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Energy civilization through industrial modernity and beyond

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Abstract

Three of the authors (Jensen Shearing, Skauge) are in the core group of the SANCOOP project: Transition to Sustainable Energy Systems in Emerging Economies. It is a South African Focused Comparative Project, financed by the Norwegian and South African Research councils 2014-2016. The included countries are Brazil, China, India and South Africa. This paper is based on theoretical discussions early in the project and some preliminary impressions from our interviews.

Energy systems have gained new relevance. Dominated by their electricity component, energy systems were the main ingredient in forming advanced industrial-based civilizations. These energy systems are now a main actor that threatens to destroy them. The IPCC (2014) declared electrical energy production (especially coal) as the main driver of climate change. Through energy production patterns, humans are now able to destroy nature's foundations of their civilizations; we are in the age of the Anthropocene. The paper will discuss the relation between humans and nature, as seen through energy. At the start, energy was mainly a local, even family matter, requiring skill and care. Since energy in itself is not a scarce resource, the problem of energy sources, organization and institutions comes into focus. We will discuss the perspectives and practices towards nature that came with industrialism, the new forces of governance and the resulting institutions of huge electricity grids and big power plants that resulted. The climate change challenge is one driver of change. Other drivers are cultural in nature: The century-old institutions of power production are developing problems of change and learning, but they remain powerful. Consumers start to be actors in new ways, in ordinary markets, but also as energy citizens and co-producers of energy. Technology development and structural changes point to smaller scale, flexibility and decentralization of energy production. These factors work together and create rapid development of new niches of energy production and many of them are approaching their tipping points to become major production regimes. The paper concludes with a discussion of actors forming the new system, including consumers as energy citizens and the crucial new regulatory challenges that emerge.

Introduction –The Challenge of the Anthropocene

Energy systems have gained new relevance. Dominated by their electricity component, they were the main ingredients in forming advanced, industrial-based civilizations. These energy systems are now a main actor that threatens to destroy them. IPCC (2014) declared electrical energy production (especially coal) as the main driver of climate change. Through energy production patterns, humans are now able to destroy nature's foundations of their civilization; we are in the age of the Anthropocene.

What is a good theory that can capture relations between humans and nature, as seen through energy? What theories capture changes, change agents and forces that hinder and promote change for climate-friendly energy systems?

At the start energy was mainly a local, even a family matter, requiring skill and care. Since energy in itself is not a scarce resource, the problem of energy sources, organization and institutions come into focus.

The paper discusses several perspectives and practices towards nature that came with industrialisation, the new forces of governance and the resulting institutions of huge centralized grids and big power plants that resulted. The climate change challenge is one force of change. Other forces are institutional and social: The century-old institutions of power production developing problems of change and learning, but they are large and powerful. Consumers start to be actors in new ways, even energy citizens and co-producers. One path of technology development and structural changes points to smaller scale, flexibility and decentralization of energy production. These factors work together and create rapid development of new markets, new manufacturing and new niches of energy production and many of them are approaching their tipping points to become major production regimes.

An alternative path is created by the forces of expertise, big organisations and ideas for economic efficiency. This path is heading towards standardization and even more centralized systems. Changes can be hindered by path-dependency forces (Berkhout, 2002).

Our paper concludes with a discussion of actors forming the new system, including consumers as energy citizens and the crucial new regulatory challenges that emerge.

Our research has its origin in the questions that the Anthropocene era has raised, and is raising, as humans recognize that they are collectively now geological agents[1] capable of eroding the eco-system services upon which they depend both for their biophysical survival and for the survival of their social world (civilizations). Today, we humans have in a double sense become children of the Anthropocene. We are both living through the consequences of impacts of our actions on earth systems and are becoming increasingly aware of our new and emerging status as geological agents. We know who we are, who we have become and who we are capable of becoming.

[1] The distinction between ecological and geological refers to the fact that human influence now reaches further than the living ecosystem; it includes the climate, oceans and land structures as well.

The combination of impacts (damage) to ecological systems that we humans have already realized, the knowledge we now have of what we have and are capable of doing to both destroy and rehabilitate ecological systems is a frightening prospect. The concept of the Anthropocene era (Schwägerl 2014) is a parallel to the concept of Risk Society (Beck, 1992). The central idea was that the new technology of nuclear power and the nuclear bomb, for the first time in history, gave man the capacity to destroy human life and civilizations more so than natural disasters. The first uses of the concept were mainly negative, like the example of nuclear weapons, but in principle it is more about a new human position as conscious actors, shaping, maintaining, destroying or enhancing our own conditions, and fate.

Our Research

In our research program we have sought to locate specific topics and geographical areas that can be studied for a fruitful analysis of the above themes.

To realize this we have singled out the production and distribution of electrical energy as our core focus. The production of electricity has both played, and will continue to play, a crucial role in shaping the trajectory of human civilizations and human impacts on earth systems such as climate systems.

A foundational assumption that grounds, and shapes, our research is that human civilizations (and the economies that sustain them) will continue to require (demand) a constant and expanding supply of electricity. Today electricity is a *sin qua non* of human civilization. While it might be possible for humans to survive as biophysical beings without abundant electricity, their contemporary ”worlds” will collapse (Diamond, 2005) without this.

As awareness of the Anthropocene and its implications has emerged so has the search for alternative ways of engaging in the extractive and production processes that contemporary human civilizations require.

Crucial within energy production and distribution has been the search for alternative methods of generating sustainable (that is eco-system friendly) electrical energy. There are major initiatives underway globally to produce energy in more sustainable ways. Indeed these developments are at the very forefront of efforts to respond to the challenges of the Anthropocene such as climate change.

Our research is focused on understanding conditions shaping developments with respect to the production and distribution of electricity. We are in particular looking for game changing forces and/or premises.

Our research strategy is to explore countries that have rising energy needs that vary significantly with respect to energy generation history and associated regulatory regimes. Specifically we have focused our attention on the four BASIC countries; Brazil, South Africa, India and China.

1 What is energy?

First, energy is not a limited resource. For example, the sun alone is capable of delivering all the energy that humans are ever likely to require (McKevitt and Ryan 2013). In addition there is the indirect old energy from the sun (coal, oil and gas), the gravitational force of the moon (tidal power), there are also wind, waves, geothermal energy, hydrogen energy (Rifkin 2002) and many others. Finally the conversion of matter into energy (nuclear - both fission and fusion) has a potential that again in theory can deliver as much energy that may ever be needed without depleting nuclear fuel resources in any significant way.

Second, energy is never lost; it is transformed and moved along long and complicated chains. In the very long run the energies of the earth and sun will probably gradually dissipate into cold space according to the second law of thermodynamics. At present and at the global and human scale of time and space scale it seems that humans forced the earth system into the state of dissipating too little energy back to the universe (this results in global warming, or more precisely, too much energy left in the climate systems). This is a process that paradoxically may postpone the possibility of the cold death of all life from the second law of thermodynamics with a very tiny fraction.

The technology of concentrating some energy resources, such as fossil fuels, and the conversion of their intrinsic energy into heat so they can provide electricity has been of great importance for development of human civilizations. Given this, a crisis in this area quickly becomes a social crisis that can lead to the destruction of civilizations - mundicide. These technologies were of course not seen as problematic when they were institutionalized and may, as we shall see later, be seen as unfortunate choices among other possibilities. Today they may seem so dominating in the socio-technical energy regime that the historically new insight of its damaging capabilities may look overwhelming. On the other hand, the long history of the less problematic technologies of hydro-electrical energy is one indication that reminds us of earlier and more fortunate choices and of new opportunities.

The impression that energy constitutes a "limited resource", and a resource that damages earth systems while used, is a construct of special historical and techno-social factors. The close links that developed historically, given the preferred energy technologies, between fossil fuels (stored solar energy) and electrical energy generation technology creates the impression of a limited and dangerous energy system. Behind this appearance are strong social and technological investments and institutions. They could have been changed earlier, but it did not seem necessary. Now it is necessary.

It is the institutionalized reliance on technologies that have used non-renewable resources to produce energy - a reliance that has a very long history - that is at the root of many of the features of the Anthropocene such as the destruction of ecological systems that are crucial for human survival as biophysical entities. Provision of energy for maintaining welfare and society is a social and political problem, not resource- or technology-based.

Our focus is on electricity, its production and distribution. Electricity in itself is relatively harmless with today's technology and administration; the problems are mostly linked to how other energy sources are used for the generation of electricity.

2 Humans, energy, society and the crisis

What is special about humans is the level of energy that they have been able to produce (=concentrate) through processes of enrolment of other parts of earth systems - these include the early enslavement of biophysical forms (humans and animals) plus the use of physical features of different earth systems. This has enabled humans to sustain massive levels of social organization (civilizations). Today energy in its electrical form is the crucial energy required for social organization (this is especially true of low-power cyberspace even if this is an extremely energy-efficient mode of communication).

A crucial driver of human engagements with earth systems has been the ongoing supply of the high levels of energy required to sustain their civilizations. This is unlikely to change without a major shift in power balance between central actors. We expect such shifts to occur through social acceptance and definition of crisis-situations, like pollution (China), supply system breakdown (South Africa) and of course the gradually developing concern for the climate and the evolving crisis of more extreme and more frequent weather events.

The Crisis

The crucial challenge of the Anthropocene is the challenge of preserving earth systems that are vital to human flourishing while continuing to produce the levels of energy needed to sustain the forms of social existence that have come to define humans. Established (industrial) ways of delivering electrical energy have promoted earth systems changes that are likely to push many societies over a tipping point of unsustainability in the foreseeable future (IPCC, 2014).

Our empirical examples come from the BASIC countries that are facing this challenge in extreme forms - needing huge energy inputs to "catch up" in development and suffering from the negative side effects of existing means of generating electrical energy.

The normative goal of this research is to be able to identify conditions that will favor pathways that will enable a global transition to high-energy ecological civilization.

As noted the crisis of the Anthropocene is a crisis of loss of civilizations; "loss of worlds". The crucial question for humans is not simply how can humans sustain the conditions necessary for their biophysical survival - although this is of course necessary. The crucial question is how can humans sustain their social worlds. The crucial question is how can we humans continue to produce the high levels of energy our civilizations require while

sustaining the eco-systems that these civilizations need to sustain humans as biophysical beings.

3 Consumption and production are not the primary problems

The level of human activity (called production or consumption) in a society is not the fundamental problem, since the level of energy flowing through is not a constraint. The real problems arise through the damaging side effects that vary with the organization and technology used. Societies have fallen apart even on low levels of consumption, if the way they use energy is damaging (Diamond 2005) and vice versa. Given a particular form of harmful energy production, the level of usage (consumption) is of course important, like in a coal-based industrial system, but it is not the key to understanding the challenge.

Stopping or reversing the general level of activity (called welfare, consumption or production) is therefore not necessary in a strictly logical way; this depends on the way energy is "produced". The key is the way it is done, not the volume.

This fact is often hidden behind ways of doing statistics (like Gross National Product (GNP)) that mix all kinds of activity together; both activities that damage and activities that heal or are neutral to nature, both living with nature and against it.

The gradually more precise focus on carbon energy extraction as a main factor in damaging climate (IPPC 2014) also implies an understanding of this premise.

4 Knowledge and values

When it comes to knowledge and motivation regarding the climate challenge and its links to some forms of energy concentration and production, it becomes slightly more complicated.

The well-documented and simple fact is, however, that the problem of the climate challenge is accepted and the basic mechanisms of climate change are well known. Humankind is rightly concerned. There might be disputes or distrust with regards to the details (how much warming is happening, are the storms this year really due to climate change) but the robust answer is that people all over the world are worried and share a basic understanding of the climate change issue. As nature is never fully deterministic and always more complex than the models, science will seldom be spot on. It may seem like it has been very difficult to see how the effects of "warming" (=more energy stored) are divided between different practical effects such as higher temperatures, more extreme and more frequent weather events and ocean current changes. But the generally accepted attitude is more and more that we have a responsibility and should act and that the effects are already accumulating around the world. Surveys tend to show that individual people are willing to act and make priorities even if they are not fully convinced by the researchers, and this can be interpreted as a quite reasonable principle of being cautious and respectful. Governments and business, the institutional level, however, are not always prepared to accept that climate change requires action from them.

5 Our basic assumptions

The main problem to be addressed here is at the organizational/institutional level. The problem is that institutional patterns of action have a long half-life; motivation and required action at the institutional level always lag behind shifts in the contexts within which they operate. Institutions develop lock-ins that are very resistant to change. This is essentially Geels' point about regimes. Regimes get stuck in past contexts - they are very conservative. But they do change. And when they change they can change very suddenly, very rapidly and very radically, given that the new technological regime existed in a niche. One can move very quickly from one regime to another. Again this is based on Geels' multi-level analysis (Geels, 2004; Elzen, Geels and Green, 2004). In our context: the institutional setting from early 1900's (large, top-down structure based on energy sources that do not take sustainability or climate into consideration), but the same mechanism is also an advantage: when political processes and drivers for change reach their tipping point, the new pattern will be more or less self-propelled and hard to change.

The idea that "systems move" and "institutions resist" are mystifying generalizations that need to be filled with people that act. Change is linked to the will and action of people, often organized in nodal networks (Burris et al., 2005), that cross boundaries of institutions, or by people in institutions that do more, or different things, compared to their role-manuscript prescribed by the formal institutional setup and tradition. Transitions away from an old institutionalized setup are our focus and in these periods, networks, individuals, bottom-up politics and markets will usually be crucial, much more than in a steady-state period.

In the next part we will analyze the two important concepts of "institutions" and "values" and bring them together. And after that we will be more specific on electrical energy systems and case studies on the lock-ins and possibilities.

6 Actors and Values

6.1 The respect for fire

The practical skill of making a fire was not far from the commodified product "energy". It was an important personal skill learned in the family setting, it was life saving and comfort-providing and necessary. It is also linked to religious beliefs. This is not a tale from hundreds or thousands of years ago, it is still a necessity for many, and we all have some part of it. For many, the positive symbolism (and taste) of "real wood fire"-such as bread/pizza baked in wood-fired ovens and the Argentinian, South African (SA) and US grill tradition (braai in SA) and the symbolic coziness and religious symbolism in lighting a candle. The skills and proudness of making a camp fire or the importance of being able and trusted by the family to handle and have your own "primus" for camping kerosene cooking. This is only to remind us that energy is originally a tale of skill, personality, family, food, survival, religion, honor, socializing, tradition and good taste, more fundamental and established long before the construction of an energy market. Fire encompasses a range of values and is tightly linked to personal and family values. As does classical fire, energy itself supports values in different forms and is integrated into personal and family life.

6.2 Governance and nature: Nature as value and the danger of commodification

Even if there is a long and important line of religious and cultural (and even scientific) expressions for the positive value of "nature", we must discuss a few very important different perspectives.

The classic ideals of governance come with several different views on "nature". The influential classic Greek elitism of Plato had a quite special construction where the ruling elite itself should be free from important aspects of their human character. Love, sexuality, emotions or children should be banned from the elite so they could have the virtue of pure reason. The whole Plato governance construct centered around a form of pure calculating reason that should be placed to rule from a point above "nature". After the classic period, the centuries of Christian/Catholic influence had their own twist where the "rational men" were to be trusted as rulers and not women because they had more nature in them (and less "God"). Nature was created by God and should be respected, but also ruled by humans (men) by applying rules and reason. In the Renaissance, governance took a turn away from religion and became more of a way of acting and thinking in its own right. Hobbes' construction of a mighty Leviathan (1651) that the weak and chaotic humans have in their interest to be ruled by is a little similar to Plato. Machiavelli advises on politics as a culture/art/craft that can be mastered and all are part of a movement away from both religion and the personalized king towards nation states ruled from a central point, applying reason and social power. In the debates on governance, morals and citizenship and their relationship to nature was also discussed. Some of the central actors, such as John Stuart Mill and John Dewey, (Selznik 1992) pointed out that humans were in, not above, nature, and that the "untouched" nature was (therefore) not an ideal, nature should be seen in the perspective of value and relevance to humans. In the discussion Selznik (1992: 58) points out the damage that is done when rationality is used without the braking force of reason and plural values. This is an important point that the new "modern" rationality attempts to use the emerging sciences as a model for politics. Hobbes used physics and mathematics as the model for his political visions, mathematicians/philosophers like Laplace (1749-1817) and Quetelet (1796-1874) argued for a ruling system based on top-down mathematical/statistical methods (Hayek, 1955). The Hobbesian vision of a one-point ruling system above humans and nature merged with new sciences that had the promise of making this possible in a precise way that included ever more aspects of nature and society taken in under the governing system (Foucault 1978, published 1991). And then we arrive at governance in the age in modernity. Governance and regulation will be further discussed in the next part. First we will use a few pages on the relevant forms of thinking and the culture and actor-forming that is relevant.

In the age of industrialism, attitudes towards nature became more aggressive and one-sided; it was all about exploitation of resources and central planning. The (short-term) progress made was easy to see (Soviet Union, Nazi Germany). This is an age that still forms parts of our thinking and values, and also was the formation period of the dominant energy regimes of today: the technology, the structure, the popular raw materials to use, the computational skills,

the mentalities as well as the distribution system and all its social fabric (Hughes, 1988). With electricity as an energy carrier; electrical grid-based energy systems became crucial to industrial growth; they became centralized and one of the main public utilities.

An old power station is a symbol of pride. Often it will have polished brass, copper and marble integrated in the technical layout and the building itself is designed as a temple of progress and prosperity. In paintings and pictures (good examples are China, Soviet-Union, US, Norway) the buildings and the high-voltage gridlines through woods and over mountains were presented in a glorious symbolic manner. It was man's victory over nature. This romantic and progress-oriented perspective is also today important (and reasonable) as symbol and value in poor countries. To be connected to electricity is the sign of progress in welfare, hygiene, education and family safety.

This modernity-type symbolism includes much more than electrical energy, even if electricity is an important and good example. The basic topic is the relation to nature in the industrial era. An important (1930's) critique came from the German philosopher Martin Heidegger (1977). He argued that modern industrialism created a way of thinking, a perspective that formed our value system with few possibilities of escape. This way of thinking makes nature appear very special: as a "standing reserve" for production. Trees are for paper, waterfalls for energy, soil for large-scale food production or metals, air is a source for fertilizer and so on. How to get the other values and the holistic soul of nature back into the human picture of nature? Heidegger thought it was almost impossible from within industrialism and searched for a solution inspired by the Nazi movement.

One specific aspect of "value" is the tendency to see it as money. With the modernity perspective of which Heidegger accuses industrialism, nature has no value *per se*, the only value is the one linked to its usage for production purposes. Even if early works of Karl Marx had a (for the time) good understanding of the metabolism of nature (Foster, Clark and York, 2010), his theory of value is linked only to the work that goes into the extraction and production. His analytical system (and his legacy) still remains a production-side value-system, where human work is the only significant value. This is also emphasized by Schumacher in his classical "Small is Beautiful" from 1973. There is a complicated addition that allows for a contribution to the owner of the land/resource, but our main argument remains.

This tendency for industrialized countries to see nature as a kind of free (and sometimes endless) stockpile of resources and recipient for waste is of great importance. We are not using the term capitalistic; the East European socialist countries had the same attitude to nature. The examples are many; one is that until the 1970's researchers and policy bodies in Norway believed that there was no connection between fishing and the actual amount of fish in the sea (Vartdal, 1975; Kolle, 2010)

But Heidegger is not only concerned about value as "price of extraction". It goes deeper, to genuine values, to the mystery, soul or spirit of nature and our lost ability to see it. Rachel Carson, by many called the mother of the modern environmental movement, was a biologist and her book (The Silent Spring, 1962) was mainly about facts. But in another work (The Sense of Wonder, 1965) she says:

> *To counter the "sterile preoccupation with things that are artificial, the alienation from the sources of our strength" it is necessary to cultivate a renewed "sense of wonder" toward the world and living beings. It is not enough to contemplate life. It is necessary to sustain it, which means actively opposing the "gods of profit and production".*

This is connected to the notion that the era of mass production also is the era of a special form of detachment, called commodification or alienation. It means that the background information and emotional links to products and its sources are gradually disappearing, replaced by calculation. We lose the attachment and the information and the emotional links to the production disappear: the place, the materials, the worker, the country and tradition. Finally the goods become only commodities, with no known relevant qualities besides price and technical properties. And this way of seeing the world also gradually becomes the way we see each other, the society, and finally, ourselves. Naturally this is not only discussed as negative by philosophers (from James Mill in late 1700, with Marx and Freud as the best known) it has also been counteracted by many forces; from branding and history telling and personalization of products via authenticity (Taylor, 1911/1998) as a strong force in markets. The pressure from consumers for products with authenticity is easy to see in many areas. Organizations such as Slow-Food try to decommodify food from its industrial settings, using words like sensuality, authenticity, tradition and social quality (Petrini 2007).

Again, electrical energy seems to be a very good example of a commodity resource. Electrical energy flows invisibly through cables and into our appliances at the flick of a switch and we have few ideas to its production, its toll on nature, and the people who do the work of generation and distribution. Electricity seems to be a fully interchangeable form of energy, being able to provide heat, light, cooling, movement; drawn from the electrical socket and manifested in the electrical device; as long as voltage and other technicalities are suitable for the device. Electrical energy is one of the most important and most commodified resources in modern life. Electrical energy as part of nature, as extracted and concentrated in ways that may harm the environment is not easily visible. Energy entangled in nature's processes is not easy to see. There are however a few authors (Paulus and Pierce, 2010; Murphy, 2007) that attack this perspective and argue for the possibility and necessity of linking nature and authenticity back into energy. One of the simplest arguments for this is that it will create possibilities for responsible energy citizens who treat electricity with the respect nature deserves.

There are already two practical tendencies in the energy markets that now can be seen as a small reversing of commodification. The first is the attempt by some producers to "label" and "brand" their energy in different ways. The simplest way is to guarantee that they only deliver

sustainably produced energy and that their chain of production is environmentally friendly as it goes into the net. They can also, like other producers, make claims regarding their organizational behavior (Corporate Social Responsibility or CSR) and take values and nature into their electricity in indirect ways (one example is that the producer will guarantee contribution to rainforest support, according to energy purchased). So electrical energy is not only energy, it is infused by values and branded as such. The other process is connected more directly to the generation of electricity. More sustainable and decentralized technologies are being developed into deliverable products and also distributional markets are more decentralized and diversified around many technologies. Off- grid technologies (solar, mini-hydro, mini-wind, heat-pumps) make it possible for individuals, families, neighborhoods, islands, boats, lighthouses, villages, individual farms and cottages as well as companies to be self-powered with their own energy. This can also be blended into their grid connection in several ways, the simplest being that grid usage is only happening when there is need above the locally produced energy or (more complicated) if there is an excess of local energy production which can be exported into the grid. (To use external energy only when needed is quite simple and included in modern solar water heaters, to deliver excess to a grid is a bit more complicated, but is implemented in large scale networks in several countries, like Germany).

6.3 Electrical power and decent behavior

Like all other social phenomena, energy is linked to norms that fundamentally express values. In some cultures you don't leave the lights on, in rooms you are not using. This is deeper than the electricity bill; it is about the values we share and the codes for decent behavior.

Generally the idea of the rational market actor has hampered our ability to see such value-driven fundamentals (Etzoini, 1988). Consumers cannot be understood from a generic private rationality-perspective alone (“Price matters, values decide"). Use of energy to make a “warm” welcoming home for guests in cold countries is as important as the habits of turning off as you leave the house. The values linked to sustainability gradually become built-in manners of decent behavior, both for individuals and companies. Recycling and waste sorting are going through such a process. Often such changes are too slow to be noticed or the analysts themselves share the values in a way that blocks this insight into them as something other/more than "the only way”. Foucault (1991) and Rose (1989) have highlighted the processes that build values into individual behavior. Daily-life values, habits, technologies and practices often show huge changes in a more sustainable direction, contrasting with more macro-oriented measures. Daily handling of waste, shopping selection of declared environmental-friendly goods and services and a respectful attitude to nature are easily detectable and often in contrast to large-scale factors like oil export and GDP growth.

In Burckhardt's (1860) analysis of the civilization process of the Renaissance in Italy, he is clear that the (self-) construction of a socially responsible individual was an important part of a process that made the whole society more decent and concerned, creating power structures

that had to take a web of factors into consideration, and where even the Doge of Venice and other noble rulers had to rule according to the norms of decent behavior. This was replacing an earlier system where "The King is the Law" (*L'etat c'est moi*) in which the level of brutality was significantly higher. Norbert Elias (1994) makes the point from another angle about how rules of behavior gradually change into a more "civilized" pattern, where "civilized" means rituals and habits that may be seen as treating the world and each other more gently and respectfully. A relatively new contribution is from Rifkin (2009) that uses the concept of "empathy" and includes the biosphere. An interesting contribution is from Bruno Latour that invites us to see the bonds (network elements) between nature, things and humans as the basic relations of a governing network (Actor-Network Theory (ANT)).

For us the point is that habits and internalized values change and reflect underlying beliefs and considerations, and considerations of energy usage and its link to nature may be one of them. There are many organizations and public initiatives today that actually work in this area, classifying both levels and type of energy usage into areas of "decent behavior". In the corporate world the popular concept of CSR (Corporate Social Responsibility) is gradually replaced by CSV (Creating Shared Values) that remind us to see also the corporate world as actors with values, and values that can be shared and, as often is the case, represent popular and non-contested values of nature.

6.4 On the planet Dune

One of the most famous science fiction novels ever written is DUNE by Frank Herbert (1965). The DUNE series consists of several volumes adding up to around 4 000 pages from 1965 and was dedicated to dry land ecologists, who at that at that time formed a very small part of the science community.[2]

On the planet Dune, water is the really scarce resource that has to be concentrated, organized, saved, stored and circulated. The villain of the story is a high-technology culture protected in large spheres, using imported energy. They have all the traditional aspects of an industrial-modernist perspective on nature: They use technology to be protected from nature, living inside their high-technology bubble. The heroes, on their side, well aware that they are part of nature, have a set of values and traditions, as well as some selected, advanced technologies. All dedicated to respecting and handling water. The metaphor of dying is "to give your water back to the tribe". Water handling and respect for the planets' very limited water resources is the foundation of the civilization and is within all sub-parts of its social systems: Religion, hierarchy, family values, trade, and technology regimes. The ability of the heroes to respectfully be a part of nature is, in the end, the secret of their victory. This kind of story is of course repeated in later popular culture and the recent Avatar-movie (2012) is an example, where the heroes literally melt into nature and the villains are high tech-protected exploiters. For our purpose it reminds us that governance and its roles and actions are rooted in ways of thinking and in organized daily-life value systems.

[2] The movie (1984, by David Lynch) is not recommended in our setting, as it concentrates on the "war- and action" aspects of the story.

6.5 Energy citizenship

The classic notion of "citizenship" is changing. It used to be linked to nation-state duties and rights, especially in the formal political system. But individual freedom and resources, as well as the changing character of nation-states, have created different citizens' identities and initiatives in many sub-areas (Isin and Wood, 1999). Citizenships, responsibilities and actions are formulated and socially created around platforms of race, sex, gender, consumerism, environmentalism, food, and (of course) energy. They are platforms for formulations of values, rights and interests, making organizations and actions emerge and forming individuals' minds. The struggles of indigenous people are examples, as is the gay movement. Food as a platform for citizens' responsibilities and actions were clear already in the early years of the role of housewife (also linked to the science and education in "home economics"). Linkages to traditional politics were made through campaigns for saving resources, reducing imports and more generally, educating new responsible citizens in food-related areas. After the era of the housewife, this citizenship was no longer connected to a personalized role; it became more generalized and was gradually linked to broader social values. The big range of food-related organizations (farmers, processors, distributers, sellers) are increasingly taking up topics such as fighting industrialization (=commodification), health considerations, environmental and climate responsibility, diversity and culture as well as minority interests and fairness for developing countries.

Energy citizenship is only in its beginning. The concept has also (in the US) been used by big oil companies pushing the interpretation as "the right to energy". But mostly the idea has been linked to the responsible energy behavior that takes the environment into consideration and there are some examples in the literature on the conditions for developing such a citizenship role. Responsible energy behaviour can be seen as an arm or a further development of "Consumer Citizenship" and its conceptual cousin "Political Consumerism". Consumer Citizenship is a common concept that covers school education, international Non-Governmental Organizations (NGO's), governmental initiatives and a substantial stack of literature. Our general argument of taking responsibility and linking to values of sustainability and nature is very clear. Citizenship development depends on the ability to have a choice, make a difference, to take responsibility and that again requires market possibilities and information on consumption and the consequences of the consumption. Technologically this also points to energy monitoring devices such as "smart" meters and the organization and information capacity of organizations (often NGO's, but paradoxically often also the sellers/producers of electricity).

The biggest users of energy are companies (50-70% of total). They are also actors (organization-level citizens) and including energy in their CSR/CSV work (even sometimes the using energy citizenship concept) is becoming more common. The fact that companies are the main consumers of electricity must be taken into account when actions and changes are discussed.

Also parallel to the food citizenship is the (anti-commodifying) process of shortening the social and geographical distance between production and consumption. The popular example is the growing "farmers' markets" and the Slow Food movements. This puts producers more directly in contact with consumers. The result is information and knowledge on food as nature, discussions on how to prepare food, the values included and how to grow etc. Consumers will become more proficient at producing and more selective about consumption, and this will impact their own activities, leading to the phenomenon of the prosumer (Toffler, 1980). The concept is a combination of "consumer" and "producer" and is used for describing consumers that are engaging seamlessly into the producer role. This can be seen in the rapidly growing popularity of many kinds of urban food production, examples are the renaissance of school gardens and allotments, as well as farm holidays. For the energy sector this will emerge as the gradual mobilization of consumers from active consumers to co-producers (prosumers) of energy, both for their own consumption and for delivering to the grid (limited by their private usage, their company needs or and access to a smart grid). Parallel to the food sector, there is a gradual development from increasing responsibility and economy in the home, to more neighborhood and political-type action and even involvement in (alternative) production. Energy is becoming linked to nature and establishes a platform for consumer actions and even a role as an energy citizen. This role is one of the most important drivers of change, given institutional and regulatory opportunities.

6.6 The weak consensus values

What kind of political value is in the link between nature and energy? We stated earlier that the value was more or less consensual: It is not seriously contested. We will probably have no political parties that state clearly that they oppose taking nature into consideration regarding electricity generation. Quite the opposite, at symbolic levels most companies and actors pay tribute to these values. Even British Petroleum (BP) tried to explain their name as meaning "Beyond Petroleum" and both Shell and Norwegian Statoil are advertising in newspapers about their commitment to clean sustainable energy. In our daily shopping life, there are tens of thousands of declarations, markings and claims on all kinds of products and services regarding sustainability. Also popular culture has changed, categories like Eco-thrillers and Climate-thrillers are now quite common. Even the famous Matrix (1999) movie-trilogy started with energy for computers being unavailable due to human-made climate change and the need for new sustainable energy sources. Surveys also underline this culture of being concerned and taking nature seriously.

So why do we use "weak consensus values" in this section heading? In this discussion, we focus on the institutional level. The basic and traditional party structure of most industrialized countries was made around the material interests of production (workers, owners, farming, fishing). There are exceptions and they are growing in number (green parties), but the primary political structure is still evolving around production-side interests. Around this political structure there usually is a system of strong organizations that are represented in committees and formal negotiations. They are even more marked by the production- side bias. And more and more there is a system of paid lobbyists strongly representing the owner side of production systems. Many lobbyists are people with green values like others, but in their work

they are bound to their institutional roles of promoting their organization's particular viewpoint or product.

It is a relevant observation that this logic not only applies to values of nature and climate; it also applies to development, nutrition, health and peace. They are all rooted in social consensus, but may be at odds with the structure and values of the formal political power system and its implementation bodies. Again, this could be seen as more or less reasonable when knowledge of damage to nature was missing and benefits of economic growth was easy to see in health and living standards. But now these common consensual values seem to become a dramatic problem when they are rejected by institutionalized power systems. There is, however, one positive side of the consensus-logic: it seems to be like a "ratchet", that is moving forward in small and largely irreversible steps. Values like nature and climate, have a good media potential, and they will gradually change practices; again the example is the myriad of small, daily life habitual changes, in new regulatory rules, labelling, the application of criminal law to environmental damage and in the emerging international negotiations (e.g. COP21 and the Paris Climate Accord).

Our task is to look for openings and configurations that link individuals to institutions in ways that makes change possible.

7 Governance, Regimes, Regulations and Institutions

Governance

The discussion of governance in the previous section ended with a pessimistic discussion of the problematic merger between Hobbesian centralism and industrial modernity hubris that lead to commodification of nature among other problems. This has been analyzed critically and it was found that attitudes have started changing, practically and also at the theoretical level. The popularity of the term "governance" that replaces "government" is a good indication, "governance" pointing to the loosely composed set of actors and systems that govern. The classical government is one of the important parts in such a system, but it is open and empirically defined, and then also open to multitudes of values and actors.

7.1 Governance of nature

This is not the place for a lengthy discussion on the character of governance activities towards nature and the trends in change, but two different and classic studies of forest governance will be discussed before we continue to more energy-specific topics.

All trees present and accounted for… (James C Scott: *Seeing like a State: How Certain Schemes to Improve the Human Condition Have Failed* 1998)

Scott's book has a strong theoretical argument in the Hayek tradition of explaining how a central authority (state) must simplify and standardize in its governance; they have to "see" the world in a special way characterized by standardization, simplification, accounting procedures and statistical techniques of averaging. And because of this tendency mistakes are made, especially when dynamic processes and pluralism are involved (like nature). Scott has his background in political science, anthropology and agrarian studies and his examples and case studies in the book are mostly from large-scale attempts to govern nature. One example is from Germany in the 19th century and is also a good illustration of Heidegger's point. It is the attempt to centrally and rationally govern the forest as a production system for wood. The best way from the state perspective is to line up the trees in rows (to allow easy counting and control procedures), to ensure they are as similar as possible and to minimize all other life forms that might disturb the process. Then it is possible to calculate production, plan the tree felling and have a rational plan for the usage of the wood, with very precise information on volume and quality. This was (and is) not so special; it is used by most industrial farm-/plantage- like enterprises. It is the long-time frame for Scott's study and the forest as a complex natural system that clearly shows that probably this strategy was not optimal. It was a kind of success in the short run, for the first few (2) generations of trees. But for all other usages of the forest and in the longer run it was a disaster that exemplifies very well how the industrial/centralized way of seeing like a state is ruining nature.

The forest becomes complicated… (Kaufmann, 1960; Tipple and Wellman, 1991)

Herbert Kaufmann's *The Forest Ranger* (1960) is a classic study in political science, about the role of the governing agent of the forest. For us, one of the main point points is that the stability, unity and success of the forest rangers are being made possible through two factors. One is the relatively limited scope for the "governing" forests, maybe "protecting" or "inspecting" are better words for the set of relevant goals with efficiency and economy as keywords for the internal life of the system. The other is a structure of freedom and fragmentation at the bottom level, leaving the individual forest ranger with broad possibilities for adaption to local conditions. Thirty years later, his study is re-analyzed by Tipple and Wellman (1991) in *Herbert Kaufman's Forest Ranger Thirty years later: From simplicity and Homogeneity to Complexity and Diversity*. One of their main observations is that Kaufmann could see the policy goals for natural resource management as stable and simple, in accordance with the limited scope of governance and the lack of conflicts in this area of politics. Thirty years later the environmental movement is an independent political force, the indigenous groups are organized and have relevant interests, the tourist industry is reaching into the forests and generally the list of values and interest to be taken into account is not only significantly longer, it has become unpredictable and unstable. Not only has the forestry system grown more complex, containing ever more shifting values and interests, but in addition the evolving scientific premises are being led by new sciences of ecology and climate. The structure of policy implementation has changed from a simple hierarchical system to a complex system of representation, negotiation and responsiveness. From a

hierarchical government implementation system of limited scope to a system of governance to be interpreted, created and handled at the local level.

Together these two contributions to understanding "governance of nature" highlight both the problems of the centralized simple implementation of a production-side perspective on nature and the challenges of the more complicated modern shifting multi-stakeholder governing systems, highlighting the many different human roles and interests that relate to nature. Just a few decades ago, energy production was almost only engineering and economic matters. Now major energy projects face a long series of possible considerations relating to an ever more complicated knowledge of nature, indigenous groups, agriculture, fishing and forests, tourist interests, aesthetical considerations, evaluation of electromagnetic fields and their possible harm, district interest and (if nuclear) a time-frame of thousands of years. Most people today will accept that this is about values and politics linked to a wide range of different skills and knowledge, while the common attitude in 1960s and 1970s was that energy projects were simple engineering/economic matters.

7.2 To govern and regulate public utilities

Energy systems are both very relevant for nature and a central public welfare utility. At least from the Roman era, public utilities have been at the core of state responsibilities, or we could go further back to Egyptian irrigation systems. They have been owned, maintained, organized, used and paid for in many ways, but the responsibility and initiative have always been at some governmental level. The governmental responsibility is normally built into laws that give public bodies special monopoly or regulatory powers and duties. The areas have been infrastructural services like water supply, sewage, waste handling roads and canals. Urban development brought these infrastructural elements more into relevance and modernity and technical progress added new elements like railways, gas distribution and several forms of electricity as well as more sophisticated services linked to planning and administration. The special aspect of electricity usage, both as energy (our interests) and communication (from telegraph to internet), is that it starts when modern industrialism and modernity starts their rapid growth and is built and institutionalized in the era of high modernity and industrialism, infused with these values. There is one important difference between electricity as energy and electricity as communication. Electricity as communication went through a dramatic period of reorganization, decentralization and technological change from the 1980's with personal computers, mobile phones and the Internet. The traditional physical copper-wire grid is no longer necessary for telecommunications; national monopolies are difficult to defend and many countries in the developing world can leap-frog the level of a physical grid and go directly to internet/mobile structures. The idea that electricity energy systems stand before a parallel revolution is important to consider. Decentralization, standard-setting to replace direct central command and a series of new technologies with the capability of downscaled energy production, from solar cells on mobile phones and lamps to wind and solar systems on houses to local area-based hydro-electrical, wind, wave, solar or biogas generation technologies. This is the direction of the technological possibilities that opens up. Utility-scale, grid-delivered electricity costs are not decreasing, while most of the small-scale electricity generation

systems are becoming more economical and these technologies may profit from the advantages of electronic mass-production that drove the computer and mobile phone revolutions.

Electricity systems emerged in most countries as small-scale private and local public initiatives, but were soon to be transformed into huge centralized, state-regulated systems, driven both by economies of scale and by general trends in governance and state development. The steep rise in electricity production in the first half of the 100s facilitated and was caused by the growth of heavy and concentrated industry, further emphasizing large plants and grids. Municipal ownership of electrical plants is as old as the industry, both the first municipal and the first private plant in the U.S.A was built in 1882, thereafter there was a steeper growth than for any other utility area for around four decades (Thompson and Smith, 1941).

It is important to note that even if public utilities can be built, owned and run by private enterprises, the basic responsibility for their existence, functions and price lies with the state (Thompson and Smith, 1941). In some countries the main part of important public utilities has been privatized (like electricity in the US in the 1930's), but they are heavily regulated due to their role as public utilities *".... by legal definition, they are vested with public interest and perform a public function even though privately owned"* (Thompson and Smith, 1941: 600). As explained in traditional (=not neoliberal) economics, this is due to at least three arguments: 1) the service's nature is critical to society (=the "public utility argument"); 2) the service being a "natural monopoly" in its nature and 3) the combination of huge up-front investment and low unit costs in production, making both investment and production vulnerable and in need of regulation for protection. It is important to note that the final responsibility is political: this necessitates a very special regulatory regime for electrical energy supply as a public utility, even more so when we take into consideration that public ownership and/or special granted money are involved in most of the large electrical energy system projects (and 100% if they are nuclear).

Regulation

Regulation, in our context, can be seen as the use of power systems (classical: state power) that ensure that (market) actors are acting in a way that is socially wanted.

Regulation is one of the oldest and most efficient ways of changing behavior. In its classic form it emanates from single-point holder of power that makes rules in order to regulate (market) transaction, procedures and individual conduct. Most classic textbooks put the logic of regulation into a market society. Regulation is about making rules to ensure that the output of the market is within socially acceptable limits. In recent years this one-way, state- centered perspective has changed (Braithwaite, 2008) into a more dynamic and multi-centered perspective that provides a wider map of regulative relations that has many actors of many kinds (state, regions, companies, independent classification and certification organizations, NGOs, etc.) on several levels (regions, nations, international, global, sectors, value-centered) with a large toolbox of regulatory techniques. At the heart of regulation is the shaping of motivation-incentives so as to reshape patterns of action at both individual and organizational

levels. Since state regulation in the electricity sector is usually old and institutionalized, the modern marketization reforms usually building upon older systems of knowledge and regulation, often even more so than in the case of the producers, it is important for us to identify the web of different regulatory forces and even nodal networks. Regulatory incentives are often seen as the best way of changing a market, creating the necessary opportunities for the changing (even game-changing) actors. One example is the tariff systems that make production of wind energy profitable for investors. The regulatory web is bridging between actors in the market, both producers and consumers on the one hand and the institutionalized systems on the other. The fact that these divisions are not clear-cut adds to their importance as dynamic possibilities of change. The situation for the regulation of electrical energy production is unique in many ways: More often than not energy sources and production facilities are publicly owned, and even more often the sources are seen as national natural resources that need special protection and rules. Technically, energy production needs a standardized distribution system that reaches the final users, creating a chain of interdependent systems that form the whole electricity sector. Again this can be organized in many ways; traditionally many countries used the basic division between levels of public administration, that is, from state via regional to local authorities. Since the strong belief in the central state has changed to a strong belief in markets, the organizational setup has changed so that some element of competition is possible at some points in the system. These systems have all the hallmarks of public utilities, and natural monopolies and present many structural challenges to multi-supplier systems. As a result the regulatory regimes are rather complicated and often involve the state, state-owned enterprises and state initiated regulatory bodies. Only small sections of the system resemble the traditional setup of a "free" market overseen by a state-initiated regulatory body. In this complicated landscape there will be regulatory and institutional lock-ins that block change as well as islands of opportunity that could be used by new actors and new technologies. One example of such a lock-in is the South African system where the monopoly of the regional and local authorities are combined with the consumers dependence on electricity into a convenient way of generating revenue for the public sector[3]. An opposing example would be the free market for solar water heaters and solar photovoltaic (PV) panels on private homes that are not accessible by regulators, but that can be subsidized and (for the solar PV panels), connected to smart meters systems and included in the grid structure (as in Germany and many other countries).

Regimes

From system dynamics (Geels, 2004), the concepts of a socio-technical landscape is of great importance, especially because it reminds us of the inter-linkedness of technology, organizations and people. Within a technological landscape there are a few (dominating) regimes that represent a technology and its embeddedness in the society. Other technologies may be possible and exist in niches. The challenge of working with change is to understand the conditions for turning a niche into a regime and dismantling an old regime, hopefully not

[3] In Norway the Court system ruled that it was not legal to use electricity prices as a kind of tax income for municipalities. But it was allowed to sell an electricity company (for profit). After this decision local government bodies sold off their electrical utility companies. One effects is that at least this kind of lock-in is avoided.

as a result of a destructive/disruptive crisis. These concepts are important, but as we see it, they will not by themselves explain changes. That needs the inclusion of actors, through democracy and citizenship on many levels, through consumer action and market dynamics, and helped by regulatory means. As such change needs actors that connect and act outside the paths laid out by institutions, often nodal networks can bring niches over the tipping point and into new (more sustainable energy) regimes.

Energy regimes, in the eyes of a modern state

The way a society is organized structures the way a problem or aspect is seen from the point of view of decision-making actors.

For a long, and important period of time (the first and second industrial revolutions) energy has been produced through a few technologies that have produced power centrally and then distributed it through a centralized grid. This arrangement made rapid and significant "progress" possible. However, gradually the cost of this "progress" was that it restricted the ability of humans and institutions to imagine and realize other more sustainable possibilities.

Indeed these alternatives became viewed as either problems or as irrelevant. An example is the energy crisis in South Africa – where the problem-solving energy alternatives that are structured by the existing grid and the pressure to provide "energy security" took precedence over other solutions. The consequence is that other possibilities are either overlooked or rejected if they do not support the existing coalition of interests of producers, government systems and consumers. The old institutional setup in production, distribution and consumption has created systems of learning and handling that support these systems and have created series of organizational and mental lock-ins that make new directions and solutions seem "impossible" or "too expensive".

Through the lens of state institutions the energy landscape may seem simple to describe due to its relatively centralized and standardized character, however this view fails to see the underlying opportunities for considering alternatives. For us, the most interesting parts are in the niches, where possibilities for change exist.

New energy regimes: Multi-sourced, decentralized

The problem with the structure we have now is not only that most of the existing energy production systems use technologies with high levels of carbon (CO_2) emissions. They also have problems that derive from the huge size of their production facilities, expensive grids and very complicated storage and reserve facilities.

The new technologies that are already functioning in niches have become innovative in two related areas. Firstly, new possibilities for new sustainable sources have been revealed. Many of them can be up scaled and downscaled in size and will therefore give possibilities of decentralization and flexibility, across the whole system. Secondly, there are new niches in grid development that are facilitating prosumer (se section 6.5) developments. Regional organization and multi-center systems are emerging. As mentioned

above, the computer network revolution might be a good parallel for what is happening in energy systems - that is the death of the system with few mainframes, passive terminals and huge central grids evolving into a system of almost endless and flexible number of units linked into self-structuring nets ruled by standards more than by command-and-control regulation.

7.2 Institutions

Institutions may be seen as sets of rules and values that are guiding actions, putting values into actions through routines, Power, values, interests are attended to without the day-to-day struggle or discussions. Most of our political institutions were cast (infused with their values) in a time where growth, industrialization, mass production and general measures of "welfare" were on the agenda and before the costs to nature and hence the cost to our own fundamentals became known and created an opposing political force. And these political systems did well. Linked to the construction of national states we got the centralized way of seeing problems of society. This is an era of huge and important discussions and conflicts, but for our purposes two main hypotheses are used:

In a way, we can say that institutions are taking on a life of their own, leaving the actors and conditions of their formation period behind. Most of the time this is good, since we can grapple with a problem, develop a solution, create an institution, go to the next challenge, and the running of the system only needs actors that perform according to their traditional roles. But when the task or the knowledge or the technology changes, this fundamental ability becomes the problem. The basic institutions of energy supply belong to the era before the environmental, sustainability and climate challenges and before the series of technological niches of solar, wind, waves and heat pump energy became usable technologies.

As these institutional assemblages emerged they were tightly coupled to the construction of nation states. As this happened, a centralized way of seeing problems of society – (like in Scott's (1998) *Seeing like a State)* - emerged.

The classic mental picture of a modern institution is as often as a "governmental body", where values and practices and power is linked to tradition, law and democracy in a package of governance.

But values can be infused and changed into habit and routine in other ways. One of the classic ways is through the agency of religion or basic beliefs and values. The Jewish tribe of the Old Testament was a classic, nomadic society. Most of their rules and administration needs were done with a minimum of institutional bodies, most were handled through religious beliefs: sexuality, family matters, food practices, and hygiene. These values were built into the backbones of the citizens and socially enforced on all levels.

The successful handling of climate challenge in Dune (see above) is also an example. Some high technology solutions, some tribal rules, some religious influences, coupled with some charismatic leadership; all built into a fundamental respect for the planet and its water. The point for us is that values can work in many ways, and that our form of modernity with heavy

reliance on formal administration is not the only way to go, or more precisely: not the only way that is in action.

Most modern societies have strong channels between individual values and policy. We will be interested in the importance of democracy and its citizenships and markets as such possible means, and the markets contain both companies/entrepreneurs and consumers and some important mixes between them.

In a more general way we can say that organizations and (socially fabricated) systems must be seen as actors (or actants) in themselves (Latour, 2005). For us this is easy to see: A huge power plant will require a grid, many competent people, an administrative body for distribution to many customers and linkages to many sets of actors who must have certain skills. More than that, it will invite and maintain a set of experts and knowledge systems. These will be good at running a centralized energy system, and equally suspicious of and uncomfortable towards other solutions. In many societies (China, SA) this way of delivering electrical energy became tightly connected (both as symbols and at the practical level) to the project of national production growth, and welfare and consumption. Historically this was especially evident in the Soviet Union where engineering, huge power plants and (metal) industry were seen as the main driving forces of progress and became the symbol of the victorious revolution and the new society.

Path-dependency and government regulations

One theoretical tradition that is useful for our discussion on institutions, power and actors is the theory on path dependencies.

> *"The message of path dependency appears to be simple: once you´re on you probably can´t get off." (Meyer and Schubert, 2007: 24)*

Within the theory of path-dependency there are different theories and suggestions as to how the path actually occurs and evolves through time. Time and "history matters" will be central, but also the ability of different actors to shape and create the path. These actors could be powerful actors like government, industry or public groups.

"Path-dependency" is described through theory in many different ways. Some researchers say "path-dependence" refers to the case where history matters (Mahoney, 2000: 507), others claim an adequate definition is rare or hard to find (Pierson, 2000: 252). Path-depending process is used increasingly to explain the emergence of novelty (Garud and Karnøe, 2001). Social scientists do distinguish between the two important terms "path-dependence" and "path-creation".

In a path-dependence process, it is claimed that early stages of the path will be most critical for the development of the path.

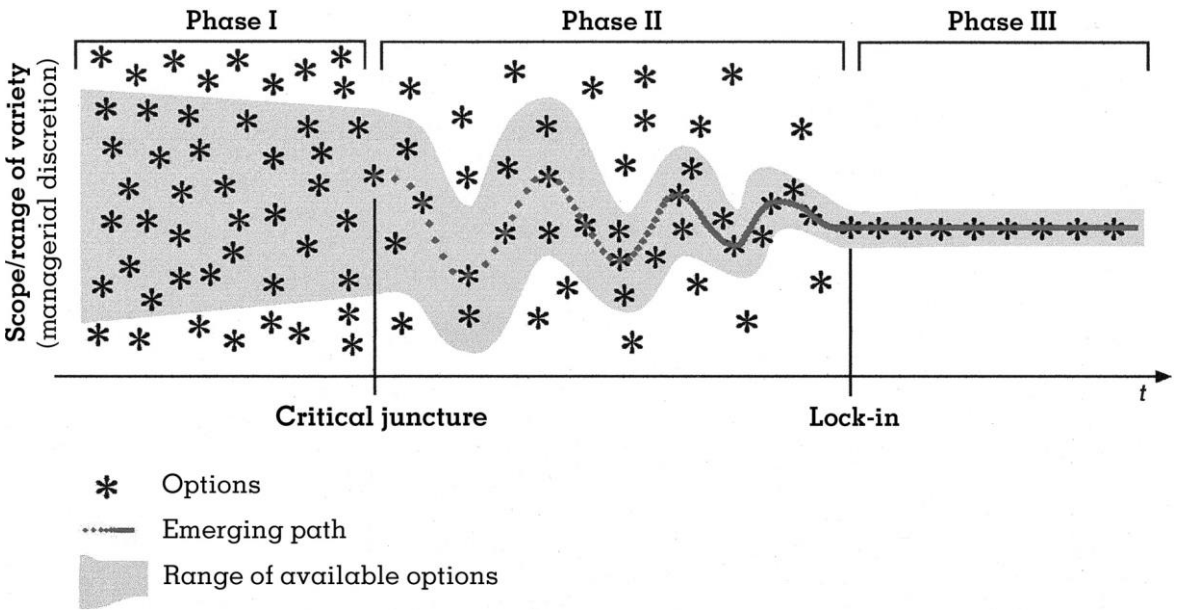

Figure 1: (A path develops and locks in)

The figure presented above shows three phases.
(1) from the start of a path-dependence process;
(2) emergent of the path and,
(3) the lock-in phase.
The process starts with many different possibilities. By making some choices in Phase 1 the range of available options is narrowed. In the beginning of Phase 2 the emerging of the path could be seen, and at the end of this phase the path becomes clearer and clearer. When Phase 3 is reached, the availability to select other options is lost. As Jörg Sydow and Schreyögg (Sydow et al., 2009: 692) explain, the flexibility is gone and businesses or regions are restricted to certain choices or action patterns. At this point the "lock-in" occurs.

It is anticipated that path-creation is not that unlike a path-dependence process. Both are based on the same assumptions that the technological development is embedded historically, the path might stabilize and if it does it is difficult to reverse it (Meyer and Schubert, 2007: 26). Uli Meyer and Cornelius Schubert (2007: 27) argue that there is a problematic simplification with the classical path-dependency concepts. The simplification could be addressed by highlighting the deliberated aspects in path creation:

1. *Powerful actors can strategically influence the development of a path. They can shape the path, while over time they are themselves shaped by the path.*
2. *Increasing returns and lock-in are subject to deliberate actions and tied in with broader social dynamics.*
3. *The creation, but also the ending of a path may be caused by deliberated actions which do not necessarily have to be external.*

Path-creation on its own is insufficient to describe how a path evolves after it is created (Meyer and Schubert, 2007: 27). The path-creation processes is set in motion by entrepreneur in real time. The aim is to shape institutional, social and technical facets of an

emerging technical field (Garud and Karnøe, 2001). By understanding path creation, it could be possible to understand how entrepreneurs escape from technological lock-in (Garud and Karnøe, 2001).

The Master's thesis "Wind power success in Brazil" (Persson, 2015) has used the path-dependence theory to explain how and why wind power technology and production during the PROINFA-programme (Program of Incentives for Renewable Energy) (Persson 2015:9) was lifted out of it niche-character. In November 2014, Brazilian companies managed, through energy auctions, to provide wind-generated electricity at prices competitive to those from hydropower and non-renewable sources. Persson (2015) concludes that the government policy to create a new energy path for renewable energy – path creation - was a necessary institutional action to reduce risk for investors. He discusses three possible explanations for the Brazilian wind-power success. New technology and entrepreneurs looking for profit were not sufficient factors for explanations. Lock-ins of energy production paths had to be opened up by a governmental actor as well, pointing to the general important role of governmental regulation in the energy sector (Persson, 2015: 85).

8.0 Summing up, focusing on factors that press for change

Our research topic is to understand the dynamics that will change the electricity energy system towards sustainability, narrowing sustainability into harmful climate impacts. In this section we will list the factors we have discussed, classify them and group them together into clusters, underlining the fact that most changes have more than one driver.

The first of the group of factors is general in its character, explaining possible reasons for change. The first and most fundamental is **the Anthropocene**, the fact that we as humans are influencing/making/destroying our habitat and are aware that this is the situation and that this should fundamentally change our ideas of and our abilities to effect change. We are reconstructing ourselves as Anthropocene actors. For energy this is narrowed down to the harm that is done by the burning of fossil fuels and hydrocarbons to extract energy and emitting huge amounts of CO_2 and other greenhouse gases into the atmosphere. Energy production is the most significant single factor that harms the climate through CO_2 emissions

The second factor is closer to our own health and short-term damage, it is about more **local pollution factors**. This is most visible in China and in some local areas around production plants, but is certainly visible and creating attention and direction.

The third factor is linked to a general consequence of modernity; **commodification,** that means that goods and services production become disconnected from the producing forces of nature and humans become anonymous and generalized, like electricity in the grid. Since the start of modern industrialism commodification has created several kinds of discomfort at the human and cultural level resulting in a longing for the personal and authentic and the responsible role of the actor-citizen.

The fourth factor is **technology development** that continuously widens the menu of possible solutions. In the energy sector these are many and will continue to be developed, due to the nature of energy as: 1) not a finite resource, 2) embedded in the fabric of the universe in so many ways. The developments may be theoretical/experimental (like nuclear fusion), developed as working prototypes (like Nuclear Generation IV), developed into real-life technologies (like wave energy and Concentrated Solar Power) or on its way out of the niche into a sociotechnical landscape of its own with mass-production and predictable pricing (like conversion to hydrogen using renewable energy from solar panels and wind). To these production technologies we must add developments in grid technology in the direction of grid intelligence and decentralization. In all cases these are possibilities that create awareness and direction for change. But which technologies become dominant, alone or in combination, will depend on many factors that create new paths. Too much literature in this field is a bit limited by technological determinism, that something must happen because it is possible (one important example is "J. Rifkin (2002), The Hydrogen Society").

The fifth and last factor we will discuss is linked to **grid-based electricity production/delivery problems**. Dependence on electricity becomes more significant, especially in urban areas. Electrical security is part of civilization. This security may be threatened by production and grid reliability crises (as in in South Africa), by more complicated and vulnerable communication and grid-loading infrastructure services and new developments in power usage (like electrical cars and induction stoves).

Pressure for change is created through actors and combinations of alternatives. Three examples are easy to observe:

(1) The very visible and dangerous air pollution in China goes together with Anthropocentric consciousness (Circular Economy, Ecological Civilization (Xi Jinping 2014, Geall/Hilton 2013)) and manufacturing profitable possibilities (wind, sun) (Mathews 2015)
(2) The electrical supply-crisis in South Africa goes together with commercially available new technology (solar, wind, batteries) and Anthropocentric considerations have resulted in pressure to change;
(3) The anti-commodification cultural trends among consumers fits well with new developments in decentralized electricity production and smart grids, in some countries also linked to Anthropocentric values.

So far we have described awareness and possibilities for change. But will change happen? And which possible (combination of) developments will make new paths and change institutions to a new change-resistant pattern? This is of course a complicated guesswork of motivations and possible paths, but some elements seem to be crucial. Involvement at the political/regulation level seem to be of special importance for electricity for several reasons. Energy supply is linked to welfare and civilization in a way that makes it a core public utility. For whoever is responsible for the production of electrical energy it becomes a political task to ensure that adequate energy security exists. Energy production and distribution also have some special properties that call for regulation and protection. The classic form of centralized production is extremely loaded with big up-front investments, long implementation times and

low running costs. This is a classic recipe for market failure if there is no protective regulation. The new decentralized and sustainable sources may benefit from market-based mass-manufacturing and consumer demand, but they also need external support to reach a tipping point of cost, volume and standardization. Herein the case of many renewable energy technologies the running costs are so low that the risk of race-to-the-bottom price wars is high, which might make these ventures financially risky. As it is for telecommunications, connectivity and standardization depends on regulation. There are also safety issues with distributed and autonomous sources of energy. The role of regulation can also be seen the other way around: How existing regulation is protecting old patterns and blocking changes. This happens by having been created to serve the old structure/ so rules, routines and culture are not adapted to the new energy sources. And also by regulation actively blocking alternatives because of vested interests that make new technology appear as a threat to the old systems and the sources of revenue they depend on. Regulation can thus both create lock-in loops and doors that can be closed or opened to change.

To end up with an optimistic and possible pattern of possible change, the following chain of events may happen so that a new sustainable energy socio-technical landscape will be the normal path:

Anthropocene responsibility will be a factor on many actor levels (politics, companies, citizens) that fit with new and more decentralized and sustainable ways of energy production, storage, distribution and consumption. This also fits well with the tendency for modern consumers to want a clearer actor status with less commodification. These forces are helped and formed by regulative skills and structures so that the new systems pass the tipping points and become the new mainstream. The material and immaterial structures of the old industrial modernity will be left to creative destruction, propelled by its destructive effects of pollution, climate damage and lack of adaptability to energy demands in developing countries. The old will give way to new forces and on the way create opportunities for energy citizenship and production that are sustainable and non-destructive.

What will be the energy scenario of this development? The possibilities are many, but there are some clear directions that point to a more decentralized multi-source production and co-production, supported by a more bidirectional and communicative grid management as well as better off-grid possibilities. The sustainable sources of wind and sun are already as cheap as the old technologies, and faster in implementation. Their limitations of intermittency are linked to the rapid development of storage technologies (batteries and hydrogen) and some prevailing large-scale plants of old technologies. Many factors press in this direction. This scenario is one of many, its only purpose is to be part of argumentation discussion that, in short, is saying that the special energy regime of industrial modernity can be changed for an energy regime that is fitted for a post-modern and Anthropocene-conscious era.

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