybe it is more effective to 'compose for' energy engagement through public awareness and cultural events than via individual, domestic incentives.

Thus, I have come to see the redesign of current energy infrastructure in terms of potentials for re-negotiating and for de- and re-composing relations between *individuality* and *collectivity*. What is at stake is to see emerging energy infrastructures as composing new definitions of what it means *to live individual lives* while also *inhabiting a collective world of humans and nonhumans*. I have deployed Sloterdijk's foam image, of 'connected isolations' and 'co-fragility,' as a metaphor for rethinking these relations between individuality and collectivity (page 60). I have also proposed to look at artworks and smart grid development as experiments for (re)composing energy collectives. Of course this is but a humble beginning. Undoubtedly, much more must be done to explore and experiment with possibilities for recomposing energy collectives and individualities.

One reason for entitling the dissertation composing *for* energy engagement is to emphasize that designing with the aim of fostering a specific engagement is never an entirely controllable process. A process of 'composing' such relations of humans, technologies, and natures may or may not lead to particular kinds or modes of engagement. Yet, just because such processes are not directly designable it does not mean we (and by 'we' I mean politicians, engineers, scholars, artists, and citizens in general) should give up. Instead the very uncontrollability might be seen as extending an invitation to experiment with possible and potential relations of relevance.

In this dissertation, finally, I have endeavored to research and intervene in an emerging cosmopolitics of energy engagement. I have done so by expanding the variety of potential actors and possible matters of concerns

included in the design of energy infrastructures to the best of my ability. I have examined the roles art can have both in terms of creating spaces for reflection and hesitation and as potential ways forward for creating public engagements around energy. I have also argued that art projects can function as a means for both artists and social scientists to enter and intervene in existing professional and political discussions about potential energy futures. Doing so, I would like to think, might lead to more flexible disciplinary boundaries, in which sophisticated conjunctions of knowledge and practice have the chance to emerge.

In the case of smart grid innovation, I have attempted to adopt a diplomatic sensitivity to possible alternative ways of engaging people. This sensitivity allowed me to discover within the field surprising notions of what energy engagement might be. In this way, I have sought to widen the imaginary space in which innovation of energy and energy engagement may take place. My hope is to push the confines of what counts as engagement in energy and as energy infrastructure innovation.

Whatever the result of the Danish parliamentary election will be, this dissertation is indeed an endorsement of replacing a 'politics of necessity' with a 'cosmopolitics of potentiality'. Let's *not* 'be realistic' when innovating future energy collectives, lets be critical and utopian as we carefully push the boundaries of what can be made possible.

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Part 2

Papers

Paper 1: Powering Ecological Futures

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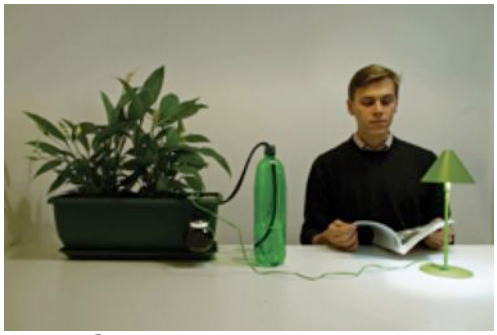
POWERING ECOLOGICAL FUTURES

By: Lea Schick and Anne Sophie Witzke

ABSTRACT

Inspired by Peter Sloterdijk's concept of 'air-condition' and Bruno Latour's ideas on 'ecologizing' this short paper discusses the engagement of digital art in environmental problems. Looking at two projects – *Nuage Vert* by the duo HeHe and *Natural Fuse* by Haque Design – the article argues that digital art can articulate the complexity and ambiguities of an ecological future.

Nuage Vert, HeHe, Helsinki 2008



Natural Fuse, Usman Haque, 2008

INTRODUCTION

We live in an era in which air conditions and atmospheres enter our awareness and are made explicit. Through rising attention to global warming and realizations of how we modify our indoors and outdoors climates, it has become clear that we must redesign the systems we use for air-conditioning different spheres of our planet's air. This includes our power supply systems. French sociologist Bruno Latour claims:

> *As soon as artists, designers and architects are busying themselves with the light element [Air], we are going somewhere. From the*

> *philosophical point of view, Air will take the place of Earth as the 'fundamental element' (Latour 2004a)*

By looking at two digital artworks, dealing with air conditions and electricity consumption, this article will use the ideas of Bruno Latour and German philosopher Peter Sloterdijk to discuss what role art may play in rethinking 'air-conditioning systems'.

AIR AS AN OBJECT OF DESIGN

During WWI, April 22, 1915, air lost its innocence when a toxic green cloud migrated from the Germans into the British camp in Ypres, transforming the air and environment into their worst enemy (Sloterdijk 2004:89). According to Sloterdijk, this day marks the beginning of a new era of our anthropological history; an era in which air and atmosphere is made explicit. In his trilogy, *Sphären*, Sloterdijk describes our time as an age of greenhouses and climate control (2004). In order to comprehend the ecological crises and our being-in-the-world today, it is essential to understand how air and atmosphere has been made explicit. Air has moved from a passive background to the foreground of our attention. With the invention of 'air-conditioning systems' such as heating, ventilation, and light, humans have become masters of controlling air and atmospheres. Through these technological systems we can isolate ourselves from common air, conditioning our private spheres as we like. According to Sloterdijk, it is distinctive for the current state of affairs that air is moving from being the invisible surrounding (Umwelt), something we take for granted, to becoming an object of technology and something we can deliberately design. Hence air has become the center of political disputes:

> *Politics, from now on, will be a section of the technology of climate-control (Latour 2004b)*

Due to the link between CO_2 emissions and energy consumption, electricity supply systems count as essential climate-control or air-condition technologies. With energy consumption not only conditioning our indoor climates but also our common atmosphere and environment in a rather

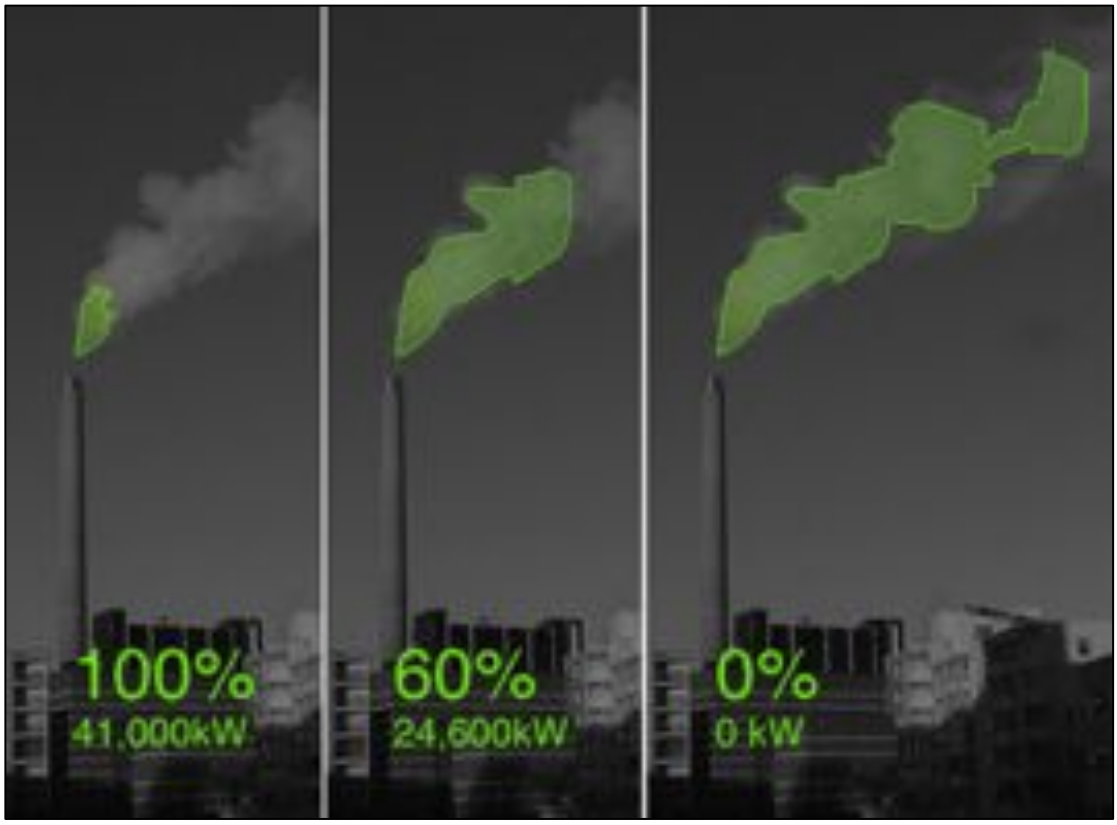
unfortunate way (Sloterdijk 2004), energy systems find themselves in the midst of political disputes.

Various disciplines such as architecture, engineering, politics, and social science are working at full throttle to redesign our way of living. Each discipline plays an important role in outlining the contours of a range of social, political, and technical changes that point toward a more ecological future. Art and experimental design are also concerned with these challenges and contribute to the field with a special sensitivity towards the complexity and ambiguity of the problems. Through the last decade an increasing number of artists and designers have been working with energy visualization and digital technology, trying to make explicit what is still implicit to most of us (Bergström et al. 2009; Dourish 2010; Gustafsson and Gyllenswärd 2005; Holmes 2011; Mazé and Redström 2008). Using computer technology - with its expanding databases, interconnectedness, and embeddedness – artists and designers present and translate energy data into interactive and networked projects with the aim of directing the public's attention to issues of energy consumption and ecological problems. Through the following presentation of two digital art projects, *Nuage Vert* and *Natural Fuse*, we will discuss how art can participate in articulating an ecological future.

NUAGE VERT

Ninety-three years after and 2133 kilometers away from Ypres, the sky turned toxic green again. This time it was vapor emissions from the Salmisaari power plant in Helsinki that was illuminated with a high power green laser animation. During one week of February 2008 the citizens of Helsinki experienced a city-scale light installation illuminating the sky and reminding the inhabitants of their rising electricity consumption and its effects on our air conditions. The installation, *Nuage Vert* (Green Cloud), was produced by the artist duo HeHe, consisting of Helen Evans and Heiko Hansen, together with the power plant Helsingin Energia. The power plant provides electricity for a former industrial harbor redeveloped into a residential district with growing energy consumption. Using the data from the power plant, the laser

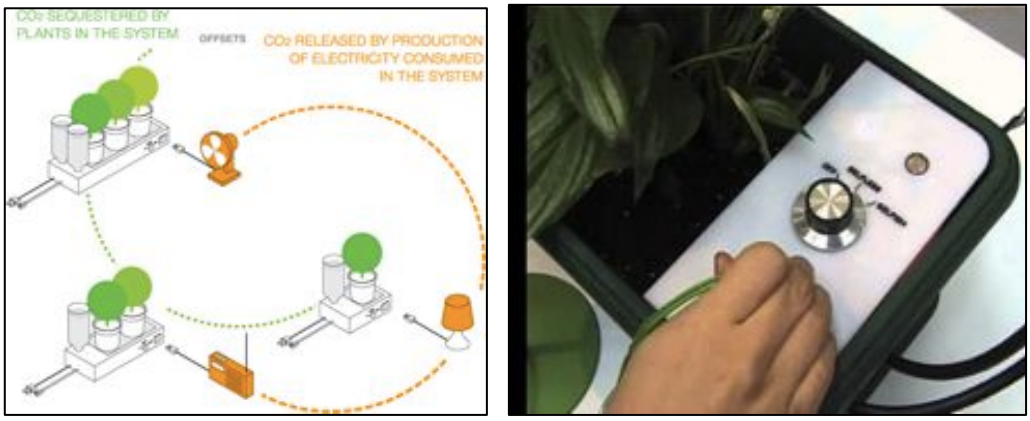
drew an outline of a green cloud onto the real cloud itself. The green cloud changed size according to the residents' fluctuating electricity consumption. When the collective consumption was low the cloud grew larger, but shrunk when the electricity use were high. Functioning as a public visualization of the local electricity level the residents were expected to respond to *Nuage Vert* by turning off electrical devises to increase the volume of the cloud (Holmes 2011:53).



NATURAL FUSE

Another project that comments on our everyday use of electricity and carbon footprint is *Natural Fuse* conceived by the design studio, Haque Design. *Natural Fuse* is a hybrid artwork networking a series of distributed plants with energy consuming devises and participants via the Internet. Each participant gets a 'Natural Fuse' unit, which consists of a houseplant and a power socket. The amount of power available to the socket is limited by the

plant's capacity to offset the carbon footprint produced by the energy expended by the electrical device. If the appliance plugged into the socket draws more power than the plant offsets, the unit will not power up *(Haque et al.* 2011:65). However, all participating units are connected through the Internet. The units are able to share their capacity and determine how much excess capacity of carbon-offsetting is available within the community of units as a whole since not all *Natural Fuses* will be used at the same time. In this way the project is about energy conservation and also about 'structures of participation' (Ibid.)



Natural Fuse, Usman Haque, 2008

Instead of the usual on/off switch each socket has a selfless/selfish switch. When the system is in selfless mode the energy consumption is well below the fixed quota and the unit will provide only enough power to not harm the community carbon footprint. In selfish-mode the owner of a plant can use as much energy as wished. However this mode might harm the community's collective carbon footprint and kill other plants. The fuse takes care of the plant through a remotely activated water-controlling system but the water system only works if there is enough energy left to use in the fuse. If the owner uses more energy than the system can offset the *Natural Fuse* system will start to randomly kill plants. Each plant has three 'lives' before a 'fuse kill' function is activated and a deadly shot of vinegar is injected into the plant. Emails are sent both to the owner of the dead plant and the owner that sent a 'kill' signal.

MAKING AIR EXPLICIT THROUGH ELECTRICITY CONSUMPTION

Both *Natural Fuse* and especially *Nuage Vert* make explicit how air and CO2 emissions have become a fundamental concern in relation to power supply systems. In these two installations one can no longer talk about electricity consumption without taking into account how it affects our air-conditions and how we deal with CO_2 emissions and pollution. By coloring and animating the chimney vapor, HeHe draws the public's attention to the smoke, which is often just an unnoticed part of the cityscape. The installation also explicates how the air-conditioning in our private houses or spheres is not as isolated as we may think. Sloterdijk describes our society as 'foam' consisting of 'connected isolations' (Sloterdijk 2004, 568). Each bubble or 'sphere' is an isolation, but the air-conditioning of one sphere always affects conditions of other spheres. All isolated air-conditioning systems are connected through their electricity use and affect each other. The green cloud artistically illustrates this and this is made 'deadly' clear in *Natural Fuse*. The climate crisis is indeed characterized by complex causality where excessive consumption at one place on the planet has effects other and far-away places and spheres.

Nuage Vert is part of HeHe's series of artworks, *Poll Stream*, working with smoke, man-made clouds and energy use. Like Sloterdijk, HeHe questions the popular notion that weather is 'natural'. By visualizing the man-made aspect of weather HeHe "propose[s] climate as man-made phenomena and therefore a social-political space" (HeHe). Existing simultaneously as a visualization of the residents' participation and the ultimate aesthetization of pollution, *Nuage Vert* is a complex socio-political sign of both environmental effort as well as wasted energy.

STOP MODERNIZING, START ECOLOGIZING

Throughout Modernity air-conditioning infrastructures such as our power supply systems have been made invisible and imperceptible. Electricity use today is a passive one-way connection and only a few people pay any thought

to how power plants are adjusting their production to our consumption. Both production and effects are completely detached from the use of electricity, just as individual household consumptions function independently from one another. The electricity system has been turned into what Bruno Latour calls a 'Black-Box', a system we don't need to know how works or how it is connected to the rest of the world (Latour 2007). Art projects like *Nuage Vert* and *Natural Fuse* attempt to open this black-box and reveal the hidden functions, effects and thus politics of the energy system. In *Natural Fuse*, these structures are shown to be quite complex involving organic, electric and social systems. Energy consumption here is not controlled by production, but it is directly connected to the offsetting available and the 'illusion' of our power supply system as an autonomous black-box system is shattered. Through the information technologies in the system the black-box is opened up and its many attachments to the world is revealed. *Natural Fuse* highlights how the participants' decisions about being selfish or not have a direct impact on the other participants and organic actors (plants) in the energy community. If people cooperate on energy expenditure the plants thrive and everyone may use more energy but if they switch to selfish mode plants will die and diminish the network's electrical capacity. Here the electricity system is fully entangled with the energy community rather than being detached and autonomic as it is normally conceptualized.

The latter view on the electricity supply system is emblematic of what Latour describes as a modernization of the world. The modernizing way of constructing the world has been characterized by the approach:

> *Go forward, break radically with the past and the consequences will take care of themselves! (Latour 2008,3)*

Our built environment has been based on cold objectivity or matters-of-fact, as Latour calls it, and the purpose of our surroundings has been to provide us with progress and speed through smoothly working effective systems that we would never have to pay attention to. Modernization has been a project of emancipation and detachment (Latour 1993). It has been all about freeing objects and designs from their various attachments and complex relations to,

and effects on, the rest of the world. But this way of designing, says Latour, has turned out to be not only highly unsustainable but also quite a deception (Latour 2008), because 'we have never been modern' (Latour 1993). While we might have believed that we were emancipating and detaching, we have in reality been producing ever more hidden attachments and effects – such as the complex network in *Natural Fuse* suggests. Those ignored connections are today revealing themselves as rambunctious monsters, traveling around the planet and coming back to hunt us, such as climate change and energy shortage (Latour 2009). Therefore, says Latour, if we want to deal with global warming we will have to stop pretend that we are modernizing and instead start 'ecologizing' (Latour 1998).

While modernizing was about emancipation and detachment, ecologizing is about drawing things together, about attachments and entanglements, and about a precautious attention to and explication of details (Latour 2007). By explicating the connections between electricity use and offset, *Natural Fuse* presents a complex conceptualization of energy systems where our usage is not only highly entangled in other people's consumption but also thoroughly attached to non-human actors such as the plants. The often-unnoticed effects of our unrestricted use of power is drawn directly into the living room and made clear through the dying plants.

POLITICS OF ARTIFACTS

Latour criticizes Modernism and Humanism for focusing too much on human actors.

> *To define humans is to define the envelopes, the life support systems, the Umwelt that make it possible for them to breathe. This is exactly what humanism has always missed. (Latour 2008, 8)*

Humans can only be defined through the objects surrounding them and these non-human actors therefore have agency; or in Latour's words, 'artifacts have politics' (Latour 1992). Both artworks portrayed here articulate a material sensitivity to the artifacts – what Latour calls the 'missing masses' (Ibid.) -

which constitute part of the power supply systems. When the black-box, i.e. the power supply system, is opened up it becomes clear that it does not consist of cold materiality but that it has been designed. The black-box is always a result of political discussion and it determines our use and therefore envelopes our being in the world. Artifacts go from being 'matters-of-fact' into becoming 'matters-of-concern'. Objects become 'things'; that is complex and contradictory assemblies of conflicting humans and non-humans (Latour 2007, 6; 2008, 7). When ecologizing, the non-human actors have to be given a voice in our political 'parliament of things' (Latour 2004c) and participate in the discussion of our collective lives (Sloterdijk 2004, 67).

> *Democracy can only be conceived if it can freely transverse the now dismantled border between science and politics, in order to add a series of new voices to the discussion, voices that have been inaudible up to now [...] the voices of non-humans (Latour 2004c:69)*

To this purpose, we argue, art has a capacity to transverse the border and represent the entanglement of humans and non-humans. By giving voice to the various non-human actors of the system - e.g. plants, CO_2, air, electricity devises, water systems - *Natural Fuse* and *Nuage Vert* are concrete manifestations of how power supply systems are not merely matters-of-facts but always matters-of-concern and how they are deeply affected by political, environmental, and ethical issues. Both art projects in this way function as small laboratories, where artists and designers experiment with visions of new ecological futures and carefully try to redesign the complex connections between humans and non-humans.

CAREFULLY RADICAL, RADICALLY CAREFUL

Ecologizing is a slow process paying attention to the details and the ways things are connected in hybrid networks or 'interconnected foam', to use Sloterdijk's term. Referring to Sloterdijk, Latour says that a redesign of our life support systems has to be 'radically careful and carefully radical.' The 'radical' here refers to the fact that we have to take non-human actors into

consideration and the 'careful' refers to paying meticulous attention to how we design connections (Latour 2008, 8). We are still in the midst of articulating a new narrative for a (hopefully) more ecological future. However there are no easy shortcuts only detours. We can never be certain that we take the right direction; that we have chosen the right solution. A redesign of a more ecological energy system therefore needs to be open, reversible and adaptable. We argue that this is where art and experimental design can contribute.

As Usman Haque, Haque Design puts it:

> *The point is that there is no 'easy energy future'. […] It is often expressed that it is the task of designers to "make things simple for people" – which I find patronizing and counter-productive. If anything, it is the task of designers to show how complex things are, and to help build tools for dealing with that complexity (Haque 2011, 86).*

The *Natural Fuse* system is clearly not an implementable or desirable design solution but rather an explication of how complex a redesign of power supply system becomes when CO_2 emissions, carbon offset, and structures of participation enter into our awareness. Instead of giving us easy answers it encourages us to discuss how it is possible to ecologize energy systems.

Through the aesthetic choices *Nuage Vert* also refuses straightforward answers. People are encouraged to 'feed' the cloud by turning off electricity devises: the less electricity usage the bigger and more beautiful the cloud becomes. Large amounts of chimney vapor however normally signify the exact opposite of environmental friendliness so this equation might be puzzling to some. Furthermore, the illuminating acid green of the cloud gives associations to toxic wars and pollution just as green has become the iconic color of sustainability. *Nuage Vert* stays ambiguous and doesn't offer simple moralistic messages.

Art is distinguished by a close relations to the time out of which it arises and by often taking the vanguard in sensing, recording, and expressing the changes and conflicts lurking underneath the surface of society. Without

giving a ready-to-go manual, *Nuage Vert* and *Natural Fuse* power a discussion of how we can rethink the future of energy consumption in a more carefully designed ecology with an attention to details and attachments. Both artworks formulate a new way of comprehending the world, which, with homage to Latour, could be termed 'ecologization' where humans are no longer sole actors but part of a larger collective with our fellow species and neighboring artifacts.

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Paper 2: Innovating Relations - or Why Smart Grid is not too Complex for the Public

By Lea Schick & Brit Winthereik

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Innovating Relations – or Why Smart Grid is not too Complex for the Public

Lea Schick and Brit Ross Winthereik

Revamping the electricity infrastructure to allow for an increased usage of renewable energy sources is a matter of concern in many parts of the world. In Europe, a major policy question is how to move energy demand to periods with surplus of renewable energy in the grid. In this paper we follow prominent Danish and German delegates working towards realizing the intelligent electricity infrastructure commonly known as 'smart grid' envisioned to be a significant actor in the management of renewable energy. Starting out with a view on smart grid that recognizes it as a partially existing object, we attend to its gradual emergence by focusing on two models and a metaphor evoked to represent smart grid development. As we contrast and compare these representational objects, smart grid emerges as a potential 'thing'. Following Latour a 'thing' is a gathering of many actors agreeing and disagreeing about what the thing 'is' (its ontological status). In the paper we show how smart grid innovation both emerges – and fails to emerge – as an object of relevance to a broader public. Even though users play an important role in the imagination of experts, a gap remains between the experts and those who smart electricity infrastructures will come to affect. Concerned with this gap we argue that Science and Technology Studies must pay attention to how smart grid development gets constructed as a public problem in specific imaginative spaces of opportunity and closure.

Keywords: Smart grid, innovation, public problems

Introduction

Above the door to the long and narrow conference room at the Siemens headquarters in Munich the Danish flag is welcoming Her Royal Highness Princess Benedikte and the participants in this afternoon's innovation delegation meeting. The delegates are lined up behind their chairs: ten Danes working on smart grid research and development, all of us participants in this Innovation Delegation Trip to Germany. On the other side of the table are the Germans, all of them prominent actors within smart grid development. We are standing there; lined up facing one another as two armies of experts, ready to innovate a new energy system with 'smart green homes' for future energy users to inhabit. As the Princess enters the room, it becomes deadly quiet and

> all one can hear is the absence of the royal trumpets. At the very end of the narrow room, behind a large decoration of flowers, the Princess reads aloud her short speech in which she explains how immensely important it is for Denmark to take on a leading role in smart grid development. It is "one of our time's utmost crucial challenges for scientists and engineers to turn around our energy system, make it more green, and create a better future for everybody".
> (field notes, June 2012)

In this paper we analyse European smart grid development by attending a delegation trip to Germany organised by the Innovation Center Denmark, which is an initiative by the Danish Ministry of Foreign Affairs[1]. The theme of this particular trip is the *Smart Green Home* and the aim is to "to initiate a dialogue between Danish researchers and Danish SMEs [small and medium-sized enterprises] with German knowledge institutions as well as key industrial players" in order to "realise the potential of an energy saving grid and to reduce the overall energy consumption in the home"[2].

The smart green home is a central element in the intelligent energy infrastructure called the smart grid. The smart grid is envisioned to become intelligent by attaching information and communication technology (ICT) to the existing power grid. ICT shall measure and regulate energy production and energy consumption in a future with renewable energy generation. The promise of the smart grid is that it will make energy consumption flexible and manageable so that it can be controlled to follow fluctuating energy production from renewable energy sources such as wind and sun. "We need to do laundry when the wind blows", is a popular way of explaining how energy flexibility will affect ordinary citizens. Private households and consumers are thus imagined to play a different, and perhaps more active, role in the energy system.

Despite an enthusiastic belief in the doability of the project – generally in the field, and in particular on the delegation trip from which we report – there are among smart grid developers a consensus about innovation of smart grid as being a very complex and difficult task. In a Danish context the innovation of smart grid is often described as a complicated jigsaw puzzle[3]: "To develop an 'intelligent' power system – a Smart Grid – is like putting together a jigsaw puzzle with some of the pieces either missing or not quite fitting." (Energinet.dk, 2011: 5). One of the 'pieces' that smart grid developers have a hard time getting 'in place' is the energy consumer[4]. This figure is sometimes being referred to as the *user*, other times as a *consumer* being reconfigured into a *prosumer*[5], and yet other times as humans or people[6].

In this article we attend to an innovation space, in which imagined users, technological experts, energy and ICT infrastructures, visualizations and scientists come together. To account for the negotiations in this space of what smart grid 'is', we ground our thinking in the second wave of actor-network-theory inspired Science and Technology Studies (STS). Following Jensen (2010: 19–29), whose work builds on Bruno Latour's (following Michel Serres') notion of the quasi-object (Latour, 1976, 1999), we approach smart grid as a *partially existing object*. Conceptualising smart grid as 'partially existing' indicates that its ontological status is uncertain in the sense that there are fundamental differences in how actors in the described innovation space see smart grid. Focusing on smart grid as partially existing is not done to 'mock' anyone participating in smart grid development or to indicate that it does not exist. In fact, a number of technologies imagined to be part of a smart

energy infrastructure, including smart meters, electrical vehicles, wind turbines, and energy management systems, are on the market and have been for some time. While these technologies exist smart grid as such is under development – and as we show – is imagined to be working in different ways.

Thus, describing smart grid as 'partially existing' is done to highlight the question of how this infrastructure gets stabilized and by what means. Drawing on Latour's notion of 'things' (Latour & Weibel, 2005) as entities that – opposite objects - should never be considered self-contained, coherent, or stable (see also Mol, 2002). Analysing an emerging energy infrastructure as a 'thing' thus accounts for the complex character of such infrastructure as being always rich and complicated entanglements of humans and technologies, discourse and materiality, nature and politics. Latourian 'things' are always gatherings of many participants agreeing or disagreeing on the nature of 'it'. When a thing becomes black boxed, that is when enough actors agree on the character of its existence, it can appear as a steady and self-contained object, as a 'matter of fact' (Latour, 2004). When, in contrast, an infrastructure, is about to 'be born' it provides a great window for studying its 'thinginess'[7] (Jensen, 2010). It is this thinginess, the many participating concerns and the gathering of actors around smart grid, which is the main concern of our study.

In order to demonstrate the partial existence of smart grid we analyse two visual representations; that is, two technical illustrations of how future smart grids might be designed. We refer to these representations, which allow us to see the smart grid as a contested and emerging entity, as 'smart grid objects'. Opting for this approach, we argue, has ontological implications in the sense that it brings into view a smart grid that is not simply gaining in technological maturity and stability. Instead, its very existence is coming into being and changing through interacting concerns of the heterogeneous network of actors partaking in its development. Thus, the smart grid objects that we describe below – two diagrams of smart grid presented on power point slides – are not downscaled versions of one, singular and 'real' smart grid. Rather, we see them as performing smart grid partiality and complexity without ever adding up to a 'whole' (Mol & Law, 2002). We add to our description of the smart grid models a metaphor for collaboration – the smart grid family. This metaphor, borrowed from our informants, creates a bridge to our discussion of smart grid innovation as being among others a matter of a group of actors formulating a public problem.

Attending to smart grid representations allows us to present smart grid as an entity emerging in a space, in which imagined energy users, technological experts, specialists on 'humans', the STS researcher, the royal family, and visual representations all participate. By studying smart grid as a partially existing object gradually emerging in a space of social and technological actors, we are also enabled to see how particular relations between experts and non-experts emerge.

We suggest that smart grid innovation is happening in an imaginative space of relations and non-relations, of opportunity and of closure. By attending to alignments and disconcertments (exemplified with respect to the developers' concern with the role of the energy user) both the sturdiness and the fragility of smart grid – it's 'thingness' (Latour, 2004: 237, 245) are brought into view.

Studying Smart Energy in the Making

Though the following analysis focuses mainly on the three days of the delegation trip, the analysis is empirically grounded in two years of fieldwork primarily among

Danish smart grid developers[8]. Our choice of focusing on a particular event highlights our approach to ethnographic stories as complex entities enacting wholes and parts in continuous variation (Jensen, 2013 online first; Winthereik & Verran, 2012). Lasting three very intense days, the delegation trip turned out to be a rich resource for teasing out smart grid innovation as an issue of 'public' as well as 'theoretical' importance. The participants taking part in this trip were mostly prominent players in the development of smart grid. Participation required all delegates, including the first author, to present their work on smart grid for the various companies and institutions visited[9]. The format of the trip – presentations and discussions comparing smart grid development in the two respective countries – meant that essential characteristics, challenges, and divergences were articulated. This allowed for observation of and participation in discussions of the interests and concerns of Danish as well as German delegates. As the delegation trip formed a 'learning environment' it was unproblematic to take ethnographic notes during the formal program. The observations made during the informal activities were written up whenever this was possible after the event. In the following, we have kept the names of the companies behind the models, but have anonymised the presenters by giving them pseudonyms.

In our analysis of the Power Point slides we are inspired by Latour's text *Visualisation and Cognition: Drawing Things Together* (1986). Here he argues that when studying how new things come into being – be it knowledge or material things – there has been a tendency to pay too much attention to discourses, language, and to the protagonists. However, it is just as important, he says, to attend to non-discursive, material elements i.e. diagrams, signs, visualizations and models partaking in the construction work. Latour, and others with him, study these objects by attending to their 'inscriptions' (see also: Akrich, 1992; Latour, 1992; Suchman, 2007; Winthereik, Johannsen, & Strand, 2008).

> What is so important in the images and in the inscriptions scientists and engineers are busy obtaining, drawing, inspecting, calculating and discussing? It is, first of all, the unique advantage they give in the rhetorical or polemical situation. "You doubt of what I say? I'll show you." And, without moving more than a few inches, I unfold in front of your eyes figures, diagrams, plates, texts, silhouettes, and then and there present things that are far away and with which some sort of two-way connection has now been established. (Latour, 1986: 13).

Latour argues that technical drawings make it possible for their protagonists to control and manage large, not-yet-quite-existing machines. In our case of infrastructure development, the models create what Latour describes as a two-way connection to the future and back again (Latour, 1986: 10). By visualizing 'the future', power and potentiality is allocated to the presenter of the model, who can hopefully convince the audience that his proposal for smart grid should function as *the* roadmap to the future. Latour argues that the power of visual models lies in their quality as 'immutable mobiles'; that is they can be moved around. For example, they can be flown to Munich and showed in several institutions and companies without being significantly distorted (Latour, 1986: 7).

As visualizations align and mobilize actors, they create new 'gatherings'; that is spaces for discussion and generative imagination. Such spaces emerge between

discourse and physical representation – between the presenter, his/her model, and the audience. This opens up *"a space of imagination and opportunity – a space where subjectivity is constituted and acted out."* (Hetherington, 2011: 459). Thus, when we analyse and discuss the smart grid models we do not see them as more or less accurate, individual roadmaps to 'the future', but as working objects embedding particular subject-positions and performing futures. We thus explore how the inscriptions enact particular futures for humans to inhabit, and we analyse how the relations between smart grid objects and the delegates make innovation happen.

Smart Grid Objects: Two Power Points and a Metaphor

Now, let us return again to Bavaria, where the old medieval town of Munich hosts the smart green homes delegation trip. Here we encounter the Danish-German delegation, puzzling about how to transform contemporary energy infrastructures based on copper cables and centralized production into intelligent and decentralized power generation based on renewable energy sources and ICT.

The first presenter is Helmut Smith (pseudonym) from a consultancy managing the federal German network for smart grid research and implementation, 'EEnergy, Smart Grid made in Germany'.[10] One of his 60 slides maps EEnergy's vision for the future German smart grid (figure 1). "This model", Smith emphasizes, "is the core model for the smart grid, according to which all EEnergy projects work. This is common knowledge for smart energy made in Germany" (Field notes, June 2012). In this model the smart grid is made up by layers, which Smith refers to as 'worlds'. The big challenge, he says, is: How to connect these worlds?

Let us take a closer look at the model. It presents a series of circles around a core. Arrows indicate movements between the circles. The inner circle is labelled the 'Closed System Level'. This 'world' is made up by

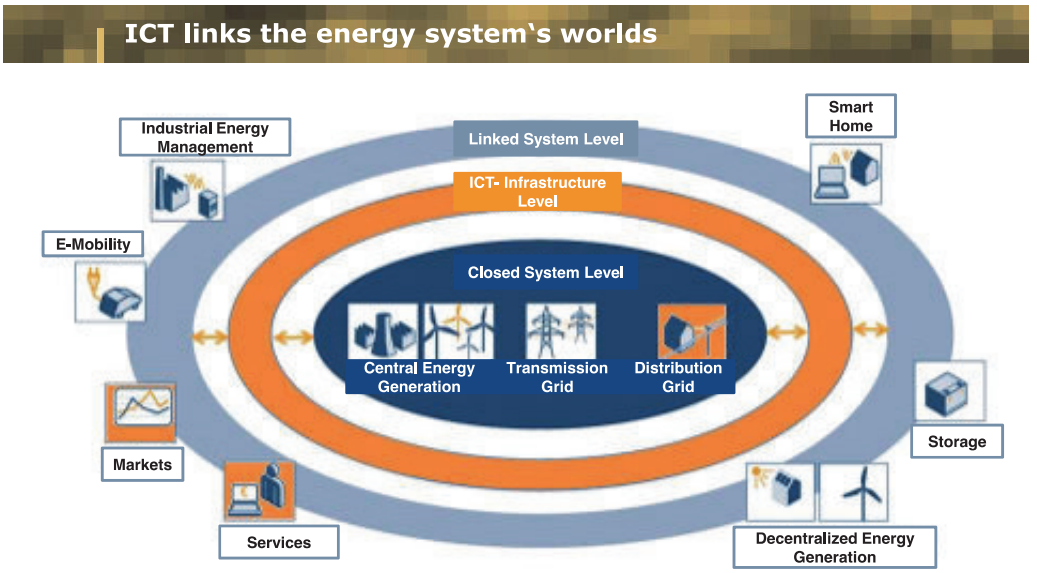

Figure 1. EEnergy's smart grid model.

centralised, large-scale energy generation sites (coal, nuclear,[11] and big wind and solar farms). It is thus the part responsible for the physical production, transmission and distribution to the grid. This is similar to the existing energy infrastructure, only with more renewable energy, and this is where the challenge emerges.

As fossil energy sources are replaced by decentralized renewable source from private photo-voltaic units, distributed wind turbines and solar panels, also gathered under the umbrella-term Distributed Energy Resources (DER), energy production is no longer under the control of big companies and the stability of the 'Closed System Level' can, according to Smith, no longer be taken for granted. The reason is that, while in today's centralized energy regime it is fairly easy to balance energy production to fit to energy consumption, this is not the case for a distributed system with fluctuation energy generation varying with sun and wind. In order to balance the system and avoid frequent blackouts, the many distributed production sites will have to be constantly measured and information sent to a centralized management unit. Smith explains that this part of the energy system, should remain a closed, stable, centralized, and secure system.

Surrounding the inner circle is the 'Linked System Level.' This 'world' is made up of DER and of so-called smart energy devices. This circle represents a large number of newcomers to the energy system; newcomers who are unstable, fluctuating and difficult to manage. ICT is thus envisioned as the mediator and manager between the new 'world' of smart energy and the more stable inner core of the system. According to Smith, the presence of fluctuating actors of the linked system level makes the energy system flexible, which is why this layer is also described as 'smart energy'[12]. The smartness in smart grid equals energy consumption being made flexible and controllable so that it can constantly be fitted to the fluctuating and uncontrollable energy production from renewable energy sources. According to EEnergy the secret behind the smart energy world and the management of energy consumption is an intelligent market platform: an 'energy stock exchange'[13] – referred to as 'markets' in the model. By constantly measuring and communicating both energy generation and consumption, the prices of electricity will vary and reflect demand and response. Thus, electricity will be more expensive when generation is low and cheap when the wind is blowing or when the demand on electricity is low. 'Smart green homes', industries, and electrical vehicles (EVs) are made 'smart grid ready' by being all connected to the energy management systems, which EEnergy has anthropomorphized and named the 'Energy Butler': "you train the butler, tell him to have the car charged before 8 am and have the dish washer finish before 8 pm and then he listens to the energy price signals [energy-market] and makes the decisions on when to start the devices in order to get a good price", Smith explains (field notes June 2012). As researchers being interested in delegation of agency and responsibility to non-human agents, we might take this personification of technological devices even further and conceptualize cars and smart houses as 'energy-brokers' constantly dealing energy between the consumers and the grid. 'Energy brokers' buy energy when the price is low, and sell it back when the return-rate is good. A crucial connection point between smart grid and smart house is the 'smart meter'; an enhanced electricity meter, which can make real-time readings. The smartness resides in the fact that the meter constantly communicates with the grid in order to get information on the load in the grid and real-time prices. And the meter can report the house's energy consumption

to the grid, which is constantly up-to-date with how much electricity each house is using.

In the model we see how smart grid consist of a growing number of objects being put into relations with one-another. As this happens, they come to form a 'whole', which outlines a space for future users of the grid. In this EEnergy model the users are imagined to live on the outside of the smart energy layer and only interact with the system through their smart energy devices. In the following section we show how Smith's smart grid model is both strengthened and challenged by presentations by the Danish delegates.

During his lengthy presentation, Smith is frequently 'interrupted' by Danish delegates who are clearly very engaged and eager to discuss various issues including technological platforms, German versus Danish policies, and conceptions of the different actors' roles in the future grid. The atmosphere in the room is relaxed and friendly and seems to invite the participants in the room to think with Smith and with one-another. Smith ends by saying that now that he has talked for a full five minutes without being interrupted: it must be time to stop.

After the break the ten Danish delegates each have 10 minutes to give a pitch on their respective work and various different versions of smart grids are introduced. This model is presented by Jakob Møller-Jensen (pseudonym) from the company Spirae.dk.

Møller-Jensen talks about the different elements of smart grid - both centralised and decentralised energy production, prosumers, and smart energy devices - as being connected as 'nodes in a network' rather than worlds centred around large-scale energy generation, as in EEnergy's model. The nodes are connected by a double-track infrastructure where both electricity and digital communication about energy consumption and production are bidirectional. Both power and data are

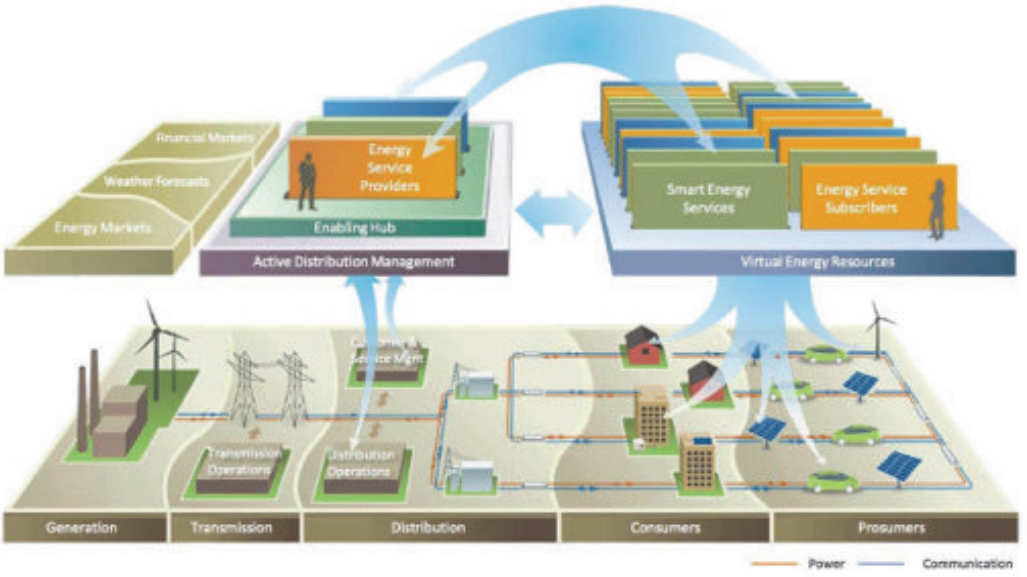

Figure 2. Spirae.dk's smart grid model.

flowing from distributor to consumer *and* from consumer to distributor.

On top of the ground-layer, hovers a virtual layer consisting of non-physical components with inputs from 'abstract' elements such as the 'financial markets', 'energy markets', and 'weather forecasts', which are all part of determining the prices of electricity. The big square 'ceilings', that is the 'Active Distribution Management' (the system that balances production a and demand) and the 'Virtual Energy Recourses' (energy services) magically float over the transmission/distribution grid and the consumer/assets grid. These 'ceilings', representing the ICT-layer, creates the spine onto which the 'smart energy' devices and applications can be connected.

Both companies imagine a future where ICT is absolutely crucial for making the existing electrical grid 'smart' and for making 'smart energy' be the result of its workings. With ICT it should be made possible to constantly measure and manage energy generation and consumption and balance those to fit one another. Møller-Jensen, Smith, and all of the other participating delegates seem to agree that the smart grid is made up of the traditional electricity infrastructure *plus* the 'new' ICT infrastructure. Both presentations describe ICT as 'glue' binding together the many elements of the future grid. And, in both cases, ICT is ascribed the role to enable the smart grid, by facilitating the inclusion and success of the smart energy actors, making the grid flexible and adaptable. However, the interesting differences between the two models become visible when comparing how they inscribe (partly similar and partly different) relations between the infrastructure and its users.

As both models visualize, 'smart energy' is about rethinking what energy consumption is – in business as well as in private homes. Electricity consumption, and therefore electricity consumers, it is envisioned by the presenters, will have to change by becoming flexible and adaptable to fit to energy production at any time. The *prosumer* seemed to be a popular figure as it was mentioned in several presentations during the trip.

While the EEnergy model depicts the smart energy components as part of 'the outer world', Spirae.dk's model depicts such entities in a less structural manner. Smith emphasizes again and again that the user should not experience the complexity of the system, but rather live on the outside of the system. In Spirae.dk's model the smart consumer figures as a node in the network on the same level as any technological object; various energy components are thus imagined inhabiting the same world. In this vision, ICT *and* people develop the system and provide its smartness together. They do so by 1) creating services on top of the ICT platform, and 2) by feeding data about their consumption habits back into the system. Spirae.dk distinguishes between 'energy service providers' (represented by a man) and 'energy service subscribers' (represented by a woman), and introduces the idea that this gendered consumer subscribes to different services, which in turn enables the distribution companies (or new third party businesses) to control smart grid ready home appliances from a distance.

Whereas EEnergy's vision integrates these services together with the physical smart energy appliances in their smart energy layer, Spirae.dk's 'smart energy' container includes only virtual applications and services. Møller-Jensen makes an analogy to *Apple's* business model notably the innovation of the APP-platform. This platform is robust enough to build many reliable apps on, but at the same time easy to use and flexible enough to allow for all sorts of imaginable and not-yet-imaginable content/apps. Likewise, for Spirae.dk,

ICT should create a solid and stable foundation, on which users and developers can build new and yet partially unknown and unforeseeable energy services (apps) and where assets can grow. Møller-Jensen argues that the engineers' innovation task is not to come up with fixed solutions, but rather to build the perfect platform on which other actors can construe content. They should "transform the electric grid into a platform for creating and delivering innovative energy applications", which must "support multiple business models" (field notes June 2012).

To sum up, both models inscribe particular subject-positions to future electricity consumers. However, in Spirae. dk's model the electricity consumer figure centrally as a participating prosumer and is thus assigned an altogether different role and a greater agency and responsibility for making the smart grid a success than is the case in EEnergy's model. Here the implementation of a perfect technological system is what makes the consumer 'smart'.

Problematic prosumers and a call for expertise on human beings

In a recent paper Cotton and Devine-Wright (2010) point out that the experts, who are responsible for developing electricity networks often refer to the affected publics as *users* and *consumers*. The problem with categorizing publics as consumers, Cotton and Devine-Wright argue, is that consumers are kept passive and not engaged in infrastructure planning (Cotton & Devine-Wright, 2010: 29). We agree with the position that top-down design and planning is problematic if it does not take into account the affected social groups. However, in the case of smart grid it is crucial to be attentive to the kinds of subject-positions that an emergent smart grid produces. Put differently, we simply cannot assume that the categories of 'consumer', 'prosumer' or 'user' come to make sense in the everyday practices of the people these labels are developed to be describing (see also Sofoulis, 2011). In pointing to the smart grid as an *emergent* infrastructure, whose effects are as yet uncertain, we analyse incongruent actors such as Power Point slides, a princess, and a metaphor for collaboration – the smart grid family.

Both Smith and Møller-Jensen emphasized that smart grids are extremely complex systems consisting of both humans and technology. Humans were the ever-present challenge to the delegates throughout the trip. Most of the delegates (most of whom were trained as engineers) regarded it as much easier to design ICT, which can act *for* the consumer and thus implement flexible energy consumption, than it is to make the consumers change their behaviour actively. Despite this there was a general consensus that, ultimately, successful implementation of smart grid depends on getting people on board and involved. But dealing with humans seemed to be a very difficult and un-familiar task, and the smart grid developers felt certain that they did not have the necessary expertise. The smart grid developers seemed quite happy to deal with technologies and material challenges, but as soon as humans were 'added' and activated, it became too complicated and they saw a need for new experts with 'know-how' on humans to become involved.

For example, in his presentation Smith specified that "there is a big gap between engineers and users when designing smart meter interfaces because engineers don't really understand that ordinary people do not find numbers and graphs sexy" (field notes, June 2012). He said that the best smart meters he had seen were designed by behavioural scientists, and mentioned how interaction designers work with intuitive information feedback such as

colour-changing light bulbs. This piece of information was accompanied by surprising looks at the faces of the audience, who had clearly not heard of this kind of ambient technology before. A representative from the *Danish Technological Institute* half proudly, half self-ironically told that they had just hired two anthropologists "to take care of the more humanist perspectives on smart grid" (field notes, June 2012). This call for specialist knowledge on humans was also felt by first author who was promptly re-cast from ethnographic researcher with "investigating how smart grid developers work with the notion of the user"[15] into an expert on how to get the humans 'on board' the development.

By participating in the delegation trip first author had become part of the 'smart grid family' together with the engineers and the designers. Below, we link this call for experts representing the ordinary electricity user to a discussion on how smart grid development might include the concerns of ordinary European citizens differently (than through expert spokespersons). But first we need to bring another smart grid object into view.

The Smart Grid Family

With a metaphor presented by Helmut Smith the relations between smart grid actors became a matter of 'family relations'. After having named EEnergy a 'smart grid family' who is collaborating to realize an intelligent energy infrastructure in Germany, Helmut Smith ends his presentation asking the Danish delegates "Where are you in the family?" (field notes, June 2012). The immediate reaction from the audience is a disconcerted laughter and the dialogue that Smith prepares the ground for is not really taking off. For the first time during the day the atmosphere in the room gets a bit awkward. We can only speculate about the significance of the Danes' disconcerted laughter (cf. Verran, 1999). Recall how the purpose of the delegation trip was "to create Danish-German partnerships", but the move from the notion of partnership to the notion of family is not immediately digestible for the Danes. Nevertheless, the metaphor keeps reappearing through jokes about 'being family', and seems to grow on the Danes during the next couple of days.

We don't know whether Smith has read his deceased compatriot the philosopher Ludwig Wittgenstein who developed parts of his philosophy around the notion of 'family resemblance' (Familienähnlichkeit) in order to explain how otherwise very different things can be characterised and recognised under a shared umbrella term such as 'games'. But Smith explains how he finds the concept of a 'smart grid family' a constructive way to deal with what he counts as one of the major challenges in smart grid development. It is a challenge, he says – and this is confirmed by the Danish delegates – to gather the many heterogeneous actors working on each their parts and interests in smart grid and to provide them with a feeling of working towards the same goal. Especially, he says, "it is challenging to make the conservative energy sector collaborate with the innovative ICT sector" (field notes, June 2012).

This particular problematization of smart grid innovation as happening in a situation characterized by family resemblance and shared goals we see as a process in which an ensemble of relevant actors is being cast. Philosopher of science Kathryn Pyne Addelson (2002) argues that issues of public controversy are "not just objective conditions lying in wait for alert citizens or professionals to discover" (Addelson 2002: 121), but are *made into* issues of public concern. This is done by gathering influential and authoritative actors around the given issue. The resulting network is what she refers to as an 'ensemble cast'

(Addelson 2002: 119). In this way, Addelson develops a language for describing how experts and the public are being configured (or cast) along with the problem they seek to solve. In this process it is being sketched out who can act and in relation to what particular problem.

Inspired by Addelson we see the delegation trip as an attempt to define the problem of smart grid and name the actors that might participate in solving this problem. Addelson highlights how the ensemble cast is in a privileged position to define what issues are turned into public problems:

> [P]ublic problems are particular definitions of suffering, dangers, and risks made by particular people, and suited for particular reasons. They label what and who is the problem.
> (Addelson 2002: 128).

Addelson argues that a crucial part of constructing a public problem is to show how the problem can be managed and/or solved through science, engineering, design, or related methods. Thus, in this view problem-posing is an inherent part of problem-solving. However, if a crucial element of constructing a public problem is to be able to demonstrate how the problem can be managed and/or solved through engineering and design, the smart grid family is not a very sharp or effective tool in doing the casting work. It simply cannot be considered a tool for making smart grid development emerge as a manageable task. Similarly, the metaphor of smart grid as a jigsaw puzzle, which we presented in the introduction, is a somewhat vague tool for framing smart grid as a manageable public problem. The puzzle depicts a world in which smart grid development (the puzzle) is complicated, but doable. *But only when the missing pieces - collaborators or technologies - are found or invented.*

So what do the metaphors do? What does their efficacy amount to? Both the jigsaw puzzle and the family present a 'whole,' in which actors are nevertheless unmarked and undefined. Both tropes encourage involvement of new not-yet-existing and not-yet-foreseeable participants. Might this vagueness be an attempt to call on publics to emerge? Such a conception of the public has been presented by Noortje Marres retelling pragmatists John Dewey and Walter Lippmann's thoughts on how publics come into being. She argues that publics emerge exactly when problems become too complex and where the experts do *not* have any answers or clear definitions (Marres, 2005).

Attending to the smart grid and its related objects as a 'thing' allows us to attend to smart grid innovation as a matter of emerging ontology. Emerging in relations between models, experts, metaphors, a princess, an ethnographer, puzzle and family, is innovation as happening in 'a space between seeing and saying' (Hetherington, 2011) [15]. Smart grid innovation is not only about solving a problem lying in wait to be solved, but just as much a matter of opening up a an imaginative space of opportunity.

When we suggest that the smart grid family enacts an innovation process happening in such an imaginative space, we also advocate for methods that see innovation as a matter of collecting actors and building 'families' in order to make the smart energy infrastructures emerge in this space in between. The imaginative space is created in events or relation-work such as the delegation trip, and the space is constituted by the different objects and actors brought into the space. When we choose to call it an imaginative space of opportunity it is because we want to emphasise that the space created at the delegation trip is only one out of many different spaces, which could potentially be created. We want to remind the reader

that the space could be constituted in many different ways. However, before we return to a potential expansion of the participatory potentials in smart grid innovation, we explore how family-building is also a matter of making 'non-relations'.

Too Complex for the Public?

Recalling Addelson's point about the ensemble cast we are inspired to ask: 'Who and what is not part of the smart grid family?' Who is not a part of the 'ensemble cast' that gets to formulate what the public problem is, and how it is solved?

Both Smith and Møller-Jensen emphasize that the prosumer should experience the complex systems (be it separate worlds or nodes in a network) as one whole and coherent system; the prosumers are not meant to see the complexity and messiness of the system, which is already to a certain extent too messy for the experts to deal with. In both models prosumers 'live' outside of the system. In Spirae.dk's model this is depicted as users being placed up in a cloud. Thus, users are placed at the end point of the innovation process, and not included into the spaces where problem-posing nor problem-solving is happening. Referring to Noortje Marres' work we may say that users are only participating at a somewhat instrumental level (Marres, 2012: chp. 2).

Thinking about smart grid as an infrastructure for the general public to inhabit, it appears odd that the prosumers, that is the public[16], is not invited to take part in 'casting the ensemble'. Instead, they are imagined to magically become 'smart' once the system is in place. This version of soft technological determinism takes users into account without really offering a possibility to participate in determining major issues of concern. The public is not invited into the innovation process. Though smart grid development is framed as an issue concerning everybody, we also observe a 'non-relation' between smart grid developers and potentially affected user groups. Therefore, besides gathering and including actors during the delegation trip, we will add that the smart grid family metaphor furthermore functions as an apparatus for excluding and making non-relations to actors. The metaphor thus participates in constructing smart grid development as an imaginative space of opportunity *and closure*.

We are not the first researchers studying electricity infrastructure development who have stated that publics are not included (enough) in the innovation process. Several studies show that 'imagined publics' play a role for infrastructure developers, but that publics are often only included as imagined threats that can disapprove and protest about prices, aesthetics and health issues (often referred to as NIMBY-ism). An inclusion of publics thus mainly serves the purpose to counteract mistrust, opposition, and scepticism for emerging technologies and to create public acceptance (Cotton & Devine-Wright, 2010; Maranta et. al., 2003; Walker et. al., 2010).

These studies show that energy network developers only (if at all) involve publics far downstream the innovation process when important decisions have already been made and when the technology is largely stabilized and black-boxed. Publics therefore, are only involved in less fundamental decisions concerning aesthetics, prices, consumer behaviour, etc. More essential issues of innovation are left to chains much further upstream in the process and are exclusive to a closed environment of experts (Cotton & Devine-Wright, 2010; Walker et. al., 2010). Cotton and Devine-Wright find it problematic that industry often has a rather homogeneous and black-boxed concept of the public. A reason for categorizing users as consumers, rather than publics, they say, is that the infrastructure developers do not like using the concept of publics, because it invokes connotations to public opinion,

which is mostly considered threatening to the development process (Cotton & Devine-Wright, 2010).

Along the lines of the above studies and in concert with our findings, Maranta et al. argue that the 'imagined lay persons' seldom have much to do with reality, but are rather 'functional constructs in expertise'; "a more or less made up conception of the kind of lay person they consider as their principal" (Maranta et. al., 2003: 151). As a result, users or publics become merely a part of the technical solution rather than being receivers of the technology. This rather techno-centric model for innovation resembles the smart grid developers, who, though they recognize that somebody with expertise in humans needs to be involved, did not think that the human-experts (and definitely not regular users) should be involved in the innovation process before the technical part is in place and working. Publics should not be introduced before the technological system is coherent and fully working. The problem in this way of thinking, however, is that it fails to recognize how user identities co-evolve with the technological systems (Jensen & Winthereik, 2013, chapter 3 and 4).

As many STS studies have pointed out there is an epistemic asymmetry between experts as the knowing ones and lay people as ignorant. Experts see a need to sustain this divide in order to hold on to their authority and legitimize their own function in society. "The epistemic divide makes experts and lay persons live in different worlds regarding what they think this very world is" (Maranta et. al., 2003: 151). Maranta et al. argue that the deficit model is to perceive users as passive, ignorant, selfish, and disinterested, and that the public has to be educated to take an informed opinion (Maranta et. al., 2003: 162). Whereas this also seemed to be the common conception among the smart grid developers on the trip – that publics are generally not interested in 'the problem of smart grid' and thus cannot be involved – we see this as a paradox because the success of smart grid is framed as largely dependent on an interested and engaged public. In this rather top-down innovation model publics are not, to reference Addelson, invited into the work of defining and constructing what the public problem is and thus how it should be solved. Instead of engaging publics themselves, the smart grid developers are advertising for human-experts to join the family. But what would happen if publics were invited to take part in the innovation on a much earlier stage of the development, before smart grids are stabilized and made coherent as a finished object (Jensen, 2010)? What if they were invited into the family and into process of defining smart grid as a public problem?

Complex Enough for New Ensemble Casts

> Today's electricity users are not 'smart grid ready', because they have no idea what a smart grid is! (Siemens representative, field notes, June 2012)[17]

Above we argued that during the delegation trip smart grid innovation was constructed as a problem with political, legal, ethical concerns mainly for experts to solve. Ending this article we propose arguments for why it is important to invite 'alien' and problematic actors into the smart grid family, whose views are not first translated by specialists with 'know-how on humans'. These actors "have no idea what a smart grid is", but it still affects them as they are implicated in the emerging smart grid infrastructure. So how to take these actors into account?

In her text *Issues spark a public into being - A key but often forgotten point of the Lippmann-Dewey debate* (2005) sociologist, Noortje Marres makes a thorough reading of John Dewey and Walter Lippmann's

debate in the 1920'es. She uses this debate to paraphrase the notion of the 'public problem'. Following this text we suggest that embracing 'ignorant', yet implicated publics, could be generative to the innovation process.

Similar to Addelson's claim that public problems do not lie in wait to be found but have to be constructed, Dewey and Lippmann says that 'publics' do not exist as pre-given entities, but are 'sparked into being'. This happens when issues become so complex, strange and unfamiliar that experts do not have clear answers so them. "Lippmann and Dewey showed that there is no reason to believe that complex affairs cannot be dealt with democratically. But to see this requires an understanding of political democracy different from the modern one. Accepting this challenge, Lippmann and Dewey arrived at the argument that complex issues actually enable public involvement in politics" (Marres, 2005: 208)[18].

Whereas our informants find smart grid too complex for potential users to cope with, complex and unfamiliar problems could in fact be suited for 'ignorant' publics to take care of. When traditional institutions and experts take care of an issue the public can sit back and relax with no need to engage. But when people suddenly feel that any authorities do not deal with an issue affecting them or that experts have no solutions to the problem, the issue becomes a matter of concern. "The hardest problems are problems which institutions cannot handle. They are the public's problems." (Lippmann, 1927: 121 in Marres, 2012: 47).

As we have shown, smart grids are imagined to be complicated technological infrastructures for publics to inhabit, and these complicated entanglements will undeniably affect ordinary people. Following Marres' view on how public problems come into being smart grid is exactly not being constructed as a 'public problem', because experts take care of the issue by providing answers and by maintaining a non-relation to publics. All doubts and problems are kept inside the closed space of expert innovation networks, and ordinary citizens should only be engaged in smart grid development insofar as their voices are mediated by 'experts on human beings'.

But when problems become relevant to people they gather around them and this is how a public come into existence (Marres, 2005; see also Latour, 2005). The public is thus defined in terms of a particular modality of issue involvement and issue relevance. Maybe, ordinary people are not necessarily as uninterested and unengaged in their energy consumption, as the smart grid developers tend to think. Maybe they just don't feel the relevance – maybe, as the above field note quote implies, publics are not involving themselves in smart grid, because they do simply not know it exists. As experts have defined smart grid as a problem for experts so solve and as the electricity grid has always been an invisible infrastructure, which consumers have not engaged with, potential future users are easily framed as ignorant and uninterested (on invisible infrastructures see Bowker, 1995; Cotton & Devine-Wright, 2010; Hargreaves et. al., 2010).

In his book *Phantom Public* (1927) Lippmann (much in line with Maranta et. al. 2003) says that the public is 'a partly imaginary entity'; an 'alien' or an 'abstract creature' (Marres, 2012: 46–50). "What if the public is indeed a problem what if this problem must be appreciated *as a problem* before it can be sorted out?" (Marres, 2012: 57, original emphasis). A way to do this, again following Marres, is to think about potential future smart grid users as 'affected publics', and not only as instrumental entities that can and should be changed

by technology. The publics' opinions and concerns should not only be tolerated and accommodated, but they should be seen as valuable and generative to the innovation of smart grids (Marres, 2012, Chapter 2). Doing so, however, entails embracing (rather than fearing) the publics' disagreements and conflicting opinions and concerns. Is this not exactly the promise of the family metaphor? Families are both about close and distant relationships. Doesn't the family metaphor exactly hold the promise of being able to include conflicting actors and discrepant publics?[19]

Marres says that publics are 'intimately affected outsiders'; they are both inside and outside the problem. Both alien to and implicated in public problems - both inside and outside the family, we might add. Because of this double-position they can often come up with unfamiliar strategies for solutions and distinctive contributions (Marres 2012: 51). This, we will argue, provides a good argument for including potentially affected publics into the smart grid family and for inviting them into the work of posing and articulating which kinds of problems smart grids are how they could potentially be solved.

To end with a couple of examples indicating openings in this direction, the Siemens representative ends her presentation of a study done among electricity consumers, by saying that a recent survey by her company showed that 'consumers *are* more than smart grid ready'. For example they have lots of good ideas for how future smart green homes should be designed. When asked to draw their future homes what appeared were highly connected homes with solutions not so far from the experts' solutions. The consumers were less concerned with how to make energy consumption flexible. The publics' suggestions thus expressed other problems, other wishes, and other concerns.

Just like people in the survey emerged to Siemens as a public with relevant views – much to the surprise of the Siemens representative - the STS researcher emerged as someone with a relevant position for one of the more technically oriented delegates. In her role as university representative she participated in *"enriching historical and technological imagination"* (Jensen 2010:43) of one of the company representatives, as during the evaluation of the workshop at Siemens one of the participants pointed towards the first author and said:" I have learned that technology ought to be considered as both a social and political entity". Other delegates from time to time mentioned to her that she was the one making smart grid (due to her being framed as one of the experts on human beings).

We have here been concerned with emerging 'relative' positions in a proposed smart grid family. Yet, the list of possible casts could be extended to for example artists concerned with electricity consumption. There are a growing number of artists who have taken up electricity and the engineering of renewable energy infrastructures as a medium to work with. The art- and design competition *Land Art Generator Initiative* invites artists into the innovation space by challenging them to create large-scale public art sculptures, which also function as renewable energy power plants. The project encompasses the disciplines of art, architecture, urban planning, renewable energy science, and ecological conservation[20]. In collaboration with the Finnish capital's energy company Helsinki Energy the artist duo HeHe has visualised and made public the electricity consumption of Helsinki citizens in a spectacular, interactive green cloud hovering in the dark sky over a power plant (*Nuage Vert,* 2008). And media artist Usman Haque has designed a network devise (*Patchube*, 2007-2011), where the public can

store and connect various data (pollution, energy consumption, CO_2 emissions, weather date, etc.). The data can be used by the public to create new and meaningful 'out-of-the-box apps', and Haque's aim is "for individuals to take control of their own data and design their own connections in smart homes" and thus to "make smart people out of dump objects" (Haque, 2011)[21].

In suggesting we acknowledge the emergence of smart energy infrastructure as an imaginative space of opportunity and we propose seeing any opportunity for participation as a step in the right direction. A Siemens representative seeing consumers differently as people with a voice. First author's presentation being reflected on by delegates framed as smart grid experts. Both are examples of emerging infrastructures for the discussion of smart grid that opens up the problem-solution nexus somewhat[22]. Including artists in the staging of 'alien' voices may include new and imaginative family members into the smart grid family.

Conclusions

> Problems of relevance [...] suggest a dynamic political ontology in which the process of the specification of issues and the organization of actors into issue assemblages go hand in hand. Here the composition of the public – which entities and relations it is made up of – must be understood as partly the outcome of, and as something that is at stake in, the process of issue articulation. (Marres, 2012: 53).

We would like to end by suggesting seeing smart energy futures as a public problem. By looking at the smart grid models as inscriptions we saw how they construct (partly similar, partly different) subject-positions for future electricity consumers, who are imagined to become more engaged and active in their energy consumption and production. This finding made us speculate on the mismatch between, on the one side, experts' imagination of active prosumers and, on the other side, an absence of actual users/humans in the innovation space.

In analysing the relations between smart grid objects, their protagonists, and their audiences, we found that innovation emerges in a collective process of making relations and non-relations. In this context, the informants' own metaphor, the smart grid family, seemed to have three effects: Firstly, it gathered a heterogeneous 'ensemble cast' of smart grid developers making them collaborate on 'one and the same' project. Second, it called for new experts to become part of the family. And third, it created a division between who is part of the family (experts) and who are not (non-experts). During the delegation trip smart grid emerged as a problem for the experts to solve. The experts then framed the problem as a matter of getting more experts involved, for example experts on human beings. The inclusion of first author into the family indicates that the family is not an entirely closed space, but the expert role was important in order to gain impact. We discussed how to open up the space to new and differently imaginative family members.

As we have seen in other studies, infrastructure developers are reluctant to engage publics in the innovation process because they fear that the many divergent opinions can slow down the process. We could add that the danger of opening up the ensemble cast to new voices might be that the yet very partially existing smart grid be articulated and performed in multiple and in-coherent ways, which makes it difficult for it to gain in reality. However, Latour argues, "an arena, can be very sturdy, too, on the condition that the number of its participants, its ingredients, nonhumans as

well as humans, not be limited in advance." (Latour, 2004: 246). It is important to keep the 'ensemble cast' open to new and unforeseeable actors because those who are considered 'aliens' might articulate the problems differently than the 'experts' and thus lead to very different solutions[23].

Recalling Addelson's proposition that "The experts play important roles in determining who the participants [in a public problem] are." (Addelson, 2002: 129), we have argued that, instead of holding on to the epistemic asymmetry between experts as knowledgeable and publics as ignorant and uninterested, experts can benefit from inviting new ensemble casts into the smart grid family. However paradoxical it might seem, we argue that a way to make publics part of the family is to frame smart grid as an 'unfamiliar' problem, that is a problem to which experts do not have any fixed solutions – but also to articulate smart grid as a problem to which they do not even know the character of the problem. We argued that it is crucial to invite publics to take part in articulating smart grid as a public problem, but even of they are not invited they may form concerned groups around smart grid development anyway. This makes it important to emphasize that we are not talking about user-involvement in the sense that publics are included as knowledge-carriers whom the experts can 'unpack' and find answers to their problems. It is not (only) about finding human-experts, who can mediate between humans and technology and who can reconfigure consumers into prosumers. Rather than fearing, we urge the smart grid developers to embrace the 'alieness' and 'unfamiliarness' of 'humans' in their unruliness, because we believe that this can bring other/new concerns to the complex and problematic 'thinginess' of smart grid. We believe that this can be generative to the innovation process and hopefully generate an infrastructure for general publics to inhabit.

Including other publics can bring new and alien ways of articulating energy futures as public problems and maybe thereby bring very different problems, concerns, and solutions into the arena of smart grid innovation. Allowing for non-experts' problems to become relevant in the development of smart grids, and other emergent technologies, can result in a more dynamic innovation process. Therefore we argue that *studying* as well as *innovating* new 'things' is a matter of focussing more on how problems and issues are posed and by whom. This, we believe, can lead to a more dynamic, and less techno-centric and less top-down innovation process – a relational ontology of green energy futures.

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Endnotes

1 Denmark has four innovation centres around the world (Shanghai, Hong Kong, Silicon Valley and Munich) aiming at strengthening collaborations between Danish and international businesses. This is indicated on the web page the following way: *"We help you innovate and grow through international partnerships"* (http://icdk.um.dk/en/).

2 http://icdk.um.dk/en/about-us/innovationcentres/munich/innovation-projects/smartgreenhome/

3 The metaphor was used several times during the trip and it is often used in smart grid documents, at smart grid events and in the media.

4 In a recent smart grid project in Denmark anthropologists were hired in order to investigate how users or humans were acting with smart grid technologies, in this particular case the heat pump. For an analysis of this study see Nyborg & Røpke 2013.

5 The concept of the *prosumer* derives from new media and is a portmanteau of consumer and producer. Below we will elaborate further on the term and its meaning in the context of smart grid. Whereas the prosumer was a topic during the trip and in the early development of smart grid, it has since vanished from the smart grid discourse.

6 In what follows we employ notions of the user, consumer, prosumer, people, humans and lay people to account for the complexity of the social groups that are partly imagined, partly already existing.

7 Using the image of the development of an infrastructure as a 'birth', Jensen here paraphrases Michel Foucault in *The Birth of the Clinic*.

8 In 2010 the Danish Ministry of Energy, Climate and Building initiated a smart grid network consisting of a number of important players within electricity infrastructures, including universities, the Danish Energy Association and the state-owned, national transmission system operator, Energinet.dk. The aim of the network has been to develop a shared 'smart grid strategy' (released May 2013), which describes a road map for Danish smart grid development. During the three years a number of reports have been released together with continuous events. First author has been doing her fieldwork following this process and reading the reports produced. One central document that has been especially influential to the fieldwork is the pamphlet 'Denmark Opts for Smart Grid', made by Energinet.dk. The pamphlet outlines state of the art of smart grid research and implementation in Denmark 2011.

9 Each day offered one or two visits to central developers of smart grid. Besides Siemens and EEnergy, which will be described in the paper, other institutions visited included Frauenhofer Institute, Munich Innovation Network, and Munich Stadtwerke. Danish participants represented five small enterprises, the Danish Technological Institute, Danish Technological University and then the first author, who represented a strategic research initiative entitled Energy Futures at the IT University of Copenhagen.

10 http://www.e-energy.de/

11 Even though the German, with the *Energiewende* policy legislated by the Germany government 2011, has decided to phase out all nuclear power plants by 2020, it appears in EEnergy's model.

12 The term 'smart energy' is commonly used by smart grid developers.

13 This conceptualization of the smart grid as an 'energy stock exchange' is commonly shared by most smart grid projects. The energy stock exchange is imagined to collaborate with existing energy trading systems such as the Nord Pool Spot and EPEX Spot (European Power Exchange), where local traders buy and sell electricity and power is being transported between countries and thereby help stabilizing the national grids.

14 As part of the participation first author had to write a page about her own work with smart grid, in which she stated that she had "investigating how smart grid developers work with the notion of the user".

15 In order arrive at the concept of an 'imaginative space of opportunity' we have been inspired by Hetherington 2011 and by Gilles Deleuze's concept of 'diagram,' which he develops from Michel Foucault (Deleuze, 1995).

16 As is also noted by Cotton and Devine-Wright (2010), when it comes to electricity infrastructures in the context of the Western world, electricity is so pervasive that it cannot be compared to regular goods, which are chosen or not chosen by the consumer. We are born into the electricity infrastructures and therefore talking about future prosumers must refer, not to a specific user group, but rather to the general public.

17 This comment also resembles first author's general observations through her two years of working with smart grid. When explaining to people that she researches smart grid, very few of these 'lay persons' have ever heard about the concept.

18 Though Dewey and Lippmann talk about politics the same counts for engineering experts and designers, as Marres also discusses in her book *Material Participation* (2012)

19 As Marilyn Strathern argued during her keynote presentation at University of California Santa Cruz on February 28th, 2013 (Emerging Worlds Lecture Series with Donna Haraway), 'the relative' is an interesting figure when thinking about (kinship and other kinds of) relations. For our purposes here, we might think of lay people as 'relatives,' who, however different and 'strange' they are, should nevertheless be invited to the family gatherings. Maybe they bring something new and unexpected to the table.

20 http://www.landartgenerator.org

21 For further discussion of the two artworks see Schick & Witzke, 2011.

22 Dantec & DiSalvo (2013) make similar argument when they make a distinction between what they call

'infrastructuring' and participatory design. Also building on Dewey and Marres they say that in participatory design users are included into already known issues and their role is to answer already defined problems. 'Infrastructuring' on the other side is a matter of including publics in order to discover unknown issues.

23 Similarly, Isabelle Stengers argues for an inclusion of 'the idiot' into the production of knowledge and engineering exactly in order to 'slow down' reasoning. She argues that the idiot's strange mumbling might be generative to the process (Stengers, 2005).

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Paper 3: Flexible and Inflexible Energy Engagements – a study of the Danish Smart Grid Strategy

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Flexible and inflexible energy engagements—A study of the Danish Smart Grid Strategy

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ABSTRACT

According to many visions for smart grids, consumers will come to play a more 'active' role in the energy systems of tomorrow. In this paper, we examine how the future 'flexible electricity consumer' is imagined in the Danish National Smart Grid Strategy. Our analysis of reports produced by the national Smart Grid Network shows that this vision relies on a techno-centric and rather 'inflexible' consumer figuration. However, rather than adopting a conventional social science approach in order to criticize this narrow imaginary, we show that potentials for critique and alternatives can be found internally in the Smart Grid Network. Paying attention to different stories, we thus aim to characterize particular forms of 'infra-critique' and 'infra-reflexivity' emerging from within the field. This mode of reflexivity, we argue, opens up to more flexible and reflexive conceptions of the 'flexible electricity consumer' as well as more flexible relations between 'the technical' and 'the social.'

1. Introduction

> The internet has got a younger brother. This is how the intelligent power grid could be popularly perceived. Just as the internet revolutionised the way we communicate, the intelligent power grid will change the way we use electricity (Lykke Friis, Minister of Climate and Energy [1]).
>
> We cannot expect users to be actively involved in their energy consumption. (Smart Grid responsible in the Ministry of Climate and Energy [2]).

Several Western, industrialized countries are currently reassembling their standard electricity infrastructures as intelligent energy systems—also known as smart grids.[1] In this process the role of the electricity consumer is renegotiated. Many smart grid projects share a vision of a future in which currently passive consumers (as they see it) will become notably more active and involved [4–6]. However, what 'being active' implies is subject to quite remarkable variation. In this paper, we analyze the Danish, national Smart Grid Strategy[2] (2013 [7]) along with reports and events feeding into its making. We examine the work of the Smart Grid Network—a group of experts assigned with making the strategy. In particular, we explore the role that the network ascribes to the future consumer and how the network imagines to "strengthen consumer engagement" [8].

Denmark aims to be a forerunner in smart grid expertise and technology.[3] The country has the highest investment in smart grid per capita [9]. The aim is for the energy consumption of the entire country to be carbon neutral by 2050 [10]. The vision is that the smart grid will play an important role in this transition because the energy production from renewable energy is intermittent and fluctuating. What this means is that whereas today energy production follows demand, in the future demand must follow energy availability. In the future, therefore, the demand side must be used as a balancing mechanism, easing pressure on the transmission grid during peak hours. Accordingly, the Danish energy sector believes that a crucial function of the smart grid is to "activate flexible electricity consumption" [7].

As suggested in the opening quotes, different understandings of the implications of the future smart grid exist even within the Min-

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[1] Also in non Western and developing countries are smart grids on the agenda. However, in countries without a national electricity infrastructure smart grids often look somewhat different. In this article we therefore stick to the generic figuration of smart grids in industrialized countries [3].

[2] The Smart Grid Strategy is written in Danish, but a summary in English can be found here: http://www.kebmin.dk/sites/kebmin.dk/files/klima-energi-bygningspolitik/dansk-klima-energi-bygningspolitik/energiforsyning-effektivitet/smart/smart_grid_strategy_uk_summary_web.pdf.

[3] Danish Energy Association: http://www.ienergi.dk/Projekter.aspx.

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istry of Climate and Energy. Analogously, two incompatible images of the consumer also emerge in our analysis. Our engagement with these incongruent images is to take them as explications of forms of "infra-reflexivity" [11] in the Smart Grid Network. Thus, we analyze the different forms of inflexibility and flexibility ascribed to the so-called 'flexible consumer.' We take a critical stand towards this delegation of responsibility to individual consumers by showing how this re-description of future consumers produces a somewhat narrow and inflexible configuration of the user [12,13]. We argue for developing a more flexible understanding of the division of labor among different actors in the field of smart grid development. We thus argue for operating with more intertwined and flexible definitions of the social and the technical in the field of energy studies, strategy planning and infrastructure development, instead of delegating the responsibility of being flexible to consumers.

2. The Danish Smart Grid Network

Since the 1970s movement against nuclear power, Denmark has been a world leader in wind energy [14–16]. However, the high share of distributed and fluctuating wind energy – today covering around 40% of the total electricity consumption – is along with rising energy consumption and peak-hour load stress, putting a pressure on the distribution grid. In 2010, The Danish Energy Association and the national transmission system operator (TSO) responded to these challenges by publishing a cost-benefit analysis, which concluded that demand-side management – enabled by a smart grid – would be the cheapest as well as most efficient solution [17]. Subsequently, Lykke Friis, the Minister of Climate and Energy, appointed a Smart Grid Network[4] which was commissioned to offer recommendations on the future of the Danish smart grid. Over the course of three years people involved in this network published four reports that presented recommendations and possible solutions [1,8,18,19]. These reports formed the basis for the national Smart Grid Strategy, published by the Ministry of Climate, Energy and Building in May 2013.

> This Strategy sets the course for development of a smart grid which can make this green transition cheaper, provide savings on electricity bills and help promote new services and products to the benefit of consumers [7].

The Smart Grid Network included actors from universities, utility companies, grid managers, technology developers, public and private institutions and private businesses. Key organizations represented included the Ministry of Climate, Energy and Building (KEBMIN), the Danish Energy Association, Dansk Energi, and the national TSO (transmission system operator), Energinet.dk.[5]

Over the period of tree years in which the Smart Grid Network existed first author, Schick conducted a qualitative study of their work. This included following discussions of Danish smart grid development at public meetings, innovation workshops, conferences, and events. During the roughly 15 events she did ethnographic observations and had conversations with participants [20]. The primary empirical material for the present paper consists of close and interpretative readings [21,22] of seven reports and policy documents produced by the key actors in the smart grid network [1,7,8,17–19,23].[6] Furthermore, three semi-structured interviews [24] with central actors from the Ministry of Climate and Energy, the Danish Energy Association, and Energinet.dk were conducted in order to get more insight into the knowledge and knowledge.

During fieldwork, it quickly became clear that the Smart Grid Network and the emerging Smart Grid Strategy was very important to actors involved in the development of Danish electricity infrastructures. An important aim of the Strategy was to streamline future development. At an event, which launched the report *Smart Grid in Denmark 2.0* [19], the Minister of Climate and Energy expressed the work of the smart grid network like this:

> "There are so many ways smart grid development could go. This work shall ensure that all actors work on one and the same project" (Danish Architecture Centre [66]).

Policy plans do not work as fixed road maps for technological development [25]. Nonetheless, strategies and policy planning are relevant actors in the field of energy futures and they can be expected to influence and effect emergent futures some way or other [21,26,27]. As Mithra Moezzi and Kathryn B. Janda write in an earlier paper of Energy Research & Social Science: "Disciplines, models, and narratives shape how we think and influence where we are going and what we believe to be possible" [28].

The composition of expertise in the Smart Grid Network was pivotal for how the smart grid was "problematized" [29] and thus for how solutions in the field are currently imagined. Here it is noteworthy that members of the network primarily represented the energy and IT sectors. Thus, they were predominantly engineers or had other technical professional backgrounds. In contrast, the network did not include any social scientists.

3. Analytical approach

Within disciplines of social studies of energy and infrastructure development researchers have in various ways highlighted critical issues concerning the domination of engineers and economists. Social science is often criticizing the lack of attention given to social and human dimensions of energy [30–33]. Social studies of smart grids have illustrated that energy consumption is predominantly approached as a techno-economic issue, and that developers tend to perceive electricity users as individualized, rational consumers primarily, if not exclusively, motivated by financial incentives [5,6,34]. The consequence is usually an instrumentalization of consumers, who should simply be educated or 'nudged,' in order to use the system as planned. In particular the emphasis on 'nudging' is indicative of the extent to which assumptions from behavioral economics shape the techniques deployed to adapt consumers to the system [28]. Yet, we also know that techno-centric systems very often do not work as intended, and that users routinely fail to behave as anticipated [4,28,35]. This is one reason why social studies of energy advocate complex approaches, centering on 'humans', "social practice" or "social potentials" [5,28,35].

Practice theory and user-studies, for example, commonly argue that the complexities of the everyday-life should be taken into account when trying to shape future user behavior. By adding 'the social' and 'energy use in practice' to the set of relevant knowledges, these approaches work to reframe some of the enduring problems which engineers, economist and policy makers face [4,36,37]. This strand of literature, for example, proposes to widen the narrow

[4] The original policy document from 2010 lists 26 experts but new members joined and some left.

[5] Energinet.dk is an independent public enterprise responsible for transmission in the high-voltage grid (>100 kV). Approximately 70 grid companies take care of distribution to the costumers (<100 kV). Grid companies are either customer-owned cooperatives, municipal businesses, or privately and/or publicly owned limited companies (DanGrid 2011, p. 12). It is the distribution grids that are challenged during peak hours.

[6] Three of the seven reports are in Danish 7,17,18. Quotes from Danish reports and interviews have been translated by the authors.

"smart ontology" [35] – the belief in a technological fix – that smart grid developers tend to share [28,35].

We share the ambition to figure out what role social inquiry may play in the field of energy; and not least how it may contribute to more multifaceted smart grid policy planning. In the following we contribute to this agenda by examining empirical and conceptual dimensions of the Smart Grid Strategy. In particular we are concerned with how users are being (re) imagined in the Danish Smart Grid. Investigating this, we start out from an approach to the relations between users and technology as a complex and intertwined matter of 'de-scription' [12,38] and 'reconfiguration' [13,39]. We follow a science and technology studies (STS) approach, which sees policy documents as part of broader networks [21,22]. In particular, we focus on how key actors relate to the contents and potential effects of the strategy. In this sense, the analysis is guided by concerns that emerge out of the Smart Grid Network. Thus, rather than turning to practice oriented user studies or theories of 'the user' or 'the social' in order to add reflexivity and complexity to the field, we have instead aimed to "sensitize" [40] ourselves to the field's internal reflexivity and complexity.

Specifically, we use different stories encountered in the interviews as generative openings for seeing the work done in the Smart Grid Network as more reflexive than it immediately appears in the documents [41,42]. This does not mean, of course, that we simply pay lip service to informants. It entails, however, that we do see the informants' reflections as articulations of what philosopher of science Bruno Latour has termed "infra-reflexivity" [11] as opposed to "meta-reflexivity", which is typically deployed in social theory. Moments of infra-reflexivity are resources, which can be used to tease out the flexible and complex entanglements of social, technical and economic issues arising as part of the endeavor to "activate flexible electricity consumption" [7]. Similrly, inspired by philosopher of science Helen Verran, we also engage with the informants' partly contradictory arguments as a form of "infra-critique" [43]. This concept does not only refer to a critique coming from the informants themselves, but Verran's use of the prefix 'infra' also creates an opposition to 'meta'. The concept of meta-critique refers to the use of theory as a stable and supercilious 'place of no-where' from which one can speak. However, for Verran, theory and critique is as unstable as practices in the field studied, and emerges together alongside and through the practices studied. Infra-critique is thus about noticing generative tension from within, possibly affecting the researcher and her theoretical field. Thus, instead of tuning to users or to theories about the social, we are interested in exploring further what social inquiry might learn from an already ongoing reflexivity and critique happening in the field of energy and vice versa.

4. Activating flexibility in the Smart Grid Strategy

> Consumers have primarily been 'passive' consumers with a predictable and regular consumption pattern [. . .] The development of a smart grid depends primarily on whether consumers see a value in making their flexible consumption available [7].

In the day-to-day operation of the conventional Danish energy system, utility companies and grid operators are rarely in contact with private consumers. The former are responsible for adapting production to consumption, while the latter are free to use energy as long as they pay their bills. It is exactly this well-defined distribution of roles, which is expected to change in the years to come. The report *Smart Grid in Denmark 2.0* states that "[t]omorrow's power system is complex, with numerous physical units, businesses and private individuals actively involved in the power system" [19]. Indeed, consumers and households are already being rethought. In an interview, the Head of the Alliance for Intelligent Energy (a subsection of The Danish Energy Association, created in 2011 to nourish collaboration in the field of smart grid development) explains that utility and grid companies used mainly to refer to consumers as "load units," but today they are more likely to be categorized as "customers" or "resource units" [44]. A concept, which is widely used within smart grid development, is the 'prosumer'. This portmanteau of consumer and producer indicates an electricity consumer who can both store and supply energy and thus help balancing the grid. Whereas the concept is wide deployed in several Danish smart grid projects [45], it only figures in the initial policy document describing the work of the Smart Grid Network [46] and in one of the early reports [1]. Though the 'prosumer' vanished from the smart grid reports a similar configuration of consumers were manifested as consumers were described as "resources for the electricity system" [17], and as "unused potentials for flexibility" [19].

However, activating flexible electricity consumption is not so much sought after for the sake of consumers. As several informants phrased it is rather a "systems need" [2,47] (see also [19]). Accordingly, the major challenge for developers is to translate the need of the system into something that is *also* valuable and motivating for consumers. Otherwise, why would they "offer their flexibility to the grid"? [19]. The Smart Grid Strategy, therefore, contains incentives to provide such customer value:

> Firstly, consumers want a financial incentive, however flexible electricity consumption also makes it possible for consumers to become involved actively in the green transition and it allows for the development of a host of new services for the more high-tech consumers [7].

In line with the results of other studies, the dominating incentive highlighted in the reports is economic. For example, "electricity consumers will have increased incentive to move their electricity consumption to off-peak hours if there is a stronger price signal from the actual price of electricity" [7]. Concerns around sustainability pose as the secondly most mentioned incentive. As noted, Danish smart grid development is seen as an essential part of the green transition [10], and customers are viewed as supportive of that transformation.

The Smart Grid Network recommended a nation-wide roll-out of smart meters, enabling flexible energy prices and billing by the hour [8].[7] Grid companies are now under legal obligation to install smart meters in all Danish homes before 2020.[8] All meter data is collected in a DataHub managed by Energinet.dk, which was launched in 2014.[9] The transparency of flexible energy prices are envisioned to activate flexible consumption, since either humans or technologies will react to market fluctuations in the market:

> [F]lexibility means that a customer, or an appliance connected to the power system, changes its behaviour to meet a need from the power system. For example, a heat pump that stops because a power line is overloaded, an electric car that adapts its charging patterns to balance out fluctuating wind power or solar energy levels, or a customer choosing to use their tumble-dryer later than planned [19].

The potentials of consumers actively choosing to change behavior are often mentioned in the Smart Grid Strategy and other

[7] In Denmark taxes accounts for a large part of the electricity bill. Whereas there is a general agreement that prices and tariffs (grid transmission) should become flexible, it is more debatable whether taxes should also be flexible.

[8] Today around 50% of households have smart meters.

[9] Centralized collection of private energy data is a contested matter in many other countries such as UK and Germany. In Denmark, however, privacy protection issue is barely raised as a problem. This may be due to the large amounts of personal data already held by government.

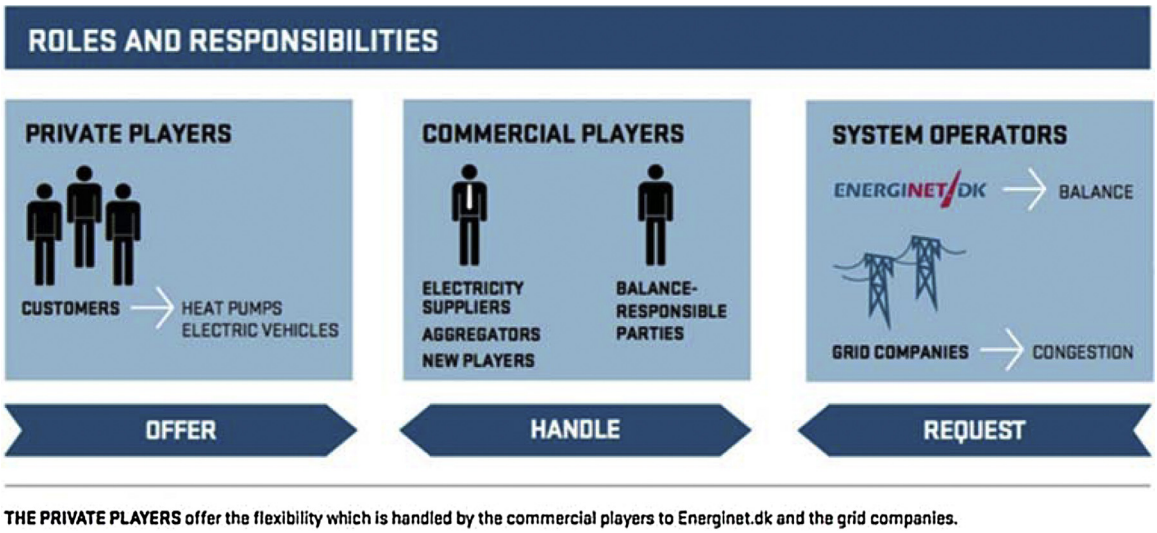

Fig. 1. Visualization of roles and responsibilities in the aggregator model in Danish Smart Grid. The figure is taken from the report Smart Grid in Denmark 2.0, p. 20 [17].

documents. Yet, the smart grid network exhibit limited confidence in this social transformation. Instead visions of automatic, technological solutions dominate the storylines. We now look closer at the two main strategies imagined to "activate flexible electricity consumption." The first and predominant model includes "aggregators" and "flexibility products". The second strategy emphasizes the emergence of new energy services and apps.

4.1. Aggregating flexibility

According to the reports, the dominating mechanism for activating flexibility is the use of flexibility products. Flexibility products are "smart grid ready" devices, which means that they can automatically react to fluctuating energy prices by turning on and off, or by being remotely controlled [1,7]. Grid operators can thus use flexibility products to regulate the grid.

Obviously, not all electricity consuming activities, e.g., cooking, watching TV or using the need for lights, are equally flexible, or flexible in the 'right' way. In the early reports [1,17], regular domestic appliances such as refrigerators and washing machines were identified as possibly flexible products, but later [7,19] on they are no longer included, since they consume too little energy to make much difference in the energy load [2,44,47]. Therefore, the flexible consumer role is limited to "consumers who get a new and bigger energy consumption—those who have a heat pump or an EV" ([47] see also [7,19]). Each of these devices doubles the energy consumption of a regular household.[10] EVs and heat pumps hold great potential for flexibility because a house can be preheated before peak hours and cars can charge at night—or even discharge if the grid needs more power [7,8,18,19].

However, a single heat pump or EV does not provide sufficient flexibility to appear as even a blink on the electricity market. Hence, the Smart Grid Network envisions the birth of a new market model in which so-called 'aggregators' play an important role:

> An important role in tomorrow's power system is that of the aggregator, which, on the one hand, handles flexibility at the retail level by offering solutions that make it interesting for customers to offer flexibility, and, on the other, gathers and administers (aggregates) individual flexibility in sufficiently large volumes for it to be procured and activated as a combined service via the wholesale markets [19].

As Fig. 1 shows, an aggregator is a commercial player functioning as a connecting point between private actors and system operators. When system operators request more or less electricity use, the aggregator can turn heat pumps and EVs on and off remotely. In this way, aggregators supply consumers with products and services, while also offering flexibility to the grid. Without loss of comfort, customers offer flexibility through a special contract with the aggregator. The model is similar to the cell phone industry, where customers often buy a package containing a cell phone and a subscription deal. Buying a heat pump or an EV might similarly include an agreement, allowing the service operator to manage the device in specified ways. For example, customers may get a heat pump cheaper if they commit to offer greater flexibility, such as enabling the operator to turn the heat pump on and off within a temperature range of e.g., 17–25°, while a range 20–22° would be more expensive. Similarly, customers may allow an operator to charge their EV at favorable times (e.g., during the night) as long as the car is fully charged when the owner leaves for work in the morning: "The car's battery can be charged for variable prizes depending on how fast it needs to be charged" [17].

This mechanism for activating flexibility depends on the emergence of "new markets for flexibility" [19]. Important to notice is that 'flexible consumption is a special 'privilege' for the small group of people, who invest in heat pumps or EVs. Furthermore, the vision implies that when consumers have chosen a subscription plan, they no longer have to work to be flexible. That work is delegated to the technology and the aggregator.

4.2. Engaging energy services

Smart grid is not only about the need of the electricity system. A number of solutions and services will also satisfy the consumers' need to be in control of energy consumption, also described as home automation [7].

Smart grid projects often focus on the development of energy awareness technologies. These might be technologies that visualize energy consumption in kWh, price signals or consumer carbon footprints [48–50]. An assumption that is often embedded in the design of such technologies is that energy feedback can change consumer behavior. Social studies, however, have shown that this expecta-

[10] A regular family household in Denmark uses around 4 MWh a year.

tion is rarely realized and that the effects tend to be short-lived [28,35,51].

The standard smart meters rolled out in Denmark do not have a visualization interface because, as the advisor to the Minister of Climate and Energy explained in an interview, it is not believed that such feedback will have any great effect on flexibility [2]. Grid companies may choose to make consumption patterns available online, but as the above quotation express, the future consumer is rather expected to invest in energy management and home-automation systems.

Such systems, however, are very expensive. Meanwhile, the possible savings for regular family amounts to little more than a few bottles of wine. This is one reason why the advisor to the Minister [2] and the Head of the Alliance for Intelligent Energy [44] express doubt about whether people will invest in such systems. Indeed, the common opinion among actors in the Smart Grid Network seems to be that energy awareness, management, and efficiency will never attract the interest of the general population. This is why such initiatives need to be accompanied by the development of other services. The Smart Grid Strategy writes:

> There is already a number of Danish companies that have specialized in home automation solutions, i.e. that the heat system automatically turns down the thermostat when a window is open, or that a message is send to the consumer informing them that a light is on or that there is an extensive water use even though nobody should be home in the house, which indicate that there may be a burglary or a burst water pipe [7].

Further examples of extra services include heat pumps that text their owners upon break down, or remotely controlled heating systems, which allow turning on the heat from a distance. Such services are not only interesting from the point of view of the consumer:

> Besides from promoting energy saving, security and surveillance [...] these solutions can also be utilized by the electricity system, either if the devices are themselves able to react to signals in the grid, or if their consumption can be controlled by an aggregator [7].

Based on flexible prices, the smart meter data, and remote control facilitated by the intelligent IT infrastructure, grid companies, aggregators and other private business actors are expected to invent new ways of using and managing electricity. "Greater competition can lead to tailored smart grid products" [7] and "[p]roducts that will utilize the new infrastructure, as we have seen with mobile telephony and the internet" [17]. Comparisons are often made with the internet, smart phones, and apps (see also [52]) and they generate great expectations for future innovation and inventiveness. General for the services and apps imagined so far is that they should make life easier for people.

The Smart Grid Network hopes that inventive apps and services will engage people in energy. However, exactly what these new products and services are, how they are supposed to emerge, and how they may change electricity consumption is not clear. Indeed, there are serious doubts about the extent to which such services hold any real potential for activating flexibility.

5. 'New' users and their problems

What kind of user figure emerges from the Smart Grid Strategy and the work of the Smart Grid Network? When the Minister of Climate and Energy commissioned the Smart Grid Network, she expressed her conviction that the smart grid would "change the way we use electricity [...] just as the internet revolutionized the way we communicate" (see Section 1). Yet, the future electricity consumer imagined in the Smart Grid Network does not seem that different from the one of today. Indeed, it appears that the network does not have much faith that energy consumers will really be able to change. To a large extent, being a 'flexible consumer' is defined as a privilege for a small subset of the population, such as the owners of heat pumps and EVs. Whereas 'being flexible' is confined to investing in "flexibility products" and subscribing to specific service plans. Thus, the real change is imagined to come with the emergence of "new markets for flexibility" [19], capable of configuring for the smart grid future. The main responsibility for 'acting flexibly' is delegated to aggregators, whereas consumers are simply equipped with the right technological tools or 'prostheses'. In the words of Moezzi and Janda, the Smart Grid Network sees "people like comfort and convenience-seeking couch potatoes" [28]. Instead of activating people, everything suggests that technology and new businesses are engaged *for* people, who are imagined as neo-liberal consumers [6]. Correspondingly, the imagined change is technological to such an extent that and it might be described as a "change of no change" [53]. Even though the smart grid was initially depicted as essential for developing a carbon-neutral energy system, environmental issues are only perceived as a motivating factor for a few 'idealistic' consumers. Even though the strategy invokes the possibility "for consumers to become involved actively in the green transition" [7], it pays little attention to *how* consumers might become involved. Instead, "involvement is made easy" [53] by being limited to choosing a service plan. Environmental and financial concerns and personal and systems issues are presented as two sides of the same coin:

> An important element [of making people aware of Smart Grid] is that electricity customers know their options, and about the advantages and disadvantages to their personal or business finances, as well as for the climate and the electric system as a whole [8].

Yet, even though the Smart Grid Network often describes the smart grid as a complex infrastructure, they clearly find it unnecessary to bother customers with the complexities (see also Ref. [52]). In short, the emergent figure of the energy consumer is a 'naturalized consumer,' which is not subject to further reconfiguration [39]. This is a consumer who is not really (able to become) interested in new issues and concerns [54]. In this sense, the Smart Grid Strategy's 'flexible consumer' is, in fact, a very *inflexible* consumer.

As mentioned, social inquiries have discussed thoroughly how smart grid projects are most often not as efficacious as hoped for [28,35,51]. The Smart Grid Strategy states that "it is essential to underline that we are dealing with a potential flexible consumption" (our empfasis [7]), which relies on whether the markets will develop as estimated. Presently, this 'potential' seems rather discouraging. In spite of large subsidies, only 3000 EVs are currently registered in Denmark.[11] The official estimation from 2010 was 600,000 EVs [17]. Similarly, expectations for how much flexibility private consumers will be able to deliver have decreased from 10 to 15% in the early reports to around 2% in 2013 [2]. Furthermore, the flexibility products have problems fulfilling the 'flexibility potential.' One large-scale smart grid test project, *eFlex*, showed that people do not use their heat pumps as intended [45]; the domestication of technology [55] does not happens as straight forward as intended by the smart grid planners and the users tamper with their pumps in 'innovative' ways [4].

In this context, the Head of the Alliance for Intelligent Energy raised concerns regarding the ways in which the energy services offer 'value' and 'incentives to participate' to consumers [44]. He

[11] This number derives from an email to Schick (January 7th 2015) from a consultant from The Danish Electric Vehicle Alliance (a subdivision of the Danish Energy Alliance). http://www.danskelbilalliance.dk/English.aspx.

described their ideas as uninventive, very rationalist, functionalist and conservative. In his view, a better alternative would be to involve the gaming industry and social media in innovation. Referring to social media as an "unexploited platforms" he asserted that:

> If you want to create a nation-wide public movement then you need to ask how social media can be brought into play—both as a platform and as a way to affect people [44].

Indeed, though we have not been able to identify many *concrete* examples of activating and engaging future energy users in the reports, all of the interviewed actors from the Smart Grid Network saw this factor as critical. The advisor for the Minister insisted, however, that such activation is not a dimension of policy planning. Instead, he delegate the task of "engaging consumers" and "creating value" to market mechanisms [2]. Providing a contrast, the Head of R&D at Energinet.dk noted that "now we have all the technicalities in place, so it is time to change gear and start involving social scientists in order to find out how to engage consumers" [47].

6. Infra-critique

At this point, we might well emphasize the narrow focus of the network's "smart ontology" [35]. It would be equally feasible to point out economic and techno-centric approach, and its lack of attention to human or "social potentials" [28,33,56]. Further, it would be easy to criticize the strategy for configuring people as neoliberal consumers, ignoring that they might also or instead be families, concerned citizens, or environmentalists [6,34,53]. Finally, we might note that in Denmark, social inquiry about energy is currently ascribed the role of solving or qualifying technologically, politically and economically defined problems downstream in innovation processes [35,57,58].

These are all relevant modes of critique. Yet, critical potentials emerge not only from social research but also from within energy planning and development itself. For example, the Head of the Alliance for Intelligent Energy criticizes the Smart Grid Strategy for being too narrow in its focus on "the grid and technical solutions" [44]. The strategy is completely unrealistic, he states, pointing out that the involved people have expertise neither in markets and business models nor in consumers. He insisted that: "by far the largest complexity is neither of an engineering nor of an technical or IT-related character. It is the customers", arguing further that in the realm of energy 'the consumer' is merely a buzzword [44]. Everybody agrees that consumers are important, but nobody actually attempts to characterize consumers and their potentials more specifically "because it is so terribly difficult [...] nobody has a clue how to embrace and engage consumers" [44].

This critique did not quite fit with the observation that one out of the total nine key-recommendations offered by the Smart Grid Network was entitled *Strengthen Consumer Engagement* [8] and described how educational materials and information campaigns shall ensure that "terms such as 'Smart Grid', 'flexible consumption' and 'demand response' gradually become more widely recognised in society" [8]. The recommendation underlines that wider public awareness and support is absolutely necessary for the success of the smart grid (see also Ref. [7]). In contrast to the rest of the strategy, this part of the strategy promotes a "codification of engagement as a state of 'informedness' and 'informational citizenship" [59].

Puzzled by the inconsistency between this recommendation and the critique raised by the Head of the Alliance for Intelligent Energy, Schick asked him, whether the 7th Key Recommendation did not provide a valid answer to how to engage consumers? His immediate response was laughter and he said that: "this is obviously just the usual strategy we resort to when we have absolutely no idea about what to do. It is so much-yesterday-thinking. I don't believe it one bit" [44]. Based on his own critique of the network he said that what was really needed was "social scientists like you who can critique this narrow-minded framework—that's really all you should do in your article" [44].

Following Helen Verran [43] and Bruno Latour [11], we see this critique emerging from within the Smart Grid Network as a form of an 'infra-critique' or 'infra-reflexivity.' The empirical field suddenly seems much less homogeneous than it might appear at first sight. Indeed, the Head of the Alliance for Intelligent Energy added that the Smart Grid Network "remains within a classical, technological energy discourse [...] this has locked innovation inside a very inflexible conceptual framework, which it is very difficult to think outside" [44]. The real problem is, he says, that nobody challenges the smart grid framing. "We are all heading in the same direction—nobody asks 'could it be something totally different?' [...] If we could just change our mindset..." [44].

From where do we get the necessary amount of reflexivity to question assumptions in the field and think alternatives? As we have just exemplified, informants may themselves be able to propose alternatives to current courses of action and to imagine transformations of their strategies or ontologies. To get these views into clearer view, we continue by discussing two stories, which both the Head of the Alliance for Intelligent Energy and the Head of R&D at Energinet.dk presented as exemplary for energy engagement. Interestingly both differ markedly from the vision in the Smart Grid Strategy. Yet, rather than criticizing the discrepancy between these stories and the strategy we see them as offering pathways toward a less inflexible conceptualization of future energy users. This does not mean that we find critique with point of departure in social theory unimportant, but it does pose that the theorizing done in the empirical field is just as important as our own and should be taken into account. We are thus interested in exploring further what social inquiry might learn from an already ongoing reflexivity and critique happening in the field and vice versa.

7. Unfolding different stories

> In reality, we need to start somewhere totally different [than grid and technicalities]. It is just difficult to say which story will unfold then... In this case there is no necessary thing called 'smart grid.' I guess maybe we need to define what we could call 'the sustainable citizen.' Only then is it possible to get insights into what kind of motivating forces actually reside within us. [44]

In this quote, the Head of the Alliance for Intelligent Energy ponders what it would mean and entail to approach energy consumption from 'somewhere totally different.' Two stories, which he and the Head of R&D told us focus exactly on a wholly different starting point, even though neither saw these stories as opposed to the figuration of the consumer generated by the strategy. Below we examine these stories as infra-reflexive accounts, which provide a different vantage point for understanding the development of smart grid in Denmark.

7.1. A 'Green' community

The idea that financial incentives are all that really counts is called into question by Denmark's biggest smart grid demonstration project *EcoGrid*, situated on the island of Bornholm. Both heads highlighted this project because of its contribution to a better understanding of smart grid potentials and incentives for user engagement. The project is famous for being one of the most ambitious smart grid projects in Europe. Indeed, Bornholm has been described as 'Denmark's laboratory for the energy system of the future' [1]. The vision of *EcoGrid Bornholm* is to turn the island into

a micro-grid in order to demonstrate that energy production and consumption can be balanced in a community. The Head of R&D at Energinet.dk reported that 2000 participants (20% of the population of Bornholm) were asked why they chose to participate in the project. Their primary response was that they had joined "in order to create a community feeling on the island" and "that it was forging identity to be part of the project." The second reason offered by participants was that they wanted to use more green power. "The people there had understood that when their electricity consumption became more flexible it would allow for more green electricity in the grid" [47]. As a third reason, they mentioned a desire to acquire new technology. The economic incentive appeared only in fourth place. The head also referred to two other projects—one conducted in a small village and one in a dormitory. Similarly to the case from Bornholm, they also made clear that energy consumption is a social and cultural practice. At the least this indicates that the Head of R&D at Energinet.dk is already aware of some of the main issues identified by practice studies of energy. Summarizing, he claimed that the main lesson from these projects is the importance of recognizing diversity: "no one model fits all". In comparison with the Smart Grid Strategy, which outlines a large, nation-wide, technocentric infrastructure where people are only minimally engaged in highly standardized ways, the contrast is glaring. Indeed, this was the context in which he emphasized the relevance of engaging social scientists to figure out how to tailor solutions to different people.

7.2. Solar panel owners: an uncultivated potential for 'sustainable citizens'

As noted, the realization of the Smart Grid Strategy depends on the emergence of new markets for energy products and services. The Head of R&D at Energinet.dk states that it is very challenging to make people invest in expensive energy flexibility products such as heat pumps and EVs. Likewise, he explains, private solar cells are a huge investment with an uncertain payback. Yet, although insolating the roof of your house is most often a better investment, more people install solar panels. Why is that, he wondered: "what is it that makes people want to participate? What is it that is needed?" [47] Answering his own question, the head concluded that "solar panels are visible from the street" whereas insulation is not. In this interpretation, signaling to neighbors that you are 'green' and 'doing the right thing' [60] appears as the crucial motivating factor.

The Head of the Alliance for Intelligent Energy agrees that solar cell owners (himself included) are exemplary of sustainable energy potentials.

> The ones who are most progressive are the 85,000 owners of solar panels. Because they can read their electricity production they start changing their behavior. They actually turn off the light and such things because they are inside a kind of game [44].

He compares using solar panels to a game because the panels encourage shifting electricity consumption to sunny hours where electricity is free[12]. Thus, the house itself becomes a micro-grid where the inhabitants are involved in balancing production and consumption. In his view, the group of solar panel owners is valuable for smart grid development because energy becomes a tangible part of their everyday. They are, he states: "extremely energy aware and potentially ultra-green customers" [44]. Although the increase in the number of private solar panels has been expensive for the state,[13] solar energy holds:

> an uncultivated potential for the national smart grid strategy' because it has created a 'nation-wide public movement of people who are extremely motivated to participate in the green transition because they are also the people for whom it makes sense to buy an EV [44].

He further explains that the people who have invested in solar panels are primarily homeowners, which is precisely the segment conventionally most difficult to engage in the green transition. The potential lies in tapping into their engagement: "the most important is actually that there is a group of people who are interested and reflective. It is foremost about creating a concern" [44].

Analyzing these two stories in comparison with the narrow, inflexible and, presumably, indifferent consumer inscribed in the smart grid reports offers an opportunity for reconsidering the potentials of smart grid more broadly. For one thing this comparison makes clear that the strategy does not take into account that already existing energy technologies may lead to the emergence of new publics [59]. Thus, it fails to recognize that people may become engaged in energy through 'detours' like solar panels.

Furthermore, these stories allow us to question the axiom that consumers cannot be made interested in energy and that energy engagement is limited to the practice of electricity consumption situated inside the home. They make it possible to consider energy engagement as part of social, community-based or cultural projects, where actors may be considered resourceful in many other ways than as economically incentivized consumers. The Smart Grid Network exercises infra-reflexivity in the form of stories, which expand our interpretation of the strategy described above.

7.3. Collective potentials

To see how these two stories diverge from and propose a somewhat different approach than the strategy, Moezzi and Janda's [28] review of different disciplinary approaches is helpful. They argue that most policy planning and energy projects are framed around unutilized "technical potentials" and "economic potentials." Lately, "behavioral economic potentials" have also become popular among scholars interested in including users by making them behave in accordance with the demands of technological systems. In general, energy strategies thus take their point of departure in a techno-economic system in which consumers are seen as instrumentalized means. Moezzi and Janda problematize the assumption here that energy consumption is an individualized practice and criticize policy planners for reproducing this narrow view.

Obviously, this critique is also relevant in relation to the Smart Grid Strategy, which frames the flexibility of consumers' individualized energy use as a potential and unused resource for the system. As we have shown, the Smart Grid Strategy is indeed dominated by a techno-economic imaginary. Thus, it is unable to see the emergence of new concerns and modes of engagement. This also partly explains the limited role it delegates to social science. The expertise of social researchers is located downstream the innovation process, envisioned as an instrument to make people fit with technology [28]. Taking the homogeneous composition of expertise in the Smart Grid Network into consideration these findings are perhaps not very surprising. What is surprising, however, is that the

[12] The settlement for selling solar electricity to the grid changed in November 2012. Before that the price was settled on a yearly basis; now it is settled hourly. People who installed panels before the change can, however, keep the settlement scheme for another 20 years. These people will have free electricity if, on a yearly basis, they produce as many kWh as they consume. With the new billing scheme producers do not get as high a price for selling during sunny days.

[13] The lucrative settlement on solar electricity (see note above) has led to less energy-tax income for the state. With the change of prize settlement the installment of solar panels went into steep decline.

'Bornholm' and 'Solar panels' stories do not speak in favor of such economic and technical approaches at all. Instead they bear striking resemblance with what Moezzi and Janda call stories of "social potential":

> we argue for a concept of social potential that provides scope for action that moves beyond individual purchase decisions and conservation actions in the home. [...] social potential gives more prominence to the social nature of energy use, and to the creative abilities of people to participate in change in ways that fits their own contexts and concerns. [It] taps into the creativity of people and social desires rather that projections of what people should want or be motivated by. In this view, people and groups become valuable and definable assets, rather than instruments of policy or causes of energy use problems [28].

As a concept, social potential focuses on how engagement exists and may emerge in social settings such as communities, and in projects where people gather around shared concerns and issues. Unlike 'practice theory', which is concerned with what people do in their domestic everyday-life, social potential is concerned with a broader environment of engagement and it is "more future-oriented" [28]. An interest in social potential requires not only asking how people are engaged today and to mode design norms based on the present. It also entails looking to "expand upon what people might do in the future" [28]. The two stories exhibit social potential as they display social issues, identity-creation and community building.

We would nevertheless argue that there it may be risky to relegate these stories to the domain of the exclusively 'social.' Doing so we tell only half the story [38]. Indeed, several decades of STS scholarship have questioned the divide between 'the social' and 'the technical' [59,61–63]. In *Reassembling the Social* [62], for example, Latour defines the social as "collective" made up of complex networks of technical and material objects, institutions, laws, politics, values, economics, humans, and organizations. Drawing on Latour Noortje Marres shows how technologies are important for the emergence of new engagement and creation of "environmental participation" [59]. How people participate in change is interwoven with a socio-technical reconfiguration of the their physical, political and social environments. This line of thinking, then, urges us to consider smart grid development as a process of assembling socio-technical energy collectives with the potential of new, emerging socio-technical "relations of relevance" [59].

The two stories suggest that technologies such as solar panels can partake in making new concerns and social practices transpire, and that demonstration projects may benefit from tapping into existing concerns, such as community-building. Through the project and the technologies being implemented in its wake (more windmills and energy and environmental monitoring) the project may lead to new, emerging concerns like 'being green'.

Being sympathetic to the overall aim of this journal's endeavoring to foreground the social as the long excluded dimension of technological development, we highlight the risk of overemphasizing 'the social'. We argue for staying tuned to the social and the technical and to the complex ways in which they are implicated in one another. Doing so implies not to take the divide between the social and the technological as given in the order of things [62].[14] It is rather a political and thus renegotiable matter configured by disciplinary divisions of labor and authority. It is people with such expertise that we argue to bring into energy research and policy planning, without proclaiming to know exactly where such experiments with multidisciplinary involvement in strategy making may take us.

8. Conclusion: policy planning and science and technology studies

What have we learned analyzing the Smart Grid Network including its infra-reflexivity and internal differences? First and foremost, we have detected a more flexible figuration of the consumer figure—maybe even more flexible than recognized by our informants. The user they bring to life is someone who *is* able to change and get engaged, and who is not solely motivated by financial gain. Furthermore, in the stories they tell the social and the technical is flexibly conceptualized as something we might call an 'energy collective.'

In line with the aim of this special issue, we have explored a particular way in which social studies of energy may engage with smart grid planning. Many have already argued for adapting interdisciplinary approaches and for involving social science and humanities research more in strategy and planning [28,33,58,64]. Our study suggests, however, in addition, that interdisciplinary sensibilities are already present, even within the techno-dominated Smart Grid Network; we have highlighted that important modes of critique and reflexivity already traverse the empirical field.

If smart grid developers already have (and are) their own sources of critique, reflexivity, and interdisciplinarity, this raises questions concerning which roles social research may play [65]. Yet, it is important to stress here that the interdisciplinarity and infra-reflexivity we have teased out is not recognized as such by our informants; they saw their work as limited by a narrow, technical framework and they called for a unspecified social science to solve the particular conundrum of how to engage the consumer. The mode of social inquiry we argue to bring into policy planning and smart grid development is not only a distinctive expertise in 'humans', 'users', or 'the social'. Our argument is *also* to include research sensitivities towards the complex entanglements and generative fluidity of social, technical, political and organizational issues and approaches. As this paper exemplifies this is exactly what allows one to see critique and reflection in the field as generative opening and alternative imagination rather than, for example, self-contradictions and inconsistencies (see e.g., Refs. [21,22]).

How would it have affected the Smart Grid Network to envision infrastructures as a matter of constructing socio-technical energy collectivities? There is no guarantee that this would have changed anything. However, what we witness today is a somewhat limiting division of labor between experts dealing with the technical, while the social is left (often in the form of work packages in research projects) for 'social scientists' to take care of later. Social research, on the other hand, often argues for taking point of departure in the social. We suggest including a more experimental and less preconceived notion of what belongs where and which topics belong to whom. As mentioned the inclusion of socio-technical research which we so advocate does not in any way replace or even diminish the crucial importance of user studies, practice theory or regnant forms of technological expertise; it should rather be seen, we suggest, as a warranted addition.

[14] Our approach is very much in line with the kind of approach that Benjamin Sovacool, in his article launching the ERSS journal, suggests as a promising potential for studying energy.

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Paper 4: Making Energy Infrastructure: Tactical Oscillations and Cosmopolitics

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Making Energy Infrastructure: Tactical Oscillations and Cosmopolitics

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ABSTRACT *Integrating renewable energy sources into the power grid and ensuring public interest in energy is a key concern in many countries. What role may art play, and what political strategies do artists employ, in order to intervene in the infrastructuring of energy and public environments? As the case study here, a Copenhagen art and energy competition invited artists and designers from around the world to submit ideas for large-scale public artworks that can generate utility-scale renewable energy. The competition process had a smooth and consensus-seeking political strategy, manifested in a set of tactical oscillations. In order to engage with local stakeholders and ensure the success of the competition, the project managers oscillated between presenting the competition as part of existing policy initiatives and as posing alternatives to existing policy. They oscillated between being situated in a pragmatic present and in an unprecedented future; between being tied to the specific site of the competition and belonging to no place in particular; and not least between being predominantly an art project and primarily an infrastructure project. Remarkable differences between cosmopolitics and smooth politics appear here, especially compared to the literature analysing the roles played by art and design when imagining new ways of living with energy. Oscillation between smooth politics and cosmopolitics may provide a generative way forward for actors wishing to engage in the infrastructuring of environments.*

KEYWORDS: art, energy, infrastructure development, imagination, cosmopolitics

Introduction

Policy planners, engineers, and infrastructure developers in Denmark—and elsewhere—currently work to find alternatives to the existing energy system. The

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Danish energy and climate vision of becoming 100% powered by renewable energy in 2050 raises challenges around how to engage people in living differently with energy in a low-carbon future. As is described in the Guest Introduction to this special issue, infrastructures are often "seen as the *underlying basis* on top of, or through which, a society or an organization operate". The current electricity infrastructure does indeed (mostly) operate as an invisible woodwork of society, which does not demand much awareness or engagement from everyday consumers or the general public (Bowker, 1995; Bowker and Star, 2000; Edwards, 2003).

However, the transition to renewable energy re-infrastructures environments in ways that make energy more visible and demand and/or generate/induce new types of public engagement and participation (Cotton and Devine-Wright, 2010; Hargreaves *et al*., 2010; Schick, 2015). As wind turbines reshape landscapes, they often give rise to new, emerging publics—often in the shape of "protesting neighbors" (Walker and Cass, 2007; Batel and Devine-Wright, 2014; Chilvers and Pallett, 2015). New visions for smart grids, flexible energy consumption, and intelligent houses are re-infrastructuring home environments in ways which will presumably change the way we will consume energy in the future (Nyborg and Røpke, 2013; Strengers, 2013; Schick and Gad, 2015).

How to re-design current energy infrastructures is a highly contested issue among energy companies, engineers, IT providers and politicians. How to design processes for alternative energy futures? What types or degrees of alterity can enter into the discussions about the future? Elsewhere, we have shown how dealing with such issue happens in a space that is partly imaginative and partly limited by restrictions in the current energy system and the way it is institutionally and materially organized. It matters which actors participate in the process of re-infrastructuring environments (Schick and Winthereik, 2013).

In this article, we address the issue from the viewpoint of art and design; we analyse an attempt to create new imaginaries around energy and infrastructural design. Our central question is: What role may art play, and what political strategies do artists employ, in order to intervene in the infrastructuring of energy and public environments? We describe how art and design are introduced into a space where the infrastructures for energy production and distribution of the future are debated. We show how making headway in this crowded and contested space is not an easy task.

Analysing the implementation of a large, international ideas competition in Denmark, we explore how this competition both intervenes and fails to intervene in existing politics and publics around energy. We explore and discuss which specific political strategies this particular art project exercises in order to gain a foothold and ensure ascendancy among local actors. As we intend to show, art is more than an *addendum* to existing orientations of how to design a sustainable energy future. Instead, art and design potentially interfere with dominant expectations as to what the future will look like and thereby offers the possibility of imagining new worlds.

To give a bit of empirical background, Land Art Generator Initiative (LAGI) is a biannual competition that, since 2010, has invited artists, designers, engineers, architects, and others to submit ideas for "large-scale, site-specific, public artworks" with "the ability to harness energy cleanly from nature and convert it into electricity for the utility grid" (LAGI, 2014a). As indicated by the slogan "Renewable Energy Can Be Beautiful", LAGI seeks to demonstrate that energy infrastructures can be visible, attractive, and engaging. LAGI proposes to let energy production move into urban areas where people can appreciate energy and green transitions in new ways. In 2010, the competition took place in Dubai and Abu Dhabi. In 2012, it was based in New York. In 2016 it will be situated in Los Angeles. This paper focuses on LAGI 2014, held in Copenhagen.

More specifically, the analysis centres on the implementation of the competition and identifies of a set of tactics and political strategies deployed by the project team to mobilize public and political actors. In particular, we draw attention to several forms of *tactical oscillation* deployed by the project in order to gain support, procure funding, and create visibility for its ideas. By tactical oscillations, we refer to modes of performing the qualities and characteristics of LAGI 2014, which repeatedly changed depending on circumstances and audiences. We show how the project oscillated between presenting itself as part of existing policy initiatives and as posing alternatives to them; between being situated in a pragmatic present and in an unprecedented future; between being tied to the specific site of the competition and belonging to no place in particular; and not least between being predominantly an art project and primarily an infrastructure project.

Recognizing these oscillations, we suggest, is crucial in order to come to terms with the often invisible and highly political work that goes into practices of infrastructuring environments. Taking seriously oscillations as a political strategy elicits particular modes of performing alternatives to the current energy system that seek impact without being in any way controversial. We describe the oscillating tactics as a smooth and consensus-seeking political strategy. We end the article by discussing how the politics and strategies for intervention of this specific case differ from other art projects.

What is offered through this analysis is a conceptualization of the potential role played by art and design in opening up the public and political imagination around energy infrastructures. We begin with a short review of existing literature concerned with the role of art and design in relation to environmental issues and infrastructure transitions.

Analytical framework: art and infrastructures

How to turn energy infrastructures into issues around which the public can gather and new politics emerge? This question has caught the interest of social scientists who explore the role of art and design in the process of publicizing infrastructures. Adaptation practices is a term generally used to cover artworks which, like LAGI,

use architecture, design, and engineering to propose alternative ways of living with climate change (Yusoff and Gabrys, 2011). Of particular interest for the present paper are designs that focus on visualizing and problematizing energy.[1] These kinds of experiments have recently inspired STS researchers to explore the relationship between infrastructure, arts, and politics. Shared among this emerging literature is the notion that artworks and creative practices can help social scientists articulate and analyse complex issues related to energy infrastructures. Due to their capacity to articulate and problematize the effects of modern lifestyles and modes of consumption, artworks are thus relevant for environmental politics.

A number of recent contributions are particularly relevant for the present paper. In her analysis of the implementation of the artwork Nuage Vert (2008/2009 by the artist duo HeHe), sociologist Noortje Marres (2013) views the art project as an apparatus for studying society, energy, and environmental politics.[2] She argues that Nuage Vert makes visible "a particular set of controversial entanglements" and thereby "enables the explication of concerns and controversies beyond what is already observable in relevant settings" (2013, p. 6). As Marres has argued elsewhere (2012), when issues and controversies are visualized and materialized, they may become issues of concern to publics emerging around them. Thus, explicating controversies and issues artworks may facilitate new forms of participation and intervention or, said differently, may be generative of new modes of environmental politics.

In their recent paper *Technifying Public Space and Publicizing Infrastructures* (2013), cultural sociologist Fernando Domínguez Rubio and architect Uriel Fogué argue that designers and architects should help making otherwise invisible infrastructures aesthetically present in public space. Analysing an installation proposal for a public square in Spain—a proposal resembling the site-specific public artworks generated through LAGI—the authors argue that exhibiting infrastructures and their workings can generate new relations to energy and environmental issues. They further argue that it is important to design infrastructures in ways that convey the political issues and controversies embedded in them. This can, they argue, "open up the possibility of new forms of civic participation and engagement" (Domínguez Rubio and Fogué, 2013, p. 1035). Inspired by science philosopher Bruno Latour—and much in line with Noortje Marres' argument—Domínguez Rubio and Fogué see such efforts to imagine and redesign public spaces as ways of making energy infrastructures into public and political "matters of concern" (Latour, 2004; Domínguez Rubio and Fogué, 2013).

Jennifer Gabrys (2014) is equally concerned with the politics that artists working with energy may enable. Analysing three artworks (including Nuage Vert), she argues that art may help articulate new modes of environmental citizenship and what she terms "a cosmopolitics of energy". Drawing on the Belgian philosopher of science Isabelle Stengers' notion of "cosmopolitics" as an approach for "slowing down reasoning" (2005, 2010), Gabrys argues that artworks have the capacity to operate as "hesitating practices". Questioning dominant visions

for "what must be done", Gabrys argues, that artworks create a space for hesitation that might help the social scientist as well as other scientists and people in general to engage with energy matters in more speculative registers. In doing so, they create new arrangements of environmental practice and participation, which might, she argues, pave the way for a "cosmopolitics of energy".

The basic cosmopolitical tenet is that we do not yet know of what the world consists. This entails the obligation to remain open to its emergent or unexpected dimensions. More than anything, this entails giving up on conventional certainties about the right way to proceed, for example, when designing for alternative ways of producing and consuming energy (for other uses of cosmopolitics in the intersection of art, design, and energy, see also Bergström *et al*., 2009; Michael and Gaver, 2009; Michael, 2012). Instead, cosmopolitics is about bringing to light hidden voices, forgotten actors, or different modes of seeing and feeling. Just as important, however, is the obligation to present such unrecognized modes of being *in full force*—that is, as invested with the capacity to transform strongly held convictions and forms of action, rather than as minor curiosities that might be ignored once technical or economic elements are brought into play (Jensen, 2011; Stengers, 2011).

Implicitly in the "cosmopolitical proposal" lies a normative commitment to question and seek alternatives to hegemonic and naturalized knowledge and politics. Whereas this normative stand is certainly present in Stengers' philosophy, it is translated by social scientists to be applied in a much more practical sense in relation to art and more speculative registers of design (see e.g. Mazé and Redström, 2008; Latour, 2011; Michael, 2012; Gabrys, 2014). For example, in a recent *Science as Culture* paper, Gabrys and Yusoff engage with Stengers' philosophy; they argue that art may "create an opportunity to arouse a slightly different awareness of the problems and situations mobilizing us" (Stengers, 2005, p. 994, in Gabrys and Yusoff, 2012, p. 2). Therefore, art can give "tangible form to the imagination of different worlds outside of the constraints of the given present" (Yusoff and Gabrys, 2011, p. 3).

The founding co-directors of LAGI were explicit that their art project challenges how energy production can happen, and they propose new ways of living with and recognizing energy in urban settings. In order to convey the artistic character of LAGI, the directors categorize their project as "art as social practice" (Personal Communication, 1 December 2014). In general terms, socially engaged art refers to art that actively intervenes in the world outside the art institutions and aims to work as agents for social and political change (Bishop, 2012; Schwarzbart and Samson, 2014). LAGI, too, aimed to engage the general public in issues concerning renewable energy. Indeed, the directors hoped that it would "truly affect public opinion that could in turn influence public policy" (Monoian and Ferry, 2012).

In the following, we explore how the LAGI 2014 project sought to make an alternative vision of the future come to life. We describe what came out of it, and relating to the literature above we will discuss cosmopolitical potentials

and limitations of the project in relation to its political and public impact. This concern necessarily takes us beyond an interest in how LAGI framed its own concerns, for the project also needed to take into account the concerns of numerous other actors, including policy-makers and urban developers. In the main part of the paper, we offer detailed examination of this process by eliciting the oscillating tactics, as described above.

Methodological considerations

Our involvement with LAGI 2014 has gone considerably beyond classical ethnographic engagement, where social life is being studied through participation in and observations of work and everyday life (O'Reilly, 2011, p. 3). Indeed, as described in the following section, first author brought the competition to Copenhagen and took on the role as local project manager during nine months in 2013 to 2014. LAGI 2014 was hosted by the IT University of Copenhagen as part of the strategic research area energy futures, in which both authors take part.

Project management entailed close collaboration with the LAGI directors and relied on assistance from a number of other research institutions.[3] For this reason the material presented is to a significant extent auto-ethnographic. The empirical material on which the paper draws consists of notes from meetings, emails, phone conversations, and documents, all of which were compiled over the roughly one-year period during which the project was planned and implemented. In addition, the analysis draws on material from earlier competitions, on personal impressions from the exhibition, and on media coverage.

The fact that an insider collected these materials raises obvious methodological questions. For one thing, the conventional and useful ethnographic tool of estrangement was not available during the time of the project. Rather, the process of achieving adequate distance from project realities had to happen by working through the empirical material with friends, colleagues, and supervisors upon return to the PhD position. Aside from this temporal process, first author attempted to strategically detach from the project in its final phase, in order to maintain a reflexive perspective (for strategic detachment from a project see, Zuiderent, 2002; Zuiderent-Jerak and Jensen, 2007). Conversations with fellow researchers were important in this regard, as was the participation in a public debate event,[4] and the contextualizing work of organizing an academic symposium.[5] In both of these events, LAGI figured as one of several ways in which alternative energy futures might be represented through art.

What is the LAGI?

> Imagine yourself walking in a large park at the edge of the city. In the distance, an object appears to rise organically from the landscape. Its armatures and folds relate to the composition of the setting. Looking closer, the large

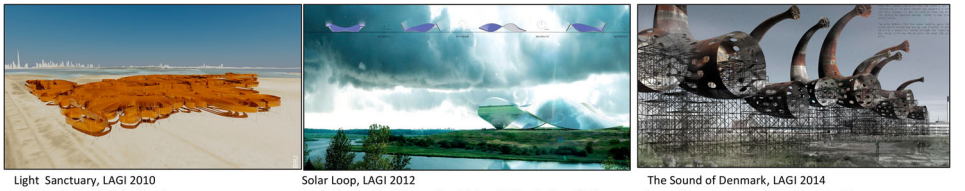
> object makes you think of the complexity of patterns that exist in the natural world while at the same time it inspires an awe of human invention and ingenuity. The geometries of the sculptural elements seem to respond to the sun and the wind. When you reach the observation platform the vision comes into perfect form, like a painting in a frame. As you watch the way that it reacts to the forces of nature, you think about the interconnectedness of human activity with the earth and the delicacy of our shared ecosystem. You are surprised to learn that the beautiful object that has so captured your attention is also a power plant harnessing the energy of nature in the creation of carbon-free megawatt-hours that are at that very moment providing electricity to thousands of nearby homes. You stay for a while listening to the energy conservation discussion that is going on there that day, stealing glances toward the artwork as it moves to follow the sun. (Koh, Monoian and Ferry, 2012)

This excerpt is taken from the catalogue of the first LAGI competition. The reader is guided into a future landscape where clean energy is produced by large art sculptures "beautifully and seamlessly integrated into the fabric of our biotic and cultural ecosystems" (Koh, Monoian and Ferry, 2012).

LAGI was founded in 2008 by the artist Elizabeth Monoian and the architect Robert Ferry. Initiating the project, Monoian and Ferry wanted to combine their expertise in a "solution-based art project", which could contribute to the transition to a more sustainable future (Monoian and Ferry, n.d.). Inspired by Land Art, an art tradition emerging in the 1960s that centred on making gigantic site-specific designs out of nature, they decided to add modern technology into the mix. Doing so, they envisioned a form of ecological Land Art with the added function of producing clean energy (Ferry, ITU presentation 2014). Aiming for global impact, the directors further decided that:

> the best way to approach this was not just the two of us sitting down and designing one public artwork that generated utility-scale energy, but to put this out as a call internationally, bringing the minds of creative individuals, engineers, scientists etc. together and have a really huge collective idea of what this could mean. (Monoian and Ferry, 2014c)

So far LAGI has been successful in attracting participants. The first three competitions—in Dubai/Abu Dhabi 2010, NYC 2012, and Copenhagen 2014—together have generated more than 700 submissions from over 50 different countries. Among the submissions are sculptures like *Light Sanctuary* (2010), a gigantic labyrinth made out of organic photovoltaic cells, generating energy for around 1,000 households. Or *Solar Loop* (2012), a large mirror-plated Möbius strip, which reflects its surroundings, functions as an outdoor concert hall and produces solar energy for approximately 2,000 households. Or *Sound of Denmark* (2014), a



Light Sanctuary, LAGI 2010
Martina Decker & Peter Yeadon

Solar Loop, LAGI 2012
Paolo Venturella, Alessandro Balducci, Gilberto Bonelli, Rocco Valantines, Mario Emanuele Salini, Pietro Bodria

The Sound of Denmark, LAGI 2014
Laura Mesa Arango & Rafael Sanchez Herrera

Figure 1. Pictures from LAGI 2010, 2012, and 2014.

design in which huge Viking horns integrated with wind turbines simultaneously produces clean energy and urban soundscapes (Figure 1).

Upon receiving submissions, an international and interdisciplinary jury evaluates the ideas and elects a winner, who gets a monetary prize of $15,000. The short-listed selection of ideas is exhibited to the public,[6] while a larger selection is published in a coffee table book along with essays on art and energy (Koh, Monoian and Ferry, 2012; Klein *et al.*, 2013; Monoian and Ferry, 2014a). Finally, all submissions are publically available in an online portfolio.[7] The LAGI directors hope that the project will lead to construction of some of the designs, but the competition centres on ideas and whatever happens subsequently is a different matter. Until this point no actual sculptures have been made.[8]

In some sense, the very form of LAGI—a competition—makes it untraditional as an art project. To be sure, it bears resemblance to conventional architecture and art competitions. In contrast with such competitions, however, LAGI's purpose is neither to find a winner nor to construct the proposed design. Instead, Robert Ferry insists that "the power of the competition model is that it allows people to be playful, innovative and creative without the binds of a specific client" (Monoian and Ferry, 2014c).

For a design proposal to be strong, it needs to contain the idea for a sculpture that is aesthetically interesting, conceptually challenging while also using technology innovatively. Moreover, the proposal should synthesize the demands of imaginative art and a functioning power plant. Thus, the design should be capable of producing a fair amount of energy with a reasonable return on investment (LAGI, 2014b). Located somewhere between art and renewable energy innovation, LAGI is thus a hybrid project.

Entering Copenhagen

In Denmark, the Nature Agency, operating under the Ministry of Environment, holds responsibility for the location of onshore wind turbines. An important dimension of its work is to facilitate dialogue and ensure the support of local populations neighbouring new wind turbines.[9] This work provides a way of dealing with the so-called NIMBY (Not In My BackYard) problem (Batel and Devine-Wright, 2014; Walker *et al.*, 2010).

In spite of a general support of renewable energy in Denmark, the process of finding locations for the increasing amount of large wind turbines is often turbulent. In 2012, the Nature Agency thus began imagining different approaches. Among other things, they envisioned a project in which a famous Danish artist would decorate the turbines to ensure that the turbines were aesthetically appealing (Personal Meeting, Nature Agency, April 2013).[10]

Already familiar with LAGI, first author contacted the Nature Agency who immediately took interest in the idea of inviting the directors to Denmark. In October 2012, an initial workshop was held with LAGI and the Nature Agency. The workshop led to first author's assignation as project manager and to the Minister of Environment taking on the role as the ambassador of LAGI 2014.

Despite its small size (three full-time employees), LAGI 2014 proved very successful in mobilizing support from politicians and key decision-makers in Denmark. Besides the Minister of Environment, also the Minister of Energy, Climate and Building participated in the project writing a text for the Design Guidelines (LAGI, 2014b, p. 3). The jury included the Head of the Danish Energy Association, the City Architect, a major, and the European Commissioner for Climate Action, Connie Hedegaard, who furthermore opened the final exhibition with the following words:

> In order to address this [global warming and a rising number of people on the planet demanding a good life] we really have to think across the traditional silos. We have to find crosscutting solutions. That is always extremely difficult—be it in a municipality, in a government, in an administration, in a business—to think across different silos is one of the most challenging things. (Hedegaard, 2014)

In her speech, the Commissioner praised LAGI for innovatively thinking and acting across arts, culture, and public involvement on the one hand and engineering and environmental infrastructure planning on the other. Indeed, the project's hybrid character as both art and infrastructure innovation proved to be the key in mobilizing support. The main sponsor of LAGI 2014, Capital Region, a publicly owned administrative organization covering 29 municipalities including Copenhagen, was enthusiastic about funding LAGI 2014 because they saw the project as providing a welcomed opportunity to traverse two separated focus areas in the organization.

As in most public administrations, the area of culture and arts is, in the Capital Region, handled by one department, while issues concerning climate, energy, environment, and infrastructure planning are located elsewhere. At the first meeting between the LAGI 2014 team and Capital Region, it was made clear that the latter had long discussed the need for projects that would more closely connect climate issues and environmental initiatives with issues pertaining to public involvement, culture, and arts.

Seeing in LAGI 2014 an opportunity to challenge its own funding structures, Capital Region intended to fund the project from two sources: the environment funds and the event funds. Capital Region also made explicit that effecting such joint funding would likely be quite challenging (meeting, Capital Region, June 2013). The innovative ambition to develop co-funding scheme did indeed founded on practical difficulties and eventually the project was exclusively funded by the department of culture.

The process of bringing LAGI to Denmark made explicit a hitherto unarticulated interest in projects that could act across silos, bring together conventional disciplines, and make the public interested and engaged in environmental infrastructures.

Established practices and innovative intervention

Riding on the back of this initial success in opening the doors to the Capital Region, the LAGI project team asked Martin Lidegaard, the former Minister of Climate, Energy and Building, to write a text for the Design Guidelines. In the text, Lidegaard offers his praise to the innovative way in which the project approached the complex matter of a green societal transition. Lidegaard emphasized the importance of "challenging conventions" and "thinking outside of the box". However, it showed to be equally important to not challenge certain conventions and to settle within certain boxes. This makes a case for LAGI's oscillatory movements in and outside the established sentiments of what counted as important in Danish environmental politics.

At the initial workshop with the Nature Agency in 2012, as well as subsequently, materials (books, webpage, and powerpoint presentations) from the competitions of previous years worked amazingly well to attract interest from decision-makers. These materials presented spectacular and quite alien, artistic sculptures from apparently distant futures (and far-away places like Dubai and New York). Even so, they held apparent appeal. A few months later, when the Nature Agency arranged a workshop aiming to rethink renewable energy with the assistance of the "creative disciplines", it used pictures from previous LAGI competitions as inspiration material (workshop at Danish Architecture Centre, April 2013).

Though the Nature Agency shared an interest in the relation between art and renewable energy, the collaboration with them depended upon the LAGI 2014 team connecting and weaving the objectives of LAGI 2014 closely together with the Agency's existing policy work and established practices. As project manager first author was asked to read through existing strategy documents and sketch out how LAGI 2014 would support these strategies. Besides being an innovative art project providing alternative ideas for future energy production, LAGI 2014 also had to define itself as part of and as addition to the policy practices. As this process of alignment suggests, LAGI 2014 was never just an art project. As far

as the Nature Agency was concerned, it related directly to questions of how to plan, design, implement, and manage future energy infrastructures in Danish environments.

For LAGI, however, this hybridity was not objectionable. After all, the criteria for successful design proposals went beyond an interest in beautiful sculptures, demanding details about the kind of renewable energy technology used, the amount of electricity to be produced, and estimations of returns on investment. Further, LAGI proposals also included descriptions of the utilization of public involvement and the creation of recreational areas, and formulation of an environmental assesment. Since these multiple practical requirements were already part of LAGI's script (Akrich, 1992), it was neither inherently problematic nor overly difficult to demonstrate that the project shared plans and visions with the Nature Agency.

Moreover, the LAGI directors were very careful not to perform the project as challenging in any sense that could be interpreted as *oppositional* to the exiting Danish politics. During a presentation, for example, first author suggested that LAGI 2014 would involve the public in a better way than the regular citizen involvement initiatives proposed by the Nature Agency. At this point, she was corrected by the directors, who pointed out that there was no need to present LAGI 2014 as an opposition to other ongoing initiatives rather the project should instead be presented as an addition to the existing approaches. Making LAGI 2014 come to life in Denmark thus became a matter of staying friends with everybody; of performing the project as part of unfolding activities, though still offering its own creative twist.

Yet, the fact that LAGI was envisioned as a combination of art and infrastructure innovation from the get-go eased this obligation. The hybridity of the project made it possible to oscillate between the modes of existence adequate to art on the one hand and policy-making around infrastructure development on the other hand without turning their contrasts into confrontations. Politicians and decision-makers could be mobilized, that is, because of LAGI's in-built flexibility, which allowed it to perform at once as an innocuous addition and as an innovative alternative to existing frameworks for infrastructuring environments.

Oscillations in time and space

In order to make site-specific land art one needs a piece of land to design for and build on. After the desert of Dubai/Abu Dhabi and the old landfill at Staten Island, NYC, next stop for LAGI was Refshaleøen, an abandoned shipyard at the centre of Copenhagen. Refshaleøen is located just across the harbour from where the most famous tourist magnet of the city, the statue of the Little Mermaid, sits. The fact that the island is the backdrop to Denmark's number one tourist attraction combined with the interesting story of the old shipyard itself generated what the LAGI founders called a "site with a wow-effect" (Elizabeth Monoian, Meeting

Cover page of Design Guidelines LAGI2014 Refshaleøen in Design Guidelines LAGI2014

Figure 2. Cover of design guidelines and pictures of Refshaleøen.

at Refshaleøen Holding, May 2013). It was a place which would be interesting for the participants of the competition to design for (Figure 2).

Aside from its geographical appeal, however, Refshaleøen also appeared to be perfectly placed in another way, as it seemed to be situated right in-between the past, the present, and the future. The LAGI 2014 Design Guidelines described the island in the following way:

> Refshaleøen is a manmade island in Copenhagen's harbour, which until 1996 housed the shipyard Burmeister & Wain. At its height, the shipyard employed 8,000 people—an icon of Danish industrial history. . . . Today the many shipyard workers have been replaced with a mixture of creative entrepreneurships, small crafts facilities, flea markets, warehouses, and cultural and recreational venues. (LAGI, 2014b, Design Guidelines, p. 5)

After the shipyard closed in 1996, ownership was transferred to four pension funds that hoped to turn the island into an integral residential and commercial part of the city. This has yet to be approved by Copenhagen Municipality, who decides which parts of the city can be developed and when. Due to many other development projects and due to lacking infrastructure, Refshaleøen is defined as a "prospective area" where no permanent construction can be built before 2023 when the

municipality will again consider the destiny of the area (Copenhagen Municipality, 2014).

During this period, the administrative company Refshaleøen Holding has been employed by the pension funds to take care of the premises and to create positive attention around the island. The strategy was and still is to attract creative people and host events that will make visible the island as a living cultural centre in the minds of Copenhageners and their politicians. Another part of the strategy is to make Refshaleøen CO_2 neutral by 2020, five years earlier than the goal of Copenhagen city (Copenhagen Municipality, 2014).

Offering pictures and descriptions of Refshaleøen, the design guidelines asked for submission of ideas: "well informed by a thorough understanding of the history, geography, details of the design site, and the broader contexts of Refshaleøen, Copenhagen, and Denmark" (LAGI, 2014b). Out of the 300 ideas eventually submitted, many were inspired by Danish maritime culture and by the transition from an industrial and polluted past to a green, clean future. As well, amidst other of Hans Christian Andersen's fairytale figures, the Little Mermaid made an appearance in many sculptures. Various proposals also translated Danish Viking history and the popular biking culture into renewable energy (Figure 3).

Displaying images of futuristic, energy-generating sculptures, manipulated into (pictures of) Refshaleøen, LAGI 2014 participated in the enactment of an appealing future for the island. In turn, this provided assistance to the efforts Refshaleøen Holding puts into making sure that the future politicians will not dispel such an attractive future. At one meeting, a representative from Refshaleøen Holding expressed how Refshaleøen was situated in time:

> If you place it at Islands Brygge [an already very hip area in the centre of Copenhagen] you place it in the present, if you place it at Refshaleøen, you place it in the future. (Meeting at Refshaleøen, August 2013)

According to this description, Refshaleøen resides in the future. But this future does not simply reside in the future, for obviously it is enacted *now* (Adam and Groves, 2007). Yet, it is also tied, via the emphasis on Danish history in general, and the history of the island specifically, to the past. Refshaleøen thus

The By-Cycle
By: Kenneth Ip & Joey Yim

Energy Duck
By: Hareth Pochee, Adam Khan, Louis Leger, and Patrick Fryer

Windshape
By: Manon Robert, Martin Le Carboulec, and Marc Antoine Galup

The Mermaid's Forest
By: Javier Fernandez Ponce

Figure 3. Pictures of four LAGI 2014 submissions.

appears as something of a temporal black hole in which the past, present, and future oscillate and coexist.

Here we find a curious analogy, for something very similar might be said about LAGI 2014. Obviously, as an ideas competition, the project excelled at imagining futures. Many of these envisioned futures were rather different from the city spaces and forms of energy generation of the present.

Yet, the LAGI directors constantly emphasized the possibility that the sculptures might be constructed in the very near future. Certainly they would *like* the designs to actualize, which is why the design criteria urged submissions to "be pragmatic and constructible and employ technology that can be scalable and tested" (LAGI, 2014b, Design Guidelines, p. 7). The outcomes were thus meant to be ideas that creatively conflate the distant future with the (almost) doable now. Not only time but also spaces were conflated in the process of implementing LAGI 2014 in Denmark.

The outcomes of LAGI 2014 were ideas for site-specific artworks made specifically for Refshaleøen. Yet, though the LAGI founders were very particular about its site-specific character, they also tended to link the particularities of location to abstract space—an everywhere. "The 2014 site at Refshaleøen is an industrial brownfield site. Its history is unique, but every city has a site similar to this" (Monoian and Ferry, 2014b).

Connecting Refshaleøen to other brownfield sites in cities around the world, the LAGI directors suggested that sculptures designed for Refshaleøen could potentially be built everywhere. In this way, they wrote the project site into a global trend, where post-industrial areas are repurposed as modern residential living spaces. Often such urban renewal projects strive to convert a polluted, industrial past into a green and clean sustainable future (see i.e. Blok, 2013; Braae, 2015).

Within this narrative, Refshaleøen played a double role. It functioned as the specific site for design while also offering a display window for sculptures that might be modified, rescaled, and built "anywhere". Indeed, the directors hoped that the books and online portfolio of submissions would function as both catalogues and catalysts for site-owners around the world interested in building a Land Art Generator. And this does indeed seem to be happening, at least on a small scale. Thus, one of the 2010 Abu Dhabi/Dubai submissions is currently being redesigned to fit to a city square in Pittsburgh, USA.

Making LAGI 2014 into a both site-specific and a multiple-sited project also came to be necessary in a Danish context. In order to gain the necessary financial support LAGI 2014 had to stretch beyond the capital. This related to the fact that the main sponsor, Capital Region, comprises not only the city of Copenhagen but also 29 other municipalities; a situation that made it politically difficult to sponsor a project that might be seen to cater exclusively to people in the city centre. Living up to the demands of the region thus obliged the project to show that it was *not* site specific, but instead regional. In practical terms, this problem was solved making partnerships with two other municipalities within the Capital Region. For these

partnerships, the project used local sites—an old gravel pit and a piece of land stretching along a main road—as secondary sites for the competition.[11] In addition to the main competition, participants were thus invited to submit modifications of their designs, showing how they would fit these secondary sites. Additionally a smaller prize was given to the best of these modified designs.

Similar to the movements between established practices and innovative intervention described in the previous section, LAGI 2014's hybrid character furthermore allowed it to be performed in a smooth choreography of time and space. Without necessary contradiction, the project managed to inhabit both present and future and to reside both specifically on Refshaleøen and simultaneously in many other places around Denmark and globally. In doing so, the project tactically mobilized the necessary support and thus came into being.

Ending the analytical section we will show how LAGI 2014 furthermore managed to oscillate between different agendas and thus created a space where somewhat conflicting agendas could temporarily coexist. As will be described in the following, this was an effect of LAGI 2014 having to fit into a landscape already inhabited by actors with conflicting concerns and agendas.

Oscillating agendas

The project's ability to support multiple and sometimes conflicting agendas became particularly visible in its collaboration with the Refshaleøen Holding. At a meeting, our contact person made clear their incentive for hosting the competition:

> Partnering with LAGI is not only a matter of supporting a green and creative project. At the end of the day, it is a pragmatic and economic matter of raising the value of the property. (Employee at Refshaleøen Holding, meeting, May 2013)

Refshaleøen Holding thus saw LAGI 2014 as a generative instrument for ensuring future support for city development. They hoped that LAGI 2014 would generate a lot of positive media attention, just as LAGI 2014's support from key decision-makers such as the City Architect was undoubtedly of importance to Refshaleøen Holding. Often described as "gentrification", the strategy of using artists and the so-called creative class as temporary instruments for turning run-down urban areas into prosperous and trendy city parts has been criticized in Copenhagen (Christensen, 2015) and around the world (Florida, 2004; Oswalt *et al*., 2013). Indeed, this strategy was widely discussed by the artists working at Refshaleøen, who were worried that their own creative practices at Refshaleøen as well as the LAGI 2014 project would eventually lead to city development making the area too expensive for them to live in. For the artists as well as for one of the LAGI

2014 collaborators, a city planner from the Copenhagen Municipality, the hopes were that Refshaleøen could remain an artistic and unpolished space in-between. At a meeting in the Copenhagen Municipality, the city planner, who was responsible for the development at Refshaleøen, explained that he was in support of LAGI 2014 exactly for the opposite reason than Refshaleøen Holding. He saw LAGI 2014 as an opportunity to construct a sculpture that could help turn the place into an inspirational area for recreation, which neither politicians nor citizen would subsequently want to ruin by supporting more polished kinds of urban development (meeting at Copenhagen Municipality, May 2013). Seeking the approval of this professional, however, did not prevent LAGI 2014 from simultaneously serving as a tool for the very development he opposed. In regard to the inevitable close relationship between art and economy, the LAGI directors did not consider supporting the economic strategy of the pension funds a problem (LAGI 2014 team meeting, November 2013).

This manifested further in a downloadable pamphlet entitled "Benefits to Cities", which the LAGI founders had made to attract the interest of potential hosts. Using the example of a recent Olafur Eliasson installation (Waterfalls, 2008) in New York City, they argued that a permanent LAGI sculpture is a good financial investment due to the tourist money it would draw in.

> Land Art Generator public artworks pay back both their carbon footprint and their installation cost over time, making them the perfect investment in our future. (Monoian and Ferry, 2014a)

Whereas other artists may be hesitant having their art serve the purpose of particular (financial) agendas, the directors did not find it problematic that LAGI 2014 served various purposes and agendas, including some at variance with their own. The enrolment of different actors (cf. Callon, 1986) thus depended on continuous oscillations in the way the project was performed: at one moment an art project, at another moment innovation of infrastructure. Contrary to Latour's (1996) story of the Aramis train, which never materialized, torn apart by too many different demands, LAGI 2014's success was in no small part due to the fact that it remained multiple (Jensen, 2010, pp. 19–31; Winthereik, 2010). These oscillations and the project's flexibility created a space where different, even conflicting, agendas were able to temporarily coexist.

Oscillations in space, no less than in time, between agendas, and between conventions and innovation, were thus deployed as tactics for making LAGI 2014 cohere, not only internally, but also with the various actors involved in bringing the project to life. In the next session, we consider what these oscillations suggest about the political and cosmopolitical possibilities and limitations of the project as a space where different imaginaries of alternative energy futures coexist and come into being.

Cosmopolitical potentials and limitations

As we have shown, LAGI 2014 was very effective in generating support and in raising expectations among a wide set of important stakeholders, but we are left with a question regarding whether LAGI 2014 was successful in engaging the public. The project generated 300 submissions, many of which were truly inventive. In light of this apparent success, however, it is noteworthy that the award ceremony did not generate much public attention, and a majority of the visitors at the exhibition opening were professionals who had been involved in LAGI 2014 during the implementation process.

After the competition, an external evaluation report noted that the project had received quite limited local media attention and had failed to root itself sufficiently in the local public and professional community for it to create lasting implications (Innovation, 2014). Noticeably, LAGI 2014 did not appear to have given rise to any further explorations of different ways of infrastructuring energy environments, not to mention on what role art might play in these processes. Nor have any partners or stakeholders pursued the possibility of constructing any of the designs at Refshaleøen or elsewhere in Denmark.

It can thus be concluded that, in spite of LAGI 2014's success as a competition, and despite the participation and the great expectations of important decision-makers, it achieved relatively little by way of intervening in public life and in re-framing discussions around the energy infrastructures of the future. This conundrum is the focus of the following reflections. Relating back to the exiting literature suggesting that art has the ability to create public engagement (Marres, 2013), new forms of civic participation and engagement (Domínguez Rubio and Fogué, 2013), radical alternatives (Yusoff and Gabrys, 2011), and spaces for hesitation (Gabrys, 2014), we ask: What kind of politics did LAGI 2014 exercise and what capacity did the project turn out to have?

On the one hand, LAGI 2014 had the desirable effect of attracting a heterogeneous set of actors with different agendas and aspirations. The simultaneous performance of the project as art or alternative innovation—and thus not made reality—created a space where different imaginaries could temporarily coexist. It created a space for action, which allowed the project to come into existence as an ideas competition in Denmark. In this sense, the project enabled people imagining different futures and allowed them to meet outside their usual silos. On the other hand, however, one of the characteristics of this space was certain harmlessness. As shown in the preceding sections, the tactical oscillations of LAGI 2014 functioned in general to mitigate any sense of contradiction. The project's hybrid and flexible character allowed it to always oscillate away from controversy, or contradiction. In a constantly consensus-seeking manner, it performed a scenario in which no one was ever wrong, since the criteria of evaluation could always be changed. In doing so the project exercises a subtle and what we might call

smooth politics. At the academic symposium, organized in conjunction with the competition, the LAGI directors argued:

> . . . we will show that in fact there can be this future working with beauty and renewable energy technology and we will slide into the politics without really having to discuss the politics. (Monoian, Sympoium: Environmental Entanglements, 29 October 2014)

In our interpretation, this statement bears witness to a view of the capacity of art to become a political actor—as having a role in making alternative energy futures—in a particular manner. The LAGI directors did see their project as a highly political endeavour, but as the quote witnesses, and as the directors often emphasized to the LAGI 2014 project team, their tactic was not to make their politics visible to potential stakeholders. Following a tactics of oscillating (without calling it so) between different positions allowed the project to exercise a smooth politics. Thus, LAGI 2014 was very successful in mobilizing support and in becoming recognized as important by key decision-makers precisely because the project managed to slide into existing ways of doing environmental politics.

This strategy may be effective in mobilizing support but may miss out on other political potentials. LAGI 2014 made energy infrastructure public by way of inviting people to submit ideas for alternative energy production and exhibit these ideas to a broad audience, thus striving to publicize infrastructures. But LAGI 2014 does not "publicize" energy in the sense advocated by Domínguez Rubio and Fogué (2013).

Rather than making visible and public the hidden politics of energy infrastructures, the LAGI directors strove to render invisible politics of any kind. This is a form of project politics that hope for a shaping of the public imaginary without making strong positional claims.

This political strategy was related to its capacity to transport people—politicians and urban planners included—to an attractive, readymade future. The difficulty of mobilizing broader public interest in and imagination around energy infrastructures, however, may arise from the public's sense that the future had already been designed as spectacle by competent others. These seductive pictures of the future do not make energy into a controversial and debatable matter of concern around which publics may emerge (Marres, 2012).[12]

The many proposals presented by LAGI all convey the idea that such alternative futures are smooth and frictionless, which was in turn problematized at the symposium, where another artist, also working with energy, proclaimed that this was "counter-productive to the transition to renewable energy" (Environmental Entanglements, 29 November 2014). According to him, the role of art is instead to show how complex, difficult, and muddy it is to re-design and eco-adapt infrastructures already in place.

While one limitation of LAGI 2014's cosmopolitics might relate to the difficulty of sparking a public debate, another relates to the *degree of alterity* inherent in the proposal. LAGI 2014 excelled in performing the future as (only) somewhat alternative. What was to be avoided was the projection of futures *so* different from the present time and the existing visions that decision-makers would be unable to appreciate them or unable to imagine how to get there. Indeed, LAGI 2014 made sure *not* to criticize or even question the existing politics.

Yet this is counter-productive from the viewpoint of cosmopolitics, which thrives on making forcefully available all the contrasts, demands, and obligations of different perspectives and practices. LAGI 2014 arguably missed out on the opportunity of creating what Gabrys (2014) calls "spaces for hesitation". Though the art project presents energy production as aesthetic power plants looking very different from wind turbines and solar panels, the competition failed to open a public debate allowing for potentially controversial discussion around how to integrate and live with renewable energy sources in the future. LAGI 2014 gained great attention, only to be quickly forgotten, perhaps because its strategy failed the central cosmopolitical test. Instead of articulating frictions, drawing creative power from its contrast, it rendered such frictions invisible or cosmetic (Jensen, 2005).

Rather than judge LAGI 2014 as a success or a failure, however, we would like to suggest a productive contrast. This entails recognition of the cosmopolitical demand that LAGI 2014 too ought to be presented in full force. The competition would have benefitted from highlighting frictions the controversial dimensions (in the STS sense) of infrastructure design. Yet it is also possible that social scientists might learn from its success to create support from politicians.

Paradoxically, one lesson to be learned is that the deliberate effort to "slide into politics" (as the directors expressed), without engaging politics head-on, might sometimes be the best way of re-inflecting conventional modes of thinking and feeling. The tactical oscillations of LAGI 2014 proved an extremely effective technique for sliding. As this article has made clear, tactical oscillation did not allow LAGI 2014 to convey via art the power to infrastructure environments differently. It did, however, offer important lessons on the challenges involved in making art and design participate in orienting energy futures towards renewability and sustainability.

Conclusion

In this paper, we have examined LAGI 2014's attempt to spur the public and political imagination around energy. We have done so by describing its ways of moving with and around various kinds of stakeholders to ensure the success of the competition. We conceptualized these movements as a set of *tactical oscillations*.

In summary, the project's hybrid character allowed it to: (1) oscillate between convention and innovation: the project managers were able to present the project as new and innovative without being at odds with existing visions for infrastructure development in Denmark. (2) Tack back and forth between the present and the future and between site-specificity and a non-situated everywhere: the project appeared as a temporal bridge, rather than make visible any chasms between existing and new politics. (3) Oscillate between different agendas for urban infrastructure development: the project's flexibility created a space where different and sometimes opposing agendas were able to temporarily coexist. We argued that flexibility and oscillations made the project successful in creating visibility and mobilizing financial and moral support among key stakeholders in the Danish energy landscape.

We have described LAGI 2014's attempts to intervene in the debate around redesigning energy infrastructure as *smooth politics*. While smooth politics proved to be rather effective in getting key stakeholders on board and for creating visibility around the project, this did not lead to any decision-making taking the environment differently into account in existing infrastructure development. Nor was it very effective in creating public engagement and participation in the project.

Comparing our analysis of the project with existing studies of other energy-related artworks, we showed how LAGI 2014 was operating through very different political strategies. Rather than rendering controversies and hidden politics visible and opening them up for discussion (Domínguez Rubio and Fogué, 2013; Marres, 2013), LAGI 2014 sought to smoothen them out and make them insignificant. Instead of proposing radically different energy futures, the design proposals were always performed as only *somewhat* new and as aligned with existing politics. Although indeed LAGI 2014 attempted to open the imagination to aesthetically different kinds of energy production, the goal was not to create space for hesitation and raise awareness of the ecological crisis (Stengers, 2005; Gabrys, 2014).

Based on these contrasts, we have argued that LAGI 2014 missed out on important cosmopolitical opportunities. However, reflecting on the case as a lost opportunity to present a cosmological proposal may not be fair to the efforts made to spur different imaginations with respect to what energy infrastructures may come to look like. Instead, we suggest that as a political strategy tactical oscillation has its strengths as well as weaknesses. From the viewpoint of cosmopolitics as creating spaces for hesitation (Gabrys, 2014), we conclude that highlighting controversy could have given rise to greater public attention, but paradoxically this would potentially reduce the participation of politicians and key decision-makers.

Our analysis contributes to the emerging empirical and theoretical investigations of what roles art may play in the process of reimagining and remaking environmental infrastructures. We do so by arguing that LAGI 2014's future-making practices hold political potentials somewhat different from those

already described. Rather than valuing one over the other, we have been curious about the different qualities of political strategies. There is indeed a need for "hesitation" and "slowing down reasoning" when (re)infrastructuring environments. However, the arguably urgent situation in which green transitions happen (or ought to happen) simultaneously calls for action—an action in which social science, humanities, and arts should proactively participate.

We have emphasized cosmopolitics' normative commitment to slow down analysis in order to articulate hegemonic and naturalized politics and to suggest alternatives. But we are simultaneously confronted with a normative urge to speed up the analysis. Reflexivity as well as participation is needed. How can the attempts to infrastructure environments work around and within this dilemma? Could artists as well as social scientists benefit from tactics of oscillating between, on the one hand, a cosmopolitics of hesitation, friction and controversy making, and on the other hand, advocating for a more smooth and consensus-seeking path? Being aware of and working actively with such different political strategies, we argue, may be productive for infrastructuring environments with art and social science.

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Notes

[1]See, for example, Nuage Vert by HeHe (2008), Natural Fuse by Usman Haque (2008), Supergas by Superflex (1996), and Coal Fired Computers by YoHa (2010).
[2]For other analyses of Nuage Vert, see also Schick and Witzke (2011, 2014).
[3]See http://landartgenerator.org/team2014.html
[4]See the event *Pynt eller Politik?* (Decoration or Politics?). http://voresomstilling.dk/artikel/pynt-eller-politik-kan-kunst-og-arkitektur-fremme-den-gr%C3%B8nne-omstilling/590
[5]Environmental Entanglements: http://energyfutures.itu.dk/events/environmental-entanglements/
[6]The 2014 exhibition took place at the Danish Design Centre in the center of Copenhagen and was open from 3rd October to 7th November
[7]http://landartgenerator.org/portfolio.html

[8]A downscaled version of one sculpture is under development in Pittsburgh, Pennsylvania. http://landartgenerator.org/blagi/archives/category/renewable-energy-public-art/windnestAt Durham University, the professors responsible for the MSc programme in Energy & Society have been in dialogue with the LAGI directors to explore if building one of the sculptures could happen as part of the programme that precisely spans engineering, planning, and social science and humanities.

[9]http://naturstyrelsen.dk/planlaegning/planlaegning-i-det-aabne-land/vindmoeller/borgerinddragelse/

[10]Due to lack of funding this was not actually completed.

[11]The partnerships with the two municipalities Allerød and Albertslund however extended to two other municipalities outside the region because they were all part of the cross-municipal partnership Green Cities. In order to engage Allerød and Albertslund, the entire Green Cities should be granted the opportunity to participate. One municipality however did not participate.

[12]In contrast, a public did indeed emerge around energy infrastructures shortly after the launch of the LAGI 2014 competition. In January 2014, the Danish Government sold 19% of the country's biggest energy provider DONG Energy (mainly owned by the state) to the American investment bank Goldman Sachs. This gave rise to major public protests causing a political crisis where one of the government parties left the coalition and six ministers resigned including the Minister of Environment and ambassador of LAGI 2014. This was, of course, not related to LAGI 2014, but though the project lost its ambassador, this controversy around energy infrastructures was not an issue that the directors regarded important to debate in relation to LAGI 2014.

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Paper 5: Generating Futures: LAGI as an Imaginatorium

By: Lea Schick & Anne Sophie Witzke

Book Essay.

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ESSAY

Generating Futures: LAGI as an *Imaginatorium*

Lea Schick and Anne Sophie Witzke

> "It is the broadest, the greenest and the most long-term energy agreement that has ever been reached in Denmark. In our everyday political work, the parties are different shades of red and blue. But together we have laid down the foundation for a green future."
>
> —Martin Lidegaard, (former) Minister for Climate, Energy, and Building, at the approval of the 2012 energy agreement.

The 2012 Energy Agreement committed Denmark to doubling the production of wind energy by 2020. With 5,000 wind turbines (one per 1,000 inhabitants) and a world record of 30% of the country's energy production coming from wind, Denmark is densely populated by wind turbines. As "sculptures" ornamenting the Danish landscape, these windmills have become both national landmarks and objects of public controversy. The Land Art Generator Initiative (LAGI) takes place within this context and contributes to the strengthening of the government's roadmap to a green and sustainable future. Compared to the Danish government, however, LAGI has a novel and quite different take on what power plants could look like, how they are formed, and by whom. In this essay, we will argue that LAGI—working as an *imaginatorium*—expands the space in which energy futures can be imagined and made. With a multiplicity of ideas for aesthetic power plants, LAGI lays a foundation for imagining multiple ways of forming our future energy landscape, in which wind turbines are accompanied by other forms of energy generation.

LAGI can be conceptualized as both a competition that collects ideas for a variety of artworks, where each can be valued for their individual aesthetic qualities, and as an art project in its own right. In this essay, we focus on LAGI as an artwork that performs a distinct artistic strategy. LAGI takes the shape of a conceptual apparatus—a generator, as the title of the project suggests—that enables the ongoing production of ideas for site-specific artworks. Even though a winner is selected, LAGI is less about emphasizing the one winning sculpture than about demonstrating a catalogue of ideas for alternative power plants. This multiplicity indicates a creative potential waiting to be explored.

Like many contemporary art projects engaged in building a more environmentally responsible society, LAGI operates within an expanded field of art, blurring boundaries between art, design, architecture, and engineering. LAGI thus departs from the idea of art as solely an object of aesthetic contemplation—art is seen as a tool for action and environmental change as well. LAGI builds on the concept of "social sculpture," formulated by the conceptual artist, politician, and environmentalist Joseph Beuys in the 1960s. His central idea was that art and human creativity hold the capacity to transform society, and that all of us can contribute creatively to this process: "Everyone is an artist," as Beuys famously stated. Similar to social sculpture, LAGI expands the gallery and museum

space, moving into public space where the artworks engage with "real life," contribute to solving problems, and have an effect on the world. LAGI thus transcends traditional art discourse and makes aesthetic tools with transformative capacities.

By fusing art and renewable energy and by inviting people to submit ideas on this important and otherwise very expert-led subject, LAGI intervenes in governing versions of sustainability and renewable energy, where efficiency, predictability, and identifiability normally dominate the way energy production is imagined and actualized. Contrary to the Danish government's energy development, based primarily on wind turbines, LAGI demonstrates how a variety of beautiful, spectacular, and thought-provoking power-plant sculptures could inhabit the country, thereby illustrating how energy production might otherwise be. When the many ideas generated through LAGI are presented alongside one another—in this very book, in the exhibitions, and in the website portfolio—an imaginative space unfolds *in-between* the creative scenarios, a space in which the spectator is invited to imagine alternative landscapes of energy generation.

Inspired by the American physicist Frank Oppenheimer, who in 1969 opened The Exploratorium, the world's first interactive science museum in San Francisco,[1] we will coin the engaging and creative space that LAGI creates as an *Imaginatorium*—a space that sparks the imagination of the viewer. Oppenheimer's Exploratorium was a democratic project that, like LAGI, mixed art with science, not only to show that science is a creative discipline, but also to empower the public and make them engage with and learn about science in new ways. Like the Exploratorium, we believe that LAGI can engage the public in thinking and rethinking the infrastructural foundation of society by creating imaginary spaces for exploring the concrete, physical form of renewable energy power plants. Through its generative capacity, LAGI thus emerges as an imaginatorium that allows us to envision the world as a more fascinating, manifold, and environmentally sound place to live.

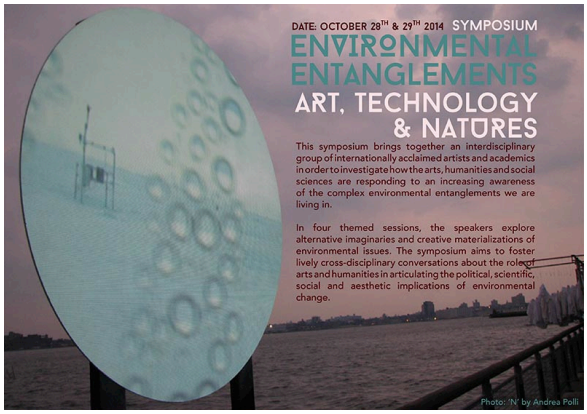
[1] A. Barry, "On Interactivity: Consumers, Citizens and Culture," in *The Politics of Display: Museums, Science, Culture,* ed. S. Macdonald (Routledge, 1998), 98–117.

Paper 6: Symposium: Environmental Entanglements - art, natures and technology

Place: Royal Academy of Science and Letters, Copenhagen.

Date: October 27.-29., 2014.

Organizers: Lea Schick (IT University, Copenhagen), Else Marie Bukdahl (Aalborg University) Anne Sophie Witzke (Aarhus University), Line Marie Thorsen (Copenhagen University).



Symposium: *Environmental Entanglements - art, natures and technology*

Place: Royal Academy of Science and Letters, Copenhagen
Date: 27.-29. oktober, 2014
Organizers: Lea Schick (IT University, Copenhagen), Else Marie Bukdahl (Aalborg University) Anne Sophie Witzke (Aarhus University), Line Marie Thorsen (Copenhagen University).

The symposium was funded by Oticon Foundation, Aksel Tovborgs legat, IT University of Copenhagen. The symposium was part of the official program for *European Green Capital, Sharing Copenhagen,* and part of Land Art Generator Initiative Copenhagen 2014.

Description of symposium:

This symposium brings together internationally acclaimed scholars and artists in order to investigate the social, political and aesthetic aspects of contemporary media art that addresses environmental change and/or transitions towards sustainable futures. In a time characterized by immense environmental issues and proclamations of the 'end of nature' and 'post-natures' natural environments are becoming revitalized topics for artists and for scholars working within the field of art, science and technology.

As architects, politicians, engineers and city planners are endeavoring to redesign cities, infrastructures and architecture to make these more sustainable and green, artists are intervening coming up with creative and aesthetic approaches.

Changes in the environment are subtle and emerge over large spans in time and place. Because these changes are not directly sensible through human perception humans are depending on technologies and scientific instruments such as sensory devices, data collections and computer models in order to comprehend them. Along with scientist and engineers artists are employing technologies to explore environmental issues. They do so to make sensible the environmental changes in subjective and experimental ways; to propose alternative solutions to the problems; and/or to point out limitations of the official methods used in science.

As the environment undergo a multitude of changes, it also becomes increasingly clear that it is a political and financial battlefield over: who has the right to the environment, who controls it, and who owns it. A growing number of artists are engaged in these socio-political controversies and intervene in the field by proposing new ways for publics to participate by various material means. For these artists the environment provides an entry into political and social issues.

An understanding of environmental change therefore begins with developing a heightened awareness of how natures, humans, politics and technologies are deeply entangled in one another. The aim of *Environmental Entanglements* is to explore how these entanglements are investigated, articulated and re-entangled through contemporary art and theory, and to discuss how art and theory might help fostering a public discourse and participation in environmental issues. The invited speakers are leading artists and scholars within this emerging field. The symposium offers a unique opportunity to enter into a dialogue with these capacities, and to get a first hand insight into artworks taking up basis elements such as air, water, and plants as topics for artistic and scientific exploration.

In four themed sessions, the speakers explore alternative imaginaries and creative materializations of environmental issues. The symposium aims to foster lively cross-disciplinary conversations about the role of arts and humanities in articulating the political, scientific, social and aesthetic implications of environmental change.

Description of four themes and speakers

Opening keynote lecture: John Law.

Natures:

In the midst of the immense human-made ecological changes the conventional separation between the 'natural', the 'technological', and the 'human' has become increasingly hard to maintain. How the natural and the human are co-evolving and intermingling is a growing field of inquiry. Employing different practical-analytical strategies, artists and academics explore and try to rethink and refigure these entangled natures and what 'new' natures mean for our understanding of time, matter and subjectivity. This has given rise to a number of

new concepts and approaches. We observe buzzing engagements, for instance, with 'the anthropocene' and 'geological time'. How might such new concepts help us to describe and understand the current 'epoch'?

Speakers:

- Jamie Lorimer, Oxford University (UK): *Wildlife in the Anthropocene: Environmentalism without Nature*
- Monika Bakke, Adam Mickiewicz University (PL): T*entative Materialities: Art and the 'geological infiltration' of life*
- Laura Beloff, ITU (DK) E*counters in Hybrid Ecologies*

Sensing Change and Mediating Climates:

Environmental changes unfold over temporal and geographical scales, so tiny or vast that they often escape the human sensorium. Our perception and comprehension of these changes are therefore to a large degree depending on techno-scientific instruments and models that measure and mediate the environment for us. The graphs and images of climate change that so vividly travels the media space have a great impact on the way environmental issues are understood and dealt with and they are thus never neutral. In this session we aim to recover the role of technology in relation to our understanding of the environment. Alongside scientists, artists are employing technologies to explore environmental issues and to unravel the role of technology. How do technologies participate in shaping our understanding of the environmental changes? What kind of sensation do they enable? What kind of politics do images and mediations enact? How do the practices of the artist relate to as well as differ from that of the scientist?

Speakers:

- Dehlia Hannah, C21 (US): *Equivocal Instruments*
- Birgit Schneider, Universität Potsdam (DE): *Seeing Red—Imaginations of Global Warming between Science and Art*
- Andrea Polli, University of New Mexico (US): *Are You Becoming Radicalized? Public Art and Activism between Environment, Culture and Information Space*

Publics, Participation and Politics:

Environmental problems and 'green' transitions are inherently traversed with more or less visible political issues. Technologies are not only useful tools for sensing the environment and developing alternative infrastructures, they also give rise to new kinds of 'politics', ranging from novel forms of public participation and inclusion of non-humans, to new ways of governing people. In this session we will explore how artists investigate and explicate political entanglements between technologies and 'natural' environments and between the human and nonhuman species inhabiting these environments. How are politics and technologies tied up? What kind of alternative 'political' engagement might art offer through the use of technologies, and what are the limitations? How does it make sense to sustain an idea about art as autonomous, when working with art entangled with environmental issues? And if not, how might we describe arts' specific contributions?

Speakers:

- Malcolm Miles, Plymouth University (UK): *The strange relation of art and green politics*
- Jennifer Gabrys, Goldsmith University (UK): *Sensing Practices and Environmental Monitoring: Putting Political Technologies to Work*
- Helen and Heiko, HeHe (UK/DE/FR): *Man Made Clouds*

Rethinking Infrastructures:

Cities, infrastructures and energy sources are proclaimed to constitute great potential for mitigating climate change and environmental problems. Infrastructures are furthermore of interest because they materialize specific ideas and perceptions of how humans inhabit and affect the environment. A growing number of artists and academics have taken up the challenge of re-imagining and re-designing the infrastructures we depend upon, by proposing alternative rationales and creative solutions. In many of these artistic proposal infrastructures are re-conceptualized as dynamic, organic and creative structures, which work across conventional boundaries between the natural and the build environment, human and non-human needs, recreation and function. What role do infrastructures play in the modern society, and how is the notion

of infrastructure tied up with certain ideas about society and nature? How is infrastructure re-conceptualized in order to support new ways of living that are less environmentally damaging? What role does art play in the transition to more sustainable infrastructures?

Speakers:

- Michael Singer, Michael Singer Studio (US): *The Visual Arts and the Ecological Challenge*
- Elizabeth Monoian & Robert Ferry, LAGI (US): *Land Art Generator Initiative*
- Prof. Ellen Marie Braae, Copenhagen University (DK): *Time concepts in recycling Post-Industrial Landscapes*

Co-Author Statement

I hereby declare that I am aware that the work in the paper:

”Powering Ecological Futures”

of which I am a co-author, will form part of the PhD dissertation by

Lea Schick

who made a

X major

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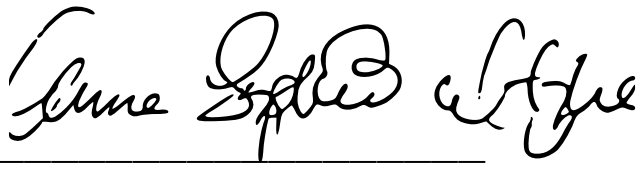
contribution to the work both in the research and writing phase.

Name: Anne Sophie Witzke

Signature: 

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Co-Author Statement

I hereby declare that I am aware that the work in the paper:

"Innovating Relations – or Why Smart Grid Is Not Too Complex for the Public"

of which I am a co-author, will form part of the PhD dissertation by

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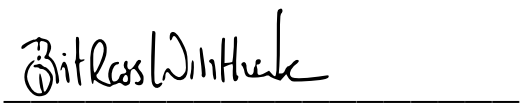
Signature: 

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Co-Author Statement

I hereby declare that I am aware that the work in the paper:

" Flexible and Inflexible Energy Engagements – a study of the Danish Smart Grid Strategy"

of which I am a co-author, will form part of the PhD dissertation by

Lea Schick

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contribution to the work both in the research and writing phase.

Name: Christopher Gad

Signature: 

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Co-Author Statement

I hereby declare that I am aware that the work in the paper:

"Making Energy Infrastructures Public through the Land Art Generator Initiative: Tactical Oscillations and Cosmopolitical Potentials"

of which I am a co-author, will form part of the PhD dissertation by

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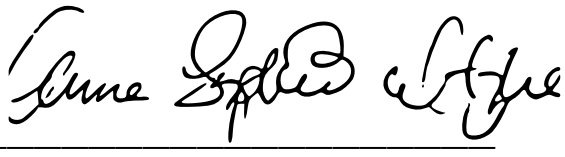
Signature: 

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