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Sofia Zavialova with Sofi Kurki, Leena-Maija Laurén, Hazel Salminen & Amos Taylor

SURPRISING ENERGY FUTURES

Neo-Carbon Energy Futures Clinique V

FINLAND FUTURES RESEARCH CENTRE
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NEO CARBON ENERGY

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The cover photo by Sirkka Heinonen, stranded in a foresight seminar in Bucharest, Romania, due to the black swan of the eruption and ash cloud of Eyjafjallajökull cancelling all the flights over Europe in 2010.

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“Quand il est urgent, c’est déjà trop tard”

Charles Maurice de Talleyrand (1754–1838)

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PREFACE

The future has seldom or maybe never been more insecure on a global scale than today. Climate change is proceeding at an alarming pace transforming the world from relatively stable holocene period to unknown anthropocene, in which the conditions will differ significantly from what we have been used to. Mark Lynas, in his book Six degrees, describes what kind of conditions there has been earlier when the average temperature has been 1–6C degrees warmer than today. At four degrees, for example, there was no ice at either pole. This meant that the sea level was tens of metres higher. Conditions for food production would be significantly worse due to droughts and intense storms and rainfalls. Combining this to fast population growth will mean huge challenges, bigger than ever seen in the history of humankind.

On the other side, the solutions to mitigate climate change are also developing rapidly. Solar power has become cheaper than coal power in large regions. In May 2017, for example India cancelled plans to build nearly 14 gigawatts of coal-fired power stations – almost as much as the peak electricity usage of Finland – with the price for solar electricity "free falling" to levels once considered impossible.

Despite these positive news, it is still unknown whether we could mitigate the climate change under +2C degrees. It would mean roughly decreasing CO_2 emissions into half three times during the next 30 years. But when the consequences of climate change will be stronger and stronger year after year, also the solutions will be implemented quicker.

In any case there will be massive changes on how the society will function in the future. This report will illustrate some them. Please enjoy.

Helsinki 30th June 2017

Jouni Keronen
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ABSTRACT

This report describes the process and results of futures clinique *Surprising Energy Futures: Anticipating Discontinuities and Testing Resilience of Renewable Energy World with Black Swans,* held on 17 May 2017 at Sitra, Helsinki. The event was the fifth futures clinique within the foresight part of the research project *Neo-Carbon Enabling Neo-Growth Society – Transformative Scenarios 2050,* conducted by Finland Futures Research Centre. The aim of the event was to contribute to the four transformative societal scenarios of Neo-Carbon Energy project. The event consisted of presentations and intermittent working sessions. Dr. Karlheinz Steinmüller discussed the topic of Black Swans and VUCA World, with comments by Prof. Jarno Limnéll.

During the working sessions seven groups co-creatively identified discontinuities and their impacts by utilising different foresight methods. Black swans and wild cards – unexpected events with dramatic impacts – were utilised to test the resilience of the renewable energy world. Each group concentrated on a specific topic, through which the uncertain and discontinuous aspects of societal development were observed. The topics were: 1) Politics: nation-states, governments, geopolitics, new ideologies, 2) Corporations and economy, 3) Civil society & peer-to-peer practices, 4) Robotisation & artificial intelligence (AI) and 5) New lifestyles.

The results of the futures clinique anticipate deep and cross-sectoral changes to emerge especially from the following six areas: i) new risks, ii) converging technologies, iii) value changes, iv) environmental economy, v) changes in big companies and vi) geopolitical changes.

EXECUTIVE SUMMARY

In this report, we describe the process, discussion and results of *Surprising Energy Futures: Testing Resilience of Renewable Energy World with Black Swans,* the fifth Futures Clinique within the Neo-Carbon Energy research project held on 17 May 2017 at Sitra, Helsinki. As a whole, the aim of the Futures Clinique, a distinct workshop method that addresses future-related issues, was to investigate the role of the uncertain and discontinuous aspects of societal development. Neo-Carbon Energy (2014–2017) as a joint research project of three Finnish research bodies (VTT, FFRC, LUT), investigates a totally emission-free energy system by 2050. In such a world, energy would be produced mainly by solar and wind, distributed and managed by smart grids, and excess electricity converted into synthetic end products.

The future cannot be anticipated in a linear way. Discontinuities, disruptions, and even surprises are the building blocks of the future world. For example, only few could imagine how solar photovoltaics emerge as a competitive energy choice or how autonomous vehicles are expected to transform transport systems. Analysing the changes of the next decades is challenging in a world, which is ***Volatile, Uncertain, Complex and Ambiguous – it is "VUCA"***. Emerging issues and weak signals, poorly conceptualised in the present, can co-evolve, strengthen and interact as discontinuities, to manifest as disruptions or black swans, unexpected events that are difficult to anticipate. At the same time, aspirations for good life are shaped by ***changes in society and values***. While not everything will change, it is important to navigate amongst this "unpredictable instability".

In the Futures Clinique, 39 participants in seven groups investigated ***discontinuities as long-term change processes, consisting of different interlinked trends***, and how they shape energy transformation to a future renewable energy based world. The groups represented five broad themes: 1) Politics: nation-states, governments, geopolitics, new ideologies; 2) Corporations and economy; 3) Civil society & peer-to-peer practices; 4) Robotisation & artificial intelligence (AI); and 5) New lifestyles. The participants explored how their theme is changing – emerging issues, novel characteristics and dimensions – as well as potential future discontinuities, black swans and their implications.

The Futures Clinique workgroup results anticipate deep and cross-sectoral changes to emerge especially from the following six specific areas:

1. ***New risks.*** As the world changes, new risks emerge, and oftentimes we do not know how to deal with them. Old identities are contested, new kinds of inequalities are emerging. Amidst turmoil, we seek for sources of trust – from 'the new' and 'the old'.
2. ***Converging technologies***. Just think of the non-linearities of a human-machine interface with "biochemical robots" in our bodies, in a world of "Internet of Everything" (IoE), electric vehicles, 3D printing, and autonomous transportation in a circular economy.

3. ***Value changes.*** The rupture of hierarchies could change the world, make cultures more pluralistic, and more prone to change. Value changes are also connected to identities and how we perceive our place in the world, and where we seek meaning from.
4. ***Environmental economy.*** Running an economy sustainably as an immensely complex task is an enormous opportunity. Emerging economies – including in Africa – could prosper in unprecedented ways, with new energy technologies, harvesting energy everywhere.
5. ***Transforming large companies.*** When the vast resources of companies are put to good use, this may drive positive change. But the concentration of corporate power is always risky. Can their benevolence be guaranteed, and if not – what then to be transformed?
6. ***Geopolitical changes.*** If 'the West' decreases in significance in world politics, and China and emerging economies gain power, what would be the guiding values of a post-Western world? And, what types of broader, cultural changes would this imply?

In a future renewable energy system, future technologies will use energy harnessed with renewables, and renewables will use future technologies. Energy security of a renewable energy world may be more resilient, and constructed differently from today's fossil fuel based world.

The Futures Clinique findings imply further considerations for thinking about the future in a renewable energy society. In a complex world, anticipating discontinuities of possible transformations can make future scenarios more resilient. As one further step, we suggest to ***think of several discontinuities together, and their possible joint effects***. This could provoke more profound transformative thinking about discontinuities, typically ill-conceptualised in the present. It could also allow asking more ***critical questions about how desirable futures can be reached***. As a whole, this report encourages thinking of understanding and evaluating these cross-impacts. This can provide rich and holistic conceptualisations about futures, as well as non-linear future change.

1. INTRODUCTION

The world is a complex system of interconnected subsystems, where change occurs in various forms and different speed. The future ahead of us is often anticipated through continuous trends – things and events that exist today and are familiar to us. However, what makes future really a future, are the things and phenomena that are new – things that break the conventional and linear development paths. Furthermore, it is exactly the unexpected and surprising events that may have the biggest impact on the society. Thus, discussing and exploring discontinuities, risks and unexpected events and their impacts on the society is a necessary effort in order to better tackle the complexity.

This report describes the process and results of futures clinique *Surprising Energy Futures: Anticipating Discontinuities and Testing Resilience of Renewable Energy World with Black Swans,* held on 17 May 2017 at Sitra, Helsinki. The event was the fifth futures clinique within the foresight part of the research project *Neo-Carbon Enabling Neo-Growth Society – Transformative Scenarios 2050,* conducted by Finland Futures Research Centre (FFRC), University of Turku. The purpose of the event was to collaboratively discuss discontinuities, risks and unexpected events, such as black swans, in a society based on renewable energy. The event contributed to the four transformative societal scenarios of Neo-Carbon Energy project (Heinonen et al. 2016b).

The event consisted of presentations and intermittent working session. Paula Laine (Sitra) opened the event with insights on Nordic megatrends. Prof. Sirkka Heinonen and project researcher Juho Ruotsalainen introduced and discussed the topic and rationale of tapping into surprising energy futures. Dr. Karlheinz Steinmüller continued with his keynote presentation on the topic of Black Swans and VUCA World, with comments by Prof. Jarno Limnéll following. During the working sessions 39 participants in seven groups co-creatively identified discontinuities and their impacts by utilising different foresight methods. Black swans and wild cards – unexpected events with dramatic impacts – were utilised to test the resilience of the renewable energy world. Each group concentrated on a specific topic, through which the uncertain and discontinuous aspects of societal development were observed. The topics were: 1. Politics: nation-states, governments, geopolitics, new ideologies, 2. Corporations and economy, 3. Civil society & peer-to-peer practices, 4. Robotisation & artificial intelligence (AI) and 5. New lifestyles.

The Neo-Carbon Energy research project as well as the topic of surprising energy futures are described in the following. The methods and core concepts utilised in the intermittent working session are illustrated in Chapter 2. The aforementioned four presentations are summarised in Chapter 3. In Chapter 4 the results of the seven groups are provided. These results were elaborated on the following day in a Post

Black Cross Impact Analysis Workshop[1], the results of which are illustrated in Chapter 5. Conclusions are provided in Chapter 6. The programme of the event is featured in Appendix 1, and Appendix 2 presents the participants of the event. The background material sent to the participants is documented in Appendix 3. Appendix 4 presents further insights by Karlheinz Steinmüller, based on an interview by Sirkka Heinonen after the futures cliniques. The raw material from the futures clinique is provided in Appendix 5. Finally, Appendix 6 provides highlights of presentations related to Neo-Carbon Energy project from Finland Futures Research Centre's international conference *Futures of a Complex World,* held in Turku, June 2017.

Sofi Kurki, Leena-Maija Laurén, Hazel Salminen and Amos Taylor provided their valuable contribution to the process and the report by moderating at the futures clinique and writing the results of their working groups. The Neo-Carbon Energy research team also greatly appreciates the input from all the participants at the futures clinique.

1.1 Neo-Carbon Energy project

Neo-Carbon Energy (2014–2017) 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 project studies a totally emission-free energy system by 2050. In such a world, energy would be produced mainly by solar and wind and distributed and managed by smart grids. The aim of the project is to study and develop a neo-carbon energy system that is entirely based on renewable energy, with hydrocarbon storages and new ways of replacing hydrocarbon-based production of fuel, liquids, and chemicals. Excess electricity from renewables would be converted into synthetic materials, chemicals and fuels.

The foresight part of the project anticipates socio-economic implications of this kind of a new energy system. The concept of neo-carbon energy builds on the work of Pentti Malaska. With his concept of neo-growth he refers to growth that is based on services, immaterial growth and smart use of resources. (Malaska 2010.) As the proposed, distributed system would provide energy at low costs, it would promote a peer-to-peer society of grassroots organisations. Accordingly, the premises of the foresight part are the following: 1) the energy system will be distributed (at least to some extent), and consumers will become energy producers (so-called prosumers), 2) the marginal costs of energy will fall, and consequently so will the costs of production and living, 3) the amount of available energy will increase, and 4) an efficient circular economy will emerge so that the system is sustainable also material-wise. Together these changes are anticipated to promote a peer-to-peer society, in which citizens, their communities and related networks have a much bigger role than today. The societal aspects of the energy transition are studied and mapped

[1] This was a brainstorming workshop where a methodological experiment was made on the feasibility of "Post Black Swans Cross Impact Analysis".

out through four transformational scenarios based on renewables-powered peer-to-peer society in 2050 (for the working paper of the scenario drafts, see Heinonen et al. 2016b).

The foresight part of the project is conducted by Finland Futures Research Centre (FFRC), University of Turku, and directed by Prof. Sirkka Heinonen. The research team at FFRC includes project researchers Joni Karjalainen, Marjukka Parkkinen and Juho Ruotsalainen, with research support from Leena-Maija Laurén and Hazel Salminen especially in the organising and conducting of futures cliniques. Research interns Nick Balcom Raleigh (2015), Merja Lang (2016), Sakari Nisula (2016) and Sofia Zavialova (2017) have contributed to the foresight part. The whole Neo-Carbon Energy project is conducted in co-operation with VTT (co-ordinator) and LUT. A key method in anticipating the possible socio-economic consequences and prerequisites of the neo-carbon energy system has been participatory futures workshops or *Futures Cliniques.* In a series of five futures clinique (2015–2017) participants from different backgrounds – project members, government, business and third sector representatives as well as students – have gathered together to examine the changing energy world and the renewable energy system. The results of each clinique have contributed to the four societal Neo-Carbon Energy scenarios. The four first cliniques are briefly described in the following. The premises and the topic of the fifth clinique – that this report also addresses – is described in Chapter 1.2. The bibliographical information for each of the five cliniques is provided in Table 1.

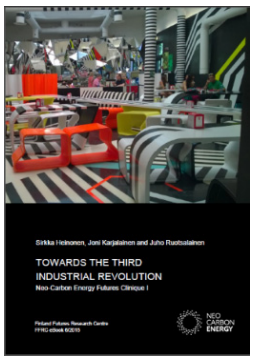
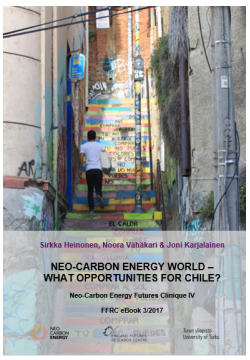
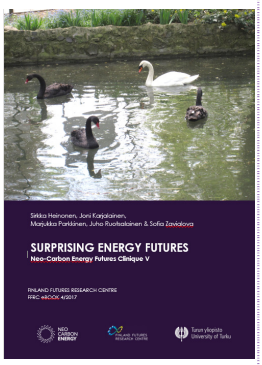
The first Neo-Carbon Energy Futures Clinique – *Creating the Third Industrial Revolution* – was arranged at Sitra May 6 2015. Around 70 experts participated in the event, working around the four tentative scenario sketches. The sketches were analysed on a general level and especially with regard to implications for Finland. Several pathways and factors that may drive a third industrial revolution and the realisation of the neo-carbon energy system were identified. The theme of work was raised during brainstorming as an important issue to be dealt with in more detail (see Heinonen et al. 2015).

Thus the **second Futures Clinique, *Fuzzy Futures of Neo-Carbon Work*** addressed the futures of work of different communities envisioned in the Neo-Carbon scenarios. The event was held at Hotel President in Helsinki 13th of April 2016. The Future of Work/Technology 2050 scenarios of the Millennium Project were used as background material for the event. The results were summarised and refined into seven categories, each providing different aspects of the possible futures of peer-to-peer work. (Heinonen et al. 2016b)

Clean Disruption for Abundant Futures was an international symposium organised as futures clinique of the Neo-Carbon Energy project, 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 constituted the **third clinique** of the foresight part of the project. It 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. (Heinonen et al. 2016b.)

The **fourth futures clinique, *Neo-Carbon Energy World - What Opportunities for Chile?*** was a bilingual event organised together with Consejo Chileno de Prospectiva y Estrategia (CChPE) and held at the premises of Instituto Nacional de Propiedad Industrial (INAPI) in the centre of Santiago. The aim was to explore what kinds of changes renewable energy transition might have for different countries and how these countries should prepare for such developments, in this case Chile. We are interested in understanding what opportunities could emerge for societies all around the world, based on their own strengths, needs and capabilities, including opportunities for novel type of growth – neo-growth – in line with sustainability and ecological thresholds. Chile has been considered a pioneer within the entire Latin America, as the country has enjoyed steady socio-economic development for the recent decades.

Table 1. *The five futures cliniques held in the foresight part of the Neo-Carbon Energy research project.*

Futures Clinique I: *Creating the Third Industrial Revolution* May 2015	**Futures Clinique II:** *Fuzzy Futures of Neo-Carbon Work* April 2016	**Futures Clinique III:** *Clean Disruption for Abundant Futures* June 2016	**Futures Clinique IV:** *Neo-Carbon Energy World – What Opportunities for Chile?* October 2016	**Futures Clinique V:** *Surprising Energy Futures* May 2017
				
Heinonen et al. 2015	Ruotsalainen et al. 2016	Heinonen et al. 2016	Heinonen et al. 2017	Heinonen et al. 2017
The four tentative scenario sketches were analysed on a general level in this opening clinique. Pathways and factors that drive the third industrial revolution and the realisation of the neo-carbon energy system were identified.	The second clinique addressed the futures of work in different communities of the four scenarios. The results were summarised into seven categories, each providing different aspects of the possible futures of peer-to-peer work.	The two-day futures clinique focused on the topics of energy, internet, clean disruption and futures of communities. The objective was to address possible futures and societal transition towards the convergence of energy and internet.	In this fourth futures Clinique the relevance and opportunities of the energy transformation with renewable energy in Chile were analysed. The four scenarios were reviewed as reflected on Chilean geographical and industrial context.	Discontinuities and black swans – surprising events with large impacts – were identified, discussed and evaluated within five sectors considered relevant for the futures of renewable energy.

1.2 Anticipating Discontinuities and Testing the Resilience of Renewable Energy World with Black Swans

In the **fifth futures clinique** of Neo-Carbon Energy project discontinuities and surprising events with large impacts were discussed and evaluated within the five sectors considered relevant for the futures of renewable energy. These themes and their importance to the topic are briefly described in the following.

Theme 1: Politics: Nation-states, Governments, Geopolitics, New Ideologies

The sovereign nation-state refuses to die. For the liberals, national identities are eroding, but novel identities have not yet taken root. For the conservative-minded, a multipolar world invites authoritarianism. Unsolved inequalities uphold tensions, migration pressures and "neo-nationalism".

Decentralised renewable energy invites new geopolitical considerations and strategic interests, as solar or wind are differently located from fossil fuel resources. To ensure energy security, countries' can produce or import renewables. They trade electricity and synthetic natural gas. Novel alliances may be formed. Certain countries refuse to collaborate, as history and deep ideological differences with neighbours uphold mistrust. If diplomacy ends, cyber and information warfare and faceless drones are used. Hackers, consciously off-the-grid, ensure privacy with blockchain technology.

Some incumbents may see their power wither away. Carbon bubble, over time, may become a genuine political and economic risk. Energy transition forerunners could make economic gains, if they converge energy with other key technologies in an 'ecologically smart world'. They might be assumed to enjoy a hegemonic position from a techno-cultural stance in 2050 and exercise "soft power".

Theme 2: Corporations and Economy

In a possible future companies are not needed at all, or they would have a smaller role than today. People would sell their workforce directly, or through different platform companies. Another possibility is that instead of paid work, production would be done in different communities producing societal value, and income would be obtained, at least in part, through a universal income.

Companies will, however, probably still have a role in 2050. The human and economic capital accumulated in companies over time could be difficult to replace by constantly changing and loose networks of individuals. In the societal scenarios of the Neo-Carbon project the future of companies is anticipated as 1) grassroots startups resembling peer communities and 2) technology giants which akin to cities or even states in terms of size and power.

Theme 3: Civil Society & Peer-to-peer Practices

In a possible future the civil society arises in a dominant position over traditional institutions and organisations. In this kind of a peer-to-peer world citizens self-organise and produce things and value with each other. Sharing economy, open source programming, social media platforms and for instance the Restaurant Day (Ravintolapäivä) are present weak signals of such future.

Current peer-to-peer practices have been empowered especially by the internet, which has made communication and organisation much easier and cheaper than before. In the future, peer-practices could be strengthened for instance by renewable, decentralised energy, 3D-printing and other digital manufacturing technologies, and automation (which could increase the leisure time that could then be used for other activities than paid labor). Peer-to-peer practices often rely on commons which are shared resources and end-products that are free to use within agreed rules. Wikipedia is perhaps the best known commons of today.

Theme 4: Robotisation & Artificial Intelligence (AI)

According to the One Hundred Year Study on Artificial Intelligence by the Stanford University, by 2030 artificial intelligence will change first especially transportation, home/service robots, healthcare, education, low-resource communities, public safety and security, employment and workplace, and entertainment.

The former editor of the Wired magazine Kevin Kelly believes that instead of centralised "Mega AIs", in the near future our environment will be embedded with "lesser" AIs that concentrate on a single task. AIs with machine learning capabilities, in turn, are not tied performing pre-programmed tasks. They interact with their environment, adjust to changing situations, and act more or less independently.

Probably both forms – narrow and general – of artificial intelligence will be used in the future, and they will have deep impacts on how societies function and people live their lives, as well as a source of new progress. Artificial intelligences could also consume a major part of the energy humanity produces.

Theme 5: New Lifestyles

In a global world of constant and ubiquitous communication, cultures and lifestyles change and evolve swiftly and constantly. The possible lifestyles and values of the future are virtually endless. It is therefore difficult to anticipate how culture and lifestyles will look like in 2050.

Because of the ambiguous nature of their change, culture and lifestyles include many possibilities for deep discontinuities. They are of crucial importance for the futures of societies because in the end it is the values of individuals, groups and nations that determine the paths of development.

For instance, the discussion on “post-truth” implies a shattered future culture where each “tribe” would have their own notions of truth. On the other hand, new communication technologies offer a possibility of border-crossing discussion and reaching new opportunities of consensus.

2. METHODS AND CONCEPTS

2.1 Futures Clinique

Participation has become an important characteristic of foresight (van der Helm 2007). Futures workshop is a widely used method in the field of futures studies. It was originally developed by Robert Jungk (Jungk & Müllert 1987; Nurmela 2013). Futures workshops gather participants – business representatives, researchers, citizens, students, non-governmental organisations (NGOs) et cetera – to work together in small groups to anticipate possible, probable and preferred futures of a selected topic (Nurmela 2013). The original aim of the method was to give voice for those who ought to be involved when making decisions about the futures but who were not necessarily heard. Instead of dividing people in those who decide and those who are decided for, the future and the right to plan it were considered to belong to everyone willing to participate. (Jungk & Müllert 1987.)

Futures Clinique is a distinctive futures workshop created by Sirkka Heinonen and further developed with her research team at the Finland Futures Research Centre (FFRC), University of Turku (Heinonen & Ruotsalainen 2013). As a method, Futures Clinique is designed to answer the challenges posed by the world that is in a state of constant change, with bottom-up initiatives (Heinonen & Ruotsalainen 2013). The main distinction to other futures workshops is that Futures Clinique is especially designed to anticipate and create radical and transformative futures – futures that differ significantly from the present moment. To anticipate such radical and transformative futures, the method places a strong emphasis on weak signals – new phenomena and issues that are more or less marginal, but can strengthen in the future.

Futures Clinique consists of three interconnected phases. In the first phase, background research is conducted, and weak signals related to the topic are scanned and analysed. These results are used in the actual session, as the results of the background research are written as an orienting material and sent to participants before the workshop. The second phase is the customised face-to-face sessions in break-out groups to explore possible futures around a specific topic (e.g. futures of energy, construction, media, cities, or work). The actual workshop part of this fifth clinique was launched with a Futures Provocation, a presentation to summon up (Lat. pro + vocare, call forth) new ideas and boldly creative futures thinking. In the very beginning of the futures clinique and during the breaks, a Futures Window was shown. Futures Window is a visual presentation of weak signals for possible futures, accompanied by background music (see Hiltunen & Heinonen 2012).[2] The aim of futures window is to develop the viewers' futures

[2] In this futures Clinique, the Futures Window was displayed without any music. It was shown in the beginning when the participants were entering the venue for registration, as well as in the working sessions as background visual stimuli.

consciousness, by opening up innovative futures thinking through visual stimuli. Viewing the futures window helps to move towards experiencing the futures, even immersing in possible futures (future images). As a third and the final step for the Futures Clinique, the whole aforementioned process is documented carefully in a final report – such as the one you currently hold in your hands – with all the material elaborated and discussed in a wider framework

2.2 Black Swans and Discontinuities

The concept of black swan refers to an event that is highly improbable and difficult to anticipate, and which has dramatic global impacts if realised. According to Nassim Nicolas Taleb's (2007) definition, black swans cannot be foreseen. Taleb claims, that black swans are an explanation to almost every significant in our world. Black swans, wild cards and X-events (a concept by Casti 2012) are used almost synonymously to refer to sudden, surprising, unanticipated events with broad and radical consequences (Heinonen 2013; Heinonen & Ruotsalainen 2011). 9/11 attacks and the fall of the Berlin Wall are often used as examples. Black swans, together with weak signals, are the most debated development paths within futures studies. Whereas there may be a lot of information available about the common trends, it is more difficult to foresee the unexpected developments (Steinmüller 2007, 22–23).

Casti (2017) criticizes the non-professional "trend following" because it is based on continuities. A more relevant question concerning the trends is how long they are going to last, how they are going to end and what will replace them. Trend following has zero information content. Instead, Casti focuses our attention on critical points a, b and c where the current trend is flipping to its opposite. These points are motored by extreme events i.e. X-events that have a dramatic impact, usually negative impacts, e.g. loss of life, loss of money, loss of emotional security, lots of things we value and and prefer to preserve. Casti calls extreme events as drivers of human progress. In the short term they are considered mostly negative and problematic, whereas in the long-term they are opportunities - clearing out existing structures that are no longer serving a useful purpose (Casti 2012). Taleb (2007) likewise points out that a black swan can be either negative or positive by its impacts.

Black swans are rather "unpractical" as they are by definition very difficult to anticipate. Thus, discontinuities were also analysed at the futures clinique. Discontinuities are not as sudden as black swans, but instead gradual, long-term and deep processes of change consisting of different interlinking trends and weak signals (or completely new phenomena). Because of complex interconnections and apparent insignificance, discontinuities may easily be ignored. (Grossmann 2007; Drucker 1968.) Indeed, discontinuity is a feature of complex systems (Cilliers & Nicolescu 2012). If the world becomes complex in an increasing manner, for instance because of interconnectedness of nations, so too would discontinuities increase, making the world more volatile.

3. PRESENTATIONS

3.1 Opening Words by Paula Laine

The event was opened by Paula Laine, the Director of Foresight, Insight and Strategy at Sitra. Laine emphasised the importance of foresight and sustainable development. Laine noted that the five themes guiding the work in the futures clinique reflected well the annually published list of megatrends by Sitra. The 2017 report focuses on the implications of megatrends pertinent to three key areas relevant for Nordic countries: questions of work and income, democracy and inclusion as well as economic growth.[3]

Figure 1. *Paula Laine discussed Nordic megatrends and the importance of foresight. Photo: Hazel Salminen.*

The Neo-Carbon Energy research team appreciates Sitra's interlinkages to the project through the foresight perspectives given by Laine, as well as through the support of the Carbon-neutral Circular Economy programme, providing the venue for the futures clinique and Liisa Lahti's input in co-organising the event.

[3] https://www.sitra.fi/en/topics/megatrends/

3.2 Futures Provocation for Suprising Energy Futures

This is a futures provocation as an element of our futures clinique, presented by Sirkka Heinonen and Juho Ruotsalainen, where the participants are encouraged to open up their future perspective and approach out-of-box thinking. Surprising energy futures can be identified by anticipating discontinuities and testing the resilience of renewable energy world with black swans as the main aim of the futures clinique.

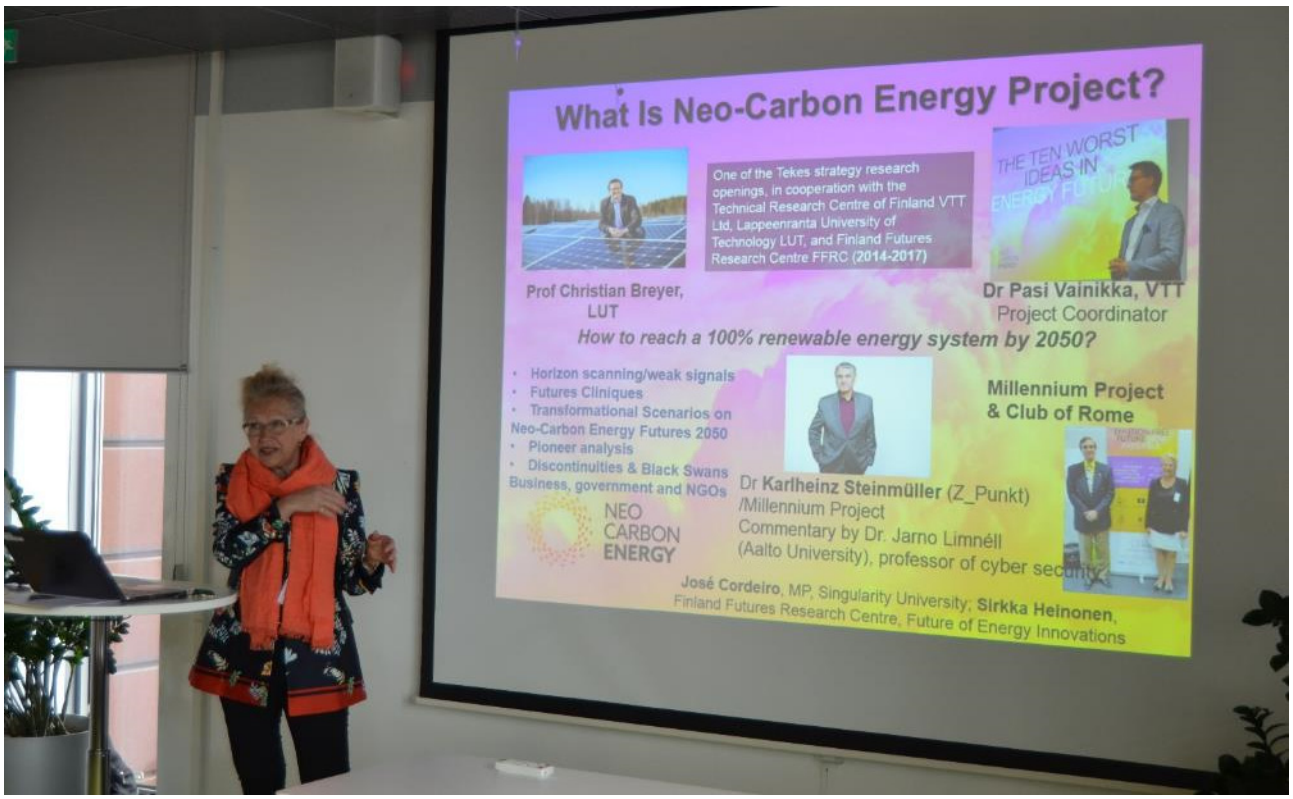


Figure 2. *Sirkka Heinonen began the presentation by introducing the Neo-Carbon Energy project. Photo: Hazel Salminen.*

The key research question in the Neo-Carbon Energy project, earlier presented in chapter 1.1, is how to reach almost 100% renewable energy system by 2050. Several methods are used in this foresight part of the Neo-Carbon Energy project. It started with horizon scanning, with focus especially on weak signals, and continued by constructing radical and transformational scenarios. These scenarios have been reflected to different case countries, with an objective of trying to find pioneers that might represent actors of the four scenarios (Lang et al 2016; Heinonen et al 2017). Within this framework, a series of futures cliniques is conducted. Today, this event on "Surprising Energy Futures" is concentrated on identifying discontinuities instead of linearities. The key focus is on discontinuities and sudden surprises, wild cards and black swans.

The event is organised in cooperation with two leading international global think tanks, the Millennium Project (MP) and the Club of Rome. The Club of Rome recently organised a conference in Brussels addressing the implementation of Agenda 2030 where renewable energy is in a central role. This

futures clinique has as keynote speaker Dr. Karlheinz Steinmüller, who is also a representative of the German Node of the Millennium Project.

In a nutshell, neo-carbonisation and neo-carbon energy refer to a future, where everything is produced with an emission-free system, based on solar, wind and other renewable energy; and energy is stored in batteries or synthetic hydrocarbons (such as synthetic methane). Synthetic products will replace oil. In the 20th century, energy infrastructure was rather centralised. In the 21st century, decentralisation proceeds and drives peer-to-peer society. Products that have been produced by oil before can be now replaced by synthetic products. Importantly, this reflects also changes in society. We are building society that is no more focused on hierarchies, top-down approaches, but horizontal networking connecting peer-to-peer society (Ruotsalainen et al. 2016).

In the Neo-Carbon Energy project it is proposed that what is actually needed, is electrification of society. Most sectors of society could be electrified. So this kind of great electrification has also been presented in a hearing to the Committee for the Future in Finnish Parliament (Heinonen 2017). Furthermore, we also have to consider sectors which are very difficult to electrify, like aviation, freight transport and steel production. However, there is solution for that as well.

Energy as integral part of societal change

Energy has to be approached within societal views - energy within society and energy as related to societal change is emphasised in the research project. Energy is not only a technological and ecological issue, but it has implications for the whole society – power relations, politics, culture, values, economy and production etc. The foresight part of Finland Futures Research Centre (FFRC) in this project is indeed to anticipate possible societal futures of the emerging renewable energy system.

As said, energy and changes in energy system are seen as integral parts of broader societal change. This is examined through four scenarios: Radical Startups, Value-Driven Techemoths, Green DIY Engineers and New Consciousness. In all of these scenarios, energy is produced in a distributed way and with renewables (solar, wind) and storages. Citizens have a much bigger role than today, because they can produce their own energy and also because energy is very cheap in these scenarios. These scenarios have been published as reports which can be found on the net (Heinonen et al. 2016b). Another report reflects these scenarios in different parts of the world, some case companies etc from various parts (Lang et al. 2016).

Transition thinking

The main idea behind these scenarios is that in history, all of the major social and societal transformations are in part caused by changes in energy supply or in energy systems. For instance, the rise of hunter-gatherer societies was facilitated by the exploitation of plants and animal meat and the agricultural

revolution was driven by the domestication of plants and animals and then, of course, the industrial revolution was catalysed by the steam engine.

What is common to these transitions is that the amount of available energy increased significantly. So the surplus energy enabled more complex and more productive societies, as well as new kinds of social formations. This led to major social and cultural changes such as the birth of leisure time during the first industrial revolution. The global culture of the Information society was enabled by oil. It would not have been possible without oil.

The current global energy consumption is approximately 104 000 TWh. By 2050 may be able to produce appx. 130 000 TWh of renewable energy (an increase of about 20% in total energy consumption). If we take into account further increases in the energy efficiency or unexpected breakthroughs in energy technologies, the amount of available energy in 2050 could even be much bigger than 130 000 TWh.

The amount of solar energy that faces the Earth per year is 23 000 TWy/year i.e. the Earth's mainlands. Compared to the current energy consumption (16 TWy/year in 2009) there is a huge difference. Theoretically, in a relatively distant future, we could have approx. 1400–6000 times more energy at our use than today. Potentially it is huge and the question is only efficiently harvesting solar energy.

Besides the increase in energy supply, one important factor is the decreasing cost of energy: if the marginal costs (price) of energy fall, so will the costs of production and living. Imagine, for instance, what ordinary citizen could do if they had almost free energy at their use or how society in general would function if clean and cheap energy was ubiquitous.

Figure 3. *Juho Ruotsalainen discussing global energy consumption. Photo: Joni Karjalainen.*

Discontinuities lead the ways into future

Together with other technological developments such as automation or AI, increases in renewable energy supply and decreases in energy price could steer our world into very unknown futures. This is why it is increasingly crucial to anticipate these emerging discontinuities in different sector of society.

Let us now approach the core of our futures clinique work in action: anticipating and identifying discontinuities and black swans. Focus on the idea of discontinuities and black swans means that we want to get out of the trap of linear thinking. This is actually one of the key issues of futures studies as well. Linear thinking is sometimes good but it is definitely not enough, we should get out of this kind of trap. Actually it is often so that future is anticipated by using megatrends and trends. It is only natural and it is needed – but it is not enough. We can know something with high certainty, for example, the size of population in Finland unless a huge number of immigration takes place. However, the future is definitely not just extension of the present because there are events that break that kind of conventional linearity. There could occur constantly surprising chain of events. For example, the growth of the Finnish economy could climb back to around 5% per year compared to the 1–2% of today in the near future. Of course, this is improbable but at the same time possible breaking the linearity of slow economic growth.

Breaking the habit of linear thinking means that BAU (business as usual) is no more seen as the norm. Surprises are the new normal. Surprises are new directions and can even be anticipated by using several foresight techniques and tactics. We can try to analyse weak signals, it is our science of emerging issues, or we can try to anticipate black swans, sudden surprising events. Naturally, there are several problematic issues involved in such anticipation. Both weak signals and black swans are rather uncertain, also unpractical at some cases. Therefore, we start with identifying **discontinuities**. We can first try to pay attention more to what is not a continuity, what is discontinuity in certain areas. They can be gradually emerging, gradually evolving, but they can embody really deep change processes. They can be interlinking with different trends, weak signals and black swans, in a rather complicated way. Issues that create discontinuities often arise from different fields. For example, ICT, Apple IPhone, combined existing technologies in a new way rather than being based on new invention as such. Machine learning and AI cause changes when they are combined with other technologies and fields, such as financing, journalism or diagnostic of medicine.

Disruptions happen when something totally new comes, and breaks the linearity and leads us to discontinuities. Examples give car as disruptor and horse as disruptee, personal computers vs mainframe and mini computers, cellular phones vs. landline phones, discount retailers (Walmart) vs department stores. Classical example of this is digital photography: it was invented by an engineer inside the Kodak company. However, Kodak as used to the conventional film industry, did not want to hear about the innovation of digital photography – and the rest is history.

The current rise of renewable energy and especially solar energy is an example of discontinuity but not really a black swan event. Ten years ago almost nobody anticipated the rapid fall in cost of solar PVs. Now of course China has produced the discontinuity (for the high price of solar energy), it can even be considered an event that China started put down the solar PV prices and produce them massively. Many other trends also converged to this phenomenon – the success of solar development.

To sum up, discontinuities that the participants will identify in this futures clinique, rise from complex interconnections. They are combinations of various developments, various issues and various technologies exist. Discontinuities on such interconnections may at first seem unrelated, insignificant and difficult to recognise. But if the world becomes increasingly complex, these discontinuities will increase and the world becomes more volatile. Transformation of society is needed to tackle grand challenges and this kind of transformation is already on its way. Foresight helps us to understand the change – to understand and anticipate also this kind of discontinuities. Besides megatrends and trends, all these discontinuities manifested by weak signals and black swans are not easy to recognise, but they are crucial for foreseeing future developments and opportunities. In a similar way we highlight what pioneers are doing in order to see glimpses into future paths (Lang et al 2016), we can look for sources for discontinuities in the marginal phenomena i.e. weak signals and black swans that break the continuities and linearities. This is the challenge in this futures clinique and the participants are encouraged to work in the mindset of identifying discontinuities, weak signals, and black swans. The results of the work in the futures clinique along with the presentation of Karlheinz Steinmüller will feed back to the scenarios and to the subsequent reports.

3.3 Karlheinz Steinmüller on Black Swans and VUCA World

Dr. Karlheinz Steinmüller gave his keynote presentation on black swans and VUCA world, a concept referring to a world that is characterised by volatility, uncertainty, complexity and ambiguity. He elaborated theoretical perspectives, historical and possible examples of wild cards or black swans as well as the value of the concept in scenario making. Steinmüller grew up in East Germany, in a world with only static, continuous and stalemate development, where the fall of the Berlin Wall felt like a sudden wild card or black swan, a topic that has been one of his favorites already for a long time.

Figure 4. *Karlheinz Steinmüller discussed black swans and VUCA world. Photo: Hazel Salminen.*

The first black swan example mentioned during the presentation was the September 11 attacks in USA of 2001. This event, according to the presenter, in a way changed part of the world's politics and the way people behave and relate to the future. The eruption of Eyjafjallajökull in Iceland in 2010 resulted in the blockage of many flights connection in Europe, disrupting the usual way people did their business and hereby, perhaps changed their perception on the future. Steinmüller touched upon the Ukraine Crisis of 2014 that changed the relations between East and West. The promises of more collaboration after the Soviet System Collapse were hasty. Politicians now have to consider a much harsher geopolitical situation in the world in the 21st century.

At the same time, we have to remember that not all the black swans and wild cards are negative by their negative nature. For example, black swans from the field of technology, e.g. mobile phones, have double-effects: positive and negative ones. Therefore, one has to be very careful when thinking about how black swans work out.

Uncertainty Accompanies Human History

The phenomenon of uncertainty that has been present throughout times. Even one hundred years ago, people did not feel certain about the world and the future. Uncertainty is something that has always accompanied human history. The population has merely lived by shifting between periods of a little more certainty and the usual uncertainty. Therefore, even if disruptions and discontinuities are considered to be the 'new normal', they have also been be a part of the 'old normal'. Increasing attention is paid to risks, as according to Steinmüller organizations such as World Economic Forum, Global Challenges Foundation, and OECD present annual reports on global shocks in the political, economic and ecological environments.

Figure 5. *Steinmüller noted, that there is an increasing attention paid to risks and global shocks. Photo from Karlheinz Steinmüller's presentation slides.*

More attention has also been paid to the disruption of business, especially in regards to the digital revolution and digitalisation. As an example Steinmüller gave the study "Digital Vortex" (Bradley et al 2015) that revises how the digital revolution redefines whole industries, e.g. technology sector, media, financial services, retail, oil & gas and pharmaceutical industries. The oil and gas business will be affected by digitalisation later than other industries. Furthermore, peer-to-peer networks, e.g. can help us getting rid of centralised structures that, perhaps, can be supportive for the Neo-Carbon project objective.

VUCA World and Vulnerabilities

Vulnerability is a topic which has also recently gained more attention. Steinmüller referred a presentation by Tomas Ries, who discussed the possible threats to the global system in different spheres (political, functional, and ecological). According to Ries, a threat in one of the spheres can produce disruptive impacts for the other spheres as well. For instance, degradation of natural resources that happens in the ecological sphere can have an impact on structural stability of the political system or on the economic base of the functional system of societies. This means that everything is interconnected, which contributes to the concept of *VUCA World*.

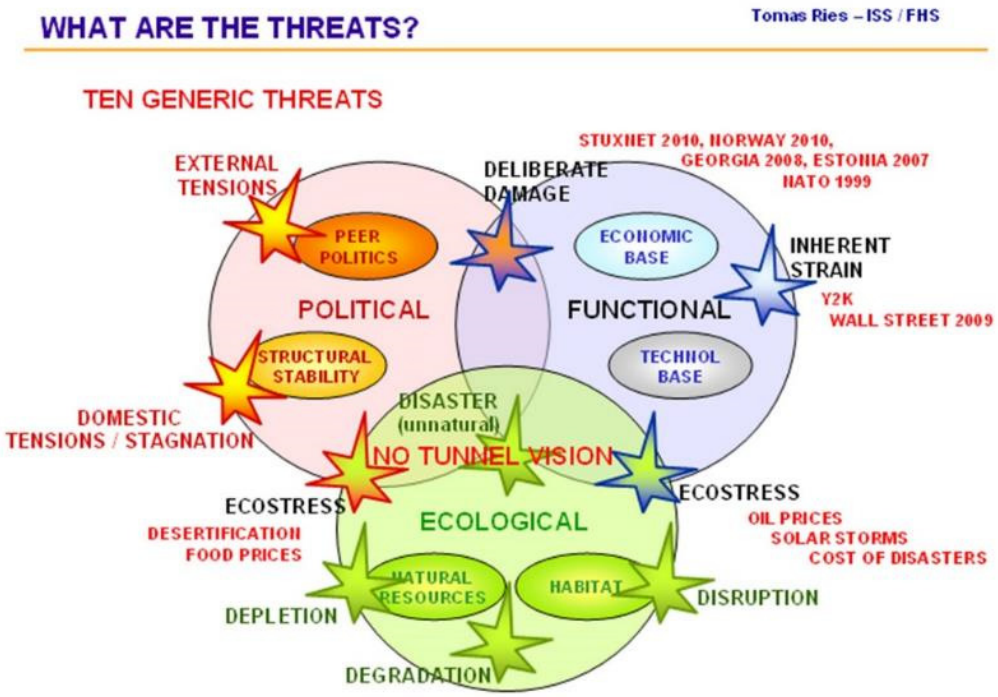


Figure 6. *Tomas Ries about possible threats to the global system in his presentation in 2010. Photo from Karlheinz Steinmüller's presentation slides.*

VUCA is an abbreviation referring to elements of Volatility, Uncertainty, Complexity and Ambiguity. Volatility can be measured as e.g. in the financial markets with the more frequent and more extreme up-and-down developments of share values. Uncertainty is behind all things. Interconnectedness of the whole system can be reflected through its complexity and ambiguity, which means that we cannot easily make sense of the developments since they may be interpreted in different ways. Thus, Steinmüller claimed, the further into the future we are looking, the more the level of uncertainty increases, whereas the level of predetermination on the contrary decreases. Thus foresight balances between predetermination and uncertainty.

There are different methods to tackle uncertainties. First, Steinmüller clarified four levels of uncertainties: *clear enough future* that can be tackled with forecasts and mathematical instruments, *alternative futures* for which to apply decision analysis and game theory, *a range of futures* usual for scenario planning, and *true ambiguity* that requires new concepts and perspectives, and tools such as analogies, black swans, scenario stories.

Consequently, according to these levels of uncertainties, one can distinguish things we know and things we do not know. In this respect, Steinmüller added a fourth type of ignorance to the widely referred list by the former U.S. Secretary of Defense Donald Rumsfeld. Next to *known knowns*, *known unknowns*, *unknown unknowns* there are also the unknown things we do not want to know. Linking Rumsfeld with Herman Kahn, who was in a way the teacher of the former one, Steinmüller mentioned Kahn's book "Thinking about the Unthinkable" (1962) dedicated to thermonuclear war. Kahn introduced the concept of "the unthinkable" to futures studies. It was a call for more intellectual openness, for more courage to tackle even awful problems with intellectual rigor and to stop simply forgetting about them.

Steinmüller quoted another, more recent study conducted by a British think tank CIMA, called "Thinking the unthinkable" (Gowing & Langdon 2016). For the study, company managers and high-ranking ministers were interviewed and asked about what they consider unthinkable and do not discuss in their organisations. As a result, it turned out that there were many things they thought about, but did not dare to talk about. Therefore, it was not the unthinkable, it is the unpalatable (things we do not like to talk about). Steinmüller emphasised that black swans can shock people out from this mood of non-thinking and non-talking.

Theory of Black Swans

Proceeding from that, Dr. Steinmüller turned to the theory of Black Swans. He opened up this topic with an example of a British prime minister (1957–1963) Harold MacMillan, who stated as his first fear "*Events, dear boy, events*". Politicians have to cope with events that happen out of their control, and therefore they can be considered as disruptions and black swans for politicians. These events are out of the politicians' radar before they take place.

In his book "The Black Swan: The Impact of the Highly Improbable" (2007) the Lebanese-American scientist, Nassim Nicholas Taleb, defined black swans as events with certain attributes: rarity (it is an outlier, outside the realm of regular expectations, "Extremistan", the world of extreme events, exists outside "Normalistan" where most things happen), extreme impact (because nobody thinks about them before, and after the event, everyone knows about them) and retrospective predictability (human nature makes us concoct explanations for its occurrence after the fact, making it explainable and predictable).

Another concept similar to black swans is 'wild cards', which Steinmüller favors over the first one. Wild cards are "surprising disruptions" with low ex-ante probability, high impact and surprising character,

which together explain their disruptive potential. They come out of the blue. This concept was introduced by French and Danish scientists, and some American colleagues, who defined it as "a future development or event with a relatively low probability of occurrence but a likely high impact on the conduct of business" (BIPE et al. 1992; see also Steinmüller 2011). Together with his wife, Steinmüller published a book about wild cards in 2004. In this book, which is available only in German language, they describes 55 wild cards. Within ten years five of them have realised, illustrating the low probability.

When a black swan or wild card happens, it acts as a 'future quake'. When occurring, a wild card or a black swan changes reality, they impact actors, their plans, strategies, aims and actions. Black swans change the reality and they alter our perception of what can happen in the future, what happens in the present and what has happened in the past. Furthermore, they change our mental landscape, therefore they can also be called the 'earthquakes of the mental landscape'. Black swans are 1) disruptions for trends, they may 2) increase and reinforce trends, 3) create new trends or 4) disrupt whole structures.

Furthermore, Steinmüller discussed the context in which a black swan occurs. Black swans have certain events, which prepare them, among which we may find weak signals, which indicate that something is approaching as black swan. This is followed by the black swan event itself and its impact. After, a secondary black swan may occur, impacting vulnerable elements in the business, environmental or political system. Therefore, black swans are embedded in causal chains or nets.

The biggest difficulty is to assess the impact of the black swan. You have to consider that even the normal way of business with no particular surprises may be difficult to predict. If you assume that something special and extraordinary happens, you are in a hypothetical world. In that case, it is much more difficult to assess the character and the probability of the outcomes. Therefore, you have to rely on rather simple and robust ways to assess black swans.

As an example for the assessment of black swans, Steinmüller referred to his American colleague John L. Petersen, who suggests to assess black swans by looking at the rate of change (if it is very rapid, it has higher impact), reach (how many persons are affected by it), vulnerability (less adaptable = more vulnerable), outcome (more uncertainty = more impact), timing (later events = better outcome), opposition (change resistors vs. advocates), power factor (more individual effect = stronger impact). Petersen suggests to go through all these measurements and then calculate the power of black swan. According to Steinmüller, Peterson's parameters give an idea of what you can regard while assessing the impact of black swans. (Petersen 1997.)

Sometimes trends, even if they are something continuous, still provoke black swans from time to time. Elina Hiltunen (2006) has questioned whether a phenomenon really is a wild card or merely blindness to existing trends, meaning that we are blind in more ways than we are sighted. Thus, we may underestimate trends and misunderstand their impacts, changes or interactions with different sectors, society, business and inventions. In respect to that, Steinmüller quoted famous French diplomat Charles

Maurice de Talleyrand (1754-1838): "Quand il est urgent, c'est déjà trop tard", in English "if it is urgent, it is already too late". This phrase can also be applied to climate change problems, as Steinmüller noted.

Steinmüller continued by explaining the relationship between trends and their impacts. Trends have primary or direct impacts, which have further impacts, impacts of impacts and so on, and then, black swans may come into the play. Therefore, we can say that black swans belong also to the trend world.

Steinmüller provided two examples of black swans originating from trends. First, the megatrend of shifting global power refers to the weakening position of the USA as the world's superpower and increasing power of China, India and Asia. Years ago Steinmüller discussed logistics scenarios for the year 2050 with Deutsche Post DHL[4]. One of the four scenarios, *Return of Protectionism*, was esteemed as rather improbable at that time. However, the scenario is not considered a black swan anymore today. If looking at the current global economic development, one should consider it as a mainstream scenario according to Steinmüller. The second example is digitalisation. It is currently debated, whether digitalisation with Artificial Intelligence, robotics, block chain and other such technologies could imply disruptions to the work place and replace quite a great number of white-collar jobs. For instance, a British study of 2013 concluded, that 47% of all jobs in the US are endangered. Although Steinmüller was convinced that these figures were too high, he stated that there are many black swans in the future of work.

'"Energy from space' is an example of a technological black swan, with photovoltaics in terrestrian orbit and energy beamed down to earth, as put forward e.g. by Jerome Glenn from the Millennium Project. Steinmüller considered this rather improbable. He characterised it as a technological breakthrough that would need high investments into space transportation. But space transportation business is on its way now. In this case, perhaps, in the end there will be winners – those who run these companies – and losers, who are most likely oil producers.

Moreover, there are environmental, ecological or natural disaster black swans. 'Extreme geomagnetic storm' would be one with the highest impact. Geomagnetic storm means that there is an eruption on the sun, which produces lots of ionised particles that travel through space into the magnetosphere of the Earth and hereby disturb the magnetosphere. Such an event already happened in 1859 and at that time, many telegraph cables burnt out. If they cut off the telegraph connection, the personnel received an electrical shock. On that day northern lights – Aurora Borealis – were seen in Central Europe. So what would happen today if another massive geomagnetic storm happened? It would destroy most of the high voltage transformers. And the long range power infrastructure would be persistently hit, resulting in the lack of electricity for six or even twelve months. However, peer-to-peer and distributed infrastructure, similarly to the one presented in Neo-Carbon Energy project, would be less influenced by such a black swan than highly centralised infrastructures.

[4] Delivering Tomorrow: Logistics 2050 A Scenario Study. Deutsche Post AG.

BS: Energy From Space

Probability	Impact	Focus
●●●●○○○	●●●●●●○	Cornucopia of cheap energy

Origin:
- Breakthrough in space transportation

Impacts:
- Independence of fossil energy sources
- Environmental impacts (?)
- New conflicts?

Winners:
- End users of energy
- Space energy companies
- Global climate

Losers:
- Oil producers
- Inflexible utilities

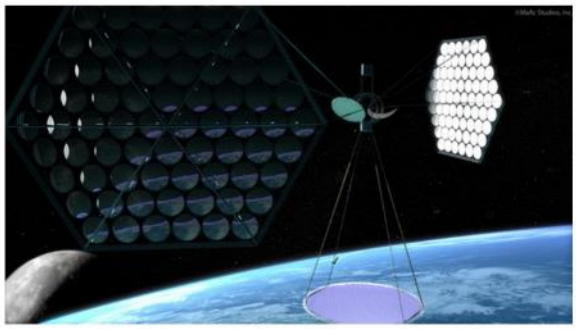


Figure 7. One of the black swans was the retrieving of energy from space, as suggested by Jerome Glenn of Millennium Project. Photo from Karlheinz Steinmüller's presentation slides.

Next, examples of societal black swans were provided. Steinmüller talked about 'vegan revolution', with references to different food scandals, e.g. BSE meat scandal or avian flu or the food problem with pork. He tried to imagine a scenario in which people would stop consuming animals and would only eat insects one day – not very probable, but still a possible black swan according to Steinmüller. High-end luxury consumers' 'food printers' in cities could lead us into a new world with different types of consumption and a positive impact on nature, since less land would be used for agriculture.

The following example was 'collapse of life expectancy'. For instance, in Russia after 1990 the statistical life expectancy for Russian males decreased rapidly. There were two main reasons for that: alcoholism and family situations. In these times, more women put their husbands out of the door – and this is one of the best indicator for shortened life expectancy according to Steinmüller. Crisis of the public health systems in many places has already started taking place (e.g. in parts of Germany), and thus the general trend of prolonged life expectancy may come to an end.

'Digital money' would be an advancing factor for a peer-to-peer economy and it could undermine the importance of the traditional bank systems. If a national or European currency would no longer be needed, many competing currencies could exist at once instead. Each of these currencies could have different functions. Many interesting scenarios can be generated with reflections to this black swan, and some of

them may have a direct link to energy. Energy itself may become the primary real currency as in some future utopian societies depicted in science fiction literature.

The next example was a techno-social wild card of 'home grown bioenergy'. If biochemists and geneticists succeed in the development of artificial photosynthesis, it could be used in i.e. "green bricks" instead of photovoltaics on the rooftop. Buildings would then produce carbohydrates or hydrocarbons out of air, water and sunshine. These chemical compounds could contribute very well in the neo-carbon world, as energy source or easily available means of energy storage.

Black Swans to Test Robustness of Scenarios

Black swans can be utilised in different ways in scenario projects. Firstly, they help to overcome existing mindsets. Black swans force to think out of the box, to look around oneself with more imagination. One's futures space or "futures map" (Kuusi et al. 2015) is extended and one has more intriguing elements in it, instead of well-known, sometimes boring megatrends and trends. Therefore, it can also counteract hype. More technical black swans can be used to collect minority opinions and so-called radical or crazy "side ideas" that can be put into the basket of black swans. Furthermore, black swans offer a robustness test for scenarios, and they possess potential to produce additional scenarios and support wind tunnelling of strategies.

Traditionally the place for black swans is considered to be within the robustness test, after the scenarios have been generated. Additionally, black swans can help in choosing scenarios by identifying scenarios that are too unstable. Scenarios that have a good chance of realization should at least overcome the impact of some of the black swans. Furthermore, black swans can be used in deriving early indicators.

The main problems with black swans are connected with their identification. Where to look for them? How to find them? Should one go through the systematic approach and look for them in different sectors of society, politics, economic, technology, ecology etc.? How can you first open your mind and look at the unthinkable, and at the unpalatable as well?

Does it even make sense to look for implausible or impossible things in the first place? Steinmüller sees the value in talking about things considered as impossible, as it enables to see the limits of one's own perception. Furthermore, possibility and scientific nature are perhaps not the only valuable or useful perspectives.

Identifying the potential approach of a black swan is connected to scanning for weak signals which indicate the advent of black swan. In Finland and other countries, a lot of literature on how to find weak signals and black swans have been published. Steinmüller suggests a principle of *Three S* of weak signal identification. Firstly, one has to be very *sensitive*, and look very carefully through a broad portfolio of sources for weak signals. One also has to be *selective* and leave irrelevant phenomena without attention.

Finally *serendipity* is very important, which means that one should be open to find weak signals even in areas where one was not looking for.

Steinmüller briefly addressed the rules for a good portfolio of black swans. Black swans should be sufficient in number and diversity. One should exclude black swans with too small impact, despite all problems with even roughly assessing potential impacts. "Too big" black swans should also be excluded, as they allow no real (counter-) strategy building or more specifically simply destroy clients. In other words, when talking about futures of Germany for example, it is not really helpful to include black swans that would completely annihilate the country.

Steinmüller concluded with insights on black swans from Z_punkt projects. The company mainly uses black swans as eye-openers in order to tackle lack of imagination, as well as in risk management as incalculable risks. Steinmüller emphasised one more time that there is a bunch of black swans in the world. The problem is to look for the right ones and to assess their probability. Additional "side" scenarios driven by black swans can be helpful and valuable with the main scenarios, as for their intellectual contents. Since 1996 a 'global financial crash' has been in Z_punkt's basket of black swans. Despite the efforts to communicate this possibility to the clients, the usual response was that it cannot be avoided, or that it is none of their problems, irrelevant or even impossible.

There is an ocean full of black swans, and despite the individual probability of each one of them is very low, their compound probability approaches – as time goes by – is one. Steinmüller finished his presentation with the thought that black swans will definitely shape our long-term future.

3.4 Comments by Jarno Limnéll

This chapter presents the comments by Jarno Limnéll to Karlheinz Steinmüller's talk at the futures Clinique on Black Swans and the VUCA World. It was presented as a video recording, made at Finland Futures Research Centre.

Figure 8. *Professor Jarno Limnéll presented comments on Karlheinz Steinmüller's ideas. Photo: screen capture from the video recording.*

Dear Ladies and Gentlemen!

My name is Jarno Limnéll and I am a professor of Cyber Security in Aalto University. I´m invited to give comments to Dr. Karlheinz Steinmüller's presentation in the Futures Clinique.

I actually just returned from Tallinn where the annual high-profile Lennart Meri conference took place. In this conference security experts from different parts of the world are trying to analyse the current situation and the future in our security environment. We discussed EU, RUSSIA, SYRIA, PRESIDENT TRUMP, ELECTION SECURITY, DISINFORMATION - and many other topics. I could summarise all the topics in the conference in two words: ***unpredictable instability (UI).*** *UI is in the world where we live at the moment – and probably many years to come. I very much agree with Dr. Steinmüller when he is emphasising VUCA World. That is the reality. Uncertainty is – more or less – everywhere.*

When we in today´s world are emphasising certain trends (which are true), I think we should ask – at least sometimes – also the opposite questions. Like in Finland we keep repeating that "Everything that can be digital, will be digital" – which is probably true, BUT I see that we should also ask – "are there some areas or some issues which

should not be digitalised?" I see for example, that the voting system in the elections is one example which should not be digitalised. At least, not at the moment.

AND when we are saying that everything is changing and of course we live in the midst of megatrends of immense changes – are there some things that will not change? I think we should ask that too. For example, coming from the security, I think it is important to keep in mind that security will stay as a basic need for us humans, and that will not change. And when everything is changing I think we should pay a special attention that people´s feeling of security should really be kept in our minds. The importance of security, especially in the individual level will not change.

I am actually writing my new book at the moment. This book is based on a large amount of data (interviews, group discussions) from Finnish youth, young people 17-30 years. I wanted to really know what are their thoughts of the current and especially the future of security in their lives and in Finland? And one thing I also wanted to understand better is that what are the issues in their own and Finland´s security which should not be changed? Which should stay as it is today also in the future. They answered me that the most important element in our security now and in the future is – trust. How we are able to maintain our social trust - to each other, to the security authorities, to policy decision-makers? For young people the future of the security appears to be the question of trust – they want to live in trust-society. I think this is very important message for all of us a little bit older– and also in wider perspective to keep in our minds. Even if everything is changing – how we are able to maintain people´s trust to this change?

Finland celebrates this year 100th anniversary of independence. In our history Johan Vilhelm Snellman, a Finnish statesman and philosopher, has been a very important person. One of his most famous messages was "High education is the protection of a small country." I think this wisdom is even more topical today – in our complex world – than it was approximately 150 years ago when Snellman said it. I think it is very important that we all keep emphasising this message in our societies. High education and civilized people – that is our solution for the future.

I would even say that the need for multidisciplinary research and higher education is greater than ever.

I liked very much in Dr Steinmüller's presentation when he encouraged us to think also the Unknown unknowns and Think the unthinkable. That is very well said. Especially when we think about the accelerating development of technology, I think we really have to be able to think "impossible things" when we are thinking about the future. It may be a good exercise for all of us to write 10 things in technology which you think that are impossible. And when you have that list, think again – are those things impossible after 50 or 100 years?

Technological advancement as my opinion should not be seen as a threat as it can offer splendid opportunities for good living conditions and sustainable well-being in the future.

But, one thing I would like to highlight here: The question will soon switch from "what machines can do?" to "what should machines do?" The outcomes of the coming technologies can define the whole future of humanity. For this reason, a desirable civic skill would be understand technological advancement, its impacts on society, work, economy and people, in order for citizens to fully be able to participate to these questions and these discussions.

Therefore, one of the most crucial topics in the years to come may be digital ethics. The biggest questions surrounding technology may not deal with technology as such, but people and humanity.

My passion has always been and probably will be also in the future, security issues. Let me emphasise two short things to my end:

First, I see that my main job as a professor to my students and as a father to my three children is to encourage them to find their internal passion. What you really want to do, where is your hunger, what you are passionate about? I see that this is one of the most important things what everybody honestly must ask for themselves. I hope that many people find their passion to think and create the future.

Second. Innovation is imperative when we think about the future. Also in security. But like I said before, I will present this point again – when we are thinking about the future and creating it – WHAT each one of us can personally do to increase people´s trust – today and in the future. In this sense we all play significant role.

Thank you very much and I wish you excellent discussions!

4. RESULTS OF THE FUTURES CLINIQUE

The objective of the clinique was to identify discontinuities and black swans and discuss their implications within a specified theme. Prior to the futures clinique, the participants received background material, in which Neo-Carbon Energy project and the concepts discontinuities and black swans were elaborated (see Appendix 3). In the futures clinique, 39 participants worked in seven break-out groups. Upon registration the participants were asked to indicate their preferences on which theme they would like to work with during the futures clinique. The five themes – described in further detail in Chapter 1.3 – were the following:

1. Politics: nation-states, governments, geopolitics, new ideologies
2. Corporations and economy
3. Civil society & peer-to-peer practices
4. Robotisation & artificial intelligence (AI)
5. New lifestyles

In total there were seven groups working on the five themes. As two of the topics – *Politics: nation-states, governments, geopolitics, new ideologies* and *Corporations and economy* – were the most popular ones, two breakout groups were made for each topic. Each of the groups had a moderator who instructed the participants with different phases of the futures clinique. Five groups worked in Finnish. The second group on *Politics: nation-states, governments, geopolitics, new ideologies* as well as the group on *Robotisation & artificial intelligence (AI)* used English as their working language.

The workshop consisted of two sessions. The objective of the first session was to identify discontinuities related to the allocated theme of the group. After introduction, each participant started individually thinking and writing down on post-its what one considers new and interesting within the given theme at the moment. These ideas were then presented to the rest of the group and placed on a blank white paper. Ideas resembling each other were clustered. Next, the second round of ideation in session was steered by the following questions; 1) How is the theme changing, what new characteristics does it have compared to earlier times? 2) Is there a dimension within the theme that has not been discussed a lot? 3) How can the relationship between the theme and energy transformation be described? At the end of session 1 the participants classified the ideas that resemble each other into clusters, and gave titles for the clusters. These collections of ideas were called *discontinuity clusters,* and they were considered to present possible discontinuities. The participants were instructed to choose 3-5 clusters for further elaboration in the next session.

The objective of the second session was to elaborate the discontinuities or the discontinuity clusters chosen at the end of the previous session, and analyse their implications on society, individuals, organisations etc. The groups utilised a modified futures table (Table 2) as a tool in this session.

Table 2. A modified futures table utilised in session 2.

Discontinuity	2050 Implications on society, individuals, organisations etc		Renewable energy

The discontinuity clusters chosen in the first session were written on the left column of the table. After, participants began to create ideas on what possible implications on individuals, society, organisations etc. the clusters may have by 2050. Implications were considered on a general level, not necessarily focused on Finland. Ideas were written on post-it notes and placed on the futures table. After generating ideas from each of the clusters, the group chose one implication considered most "discontinuous" compared to the present moment from each row. In the following phase the group observed the chosen, most discontinuous implications and discusses what kinds of black swans could stem from them – or their combinations – by the year 2050. The black swans were written on post-it notes and placed on the black swan column of the table. At the end of the session, the group considered the implications, both preventing and advancing, that black swans may have on the renewable energy world. The implications were written down on post-it notes and place on the renewable energy column of the futures table. The futures clinique concluded with a cross-fertilisation session, where the groups presented their results to other participants. The results of the seven groups are provided in the following sub-chapters.

4.1 Group 1a: Politics: Nation-states, Governments, Geopolitics, New Ideologies

Group 1a anticipated the possible fundamental changes in politics, nation-states and geopolitics by 2050. Group members were Burkhard Auffermann, Christian Breyer, Liselotte Gijzemijter, Karlina Ozolina and Claire Schuen. The group was moderated by Amos Taylor.

Figure 9. *Group 1a discussing the discontinuities related to politics and new ideologies. Photo: Sirkka Heinonen.*

Session 1

In **session 1** group 1a came up with four groups of ideas regarding the development of futures of nation-states, goverments and geopolitics. These clusters are described in the following.

Smart political adaptation? Because of this new shift whereby Communism embraces consumerism to maintain power, it offers a highly enforced super structure of policy that is being used to transition to renewable energy, i.e. decisions made at the top. This was offered as one way in which government can change direction without losing power, making a new deal. The result of this was that there could very well be a shift to an adapted communism - which was one of the chosen black swans. **The demise of the US, and democracy** as a global leader was seen as a discontinuity, replaced by new communism. As an energy implication this was seen to offer a system of governance for renewable energy.

The clustered issue of the **Threat of nationalism?** was a key topic. Related to many of the session issues was the discussion on the threat and rise of nationalism, with new strange alliances that depicted competing politics, discontinuing the EU as we know it, because of right-wing national populism based on attitudes of fear. Insufficient Education was seen as a cause.

Population growth vs. population collapse? Migration, a definite result of climate change affecting negatively to sea rise, drought, crop failures, etc. would put untold pressures and force new ideas about national identity - even in some cases governments to leave their disaster struck lands (could Finland relocate to Norway and Swedish higher ground if sea would rise?). Cities being affected by rising water was discussed, as well as Finland could be totally lost under ice if Gulf Stream would change. The later chosen **black swan** would be a **mass death of migrating people (mega death**) that would be shocking. It was discussed that we can already see every-day escalating deaths from migrant sea crossings, or directly from climate change 'natural' disaster. A more protectionist, independent, fractured energy resulted from this idea.

Changing views on Women were perceived as important for development**. Educating women** specifically was seen as a way in which to control population growth and form stability. This led to women work/mother/life balance was discussed as important as women are pressured in some areas to stay home and not to peruse a career, even they may well be more educated. China having a limit on 2 children per family, was a one way to restrict this, a result of **1.4 child per family** was seen as one suitable policy by Brayer. Women in fact could be in a much more leading role in the future by these logics, a situation not seen before, resulting in debates about equality. This was not taken as a black swan, but given more time probably would have identified the sudden strong position of women as a black swan.

What is the **Role of energy policy?** It was discussed that we have not yet seen the full fight that the fossil fuel industry would utilise if put in the corner, still in a fairly powerful position now, in the future we could see the full force of political, military, and financial return of the fossil fuel. They would manipulate, greenwash, extort and terrorise to keep power. This became another black swan - **the revenge of the fossil industry** to be taken in the final session.

Session 2

In the session 2, the four areas of discussion were immediately naturally clustered and given 'general titles'. The ideas from the clusters were directly moved over to the table as they were seen as already formed ideas, and as time was short the same direction of this discussion was kept.

The black swans were given brief time to consider, and at first there was a pause, then the realisation came that already black swans were found, and they had just to be articulated. By fully discussing the major issues, discontinuities, shocks, and new situations, even if black swans were not at the forefront of the first half of the Clinique they eventually emerged. The black swans were as follows:

Mega Deaths Caused by *Forced migration* causing reactionary shocks from this emotional issue, that resulted in more protectionist off-grid energy production;

Giving up Capitalism, caused by *new strange political alliances (regional cooperation),* and the *Future of capitalism: beyond the money in the pocket;*

Revenge of the fossil fuel industry, in part caused by insufficient *Education on the subject, with the real problem being the power of lobbyists etc.* resulting in the *Decentralisation of small unis for energy production.*

4.2 Group 1b: Politics: Nation-states, Governments, Geopolitics, New Ideologies

Also group 1b anticipated the possible fundamental changes in politics, nation-states and geopolitics by 2050. The group participants were Olli Pekka Hatanpää, Tiina Koljonen, Petteri Laaksonen, Alex Pitkänen and Eeva Primmer. Moderator of the group was Joni Karjalainen.

Session 1

In the **first session**, the group discussed and developed four discontinuity clusters that address politics and geopolitics, including the forces that are shaping them, such as ideologies and values.

As a warm-up to the task, the group began their work by discussing **natural disasters** as black swans (an eruption of a super volcano that could cause five years of 'nuclear winter') or the realization of the extreme scenarios of climate change, leading to the melting of Greenland, causing several metres of sea level rise and the halt of nuclear power plants, akin to the science-fiction book "Sarasvatin hiekkaa" by Risto Isomäki.

The group then moved to their task and to think contemporary issues that underpin politics, geopolitics to think how they could be shaping societies. At first, they started reflecting the issue of **migration** which has underpinned several recent political events. The movement of people is increasing globally, and nation-states across the world seem to be struggling with this. Migration includes work based migration as well as forced migration of refugees fleeing unstable countries. In Europe, certain countries are addressing migration flows more compassionately, while others attempt to restrict these movements, for instance with strict quotas. At times these two reasons, economic and socio-political migration get confused. Addressing these migration flows, including an integration of immigrants into new communities, could prove to be important. It was also noted that in 2050–2100, 80% of the world population is forecast to live in Africa and Asia. If both population growth continues with in line with the current estimates, and the volume of migration flows increases – perhaps even expedited by worsening livelihoods due to climate change – it is feared that the control of these flows becomes very challenging. Despite a rich discussion, the group chose not analyse this idea further in the following session, and instead, focused on the four following themes.

The first cluster of ideas concerns **new values & ideologies**. The participants seemed to agree that new forms of meaningfulness are already shaping current behaviour and expectations: at present, there is a strong sense of environmental care and conservation, and interest in overcoming the necessity of 'owning things'. Previous generations, in contrast, often started by having little, and considered ownership very important. The group also discussed the youth, and their aspirations. Today's youth was seen as responsible, mindful of "not leaving their 'buddy' behind", and extremely tolerant. At the same time, the young generations hope for adventures and variation to their lives. Virtual "mobility" and more mobile

lifestyles have already created a rupture of work. As working and leisure time are blending, new revenue logics are generated.

The group discussed what could be the next 'big' ideology. This highlights the uncertainty of the values expected to guide future life. What will young people want? If modernization strengthened individualism in Western societies, its critical counterforces today seem to be searching for more collectivist ideals. In the past, identities have been bound to place and locality, whereas with globalization, it may be that supranational "tribes" become commonplace. Identity in the future might be something akin to trans- or post-humanism, and a post-internet generation. Whether this (trans-)nationalism will be civic- or ethnicity-based, is an interesting question. At the same time, nationalism is moving in two directions: fading away in many places, while experiencing a resurgence – possibly particularly in the minds of groups less exposed to globalisation. While gaining access to a wealth of information, living with their smartphones, novel generations were hoped to be critical enough with the sources of where they find information.

The second discontinuity cluster describes **the relationship between markets and the state**. The decision making power has seemed to disperse – from nation states to large corporations. The market economy is denting any protectionist ideals and pushing regulations to be harmonised. However, recently there have been flashes of protectionism and, if they were to strengthen, they would undermine the current global institutional framework (including world trade rules and the role of WTO). One possible future would see trust in the constitutional state to collapse.

In one scenario, the European Union (EU), which holds the third biggest population in the World, eventually becomes a federation: with a unitary defence, common energy markets and infrastructures (such as electricity grids), as well as joint taxation. Notably, taxation would require 'the social pillar' of the EU to be developed, which was dismissed in the early formation phase of the union. There would have to be strong reasons, and a far more deep connection between the EU and European citizens than today, to enable a novel type of a 'social contract'.

This (neoliberal) free market ideology, was viewed as the current hegemonic paradigm, and despite its problems, some see it as a strong driver of technological development.

In the future, ideally, responsibility of both of the citizens and of the corporations – through social change – would replace regulation. If companies were to strive "to do good", there would be little need for regulation, and politics and markets would become increasingly sustainable. A more cynical view deemed that consumers must lead this transition, and that the private sector, despite expectations of its benevolence, will not achieve such change by itself.

The third discontinuity cluster is **technological change and the problem of waste**. On the one hand, new technologies are expected to change society in multiple ways, and bring forth innovations, including those that solve climate change. On the other hand, novel technologies carry risks that we do not

necessarily yet understand in the present. As the speed of change increases, reaction needs to be faster. For instance, much is expected of blockchain technology, and it was envisioned even to change conventions how agreements are drawn. Then again, it was debated whether blockchains, now thought to be extremely secure, will prove to be so in the long-term. This was selected as an interesting area to be discussed in more detail during the second session, which focused more on the relationship of technological change and environmental conservation.

The fourth discontinuity cluster consisted of an array of **geopolitical changes, dynamics and tensions around the world**. In the 2010s, there seems to have some competition of global leadership, as the world is more multipolar than in the 'bi-polar' Cold War era. China is spearheading the BRICS countries and the European Union, despite its internal struggles, seems to be looking into the future. There is also more optimism about the African continent than some decades ago. In contrast, the actions in first months of President Donald Trump's tenure have caused dismay around the world. Although it may be too early to make a judgment on limited evidence, the Trump administration has hinted of a more 'isolationist' position of the U.S. than in previous decades. Indirectly, the discussion seemed to address a future where the U.S. was not necessarily 'the' global leader anymore. If, instead, Chinese values were to spread around the world, this could bring forth interesting new developments.

Geopolitics, in addition to competition, is also about tensions. These manifest especially in 'geopolitical hotspots' such as the South China Sea, the "STANS" region in Asia, and the Middle East region. The escalation or de-escalation of these tensions will tell, whether they fold into actual crises. One possible factor that would escalate tensions is resource and natural resources scarcity, an issue known already for a while, when local and foreign actors plan how they can secure resources access in the future. In the worst case, geopolitical tensions may catalyse a so called "It Was Close scenario" akin to the Cuban crisis in the 1960s. As one example, it was imagined that a failure in the already tense India – Pakistan relations could deter a nuclear crisis.

"The geopolitics in space" was recognised as an emerging area. The 21st century is now seeing new space hype thanks to wealthy philantrophists like Elon Musk who are planning Mars and space explorations. Some doubts were expressed about the rationale of such ventures, in general, considering that we only have one planet. A pessimistic geopolitical view sees such efforts as early signs of colonizing space. In the worst case, space exploration could be turned into a hostile competition. After all, in the 1980s, towards the end of the Cold War, it was feared that a space race leads into the deployment of space weapons.

Session 2

In **session 2** the group elaborated the *implications* (for society, organisations, individuals etc.) of their discontinuity clusters:

Discontinuity 1: New values & ideologies. Changing values seem to be challenging the market fundament from multiple perspectives. Symbolic in the lives of the previous generation was working from nine to five in awe of the Taylorist factory model. This eventually would lead to owning a house, and starting a family. While such ideals have not disappeared from today's society, but are taken more self-evidently as outcomes of the adult life, and therefore not really act as meaningful symbols anymore. Despite aspirations of this 'something else' or 'something more', it is not entirely clear, what a new, post-material ethos that delivers meaningfulness will look like. Spirituality, in addition to post-internet identities and transhumanism, might provide one answer. If we understand better what novel ideologies are about to emerge, this might give us hints, what future value systems, especially in Western societies, will look like.

Discontinuity 2: The relationship between markets and states. If the platform economy and corporate power are allowed to dominate, two opposing futures images seem to emerge: one of benevolent large corporations, which solve global problems, or a dystopia of massive "evil corporations" where money is earned by the few, workforce and natural resources are exploited, and the externalities of economic activity are ignored. It was also speculated, how in an unregulated financialized techno-economy, **financial shocks could be caused by algorithms that stimulate global stock markets**. This is an example of an eventual black swan as a result of discontinuities. Such an event, could happen semi-accidentally, without proper prior human understanding – until afterwards.

It is debatable whether large corporations have the necessary benevolence, vision and skills to steer society to a 'safe and sustainable' path. More conventional views would expect states to provide necessary regulation. In either case, large corporations seem to have an important role with regard to natural resource ownership and use, and how research and development efforts are lead. A highly important question for the future of societies could be moulding the partnership between the state and markets into a just and working one. To reach a whole-of-society change, industrial change has to become a shared effort.

Discontinuity 3: Technological change and the problem of waste. We may see new, unforeseen technological convergences that we cannot yet imagine. Future technological change may include, for instance, sustainable cleaning of carbon dioxide (CO_2) from the atmosphere. In such scenario, carbon (C) and carbon dioxide (CO_2) actually become valuable resources. Artificial intelligence (AI) is hoped to help in replacing materials and reducing the use of natural resources to decrease global consumption. 3D printing promises a resource-efficient and environmentally friendly production technology. Then again, more sceptical views are pessimist with such techno-optimism. AI is an energy-hungry technology and 3D printers may merely end up producing more materials and waste than before. Micro-plastics may only further contaminate already polluted ecosystems, and end up filling world's oceans. Perhaps, if the space explorations advance, the human footprint will then expand in the form of spitting out new 'space junk'.

Discontinuity 4: Geopolitical changes and dynamics around the world. In light of the emergence of China, the group discussed that it is still ill understood what exactly the "Chinese thing" is. Are traditional analytical lenses suitable for thinking of China's potential significance in the future? A second interesting discontinuity is the increasingly strong aim to detach from fossil fuels. If fossil fuel divestment does begin to happen, and push for transitions at an increasing rate, countries around the world will need to think ahead of transition strategies – much more deeply than they until now have. In one of the transition scenarios, a neo-carbonized system is globally taken into use. This may also imply the strengthening of efforts to build a global electricity grid. As such efforts are already underway, it was then debated that, who has the motive to build this grid – who is expected to benefit? Could some problematic situations emerge, if and when such global grid is built? It was noted that China, interestingly, has been in favour of advancing this agenda. Whatever the interests, it was finally noted how there are growing fears that coastal cities could 'drown' under the water. This was understood as a strong driver that is encouraging cities and countries to engage, and renew their commitments to, global governance.

At the end of session 2, the group developed four (plus one) further black swans. The first black swan event was **a total industrial revolution** where an entirely new 'green' industrial paradigm emerges. This was considered interesting because although such development is understood as 'a preferred future', we do not know exactly how such a world might look like. The second black swan was **'clean energy for all'** where the energy landscape of the world *is* transformed entirely from the present – 80 percent of global energy production today is reliant on fossil fuels. This would shape industrialized and developing countries in unforeseen ways. Such changes could benefit from another, mini-black swan, the emergence of a **'new winner technology'**. An unforeseen technology could, on the one hand, expedite the efforts to reach carbon-neutrality, while on the other hand, undermine efforts to push for a neo-carbonized energy future. (At the moment, we actually seem to be witnessing a similar debate with the renewable energy vs. nuclear discussion.) These first black swans are in some way paradoxical, and share common characteristics. Such black swans actually imply the fulfilling of goals that a part of humankind is already striving to, as end points to 'existing' development trajectories. Should they emerge, they exemplify pessimism related to transformative change and ambitious targets.

The third, a seemingly highly unlikely event would be a holistically **'reformed United Nations (UN)'**. This United Nations would be much more powerful than our today's UN, becoming considerably more powerful than a discussion forum. The 'future UN' would take control of the means of production, if nation-states conclude that they are too weak to act by themselves on climate change. Such a scenario could be realized perhaps as an outcome of climate disasters. The fourth black swan anticipated **the world to fulfil with junk**. Unfortunately, there is already some evidence of such a future. Streams of plastic are circulating in world's oceans. In news, we are reading how plastics are harming water animals from small fisheries to large mammals, or island wildlife and habitat in the Pacific Ocean. It seems that even the remotest ecosystems are not be spared. As the human population, and the world economy are expected to continue

their expansion, this implies a strong need to think of not only the principles, but a practical, holistic, dynamic and cross-sectoral implementation of the 'circular economy'. These two black swans are pessimistic, but evidence-based, and such judgments can be drawn from trends present witnessed already today.

In the end, in terms of renewable energy, the group discussed one direct connection of these discontinuities, black swans and renewable energy. As an example, if the '*Clean Energy for All*' principle becomes mainstreamed, in the long-term, this may provoke legal implications. In 2015, a class action lawsuit involving almost 800 Dutch citizens', enabled by a climate change activist platform, took the Government of Netherlands to court, for not adhering to its climate change targets. The court ruled in favour of the citizens[5]. As several countries and communities are expected to be impacted by climate change, climate change litigation may become more common than it would have first seemed. Unless there is tangible action, private or public sector actors might be sued of violating this principle on the basis of protecting human rights from climate change.

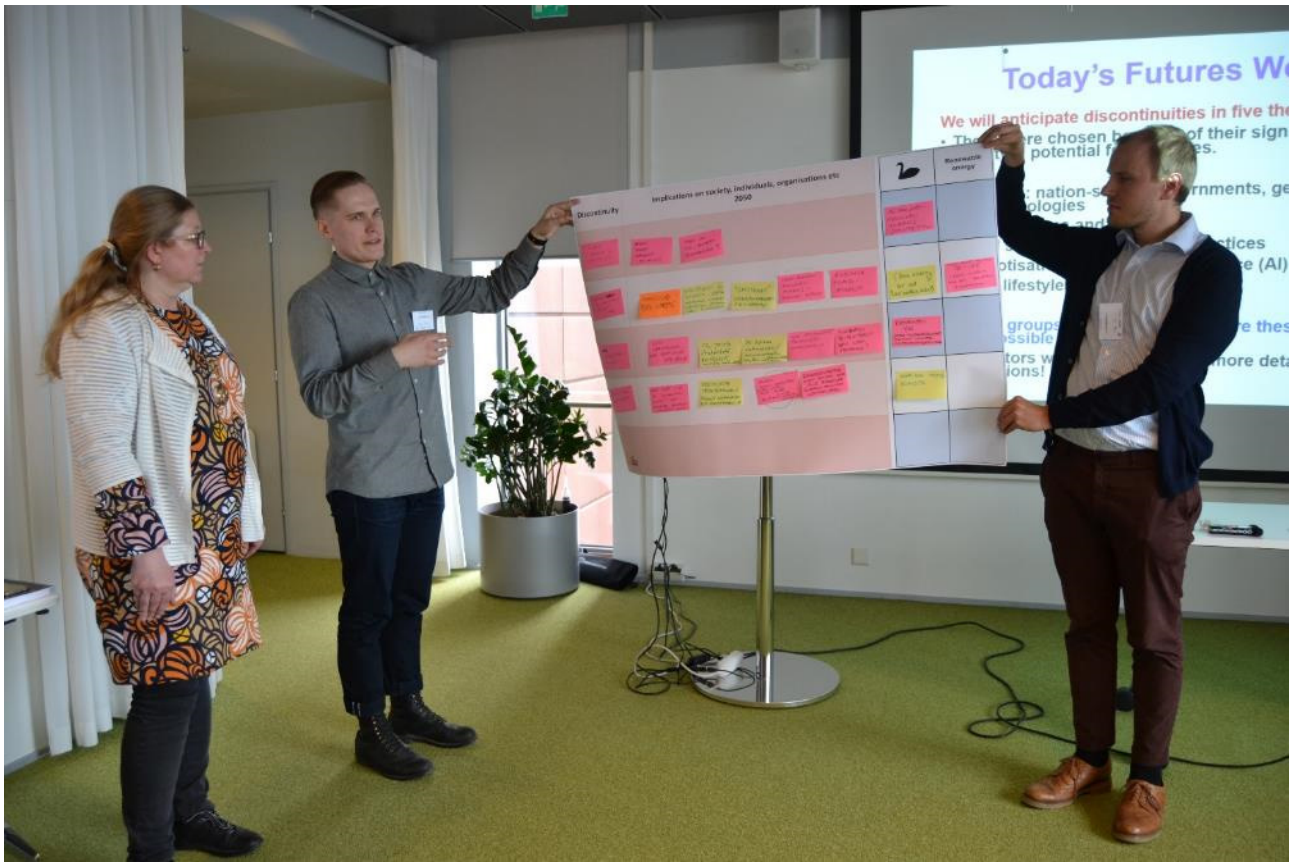


Figure 10. *Group 1b presenting their results in the cross-fertilisation part of the clinique. Photo: Sirkka Heinonen.*

[5] http://www.nature.com/news/landmark-court-ruling-tells-dutch-government-to-do-more-on-climate-change-1.17841

4.3 Group 2a: Corporations and Economy

Group 2a focused on how corporations could change by 2050 and how the global economy could look like by then. The group consisted of the following members: Sakari Höysniemi, Ari Karjalainen, Jouni Keronen, Maija Larmo and Pasi Vainikka, with Sofi Kurki as the moderator.

Session 1

In the **first session** the group explored a variety of issues relating to the economy/energy nexus.

Their first cluster was about **Internet of Energy/Everything.** By exponential growth of actors prosumers change the landscape, and different institutions will be and are challenged by smaller actors. Prosumers are not only the producers but increasingly also people involved in the flexibility market, this will result in even greater amount of people participating in the economy. Change in taxes and circular economy may result in high international competition of community taxes will result in giving them up. The platform economy is raising issues on the futures of taxation as well, what will be the ways in which taxation develops? If capital seeks profit, what are the implications, and can we for instance find a model that looks for impact of the investment to e.g. climate? Digitalisation and related democratisation through connectivity, whether it is blockchain or operating without a central bank, prosumers, the internet of energy devices etc. Also the media has democratised although as the traditional media is drifting in trouble the vacuum has been filled by disinformation, and we're yet to see the recoil from that, the media blockchain separation facts from fiction. But in the big picture the world is democratising and some structures are losing power.

The second cluster combined ideas under the title of **Implications on climate change.** There is a report going to be published that says that the humanity will have much less time than previously thought to radically reduce emission in order to keep to the 1.5° limit. Once this news reaches the public, will it result in a world largest demonstration? The development of platform economy is a central characteristic of this kind of a future. Following questions arise: How will corporations change by the impact of platform organisations? What will be the model through which economies are run in the future? Individual may group around issues of interest (c.f. Solved), and the ten next years will show how this evolves.

The third cluster addressed **Alternative facts.** Corporations and sovereign states may become opponents for each other, but what will the power relationship between large companies and sovereign states be like? In climate negotiations the negotiating partners are most likely nation states. On the other hand, 95% of the funding for the climate actions comes from the corporations. This results in a mismatch. Large companies also often have a very long strategic time frame, unlike to some states (the U.S. as an example). The corporation has responsibility over an investment that has a lifespan of 50 years, yet the only responsibility for a politician is to get re-elected. In the future we may witness a revenge of the "fossil world": as the energy transition moves forward, nastier measures will be adapted by the fossil powers.

There are already signs of this in the form of personal attacks on alternative energy researcher. Furthermore, the USA elections function as an example of giving power to a strong fossil proponent. This can be seen as a signal of a phenomenon that strengthens in the future. Fossil driven economies and companies will continue to be a major force for some time in the future. The question is rather, how they will be able to react to the trends. A bad example of how this is the very affluent fossil countries like Saudi-Arabia who are able to place persons of their choosing as IPCC reporters. This results in totally alternative facts that are on their part eroding trust in science. "Carbon neutrality by the end of the century" instead of facing the reality of having 14 years time to make the transition. And they blow up as other countries start using these "facts" in their policies. This is the nature of the invisible power that they are using. An exhaustion of cash flows of an energy company may occur in the future. Traditionally for instance in Helsinki the energy company has made a major contribution to the city's finance. Regional building activities have since replaced the financial role of energy. Last year the amount was 250 million euros to the city budget merely from the sales of commercial lots. That equals the amount generated by the energy company in the past. As the energy company's contributions decline, land development takes its role. This relates to the energy transition and is also connected to the disruption of the city's revenue logic. What are the ways to solve this in the future?

The fourth discontinuity clusters addressed Solar economy. The group discussed fossils in USA and development of ICT in China and India. Donald Trump had the possibility to make USA the top power of renewable technology due to the progressive technology know-how, but instead USA is now playing for China and India, who are gaining momentum as USA supports fossils. Rapid drop of costs of energy electronics may take place in the future. However, it is difficult to make estimates on the evolution of solar tech due to the very rapid development. Vulnerability of ICT may have an impact on the future. It is fearsome that the NSA and CIA are losing control of the Internet. It may well be that the Internet fails. This kind of a future is *a winner takes all world*, where standards are created by the big players and this may have unintended consequences for the system.

Session 2

In the Session 2 the group continued to explore the implications of their selected clusters: Internet of Energy/Everything, Implications of climate change, Solar economy, Victims of transformation (corporations & people).

Figure 11. *Group 2a at the beginning of session 2. Photo: Sirkka Heinonen.*

Discontinuity 1: Internet of Everything. The internet of everything enables crowd funding or crowd sourcing to become a major force in the economy. This results in emergence of circular economy. A key point related to the development of a carbon neutral economy is the Death of distance, meaning the tendency and ICT-assisted ability to stay in a given location without sacrificing the quality of life.

Discontinuity 2: Solar economy. Cheap energy means that the value is increasingly created in the information and services connected to energy distribution. Hopefully services will replace tangibles in consumption. Going to a forest or sailing, for example will be the kinds of highly valued experiences that will replace current forms of consumption. Multiple new energy resources could result in a situation, where energy is everywhere. Chaotic development may result from different paths, for instance internet of energy that is followed by the collapse of the European energy network or a continent-wide electricity shock in USA or EU.

Discontinuity 3: Climate change implications. The group found both positive and negative sides to climate change implications from the perspective of the economy: while the price of coastal real estate drops, the stock of pile-driving companies and construction firms will go up. Fisheries are on the decline leading to the extinction of wild fish, but fish breeding in artificial conditions is likely to continue. An interesting implication already demonstrated is the UAE's plan to move an iceberg from the Arctic to the

coast of UAE to provide a source of fresh water. The rising CO2 levels not only affect the health of the planet, but also that of the individuals. For instance a recent study found that high levels of CO2 in the air result in lowered cognitive capabilities. Immigration is sure to continue as climate change destroys liveable environments. The group suggested adopting a proactive strategy to immigration, selecting a great number of educated immigrants before others wake up to the inevitability of the situation. Artificial nutrition would provide a means to combat some of the issues posed by the threat of climate change to crops and agriculture in general. Veganism was expected to grow.

Discontinuity 4: Victims of transformation (corporations & people). The energy transformation will result in a deep chasm between the people who win and those who lose. The biggest cultural differences will be those between the winners and losers of the new energy transformation. This will probably result in great unrest, but rather in the form of smaller, Syria-like conflicts, not World War III as such. However all contributing to a chaotic world. There is a positive solution to current and projected crisis of work. For instance in Europe there are about 30 million unemployed people, representing a potential workforce. If all these people would be put into the service of energy transformation it would be an enormous resource, for instance for installing new energy systems or the like. This could be compared to FDR's new deal and the transformation of the socio-technical system in the US after the great depression. Funding could be provided by companies who would benefit, and who still are in possession of great wealth.

When considering the black swans and their implications on the renewable energy world, the group suggested the following events. An **Internet collapse** could **significantly delay** the development of renewable energy system. Similarly, a **collapse of the powergrid** would mean that systems would have to be **operated manually**. **Economic slow-down** could also be the result of a pandemic, or for example **super-zika epidemia.** Finally, it was suggested that a sudden **collapse of a major state, such as Saudi-Arabia,** could imply the **death of the old worlds** as we know them, or even cause military operations.

4.4 Group 2b: Corporations and Economy

The group anticipated on how corporations could change by 2050 and how the global economy could look like by then. The group members were Sakari Nisula, Nina Orvola, Lotta Partanen, Leena Pentikäinen, Lassi Similä and Risto Sivonen. The moderator of the group was Leena-Maija Laurén.

Session 1

From the beginning the group innovated freely and openly and thus generated seven separate clusters for considerations in the further discussions.

Figure 12. *Group 2b at the beginning of session 1. Photo: Sirkka Heinonen.*

Major natural devastations with economic effects: Implications for this kind of devastations were found from the nuclear power plants in Fukushima, Japan which became a total natural disaster to the local economy and life.

In other parts of the globe draught has been more severe and also seas have been drained from fish and thus caused famine. Lack of food cause economic problems in these areas and paradoxically there are due to the expected 7 m-sea-level-rise in many areas of the globe abundant hauls in waters.

Measured on the 2017 consumption levels, global statistics show that the 'available annual resources' are totally consumed by the month of August each year, and the rest of the year the yield from the resources is negative e.g. taken from the consumption of the future years. By 2025 the global population will consume and utilise the annual amounts of global resources available by the month of March each year. Therefore the need for accepting the view that by the year 2050 at the global energy level leaves solely one solution: only strictly circular-economy corporations and sustainable business functions will survive.

More drastic discontinuities are assumed to surface the oceans as by 2050 the overall water levels are rising up to 7 meters higher as compared to the current levels of oceans and this will be causing disasters and another worldwide migration crisis, that of climate-refugees. The mobility from dry and flooded areas is effecting the movements of peoples. In the case of Helsinki, most of the city territory of today will be submarine areas under the Baltic Sea. Looking for help for Helsinki? Traditionally the Dutch have had the knowledge for preventing all in-flux-water-disasters for lowlands, but in the future ice-melting disruptions its knowledge might no longer be valid in the flooded habitats. Furthermore the non-salty and potable water for human survival becomes another issue in this context.

It has been documented that ice in the two Polar Regions melting has had an unexpected effect: the ocean water levels have risen more and unevenly distributed in the oceans. The suggested explanation to this disruption is that due to the rotating of the Earth the water masses have been concentrating on the regions closer to the Equator because of gravity. This escalates the problem.

Failed innovation: Due to the lack of innovations there will be a downturn, an economic shock which could be compared to the previous financial crisis. Limited resources and lack of innovative solutions are linked to the nutrition crises. 'Black boxes' could mean new forms of agriculture without soil to cultivate which can be 'potatoes in the air' having nutrients regularly being sprayed to the growing plants. For billions of people and their Human survival there are the basic needs for food, but what kind of the technology will supply? Our Western way of consumption, energy and food, how many people can the resources of the Earth support in 2050? It is most likely that in all cases the consumptions will increase. With the new heat waves the need and demand for cooling down technologies will expand. The other alternative: WHAT IF energy is not free? These prerequisites influence the production level of energy, thereafter the consumption accordingly. The IT sector will be more effective in its energy usage by 2050, but … is it sufficient?

Change in the operational environment: In the future years if no free trade is allowed, globalism will fade and regionalism will dominate. Regulations of today in business contexts will disappear as Trade Unions and EU will disintegrate causing corresponding changes to the (internal/external) market structures.

Major transnational corporations operating in several countries have opportunities to transfer capitals between countries all according to their internal money movements. When these companies have long-term liabilities e.g. they can own loans to themselves, and later these debts can be converted into new

money movements causing bankruptcies. After these events what will the disruptive outcomes be locally as the scales of transnational businesses are often immense compared to a nation state?

Changes in the consumption and production systems: Consumption and production will change because people become environmentally conscientious in their habits. This environmental awareness is estimated to be most radical in the energy consumption. A zero-waste-society will demand policy changes because only fully circular ecosystems can survive.

Further discontinuities on the markets are also indicated in appearance of an 'end of pro-consumerism of material goods' era.

Globally, the current level of consumption of the fossil energy should be cut down with 70 % as the estimated indication is that by 2025 the current level will be doubled if nothing is changing before it. The target for diminishing consumption is very demanding, and not likely to be achieved at all.

Change in the businesses and populations: Old industrial structures are no longer needed. Virtual conditions can create new forms of (smaller) companies which are enabled by global networking as there are no limitations tying down to geographical places. This appears to be a major change compared to the current situation where global markets require large companies backed-up with their resources.

Locally 'Sun roof energy' panels can serve as a-small-scale example of a market case in which the energy-saving & energy-producing -production model can outdate a traditional tile production factory specialised in the red roof tiles. No need for the old model after the replacement.

Combining the expanding population in Africa to the limitless energy resources of the continent – provided that they can themselves utilize them – by 2050 the African economies will rise like a 'Leap frog' technology.

In case all the food production of the globe will turn solely to organic agriculture, then within 2 years, some 2 million people will starve to death as the effectiveness and yield will drop.

Technology and disruption: By 2050 the global ecosystems will be unstable due to several technological ruptures which irreversibly influence the interconnections in the ecological balance of Nature. Leading explorative companies such as Tesla may invent and their PV projects succeed. Revolutionary technological breakthroughs give unprecedented solutions (electric cars, 3D printing, batteries, PV etc.) as well as continuous robotisation and digitalisation in the 'former' work places. Therefore the concept of a 'worker' will change, as the production systems are ever more automated. However, investments in technologies may become very expensive and cause rigidity in organisations.

On the other side, experiments with new systems of 'universal-allowances paid-to-all' in order to compensate the loss in incomes by working which are in the future taken away from the humans by the robots. However, the new systems need funding, but will there be enough corporate taxation systems or what?

Political solutions can impose regulations and stop certain kind of consumption. One of the cases can be that of banning cars with combustion engines and replacing these models with electric cars which will significantly change the production and markets.

According to one of the introductory lecture claims, all historical major changes in industry have been caused by an increase in the supply of energy. Thus, by 2050 new leading countries due to their vast resources may be on the global arena: Russia, China and some from Africa.

Transnational corporations as states of instead of nation states: Many major companies such as mills will be self-sufficient as they can supply for their own energy. When corporations grow bigger than the national economies and a new type of discontinuity will rule as to democracy. History has shown examples in Europe where dominant business families such as the House of Medici in Italy or the Hanseatic Merchants in the North who ruled over the relations between market commerce and ownerships.

As a concluding momentum in the Session 1 discussions the group made selections according to their priorities by separately marking as their 3 priorities on the post-it-notes by x:s. As a group's result a consensus was achieved by circling those with the most nominations. Thus 5 clusters of discontinuities were found and then transferred to the next stage of analysis in Session 2.

Session 2

Discontinuity 1: Change of operational environment. After the fact that companies are no longer allowed to operate globally over national boarders the commerce and international exchange of goods and services will be more difficult if not impossible. The consequence of this is that all raw materials, products and services are not available everywhere. This causes increased inequality between regions as well as between countries. Nothing can stop the collapse of national alliances such as EU.

Discontinuity 2: Technological ruptures. Labour markets will change due to rapid developments in the changing of working environments, conditions and contents of 'work'. The altered situation after the technological ruptures demand for new forms and services of mobility as well as ways to create digitalised-money-payroll systems. Even 'programmed agents' for linkages between incompatible IT systems are needed for fluent performances. When technology dictates a new world of work, and this structure takes over traditional-wage-model, then idleness of workers will be eminent. This development paves for individual people to have more creativity, more conflict of interests but also more efficiency. However, attitudes to and against technology in the work infrastructures will be on all agendas. Some people do refuse to join the digitalized world. The reason can be their personal sensitivity to electricity. Changes in society include production of disposable, non-returnable, shorter lifespan products having purposefully been made with 'Designed obsolete' in contrast to the sustainable long-term-targets in an energy-saving society.

Discontinuity 3: Corporate states/change of population of companies. Power shifts will enter and rupture the markets leading to disruptions in democracies. By 2050 a new structure will dominate. Citizens

are voters when they act as stakeholders or consumers. Commerce is only operated by the leading companies which can regulate the availability of all products and services. This phenomenon of 'regulated allocation' show the polarisation of the markets where on one side there is 'closed circulation' by big companies, and on the other side 'open circulation' by any virtual actor or SME.

Discontinuity 4: Change of consumption habits/change of productions systems. One energy-related example of rubbing the production and thereafter the consumption systems can be given here. There was a total makeover of habits after 'Design Obsolete. Production of consumer goods such as a lightbulb which burns some 2000 hours was declared in the 1920s by the production companies in a historical, joint agreement for shortening factitiously the maximum lifecycle of the product for 1000 hours. Technically any light bulb could burn 'forever' so that the new rule for production was forced to make the life-span shorter. However, in a new cycle of rules, the EU directives in the early 1990s dictated that the 1000 h glow lamps be changed as they were no longer environmentally accepted. However, the regulations make the lifespan of products longer and thereafter they could also be repaired.

All this indicates a profound difference in enabling sustainability in all systems, which can be likewise extended to all electronic whitegoods and gadgets in order 'to last forever'. At certain cases this is contradictory to the company's needs, like the technology and materials used in the special elevators by KONE to last 20–30 years only.

When this regulation is imposed in the industrial production and consumption to become an overruling principle then the service production economy will need to provide any customer accordingly.

Finally in the future circumstances, only those organisations and societies will be thriving when utilizing advanced capabilities of robotics where the production is fast, cheap and accurate.

A material account accumulates digital currency: selling and re-selling the same raw materials, cases of environmentally 0-waste are possible where the output – previously scrap – becomes input for other production processes. Thus in 2050 only circular economies can survive.

Discontinuity 5: Failed innovations/Big natural catastrophes. Futures scenarios indicating drastic natural catastrophes added to the lack of innovative solutions inside the corporate world, will evidently lead to the need for increasing regulations in the society. Under these uncertain circumstances the fear of technology will also increase.

The group 2B then discussed and analysed further their emerging issues in order to generate consensus on Black Swans. These thematic issues were put forward by the group:

- Military conflicts could start between regions due to conflicting interests and powers.
- Failed innovations in the new economic systems.
- Leading companies impervious to the consumers' needs, values and habits in practice.
- The capitalistic system will be shut-down and the citizen-ruled democracy will rule.
- *After globalism there will be 'forced regionalism'.

- Pandemic expansion of so-called 'electricity allergy' – a sensitivity condition – may cause major disruptions to the trends of technologies in production and consumption.

Finally, there were concluding remarks by the group for particular implications for the year 2050 and six black swans were found. Directly driven from them to the renewable energy settings no clear notions were expressed. Generally the group saw these six black swans to relate to their major discussion theme of renewable energies and thus indicating their views on possible pro/con effects. They were in short:

1. Military conflicts disturbing markets
2. Lacking innovations disturbing markets
3. Nonchalance to human needs changing consumer and prosumer habits
4. Collapse of capitalism enabling local democracies
5. Regionalism after globalism
6. Human pandemic due to sensitivity to electricity stopping the technology-driven systems

In the moderator's summarising efforts – and particularly in the event that any one of them will happen – all the above can be estimated to have significant repercussions to the impacts on enabling carbon-free societies based on renewable energy solutions by the year 2050.

4.5 Group 3: Civil Society & Peer-to-Peer (P2P) Practices

This group anticipated the role of citizens in 2050 as well as how they could change established practices and institutions. The group members were Samuli Honkapuro, Liisa Lahti, Timo Tyrväinen, Noora Vähäkari and Maria Åkerman. The moderator of the group was Juho Ruotsalainen.

Figure 13. Group 3 discussing the impacts of the discontinuity clusters. Photo: Sirkka Heinonen.

Session 1

In **session 1** the group came up with four discontinuity clusters regarding the development of peer-to-peer practices and the civil society.

The first cluster, **Top-Down P2P**, highlights the fact that even though peer-to-peer is often seen as a grassroots phenomenon, in practice peer-to-peer models often originate from or are facilitated by large organisations such as social media companies. In terms of, for instance, a decentralised energy system this could mean that a municipal energy facility owns the solar panels that are installed in the homes of consumers.

In a possible future, large companies incorporate peer-to-peer culture and practices in their organisation, and thus become the main drivers of peer-to-peer. Another possibility is that small communities and units merge together as the new "giants". Both possibilities are more or less probable, because networks have a natural tendency to grow. This is called the "network effect": networks are the more useful and valuable the more users they have. Two phones are almost useless, but a network of a million phones is transformational. Another reason for the growth of networks, communities and units is that people are not necessarily happy in small communities. They often want the diversity and possibilities that come with bigger groups. Furthermore, peer-project often require a "primus motor" or a core group which take care of the main responsibilities and keep the wheels turning. Thus a fully decentralised and egalitarian peer-to-peer networks are mostly theoretical (although possible).

The second discontinuity cluster, **Dark Side of P2P – New Inequality[6],** is about new, emerging inequalities and the downsides of peer-to-peer. This is a discontinuity in the development of peer-to-peer society in the sense the equality and social wellbeing are often assumed to describe peer-to-peer projects and communities –the concept itself is by definition about equal peers. Peer-to-peer is also often associated with the "good" things. However, Peer-networking empowers sinister aspirations as well, such as terrorist groups and counterforces for climate activism.

Peer-to-peer networks place a lot of responsibility on the individual. For instance, in todays' social media peer-networks what kind of media contents an individual consumes is his or her individual choice – whereas in the past citizens got more or less the same information from respected journalism outlets. If in the economy of tomorrow work and production take place in different peer-communities instead of traditional workplaces, the "life management" responsibility of an individual becomes even more pressing. It is very possible that sociocultural and economic inequalities and fragmentation intensify and deepen in such a future. What about those who do not want to or are not able to become part of citizen networks?

On the other hand, if the price of the means of production and energy decrease significantly, the threshold of production and meaningful work decreases for everyone. The ease and simplicity of establishing a community ensures that in principle everyone can find like-minded people, work together, establish education groups etc. Local economies, communities and networks are key here. Digitalisation also enables direct democracy (instead of representative), and this could also mitigate the risks of new inequalities if people's worries and problems were better heard. This can, however, lead to new problems – direct democracy would most likely be a more chaotic system than the current one.

The third discontinuity cluster, **Risks of the Internet Grow**, is about the negative developments of the internet, made concrete for instance by the global malware attack in May 2017. If people increasingly deem the use of internet and digital devices risky, this may have implications for the open internet and to

[6] This theme has also been discussed in the previous Neo-Carbon futures cliniques.

peer-to-peer. We may migrate into closed, closely guarded and tightly encrypted networks, communities (virtual and physical) and social media services. This could even give rise to physical peer-to-peer networks as an alternative to organisation through web. Furthermore, if the world became more chaotic, unpredictable and unsafe because of peer-networks with bad intentions, seek for communal self-sufficiency, within and outside cities, could strengthen.

The fourth discontinuity cluster, New Trust, opens new hope amidst the darker tones of previous clusters. It focuses on the fact that in order for a peer-to-peer civil society to function properly without current institutions, trust needs to be established in new ways. First of all, trust needs to have a strong material and economic basis. Without decent income and standard of living, it is hard to trust fellow citizens and society in general. Thus "new trust" could be established on a new economic and production system of e.g. 3D printing, basic income, and urban agriculture/vertical farming. Now the challenge is that most work and labour is unnecessary and ripe for automation – perhaps some combination of artisanal "hobbyist" work and basic income (funded by redistributing wealth created by robots and artificial intelligences) could offer a solution. Artificial intelligences could even be used as "neutral" solvers of disputes and connecting individuals and communities etc. in order to increase trust in society. Human proximity could also be crucial: it may be that the closer you are to institutions, communities, and networks, the more trust grows. Some wholly new, technology-abled, institutions would also be needed. Peer-to-peer feedback could be one such mechanism, and blockchain solutions could remove the need for third parties in transactions such as loans. Everyday actions also count: if citizens behave ethically, for instance by promising to halve his/her carbon print (so called Citizen Climate Pledge), this may in aggregate increase trust towards co-citizens.

Session 2

In session 2 the group elaborated the implications (for society, organisations, individuals etc.) of their discontinuity clusters:

Discontinuity 1: Top-Down P2P. If big companies managed to "take over" peer-to-peer practices, this could mean the disappearance of small entrepreneurship in the sense it is now understood. There could still be startups and small- and medium-sized firms, but these would operate under the big ones. As a consequence of the strengthening of big players, pluralist culture could wilt, and society become more uniform. The "P2P Giants" could be prone to big and alluring projects, such as conquest of space and Mars. Such projects would provide an intriguing story that would help the companies build their brand. Of course they would bring economic and other benefits too, such as mining minerals from asteroids.

Discontinuity 2: Dark Side of P2P – New Inequality. A peer-to-peer society (strengthened by the big players) would be both highly individualistic and networked – and new types of communities would emerge from the combination of these two. However, this kind of society would place a lot of responsibility on the individual and assume that citizens are self-imposed. This could worsen the situation for those who

are not able to be "free actors", such as disabled and illiterates. On the political level, the full realisation of peer-to-peer could lead to the crumbling of representative democracy and the current political parties or forces. Politics – and the rest of society – would become very "bouncy" and constantly changing. Movements with single agenda would flourish, but they would also disappear quickly.

Discontinuity 3: Risks of the internet grow/explode. If the open internet became impossible to use because of constant cyber-crimes, spying, information warfare etc., this could lead to closed digital networks, services and communities. For the physical world this could imply the strengthening of localism, self-sufficiency and small, intimate communities. These, in turn, could increase hierarchies, if peer-pressure in communities would tighten.

Discontinuity 4: New Trust. Creating new trust requires first of all establishing new institutions to replace the old ones. How this will be done remains to be seen. Artificial intelligences could be used in clever ways in, for instance, designing how income and prosperity could be distributed. Working to prevent an environmental crisis (i.e. a shared threat) could create a societal mood in which people realised fellow-citizens are ready to give up their personal gains for the common good. New trust can also be based on technological developments and platforms. For instance, virtual reality communities could aid in enforcing trust between strangers, and the same applies to virtual tourism. Hyperloops and other new forms of transportation could be of help in establishing global trust as it would be make travelling faster and more convenient.

At the end of session 2 the group came up with four black swans, and revisited their previous ideas from the perspective on renewable energy. The first black swan event was **finding extraterrestrial life**. This could promote global communality as humanity would face the alien lifeforms as a species, not representing nationalities or other groups. The second black swan was **the disappearance of nation states**. This can result if peer-to-peer networks arise in a dominant position and replace nation states. The third black swan was **mass deaths and even genocides** due to climate refugees. If masses of people are enforced to become refugees because of the effects of climate change, the situation can escalate into humanitarian crises if refugees are gathered in "concentration camps". The fourth black swan was **virtual civil war (between or inside closed networks)**. If the open internet is "balkanized" into numerous closed networks and communities, these can wage new kinds of cyber warfare.

In terms of renewable energy, Top-Down P2P can manifest itself so that every citizen has solar panels on their roof, but the panels are leased by some big corporation. The rise of global communality could advance renewables significantly, if it also heightens ecological consciousness. Finally, self-sufficient energy can be one of the cornerstones of peer communities: not only as providing energy, but self-sufficiency could glue communities closer together.

4.6 Group 4: Robotisation & Artificial Intelligence (AI)

Group 4 focused on the discontinuities brought about by robotisation and artificial intelligences by 2050. The following participants worked in this group: Michael Child, Naomy Kering, Elina Kiiski Kataja, Osmo Kuusi, Aleksej Nareiko and Shameer Prasla. The group work was moderated by Hazel Salminen.

Session 1

In **session 1,** the group discussed ideas about possible discontinuities and came up with four discontinuity clusters regarding the development of robotisation and AI.

The first cluster, **Ethics & trust**, concerns the basic issue of the lack of trust that people often seem to have towards the trend of automatization and AI. The group discussed some reasons for this distrust as well as possibilities for building a level of trust that would support the wider development and introduction of AI technologies.

Some robots are already really big, strong, and agile, and quite effective at executing certain tasks. Why would not corporations and states start using them for *any* kind of work, also outsourcing the "monopoly of violence", i.e. policing our societies? Drones are evolving and taking on new and not always so nice functionalities, e.g. as weapons or spies. What will be the social contract to negotiate this change? These kinds of robots can be very strong and, thus, they make revolting against them really difficult. If we don't create a social contract in advance, we may end up in a situation that is not so favourable for humans.

In this cluster, also security and terrorism were discussed. As challenges of e.g. cyber security and related terrorism arise, there is a definite need for "cyber trust" so that the actors know how they can act in cyber space.

As there is a lack of trust, we think we need more security – but why don't we turn it around and say that we need more trust in robots and other kinds of AI than active security measures against them? *How* we can create this trust is an important and necessary discussion that should be had very soon.

At the moment, we don't necessary understand why AI acts the way it acts, because the algorithms are hidden or even secret. For example, AI is used to make forecasts in different fields (weather, energy generalisation and use etc.), but nobody understands how. It was seen as interesting how we are more critical to errors and mistakes done by machines than those made by humans. Somehow we feel less in control when a machine is self-driving than when it's operated by a human, even though, based on probability, it should be the opposite.

One suggestion the group discussed was that in the future, all AI would be designed to be responsible, i.e. required to be able to explain to humans (in human language) how they came to their conclusions or decisions. If the HR support AI (mentioned in the cluster Applications – robots for humans) goes through job applications and rejects some of them, it must be able to explain why. E.g. the application

contained a lot of spelling mistakes and, thus, the conclusion is that the applicant is not bright or thorough etc.

When systems are large (electric network etc.), there are problems related to safety. Recently, there was a worldwide ransomware cyberattack, and we could have similar incidents of AIs running out of control. Another scenario ideated by the group was an infrastructure disaster, a kind of "AI Chernobyl". One possibility would be to assert a "divide and rule" policy, setting limits for how complex or connected AI networks and infrastructure can be – a demand for a sort of "anti-singularity". It was argued that even though trust is important, we shouldn't trust machines blindly.

In the second discontinuity cluster, **the Convergence of humans & machines**, the group discussed what could happen if and when the developed robots and AI converge with humans and human life to an increasing degree. Already today, jobs are being replaced by robots, and in the future, even to a greater extent. Perhaps we will see AI being used also in fields traditionally seen as suitable only for humans, such as the arts: could AI/robots be used as actors or musicians? Could we have a philharmonic robot orchestra? In 2017, AI is already used in e.g. improvised theatre shows to feed information and ideas to the human actors, but this could be just the beginning..!

Some robots today already have very humanised features – they can express emotions, be funny and we might even empathise with them, not just when communicating with them in text but even face-to-face.

Finally, as care services performed by AI/robots becomes more common, robots may become our companions to the extent that they are a part of the family – initially, at least emotionally and socially. Already now robots that look like furry animals are used in elderly care in a way to replace real animals, and even human contact. In 2030, how far will this humanisation (or "animalisation") process have gone? Will robots become so close to us that they are regarded as companions and even family members? Today, 60% of the residents in Helsinki live alone, which means there could be a market for computer-human relationships, as long as they are socially accepted.

The group also speculated whether, further on in the future, this could happen even on a concrete level. Will human-robot relationships become a regular thing and what will this mean for our laws etc.? Can humans and robots ever have offspring and create an actual convergence of humans of machines? This cluster of disruptive ideas sparked a conversation on what actually makes us human, and what will happen when we can't separate humans from non-humans anymore.

The third discontinuity cluster, **Assisted/augmented consciousness** collected ideas that revolve around how technology can be used to enhance or support human consciousness, or at least act as a means of communication between the human brain and machines. Some visionaries are now even looking at how the human mind could be connected to machines. Perhaps further on in the future we will be able to upload our ideas and save them on some kind of virtual memory. If this becomes a practical possibility, then we could even imagine that people (their minds) can stay "alive" in machines even after their bodies die.

There was also a brief discussion on whether the brain functions of e.g. insects and other creatures can be augmented through technology. Humans seem to want to create robots that think and feel like us, but perhaps we should broaden our perspectives and extend the possibilities to other species as well?

The discussion between the relations between humans and machines continued in the group, and resulted in naming a fourth discontinuity cluster, **Underlining technology**. This basically means that technology and AI is integrated into everything. When AI now is learning to use human language; recognise and analyse images (e.g. cancer type from a photo); use big data, i.e. has availability to everything that is online and can use it much more effectively than humans do; and finally, identify, react to and make decisions based on emotions – a big change is taking place. These combined skills of AI systems will cause also non-repetitive, professional occupations to be in danger as robots can start performing even very intellectually demanding and knowledge-based work. One discontinuity could, thus, be the mass employment of highly educated people. Of course, human beings have strengths in how we connect emotionally and what we in this way can provide to each other, but machines are also developing in this area.

The group also discussed how we often forget that AI is not just robots, but all kinds of machines and artificial intelligence, and robots are not just the human-looking androids, but there is a great variety in size and shape. In health care, there are robots the size of pills, which can be sent down a person's intestinal system for diagnostics or even to fix something. Then, there are robots as huge as an apartment block. There are very large, complex systems and then small, manageable systems, which are interconnected.

The fifth discontinuity cluster was named **Applications – robots for humans** and concerned various ways in which AI and robots can be useful for us humans when we reach the limits of our own bodies or minds. Examples of this are e.g. smart houses, where the energy use and storage could easily be regulated and optimised with AI. This technology already exists and is in use, but if it becomes the norm, the way we construct and understand housing could change quite a lot.

Another side of the coin is that there are still environments on Earth that are unsuitable for most humans to live (too cold, hot, or dry, or under water). With the development in the coming decades, robots and AI can most probably help humanity inhabit also these areas. A suggestion was also given that Earth could be kept for humans and all space given to robots/AI, because humans simply cannot survive in space. It makes much more sense to send robots there, to explore and e.g. do asteroid mining.

Currently, AI mostly does simple tasks that also humans can do, but it can perform them faster. This will probably continue also in the future. As such, it is not a disruption, but an example of technology that can work for e.g. HR and process all the applications for new jobs, and categorise them into the related jobs, while automatically disapproving applications that are not of a certain standard. This makes the final job of shortlisting and selecting the right candidates an easier task – but how long this final decision will be made by human HR professionals, is impossible to say…

The sixth cluster of discontinuities related to **Transport** issues. The main question related to transportation and robotisation is the increasing level of automatisation of various modes of transport: e.g. automated harbours as well as self-driving transportation in cars, trains, freight carriers, delivery drones etc. As mentioned above, the evolution of drones has brought forth many new functionalities, all of which are perhaps not so preferable. Also the laws have not quite kept up with the development of drones and the increase in popularity due to decreased prices.

The group discussed how all of these developments could both be driven by and reduce traffic congestion in cities, and self-driving cars could also change how we think about car ownership. This discussion closely related to the discussion of cluster one, ethics and trust. A lack of trust will stall the development and popularity of self-driving vehicles.

The seventh and last cluster of discontinuities covered the topics of **Resources & energy**, which was covered briefly. One issue that was brought forth was that those who promote technology rarely discuss the amounts of minerals and other resources that are needed to build robots and other machines. If we are already running short of materials to build enough smartphones to meet the current need, how can we imagine continuing to build bigger and smarter machines, especially if this technology looks to become even more pervasive in our societies? The limits to resources must have an effect on the design and materials of robots. Perhaps in the future, they will build themselves out of materials we don't know of yet? One way that this could happen is through the earlier mentioned idea of robots in space: mining on asteroids or other planets. At the same time, discarded materials will have to be recycled much more efficiently? In any case, a much more resource-effective production system needs to be developed.

In the same vein, in contrast to the industrial revolution, which was based on steam for its energy needs, the development and use of robots and AI are dependent on electricity. This will put pressure on the electricity production and may cause disruptions in the current system. At the same time, there will hopefully be breakthroughs in the development of technology for conserving the environment. So in addition to material resources, the production systems must also be energy efficient.

In general, the topics were seen as very interconnected, and so there were quite a few ideas that could have been put into more than one cluster. During the ideation, in addition to the seven more thematic clusters, the group also came up with a typification, which divided the discussed ideas into three human-robot relationships:

1. Humans for robots

This encompasses all the ideas and developments where humans are providing something to robots and AIs. Robots for example need electricity, and this has implications on the kind of energy systems that must be developed. In very dystopian post-singularity scenarios, we can even see humans being used as workforce or even slaves for robots, which would be the very extreme example of a human-robot connection.

2. Robots for humans

This contains all the ideas, products and developments where technology is used to make human life better or at least easier: as tools, teachers, connectors etc. As an example, all robots that do repetitive tasks in factories, which, if performed by a human, would cause health problems like worn-out joints or back pains. Everything from asteroid-mining robots to CV-reading AI belongs to this category, as well.

3. Robots = humans

This category, suggests there could be interreplaceability between humans and robots (robots instead of humans and vice versa).

Session 2

In session 2 the group explored possible *implications* (for society, organisations, individuals etc.) of the four discontinuity clusters that were chosen as the most interesting. (In the descriptions below, the underlined implications were the ones finally seen as being the most disruptive.)

Discontinuity 1: Ethics & trust. The question of lack of trust in technology was seen as possibly giving birth to practical solutions such as robots being given a "fair trade" certificate, so that users can know which ones can be trusted to be ethical according to a specified standard. There could be a legal framework what defined the responsibilities of AI as well as who is responsible if rules are violated. Also the idea of Elon Musk was mentioned: that AI and the human brains must be combined, or otherwise AI cannot be controlled. This, however, was not seen as being practically completely possible before 2050. Another angle to the lack of trust was having AI development become an open source project, so that all algorithms etc. are open to scrutiny.

If these attempts to manage the lack of trust in new technology and especially AI were not to work, a need for stronger defence would arise, giving rise to the more dramatic reactionary movement of humans strongly protesting the developments. Either we could see a fundamentalism, which just halts technology and takes humanity "back to the middle ages", or even a new Luddite-style religious movement against the development of technology.

On the other hand, if people start trusting technology without putting in strong enough checks and control systems, there could be a possibility of a machine revolution, where AI and robots revolt against humans.

Figure 14. Group 4 working on the discontinuity clusters related to robotisation and AI.

Discontinuity 2: Convergence of humans & machines. In the case of a continued convergence of humans and machines, there would be different kinds of legal implications. As robots develop to the point where they are not easily distinguishable from humans, there will probably be a requirement to carry identification for clarity (human or not). If robots/AI at some point were to be seen as equal to humans, a new Bill of Rights which also includes machines and their rights, not only humans, should be drafted.

In the extreme case of human-machine relationships becoming more common, there would be discussions and possibly legislation on human-machine marriages. There was a discussion on whether the given time frame is long enough for it to be realistic to suggest **accidental human-robot children**, but at least with the increased use of technology-supported implants and stem cell applications, it might be plausible that **people live long, 150–200 years** and since **accidents might be the only thing killing people, they would practically live their lives in cages** in order to be protected. In general, **genetics** research was expected to continue developing and on its part further the occurrence of **cyborgs**, in one form or the other. By 2050, these cyborgs (part human, part machine) would be **unidentifiable** and undistinguishable from (100%) humans.

In the virtual world, we already have AI programs that communicate believably like humans, and by 2050, there will be virtual realistic figures who will be practically impossible to distinguish from humans online.

Discontinuity 3: Applications (robots for humans). Perhaps the topic most close to everyday life are the applications where robots/AI are used **for** humans, or basically to make work or life easier, processes more effective etc. Implications for the developments in this category were e.g. related to transport, as the increased automation in the form of self-driving cars would most probably lead to a changing understanding of vehicle ownership as well as greater (or less?) transport safety.

In the sphere of work, a chain reaction was discussed, which would start with the work of professionals being extensively replaced by intelligent machines. This trend we can already see starting to happen. This could increase the need for purpose and meaning in our everyday lives, as most people would not have a day job to spend most of their waking hours at, and if this need isn't fulfilled, at its most extreme, could cause mass suicides because of meaningless lives. On the other hand, there could be a great opportunity if the increased free time of jobless humans could be put to good use, and if they would have some means of supporting themselves and their families.

One idea that was inspired by the "1-day-per-person" democracy (every person gets to rule for one day) was formulated so that, instead of everyone having their own robot, every human being would be able to rule all the robots in world for a specified amount of time (1 day, 1 hour…).

Another possible, specific implication of the further development of robots was stated as having bio-chemical robots that are smart drugs. The fact was brought up that, although the technology would be developed for human beings, it also directs human behaviour. This gives technology great power, which can be used consciously by developers, or have random, unexpected effects.

The downside of having humans, with human weaknesses, operating and using technology is that, in addition to it being used for good – as intended – it can also be used for purposes that are harmful for anything between one person and all of humanity. This we saw already in the 20th century. One of the gravest risks is the **danger of weaponisation** of robots, AI, and other technology. Whoever has control over a machine can also make it destructive in one way or the other. Wars of robots was mentioned as one such implication – which could mean both that humans would be knowingly operating them and using them for this purpose, or that the robots would attack each other even without human interference.

Discontinuity 4: Underlining technology. In the future, technology will be everywhere, it seems. Our every move will be known and analysed through the big data collected, which, among other things will lead to practically no privacy.

Already today, AI can understand and use human language, identify figures or other details in pictures, identify emotions etc. on human faces, and use the big data available through the Internet. When these skills are fluently integrated, this will have great implications for human work, as discussed above. There will be a considerable loss of jobs, and the understanding of the concept of work will change. Humans will have radically more free time, which then can be used for non-traditional forms of work. This could increase the interest in working in areas such as creativity, leisure, and learning. However, as much of this

may not be paid work, some other way to make sure that people can provide for themselves must be found. The need for societal stability and ways to provide for their citizens may become so pressing in some states that the – so-far mostly theoretical – solution to income differences and the problems of the welfare state might actually become reality: the universal basic income.

Rising from these discontinuity clusters and the implications which were seen as most disruptive, the group formulated four black swans (with one having two opposite sides to it). The first black swan came as a reaction to the increased distrust of humans toward the new technology: **Humans revolt; they disown technology and return to the Middle Ages** figuratively speaking, i.e. a substantial number of people tire of technology taking over all jobs and all aspects of society, and decide to overthrow it and go back to a more low-tech way of life. On the flipside of this black swan, we could also see **Robots revolt/go out of control**. This would mean that either AI or robots would simply stop responding to humans trying to control them, or they would actually have developed some level of consciousness to the extent that they stand up against being controlled. Or both black swans could happen, one caused by the other, finally one destroying the other. In the second black swan, **cyborgs** appear that cannot be distinguished from human beings (either in virtual space or as physical manifestations). This could mean that human brains have been successfully connected to microprocessors or, as the more easily achieved example, humans receive back-up body parts through stem cell technology. The third black swan is the **weaponisation of civil robots**, where regular robots (and other technology), which were not meant for it, would be used as weapons, either by the owners themselves or someone else. Finally, the fourth black swan was the emergence of a **global (benevolent) government**, as this was seen to be the only practical way to ensure the introduction of the global basic income discussed in cluster 4: Underlining technology.

The group briefly discussed renewable energy during the process, but the black swans finally chosen were seen as so disruptive that, for many of them, renewable energy was not a central issue. Unfortunately, the group ran out of time when discussing the black swans, and thus no formalised suggestions for renewable energy were stated.

Practically seen, however, in the black swan "Humans revolt", most of the energy sources used after the revolt would be renewable, as they have been for most of humanity's history: wind, sun, water, and wood for burning.

In the case of a "Global (benevolent) government", one could of course imagine that the government may also create laws for the benefit of the ecosystem and a sustainable development of humankind, e.g. by restricting and penalising pollution as well as by promoting renewable energy sources.

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4.7 Group 5: New Lifestyles

Group 5 worked around the theme of New lifestyles. They anticipated what new lifestyles and values could emerge by 2050 and how they would change society. The members were Heidi Auvinen, Hannu Kari, Sampo Kouri, Laura Matero, Janne Salovaara and Maaria Tiensivu. Marjukka Parkkinen acted as the moderator for the group.

Session 1

In **session 1** group 5 discussed and generated the following six discontinuity clusters regarding the development of new lifestyles.

The first discontinuity cluster, **Developing/searching/realising oneself**, gathered ideas considering individuals and ways to improve their skills, knowledge and lives overall. Searching for oneself can happen i.e. by meditating. Some may also become so-called lifestyle indians, abandoning the everyday considered as normal. Lifestyles remain active and mobile independent of different ages. Because of digital skills and high consumer power there are no significant differences between life after or before kids, for example. Furthermore, digitalisation together with globalisation increases possibilities at niche markets. On the contrary, the technology may become increasingly harder to be understood, which may, together with lack of faith, lead to the emergence of primitive religions. Self-studying via internet increases individualism, but simultaneously platforms such as Wikipedia and Google Translator may replace studying.

Stupidity, the second discontinuity cluster, refers to a situation where misinformation and anti-intellectualism prevail. Information bubbles has led to tribalisation, and such a future is influenced by post-truth mentality. As there is an endless amount of information available, understanding has lost its significance. The shortening of time perspective and impatience to work hard make the situation even worse. An analogue between mental mind set and cooking can be made: if the situation in 2017 resembles real, more slow cooking, the future can be defined as an microwave oven.

The third cluster is **Democracy of masses/anarchy of individuals,** in which the aspects of democracy were discussed. One dominating topic was the polarisation of citizens. The society may be divided into skilled and unskilled ones, the poor and the rich, masters and slaves or unemployed and employed. This may easily lead into *we versus them* situation. Once people position themselves either strongly for or against something, is there anything else left than extremities? Is there space for different shades of grey anymore? Masses – who are also more easily steered and manipulated – become more passive and marginal groups radicalise. Radicalisation could also happen on a global level. Polarisation could lead to different outcomes and phenomena, such as anti-greenness or celebration of mediocracy. Democracy may become a privilege of small communities only. Regulation following climate change can become considered as threat for individual freedom. It was also questioned if people overall are motivated enough to turn their lifestyles into sustainable. What kind of force would it require? Overall, different

ideologies or educational levels may lead to growing diversity in lifestyles. Those who tolerate well uncertainty become the small group of heroes or survivors.

Cluster four was named as **Detachment**, which opens up topics related to privacy and even isolation. Everyday life and living are a balance of privacy on one hand and communality on the other. As different i.e. communal units start breaking down, people will have more time to themselves. However, if the identity of an individual is broken, the situation may be confusing. What are we then? Even though people are well connected they may feel isolated. Lack of prospects, insecurity and the feeling that nothing can be built on leads to systemic disbelief, insignificance and apathy. Empathy may function as a solution.

Rupture of hierarchies – the fifth cluster – is about transformation of rankings and social order. Steady structures such as permanent jobs and ownership may become history. Freelancing becomes an umbrella term for the whole life, referring to precarious work, education, career path, customer path and even leisure time. Applications such as Uber and AirBnB already disrupt employment. Through so-called reputation systems they can also make a shift in what is considered valuable. When work does not have to be done individuals and society could concentrate in cultivating creativity. This would also alter the economic environment. Instead of money people may exchange of skills and time may literally replace money. The situation of poor becoming poorer could even lead to abandoning of money.

Finally, the sixth cluster, **Escape from the everyday,** relates to ideas of escapism in different levels, physically, mentally and virtually. People may return to countryside or eco villages. On the contrary, urbanisation will most likely draw people to cities as well. Travelling is more ecological, supported by innovations such as electric car charging network or electric planes. Experience economy further increases the popularity of travelling. Augmented reality has potential to bring people from different backgrounds together in physical spaces in a similar way than mobile game Pokémon in the summer of 2016.

Virtual worlds may also become more tempting than the physical environment. For example immigration crisis leads to decrease of space, which makes people escape to abundant virtual spaces in a Matrix style. Virtual reality travelling is a fad in this kind of future. Furthermore, so-called pleasure stimulators could enhance the wellbeing of people. Expert computer players and their skills could also be used in other fields, such as media or even warfare.

Escapism also influences social relationships. As more attention is paid on networks of work, online activities, hobbies and other individual interests, less focus is given on traditional relationships related to family, relatives or other local communities. This has an influence on ways of production as well. It is important to consider, what are the things one needs and can produce by oneself, and when are the tools owned by the community needed.

Figure 15. *Group 5 clustering their discontinuities at the end of session 1. Photo: Sirkka Heinonen.*

Session 2

In **session 2** the group elaborated the *implications* (for society, organisations, individuals etc.) of their discontinuity clusters generated in the previous session:

Discontinuity 1: Stupidity. If anti-intellectualism and misinformation become the prevailing characteristics in the society, politics and individual lives would be steered by irrational bouncing and short sightedness. Addiction to smart devices and the information they provide would lead to helplessness. Artificial intelligence could be trusted to replace the lost common human sense. Society might even become consciously simplified. In a more preferable scenario the decision making power would be given to the wise. However, the brain power would concentrate in individual super universities.

Populism may lead to the rise of a new dictator. If given the power, modifying of the genes could lead to a superhuman species of homogenous group of people. Perhaps everyone becomes a hetero white male person. Finally it was stated that as there cannot be stupidity, because there is no measurable wisdom either. However, there are other measurements for popularity or impact for example.

Discontinuity 2: Escape from the everyday. Escapism from ones lives would have both positive and negative impacts on the society. Overall, the concept of static living would disappear, as people would be in a constant movement. Virtual travelling and disappearance to non-physical spaces could enhance mental well-being and also prevent physical sicknesses. The avoidance of dull life could lead to so-called

funemployment, as employment would be a sign of affluent society. If escapism would prevail, the concept of everyday could disappear. As a counter trend people could try to return to so-called normal days and real life.

Discontinuity 3: Rupture of hierarchies. New systems of hierarchies would most likely be hybrid, as individual, public and private sectors would merge and diffuse. Old systems would be replaced by new hierarchies or they could be defined by ransom flow of everyday or economics. One option would even be a new caste system. This would lead to confusion on the roles, as it would not be clear anymore, who is responsible. Work places would have to lure new employees with other assets than money. Rupture of hierarchies could also lead to radical actions and extreme phenomena.

Discontinuity 4: Democracy of masses/anarchy of individuals. If democracy is largely defined by populism, it disables the making of harder decisions. Thus, the threat of big conflicts might increase. If politics were not considered interesting anymore, the political positions could be allocated to devoted experts only, making them martyrs of politics. If citizens would gain more power, citizen led democracy could result into faster cycles of democracy and direct influencing, which could also happen from "outside the borders". Instead of representatives, people could vote for topics or themes.

Discontinuity 5: Detachment & Developing/searching/realising oneself. This cluster combines the ideas from self-development as well as detachment from society. Individualism could lead into pleasant lifelong learning experiences, as school and education would be considered as individualist trip that can be modified according to one's needs. Furthermore, one could modify the virtual me, through which virtual encounters happen. If value would be based on the reputation of an individual, it is necessary to ask, what happens if it is lost? How can the trust be rebuilt and how can become worthy again? On the downside, ways of marginalisation may become more multiple. Human disappointment and absolute redundancy of contacts could lead into a situation where some people have simply disappeared from the system and live in a life-long anonymity. It is important, how the society reacts to drop-outs or marginalised who feel detached from the society and unable to find oneself. Finally, it was discussed whether all this would lead into growth, or on the contrary, decrease of atheism.

At the end of the second session the group generated ten black swans with reflections on what may cause them to occur. The interaction between three implications – *Individual super universities, Conscious simplification of society* and *Decision making power for wise* – was considered to result in three different black swans: 1) **Decision to cut down the number of people and possible gene selection,** 2) **Killing the wise people and keeping the stupid, easily controlled ones** and as the opposite, 3) **Reign of a positive and wise dictator**. If the number of people would be decided to be decreased – in human ways, as it was emphasised – same would most likely be done for the consumption too. An enlightened dictator, who would also steer the energy use into more sustainable direction, would have a positive impact in Finland or even on a national scale. The fourth black swan was **"Human container" for marginalised ones,** meaning the isolation of those who are willing to detach from the society into the virtual world. This escape from the

physical world would dramatically change the society. Black swan number five was **Stimulation of *nucleus accumbens*** (also known as the pleasure centre of the brain), which refers to ways of how to escape from the mundane. The sixth black swan – **Caste confirmation** – would be caused by new caste system and new hierarchies. **Decisions instead of decision-makers! The whole democratic system based on referendum** was the black swan number seven, referring to a situation where decision-making would not revolve around individual representatives anymore. The final three black swans referred to social relationships and reputation. If one loses reputation, **resetting one's own life and thus regaining memory and trust classifications** may become the only choice. Also, the **selling of one's physical body for forced labour** or for an **unwanted position in politics** could be a solution. Marginalisation could also lead into **becoming embittered and trying to bring down the information system** and thus **returning to the Stone Age.**

Finally the implications of the black swans on renewable energy were discussed. New lifestyles could have major impact on energy consumption. If people would escape to the virtual world and keep their so-called **physical needs in minimum,** this would decrease the consumption of energy**. Increasing the taxation on fossil energy radically** – by the enlightened dictator for example – would make the excessive energy consumption impossible. Once politics would not concentrate around individual decision-makers, **a common decision for national energy allocation or budget** that limits the consumption could be possible. If people would feel happy about living in a virtual world, with their physical bodies in containers, it would not make a difference where they are settled. If, quite radically, the containers would be situated in space, they would not consume the energy on Earth.

5. RESULTS OF THE POST BLACK CROSS IMPACT ANALYSIS WORKSHOP

A Post Black Swans Cross Impact Analysis Workshop was held at the FFRC Helsinki office on the following day of the futures clinique. This was a methodological experiment to combine anticipation of black swans to identification of their impacts on four scenarios in a cross impact matrix. A tentative title for this hybrid method was chosen as "post black swans cross impact analysis".

The purpose of the session was to test the four societal Neo-Carbon Energy scenarios with black swans that were generated at the futures clinique the day before (Chapter 4). The participants of this session were Karlheinz Steinmüller, Osmo Kuusi, Amos Taylor, Sirkka Heinonen, Juho Ruotsalainen, Marjukka Parkkinen and Juho Ruotsalainen.

Figure 16. *Karlheinz Steinmüller, Sirkka Heinonen and Juho Ruotsalainen analysing black swans and their implications on the four Neo-Carbon Energy scenarios. Photo: Marjukka Parkkinen.*

In the beginning of the session the black swans generated in the futures clinique the day before were discussed. The most interesting ones from the following list, which combines the results from the seven groups, were chosen for cross impact analysis for a further analysis:

- Mega deaths
- Giving up capitalism
- Revenge of the fossil fuel industry
- Total industrial turning point reached
- Clean energy for all
- "new winner tech."
- Reformed UN
- Takes control of means of production because of climate disasters
- World fulfils with junk
- Internet collapse
- Collapse of powergrid
- Super-zika epidemia
- Collapse of a major state/Saudi-Arabia
- Military conflict between regions
- Failed innovations
- Leaders blind to consumers: needs, values, practice
- Political shutdown of capitalist system (democracy led by citizens)
- Forced regionalism
- *Electricity allergy*
- Some people say that they have a condition that they cannot bare electricity – what if more people start feeling this way? It becomes trendy?
- Global communality - Finding extraterrestrial life
- Nation states disappear
- Mass deaths, even genocide following climate refugees
- Virtual civil war (inside/between closed networks)
- Humans revolt – disown tech & go medieval
- Robots revolt/out of control
- Cyborgs
- Weaponization of civil robots
- Global (benevolent) govt
- Decision to cut down the number of people – gene selection?
- Killing the wise people and keeping the stupid, easily controlled ones
- Positive, wise "Hitler"
- "Human container" for marginalised ones
- Caste confirmation
- Decisions instead of decision-makers! The whole democratic system based on referendum
- Stimulation of nucleus accumbens
- Resetting own life (memory and trust classification)
- I sell my physical me? Forced labour? → Person devoted for politics?
- I become embittered → I bring down the information system → return to Stone Age

Seven black swans or combinations of different black swans were chosen for a cross impact analysis. Incomprehensible black swans were left out. The group also made additions to the chosen black swans. After defining the black swans or their combinations, the group systematically discussed their impacts on the four transformative Neo-Carbon Energy scenarios utilising a post black swans cross impact analysis matrix (Table 3).

Table 3. *Post black swans cross impact analysis matrix.*

Trans-formational Scenarios 2050 / Impacts	**Radical Startups**  Society is organised around startups, which serve social and cultural goals besides economic ones.	**Value-Driven Techemoths**  Large technology companies, with a peer-to-peer ethos, have become "states within states".	**Do-It-Yourself Engineers**  Citizens have organised as local communities to survive and ecological collapse.	**New Consciousness**  Shared identi-ties replace individualism. Robotisation and AI have enabled a self-actualizing economy.
Black Swan 1	**Quantitative** **Qualitative**	**Quantitative** **Qualitative**	...	
Black Swan 2	**Quantitative** **Qualitative**	....		
Black Swan 3				
Black Swan 4				

Both semiquantitative and qualitative implications were considered. The arrows indicate whether the semiquantitative implications of the black swan would be positive or negative. The amount of arrows refers to the extent of the implications. Due to limited amount of time, two black swans and their implications were not analysed. The results of the session are provided in Table 4.

Table 4. *The results of the Post Black Cross Impact Analysis Workshop.*

Black Swan	Radical Startups	Value-Driven Techemoths	Green Do-It-Yourself Engineers	New Consciousness
Total industrial revolution (bio or 3D). Sudden breakthrough in inexpensive 3D is ecologically friendly, data-	QUAN: +, ↑↑↑ Boosts the Startups QUAL: Startups 3D print their renewables solutions. Fits small scale. Standardization problem. Problems	QUAN: ↑ QUAL: Monopolisation of 3D could stagnate economy. Further polarization. 3D print skyscrapers.	QUAN: ↑ QUAL: Recyclable 3D materials. Self-made 3D printers.	QUAN: ↑↑ QUAL: Open source of 3D, open ownership

driven, customized, close to consumers.	because a big pool of data does not exist.			
Collapse of the U.S.A. Divide of the country. Political vacuum. Infrastructure collapses. Weak social security and education. Independent 'California'. Return of the Wild West.	QUAN: ↑ QUAL: Exodus of US scientists and Silicon Valley. Radical startups in other countries.	QUAN: ↑ ↓ QUAL: Asian techemoths in China and India. Strong company power. US techemoths fall, Asian rise.	QUAN: ↑ (US) ↑ (others). QUAL: Multiple DIY communities especially in the US. Re-juvenation of the USA.	QUAN: ↓ ↓ QUAL: Security, US mercenaries. World of fear of other 'failed states'. Vulnerable. Militant Buddhism.
Mass deaths due to climate change. 'Methane bomb' from the melting permafrost.	QUAN: ↑ QUAL: innovations/ solutions to help or prevent. Changes ethos of startups profoundly. Or "we told you so". Anti-fragility.	QUAN: ↑ ↑ QUAL: police-state like techemoths. Techemoths called to help, safe havens for survivors. Gov't cannot help.	QUAN: ↑ ↓? QUAL: Survival of the fittest. Closed self-sufficient communities. Gov't cannot help.	QUAN: First ↓ ↓, then ↑ ↑ QUAL: Empathy. First shock, then rethinking collective action.
Revenge of the fossil fuel industry.	QUAN: ↓ QUAL: Commercial, cyber warfare against RE startups. Some countries abandon Paris agreement. Finance fake news.	QUAN: ↓ ↓ QUAL: Old money vs. new money. Large oil companies warfare against RE techemoths. RE finance bubble blown by fossil companies. Dumping of the oil price.	QUAN: ↓ ↓ QUAL: DIY Engineers (and hobby technologies) criminalized and sanctioned. Execute activists.	QUAN: First ↓ ↓ ↓, later ↑ ↑ ↑. QUAL: Evangelisation of fossil thinking. Missionaries of the old world. Fake consciousness. But mostly revenge fails.
Digital Anarchy. Virtual civil war. New forms of warfare. Your virtual existence is deleted or shamed.	QUAN: ↑ QUAL: Drone terrorism with facial recognition. Russia and North Korea as terrorist states. Hacked robots/IoT used in attacks.	QUAN: ↓ ↓ QUAL: Outside hackers as a counterforce. Very vulnerable.	QUAN: ↑ QUAL: Life without Internet is "normal". Neo-luddites Internet-free. Back to analog tools / ways of produce. Back to handmade world.	QUAN: ↓ ↓, later ↑ QUAL: Vulnerable online life. Carbon capture. Diabolization of fossil thinking.
Collapse of Internet and Power Grid. Electricity allergy.	QUAN: QUAL:	QUAN: QUAL:	QUAN: QUAL:	QUAN: QUAL:
Others: Robots revolt. Stimulation of neural pleasure system.	QUAN: QUAL:	QUAN: QUAL:	QUAN: QUAL:	QUAN: QUAL:

When looking at the assessment of black swans (Petersen 1997, 2003): rate of change, reach, vulnerability (and whether a society can adapt to it or not), outcome, timing, opposition and power factor. It was stated that more clearly defined black swans are required to use this assessment criteria. With many black swans there is a need to understand their origins; otherwise black swans are too large or general to analyse. Furthermore, black swans that leave no room for surviving are not worthy of analysis. For example, an asteroid hitting the Earth and destroying all scenarios is an example of a black swan that does not generate different impacts for different futures depicted. Accordingly it was stated that the black swans in the session prove that the scenarios differ sufficiently.

In the discussion it was stated that the black swans are prone to leave out the richness of the scenarios, as only the main actors of the scenarios are addressed. The analysis concerns mostly the pioneers within the scenarios, and it was seen necessary to concentrate also on the regular citizens in further analysis. Interestingly, the New Consciousness scenario was seen as the most vulnerable one, as it is also the most utopian one.

Finally, it was stated that the black swans offer a useful tool to test scenarios, as they reveal possible need to re-visit the gaps within scenario stories. Instead of aiming to 'save' scenarios from black swans, it is more important to critically observe the future presented in it. Do Black Swans advance, postpone or destroy a scenario? Is this change at the core of the scenario or not?

6. CONCLUSIONS

The future always brings about surprises. Ten years ago, only few could imagine how quickly renewable energies could claim ground – as exemplified by the rise of solar photovoltaics – how close we now are to autonomous vehicles, or how the political atmosphere in Western societies has changed. In anticipation, it is thus crucial to pay attention to not only trends but also to weak signals and black swans, as unexpected events. However, perhaps even more important than weak signals or black swans are discontinuities. Discontinuities are not sudden events or individual phenomena. They are long-term change processes which consist of different interlinking trends, weak signals, and black swans. It is precisely these broad and deep processes of change that, in the end, change the world.

In thinking of the rapid pace of technological development, one may make the claim that in the present, discontinuities are increasing. If this indeed is the case, it has partly to do with energy as well as new energy technologies. When new energy systems provide more energy than their predecessors, additional energy can enable the use of new technologies, to create even more complex societies. As we are preparing to take into use a renewable energy system that harnesses the abundance of solar and wind energy, changes could become faster, and even more transformative, than today.

The goal of this futures clinique was to map out such possible discontinuities. As we look at the results of the futures clinique, we can think and expect deep and cross-sectoral changes to emerge especially from 1) new risks, 2) converging technologies, 3) value changes, 4) environmental economy, 5) changes in big companies, and 6) geopolitical changes. Therefore, in the following we summarise the results of the futures clinique in more detail, with the aid of these six categories.

New risks. As the world changes, new risks emerge, and oftentimes we do not know how to deal with them. Amidst turmoil, we are seeking for sources of trust – from 'the new' and 'the old'. In the years to come, a major cultural issue concerns the relations of nationalism versus globalism and liberalism versus conservatism, and how they play out. If nationalism and conservatism strengthen, this could be a major discontinuity globally, and as such pose new risks. Processes of change, in turn, imply that we have to think in advance of the possible victims of transformation. New kinds of inequalities can also imply severe risks. If we are moving to a predominantly immaterial, creative and automated economy, what kinds of social issues will we have to deal with? Eventually, hacking/cracking, espionage, blackmail and surveillance could become so severe that the internet as we know it today may come to its end. People could recede into closed networks, platforms and services, and this would be a discontinuity in the development of the open internet.

Converging technologies. In terms of technology, convergence may be one of the main factors that disrupts linear developments. In this respect especially the convergence of humans and machines, "Internet

of Everything" (IoE), and autonomous transportation are key. As artificial intelligences become more developed, we may begin to think of them as our peers. Biochemical "robots" in our bodies would converge humans and machines in a very concrete way – and even change our consciousness if they had cognitive functions. Internet of "everything" refers to a situation where everything – our energy systems, businesses, leisure etc. – are thoroughly networked. Crowdsourcing and crowdfunding would become the prevailing norm, not the exception. If transportation became autonomous, it would not change only how we move but for instance how we socialize and design our cities. Transportation would become much more efficient, which would free city space for other uses and make crossing distances easier than today.

Value changes. Changes in values are fundamental, as value systems guide our behaviour. In terms of production systems, if more goods and services were exchanged peer-to-peer, outside established market mechanisms, this could shape how we today perceive the "free market". This, in turn, would have wide systemic effects. Whether we will live in market economies also in the future or not, the rupture of hierarchies could be expected to change the world. Among many other things, it would make cultures more pluralistic, and more prone to change. Values are also connected to identities and how we perceive our place in the world. In times of rapid change and increasing social complexity, developing, searching and realising oneself would become even more important than today. This could affect how we allocate the use of resources and what we expect to disrupt current trends.

Environmental economy. By 2050 the rise of an environmental economy may have changed societies much more than we can conceive today. Multiple new energy technologies and sources could lead to a situation where energy can be harvested everywhere. China, India and other developing economies, especially in Africa, may prosper in a way unprecedented. On the other hand, keeping the system running sustainably – including how circular economy can be used to deal with waste – is an immensely complex task. Information, big data analysis and artificial intelligences are thus imagined to be an integral part of an environmental economy.

Transforming large companies. The Facebooks and Googles of tomorrow may develop as all-encompassing entities that are involved in virtually everything. This would change the nature of such companies as some kind of semi-public actors (which they to some extent are already). This could be a positive thing, if their vast resources are put to good uses, but on the other hand concentration of corporate power is always risky. In any case, how these mega corporations change currently established paths is deeply uncertain. Already, the emergence of platform economy, thanks to technological change and peer-to-peer principles, has raised questions about the justification of profits and proposals about changes in taxation. And, can small, nimble companies that use global networks challenge these giants?

Geopolitical changes. It may well be that 'the West' decreases in significance in world politics – and thus its place in steering the global development. However, we do not know what the alternative is. Except for authoritarianism, what would be the guiding values of a post-Western world? Perhaps some kind of religious, national/regional conservatism? Or a mixture of these two? And, if sustainability gains increasing

importance, will this change geopolitics? Regarding the future, the core question in geopolitics is not which countries are expected to gain power at the cost of others, but what the cultural consequences of these power shifts will be.

Renewable energy is connected, in multiple levels, to these changes. Future technologies to be taken into use and use energy harnessed with renewables. Renewables, in turn, can be optimized and put into better use with technological change. A transformation to a world that runs on renewable energy, and synthetic processes generated from them, is about a creative destruction of the old that could be a holistic industrial revolution. As it is expected to create numerous opportunities, it is also about novel type of geopolitics and energy security, transitioning into a society that will be vulnerable to different kinds of risks than a fossil fuel based world.

The futures clinique findings imply further considerations for thinking about the future society that uses renewable energy. One useful way is to think with these six categories of discontinuities and renewable energy their deeper interlinkages and possible co-evolution. In a renewable energy system, the Internet of Energy/Everything, for instance, can co-evolve with circular economy for the environmental economy to be realised. Alternatively, the unexpected impacts of certain converging technologies may only be realised afterwards. Therefore, we may wish to enquire the values of emerging (and converging) technologies themselves. If the AI is embedded everywhere, will their algorithms be ethical and open to scrutiny, or closed and driven by self-interest? Are they developed by benevolent large companies or states, malicious rogues, or perhaps both? Such issues may shape *how* we interact in the human-machine interface of the future. As we have argued, vivid futures images, and their resilience, may be gained through exploring discontinuities. We expect such exercises to allow us to better understand changes and their interplay in a complex world. Thereby, we may form a more holistic picture of alternative futures to be interpreted in diverse settings.

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APPENDIX 1. Programme

PROGRAMME

Surprising Energy Futures
Testing Resilience of Renewable Energy World with Black Swans

17th May 2017, 11:30 AM – 4:15 PM
Sitra, Itämerentori 2 (14th floor), Ruoholahti, Helsinki

11:30	Light lunch and coffee – Futures Window
12:00	Opening words **Paula Laine**, Director, Foresight, Insight and Strategy, Sitra
12:10	Futures Provocation for Surprising Energy Futures **Prof. Sirkka Heinonen and the FFRC research team**
12:25	Black Swans and VUCA World **Dr. Karlheinz Steinmüller**, Millennium Project
13:05	Comments, **Prof. Jarno Limnéll**, Aalto University (video)
13:15	Thematic work in breakout groups
15:30	Cross-fertilisation and Concluding Discussion
16:15	Event ends

#blackswans2050

Finland Futures Research Centre organizes this Futures Clinique in co-operation with Sitra (Carbon-neutral circular economy) and the Millennium Project (Millennium Forum).

APPENDIX 2. Participants

Auffermann Burkhard, Finland Futures Research Centre
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Child Michael, Lappeenranta University of Technology
Clément Nathalie, KPMG Oy Ab
Gijzemijter Liselotte, EKOenergy
Hatanpää Olli Pekka, Helsinki-Uusimaa Regional Council
Honkapuro Samuli, Lappeenranta University of Technology
Höysniemi Sakari, University of Helsinki
Kari Hannu, The National Defence University (NDU)
Karjalainen Ari, Helsinki City
Kering Naomy, Student
Keronen Jouni, Climate Leadership council ry
Kiiski Kataja Elina, The Finnish Innovation Fund Sitra
Koljonen Tiina, VTT Technical Research Centre of Finland Ltd
Kouri Sampo, VTT Technical Research Centre of Finland Ltd
Kuitunen Aino, Lappeenranta University of Technology
Kuusi Osmo, University of Turku
Laaksonen Petteri, TuuliSaimaa Oy
Lahti Liisa, The Finnish Innovation Fund Sitra
Laine Paula, The Finnish Innovation Fund Sitra
Larmo Maija, Tmi Maija Larmo
Matero Laura, Turku School of Economics
Nareiko Aleksej, University of Turku
Nisula Sakari, Turku School of Economics
Ozolina Karlina, EKOenergy
Partanen Lotta, Fortum Oyj
Pitkänen Alex, The Ulkopolitist
Prasla Shameer, Entrepreneur
Primmer Eeva, Finnish Environment Institute (SYKE)
Salovaara Janne, Big Plans Bakery
Schuen Claire, University of Turku
Similä Lassi, VTT Technical Research Centre of Finland Ltd
Sivonen Risto, Turku School of Economics
Tiensivu Maaria, 15/30
Tyrväinen Timo, Climate Leadership Council
Vainikka Pasi, VTT Technical Research Centre of Finland Ltd
Vähäkari Noora, Finland Futures Research Centre
Åkerman Maria, VTT Technical Research Centre of Finland Ltd

Moderators

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Kurki Sofi
Laurén Leena-Maija
Parkkinen Marjukka
Ruotsalainen Juho
Salminen Hazel
Taylor Amos
Finland Futures Research Centre

Supervisors

Heinonen Sirkka
Finland Futures Research Centre
Steinmüller Karlheinz
Z-punkt

APPENDIX 3. Background Material

Surprising Energy Futures

Anticipating Discontinuities & Testing the Resilience of Renewable Energy World with Black Swans

Neo-Carbon Futures Clinique
Background Material

Juho Ruotsalainen, Sirkka Heinonen, Joni Karjalainen and Marjukka Parkkinen

Helsinki 20 April 2017

FINLAND FUTURES RESEARCH CENTRE

NEO CARBON ENERGY

What is Neo-Carbon Energy?

Neo-Carbon Energy is a research project of VTT, Lappeenranta University of Technology (LUT) and Finland Futures Research Centre (FFRC). The project investigates a 100% emission-free energy system by 2050. Energy would be produced mostly by solar and wind, managed by increasingly smart grids, and stored in batteries and synthetic hydrocarbons, such as methane. Excess electricity from renewables will be converted into synthetic materials, chemicals and fuels, to even substitute fossil fuels.

The futures research part of the project anticipates possible societal implications of such an energy system. This task rests on three assumptions: 1) the energy system will be distributed (at least to some extent), and consumers will become energy producers (so-called *prosumers*), 2) the marginal costs of energy will fall, and consequently so will the costs of production and living, 3) the amount of available energy will increase, and 4) an efficient circular economy will emerge so that the system is sustainable also material-wise. Together these changes are anticipated to promote a peer-to-peer society, in which citizens, their communities and related networks have a much bigger role than today. The socio-cultural scenarios of the Neo-Carbon project map out four different futures of a renewables-powered peer-to-peer society (for the working paper of the scenario drafts, see Heinonen et al. 2016[7]).

Throughout history changes in energy supply have led to dramatic social, economic and cultural changes. Agriculture led to permanent settlements, and eventually to first civilizations. Coal and steam engines led to the industrial revolution, which laid the foundation for our present societies. For someone born in the early 20th Century, our most recent societal development would have been very hard to grasp.

Now, with the rise of renewable energy we may be at the threshold of a similar societal transition. The current global energy consumption is approximately 104,000 TWh. The projections for energy demand in 2050 vary greatly. We can, however, assume that global energy demand will increase by 20%−30% by then, and that this demand can be supplied 80%-100% by renewables (REN21 2017). If we take into account further increases in energy efficiency and possible technological breakthroughs, the amount of available energy in 2050 can be much bigger than that of appx. 130,000 TWh. Economic and energy models that we employ today are based on current knowledge, and cannot capture the effects of technologies or techniques that have not yet been developed. David Roberts, an energy reporter says: *"It is viewed as irresponsible to include speculative new developments in models, but at the same time, it's a safe bet that the energy world will see dramatic changes in the next few decades."*[8]

[7] https://www.utu.fi/fi/yksikot/ffrc/tutkimus/hankkeet/Documents/NeoCarbon-WP1-1-2016.pdf

[8] http://www.vox.com/energy-and-environment/2017/4/7/15159034/100-renewable-energy-studies

Increases in the energy supply, and decreases in the price of energy, together with other technological and societal developments such as robotisation and artificial intelligences will steer our world into unknown futures. That is why it is increasingly crucial to anticipate emerging *discontinuities* in different sectors of society.

Anticipating Discontinuities and Black Swans

The future is often anticipated through continuous trends – through things that exist today and are familiar to us. This is mostly so because it is mentally less challenging to think of the future as an extension of today. And of course, the future resembles the present and the past. Not everything will change. However, what makes future really a future, in the futuristic sense, are the things and phenomena that are new – things that break the conventional and linear development paths.

To anticipate such changes we should first of all pay attention to *weak signals,* the first signs of change. For instance, in 1957 it was found that CO_2 produced by humans will not be readily absorbed by the oceans[9]. This can be seen as one of the initial signs of conceptualizing modern climate change. Or, at the end of 2016 it was reported that the iPhone manufacturer Foxconn in China is about to replace almost all of its workers with robots[10] – a sign of fully automated production.

In addition to weak signals, we can try to anticipate *black swans* (or wild cards), which Nassim Taleb (2010) claims explain almost everything that is significant in our world. Black swans / wild cards are sudden, surprising, unanticipated events with broad and radical consequences. Think for instance the 9/11 attacks or the fall of the Berlin Wall. A cluster of weak signals may point out to a black swan.

Black swans are, however, rather "unpractical" as a method for anticipation, because they are by definition very difficult to anticipate. **Instead, we can pay attention to and analyse *discontinuities*. They are not sudden events, but gradual, long-term and deep processes of change consisting of different interlinking trends and weak signals (or new phenomena)**. A discontinuity, or different discontinuities together, can "launch" a black swan. Black swans can, in turn, initiate or strengthen a discontinuity. Futurist Marcus Barber has said that a series of interrelated discontinuous events might achieve a similar outcome to a big one-off black swan event[11]. One can also argue that discontinuities eventually bring about more deep and radical changes than black swans, as they are not one-off events but longer processes.

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[9] http://history.aip.org/climate/timeline.htm

[10] http://www.theverge.com/2016/12/30/14128870/foxconn-robots-automation-apple-iphone-china-manufacturing

[11] https://en.wikipedia.org/wiki/Cascading_discontinuity_set

Issues that constitute a discontinuous development process often emerge from different fields. Consider machine learning, which is starting to converge with other technologies in a variety of unexpected ways. Together with patient data and an algorithm, machine learning can predict breast-cancer risk 30 times as fast as a human can (Greenberg et al. 2017). Or imagine what clean, low-cost and abundant solar electricity can achieve, if it is combined with hi- and low-tech robots, in industries and at homes.

The issues and trends behind discontinuous development processes are often regarded as unrelated and irrelevant. Because of complex interconnections and apparent insignificance, **discontinuities may not be easily recognised and are ignored**. (Grossmann 2007; Drucker 1968.) For instance, ecological deterioration can have a significant impact on the global economy, but this is seldom taken into consideration in economic projections. Indeed, discontinuity is a feature of **complex systems** (Cilliers & Nicolescu 2012).

A system is complex if it is interconnected with numerous other systems and if its cause and effect relations are not linear – the world economy is a complex system (virtually everything that happens in the world affects the global economy), whereas a combustion engine is not. **If the world becomes increasingly complex, for instance because of interconnectedness of nations, so too should discontinuities increase and the world become more volatile**.

The internet and the First World War are illuminating examples of discontinuity. Both are often seen as 'black swan events', although in reality they are the result of longer discontinuity processes. The internet was invented in the 1960s, but began to spread and influence society in the early 1990s with the invention of the World Wide Web. There were many discontinuity processes during 1970s and 1980s that laid the groundwork for the spread of the internet, such as globalisation and transition from industrial to information economy. Actual black swan events in the history of the internet could have been the invention of the first graphic web browsers (Mosaic, Netscape), which made the internet easy to use for the masses.

The First World War, in turn, had many underlying processes such as militarism, nationalism, and strategic alliances between nations. Eventually, the war was triggered by the assassination of Archduke Francis Ferdinand in 1914, an event that may be claimed to be a black swan. However, numerous other events could have had the same effect. **From this perspective, black swan events are less important than the wider and deeper discontinuity processes behind them. Black swans can thus be seen as the culmination of discontinuity processes**. According to van Notten et al. (2005) "*Abrupt discontinuity tends to manifest itself through events but these are usually connected to underlying processes. In such cases, events are often the proverbial last straw that broke the camel's back*." Along these lines, the fall of the Berlin Wall was preceded by discontinuities in the Soviet system, for instance by Michael Gorbachev's rise to power and the politics of glasnost and perestroika (ibid.).

Some more examples on historic discontinuities:

- The decline in the ratio of energy consumption growth to GNP growth in the OECD countries after 1973 (van Notten et al. 2005)
- From the sixties onwards, the transformation from an international economy of interacting national markets, to a world economy with a single global market (Drucker 1968)
- The establishment of knowledge as the crucial economic resource (Drucker 1968)

With regard to energy, the rise of renewables, especially solar PV, is an example of a discontinuity process without a concrete black swan. It is also a good case in point in the difficulty of anticipation. No longer than ten years ago, almost no one anticipated a rapid fall in cost of solar PVs (and even today the International Energy Agency largely fails to grasp the fast progress of solar and wind[12]). A major cause for the discontinuity in the price of solar was China – often associated with coal rather than renewables – which was the first country to mass-produce and offer cheap solar PV panels. So, many trends – development of new energy technologies, the rise of ecological values, the spread of knowledge about climate change, grass-roots and prosumeristic ethos of the internet, changes in Chinese society & economy etc. – converged to tip the development off its linear path.

What will we do in Futures Clinique?

In the forthcoming Neo-Carbon Futures Clinique, we will anticipate discontinuities in small groups around the five themes listed below. These themes are selected because they have a lot of potential for discontinuous development – they are not linked to renewable energy as such (although transforming energy systems will have implications for all of them). We will also attempt to imagine black swans/wild cards, and foresee their impacts on the renewable energy world.

1) **Politics: nation-states, governments, geopolitics, new ideologies**
2) **Corporations and economy**
3) **Civil society & peer-to-peer practices**
4) **Robotisation & artificial intelligence (AI)**
5) **New lifestyles**

The groups will anticipate possible discontinuities in these fields by searching for answers to the following questions: How is the theme changing? What new issues have emerged compared to previous times? Is there something in the theme that has been neglected in current conversations? After identifying discontinuities or "clusters" of discontinuities, as well as their impacts, the groups will continue and anticipate possible black swans (foreknowing the unknown) and their repercussions on the world that is based on renewable energy.

[12] http://www.vox.com/2015/10/12/9510879/iea-underestimate-renewables

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APPENDIX 4. Interview of Karlheinz Steinmüller

Interview of Karlheinz Steinmüller on VUCA World and Black Swans

by Sirkka Heinonen at Finland Futures Research Centre (FFRC)

Helsinki 18th May 2017

Transcription by Sofia Zavialova, Millennium Project Intern/Finland Futures Research Centre (June 2017) for the Neo-Carbon Energy Project

SH: This is an interview and a great pleasure for me to make this interview with **Dr. Karlheinz Steinmüller from Z_punkt and the German Node of the Millennium Project.** Welcome to this interview!

KS: It's also a pleasure for me.

SH: We are now at the Helsinki office of Finland Futures Research Centre (FFRC), University of Turku. I would like to ask you some questions about the changing world, about all these uncertainties and surprises that are happening. You have raised the awareness that we are living in a VUCA world. **Can you open up a little bit what this VUCA world means?**

KS: Well, VUCA simply reads as this: 'V' for 'volatile' that means ever changing, 'U' for 'uncertain', you have always problems to predict, 'C' for 'complexity' that means many factors interacting and 'A' for 'ambiguity' that means that you have difficulties to make sense of it.

SH: Yes, and actually all those concepts in V-U-C-A, they are important in futures studies and especially these ambiguities, are really interesting. **Doesn't it mean that there are different interpretations where they are going to make sense of the change and world?**

KS: Yes, in a way, future studies lives from the VUCA world. If it, the world, would not be volatile, uncertain, complex, and ambiguous, we would have no job. So, it's very helpful and supportive for us.

SH: That's right. It's food for our thought. **You have been called Mr. Wild Card, because you are expert in this specific niche in futures studies. What is your definition of a wild card and can you give us a recent example of a wild card?**

KS: Well, wild cards are events or developments with a very low probability before that event and with a very high impact on the conduct of business or on the development of the world in general. And because they have low probability and they have a high impact, they come for most people as a surprise. And if you have a surprise you react not in an adequate way, you have no plans for it, and my main message is that we should always consider wild cards, so that we can think in advance, and have preparations, have always a plan B or a plan C in our mind. Recent examples, include, for instance, the BREXIT, which happened even to most British foresight people as a surprise, not to speak of the European ones, or the election of Donald Trump to American president. Such things happen always in politics. But then there are also technological

wild cards. Twenty years ago nobody would have depicted a future in which smartphones play the role they now have. In a way this was also not an event wild card but a development wild card.

I myself am very open to wild cards and I like wild cards because I experienced one really big wild card: This was the fall of the Berlin Wall, the implosion of the Soviet Empire and German reunification. And it came even to German science-fiction writers, to most of them at least, as a surprise.

SH: **So, then what do you say if wild card gets identified beforehand, it's not a wild card, really?**

KS: Well, sometimes I distinguish black swans from wild cards. Black swans are the real unknown unknowns, things for which we do not even have name, which are really not in our minds. But wild cards are things we have already identified, but they are different from risks since we cannot really assess a probability. They are singular events or developments, without any precedent. So that you have problems in assessing also their impact, though we can only say "well, low probability, high impact", but we have to guess the probability.

SH: Yes.

KS: We can speculate about impact. And this, of course, is wonderful for a futurist.

SH: **How about if you look at the past, so can we, do you think that we can learn from past wild cards and black swans and should we learn and how we learn?**

KS: Yes, we can and should. For instance, in 1996 and 97 there was a possible wild card called Y2K or Millennium bug, the Year 2000 Computer Problem. Because people identified this as a possible major disruption not only for computers but on everything which depended on computers, they took preventive methods, they deployed new software, therefore this wild card did not happen. It was mitigated…

SH: Right, that's right…

KS: This can happen to "poor" wild card that never realize. So, we really can do something about it. Or think about the election of Marine Le Pen to the French President. It did not happen. It was a wild card but, fortunately, in France the non-populists forces were strong enough to prevent it. So it's worthwhile to think about wild cards.

SH: Yes, that's right. **Then a little about the concept of weak signals, because weak signals or a cluster weak signals can be behind for a coming wild card or black swan, but according to your observations, can you name some examples of recent weak signals that have not yet been paid enough attention to, that we are ignoring some kind of weak signals?**

KS: Well, one or two years ago I would have said that the sudden decline in life expectancy in certain groups of especially male population in some countries would be a weak signal. For instance, in Russia we had it after the fall of the Soviet Union or in parts of the United States it is the Rust Belt, we had it in the low-income white population and this was a weak signal for political changes since people with such a bad living situation become angry and try to vote for populists or to do something stupid. So, this is a weak signal. The problem with weak signals is that the signal alone does not mean anything. You need always interpretations. You can go around in a city and observe what is changing but if you have no interpretation for the changes, it's perhaps a big signal but for nothing or you don't know for what and so it is no help for

you. As a matter of fact, the concept of weak signal in itself is a little bit difficult, since what does 'weak' really mean? Weak with respect to what? Perhaps, in relation to the impacts of the real thing for which the weak signal is a signal, maybe? Or 'weak' in comparison to other signals? You have always noise levels, in the present, noises which for instance come from trends. Trends are very loud noises, if you take it, poor weak signals are not strong enough against these noises. And next comes the term 'signal'. If you are a communication engineer, you would say "noise is no signal" and nobody has sent it. So it is one of the metaphorical terms of foresight; helpful, but one should handle it with some care.

SH: **And it's polemic and it's also subjective: 'weak' to whom?**

KS: Yes, yes.

SH: Then let's turn to technology foresight, because it's one of your key interest and also mine. So, **how do you see the role of technology foresight within the field of futures studies at this moment.**

KS: Well, I think traditionally technology foresight was overemphasized in futures studies, since one could rather easily design roadmaps for the future development of nearly established technologies. Not so for really emergent ones, which are not here, but for the ones we have already in the form of prototypes or ideas which are just leaving the labs. So, one could do something with it in difference to social foresight, which is much more difficult since it depends to a very high degree on perceptions and on ideologies, on your specific blindness and your own world-view. So, foresight people usually took technology as a starting base, and I hope and I think really that it is now changing a little bit. And if we put a bit more attention to black swans and to wild cards from the social sphere we avoid being too much focused on technology. Nevertheless, technology foresight stays in important part of foresight.

SH: Yes. **For me as well, I think technology rather as an enabler, it shouldn't be like the main driver or the dominating factor in, within futures studies, but an enabler or a platform. But on the other hand, we are in a very interesting position now with this artificial intelligence developments etc. So, what is according to your view the biggest challenge when we are developing interfaces between humans and machines?**

KS: Well, we have already interfaces between humans and machines – in the form of all these apps we run in our smartphones. And it is for me, well, difficult to predict what could happen in the interaction between the human mind and artificial intelligence. I do not so much think that we need brain implants or such things but that in everyday life we rely more and more on all these smart gadgets and software tools, which give advice to us, which perhaps navigate us in certain directions, which help us sometimes, which prevent some stupidities of us, perhaps, or which induce a new kind of stupidity in our behavior. So the interaction is an interesting thing. An example: In the last years we have observed the formation of these so called filter-bubbles. These filter bubbles are the outcome of an interaction between people and the Internet. I mean, search engines and so on. Therefore I expect much more in this direction, and the worst which could happen is that everybody is living in his or her personal bubble surrounded by his own artificial intelligence butler who helps them. Yes, but detached from other people. The best which could happen is, of course, that these tools help us to communicate better with each other, to understand better what the others want and what our own deep visions are.

SH: **And improve the state of humankind and nature, etc.**

KS: But, as always, it will have matured, and the future lies between all the scenarios we develop.

SH: That's right. **And now let's talk about a little bit of the renewable energy and renewable energy revolution, which is actually the topic of our TEKES funded Neo-Carbon Energy project. And when thinking about this renewable energy transition and revolution, what would you say as the key driver and as the key obstacle?**

KS: Oh, I suppose there is not one driver and not one main obstacle, but there are different drivers. One is of course market penetration and that more people are using renewable energy so it is driven partly by lifestyles and partly by, say, societal consciousness, and the other is technological development combined with market developments. I would say that one of the most recent key drivers was China with its strategy to produce photovoltaics at extremely low prices – which, by the way, pushed a lot of German companies totally out of existence. So, there are such drivers, and of course there are not only abstract and objective obstacles but real enemies to the revolution, large oil companies, for instance, who should find new business models, perhaps without oil or using oil for more sensible things than only burning it. A main obstacles, of course, is a certain inertia of society. It is for people not so easy to change their own way of life, to rely more on renewable energy, for instance, in the transportation sector. Transportation sector anyway is the one with the biggest obstacles to the energy transition, since it relies to a large amount on fossil energy. Only rail transportation is running on electricity now and even that is partly fossil electricity. So it would be good thing if we had not only electric cars but electric cars running on renewable electricity and not on the ordinary national portfolio of different energy sources. Much disruptive change is necessary in this field, and I think we need several transitions – or better: revolutions – combined to the energy transition: one is the transportation transition, another the food and nutrition transition. These fields are much more difficult to change than, say, heating of buildings.

SH: **So it's just mainly a technical thing, but social aspects are related to lifestyles…**

KS: And then there is another interesting problem, perhaps sometimes even an obstacle: the power demand of all our smart gadgets, of the Internet and all the devices. This power demand is increasing at terrible rates and at some places it is already 10% of the total power demand. Some companies install their server farms already in Northern countries, in the future even behind the polar circle so that they are cooled by the cold Arctic environment.

SH: **Yes, and the number of gadgets is increasing all the time and you have to have extra batteries with you to charge… But then can you imagine a black swan that would propel this renewable energy?**

KS: There is one very technical wild card: super conductivity room temperature. Well, I am a physicist and therefore I like such things. Up to now, we have super conducting materials that work at the boiling temperature of liquid nitrogen. It's about minus 196°C. This is already rather hot in comparison to temperatures around absolute zero, necessary for conventional superconductors. If we would succeed in developing a material which has no electrical resistance at either 0°C (centigrade) or even better 25°C, we could construct electrical power storage elements, super conducting circular coils with tremendously high capacity and no loss at all. We could build such super batteries into cars. And we could use super conducting wires for high voltage transmission without any losses. A solution to the storage problem would

help wind power and solar power quite a lot. Storage is one of the main bottlenecks now and superconductivity at room temperatures would be a solution but it is highly, highly improbable.

SH: **Yes, and it fits the definition of the black swan. How about geopolitics, can you imagine black swan for Europe and that would have dramatic impact on Europe?**

KS: Well, one can imagine a lot about a better political architecture of Europe. For instance, if nation states, the member states, which are still the strong part of the European Union, would give a little bit of their power to the cities, the communities, the regions, that we would have not only the European Parliament with parties from the different countries but a real secondary parliamentary body with representatives from the regions and from the main cities. If they hada real say European affairs – with positions different tothe political parties and the member states – then they could bring Europe closer together. Another idea would be to give some NGOs more influence, but NGOs are lobby groups itself so it's difficult to define which would be the right constitution of this, well, civil society advisory body for the European Union.

SH: **It would create some kind of new landscape for the power.**

KS: Yes, we need a new political architecture for the European Union. Not United States of Europe, but something like United Regions of Europe or the United Tribes of Europe.

SH: **Yes, and now, the final question. Yesterday you gave an excellent talk at our fifth Neo-Carbon Futures Clinique and the title for that Clinique was "Surprising Energy Futures for testing resilience of renewable energy world with Black Swans". We had some 50 participants at SITRA and we tried to anticipate black swans and discontinuities and their implications on our society. Considering your experience yesterday at the Clinique, was there something that struck you or you found surprising personally about this? Because you heard also the results briefly presented.**

KS: Well, I was struck by the very strong part played by political considerations. Of course, there were lots of black swans related to technology but there was also very strong thinking about political architecture and what would be needed from political leaders. Perhaps the most important black swans for renewable energy are there in the fields of society and politics. They are not technology, not super conductors, but they are superforesighting human brains.

SH: That was a nice observation. So, Dr. Karlheinz Steinmüller thank you very much for this interview.

KS: It was a pleasure, Sirkka.

SH: Thank you.

APPENDIX 5. Results of the Futures Clinique 17 May 2017

Group 1A. Politics: nation-states, governments, geopolitics, new ideologies

Session 1

Population growth vs. population collapse?

- Regulating population
    - Trust/Education/Health = 2 kids – young couples
- Population growth vs. population collapse?
- Eco-anxiety = population growth
- Reproductive rights for women
- Common value unified ideology?!
- Population growth in the poor parts of the world, no economic basis for survival → increase of refugees 100 times more than 2015

Role of energy policy?

- Consequences of climate change → catastrophe, as politics fail
- Climate change has to be tackled, otherwise more and more sectors will collapse
- Green growth opportunity
- Strong policy in renewables pushes some countries, such as India, China
- Forced migration changes idea of nations
    - Finns move to Norway?
- Fossil fuel industry fight against sustainability
- Media impact
- Corruption (legal, illegal)
- Fossil/oil gets really nasty!

Smart political adaptation?

- (China) new deal 'capitalism'
- Regionalism
    - The Pacific
- Smart regulated market
- OBAOR
    - One Belt And One Road
- Future of capitalism? Beyond money in own pocket
- Not enough wealth (?) for too many people
    - Capitalism not able to deal with humans and their needs?
    - Regulated markets? → limits
- Long-term planning in need!
- Politics in crisis mode
- Short-term oriented
- Less long-term actions

Threat of nationalism?

- Role of nation-state vs. multilateralism
    - EU integration or re-nationalisation?
- Does the EU still exist? Is it relevant? Does it have any significance/relevance in this future?
- Future EU?!
- Right-wing populism
- New nationalism
- New 'strange' political alliances
    - Good and bad
    - Globalization has to produce more winners/faire results; otherwise populistic nationalists may take over
- Current issues that will affect future 2050
    - Rise of nationalism/populism worldwide
- Related to lack of/inefficient education
    - Changing world powers that result in uncertainty and fears
    - In globalizing world nation-states become less important → societal change results in fear → rise of nationalism
    - Future of EU

Session 2

Discontinuity 1: Population growth vs. population collapse

- Education, reproductive rights, health care, trust, gender equality
- Individualism
- Food security, health, social security
- Strong women lead the way
- Forced migration

Discontinuity 2: Threat of nationalism?

- Education needed
- Weak international cooperation
- New strange political alliances (regional cooperation)

Discontinuity 3: Smart political adaptation?

- Education, preparation to participation
- NGOs gilling gaps (e.g. Greenpeace, WWF)
- Long-term planning needed
- Future of capitalism: beyond the money in the pocket

Discontinuity 4: The role of energy policy

- Education, but the problem is power of lobbyists etc.
- Strong vs. weak economic development
- Decentralisation small unis for energy production

BLACK SWAN	RENEWABLE ENERGY
Mega deaths • Caused by Forced migration	More off-grid energy production
Giving up capitalism • Caused by New strange political alliances (regional cooperation)and Future of capitalism: beyond the money in the pocket	Smart political planning possible
Revenge of the fossil fuel industry • Caused by Education, but the problem is power of lobbyists etc and Decentralisation small unis for energy production	

1B. Politics: nation-states, governments, geopolitics, new ideologies

Session 1

- Networks of cities replace nation states
- Areas suitable for farming drain and new ones are not acquired fast enough
- Environmental awareness increases
- Eruption of a super volcano → 5 years of nuclear winter
- Melting of Greenland → +7 m sea surface → nuclear power plants stop (Sarasvatin hiekkaa)

Cluster 1

- Value: source critique
- New generator of meaningfulness emerges as a counterforce: environment + (ownership) subsistence
- What do young people want?
- Identity: (or trans-...) post-humanism? (Post-internet generation)
- What is the next big ideology?
- Ideology: individualism or collectivism?
- Value: Buddy is not left behind
- Future of (trans)nationalism: Ethnic of civic? Fades away or resurgence?
- Supranational "tribes" grow
- Youth:
    - Tolerance
    - Responsibility
- Variation – adventure

Cluster 2

- Integration of new residents succeeds
- Immigration increases
- 2050-2100

    - 80% of World population lives in Africa and Asia

Cluster 3

- Rupture of work and working vs. leisure time/revenue logic
    - Virtual"mobility" as an enabler
- "It was close –scenario"
    - India – Pakistan nuclear crisis, cf. Cuban crisis
    - Escalation or de-escalation?
- Geopolitical tension, e.g.
    - South China sea
    - "STANS" region
    - Middle East region
- Global competition of leadership
- Resource/natural resources scarcity & localisation
- "Geopolitics in space"
    - Weaponization of space?

Cluster 4

- Protectionism cracks institutions regulating markets
- Trust in constitutional state collapses
- Blockchain technology changes agreement convention
- The decision making power disperses from nation states to large corporations
- Market economy cracks nationalist protectionism →
    - Regulation harmonised
    - Principles yield
- Speed of change increases → reaction needs to be faster
- Social change → politics and markets become sustainable
- Responsibility of citizens and corporations replaces edicts
- Consumers lead the transition
- EU becomes a federation
    - Unitary defense
    - Infrastructures
    - Energy markets
    - Taxation
    - Third biggest in population in the World

Session 2

Discontinuity 1: New values & ideologies

- Difficulties in dismantling the market ideology
- What are the new, emerging value systems like?

Discontinuity 2: The relationship between markets and states

- Massive "evil corps"
- Centralised corporate power leads to exploitation of workforce, natural resources, and their externalities

- "The ownership" of natural resources, the development of R&D
- A broad industrial breaking point – a shared effort
- Financial shocks caused by algorithms

Discontinuity 3: Technological change

- New space junk, new technology – new waste
- The sustainable cleaning of CO2 from the atmosphere -> C/CO2 as a valuable resource
- AI replaces use of material/natural resources → global use decreases
- New unforeseen technological convergences
- Will 3D printers merely produce more material?

Discontinuity 4: Geopolitical changes

- We do not know what is the "Chinese thing" – are traditional analytical lenses suitable?
- Detachment from fossils → other natural resources sum of crisis
- Who has a motive to build a global electricity grid – who benefits? What about problematic situations?
- The drowning of the coastal cities under the water encourages to renew global governance

BLACK SWAN	RENEWABLE ENERGY
Total industrial turning point reached	
Clean energy for all "new winner tech."	Human rights violation UN-case Clean energy for all – for violating the principle
Reformed UN Takes control of means of production because of climate disasters	
World fulfils with junk	

2A. Corporations and economy

Session 1

Internet of Energy/Everything

- Ecosystems & networks & platforms
- Democratisation through connectivity
- Exponential growth of actors
- Change in taxes – circular economy
- Digitalisation IOT/IOE
- Development of platform economy (platforms)

Implications of climate change

- Development of platform economy (platforms)
- ⬆Responsibility

- World largest demonstration
    - 1,5 ° limit

Alternative facts

- Corporations vs. sovereign stores
- Revenge of the "fossil world" → USA elections
- Alternative facts
- Cultural and material power of fossil driven companies
- Exhaustion of cash flows of an energy company

Solar economy

- Fossils USA | ICT China India
- Rapid drop of costs of energy electronics
- Vulnerability of ICT
- Energy changes
- Winner takes it all

Session 2

Discontinuity 1: Internet of Everything

- Crowd funding/crowd sourcing ⬆
- Chaos & 0 (IT)
- Emergence of circular economy
- Untangibles
    - Services
    - Business
- Platforms, networks, ecosystems
- Death of distance

Discontinuity 2: Solar economy

- Cheap energy, value is in the information
- Multiple new energy resources → energy everywhere
- Chaos 3.0 (energy network collapse)

Discontinuity 3: Climate change implications

- Price of coastal real property drops → financial crisis
- Stock of pile-driving companies goes up
- Construction never ends!
- Fish breeding ⬆
- Water world
- Wild fish
- UAE Iceberg business
- Health ☹
- Front-loaded strategy for immigrants
- Artificial nutrition
    - ~~o~~ Protein sources

- ~~o~~ Vegetarianism → Vegan

Discontinuity 4: Victims of transformation (corporations & people)

- Unrest
- WW III (N)
- Potential workforce
- Cultural differences

Idle labour and human power

BLACK SWAN	RENEWABLE ENERGY
Internet collapse	Significant delays in development
Collapse of powergrid	Manual mode for all systems
Super-zika epidemia	Economic slow-down
Collapse of a major state/Saudi-Arabia	Military mode
	Death of the old worlds

2B. Corporations and economy

Session 1

Big natural disaster and implications (cf. Fukushima)

- Magnetic center changes
- Seas drained of food
- Discontinuity by 2050
    - Water level ⬆ by 7 meters → world wide refugee crisis

Failed innovation

- Economic shock resembling financial crisis

Change of operational environment

- Regionalism → free trade not possible → global economy falls
- Breakdown of EU and similar changes to markets

Change of consumption habits/change of production systems

- Awareness of people impacts their consuming habits radically when it comes to energy
- (Policy change) Zero waste society → only fully circular ecosystems survive

Discontinuity by 2050
End of consumerism of material goods
Change of population of companies

- Virtuality enables i.e. new forms of companies → networked → large companies not needed in global economy
- Rise of African economy enabled by limitless energy

Technological ruptures

- Technological ruptures → eco systems not stable
- Automatization of all transportation & logistics
- Tesla succeeds with their PV projects
- Big technological breakthroughs (electric cars, 3D printing, batteries, PV, etc, etc)
- Changes brought about by robotisation/digi
- Universal pay → funded by corporate tax?

Corporate states

- Companies start to be self-sufficient
    - E.g. big mills producing their own energy
- Corporations grow bigger than states → discontinuity: corporation leads democracy
- Historical comparisons
    - Medicis
    - Hanseatic merchants

Session 2

Discontinuity 1: Change of operational environment

- A corporation cannot act beyond national borders
- Exchange between national economies becomes more difficult
- Raw materials, products and services not available everywhere
- Inequality regionally inside a country/between countries
- National alliances collapse (EU)

Discontinuity 2: Technological ruptures

- Change of work, labour markets, payroll systems
- New forms and services of mobility
- Idleness
- Technology dictates behaviour
- More creativity
- More conflict
- More efficiency
- Attitudes against technology

Discontinuity 3: Corporate states/Change of population of companies

- Rupture of democracy (power shifts)
- Citizen votes as a shareholder or a consumer
- Company leads by regulating availability
- Closed circulation (big company) vs. open circulation (virtual)

Discontinuity 4: Change of consumption habits/Change of production systems

- "The lightbulb" burns forever, all electronic whitegoods, gadgets will last forever → service economy + 500 updates
- Organizations and societies with advanced capabilities in robotics (fast, cheap, accurate) will thrive

- "Material account" accumulates digital currency
    - Resold, raw materials, scrap (zero waste)
- Only circular economy survives

Discontinuity 5: Failed innovations/Big natural catastrophes

- Increase of regulation
- Fear of technology

BLACK SWAN	RENEWABLE ENERGY
Military conflict between regions	
Failed innovations	
Leaders blind to consumers: needs, values, practice	
Political shutdown of capitalist system (democracy led by citizens)	
Forced regionalism	
Electricity allergy Some people say that they have a condition that they cannot bare electricity → what if more people start feeling this way? It becomes trendy?	

3. Civil society & peer-to-peer (P2P) practices

Session 1

Top Down P2P

- Peer-to-peer models do not necessarily emerge from bottom-up, but top-down
    - Large corporations as drivers of P2P
- The "probable" future of P2P?
- Merging of small communities and units as new "giants"
- Or dominance of large corporations
- ??????? (Oulun Energia)
- It may well happen that i.e. municipal energy facilities start spreading solar panels systematically and create a new client base for themselves
- People not necessarily happy in small communities
- Natural tendency of networks grows
- Primus motors
  ➔ Individuals
  ➔ Organisations
    - Business still ???
    - SIB ← → service providers
    - New kind of entrepreneurship/business
    - ??? lippakioski

- (New) interesting thing – Finland 100. It feels like these transitions, discontinuities, are observed more through the history ← spiritual level and preparedness ← to observe through

New trust

- Trust <> AI/bot ← → Could it be confirmation for trust
- The closer you are to institutions/networks, the more trust grows?
- Could trust be based on new economic and production system?
    - On 3D printing, basic income, urban agriculture
- (A large) part of work tasks are unnecessary
    - Can be suspended or replaced with automation
- Change of ?????/????
    - New trust systems/institutions
        - Peer-to-peer feedback
        - Blockchain
- Citizen climate pledge → citizen's environment awareness → could it function as a catalyst for communality
- The rise of climate awareness → consumer choices become more low-carbon
- Examples of rapid changes in consumer preferences:
    - Local food popular
    - Emergence of small brewery beers

Both international trends in developed countries

Risks of internet grow

- Exacerbation of web use and increase of risks → implications to P2P?
- Closed networks?
- Self-sufficiency creates resilience
- New rise of physical peer-to-peer networks as an alternative to organisation through web
- Away from Facebook etc to smaller services
- End of urbanisation? Aim to communality in cities as well

Dark side of P2P – "new inequality"

- Sociocultural reorganisation of humans intensifies
- Fragmentation and new localisation vs. global forums of learning and exchanging ideas (also ????)
    - DVS spreading technologies via 3D printing
    - Local economy of local networks
- What happens if everyone does not want to/cannot become a part of citizen networks?
- Cultural context is relevant = can we assume same development everywhere in the world?
- Digitalisation enables real democracy
    - Good or bad thing for the humanity?
    - Will it realise after all?
- Counterforce for climate activism can strengthen: "black-blue bubble"
- Evolution "reverses"¨
    - Development of life expectancy and intelligence
    - Natural selection does not work

Session 2

Discontinuity 1: Top-down P2P

- Conquesting space/Mars
    - Story that a company sells itself with
- Minerals from asteroids
- Small entrepreneurship disappears
- Multiculturalism disappears
- However, big actors are flexible and give freedom for customers

Discontinuity 2: Dark side of P2P

- Status of minorities
    - Illiterates
    - Disabled
- Crumbling of representative democracy
- Movements with single agenda
    - Emerge and disappear
- Vote for and against
- Bouncing politics

Discontinuity 3: New trust

- VR communities multiply and increase trust + all senses
- Virtual tourism (Street view as a weak signal)
- Hyperloop etc. new forms of mobility invested in
- New institutions creating trust
    - Need to be created
    - AI, funding, etc.
- Increase of citizen environmental awareness

Discontinuity 4: Internet risks explode

- Localism, self-sufficiency, physicality
- Closed small communities
- Hierarchies increase – Pressure of communities grows

BLACK SWAN	RENEWABLE ENERGY
Global communality - Finding extraterrestrial life	Everyone has panels on the roof, but a big corporation owns them
Nation states disappear	
Mass deaths, even genocide following climate refugees	
	Advances significantly renewables
Virtual civil war (inside/between closed networks)	Self-sufficient energy

4. Robotisation & artificial intelligence (AI)

Session 1

1. Humans for robots
2. Robots for humans
3. Robot = human

Ethics & trust

- Ethical AI, responsible AI
    - All AIs are required to be able to explain to humans how they came to their conclusions/decisions
- Divide and rule
    - After an AI infrastructure Chernobyl regulation sets limits to AI networking complexity
- I saw a video of a really agile, big strong robot executing different tasks really effectively. → Why wouldn't corporations or states use these for any production? Also because they are really strong they make revolting against them really difficult. If people are not needed what will be the social construct
- Challenges of cyber security + terrorism - need for cyber trust
- Artificial oracles
    - AI is used to make forecasts in different fields (weather, energy generalisation & use)
        - But nobody understands how
        - Trust in artificial oracle is needed

Convergence of humans & machines

- Many today's non-traditional jobs replaced by robots
- Market for real human relationship
- Robot + people = families & companions?
- AI in arts: use them as actors, musicians? (AndroidMe show in Toronto)

Tech assisted/augmented consciousness

- Tech-assisted consciousness – or at least means of communication between train & machine
- Augmented brains of insects and other creatures

Underlining technology

- Trust between machines and human beings
- Human language understanding machines replace people in professional occp.
- Use of big data, identification of emotion
    - Finding of characters from pictures
    - Use of human language intergrate
- Smart large complex system ← → small makeable systems robots

Applications – robots for humans

- Human life possible in harsh places on the Earth
- Earth for human beings. All space for robots/AI
- Smart houses

    - Regulating/optimizing energy use + storage
- (AI) *Some technology that can read people's CV and categorise it into the related jobs

(Transport)

- Automated harbours
- Autonomous vehicles + new concept of ownership
- Self-driving transportation – cars, freight carriers, deliveries, etc.
- The evolution of drones – many new functionalities

Resources & energy

- Diminishing natural resources → building robots
- Robots in space → asteroid mining
- Robots + AI need electricity – contrast to steam-based industrial revolution
- Technology to conserve the environment

Session 2

Discontinuity 1: Ethics & trust

- The idea of Elon Musk: AI & human brain must be combined, otherwise (AI) it won't be controlled
- Back to middle ages: technological hal & fundamentalism
- Robots have "fair trade" certificate → they can be trusted
- Legal framework that defines responsibilities of AI & who is responsible it rules being violated?
- AI as open source project
- AI-invented "religion"
- New luddite & religious movements against development
- Machine revolution: revolting against human
- Need for defence

Discontinuity 2: Convergence of humans & machines

- A new Bill of Rights needed for all
- Virtual realistic figures like humans
- Gay marriages & now human-machine marriages? (Sex doll are already in market)
- Genetics → cyborgs
    - Unidentifiable
- Accidental human-robotic children
- People live long 150-200 years → life in a cage as accidents might be only ones killing you
- Need for identification (clarity)

Discontinuity 3: Applications (robots for humans)

- Changing concept of vehicle ownership
- Greater or less transport safety?
- Technology directs human behaviour
- Work of professionals is extensively replaced by intel. machines
- Danger of weaponization
- Wars of robots is the new form of war

- Bio-chemical robots as smart drugs
- Massive suicide because of meaningful lives
- Need for purpose, meaning
- Greece-type 1-ay-per-person democracy (1 day 1 person rules the world of robots)

Discontinuity 4: Underlining technology

- Our every move will be known and analysed/big data → no privacy
- Loss of jobs/changing concept of work
- Universal income
- Integration of
    - Use of human language
    - Identification of figures from pictures
    - Identification of emotions e.g. from faces
    - Use of big data internet
- More free time for humans
    - Can be used for non-traditional forms of work
- Most of people work with creativity, leisure & learning

BLACK SWAN	RENEWABLE ENERGY
Humans revolt – disown tech & go medieval	
Robots revolt/out of control	Saviour of people? Friend of robotic enemies?
Cyborgs	
Weaponization of civil robots	
Global (benevolent) govt	

5. New lifestyles

Session 1

Developing/searching/realising oneself

- Active, mobile lifestyles "before kids" an "after kids" (Digital skills and consumer power high)
- Increased possibilities at niche markets due to digitalisation: Global markets
- Self-studying via internet → individualism
- Technology increasingly harder to be understood → is there enough of faith? Emergence of primitive religions?
- Mediation: searching for oneself
- Wikipedia, google translator replace studying
- "lifestyle Indians"

Stupidity

- Knowledge vs. understanding
    - Understanding loses its significance
- Shortening of time perspective and impatience to work hard

    - Microwave oven vs. cooking
- Bubbles and tribalisation ← → post-truth
- Misinformation, "bubbles", anti-intellectualism

Democracy of masses/anarchy of individuals

- Democracy of small communities
- Global radicalisation – polarisation
- Growing (?) diversity in lifestyles based on e.g. ideology or educational level
- Anti-greenness
- For! ← → Against!

    - What else?
- Division in society
    - Skilled ones/Unskilled ones
    - Poor/Rich
    - Employed/Unemployed
- Masters/Slaves
- Passivity of masses (cf. radicalism of marginal)
- Polarisation and communication of different generations/socio-economic groups (we vs. them)
- Polarisation
    - For/against, no shades of grey
- Are people enough motivated to voluntarily turn their lifestyles into sustainable? With what kinds of "force"?
- Climate change and even regulation vs. individual freedom
- Small group of heroes/"survivors" → those survive the best in uncertainty
- Steering/manipulating the masses
- "Celebrating" the mediocracy

Detachment

- "Breakdown" of units
    - Individualist time, but the identity of an individual is broken. What are we then?
- Well connected/isolated
- Empathy?
- Privacy vs. communality in living & everyday
- "Lack of prospects"
    - Everything is too insecure and nothing can be built on. Leads to systemic disbelief, insignificance, apathy

Rupture of hierarchies

- Rupture of employment through applications
    - Uber
    - AirBnB
- Trust/sharing economy vs. culture of bothering
- Reputation systems (in online platforms)
- "Freelancers"

    - Precarious work, education, career path, apartment and customer path… also on leisure time
- Ownership and steady structures (i.e. permanent job) history?
- "Cultivation of creativity"
    - When work does not have to be done
- Exchange of skills? Is money needed? Time is money? Poor become poorer → abandoning of money?

Escape from the everyday

- Back to countryside, in eco villages – or cities and virtual worlds?
- Still less focus on trad. family/relatives/local relationships and more social connections via work, interests, hobbies, online activities, etc. ???
- Augmented reality brings people together (cf. Pokémon)
- Immigration crisis? Decrease of space? Escape to "matrix", beautiful virtual world?
- Consumption vs. experiences → what is appreciated in the future?
- Experience economy – travelling ecologically? → electric car charging network
    - Or electric planes
- "Pleasure stimulators"
- Capitalising expert computer players
    - … in warfare?
    - … in media?
- VR travelling
- What are the things I need that I cannot produce myself? Or with tools owned by the community?

Session 2

Discontinuity 1: Stupidity

- Addiction to smart devices/helpless people
- AI replaces common human sense
- Modifying of genes has led to Spock superhuman! (Everyone is hetero white male)
- New Hitler/populism
- There is no stupidity, because there is no measurable wisdom either (AI deep learning) There are other measurements for popularity or impact
- Individual super universities
- Conscious simplification of society
- Decision making power for wise
- Irrational bouncing, shortsightedness (in politics, own life)

Discontinuity 2: Escape from the everyday

- "Funemployment"
    - Employment is the "richness" of a prosperous society
- Escapism, virtual well-being, physical sickness
- Everyday has disappeared
- Living non-static assumption → always in movement
- Counter trend: return to normal days and "real life"

Discontinuity 3: Rupture of hierarchies

- Hybrids of individual, public, private sectors
- Confusing roles; who is responsible?
- Radical extreme phenomena
- New caste system
- Replaced by new hierarchies OR random-flow-of everyday and economy
- Work places need to offer other things than money

Discontinuity 4: Democracy of masses/anarchy of individuals

- Voting for things, not for representatives
- Influencing from "outside the borders"
- Faster cycles of citizen led democracy and more multiple forms. Direct affection
- The amount/threat of big conflicts increases
- Martyrs of politics: Long government periods for devoted experts
- Democracy turns into populism → hard decisions cannot be made

Discontinuity 5: Detachment & Developing/searching/realising oneself

- Growth of atheism
- Human disappointment and absolute redundancy of contacts. "Those disappeared from the systems". Life-long anonymity
- Diversity of marginalisation
- How does the society react to drop-outs/marginalised? (Detachment + "unable to find oneself"
- "School" is an individualist trip what transforms individually, throughout life
- Modifying the virtual me
- After losing trust – how do I rebuild the trust in me?

BLACK SWAN	RENEWABLE ENERGY
Decision to cut down the number of people → gene selection? • Caused by Individual super universities, Conscious simplification of society and Decision making power for wise	Decision to cut down the consumption → consumption
Killing the wise people and keeping the stupid, easily controlled ones • Caused by Individual super universities, Conscious simplification of society and Decision making power for wise	
Positive, wise "Hitler" • Caused by Individual super universities, Conscious simplification of society and Decision making power for wise	Positive impact → global/Finnish scale
"Human container" for marginalised ones	Energy from space

Caste confirmation • Caused by New caste system and Replaced by new hierarchies OR random-flow-of everyday and economy)	
Decisions instead of decision-makers! The whole democratic system based on referendum	A common decision for national energy allocation/budget (limited amount)
Stimulation of nucleus accumbens	
Resetting own life (memory and trust classification)	
I sell my physical me? Forced labour? → Person devoted for politics?	
I become embittered → I bring down the information system → return to Stone Age	

APPENDIX 6.
Neo-Carbon Energy at the Futures of a Complex World Conference

Sirkka Heinonen & Sofia Zavialova (eds.)

NEO-CARBON ENERGY & THE MILLENNIUM PROJECT AT THE INTERNATIONAL CONFERENCE "FUTURES OF A COMPLEX WORLD"

TURKU, FINLAND – JUNE 12 & 13, 2017

NEO CARBON ENERGY

NEO-CARBON ENERGY WP1 WORKING PAPER 1/2017

VTT · LUT Lappeenranta University of Technology · Turun yliopisto University of Turku · FINLAND FUTURES RESEARCH CENTRE

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INTRODUCTION

This is a report of the Neo-Carbon Energy project presentations, as well as related Millennium Project contributions at the "Futures of a complex world" held June 12-13, 2017 at Turku School of Economics in Turku, Finland. The Neo-Carbon Energy project is funded by Tekes new strategic openings programme and carried out in collaboration between Finland Futures Research Centre (FFRC), University of Turku, Technical Research Centre of Finland VTT Ltd (co-ordinator), and Lappeenranta University of Technology (LUT).[1] The Conference was an annual international conference organised by Finland Futures Research Centre (FFRC), University of Turku, in co-operation with Finland Futures Academy, National Foresight Network, Helsinki Node[2] of the Millennium Project, and Foresight Europe Network (FEN). The Neo-Carbon Energy project engaged the international futures studies community by way of multiple presentations, chairing of sessions, and a workshop on the future of work. The conference was attended by almost 330 people from 29 different countries.

The nine instances of Neo-Carbon Energy at the conference reported by the editors for this working paper were:

1. "Surprise as the new normal – Implications for energy security" by Sirkka Heinonen, Joni Karjalainen & Karlheinz Steinmüller
2. "Transition towards long-term sustainability of the Finnish energy system" by Michael Child & Christian Breyer
3. "The postnormality of renewable energy – Complexity, contradictions and chaos in a world of abundance" by Juho Ruotsalainen, Sirkka Heinonen, Joni Karjalainen & Marjukka Parkkinen
4. "Can we overcome complexity with anticipation for climate compatible governance?" by Joni Karjalainen & Juho Ruotsalainen
5. "Clean transformation as a complex endeavour – The case study of Chile" by Noora Vähäkari, Joni Karjalainen & Sirkka Heinonen
6. "Deconstructing survivalism as futures knowledge" by Marjukka Parkkinen
7. FEN workshop on the future of work moderated by Cornelia Daheim, Epaminondas Christofilopoulos, Sirkka Heinonen, Ondrej Valenta, Ole Wintermann & Ibon Zugasti
8. Comments to the keynote speech of Cornelia Daheim on "The Future of Work – Scenarios for 2050 from the Millennium Project and beyond" by Sirkka Heinonen
9. Chairing at session 1 – Special session with a keynote speech: Aging society and urbanization & session 2 – Foresight in technology by Sirkka Heinonen

These appearances of the Neo-Carbon Energy project at the conference "Futures of a complex world" 2017 are briefly described in the following pages, consisting of the abstracts, highlights, links and other relevant information. All abstracts are also included in the Book of Abstracts of the Conference (https://futuresconference2017.wordpress.com/). All the presentations that the speakers made available are at www.futuresconference.fi2017

[1] See www.neocarbonenergy.fi and http://www.utu.fi/en/units/ffrc/research/projects/energy/Pages/neo-fore.aspx

[2] Helsinki Node of the Millennium Project is Co-Chaired by Sirkka Heinonen (FFRC), Juha Kaskinen (FFRC), Osmo Kuusi (Aalto University, FFRC), Sari Söderlund (Finnish Parliament, Committee for the Future), and Toni Ahlqvist (University of Oulu).

1. SURPRISE AS THE NEW NORMAL – IMPLICATIONS FOR ENERGY SECURITY AT SESSION 4 – INNOVATION IN FUTURE ENERGY

PRESENTED BY **SIRKKA HEINONEN, JONI KARJALAINEN** AND **KARLHEINZ STEINMÜLLER**[3]

Figure 1. Joni Karjalainen and Sirkka Heinonen presented the NEO-CARBON ENERGY research on the complexity and unexpected events at session 4 on Tuesday, 13 June 2017. Photo: Sofia Zavialova / FFRC.

CONFERENCE ABSTRACT

We are living in a world of ever increasing interconnectedness through digitalisation and globalisation, exacerbating environmental conditions, severe economic challenges, uneven distribution of wealth, and geopolitical crises. Nation-states claim independence and sovereignty for themselves, but their autonomy is restricted by the tsunami of transborder flows of trade goods and finance, of information, people, weapons, technology, energy, and pollution. The world is a complex system and the rapid change among its sub-systems builds up enormous pressure for any efforts to anticipate change and shape the processes of transformation.

Surprise is an intrinsic aspect of change, in particular when it takes place at an accelerating pace with high degrees of volatility, uncertainty, complexity, ambiguity (VUCA). In foresight, which aims to alleviate uncertainty associated with impending changes, horizon scanning has much focused on the probable or even predictable – surprise-free developments. We assume that more emphasis should be paid on the constant and systematic anticipation of wild cards and black swans. Taleb even claims that the world is most changed by such events.

Energy is a complex issue. Without energy there is no life, neither biological nor economic. Taking into account the huge ecological and social costs of the present energy system, the

[3] Presentation delivered by Sirkka Heinonen & Joni Karjalainen.

need for a new emission-free, cost-effective, and democratised energy system is obvious. An energy transformation to reach 100% renewable energy is envisioned in four transformational neo-carbon energy scenarios. Energy is no more just an economic or technical issue. It is increasingly a societal and even cultural issue – above all a security issue. As regards energy security, various sudden events and surprises – wild cards and black swans – could play a major role. Therefore, we probe the resilience and anti-fragility of these transformational energy scenarios. We present the results of a futures clinique where the scenarios were tested. This way, we explore the implications of surprises for energy security, as the world increasingly seeks to move towards a renewable energy based society.

Key words: Renewable energy, Transformative Scenarios, Energy Security, New Normal, Complexity, Wild Cards, Black Swans, Uncertainties, Turbulent Times

HIGHLIGHTS

- We are living in a trap of linear thinking.
- The future is too often anticipated through trends only.
- Future is not extension of present – chains of events can break linear development paths and cause surprises.
- The world is VUCA: *volatile* (ever changing), *uncertain* (always challenging to predict), *complex* (with many actors interacting), and *ambiguous* (it is difficult to make sense of).
- When we are imagining a future, as a futures image, or by using scenarios, we have to think of futures unfolding in a non-linear way. By thinking about megatrends, trends, emerging issues and weak signals, and their interconnections, we can think of possible discontinuities that, taken together, could lead to surprising events.
- The present rise of renewable energy and especially solar PVs is an example of a discontinuity without (marked) black swan events. No longer than 10 years ago almost no one anticipated the rapid fall in cost of solar PVs. A major cause for the discontinuity in the price was China - the 1st country to mass-produce and offer cheap solar PV panels. Many other trends converged to tip the solar development off its linear slow path.
- Democratized 100% renewable energy future could be a “preferred” future compared to the world we are living in today. But it implies a transformation from the present to an unfolding future. Consequently, when we expect a transformation to happen, this implies a need to anticipate non-linearities.
- Together with other technological developments, such as automation and AI, increases in (renewable) energy supply and decreases in energy price could steer our world into unknown futures. It is increasingly crucial to anticipate emerging discontinuities and surprises in different sectors of society because they may indirectly or directly have impacts for the renewable energy world
- Energy is not only a technological issue, but cuts across culture, values, economy, power relations, and the environment.
- In an electrified future, electricity is produced with solar, wind (and other renewables) and excess electricity is converted into synthetic end products. With synthetic hydrocarbons the sectors which are difficult to run with electricity (e.g. aviation and freight transport) can be made emission-free.

- We argue that thinking about the unexpected events of future society can make a 100% renewable energy based scenarios more resilient, and improve the energy security of such futures.
- In a Futures Clinique (which is a creative futures workshop method), participants thought of discontinuities, black swans and their implications to renewable energy. This helped to map issues that can impact the future in a positive or negative way (such as total industrial revolution, revenge of fossil fuel companies, Internet of powergrid collapse, collapse of a major state, shaping of the human-robot relationship, introduction of national energy budgets, and so forth).
- After the Futures Clinique, the most interesting black swans were analysed by the research group and guest experts in a Cross-Impact Session to think both of quantitative and qualitative impacts.

VIDEO

Interview of Karlheinz Steinmüller on VUCA World and Black Swans by Sirkka Heinonen at FFRC. Please see video and transcription of the interview at:
https://sites.google.com/site/futuremediac/videos--presentations

SLIDES & REFERENCES

"Surprise as the new normal – implications for energy security" by Sirkka Heinonen, Joni Karjalainen & Karlheinz Steinmüller

Heinonen, Sirkka, Karjalainen, Joni, Parkkinen, Marjukka, Ruotsalainen, Juho & Zavialova, Sofia (2017). Surprising Energy Futures – Implications for Energy Security. Neo-Carbon Energy Futures Clinique V, FFRC eBook 3/2017.

2. TRANSITION TOWARDS LONG-TERM SUSTAINABILITY OF THE FINNISH ENERGY SYSTEM AT SESSION 4 – INNOVATION IN FUTURE ENERGY

PRESENTED BY **MICHAEL CHILD** AND **CHRISTIAN BREYER**[4]

Figure 2. Michael Child presenting the results of research at LUT in the Neo-Carbon Energy project. Photo: Sofia Zavialova / FFRC.

CONFERENCE ABSTRACT

The Finnish energy system is at a crossroads due to an aging system of power generation and opinions about different modes of low-carbon energy generation. In addition, there are responsibilities to mitigate climate change, worries of fluctuating energy prices, goals regarding national energy security and a wish to both retain a competitive industrial sector and meet the needs of a future society. The purpose of this research is to examine the components of a fully sustainable energy sector for Finland in 2050. A key motivation is to examine the benefits of Power-to-Gas (PtG) and energy storage systems. Naturally, there are several potential pathways towards the future. At the same time, there are a number of technological decisions related to energy use and production that are made years in advance and influence future possibilities for decades to come. Among these are the roles of renewable energy technologies, nuclear power, energy system infrastructure, and storage systems. A cost optimal energy system transition was simulated for Finland for the years 2015-2050 using the LUT energy system model. Our research concludes that a 100% renewable energy system is possible for Finland in 2050. As well, we offer complete transparency of all technological and economic assumptions. Results assure the reliability and sustainability of a 100% renewable energy system at an hourly resolution.

Key words: Renewable Energy, Sustainability, Power-to-Gas, Energy Storage

[4] Presentation delivered by Michael Child/LUT.

HIGHLIGHTS

- A 100 % renewable energy system – based on solar, wind, bio-energy, and hydro – is possible in Finland by 2050. It would be cost-efficient and provide all the reliability and stability needed.
- The role of prosumers – citizens, enterprises, even industries – can be rather significant in the future Finnish energy system.
- The energy system in Finland is getting rather old, and many technologies in the system will retire in the next 20-25 years. So there is a good opportunity now to "naturally" replace these elements.
- Main storage technologies would be batteries and gas-storage.
- Fossil natural-gas will be replaced by domestically produced synthetic, sustainable methane.
- The levelised cost of energy (LCOE) in this system is estimated to be 60€/MWh in 2050 – PV-Wind-Gas is the least cost option.
- Obstacle: in Finland people often think that solar and wind cannot do the job
- Heat and mobility sectors are not yet modelled, but will be

SLIDES & REFERENCES

"Transition towards long-term sustainability of the Finnish energy system" by Michael Child & Christian Breyer

3. THE POSTNORMALITY OF RENEWABLE ENERGY – COMPLEXITY, CONTRADICTIONS AND CHAOS IN A WORLD OF ABUNDANCE AT SESSION 4 – INNOVATION IN FUTURE ENERGY

PRESENTED BY **JUHO RUOTSALAINEN, SIRKKA HEINONEN, JONI KARJALAINEN** AND **MARJUKKA PARKKINEN**[5]

Figure 3. Juho Ruotsalainen presents on postnormal times and the implications from renewable energy. Photo: Sofia Zavialova / FFRC.

CONFERENCE ABSTRACT

By 2050 we will be able to satisfy our growing energy needs with renewables. This paper anticipates the futures of energy-related societal development by taking a critical view on the narrative of progress: by 69 potentially increasing the amount of available energy in societies, renewables may also bring about more complexity, contradictions and chaos – defining features of postnormal times as described by Ziauddin Sardar.

Thanks to cheap and often even free energy, a renewable energy system will improve energy security, self-sufficiency and decrease the costs of living and production. This empowers citizens to organise their lives around peer-to-peer communities. The renewable energy system thus enables a power shift from traditional institutions and organisations to self-organising citizens. The decentralisation of social power could increase the complexity of societies and pose novel challenges for current models of governance, as the number of actors affecting societal and economic development would grow. At the same time, social stability could decrease due to the decentralisation of social power, as Erving László claims.

[5] Presentation delivered by Juho Ruotsalainen.

The paper complements the theory of postnormal times by adding new energy systems as among its defining features. It opens a critical perspective to the “grassroots power” fostered by information and communication technologies. It anticipates new social contradictions and social problems in a future information society of material and immaterial abundance. Along with energy, it deals with robotisation and the future of the internet as causes of increasing chaos, complexity and social contradictions.

Key words: Renewable Energy, Postnormal Times, Complexity, Progress, Power Shift, Information Society

HIGHLIGHTS

- The new, renewable energy system will produce more energy than today and increase energy efficiency significantly.
- The surplus energy allows many new things, such as widespread use of artificial intelligences, robotization, and betterment of living conditions – in a word, progress.
- Decrease in the price of energy, with new technologies, also empowers actors, both big and small – from technology giants to terrorist groups. This upends power relations in societies.
- These changes – increase in energy supply, decrease in energy price, new technologies, and empowerment of actors – promote postnormal times: increased complexity, chaos, and contradictions in society.
- In postnormal times, social and cultural stability decreases – which is both good and bad. But in any case we have to see the energy transition to renewables as a much more complex and multi-sided phenomenon than mere progress as it is often understood.

SLIDES & REFERENCES

“The postnormality of renewable energy – complexity, contradictions and chaos in a world of abundance” by Juho Ruotsalainen, Sirkka Heinonen, Joni Karjalainen and Marjukka Parkkinen

4. CAN WE OVERCOME COMPLEXITY WITH ANTICIPATION FOR CLIMATE COMPATIBLE GOVERNANCE? AT SESSION 6 – FUTURES OF ENERGY

PRESENTED BY **JONI KARJALAINEN** AND **JUHO RUOTSALAINEN**[6]

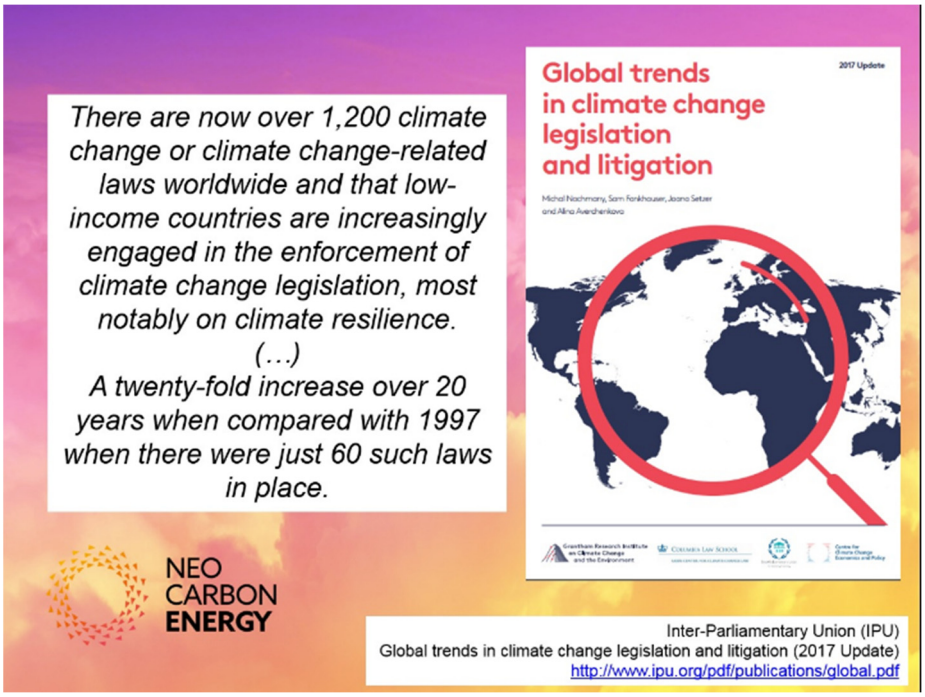

Figure 4. Joni Karjalainen discusses the challenges of complexity and the need for climate compatible governance.

CONFERENCE ABSTRACT

Our ability to understand how society works is evermore challenged. The aim of this contribution is to examine how knowledge about planetary boundaries and climate change is inducing systemic pressures to society and shaping decision-making. The contribution derives from an on-going foresight project that studies energy-society transformation to explore how a renewable energy society could be achieved by 2050. As old dependencies in fossil fuel use are being questioned, novel systemic dependencies between renewable energy, economy, society and politics may emerge to determine when and how energy will be used. The current pathways to reach a 100% renewable energy system assume intermittent renewable energy, smart and interconnected grids, energy storages, and demand-side management. In the future, nature and weather patterns around the world could affect the use and design of energy-related technologies. This may shape related costs, trading prices, and allow energy to be managed in a nano- to milli-second level. Together, this may be seen to add systemic complexity. However, we may also wish to reduce systemic complexity. Emerging off-grid solutions and services increase the independence of actors, and decrease the systemic connections of actors in the energy system. We suggest that for climate compatible governance, a long-term development vision on a 100% renewable energy society may be desirable, but it is worth anticipating these two opposing drivers to counter unexpected and

[6] Presentation was delivered by Joni Karjalainen.

yet inevitable contestations. Furthermore, to reach renewable energy around the world, energy independence and forms of hybrid governance may deserve further attention in energy policy debates.

Key words: Decision-Making, Governance, Independence, Long-Term Vision, Nature, Off-Grid, Renewable Energy, Systems Thinking

HIGHLIGHTS

- According a 2017 the Inter-Parliamentary Union (IPU) report, Now over 1,200 climate change or climate change-related laws worldwide and that low-income countries are increasingly engaged in the enforcement of climate change legislation, most notably on climate resilience. A twenty-fold increase over 20 years when compared with 1997 when there were just 60 such laws in place.
- When representing systems, they can be divided into simple, complicated, complex and wicked
- New modes of governance seek to overcome the silo effect, recognize power dynamics, inspire people from the bottom up, and conceive power as communicative planning
- Emerging governance approaches cover (at least) multi-level governance, deliberative governance, adaptive governance, reflexive governance, hybrid governance and anticipatory governance
- Anticipatory governance (Guston 2014) is motivated by risk and uncertainty beyond conventional risk assessment. It aspires for people to be able to actively shape technology rather than become shaped by it
- It has been argued that forward engagement, with a whole-of-government (governance) approach to complex issues, can be cultivated as a systemic culture (Fuerth 2009).
- Products of science and technology do not appear magically, they appear in the hands of people (Sarewitz, 2011) through technoscientific imaginaries (Wiek, Foley, & Guston, 2012).
- One means of thinking about different (emerging) modes of governance is through a six-point checklist: 1) does it address complexity 2) is it forward-oriented 3) does it involve engagement 4) does it recognize power 5) is it interested in transformations 6) does it seek to be climate compatible?
- Even policies struggle to acknowledge the complexity of the world. Is this the case also with policy analysis tools? After all, policy analysis claims to be a “systematic evaluation of the technical and political implications of alternatives proposed to solve public problems”. Is thinking of policy mixes (Kivimaa and Kern 2016) alone enough?
- Emerging governance theories, as analytical lenses, aim to overcome past theory limitations. These theories seem to have potentially overlapping areas. Governance theories, too, struggle with the long-term: transformation, complexity, and surprises.
- In sum, it is unclear what governance should think about complexity. It was raised as a question, whether it is realistic or even desirable to try and overcome it. Even so, it seems that thinking of alternative futures deserves further attention in governance theory and policy analysis.

SLIDES & REFERENCES

“Can we overcome complexity with anticipation for climate compatible governance?”
by Joni Karjalainen & Juho Ruotsalainen

5. CLEAN TRANSFORMATION AS A COMPLEX ENDEAVOUR – THE CASE STUDY OF CHILE AT SESSION 6 – FUTURES OF ENERGY

NOORA VÄHÄKARI, **JONI KARJALAINEN** AND **SIRKKA HEINONEN**[7]

PARTICIPANTS' VIEWS

- Peer-to-peer society necessitates collective trust to fellow citizens, decision makers, social structures, companies
- Fully decentralised system not taken for granted – certain level of authority is needed
- Diversification of economy – solar energy as 'the new copper'?
- What is the role of the weight of the political history of Chile?

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Figure 5. Noora Vähäkari and Joni Karjalainen highlighted the renewable energy transformation potential of Chile, and reported on the results of a Futures Clinique conducted in Santiago by FFRC team.

CONFERENCE ABSTRACT

Societies are complex systems where some elements change fast, others more slowly. Our paper studies energy transformation in Chile, a country with plentiful renewable energy resources, and focuses on the energy-society nexus. We explore local pathways for change by using four transformative socio-cultural scenarios 2050 that explore how renewable energy could be harnessed in line with the peer-to-peer principles. The scenarios were reflected with local experts in a futures clinique in Chile in October 2016. Following a semi-backcasting approach, the local experts used the futures wheel and the PESTEC method to analyse opportunities and risks of an energy transformation for Chile. The participants highlighted the need to diversify Chile's economic structure and the democratization of energy. A post-copper era was proposed, in which 'new' wealth and business could emerge from Chile's abundant renewable energy resources, assuming that they are responsibly harnessed. In literature, it has been argued that the politics of energy transformations can be either citizen-, market-, technology- or state-led. However, our findings rather emphasize the cultural, institutional and social dynamics of transformation. Such factors may include trust and civic engagement to build commonly shared values. Community needs would be expected to inspire innovation, public and private investments as well as private-public partnerships. Democracy, too, may have to extend beyond conventional representation to

[7] Presentation was delivered by Noora Vähäkari and Joni Karjalainen.

ensure opportunities and wealth are equally shared. As conclusions, Chile has the capacity to become 100% renewable energy powered in the future by harnessing its abundant solar and wind resources. In support, a long-term vision and an encouraging business culture where failure is tolerated are required. Increasingly dynamic relations across actors and sectors, more localized management structures, and a collective mindset can further nurture the complex process of energy transformation in Chile's society.
Key words: Chile, Complexity, Diversification, Neo-Carbon, Post-Copper, Renewable Energy, Transformation, Trust

HIGHLIGHTS

- Climate change is driving a transformation of the energy system and society. There are many types of 'low-carbon' energy transformations: carbon capture & storage, nuclear, renewable energy system. This presentation is about a future society based on renewable energy.
- A model of a renewable energy system is a so-called 'neo-carbon energy system' where everything is produced with solar, wind, and other renewables. Synthetic processes are used replace fossil fuel based ones. This makes the system emissions-free. It is also more decentralized than our present energy system – supporting the principles of peer-to-peer society.
- We have to think 'what if': what the implications of such sociotechnical change could be in different places around the world – hence the case study of Chile.
- Chile was chosen as a case study, as it has been considered as a pioneer in Latin America. It has a stable business environment and invests in education, although further social reforms are encouraged. The country had a difficult period in its political history during 1973-1990, which is still remembered. Economically, copper production has been a major economic activity in Chile.
- Chile receives some of the highest solar irradiation on Earth in the Atacama Desert. There is a strong interest in the solar energy in Chile, with media headlines in 2016 stating that "Chile Has So Much Solar Energy That It's Giving It Away For Free". Especially mining companies are already using solar.
- The uptake of solar energy has been enabled by a supportive policy environment and a stable business environment in Chile. This has attracted investments into solar energy.
- Chile also has a long windy coastline, but to date little wind power capacity and considerable untapped geothermal energy resources. Certain hydropower projects have been opposed for environmental and livelihoods/cultural reasons.
- The Government of Chile has set an energy policy target to reach 70% of its energy produced with renewable energy. In May 2017, the National Energy Commission announced that even 100% renewable energy could be possible.
- Typically, energy transformations are studied by using the transitions theory and multi-level perspectives (MLP) framework. Novel technologies are assumed to typically emerge from 'strategic niches'. It is also understood that socio-technical imaginaries shape expectations of future change. Problematically, culture and values have a fairly limited role in such theoretical frameworks. In reality, societal development is a complex endeavour.

- In the foresight part of the Neo-Carbon Energy project, a transformation towards a 100% renewable energy society has been anticipated with the use of socio-cultural scenarios 2050. The scenarios are called *Radical Startups 2050, Value-Driven Techemoths 2050, Green DIY Engineers 2050* and *New Consciousness 2050*. In describing transformation, their key axes are peer-to-peer and ecological consciousness.
- These scenarios were tested in a Futures Clinique in Santiago, Chile in October 2016. In the Futures Clinique, the participants outlined that 1) a peer-to-peer society needs collective trust between fellow citizens, decision makers, companies – i.e. the social structures broadly; 2) hence a fully decentralized energy system as a technocratic solution cannot be taken for granted. 3) It was speculated whether solar energy could become 'the new copper' for Chile – a 'clean' natural resource that provides the country with future wealth in a sustainable manner
- At the moment, infrastructure is being further developed, to interconnect grids better. This would already allows renewable energy to be transmitted from areas where it is produced to where it is consumed inside Chile
- If collective trust and communality are developed, they may support the uptake of a decentralised energy system
- In future, Chile is expected to have enough renewable energy to be exported to other South American countries
- In sum, socio-cultural factors can reinforce technology-driven transition – or hinder it

SLIDES & REFERENCES

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6. DECONSTRUCTING SURVIVALISM AS FUTURES KNOWLEDGE AT SESSION 2 – FUTURES OF DEMOCRACY, SOCIETY AND VALUES

PRESENTED BY **MARJUKKA PARKKINEN**

Figure 6. Marjukka Parkkinen opened up survivalism as futures knowledge. Survivalism is a flourishing feature in one of the Neo-Carbon Energy scenarios i.e. DIY Green Engineers.

CONFERENCE ABSTRACT

Survival is in the core of being human, and specifically, it is a question concerning the futures. This research focuses on the socio-individual paradigm of looking at the futures with an aim to survive by pre-paring for it. I analyse survivalism (also known as preparedness) as a futures-oriented approach and knowledge. Survivalism is a very specific, yet under-researched approach towards futures. It is a socio-material futures-oriented practice embedded in every day. According to the hypothesis of the research survivalist knowledge is free of external focal limitations. The lack of restrictions to concentrate on some-thing particular enables peripheral vision and the rhizomatic process of exploring the futures in constant flux offers leverage to meet the challenges set by complexity.

This paper answers the research question: ”How are alternative futures observed, constructed and pre-pared for in survivalist discussions?” Causal layered analysis is utilised as a method to deconstruct and critically observe survivalism as an approach to futures. The primary research material consists of Finnish survivalist web forum texts. The purpose of this paper is two-fold, combining empirical and theoretical approaches. The empirical objective of the study is to analyse survivalism as futures knowledge. The second purpose of this paper is to contribute to the critical post structural framework of futures studies as well as the discussion on the epistemological foundations on which the knowledge or assumptions on futures can be based on.

Key words: Survivalism, Preparedness, Causal Layered Analysis, Futures Knowledge, Deconstruction

HIGHLIGHTS

Survivalism ethos relates well to one of the four transformational scenarios – Green Do-It-Yourself Engineers – of the Neo-Carbon Energy project. An article on the topic is planned to be written within the foresight part of the project.

- It is said that most futures studies done by organisations is defined by a focus on something particular. However, at the same time there is a demand to see far beyond an exact focal point, as it is exactly the unexpected events that have the greatest impacts on the society. There is an interesting balance between what can be known about futures and what on the other hand is left beyond our focus.
- **Survivalism** is taken as an example of one way of seeing the futures from a different viewpoint. According to the hypothesis, it is not confined by external focal limitations in a similar way than organisations are. The research question of the paper is: ”*How are alternative futures anticipated and prepared for in a contemporary survivalist context?”*
- **Surviving** can mean many things, such as simply remaining alive, to enduring, outliving, carrying on and even prospering. To survive means to continue existence despite different circumstances.
- **Survivalism** is a movement based on surviving, and can be described as a philosophical and practical approach to man-made, natural or supernatural disasters of different scale. Survivalist efforts commonly focus on collecting items for defence, safety or eating, as well as improving mental, social, and physical skills that they consider necessary for surviving. Many survivalists believe that the social, economic or ecological world we are living in is coming to an end.
- According to the preliminary results, survivalist approach is to a large extent free from external limitations to speculate any kind of futures possible. For example, the scenarios may consist simultaneously of climate change and coffee makers or terrorist attack to divorce.
- Survivalist approach can be described as rhizomatic, which is a philosophical concept by Gilles Deleuze and Felix Guattari. Instead of fixed and rigid models, rhizomatic knowledge is directed in all directions, and everything can be connected to everything.
- However, in general there are three large themes that can be said to frame contemporary survivalist discussions. Survivalist approach is negotiated between the dimensions of 1) communal and individual (*Who are surviving?*), 2) universal & personal (*Of what one survives from?*) and *3)* material & speculative (*How does one survive?*)

SLIDES & REFERENCES

“Deconstructing survivalism as futures knowledge” by Marjukka Parkkinen

7. FEN WORKSHOP AT SESSION 6 – THE FUTURE OF WORK: AN INTERACTIVE WORKSHOP ON PERSPECTIVES AMONG EUROPE

MODERATED BY **CORNELIA DAHEIM, EPAMINONDAS CHRISTOFILOPOULOS, SIRKKA HEINONEN, ONDREJ VALENTA, OLE WINTERMANN & IBON ZUGASTI (MILLENNIUM PROJECT NODE REPRESENTATIVES)**

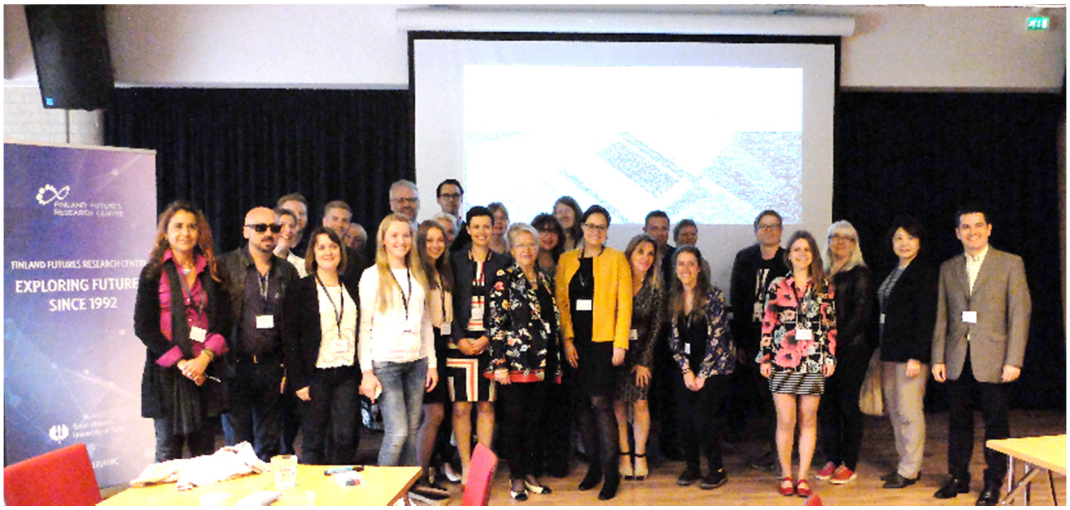

Figure 7. FEN workshop participants. Photo: Marjukka Parkkinen / FFRC.

Figure 8 & 9. FEN workshop in the process: brainstorming and presentations. Photos: Marjukka Parkkinen & Sofia Zavialova / FFRC.

CONFERENCE ABSTRACT

The Millennium Project, an international think tank on global future perspectives (http://millennium-project.org/), has developed long-term scenarios on the future of work and technology 2050. This workshop moderated by Cornelia Daheim, Chair of FEN (Foresight Europe Network)[8] and the German Node of the Millennium project, brings in different perspectives on the scenarios and the question how work might develop, by contrasting different national or regional perspectives and facilitating an interactive discussion.

[8] FEN = FORESIGHT EUROPE NETWORK – the new joint initiative of the European Millennium Project Nodes Initiative (EuMPI) & the European Regional Foresight College (ERFC) was established in Paris, October 24, 2014. See http://www.feneu.org/en/news/

These perspectives are provided by representatives of different countries, mostly chairs of the regional Nodes of the Millennium Project and members of the Foresight Europe Network. They share what is specific in their national or regional discourse on the topic, e.g. from national workshops or studies on the thematic under discussion. The session is organized as a participatory workshop, i.e. it will feature short presentations as a starting point, but will afterwards enable an interactive, yet systematic discussion. Exemplary questions are: Could the synergy of automation, digitalization and robotics replace a major share of jobs in Europe (and other world regions)? What are upcoming changes in skills demands, which new occupations might emerge? How does the trend towards new organizational forms (agile work, teams "without" hierarchy as in holocracies etc.) bring about new demands on the education system? How can public and private institutions prepare for and answer to the potentially disruptive changes in the work landscape?

Thus, the discussion will focus on how participants expect work, jobs and skills demands to change in the next decades, and what actions should be pursued in order to deal with potentially disruptive developments in the field.

Key words: Future of Work, Jobs and Skills, Automation & Technology, 2050, Scenarios, Europe

INTRODUCTION TO BRAINSTORMING IN THE FINNISH TABLE

As a table facilitator, Sirkka Heinonen, Chair of the Helsinki Node of the Millennium Project, gave a presentation based on the results from the futures clinique "Fuzzy Futures of Work" (Ruotsalainen et al. 2016) organized by the Neo-Carbon Energy research project at Finland Futures Research Centre[9]. The results are embedded in the vision of "Peer-to-peer Work in Digital Meanings Society 2050" and its seven elements, which are overlapping and intertwined, but focus on specific subtopics. Sirkka Heinonen was assisted by Sofia Zavialova, Millennium Project Intern at Finland Futures Research Centre (FFRC), University of Turku.
The workshop on the Future of Work was run in three rounds. Participants in all five Tables (Czech, Finland, Germany, Poland and Spain) were organized according to the rotation principle. For each round different groups were formed. In the Finnish Table the seven themes / elements that together compose a vision of the desirable future of work in the digital meaning society 2050 were presented (Fig. 1). Each group was invited to answer the following questions:

- Which of these following elements do you find the most interesting?
- What would you like to add or comment?

[9] See https://www.utu.fi/en/units/ffrc/research/projects/energy/Pages/neo-fore.aspx. See also journal paper by Ruotsalainen et al 2016b.

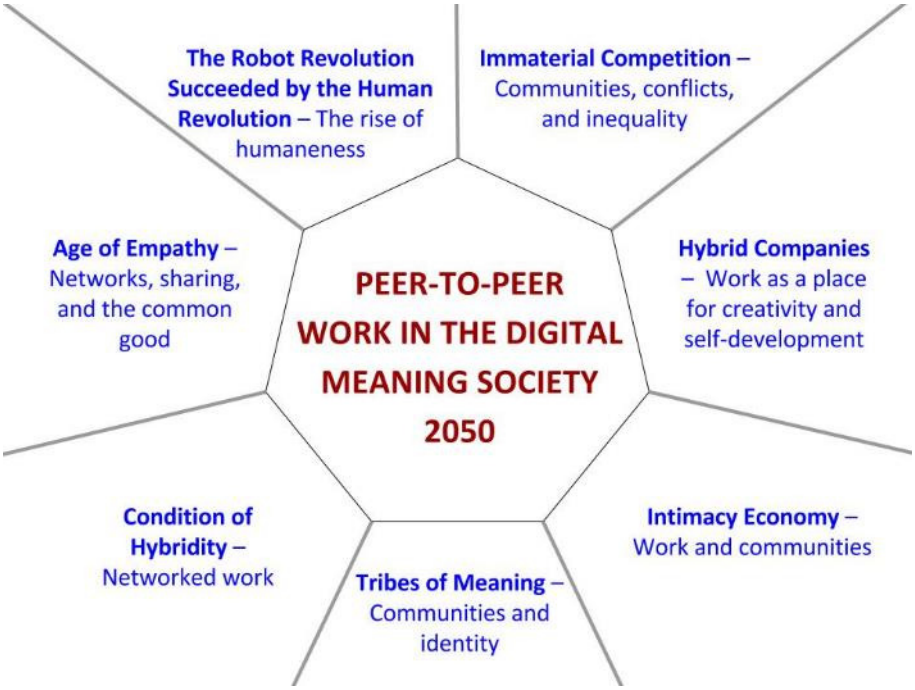

Fig. 10 The seven themes of peer-to-peer work in the digital meaning society 2050.

Characteristics of the seven elements of peer-to-peer work in the digital meaning society 2050 are the following:

Hybrid Companies – Work as a place for creativity and self-actualisation
In hybrid companies, no sharp division between work and leisure would exist, and a person would be seen as an individual and a human being also when he or she is working – not as a presenter of certain work role. Companies would function as "free enterprises", as concentrations of intellectual and social capital, rather than the profit-maximizing entities of today. This element of the desirable future of work can be described by the dominance of immaterial needs and values. Work in such companies would require workers to self-define their jobs. Management would be replaced by self-management. The function of human work would be to offer a place for workers' self-expression. Work would be meaningful, creative, and purposeful – products would be "authentic" expressions of workers' individuality.

Intimacy Economy – Work and communities
In the "intimacy economy", traditional organisations would be replaced by work-communities as communities of passion. Workplace relationships would be more personal than professional. Customers would also be part of community. Mutual co-creation between producers and consumers would take place. In this sense, the whole society would function as an organic whole. Demand would define supply in much more intricate ways than today. Platforms that connect people with similar interests and enable working flexibility across industries would exist. At different stages of life an individual could be an employee, an employer, a freelancer, and everything in between.

Tribes of Meaning – Community and identity
Communities would allow individuals to construct identities in a meaningful way and to be part of something larger than themselves. Identities, meaning and purpose would be based first and foremost on different communities, and on work done at these communities. Culture

would become much more diverse than today with the freedom to choose one's own way of life as a guiding principle. The ability to ”know thyself“ and consequently life-coaching would become immensely important. Peer-to-peer world would be more chaotic and more in flux than the present world. This could lead to the emergence of ”closed bubbles“ of like-minded people as a psychological coping mechanism against the chaos, or, on the contrary, to a ”global village“ that would replace local communities as a kind of new world religion.

Condition of Hybridity – Networked work
If communities were the basic units of new work, the general organisation model for work could be provided by networks. Organic, porous network structures would replace rigid bureaucracies, and different communities would be linked together by interlocking networks. Networks would merge different values, individuals, worldviews and practices together. They would ensure that individuals retain the freedom to choose for themselves and are not embraced by their communities too dearly. On the other hand, networks would dissolve stable social structures such as nations, and their loss could make people want to belong to “closed” communities that set more or less strict constraints in the behavior of the individual.

Age of Empathy – Networks, sharing and the common good
Thanks to automation, people would have universal income that guaranteed basic standards of living. This, in turn would create a basis for altruism, sharing and solidarity. Empathy would be the guiding principle of interaction in the society. Knowledge and ethical goals would replace monetary compensation and all these would lead to decline of the accumulation of private profit. Individuals would seek spiritual and social fulfillment instead of material rewards. Sharing economy and volunteering work could become a substantial part of work routine.

The Robot Revolution Succeeded by the Human Revolution – The rise of humaneness
In the age of high-tech, society would be highly technologized, but technology would be ”discreet“ and invisible. Relationship with technology would be more intimate and effortless, i.e. technology would become more independent so that it would work in the background without a need for human intervention. Humans would be freed to use and develop their human skills, those that machines would not yet possess. Creativity and social intelligence would become even more pivotal than today. Humans would ask questions, set goals, and invent new needs, whereas the role of robots would be to help implementing these plans. This would be a kind of a technology-assisted ”back to nature“ future in which humans would cultivate those attributes that make us humans.

Immaterial Competition – Communities, conflicts and inequality
Nevertheless, this future society might also have its own social problems. The dominance of immaterial values could place people in unequal positions, as some would have more cultural capital and social than others. Despite of material and energy abundance, there still could be competition between companies, marginalization and sociocultural inequality. As a result of shattered public sphere, expert knowledge, and authorities can lose their power and status. Each community and network could have their own notions, knowledge, and morals. Together with chaos and insecurity cased by fragmentation of culture and values, religious fanatism could become alluring for many.

BRAINSTORMING

During the workshop, the following three themes were chosen by voting in each rotation group, accordingly. Each participants had one vote. The 1st rotation group chose **age of empathy** (4 votes), the 2nd rotation group voted for the **robot revolution succeeded by the human revolution** (3 votes), and the 3rd rotation group **hybrid companies** (4 votes). Further in the working phase, participants opened up the chosen theme, discussed it, and came up with new ideas, often reflecting their own country situation and future prospects. All the ideas given and discussed were written and added to the poster (see below Fig.).

The participants in the 1st group were: Amos Taylor, Karolina Mackiewicz, Marjukka Parkkinen, Miki Kuribayashi, Reyhan Huseynova, Sari Söderlund and Sofi Kurki. The participants in the 2nd group were: Tero Villman**,** Robin von Euler**,** Nadezhda Mikova**,** Otto Tähkäpää**,** Erica Bol**,** Reyhan Huseynova and Piero Dominici. The participants in the 3rd group were: Camilla Barragán**,** Martha Laura Montemayor, Marrama Zorrilla Vicente, Miriam Vilageliu, Odelot Capdevila Karen, Piero Dominici and Reyhan Huseynova.

Figure 11. Several ideas were proposed and discussed concerning the chosen three elements. The groups' ideas are presented below in the text. Photo: Sofia Zavialova / FFRC.

1 AGE OF EMPATHY

In the age of empathy, the main change can be traced in the shift from welfare state to empathy state, where even the cities are planned according to the "empathy model". Negativity is seen as a disease to be cured. Expertise is shared freely so that everyone benefits. The prestige status of work is at the backstage, and all types of labour are treated equally. Prosuming trend is growing into massive passion that drives the economy. This can be demonstrated by the emergence of prosumeristic fashion 7.0. (i.e. influencers' fashion is massively consumed). Empathy is extended to the world of robots and to nature as well. People are seen as deeply mutually dependent, and empathy is considered as one of the key qualities that is trained and taught at special courses or through 3D games. At the same time, there are also outsiders in such a society who are not willing or not capable to empathize, share and volunteer and this is still an issue to concern in the future. Besides, empathy may

also be seen as a pretense of instrumental reasons. If empathy is seen as currency, it is subjected to have this kind of instrumental value, instead of the original “deep” value.

Documentation of ideas in group “Age of Empathy”:

- Negativity as disease to be cured
- Expertise sharing
- Mutual dependence
- Understanding different kinds of work -> valuing the work equally (increasing tolerance)
- Hologram
- Empathy
- Engineer
- Environmental empathy
- From welfare to empathy state
- Empathy trainings?
- The outsiders of empathy society?
- Empathy model city
- What are the mechanisms for defining the common good?
- Does everyone have something to share / does everyone have an opportunity to volunteer?
- New generation with robots having empathy
- Learn through the 3D game
- Empathy as pretense for instrumental reasons?
- Prosuming Passions. Fashion 7.0.

2 THE ROBOT REVOLUTION SUCCEEDED BY THE HUMAN REVOLUTION

The “robot revolution” in title of this group refers to widespread use of robots and automation, which both enables and creates demand for “humane” values. In the time of robot revolution and the rise of humaneness, dimensions of such traditional terms as ‘robots’ and ‘human’ are reconsidered. New legislations, policies, ethical codes and overall common understanding are emerging. Global governance is needed to level equality. Each country that wants to be a forerunner in robotisation should have a national vision and road map. These changes have a great impact on the education system as well. Robots are involved in tackling societal problems. Robots are, for instance, used as part of retirement plans. Ethical discussions are constantly needed in order to yield common understanding of human/robot interaction. New human-machine interfaces emerge. Robots become humanized and their rights are taken into consideration and are legally protected.

Documentation of ideas in this group “The robot revolution succeeded by the human revolution”:

- Humanizing robots
- New human-machine interfaces
- National visions & road map
- Global governance to level equality
- Ethical discussions and common understanding

- Robots rights (not only human rights)
- We have to realize human revolution. We must recover the dimension of humaneness
- Rethinking education
- Values -> Policies -> Laws
- Robot as retirement plan (when I get old I want my own robot (income)).

3 HYBRID COMPANIES – WORK AS A PLACE FOR CREATIVITY AND SELF-DEVELOPMENT

In the third theme, the leadership structure is going through considerable transformations. The change in communication culture is taking place as well, especially at organizaional and educational levels. The sense behind the act of communication has a deeper meaning than simply extending connections, networking and marketing. More open-minded approach starts dominating also at the public level. “Free enterprises” are emerging thanks to sufficiently flexible framework. The state realized the importance of fit between creative potential of the labour forces and the work opportunities that they get, therefore it took the leading role in coordinating even distribution of working places according to people’s preferences and capacities. Continued education programs that are focused on interdisciplinary team-work are available. Education is oriented on peace and conflict management, and developing emotional intelligence is one of the most appreciated goals.

Documentation of ideas in group “Hybrid companies”:

- High level of IT development
- Change the leadership structure
- Facilitate. Have a sufficiently flexible legal framework to allow for these ‘free enterprises’ to emerge.
- Open-mind approach for self-development
- Administration must offer their jobs to everyone
- Continued education programs
- Interdisciplinary team-working
- Help identify all personal talents & develop them
- Experience validated as much as academic studies
- Open-minded. What we can do before?
- A new culture of communication
    - communication VS connections
    - communication VS marketing
- Developing emotional intelligence
- Education for peace / conflict management

Finally, a summary of the discussions was presented by Sirkka Heinonen in the end of the workshop, as was done for the other four tables as well by their moderators. The work done in this session can be fed into the reflections on Future of Work and Technology 2050 if feasible.

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8. COMMENTS TO THE KEYNOTE SPEECH OF CORNELIA DAHEIM ON "THE FUTURE OF WORK – SCENARIOS FOR 2050 FROM THE MILLENNIUM PROJECT AND BEYOND" AT PLENARY SESSION

BY **SIRKKA HEINONEN**

Figure 12. Cornelia Daheim giving her keynote speech on the future of work. Photo: Juho Ruotsalainen / FFRC.

Figure 13. Sirkka Heinonen commenting the keynote speech of Cornelia Daheim. Photo: Juho Ruotsalainen / FFRC.

COMMENTS

At the conference “Futures of a complex world” held on 12-13 June 2017 in Turku, Professor Sirkka Heinonen was invited to give her comments to the keynote speech of Cornelia Daheim, a foresight expert and consultant, chair of the Foresight Europe Network (FEN) of the Millennium Project, and founder and principal of Future Impacts.
After welcoming the audience and expressing her pleasure in discussing the speech of Mrs. Daheim, Professor Heinonen pointed out that future of work occurs to be a hot topic nowadays, since work is so close to our hearts, lives, and livelihood, and therefore, is a serious issue to be tackled.

Primarily, Heinonen talked about the similarities between two sets of scenarios on the future of work. There are several scenarios constructed on the future of work, and here closer attention is given to the scenarios produced by the Millennium Project (MP) and the transformative scenarios made within the Neo-Carbon Energy Project. The comparison of the two sets revealed the existence of quite many similarities between them even if the MP has three scenarios and Neo-Carbon Energy project four. According to Heinonen, the found similarities raise the key issues very well.

Heinonen noted that the important challenge emphasized by Daheim was a big need in positive narratives. Everybody knows all the risks, threats and negative sides that cannot be ignored – such as high rate of unemployment and the threat of robots replacing human jobs. However, these problems should not just be bemoaned over but they ought to be seriously tackled, in order to create the preferred future. In relation to that, Heinonen highlighted the intriguing concept of *hybrid futures* and opened it up more in detail. Typically, hybridity happens in many sectors of life and there is nothing new about it. ‘Hybrid’ means a combination of two or more things, but it is not just a simple combination; there is something more in these kind of hybrid entities. Of course, in biology the term ‘hybrid’ refers to an animal that has been produced from two different types of other animals. In ancient mythology, a lot of hybrid figures were used and they usually had some kind of superpower (e.g. snakes with several heads causing havoc or Centaur with positive power). Perhaps, this metaphor of hybridity with added value (positive power) can be applied to modern day and the future of work.

Further, Heinonen challenged the audience to inquire what hybridity in work would mean. It would mean several combinations. Combinations of physical, virtual, digital work, techniques, spaces, practices, contents. But it could also mean that we focus our attention to hybridity of organization, companies and the networks. It would also refer to combination of public and private sectors, technology, culture and art. In addition, it would mean different activities in life - working not as a separate activity but in the mélange of housing and leisure. To this respect, Heinonen mentioned ‘bleisure’, the term that was coined by one of the participants in the futures Clinique “Fuzzy Futures of Work”, meaning hybridity of business and leisure. She also referred to Daheim who said that in the future, work would not be perceived as just income and status thing, but would be associated more with our identity, social connections and meanings.

According to Heinonen, apart from paradigm shifts in the field of work also transformations in the field of energy should be taken into consideration, because there are similarities therein as well. From societal perspective, the most radical consequence of the renewable energy transition that we are in, may be rapidly the falling marginal costs of energy. On the other hand, as physical production is being automated, the marginal costs of physical products are also decreasing. Hence, according to Heinonen, we may be entering an automated and robotized *"post work" society*, where collaborative and cocreative models of organisation replace traditional organisations. To this respect, prosumerism (consumers = producers) and sharing economy increase, and they are undoubtedly important in changing both the paradigm of work and of energy.

Work or paid labour salary work as we know it today is ending and something else is needed instead. Based on her research, Heinonen proposed that peer-to-peer production model as a possible answer to this kind of a quest for a positive narrative. Both from the point of energy transition and also form the point of paradigm of changing work and production. She advocated this *"peer-to-peer work in digital meaning society by 2050"* to be a preferred future vision of the future of work. This digital meaning society means that we have digitalisation which is related to automation and robotisation but we should not aim at digitalisation as such. It is just an enabling platform for digital products and digital services. The main idea and focus in the concept of digital meanings society is on work as redefined as *meaningful activity*. Heinonen talked about an initial workshop of the last year where the MP scenarios were used. The results from the futures clinique were documented in the report "Fuzzy futures of work" and in a journal paper that are available online as well. Heinonen and her research group studied future of work in the world of automation and distributed low-cost renewable energy. Five groups were invited to tackle the question of what the future of work would look like in their scenarios. As a result, the key themes were clustered and classified into seven categories. As a result, a vision of "Peer-to-peer work in the digital meaning society" with these seven key elements was elaborated. It was organised as an initial "warm-up" workshop for a national workshop to discuss MP scenarios later. This of course requires one or two stakeholders to take charge of this task.

Heinonen mentioned a very interactive workshop that was moderated in the FFRC conference by Daheim just before this keynote session. During the workshop five tables were invited to present their considerations, reflections for the future of work.[10] The results will give further feedback to the MP scenarios.

Moreover, Heinonen opened up and described one of the above mentioned seven key elements of peer-to-peer work in digital meanings society 20150, i.e. *hybrid companies* – work as a place for creativity and self-actualisation. According to this element, in the future work will be seen as a place for creativity and self-actualisation. This idea intervenes directly with the same kind of contents that MP scenario "Self-Actualized Economy" has. There is no sharp division between work and leisure and more focus is paid on immaterial needs and values. Companies are truly functioning as "free enterprises". They are mainly seen as concentrations of social and intellectual human capital, which is their asset. They are not just profit-maximising units. Undoubtedly, this characteristic is an ideal preferred future - it is not automatic but this is the key element of this kind of vision, i.e. self-defined job, self-

[10] For results, see Chapter 7 in this working paper.

management and constant learning. The function of human work is to offer a place for workers' self-expression. Therefore, the work is meaningful, creative and purposeful. Products are "authentic" expressions of workers' individuality. Together with technological developments, such as robotisation, automation, and artificial intelligence, increases in search for meanings and social capital in work and on the other hand, decreases in energy and automation / production costs could steer our world into unknown – complex and hybrid futures.

To conclude, Heinonen stated that in order to attain decent future for work, hybridity as well as the vision for peer-to-peer work in digital meanings society could be used as a lens for optimal combinations in the nature, organising, practices and meanings for work. Futurists should foster debate about alternative options. She suggested to redefine work as meaningful activity and systematically trying to find solutions through that in order to achieve this goal. Lastly, she asked Daheim to comment this proposal.

Daheim responded to the question by providing an example of digital learning apps that were developed by young people in Germany as one of the alternative ways to tackle the refugee crisis and to help refugees to learn German language and to adapt to the new environment. Different start-ups and new forms of cooperation were formed in order to work on this digital solution. That was evidence and an illustrative example of digital meanings society.

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9. CHAIRING AT SESSION 1 – SPECIAL SESSION WITH A KEYNOTE SPEECH: AGING SOCIETY AND URBANIZATION & SESSION 2 – FORESIGHT IN TECHNOLOGY

BY **SIRKKA HEINONEN**

At the Conference, two Sessions were chaired by Sirkka Heinonen, leader of the foresight part of the Neo-Carbon Energy Project and Chair of the Helsinki Node of the Millennium project. In both of these sessions there was a presentation by NISTEP representative from Japan (Mr. Naoki Saito, and Dr. Miki Kuribayashi, see below). In April 2017 Sirkka Heinonen had been at NISTEP, Tokyo to give a foresight lecture on hybrid methods, using material and results from the Neo-Carbon Energy project.

Figure 14. Sirkka Heinonen chairing at Session 1 on Aging Society and urbanization while Naoki Saito is speaking. Photo: Anne Arvonen / FFRC.

Figure 15. Naoki Saito giving his keynote speech on matured aging society and foresight in Japan. Photo: Anne Arvonen / FFRC.

Session 1 was a Special Session on Aging Society and Urbanization. At this session, chaired by Sirkka Heinonen, three reports were presented. A plenary speech "Towards multi-generational cohabitation in the era of matured aging society, from the perspective of S&T foresight in Japan" was given by Naoki Saito. Nourhan Hegazy talked about "Critical futures of aging in society-enabling futures of intergenerational knowledge creation" and Christopher D. F. Rogers introduced his research about "Engineering future cities – The value of extreme scenario methodologies".

Figure 16. Sirkka Heinonen, Nourhan Hegazy, Naoki Saito / NISTEP & Christopher D. F. Rogers. Photo: Aleksej Nareiko / FFRC.

At session 2, in the section of "Foresight in Technology", the following presentations were given: "Participatory foresight and the future internet: Buliding futures through communication" by Mario Guillo, Ana Bossler and Enric Bas, "The strategic transformation for future societal vision – Japan's innovative approach" by Miki Kuribayashi/NISTEP, "To understand creativity in virtual work: identification of leadership toward creativity in different types of companies" by Iris Humala, and "The capability of strategic foresight – a cultural approach" by Stefan Josef Marquart and Michael König.

Figure 17. Iris Humala, Miki Kuribayashi, Sirkka Heinonen, Ana Bossler & Stefan Josef Marquart. Photo: Sofia Zavialova / FFRC.

FURTHER INFORMATION ON CO-OPERATION BETWEEN NEO-CARBON ENERGY PROJECT AND NISTEP

Heinonen, Sirkka (2017). Hybrid Methods for exploring transformative futures -the importance of identifying pioneers and black swans. Visiting expert lecture at National Institute of Science & Technology Policy (NISTEP), at the Ministry of Education, Culture, Sports, Science & Technology (MEXT), organized by Science and Technology Foresight Center (STFC), NISTEP "Human Information Technology Ecosystem" project by RISTEX, 24th April 2017, 67 ppt slides.

Video of the lecture: https://sites.google.com/site/futuremediac/videos--presentations

Heinonen, Sirkka (2017). New Directions for Japanese Futures Studies (in Finnish). Newsletter of the Finnish-Japanese Association KOKORO 2/2017, p 24-26.

CONCLUSION

Like in 2015, this year the Neo-Carbon Energy project contributed to the annual conference "Futures of a complex world" (12th-13th June 2017) organised by Finland Futures Research Centre, University of Turku. Its input consisted of mainly six presentations directly from the Neo-Carbon Energy project, two events in particular from the cooperation with the Millennium Project (MP). MP was represented by Ms Cornelia Daheim and Professor Sirkka Heinonen, German and Finnish MP Nodes respectively. Together with Daheim, Heinonen moderated a workshop where results from the futures clinique "The Fuzzy Futures of Neo-Carbon Work" were introduced to the audience and further elaborated. Heinonen also chaired two sessions and commented the keynote speech of Daheim, where similarities between the two sets of scenarios resulting from MP and NCEP were demonstrated.

The abstracts and highlights of presentations from the Neo-Carbon Energy project are included here. Additionally, the report contains the summary of the workshop on the future of work as contribution from the MP. The two sessions Heinonen was chairing are also presented here since there are methodological and foresight activities co-operation under planning between Finland and Japan. In both of those sessions there was one representative from NISTEP (National Institute for Science and Technology Policy in Japan), and in addition Heinonen had been earlier lecturing at NISTEP.

Next year's conference "Energizing futures – sustainable development and energy in transition" organized by Finland Futures Research Centre will take place in Tampere, 13th-14th of June 2018. The forthcoming conference will focus on the future of energy and sustainable development. The conference will address such topics as renewable and non-renewable energy sources, energy transition, energy markets, energy efficiency and policies, energy end-use patterns and consumer behaviour. For the 2018 conference, the Neo-Carbon Energy project will have further results and findings – finalised scenarios and case studies from Argentina, China, Africa and Australia – to share with the expert audience in order to get feedback, provoke further thinking, and research development processes.

Overall, these presentations contribute to the internationalisation goal of the overall project by disseminating information and tentative results, exploring possible applications, as well as inviting comments and perspectives from beyond the project team. Neo-Carbon Energy project team members also made new contacts within the futures research and foresight community, growing the project's international network. These global networks, notably the Club of Rome and the Millennium Project, would play a key role if the world's energy economy is to be transformed into an emission-free Neo-Carbon system. We do this work not only for Finland's future, but for the well-being of all of Earth's inhabitants. The elaborated Neo-Carbon Energy scenarios, under development at the time this report was prepared, will be published when completed by the end of 2017. Professor Sirkka Heinonen and her project team – Joni Karjalainen, Juho Ruotsalainen, Marjukka Parkkinen, Sofia Zavialova – at Finland Futures Research Centre invite readers of this working paper to share their own insights and perspectives in the spirit of shaping a bold new vision for renewable and emission-free energy in Finland and the world.

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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.

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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.

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