Sirkka Heinonen, Joni Karjalainen, Marjukka Parkkinen & Juho Ruotsalainen

CLEAN DISRUPTION FOR ABUNDANT FUTURES

Neo-Carbon Energy Futures Clinique III

NEO CARBON ENERGY

Finland Futures Research Centre
FFRC eBOOK 2/2017

Turun yliopisto
University of Turku

FINLAND FUTURES RESEARCH CENTRE

Sirkka Heinonen, Professor
Finland Futures Research Centre, University of Turku
sirkka.heinonen(a)utu.fi

Joni Karjalainen, Project Researcher
Finland Futures Research Centre, University of Turku
joni.karjalainen(a)utu.fi

Marjukka Parkkinen, Project Researcher
Finland Futures Research Centre, University of Turku
marjukka.s.parkkinen@utu.fi

Juho Ruotsalainen, Project Researcher
Finland Futures Research Centre, University of Turku
juho.ruotsalainen(a)utu.fi

Cover photo: Shanghai First Foodhall by Marjukka Parkkinen

ISBN 978-952-249-474-0
ISSN 1797-1322

Finland Futures Research Centre
Turku School of Economics
FI-20014 University of Turku

Visiting address: Rehtorinpellonkatu 3, FI-20500 Turku
Korkeavuorenkatu 25 A 2, FI-00130 Helsinki
Åkerlundinkatu 2, FI-33100 Tampere

Tel. +358 2 333 9530

www.utu.fi/ffrc
tutu-info@utu.fi, firstname.lastname@utu.fi

”Energy and persistence
conquer all things.”

Benjamin Franklin
(1706–1790)

CONTENTS

PREFACE

This report describes the results of the two-day event focused on the futures of energy, internet, clean production, practices of selforganising, and changing social relations. The used material for the foresight work were the four transformational scenarios of the Neo-Carbon Energy project. Neo-Carbon project studies the replacement of fossil carbon and fuels, with those produced from carbon dioxide, water and electricity. The Neo-Carbon Energy scenarios aim to open up horizons for various futures of how an emission-free society will look like.

Today we live in the middle of remarkable energy disruption, clean disruption. It is driven by global megatrends interacting with and amplified by a set of shifts taking place within the power sector. The megatrends like technological breakthroughs, climate change and resource scarcity, demographic and social changes, a shift in global economic power and rapid urbanization, IoT and artificial intelligent are challenges for all businesses. Energy system disruption takes place both at the level of individual technologies and at the systemic level. The great electrification and the internet of energy are coming, faster than ever thought.

If you are not paying attention to what is going on in energy, you should. There is massive economic opportunity ahead. Energy Internet will be a smart, responsive, decentralized network of energy and information that would create millions of jobs worldwide. Internet of energy would be based on multi-directional flows of renewable energy, supported by the digital revolution and the rise of big data. On an energy internet, all devices would be connected and communicating with their environment and with each other.

Despite of the megatrends, like technological breakthroughs in energy internet the role of the individual consumer will be crucial. The new disruptive innovations will create a totally new market for the customer to act also as the producer and storage, active market player. The report shows that through the convergence of technologies like artificial intelligence, robots, electric vehicles, and self-driving cars, not only new services are created, but lifestyle changes are enabled as well. While this may be highly significant in the long-term, in the short-term such a future depends on the choices made today. These choices can be black swans; highly improbable, hard to anticipate and surprising with radical consequences on practically everything.

“Growth will become more innovation-dependent”

Helsinki 30th May, 2017

Pia Salokoski

Smart Energy Programme Manager
Tekes, Finnish Funding Agency for Innovation

ABSTRACT

This report presents the results of an International Symposium "Clean Disruption for Abundant Futures", which was organised as a futures clinique of the Neo-Carbon Energy project and Summer School of the Finland Futures Academy, as well as Helsinki Node's Millennium Forum at Museum of Contemporary Arts Kiasma, Helsinki, June 7–8, 2016.

The two-day futures clinique focused on the topics of energy, internet, clean disruption, new organisation practices and futures of communities. The objective of the event was to address possible futures and related societal transition towards the convergence of energy and internet. In the clinique, abundant futures defines the stance towards futures, as ample resources would be available in such a system. This, in turn, affects social relations and communities of the future.

The clinique generated futures dialogue that consisted of expert lectures, commenting and discussion, as well as intermittent working sessions in small groups. The keynote speeches gave input for the group work, where participants probed the abundant futures in six breakout groups. The four transformational scenarios of the Neo-Carbon Energy project were used as material for the groups' foresight work.

This dialogue and elaborations on abundant futures and renewable energy are documented in this report. Four recurring themes can be identified from the group work. Perhaps the most common is the idea of so-called "post-institutional" future of tribal-like communities. Another frequent theme is the change of the concept of work through i.e. automatisation and hybridisation of work and leisure. The third theme describes immaterial values and the significance of meaningfulness. Finally, the fourth theme identified in the results addresses the possible social drawbacks of the future. Consequently, the clean disruption for abundant futures is a cornucopia with huge potential, but by no means automatically only beneficial. Critical mindset is needed both for the decision phase and implementation ways of clean disruptive technologies, practices, lifestyles, and regulation.

EXECUTIVE SUMMARY

This report presents the results of an International Symposium *"Clean Disruption for Abundant Futures"*, which was organised as a futures clinique (a certain kind of futures workshop) of the Neo-Carbon Energy project and Summer School of the Finland Futures Academy (FFA), as well as Helsinki Node's Millennium Forum at Museum of Contemporary Arts Kiasma, Helsinki, June 7-8, 2016. Futures dialogue ensued through expert lectures, comments and discussion, as well as intermittent working sessions in small groups. The four transformational scenarios of the Neo-Carbon Energy project were used as material for the groups' foresight work. The two-day event focused on the futures of energy, internet, clean production, practices of self-organising, and changing social relations. The starting point for the event and workshop sessions was that 'clean disruption' with an abundance of energy and (recycled) resources will affect social relations and shape the communities of the future in a number of ways. The workshop groups anticipated what such changes could be like.

The keynotes (see chapter 2 for transcriptions) also dealt with the energy transition and related social transformations. Sirkka Heinonen defined disruption as a change (typically in an industry), which leads to a fall of the old one replaced by the new. Through the convergence of technologies (e.g. artificial intelligence, robots, electric vehicles, and self-driving cars), not only new services are created, but lifestyle changes are enabled as well. While this may be highly significant in the long-term, in the short-term such a future depends on the choices made today. In the worst case scenario, opposite to abundance, looms collapse. José Cordeiro anticipated more changes in the next 20 years than have taken place in the last 2000 years. And, while most of this will be positive, increasing our knowledge of what is the human factor in misusing new technologies cannot be disregarded. Still, the benefits of increasingly economical solar energy cuts across society in many forms. Finally, Cordeiro presented his notion of "Energularity" or "energy singularity", which maps the possibilities of almost limitless energy. Despite knowledge of global warming, global electricity consumption is still growing very fast, as explained by Christian Breyer. A zero emission energy system has to be launched by 2030 to provide renewable energy for everyone in 2050. Already today, almost all energy scenarios accept an increasing share of renewable energy, but most of them understand poorly or do not explore how a renewable energy future might be achieved. Breyer showed how to reach almost 100% RE supply, the set of technologies can be adapted according to the principle of least costs and availability of renewable energy resources across different regions In a 'neo-carbon' energy system. Markku Wilenius showcased how transformations in values and organization models may bear an impact on society with a force comparable to technological change – why in order to understand systemic change capturing social change is fundamentally important. Passion, emotional intelligence, creativity from collective work, information shared "bottom

up" and motivating with meaningful acts signify such organisational dynamics. Pioneering companies already apply these principles, spanning across hundreds of employees.

In the group work, the participants worked in six groups. As the participants probed how the future could look like, many imagined a peer-to-peer – self-organising citizens – mode of social organising as the social form of the future. Most groups saw these groups as both global and local – “glocal”. Glocality could create new kinds of groups, "guilds" or "tribes" that cater for identity formation. Furthermore, this "global multiculture" could decrease tensions. New “guilds” and “tribes” were expected to become more significant than today’s language or national barriers, which were expected to bear less or no significance due to social change and technological advancements. Ideally, there would be more freedom and flexibility, and work would become play-like and gamified. In a ubiquitous world where “everything” is connected, all thoughts and feelings could even be shared in a hyper connective fashion. Communication between humans, robots, and animals would be realised in novel ways, such as education degrees which would be being uploaded to the brain. New conceptions of time, with more time for play, leisure and meaningful activities, were mentioned by several groups. Creativity and art would have room to flourish.

Unexpected social changes were also imagined. Ethically, it may be unclear what are the limits and implications of modification of humans. Individualism could decrease in tribe-like societies, but not perhaps wither away entirely. Despite disappearing hierarchies, some individuals would probably be more influential than others. Another potential downside in a world of only a few problems is also that people may get bored. As it may not be possible to be offline anymore, humans could seek to turn to spirituality or otherwise nurture their cognitive wellbeing. One group mentioned "neo-shamans" or personal trainers for spiritual development. If society becomes ever more technologised, some may wish to turn against technology, even in extreme ways. One group mentions brain-to-brain data protection or blocking certain people to communicate with oneself. When it is assumed that the 'clean disruption' takes care of ecological problems, the relationship between 'abundance' and ecology has not been sufficiently described. Some groups aspired for biosphere health. In an efficient world of aplenty, it is not entirely clear what it will mean to be frugal.

If human-technology interface deepens, very radical and unexpected events, so-called black swans, could emerge. For instance, if we turn dark energy and dark matter into energy and matter, this could bring an endless source of energy and materials. A “global electricity allergy” from wireless energy transmission, or a “robot allergy” that would require an “antihistamine” against electronics could emerge. More typical, pessimistic black swans envisioned natural disasters, viruses, and threats by the technologies as 'external shocks'. In the event of a severe disaster, technological advancements would suddenly become a scarce resource. This could imply contestations between groups that are unequally advanced by technology, competition as resource wars or self-sufficiency as a solution.

1. INTRODUCTION

This futures clinique report is part of the Tekes-funded Neo-Carbon Energy project[1]. The project examines a 100 % renewable energy system with hydrocarbon storages and materials. The foresight part of the project anticipates socio-economic implications of the new energy system. As the energy system would be distributed and provide energy at low costs, it is assumed to promote a peer-to-peer society of grassroots organisations.

In this report we present the results of the futures clinique as well as the futures dialogue, which took place at the International Symposium "*Clean Disruption for Abundant Futures"*. The event was organised as a two-day futures clinique by Finland Futures Academy (FFA) and Finland Futures Research Centre (FFRC), University of Turku at Museum of Contemporary Arts Kiasma, Helsinki, June 7–8, 2016. The event was also a Millennium Forum organised by Helsinki Node of the Millennium Project. The symposium was conducted as a futures clinique that focused on the topics of energy, internet, clean disruption and futures of communities.[2] The objective of the event was to address possible futures and the societal transition towards the convergence of energy and internet, an idea also coined as EnerNet. The provocative concept of 'abundant futures' defined the stance towards futures, as ample resources would be available in such a system. This, in turn, would also affect social relations and communities of the future. The four transformational scenarios of the Neo-Carbon Energy project provided the starting point, basis and material for the futures clinique (Heinonen et al. 2016).

One of the main objective of the clinique was to generate a futures dialogue through expert lectures, commenting and discussion, as well as intermittent working sessions in small groups. Both of the two days of the symposium began with expert lectures. The keynote speakers were Prof. Sirkka Heinonen,

[1] Neo-Carbon Energy is a joint research project of the Technical Research Centre of Finland (VTT), Lappeenranta University of Technology (LUT), and Finland Futures Research Centre (FFRC). It is funded by the Finnish Funding Agency for Innovation (TEKES). The foresight part with a series of futures clinique is directed by prof. Sirkka Heinonen at the Finland Futures Research Centre (FFRC), University of Turku. The research team at FFRC includes project researchers Joni Karjalainen, Marjukka Parkkinen and Juho Ruotsalainen, with research support from development manager Leena-Maija Laurén and project researcher Hazel Salminen. Main participants in this foresight part of the project from are research team leader Tiina Koljonen and research scientist Lassi Similä from VTT, and Professor Samuli Honkapuro and post doctoral researcher Olga Gore from LUT.

[2] This futures clinique also functioned as a Summer School for doctoral and master's students of futures studies and other related disciplines. Summer School is annually organised by Finland Futures Academy (FFA), which is a network of 10 universities, coordinating academic futures education in Finland. For the 2016 Summer School, the foresight part of the Neo-Carbon Energy was invited to organise the event. Finland Futures Academy is coordinated by Hanna-Kaisa Aalto and Sari Söderlund.

Dr. José Cordeiro, Prof. Christian Breyer, Prof. Markku Wilenius and Adjunct Prof. Pasi Vainikka (see Appendix 1). The lectures were followed by discussion on the topic. The first clinique day was chaired by Prof. Toni Ahlqvist, Oulu University, and the second one by Ms. Sari Söderlund from Finland Futures Academy, both Co-Chairs of the Helsinki Node of the Millennium Project. During the afternoon sessions, participants worked in small break-out groups. A group of almost 50 experts, researchers, decision-makers and students worked in six groups (see Appendix 2). The four transformational scenarios of Neo-Carbon Energy project were reflected during the work (Heinonen et al. 2016). At the end of the day, the results were presented to other groups.

In this chapter, the process of the International Symposium is described – discussing a neo-carbon system enabling the clean disruption towards abundant futures. After that, Chapter 2 features the documentation of the expert lectures that were held at the International Symposium. In Chapter 3 futures clinique as a foresight method is presented together with a brief description of the four scenarios that provided the starting point for the group work. The results of the working sessions are provided in Chapter 4 according to each of the six groups (two of the four scenarios had two working groups each, and accordingly the total number for working groups arose to six). Conclusions are provided in Chapter 5. The programme and the speakers are to be seen in Appendix 1, while Appendix 2 lists all the participants. Appendix 3 presents Millennium Project's Guest Expert José Cordeiro's views on humans and technology in the future, based on an interview conducted by Juho Ruotsalainen after the symposium in October 2016.

Figure 1. The futures clinique generates dialogue on possible and preferable futures in many forms. Markku Wilenius posing a question to José Cordeiro during the questions & answers session, chaired by Toni Ahlqvist.

1.1 Neo-Carbon enabling the clean disruption for abundant futures

Neo-Carbon is an energy system in which energy is mainly produced by solar and wind, and stored in synthetic hydrocarbons and batteries. Virtually everything produced from oil can be produced from synthetic hydrocarbons instead – chemicals, plastics, fertilizers, even food. Hydrogen is electrolysed from water and carbon dioxide captured from air or process gases. These are then synthesised as fuels or other materials using renewable electricity. In a nutshell, the energy system is carbon neutral, and electricity from renewable energy can be used for various purposes.

It is often assumed that the transition to renewable energy systems requires reducing energy consumption in society, and that the energy abundance provided by oil has come to an end (Heinberg & Friedly 2016). This report takes an opposite stance: that a 100 % renewable energy system can meet increasing energy demands (Breyer et al. 2016), and possibly lead to a world of sustainable abundance, or "abundance without guilt" (Lord 2014) – a *de facto* abundance. If humanity could capture one permille (0.1%) of the solar energy facing the Earth, the humankind would have roughly 6 times the energy that is consumed today (Naam 2011). Renewable energy is abundant; the question is about capturing it efficiently. If the promise of abundance in renewables is realised, higher levels of organisation and complexity in societies can be achieved, and overall, society thus is transformed.

If we are to achieve renewable energy abundance, an Internet of Energy is needed to replace the current electricity grids. The concept of the energy internet resembles that of a smart grid, in which communication and information technologies are used for dynamic optimisation of grid operations and resources. However, the energy internet is a broader and more holistic concept than the smart grid. A smart grid does not require a decentralised production mode of energy, whereas in an energy internet energy is produced, distributed and managed in a decentralised manner (Boucher 2015). Analogous to the internet, an energy internet would be a peer-to-peer system without a controlling centre, citizens and companies alike feeding their surplus renewable energy to the energy internet. Energy would be locally stored in every building and throughout the infrastructure by various energy storage technologies. Jeremy Rifkin (2011, 50) writes of the energy internet: "*This intelligent energy network will embrace virtually every facet of life. Homes, offices, factories, and vehicles will continuously communicate with one another, sharing information and energy on a 24/basis*." On an energy internet, smart technologies do not only optimise the operation of single devices, but "everything" communicates with "everything", sharing information so that the whole can be optimised. In other words, the energy internet does not refer to the energy grid alone, but describes everything involved in energy consumption, production and distribution. Therefore, energy internet is closely related to the *Internet of Things* (IoT), which refers to devices and objects with internet connection and sensors. On an energy internet, all devices would be connected and communicating with their environment through the IoT.

As a holistic concept, the energy internet has implications for the whole of society. Just as the internet has led to an abundance of information, the energy internet has the potential to lead to an abundance of energy. This, in turn, can revolutionise our whole economy and ways of living. Low-cost renewable energy could, for instance, be used for the ubiquitous use of robots and artificial intelligences (AIs) and to lower the barrier of do-it-yourself (DIY) production and "cottage industries". As a lateral communication technology, the internet has given new power to the civil society. In a similar manner, the new peer-to-peer energy model could usher a collaborative era in energy systems as well (Wu et al. 2015). Such a complicated system requires co-development and co-experimentation with various stakeholders, including citizens (Lösch & Schneider 2016). Furthermore, some authors claim that decentralised energy system promotes a more democratised peer-to-peer society where power stems increasingly from the grassroots (Sovacool & Brossmann 2010; Rifkin 2011; Ruotsalainen et al. 2016[3]; 2016b[4]). The line of argument here is largely economic: if individuals or communities produce their own energy (or receive nearly-free energy from the grid), they gain independence and are empowered to small-scale manufacturing.

[3] https://www.utu.fi/fi/yksikot/ffrc/julkaisut/e-tutu/Documents/eBook_11-2016.pdf

[4] http://rdcu.be/tf0b

2. PRESENTATIONS ON CLEAN DISRUPTION AND NEW ORGANISING OF WORK AND ENERGY

This chapter consists of the presentations by the keynote speakers of the International Symposium. First, a recapitulation to the aims and contents of the event, as well as reflections on the concepts of disruption and black swans are presented by Sirkka Heinonen (Chapter 2.1). Then, the keynote by José Cordeiro on "Clean Disruption, EnerNet, and Energularity" is provided. Commentary remarks are made by Christian Breyer on "Towards a New Consciousness" (Chapter 2.2). Another keynote was then delivered by Christian Breyer on "Introduction to Neo-Carbon Energy project – How to reach 100% renewable energy system" (Chapter 2.3).

On the second day, the first keynote was given by José Cordeiro on "Innovations from the Energy Internet: Cases from the Singularity University and beyond". Its contents are integrated to Cordeiro's first talk (Chapter 2.2). "Systems of self-organising work" were then presented by Markku Wilenius (Chapter 2.4). Ten illusions that concern our understanding about energy were opened up by Pasi Vainikka as a provocation (Chapter 2.6) before the second day's group work. All the results of the small groups are presented in Chapter 4.

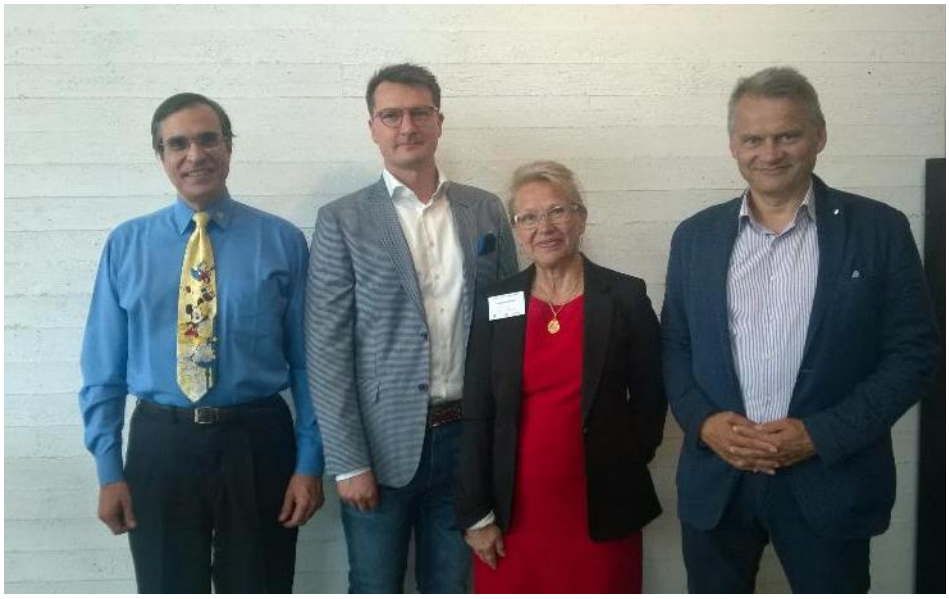


Figure 2. Keynote speakers at Kiasma venue (from left: Cordeiro, Vainikka, Heinonen and Wilenius).

2.1 Sirkka Heinonen's orientation to Disruption and Black Swans

Figure 3. Sirkka Heinonen opened the Symposium and orientated the participants to futures thinking.

Many Stakeholders Interested in Clean Disruption for Abundant Futures

Heinonen pointed out that many stakeholders are interested in clean disruption for abundant futures. Therefore, the following organisations arranged this International Symposium co-operatively – Finland Futures Academy (FFA), Finland Futures Research Centre (FFRC), University of Turku, Tekes-funded Neo-Carbon Energy Project, and the Helsinki Node of the Millennium Project. The recent work by the Millennium Project that probes future scenarios of work and technology 2050 was disseminated to the participants as inspiration to Clinique work.[5]

The event was also a specially structured methodological event called futures clinique (see more in Chapter 3) and last but not least it was a Summer School for doctoral students and masters students of the Finland Futures Academy (FFA). The students had received required reading material prior to the event, and after working equally in the clinique among all other participants, they delivered an essay to be evaluated.

[5] See http://www.millennium-project.org/millennium/Work-Tech-2050-Scenarios.pdf

What is disruption?

Disruption happens when a change in an industry leads to a fall of the old one replaced by the new one (Christensen 1997; Seba 2014). Disruption refers to a process when a disruptive innovation based on disruptive technology outperforms its competition and causes market leaders (incumbents) to fail (Christensen 1997). Disruptive technologies and innovations are used for value creation, as they are starting the process of disruption. Technology in this context means "the processes by which an organization transforms labour, capital, materials, and information into products and services of greater value." Innovation here refers to a change in one of these technologies. A new technology means a method, application, or a way of doing things that leads to disruption in an industry. (Ibid.) Disruptive innovations typically enter the market from the low-end or create a new market where the products that are more convenient, simple and cheaper than mainstream products.[6] Initially they are inferior in performance. In the end these innovations outperform and replace the incumbent of the market and consequently *disruption* happens.

DISRUPTOR	DISRUPTEE
Car	**Horse**
Personal computers	**Mainframe and mini computers**
Cellular/mobile phones	**Landline phones**
Discount retailers	**Department stores**
Digital photography	**Film photography**
CD music	**Digital music/mp3**
Fossil fuel	***Renewable energy***

Figure 4. Examples of disruptive innovations (modified from Christensen 1997; Seba 2014).

[6] On the other hand, some products, such as mobile phones initially were expensive, but more convenient by being portable.

Clean disruptions disrupt industries that use polluting energy sources like fossil fuels – oil, natural gas, coal and uranium. Superior technologies and business models are introduced to the markets making the old ways of energy production and use, as well as, transportation obsolete. Three major clean disruptions are 1) electric vehicles (Tesla), 2) autonomous/self-driving cars (Google) and 3) technologies in solar and wind power. According to Seba (2014) clean disruption is not only possible, but rather inevitable and it will be completed by 2030.[7]

Many Faces of the Clean Disruption for Abundant Futures

The Clean Disruption for Abundant Futures seminar was about several things. The focus was on societal disruptions, transformations and discontinuities enabled and fostered by the neo-carbon energy system. Therefore, the event was not looking at linear development but rather surveying at these very critical points where developments and bifurcations occur. One of the key elements introduced was the so called neo-carbon energy system in which energy is produced mainly by solar and wind and stored in synthetic hydrocarbons as well as batteries. Energy in this system will be clean, cheap and produced in a distributed manner (e.g. by households). The parallel was, that the future energy systems are increasingly decentralized just like many aspects of our current society.

Heinonen emphasised that the objective of the futures clinique was also to address possible socio-economic futures as related to the neo-carbon energy system and the convergence of energy and internet. This represents the element "*Clean Disruption*" in the title of the symposium. In such a system, ample resources would be available, and this, in turn, will affect social relations and communities of the future. This refers to the element "*Abundant Futures*" in the title of the symposium. We are looking into what are social relations, communities and workplaces like in a future of renewable energy and ubiquitous communication where all traditional concepts are in transition. These comprise key areas such as the concept of work, that of housing, transportation etc.

The expected main outcomes of the event were four different futures images to be produced by the working groups and inspired by keynote presentations and supported by background material. The futures images will further be used after the futures clinique to enrich and elaborate the four transformative scenarios of the Neo-Carbon Energy research project. These metascenarios were constructed as desktop foresight work within the Neo-Carbon Energy project. The idea is to use them throughout the

[7] Kevin Kelly (2016) in his recent book The Inevitable sees AI as the biggest disruptor in modern society. He considers it "hard to imagine anything that would change everything as much as cheap, powerful, ubiquitous artificial intelligence".

project as background material and testbed both in the futures clinique process[8] and in other foresight stages.

Professor Jim Dator from the University of Hawaii has claimed that scenarios can be either in the category of growth, discipline, collapse or transformation. Heinonen highlighted that all of the tentative four scenarios of the Neo-Carbon project – Radical Startups, Value-Driven Techemoths, Green DIY Engineers and New Consciousness – fall into the category of transformation, which is the most radical one. This was chosen to be the category of all our four scenarios in order to head for radically novel scenarios instead of falling into the frequently arising pitfall of presenting conventional scenarios that do not differ enough from the present, or portray mainly linear developments. (Heinonen et al. 2016.)

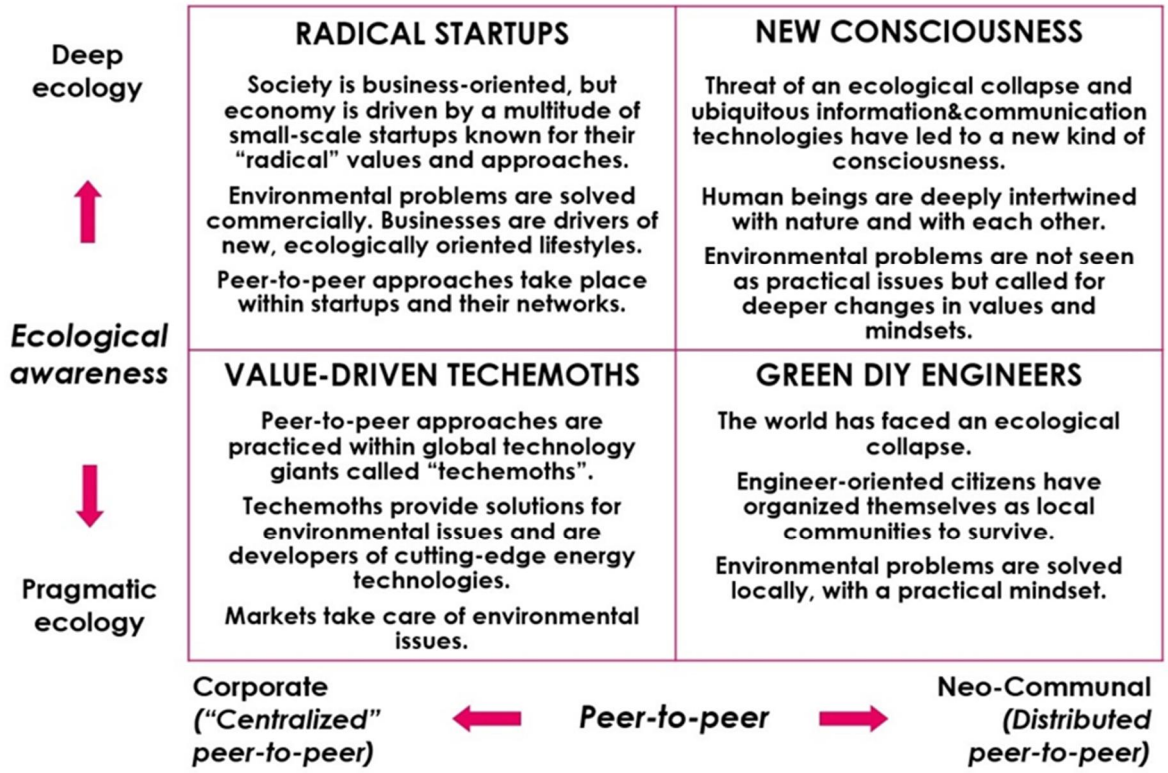


Figure 4. The four transformational neo-carbon energy scenarios act as a basis for future elaborations within the futures clinique.

[8] The total of five futures cliniques form the backbone of the foresight process in the Neo-Carbon Energy project.

The transformation and transition of our society

Our society is on the verge of transformation which takes places via transition towards renewable energy systems. In practice this means a paradigm change. Professor Pentti Malaska always emphasised that there is a critical triangle between humans, nature and technology.[9] Energy is as much about technology as it is about environment and about us humans, our lifestyles, values and politics. Our invited keynote speaker, and the Millennium Project representative, José Cordeiro emphasised already 10 years ago in his talk "Promises and Perils of New Technology" the central role of technological convergence in nano-bio-info (NBI) and artificial intelligence (AI) (Cordeiro 2006). Today, we are in the same position, but this time with ever more concrete realisations. Transformation into an abundant society is by no means automatic – it all depends on today's choices for guiding development towards renewable energy world. The alternative paths neglecting the necessity of transiting into renewable energy world point towards negative prospects.

In its extreme form, transformation may turn out as abundance or as a collapse. Accordingly, the exact opposite of abundance is collapse (or scarcity). In his book "Collapse" (2005) Jared Diamond claims that humanity faces collectively many of the issues that historic societies such as Eastern Islands or Norse in Greenland. These are just two examples of many such past societies that collapsed or vanished, leaving behind monumental ruins. By collapse Diamond means "a drastic decrease in human population size and/or political/economic/social complexity, over a considerable area, for an extended time". Collapse is "an extreme form of several milder types of decline and it becomes arbitrary to decide how drastic the decline of a society must be before it qualifies to be labelled as a collapse". Diamond asserts that "even the richest, technologically most advanced societies today face growing environmental and economic problems that should not be underestimated". (2005, 2–3.) Consequently, we are not aiming towards collapse but it may be looming unless we co-creatively make a better future. According to Diamond even the richest, technologically most advanced societies today face increasing environmental and economic problems that should not be underestimated.

Transformation may also manifest itself as an end to something existing, or as metamorphosis or ascension to another level of existence or development. The last book of writer and thinker D.H. Lawrence (1981) was called "Apocalypse", which he wrote just a few months before he died. He had been working on this topic for several years. Lawrence claims that earlier civilizations sustained a lot of wisdom, a sense of wholeness, which we have lost and this is one of the reasons for many of the problems of modern

[9] See Malaska's original Finnish article on Futures Consciousness and the Knowledge of the Future forthcoming in English in Heinonen, S., Kuusi, O. & Salminen, H. (2017) How do we explore Our Futures? Methods of Futures Research. Acta Futura Fennica 10. Finnish Society for Futures Studies.

society. He warned us not being entangled in a humanless (sic) technology which would destroy us until we change our minds. We should pay attention to what ancient civilisations knew. Instead of mere rational thinking, a combination of hearts and minds is needed. For this purpose he recommends the humankind to develop the concepts of sense-awareness and sense-knowledge. He underlines collectiveness and unison: “No man is or can be a pure individual” (Lawrence 1981, 106).

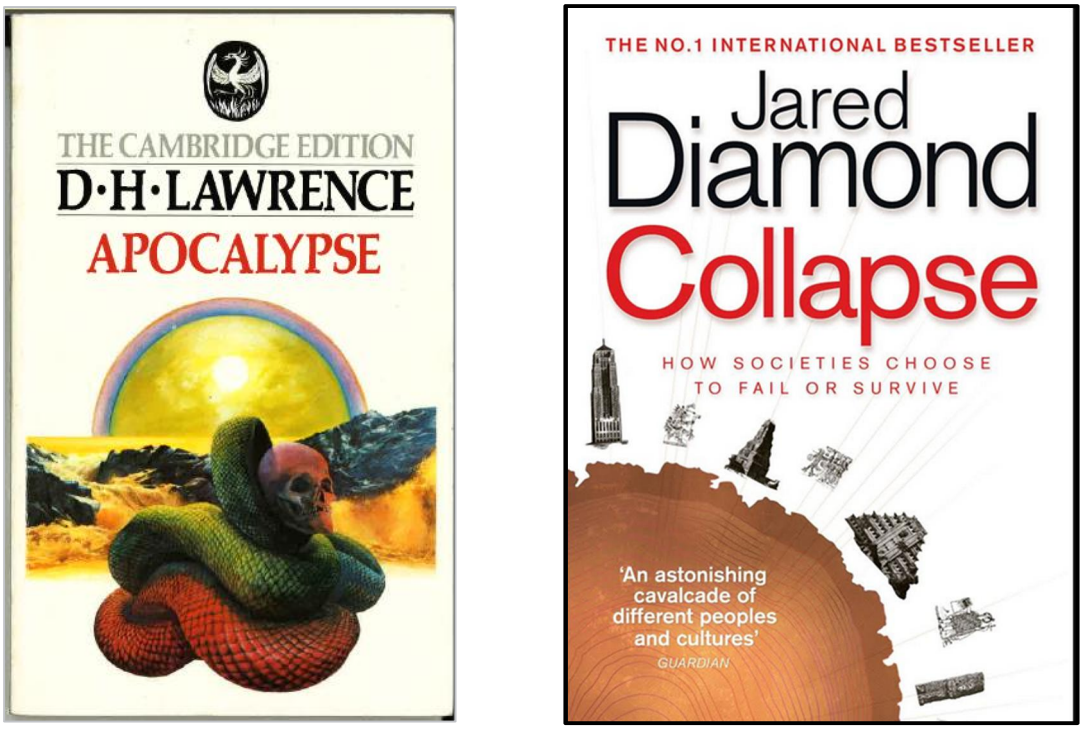


Figure 5. Both Jared Diamond and D.H. Lawrence vision a possibility of collapse – one category of Dator’s classification of scenarios – for humankind unless a new way of thinking, feeling, and action is heeded.

2.2 José Cordeiro's presentation on the Energularity: The Future of Energy and the Energy of the Future

In his presentation documented in the following, José Cordeiro dealt with the Millennium project's global energy scenarios, technological singularity, solar energy, decarbonisation of energy, electric vehicles, and energularity. Cordeiro is an engineer by education and professionally he is specialised in the energy sector, which is also one of the 15 global challenges that Millennium Project deals with. He is the Venezuelan representative in the Millennium Project and took part of the 2020 Global Energy Scenarios project carried out during 2005 and 2006.

Figure 6. José Cordeiro discussing mindfacturing at the futures clinique in Kiasma.

2020 Global Energy Scenarios

The "2020 Global Energy Scenarios"[10] research project was commissioned to the Millennium Project by the government of Kuwait. There were four different scenarios: 1) business as usual (what would happen if nothing happens?), 2) environmental backlash, 3) high tech pushes off the limits and 4) political turmoil. The methodology of the research included: Annotated bibliography of global energy scenarios and

[10] http://www.millennium-project.org/millennium/scenarios/energy-scenarios.html. The scenarios are included in the cd of 2008 State of the Future by the Millennium Project.

related research (over 100 pages); Delphi round 1 with data collection and ratings; International Futures (IFs) model's input (what the US, EU, Russians, Japanese etc. are doing). The IFs software is now freely available for research and forecasting purposes and maintained by the University of Denver, Colorado. Cordeiro was writing first drafts of 4 global energy scenarios; Delphi round 2 – Feedback on scenario drafts and final draft. Those four scenarios are in a nutshell as follows:

Scenario 1: Business as Usual

- Assumptions – Scenarios Axes
  - Moderate growth in technological breakthroughs
  - Moderate environmental movement impacts
  - Moderate economic growth
  - Moderate changes in geopolitics and war/peace/ terrorism
- Global dynamics of change continue without great surprises
- Leaders give speeches, conference declarations are held, but nothing really changes, all energy sources increase
- Oil averages $160 per barrel; expected to average $200 in 2025 does push energy conservation and efficiency but no great breakthroughs

Scenario 2: Environmental Backlash

- Assumptions – Scenario Axes:
  - Moderate growth in technological breakthroughs
  - High environmental movement impacts
  - Moderate economic growth
  - Moderate changes in geopolitics and war/peace/terrorism
- Backlash from both nature and the environmental movement
- India Ocean Nuclear accident galvanizes environmental movement (happened actually in Japan 2011)
- Range from Eco-terrorism to political protests
- Environmental friendly politicians elected, create G-8 GLEEM Plan
  - UN Eminent Scientists Group sets measures & standards
  - World Energy Organization
  - Global Collective Intelligence System
  - WTO to enforce new energy standards
  - International Environmental Court, Kyoto 2.0

Scenario 3: High Technology

- World economy reaches US$ 80 trillion
- Internet 4.0 connects over half of humanity, which is growing stable at 7.5 billion people
- Technological convergence accelerates
- NBIC: Nano-Bio-Info-Cogno bloom
- Moore's Law survives and thrives due to quantum computing, 3D circuits and sub-atomic particles
- Artificial intelligence reaches human intelligence levels, and a technological "singularity" is expected any time soon
- Biological evolution, slow and erratic, is overtaken by technological evolution, fast and designed
- Cyborgs and clones are becoming normal and accepted in societies, and their numbers increase faster than those of the "naturals"
- Humans will never be the same, in fact, the first transhumans and posthumans have already arrived
- Advanced robotics and space exploration are ready to take-off

Scenario 4: Political Turmoil

- Assumptions – Scenario Axes:
  - Moderate growth in technological breakthroughs
  - Low environmental movement impacts
  - Moderate/low economic growth
  - Major changes in geopolitics and war/peace/terrorism
- Environmental Backlash PLUS political turmoil due to:
  - The Caucasus – pipelines down, Armenians- Azerbaijani, Kurds- Turks increased conflicts
  - Northwest China – pan-Islamic movement
  - East China Sea (China-Japan) and South China Sea - Spratly Islands, South China Sea China, the Philippines, Vietnam, Taiwan, Malaysia and Brunei)
  - Canada, US, Denmark, Russia, Norway conflict over Arctic jurisdictions

Table 1. New car purchases in 2020. Estimates given in 2005 in Energy Scenarios 2020 Project.

International Delphi panel average estimates made in 2005 for Kuwait Petroleum Corp in 4 scenaios:	Business as Usual	Environmental Backlash	High Tech	Political Turmoil
2.15 Percentage of all new vehicles powered by hydrogen in 2020	5.0	9.5	13.3	1.4
2.16 Percentage of all new vehicles powered by biofuels in 2020	3.1	19.0	20.6	4.3
2.17 Percentage of all new vehicles powered by electricity in 2020	6.9	15.4	11.3	4.1
2.18 Percentage of all new vehicles that are hybrid in 2020	21.6	31.7	25.9	10.5
2.19 Percentage of all new vehicles powered by gasoline in 2020	55.6	26.5	23.9	71.9

Cordeiro points out some interesting energy-related ideas raised in the Millennium project Delphi study such as:

- Apollo-like Energy Program – SSP & Carbon Sequestration & Re-Use
- $2000 electric car 10KW batters from China (3/car) US/Finland
- Japan plans receive electricity from orbital Solar Power Station by 2030
- Ocean-based wind power microwave relay or hydrogen production
- Thin-film solar flexible sheets lower costs for buildings
- Algal biofuels: Algae produce oils naturally. New genetic codes grow microscopic plants that produce oil that can substitute for petroleum
- Fuel cells for mobile phones, computers, and light buildings
- Nanotech for efficiencies in general and electric transmission
- Plants break the CO2 bonds – CO2 is bonded to nitrogen atoms making less stable carbamates which then can release Carbon. Can we do the same and use Carbon from the air make fuel?
- Energy efficiencies from urban systems ecology approaches with nanosensors and transceivers in everything to manage a city as a whole from transportation to security
- Sea Water Agriculture and Geothermal variation
- Solar farms to heat sterling engines
- Cordeiro concluded from the Millennium project Global Energy scenarios the following:
- Business as usual is likely to lead to increasing energy prices
- Continued climate change
- Water shortages and environmental migrations
- Some elements of scenarios 2 and 4
- Nuclear & fossil fuel companies should invest into alternatives (e.g. Exxon synthetic biology algae)
- Need to change base load electricity and meat production
- Europe should push the US and China into a 10-year Apollo-like goal with an international R&D NASA-like program

Technological singularity

José Cordeiro is active in the Singularity University, which is focusing in medicine, neuroscience, robotics, human enhancement and environment. Cordeiro's favourite definition of technological singularity is the "moment when artificial intelligent reaches human intelligence, which will mark the end of the human age", at the latest in the year 2045. Some people think that this could take place as early as 2029. One of the consequences is that with the technological singularity humans become immortal. It will also be the beginning of post human age where we live better and longer and will move from scarcity to abundance. Cordeiro describes the fast development of ICT thus. In 30 years we have moved from 1 K memory cards to more than 1 TB (1 000 000 000 Ks) memory cards. In the field of sequencing the genome 2003 it took 13 years to find our human genome with the cost of US$ 1 billion, 2015 it took 5 days with the cost of US$ 1 000 and it has been estimated that 2025 it will take only one minute with the cost of US$ 10 to find out your genomes. Consequently, all technology is developing exponentially making things smaller, faster, cheaper and better. The problem is that our brains have difficulties in understanding the rapidity of the change sine brains operate linearly. As an example if we take 30 linear steps, we have moved 30 meters, but if we take 30 exponential steps, we have moved 1,073,741,824 metres = 26x around the Earth.

The exponential growth in solar energy

Exponential growth also applies to energy, which Cordeiro characterizes as the largest industry on the planet (US$ 8 trillion). Solar energy has grown exponentially for the last 20 years and now it has reached 1% share. With the current growth rate by 2030 just about 100% of energy will be solar and as a result we are going to move to energy abundance. However, there are many geopolitical issues related to energy, North Pole and Middle-East competition for oil and gas, deep-water oil, China-Africa new energy alliances and lithium and other rare earth elements.

The industrial age of energy and transportation will be over by 2030 according to Cordeiro. Exponentially improving technologies such as solar, electric vehicles and self-driving cars will disrupt and sweep away the energy and transportation industries as we know it. The same Silicon Valley ecosystem that created bit-based technologies that have disrupted atom-based industries, now creating bit- and electron based technologies that will disrupt atom-based energy industries.

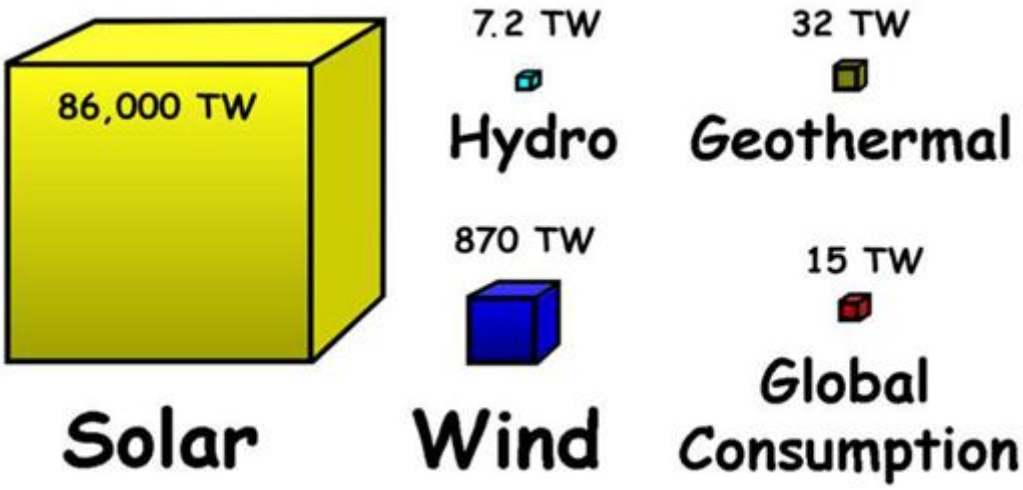


Figure 7. Cordeiro's presentation of available renewable energy.

According to Cordeiro, Clean Disruption projections based on technology cost curves, business model innovation as well as product innovation show that by 2030 all new energy will be provided by solar or wind, all new mass-market vehicles will be electric, autonomous (self-driving) or semi-autonomous. The car market will shrink by 80% and gasoline will be obsolete. The same will apply to nuclear, natural gas and coal energy production. Up to 80% of highways and parking places will not be needed and the concept of individual car ownership will be obsolete. As a result, the car industry will be disrupted and the taxi industry will be obsolete.

Cordeiro referred to an inquiry by the US National Academy of Engineering concerning what are the most important engineering challenges in the future. Number one answer was how to make solar energy economic. MIT was the first university to provide an energy course for every student, because energy is the largest industry and the greatest challenge for humanity. The importance of energy research is also highlighted by Bill Gates: "the world needs to invest a lot more in energy R&D to provide the breakthroughs that can get down to near-zero carbon emissions in the next 75 years." We are still in the old paradigm when for example in the US about 78% of the energy production is still based on fossil fuels and more than 54% of it is wasted (rejected energy).

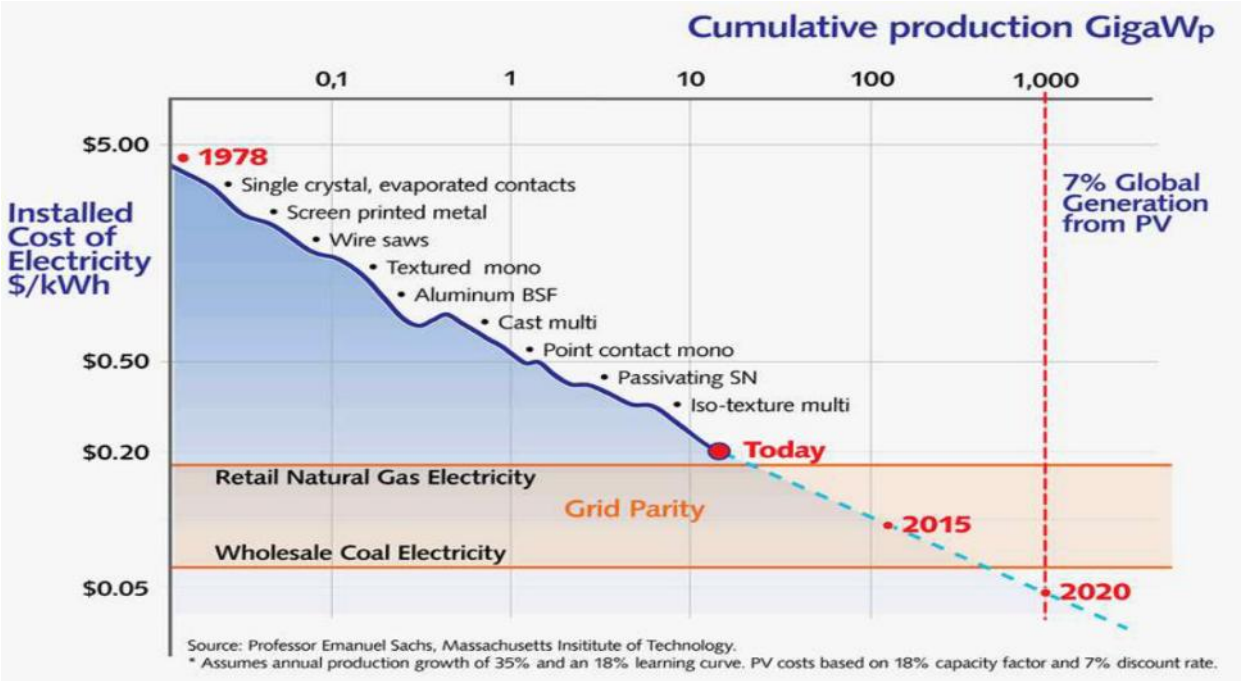
Inefficient petroleum is still dominant in transportation. The gasoline car is very inefficient; it changes only 15-20% of energy into the movement. Electric cars can transform between 80-85% of the electricity of the batteries into movement. Therefore electric car is five times more efficient than the gasoline car. In the future, energy consumption will shrink because we are going to eliminate a large part of the now wasted energy with the developed technology and more advanced energy systems.

Decarbonisation of energy

Oil companies are discovering that the world is changing very fast. Cordeiro pointed out that the British Petroleum changed its name to BP because it is no more British or profiling itself as a petroleum company to the public. Scenarios of oil companies indicate that the decarbonisation of energy has now started and will continue rapidly. This is despite that this planet has still plenty of oil. However, it is more difficult to exploit since the production costs of deepwater, arctic, heavy oil and shale oil are much more expensive than conventional oil. Another element in the big picture is the global warming, where the use of fossil fuels probably has an important role despite the fact that solar activity may have a bigger role to the phenomena than expected.

For the first time ever, speaking for the oil and gas industry, the American Petroleum Institute (API) is including solar among the energy sources that should be taken seriously in the next couple of years, since solar will double almost yearly. Deutsche Bank (2015) has produced a 185 page report that suggests that solar generated energy will be the dominant source of energy worldwide within the next 15 years, because it will be cheaper and cleaner than fossil fuels. Even California has 30% of energy produced from renewable and the governor has put a new target of 50% in the next four years. Also Germany has been able to transform into renewable solar and wind energy in a short period of time.

Table 2. Solar costs decreasing 10% per year.



Denmark is the world leader in wind energy. Iceland on the other hand is very strong in geothermal energy, but also for solar and wind. Some of the Caribbean countries rely already on 100% renewable energy[11] and many more are following. Even Texas City, home to American oil, is aiming to become 100% renewable within two years because it is cheaper and more reliable. Solar energy has reached *grid parity* already in many parts of the world, and most of the world will reach it by the year 2025 when solar energy becomes cheaper than fossil fuels. This direction is unstoppable and in the future everything will be connected to everything else. Cordeiro claims that we are also going to have a wireless energy transmission, which means that cables will soon be like fossil technology.

Electric vehicles deployment

According to Cordeiro's vision, all the cars will be intelligent and he pointed out that BMW has estimated that all the new cars by 2025 will be electric. Tesla has introduced the so called supercharger stations, where each car can be charged in 20 minutes for free. There is under construction a net Zero energy Tesla Gigafactory, where annual battery production will be 50 GWh by 2020, enough to provide renewable energy for 500,000 Tesla cars. Chinese BYD Company plans to rival Gigafactory battery output soon. South Korean companies have plans to produce car batteries with double the size with half the price compared with Tesla production. In New York in the year 1900 there were only horse carriages available for transportation save one single gasoline car. In the year 1913 the whole transportation had changed into gasoline cars and no horse carriages were available anymore. Consequently, the transformation was very rapid in a short period of time and a similar phenomenon is to be expected to happen now globally from gasoline to electricity.

[11] E.g. CostaRica has been running on 100% renewable energy for 2 months straight between June and August 2016.

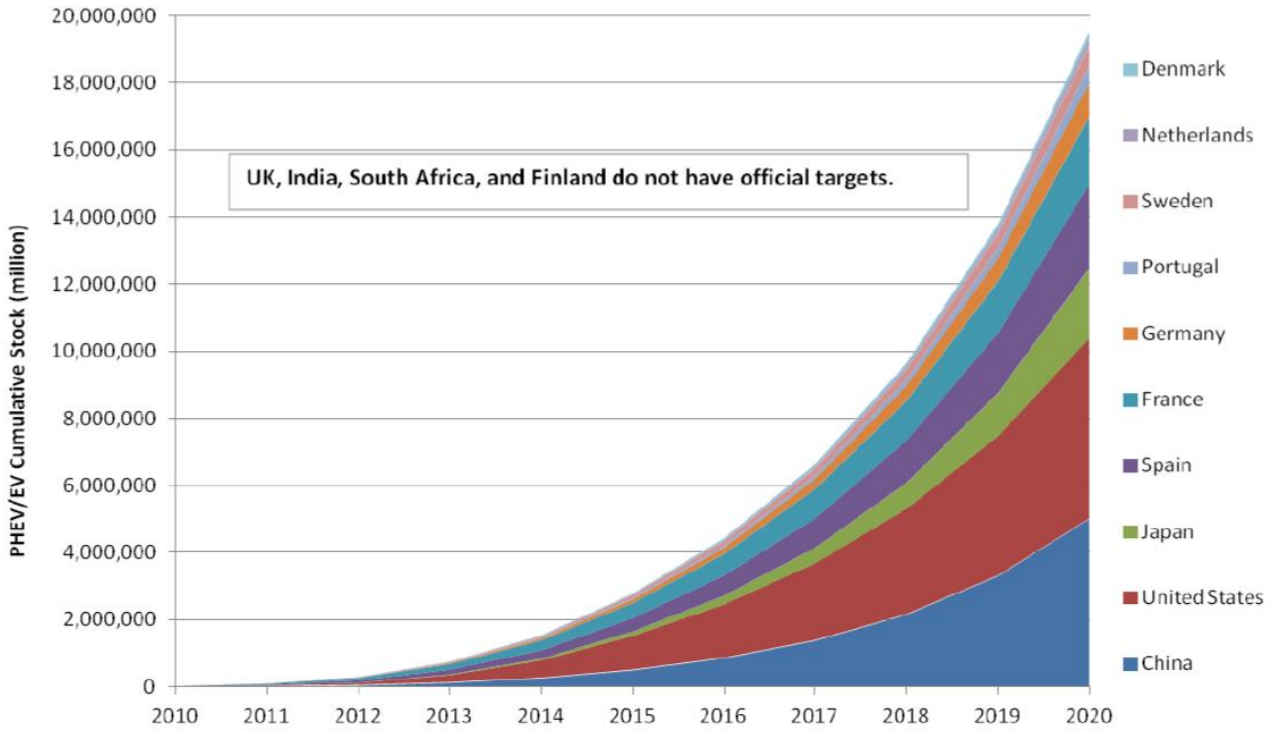


Figure 8. Electric vehicles deployment.

We are living in "Enernet: Energy Internet", which means that we are moving from dirty to clean energy, from dumb to smart grid, from inefficient to efficient energy systems, from expensive to cheap energy, from centralised to distributed system, from low to high redundancy, from fossil fuels to renewable sources, from producers to prosumers control and from big oil utilities to entrepreneurs. Buckminster Fuller (1895-1983) saw already in the 1980s the energy internet and his ideas led to the establishing of the Global Energy Network Institute (GENI). In principle, with the technology of today, if we had 6 land blocks of 100 Km2 with 3 TW in different continents, those would provide enough energy to satisfy the current needs of humanity, including transportation. It is also possible to install a solar power system into space and Japan has already plans to start such a production by the year 2030.

Energularity

José Cordeiro has introduced a new concept called "Energularity", which refers to energy singularity based on technological singularity introduced by Ray Kurzwail and Methuselarity (humanity will live as long as Methuselah) named by Aubrey de Gray. The idea of energularity is based on Russian cosmologist Nikolai Kardashev[12] measuring a civilization's level of technological advancement, based on the amount

[12] Kardashev is a Russian astrophysicist, Doctor of Physical and Mathematical Sciences, and has been the deputy director of the Astro Space Center (Russia) of PN Lebedev Physical Institute of the Russian Academy of Sciences in

of energy a civilization is able to use for communication. The scale has three designated categories: Type I civilization – also called planetary civilization – can use and store energy which reaches its planet from the neighbouring star, type II civilization can harness the total energy of its planet's parent star, type III civilization can control energy on the scale of its entire host galaxy. Type IV civilization can harness the energy of superclusters of galaxies and type V civilization can use and store energy which reaches its planet from the whole universe. The universe is full of energy, there is no shortage of it; there is only shortage of imagination.

Table 3. Energy content (MJ/kg) by fuel type.

Fuel type	Energy content (MJ/kg)
Pumped stored water at 100 m dam height	0.001
Bagasse	10
Wood	15
Sugar	17
Methanol	22
Coal (anthracite, lignite, etc.)	23 - 29
Ethanol (bioalcohol)	30
LPG (liquefied petroleum gas)	34
Butanol	36
Biodiesel	38
Oil (medium petroleum average)	42
Gasohol or E10 (90% gasoline and 10% alcohol mix)	44
Gasoline	45
Diesel	48
Methane (gaseous fuel, compression-dependent)	55
Hydrogen (gaseous fuel, compression-dependent)	120
Nuclear fission (Uranium, U 235)	90
Nuclear fusion (Hydrogen, H)	300
Binding energy of helium (He)	675
Mass-energy equivalence (Einstein's equation)	89,880,000
Antimatter as fuel (estimated according to $E = mc^2$)	180,000,000

However, we are going to move up in the ladders of energy efficiency. Today our energy efficiency range is 10-15 (MJ/kg), which is the efficiency of fossil fuels as you can see from the Table above. In the future we will move beyond the fossil fuels. Based on Einstein equation, if we could change the mass of a single grain of salt to energy, it would provide all the energy humanity is using during one year. The ultimate source of energy is antimatter. We are not there yet, but we are going in that direction.

Moscow. See his article on Transmission of Information by Extraterrestrial Civilizations. Societ Astronomy. 1964, 8:217.

Cordeiro's Conclusions

There are many new forms of energy resources under research. Different types of bioenergy such as live carbohydrates can be produced from fossil hydrocarbons. Craig Venter is doing research on how to produce petroleum from bacteria. Toshiba is developing micro sized nuclear reactors, and various types of nuclear fission reactors are under development (ITER is the next step toward a solution based on Tokamas). US National Ignition Facility (NIF) is developing Laser Inertial Fusion Engine (LIFE), which is an advanced energy concept to meet future worldwide energy needs in a safe and sustainable manner without carbon emissions. We know that nuclear fusion is possible because that is how our Sun is creating energy – the point is to find ways to accomplish it.

Zero point energy is also one option discussed. It is based on the Casimir effect evidence in which random electromagnetic waves remains after all energy has been removed and it has been theorised to indirectly cause gravity and inertia. Thomas Valone is one of the researchers specialised on this topic and he has written a book "Zero Point Energy – The Fuel of the Future". We are moving towards cheap or free energy. We will end the energy poverty and move beyond scarcity into abundance. This will give us a chance to solve the water and food problems, improve infrastructure and transportation and increase energy security.

Figure 9. Christian Breyer presenting the commentary remarks to Cordeiro's talk.

Figure 10. After Cordeiro's presentation and Breyer's commentary remarks the discussion session was chaired by Toni Ahlqvist.

Figure 11. During the questions & answers session audience posed questions to José Cordeiro and Christian Breyer.

2.3 Christian Breyer's Introduction to the Neo-Carbon Energy Project – How to Reach a 100% Renewable Energy System

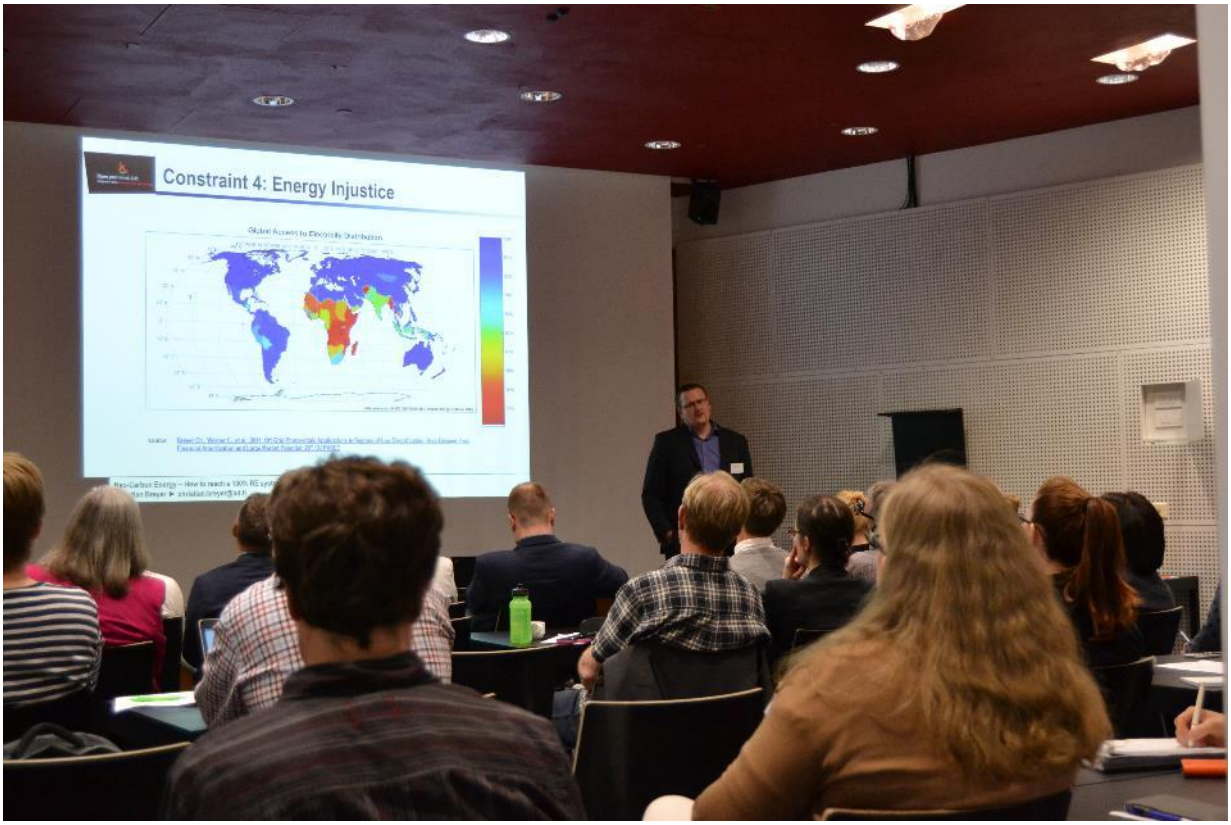


Figure 12. Christian Breyer introduced the Neo-Carbon Energy project.

From unsustainable to renewable

By 2030 we have to launch a zero emission energy system to provide renewable energy for everyone. We have a solution which we call Neo-Carbon Energy. It is a completely revised renewable energy system which is emission-free, cost effective and independent. Solar and wind are used as a main primary energy source that is affordable and available for everyone. By combining renewable electricity, water and carbon dioxide from the air we can produce fuels without emissions. These fuels are stored and distributed within existing infrastructure and technology. This kind of energy storage, combined with batteries, is one major option of how we can balance the variable energy production of solar and wind.

Neo-Carbon Energy electrifies the world and transforms our energy use from unsustainable to renewable, new business and technologies for energy storage, smart energy services, transportation and industrial energy use will be generated. Our present fossil fuel based energy systems will die and a new one based on solar and wind will rise forcing the energy companies to re-invent themselves. The world's energy power structure will change as energy production becomes independent, bringing power to the people. In 2050 an emission-free energy system has to be in place to reach a zero emission energy system right in time.

Constraints for the energy systems

There are several major constraints for the energy systems in the future. The first constraint is that the global electricity demand has grown considerably since the Second World War and is still growing very fast. At the same time "climate change presents a unique challenge for economics: it is the greatest and widest-ranging market failure ever seen" (Stern 2006). Thermometer readings all around the world have risen steadily since the beginning of the Industrial Revolution. According to an ongoing temperature analysis conducted by scientists at NASA the average global temperature on Earth has increased by about 1.1° Celsius since 1850. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.20°C per decade. The extent of climate change effects on individual regions will vary over time and with the ability of different societal and environmental systems to mitigate or adapt to change.

Another obvious constraint is that fossil fuel reserves are finite and it is only a matter of time when they run out. Every year we consume currently the equivalent of over 11 billion tons of oil in fossil fuels. Crude oil reserves are vanishing at the rate of 4 billion tons a year. If we carry on at this rate without any increase for our growing population or aspirations, our known oil deposits will be gone by 2052. We still have gas left and also coal, but if we increase gas production to fill the energy gap left by oil, then those reserves will only give us an additional eight years, taking us to 2060.

One of the development conundrums of our era is energy inequality. A third of the world's population does not have access to affordable electricity. A European would use 100 kWh of electricity, which is the current definition of modern energy access, in five days, as the average Ethiopian would use that much power in two years.

Heavy metal emissions are another global issue causing severe health damage. Based on German filter standards about 100 000 people are globally killed per year from cancer by heavy metal emissions from coal burning and 400 000 people are killed, if we take into account worse filter standards. Ontario in Canada decided to phase-out coal due to the very high subsidies in the health system which is twice as high as the value of power.

We should also note that global energy subsidies are almost fully allocated for fossil (and nuclear) fuels. Fossil fuel subsidies are as large as the global expenditures for the health sector. Renewable energies would grow much faster if harmful fossil-nuclear subsidies would be phased-out. An additional negative element is managing system complexity in fossil and nuclear fuels. There are many energy conversion steps which are the reasons for low efficiency and high costs and complex value chains in fossil and nuclear fuels compared to renewable energy.

Our performance is excellent, unfortunately under the wrong banner. According to Jared Diamond (2005) humanity is following a historic collapse pattern, which includes over exploitation of natural re-

sources, non-adaptive social behaviour, military conflicts and structural change in trade routes. Decarbonised power systems are desperately needed since we produce carbon well above the world biocapacity (Ewing et al. 2010). Fortunately, the COP21 Agreement in Paris is paving the way to survival. In the Agreement 195 countries adopted the first-ever universal, legally binding global climate deal. The agreement sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C.

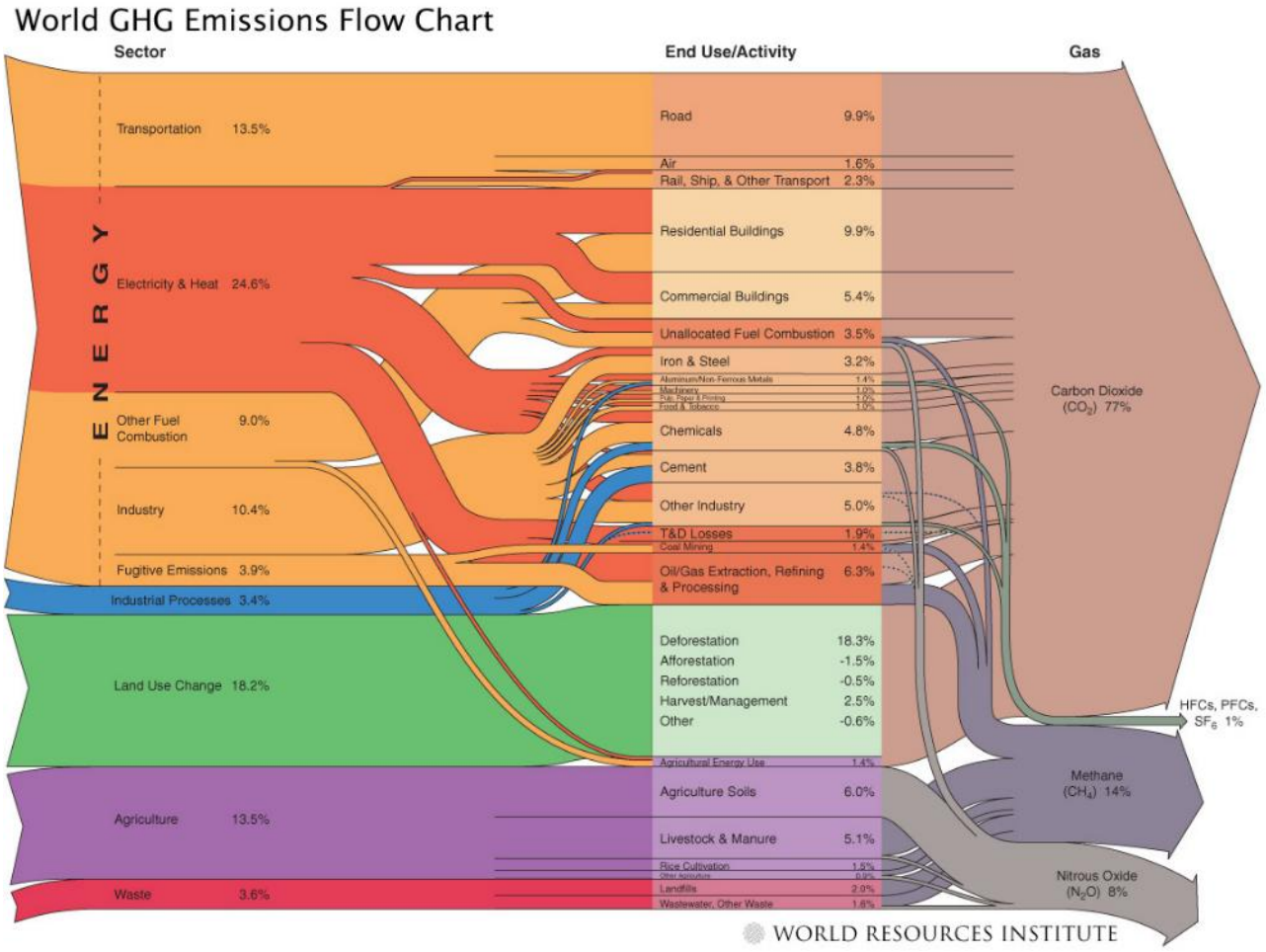


Figure 13. World GHG Emissions Flow Chart.

Sustainable energy production

According to World Commission on Environment and Development (WCED 1987) the definition of sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Major criteria for sustainable energy scenarios are when following aspects are taken into consideration: energy resource base, climate change impact, societal cost, coverage of energy sectors and energy access for all.

The real low carbon investments can be found in wind and solar power besides nuclear, the role of which is currently much smaller than the other two. Although wind is still number one, the growth rate of solar is twice as fast as wind due to the fact that it is more modular, it is easier to use and it is more distributed than wind. Approximately 100 countries currently utilise wind technologies, but all countries in the world are already using solar technology because it is easier to utilise. When we talk about the capacity expectations of PV, we can see that there are some contradicting estimates. Leading reports show at least 2-4 times higher numbers of growth of PV than IEA WEO for 2030 and 2040. IEA WEO is lagging behind due to assuming wrong growth. Greenpeace and BNEF have been close to the real numbers in the past 10 years. Forecasts of fossil fuel companies such as Shell, BP and ExxonMobil are as conservative as the IEA WEO.

Climate change is still a major challenge accepted by all energy scenarios and increasing share of RE is accepted almost by all scenarios. However, assumptions of future energy demand and energy efficiency efforts differ widely. There are no scenarios discussing the impact of peak-oil, -gas, -coal and -uranium and respective price. Dominance of the power sector in the future is by now only understood by WWF and Greenpeace. The cost advantage of solar PV (Photo Voltaic) vs. CSP (Concentrated Solar Power) is reflected only by IEA-PVPS. The role of storage and long distance grids is not reflected by any scenario. This applies also to power-to-gas and power-to-X technologies as a storage and bridging technology.

Breyer showed how solar photovoltaic energy production has many advantages. It is accessible everywhere and there are no resource conflicts. The question is about highly modular technology – off-grid, distributed in roofs and in large-scale. The benefit is also that there is a high learning rate due to this 'simple' technology. The theoretical efficiency limit is 86% and currently the best lab efficiency is 46%. The sector is developing fast and the best photovoltaic panels in markets can produce some 20%. There is a high growth rate, which is more than 40% during the last 20 years (this means doubling every three years) and simultaneously there is a fast cost decline. Solar photovoltaic energy production is the least expensive electricity source in a fast growing number of regions. We can say that it is the most important key enabling technology for survival of human civilization.

Wind energy is also accessible in all world regions and has no resource conflicts either. It is likewise a modular technology – off-grid, community turbines and large-scale. Furthermore, it is already at a low cost level – 3 – 8 € ct/kWh, which means in practice that it is the most cost effective electricity source in rich wind resource areas. It has high full load hours due to 24/7 harvesting and we can state that it is the second most important key enabling technology for the survival of human civilization.

Batteries convert PV into flexible 24/7 technology is showing the same high learning rates as PV. Batteries are as well a highly modular technology – from phones to storage plants. They also push an extremely

fast mobility revolution (fusion of renewables, modularity, digitalization, less complexity). Electric vehicles also show high growth rates, more than 70% per year, which means double in every two years. It has fast cost decline with a consequence that it will be the least expensive mobility solution from 2025 onwards. It will probably be the key reason for collapse of western oil giants and the 3rd key enabling technology for survival of humankind.

Power-to-X

Power-to-X enables sustainable production of hydrocarbons. Ingredients of the system are electricity, water and air. The COP21 Agreement would be wishful thinking without Power-to-X. It has been estimated to become profitable from 2030 onwards and it can also provide a flexible seasonal storage option. Global hydrocarbon downstream infrastructures is usable and even the most difficult sectors to decarbonise, such as aviation, chemistry, agriculture, etc. can be managed with PtX. It will be the 4th key enabling technology for survival of humankind.

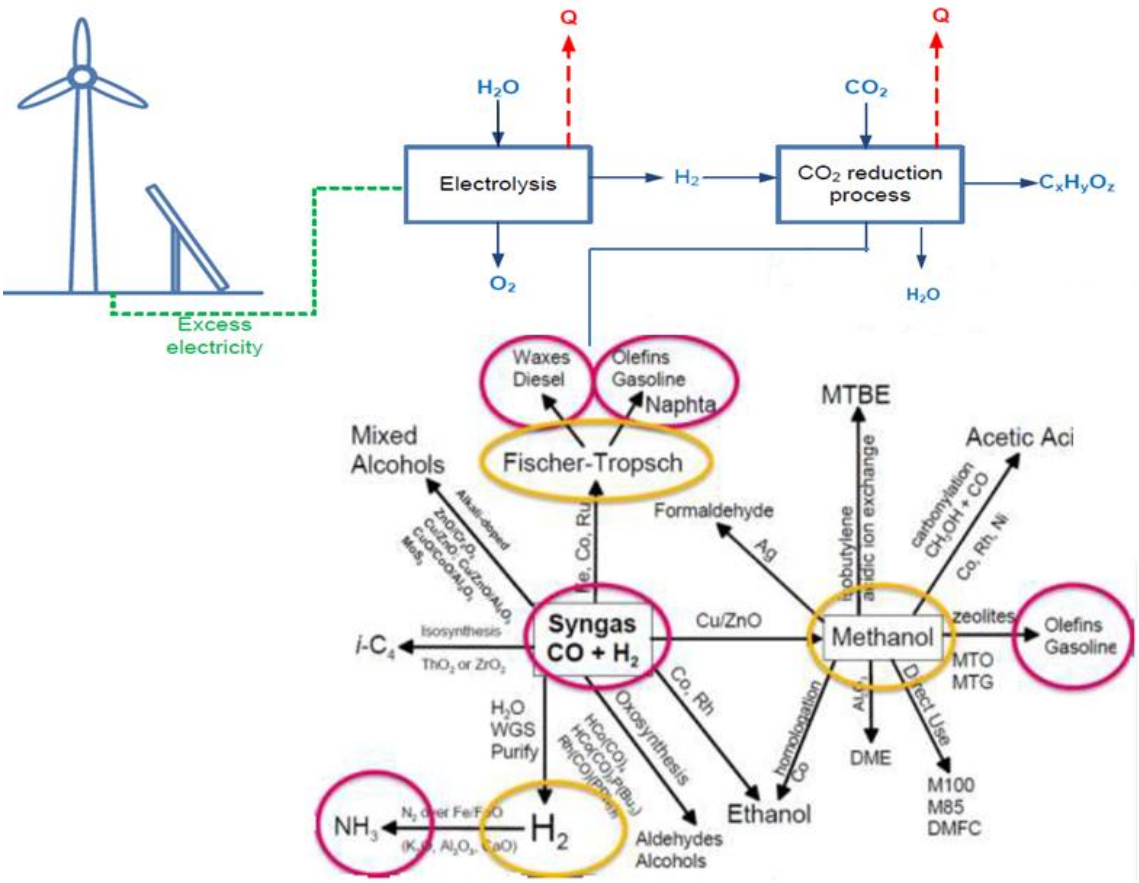


Figure 14. Power-to-X in principle process steps (top) and major synthesis routes for synthetic fuels and feedstock chemicals.

As far as total annual costs are concerned and despite overall costs being somewhat similar for test scenarios, 100% RE scenarios have less exposure to risks of higher costs related to WACC and carbon emissions. When we look at the annual production and consumption of energy, seasonality of solar PV is complemented somewhat by wind power generation. CHP generation in colder months also complements solar PV. Storage technologies add considerable flexibility to system (Child & Breyer 2016).

Optimally structured energy system

A definition of an optimally structured energy system based on 100% RE supply includes an optimal set of technologies, which are best adapted to the availability of the regions' resources. It also has an optimal mix of capacities for all technologies and every sub-region of a given larger area and optimal operation modes for every element of the energy system in addition to the least cost energy supply for the given constraints.

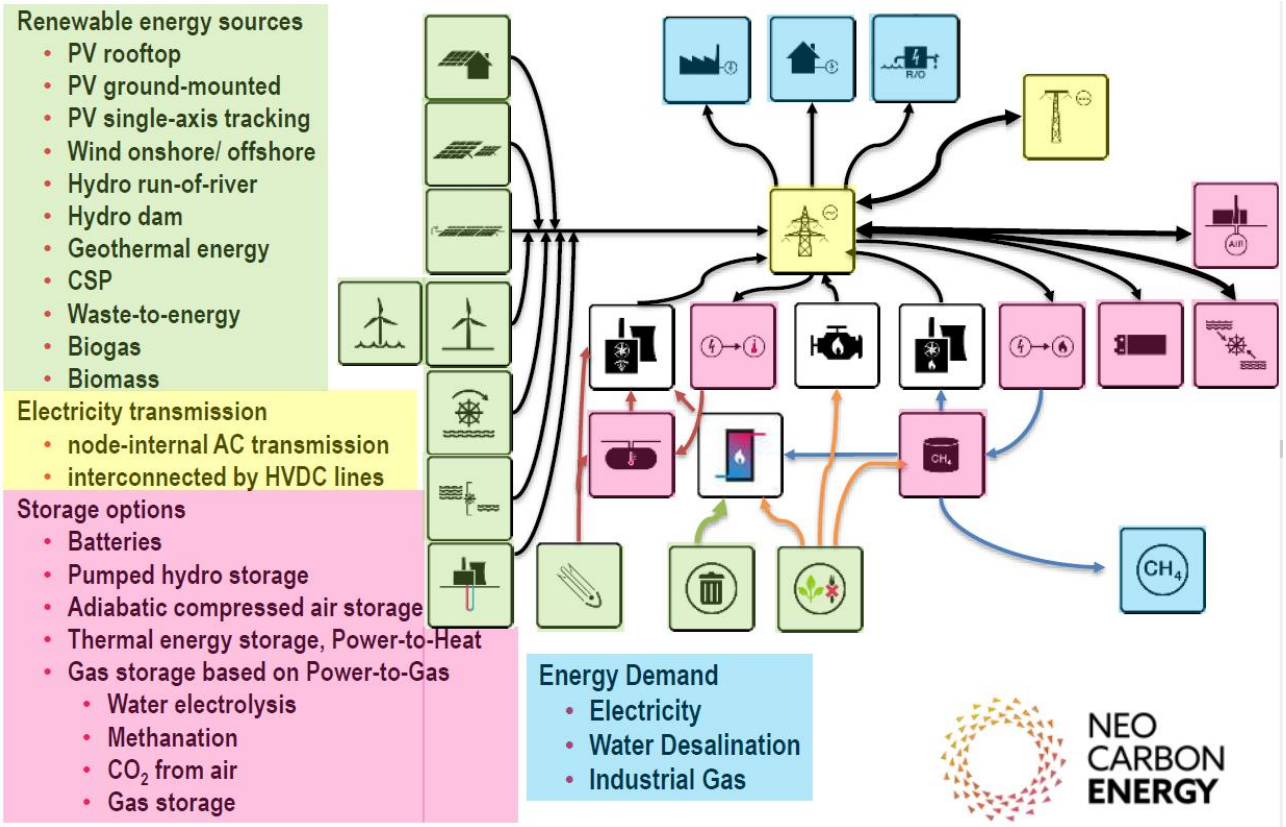


Figure 15. Block diagram of the LUT Energy System model.

If we look at the electricity capacities in Europe an area-wide scenario that shows a small share of system PV capacities in most of the region and prosumer share is significant. Sunny conditions in Iberia lead to a significant share of PV single-axis and >50% wind share in Baltic, Denmark, British Isles, France, Poland, Ukraine.

PV plays a major role in Area-wide desalination gas scenario for Central and Southern Europe. PV single-axis and wind are the main sources of electricity for water desalination and industrial gas production. Resistance against new grids could drastically increase the PV share in electricity production. The excess energy in the area-wide open trade desalination and gas scenario is lower than for independent sectors (reduction from 141 TWh to 132 TWh, also relative shares of excess energy decrease from 3.2% to 2.2% of total generation). Existing pumped hydro storage plays a significant role. The relative share of prosumers' batteries increases significantly in the integration scenario in Northern Europe. Absolute storage capacities increase in Southern Europe and decrease in Central and Northern Europe when sectors are integrated.

In the Middle-East and North Africa area-wide scenario shows a high share of PV single-axis and wind energy capacities in most of the regions, prosumers share is also significant. Sunny conditions in most of the regions lead to a significant share of PV single-axis. Wind energy has the highest share in North African regions, Saudi Arabia, Yemen, Oman, Syria, Iran, Jordan and Iraq. Installed capacities for PV and wind has increased significantly by 390% and 293% compared to the area-wide scenario for covering the huge local desalination and industrial gas demand.

PV plays a major role in the area-wide desalination and gas scenario for Israel, UAE, Bahrain, Qatar, Yemen and Oman. PV single-axis and wind are the main sources of electricity for water desalination and industrial gas production. Also in this area the resistance against new grids could drastically increase the PV share in electricity generation (Aghahosseini et al. 2016). Recent (ibid.) examples of wind PV cost in MENA area comes from Morocco, where wind onshore PV utility tender confirmed price of 30 USD/MWh and similar tender in Abu Dhabi confirmed 24.9 USD/MWh.

In an overview on the world's regions we can say that 100% RE is highly competitive because it shows the least expensive cost structure, even in matching supply and demand in all hours of a year. The PV share can be expected to be about 40% (range 14-50%), hydro and biomass is limited the more the sectors are integrated. Flexibility options limit storage to about 10% for year 2030 technical and financial assumptions and it may further decrease with heat and mobility sector integration. Most generation is locally within sub-regions (grids 3-23%).[13]

Breyer's Conclusions

We can note that the tremendous energy-related global problems induce the collapse of our global civilization – without a drastic and fast change of our energy basis. The COP21 Agreement in Paris is the

[13] For more sources, see www.researchgate.net/profile/Christian_Breyer.

first real attempt for survival of civilization. Net zero emissions is equal to phase-out of all fossil fuels by 2050. Unfortunately, we must reiterate that currently global energy scenarios are of poor quality with the only exception is Greenpeace's Energy R[e]volution scenario. The sustainable resource basis is excellent. Key enabling technologies are solar PV, wind energy, batteries and PtX. A 100% renewable energy system is a low cost solution and COP21 together with 100% renewables create the largest business opportunity ever. The major survival barrier seems to be slow, inflexible and lobbyism-stressed politics.

2.4 Markku Wilenius' presentation On Systems of Self-Organising Work

Future scenarios of the Limits to Growth Report

The Club of Rome published the Limits to Growth Report in 1972 and it has been updated a couple of times ever since. The report included many scenarios of the future and was really the first effort to build an idea how the complex system called humanity is moving forward. The report prepared by MIT was the first real simulation of the globe towards the future. It is astonishing that those scenarios about food production, non-renewable resources, about population growth, pollution levels and industrial output are more or less correct.

If the vision painted by José Cordeiro of immortality of the humanity will materialize in 20 years time, the population growth will look probably a little different than the Club of Rome Report expected and this will naturally present some problems for us in many fields. There is another recent modelling exercise, the SimRess project that has recently analyzed the potential effectiveness of policy measures and mixes in the field of resource policy[14]. Considering a time horizon through 2050, the project interpreted model simulation results from both a system dynamics model and an econometrics model and the result was that we are close to the edge.

[14] http://simress.de/en

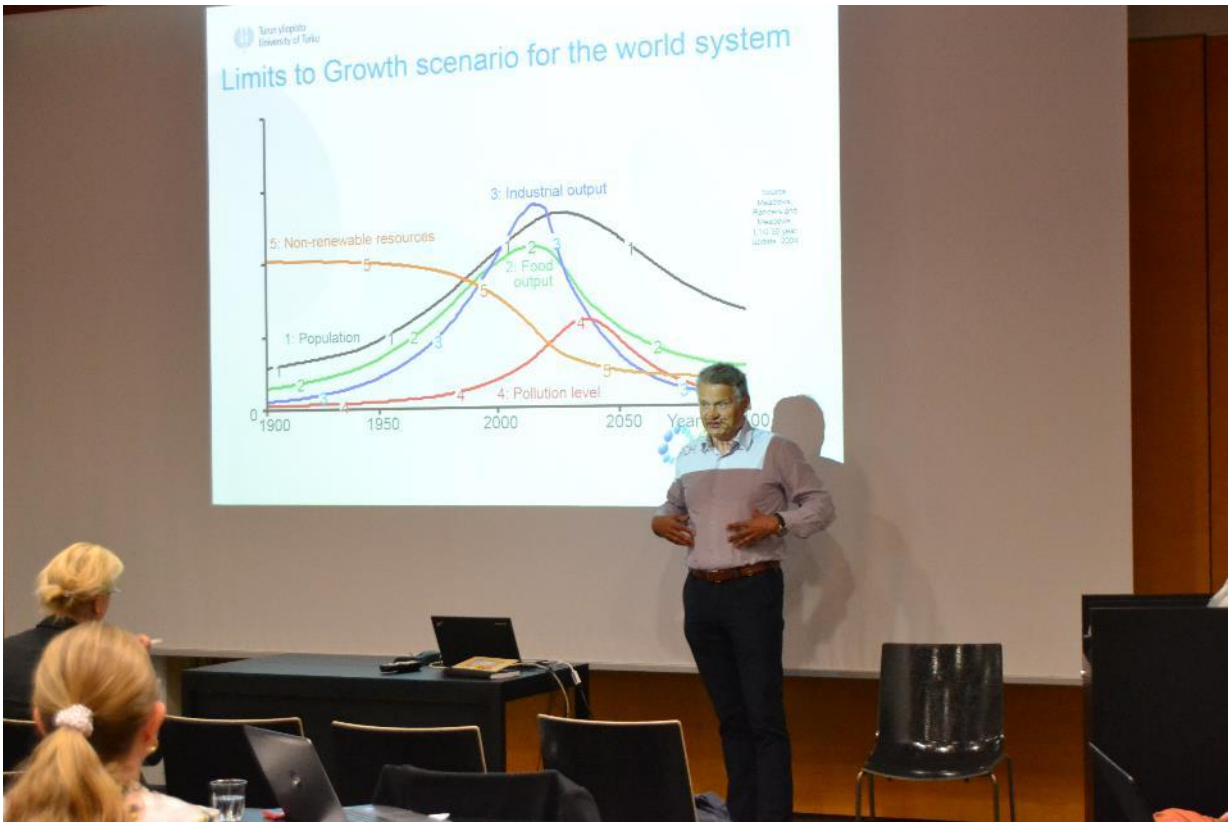


Figure 16. Professor Markku Wilenius discussed systems of self-organising work.

What is striking in both of these scenarios and simulations is that the next 10 to 20 years are the defining moment in our system. Either we go on with the trajectory installed or something totally different. If we go on with the present path, then something we would not desire to see will happen because all these models imply that some kind of collapse is coming. The question is how to tackle these current challenges? The one thing is to look at technologies, which is extension of humanity and is a good thing as such. But not just any kind of technology, we also have to look how technology is used and how people are treated.

Transformations in working life

People need appreciation and as individuals we are creative beings but creativity really springs out of collective work because we are ultimately social beings. There are several examples of companies, which are very successful because they treat people with respect and let them organise their work individually. In Finland we have Reaktor, which is a digital service company with a tremendous track record. This is a result of a certain philosophy on how the company is built, namely through love of their work, they are passionate about their hobbies, caring personalities with emotional intelligence and that lead to embrace change with their own responsible example (Kurki, Pura & Wilenius 2016; Kurki & Wilenius 2016).

These companies know that the world has to be changed. There is a large movement going on, which are creating a real revolution, even larger than revolution we are seeing coming through technology and coming through energy revolution. This is because of the changing perception of human being. I believe that we are only at the beginning of anthropomorphic era because we are only at the beginning of understanding ourselves as human beings and as social beings. All this happens in the context of huge changes in technology, energy and the environment.

The question is how to cope and how to live through working life in this rapidly changing environment. We know that working life is for us very important and in many ways defines us. We need to look here at the big picture and specifically the pattern of societal waves of advancement since the birth of industrialization. It is necessary to understand the movement in the industrial societies in a systemic way. In different parts of the world cycles have happened in different ways but by and large the dynamic pattern of societies moving to post-industrial era.

Development waves in industrialised societies

Changes have taken place in cycles, this applies not only to what society is producing, how it is producing but also what is our idea of humanity. The question really is about conscious revolution meaning that we are building a very different type of awareness about where we stand as humanity. In that it is very important to understand where we come from, what is the background of all of this, what is this huge revolutionary movement that has taken shape during industrial time in particular?

It is very clear that when we are moving over to the next phase, over to the 6th wave, the issue is all about how we become more intelligent in everything we do. At the core of that from the human interest point of view is integrating human, nature and technology. How this spreads in everything that we do, produce or distribute is the code for humanity for the next decades under the circumstances described before. We have less than 10 years time to change (Wilenius 2017a).

In order to get the 6th wave to operate the way we would like it to operate, we need to embrace the complexity of the system (Wilenius 2017). All these forces that are bringing up either the right type of questions or the right type of answers need to be somehow getting to the play. If we view just one thing, the next phase of globalisation, it is going to be the end of OECD dominance. At the end of 6th wave the power shift will have to happen and it has to happen in a way that non-OECD countries will have approximately the same weight economically, politically and from military power point of view as the OECD countries have today i.e. 2/3 and 1/3 must switch around.

Table 4. The succession of development waves in industrial societies.

THE SUCCESSION OF DEVELOPMENT WAVES IN INDUSTRIAL SOCIETIES

K-Waves	1st wave	2nd wave	3rd wave	4th wave	5th wave	6th wave
Period	1780–1830	1830–1880	1880–1930	1930–1970	1970–2010	2010–2050
Drivers	Steam Machine	Railroad Steel	Electricity Chemicals	Automobiles, Petrochemicals	Digital communication technologies	Intelligent, resource efficient technologies
Prime field of application	Clothing industry and energy	Transport, infrastructure and cities	Utilities and mass-production	Personal mobility and freight transport	Personal computers and mobile phones	Materials and energy production and distribution
Human interest	New means for decent life	Reaching out and upwards	Building maintenance	Allowing for freedom	Creating new space	Integrating human, nature and technology

Many innovation platforms, such as the expansion of resource efficient technologies and web-based smart products and services will pave way for the future but still the key element might be the trajectories for social change such as web-based empowerment of the people and maturing environmental concerns. We need to take advantage of the fact that we are more intelligent, more knowledgeable, more conscious in our actions than ever before. When we think how we can change the scene from the past when our growth was mostly about the material productivity and consumption, population and GDP growth all tied together. This is something we need to decouple along with the oil consumption. Luckily the amount of the so called cheap oil is diminishing and that presents us a different kind of opportunity. Now there are more indicators that change not only needs to happen but also it can happen because the market conditions change.

Ultimately in understanding this threefold society, namely culture-freedom, social-equality and economy-solidarity, lays the secret. To the question that is it a human right for a person to be able to express oneself, most of the people will answer positively. The principle of culture is freedom and whenever you violate that you do something wrong. In social sphere of the society equality is also very important. When we come to the economy part of the society the attitude still is that it is all about competition, which business schools are still teaching and as a result this is what we get.

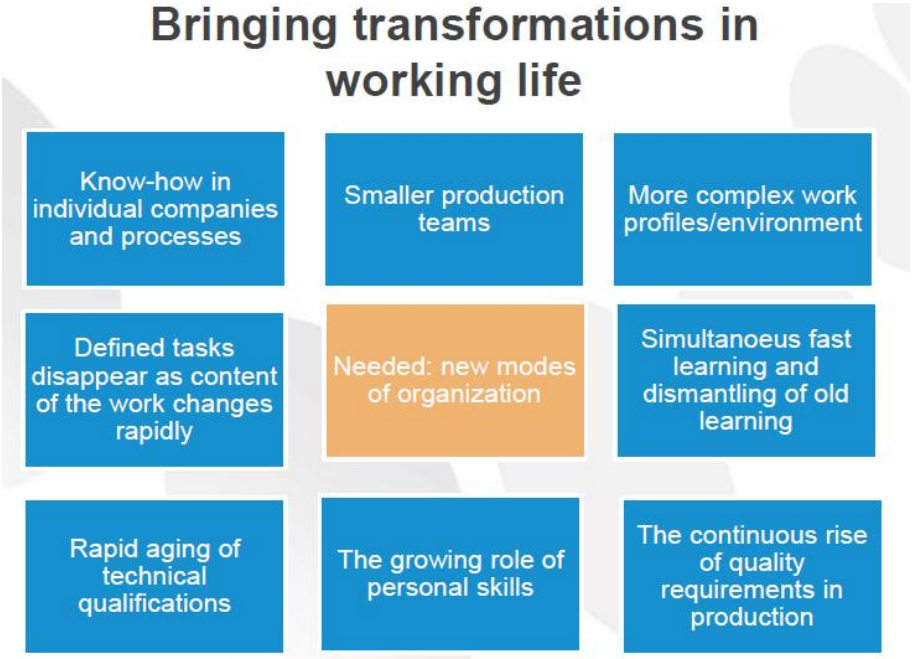


Figure 17. Bringing transformations in working life.

What is wrong with our system?

We must ask ourselves what is wrong with our system when despite the greatly increased productivity during the past 200 years, most of the countries are in serious debts. What is wrong with the economy that is creating great amount of output that nobody wants, like pollution? How is it possible that we have created this monster? I believe it is because we have not really understood what the principle of the economy is all about, namely solidarity. It is all about partnership, how we deal with one another internally and externally. Only when we start to understand this principle and put it into practice, like the companies mentioned before have done, we can build healthy societies and healthy companies. Until the time when this principle is understood we are going to wrong direction no matter how fancy technologies we have.

We have this new idea and a new paradigm shift to understand organisations in systems way, meaning to understand the internal loops and external loops of the organisation. We need to reject the classic management such as focus on processes, hierarchies, obsessed with success, using known remedies, immediate action, enforcing uniform behaviour and bias towards experts. We need to pay attention to the new school of management such as focus on people, no hierarchies, learning from failures, finding new remedies, encouraging different opinions and empowering employees to use their experience. This is why companies such as Reaktor, providing a human-centric organisation and consciously breaking from old ways of running business, have had excellent long-term performance.

A lot of things that organisations do are to retreat to old memory of human cultures and history, to the times when we were still organised to tribes. There are some features in tribal behaviour that we as human beings are deeply connected to. What if company is a tribe? This was the question we asked when we studied the creative technology company Reaktor and compared it with Maori tribes. In the comparison of practices we noticed some similarities how some of the collective everyday actions worked.

There is a lot of symbolism, which is something special to humanity. Symbolism also means that you are building a collective identity. In the study was compared what are the entry points to certain activities such as going to the work in the morning, how to start and welcome people, how to think what is important in the work and how to analyse what has been done in the work. The tribes in New Zealand had their similar things, and yet, because of the industrial order and industrial way of doing things, we have lost most of it in our professional life. We may ask why? This is because we live in the system and what is outside of the system is also inside of the system.

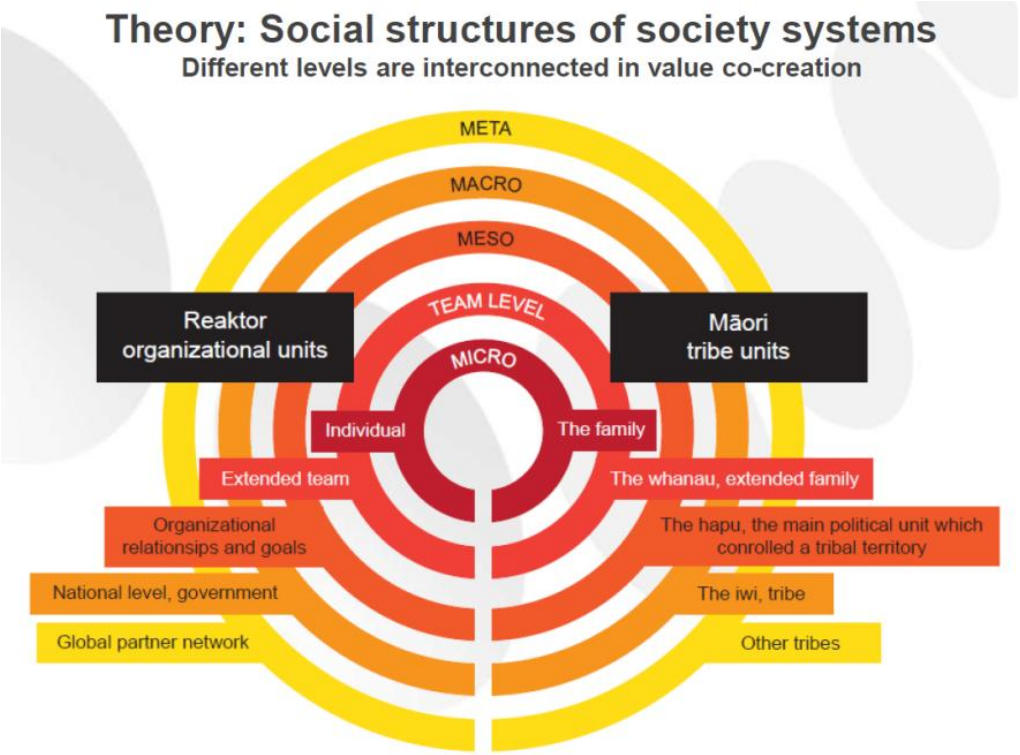


Figure 18. Social structures of society systems.

These organisations understand that what they do inside is what they do outside. There is actually no wall between them and customer and the way that they treat themselves is also the way they treat their customers, or in other words everything you do inside radiates somehow also to outside. If you treat

your customers really well it is likely that you treat your personnel well and vice versa, when you treat your people well they automatically treat their customers well because everything goes in systems.

The company Reaktor is doing things differently than an ordinary service provider. If you do things in industrial way you create a package, which you deliver to the client no matter what the client needs or feels and this is what most of the IT-companies are doing today. Instead, the working principle of Reaktor is to be self-organized, which "simply means that our teams have the freedom to choose how they work, observing any conditions set by the client or the project itself. To reach and enact a decision, the team does not need to consult our executive group or anyone else from the head office. In fact, the main function of the head office is to facilitate the work of our teams by means of financial management, sales, recruitment, and administrative support…Indeed, one way to think of Reaktor is to consider a group of networks, or links between people without an imposed hierarchy. The more links between people and the stronger these links are, the stronger the network becomes."

The question is how to understand self-organisation as a principle, which really leads us from being an operational unit to human beings who love to serve and give out their best and this is how we can get out of this present cul-de-sac that we are in this larger system that we are talking about. There is no hope that we can solve the problems where humanity now is, unless we look at the internal principles in which we are operating and raise our awareness around them. We need to re-think about all our practices in order to become truly self organised by encouraging informal networking and personal relationships within the organisations having a community focus.

Wilenius' Conclusions

The community's effort to enhance team spirit and dynamics should be a natural part of everyday. If we focus on communications the collective knowledge is actively shared and greatly appreciated and therefore knowledge and problems are shared collectively. Information should be shared from "bottom up": employees inform the higher level and they involve the highest level if necessary. Physical or virtual meeting place is important providing a platform for communication and as a result authority will gradually shift from leaders to teams (relational leadership). When the employees have a real stake in the decisions then they can also have an impact on the work. The headquarters' role should develop from directing to supporting the work. There should be a clear vision of what is done, for whom, and freedom to decide how.

We can formulate a self-organising manifesto by putting our focus on communities instead of the individual. You will save in administrative costs if you invest on employee's recreation. Instead of collecting huge data use and share it. Do not motivate with money, but with meaningful acts. Understand that our

client is your friend. Only if you are free can you truly be responsible since you are married to your organisation.

2.5 Pasi Vainikka's presentation on the Worst Ideas Misleading the Awareness of the Present Situation as Regards Energy Future

Pasi Vainikka is Co-ordinator of the Neo-Carbon Energy Project. He acts as principal investigator at VTT, and as adjunct professor at Lappeenranta University of Technology (LUT).

Vainikka emphasises that discourse on energy is constricted by many clichés, taboos and mantras that are based on the past. They initiate incorrect chains of conclusions and create a misleading awareness of the present situation. Therefore, to clear up the discussion provocatively, he proposes a list of ten most destructive ideas of energy future.[15]

Table 5. Ten Worst Ideas about Energy Future according to Vainikka.

1. Renewable energy is expensive
2. Digitalisation does not accelerate change in the energy sector
3. The price of electricity cannot be below zero
4. Basic industry needs baseload power
5. Cheap energy creates jobs in industry
6. Combined heat and power production is cheap and efficient
7. Bioenergy reduces emissions
8. Oil refining is coming to an end
9. Energy is energy
10. Capitalism has led to climate change

[15] The list of most destructive ideas of energy future was originally published in Talouselämä magazine, issue 1/2016.

The idea of the list of “The Ten Worst Ideas in Energy Future” is that we are not only doing research but we are also delivering key messages to the decision makers and to the public. Consequently, we should put issues into a language that can be discussed by analysing the current system and how the future system might look. We have heard that there are many opportunities open for us in the energy sector and even abundant energy future. However, George Friedman has asserted that "constraint theory defines for you what outcomes are possible and what outcomes are impossible. It also eliminates wishful thinking." [16]

By analysing what is impossible, we have a better understanding what are our real options. After the Paris agreement it has become clear that we need to go rapidly towards an emission free energy system. For us engineers it is not difficult to imagine what kind of technical possibilities we have to create for this new system. We are heading towards great electrification where we have nuclear, wind, solar and geothermal, which all are already technically available. Carbon capture and storage is with a question mark.

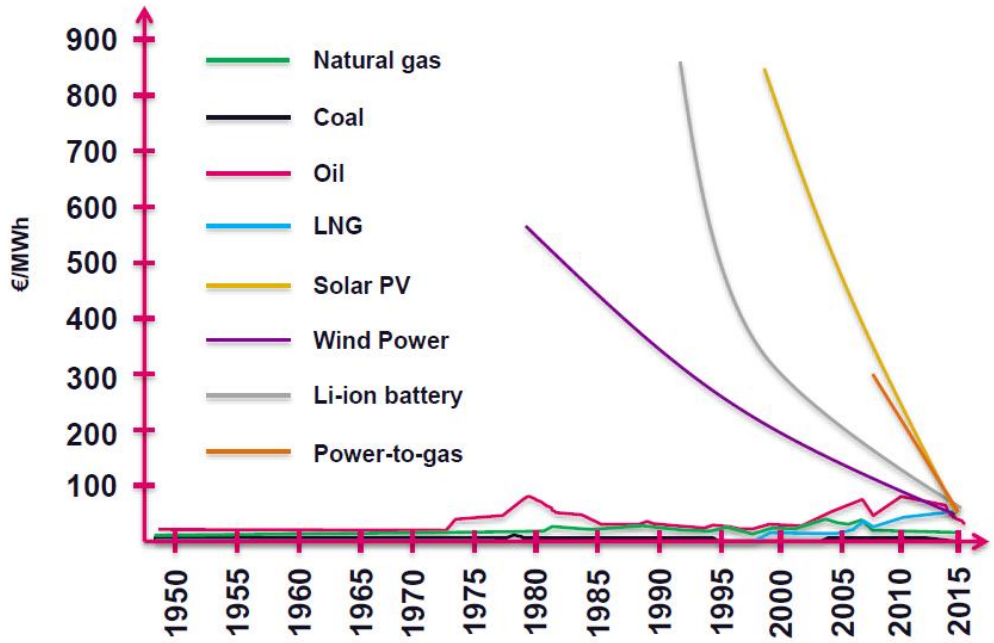


Figure 19. Historical cost development of different energy sources.

[16] http://www.businessinsider.com/stratfor-george-friedman-predictions-for-the-future-2016-2

Cost effective renewable energy

A move towards 100 % renewable energy based system is highly based on solar and wind and it is clearly linked with behaviour of different actors in society. The current discourse on energy is constricted by clichés, taboos and mantras that are based on the past (see Table above). They initiate incorrect chains of conclusions and create a misleading awareness of the present situation. One of the claims is that renewable energy is expensive. However, in India, China and the US, solar and wind power already cost the same as fossil or nuclear power. This means production costs are below 50 Euros per megawatt-hour without subsidies. The third phase of Dubai's DEWA solar project attracts record low bid of US 2.99 cents per kilowatt-hour. In Europe, wind power is the cheapest new power generation capacity. One third of all new global capacity and two thirds of new US capacity is solar and wind power. Do we still need to continue discussing this?

The role of digitalisation

Digitalisation has changed all the sectors of society into which it has permeated. In the energy system, this means that internet and cyber security's role will become increasingly significant. Compared to the current system, a distributed production system based on solar and wind power is easier to build to recover from a cyber-attack. This alone would be a sufficient justification to switch over to a new energy system - the Internet of Energy. In addition, the factory model we have moved from steam engine based production to manufacturing the semiconductor, which is an important technology change. Another change is at the system level. Currently we have the one way energy system. In the future all these technologies can be facilitated in the cloud where all cars, washing machines, buildings etc. have their own IP address, which means that energy systems' management becomes more flexible.

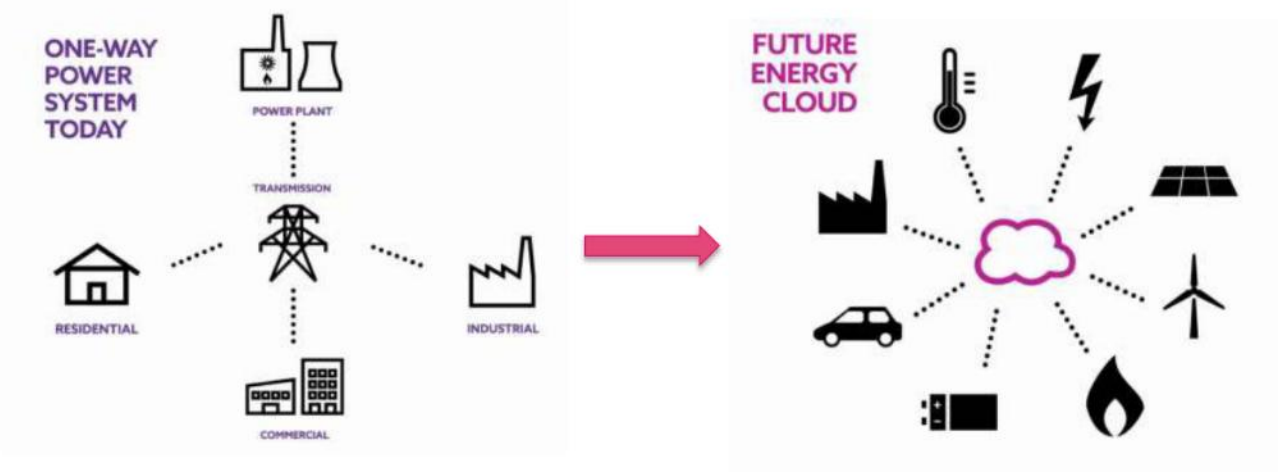


Figure 20. From one-way power system to energy cloud.

Energy is the largest sector in global economy, but it is also the largest income redistribution system. When we move from fossil fuels to 100% renewable in the coming decades, global income redistribution falls apart. This disruption may have dire consequences especially in those countries, which are now the main fossil fuel producers and have currently large revenues from these products.

Energy is one of the most vulnerable industries and it is becoming more exposed as it is modernised. Smart power grids will make our electricity delivery more efficient, but also make the system more exposed to a cyber-attack. As numbers of targets for attack are increasing, the capabilities for those who want to disrupt the system are also expanding. In the cyber world, wars are not declared, they just begin. This increases the fuzziness of future system control and operation. Therefore in a digitalised world we shift from physical security to cyber security.

Figure 21. The ten worst ideas in energy futures according to Pasi Vainikka.

Baseload energy

Currently our energy system is rather stable day by day and there are no major differences in baseline power. When renewable energy comes, this situation will change. There will be huge differences in production during 24 hours and storage of energy is going to have an important role. As in wind and solar power energy itself is free of charge, the market price of electricity cannot be locked above zero. In the renewable energy system, electricity production is greater than the consumption for a significant part of

the time. Thereby the electricity price is determined based on consumption as well as demand and energy and storage behaviour.

Vainikka draw our attention to the fact that it has been said that basic industry needs baseload power. However, at times in Denmark, wind power is produced 1.4 times more than what is consumed. During the year 2016 the variable wind power covered 40 percent from the overall consumption. The country has not collapsed. Quite the opposite: Denmark exports seven billion euros worth of energy products every year. In Germany, which is a major industrial country, at times solar and wind power produced 90% of the energy that was used. Based on these examples we can estimate that energy needs of industry can be guaranteed also in the era of renewable energy.

Cheap energy and reduced emissions

In Finland's reference countries, there is no link between the gross domestic product and energy consumption. Cheap electricity has not guaranteed the profitability of fine paper production. Instead, era for the product came to an end. For example, the paper company UPM produces more energy than it needs. In 2014, steel company Outokumpu would have needed someone to pay it 60 euros per megawatt hour for its electricity consumption in order to turn the result of the company positive.

Combined heat and power production is cheap and efficient

Heat produced using heat pumps is half the average price of district heating. This has not gone unnoticed by house owners. Today the majority of detached houses install heap pumps as the means for heating, even in district heating areas.[17]

According to the Natural Resources Institute Finland, the Finnish targets concerning the use of wood energy cannot be justified with climate benefits: burning wood biomass releases carbon dioxide and although forests grow back, their carbon stock has reduced. Finland's forest energy vision is quite the opposite to that of China and the US. China has announced that it will increase its forest stock by twice the amount of Finnish forest stock over the next 15 years. The US objects classification of forest energy as carbon-neutral. According to Vainikka there exists a biocarbon bubble, which means that bioenergy is charged with expectations that cannot be realised due to the reasons mentioned above.

[17] Taxpayers may soon notice that they have had heating systems built twice.

Oil refining continues

New records have been set in oil production. By 2020, 55 percent new production capacity will be built. In recent years oil price has been over one 100 dollars per barrel, for the past year only 50 dollars per barrel. Four-fifths of proven oil reserves can be taken into use at a price below 70 dollars per barrel. This inexpensive oil will be available for at least 50 years.

Energy is politics

Energy is not “just” energy, it is politics. It is security, foreign, economic, employment, national, regional, innovation, industrial and environmental policy. This is why preparing a good and solid national energy strategy is difficult and requires an exceptional amount of versatile expertise. Several changes are simultaneously affecting the energy field. The package is wicked to deal with. Vainikka claims that the problem is the lack of capitalism. Air is a shared resource that is not owned by anyone. This way the impacts of the fossil emissions are not compensated by the ones who created the problem. Emissions and the price of energy would settle at the correct level if the producers of fossil fuels and the parties suffering from the emissions had a trade system for compensating the harmful effects of emissions. This kind of a model is probably impossible to realise. The market remains incomplete and the pollution of the shared atmosphere continues.

3. FUTURES CLINIQUE AS A FORESIGHT METHOD

Futures workshops are a central method in futures studies, originally developed by Robert Jungk (Nurmela 2013). In futures workshops the participants – business representatives, researchers, citizens, students, non-governmental organisations (NGOs) et cetera – work together in small groups to anticipate possible, probable and preferred futures of a selected topic (Nurmela 2013). *Futures Clinique* is a distinctive futures workshop developed by Sirkka Heinonen at the Finland Futures Research Centre (FFRC), University of Turku, together with her research team, particularly Juho Ruotsalainen within several research projects. (Heinonen & Ruotsalainen 2013).

Futures Clinique is a special type of futures workshop that utilises various foresight methods to probe especially *possible and preferred futures* (rather than probable). Much attention is paid to discontinuities, disruptions – and subsequent transformation. It aims at strengthening and deepening systematic futures thinking and foresight of the participants through a co-creative and interactive process. In this Futures Clinique five foresight methods were used: Futures Window, Futures Wheel, Futures Table (PESTEC), Futures Image and Black Swans. For the methods, see more in Chapter 4. Work of the each group is facilitated by an appointed moderator. The role of moderators is important in the futures clinique process, since they not only moderate their own groups, but also participate in opening up and analyzing the results. Moderators for this futures clinique were Nick Balcom-Raleigh, Sofi Kurki, Merja Lang, Sakari Nisula, Hazel Salminen and Amos Taylor.

Figure 22. During the futures clinique, participants work in small groups, utilising different foresight methods.

The main distinction to other futures workshops is that futures clinique is especially designed to anticipate and create radical futures – futures that differ significantly from the present. Futures clinique places a strong emphasis on weak signals – new phenomena and issues that are more or less marginal, but can strengthen in the future. Real change lies in weak signals, as they bring about issues that are qualitatively different from the issues of the present. On the contrary, trends and megatrends point to quantitative changes – more or less of something that already exists, is widely known and can be measured. In other words, the futures clinique deals with discontinuities instead of continuities. It also invites to thinking about uncertainties and surprises, sudden events with low probability and high impact i.e. black swans (Taleb 2010; Heinonen 2013).

The futures clinique process begins with a background research, in which weak signals are scanned and analysed. The results of the background research are written as an essay to be sent to participants before the workshop. The actual workshop begins with a futures provocation, a presentation to summon up (Lat. pro + vocare, call forth) new ideas and creative futures thinking. After the futures provocation, a futures window is shown. Futures window is a visual presentation of possible weak signals, accompanied by background music (see Hiltunen & Heinonen 2012). It is intended to develop the viewers' futures consciousness, by opening up innovative futures thinking through visual stimuli.

The futures window is succeeded by groupwork sessions, in which several foresight methdods are used. These include the futures wheel, which is a mindmap-like method of collecting ideas, discussing them and anticipating their effects (Glenn & Gordon 2009). The most interesting and relevant ideas of the Futures Wheel will then be analysed and elaborated by using the PESTEC table, which is a structural tool to study the political (P), economic (E), social (S), technological (T), environmental (E) and cultural/citizen/customer (C) aspects of an issue. Finally, the results can be summarised in a tentative scenario narrative or a manifesto, for instance. In the end of the groupwork sessions it is also fruitful to try to anticipate possible black swans – sudden, unexpected events with drastic consequences – and how they would affect the future the group has created (as a kind of sensitivity test). The final phase of the groupwork sessions is the presentation of the results of each group to other groups i.e. cross-fertilization. After the workshop, the moderators document, analyse and synthesise the results into a research report. In the report, the results are often summarised and broadened as scenario sketches. The process and the results of this futures clinique are presented in Chapter 4.

3.1. Background material

The participants of the futures clinique worked in six groups, each representing one of the societal scenarios of the Neo-Carbon Energy project (Heinonen et al. 2016). In all of the scenarios, society is based on decentralised renewable energy system. Owing to the new energy system, and increases in energy efficiency, the amount of available energy has increased significantly. The surplus energy is used especially for automation and ubiquitous artificial intelligences. Humans are freed to concentrate on self-organising, creative work. The energy system has also elevated the position of citizens power-wise, as they are able to produce their own energy for free and, if needed, lead a self-sufficient life. Despite this opportunity, companies and other organisations would likely still exist – a plausible future is a hybrid of peer-to-peer networks and organisations of today (see Ruotsalainen et al. 2016; Ruotsalainen et al. 2016b). The following scenarios depict different possibilities of how such society could look like. The Green DIY Engineers scenario is an exception, as it is a collapse scenario and society as we know it today does not exist anymore. Summaries of the scenarios, sent to participants beforehand, are described below.

Radical Startups

Economy is driven by networks of startups enterprises. Startups are community- and tribe-like, with very flat hierarchies. They promise their workers opportunities for self-expression, and often the opportunity to work with like-minded individuals is the main motivation by which people decide where to work. The borders between leisure and work, and between companies and the rest of the society are blurred in this world of deeply networked startups.

Value-driven Techemoths

The economy is dominated by a few big corporations, who have successfully merged different business sectors, ambitious R&D, as well as functions previously provided by the public sector. These technology giants, or "techemoths", offer resources, facilities, and platforms for self-organising employees, as well as all the basic amenities from housing to leisure to education.

Green DIY Engineers

Society is organized around thriving local communities to survive an ecological collapse. Do-It-Yourself economy and practical mindsets flourish, and engineer-oriented citizens live off their skills and knowhow, spread through mesh networks. Tinkering, smart scarcity, local energy production, self-sufficiency and upcycling of products are trending.

New Consciousness

Robots take care of all manufacturing, and most of cognitive work as well. People are freed from work and get to spend their time on leisure activities, which also provide value for the society at large. Society is organized as global collaboration and open sharing of resources and information. Humans share a collective tech-enabled consciousness – through ubiquitous communications, virtual reality, and also rudimentary brain-to-brain communication. They are deeply intertwined with each other and the nature. (For this scenario see Breyer et al 2017).

4. FUTURES CLINIQUE WORKFLOW AND RESULTS

The futures clinique consisted of four group work phases in terms of methods application: 1) futures wheel, 2) futures image, 3) PESTEC table and 4) black swans. In the first phase the groups filled a futures wheel (see chapter 3 for method description). The purpose of futures wheel was to imagine their own future society based on their scenario descriptions, paying special attention to social relations. In *the centre of the futures wheel* each participant wrote one or a few things (e.g. about living, housing, sports, values, politics) that could be completely different in a 2050 society according to the group's scenario (see Chapter 3.1 for scenario descriptions). Participants wrote the ideas down on post-its, presented them to others, and placed on the centre of the wheel. Then, on *the first circle of the futures wheel*, the groups started discussing and creating their possible future: how would social relations (communities, leisure, work, volunteering etc.) be different from today, how would people do things together, what kinds of new communities would emerge, and how values would change. On *the second circle of the futures wheel*, the groups continued to develop their imagined future world by coming up with new products and services needed in their future society. What products and services are needed in this future? What is the energy system like in the future, and what energy products and services would be needed?

In the second phase the groups synthetised the core ides of their futures wheel into a futures image of their imagined society. This was done as bullet points on a blank paper sheet.

In the third phase the groups filled a PESTEC table (see chapter 2 for method description), where the groups examined the implications of their future society in each PESTEC dimensions based on their futures wheel and futures image. So the work proceeded dynamically forward, based on each previous ideation phase.

The following questions were used to frame the discussion in the PESTEC table:

How would the futures image 2050 that you constructed in the previous phase:

P = ...disrupt politics and change policies compared to the present?

E = ...change the economic structure? What businesses die, what new emerge?

S = ...change who are the key actors in communities? How does the social mood change (trust, etc.)?

T = ...be supported by technology, and which technology exactly is relevant?

E = ... conserve the environment? Or, could there be new environmental impacts?

C = ...change norms? What are the new norms of the prevailing culture in 2050?

After the groups filled the PESTEC table, they identified, according to their collective opinion, the *most disruptive impact* on each PESTEC dimension. Finally, based on the selected disruptive impacts and PESTEC ideas in general, the group elaborated their futures image by adding new elements from the PESTEC table to it.

In the fourth phase the groups identified possible black swans – sudden, unexpected events with radical consequences – that would change the future imagined by the group. They were also asked to come up with one black swan event that could promote their future, and another that could destroy it. After brainstorming possible black swans, each group chose one of the black swans, or created one more, and handed it to another group. Thus, the resilience of the groups' imagined futures was tested by the black swans generated by other groups: how could this black swan change the future, and how could society respond to it?

In the following chapters the results of each group are documented and analysed. The futures wheels are "carbon copies" of the paper sheets the groups produced. Thus some ideas may not be in their "right place" as group members might have placed for instance an idea meant to the first circle of the futures wheel into its centre. However, in the textual analysis of the futures wheel the ideas are placed in their right "slots" (centre/1st circle/2nd circle) with the help from audio tapes from each group's work.

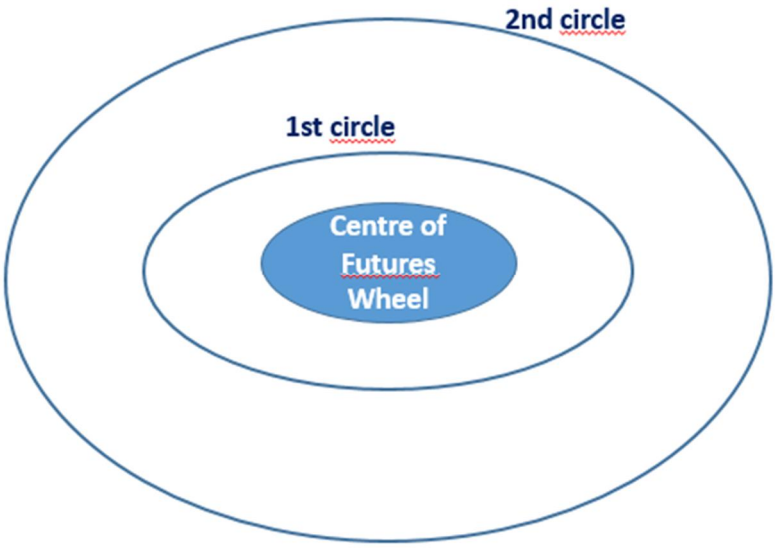


Figure 23. The Futures Wheel with its core or centre, 1st circle and 2nd circle. The Futures Wheel tool, slightly modified from the originally developed one by Glenn (2009).

4.1 Group 1: Radical Startups

The Group 1 worked on the scenario "Radical Startups" (for scenario descriptions, see chapter 3.1). Group members included: Tuuli Aalto-Nyyssönen, Teemu Ijäs, Juha Koivistoinen, Tiina Koljonen, Kirsi Kostia, Janne Salovaara and Satu Tuittila. The group was moderated by Sofi Kurki.

Figure 24. At the end of the futures clinique the results were presented and cross-fertilised. Group 1 presenting their results for Radical Startups scenario.

Futures Wheel

The group produced the following ideas through discussion on the futures wheel. Ideas on what each group member thought would be different in the year 2050 were written in the core-. On the 1st circle the group discussed how social relations could be changed by then in their scenario world. Products and services, including energy, needed in this future were discussed on the 2nd circle. The most interesting ideas that were further developed into the PESTEC table are marked on purple.

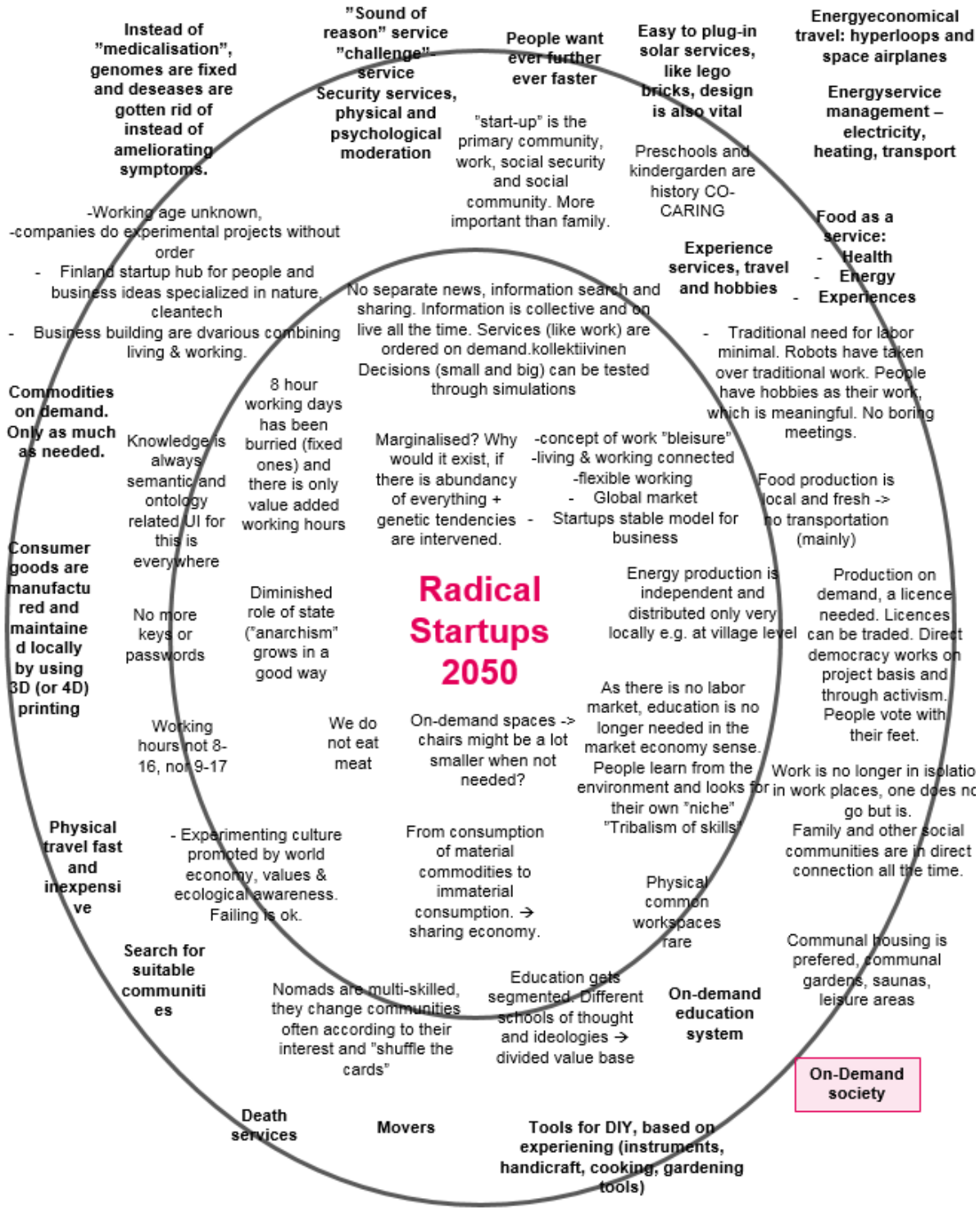


Figure 25. The Futures Wheel of Group 1 on the Radical Startups scenario.

The centre of the futures wheel

The ideas in the centre of the futures wheel describe how each participant imagines a society led by "radical startups". These ideas can be classified into two groups. The first group of ideas describes changes in consumption habits and an emphasis on immaterial values. Instead of material commodities consumption would be mainly immaterial. Sharing economy flourishes. Meat is not eaten. Spaces are

used on-demand, so that for instance chairs would diminish in size when not used. The eight hour work day is displaced, and people work only for the "value-added" hours.

The second group of ideas describes a "post-institutional" future. The role of state has diminished so that social relationships are "anarchic" (i.e. self-organising) in nature. There are no labor markets and formal education in the current sense. People learn with each other in niche "skill tribes". News and information are not separated into news organisations, but are collective and live all the time. Decisions can be tested through simulations. Leisure and work are intimately and flexibly connected, and markets are foremost global. Services, and work contributions, are ordered on-demand. Due to flexibility of work arrangements, marginalization hardly exists. "Post-institutional" communities are fundamentally enabled by distributed, village-level energy production.

The first circle of the futures wheel

The first circle of the futures wheel documents how the group discussed the future of a radical startups society in 2050. These ideas, too, can be divided into two groups. The first group of ideas describes work and production. Because robots have taken over traditional work, the need for such labor is minimal. Instead, people have hobbies as their work. Companies do experimental projects and cherish unhinged creativity. Work is equally everywhere and nowhere – free from spatial and temporal boundaries. An upper limit for working age is also unknown. Startups are the primary communities of citizens, often even more important than families. Physical workspaces are rare, at least stationary ones, although business premises usually incorporate also housing. Due to their networked and unbounded nature, communities are connected to each other all the time, and work can be delivered on-demand.

The second group of ideas describes culture, values and social relations. Communal housing is preferred, including communal gardens, saunas, and leisure areas. Preschools and kindergartens are arranged communally, as "co-caring". Food is produced locally, which ensures freshness and minimises transportation. Many live as nomads, who are multi-skilled and change communities according to their current needs and interests, and to increase serendipity. An interface for knowledge retrieval is embedded everywhere in the environment, functioning through speech commands. Knowledge retrieval is "semantic" so that the interface understands the context of searched information. As in business, the whole culture fosters experimental mindsets, promoted by global economy, cosmopolitan values, and ecological awareness. Failing in different life and business projects is ok. Culture is highly pluralistic, and for instance education has transformed from the mass-model to a tailored, segmented model. There are different schools for different ideologies and schools of thought.

The second circle of the futures wheel

On the second circle of the futures wheel the group came up with products and services, including energy. A guiding idea the group coined, and the idea chosen by the group to be worked in the PESTEC table, is "On-Demand Society". On-demand means that products and services are delivered when they are needed, and tailored according to needs. When for instance commodities are delivered on-demand, perhaps with drones, waste is reduced as only as much as needed can be bought at a time. On-demand education could be "ubiquitous" in the sense that information is delivered automatically when a need arises. Social relations could also be "automated" and arranged on-demand through a match-making service for like-minded or in other ways matching individuals and communities. Food-as-a-service could for instance tailor food portions according to personal health indicators, provide experiences, and minimise energy consumption. On-demand production could be increasingly local if consumer goods were manufactured locally using 3D printing. Functional and easy to use do-it-yourself tools could maximize the extent of tailorisation. Energy would also be a service. "Energy service management" would take care for instance of energy efficiency in electricity, heating and transport. Easy to use plug-in, "Lego brick" energy services could be offered. Design would be as crucial in energy products and services as it is in other consumer goods. In a global, networked world the need for travel could increase, and this would require fastness, inexpensiveness, and energy-efficiency from transportation – provided by such new transport technologies as hyperloops.

Futures Image

SOCIETY ON-DEMAND

- On demand economy
    - Services
    - Production
    - Information, knowledge
- Functional community / tribes / cults
    - Working, living, learning
        - "Bleisure"
    - Basic income
    - No worktime, -age, etc.
    - Not permanent
- Social capital
    - Human economy

PESTEC Table

Group 1 chose the idea of *society on-demand* from their futures wheel to be further elaborated in the PESTEC table. The group discussed and wrote down the implications of their futures image in 2050 according to the six PESTEC dimensions. The most disruptive ideas were chosen from each dimension. These are highlighted in Table 6 with a purple text box. Group 1 estimated, that the society on-demand in 2050 could lead to a world with no politicians (P). Neither would the world be dependent on a single economic system or banks (E). In this kind of society failing (S) would not be considered as shameful anymore but, on the contrary, it would be supported. On the technological side wireless energy (T) was seen as the most disruptive idea. Electricity would be produced through photosynthesis (E) among many other means. Overall, production would not be an intrinsic value (C) in such a society.

Table 6. PESTEC table of Group 1 on "Society on-demand".

PESTEC	Society on-demand					
Political	**No politicians**	Political systems local cells, can be different forms.	Project politics	Need democracy	Energy economy etc. big issues (space travel) governed by global AI system	Agreements based on local needs
Economic	**No banks, no one single economic system**	Basic welfare: services, food… money is not central		Experience economy	No large corporations	Circular economy of materials
Social	**"Today I want to fail"**		Social mood is curiosity	Self fulfillment / communal fulfillment		
Technological	**Wireless energy**		Open code	No patents	Local production	
Environmental Energy	**Electricity production through photosynthesis**		Intrinsic value	Self-sufficient "tribes"	Energy production local, zero emissions.	
Cultural Customer Citizen	**Production not an intrinsic value**		No monocultures	Units / communities have their own cultural codes.	Functional arts	Handicraft valued

Black Swan

This group identified 5 possible black swans, as potential future events that are unforeseen. It also identified 3 different black swans that could promote the future, and one "All the resources owned by few huge corporations (e.g. Google & Facebook)" that could collapse the group's future.

IDENTIFIED BLACK SWANS	
• A: Corporation war • B: Dark energy and dark matter are turned into energy and matter. –> Endless source of energy, endless source of material • C: All the resources owned by few huge corporations (e.g. Google & Facebook) • D: No clocks, no time-zones, no waiting • E: A total shut-down of the current society	
Promotes the group's futures image (+)	Destroys the group's future image (-)
Event A?, D? E?	Event B?, C (turns into techemoth scenario)

THE GROUP RECEIVED A BLACK SWAN FROM GROUP 4 How could it change the group's futures image or affect its resilience?
• Dolphins can communicate to humans and teach us Either dolphins make us "untech" ourselves; or provides support for the communal values already present in the scenario.

BLACK SWAN GENERATED TO GROUP 1
• A generation of religious fundamentalists against technology

4.2 Group 2: Value-Driven Techemoths

The Group 2 worked on the scenario "Value-Driven Techemoths" (for scenario descriptions, see chapter 3.1). Group members included: Pia Alatorvinen, Kaisa Kaukiainen, Aino Kuitunen. Joonas Lindeman, Risto Nikunlaakso, Elina Salminen, Marja-Liisa Sutela, Paula Tommila. The group was moderated by Sakari Nisula.

Figure 26. Group 2 presenting their results for Value-Driven Techemoths scenario at the end of the futures clinique.

Futures Wheel

The group produced the following ideas through discussion on the futures wheel. Ideas on what is different in the year 2050, and how social relations could be changed were written in the core. This group placed the products and services necessary in this future on the 1st circle, and energy issues, services and products needed in the group's imagined future are on the 2nd circle of the wheel. The most interesting ideas that were further developed in the PESTEC table are marked on purple.

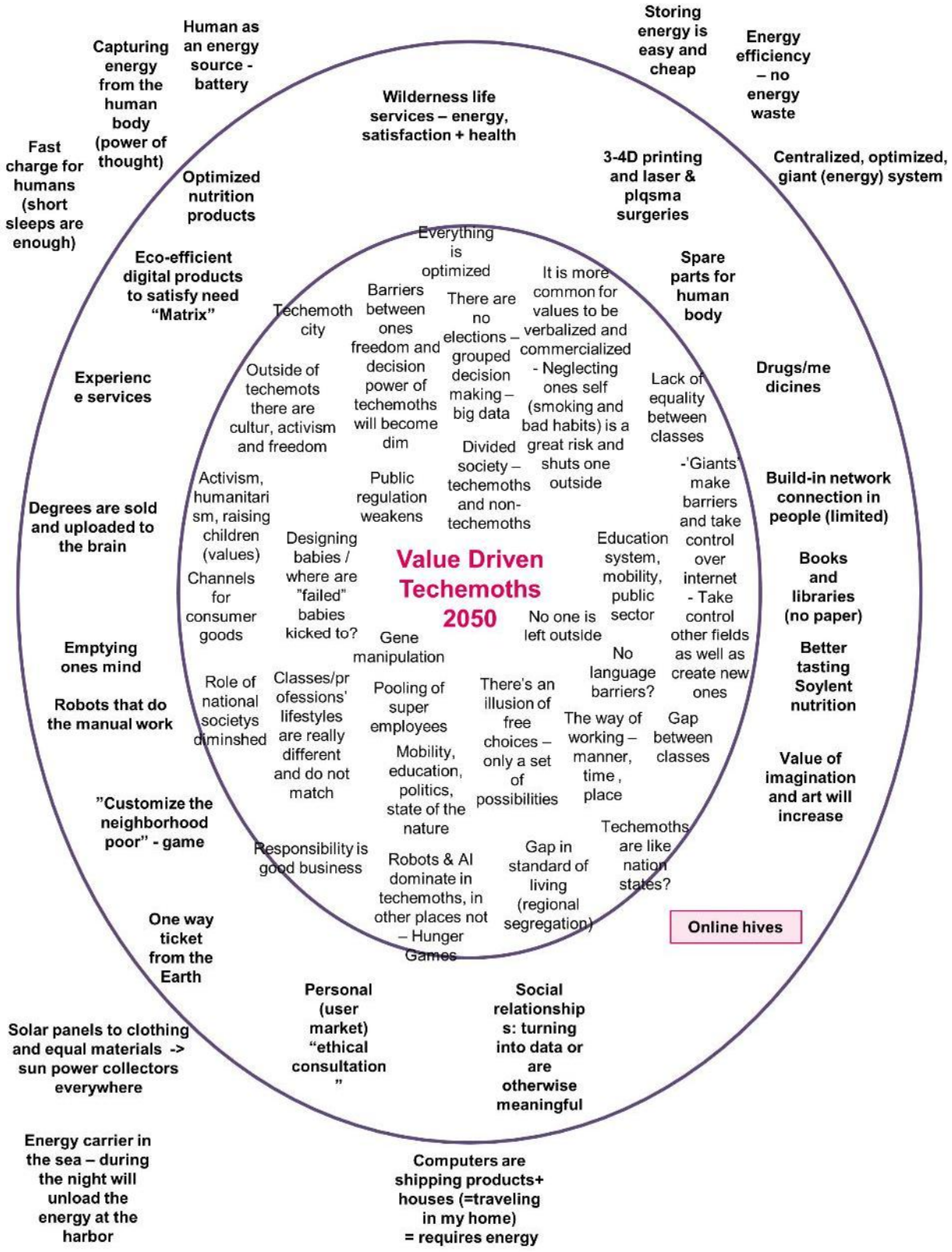


Figure 27. The Futures Wheel of Group 2 on the Value-Driven Techemoths scenario.

The centre of the futures wheel

The ideas in the core of the futures describe how each individual participant in the group imagined a society organised around "Value-Driven Techemoths". The first category of these ideas describe a highly corporatised society – mostly from a critical point of view. If technology companies had the hegemony of power, everything would be optimised. This implies a "commercialisation" of values so that for instance habits bad for economy would be deemed reprehensible and "anti-social" even to a greater extent than today. Efficiency would be the guiding principle, downplaying other values. The productivity of Techemoths would be ensured by pooling "super employees" – perhaps even genetically modified by gene manipulation. Giant companies could create an illusion of free choice – citizens would be free to choose but only within the set of possibilities defined by companies. Techemoths could take control over the internet with their "walled gardens", and this could lead to control of other fields as well, such as online retail and journalism.

The second category of ideas describe inequalities and life outside techemoths. Firstly, a fundamental division in society would be between those employed by techemoths and those who are not, the first class being in many ways in better positions than others. Regional segregation could also deepen depending on where techemoth premises would be situated. Secondly, robots and AIs of techemoths would be in many cases much more efficient workers than humans, degrading the value of human work. Thirdly, if gene manipulation was widespread, "non-designed" humans would be in inferior social status. However, communities outside techemoths could often be the places from where the most vital culture, lifestyles and citizen activism would emerge, defined by freedom techemoths would not be able to offer. "Humanitarian" activism could also proliferate as a counterbalance to the corporate ethos of techemoths. Some techemoths could see social responsibility as a "good business", pursuing that no one would be left outside. Social segregation could also hurt techemoths if people's values did not match those of techemoths.

The third category is about the diminishing role of state and the rise of global "techemoth cities" or "techemoth nation-states" with no language barriers thanks to translation technologies. Public regulation could weaken, and mobility, education, state of the nature and even politics would be increasingly defined by techemoths. In a political system emphasising efficiency, elections could be replaced by algorithmic decision-making based on big data.

The first circle of the futures wheel

This group produced ideas for new products and services in a techemoth world on the first circle of the futures wheel, leaving the second circle for energy innovations. Fittingly to the general ideas about a

"techemoth society", ideas on products and services highlight almost unanimously efficiency in different forms. Food is called "optimized nutrition products", books and libraries are wholly digital, drugs are used to enhance performance, human bodies are amplified with 3D printed synthetic body parts and social relationships are managed and individuals matched through data. Because robots take care of manual work, human production concentrates on experiences. Experiences, however, would also often be about efficiency. Workers tied behind corporate walls crave for outdoor experiences, and "wilderness life services" are indeed offered – the main selling point of experiences is to provide increased energy levels, satisfaction and health. Education degrees are be uploaded to the brain. The value of imagination and art has increased, on one hand due to immaterial nature of labour, and on the other hand as a means to escape the coercive corporate culture. These are, however, also commodified and sold as experience services. For instance, a service of emptying one's mind is highly popular.

The second circle of the futures wheel

On the second circle of the futures wheel this group focused on energy products. Energy products and services would be at the same time centralised and distributed. Techemoths would be the main providers of energy, housing their own giant, optimised energy systems. As everything else in society, the energy system would be highly efficient, with no energy wasted. Storing energy would be easy and cheap for consumers. The efficiency of the system would depend on ubiquitous solar power collectors – for instance clothing would have solar panels. The heat and kinetic energy of human bodies would be efficiently harnessed – and through cybernetic implants the human body could be stimulated with electricity so that only short periods of sleep would be needed.

Futures Image

ETHICAL OPTIMISATION

- world divided into techemoths and non-techemoths
- ubiquity of corporate power
- optimized everything
- Key product
    - downloadable skills and professions
    - ethical and aesthetical consultation
- Key energy products /services
    - Human battery
    - Abundant resources

PESTEC Table

Group 2 chose from their futures wheel the idea of *online hives* to be elaborated in their PESTEC table. In PESTEC phase, the group discussed and wrote down the implications of their futures image in 2050 according to the six dimensions illustrated in below Table. After filling the table, the most disruptive ideas were chosen from each dimensions. These are highlighted with a purple text box and start each dimension.

According to the group, a society of online hives in 2050 relies on Big Data decisions (P). Furthermore, cultural barriers are overcome (C) with the aid of big data. Reputation and creativity are highly valued, and they may even be treated as a new currency (E). This makes the society more equal. Overall, the social life may end up to forming around bubbles (S), or tight communities of the like-minded. The group wondered, whether it is possible to be offline (T) in the future. In the future limitless clean energy (E) is available.

Table 7. PESTEC table of Group 2 on "Ethical Optimisation".

PESTEC	ONLINE HIVES – GROUP 2
Political	**Big Data decisions**; Facebook elections – crowdsourcing, weighted votes; Group intelligence; AI as a leader; Techemoths are forbidden in some countries; Cyber war =easier way to attack; Excluding atmosphere
Economic	**Reputation, creativity etc. are valued – new currency? Equality**; Circles that have diff. ways of consuming; Crowdfunding – sub-cultures; Transformed economy?; Martians (elite) and peasants (other) "Houston, you have a problem"
Social	**Bubbles – ponts of interest**; No governments/ nations; One language?; Privacy is luxury; People are using the internet, it is not using people
Technological	**Is it possible to be offline?**; Virtual reality; Technolog y will able bad mouthing; Losing reputation; Telepathic communication; Internet will become more like a service; No need for mobility; Techemoths make barriers and 'eat' the internet inside of them; Internet turn more normal and "disappear" from sight
Environmental Energy	**Limitless clean energy**; Nutrition? Austerity or Limitless energy as nutrition; Animal hunt parks (cloned)
Cultural Customer Citizen	**Cultural barriers are overcome with Big Data**; Universal products; Data and things share the culture; China/Asia ?; Anti-culturalism - Different "logics" in different cultures; There's no individual, so there's no interest

Black swan

This group identified 11 possible black swans, as potential future events that are unforeseen. It also identified "Collective Enlightenment (spiritual)" that could promote the future, and "Artificial Intelligence leaves/destroys the mankind" that could collapse the group's future.

IDENTIFIED BLACK SWANS	
• Earthquake in Silicon Valley. Leads to great destruction and many losses. • Electromagnetic pulse from the space. Leads to destruction of electronic devices. • Bad guys take over the internet. Take a control over techemoths. • Aliens come to Earth. Will give us more developed technology that will boost the scenario. • Pandemic. Many lives lost. • Sun will flame out. End of life. • World peace. Will boost the scenario, because there's more cooperation. • Collective Enlightenment (spiritual). Will boost the scenario, because people come together and work towards common goals. • (Cyber) World War. Steps back with the development of techemoths. • People stop being online. No one is using the network and everyone is protecting one's privacy. • Artificial Intelligence leaves/destroys the mankind. End for the technological development.	
Promotes the group's futures image (+)	Destroys the group's future image (-)
Collective Enlightenment (spiritual). This will bring people together and they start to use technology for better collaboration.	Artificial Intelligence leaves/destroys the mankind This will destroy the scenario…

THE GROUP RECEIVED A BLACK SWAN FROM GROUP 1

How could it change the group's futures image or affect its resilience?

- A Generation of religious fundamentalists against technology

This will cause terrorist attacks against techemoths and great separation between people in and out the techemoths. Infiltration to techemoths is used as well. However, techemoths are resilient against this kind of Black Swan.

BLACK SWAN GENERATED TO GROUP 5

- Collective Spiritual Enlightenment.

4.3 Group 3: Green DIY Engineers

The Group 3 worked on the scenario "Green DIY Engineers" (for scenario descriptions, see chapter 3.1). Group members included: Christian Breyer, Upeksha Caldera, Liisa Haapanen, Pasi Hario, Rami Kangas, Joni Karjalainen, Riina Repo, Tuula Savola. The group was moderated by Hazel Salminen.

Figure 28. Group 3 discussing their PESTEC table for the Green DIY Engineers scenario.

Futures Wheel

The group produced the following ideas through discussion on the futures wheel. Ideas on what each group member thought would be different in the year 2050 were written in the core. On the 1st circle the group discussed how social relations could be changed by then in their scenario world. Products and services, including energy, needed in this future were discussed on the 2nd circle. The most interesting ideas that were further developed in the PESTEC table are marked on purple.

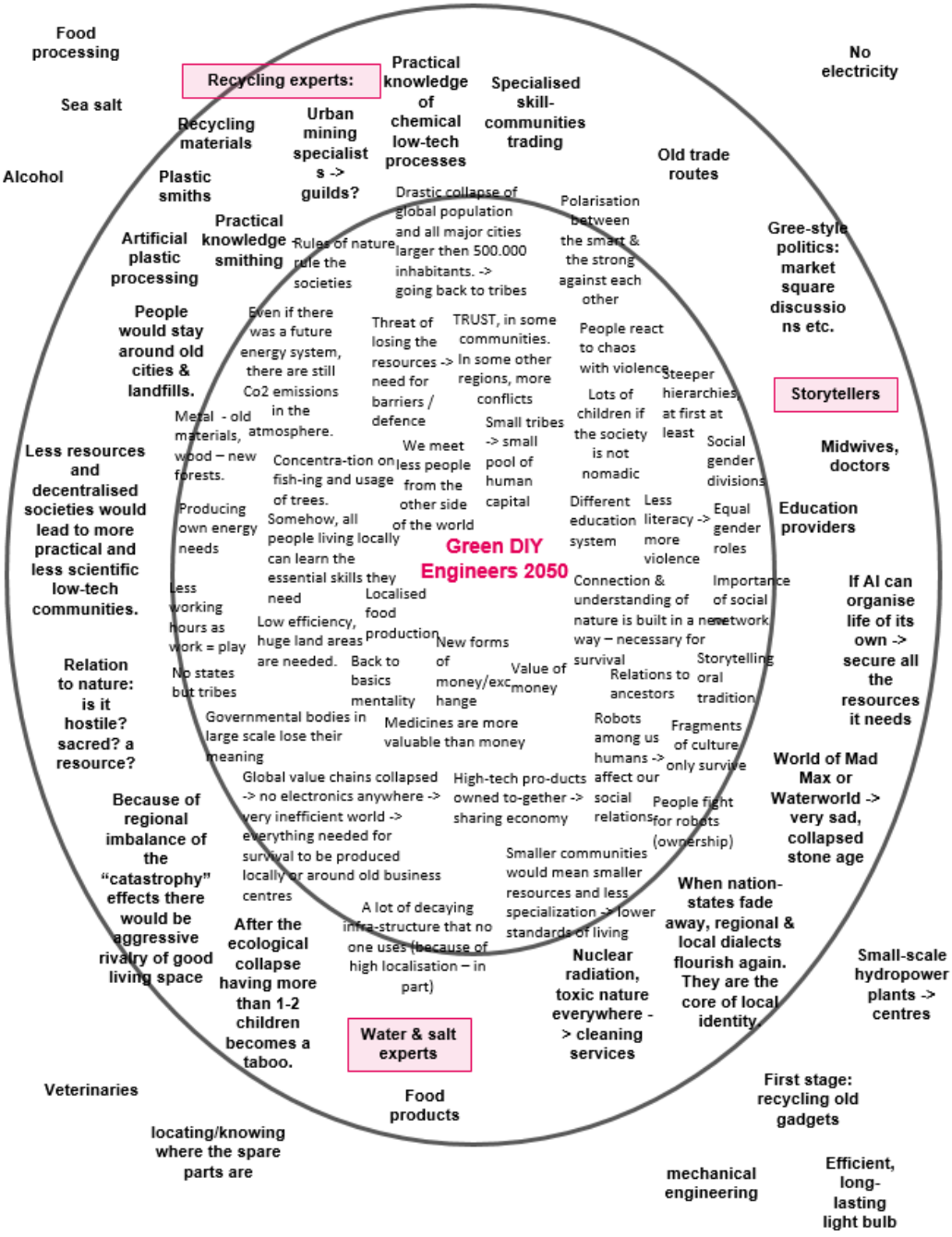


Figure 29. The Futures Wheel of Group 3 on the Green DIY Engineers scenario.

The centre of the futures wheel

In the centre of the futures wheel, where each member of the group produced their own initial ideas about a Green DIY Engineers society. First of all the small size and tribal-like nature of such "societies" was emphasised. If global population fell drastically due to the systemic adverse effects of the climate change and ecological crisis, people would live increasingly in small tribes instead of cities or nation-states. Everything from food to energy to technology would have to be produced locally, scavenged from abandoned places such as former cities, or stolen and conquered from other tribes. Social networks

would increase in importance, because they would offer much-needed resilience, and nimble social networks would require relatively small populations. However, smaller communities would mean fewer resources and less specialisation, lowering the standards of living. Small tribes would also mean a smaller pool of human capital. Low efficiency induce a "back-to-basics" mentality. Tribes would locate in places where natural resources, such as fish and timber, are available aplenty. The threat of losing resources would be mitigated by physical barriers and defence systems. Still, lower resources increase the risk of chaos and conflicts, manifesting as constantly present violence between and within the tribes. Especially hi-tech gadgets, such as robots, from the pre-disaster era are fiercely fought over. Thus new ways to increase trust would be invented. Storytelling and oral tradition, linking the tribe to ancestoral past, would be a crucial way to build tribal cohesion. Cultures would become less pluralistic and more uniform, partly due to the need for social control and partly because "citizens" would meet less people from other parts of the world. Steep hierarchies could also be used to hold the tribes together, but in the long run this could also cause friction, and for instance cause conflicts between "the smart" and "the strong".

Only fragments of the pre-disaster culture would survive and they could obtain even mythical characteristics, as objects of awe and even fear. How would such tribes relate to, for instance, the robots that would be scattered here and there, and how would such objects affect our social relations? Because the capitalistic market economy would have collapsed, there would be less working hours and more time for play, which could make culture relatively joyful despite of scarcity. In tribes that are not nomadic there would be also a plenty of children, creating a playful atmosphere. A re-established relationship and connection to nature would also be a source of spiritual wellbeing, but knowing nature would also be necessary for survival – rules of nature would rule the tribal societies. Instead of money, goods would be shared and exchanged through barter – some rare and vital items, such as medicine, would be highly valued. The remaining hi-tech products would especially be co-owned within the tribes.

The first circle of the futures wheel

Around the first circle of the futures wheel the group discussed and imagined their scenario together. Two "occupational" groups are accentuated. First, storytellers would be of crucial importance, as post-national social relations require local dialectics to flourish again – local stories treasured by the storytellers are the core of local identities. Second, especially water and salt experts would be needed as water would often be a scarce resource. Other important occupations would be doctors, midwives, educators, experts of urban mining, and "cleaners" who would get rid of nuclear radiation and other toxics. Alongside these basic and necessary occupations each tribe would specialise in certain areas, and tribes would trade products with each other. Ancient trade routes could re-emerge.

Less resources and decentralised communities would lead to more practical and less scientific low-tech communities. Efficient material recycling would be key. Practical knowledge of low-tech chemical processes would be highly needed. Plastic smiths would "forge" different, functional items from recycled and "mined" plastics.

In terms of social relations in general, communities would locate mainly around old cities and landfills (to mine resources). Rivalry for good living areas would be aggressive due to the imbalance of "catastrophe effects". Oftentimes it would be a sad Mad Max world, even a collapsed "stone age". Having more than one or two children would be a taboo due to resource scarcity. Due to local and small-scale nature of communities, decision-making would be democratic, including for instance public market square discussions. Relation towards nature would be mixed: nature would be conceived as hostile, but also deemed as sacred. A practical stance towards nature could however prevail, as nature would be a source of much-needed resources.

The second circle of the futures wheel

On the second circle the group anticipated practical products, services and solutions needed in a world of scarcity. Recycling expertise would be perhaps the most important skill. The skill to locate spare parts would be important, and old gadgets would be recycled for new uses. Mechanical engineering would be a ubiquitous general skill as it would have many uses. Electricity could be produced for instance with small-scale hydropower plants. As energy would probably be relatively scarce, long-lasting light bulbs would be valuable property for communities. Veterinarian skills would also be needed to ensure the wellbeing of livestock and other animals. New, long-preserving food products and food processing techniques would also be needed.

Futures Image

STORYTELLERS & PLASTIC SMITHS

- Tribes not countries
- Fragmented communities: some are 'survival of the fittest', others cooperation
- Young society (many children; diseases)
- Local production of food etc.
- Oral tradition valued
- Low literacy (no writing materials)
- No electricity – mechanical energy production
- Healthcare by local midwives etc.
- A lot of decaying infrastructure -> urban mining, recycling, upcycling
- Only non-digital knowledge available
- Water & food processing valuable
- Communities are located near old infrastructure + water (energy) resources + arable land.

For their Futures Image description, the group used their given scenario to ideate the basic premises for this post-collapse society, where the global human population has encountered and partially survived an ecological crisis and now faces quite a changed reality. Two of the most profound changes in comparison to the pre-crisis world are that the size of the human population has dwindled to a fraction of what it used to be, and that, because of the collapse of the previous technological infrastructure, high-technology products cannot be used as there is no large-scale electricity production. In fact, the group saw that the technology is strictly low-tech—not run by electricity but by mechanical energy.

At the global level, the nation-state system has collapsed because it is not possible to upkeep the needed infrastructure, and the human population lives in tribes of various sizes. The communities are fragmented; some tribes function more along the lines of a 'survival of the fittest', but there are also many tribes who cooperate through small-scale trade. There is no money, as such, rather a bartering system where products and services are valued equally.

Food and other necessities are produced locally, and most people acquire a basic level of skillsets needed to produce food and everyday things. However, there is also some specialization of skills in a sort of guild system, e.g. when it comes to healthcare (local midwives) and the low-tech solutions needed to support the basic running of the communities. Since the ecological collapse, clean water is a scarcity and, thus, the know-how of how to process water as well as food and materials is seen as the most valuable technological skillset. Since there is no or only limited electricity and much of the large-scale technological infrastructure has been lost, the knowledge of how to repurpose old materials (urban mining, recycling,

upcycling) is held in high regard. The so-called 'Plastic Smiths' use basic chemistry and mechanical technology in order to make use of the materials they can retrieve from the decaying, old infrastructure around them. For this reason, the communities are often located near old infrastructure (previous urban areas), in the vicinity of arable land and water, which can be used also as an energy source.

Another societally crucial effect of the large-scale collapse that has taken place is that only non-digital knowledge is available anymore. This means that practically no digital information has survived, which has brought back the importance of oral traditions. There are also no writing materials, which has led to low literacy levels. This only heightens the importance of the few skilled storytellers, who can remember and re-tell what it was like in the old days—underlining the old ways that lead to the catastrophe but also pinpointing the good things that did exist before: cooperation, humanity, and creativity.

In general, the societies are young, as people have many children and old age is perhaps not as commonly reached as before, due to environmental pollution and diseases that cannot be cured or treated with the local, limited healthcare. This makes it even more important to value and remember the past that otherwise may be forgotten, through the stories of the Storytellers. After writing their futures image, the group summarized its main elements in the below PESTEC table.

PESTEC Table

Group 3 chose the idea of *storytellers and plastic smiths* to be elaborated in their PESTEC table. The group discussed and wrote down the implications of their futures image in 2050 according to the six PESTEC dimensions. These are illustrated in the following Table. The most disruptive ideas were chosen from each dimensions. These are highlighted in the Table with a purple text box, arranged as first elements on each dimension.

In the imagined future the best storytellers become leaders, and the narrative voting takes place by telling stories together. (P) The economic order does not revolve around money, but instead ideas and things are traded (E). The storytellers and plastic smiths are also the most respected members of the community (S). Technological solutions are slow and risk-resistant (T). Environmental-friendly solutions have led to a situation where everything is recycled and only renewables are used as a power source (E). The role of storytellers in the community is important, as the narratives prevent the society from repeating the mistakes from the past (C).

Table 8. PESTEC table of Group 3 on “Storytellers & Plastic Smiths”.

PESTEC	Storytellers and Plastic Smiths										
Political	**Best storytellers as leaders+ narrative voting = telling stories together**	People w/ knowledge of certain disciplines leaders	New democratic, unified humankind rising from the ashes after seeing the errors of rivalry national states	No national states, much more local politics Very local, no nation state type govern-mental bodies	No nation states	Society not so political as people are busy fighting a common threat, ”the nature”	- Animist settlements - Science vaults - Mining camps - Water cities - Nomad tribes - Military forts	Narrative battles	Pick the good things of the old world and leave the bad things behind	Alliances of tribes Compare East Asian culture	
Economic	**No traditional money; trade of ideas & things**	No money -> Trade is based on direct use value of prod/serv.	No old corporations anymore; all assets invested in them were lost	Highly specialised, connected through trade: Mining cities – Fishers – Traders – Science guilds – Farmers - Keepers of info/books/knowledge	Everyone is an entrepreneur in some way – no large companies	Skills sold as <u>services</u>, products sold as <u>services</u> or in some cases owned together -> sharing economy	No money form. Money has no longer large value -> economy runs on services & products	Trust through the need of one’s community and trade between tribes			
Social	**The storytellers & plastic smiths are the most respected community members**	Trust, cooperation <u>within</u> tribes, distrust between tribes Guilds are important	Relationships are very important Career thinking left behind	Old people are rare - and their expertise valued	- Learning from different tribes - Maybe tribes can spefialise in some things	Family and other small social units are important	Lots of interactive actions.	Social mood: after overcoming collapse, it is a mixture of survivalism and fatalism, ”inshallah”, and solution orientedness			
Technological	**Risk-resistant slow-tech**	Low-tech, recycled technologies. Emphasis on what is actually needed.	Assumption that much of technology coul be lost because of the collapse	Mechanical technology: to make clean water, recycle	Ability to use a technology for different purposes -> <u>modification</u> of existing tech resources	Experiments with restricted amounts of material	Pv-driven (off-grid) thinking No global networks, i.e. Internet	<u>Networks</u> forming around technologies: materials, amaintainance, manufacturing…	Emphasis is put on practical tehnology that is easy to use and doesn’t require a lot of maintenance		
Environmental Energy	**Decision: recycling everything + only renewables as power sources**	Low-tech power plants: gas, oil, hydro Mainly physical: animals, wind	Tech vaults near low tech power supplies: hydro/oil/gas -> electricity -> fixers -> digital info -> ”for the new world”	Water, sun, leftovers/waste as source. Practical low tech.	Nature thought of as a resource but also respected & taken care of to keep it productive	Post-collapse world: challenging climatic conditions + heavy pollution -> only most favourable sites are inhabited	The rate of CO2 emissions is lower because there is less energy-intensive economic activity	Nature left more on its own -> cities disappear under new growth	Use resources in a sustainable way, e.g. water, land		
Cultural Customer Citizen	**Norm: avoiding the mistakes of the past -> the role of storytellers is central**	Environment affects culture heavily (and norms)	Local economies -> personal relationships btwn producers & consumers	Ambiguous relationship w/ the myth of golden age + demons of past	Less greed, no money-driven, experience-driven Togetherness	Animistic ethos; Mythical storytelling of the dystopic past	People fear for new, unanticipated collapses & this makes them humble, almost religious	Sharing with future interest DIY -> you are your own customer	Relationships (man-machine-animal) Religion?		

Black Swans

This group identified 16 possible black swans, as potential future events that are unforeseen. It also identified "Human colony sent to Mars before the eco-disaster returns to Earth (with good intentions)" that could promote the future, and "Human colony sent to Mars before the eco-disaster returns to Earth (with intensions of dominance)" that could collapse the group's future.

IDENTIFIED BLACK SWANS

- Event: An alien invasion. This will lead to the aliens taking the humans as slaves, because they only have very low-tech weapons to protect themselves with.
- Event: Aliens approach the planet, having documented the whole history of humanity. This means that humanity would get back all the old knowledge that they now only have small fragments of left.
- Event: Life from outer space to live on earth. This can cause a clash between humans and aliens, depending on what the impact of the aliens is.
- Event: Members of the global elite, who had escaped the eco-collapse of Earth by colonizing Mars return: (see below, modified).
- Event: "Memory houses" are found: These findings of old knowledge might help humanity restore some of the old structures, understand their past better, and perhaps develop some technologies that were lost.
- Event: Finding out everything is one big virtual reality.
- Event: It is discovered that humanity actually lives inside a matrix in a million-year vault.
- Event: Water takes over the land (e.g. due to climate change and melting ice caps), which would lead to a total submerging of land, or "Noah II". The human cultures, as well as the animals, would have to adapt to a life in/on the water.
- Event: New types of plants, mutated because of the ecological disaster, are found. This could lead to new medicinal discoveries, and previously fatal or non-curable diseases could be cured.
- Event: A meteorite hits Earth. Depending on its size, the effects could be minor (since the human communities are small and scattered) or major, if e.g. a dust cover would affect the global climate.
- Event: Genetic diseases develop due to the small DNA pool, since humans live in small communities. This could lead to new diseases and even sterility.
- Event: Discovery of old high tech that can work as low tech, as well. This could help support the livelihoods of the people, if the technology was used for food production etc., or help restore some of the lost digital information.
- Event: The realization that one bigger area remains with access to energy, manufacturing capacity, and military. This could lead to the people living in this area starting to dominate the other tribes, but possibly also engage in trade.

- Event: AI has survived the eco disaster. This could either be a great help for the human communities, if the AI can somehow gain a power supply to sustain it, and if it is conditioned to cooperate with humans. Or, it could become the enemy…
- Event: A volcanic eruption causing a large ash cloud and leading to a new ice age. The cooler climate would be a challenge for the futures image communities, since they depend on agriculture and foraging for food.
- Event: An old nuclear power plant deteriorates to the extent that there is a radiation disaster. This could be the end of global life, or then it could be the beginning of new mutations – favourable and unfavourable – in living beings.

Promotes the group's futures image (+)	Destroys the group's future image (-)
Human colony sent to Mars before the eco-disaster returns to Earth (with good intentions) This will bring high-tech back to earth: - energy technology - technology to clean the polluted areas - technology to revive the information that was lost when there was no more digital technology -> this information would be used to learn more about the past. The returning settlers would also be able to bring back old dna to replace plants and animals lost in the eco disaster.	Human colony sent to Mars before the eco-disaster returns to Earth (with intensions of dominance) This will lead to a cultural clash, as the returning colony would have immensely more technological power than those who had stayed on Earth. It may go as far as to the colonists re-colonising Earth and enslaving the humans and animals there.

THE GROUP RECEIVED A BLACK SWAN FROM GROUP6

How could it change the group's futures image or affect its resilience?

- Killer tick plague

  Although the populations are already small in this futures image, some people will die from the plague, as it is transmitted by ticks and their hosts, e.g. deer, who partially share their living areas with humans.
  The plague would affect trade, as people would be wary of meeting new people in fear of catching the disease. This would lead to mistrust between strangers, and even people you know, and inadvertently lead to isolation between people and between groups of people. Since the cause of the plague would not necessarily immediately be known, perhaps a renewed spirituality would emerge, as people would try to explain why some are falling ill and others not. There would be some attempts to find a cure, and as the futures image

states, there is some healthcare and medicinal knowledge, so in this respect, there would be some resilience.
In the futures image, the storytellers and recycling experts were held in high esteem, but their knowledge was not necessarily spread widely, rather just within their own guild (parent to child, e.g.). This would weaken the resiliency of the communities, if some of the key people, holding important information about the past or about survival skills in the present, were struck by the disease. Thus, the black swan of the tick plague would, in the long run, lead to a realization that knowledge and know-how should not be concentrated only to a few people. This would lead to changes in the societal guild structure, and education would become more universal, also when it comes to storytelling and recycling expertise. In general, however, the communities in this futures image would be quite resilient, because they have already survived an ecological disaster, and everyone has the basic skills needed to find food and shelter. Only the specialized skills and the trade exchanges would be in risk of being affected.

BLACK SWAN GENERATED TO GROUP 6

- Brexit leads to a global economic collapse

4.4 Group 4: New Consciousness

Group 4 worked on the scenario "New Consciousness" (for scenario descriptions, see chapter 3.1). Group members included: Hanna Karilainen, Otto Koskinen, Sirpa Ojansuu, Laura Perjo, Titta Tapiola, Pasi Vainikka, and Sari Vesiluoma. The group was moderated by Nick Balcom-Raleigh.

Figure 30. Group 4 presenting their results for the New Consciousness scenario.

Futures Wheel

The group produced the following ideas through discussion on the futures wheel. Ideas on what each group member thought would be different in the year 2050 were written in the core. On the 1st circle the group discussed how social relations could be changed by then in their scenario world. Products and services, including energy, needed in this future were discussed on the 2nd circle. The most interesting ideas that were further developed in the PESTEC table are marked on purple.

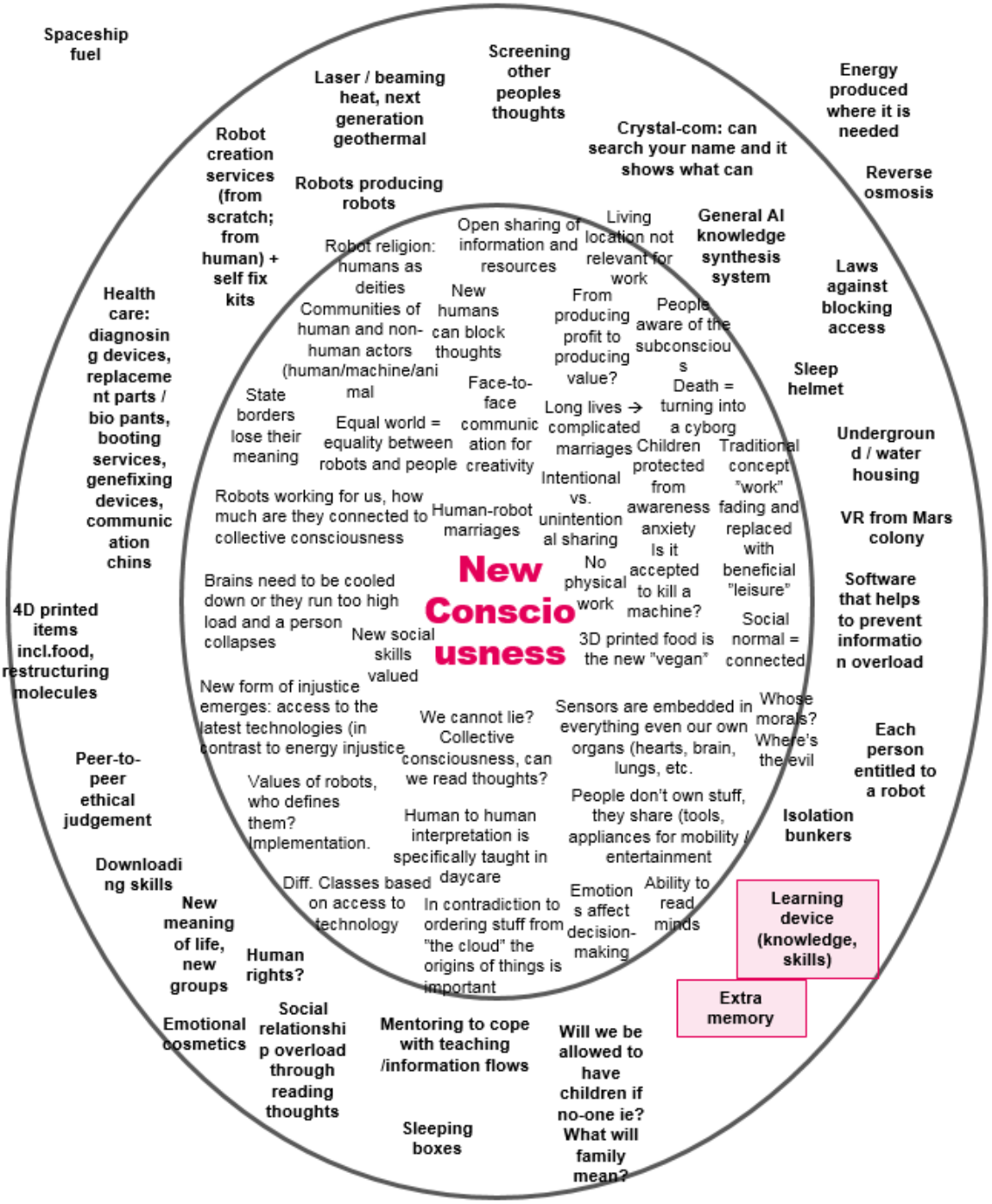


Figure 31. The Futures Wheel of Group 4 on the New Consciousness scenario.

The centre of the futures wheel

The largest group of ideas in the centre of the futures wheel concerns human-robot relations and cyborgs (humans augmented with technology). In a robotised future, non-human entities (machines and animals) could be treated as independent actors and even equal with humans. Communities would thus consists of other beings than humans as well. This "new equality" would grant robots basic rights; there could even be human-robot marriages. As artificial intelligences become more and more sophisticated, new ethical questions emerge, such as is it accepted to kill a robot? Who defines the values programmed into robots, and what the values are? Robots could even create their own religion, treating their human creators as deities. If humans developed a technology-enabled collective consciousness, robots could be connected to it, possibly creating new modes of consciousness and cognition altogether.

Sensors and other cybernetic implants could be embedded in our every organ (heart, brain, lungs etc.). In the time of dying, afterlife could be achieved by turning the person into a full cyborg. Cyborg abilities could give humans new features, such as an ability to read minds, blocking unpleasant thoughts, and on the other hand enhance our ability to connect with a person's sub-consciousness. Technologically amplified consciousness could also bring about new neurological issues. For instance, cyborg children could have to be protected from awareness anxiety, and brains could have to be cooled down in order to prevent them running on too high loads, making a person to collapse.

The second group of ideas is about social relations. First of all, new class divides and forms of injustice could be determined based on access to technology. In a highly technologised society, those with better technology would thus be in superior position to others. However, social inequalities could be hampered by higher emphasis on social, face-to-face interaction. The new social normal would thus be constant connectedness. In order to establish a new, more socially oriented consciousness social skills and human-to-human interpretation should be taught in day care. As a consequence people could become more tolerant and open minded, and even state borders could lose their meaning if people developed a more shared, social and transnational consciousness. However, place could increase in importance, as in a "borderless" world people would still, and increasingly so, need something to which anchor themselves to. Thus, for instance, instead of ordering stuff from "the cloud", the origin of things would be important.

The third group of ideas deals with work and production. Interestingly, all of the ideas describe a "post-capitalistic" future where almost fully automated production transforms the concepts of work and production. The traditional concept of work would be fading, and replaced with the concept of "beneficial leisure". Instead of time for relaxation, leisure would be time for productive acts. People would not have to produce profits anymore, but instead cultural, social and practical use value. Instead of owning stuff, people would share it. Information and resources would be openly shared, thus enabling their maximal utilization.

The first circle of the futures wheel

In the first circle the group anticipated through discussion a possible future of "new consciousness", paying special attention to social relations. The only distinct group of ideas here deals with different kinds of information overload. If people had a shared consciousness, through cybernetic implants and through constant interaction, the information one constantly receives could often be overwhelming. Mentoring would thus be needed to cope with information flows. Isolation bunkers could be needed to allow withdrawing from communication every now and then. Even "emotional cosmetics" could be desired to "smoothen" one's intense emotional life.

A second set of ideas is a loose group related to social relations in general. Due to omnipresent communications, living location would not be relevant for work or other fields of life anymore. Because of this, some people could live in places such as underground and on or even under water. Perhaps locating in faraway places would sometimes be a way to escape constant socialising? A new, shared consciousness would however mean a transformation in social relations and shared values. What would be the meaning of life in such a society? Perhaps it would be based on equal, peer-to-peer social organisations? If norms and values were commonly discussed and decided, they could be internalised and adopted more deeply, thus making life more meaningful. General Artificial Intelligence knowledge synthesis systems would augment knowledge and information capabilities, enriching culture for its part. Finally, if each person was entitled to a personal robot taking care of for instance everyday chores, he or she would have more time for meaningful activities.

The second circle of the futures wheel

In the second circle the group composed ideas on products and services. Also here cognitive capabilities and issues are accentuated. Cybernetic "learning devices", extra memories, and different software applications would be highly valuable to cope with information overflow. Even skills could be downloaded. People would, however, need more opportunities to wind up, and sleeping boxes, sleep helmets, and other devices "enhancing" deep sleep would be in high demand. If people placed emphasis on their "spiritual" and cognitive wellbeing, they probably would be increasingly concerned on their physical health as well. Thus the market for different health care products and services, such as diagnosis devices and "genefixing" gadgets, could grow. In a similar vein, people would probably avoid all tasks unnecessary for their mental development, and thus self-producing robots and robot "from scratch" creation services would be a must. Food and even restructured molecules could be 4D printed (products that self-assemble and self-modify after printing).

In terms of energy the group deemed the development of sustainable spaceship fuels as worth of attention. Next generation geothermal could be valuable, and the thermal power could be transmitted through laser or "beaming heat". In general, energy would be produced locally where it is needed.

Futures Image

NOT SHARING MY HEADACHE

In this future, due to brain-to-brain communication technology, the standard in society is that all thoughts and feelings are shared. Yet, people still have interest in keeping some thoughts and feelings private. To this end, new services are available to manage what is and is not shared. Each person is entitled to a robot at birth. People generally have established new social relationships with machines. New forms of family, community and life stages have emerged. Traditional work is replaced with leisure that benefits the society. New GDP is BVS, referring to "benefits of value to the society". in the standard is that everything is shared. However, people still have interest in controlling their lives. To this end, new types of services have emerged to managing what is shared. Learning is done at loading stations. Big ethical questions concern the limits of modification of humans. A new method is introduced for developing codes of conduct: a peer-to-peer judgement. All energy is produced and consumed at the point where it is needed under a model called net-zero production.

PESTEC Table

Group 4 chose from their work with the futures wheel as their focus the concept of *not sharing my headache.* The implications of group's futures image in 2050 were discussed according to the six PESTEC dimensions. The most disruptive ideas were chosen from each dimensions. These are highlighted in the following Table with a purple text box.

Instead of representative democracy the society of the future was considered to feature a direct self-organizing democracy (P). Measuring wealth has been disrupted and the economic prosperity of the society is measured through Happy Planet Index (E). The lack of need to work has resulted in in more free time, energy and focus to be invested in social relationships (S). Food production is disrupted by 3D or 4D printing and the materials for production are made by each individual themselves (T). The centralized high-cost energy production is disrupted (E). The society is less hierarchical, but some are still more influential than others (C).

Table 9. PESTEC table of Group 4 on “Not Sharing my Headache”.

PESTEC	Not Sharing My Headache					
Political	**Direct self-organizing democracy instead of representative democracy**	Self organizing and alliances instead of parties	Rights not based on citizenship or place of birth	Nation states still exist OR replaced by other types of societies / groups people think to belong to	Download an app in the morning, be in the parliament in the day	
Economic	**Economic prosperity is measured through Happy Planet Index. Measuring wealth is dusrupted.**	Abundant energy disrupts solar coins	Respect is a new ”currency”	Humans do not create any tangible assets (They create only intangible assets / value		
Social	**Not needing to work releases time, energy and focus for social relationships**	Profession-oriented education disrupted by education aiming at improved self-actualization capabilities	Download your profile of the day in the morning			
Technological	**Food production disrupted 4/3D printing. No localization, materials for production made by each person?**	Virtual reality cannot be distinguished from reality anymore (the two merge)	Instant translation devides, no lingual problems	Instant translation devices + brain to brain communication disrupting communication barriers	Virtual reality directly created in the brain (non-surgical tech)	Enhanced trees: PV+artificial photosynthesis + recreational use
Environmental Energy	**Disrupting centralized high-cost energy production**	From scarcity to abundant energy	Cleaner environment and value uniting people	Prosumers: people making and using energy	Aesthetic and recreational (well-being) value of nature is bigger and production value	
Cultural Customer Citizen	**Far fewer hierarchies (But some are more influential)**	New professions to tell people what they could want or know				

The group identified new forms of direct self-organizing democracy disrupting the current political systems. People would organize themselves in new ways and form alliances; traditional political parties would no longer exist. Nation states have turned into new forms of belonging and the citizenship is no longer based on place of birth. The economic system changes profoundly as prosperity is measured through Happy Planet Index and respect would replace money as currency. Not needing to work to make a living disrupts the focus of life: More energy is dedicated to social relationships and self-actualization. Also education system is built to support maximising the self-actualisation abilities. Disruptive technologies transform our food production, sense of reality, cross-lingual communication and concept of forests. Centralized high-cost energy production would no longer exist. Energy and environment would be new foci of human interest: prosumers make the energy they need and find meaningful common goals in nature preservation.

Black Swans

This group identified 10 possible black swans, as potential future events that are unforeseen.

IDENTIFIED BLACK SWANS

- Meteorite: Global threat unites the humanitys
- All news reported by AI
- Super bacteria
- Brain-to-brain immune system – self recovering
- Computer virus – destroying infrastructure
- Mental illness virus
- Delete all virus – destroys all knowledge
- Manipulated information – makes people turn against each other
- New species in ocean, teach us
- Robot uprising
- Dolphins – understanding + learning
- Mars exploding
- Life in space – we can learn

Promotes the group's futures image (+)	Destroys the group's future image (-)
-	-

THE GROUP RECEIVED A BLACK SWAN FROM GROUP 4

How could it change the group's futures image or affect its resilience?

Global electricity allergy epidemics allegedly caused by the Japanese wireless space energy transmission experiment.

➔ No electrical gadgetry
➔ All of society paralyzed – scratching + sneezing
➔ Robots are fine, but we are allergic to robots
➔ Attempts to shut off robots, but robots consider it "Killing them"
➔ Photonics replace electronics
➔ Effort to develop anti-histamine to electronics

BLACK SWAN GENERATED TO GROUP 4

- People would learn how to communicate with dolphins and would learn from them

4.5 Group 5: New Consciousness

Group 5 worked on the scenario "New Consciousness" (for scenario descriptions, see chapter 3.1). Group members included: Toni Ahlqvist, Ria Gynther, Tiina Laurila, Osmo Kuusi, Lassi Similä, Panu Sutela, Anne Rahikka. The group was moderated by Merja Lang.

Figure 32. Group 5 discussing the futures wheel for the New Consciousness scenario.

Futures Wheel

The group produced the following ideas through discussion on the futures wheel. Ideas on what each group member thought would be different in the year 2050 were written in the core. On the 1st circle the group discussed how social relations could be changed by then in their scenario world. Products and services, including energy, needed in this future were discussed on the 2nd circle. The most interesting ideas that were further developed in the PESTEC table are marked on purple.

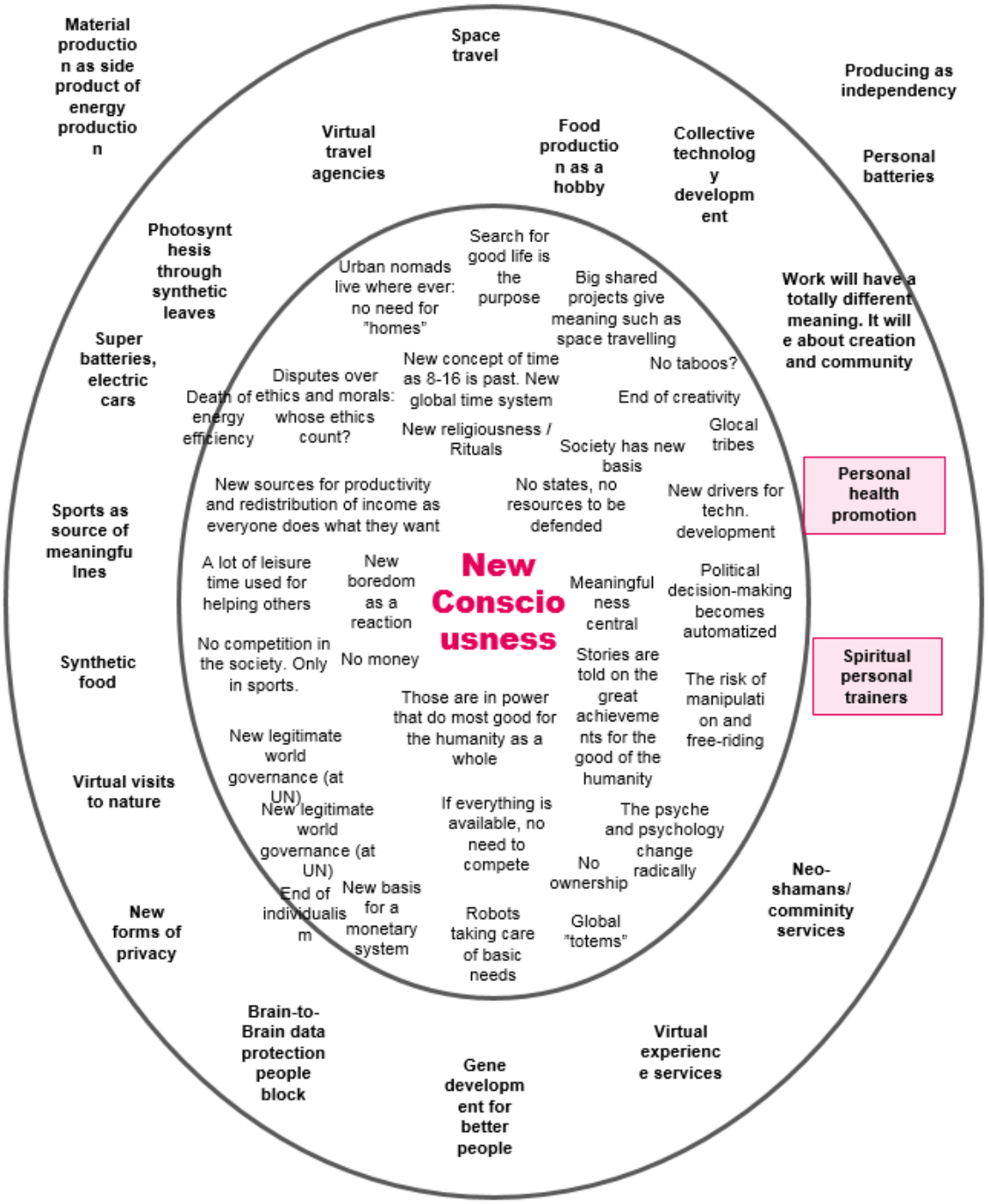


Figure 33. The Futures Wheel of Group 5 on the New Consciousness scenario.

The centre of the futures wheel

On the centre of the futures wheel each member of the group produced their own ideas on the futures of the "new consciousness" scenario. The largest group of ideas here is about the new basis of society. If, especially, much of production is automated, the whole economic system would transform, and with it also lifestyles. Everybody is be free to do "what they want", and new ways to redistribute wealth are needed – such as with basic income. Robots take care of basic needs, and people have a lot of free time. New conceptions of time have also been developed because the 8 am – 4 pm time has lost its purpose. The search for good life has risen as the guiding principle of people's actions. The new surplus time is often used for helping others, contributing to the societal goal of "good life". Because there is little scarcity, competition has lost its meaning, except for some areas such as sports. No ownership or money is needed anymore. Services and goods are accessed when needed. A permanent place of living has lost its purpose, and people live as global nomads. In the past, the driver for technological development was mainly economic (increases in efficiency and thus in profits), but as economic scarcity is not an issue anymore, new motivations for technological development are needed. One quite obvious answer is that technology is developed to serve people's authentic needs. Helping others spills to the politics as well: those are selected to be in power who do most good for the humanity as a whole. On the other hand, due to developments in artificial intelligence and big data, political and other kinds of decision-making have partly become automated. The conceptions of psyche and psychology have also changed radically due to developments in artificial intelligence. Many artificial intelligences have "psyches" totally unknown before. In human consciousness, the era of individualism has ended because people are connected in many ways to the psyches of other people.

However, the world of "aplenty" has its own downsides. Because there is no need to be frugal, many have become lavish and wasteful, and energy efficiency is often neglected. If a need to be frugal emerged once again for some reason, people could have problems with adapting to the situation. People also get bored quite often – and this has already had various implications, such as restlessness and even rebellion – doing meaningful things is up to people themselves. Creativity has also suffered, as things are often too nice and there are few problems to be solved. Free-riders, those who do not provide for the common good in any way, have also become an issue. Because people are more mentally and psychologically connected, the risk of "hive manipulation" has increased. In a world of more collective social relations, disputes over ethics and morals are often accentuated: whose values count?

The first circle of the futures wheel

On the first circle of the futures wheel the group discussed their scenario together, paying special attention to social relations. The group imagined their future society as *glocal* (at the same time global and

local) in nature. In practice this means that there are no nation-states anymore, and societies and life-styles are in this sense global. A new legitimate world governance is the central political unit. However, as people still live locally, sub-national, local communities matter at least as much as the global culture and decision-making institutions. The social units are called "glocal tribes": locally situated communities that have members all over the world. Perhaps due to the global "multiculture" there are no taboos anymore – tribes and communities are usually very tolerant and open-minded.

In a post-scarcity world *meaningfulness* – a sense of life's purpose – has arisen as a core value and goal. Meaningfulness is often be pursued through new kind of religiousness and collective rituals. Communities have their own "totems", items and values of worship. Big, globally shared projects, such as space travelling, also provide for the sense of purpose and meaning. All in all, meaningfulness are pursued through projects and routines that help the individual to transcend themselves and help him or her become part of something bigger than oneself.

The second circle of the futures wheel

On the second circle of the futures wheel the group produced ideas about practical solutions and energy services. Also here the pursuit for meaningfulness is highlighted. Neo-shamans offer "community services", and personal trainers spiritual development. Due to automation, work has a totally different meaning than before: it is about creativity and community building, and oftentimes these intermingle as processes of co-creation. Technology, for instance, is developed collectively so that it better matches the needs of each individual and community. Work, and some basic functions of society, such as food production, resemble hobbies more than paid work.

Despite the emphasis on communality, individualism also thrives, as in the form of personal health promotion and competitive sports as a source of meaningfulness. Production is also a means for acquiring independency, not only a way to do things together. Genes can be manipulated for the "betterment" of individuals. In a communal culture emphasising sharing and communication, new forms of privacy are needed. This means e.g. brain-to-brain data protection and even blocking certain people to communicate with oneself.

In a society of sophisticated technology the lines between "real" and "artificial" have become blurry. Virtual experiences are often as real as "real" ones. People's connection to nature is enforced with virtual visits to nature, and physical travel is sometimes replaced by virtual travels arranged and curated by virtual travel agencies. Synthetic food often tastes as delicious as organic food, and is nutritionally tailored according to individual needs.

Energy is provided by photosynthesis of synthetic leaves. Energy is stored in personal light-weight but long-lasting personal batteries, and electric cars and other technologies with relatively high energy needs

are powered by “super-batteries”. Space travel is one of the new, emerging industries requiring a lot of surplus energy.

Futures Image

MEANINGFUL LIVING

In this futures image glocal tribes are the basic structure of the society. Above there is an enlightened governance that works through online networks and is based on humans and AI. It is self-organised and iterative system. Material things have lost their meaning, as people and the economy is no longer based on exchange or selling but on wellbeing. Working is no longer the focus of life, and people have almost unlimited free time. Stories, myths and “collective content production” have become important for the social cohesion. Individualism still exists but it is directed towards social wellbeing. For some this image is also suffocating, as negative thinking is not welcomed. Brain-to-brain technology has made communications unlimited. Unlimited clean energy production is also available.

PESTEC Table

Group 5 chose from their work with the Futures wheel as their focus AI based global governance, experience and health economy, tribalization of the society as well as new leisure and space travel. In PESTEC table illustrated in the following the group decided to elaborate the idea of *meaningful living.* The group discussed and wrote down the possible implications of their futures image in 2050 according to the six PESTEC dimensions. The ideas that were considered most disruptive were chosen from each dimensions. These ideas are highlighted in Table 10 with a purple text box.

In 2050 the global governance is organized in online communities with the help of artificial intelligence. This political system is both self-generating and self-iterative. (P) Businesses concentrate on selling well-being, health and experiences (E). The society revolves around tribes that share similar lifestyles. People switch between tribes easily. These communities are considered as extensions of family and they function as objects of solidarity. (S) Brain-to-brain technology is an important technological innovation (T). The unlimited energy production has enabled different innovations such as space travelling (E). The work is no more considered the centre of life (C).

Table 10. PESTEC table of Group 5 on “Meaningful Living”.

PESTEC	Meaningful Living					
Political	**Global governance is organized in online communities with the support of AI. The political system is self-generating and self-iterative.**	“Tribes” take the form of societal unit that also part in the political decision-making	States and borders and political parties no longer exist, there are very few traditional laws	society no longer has the function of redistributing resources	Individuals have more responsibility over their own lives.	
Economic	**Businesses sell wellbeing, health and experiences**	Ownership is no longer valued, shared economy touches all the spheres of life	People sell services they want to sell, pleasure is the main motivation	Robots take care of those jobs people no longer want to do	Material production is no longer the basis of economy	
Social	**People switch lifestyle based tribes easily. Tribes are considered as extensions of family and are being the objects of solidarity**	Individualism is strong but “common good” is the driving force of individual action. (Persona 20% individual / 80% the community)	There are new rising occupation such as information miners.	People with “ethical excellence” take the place of spiritual/ community leaders	People generally trust each other	Loneliness no longer exist
Technological	**Brain-to-brain technology**	An extended memory capacity expands the close social networks and makes it possible to know well an unlimited number of people	Technology is ubique			
Environmental Energy	**Unlimited energy production, space travel possible**	Augmented nature: information about nature and species can be received immediately	The nature has become a valued mystery and evolution has a sacred status of offering something surprising	Nature is a taboo that can’t be exploited		
Cultural Customer Citizen	**Work is no longer the center of the life**	Culture services are now all participatory, old public culture institutions disappear	The division between cities and countryside is no longer meaningful	Human touch becomes a cherished	Citizenship is based on tribes that can change rapidly	

The two main elements identified disrupting the current political structure were the new form of global governance that is partly based on people with raised “humanity capital” and partly on artificial intelligence that is self-iterative and self-generating. Glocal “tribes” were identified as a central unit of the society, what creates an interesting tension between individualism and collectivism. On one hand, people are very individualistic and services are tailored to their specific needs. On the other hand, tribes are such a strong point of identity enhanced by the brain-to-brain technology and hyper connectivity that the person is more a part of the larger whole than an individuum. However, at the same time people need to take more responsibility over their own lives, as the top-down state processes no longer steer the choices that people make. This has been a fertile soil for many health services to boom. Experience economy is also booming, as materialism no longer drives people. Generally, people are more interested in enhancing the common good. Also enabling big projects such as space travel have become ways of finding meaning in life. Space travel is possible due to abundant energy availability. Nature has become a mystical place, a taboo even and recreation in nature is done through virtual trips. On the other hand the border between cities and countryside is no longer meaningful as not having to work has freed people from their traditional localities. This means that biodiversity has generally recovered everywhere.

Black Swans

This group identified 5 possible black swans, as potential future events that are unforeseen. It also identified "an asteroid bringing new resources as it would accelerate the technological development" that could promote the future, and "Internet collapses inevitably"" that could collapse the group's future.

IDENTIFIED BLACK SWANS

- A massive nuclear disaster that would result in a nuclear winter
- Human body starts to reject technological body parts. It is no longer possible to link to brain-to-brain networks or to live forever
- An asteroid is about to hit the Earth. It can result in massive destruction or if successful, humans find a way to exploit its resources
- EU / UN collapse, political disintegration. Can bring about the change faster or cause chaos if happens very quickly.
- Birth of an imperialistic terrorist state

Promotes the group's futures image (+)	Destroys the group's future image (-)
The asteroid bringing new resources as it would accelerate the technological development	Internet collapses inevitably. This will make the global tribes an impossibility

THE GROUP RECEIVED A BLACK SWAN FROM GROUP 5

How could it change the group's futures image or affect its resilience?

- Black Swan received was collective spiritual enlightenment. This black swan would fulfil our scenario and accelerate it.

BLACK SWAN GENERATED TO GROUP 4.

Global electricity allergy epidemics caused by the Japanese experiments on wireless energy transfer from the space was given to group "New Consciousness".

4.6 Group 6: Radical Startups

Group 6 worked on the scenario "Radical Startups" (for scenario descriptions, see Chapter 3.1). Group members included: Jero Ahola, Abdelrahman Azzuni, Piritta Fors, Jussi Mäkinen, Victoria Poljatschenko, Heidi Salokangas, Pia Salokoski and Minna Tikkanen. The group was moderated by Amos Taylor.

Figure 34. Group 6 constructing the futures wheel for Radical Startups scenario.

Futures Wheel

The group produced the following ideas through discussion on the futures wheel. Ideas on what each group member thought would be different in the year 2050 were written in the core. On the 1st circle the group discussed how social relations could be changed by then in their scenario world. Products and services, including energy, needed in this future were discussed on the 2nd circle. The most interesting ideas that were further developed in the PESTEC table are marked in purple.

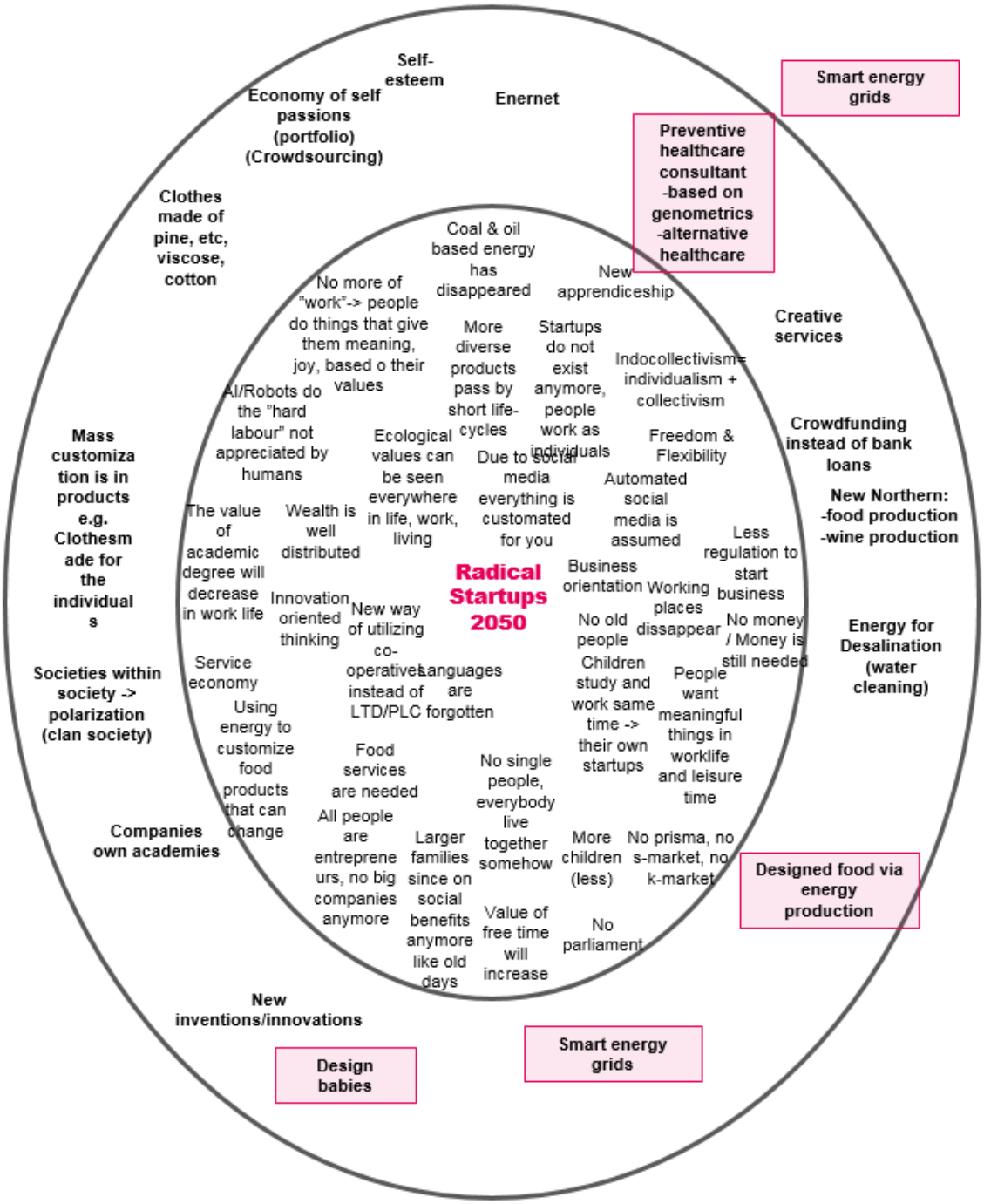


Figure 35. The Futures Wheel of Group 6 on the Radical Startups scenario.

The centre of the futures wheel

Some ideas on the centre of the futures wheel describe the future of startup businesses and the economy in novel ways. Startups may disappear as companies. Instead, people would work as networked individuals or in new kinds of cooperatives. Workplaces as separate spaces could disappear as well. Such economy could be described as *hybrid.* The same kind of hybridity is reflected in the combination of

business orientation and equal distribution of wealth, and children who study and work at the same time in their own startups.

In terms of lifestyles, people would pursue meaningfulness in both work and leisure time. Ecological values would be implemented in work as well as in everyday living. "Automated" social media of clever algorithms would custom everything according to individual tastes and needs. This kind of radical individualism would manifest itself for instance in all-encompassing innovation oriented thinking. At the same time, manifesting the hybridity of society and culture, communality would be emphasised. Only a few would be single, and almost everyone would live together with other people. Thanks to translation technologies language barriers would be transcended, and communities would be "multicultural". Youth would be valued: people would have more children than before, and old people would have ceased to exist thanks to anti-aging technologies and medicines.

The first circle of the futures wheel

On the first circle of the futures wheel the group discussed their scenario together, paying special attention to social relations. As well as in the centre of the futures wheel, the change in the conception of work is emphasised. There would be no "work" in the present sense, but people would do things that give them meaning and enjoyment, and things that are in line with their values. The economy would be a full-blown service economy. AI's and robots would do the "hard work", which would not be appreciated by humans at all anymore. Because work would be highly individual-driven, the value of academic degrees would have decreased. Instead, apprenticeships would again be the learning path in jobs for many, reflecting the personalised craftsmanship mode of work. Maybe guilds could be revisited, offering new kind of "indocollectivist" (combining individualism and collectivism) social relations? The value of free time would have increased, or maybe the separation between work and leisure has been extinguished altogether? The question about money is open: would such a world still need money, or would there have been some kind of revival of exchange economy? Everyone would be their "own entrepreneur", and big companies would exist no more. This would have been made easy with low regulation in starting a business. There would be a lot of freedom and flexibility in society in general, and even processes of representative democracy could be replaced by some kind of grassroots, direct democracy initiatives.

The second circle of the futures wheel

On the second circle the group anticipated practical products, services and solutions. They reflect the "pre-industrial" ideas of the first circle of the futures wheel. "Startup clans" can bring about societies within society, and the adjacent polarisation this implies. Companies can have their own academies, as the trust in general academic degrees has waned. Economy would be divided into spheres of "passions", and instead of loans projects would be funded by crowdfunding: those with matching "passions" would

fund projects that are tailored to their tastes. Mass customisation would be the norm. The individualised economy would be reflected for instance in personal preventive healthcare based on genometrics and design babies. Material sustainability of production would be ensured by new renewable materials, such as clothes made out of pine. Energy would be renewable, and distributed through smart grids and the "enernet" (energy internet). The clean surplus energy could be used for instance to produce food that is designed and customised according to personalised needs and grown in greenhouses (this way for instance wine could be produced in the northern countries), and to produce clean water through desalination.

Futures Image

NEW ENTREPREUNIAL LIFESTYLE

- Preventative healthcare
- Clean water for everyone
- New Northern food & Wine
- Design babies
- Mass customization
- Indocollectivism
- Freedom & Flexibility

PESTEC Table

Group 6 chose from their work with the Futures wheel as their focus the concept of *new entrepreunial lifestyle,* which was elaborated in the PESTEC table. The group discussed and wrote down the implications of their futures image in 2050 according to the six PESTEC dimensions. The most disruptive ideas were chosen from each dimensions and they are highlighted in the following Table with a purple text box.

In 2050 the governments have been replaced by value-driven socially organized tribes (P). 'Failing by doing, bankrupty an asset': translates as learning by doing - but most importantly learning from your failures. Bankrupty, 'going for bust' is a worn as badge of honor rather than a stigma for people. (E) The society is somewhat Orwellian. The loss of privacy and losing control bring out the darker side of the human nature (S). Internet of things is one of the key technological solutions (T). 'The Finnish Jungle' has appeared through global warming where forests have transformed in this habitat to be more jungle like, offering new possibilities and also threats (E). Work has become play-like and it utilises gamification (C).

Table 11. PESTEC table of Group 6 on “New Entrepreneurial Lifestyle”.

PESTEC	New Entrepreneurial Lifestyle				
Political	**No governments, but socially organized tribes – Tribes by values**	Laws have changed so that there is no difference between entrepreneur and employee or no regulations to start business			
Economic	**Failing by doing – bankruptcy asset**		Well distribution of wealth	Encouraging politics - Basic income	
Social	**Dark side of human nature •Loss of privacy •Loosing control •”George Orwell”**		No jealousy and no envy of entrepreneurs	Not married with a company	Entrepreneur /Criminal
Technological	**Internet of Things**		Ubiqutous computing	Enernet	
Environmental Energy	**Finnish Jungle**	New plants available because of climate change thus no desert anymore	Finnish healeanation	Enernet	Ice energy Energy from Nordic lights
Cultural Customer Citizen	**Work is game play**	Culture of success and Innovatio n	Revolution Old families power gone	Entrepreneur story startup begin mid.end	

Black Swans

This group identified 4 possible black swans, as potential future events that are unforeseen. It also identified “an asteroid bringing new resources as it would accelerate the technological development” that could promote the future, and “Internet collapses inevitably” that could collapse the group’s future.

IDENTIFIED BLACK SWANS

- Hacking – Internet of Things (IoT). This will cause A) criminal invasion of privacy & with extreme cases of blackmail, extortion, B) competitive blocking of brands via IoT as a competitive edge and C potential to be less open to unestablished brands in this futures image because…of constant high level of IoT hacking (motivated by crime-mafia, corporate sabotage, political ideals, or just youth hackers expressing their skills)
- Power taken control. This triggers A) similar to IoT power networks are manipulated, held hostage, temporarily limited, switched on and off B) causing huge shocks to the system that assumes a constant power to supply wide range of services and tech developments and C) resulting in slow in growth of new services and brief unstable times where hackers and counter power hackers take control of the system

- Tick, New poisonous spiders. This can cause A) sickness and in some rare occasions death, but vaccines are constantly being discovered to adapt, B) people stay out of some areas of nature because of fear, letting some nature turn to 'Finnish Jungle' and C) new medical and health-tech solutions are business opportunities that offer services to combat and track these on our environment and bodies. Some genetic modifications and IoT sensors have side effects because of insect toxins.
- Out of control / Manipulated genetics – Designer babies/ designer selves/ designer food/ potential play with genetics always on the cutting edge of what is possible (ethical or legal) also has unknown side effects. Experimentation, openly exploring in science and business genetic possible impossibilities may well result in uncontrollable outcomes for environment, humans, food, animals.

Promotes the group's futures image (+)	Destroys the group's future image (-)
AI – Entrepreneur friendly president This will give leadership and direction and guide the highly complex changing entrepreneurial needs of the sector. AI Pres. will judge the values of the different 'tribes' – groups of likeminded people, and facilitating and stimulating the startup process to a record new level, in a way that no human could. AI is accepted by people to follow a more ethical and wiser role, especially as it seems to show results. This new phenomena explodes the startup scene.	Harmful new species – out of control This will affect deeply the health of people even though they have sophisticated medical solutions, these unbalance the normal healthy status. Still no cure found for these insect bites, poses a problem and people are more fearful to be in contact with them.

THE GROUP RECEIVED A BLACK SWAN FROM GROUP 3

How could it change the group's futures image or affect its resilience?

- BREXIT
  - Economic collapse of the world
  - EU falls apart
  - Nations dissolve

  Not so disruptive EU collapse as flexible entrepreneurs move fast to adapt. Maybe international mobility logistics problem, but entrepreneur can adapt to this.

BLACK SWAN GENERATED TO GROUP 3

- Killer tick insect infestation (brought on by warmer environmental change in the north)

5. CONCLUSIONS

The two-day Futures Clinique on “Clean Disruption for Abundant Futures” focused on the topics of energy, internet, clean disruption and futures of communities. The purpose of this futures clinique was to elaborate in small groups the social and cultural aspects of the societal scenarios built in the Neo-Carbon Energy project. In all of the scenarios, society is powered by a decentralised renewable energy system with a high energy efficiency, granting societies surplus energy and thus transforming economy, culture and social relations. It is also assumed in the scenarios that the new, decentralised energy system empowers citizenship and thus promotes a peer-to-peer society where citizens self-organise. In the *Radical Startups* scenario society is based on startup companies with social and cultural aspirations. In the *Value-Driven Techemoths* scenario giant technology companies reign, but the companies offer a platform for self-organising workers. In the *Green DIY Engineers* scenario citizens have established local communities to survive an ecological collapse. In the *New Consciousness* scenario individualism has given way to a media-technology-enabled, global shared consciousness, where everything is organised around porous and constantly evolving networks. The event specifically aimed to address possible futures and the societal transition towards the convergence of energy and internet. ‘Abundant futures’ as a provocative concept defines the stance towards futures - ample resources would be available in such a system. This, in turn, would affect social relations and communities of the future.

As the most interesting ideas from the futures wheel, the groups chose *“On-Demand Society”*, *"Online Hives"*, *"Learning Device"*, *"Extra Memory"*, *"Spiritual Personal Trainers"*, *"Personal Health Promotion"*, *"Smart energy grids"*, *"Preventive healthcare based on genometrics"*, *"Designed food from energy production"*. The groups then investigated these ideas further and built futures images. They were called “Society On-Demand”, “Ethical optimization”, “Storytellers and Plastic Smiths”, “Not Sharing My Headache”, “Meaningul Living”, and “New Entrepreneurial Lifestyle”. For details of each groups’ ideas, we urge the reader to look especially at the futures wheel and the futures image of each of the six groups more in detail. Here we will summarise the results briefly: what common ideas about social relations, culture and economy do the groups’ results share?

In the groups’ results, perhaps the most common is the idea of a “post-institutional” future, where tribal-like communities have returned. This is interesting, because although the scenarios emphasise peer communities, the groups accentuated the tribal nature of such communities even further. Nothing also prevented participants to take a critical stance toward such communal futures, or to highlight the role of the state or some other official institution. Perhaps some kind of revisit to pre-industrial times is a preferred future for many in today’s world, made possible by new technologies? Or maybe the longing for

such communities is a symptom of collective fear of a social, societal or ecological collapse? Below are presented some ideas reflecting the neo-tribal future:

- The role of state has diminished so that social relationships are "anarchic" (i.e. self-organising) in nature.
- There are no labor markets and formal education in the current sense. People learn with each other in niche "skill tribes".
- Startups may disappear as companies. Instead, people would work as networked individuals or in new kinds of cooperatives.
- Communal housing is preferred, including for instance communal gardens, saunas, and leisure areas. Preschools and kindergartens are arranged communally, as "co-caring". Food is produced locally, which ensures freshness and minimises transportation.
- Due to omnipresent communications, living location would not be relevant for work or other fields of life anymore. This could lead to two alternative futures: either people could more easily live and socialise with the like-minded, or tightly-knit groups lose their relevance.
- If global population fell drastically due to the systemic adverse effects of the climate change and ecological crisis, people would live increasingly in small tribes instead of cities or nation-states. Storytelling and oral tradition, linking the tribe to ancestoral past, would be a crucial way to build tribal cohesion
- In constant connectedness, new modes of consciousness and cognition could emerge.
- Thanks to technology-aided interconnectedness, language barriers will not matter anymore. The significance of nation states has also weakened. Previously, these two were strong (if not core) determinants of identity.

Another recurring theme was the change in the conception of work. If production was automated, the role and nature of human work would change. Work would become predominantly creative and social, and the lines between work and other spheres of life would be blurred. This can be seen as one aspect of a tribal future: in such communities work, leisure and community activities would be inseparable. Below are presented some ideas reflecting the future of work:

- There would be no "work" in the present sense, but people would do things that give them meaning and enjoyment. The economy would be a full-blown service economy.
- Because robots have taken over traditional work, the need for [human] labor is minimal. Instead, people have hobbies as their work.
- Work is equally everywhere and nowhere – free from spatial and temporal boundaries. Startups are the primary communities of citizens, often even more important than families.

- The traditional concept of work would be fading, and replaced with the concept of "beneficial leisure".
- Companies do experimental projects and cherish unbridled creativity.
- Overall, the value of "imagination and art" could increase.

A third common theme describes values, which would be mostly immaterial. All activities would pursue the goal of meaning and meaningfulness. Below are presented some ideas on such values:

- Instead of material commodities consumption would be mainly immaterial. Sharing economy flourishes. Meat is not eaten. Spaces are used on-demand. The eight hour work day is displaced, and people work only for the "value-added" hours.
- In terms of lifestyles, people would pursue meaningfulness in both work and leisure. Ecological values would be implemented in work as well as in everyday living. "Automated" social media of clever algorithms would custom everything according to individual tastes and needs.
- In a "robotised" future, non-human entities (machines and animals) could be treated as independent actors and even equal with humans.

Finally, a fourth common theme between the groups describe the possible social ills and drawbacks of the future. Mostly these have to do with technology and companies. Below are presented some ideas reflecting these issues:

- New class divides and forms of injustice could be determined based on access to technology. In a highly technologised society, those with better and more technology would be in superior position to those with less and inferior technology.
- If technology companies had the hegemony of power, everything would be optimized so that anything that is "unproductive" or in other ways a threat to efficiency would be deemed "unethical".
- If people had a shared consciousness or were communicating with each other literally all the time, the amount of information one constantly receives could be overwhelming and lead to different psychophysical conditions.

The groups also coined a collection of black swans – highly improbable, surprising events with radical consequences. Many of the black swans, of which a collection is presented below, also describe the dark side of our "post-institutional", technology-driven future.

- Birth of an imperialistic terrorist state
- Collective Enlightenment (spiritual). Will boost the scenario, because people come together and work towards common goals.

- Computer virus – destroying infrastructure
- Corporate warfare
- (Cyber) World War
- EU/UN collapse, political disintegration. Can bring about the change faster or cause chaos if happens very quickly.
- Hacking of the Internet of Things (IoT). This will cause A) criminal invasion of privacy & with extreme cases of blackmail, extortion, B) competitive blocking of brands via IoT as a competitive edge and C) potential to be less open to unestablished brands because of constant high level of IoT hacking (motivated by crime-mafia, corporate sabotage, political ideals, or just youth hackers expressing their skills)
- New types of plants, mutated because of the ecological disaster, are found. This could lead to new medicinal discoveries, and previously fatal or non-curable diseases could be cured.

Other, more futuristic black swans question the unfolding human-technology interface and entertain also the possibility of "radical" long-term future developments:

- Human body rejecting technological body parts through A) electricity allergy or B) robot allergy
- Self-recovering brain-to-brain immune system
- Turning dark energy and dark matter into energy and matter, this could bring an endless source of energy and materials.

In summary, many of our examples discuss the interplay of empowerment of the individual and the local in connection to *hybridity* and *interconnectivity*. New modes of consciousness and cognition from constant connectedness have, in a way, already become a reality. Jointly, this may shape 'reality' and how humankind will perceive its place in the world. The levels to which it may reach, may depend on the technological developments described in this report. Most developments described by the groups describe positive developments, but also the potential drawbacks and unexpected developments provide interesting food for thought. It has to be borne in mind that the clean disruption for abundant futures is a cornucopia with huge potential, but by no means automatically merely beneficial. Critical mindset is needed both for the decision phase and implementation of clean disruptive technologies, practices, lifestyles, and regulation. For further research, when it is assumed that the 'clean disruption' attends to ecological problems, the relationship of 'abundance' and ecology is not yet described sufficiently in detail. Despite some groups that aspired for biosphere health, it is not entirely clear what it will mean to be frugal in an efficient world of plenty. This could provide avenues for further enquiries.

REFERENCES

Aghahosseini A., Bogdanov, D. & Breyer, C. (2016) The MENA Super Grid towards 100% Renewable Energy Power Supply by 2030. 11th International Energy Conference, Tehran, May 30–31, 2016.

Boucher, M. (2015) Decentralized Energy: Prospects, Justice, and Transition. Energy Research & Social Science 11, 288–293.

Breyer, C., Heinonen, S. & Ruotsalainen, J. (2017) New Consciousness: A societal and energetic vision for rebalancing humankind within the limits of planet Earth. Technological Forecasting and Social Change.

Child M. & Breyer C. (2016) Vision and Initial Feasibility Analysis of a Recarbonised Finnish Energy System. Renewable and Sustainable Energy Review, 66, 517–536.

Christensen, C.M. (1997) The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Boston, MA: Harvard Business School Press.

Cordeiro, J. (2006) Interviewed by Sirkka Heinonen and Elina Hiltunen at VTT on Promises and Perils of New Technology. https://sites.google.com/site/futuremediac/videos--presentations (please scroll down, the video is almost at the bottom of the page)

Deutsche Bank (2015) Industry Solar. Markets Research. 27.2.2015. https://www.db.com/cr/en/concrete-deutsche-bank-report-solar-grid-parity-in-a-low-oil-price-era.htm?kid=solar.inter-twen.tw

Diamond, J. (2005) Collapse. How societies choose to fail or survive. London.

Ewing, B., Moore, D., Goldfinger, S., Oursler, A., Reed, A. & Wackernagel, M. (2010) The Ecological Footprint Atlas 2010. Oakland: Global Footprint Network.

Glenn, J. (2009). The Futures Wheel. In: Glenn, Jerome & Gordon, Theodore (2009) Futures Research Methodology Version 3.0. Washington DC.

Glenn, J. & Gordon, T. (2009) Futures Research Methodology Version 3.0. Washington DC. http://www.millennium-project.org/millennium/FRM-V3.html

Heinberg R. & Friedly, D. (2016) Our Renewable Future: Laying the Path for One Hundred Percent Clean Energy. Washington DC: Island Press.

Heinonen, S. (2013) The Dance of the Black Swans. The Concept and Manifestations. In: Black Swans – What Will Change the World Next? Entries from the writing contest of the Committee for the Future of the Parliament of Finland, p. 20–40.

Heinonen, S., Karjalainen, J. & Ruotsalainen, J. (2016) Radical Transformation in a Distributed Society – Neo-Carbon Energy Scenarios 2050. NEO-CARBON ENERGY WP1 Working Paper 1/2016. Finland Futures Research Centre, ISBN 978-952-249-415-3, 84 p.

Heinonen, S. & Ruotsalainen, J. (2013) Futures Clinique – method for promoting futures learning and provoking radical futures. European Journal of Futures Research, 15:7, DOI 10.1007/s40309-013-0007-4, 11 p. http://link.springer.com/article/10.1007%2Fs40309-013-0007-4.

Hiltunen, E. & Heinonen, S. (2012) Creative Foresight Space and the Futures Window: Using Visual Weak Signals to Enhance Anticipation and Innovation. Futures vol 44, 248–256.

Kelly, K. (2016). The Inevitable: Understanding the 12 Technological Futures That Will Shape Our Future. New York.

Kurki, S., Pura, M. & Wilenius, M. (2016) Re-Acting the Future. New Ways to Work: The Case of Reaktor. FFRC eBook 6/6016. http://www.utu.fi/fi/yksikot/ffrc/julkaisut/e-tutu/Documents/eBook_8-2016.pdf

Kurki, S. & Wilenius, M. (2016) Trust makes this organisation unique. Looking at the future of work through two human-centric organisations. European Journal of Futures Research 4:23 http://dx.doi.org/10.1007/s40309-016-0095-z

Lawrence, D.H. (1981) Apocalypse. London: Granada Publishing Limited.

Lord, B. (2014) Art & Energy: How Culture Changes. The AAM Press, Arlington.

Lösch, A. & Schneider, C. (2016) Transforming power/knowledge apparatuses: the smart grid in the German energy transition. Innovation: The European Journal of Social Science Research, DOI: 10.1080/13511610.2016.1154783.

Naam, R. (2011) Smaller, cheaper, faster: Does Moore's law apply to solar cells? Scientific American, http://blogs.scientificamerican.com/guest-blog/smaller-cheaper-faster-does-moores-law-apply-to-solar-cells/ Retrieved 31st August 2016.

Nurmela, J. (2013) Tulevaisuusverstas ja uusia ”verstashenkisiä” tulevaisuuden muovaamisen menetelmiä, p. 213–217. In: Osmo Kuusi, Timo Bergman & Hazel Salminen (eds.). Miten tutkimme tulevaisuuksia? Acta Futura Fennica no 5. Helsinki.

Rifkin, J. (2011) The Third Industrial Revolution. How Lateral Power is Transforming Energy, the Economy, and the World. Palgrave Macmillan, New York.

Ruotsalainen, J., Heinonen, S., Karjalainen, J., Parkkinen, M., Laurén, L-M & Salminen, H. (2016) The Fuzzy Futures of Neo-Carbon Work. Neo-Carbon Futures Clinique II, Finland Futures Research Centre, FFRC eBook 11/2016. https://www.utu.fi/fi/yksikot/ffrc/julkaisut/e-tutu/Documents/eBook_11-2016.pdf

Ruotsalainen, J., Heinonen, S., Karjalainen, J. & Parkkinen, M (2016b) Peer-to-peer work in the digital meaning society 2050. European Journal of Futures Research (2016) 4:10. http://rdcu.be/tf0b. DOI 10.1007/s40309-016-0092-2

Seba, T. (2014) Clean Disruption of Energy and Transportation: How Silicon Valley Make Oil, Nuclear, Natural Gas, and Coal Obsolete by 2030. Beta edition.

Sovacool, B. K. & Brossmann, B. (2010) Symbolic convergence and the hydrogen economy. Energy Policy 38, 1999–2012.

Stern, N. (2006) Economics of Climate Change. mudancasclimaticas.cptec.inpe.br/~rmclima/pdfs/.../sternreview_report_complete.pdf

Taleb, N. (2010) The Black Swan. The Impact of the Highly Improbable. Random House, New York.

WCED (1987) Our Common Future. Oxford: Oxford University Press.

Wilenius, M. (2017) Patterns of the Future. Understanding the Next Wave of Global Change. World Scientific, London.

Wilenius, M. (2017a) Global change and K-waves: exploring the pattern of the future. Routledge Handbook of Resource Nexus. (Forthcoming)

Wu, F. F. & Varaiya, P. P. & Hui, R. S. Y. (2015) Smart Grids with Intelligent Periphery: An Architecture for the Energy Internet. Engineering 1:4, 436–446, DOI 10.15302/J-ENG-2015111.

APPENDIX 1. Programme and keynote speakers

Tuesday 7th June 2016

Futures Provocation & Dialogue

9:15–9:30 Registration and Coffee
9:30–9:45 Opening words and introducing the aims of the 2-day workshop, Sirkka Heinonen
9:45–10:45 Keynote as Futures Provocation: Clean Disruption, EnerNet, and Energularity, José Cordeiro
10:45–11:30 Towards a New Consciousness: Commentary remarks by Christian Breyer Questions & Answers session Questions posed by the audience
11:30–12:15 Lunch
12:15–13:15 Introduction to Neo-Carbon Energy project – How to reach 100% renewable energy system?, Christian Breyer
13:15–13:30 Futures Clinique as a method, Sirkka Heinonen
13:30–13:45 Futures Window – Cavalcade of Visual Weak Signals

Session I

13:45–14:00 Introduction to the work
14:00–15:30 Method: Futures wheel
15:30–16:30 Cross-Fertilization (all groups together)

Wednesday 8th June 2016

Futures Provocation and Dialogue

9:00–9:30 Coffee
9:30–10:15 Innovations from the Energy Internet: Cases from the Singularity University and beyond, José Cordeiro
10:15–10:45 Systems of self-organising work, Markku Wilenius
10:45–11:15 Questions & Answers session
11:15–11:30 Stimuli for afternoon session (method & inspiration)
11:30–12:15 Lunch

Session II

12:15–12:30 What is disruption?
12:30–14:00 Method: Futures Table PESTEC
14:00–15:00 Black Swans
15:00–16:30 Cross-Fertilization (all groups together)

Keynote Speakers

Dr. José Cordeiro, MBA, Ph.D. is a world citizen, born in Latin America, educated in Europe and North America who has studied, visited and worked in over 130 countries in Africa, Asia, Europe, and the Americas, on topics such as technological foresight, futures studies, globalization, economic integration, long-term development, energy, education and monetary policy, and has authored and co-authored several books. José is also director of the Single Global Currency Association (SGCA), the Lifeboat Foundation, co-founder of the Venezuelan Transhumanist Association, the Internet Society Venezuela Chapter, board advisor to the Center for Responsible Nanotechnology (CRN), member of the Academic Committee of the Center for the Dissemination of Economic Knowledge (CEDICE), and many more. He has also acted as an advisor and consultant in the areas of strategy, finance and restructuring, including large multinational and regional oil companies.

Prof. Christian Breyer, D.Sc. (Tech.), is Professor of Solar Economy at Lappeenranta University of Technology (LUT). His professorship is the first of its kind in Finland and the Nordic countries. He focuses on research and teaching on solar economy, energy scenarios and market mechanisms. His academic background is in physics, energy systems engineering and general business. In his career, he has engaged in the Photovoltaic Power Systems Programme of the International Energy Agency (IEA), acted as Chairman of the Scientific Board for the Energy Watch Group, and is one of the co-founders of DESERTEC Foundation. Breyer has published around 100 scientific articles and books as author, co-editor and contributor.

Prof. Sirkka Heinonen *has a wide and prominent expertise in futures studies.* She acts as professor of futures studies and research director at Finland Futures Research Centre. She is also visiting professor at the University of Science and Technology of China (USTC) in Hefei, China. Prof. Heinonen specialises in technology foresight, information society, futures of cities and rural areas, sustainable

development, and futures of lifestyles, technology, and philosophy. Heinonen has developed the Futures Clinique method. She is the chair of the Helsinki Node of the Millennium Project and a member of the Club of Rome.

Heinonen also leads the foresight part of Neo-Carbon Energy project. In the foresight part of the project, possible socio-economic consequences and prerequisites of the neo-carbon energy system are anticipated (https://www.utu.fi/en/units/ffrc/research/projects/energy/Pages/neo-fore.aspx). Neo-Carbon Energy is funded by Tekes – the Finnish Funding Agency for Innovation.

Prof. Markku Wilenius has been working with futures studies for 20 years. He has a wide expertise and experience on futures research, strategic thinking, and corporate foresight. He has acted as professor of futures studies at Finland Futures Research Centre since 2004. He specialises in the implications of information society, futures of mobile technology, futures of food consumption, the role of culture within economies, the use of innovation and creativity in companies, and futures of media. His current research topic is the long socio-economic waves and their implications on Finnish economy and society. Prof. Wilenius is UNESCO chair, a member of the Club of Rome, owner and CEO of three companies, and president of three foundations.

Prof. Pasi Vainikka is the coordinator of the Neo-Carbon Energy Project. In the neo-carbon energy system electricity is produced with renewables, used for cooling and fuels, and CO2 from the air is used as a source for plastics, chemicals and medicine. The economy can get a basis for products previously produced from oil and coal (www.neocarbonenergy.fi). He acts as principal investigator at VTT Technical Research Centre of Finland and as adjunct professor at Lappeenranta University of Technology (LUT).

APPENDIX 2. Participants

Aalto-Nyyssönen, Tuuli	University of Turku/Open University
Ahlqvist, Toni	University of Oulu
Ahola, Jero	Lappeenranta University of Technology
Alatorvinen, Pia	University of Oulu
Azzuni, Abdelrahman	Lappeenranta University of Technology
Breyer, Christian	Lappeenranta University of Technology
Caldera, Upeksha	Lappeenranta University of Technology
Fors, Piritta	Turku School of Economics
Gynther, Ria	Tampereen yliopisto
Haapanen, Liisa	University of Turku
Hanhike, Tiina	TEM
Hario, Pasi	University of Turku
Ijäs, Teemu	University of Helsinki
Kangas, Rami	University of Turku/Open University
Karilainen, Hanna	University of Turku/Helsinki Summer University
Karjalainen, Jonl	University of Turku
Kaukiainen, Kaisa	University of Helsinki
Koivistoinen, Juha	Lappeenranta University of Technology
Koljonen, Tiina	VTT
Koskinen, Otto	Lappeenranta University of Technology
Kostia, Kirsi	University of Turku
Kuitunen, Aino	Lappeenranta University of Technology
Kuusi, Osmo	Aalto University/University of Turku
Laurila, Tiina	University of Helsinki/Open University
Lindeman, Joonas	University of Helsinki
Mäkinen, Jussi	University of Oulu/Open University
Nikunlaakso, Risto	University of Turku/Helsinki Summer University
Ojansuu, Sirpa	University of Tampere/Summer University
Perjo, Laura	University of Turku
Poljatschenko, Victoria	University of Helsinki
Rahikka, Anne	University of Turku/Open University
Repo, Riina	University of Oulu
Salminen, Elina	Turku School of Economics
Salokangas, Heidi	Lappeenranta University of Technology
Salokoski, Pia	Tekes
Salovaara, Janne	University of Helsinki
Savola, Tuula	Tekes
Similä, Lassi	VTT Technical Research Centre of Finland Ltd
Sutela, Marja-Liisa	University of Oulu/Open University
Sutela, Panu	Aalto University
Tapiola, Titta	University of Turku
Tikkanen, Minna	University of Turku
Tommila, Paula	University of Turku/ Helsinki Summer University
Tuittila, Satu	University of Turku
Vainikka, Pasi	VTT Technical Research Centre of Finland Ltd
Vesiluoma, Sari	University of Turku/Tampere Summer University

APPENDIX 3. Cordeiro on singularity and artificial intelligence transforming humanity

This chapter presents the interview with José Cordeiro (JC) by project researcher Juho Ruotsalainen (JR) from the Neo-Carbon Energy project, Finland Futures Research Centre, on the occasion of a seminar "Energy Fair 2016" organised in Tampere on 25th October 2016 by Expomark Ltd. Neo-Carbon Energy project had its own event at the fair "Emission-Free Future – Now". José Cordeiro was one of the speakers at the event with the title "*Singularity: Machine and human become one. Energy is next in the line*". What follows is a slightly edited transcription of Cordeiro's interview.

JR: So, you are saying that humans will consume less energy in the future because of the increase in the energy efficiency?

JC: Actually, I believe the opposite. I believe we are going to consume much more energy, because we are going to do many more things. And also beyond planet Earth, we are going to colonize Mars, and we need plenty of energy. However, we will be much more efficient, so, compared to what we have now, we will use less energy, but, because we're doing many more things, we will be consuming a lot more energy, we will need to increase supply of energy.

JR: How should the surplus energy be used in your opinion? You have previously talked about space travel, but besides that?

JC: We don't know what we are going to do in 20 years. But I'll tell you what happened with the internet. When internet began, there was very limited broadband. And some people were saying "oh, because we have so little broadband, we have to be not only efficient but we have to stop the increase of broadband". Fortunately, we increased it by millions of times. And we do millions of things. And we have videos and teleconference and virtual reality (VR) now, on the internet. So, I don't know what will happen with energy but we will create new applications within twenty years that we cannot even foresee. I just mentioned space because it is very energy intensive to go to space. But here on planet Earth, maybe we will combat climate change, we will need energy to counteract some of the negative impacts of the climate change. And that could require 20-30 % more energy than we are producing today. And that's just one example. Energy will be required more for industrial developments, and we will have many more [industries] – maybe for 3D printing, new manufacturing capabilities, other types of food and agriculture.

JR: Do you have any personal favourites? About how it should be used?

JC: Well, we are going to live longer, and that is important, healthier lives. So, anything that has to do with health, education as well, because we will be in schools all of our lives. We will have to reinvent ourselves every twenty years. So, those are important sectors. But again, as of now, the sector that needs the most energy is the industrial sector. So that is my favourite because I believe we are going to have many more industries in the future, and they will require as much energy as today – they will be a big consumption factor. But again, exploration of space, we may need to double the energy just because to get off this planet. So we are talking about incredible amounts of new energy that we will require. But industry in general.

JR: Do you have any idea what the industries of the future could be? New ones, or the ones that could transform things?

JC: Well, new types of manufacturing, as I mentioned. We will go into nanotechnology, to create things at the atomic level, we will be 3D printing many other things. However, those might be very energy efficient. So, even biotechnology is in a way a natural nanotechnology, and it is highly efficient. Also our brains are incredibly efficient. Our brains only consume 30 watts (W) of power. And there are some projects to actually decrease by 90% the amount of energy that electronic equipment uses today. The fact that it will be possible is that our brain does it. If we build a computer today, almost equivalent to our brain, would require a nuclear plant to power it, because it would need a one gigawatt (GW) of power. So, our electronic industry is very energy inefficient, today.

JR: Okay, so the next question is about our biggest threats and issues to be solved. If we assume that the humanity reaches material and energy abundance, what would be in your opinion the biggest threats, and in general, problems to be solved, in, let's say, 2040?

JC: Well, artificial intelligence is improving very fast. In fact, in twenty or thirty years we might have artificial intelligence reaching human intelligence. That is called the singularity. Actually, I think it is an opportunity, not a threat, but some people are afraid of the technological singularity. I am not afraid, because how can we be afraid of more intelligence? We should be afraid of being more stupid. So the problem is not artificial intelligence, the problem is human stupidity. And human stupidity is natural. It is not artificial. We are naturally stupid. And this is my concern, because we will have such advanced technology that we may use it in bad ways, to destroy humanity. This is a possibility. I don't think it will happen because there are more good people than bad people in general, and we normally use technology for better, not bad things. But it is a possibility. Stephen Hawking and Elon Musk have been talking about the dangers of artificial intelligence, and that is why they are saying we need quickly to colonise Mars. We need to begin to move into Mars, to have, at least, a bi-planetary civilization. So that if we destroy civilization here on planet Earth, we can continue on Mars. Or maybe some other place in space. So these are real existential risks. But again, I think many of these ideas are self-fulfilling prophecies. And that is why I'm always optimistic. We need to think that we will survive, we will improve. If we think we will destroy ourselves, then sadly, that might happen too. In our mentalities, it is therefore important to be optimistic, and positively futuristic.

JR: So you're saying that we will augment ourselves with artificial intelligence?

JC: Yes. I think we will see soon the end of the human age. But that is also good, because it will be the beginning of the post-human age, of improved humans, of augmented humans, basically immortal humans. Incredibly intelligent humans. And I can see only good things coming from being more intelligent, not bad things.

JR: What about besides artificial intelligence? Do you see any other threats in the next twenty years?

JC: All technologies can be used for good and bad things. The problem is not technology. The problem is what humans do with those technologies. One of the first technologies humans used was fire. And fire can be used for food, to cook, to warm people, or to burn houses, or people, like some Christians used to do. Another religions too, not of course only Christians. Many are also worried about nanotechnology, because we could create something called the grey goo, small nanobots that could be eating everything.

So, the grey goo is a real possibility. Many science fiction novels have been written about the grey goo, and the threat of nanotechnology. But, once again, I think the biggest threat is artificial intelligence. For those who are afraid of it, I actually think it will be the biggest opportunity to transform humanity, in a positive way. But, it could be bad. So we need to be aware of that possibility. It is the Terminator scenario, the Skynet becoming bad and trying to destroy humanity.

JR: Do you have any other personal interests besides artificial intelligence and energy technologies?

JC: Well, sure. I consider myself a futurist, a transhumanist, a singularitarian, and an immortalist, and a cryonisist. I believe that in the next twenty or thirty years we will be able to cure aging. We consider that aging is a disease, but a curable disease. However, in the next twenty to thirty years, people will still die. And the only way to keep those people is to cryopreserve them, and in no more than forty years we should be able to reanimate those people. So I'm very fascinated by that idea. I am actually creating a foundation in Spain to cryopreserve people. We have already frozen our first Spanish brain, a few months ago. And this is only beginning. Actually tomorrow I will meet also with the Finnish cryonisists. We have groups all over the world, and here in Finland as well. So this is one of the most interesting things, because the future will be science fiction, magical, in a way. And I want to see it, and I want everybody to have the opportunity. But if you happen to die, in ten years, twenty years, maybe up to thirty years, the only way for you to be brought back to life is to cryopreserve you.

JR: Are there any other clinics besides Spain or perhaps Silicon Valley that freeze brains, or..?

JC: Right now there are three major cryopreserving facilities, two are in the US and one is in Russia, outside Moscow. Actually I was there just two weeks ago. They have about 50 humans frozen, and about 100 animals. People also freeze their pets, so that they can bring them back in the future. So, this is a fascinating idea, because I think we will cure aging, and we are going to have very long and productive lives in the future. We will move to the economics of abundance from the economics of scarcity.

JR: How do you see values, and culture, and lifestyles by 2040? What do you see as the biggest changes in values and cultures by then?

JC: In 2040 we will probably still be in the human age. I talk about post-human age after the singularity. And normally we think that the singularity will be in the year 2045. Even though, by 2029, we expect to pass the Alan Turing test, which means that you will not know if you are talking to a human or artificial intelligence. But, at the latest by 2045 we will reach the singularity and the beginning of the post-human age. However, you talked about 2040, it would still be the human age. I mentioned we are going to have much longer lives, maybe not indefinite lifespans, but we will probably be living a hundred years, so we will be productive in many ways, also, that is why education is important. We will need to re-invent ourselves every ten to twenty years. We will also need to keep ourselves in good physical shape. So that is why I mentioned two of the biggest sectors in the future will be health, or medicine, and education, and training. They will be big, because we will need to reinvent ourselves and we will be living longer, and longer, and longer. The world of the future will be very technologically advanced, and we will have things like in a parallel world with virtual reality and augmented reality, as well.

JR: So you think that change and adaptability will be the kind of core values in the future?

JC: Yes, as the Greeks used to say, the only constant is change. This is happening faster and faster. We are living in exponential times. So I like to say that in the next twenty years we will see more changes

than in the last two thousand years. And most of the changes will be positive. And people need to understand these are good things. We transform humanity, and we want to do it for positive, not for negative outcomes.

JR: You mentioned virtual reality and augmented reality. Do you have any visions on them?

JC: We will probably be creating a parallel economy, and a parallel world, maybe as large as the real world, and maybe even larger. It could be two, three, four parallel worlds of incredible opportunities. Things we yet cannot do in the physical world, but we can do in these artificial worlds. They will let us experience many things, including being in different countries and planets. So I think it's going to be very positive also to put yourself in the circumstances of another person, of another culture. We will create more empathy in the planet. Also a lot of gaming. Gaming is important for learning. So gaming and artificial reality could be fantastic. Medical doctors, they will be doing their medical training in augmented reality.

JR: How do you see the impacts of artificial intelligence on society, outside the sphere of economy and production, and, let's say, healthcare?

JC: One of the two most recent practical examples of artificial intelligence are Watson, by IBM. Watson was created to do many things that humans cannot do, or improve them. For example, Doctor Watson will be a medical doctor that will have all the medical knowledge of the world, in real time. It will read all the publications that no human can do. It will also have your genome and the genome of other people. So the best medical doctor will be Doctor Watson, artificial intelligence. Actually, in terms of medicine, now we have big data, because after sequencing the human genome, which is 3 gigabytes (GB) of data per person, we can make medicine preventive. Not curative, but preventive. But this implies analysing big data. Humans cannot do that. Our brains are very limited, our work capabilities are very limited. But artificial intelligence will let us use big data in many ways that we cannot even imagine. So artificial intelligence will help us in all fields of human knowledge, from medicine to education to industry, finance, better systems to forecast economic developments, and actually to suggest development strategies that we cannot understand yet. And because we will have many more sensors there will be, by 2020, Cisco talks that there are going to be 20 billion sensors, and then it will be 50 billion, 100 billion [sensors]. So every human will have different sensors, and they will monitor our bodies, activities, the environment, the things we want to know about, care about, and that we can change. So, this is radical, and artificial intelligence can do that. We humans have limited brains, we cannot do that on our own.

JR: So you see the combination of artificial intelligence and big data as very disruptive.

JC: Yes, completely disruptive. And again, we have limited brains, and therefore we need to augment our brains. As Google says, they want to be the third part of your brain. So, imagine, and then it's going to be the fourth half, and the fifth half. So, people talk about exocortex. The brain has traditionally three parts, the reptilian brain, the limbic brain, and the neocortex. So now some people are talking about an exocortex, we will be able to connect our brains to this global brain, to the planetary internet. That will be a fourth part of our brain, that will connect all humans and that will make us incredibly more intelligent. The exocortex, or as Google says, actually this was mentioned by Sergey Brin, the co-founder of Google, that they want to be the third half of your brain. A very powerful idea, and also it will be much faster because we are very slow. Our brain computes in ten hertz, electronics compute in gigahertz.

JR: Ok. Many thanks for the interview!

RECENT FFRC eBOOKS

1/2017 Hario, Pasi – Parkkinen, Marjukka – Siivonen, Katriina & Tuittila, Satu: Historian museo Turkuun. Osallisuusverstasprosessin tulokset.

12/2016 Heinonen, Sirkka – Karjalainen, Joni – Helle, Aino & Nisula, Sakari: Argentinian Energy Landscapes. Case Study of the Neo-Carbon Energy Project.

11/2016 Ruotsalainen, Juho – Heinonen, Sirkka – Karjalainen, Joni – Parkkinen, Marjukka – Laurén Leena-Maija & Salminen Hazel: The Fuzzy Futures of Neo-Carbon Work. Neo-Carbon Futures Clinique II.

10/2016 Apostol, Oana: Sustainability Best Practices. Benchmarking Results of the SUSTIS Project.

9/2016 Heikkilä, Katariina: Perspectives to Sustainability In The Shipbuilding Network. Interview Results of the SUSTIS Project.

8/2016 Kurki, Sofi – Pura, Minna & Wilenius, Markku: RE-acting the Future. New Ways to Work: The Case of Reaktor.

7/2016 Ruotsalainen, Juho & Heinonen, Sirkka: Intiimi journalismi. Diginatiivit mediat tulevaisuuden journalismin edelläkävijöinä.

6/2016 Höyssä, Maria – Aalto, Hanna-Kaisa – Kurki, Sofi – Minkkinen, Matti – Siivonen, Katriina – Tapio, Petri – Wilenius, Markku & Arvonen, Anne (eds.) Coolest Student Papers at Finland Futures Research Centre 2015–2016. Tulevaisuuden tutkimuskeskuksen valittuja opiskelijatöitä 2015–2016.

5/2016 Hietanen, Olli & Saarimaa, Riikka: VOIMAKAS – elinvoimaa puutarhasektorin uudistumiseen ja kasvuun -tulevaisuusverstaiden tulokset.

4/2016 Ahokas, Ira – Ahvenainen, Marko – Pohjolainen, Pasi & Kuhmonen, Tuomas: Proteiini-kysymys ja sen ratkaisumahdollisuudet Suomessa. Systeeminen tarkastelu sekä kirjallisuuskatsaus järjestelmän nykytilasta ja muutospoluista.

3/2016 Heinonen, Sirkka – Leponiemi Lauri & Parkkinen Marjukka: Futuristiset rakennukset metaforisina viesteinä. Rakennetun kaupunkikuvan tulkintaa tulevaisuusperspektiivistä.

2/2016 Nygrén, Nina A.: Järvien hoito ja kunnostus 2030. Tulevaisuusverstaiden tulokset.

FFRC eBOOK 2/2017

Sirkka Heinonen, Joni Karjalainen, Marjukka Parkkinen & Juho Ruotsalainen

CLEAN DISRUPTION FOR ABUNDANT FUTURES
Neo-Carbon Energy Futures Clinique III

ISBN 978-952-249-474-0
ISSN 1797-1322

FINLAND FUTURES RESEARCH CENTRE

Turun yliopisto
University of Turku