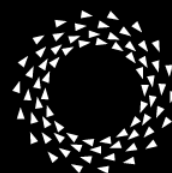Sirkka Heinonen, Joni Karjalainen and Juho Ruotsalainen

TOWARDS THE THIRD INDUSTRIAL REVOLUTION

Neo-Carbon Energy Futures Clinique I

NEO CARBON ENERGY

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"We have the science, the technology, and the game plan to make it happen. Now it is a question of whether we will recognize the economic possibilities that lie ahead and muster the will to get there in time."

Jeremy Rifkin

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PREFACE

This report presents the results of "Creating the Third Industrial Revolution", a Futures Clinique of the Neo-Carbon project, organised in Ruoholahti, Helsinki May 6, 2015 at Sitra.

Carbon neutrality and resource efficiency are rapidly becoming globally shared objectives. In order to make Finland a carbon-neutral and resource-wise society, individuals, businesses, decision makers and the public sector must all face up to major challenges. Economic growth can be achieved through promoting business that solves global problems related to climate change.

Energy plays a crucial role in developing a sustainable society. Energy systems have societal consequences reaching beyond energy. The transformation towards renewable, decentralized energy production opens up a possibility to create a society in which not only energy, but industrial production takes place on a very local level.

Energy is more than just a technological issue. A whole new narrative of the future society is needed. The ideas created in the Futures Clinique will guide Neo-Carbon Energy project in finding new sustainable solutions for Finland's wellbeing in the future.

Helsinki 20th August 2015

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ABSTRACT

Keywords: neo-carbon, third industrial revolution, energy futures, renewable energy, foresight methods, transformative scenarios, Futures Clinique, Futures Window, Futures Wheel, PESTEC, black swans

This report presents the results of *"Creating the Third Industrial Revolution"*, a Futures Clinique organised in Ruoholahti, Helsinki May 6, 2015 at Sitra. Futures Clinique is a distinct futures workshop method. The futures clinique was conducted within a research project NEO-CARBON ENERGY and its futures research part "Neo-Carbon Enabling Neo-Growth Society – Transformative Energy Futures 2050", funded by Tekes. Neo-Carbon Energy is an ongoing joint research project of the Technical Research Centre of Finland (VTT) as co-ordinator, together with the Finland Futures Research Centre (FFRC) and Lappeenranta University of Technology (LUT) as partners. The technological aim of the project is to study and develop energy storage systems for wind and solar, a combination that is called the Neo-Carbon Energy system. The system is cost-effective, independent and carbon-neutral, as carbon dioxide is captured from the air to produce synthetic methane or other carbon-based chemicals.

Around 70 experts participated in the Futures Clinique. The participants included project members, government, business and third sector representatives as well as students. They worked around four tentative scenario sketches until the year 2050 called *Radical Startups*, *Value-driven Techemoths*, *Green DIY Engineers* and *New Consciousness*. All of the scenarios are transformative i.e. implying fundamental change and differ more or less radically from the present. The scenario sketches were analysed on a general level and especially with regard to implications for Finland. Four different futures research methods were employed in the workshop: 1) Futures Window, 2) Futures Wheel, 3) PESTEC Table, leading into a vision summarized as an energy manifesto, as well as 4) anticipation of potential black swans.

The different groups in the Futures Clinique identified several pathways and factors that may drive a third industrial revolution and the realization of the neo-carbon energy system. In Finland, cross-disciplinary innovation that combines energy knowledge with "soft" skills will drive future change. In addition to a courageous vision, investments into demonstrations can manifest the potential of future solutions, driven by ecological values and teamwork. Unpredictability in the political environment was identified as a barrier to the emerging vision. Political leadership and long-term visionary thinking could help overcome this. Should change not happen from within, external ecological or economic shocks to our present systems may expedite solutions driving the third industrial revolution and a neo-growth society. Awaiting for the world to change could, however, signify the loss of momentum. The opportunities provided by neo-carbon are there to be grasped proactively. The project work will continue based on these findings and invites future collaborators for this emerging vision.

1. INTRODUCTION: NEO-CARBON ENABLING THE THIRD INDUSTRIAL REVOLUTION

Despite all the efforts to reduce the energy-related greenhouse gas emissions, the annual emissions globally have doubled since the 1970s. The proportion of fossil fuels from the global energy use is currently at over 80 percent – at the same level it was in the 1990s. In the 20th century, energy consumption did not decrease and mainly energy efficiencies were obtained. The fossil fuel economy globally is expected to burn approximately 2 795 Gt of carbon, far too much to limit climate change below safe scientific limits. To mitigate this, the design of a future infrastructure and economy is imperative. The world needs concrete and feasible solutions.

This report documents and analyses the results of the first Futures Clinique of the NEO-CARBON ENERGY project organised in Ruoholahti, Helsinki May 6, 2015 at Sitra[1]. Futures Clinique (see chapter 2) is a distinct futures workshop developed through several pilots at the FFRC by Professor Sirkka Heinonen (Heinonen & Ruotsalainen 2013b). Contrary to traditional futures workshops, Futures Clinique is more rigorous and radical as a method: it consists of extensive back office research and background material provided to participants, utilising different foresight methods in the actual fast-advancing workshop, provoking out-of-the box thinking, as well as a thorough documentation and analysis of the results. Futures Clinique is developed to identify and analyse weak signals, which today may be marginal issues and phenomena but that can strengthen in the future. In other words, Futures Clinique concentrates on new, emerging issues – instead of analysing conventional development paths only such as megatrends and trends. Uncertainties and surprises with low probability but high impact i.e. black swans are also being explored within a Futures Clinique. This first Futures Clinique of the project focused on the elaboration and analysis of four tentative scenario sketches called *Radical Startups*, *Value-driven Techemoths*, Green DIY Engineers and *New Consciousness*. These scenario sketches will be developed further during the project. The results of this futures Clinique will be used to feed into the scenarios. Such dynamic elaboration will continue in other forthcoming futures workshops and events as well.

NEO-CARBON ENERGY project and the futures of energy

The NEO-CARBON ENERGY project was launched in 2014. This joint project is one of the Tekes strategic research openings and is carried out in cooperation with Technical Research Centre of Finland VTT Ltd (co-ordinator), Lappeenranta University of Technology (LUT), and University of Turku, Finland Futures Research Centre (FFRC). The **technological aim of the Neo-Carbon Energy project** is to study and develop synthetic methane energy storage systems for wind and solar. The system is carbon neutral, as carbon dioxide is captured from the air to produce synthetic methane. In addition to energy storage, such a

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[1] Sitra is one of the appointed reviewers of this futures work package in Tekes project. Sitra provided facilities for the Futures Clinique. http://www.sitra.fi/en/blog/carbon-neutral-industry/new-ideas-for-novel-energy-system-sparked-futures-clinique

technological combination can also contribute to other types of applications and new products as liquids and chemicals. Information about the project and its objectives can be accessed online at: www.neocarbonenergy.fi as well as through social media: http://facebook.com/neocarbonenergy and https://twitter.com/neocarbonenergy.

Energy production is not solely a technological issue. How energy is produced and consumed affects the whole society. An energy system of wind, solar and their storage is a distributed way of energy production. The neo-carbon energy system provides the material base for a distributed society and enables a peer-to-peer society where individual citizens and communities can become energy producers. This, in turn, enables them to become producers of material goods as well using 3D printers and other digital manufacturing technologies. In contrast, a non-renewable economy was built on highly centralized systems. If production shifts from large organisations to energy-independent local communities and peer-to-peer networks, the entire social and power structure of society could change, and increasingly stem from the grassroots.

The solution of the neo-carbon energy system is an entirely new energy system that is emission-free, cost-effective and independent. This system will be based solely on solar and wind, alongside hydropower and biomass. The main problem that has prevented moving from a fossil fuel based energy system to a system based on solar and wind is the intermittent nature of solar power and the highly variable nature of wind power. Neo-carbon system provides a solution to this problem. Solar and wind are currently the only sufficient and infinite energy sources. Furthermore, they are also expected to be the most cost-effective production methods in the largest energy markets by 2020.

Studying energy futures with radical transformative scenarios

The foresight part of the project is conducted at the Finland Futures Research Centre (FFRC) (for more information, see https://www.utu.fi/fi/yksikot/ffrc/tutkimus/hankkeet/Documents/NEO-CARBON_ NEO-FORE_Brochure.pdf).[2] The research studies the societal implications of the neo-carbon energy system and focuses on the related economic, political, cultural and social changes. Equally, the future energy system and landscape is affected by socio-cultural changes such as changes in value systems and people's lifestyles. A possibly distributed energy production system is driven by low-carbon technologies and emerging issues such as prosumerism. As a result of technological and social change, radically new innovations, services and practices could emerge. What kinds of business opportunities, organization models and lifestyles does the peer-to-peer neo-carbon society enable to companies, citizens and the society? Could such growth be environmentally sustainable and serve the overall well-being of citizens instead of conventional economic goals?

The futures research part of the study is based on horizon scanning of the changing world and energy landscape. These phases are feeding into the construction of four transformational scenarios on the neo-

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[2] The research team at FFRC consists of prof. Sirkka Heinonen as director of this futures-orientated part, with Joni Karjalainen and Juho Ruotsalainen as project researchers. In summer 2015 Marjukka Parkkinen and Nick Balcom Raleigh worked as interns for the project at FFRC Helsinki office.

carbon world and neo-carbon societies until 2050.[3] This project has intentionally chosen to focus on transformational scenarios. Accordingly, four transformative scenario sketches of Neo-Carbon futures 2050 have been constructed, and they are analysed in Futures Cliniques as distinctive futures workshops as well as with the use of other innovative foresight tools and processes. These scenarios are then tested and complemented in a cross-fertilization process and with feedback from stakeholders such as business, government and non-governmental organisations (NGOs) representatives. The futures research is stimulated with international perspectives from innovative case studies around the world (China, Africa and Latin America).[4] The potential of neo-carbon energy solutions is also tentatively probed in these case studies.

Instead of one linear pathway to the future, there are many possible, alternative futures influenced by our present choices. A case for 100% renewable energy and required shifts is increasingly on the table (Lund 2014). Curiously enough, many past energy scenarios have failed to foresee unprecedented events or the pace of technological change (Karjalainen et al. 2014). Such changes could transform the economy in significant ways. While the necessity of an energy transition seems inevitable; numerous questions on how these energy investments are financed, what policy choices are appropriate, what kind of research and development (R&D) is needed and how the rights of citizens are protected amidst such potentially large societal changes, are arising. Frequently, scenarios are cautiously paying attention to what is probable instead of what is possible. Such approach fails to catch opportunities that are hidden in new emerging issues or whole societal transitions.

The Third Industrial Revolution…

In all of the four transformative scenarios, the world has gone through the **third industrial revolution** (see Rifkin 2011). According to Rifkin (ibid.) any industrial revolution requires two interlocking developments: a new mode of energy production and a new set of communication technologies.

The first industrial revolution of the 18th and 19th centuries was fueled by the steam engine, coal and the printing press. Inexpensive print technology and state schools gave rise to a print-literate workforce with the skills to manage and coordinate the increased commercial activity. The second industrial revolution (early to mid-2000th century) was ushered by oil, combustion engine, nuclear, electricity, radio, television and telephone. Society became centralized and bureaucratic and thus highly efficient. Mass production and mass consumption emerged.

According to above logic, the "information society" (appx. from 1970s to early 2000s) cannot be understood as a separate phase of an industrial revolution, as it did not involve a new energy technology. Furthermore, the internet began to spread not until mid-1990s. The information society was thus defined mainly by the computer, not by the internet as a new communication technology. In this light, the infor-

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[3] Prof. Jim Dator (2009) from Hawaii University categorizes scenarios into four generic archetypes: growth, discipline, collapse and transformation.
[4] Case reports are forthcoming on China, Argentina and Africa. Global high profile futures networks are also consulted within this project, esp. Club of Rome and Millennium Project.

mation society could rather be seen as a late phase of the second industrial revolution, in which the efficiency of industrial production was greatly enhanced and globalized by the use of computers.

The third industrial revolution is now being paved by **renewables such as solar and wind, energy storage technologies, the internet and new digital manufacturing technologies** such as 3D printing. Contrary to the technologies of previous industrial revolutions, renewables, the internet and new manufacturing devices are *distributed technologies*. Renewable energies are found everywhere instead of certain areas. They are also relatively affordable to exploit.[5] Internet is a networked communication technology without centres of control and with low costs of communication. A basic 3D printer can be bought for a few hundred dollars. Thus, the third industrial paradigm promotes a decentralized society.

In the third industrial period, the household and communal level will become the main areas of production. Citizens produce goods, services and energy by themselves, utilizing digital production technologies and distributed renewable energy resources. Surplus energy is fed onto the "energy internet" (smart grid). Citizens and micro-businesses use the internet to organize their productive efforts and to produce and attain information. Societal and economic **power is redistributed from large organisations to small-scale actors**.

Each industrial phase not only revolutionizes production, but changes values, needs and cultures as well. The first industrial revolution developed hand in hand with the nation state, scientific worldview, and Western liberalism. The second industrial phase was marked by mass production and consumption and rationalized bureaucracies. The third industrial revolution will be characterized by niche markets, glocal (global & local) cultures, "immaterial" and creative economy, systemic worldview (seeing the world as interlinked systems, as a whole where everything is interconnected) and the combination of individualism and communities ("indocollectivism").

Culture-wise, the most fundamental feature of the third industrial revolution could be the ubiquitous internet, which will connect everything and everyone in an integrated global network. People, machines, natural resources, production lines, logistics networks, consumption habits, recycling flows – virtually every aspect of social, economic and non-human life will be linked via a common network. The internet becomes a nervous system (van Dijk 2012) for the whole globe. On the internet, all communication takes place through the same medium and in the same 'environment'. Castells (1996) calls this feature of the internet *symbolic isomorphism*: on the internet, different cultural expressions, institutions and spheres of life are morphed into each other.

…is in peer-to-peer ecosystems based on neogrowth and deep ecology

If the first and especially the second industrial phases were deeply materialistic – growth was seen as increases in material prosperity – in the third industrial phase "immaterial" values would gain hold. Due to highly efficient and automated production, material needs would be met easily – and if renewables and bi-

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[5] Renewables mainly carry capital costs in the installation phase, but their operating costs are fairly low – compared to non-renewable fuels in centralized power plants.

omaterials would be in wide use, also ecologically sustainably. People would be free to pursue "higher" needs and goals. Production would become immaterial in large proportion. Human growth would enmesh with economic growth and sustainability – a concept of growth which Pentti Malaska (2010) has called **"neogrowth"**. However, this wouldn't necessarily mean that material wellbeing would be shunned upon. In this sense, a neo-growth society can be seen as a "matured" phase of the information society, in which the potentials of information and communication technologies (ICTs) are thoroughly utilised. New needs could naturally be material as well, but compared to automated production, human labour would develop toward more "artisanal" fashion.

As new values would question the concept of private property, the economic feasibility of property rights would have to be rethought. Yochai Benkler (2002), a Harvard Professor of Entrepreneurial Legal Studies, claims that as production becomes increasingly immaterial, **commons-based peer-production** arises as the core organizational principle instead of markets and bureaucracies. In markets, production is organised through prices signals, and in bureaucracies through command chains. In commons-based peer-production, in turn, production is self-organising. Producers decide for themselves what they produce, with what resources, how and with whom. Benkler claims that self-organising is the most efficient way of organizing creative production, as resources, requirements etc. cannot be objectively defined and thus managed "from above".

Consumers of a peer-to-peer society become "prosumers", when they increasingly participate in the production phase of the economy. The idea of **prosumerism** stems from meshing together the words 'producer' and 'consumer'. Futurologist Alvin Toffler (1980) coined the term to depict "proactive consumers" who personally help improve or design the goods and services and expected prosumers to transform the marketplace as well as change the role of the consumer[6]. The recent fall in solar PV prices can be argued to have brought prosumerism to the energy sector, and is consequently transferring "power to the people" (van der Schoor and Scholtens 2015).

Commons are material or immaterial resources accessible to all members of a society. Information can be seen as commons in nature, as information can be used by many at the same time, and information does not deteriorate or deplete when "used". As the production and distribution of information becomes cheaper and cheaper due to ever-developing ICT's, information is no longer scarce and its price falls. The main scarcity left is human creativity. In this condition, it is not feasible anymore to withhold information inside an organization. According to Benkler (ibid.), the more openly and abundantly information flows, the better it is for creativity. Patents and once-proprietary information will become openly shared, as companies such as Facebook or Tesla Motors are already doing[7].

As individuals would be constantly connected to the internet, the borders between the individual and their networks could begin to dissolve. After all, we already live in a network society (van Dijk 2012). This development would set under question the whole modern notion of separate, self-contained, profit-seeking

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[6] In some instances, the term prosumerism has also been interpreted as a market segment between a "professional" and a "consumer"
[7] http://bits.blogs.nytimes.com/2015/03/29/open-sourcing-cars-and-computers/

individuals (see Hayles 1999; Rifkin 2014). Access would be valued over ownership, transparency over privacy, and collaborative co-creation over competition[8]. As the role of the ego would be hindered, spirituality and transcendence (i.e. seeing oneself as part of "something bigger") could re-emerge as basic features of culture. Indeed, a *living organism* could become a metaphor for the whole society (the concept of **business ecosystems** can be seen as a weak signal of this kind of comprehension). In nature, there are no separate entities, but everything affects everything else. In living organisms, changes happen everywhere, all the time and in a self-organising urge. (Laloux 2014.)

As the costs of collaboration (i.e. transaction costs related to information and communication) are falling, the meaning of competition changes. Firms and organisations gain competitive advantages by collaborating instead of competing. They begin to lose their clear boundaries and start to form **ecosystems**. The core idea of business ecosystems is that companies cooperate and exchange information in a much more open manner than before. Business ecosystems include other companies as well as citizens, consumers, governmental organisations etc. In business ecosystems value is added through open innovation and co-creation. Firms and other actors coevolve together. As in biological ecosystems, companies create mutually beneficial ("symbiotic") relationships with customers, suppliers, and competitors.

James F. Moore (1996, 26), who coined the concept, defines business ecosystems as follows: "*An economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world. The economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they coevolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments, and to find mutually supportive roles.*"

Business ecosystems can be seen as a weak signal of a whole society organizing as an ecosystem. In this kind of society, all actors exchange information openly and form cooperative relationships with each other. As opposed to network society, the "ecosystem society" is more dynamic, more open and stemming from the grassroots. In an "ecosystem society" people share, collaborate, team, experiment, and grow together. They develop shared patterns of behavior – shared cultures – that streamline the flow of ideas, talent, and capital throughout a system. (Hwang 2014.)

New kinds of patterns of collaboration and interconnections are manifesting and driving responsible innovation (Pavie et al. 2014). An increasing awareness of planetary boundaries is driven not least by the puzzle how to deal with the growing climate change concern (IPCC 2014; 2013; UN 2011). This is posing questions on peoples' values and how human life and interactions can be organized in ways that are both sustainable and functional.

The natural world is a subtle balance of complex inter-relationships in which the existence of organisms is dependent on the existence of others within ecosystems. **Deep ecology** is a contemporary ecological and environmental philosophy that recognizes the inherent worth of living beings. Deep ecology portrays hu-

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man beings within the ecology. The impacts of human action on the ecology are manifesting in varying time trajectories and as a feedback loop, may bring not only economic losses, but threaten all organisms, including human beings themselves. A holistic view of the world can account for the complex interrelations and impacts of economic activity and help respect the living environment. In contrast, pragmatic ecology emphasizes only the instrumental utility of nature to human needs[9]. Some ecologists have even suggested that environment should have certain inalienable legal rights for it to live and flourish. Nature can also be conceived as an entity and stakeholder of its own right with whom humans should make a contract (see e.g. Serres 1990 and Heinonen 2000).

A holistic philosophy of **_innovation-driven, evidence-based foresight and futures consciousness_** could provide ethical guidance in the discussion how modern human societies and the economy can be re-structured. The search for neogrowth and identification of the processes of third industrial revolution provides a most interesting avenue for the pursuit of this endeavour.
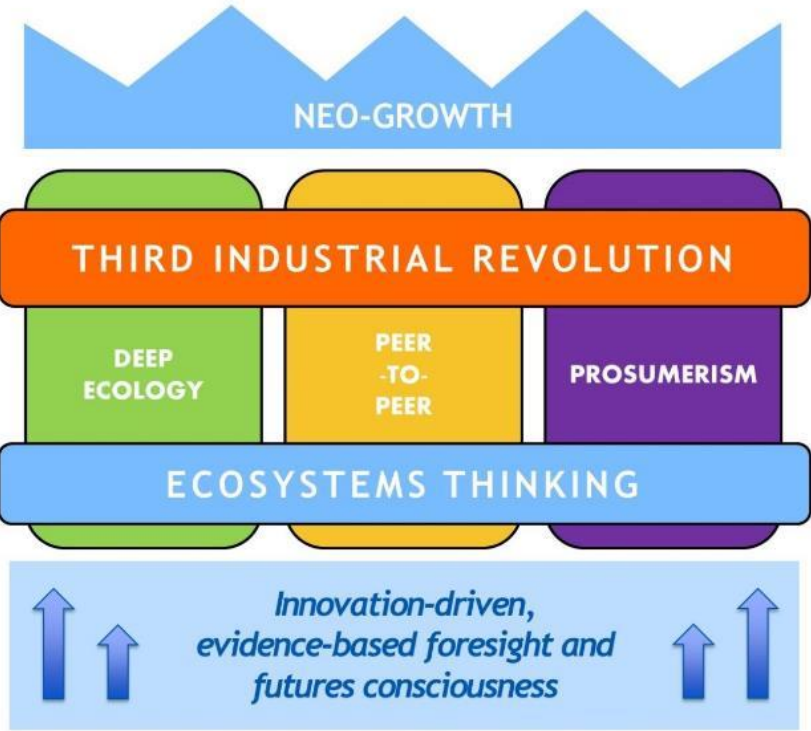

Figure 1. Innovation-driven, evidence-based foresight and futures consciousness driving the third industrial revolution and neo-growth solutions.

The ideas and concepts introduced above are summarized above in *Figure 1*. These ideas will be elaborated and made more concrete in the Neo-Carbon scenarios. These scenarios will be presented briefly in the following chapters.

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[9] When Arne Næss (1973) initially coined the term deep ecology, Naess compared it with shallow environmentalism which he criticized for its utilitarian and anthropocentric attitude to nature and for its materialist and consumer-oriented outlook.

2. FUTURES CLINIQUE AS A FORESIGHT METHOD

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

The main distinction to other futures workshops is that Futures Clinique is especially designed to anticipate and create *radical futures* – futures that differ significantly from the present. Futures Clinique places a strong emphasis on *weak signals* – new phenomena and issues that are more or less marginal, but can strengthen in the future. Real change lies in weak signals, as they bring about issues that are *qualitatively* different from the issues of the present. On the contrary, trends and megatrends point to *quantitative* changes – more or less of something that already exists, is widely known and can be measured. In other words, the Futures Clinique deals with discontinuities instead of continuities. It also invites to thinking about uncertainties and surprises, sudden events with low probability and high impact i.e. *black swans* (Taleb 2009; Heinonen 2013a).

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

The Futures Window is succeeded by groupwork sessions, in which several foresight methdods are used. These include the Futures Wheel, which is a mindmap-like method of collecting ideas, discussing them and anticipating their effects (Glenn 2009). The most interesting and relevant ideas of the Futures Wheel will then be analysed and elaborated by using the PESTEC table, which is a structural tool to study the political (P), economic (E), social (S), technological (T), environmental (E) and cultural/citizen/customer (C) aspects of an issue. Finally, the results can be summarised in a tentative *scenario narrative* or a *manifesto*, for instance. In the end of the groupwork sessions it is also fruitful to try to anticipate possible *black swans* – sudden, unexpected events with drastic consequences – and how they would affect the future the group has created (as a kind of sensitivity test). The final phase of the groupwork sessions is the presentation of the results of each group to other groups i.e. cross-fertilization. After the workshop, the moderators document, analyse and synthesize the results as a research report. In the report, the results are often summarized and broadened as scenario sketches. Before the report is published, it is sent to the participants so that they can comment and still add to it. The process and the results of this Futures Clinique are presented in chapters 3 and 4.

3. BACKGROUND MATERIAL: FOUR TRANSFORM-ATIVE SCENARIO SKETCHES 2050

Before the actual Futures Clinique, the participants to the Clinique were provided with a short background text to introduce them to sketches of four transformative scenarios. These scenario narratives have a mixture of ideas. At this stage, the scenarios may also still have some contradictory or open-end elements. The Clinique participants were able to let the Clinique organisers know of their interest on a particular scenario that they would like to work on in the Clinique. This material sent to the participants is described below.
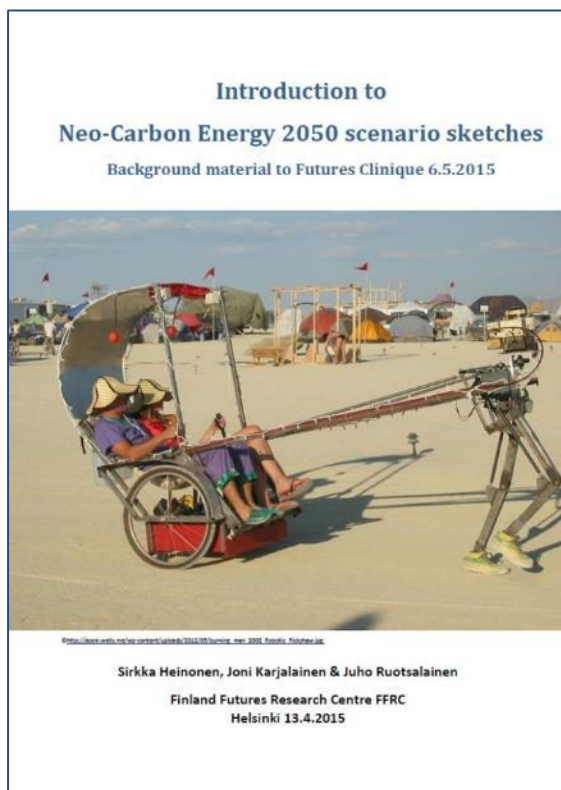

Figure 2. "Introduction to Neo-Carbon Energy 2050 scenario sketches" was shared as the background material.

Neo-Carbon scenarios 2050

This text is an introduction to the four preliminary scenarios of Neo-Carbon Energy world in 2050: Radical Startups, Value-Driven Techemoths, Green DIY Engineers and New Consciousness.

The scenario sketches have been constructed in the Neo-Carbon Energy Project, which is one of the Tekes strategy research openings and the project is carried out in cooperation with Technical Research Centre of Finland VTT Ltd (co-ordinator), Lappeenranta University of Technology LUT and University of Turku, Finland Futures Research Centre. For more information on the project, see http://www.neocarbonenergy.fi/ and http://www.utu.fi/fi/yksikot/ffrc/tutkimus/hankkeet/Documents/NEO-CARBON_NEO-FORE_Brochure.pdf.

Possible futures of the neo-carbon society are studied through four scenarios, which are now tentative but will be complemented, tested and elaborated throughout the Neo-Carbon project. All of the scenarios are "transformative" meaning that none of them is a so-called "Business as Usual" scenario. All scenarios differ more or less radically from the present. The scenarios are called Radical Startups, Value-Driven Techemoths, Green DIY Engineers and New Consciousness.

The scenario sketches have been formed using two axes and their opposite values (see table 1). The X axis is called "Peer-to-peer" and its values are Corporate ("centralised") peer-to-peer and Neo-Communal (distributed) peer-to-peer. The Y axis is called "Ecological awareness" and its values are Pragmatic ecology and Deep ecology. Out of these two axes and their opposite values four initial scenarios have been formed. The scenarios are summarized in the below fourfold table (table 1).

In each of the scenarios energy is produced according to the neo-carbon energy model. However, energy solutions, cultures, values and business practices vary from scenario to scenario, and the neo-carbon (wind, solar, methane/storage) system can be realized in different ways. All scenarios depict a distributed society, in which production, decision-making and lifestyles have become increasingly local (albeit the ubiquitous internet has made temporality and distances largely insignificant). Due to sophisticated digital manufacturing technologies, shared resources and local renewable energy, production has returned to local "communities", akin to pre-industrial conditions. This transition is referred to as **the third industrial revolution** (see Rifkin 2011).

Table 1. Four transformative Neo-Carbon Energy scenarios.

TRANSFORMATIVE SCENARIOS 2050 FOR NEO-CARBON ENERGY

	Corporate ("Centralized" peer-to-peer) ← Peer-to-peer →	Neo-Communal (Distributed peer-to-peer)
Deep ecology ↑ **Ecological awareness** ↓ **Pragmatic ecology**	**Radical startups** Society is business-oriented, but economy is driven by a multitude of small-scale startups known for their "radical" values and approaches. Environmental problems are solved commercially. Businesses are drivers of new, ecologically oriented lifestyles.	**New consciousness** Deep ecological values and distributed models have led to altogether new kind of consciousness and worldview. Environmental problems are not seen as practical issues but calling for deeper changes in values and mindsets.
	Value-driven "Techemoths" Peer-to-peer approaches are common, but they are practiced in more or less traditional organisations. Markets take care of environmental issues.	**Green DIY Engineers** Engineer-oriented citizens have organized themselves as local communities to survive ecological collapse. Environmental problems are solved locally, with a practical mindset.

Axes of the scenarios

Peer-to-peer refers to models of organisation where individuals organize their joint efforts in open cooperation. There is no involment of hierarchical structures such as governmental organisations or company administrations. In other words peer-to-peer is a bottom-up, grassroots approach as compared to up-bottom, bureaucratic approach.

In practice peer-to-peer can mean for instance social media networks, open source programming communities, grassroots political movements, consumer movements and co-working spaces. A central concept related to peer-to-peer is *prosumerism* (producer + consumer), which refers to consumers/citizens turned to active producers.

Peer-to-peer has been leveraged by the internet, which is a peer-to-peer infrastructure in itself: it is a network of networks and does not have a governing centre. Internet consists of individuals linked to each other; its social mode can be called *networked individualism*. Different actors are at least in principle equal power-wise, and on social media individuals often have more power than large companies.

It is often assumed that the more dominant and pervasive the internet becomes in society, the more prevalent and common peer-to-peer approaches grow – this is called the *network society* (see Castells 1996). In an ideal-type network society everything is in one way or another organised around peer-to-peer networks.

Traditionally the energy sector has been highly centralised. Non-renewable energy sources are not evenly distributed and their harnessing and utilization has required notable resources. Whereas renewable energy sources, especially solar and wind, are relatively evenly distributed and their harnessing and utilization is relatively cheap – and the costs are decreasing fast.

The combination of solar, wind and smart electricity grids allow an distributed energy system, where energy is produced peer-to-peer, and where traditional energy companies lose their stance and have to rethink their function. Because energy is such a fundamental sector in society, peer-to-peer energy production would form a central part for the foundation of a peer-to-peer (network) society. In addition, distributed energy production could in general steer societal values heavily towards grassroots approaches.

In the 2050 societal scenarios of the NEO-CARBON project, peer-to-peer is assumed the following two opposite variants (=extreme ends of scenario axis):

- Corporate peer-to-peer ("centralised"): people self-organise freely, but **within "traditional" organisations**. Organisations are **enabling platforms** for individuals' peer-to-peer formations, **providing resources and facilities**. Hierarchic structures have been replaced with egalitarian ones.
- Neo-communal peer-to-peer (distributed): People organise their joint efforts independently. They form grassroots communities, **based on shared values and interests**. Often these communities develop into businesses. Neo-communal peer-to-peer formations are more numerous and widely distributed than in the corporate peer-to-peer model.

Ecological awareness axis refers to a situation where ecological values and lifestyles have become the norm in society. By ecological values is meant values that acknowledge the primality of the wellbeing of ecosystems.

In the 2050 societal scenarios of the NEO-CARBON project, this axis is assumed the following two opposite variants:

- Deep ecology: an ecological and environmental philosophy advocating the inherent worthiness of living beings regardless of their instrumental utility to human needs. Nature is seen as a subtle balance of complex inter-relationships in which the existence of organisms is dependent on the existence of others within ecosystems. Nature and life in its different forms are seen as "sacred".

- Pragmatic ecology: acknowledges the great importance environmental issues, but mainly in relation to human wellbeing and survival. Concrete results are prioritized, without necessarily any deeper worldview – except for utilitarianism – guiding actions. **Nature is seen first and foremost as resources to be utilized by humans – nature is considered as valuable because of the benefits it offers to humans**.

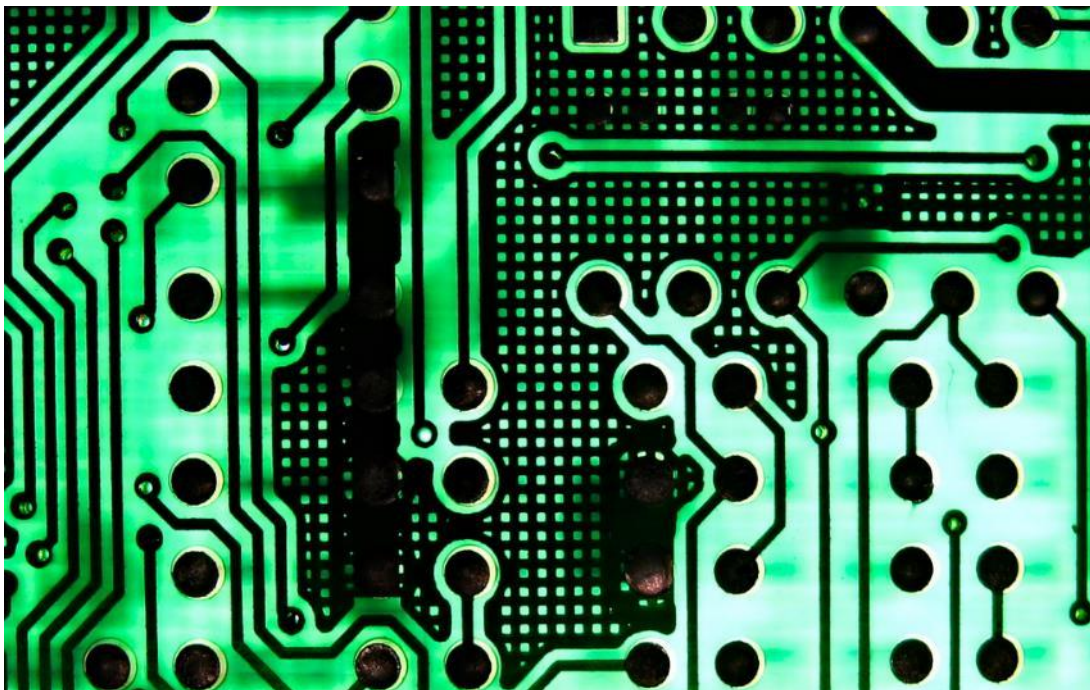## 3.1 Radical startups (Corporate peer-to-peer & Deep ecology)

Figure 3. Radical startups could design futuristic solutions. Source: Wikimedia

In the 2010s, innovation and economic growth began to stem significantly from startup enterprises. Startups offer new products and services for niche markets. Their goal is exponential growth instead of linear one. Their market value is not based not so much on their productivity than on expectations for future profits. They thus aim to "disrupt" society and its practices, as "disruption" opens up new possibilities for revenue and future profits. Startups being a major driving force, society has become unstable and constant-

ly changing. Precarity has become the new normal. However, the ease of establishing a business makes the instability more bearable.

Society is organized as horizontal peer-to-peer networks. This reorganization has taken place in numerous small and medium-sized startups known for their radical values and approaches. These companies are not akin to the "traditional" companies still predominant in the 2010s but are more community- or cooperative-like. Startups collectives have leveraged the Silicon Valley ethos of individual emancipation, creativity, communalism and networked practices as society's mainstream.

Working in startups is often leisure-like, as workers bring their hobbies and free-time interests to work. The line between work and leisure has become often non-existent. Startups can be seen as "communities of interests" where people can often express themselves best and do things that are meaningful to them. Hierarchies are extremely flat. Establishing an enterprise is easy. This mitigates inequalities, but still citizens can be divided into those who work at "elite" startups and those who are employed by "lesser" businesses.

As it merged work with hobbies, the new corporate culture began to evaporate the division between companies and the rest of society. Consumers demand moral, aesthetic and value-related integrity from companies, just as they expected these virtues from each other. *Authenticity* has become the leading value for the new breed of startups. These new companies firmly stood behind what they believed in, instead of trying to please as many customers as possible.

Startups are drivers of new, ecologically oriented lifestyles, and many of them have adopted the philosophy of deep ecology – partly to build an "authentic" brand with "street-credibility". Environmental problems are solved first and foremost commercially. Many startups specialize in environmental issues, energy technologies and environmental services. However, due to the vast number of different startups, the production structure is highly diverse.

ICTs are everywhere and society is "smart". Smart technologies, applications and services emphasize the active role of individuals – they enable more than automatize. Still, the energy and resource consumption of ICTs is an issue to be solved.

Table 2. Energy in the Radical Startups scenario.

Energy in the Radical Startups scenario
Energy is produced in clusters of startups, mainly wind & solar. The energy system has been achieved through private sector innovations, no subsidies. Forests are not used as biomass.
Demand for energy relatively high, but ubiquitous smart technologies and carbon-negative business models of startups somewhat mitigate consumption.
Proximity and collective learning within startup communities provide knowledge on energy innovations and saving solutions. Energy consumption is thoroughly monitored. The wealthy consume more energy than the poor.
Built environment optimizes its energy flows efficiently. However, ubiquitous ICTs themselves use a lot of energy.
Energy is not seen as solely practical issue "out there", but taken as personally important.

3.2 Value-driven techemoths (Corporate peer-to-peer & Pragmatic ecology)

Figure 4. Large companies in their new premises could let employees to gather to co-create yet unforeseen neo-carbon solutions in their research and development (R&D) departments. Source: Flickr
https://c2.staticflickr.com/6/5093/5559035701_8a59d9fb55.jpg

In the Value-driven techemoths scenario, peer-to-peer approaches are common, but they are practiced within big corporations. Companies act as hubs and platforms for individuals' shared projects. They provide resources and facilities, and give their "employees" full freedom to pursue their interests. Ecological orientation is pragmatic, as is the whole ethos of society: functionality and efficiency are emphasized. The culture is relatively homogenous, as values tend to unify among the workers of corporations.

Internet and consumer electronic behemoths such as Google, Facebook and Apple provide the operational model for the whole society. Due to their economic dominance[10], they have steered society's values and culture to their liking. When traditional media companies lost their stance in channelling information flows, social media giants claimed the dominant position in news distribution. Thus they are in a position to affect culture in various ways.

Large companies have began to take care of many of the responsibilities previously looked after by the public sector and other companies. They are, for instance, significant scientific actors thanks to their extensive, bold and experimental science projects[11]. Due to the climate and energy crisis, they are deeply involved in energy technology research and development.

As they have become attractive for networked individuals, large corporations have grown even larger than before. These companies' headquarters, built in 2010s, were designed as city-like[12]. They are the new

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[10] http://www.newscientist.com/article/mg21228354.500-revealed--the-capitalist-network-that-runs-the-world.html
[11] http://www.fastcompany.com/3028156/united-states-of-innovation/the-google-x-factor
[12] http://www.spur.org/publications/article/2012-01-07/not-so-corporate-campus

city-states with their own legislation, democratic decision-making and governing practices, accommodation facilities, amenities, recreational and leisure opportunities etc. Citizens associate strongly to corporate cultures, just as they associated to national cultures before. Although big tech companies are almost fully self-sufficient local units, their markets and corporate cultures are global.

Ubiquitous ICTs take care of energy optimization – everything has become "smart". However, smart technologies themselves consume a lot of energy and resources. In addition, society is highly polarized. The public infrastructure outside company campuses is often in poor conditions. The impoverished, approximately 30% of the population, which is not employed by the big companies, often have insufficient knowledge or resources to make sustainable choices.

Table 3. Energy in the Value-Driven Techemoths scenario.

Energy in the Value-Driven Techemoths scenario

Tech companies develop energy technologies and produce energy, mainly in solar & wind but biomass is also used. R&D is ambitious and "futuristic". Companies provide products and services that reduce CO2 emissions. Energy solutions vary from company to company according to their different needs.

Demand for energy is high, but ubiquitous smart technologies somewhat mitigate consumption and corporation-scale neo-carbon system neutralizes emissions.

Inequality causes waste of energy. Energy education is provided mainly by tech companies. Smart technologies are not evenly distributed. Infrastructure is often in relatively poor condition outside tech campuses.

Citizens are not committed "by heart" to energy issues. They assume that energy issues are taken care of by somewhere else, are "automated".

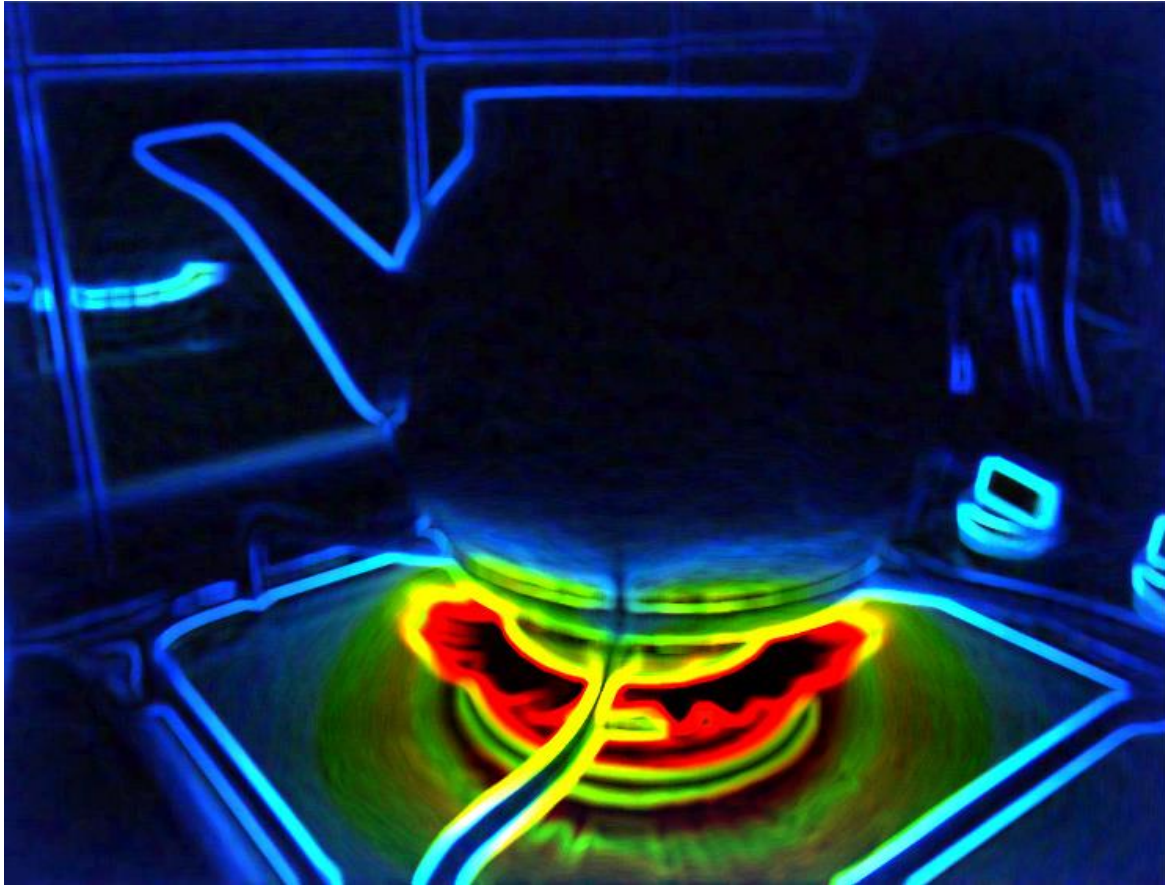## 3.3 Green DIY Engineers (Neo-Communal Peer-to-peer & Pragmatic ecology)

Figure 5. In a DIY world, ecological problems could be solved with a practical mindset. Source: http://www.unprofound.com/search/pics/thermocolur.jpg

The world has faced an ecological collapse. To survive in the harsh conditions, engineer-oriented citizens have organized themselves as local communities. Communities are well connected to each other and cooperate in various ways, but some are off-grid and totally self-reliant. Communities are densely built with lots of shared public spaces. Travelling across long distances is rare, and flight travel is almost non-existent. Africa, with its tradition of amateur tinkerers[13] has been a forerunner in DIY solutions, and has achieved a significant global political, economic and cultural role[14]. African culture has especially influenced the design of tools and other utility articles, as African art has traditionally emphasized sculpture instead of painting.

Environmental problems are solved locally, with a practical mindset. Citizens have to cope with what equipment and parts happen to be available. Formal institutional education is rare, but communities provide training in engineering skills. For these reasons, *do-it-yourself* (DIY) is the most common breed of engineers. In spite of the practical ethos, the excited and curious amateur mind (*amator* meaning "lover" in Lat-

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[13] http://www.bbc.com/future/story/20130625-africas-diy-aircraft-builders
[14] http://www.theguardian.com/global-development/2014/jan/31/i-have-dream-africa-nkosazana-dlamini-zuma

in) merges practicality with beauty and joy. In the face of an apocalypse, aesthetic beauty and play reveal the sacredness of life.

Global temperatures are rising at an average of 5 °C by the end of the 21st century, and even more so in the polar regions (IPCC 2014), and climate change has already caused severe and increasingly intensifying environmental turmoil. The situation has become even worse because of accelerating species extinctions, which are causing unexpected collapses in ecosystems[15]. Ecosystem catastrophes have led to draughts and disastrous shortages in food supply, caused new epidemics and damaged forests. Global trade has plummeted and faced its most drastic depression to date. States as well as businesses have become paralyzed.

Communities are self-sufficient and located in rural areas outside cities but sometimes also in urban settings. As everyone has his/her place in the community, "unemployment" is a phenomenon of the past. Everything is recycled with almost zero-waste[16]. Food is produced locally, and DIY synthetic biology and bioengineering experiments have produced nutritious plants with very high yields. Biomaterials provide communities with bioplastics, chemicals, pharmaceuticals and construction materials, such as organic bricks[17]. Thus, some of the communities live in relative abundance.

Table 4. Energy the DIY Engineers scenario.

Energy the DIY Engineers scenario

Energy solutions vary greatly, as communities are geographically dispersed. Energy solutions have to be tailored to local conditions. Pragmatic, local solutions ensure efficiency. Energy efficiency ensures resilience. Local wind, solar & biomass are the main sources of energy. Energy is used as little as possible.

Technology production and development are conducted at local level, by DIY engineer groups. Energy technologies have to be built using local resources mainly. Relative scarcity drives towards more diverse energy pallet compared to other scenarios.

Local democracy enforces commitment to decisions considering energy.

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[15] http://www.nature.com/nature/journal/v486/n7401/full/nature11118.html
[16] http://www.mindbodygreen.com/0-16168/i-havent-made-any-trash-in-2-years-heres-what-my-life-is-like.html
[17] http://momaps1.org/yap/view/17

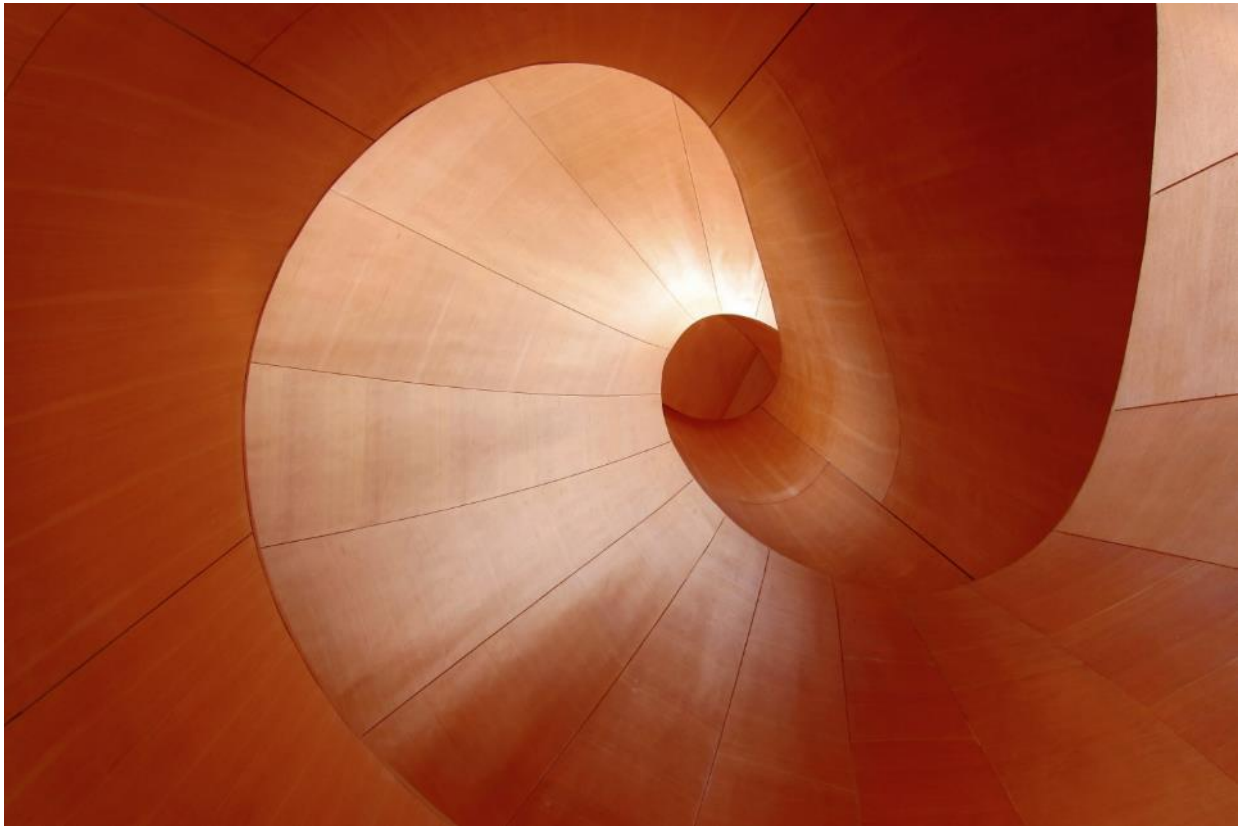## 3.4 New Consciousness (Neo-Communal Peer-to-peer & Deep ecology)

Figure 6. In a new conscisousness, the world is understood from a systemic worldview, as a sum of its parts. Photo: http://cdn.morguefile.com/imageData/public/files/j/jeltovski/hr/fldr_2011_08_26/file4701314415528.jpg

An ecological crisis, "World War III" (escalated numerous small conflicts of "hybrid warfare") and ubiquitous ICTs have led to a new kind of consciousness and worldview altogether. Deep ecology has become the norm. People do not conceive themselves as separate individuals, but deeply intertwined with other humans and with nature. Although the society is essentially global, a "world village", people live mostly in close-proximity communities. Phenomena are conceptualized and understood from a systems-oriented worldview, which sees "everything connected to everything else" – as parts of a single, global system. Nature is entitled to "universal rights". New values have changed behaviours thoroughly, which has led to drastic improvements in the state of the environment and social ills.

Information and communication technologies have become pervasive and ubiquitous. Virtual technologies are highly developed, encompassing all senses, and the physical and the virtual have become inseparable. As everyone is constantly connected to networks of other individuals, clear lines between individuals have begun to wither away. Identity is understood as a person's interaction with his or her environment, and thus, as porous, deeply interactive and ever changing. Vice versa, the industrial society with market economy was based on separate, self-profit seeking individuals. This worldview was a major factor behind the global environmental catastrophe, as individuals pursued increasing material wellbeing and to satisfy their ever-increasing needs.

Spirituality has re-entered culture's mainstream. Spirituality in its current form does not mean religiosity or belief in the supernatural, as it has previously often been, but is a logical consequence of the principle "*everything is connected*". In its most broad definition *spiritual* is the experience of merging with something much greater than oneself and transcending the limitations of the self.

Due to the technological, political and "spiritual" changes, the world of New Consciousness is a kind of a Star Trek utopia or working socialism – a society of "fully automated luxury communism"[18]. Robots and algorithms take care of most of the production. Freed from the constraints of work, people are free to pursuit whatever pleases them. Perfect democracy has been achieved. As military spending is needed no more, investments can be used in other areas such as poverty reduction and R&D. Universal, high-quality health services and increasing GDP have solved population growth.

Table 5. Energy in the New Consciousness scenario.

Energy in the New Consciousness scenario
Forests are not used as biomass. Solar & wind on a very local level, distributed through a global smart-grid. Technology development and production funded and conducted by global joint efforts.
Demand for energy relatively high, especially due to the highly developed virtual realities and the global scale.
Energy solutions are different in cities vs. local communities.
Energy is seen as "sacred", source of life. Citizens are extremely committed to energy decisions & policies. It is taken as self-evident that energy is a deeply personal issue.

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[18]   http://www.theguardian.com/sustainable-business/2015/mar/18/fully-automated-luxury-communism-robots-employment

4.　FUTURES CLINIQUE RESULTS

The futures clinique was opened by words of welcome by Senior Lead Tiina Kähö from Sitra. Professor Sirkka Heinonen then delivered her futures provocation "Transformation Through Neo-Carbon Energy and the Third Industrial Revolution". After the futures provocation, Futures Window, a visual presentation of weak signals accompanied by background music (for more details of the method see Hiltunen & Heinonen 2012), was shown.

The actual workshop took place in eight groups, two groups per each of the four Neo-Carbon scenarios. Every group had a moderator, assigned to manage and guide the group work, as well as to document and comment on the work and results.[19] Group 1 was moderated by Amos Taylor (student, Futures Studies Masters Programme, intern at Finland Futures Research Centre/Helsinki Office/summer 2014), Group 2 by Joni Karjalainen (project researcher, Finland Futures Research Centre), Group 3 by Emmi Tardy (student, Futures Studies Masters Programme), Group 4 by Marjukka Parkkinen (student, Futures Studies Masters Programme, intern at Finland Futures Research Centre/Helsinki Office/summer 2015), Group 5 by Shameer Prasla (student, Futures Studies Masters Programme), Group 6 by Ellinoora Leino-Richert (student, Futures Studies Masters Programme), Group 7 by Nick Balcom Raleigh (student, Futures Studies Masters Programme, intern at Finland Futures Research Centre/Helsinki Office/summer 2015), and group 8 by Juho Ruotsalainen (project researcher, Finland Futures Research Centre). According to the procedure developed for futures cliniques, Sirkka Heinonen circulated in all of the groups, answering any questions and supporting the moderators when necessary.

The workshop was divided into three sessions each representing a futures research method: futures wheel, PESTEC, and a combined final phase of an energy manifesto and the identification of a black swan.

1. Futures Wheel

Futures Wheel is a mindmap-like method for collecting and analysing ideas on possible futures of selected topic (Glenn 2009).

In the beginning of the Futures Wheel session, moderators asked members of their group to think by themselves **one or a few general ideas concerning the scenario** and to write them down to post-it-pads. For instance, what is the most interesting idea in the scenario paper? The post-its were placed to the center of the wheel. After this "warmup" the participants started discussing the scenario: how could society be like in that kind of future? Each participant wrote down the ideas they had brought up and **placed them to the inner circle of the wheel**.

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[19] The moderators receive a brief training into the tasks of a moderator before the Futures Clinique. They are also given detailed written instructions for the work. This procedure, developed by Sirkka Heinonen, provides an opportunity for the students of the Master's Programme in Futures Studies at University of Turku to connect with real ongoing research projects and to apply foresight methods. The moderation itself with subsequent documenting and commentaries is a learning process.

After the inner circle, the groups started discussing the scenario in more concrete terms. What could the ideas of the inner wheel mean in practice? What kind of businesses, services or products could come out of them? Again, each participant wrote down the ideas they had brought up in the discussion and **placed them to the outer circle**.

After both circles had been finished, the group chose **one idea (or a cluster of ideas) from the two circles of the wheel**. Which of the ideas were the most interesting or relevant?

2. PESTEC

PESTEC table (Political, Economic, Social, Technological, Environmental, Cultural/citizen/customer) is a method which enables a systematic analysis of the different measures, steps and preconditions for a preferred future. In this session the group elaborated the chosen idea (or the cluster of ideas) selected from the futures wheel **to be fitted into the Finnish context (what kind of society Finland is in 2050 in group's scenario)**. This was done by filling the PESTEC table.

The moderator asked the group to start discussing their idea(s) by going through each of the PESTEC dimensions – what are the political, economic, social, technological, environmental and cultural implications of the chosen idea/ideas for Finland? The PESTEC dimensions can be worked on in any order, so the members could start from any dimension.[20] For instance, the discussion could concern issues such as what political measures would the idea/ideas require, how would they affect the Finnish economy or what economic opportunities could rise from it/them etc. If a dimension seemed to lack ideas, the moderator encouraged the group members to come up with more ideas for that dimension. Anyone presenting an idea would write it down on a post-it and place it to the PESTEC table. After each of the PESTEC dimensions has been filled, the group chose the most interesting or relevant idea from each dimension. The chosen idea was marked by circling it. The circled ideas would be linked with one other.

In the end, the group was asked to give a fitting provocative or inspiring title to their work and to write it on top of PESTEC table.

3. Energy implications

After drawing their vision and analyzing the causes with PESTEC, the group was asked to analyse the energy implications of their scenario, if they had not already done so. If they had time, each group was also asked to transform their preferred vision into an inspiring energy manifesto.

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[20] The dimensions are somewhat overlapping, i.e. in some case one element could be attached either on social or cultural dimension, or some other element equally well on economic or political dimension. The person who is ideating an element can choose the emphasis that he or she wants to put on it.

4. Black swan

After completing all the steps – brainstorming, systematic analysis and analyzing the energy implications or drafting an energy manifesto, the group was asked to identify a potential black swan (Taleb 2007; Heinonen 2013a). Black swan is an unexpected event that can either expedite or undermine the coming of this preferred future.

After the group work phase, all groups presented their work to other groups (only five minutes were allocated per presentation due to the high number of work groups). Commentary and quick questions from the audience were allowed. After the group presentations, a discussion about the results of the group work as a whole took place.

4.1   Group 1: Radical Startups

Group 1 worked on the scenario "Radical Startups". Group members: Amos Taylor (moderator), Karoliina Auvinen, Cyril Bajamundi, Tiina Hanhike, Lassi Similä, Steven Vanholme.

Figure 7. Group 1 immersed in reflecting the scenario Radical Startups.

Futures Wheel

Through discussion, the group produced the following ideas on the futures wheel. The more general ideas are found on the inner circle of the wheel. Based on them, the more focused ideas are on the second circle of the wheel. The key issues that were further developed are marked on red.
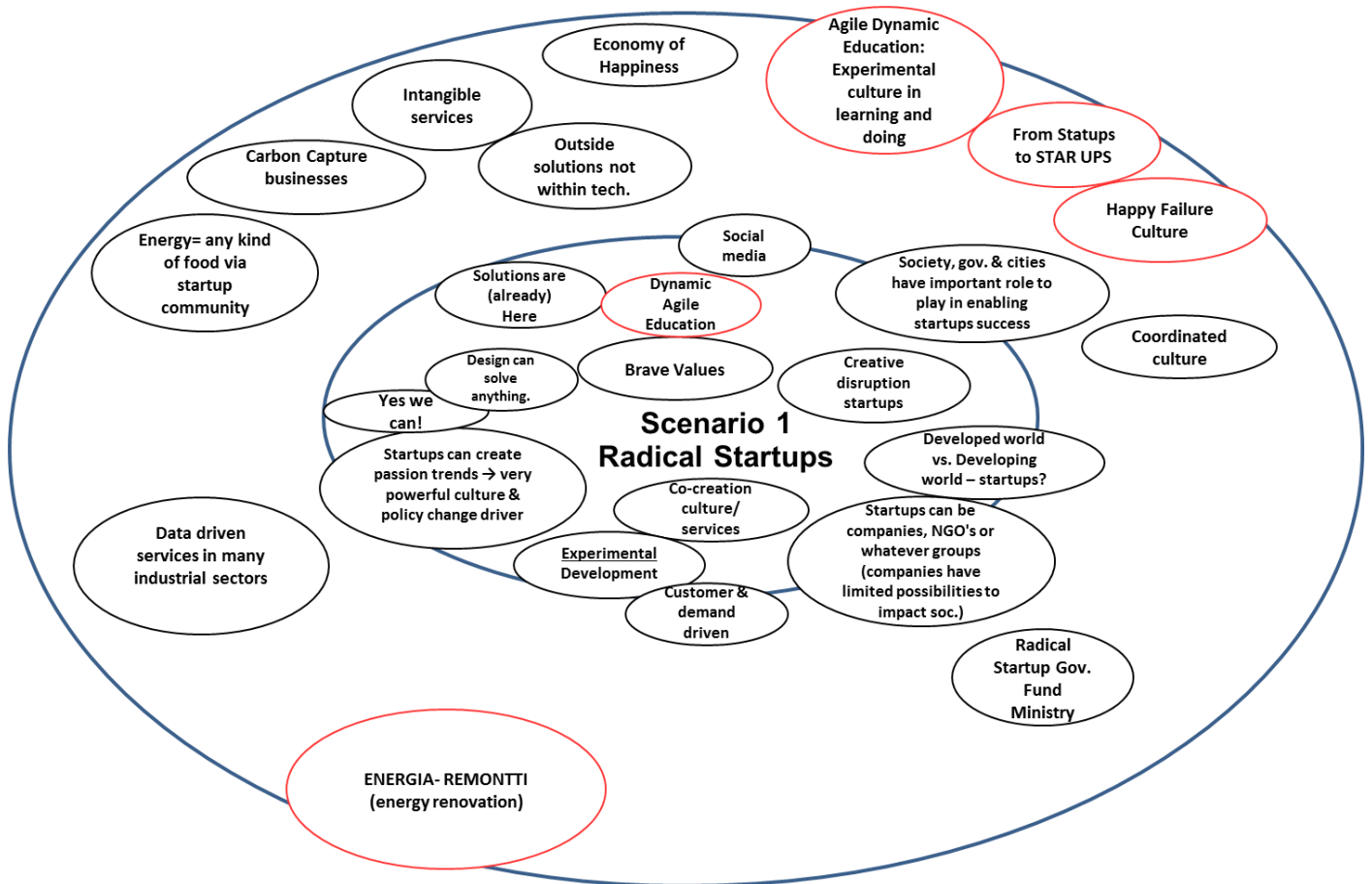

Figure 8. The Futures Wheel of Group 1 on Radical Startups scenario.

PESTEC Table

Group 1 chose from their work with the Futures wheel as their focus **energy renovation and related educational, entrepreneurial and learning-by-doing culture** as the key topics to elaborate in the PESTEC Table. The reflections on the cluster of ideas were structured according to the six dimensions of the PESTEC (Political, Economic, Social, Technological, Ecological and Cultural/Citizen/Customer):

Table 6. PESTEC table of Group 1 on energy renovation.

PESTEC	**ENERGIA-REMONTTI (energy renovation): From startup to STAR UP**			Scenario 1 Radical Startups (Moderator Amos Taylor)
Political	Legislation is modified so that it enables startups to grow, creating & facilitating market platform.	Long term goals are fixed to reach zero-carbon society by 2050	Business development & funding system modified to take more risks & support service. Infrastructure & tech innovations.	Lean Bureaucracy
Economic	Academic research is strongly linked to business development, policy & government	Making money with the environment		
Social	Agile – Dynamic education experimental culture, learning & doing	Social Security rewarding startups (after failure)	Climate change & other problems will unite people & institutions in more closer cooperation.	Language not a barrier, technology translates
Technological	Dispersed technological landscape instead of one-fits-all solutions	Authentic Eco tech Clean tech	Eliminate Fossil Fuel Utilization studies/ research	
Environ-mental	Internalisation of external costs	Be aware of carbon footprint	Making fossil fuels expensive would create business opportunities for sustainable startups to make STAR Ups grow	
Cultural Citizen Customer	Failure OK in our culture. Start again!	Be Brave, Try First.... Born entrepreneur.	Positive Psychology	Team Spirit Cooperation 'very local'.	From Internal competition & envy towards boosting together successful teams.

In order to renovate energy through a culture of startups an agile and dynamic education system was identified as a crucial enabler. Behind this supportive education is a lean bureaucracy, a system where legislation is modified so that it enables startups to grow creating and facilitating a market platform limiting the barriers. Fluid collaboration between education, government and the business environment allow a constant 'bubbling' of entrepreneur innovations, many of which are based around new uses of energy.

Positive values that encourage confidence - to *be brave*, *experiment*, *we can do it*, *its ok to fail in our culture - just start over* were constant themes in the process of building this scenario. A shift from envy in others (a typical Finnish attitude) was replaced with a team attitude understanding better the interconnected society. Failure in experimentation and starting a business is seen as a natural accepted part of the learning process in which the culture embraces *learning by doing* attitude to problem solving, and does not pass harsh judg-

ment. Culture engages in playing with the latest innovation that creatively-disrupts constantly, pushing the envelope of diverse expressions of technology and social innovation. With this shift in values and a supportive education structure that constantly and easily educates, being an entrepreneur becomes a heightened state where the norm is that you are almost *born an entrepreneur*, it so comes naturally and the concept of startup has ascended in a competitive ethos to *Star Up.*

In *Star Up* the network or *team* of everyone associated and interconnected with this process is elevated with a united effort to tackle problems (like climate change). It is a diverse offering of intangible products and peer-to-peer services as well as new experimental technological advances all focused on maintaining post fossil fuel development. Fossil fuel and peat burning practices are heavily taxed and greatly discouraged and seen socially as being in terrible taste. With the *internalisation of external costs*, where all materials are the responsibility of the producer a circular approach is taken to the life of products and services, and this is a skill that star up's intrinsically understand. Authentic eco-tech and clean-tech are highly valued with its transparent pedigree and integrity of ethical practices. In this way, working with the environment in an ethical manner is very profitable and achieves growth, as dirty energy practices become too expensive this consequently offers countless opportunities for startups to thrive. A dispersed technology offering rather than one-fits-all solutions sees fresh ideas coming from outside and a crossover discipline approach to problem solving and innovation is pursued.

New types of business surrounding energy, like directly collecting and harnessing carbon from the air, was one example drawing from the personal expertise of the group who suggested that this experimental production would become more affordable (as it is too expensive right now to be put into practice). It would become a highly profitable business. Of course, new wind and solar technologies have matured and offer verities of strategic local applications to larger ventures. '*Any food you can imagine'* – the group suggested, can be produced using the water and energy resources in new innovative circular ways, mindful and aware of the environmental footprint, fearlessly bold in its aspirations. Amongst this experimentation and sharing of intangible goods, services and products that are more conceptual and value based, and data driven. There is a general attitude that the *solutions are already here,* they just need to be applied.

Education is an essential part of the coordinated culture effort that supports the radical startup culture, where academic studies directly approach the emerging problems, with less and less fossil fuel business cooperation with universities. Politicians and educators look to create new markets and new kinds of growth based on happiness and wellbeing.

Energy implications

As their energy manifesto, the group chose to be: ***Lean Brave Agile***

In practice, this means: Be Brave And Committed to → A Clear Timeline For Phasing Out Fossil/Peat (2025!) (2035)

- With a positive can-do attitude formed around a commitment to tackling climate change these aims can be truly achieved in a prosperous way.
- In the future we would look back and thank the previous generation for this commitment.

Possible black swan

This group identified one black swan (a potential future event that is unforeseen):

- **Corruptability of the investment mechanism.** Crowdfunding network, angel investors, investment banks that keep the startup innovation process liquid – an attack on that ability with which startups can meet possible opportunities and remain agile could be a black swan. This could happen through corruption, political decisions or by mistake.

Moderator's comments:

1. **Rather than constant modifications to legislation**, a lean simple and clear-cut legislation was formed in which to best facilitate the startup market.
2. **Social security for startups** to fail and turn around was an important aspect, unclear to what extent this could be private and how much was government supported. This suggested education and social supporting business opportunities.
3. **The ecological "energiaremontti" (energy renovation) agenda** that some of the group members directly represented was very present and often restricted visions of wider business and cultural potential, however it did fit very nicely with the star up concept and they were able to share their expertise in this matter to better define the barriers which were education and legislation and attitude.
4. **Discussing food** and the Finnish cucumber and tomato – why right now it seems slightly crazy to heat indoor farms during the hard Finnish winter to produce off-season produce drawing power directly from the grid, that could rather be imported from naturally sunny Spain. However by solving the energy problem and going green then more ambitious ways in which to create and experiment with growing conditions can be made, offering endless possibilities for food verity production and business offerings locally. Scarcity of water in other countries, that is not the case for Finland but is an interesting problem considering what resources could be used more wisely and innovatively. Often the third world view was juxtaposed with the Finnish context and one solution on the horizon was that language translation would ease internationalisation to a great extent.

4.2   Group 2: Radical Startups

Group 2 worked on the scenario "Radical Startups". Group members: Joni Karjalainen (moderator), Arno Amberla, Antti Heinilä, Jouko Kajanoja, Ari Karjalainen, Olli Pyrhönen, Johanna Sippo.

Figure 9. Group 2 discussing the Radical Startups scenario.

Futures Wheel

This group produced the following ideas on the futures wheel about radical startups. Reactions to and ideas generated from the scenario were placed on the inner circle of the wheel. After this, more concrete solutions are listed on the second circle of the wheel.
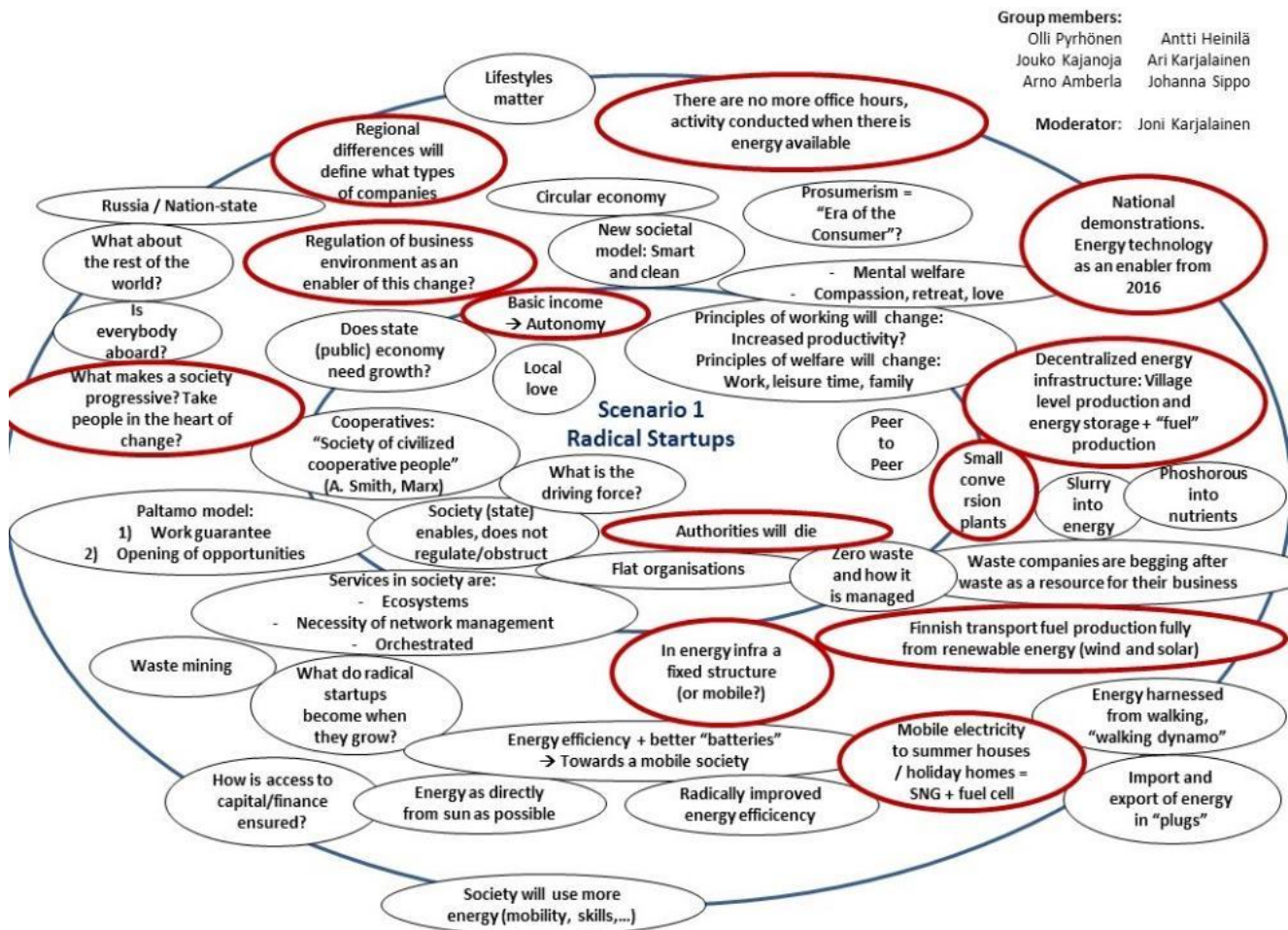

Figure 10. The Futures Wheel of Group 2 on Radical Startups scenario.

Authorities are dying.

Some participants referred to Adam Smith and Karl Marx, in idealising the scenario as "a society of civilized cooperative people". A new model of welfare will be based on neo-growth, which is both smart and clean, and new types of deep relationships between human beings, who have re-connected with themselves, flourish. The interconnection of renewable energy and welfare might also change people's behaviour. **There will be no more office hours**, and human activities will sync with nature, to be conducted during the times when energy from the nature can be harnessed. The most talented people will choose to join and seek their passion in small startups, and have abandoned the ideal of the past by getting contracted by large companies. The share of traditional wage work (*palkkatyö*) continues to decrease.

As for the organisations per se, they will be characterised by flat organisational models. Startups could be networked, or form a village-type of a community, also conducting business-to-business (B2B) functions. As for citizens, with the **introduction of basic income**, autonomy of citizens will be increased and they can steer their efforts to meaningful projects. Paltamo model of work guarantee and open opportunities was mentioned. All these will change principles and models of working and welfare. This logic of new business ecosystems will **increase skills demands in the area of network management** (*verkostojohtaminen*).

Radical startups will have a deep understanding of their customers' needs. With prosumerism, this will be remembered as **the Era of the Consumer**. Therefore, companies will be conducting lifestyles branding. Regional differences will determine, what kinds of radical startups prosper and where. Zero waste and its associated management has created a whole new industry. Startups will have no problems in getting access to finance.

Renewable energy development zones (REDZ) spearhead change. National demonstrations of energy technologies are leading the change, and an enabler from year 2016 onwards. Decentralized energy infrastructure consists of village level energy production, energy storage and "fuel" production, with small conversion plants, slurry into energy and phosphorous into nutrients. Energy efficiency will be radically enhanced. Waste companies will crave for waste to use it as a resource for their core business.

Energy will be mobile. Energy would be harnessed by a mobile infrastructure: in addition to fuel cells, there are wearable clothing harnessing solar energy & pocket-sized batteries. Village-size storage and production of synthetic gas would be realized in tanks owned by the locals. Mobile electricity for summer houses is provided with synthetic natural gas (SNG) and fuel cells. In the transport sector, energy innovations have reduced the fuel import bill of Finland, which in 2015 still stood at EUR 8 billion.
Local love flourishes.

PESTEC Table

From their work with the Futures wheel, Group 2 chose to elaborate in the PESTEC Table **how future energy innovations could manifest in the planning process for the future area of Östersundom** [21]. The reflections on the cluster of ideas were structured according to the six dimensions of the PESTEC (Political, Economic, Social, Technological, Ecological and Cultural/Citizen/Customer):

Table 7. The PESTEC Table of Group 2 on Sampo – Östersundom 2050.

PESTEC	"Sampo"- Östersundom 2050
Political	"Östersundom" as a Special area Lean bureaucracy → Leapfrogging in administrative procedures Long-term (energy) policy and politics to secure momentum
Economic	Cleantech market for startups must be created Demonstration supports Village houses for these radical start-ups Energy (kW = kilowatt) import and export plus technology development Services in society are provided by an ecosystem: municipal + SMEs + third sector + voluntary work
Social	Society of encounters "törmäyttäminen" Inter- and crossdisciplinarity University of Helsinki and Lappeenranta Uni. Technology: Supportive organisations for energy and the economy Stimulating enthusiasm and a culture of doing
Technological	Inter- and crossdisciplinarity Research funding is ensured as the basis of actions
Environ-mental	Waste that cannot be used is very expensive Self-sufficiency in and production of energy Carbon neutral (renewable energy) zones Road tolls into use
Cultural Citizen Customer	Culture of piloting and experimentation Start-up tycoons

Out of the general discussion, the group selected as a concrete initiative the area of Östersundom into the future.

Politically: Östersundom would be a pilot area, a special Renewable Energy Development Zone (REDZ). A long-term strategy, and supportive policies, including energy policy, will secure momentum for the bottom-up development of Östersundom until 2050. These strategic developments will be enabled by lean bureaucracy, symbolic of "leapfrogging" into a new user-friendly era of administrative protocols and processes.

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[21] Östersundom is an area located in the eastern part of Helsinki bordering the county of Sipoo.

Economically: In Östersundom, radical startups are able to convene in "village houses", hubs for ecological innovation. Technology development of these energy technologies is supported by the import and export of energy.

To hasten the development of new and innovative energy technologies in Finland, the Finnish Government will provide financial support for demonstration projects. Cleantech market for these startups is stimulated.

Services provided in the society are provided by a multitude of actors: municipalities, small- and medium-sized enterprises (SMEs), the third sector and voluntary work.

Socially: Östersundom breaths from a culture of cross-disciplinary encounters, in Finnish understood as *"törmäyttäminen"*. University of Helsinki and Lappeenranta University of Technology (LUT) will provide an umbrella of collaboration for these new innovations. Their work is crucial in driving a new economy and new energy solutions that will change lifestyles, the economy and create new technologies.

Technologically: New innovations are created by the inter- and cross-disciplinary innovation by startups, manifesting a new spirit of collaboration beyond borders. Government research funding for the core areas serves as the backbone of the innovation in this sector.

Environmentally: Östersundom as the hub of renewable energy will be a carbon-neutral zone. Road tolls will support this objective. Energy-wise, it will be self-sufficient in energy production. Waste, which cannot be used, will be very expensive.

Culturally: A culture of doing, piloting and experimentation stimulates innovation and the up-take of new solutions and ideas. Startup tycoons will lead the way to show examples for an emerging number of actors.

Energy implications

Based on their futures wheel and PESTEC, this group had an energy manifesto, which contained different energy implications:

"Sampo": symbolizes a new holistic strategy following the identification of a new source of wealth. Östersundom becomes the heart of renewable energy development and innovation, and hosts a National Renewable Energy Expert Centre. Storage solutions are the spearhead of the work of this centre.

- Östersundom benefits from a **kilowatt-level smart grid**, which manages electricity, heat, water, and transport.
- Energy storage systems are available according to different timescales, **from daily storage to yearly storage**.
- All roofs will be **green roofs covered with solar panels**, and the non-used areas next to the highway will have a park of solar photovoltaics.
- The adjacent **"sister" city will have a wind park**.
- **Village-level energy storage and conversion (N * 100 kW)** are used.

Possible black swans

Three black swans (future events that are unforeseen) were identified by the group that could jeopardize the "Sampo" vision:

- Change in political will or bureaucracy with surprising regulations could stop this development vision and the determined plans for an ecosystem of renewable energy and associated storage
- Abundance of affordable energy imported elsewhere
- The dissolvement of European Union (EU)

Moderator's comments:

1. **What makes a society progressive?** Conservative forces could undermine a courageous vision and steer the energy of people into petty fighting around legal obstacles and sorts.

2. **As startups endorse multi-talents, what will happen to those who are left out of these developments?** Based on the discussion, it seems evident that in order to drive change of this magnitude, people need to be harnessed as drivers and into the heart of radical change. But discussants were worried whether everyone can have a multitude of skills, and if those who do not possess such qualities, will be left outside the startups, fuelling societal inequality. And when the question is placed in a broad perspective: if Finland advances rapidly, will rest of the world be able to follow, especially countries who adhere strongly to the nation-state ideology like Russia?

3. **What do radical startups become when they grow?** Although not elaborated more in detail, it is worth thinking in advance, how growth and maturization could drive or challenge the DNA of the company, as it succeeds (think of consumer disaffection with Facebook these days).

4. **Will regulation be needed to achieve this model, and if so, what kind?** While it was seen evident that surrounding society and the state will work as the enablers of this new vision, it was less elaborated what kinds of regulation more concretely is needed.

5. **In the long-term future, what is the most optimal solution for photovoltaics vis-à-vis rooftop and land area use?** Integrative solutions for solar photovoltaics must be thought. It was reported that increasing solar PV installations could compete with land use or roof area in the United Kingdom. However, these worries were soon reported as exaggerated (The Guardian 2015). In turn, France gave a Decree for new rooftops in commercial zones "to be partially covered by plants or solar panels" later in spring 2015 (The Guardian 2015b).

4.3   Group 3: Value-Driven Techemoths

Group 3 worked on the scenario "Value-Driven Techemoths". Group members: Emmi Tardy (moderator), Jari Ihonen, Osmo Kuusi, Jarmo Partanen, Aino Peräkorpi and Timo Tyrväinen.

Figure 11. Group 3 participants looking at the Value-Driven Techemoths Futures Wheel with Clinique moderators.

Futures Wheel

The analysis of Group 3 lists the key questions and elements from the scenario "Value-Driven Techemoths" on the inner circle of the wheel. The more concrete ideas are on the outer circle of the wheel. The key issues for further development have been circled on red.
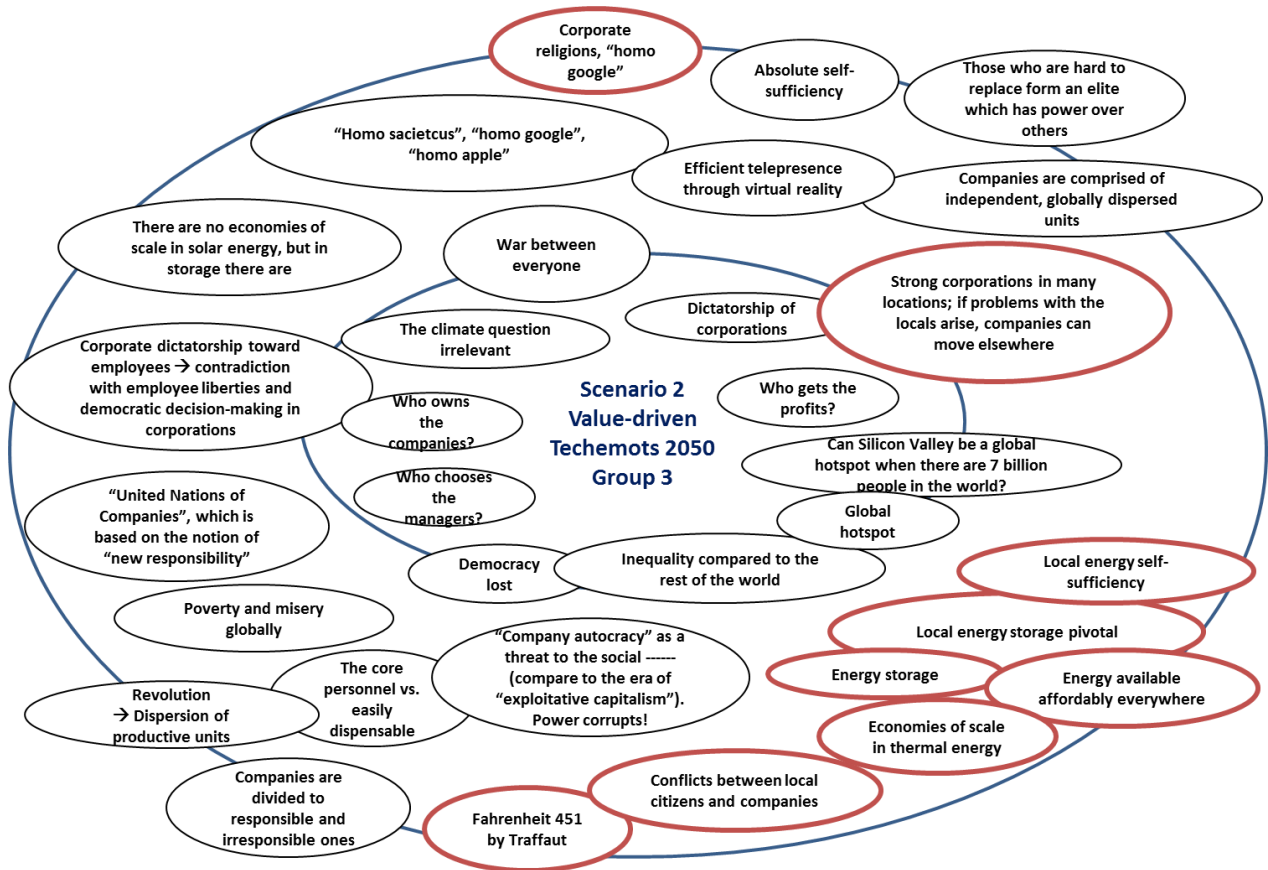

Figure 12. The Futures Wheel of Group 3 on Value-Driven Techemoths scenario.

PESTEC Table

From their work with the Futures wheel, Group 3 chose to elaborate in the PESTEC Table **how strong corporations could drive energy self-sufficiency and storage, and in relation to this the group especially paid attention to the role of the transportation sector**. The reflections on the cluster of ideas were structured according to the six dimensions of the PESTEC (Political, Economic, Social, Technological, Ecological and Cultural/Citizen/Customer):

Table 8. PESTEC Table of Group 3.

PESTEC	Themes: 1. Strong corporations in many locations 2. Energy self-sufficiency and storage 3. Transportation as part of the energy system				
Political	City planning takes into account energy storage with reserves of up to a few months of thermal storage	2% certificate requirement for renewable energy (direct solar & wind)	Local self-sufficiency of energy		
Economic	Separation of production and network businesses in cities.	Citizens no longer required to pay "hidden taxes" Cities can function one month with stored energy	Export of new storage technologies	Investments in new innovations Sensitivity towards changes	Economy has changed with the rest of society, but enterprises and competition are still needed
Social	Competitiveness challenges of Finland	Contradictions between corporations and society	Increase in wellfare		
Technological	Centres specializing in niche markets	Tele-presence Development of new technologies has to continue	New storage technologies, e.g. steering of solar panels	Underground storage of solar heat	The role of 3D printing
Environmental	Co-production of heat and electricity changes its role	Transportation planning	Controlling the emissions of transportation		
Cultural Citizen Customer	Trust in energy produced by corporations→ dependency	Citizens of Helsinki, Finland in general → What forms of energy are wanted? → Attitudes			

The group drew attention to an internal contradictionary challenge in the scenario: how to achieve democracy and open grass-roots organisation within companies, when in definition managers and shareholders have the final power. In addition, even though companies could evolve as grass-roots organisations, where employees had much more autonomy and independency than today, the owners would still get the profits. Strong companies are also a threat to democracy in society in general. If companies had even more power than today, the situation would be more or less a "corporate autocracy" where companies' interests would overcome those of the general public. Societies would be led by companies instead of citizens and democratic institutions. The imbalance of power would be intensified if the rest of society would be dependent on the energy produced by companies.

The situation could even lead to a "war between everyone" where companies would fight against each other and against citizens opposing them. Inequality between citizens could mean that everyone would try to protect their own interests against the others and instead of providing for the public good. The same would apply on a global scale as well.

However, some companies could come to conclusion that genuinely equal organisation structures and democratic decision-making processes are the best and also the most profitable solutions in the end. Companies could divide into "responsible" and "irresponsible" ones. "Responsible" companies could even form a "United Nations of Companies" to replace old global governing and cooperation structures. In this scenario global mega corporations would have units all over the globe, and if the companies behaved in an autocratic manner, conflicts with the locals would sooner or later arise. If companies were more responsive to local needs and customs, these conflicts could be avoided.

Energy wise the group stressed the importance of storage technologies for techemoths. If large companies would produce all their energy and sell the surplus, they would need notable storage capacities. Finland could become an exporter of storage technologies, especially for urban areas.

Energy implications

Based on the Futures Table and PESTEC table work, the group analysed the following energy implications:

- Export products for Finland
  - **Energy storage especially**
- Creating **new products and systems** in the energy field
- Focus on **urban energy storage and transportation** possibilities

A related question came about as an outcome of the debate: What is **Finland's competitive advantage**, since Finland is probably losing in solar energy?

Possible black swan

This group identified one black swan (a potential future event that is unforeseen):

- Revolution against corporations – growing inequalities and discontent towards techemoths could even lead to a revolution against them.

Moderator's comments

The group made an important clarification on the scenario by emphasising the contradictions between strong corporations and the rest of society. In the original scenario draft this aspect was somewhat neglected.

One interesting point the group did not bring up is the effects of artificial intelligence, robotics and automation on the power relations between companies and citizens. If manufacturing requires less and less human workforce, companies could become even more detached from the rest of society and its needs than the group envisioned.

4.4   Group 4: Value-Driven Techemoths

Group 4 worked on the scenario "Value-Driven Techemoths". Group members: Marjukka Parkkinen (moderator), Olli Pekka Hatanpää, Jyrki Laurikainen, Joona Poukka, Pasi Vainikka, Robert Weiss

Figure 13. Group 4 participants working and debating about the contents of the PESTEC table.

Futures Wheel

This group analyzed the scenario "Value-Driven Techemoths". On the inner circle of the wheel (marked on blue) are the key issues and elements, while the more concrete ideas are on the outer circle of the wheel (marked on light orange).
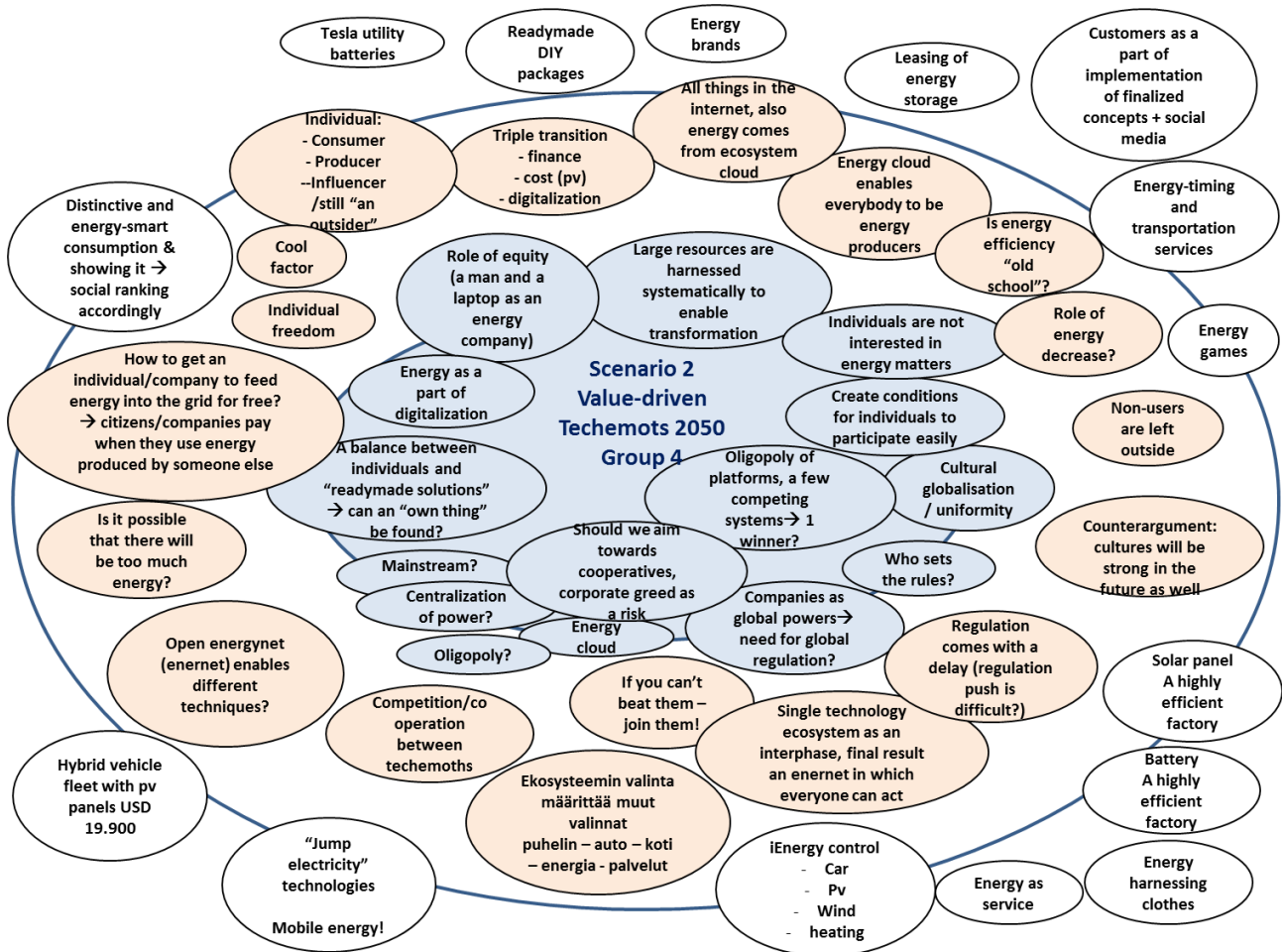
Figure 14. The Futures Wheel of Group 4 on Value-Driven Techemoths scenario.

PESTEC Table

From their work with the Futures wheel, Group 4 chose to analyse in the PESTEC Table **how a large company might profit from providing energy cloud services, and gain its competitive advantage from branding (the "wow" factor of a future energy technology) to please the status-seeking consumer**. The reflections on the cluster of ideas were structured according to the six dimensions of the PESTEC (Political, Economic, Social, Technological, Ecological and Cultural/Citizen/Customer):

Table 9. PESTEC Table of Group 4.

PESTEC	Large companies providing energy cloud services				
Political	Enabling regulations arouse enthusiasim	An experiment in the markets	Trust in owning a cloud	Owned by municipality vs. state, or the parliament/EU?	Energy independence (asymmetries) and security get a new meaning
Economic	Profits will be distributed unevenly/will accumulate for the top rich	Finland will get jobs	Where is the business? Case	Techemoth cooperatives	Debt, equity: Great China Wall project becomes difficult
Social	"Energy goes consumer market"	Cool gadgets	Taking advantage of The Finnish Brand Nature Clean Technology	Urban Greens Vs. Rural Hillbillies?	Energy use as a language and way of communication (2015 Instagram) → Class divide
Technological	Markets concentrate on broadband & services – energy a minor point	Self-directive functions – making artificial intelligence posssible	IT-firms - know the processes - know the technology	Real-time data & sharing of information: "I consume this little"	A local solution techemoth sells the technology – not enernet
Environmental	"Of course it is!"	Business as a driver - regulation follows		Environment is a utility in two ways: 1) surviving 2) "look, I'm saving energy!"	
Cultural Citizen Customer	Cool factor is a great catalyst		Consumers are bying a brand and status	Sharing economy will strengthen	

Throughout the different phases of the workshop the discussion within the group revolved around a couple of themes that emerged in the initial round; the relationship between *techemots* and individuals, power relations between different instances and digitalization and different technological energy solutions.

Techemots are seen as enablers for participation. However, it was questioned, whether an individual is able to find a convenient solution among the ready made ones offered by big corporations. Along with the techemoths, power also outside of their corporate field is concentrated on these few giant superpower corporations. Thus there is a need for global regulation. Also the operating model was discussed; although the techemots have the power, they are still depended on the individuals. Thus the operating model may adapt co-operative characteristics, which is in contradiction and a balancing factor to corporate greediness.

Along with the Internet of Things, also energy comes from an ecosystem cloud. Big corporation resources are systematically harnessed in order to make the transformation happen and the regulations that make experiments possible support the transformation. This cloud enables everyone to be an energy producer. Energy is also a brand and a service. It can be said that the attention of markets is drawn more into services and a functioning broadband than the energy itself, as the energy becomes self-evident. It can be said that energy hits the consumer markets. The products and services provided by techemots are without exception environmental friendly.

A company or an individual can get paid as they "download" energy into the cloud. Choosing a certain techemoth ecosystem also defines choosing other products. Buying a certain type of energy results buying a compatible phone, car, services and a house. The competition results in oligopoly of energy platforms, where only a few competing systems exist. Thus a situation, where there is only one winner, is possible. Also an intermediate state was suggested as a phase of a one single techemoth ecosystem, preceding an enernet phase, where several techemots could exist simultaneously. The open enernet also enables different techniques connected to production of energy.

Individual is simultaneously a producer, consumer and an influential person. Individuals participate in realizing ready-made concepts of corporations and there is a strong trust in the solutions offered by the techemots. However, an individual is still somewhat left on the outside, as techemoths have the real power. There is still enough to choose from, and this is where an individual gets to influence. Some class division is present, as people who decide to stay outside these choices are also left out of social spheres and remain unaware of environmental friendly aspects. So-called *cool factor* as a catalyst makes the products offered by techemots attractive for individuals. Technological solutions are simple and artificial intelligence enables self-guided functions. A gadget becomes alluring, even though it is no better in quality, price or functions than the competitor. Cool factor is enhanced with sharing the energy consumption/ production information of oneself with others; energy efficient consumption itself is cool.

Energy implications

The group elaborated the energy implications in their following energy manifesto:

iEnergy – Cool Energy Cloud
- *100% reliable – Trust in us*
  - Energy cloud service is **strongly trusted by the customers.**
- *Earning model – join us*
  - **Customers are simultaneously producers, consumers and influencing** (although not strongly) the corporate actions.
- *In your local store, at your site*
  - Energy hits consumer market and **becomes an inbuilt part of products and services**.
- *Technology – Don't worry, it works!*
  - Products are easy to use, automatic, and self-guided

- *Ecological? – Yes, of course*
  - **Environmental friendliness of products and services is self-evident**, as the techemots take responsibility for ecological aspects as well. Customer can simply rely on the product being ecologically sustainable.
- *Coolest 4 you!*
  - Cool factor is a big part of the product. The design is attractive, but also the information connected with the cloud is shared to enhance the coolness

Possible black swans

This group identified the following three black swans (potential future events that are unforeseen):

- Pearl Harbor effect – for example draught in California, which has made the effects of climate change very real for many Americans
- Energy production and consumption become so local that cloud is not needed
- The energy cloud app collapses

Moderator's comments

A lot of the group's discussion revolved around the power relations between big corporations, individuals and other instances; will there be many techemots and competition of platforms, or one winner? Will the society become an oligarchy? Who sets the rules, techemots or an outside instance regulating the corporate actions globally? Will an individual find suitable solutions within the platforms offered? Although the different parts of the futures wheel intertwined, a process from more general towards exact could be seen in the different spheres of the wheel.

4.5   Group 5: Green DIY Engineers

Group 5 worked on the scenario "Green DIY Engineers". Group members: Shameer Prasla (Moderator), Michael Child, Wenfei Liao, Kaisa Matschoss, Renita Niemi, Markku Nordström

Figure 15. Group 5 participants working on the Green DIY Engineers scenario.

Futures Wheel

This group's analysis of the scenario "Green DIY Engineers" marks the key questions that arose from the scenario on the inner circle of the wheel. On the outer circle of the wheel, marked on red are the core elements that underpin this future.
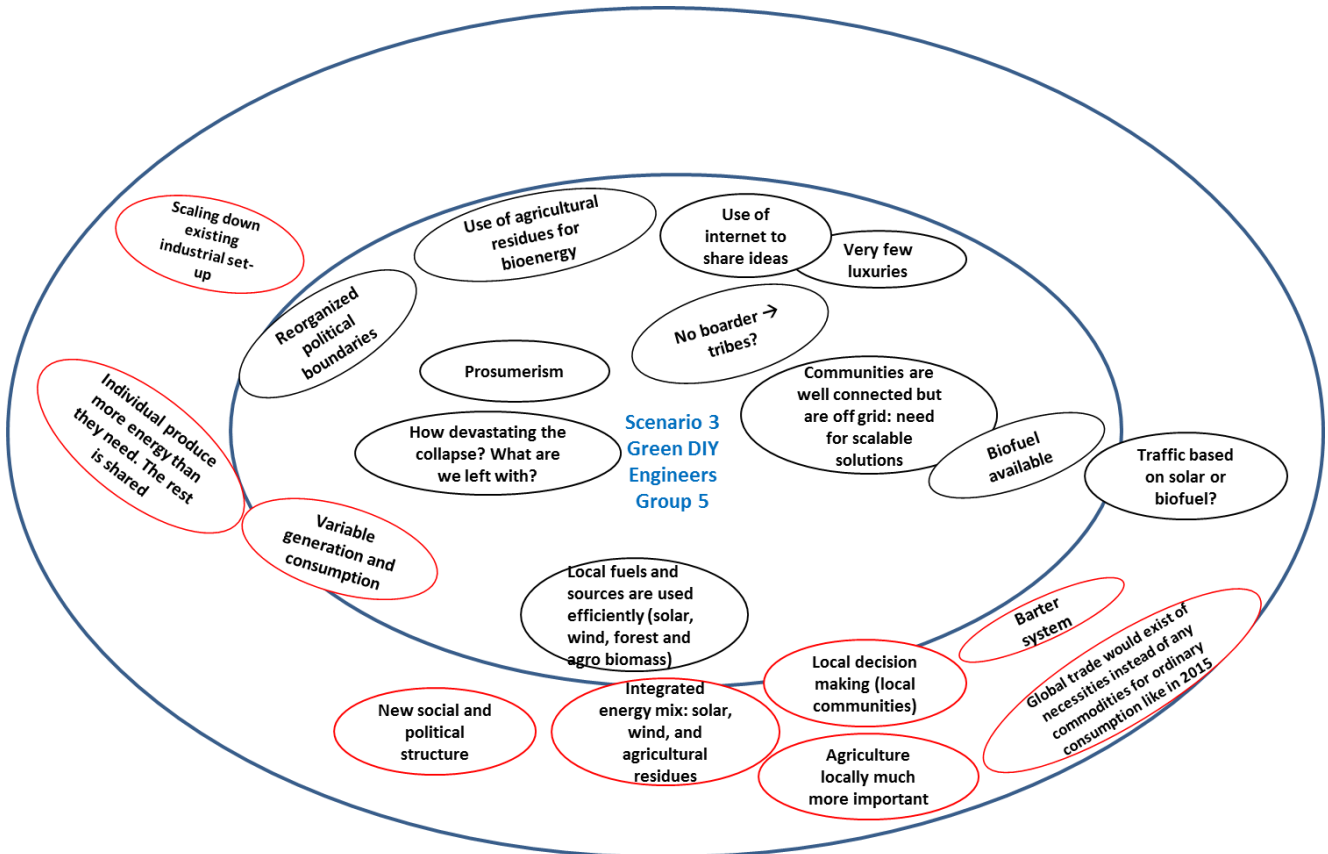
Figure 16. The Futures Wheel of Group 5 on Green DIY Engineers scenario.

PESTEC Table

From their work with the Futures wheel, Group 5 chose to analyse in the PESTEC Table **how Green DIY Engineers might live in a new social and political structure and use an integrated energy mix based on solar, wind and agricultural residues.** The reflections on the cluster of ideas were structured according to the six dimensions of the PESTEC (Political, Economic, Social, Technological, Ecological and Cultural/Citizen/Customer):

Table 10. PESTEC Table of Group 5 on integrated energy mix.

PESTEC	Integrated energy mix: solar, wind, and agricultural residues					
Political	Removal of any barriers in regulation (that inhibit distributed generation)	Clearing roles and responsibilities	**Local political situation will determine local choices**	Use of Peat: Peat-lands - continue using disturbed ones? Protect natural ones with policy?	What will be role of peat in Finland? Net metering	
Economic	Who pays for the new system?	**Ownership locally/regionally: can it be owned**	Taxation abolished from renewable energy			
Social	Equal access for all e-services collaboration cooperation	**Sense of community will be strengthened**	Community based energy hub: trade or credit system	Affordability Security from sharing	New value system: joint, shared values (the mindset common to Finns)	Change in social structure/governance (no need for lobbyism)
Techno-logical	How do we transmit energy in future?	**Energy storing (accumulators instead of transmission)**	Problem of raw materials for producing solar panels			
Environ-mental	**Very energy efficient system**	Peat-lands ought to be protected for biodiversity	Sustainable management of forest by DIY engineers			
Cultural Citizen Customer	Energy clubs and energy kiosk (where people gather to share energy and social interaction	Education for all	**Strong regional identity and sharing of ideas internationally**	Migration of ideas: peer-to-peer energy sharing to something more in social & cultural areas	Wastefulness seen negatively (as taboo?)	

Green DIY Engineers are essentially empowered local communities. They are supported by still prevailing central government, which has removed barriers of regulation that inhibit distributed energy production. Taxation is removed from renewables.

Society is politically, socially and economically different from present one – where sharing and collaborations are important values for survival of the community. Open source offers a model for collaboration. Society is tribe-like, meaning shared values and tightly knitten social relationships. Finland is in a good position in this respect, as shared values and collaboration are part of the Finnish mindset.

Energy is produced locally. Self-sufficient energy production has cultural value as well, as it strengthens the identity of communities. Wasting energy and resources are a cultural taboo. Pursue for maximal efficiency is exemplified in vertical farming, which requires much less land than "traditional" forms of agriculture. Agricultural residues are used to produce bioenergy. Energy storage is even more important than in other scenarios. Global trade is for necessities only (instead of consumer products).

Energy implications

As a final step, the group discussed key points that may have implications for energy futures:

- Focus on local/regional solutions
  - o Identity, ownership, generation
  - o Also sharing beyond borders
- Empowerment of people
  - o Politically
  - o Encourage the sense/feeling of competence
- Community (local-private) ownership to be prioritized
- Community based investment in energy infrastructure
- Promoting values that help people share resources and collaborate
- Open-sourced idea and innovations
- Education of issues concerning sustainability

Possible black swans

This group identified the following two black swans (potential future events that are unforeseen):

- A revolution in battery storage technology - probably Lithium ion batteries - so that batteries would be cheap and readily available to everyone.
- A high level of acceptance of flexible demand. This involves the relationship that people have with energy. It is such a personal relationship that adjusting demand is not really done by effort, but quite naturally.

Moderator's comments

The scenario is "unrealistic" in the sense that it assumes a total ecological collapse. By 2050 a collapse of such severity is improbable. However, increasing conflicts and turmoil caused by the effects of the climate change might make local self-sufficient communities attractive to citizens. Thus the exaggerated vision of the scenario is helpful in outlining some very possible features of future lifestyles.

4.6   Group 6: Green DIY Engineers

Group 6 worked on the scenario "Green DIY Engineers". Group members: Ellinoora Leino-Richert (moderator), Liisa Lahti, Martta Nieminen, Heikki Ilvespää, Esa Vakkilainen.

Figure 17. Group 6 participants working on the Futures Wheel in their scenario.

Futures Wheel

The inner circle of the wheel marks the group's reactions to the "Green DIY Engineers" scenario. The outer circle of the wheel elaborates what are the concrete solutions of the do-it-yourself society proposed by the group in its discussion.
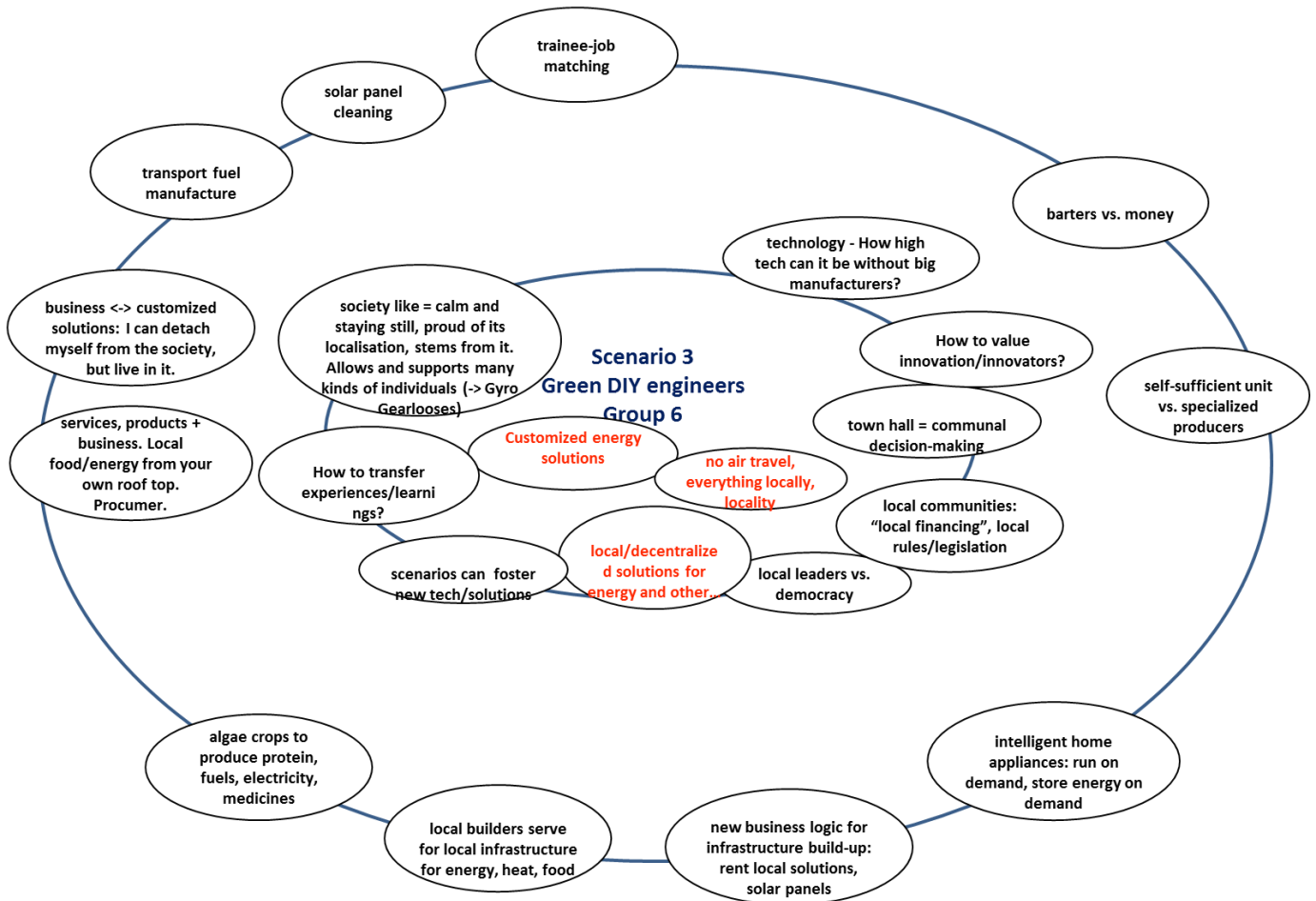
Figure 18. The Futures Wheel of Group 6 on Green DIY Engineers scenario.

PESTEC Table

From their work with the Futures wheel, Group 6 chose to analyse in the PESTEC Table **how customized energy solutions might be realized locally and in a decentralized way**. To characterize their world where **waste has value and nutrients and energy are recycled, the group stated provocatively: "Eat your own droppings!"**. The reflections on the cluster of ideas were structured according to the six dimensions of the PESTEC (Political, Economic, Social, Technological, Ecological and Cultural/Citizen/Customer):

Table 11. PESTEC Table of Group 6 on "Eat your own droppings".

PESTEC	Eat your own droppings			
Political	independency: -> fragmentation -> isolation?	legislation supports many customs (= very good new legislation has been developed)		be smart, then you will be rewarded -> economy <-> politics (allowing, supporting)
Economic	barter	no trade deficit in FIN due to local energy self	(bio) oil expensive	
Social	smaller and bigger communities are doing well "even outside of Helsinki"	it is normal/cool to be a master of your own energy	Finland 2050 can decide its own consumption and production I own a part of society's infrastructure	low unemployment / flexible forms of work
Technological	How high tech can DIY be? solar, wind, bioprocesses are widely used locally	transport by biogas	food production: we need more -> labour and tech, e.g. green walls	processing and technology more simplified, no transportation (e.g. food, bio fuels) bioprocesses
Environmental	waste has value recycling nutrients and energy	- 80% CO2 achieved	surrounding nature has a measured value -> (combination) for health, as resource, refreshing value	
Cultural Citizen Customer	combining art and utility easier	culture? art? making things visible by YIMFY (yes in my foreyard)	favoring local services and products	self-sufficiency vs. producers

In the beginning of the Futures wheel practise, the group discussed what do the words "local" and "localised" mean exactly. How local are we talking about? The group came to a conclusion that besides localised energy production in both small and bigger communities, also food would be produced by prosumers. This kind of lifestyle is related to the "old days": people are returning back to their roots. People would live more "on the spot" meaning that there would be less travelling, which decreases the amount of energy consumption (cf. air traffic).

The group thought that localisation enables better piloting of new energy solutions in smaller production units, e.g. producing electricity with algae. Legislation would be more flexible, and it would allow and support people instead of being forbidding. Local communities would exchange energy and food without

money transactions. Because of DIY engineers, there would hardly be any unemployment. Prosumers would concentrate on bioprocess development and production. All waste would be recycled (0-waste) and it would have value. A DIY person would place his/her beautiful energy production plant on their foreyard, because it represents a piece of art by itself.

Energy implications

- prosumer energy (energy consumers and producers are the same)
- more local/consumer energy production and storage
- no import of fossils (we have enough of DIY energy, self-sufficient society)
- valuation energy ↔ environment, energy ↔ free time (renewables are better for the environment, less free time for prosumers)
- enernet (interconnected energy → easier to sell to others)
- variable price of electricity for all (prices vary due to many producers)

As a manifesto, the group came up with a more practical idea: **a self-sufficient Savo** as a model region where new energy solutions can be piloted and tested.

Possible black swans

This group identified one black swan (a potential future event that is unforeseen):

- 1 000 000 Africans move to Finland. This is considered as a positive thing, because they bring (DIY) expertise, organise own communities with own solutions and also workforce. One negativity is that the million new people do use a lot of land resource.

Moderator's comments

A return to "old days" and localised lifestyles due to energy transformation is an interesting idea, because it has been proposed earlier as well. In the early 20th century when The United States was being electrised by public electric power, the transformation was promoted by the claims of Regional Planning Association of America that the electricity would enable decentralization of industry, the restoration of country life and the upbuilding of small communities. President Franklin Roosevelt supported the change also as a part of his New Deal and hoped that the new form of energy would promote a social revolution of local lifestyles.

The result was quite the opposite, as electric power turned out only to continue centralisation of industries and communities. It is interesting to see what will happen this time.

4.7   Group 7 : New Consciousness

Group 7 worked on the scenario "New Consciousness". Group members: Nick Balcom Raleigh (moderator), Christian Breyer, Janne Hukkinen, Minttu Jaakkola, Samuli Sinisalo, Maarit Vuorela.

Figure 19. Group 7 participants who analyzed the components of the New Consciousness.

Futures Wheel

The first "New Consciousness" group outlined a broad range of elements regarding the scenario on the inner circle of the wheel. On the outer circle there are remarks and comments about how the world of new consciousness might look like.
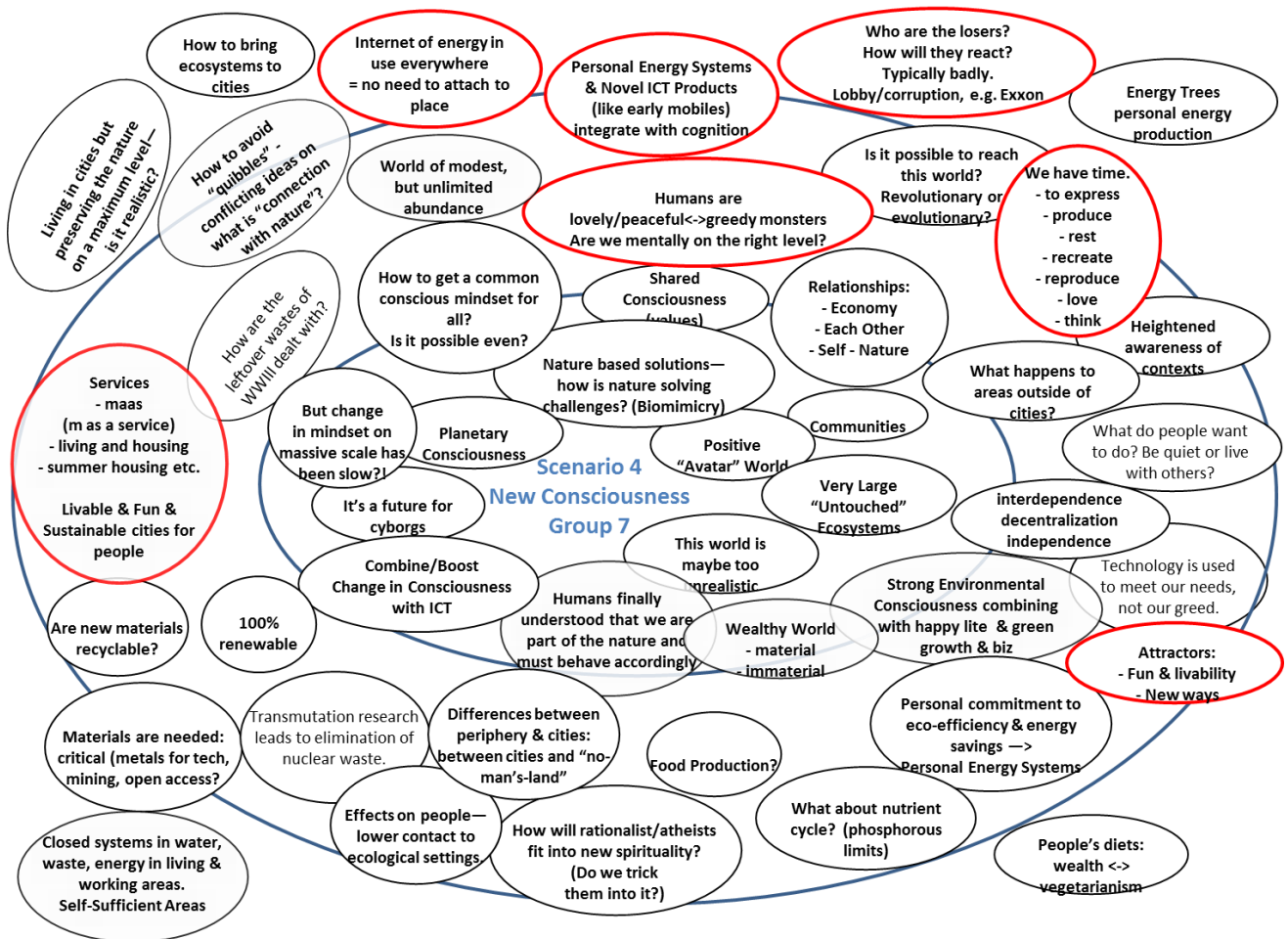
Figure 20. The Futures Wheel of Group 7 on New Consciousness scenario.

The discussion for futures wheel started with the topic of consciousness as a concept and its scope in the scenario as well as questions about how we can evolve our consciousness to such a grand planetary level. Other observations during the first round of sharing included relationships, the elevated role of nature, the role of ICTs, harmony between growing business and natural world, and new appreciations for the immaterial leading to a sense of having greater wealth. The participants also observed central values of independence and decentralization as well as community. One participant said the scenario reminded him of the world depicted in the popular movie *Avatar*. It was pointed out that maybe this scenario was too unrealistic. This participant's observation shows an understanding of how some features of the scenario conflict with

each other in today's world making it difficult to imagine them being harmonized in the future. It also points to the lack of dramatic conflict in the scenario's narrative.

During the second round, the group raised many interesting questions. Themes included a continuation of the discussion on how humanity achieves this new consciousness, roles of technology, the types of materials and systems surrounding their reuse, water and food, the conversion of the energy system to one that is 100% renewable and all nuclear waste has been eliminated through transmutation. There were also some questions about how social life would be and what kinds of things people will want to do with each other or alone. One idea that wasn't documented too well is that of people would have a greater empathy for each other's interests in nature. Unlike today, where you have some people interested in birding, others in rock climbing, and still others in foraging from mushrooms or berries, you'd have a world where people have a deep understanding of each other's appreciations of the natural world. The remaining questions from the second round investigate what conflicts may have occurred along the way – was this an evolutionary transition, or a revolutionary one? Who are the losers and how did they react to the changes? Typically today, one participant observed, corporations will react badly when confronted for the environmental wrongdoings. Also, humanity has two faces – lovely and peaceful versus greedy monsters. The group imagined there might be quibbles over conflicting ideas about what is "connection to nature."

The third round of discussion produced a few more concrete ideas regarding what kinds of businesses one would expect to encounter in the scenario. These ideas included a "personal energy systems" (inspired by Tesla's recent announcement of their home battery product), novel ICT products that integrate with cognition, the internet of energy and its implications for nomadic living, and energy trees. One participant suggested there would need to be attractors to pull people into this new way of living, possibly fun and livability.

PESTEC Table

From their work with the Futures wheel, Group 7 **analyzed the values and mindsets of the world of "new consciousness", and how in the future thanks to this changed awareness several societal functions might be performed differently**. The reflections on the cluster of ideas were structured according to the six dimensions of the PESTEC (Political, Economic, Social, Technological, Ecological and Cultural/Citizen/Customer):

Table 12. PESTEC Table of Group 7.

The group produced a PESTEC futures table based on reinterpreted ideas they generated during the Futures Wheel. These themes included:

- catastrophe as a trigger
- doing things differently because of the change in consciousness
- people are the winners
- how do we get there via values, knowledge, actions, and mindsets?
- roles of tech and services as attractors, tricks, easier living and liberation.

Most of the ideas on the PESTEC futures table are self-explanatory. Some require elaboration:

- *Political:* Leadership should come from politics

  The group discussed how too often elected officials are timid about taking the bold steps required to bring about transformational changes, choosing instead to focus on incremental and shortsighted changes that please voters and companies. The group concluded that elected officials and political leaders would need to take a long view and support visionary changes in order for the New Consciousness scenario to emerge.

- *Economic:* Economic invaders disrupt old ways of doing things

  By economic invaders, they meant entrepreneurs like Elon Musk and his company Tesla. Big industries will need to be shaken out of their typically shortsighted ways of doing things by economic threats posed by new and innovative companies.

- *Social:* Sharing, empathy, and trust increase

  The increase in sharing, empathy and trust will drive many other dimensions of social life. It will also play a role in how people relate to nature.

- *Technological:* Tech as an enabler to sustainable lifestyles

  Technology will make it easier to live in a sustainable way. Most technology will be created and used to support sustainable living.

- *Ecological:* Mindset of having a personal relationship with nature and surroundings.

  People will be more perceptive of nature and appreciate it in a personal way.

- *Cultural:* People can and have to demand change.

  The group believed the only way for the world to reach this transformative future, people would need to demand change. But, notice the word 'can' as well. It will be important for governments and governing systems to be both receptive and responsive to people's voices.

In the view of the group's moderator, the most novel and unique items on the PESTEC are:

- *Urban construction increases biodiversity as rule (any time there is construction, it must).*

  This idea was controversial in the group, but once we all understood what the participant meant, it was accepted. Construction generally consumes resources, produces landfill waste, contributes to greenhouse gas emissions, and destroys habitat. In "New Consciousness," there would be a rule that all urban construction does the opposite and actually adds habitat and supports biodiversity.

- *"Open House Day"*

  The idea for "Open House Day" came from a discussion about what kinds of art or cultural phenomena fit in this scenario. What would heighten people's sense of empathy toward each other? "Open House Day" is imagined to be a day when everyone opens their homes to everyone else for visiting and experiencing each other's lives. It might first start out like restaurant day with only a few people opening their homes, but eventually would evolve to be a universal event in which everyone participates.

Energy implications

The group generated the following bullet points and black swans describing what Finland's energy future would look like in 2050 under the "New Consciousness" scenario:

- Personalized energy systems
    - small scale and ad hoc production
    - wearable autonomous systems allow people to produce energy wherever they are
- Solar, wind, biofuel, e-produced hydrocarbons (renewable)
- Sustainable bio-energy from agricultural forest industry bi-products
- 100% waste-free and cycle economy
- Electricity as currency (people exchange their excess, personally produced energy)
- Energy cooperatives [share economy]

Possible black swans

This group identified two black swans (potential future events that are unforeseen):

- Nuclear Family Funparks

    Because nuclear energy is no longer used, the old nuclear power plants are converted to family fun parks.[22]

- Everyone is "off the grid."

Moderator's comments

Reflecting on the conversation and work of Group 7, the significant questions they asked regarding how consciousness can or will change may be the most significant dynamic of this scenario. One of our group members had deep interest and experience in consciousness as an academic subject[23]. While much of the early conversation in our group work focused on the concept of consciousness, we left more questions than answers. The development of the New Consciousness scenario may benefit from further research into the academic discipline of consciousness studies – at minimum a literature review but possibly even a Delphi with top consciousness experts around the world.

Identifying driving forces shaping consciousness such as religious beliefs, new forms of relationships between individuals and nature, and political movements, and scanning for future signs in these areas will be a key to understanding the dynamics behind how the "New Consciousness" scenario evolves. For ex-

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[22] This concept resembles a similar conversion of waste landfill sites into amusement parks and recreational ares, e.g. Dream Park in South Korea which is a popular eco-tourism site..

[23] In 2015 in Turku Conference "Futures Studies Tackling Wicked Problems" a key topic was futures consciousness. See http://www.futuresconference.fi/2015

ample, the Pope issuing an Encyclical Letter calling on humanity to address climate change[24] and the World Council of Churches organizing a pilgrimage to attend COP21 in Paris[25] are strong signals of an evolving moral basis for eliminating carbon emissions. Such a moral basis will contribute to a dramatic change in consciousness. Once internalized, new belief structures and mental models can have strong influence on systems. What would happen if a powerful oil CEO, via her religious beliefs, determined it was morally imperative for her company to lead in ending all oil production?

While discussing what could change consciousness, the group determined catastrophe would be a key driver. This matches the logics of this scenario as they received it, but is it *creative* and *transformational* enough to rely on crisis for transformation? WWIII and an ecological collapse would be horrible to live through. I personally don't want to experience it nor do I wish it upon my nieces and nephews. War and Ecological Collapse have high risks – on top of climate change, the additional pollution from war could permanently make Earth uninhabitable, especially if nuclear or biological weapons are used. Identifying the obstacles to the desirable parts of this future and imagining new ways around them, would allow us to have a New Consciousness scenario where emerging catastrophes are smartly avoided as the least risky way to propel humanity and all of Earth's species to a better tomorrow. During the group conversation, one group member pointed out many obstacles to the scenario, such as common systemic relational patterns between fossil fuel companies and governements. Efforts of supporters of renewable energy are often maligned by fossil fuel industry lobbyists. In addition, conflicts between environmentalists and industry are repetitive in nature — we are experts now at framing issues and destroying the issues framing of others, but not at making cohesive, more ecologically sound plans. Imagining new patterns that can replace the old ones and insisting that they are viable – e.g. proclaiming that 100% renewable is cost-effective and morally correct – may be more likely to successfully "shape" the future toward the New Consciousness scenario.

Finally, some strong images capture my imagination from this group's contribution to Futures Clinique. For example, what would personal relationships with nature look or feel like? Do I already have one now and how would it be different, especially if ICTs and advanced micro sensor technologies proliferate? Or, what would would an energy-based, decentralized currency look like? Would using energy-based money bring us into harmony with the rest of nature, which essentially already "trades in energy" in terms of the food chain? (plant converts sunlight, bug eats plant, bird eats the bug, etc.) Or, what types of new artforms and social rituals will serve to elevate empathy and compassion among people? I now find myself looking for signals of these images in the world around me and the media I read. I hope my fellow group members have enjoyed doing the same.

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[24] Francis, Pope (2015) "Encyclical Letter **Laudato Si'** Of The Holy Father **Francis** On Care For Our Common Home" http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html

[25] Council of World Churches (2015) "Pilgrims of climate justice plan to impact COP 21 in Paris" oikoumene.org Press Release 23.1.2015 http://www.oikoumene.org/en/press-centre/news/pilgrims-for-climate-justice-plan-to-impact-cop-21-in-paris, retrieved 5.8.2015.

4.8   Group 8: New Consciousness

Group 8 worked on the scenario "New Consciousness". Group members: Juho Ruotsalainen (moderator), Antti Alaja, Jaakko Blomberg, Samuli Honkapuro, Mari Sepponen.

Figure 21. Two group 8 participants reflecting what are the implications of their scenario.

Futures Wheel

The second group that worked on the "New Consciousness" scenario listed the future elements on the inner circle of the wheel. The cluster of more concrete ideas is marked on red in the bottom of the futures wheel.
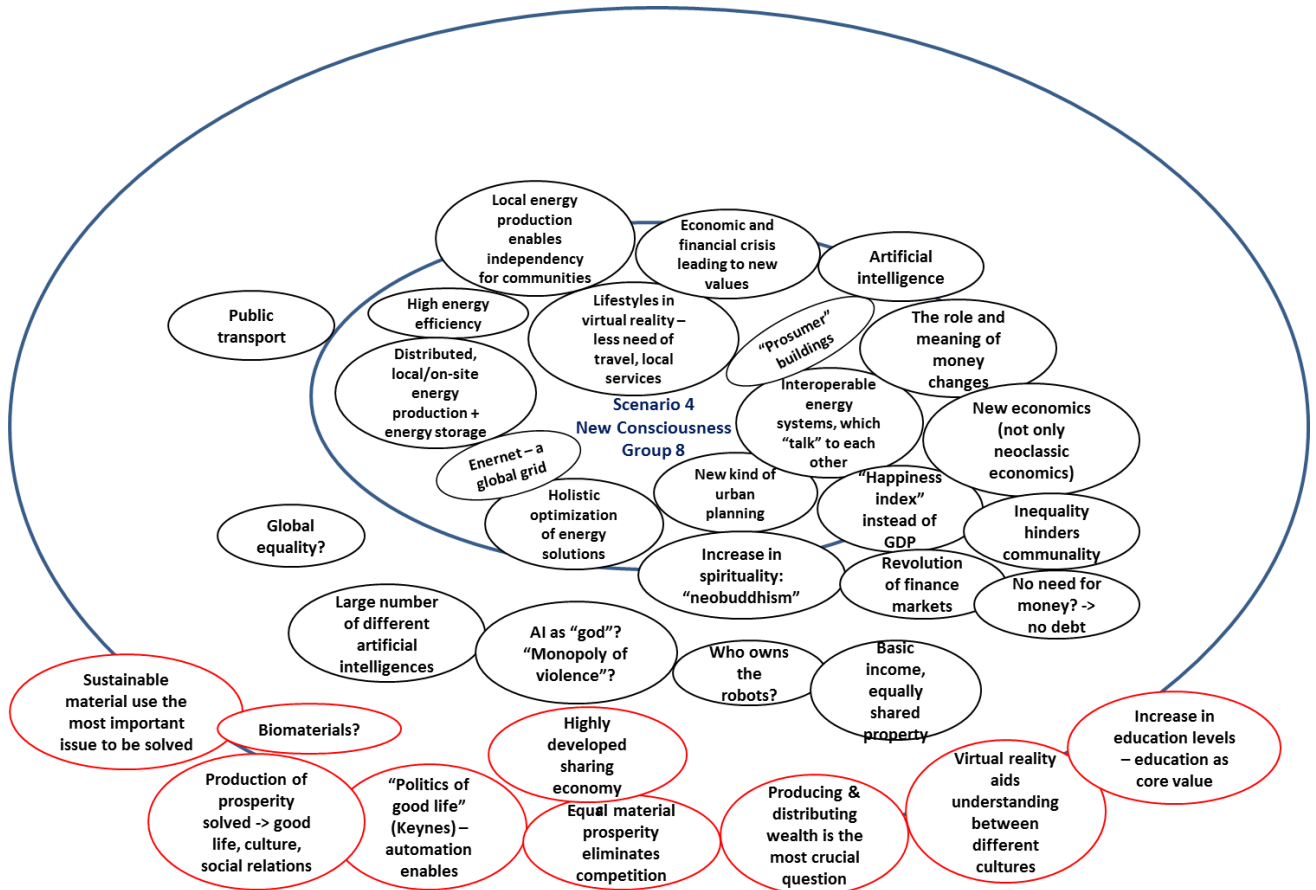
Figure 22. The Futures Wheel of Group 8 on New Consciousness scenario.

PESTEC Table

From their work with the Futures wheel, Group 8 **analyzed ways how a new consciousness might be achieved and what prerequisites for this kind of a world might be required** in the PESTEC Table. The reflections on the cluster of ideas were structured according to the six dimensions of the PESTEC (Political, Economic, Social, Technological, Ecological and Cultural/Citizen/Customer):

Table 13. PESTEC Table of Group 8 on how to achieve new consciousness.

PESTEC	How to achieve new consciousness? - Efficient production and equal distribution of wealth - Material sustainability to be solved –> biomaterials and shared property - Efficient "production" and distribution of knowledge, education and culture		
Political	Diverse economics education (not only neoclassic economics)		
Economic	Debt as a "positive" issue, enabler of bold investments and new growth	Basic income, shared property (especially robots)	What should grow (in a highly automatized production)? - R&D - Local economies - Renewables - "Creative economy", immaterial production - Maintenance
Social	Environmental awareness as crucial value -> how to achieve?	Informal, unstructured peer-to-peer learning environments	
Technological	Open data, abundance of information, discussion groups as disseminators and evaluators of information	Internet of Things, interoperability of systems	
Environ-mental	Responsible, environmentally aware consumerism		
Cultural Citizen Customer	High-quality, plural and diverse media	Peer-to-peer specialized niche media	

Group 8 came to the conclusion that a "new consciousness" requires a solid material base – a prosperous society where wealth is distributed equally. Otherwise solidarity and altruism would not be possible. Education and knowledge should be efficiently "produced" and distributed as well – they promote a civilized and tolerant society. However, in a highly diverse culture, traditional educational institutions would be outdated. What are needed in their stead are informal, unstructured peer-to-peer learning environments. Diverse, specialized media arise as new suppliers of educational contents.

The politics of good life, advocated by John Maynard Keynes in the 20th century, are embraced as the core value in society.[26] Economy is seen as the means to achieve "good living". Neoclassic economics with its emphasis on rational, profit-maximising individuals is only one branch in the diverse economics curriculum.

Production is highly efficient due to robotization; distributing wealth has become the pivotal issue. Most of property is commonly owned, although there is some private property. Exchange economy has largely replaced monetary economy, and thus there is significantly less need for competition and maximizing one's interests than before. Basic income is guaranteed to all. As material production is essentially automated, citizens are freed to pursue immaterial values. "Creative economy" in its different forms is by far the largest sector in economy. However, as a big proportion of production and exchange happens outside monetary exchange, paid labour is not the only or even the main form of work.

However, material prosperity poses challenges for material sustainability. Shared property mitigates consumption of raw materials as it makes the use of material resources much more efficient than before. Biomaterials are also highly developed, and most of material production is renewable. Despite these steps forward, global wealth causes serious ecological burden still to be solved.

For Finland especially this means a need for departure from the "fear of debt" and austerity, which are uniquely deep in Finnish culture compared to many other countries. Debt should be seen as an enabler of bold investments and as a source of innovations and new growth. Otherwise economy would stall and production would be allocated to traditional industries.

Energy implications

Energy-wise, the system is based on solar + wind + global grid + storage. Storage technologies are divided roughly in two: households and small organisations rely on batteries (well-designed, aesthetic "iBatteries") whereas large organisations use synthetic methane. Overall the aesthetics of energy infrastructure is emphasized, and energy technologies are a desirable part of citizens' "everyday environment". Energy consumption is "active" meaning that consumers are aware of their energy consumption. Each has a personal CO2 account, which cannot be exceeded, but the surplus can be sold. Along with active consumers, energy efficiency is ensured "passively" through automated energy optimization.

Possible black swans

This group identified one black swan (a potential future event that is unforeseen):
- Brain-to-brain communication → A hive mind

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[26] Already Aristotle advocated the pursuit of good life as a societal and individual goal.

Moderator's comments

Discussions on a peer-to-peer society often neglect inequalities and power relations. The most valuable contribution of the group to the New Consciousness scenario was the notion that a grass-roots society is not self-evidently harmonious, and economic policies will be needed to truly enable citizens to act on their own. The group came to an innovative conclusion: even a highly networked and unhierarchical society needs an active state – at least in providing equal opportunities for all. This is an unorthodox view, as the current wisdom often claims that the state should have as minimal a role as possible. The winds are changing, though, as for instance IMF calls for more equal distribution of income[27].

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[27] http://www.imf.org/external/pubs/ft/survey/so/2015/NEW061715A.htm

5. CONCLUSIONS

Several pathways with combinations of different elements may drive the third industrial revolution and the neo-carbon energy system. Work in this Futures Clinique identified various forces that can drive or hinder the uptake of future neo-carbon solutions and applications. The main discussion points from the Futures Clinique are summarized below with some reflections.

The innovation process itself of future **energy-related innovation will benefit from cross-disciplinary inputs** across the board. In academia, energy knowledge will need to be combined with skills from "soft" sciences, and for an ecosystem private, public and the third sector as well as citizens are need-ed. Home-grown neo-carbon solutions would scale-up and increase Finnish competitiveness. The groups suggested setting demonstration units for future marketing – R&D efforts to make to decision-makers and business the neo-carbon economy visible – visiting both from home and abroad. Finnish companies' in-vestment in the new innovations would position them as forerunners and significantly speed up the pro-cess. Groups that analyzed *value-driven techemoths* acknowledged not only can they make invest into innova-tions, but also do branding akin to Tesla's endeavours with the PowerWall. Especially in Finland the role of large companies may be significant due to the traditionally corporatist nature of decision-making. However, if this does not happen, in the long-term **"economic invaders" will emerge to distrupt "the old ways of doing things"**.

Political leadership can have an enabling role in driving neo-carbon solutions by assuming a long-term view. Across groups, the participants felt that more predictability is needed in the policy environment that guides the Finnish cleantech sector. Clever legislation and strategic development of the policy environment is needed. Continuity in research funding is an important starting point. **"Renewable energy develop-ment zones" and community-based energy hubs were proposed** as innovation platforms. Special in-centives such as tax benefits could be considered. In this Clinique, participants did not yet discuss what kind of regulation exactly could best drive the neo-carbon industry. An exogenous factor is the price of CO_2: if it increases this will likely expedite the development of clean technology solutions – *globally*. Such development might also make Finnish-based ideas in the energy storage face increased competition. One assumption discussed so far is that technological **forerunners may be able reap the fruits of the techno-logical transformation** because they will set up the rules as they go. Running ahead of others could be beneficial.

Ideally, exports will increase and trade deficit is reduced. Like in any learning curve, the process of de-signing the future energy system will require trial and error. In Finland, acceptance of failure and a culture of experimentation should be endorsed. This was highlighted especially by groups that analyzed the ways *radical startups* could drive positive change. New ways of collaboration are manifesting how Finnish working life has drastically changed from earlier decades, and will continue changing. Here, social welfare and educa-tional systems may have an increasing enabling role. One group suggested that in the future, **a "corporate basic income" could provide startups the social security that allows failure**. But, if the rest of the so-ciety is left behind, growing inequalities, a trend prevalent in many OECD countries during the past dec-

ades and especially Finland, could magnify. The IT success in Finland in the 1990s was fueled by both the targeted education of engineers for Nokia as well as informal learning that educated a generation of do-it-yourself coders. Informal encounters can provide agility and dynamism that will fuel the learning process. Theferore **empathy, trust and the sharing of knowledge** are not only qualities of "a new consciousness". Perhaps the entrepreneurship boom could be transferred to create future neo-carbon businesses from renewable energy and its associated storage – creating emerging sectors to supplement the "app boom"?

Technologies of 2050 are different from the world of today. Rather than one-size-fits all technologies, there may be a diversity of them, it was suggested. **When universities stop the research of fossil fuel technologies**, there is increasing room for authentic eco-technology. Energy could be stored in "accumulators", like suggested by a *Green DIY Engineers* group. Omnipresent energy awareness and **highly personalized energy systems could be an increasing future reality**. While energy technologies themselves will develop, also other technologies can enable sustainable lifestyles. Bioprocesses can be much a part of the economy. Future questions to be investigated include what other sectors will drive grow in a neo-growth economy.

A value shift for acknowledging the ecology is already driving a future mindset and curiosity to new solutions. Environmental policy can further incentivize the private sector – by internalizing the externalities of economic activity. The material basis will need to be acknowledged, as even the manufacturing of solar panels requires certain raw materials. Globalisation has increased trade flows, liquidity of finance and mobility of people. In income-rich countries increasing interconnectedness is taken as almost granted in the 2010s. However, as CO_2 emissions keep on rising, some Clinique participants questioned **whether it is realistic to assume that the transport sector will continue business-as-usual**. The rapidly growing amounts of air travel and related increasing energy use were singled out. Transformation of the transport sector and planning may be major future discussion points. Very high energy efficiency will be needed across the board. In a DIY world, new energy solutions could materialize in smaller units with electricity production from local algae. In terms of energy, one group suggested that there may be neither place for fossil fuels *nor* nuclear energy in the future. If such a future arises, this has **considerable implications for the energy landscape and future economic structure**.

Society might go **from #nimby (not in my backyard) #yimfy (yes in my front yard)**, where a "new responsibility" drives the *ethos* for a neo-carbon society. A *new consciousness* can appreciate the interlinkages of the economy and natural world and drive the values of immateriality, independence and decentralization. Wastefulness could be a future societal taboo – in Finland it already is to an extent. If climate change impacts are increasingly severe, locally-driven and community-based solutions may be the only way forward. Positively, this could empower people, drive open source collaboration and feelings of competence. Experimentation and creativity can change attitudes both inside and outside companies. Future will tell how the energy transformation will be realized: whether it will emerge bottom-up, from within larger companies – or manifest in some sort of a middle-ground solution. **The energy futures are ours to choose**.

It has to be born in mind that energy is anything but an insular issue. The energy future we choose affects other future directions as well. This emphasizes the importance of observing energy in relation to other trends and development paths. Perhaps the most crucial issue to be dealt together with energy transition

is changes in economic production. Automation, robotization and artificial intelligence may render a significant proportion of today's jobs obsolete and leaving many unemployed. At the same time productivity increases, which is intensified by the plummeting costs of energy. This could lead to an economically divided society, where owners of the means of production reap most of the new economic gains. The opposite scenario could result in a mass-scale economic empowerment, where growth would be distributed equally and where ordinary citizens would become producers thanks to shrinking costs of production. In either case, the question of material sustainability would become a pressing issue.

The results documented in this report will be used to elaborate the scenario sketches of the Neo-Carbon project as full scenarios. Smaller futures cliniques will be held as well, with more narrow and focused themes picked from the results reported here. The aim is that at the end of the Neo-Carbon project, the four scenarios paint a detailed landscape of what the society based on distributed renewable energy could be like.

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APPENDIX 1. PROGRAMME

NEO-CARBON ENERGY Project invites you to

Neo Carbon Futures Clinique I
CREATING THE THIRD INDUSTRIAL REVOLUTION
Wednesday 6 May 2015 at 11.30–16.00
Sitra, 14th floor, Itämerentori 2, Ruoholahti, Helsinki

PROGRAM

11.30	Coffee and light lunch
12.00	Words of Welcome, Tiina Kähö, Senior Lead, Sitra
12.05	Futures Provocation "*Neo Carbon Energy and the Third Industrial Revolution*"
	Sirkka Heinonen, Professor, Finland Futures Research Centre
12.30	Futures Window
12.40	SESSION I: Futures Wheel: Discussing and elaborating the scenarios
13.25	SESSION II: PESTEC Table: Adapting the scenarios to the Finnish context
14.25	SESSION III: Energy Futures: discussing the energy implications of the scenarios for Finland
15.00	SESSION IV: Cross Fertilization: Groups present their results to others
– 16.00	

After the Futures Clinique, the participants will receive the report draft documenting the results of the group work for comments.

   Contents of the Neo-Carbon Energy project will be presented at the FFRC international conference in several sessions, for example in a foresight game about the Neo-Carbon scenarios. The conference "Futures Research Tackling Wicked Problems" will be held in Turku on 11-12 June 2015. For more information, please see: futuresconference.fi/2015

APPENDIX 2.   PARTICIPANTS

Futures Clinique "Creating the Third Industrial Revolution", Helsinki 6th May 2015

	Name		Organisation
Group 1: Radical Startups (English) Moderator: Amos Taylor Finland Futures Research Centre, MA Programme in Futures Studies	Karoliina Steven Tiina Lassi Steven	Auvinen Collins Hanhike Similä Vanholme	Aalto University University of Helsinki Ministry of employment and the Economy The Finnish Ass. for Nature Conservation
Group 2: Radical Startups Moderator: Joni Karjalainen Finland Futures Research Centre	Arno Antti Jouko Ari Olli Johanna	Amberla Heinilä Kajanoja Karjalainen Pyrhönen Sippo	Proventia City of Forssa Emma Palvelut City of Helsinki LUT Ellun Kanat
Group 3: Value-Driven Techemoths Moderator: Emmi Tardy, Finland Futures Research Centre, MA Programme in Futures Studies	Jari Osmo Jarmo Aino Timo	Ihonen Kuusi Partanen Peräkorpi Tyrväinen	VTT What Futures Ltd. LUT Suupohja Aktia
Group 4: Value-Driven Techemoths Moderator: Marjukka Parkkinen, Finland Futures Research Centre, MA Programme in Futures Studies	Olli Pekka Jyrki Robert Joona Pasi	Hatanpää Laurikainen Weiss Poukka Vainikka	Helsinki-Uusimaa Regional Council Rakli VTT Finnish Energy Industries VTT
Group 5: Green DIY Engineers (English) Moderator: Shameer Prasla Finland Futures Research Centre, MA Programme in Futures Studies	Michael Wenfei Kaisa Renita Markku	Child Liao Matschoss Niemi Nordström	LUT University of Helsinki City of Helsinki Aalto University Novago
Group 6: Green DIY Engineers Moderator: Ellinoora Leino-Richert, Finland Futures Research Centre, MA Programme in Futures Studies	Heikki Liisa Helka Martta	Ilvespää Lahti Lamminkoski Nieminen	UPM Sitra e2 University of Helsinki
Group 7: New Consciousness (English) Moderator: Nick Balcom Raleigh, Finland Futures Research Centre, MA Programme in Futures Studies	Christian Janne Minttu Samuli Maarit	Breyer Hukkinen Jaakkola Sinisalo Vuorela	LUT University of Helsinki Nesling Foundation Sorsa Foundation Tekes
Group 8: New Consciousness Moderator: Juho Ruotsalainen, Finland Futures Research Centre	Antti Jaakko Samuli Mari	Alaja Blomberg Honkapuro Sepponen	Sorsa Foundation Yhteismaa LUT VTT

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