



Sirkka Heinonen, Noora Vähäkari & Joni Karjalainen

NEO-CARBON ENERGY WORLD - WHAT OPPORTUNITIES FOR CHILE?

Neo-Carbon Energy Futures Clinique IV

FFRC eBook 3/2017



NEO
CARBON
ENERGY



FINLAND FUTURES
RESEARCH CENTRE



Turun yliopisto
University of Turku

Sirkka Heinonen, Professor

Finland Futures Research Centre, University of Turku

sirkka.heinonen(a)utu.fi

Noora Vähäkari, Project Manager

Finland Futures Research Centre, University of Turku

noora.vahakari(a)utu.fi

Joni Karjalainen, Project Researcher

Finland Futures Research Centre, University of Turku

joni.karjalainen(a)utu.fi

Copyright © 2017 Heinonen, Vähäkari, Karjalainen, Finland Futures Research Centre and University of Turku

Cover picture by Noora Vähäkari "Escaleras coloridas en Valparaíso"

ISBN 978-952-249-476-4

ISSN 1797-1322

FINLAND FUTURES RESEARCH CENTRE

Turku School of Economics

FI-20014 University of Turku

Rehtorinpellonkatu 3, 20500 Turku

Korkeavuorenkatu 25 A 2, FI-00130 Helsinki

Åkerlundinkatu 2, FI-33100 Tampere

Tel. +358 2 333 9530

www.utu.fi/ffrc

tutu-info@utu.fi, firstname.lastname@utu.fi



**"You can cut all the flowers
but you cannot keep Spring from coming."**

**Pablo Neruda
(1904-1973)**

CONTENTS

EXECUTIVE SUMMARY	5
RESUMEN EJECUTIVO	7
PREFACE	9
PREFACIO	10
1. INTRODUCTION: NEO-CARBON ENERGY ENABLING NEW OPPORTUNITIES FOR CHILE	11
2. FUTURES CLINIQUE – A FORESIGHT EXERCISE WITH THE NEO-CARBON ENERGY SCENARIOS 2050	20
2.1 Futures Clinique as a Foresight Method	20
2.2 Four transformative scenarios 2050, key trends and drivers – the background material	23
3. NEO-CARBON ENERGY FUTURES CLINIQUE – PROCESS AND RESULTS	29
3.1 Radical Startups 2050 (Group 1)	31
3.2 Value-Driven Techemoths 2050 (Group 2)	37
3.3 Green DIY Engineers 2050 (Group 3)	42
3.4 New Consciousness 2050 (Group 4)	48
4. CONCLUSIONS	53
REFERENCES	57
APPENDIX 1. Programme	61
APPENDIX 2. Participants	63

EXECUTIVE SUMMARY

This report presents the results of the “Neo-Carbon Energy World – What Opportunities for Chile?”, a futures clinique organised at the Chilean Intellectual Property Institute INAPI in Santiago de Chile 24th October 2016, jointly by Finland Futures Research Centre of the University of Turku and Consejo Chileno Prospectiva y Estrategia (CChPE). Chile is a case study conducted in the foresight part of the Neo-Carbon Energy project. ***Chile is a country with robust renewable energy resources, which has received high attention by international investors and has led to a dramatic increase in the uptake of solar energy in the country.*** Chile is also a pioneer in economic development in Latin America, thanks to its steady political and economic conditions. The country keeps on investing in education to catalyze socio-economic development, but remains underpinned by the deepest inequalities in OECD countries.

In the Futures Clinique, ***four transformative scenarios of 2050 of the Neo-Carbon Energy research project were used to analyse the relevance and opportunities of the energy transformation with renewable energy technologies in Chile.*** In the group work, each group worked on one of the four scenarios (Radical Start-ups, Techemots, Do-It-Yourself Green Engineers, New Consciousness) to reflect the significance of this scenario to Chile. The participants of the Radical Startups group ***emphasized that the startup culture and enabling political focus have not taken up yet.*** No matter the nature and scale of an organization, they should put more effort in citizen wellbeing and societal needs. Those analyzing the Value-Driven Techemoths scenario found that ***at the moment, there are few Chilean technology companies. However, there are large enterprises in the country, in the hands of a few powerful families.*** A trajectory where their position strengthens would not automatically be beneficial to the society, unless these companies genuinely commit to commonly shared values of environmental protection, climate change mitigation, and social wellbeing. The Green DIY Engineers group found that their scenario was unfit as such for the Chilean context. Individual households were deemed as too small units and instead small towns and communities were seen as more suitable sized units for the do-it-yourself context. ***If these towns would have low hierarchies and that authorities that act based on local needs, such a model would be equitable and provide sustainable development for the country.*** According to the New Consciousness group, values would have to change considerably and citizen-driven change would have to be re-established. ***As a profound, cross-cutting aim that drives the nation, deep ecological New Consciousness would be supported with open governance and new institutions of horizontal governance ensure the uptake of renewable energy and quality of life extremely locally.***

As a conclusion, energy is a complex phenomenon, and a revolutionary transformation of a sector as broad brings up its complex nature that touches upon social, economic, cultural and environmental values and norms. Economic diversification in a resource-dependent economy such as Chile requires

restructuring of the system. Simultaneously, decentralized energy production, such as the Neo-Carbon Energy project suggests, urges courage and trust, something that Chileans claim they often miss. Peer-to-peer mentality might be more difficult to adapt than ecological consciousness, as the political history, socio-economic inequality and culture constantly challenge trust and credibility. Government and public organizations that are distant to the needs and hopes of citizens are awarded with skepticism. If the country wants to be a pioneer of the renewable energy industry in Latin America, it should also question the ownership of the projects and investments as they are now, since all of them are currently foreign.

For further research, we are looking more deeply into the transformation of the renewable energy sector and the discussion as of now. It is also necessary to understand any previous social change processes in Chile and see whether the abovementioned features are evident there too. The question of national ownership of the process is similarly interesting.

The Clinique process and scenarios need to be reviewed critically particularly when bringing into a new socio-cultural or economic context. The analysis phase needs to be specified and determined better to avoid subjective perceptions. However, this exercise showcased well the loopholes and strengths of the method in a foreign context, and brought new perspective of thinking about the future to tens of energy sector experts in Chile with rather little experience on participative and innovative working processes.

RESUMEN EJECUTIVO

Este informe presenta los resultados del taller “Neo-Carbon Energy World – What Opportunities for Chile?”, organizado por el Finland Futures Research Centre, de la Universidad de Turku, y el Consejo Chileno de Prospectiva y Estrategia (CChPE), en el Instituto Chileno de Propiedad Intelectual, INAPI, en Santiago de Chile, el 24 de Octubre de 2016. Chile es un estudio de caso abordado en la sección de prospectiva del proyecto Neo-Carbon Energy. **Chile es un país con recursos de energías renovables robustos, que ha recibido gran atención de inversionistas internacionales y alcanzado un importante incremento en su utilización de energía solar.** Chile es también un pionero en desarrollo económico en América Latina, gracias a sus estables condiciones políticas y económicas. El país ha mantenido su inversión en educación para catalizar desarrollo económico-social, sin embargo se mantiene marcado por los niveles de desigualdad más extremos de los países de la OCDE.

En la Clínica de Futuro, se usaron **cuatro escenarios transformativos de 2050, provenientes del proyecto de investigación Energía Neo-Carbon, para analizar la relevancia y oportunidades de la transformación de energía con tecnologías de energía renovables en Chile.** En el trabajo de grupo, cada grupo abordó uno de los cuatro escenarios (Emprendimientos Radicales, Grandes Empresas tecnológicas, Ingenieros Verdes Hágalo-Usted-Mismo, y Nueva Conciencia) para reflejar la aplicación de este escenario a Chile. Los participantes del grupo Emprendimientos Radicales enfatizaron que una cultura de emprendimiento y un foco político favorecedor no existen en el país aún. No importa la naturaleza y escala de una organización, deberían poner más esfuerzo en el bienestar ciudadano y las necesidades de la sociedad. Aquellos analizando el escenario de las Grandes Empresas Tecnológicas, encontraron que **hasta el momento, hay pocas compañías chilenas de tecnología. Sin embargo, hay grandes compañías en el país, en manos de unas pocas familias muy poderosas.** Una trayectoria donde su posición se fortalece no sería automáticamente beneficiosa para la sociedad, a menos que estas compañías genuinamente se comprometieran a valores comunes de protección al medio ambiente, la mitigación ante el cambio climático, y el bienestar social. El grupo de Ingenieros Verdes HUM, encontró que su escenario era inadecuado al contexto chileno. Hogares individuales fueron consideradas unidades demasiado pequeñas, y en vez, pueblos y comunidades fueron vistas como unidades de tamaño más apropiado para el contexto del HUM. **Si estos pueblos tuvieran jerarquías compactas y autoridades que actuaran basadas en las necesidades locales, este modelo sería justo y proveería desarrollo sustentable para el país.** De acuerdo con el grupo Nueva Conciencia, los valores tendrían que cambiar considerablemente y cambios empujados por los ciudadanos tendrían que ser re-establecidos. **Como uno profundo objetivo transversal que liderara la nación, una nueva conciencia ecológica profunda sería apoyada con gobernanza abierta e instituciones nuevas de gobernanza horizontal que aseguraran la utilización de energías renovables y la calidad de vida muy localmente.**

Como conclusión, la energía es un fenómeno complejo, y la transformación revolucionaria de un sector tan amplio involucra valores y normas sociales, económicas y culturales. La diversificación económica en una economía dependiente de recursos naturales como es Chile, requiere reestructuración del sistema. Simultáneamente, la producción descentralizada de energía, como las que el proyecto de Energía Neo-Carbon sugiere, requiere valentía y confianza, algo que los chilenos consideran que ellos no poseen. Una mentalidad de respeto entre pares podría ser más difícil de adaptar que la conciencia ecológica, ya que la historia política, la desigualdad socio-económica y la cultura constantemente desafían la confianza y la credibilidad. El gobierno y las organizaciones públicas que están distantes a las necesidades y esperanzas de los ciudadanos son miradas con escepticismo. Si el país desea ser un pionero de la industria de la energía renovable en América Latina, debería también cuestionarse la propiedad de los proyectos e inversiones, ya que hasta ahora, todas son extranjeras.

Para futuras investigaciones, estamos buscando más profundamente en el tema de la transformación del sector de las energías renovables y la discusión como se da ahora. Es también necesario entender cualquier proceso de cambio social previo en Chile y ver si las características mencionadas anteriormente eran evidentes también entonces. La pregunta sobre la propiedad nacional del proceso también es interesante.

El proceso de la Clínica necesita ser revisado críticamente, particularmente cuando vienen nuevos contextos socio-culturales y económicos. La fase de análisis necesita ser mejor especificado y determinado para evitar percepciones subjetivas. Sin embargo, este ejercicio mostró bien las falencias y fortalezas del método en un contexto diferente, y mostró nuevas perspectivas de pensamiento acerca del futuro a decenas de expertos en el sector energético en Chile, con poca experiencia en procesos de innovación participativos.

PREFACE

It is exciting to observe the fruit of the joint work between the Finns and Chileans on the potential of renewable energy in our country. During the meeting on Strategic Prospects of Chile, organized by the Chilean Council of Foresight and Strategy, we were fortunate to work with a highly qualified Finnish team. Finland is developing a participatory method to study how to achieve a society that uses 100% renewable energy by 2050. This team is developing the Neo Carbon Energy World project along with the University of Turku, one of the top centers for strategic foresight. The analysis begins with a global look at trends and factors driving change, assessing risks, and outlining the opportunities available to each country. Different scenarios are then explored, with various policies and projects identified.

Two major lessons emerge from the “futures Clinique” organized by the Finnish team in Chile. The first is that Chile has a very high potential to become a leading country in renewable energy. The work explores four scenarios for 2050, and its analysis reaffirms the logic outlined in the “Energy 2050” study produced by the Chilean Ministry of Energy which, in my opinion, is a good example that could be applied to other productive sectors. To do this, Chile must strengthen its institutional capacity, research and development sectors, and bring together high-level talent. The second lesson is that we should use this participatory methodology to achieve better results. The method, devised by Finnish experts, allows listening and learning from the most qualified people, to collect the best ideas and to learn which aspects to prioritize. Specifically, this procedure highlights how expanding participation increases the national capacity to think and act.

Chile lacks a clear system of foresight and long-term planning, preventing it from developing long-term strategies and improve the formulation of public policy. Creating this type of system should be our priority, and Finland is and can be a valuable point of reference. In the short-term, we must begin to create “strategic prospective” centers in the executive branch of the government, universities, and think tanks, and then take advantage of the groups and knowledge existing in the Congress, the private sector and the Armed Forces. Sustainable growth is a key priority for Chile and Finland, as well as all of the countries that have committed to the Sustainable Development Goals of 2030. Energy plays a key role in achieving these goals and this short document is an excellent contribution.

Santiago, Chile 29th June, 2017

Sergio Bitar

Former Minister and Senator of Chile

President of Chilean Council of Foresight and Strategy

PREFACIO

Es estimulante observar el fruto de un trabajo conjunto de finlandeses y chilenos sobre el potencial de la energía renovable en nuestro país. Durante el Encuentro sobre prospectiva estratégica de Chile, organizado por el Consejo Chileno de Prospectiva y Estrategia, tuvimos la suerte de contar con un equipo finlandés de alta calidad. Finlandia está desarrollando un método de trabajo participativo para estudiar como alcanzar una sociedad con 100% de energía renovable en 2050. Este equipo desarrolla el proyecto Neo Carbon Energy World, vinculado a la Universidad de Turku, donde están los mejores equipos en estudios de futuro. El procedimiento de análisis comienza con una mirada mundial para detectar las tendencias y factores que empujan el cambio, apreciar los riesgos y esbozar las oportunidades que podría aprovechar cada país. Luego se exploran escenarios y se identifican medidas y proyectos.

Dos grandes lecciones surgen de la experiencia realizada por la “clínica de futuro” coordinada por el equipo finlandés en Chile. La primera es que Chile tiene un potencial muy alto de devenir un país de vanguardia en energía renovable. El trabajo presenta cuatro escenarios 2050, y su análisis permite reafirmar la lógica trazada en el estudio Energía 2050 del Ministerio de Energía que, a mi juicio, es un ejemplo que podríamos aplicar en los demás sectores productivos. Para ello debe ser capaz de fortalecer su capacidad institucional, de diseño, investigación y reunir los talentos.

La segunda conclusión es la conveniencia de emplear una metodología participativa. El método desplegado por los expertos finlandeses permitió escuchar a las personas más preparadas, recoger las mejores ideas y detectar los aspectos que debemos fortalecer. Ampliando los espacios de participación se expande fuertemente la capacidad nacional de pensar y actuar.

Chile carece de un sistema articulado de pensar futuro para elaborar estrategias y mejorar la formulación de políticas públicas. Crear un sistema es prioritario y Finlandia es una referencia valiosa. En el próximo tiempo hemos de instalar unidades de Prospectiva Estratégica en el ejecutivo, universidades, centros de estudio, y lograr una buena articulación entre ellas, aprovechando también la existente en el parlamento, en empresas y Fuerzas Armadas. El crecimiento sustentable es una prioridad que Chile, como lo es para Finlandia y todos los países responsables que han suscrito los Objetivos de Desarrollo Sustentable 2030. Para hacer realidad las nuevas metas, la energía juega un papel crucial. Este breve documento es una contribución a ese propósito.

Santiago, Chile el 29 de junio 2017

Sergio Bitar

Presidente Consejo Chileno de Prospectiva y Estrategia
Ex Ministro y Ex Senador de Chile

1. INTRODUCTION: NEO-CARBON ENERGY ENABLING NEW OPPORTUNITIES FOR CHILE

This Futures Clinique report is part of the Neo-Carbon Energy project (2014-2017), funded by Tekes – the Finnish Funding Agency for Innovation¹. The Neo-Carbon Energy project examines a 100% renewable energy society and its energy system. Technologically, the energy system implies an increasing use of solar, wind, short-term and seasonal energy storages, and the generation of synthetic materials and materials from the electricity produced, all implying the electrification of society.

The foresight part of the project – *Neo-Carbon Enabling Neo-Growth Society – Transformative Energy Futures 2050* – anticipates the socio-economic implications and emerging lifestyles that could result from the new energy system, and investigates drivers and obstacles for its inception. An energy system that is based entirely on renewable energy sources would be increasingly distributed, and provide energy at low costs. Therefore, it could promote a peer-to-peer society, a high prominence of grassroots organizations, in which power shifts increasingly to people.

One of the objectives in the foresight part of Neo-Carbon Energy project is to examine what kinds of changes this might have for different countries and how these countries should prepare for such developments. In the same vein, we are interested in understanding what opportunities could emerge for societies all around the world, based on their own strengths, needs and capabilities, including opportunities for novel type of growth – neo-growth – in line with sustainability and ecological thresholds (Heinonen et al. 2015; Malaska 2010). One of the case countries² chosen in the project is Chile. Chile has been considered a pioneer within the entire Latin America, as the country has enjoyed steady socio-economic development for the recent decades (Benedikter and Siepmann 2015). Chile's economy, still highly reliant on mining and especially copper, has been resilient even in times of fluctuations in commodity prices and modest economic growth. In a continent of many turbulences (O'Toole 2010), Chile has chosen to invest in education and aim to enhance the skills of its people. This way, it

¹ Neo-Carbon Energy is a joint research project of the Technical Research Centre of Finland (VTT, co-ordinator), Lappeenranta University of Technology (LUT), and University of Turku, Finland Futures Research Centre (FFRC). The foresight part of the project is led by Prof. Sirkka Heinonen at the Finland Futures Research Centre, and the research team consists of project researchers Juho Ruotsalainen, Joni Karjalainen and Marjukka Parkkinen, supported by Leena-Maija Laurén and Hazel Salminen. See more at www.neocarbonenergy.fi, <http://utu.fi/en/units/ffrc/research/projects/energy/Pages/neo-fore.aspx>

² Other case countries in the Neo-Carbon Energy project include Argentina, Australia, China, Kenya, Tanzania & South Africa.

is making efforts to make it an increasingly knowledge-based economy. However, this does not remove the fact that Chile today does have the deepest inequalities out of OECD countries, a feat which the country will have to still resolve.

The key objective of this Futures Clinique was to test the given Neo-Carbon Energy scenarios in Chile against the backdrop that is the current renewable energy boom in the country (Heinonen et al. 2016a; 2016b). The participants were invited from various fields of expertise, such as urban planning, innovation research and promotion, mining, and the energy sector. The Clinique was organized together with Consejo Chileno de Prospectiva y Estrategia (CChPE) and held at the premises of Instituto Nacional de Propiedad Industrial (INAPI) in the centre of Santiago, with inspiring and luminous views over the city on the 18th floor. This connects with the objectives of understanding how renewable energy can be made part of everyday urban life - livable and ecologically smart cities (Parkkinen & Heinonen 2016). The Clinique provided new interesting data to analyse Chile as a case study in the Neo-Carbon Energy project, as well as introduced the Futures Clinique as a participatory method (Heinonen & Ruotsalainen 2013) on how to think about and work with the future for the local experts (see Chapter 2). A multi-disciplinary approach, spanning across sectors to study energy from a socio-cultural perspective (Sovacool 2014; Miller et al. 2015, see e.g. Ryghaug & Toftaker 2014) was fundamental due to the broad nature and complexity of the topic. It allowed the attendees to elaborate various future scenarios of their own country, think who are the existing and future actors that can make change happen (see e.g. Similä & Koljonen 2016), and explored what different types of opportunities could be harnessed in Chile to make the energy transition beneficial and motivating for the citizens and key stakeholders.

Prof. Heinonen was also invited to give a keynote speech at an International Seminar on Foresight (Seminario Internacional de Prospectiva y Estrategia para el Desarrollo del Chile del 2030, see <http://seminario.prospectivayestrategia.cl/26-de-octubre/>) by the Chilean Millennium Project node Mr. Hector Casanueva, the President of CChPE, Mr. Sergio Bitar, the Executive Director Mrs. Paola Aceituno and the CChPE team, whom the FFRC team is to thank for the support for co-organising the trip and contributing to the report. In this respect, special thanks go to Mrs. Paula Castro of CChPE.

The FFRC team also had meetings with Fundación Chile, the Ambassador of Finland in Chile Mr. Mika-Markus Leinonen, FINPRO, Asociación Chilena de Energías Renovables A.G, Laboratorio de Gobierno, Centro de Desarrollo Urbano Sostenible at Pontificia Universidad Católica de Chile, and Centro de Energía, Universidad de Chile.

Finally, the authors would like to thank the Consejo Chileno de Prospectiva y Estrategia, and the donors that made possible this project: Consejo Nacional de Innovación para el Desarrollo, Ministerio de Energía, and Instituto Nacional de Propiedad Industrial. Their resources, together with the Neo-Carbon Energy project, made this research visit possible.



Figure 1. (From the right) Joni Karjalainen, Noora Vähäkari, Linda Nerg, Sirkka Heinonen and Sergio Bitar at the Futures Clinique.



Figure 2. (From the right) FFRC and the Ambassador of Finland in Chile Mika-Markus Leinonen visiting Laboratorio de Chile.

Chile - the Solar Pioneer in Latin America

The role of pioneers is an increasingly important topic to be studied in order to understand what makes profound transformations to happen. ***The energy transformation towards an increasing uptake of renewable energy in society is spearheaded by multiple forerunners around the world.*** Pioneers can be individuals, communities, companies, institutions, NGOs, movements – or perhaps entire societies. In a recent Neo-Carbon Energy study, an international expert survey for foresight experts was conducted to identify possible pioneers. The questionnaire addressed an international expert community of futurists, energy experts and entrepreneurs working on energy questions and societal change, which consisted of members of the Club of Rome, the Millennium Project and national level energy and innovation networks. The respondents also evaluated the possibility, probability and desirability of future-oriented scenarios (Lang et al. 2016.). In the same vein, but using different foresight methods – a Futures Clinique in particular – we were specifically interested in investigating a single country, and the prerequisites and opportunities of Chile in pioneering the energy transition towards a society that uses a neo-carbon energy solution.

It is only rather recently that solar photovoltaics and concentrated solar power (CSP) have emerged to shape Chile's energy landscape. Historically speaking, Chile is an importer of fossil fuels and has had the highest electricity prices in Latin America.³ Collaboration in energy issues has not been altogether unproblematic. Argentina's energy crisis in 2004 stopped natural gas imports to Chile and has made it skeptical to the ability of its neighbours to contribute to solving its energy issues (Heinonen et al. 2016c). ***Today, Chile tops the rankings in renewable energy market attractiveness*** (EY 2016). The price of renewable energy technologies has now become less expensive than the electricity sold in Chile's electricity spot market. As reported by Bloomberg, in the most recent energy auction in August 2016, renewable energy contractors "dethroned the country's incumbent energy suppliers". Winning almost all the bids, fossil fuels companies systematically lost because of higher prices (Dezem and Quiroga 2016; Sanders 2016). In solar energy, Chile has 1,000 gigawatts (GW) of generation potential. ***The current domestic demand is only 20 GW, which is less than 1/50 of the entire potential of the country. Especially in the northern part of the country around the Atacama Desert solar resources are exceptionally abundant, among highest in the world.*** This has not gone unnoticed

³ The financing of the energy transition to increase the share of renewable energy in society is an issue that penetrates multiple levels, something to consider when thinking of the opportunities for the uptake of renewable energy based solutions. In Germany, known for its energy turn (*Energiewende*) through the uptake of solar and wind energy, while citizens have paid relatively high costs of energy, they have also supported the transition in large numbers. This suggests that while a low cost of energy for citizens may, in principle, be a desirable outcome, in the transition phase citizens may be willing to invest in the short-term, to guarantee a sustainable future pathway in the long-term.

by energy-intensive industrial investors and mining companies like BHP, Anglo, and Codelco who wish to mitigate their power costs. The government of Chile has also set a policy to enforce mining companies to generate 20% of their electricity use from renewable energy sources by 2025. Today, electricity from solar CSP plants now feeds for example Chuquicamata, the world's largest open pit copper mine.

After the government of Chile published a national energy strategy for 2012–2030⁴, it was shortly replaced by a more thorough Energía 2050⁵. As ***the current energy policy strategy for the country, Energía 2050 aims for a 70% renewable energy share by 2050*** (Gobierno de Chile 2015). The new energy policy is indicative of a new paradigm in energy policy and marks a rapid shift in the national energy sector development since 2012. In the previous strategy, the problems of short-term planning and reliance on fossil fuels were addressed (but not resolved), and more focus was put on harnessing the potential of non-conventional renewable energy sources, such as solar energy. There, emphasis was put on energy efficiency and in the increase of domestic hydropower production, while also ensuring the supply of conventional energy sources, namely imported coal or LNG.

In general, Chile's energy demand has increased because of the booming mining production and economic growth. In the long-term, economic growth can be expected to have an impact in the increase of energy demand. Population growth rate is rather steady, and Chile's population of 18 million people (2016) is expected to grow only little, to reach around 20–21 million by 2050 (UN DESA 2017). With regards to the short- and long-term prospects of the energy sector in Chile, a major short-term focus is in increasing the generation capacity and lowering the prices. According to recent media reports, consumer prices in Chile could be reduced by 25% by 2021 (Dezem and Quiroga 2016).

Neo-Carbon Energy – the Basis for a Renewable Energy Powered Society

If a given society wants to have an emission-free energy system in place by 2050, its principles need to be designed now. Neo-Carbon Energy is about creating a new emission-free and reliable energy system. ***This system will be based mainly on solar and wind, which will be the cheapest sources of energy by that time.*** When all energy using processes in a society are zero emitting, solar and wind energy form the basis of energy supply. Energy generated from solar and wind will be stored in various forms with energy storage. ***Neocarbonization means that all energy consuming sectors will be electrified, primarily by using large shares of electricity generated by solar and wind energy. This includes transportation, heating,***

⁴ www.centralenergia.cl/uploads/2012/06/National-Energy-Strategy-Chile.pdf

⁵ www.energia2050.cl/en/

cooling, electricity, industries, food and water production. This happens with electrification, directly or indirectly. The basic principles of this system are explained in Figures 3 and 4, and more in detail in the Neo-Carbon Energy project web page: www.neocarbonenergy.fi. This energy system can be tested by using the Internet of Energy simulation tool: www.neocarbonenergy.fi/internetofenergy.

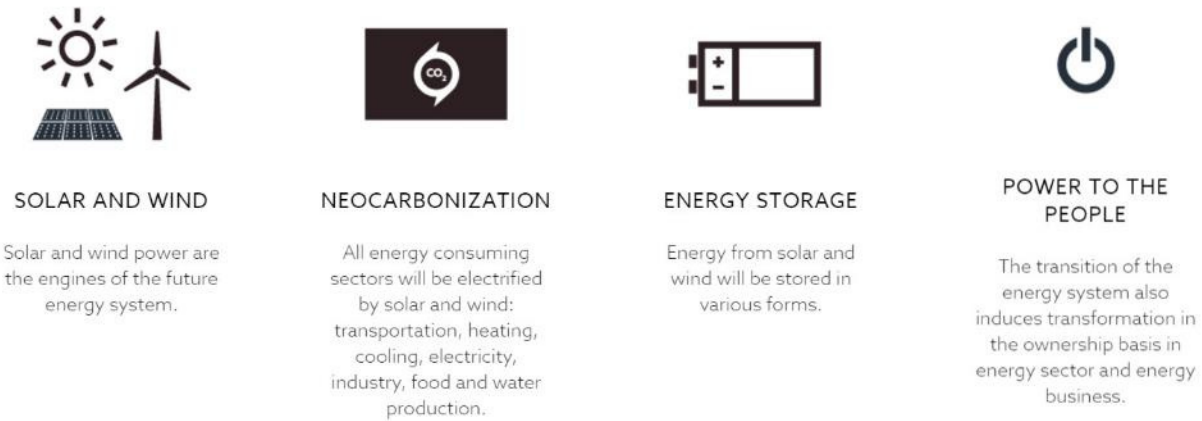


Figure 3. The principles of a neo-carbon energy system consist of an increasing role of solar and wind energy, neo-carbonisation (or the electrification of all energy consuming sectors), energy storages, and the decentralization of the energy system, which opens up novel opportunities for citizens to play an active role in the energy sector.

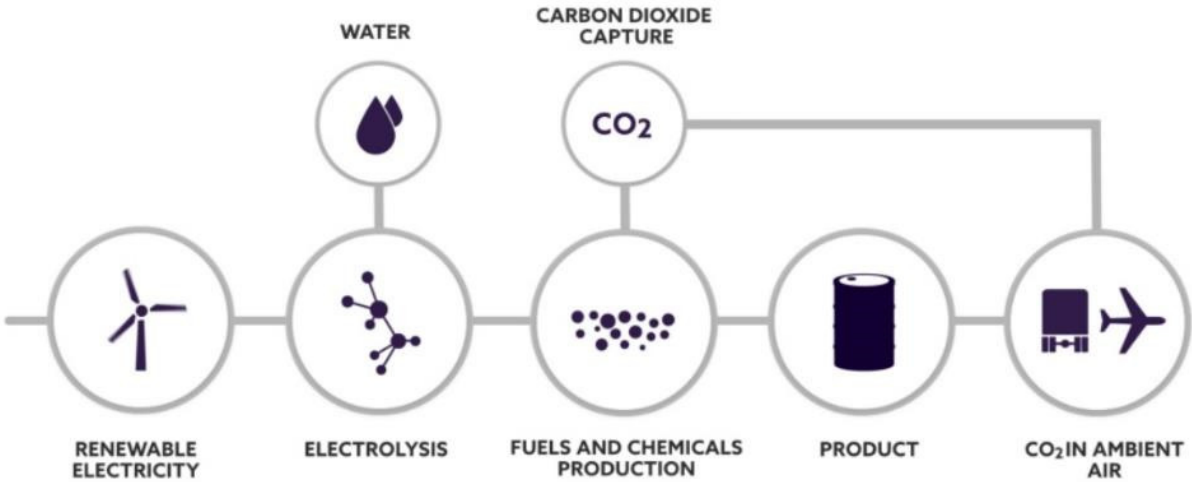


Figure 4. Neocarbonisation implies that all energy is generated with renewables. By using renewables-based electricity, several types of novel synthetic end products can be created. Source: Neo-Carbon Energy.

The opportunity to mitigate potentially dangerous levels of climate change is closing. With the current emission rate, no carbon dioxide (CO₂) can be emitted after 2035 to limit global warming below 2°C. On the contrary, several reports indicate that our current energy use and lifestyles could be taking the world to a much warmer path (IPCC 2014; World Bank 2013). At the same time, there is a lot unburnable carbon in coal, oil and gas deposits, which problematically, have already been discovered, and

companies and states have already locked investments in them. Carbon budget refers to the amount of CO₂ that can be emitted before reaching the limit to stay below 2°C, and with the current energy use, this budget is soon used. ***Such a situation could lead to a so-called carbon bubble. Companies that have significant fossil fuel assets, or carbon dependent business, could see their assets become stranded. This is a market risk that has not been considered by financial markets.*** Furthermore, this would imply that the current market value of many companies, especially those that are heavily invested or reliant in carbon-intensive energy sources, is overestimated. Because of this dilemma, a debate on the appropriate strategy for mitigating emissions is increasing by countries, companies and citizens alike.

It has been typically assumed that energy transition requires energy consumption in society to be reduced, and that the energy abundance provided by oil has come to an end (Heinberg & Friedly 2016). Inevitably, all energy consumption does have environmental impacts. It is also increasingly understood that energy needs to be studied together with water and food for genuine sustainability and to build multiple synergies⁶. ***A 100% renewable energy based solution provides a distinctive and appealing alternative. Recent studies suggest that 100 % renewable energy system can meet increasing energy demand*** (Breyer et al. 2016), and with declining marginal costs of production (Rifkin 2014), possibly lead to a world of sustainable abundance – one “without guilt” (Lord 2014). The challenge is harnessing this energy potential. If humanity could capture one per mille (0.1%) of the solar energy facing the Earth, it would have roughly six times the energy consumed today (Naam 2011). If a technological setup to harness the abundance in renewables is in place, this could imply a major transformation not only for business but for entire societies, as a whole.

Using these principles, a novel study calculates the power systems for South and Central America in the year 2030 using hydro, wind and solar power i.e. based on a neo-carbon energy system (Barbosa et al. 2017). ***This is perhaps the first time when a research effort to model an energy system entirely based on renewables for the region has ever been conducted.*** When calculating a 100% renewable energy (RE) system⁷, they found that renewable energy is able to cover 1813 TWh of estimated electricity demand of the area in 2030, and in addition able to generate the electricity needed to fulfil 3.9 billion m³ of water desalination and 640 TWh of synthetic natural gas demand. Existing hydro dams could be used as virtual batteries for solar and wind electricity storage, which would diminish the role of storage technologies. In terms of costs, the total levelized cost of electricity (LCOE) is 56–62 €/MWh – and for the integrated

⁶ As pointed out recently in the high-level international Watershed Conference: <http://worldwatervalues.org/>.

⁷ The researchers are also part of the Neo-Carbon Energy research project. The research team used an hourly resolved energy model and divided the region into 15 sub-regions and four different scenarios. The four different scenarios consist of three according to different high voltage direct current (HVDC) transmission grid development levels (region, country, area-wide) and one integrated scenario that considers water desalination and industrial gas demand, which is supplied by synthetic natural gas via power-to-gas (PtG).

scenario, the levelized cost of gas (LCOG) is 95 €/MWh and the levelized cost of water (LCOW) 0.91 €/m³ (using currency values of the year 2015). When desalination and power-to-gas are integrated into the system, the total cost is reduced by 8% and the cost of electricity generation by 5% (Barbosa et al. 2017.) These results are encouraging, considering the enormous task of transitioning energy systems into carbon-neutral.

Technologically, to achieve renewable energy abundance, an “internet of energy” is needed to replace the current grids. The concept of the energy internet is close to that of a smart grid, in which communication and information technologies are used for dynamic optimization of grid operations and resources. However, the energy internet is a broader and more holistic concept than the smart grid. A smart grid does not require a decentralised production of energy to be in place, whereas in an energy internet, energy is produced in a distributed and decentralised manner (Boucher 2015). Analogous to the internet, an energy internet would be a peer-to-peer system without a controlling centre, where citizens and companies alike feed their surplus production to the energy internet. Energy would be locally stored in every building and throughout the infrastructure by various storage technologies. Jeremy Rifkin (2011, 50) writes of the energy internet in the following way: ***“This intelligent energy network will embrace virtually every facet of life. Homes, offices, factories, and vehicles will continuously communicate with one another, sharing information and energy on a 24/7 basis.”*** In an energy internet, smart technologies do not only optimise the operation of single devices, but “everything” communicates with “everything”, sharing information so that the entire entity can be optimized. In other words, energy internet does not refer to the energy grid alone, but to everything involved in energy consumption, production and distribution, and connected via ICTs. Energy internet is thus closely related to the *Internet of Things* (IoT), which refers to devices and objects with internet connection and sensors: in an energy internet, all devices would be connected and communicating with their environment through the IoT.⁸

Furthermore, some authors claim that decentralized energy system promotes a more democratized, peer-to-peer society where power stems increasingly from the grassroots (Sovacool & Brossmann 2010; Rifkin 2011). This line of argument here is largely economic: if individuals or communities produce their own energy (or receive nearly-free energy from the grid), they gain independence and are empowered to small-scale manufacturing. Low-cost renewable energy could, for instance, lower the barrier of do-it-yourself (DIY) production and “cottage industries”. The energy internet could indeed have implications for the broader society. Internet has led to an abundance of information and shifted power to the civil society, and similarly the energy internet has the potential to lead to an abundance of energy. Interestingly enough, the lowering costs of solar energy are also driving an opposite trend. Increasing energy independence makes off-grid living an increasingly viable option. There are already individual towns and

⁸ For energy internet (= Eternet) see more in Heinonen et al. 2017.

communities that have become self-sufficient and decided to go 100% renewable. A new peer-to-peer energy model, whether increasingly interconnected – or one providing community-based self-sufficiency – could usher a collaborative era in energy systems as well (Wu et al. 2015).

However, in addition to the technological feasibility of an energy system, there are political, economic and socio-cultural drivers and barriers. In energy literature, four archetypes for energy transformations have been identified: citizen-, market-, technology- or state-led (Scoones, Leach and Newell 2015). However, most likely society-wide transformations are in any case too complex for any single actor alone to achieve. Therefore, ***in order to achieve such a complicated system requires co-development and co-experimentation with various stakeholders, including citizens*** (Lösch & Schneider 2016). It is, amongst other things, not yet entirely sure how the future of energy markets may look like in a 100% renewable energy system (Salovaara et al. 2016). These deliberations need to be conducted across the world by citizens and within diverse social groups, rather than merely expected to emerge as technocratic solutions (Stirling 2014). In our work and in this report, we hope to pay particular attention to the cultural, institutional and social dynamics of energy transformation, as they are too often overlooked. Only this way, the renewable energy transition can be realized in a way that is equitable and democratic, and may enjoy legitimacy in the eyes of not only by narrow expert groups or scientists, but as an action plan shared by businesses, citizens and decision-makers – *and* future generations alike.

2. FUTURES CLINIQUE – A FORESIGHT EXERCISE WITH THE NEO-CARBON ENERGY SCENARIOS 2050

2.1 Futures Clinique as a Foresight Method

Futures research is systematic, holistic, multidisciplinary and critical long-term analysis of futures topics and alternative developments (Heinonen 2016a). It is a relatively new discipline, established in 1940s, systematically looking into future developments, opportunities and risks with specific methods, notably by constructing different scenarios of future worlds. Futures research or futures studies have several specific purposes, but the core general purpose is to maintain or improve the freedom and welfare of humankind. The goal of futures researchers is to contribute toward making the world a better place to live in, and to benefit people and the life-sustaining capacities of the Earth (Bell 1997). Systematic futures thinking can also be considered a capacity, a skill that will be in a crucial role not only in futures education, but also in the competitiveness and survival of institutions (Masini 1993). There are three main principles in futures studies: 1) future cannot be predicted; 2) future is not predetermined, there is not just one future; and 3) future can be affected (you can create the future) (Amara 1981).

Foresight is structured participatory debate about the future of complex issues (Heinonen 2016a). It is a more recent development, very practically orientated approach to futures thinking, debating about the future, and creating the future (ibid.). Foresight provides a framework and structured debate platform for a group of people concerned with common issues at stake (e.g. future of EU manufacturing, R&D and innovation priorities, transport and mobility, etc.) to jointly think about the future in a structured and constructive way. Both futures studies and foresight aim at supporting decision-making (i.e. policy makers, experts and other stakeholders) to develop visions of the future and pathways towards these visions. Foresight is more and more perceived as a valuable policy instrument (<http://forera.jrc.ec.europa.eu/>). Futures studies and foresight are not about predicting the future, but openly exploring how the future might evolve in different ways, depending on the chosen vision of the future, on the actions of different players in society, as well as on the concrete plans and decisions made today. It is also worthwhile noticing that there are three kinds of futures. The three classical approaches which are all needed are: 1) possible futures, 2) probable futures, as well as 3) desirable futures (Amara 1981). Too often, however, the emphasis is only on the probable futures. This rules out a huge number of opportunities that will be missed unless an open exploration of possible futures is made, with the subsequent choice of the desir-

able, preferred future. Foresight can and should be made at all levels of society – organisations, institutions, NGOs, governments,⁹ even individual citizens. All these actors could make a **futures strategy** for their activities, taking systematically into account future developments in the long-term as well (Heinonen 2016a). Futures studies and foresight can also be focused on certain geographical areas, different countries, and continents, where they may have somewhat different approaches, methodologies, topics and objectives. In Latin America there are specific studies carried out concerning the region (Cordeiro 2012; Mendoza 2015). In the Millennium Project¹⁰, which is a global think tank where besides some 60 different country-based nodes, there is a special group concentrating on Latin America, as there is also a special group for European Nodes. The Millennium project collaborates through its nodes and produces State of the Future Report (Glenn, Florescu et al. 2015) as useful material for all interested in the future and futures work.

Public policy and good governance could also benefit from foresight process. Currently, as Boston (2017, 350) claims there is a lack of public investment in high-quality foresight methods and processes, and a failure to integrate the results of such exercises into mainstream policy-making. Therefore, it is of crucial importance to both promote academic futures studies and pragmatic foresight to disseminate the results of foresight work into decision-making. One aim of futures studies is to provide high quality policy advice.

Futures Clinique is a distinctive futures workshop developed by Sirkka Heinonen at the Finland Futures Research Centre (FFRC), University of Turku (Heinonen & Ruotsalainen 2013), especially designed to anticipate and create radical futures – that may differ significantly from the present. Futures Clinique is a special adaptation of a futures workshop, which is a central method in futures studies (Jungk & Müllert 1987; Nurmela 2013). In futures workshops, the participants typically represent a diversity of backgrounds – governmental experts, business, researchers, citizens, students, non-governmental organisations (NGOs), et cetera – and work together in small groups to anticipate possible, probable and preferred futures of a selected topic (Nurmela 2013).

In a Futures Clinique, when long-term changes are anticipated, special attention is intentionally paid to weak signals. Weak signals are novel phenomena and issues that are considered more or less marginal in the present time and not yet well understood. But because they could strengthen in the future, it is important to analyse and interpret their significance. (Day & Schoemaker 2006). ***Weak signals are signs of actual change, indicative of issues that qualitatively differ from the present moment.*** In contrast,

⁹ For example, a country can have a national foresight system and process where several key foresight units collaborate in anticipating the future. For Finland, see Heinonen 2016b.

¹⁰ For more information about the Millennium Project, please see <http://millennium-project.org/>.

trends and megatrends, which more or less have already been recognized and are known, can more easily be quantitatively measured. In other words, a Futures Clinique deals with discontinuities instead of continuities. It also invites participants to think about uncertainties and surprises, sudden events that have a low probability and high impact i.e. *black swans* (Taleb 2010; Heinonen 2013).

The Futures Clinique process begins with a background research, which includes a scanning and analysis of weak signals. The results of the background research can be summarized and shared with the participants either before or during the workshop. The actual Futures Clinique begins with a **Futures Provocation** (Lat. *pro + vocare*, call forth), a presentation to inspire 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, which is accompanied by background music (see Hiltunen & Heinonen 2012). Its aim is to stimulate the viewers' futures consciousness by opening up innovative futures thinking through different types of visual stimuli. Viewing the Futures Window is a kind of time travel of imaginative futures, visually perceived through weak signal cavalcade. Mental time travel is a concept in futures studies for making futures more approachable or immersive (see Cuhls 2016). The Futures Window work phase is succeeded by group work sessions, in which several foresight methods are used.

In the group work, *the Futures Wheel* is a user-friendly foresight method that resembles a mind map. By applying the Futures Wheel, participants collect ideas, discuss them and anticipate their effects (Glenn & Gordon 2009). The most interesting and relevant ideas of the Futures Wheel will then be analysed and elaborated. This can be conducted by using the PESTEC table. **PESTEC table** is a foresight tool that allows an analysis of a particular issue by breaking it down into political (P), economic (E), social (S), technological (T), environmental (E), and cultural/citizen/customer (C) perspectives (Heinonen et al. 2016). When concluding the group work, the results can be summarised in *a tentative scenario narrative* or *a manifesto*, for instance. In the end of the group work, it is also fruitful for the group to try and anticipate possible *black swans* – sudden, unexpected events that could have drastic consequences if they occur. This way, the group can test how such events would affect the future the group has created, as a kind of sensitivity testing.

Finally, the results of each group are presented to other groups to ensure **cross-fertilization**. Other groups are able to comment, reflect, and provide feedback to the presentations. This marks the final phase of the group work. After the workshop, the moderators document, analyse and synthesize the results as a research report. In the Futures Clinique report, the results are summarized, a preliminary analysis is conducted, and the results can even be broadened into scenario sketches. Before the publication of the report, it is usually sent to the participants so that they can comment it. The process and the results of this Futures Clinique, customised to meet the objectives of the research project and to provide insights for a wider audience of readers, are presented in chapter 3.

2.2 Four transformative scenarios 2050, key trends and drivers – the background material

The participants of this Futures Clinique worked in four groups, each representing one of the socio-cultural scenarios of the Neo-Carbon Energy project: Radical Startups 2050, Value-Driven Techemoths 2050, Green Do-It-Yourself Engineers 2050, and New Conscisouness 2050 (Heinonen et al. 2016). All of the scenarios have been constructed as *transformative scenarios*, in line with Jim Dator's scenario archetypes (Dator 2009). The scenarios are transformational in order to avoid too conventional a logic and to explore developments beyond business-as-usual. There are good reasons to do so, as there is currently an urgent societal demand to transform energy systems. Energy and climate change experts are paying an increasing consideration to energy system options, which are cognizant of the problem with the current fossil fuel based energy supply. Where this is a growing field, related socio-economic and socio-cultural assessments are still few.

As background material, summaries of the scenarios were described to the participants before the start of actual group work. The basic principles of the neo-carbon energy system – increasing use of solar and wind, energy storages, electrification of energy-consuming sectors, bringing power to the people – were also explained and shared with the participants. This was conducted to ensure that all Futures Clinique participants can familiarize with the background research and related assumptions and to provide a context for the group's work to immerse the participants into their future-oriented task. For practical purposes, only the key elements rather than the technological setup in full detail (see Chapter 1) were explained. When the group work was started, the participants were also shared a two-pager. The front page describes a short scenario narrative, provided a scenario image, the key observed trends, and weak signals that underpin the scenario in question. These are described in Figures 6–9 for each scenario group, respectively. In each group, the back page listed the technology principles, exactly as shown in Figure 5.

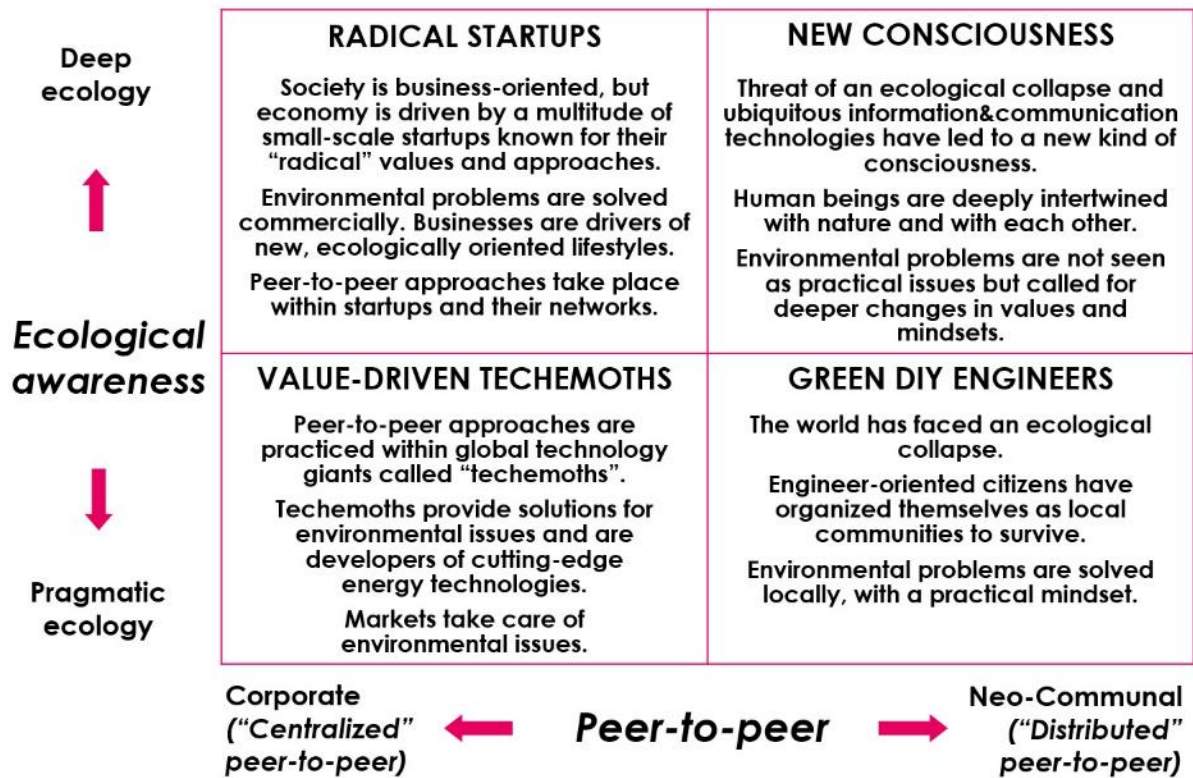


Figure 5. Four transformative Neo-Carbon Energy scenarios 2050.



Figure 1. Radical Startups scenario. (http://www.e-architect.co.uk/images/jpgs/barcelona/faib_jabo_house_p200710_ag8.jpg)

Radical Startups

(Corporate peer-to-peer & Deep ecology)

The economy is driven by a multitude of small-scale startups known for their radical values and approaches. Their selling point is promising to do societal and environmental good, and offering workers opportunities for self-expression. Environmental problems are solved first and foremost commercially and develop in startup networks. Businesses are drivers of new, deep ecological lifestyles.

Key trends in the present

- Consumers' needs are diversifying. Startups can often supply niche markets better than large, rigid enterprises.
- Startups are vanguards of a new working culture, where expressing oneself through work becomes an important motivator.
- In an ecological transition where everything is to be transformed as ecologically smart, diverse ecosystems of startups are needed to make the change possible.

Weak signals

- Open source is spreading outside software businesses – meaning e.g. open patents
- People are increasingly working as freelancers. This may indicate a change in work ethos, where person's identity is hard to distinguish from his or her work identity
- Many startups are emphasizing other than mere economic values, driven by ethics and social needs

Figure 6. Radical Startups 2050 scenario.



Figure 2. Corporations' headquarters have self-sufficient facilities for peer-to-peer projects, often outside cities (Apple).

Value-Driven Techemoths (Corporate peer-to-peer & Pragmatic ecology)

Peer-to-peer approaches are common within large technology corporations. Technology giants, or "techemoths" represent the Silicon Valley vision of emancipation, creativity and open source. They also invest in ambitious energy and environmental projects. Ironically, their employees often live inside corporate walls. Citizens assume that environmental issues are "automated" on their behalf. Markets take care of environmental issues.

Key trends in the present

- Samsung is developing SamsungVillage as a campus to offer everything from housing and leisure to education.
- Big technology companies are buying promising startups, enforcing the dominance of big enterprises
- The workplace cultures of big companies are becoming less hierarchical, as manifested in Google where employees can spend some of their working hours on their own projects.

Weak signals

- Tech giants are investing in bold science projects, including renewable energies
- Inequalities are widening. In a possible future, the elites employed by big companies are well-off, but the rest have to cope by themselves
- In this kind of future, the most original innovations could stem from the fringes of society instead of big companies

Figure 7. Value-Driven Techemoths 2050 scenario.



Figure 3. Green DIY Scenario. http://jason.wells.me/wp-content/uploads/2012/05/burning_man_2002_Robotic_Rickshaw.jpg

Green Do-It-Yourself Engineers

(Neo-Communal peer-to-peer & Pragmatic ecology)

Countries fail to escape the fossil fuel economy. The world faces an ecological collapse, with drastic weather pattern changes and accelerating species extinctions. Nation states wither away and global trade plummets. To survive, engineer-minded citizens organise as local communities and solve environmental problems locally with a "do-it-yourself" attitude. Some communities are entirely self-reliant, and go off-grid.

Key trends in the present

- If current trends continue, the effects of climate change will be dramatic
- Species extinction is accelerating, which if continued will cause severe collapses in ecosystems
- Ecological values are becoming mainstream, as exemplified in Pope's climate change message
- Communal living is a strengthening trend among the youth

Weak signals

- Early warning signs make survivalist spirit an increasingly appealing choice
- Climate change is already underpinning emerging conflicts, which could lead to nations and communities closing their borders
- Local Do It Yourself solutions could prove more agile than large-scale projects in a world of natural disasters

Figure 8. Green DIY Engineers 2050 scenario.

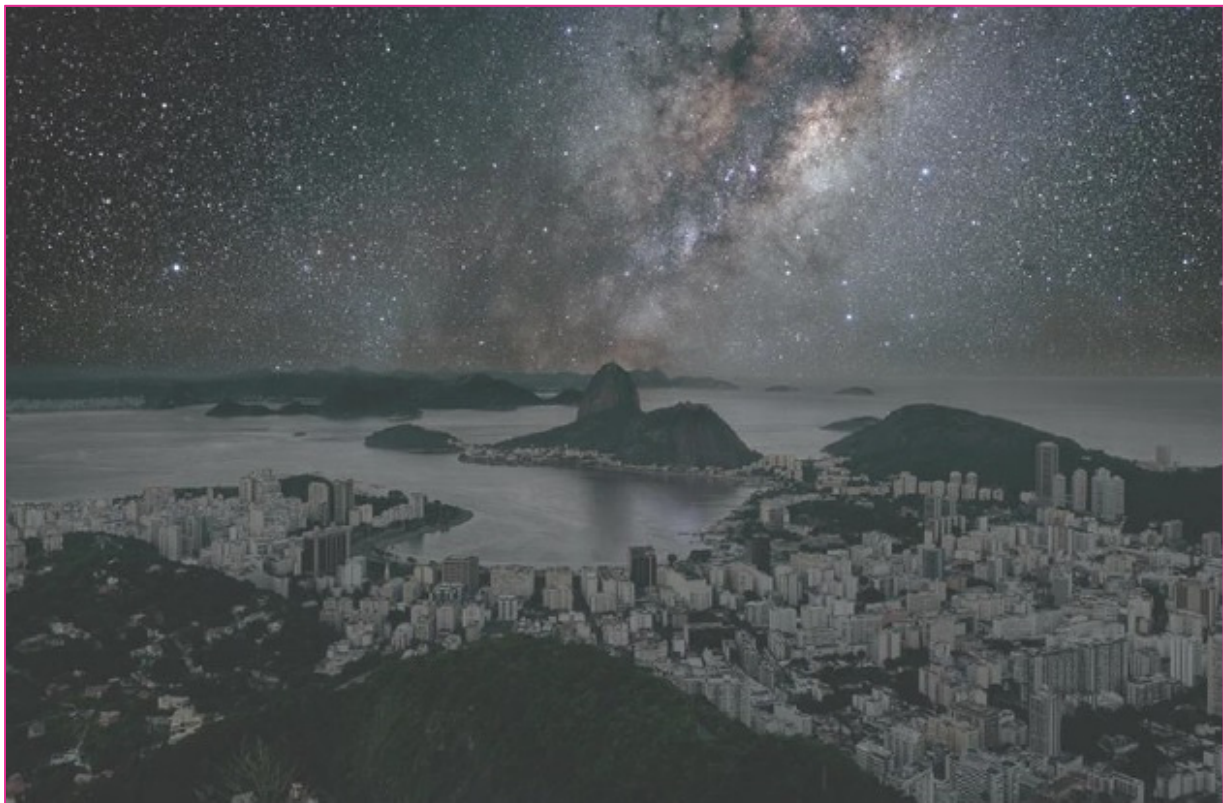


Figure 5. New Consciousness scenario (<http://www.wired.com/2014/11/thierry-cohen-darkened-cities/>).

New Consciousness

(Neo-Communal peer-to-peer & Pragmatic ecology)

Collective identities and values of deep ecology have replaced individualistic identities and values of self-benefit. Thanks to ubiquitous ICTs, people are deeply intertwined with other humans, and have become more emphatic towards nature as well. People see “everything to be connected to everything else”. The world is organised as open global collaboration of shared resources and information.

Key trends in the present

- People are increasingly aware of the drastic consequences if the climate change develops as it has thus far
- 24 % of US teens use social media “almost constantly”
- War and conflicts are increasingly boundless and ubiquitous. This could lead to a situation where peoples have to rethink their relationships, as was the case with previous world wars.

Weak signals

- Millennials (born between 1980 and 2000) are more tolerant and more oriented toward a cooperative foreign policy than their elders
- Falling marginal costs are paving way for a production based on “collaborative commons”
- Systems thinking is gaining ground at the expense of the “traditional” scientific paradigm to map out the complex connections between parts.

Figure 9. New Consciousness 2050 scenario.

3. NEO-CARBON ENERGY FUTURES CLINIQUE - PROCESS AND RESULTS

Futures thinking means addressing change and complexity. Before each futures Clinique, a futures provocation is made as stated earlier in Chapter 2.1. In this futures Clinique, the futures provocation emphasized that the whole concept of future is about change.(Heinonen 2016a). When exploring future possibilities, we are faced with changing circumstances, with the ever changing world. We are in a heideggerian state of becoming – this applies especially to technology and industrial development. Kelly (2016) reminds us that the things we will make in the future will be constantly, “relentlessly becoming something else”. Consequently, the future is very open – it is a wide-open frontier. We just have to visit it proactively in our thinking, in order to tackle obstacles and reach desirable and decent futures. This kind of provocation is intended to orientate the participants’ mind towards open futures – by co-creatively deciding on the pathways toward it.

By using the methods that were described in Chapter 2, the group work in this Futures Clinique proceeded in four work phases. In the group work of the Futures Clinique, each small group worked on one of the four Neo-Carbon Energy Scenarios (Radical Start-ups, Value-Driven Techemots, Do-It-Yourself Green Engineers, New Consciousness) to reflect the significance of this scenario to Chile in 2050. Each group was assisted by a moderator (Group 1 Linda Nerg, Group 2 Paula Castro, Group 3 Noora Vähäkari, and Group 4 Joni Karjalainen). The participants were instructed to discuss as well as write down their ideas on post-its, while presenting their ideas to others. After being handed the scenario descriptions, the groups started the work with the Futures Wheel. This was followed by a work on the PESTEC table. Black swans were used to test the scenario results. In the end, the groups presented their key results to other groups, as a summary of their work.

Futures Wheel

The Futures Wheel was worked with in multiple steps. First of all, **the participants were asked to imagine one thing that could be completely different in Chile in 2050 compared to the present day, if the society was developed like the group’s scenario describes.** So, each participant wrote at least one thing – for instance on living, housing, sports, values, politics – and placed it in the centre of the futures wheel. The purpose of this phase was to collectively begin the imagination of the future for Chile and the different elements and functions of that society. While doing this, the group also started discussing the model of a peer-to-peer based neo-carbon future and the significance of on-going changes, different developments, issues and trends for the group’s scenario.

The first circle of the futures wheel was **divided into three sections: i) energy, ii) companies and public organisations, and iii) citizens, customers, culture and values.** In the energy section, the participants discussed how a renewable energy powered Chile in 2050 could be, energy policy, carbon emissions, societal benefits, access to and ownership of technologies, and so forth, answering questions such as: *“What is the energy sector like? What technologies are in use?”* On companies and organisations, the groups reflected how organizational practices, management and leadership styles, working life and institutional power structures might change by 2050. They discussed: *“What are companies like? What do they produce?”* As for values, the participants outlined their views on citizens and reflected on: *“How do values change? What is the role of individual citizens? How are communities formulated?”* All the time, the group took note of the context of their scenario setting.

Then, on the second circle of the futures wheel, the groups continued the discussion by discussing and identifying actors that will be relevant and influential in their scenario in 2050. The participants were asked to identify contemporary actors whose role could be increasingly or less prominent or to invent and imagine entirely new actors. The actors, chosen in reflection with the three abovementioned sections, were analysed: *“Who are they or what are they like? Are there some new actors that we do not know about yet?”* **After all the circles were finished, the group chose a group of ideas from the futures wheel that they deemed interesting and important.** The group also tentatively summed up, if they considered their scenario and the ideas they had developed possible, probable, and desirable for Chile.

PESTEC and Black Swans

Following the Futures Wheel and the selection of the ideas, the group gave their futures image a working title. Based on this, they then started to discuss how their ideas can be realized in Chile. In doing this, the group emphasized the desirable aspects of this future. The chosen ideas were reflected by using the PESTEC table. To make the group’s ideas a reality by 2050, what should and could happen in Chile:

P = ...in politics and policies?

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

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

T = ...in technological development? What new technologies are needed?

E = ...in the state of the environment or its conservation?

C = ...in values and culture? What are the new norms and values of the prevailing or emerging in 2050?

After filling the PESTEC table, the groups identified in each of the six dimensions which in their opinion were the most important factors, and circled them with a marker. As a final step, the groups tested **the resilience of their scenario by identifying possible black swans – sudden, unexpected events with radical consequences** – that could challenge the future imagined by the group. They were also asked to come up with black swan events that could either promote their image of the future or collapse it. Such surprising events could emerge as an outcome of environmental or societal developments. In the end, **each group presented the main points from their futures wheel, the PESTEC table (title and one most important element from each dimension) and the black swans**, which were followed by a short commentary and feedback.

The following sub-chapters present the results of the futures clinique and each group's work. The futures wheels and PESTEC tables were documented as "carbon copies" of the paper sheets that the groups produced. Consequently, some ideas in the figures may not be exactly where a post-it was placed by the group. However, a textual analysis of the futures wheel and PESTEC table is included in this report, by using the audio recordings from each group's work and the groups' final presentations.

3.1 Radical Startups 2050 (Group 1)

The Group 1 worked on the scenario "Radical Startups" for Chile. Group members: Patricio Valdivia, Sallamarja Mäenpää, Paula Jadue, Javier Bustos, Marcela Araneda, and Jaime Alvarez. The moderator of the group was Linda Nerg.



Figure 10. Group 1 working on the Radical Startups scenario and the Futures Wheel.

Futures Wheel

Through discussion, Group 1 produced plenty of ideas on the futures wheel. Ideas on what is different in the year 2050 were written in the core. After the more general ideas about this future, the group started to think about ideas that are particularly relevant to the Radical Startups scenario. In the 1st circle of the wheel, the group discussed energy; citizens, customers, culture and values; and public and private organizations. In the 2nd circle of the wheel, the group imagined and discussed the role of actors. In the end, the group selected and clustered the most interesting ideas to be further developed in the PESTEC table. The futures wheel is presented in Figure 11, and the most interesting ideas that were selected are marked in purple.

The ideas that were added in the core of the futures wheel describe how the group's participants imagine the Chilean society to be by 2050. First of all, it was expected that environmental disasters could prevail and become even more profound. But at the same time, renewable energies could mainstream and environmental legislation could be improved. Urbanization and demographic concentration were expected to continue, and despite increased investments in social services and education, so would segregation and inequalities. The group perceived their ideas not only as possible, but even probable. This means that the ideas developed would not imply a radical change from the business-as-usual. However, the first phase of the wheel was meant to aid the participants to open their minds and think ahead, beyond of their typical perceptions, and the brainstorming continued in the later stages of the group work.

In the 1st circle, energy, public and private organisations, and citizens, culture, customers and values were elaborated in the context of the given scenario. With regard to organizations, more cooperation and openness was suggested. Open data and open governance would support more cross-sectoral work and multidisciplinary approaches, and this would shape the development of the society. It was deemed that transparency of decisions should be more open. Here, it is possible that due to the still relatively short period of democracy in Chile, the trust of citizens' for their government has not yet developed. Citizens would need to be informed of governmental actions more. The group argued that the government needs to push more investments on renewable energy and move beyond rhetoric when they discuss climate change mitigation. All in all, these abovementioned issues in the 1st circle emphasized the lack of trust across sectors.

The group saw that **in the 2050 scenario world, the knowledge gap between public and private organizations, such as universities and businesses, will be bridged.** With regards to citizens and culture, more ecologically aware and knowledge-based society was suggested. The use of technologies would substitute some behaviour that is today still conducted physically, such as shopping. While individualism would still prevail, also new type of local communality and shared community-

based identity might arise. Because people are aware of the consequences of their actions, they can make informed and sustainable daily choices.

On energy, the most interesting ideas included renewable energy uptake and Chile as a knowledge and technology-based society (particularly on different renewable energy technologies). The group suggested that a conflict of interest economically will deepen the development gap between Chile and its neighbouring countries by 2050. There will be a definitive run-down for fossil fuel based technologies and businesses, when Chile becomes a renewable energy (RE) hub of the continent. There was a consensus about this between the group members, and no alternative or distinctive options were raised. Interestingly, the focus on radical startups, or a breakthrough of the startup scene in general here is not very evident.

In the 2nd circle, actors in this scenario include for example CORFO¹¹ universities, ministries, renewable energy agencies and associations, innovation centres and companies. There will also be companies that are focusing on recycling business. All in all, the ideas on actors in this scenario are rather probable and conventional, yet they are positive. However, supportive authorities or institutions in regards to the development of a startup culture were not evident in the discussion.

¹¹ CORFO is somewhat similar to Tekes - the Finnish Funding Agency for Innovation in Finland.

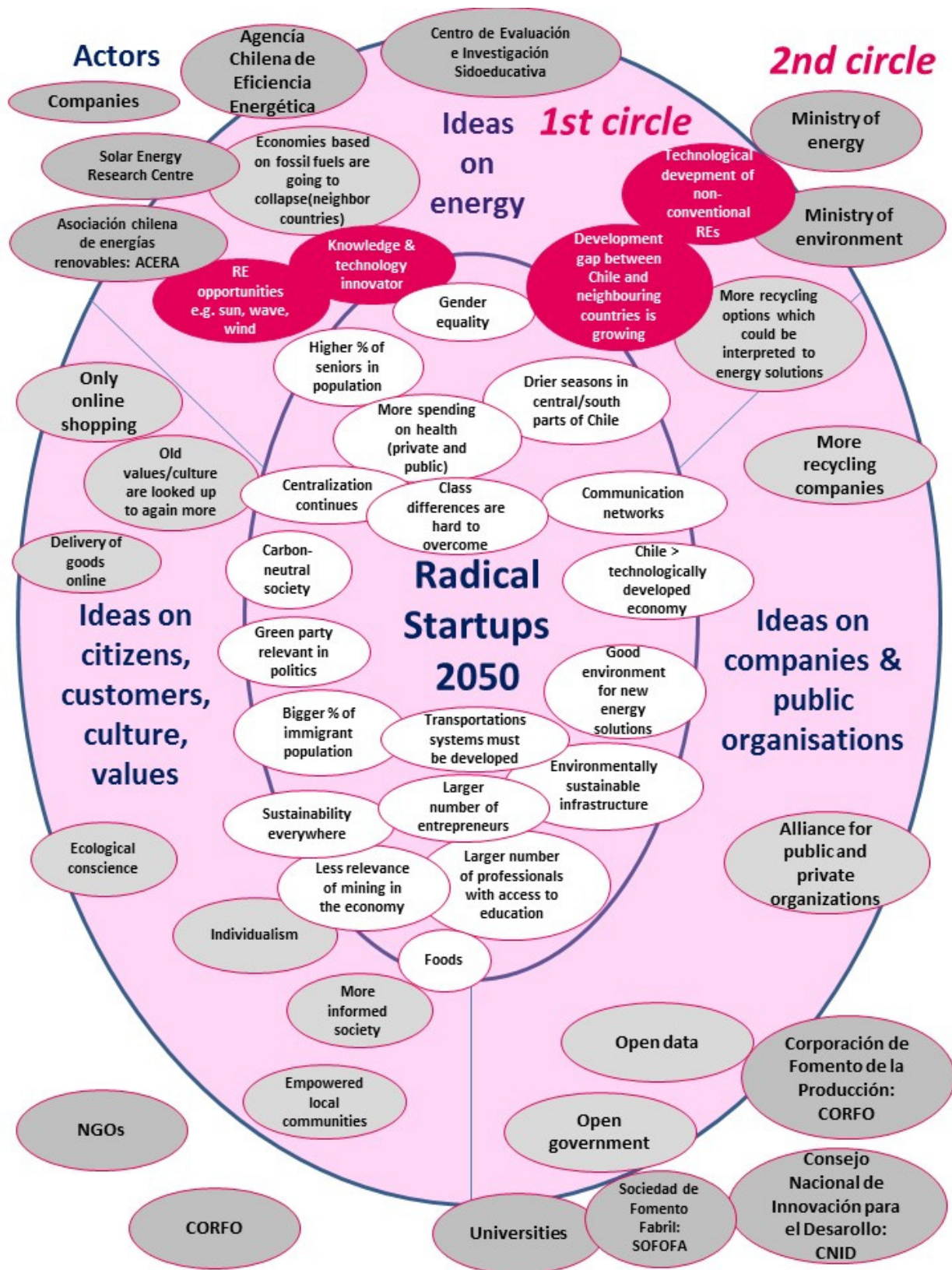


Figure 11. The Futures Wheel of the Radical Startups 2050 scenario for Chile

PESTEC Table

In the PESTEC table, the most interesting or potential ideas from the wheel are elaborated further in six dimensions; political, economic, social, technological, environmental and cultural. In the end, they were combined as an overarching topic to create a specific image of the future, based on the scenario given. First of all, key political phenomena or trends included decentralization of political power, international cooperation, and public investments in innovation. **Trust in renewables in the political field was considered as the most crucial aspect in enabling this scenario.** Economically, decentralized energy production was judged as the most feasible option. At the same time, investments in technological development and reducing costs were seen as important. **Decentralization of energy production supports a more equitable distribution of wealth and opportunities, and therefore makes an integrated society a possibility.** Technological development and state-level support for renewables at the same time assumes, and supports, the valuation of human capital. Regarding the state of the environment, a thorough understanding of what is the baseline situation of environmental health is required. This image of the future comes down to collaborative work and shared trust, which implies a key cultural shift of values and attitudes.

Table 1. The PESTEC table of Group 1 was called "Decentralized energy for the people".

PESTEC	2050 Decentralized energy for the people				Surprise factors / Black swans
P olitical	Public investment in R&D & innovation	Political decisions to invest on renewables	International alliances	Political decentralisation	Mandatory global rules for climate change (i.e. carbon tax) Cost-effective storage for energy Climate change catastrophe
E conomic	Financing new technologies and projects	Reducing the costs of transaction and scale		Decentralized energy will be more convenient than centralized	
S ocial	Social acceptance of resiliency and energy independency	Social acceptance (e.g. Nimby effect)		More integrated society	
T echnological	Diffusion of information and knowledge	Technology transfer	Human capital (local & foreign)	Focused technological development	
E nvironmental/ E nergy	Recognize and accept trade-offs			Recognize and actualise baselines	
C ultural/ C ustomer/ C itizen	Collaborative work	Reach critical mass of people and ideas		Better tolerance of risks and uncertainty	

Black Swans

The group identified three black swans as potential future events that could be unforeseen. The first two would support a positive change and the last one an utter climate disaster with impacts that are unforeseeable to this scenario. The first black swan, **a mandatory global carbon tax could boost the uptake and production of decentralized renewable energy in particular, and be beneficial for individuals who are willing to invest in it.** Even countries that still struggle with emission mitigation would have an incentive to transform the basis of their energy economy. The second black swan was the development of cost-efficient storage for solar energy (e.g. lithium batteries), which would provide another global export product for Chile. However, as a third black swan, it was feared that climate change impacts could undo many of these critical developments. An example of this would be if, for instance, the Atacama Desert was to become unbearable to live, and consequently, inhabitable.

Reflections

The development of a **startup culture and a supportive policy environment enabling new small business did not dominate as a main feature of the discussions** over the scenario. Chilean markets have not accustomed to the trend, even if the attitude towards them is largely positive. The focus in the group discussion shifted to the development of the national renewable energy sector and efforts for climate change mitigation on a broader scale. The impacts to the sensitive ecosystems that feature Chile are a significant concern of citizens. **A general message was the group's consensus to make the public and private sector actors to work more towards the benefit and wealth of the entire society.**

The group also raised a challenge to the scenario. Regional integration in Latin America is far from what it is for example in Europe, and the isolation of Chile from the rest of the continent was raised as a concern. This is one of the rationales behind the objective of economic diversification and renewal of the dominant copper markets. This is a sensitive topic that feeds differentiated opinions, and no one clear answer was provided.

In general, working in Spanish made the participation more accessible and equitable. The discussion highlighted the variety of opinions and challenges that policy makers face in seeking compromises to identify what are the best development paths for Chile.

3.2 Value-Driven Techemoths 2050 (Group 2)

The Group 2 worked on the scenario “Value-Driven Techemoths”. The group members were Grecia Perez de Arce, Nicola Borregaard, Felipe Welch, Diego Lizana, Susana Coper, Carlos Finat and Tomás Gómez. The group was moderated by Paula Castro.



Figure 12. Group 2 reflecting the significance of Value-Driven Techemoths 2050 scenario for Chile.

Futures Wheel

Group 2, the “Value-Driven Techemoths 2050” scenario, first produced ideas on what is different in the year 2050 in the core, and then moved on to think of ideas particular for the scenario. At first, they discussed the issues of energy; citizens, customers, culture and values; and public and private organizations, and in the end, the role of key actors for their scenario in future Chile. The most interesting ideas were clustered, and then further developed in the PESTEC table. The futures wheel of Group 2 is presented in Figure 13. The most interesting ideas have been marked in purple colour.

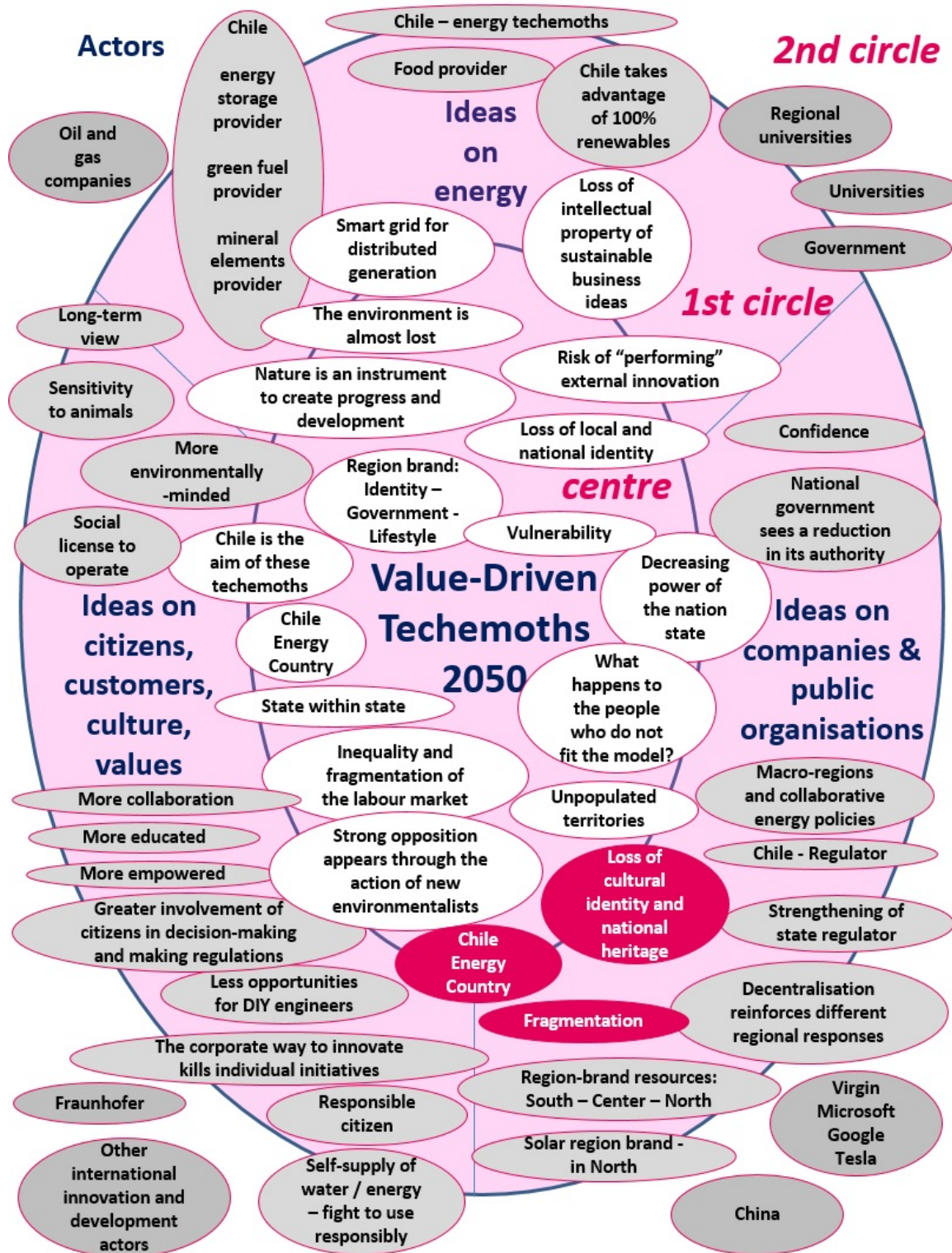


Figure 13. The Futures Wheel of the Value-Driven Techemoths 2050 group, reflected and discussed for Chile.

Out of the ideas invented in the centre of the wheel, the group found three ideas to be of high interest or importance for this scenario. These issues were Chile profiling itself as an Energy Country, the loss of cultural identity and natural heritage, and the issue of social fragmentation. To begin with, the group expected that Chile could use high shares of renewable energy sources, and in this scenario tailor their

use regionally, and also accordingly be able to “brand” its regions. These ideas, and values overall, would also be expressed through lifestyles. However, it was feared that in a market-driven world, environment would be instrumentalized and subjected to the goals of “progress and development”. Therefore, despite the high uptake of renewables foreseen for the future to address energy challenges, environmental quality overall could still be seriously degraded.

Chile would be the subject of large foreign companies who would be perceived like states inside a state. As the Chilean government would have less power than before, the state regulator would need to be strong and citizens would have to be more closely involved when new regulations are formed, to realise this future in a positive way. **A world driven by such tech companies could make life rather difficult for the do-it-yourself type of initiatives. Because corporate innovation tends to control intellectual property rights (IPR), it would block open innovation and kill initiatives of enthusiastic individuals.**

Although discouraged of experimenting, citizens would still be increasingly collaborative, educated, empowered, and long-term-oriented. All in all, the Chilean society would be more responsible, conscious, environmentally-oriented and increasingly sensitive to animal rights. In similar fashion, educated citizens would also demand the large companies to have a “social license to operate”. What would remain problematic, though, was the fact that the dynamics of inequality of income or opportunity would not really be solved. **There would be differing opportunities in the labour market – plenty of room for imagination for those inside the large technology companies with their extensive resources, but few for those who do not work for them.**

Energy-wise, Chile would position itself as a regional leader and take advantage of being 100 percent renewable, thanks to these energy techemoths. Chile would have smart grids that enable distributed generation. This energy mission could be **reinforced with different regional responses, as each region in Chile would brand itself differently.** This is already happening thanks to the robust solar resources in the north of Chile. Chile would produce green fuels, energy storages, minerals, and food.

In Chile, this **regionalisation could imply a strengthened role of regional universities.** The role of foreign stakeholders in the energy transition would be significant. The main collaborators and partners would include China, international technology companies (Google, Microsoft, Tesla, Virgin), as well as foreign (energy, innovation and technical) experts like Fraunhofer ISE from Germany. Undoubtedly, the actions of oil and gas companies, too, would have a significant role in shaping this future. There would also be space for new actors, in part due to the fact that the central government would have less power than before.

PESTEC Table

Table 2. The PESTEC Table of Group 2 called "Chile - The Power of Energy" for 2050.

PESTEC	2050 Chile – The Power of Energy				Surprise factors / Black swans
P olitical	Agile state with capacities in futures thinking	Decentralisation of the central government	Empowering local government	Participative policy-making	<p>Unexpected negative consequences of climate change on renewable energy sources</p> <p>Lost opportunity – another country leads intelligent networks</p> <p>Another type of energy production (nuclear fusion)</p>
E conomic	Long-term economic planning and policy	Diversification of productive structure	Companies must aim to achieve social license in order to operate		
S ocial	Shared value	Active, inclusive participation with impact	Empowered citizens	Fragmentation – Inequality of opportunities	
T echnological	Incentives applied R&D oriented to energy	Appropriated technologies	Electrification of mobility and heating, cooling	Distributed generation	
E nvironmental/ E nergy	Strong environmental requirements, including on carbon-neutral country				
C ultural/ C ustomer/ C itizen	Long-term thinking in the educational system	Trust	Other system of actors who take decisions	Citizens' interest groups Loss of cultural identity and natural heritage	

In its PESTEC table, the Techemoth group’s members focused on the desirable future for Chile, and especially discussed its future image from a political perspective. The group envisioned an agile state that, thanks to its capacities in futures thinking, would be able to serve its people to really meet their needs, and concluded that such **a state would have to be able to act as a balancing force against the self-interest of big companies**. This signifies that the group had doubts of the value-drivenness of the private sector. As regards large companies, they would have to be genuinely committed to their values to be able to convince the broader society and earn trust. Only in such a mode of operation, shared value would be created for the entire society. Still, to an extent, it was feared that cultural identity and natural heritage are lost because of the power of foreign companies.

Thanks to decentralization, local governments would have more power and policy-making would be more participatory. The group hoped that over time, Chile’s long-term economic planning, aided by supportive policies, would diversify Chile’s economic structure. There would be more sectors that make a significant contribution to national wealth creation. Nevertheless, inequalities of opportunities would be part of this corporate-driven world. However, as citizens would be increasingly educated and

empowered, they would voice their opinions through interest groups. A contentious issue was the group was the role of trust, how it can be obtained and maintained culturally.

Strong environmental requirements would drive market development, including a political vision of Chile has a carbon-neutral country. In the energy sector, distributed generation would be the norm. Mobility, the cooling and heating sectors would all be electrified. Research and development (R&D), and the development of the sector through incentives would together expedite the adoption and development of renewable energy technologies.

Black Swans

The group invented three black swans for Chile's techemoth future. First of all, **unexpected negative consequences on climate change** could have unanticipated impacts, even for the use of renewable energy resources. A second unexpected black swan, anticipated by the group, was **competition. It was imagined that another country becomes a renewable energy leader instead of Chile, and the country is left wondering what might have been.** Thirdly, **another type of energy breakthrough**, such as that of nuclear fusion, could either collapse or further expedite a revolution towards the increasing use of renewable energy resources.

Reflections

The initial reference for the group to start working on this exercise was the example set by large globalised social media and internet companies like Facebook, Apple and Google. The application of a model of Value-Driven Techemoths to Chile proved difficult at the beginning of the group work because the participants, and most people in Chile, see those companies as settled and operating from developed countries in the Northern Hemisphere, rather than from a remote, small, less developed country like Chile. In order to spark the imagination of how that model could take shape in Chile, the group discussed this scenario by using the example of a well-known reality in the country. In Chile, a few traditional families own a variety of big businesses such as supermarket chains, department stores, banks and airlines. These families have become powerful economic actors, almost institutions themselves. Consequently, when their actions were imagined into the future, it was seen that they could resemble or behave like value-driven techemoths. These families have accumulated enormous wealth, and therefore may acquire stronger and deeper influence in aspects such as social relations and lifestyle than ordinary citizens.

Among the participants of the group, **this scenario was perceived very negatively for Chile and for the world.** There were concerns especially for the future and understanding of concepts such as democracy, sovereignty and the nation-state. The idea of companies having such a strong influence

on so many dimensions of people's lives, from the most domestic aspects up to their values and culture, was seen as worrisome and discouraging. The threat to identity, at several levels – individual, local, national, et cetera - was a major concern for the participants, when they described Chile in 2050 under this scenario.

3.3 Green DIY Engineers 2050 (Group 3)

Group number 3 worked on the scenario “Green DIY Engineers”. The group members were David Pozo, Rosana Brantes, Claudio Huepe, Patricio Bofill, Ángel Caviedes, and Leonardo Ramírez. The group was moderated by Noora Vähäkari.

Futures Wheel



Figure 14. Green DIY Engineers group working on their Futures Wheel.

Group 3 produced ideas on what is different in the year 2050 in the core, then moved on to think of ideas particular for the Green DIY Engineers scenario. In the 1st circle, the group discussed energy; citizens, customers, culture and values; and public and private organizations. Then the members moved on to discuss the role of actors and placed them on the 2nd circle of the wheel. The most interesting ideas were discussed and clustered, and further developed in the PESTEC table. The wheel is presented in Figure 15, and the most interesting ideas elaborated further are marked in purple.

In the centre of the wheel, where each member of the group produced their own initial ideas about the Chilean society in 2050, numerous ideas were presented. These included both negative and positive phenomena, such as carbon dioxide emission reductions and stricter climate change legislation, pollution taxes and more distributed wealth and equal opportunities among citizens. However, also dense urbanization, desertification, water scarcity, and large environmental problems were addressed. Artificial intelligence, robotisation, local sustainable food and energy production, and alternative economic structures were considered as possible alternatives. Brainstorming these general ideas on the societal change in 34 years' time was primarily challenging, but it paved the way for the second phase of the work.

In the 1st circle, discussion moved towards the actual scenario, yet **participants found the fundamental idea of localization in the Chilean context somewhat challenging**. Initially in the Green DIY Engineers scenario, if global population was affected by the systemic adverse effects of climate change and ecological crisis, people would live increasingly in small communities instead of cities or nation-states. According to the participants, localization and moving back to smaller communities is not likely in Chile where urbanization rate is extremely high, and Santiago Metropolitan Area inhabiting almost half of the total population of the country. The group found it difficult to wrap their heads around the thought of decentralized and self-sustaining populations and small tribes. Thus, **the group agreed to an idea of smaller communities and towns where services would still be provided by some sort of, yet not conventional, authorities**. Communities would be constantly challenged by immense environmental disasters, as the society would be still bearing with the consequences and actions of the previous generations. In the Green DIY Engineers scenario, energy consumption and demand is low, it is produced locally, affordably and sustainably with new technologies and storage possibilities. The Chilean mining resources offer an abundant potential for developing an industry around energy storage and batteries due to vast lithium reserves. The idea of a new type of communality that is thriving from the sense of shared location and shared needs and challenges would emerge. **Sustainable lifestyle choices would be built into the new culture of living**. Simultaneously, technical innovations to tackle water scarcity and everyday-life issues will be evident. In organizational level, there is definitely more need for local solutions and grassroots activities. Research will need to bind with business in order to tackle local issues. New, completely independent organizations will emerge as a response to fill the gap between public and private institutions that seem too distant to the everyday challenges, particularly in rural areas. Due to decentralisation of people and industries, also the former centralized government and administration model would start to crumble. **In order to businesses and research to really respond to the local challenges, energy would need to be available and affordable to everyone despite of their location**. Inequality will be addressed through local production and educated, innovate people contributing to the common good.

In the 2nd circle, the group identified essential actors in the scenario in all three abovementioned sectors. The group struggled with coming up with new very radical actors, as the circle mainly constitutes of various ministries, universities, research and innovation institutions, foundations and existing authorities and companies. Of course, co-working across sector boundaries and institution types is encouraged, and new era cooperatives and consultancies open up to address the regional and local needs and challenges. Multi-disciplinarity in approaches and stakeholder engagement, as well as unorthodox ways of cooperation support successful solutions to the emerging issues.

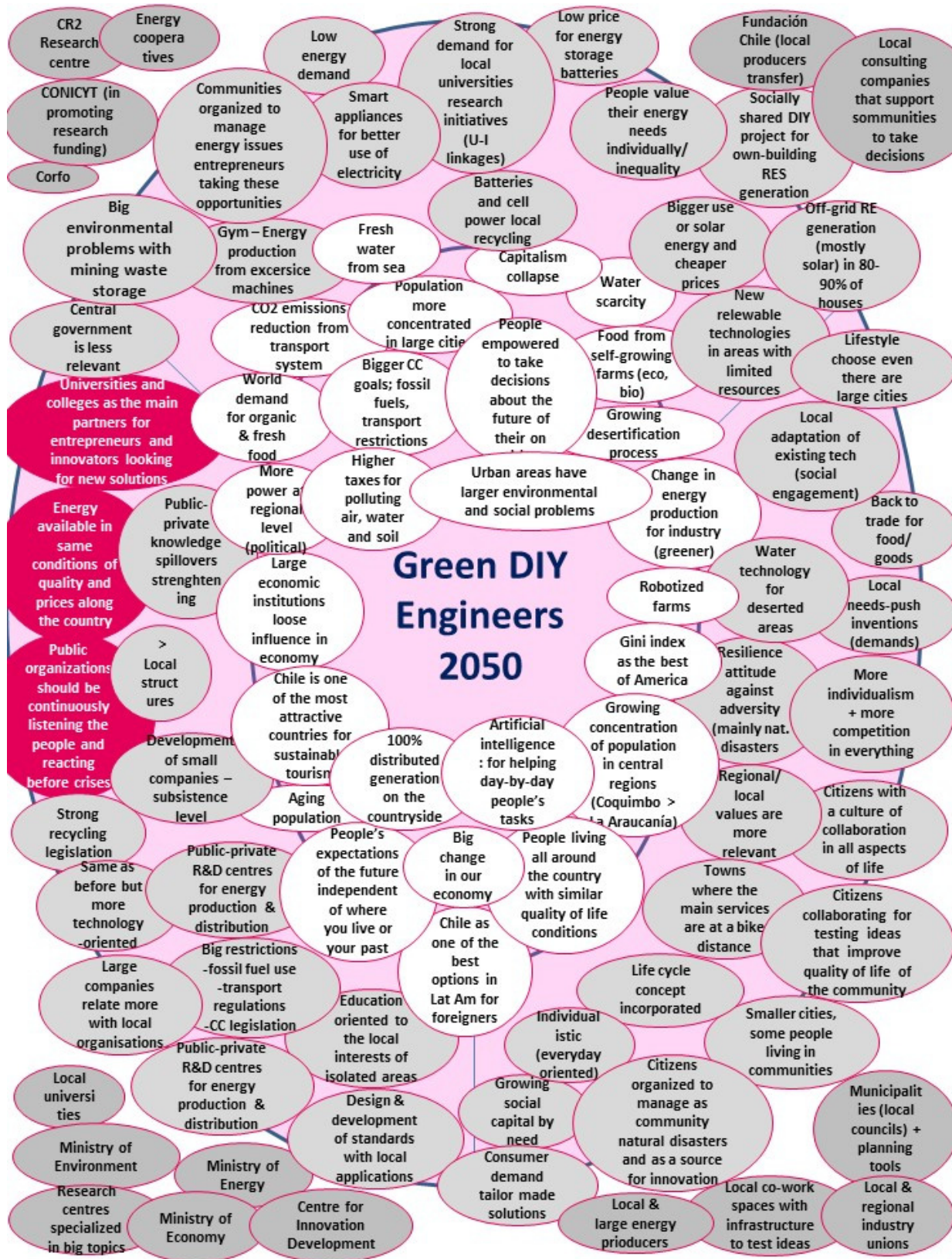


Figure 15. The Futures Wheel of the Green DIY Engineers group, reflected for Chile.

PESTEC Table

Table 3. The PESTEC table of the Green DIY Engineers group called "The bridge for a new mindset"

PESTEC	2050 The bridge for a new mindset		Surprise factors / Black swans	
P olitical	Institutional setting: bridge & bonding by actors (better rules and better coordination and cooperation)	Laws, regulations, incentives specific for clean energies (solar)	Lithium breakthrough Grafeno/Graphene (copper substitute)	
E conomic	Start-ups outsourcing medium/large companies	Economic incentives to produce this (renewable) energy		
S ocial	Get regional universities to work on local issues: -R&D initiatives -Education & training -knowledge transfer	New institutions working close to universities and local needs development.		Empowerment of local communities as an industrial location factor (usually it is an invisible factor until social-industry tensions)
T echnological	Proactiveness exploiting/developing local technologies	Energy storage systems that enable renewable energy distributed generation based on variable sources		
E nvironmental/ E nergy	Deal with environmental issues not as a barrier but as an opportunity for innovation	Re-value the local aspects of natural resources in order to organize a multilevel regulatory system		
C ultural/ C ustomer/ C itizen	Develop confidence between actors involved in the process of new ideas	Need of a new mindset involving trust, bravery, failure...		

In the PESTEC table, the most interesting ideas from the wheel were chosen and elaborated further. The ideas translated into key principles from which the scenario was developed further in the Chilean context. The key ideas were presented in the Futures Wheel in purple, and are now summarized as the title for the table; "The bridge for a new mindset". The title underlines the prerequisite for such a society to take place in 2050, as the **bridging of sectors and actors is crucial together with acceptance, adaptation and development of a new radically different mindset of how the society functions**. In the table, the participants were asked to fill in ideas in the framework of what the newly constructed scenario allows. To gain a comprehensive understanding of the society, all dimensions from politics to culture were to be filled. Again, the most interesting or suitable ones were collectively chosen and marked in purple. These now formulate a path of how the Chilean society, comprised of multiple mini-societies and communities, would look like and function in 2050 in the given scenario. All the provided ideas emphasize the **development of a society where local technological innovations and grassroots empowerment together with corporate support aid the transition and domination of decentralised renewable energy**. What came up as a critical factor in this sense was the

fundamental lack of trust in fellow citizens, authorities, and businesses. The current and prevailing socio-economic inequality and level of corruption manifest this challenge. The participants also stated that Chileans have a small-country personality – unambitious and downplaying – and barely trust their own ideas to take up. **Building up collective trust and courage is a cultural factor crucial in this scenario**, and in any positive development objectives.

Black Swans

Due to very minimal time towards the end of the working session, the group identified two black swans that would interrupt, exhilarate or devastate the given scenario. The first one is a global lithium breakthrough in the development and production of sustainable and efficient energy storage systems, such as batteries for solar energy. This would be beneficial for Chile, as it could create a whole new market segment and export product. The other black swan would also instigate a major surprise for Chile. Graphene is a synthetic copper product that, if hit the global markets in a massive scale, could ensure the death for the Chilean copper dominance and undoubtedly cause a national economic shock.

Reflections

The group expressed that the given scenario description did not apply to the Chilean context as such, and it was given the opportunity to tailor it according to its best understanding of what would be possible and preferable in the country by 2050. Flat, non-hierarchical subsistence economies were replaced by **low-hierarchy communities where authorities are close to citizens and serving their purpose primarily**. This societal structure is also reflected in the way in which everyday engineering is perceived: **not all citizens would be household-level tech geniuses, but decentralised energy solutions and recycling would be made easy for all to use**. The group opted not for the abandonment of the norms and structures of today but considered it more feasible to adjust the society to the given setting and environment. The needs are there and the resource scarcity is there. The existing functions and actors have been transformed to be more participatory and human-centred, and less bureaucratic and distant. **The fundamental role of trust and social integration are the prerequisites and consequences of cultural change that are necessary in enabling such a scenario**. The group also discussed the tolerance for failure, which is a very humane and necessary feature for an equitable society. Finally, the introduction of graphene is not necessarily a challenge for the Chilean society – in a localised DIY Engineers world the major pillar for the national economy (copper) loses its significance inevitably, but new substitutes could open up more affordable and efficient solutions to energy transmission, communications and so forth.

3.4 New Consciousness 2050 (Group 4)

Group 4 worked on the scenario "New Consciousness". Group members: Mauro Tesei, Carla Alvial, Raúl Frías, Marcelo Ramírez, Soledad Quiroz, Waldo Bustamante, Leonardo Muñoz. The moderator for the group was Joni Karjalainen.



Figure 16. Group 4 reflecting the New Consciousness 2050 scenario for Chile.

Futures Wheel

The group produced the following ideas through discussion on the futures wheel. Ideas on what is different in the year 2050 were written in the core, and ideas particular for the New Consciousness scenario. After this, the group discussed questions concerning energy; citizens, customers, culture and values; and public and private organizations. The role of actors was discussed in the 2nd circle of the futures wheel. In the end, the most interesting ideas were discussed and clustered, to be further worked on in the PESTEC table. The wheel is presented in Figure 17, and the most interesting ideas elaborated further are marked in purple.

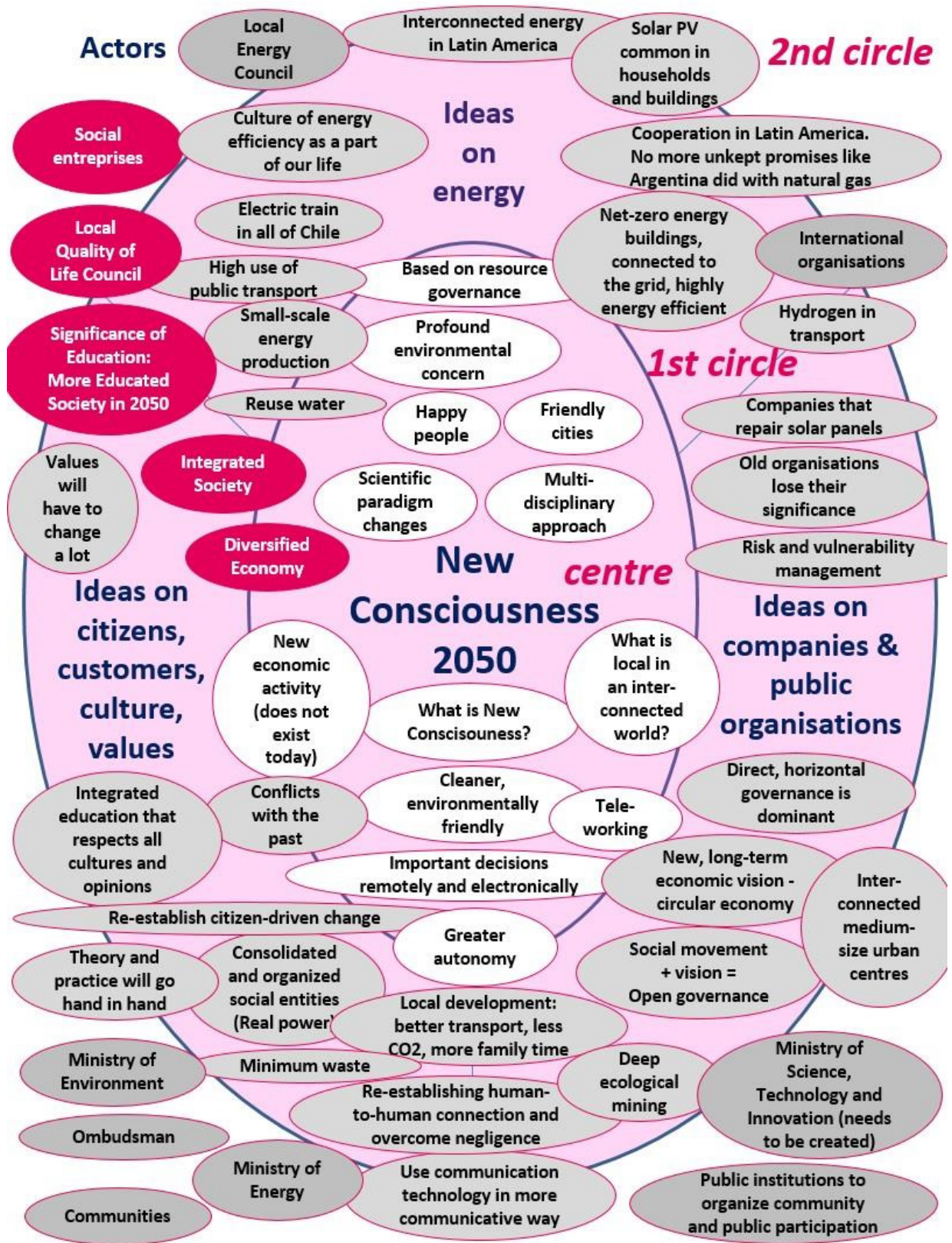


Figure 17. The Futures Wheel of Group 4 on New Consciousness scenario for Chile.

Based on the New Consciousness 2050 scenario for Chile, the group concluded **an integrated society with a diversified economy** as the most important goal. Concerning citizens, it was also recognized that in this scenario values will need to change significantly to a more profound respect to ecological limits. The group members were a bit sceptic on whether such profound ecological consciousness can be achieved, but saw it as a very important issue. A key enabler would be **Chile having a more educated society in 2050** where all cultures and opinions are respected. **Chile, which has a difficult political history, would need to re-establish a level of citizen-driven change.**

A worldview shift towards consciousness could be supported by a change in the overarching scientific paradigm. Here, theory and practice also go better hand in hand. As for values and practices of daily life, citizens' autonomy increases. Citizen-led change for consciousness could be achieved with a vision, social movement and practices of open governance. But in the era of social media, **re-establishing the connection between human beings would require the use of communication technology in a more communicative way**, to overcome the habit of negligence, not paying attention to what others do. One group member wondered what this new consciousness actually consists of.

By 2050, a culture of energy efficiency and minimum waste has surfaced. Small-scale energy production, including solar photovoltaics are common in all households and highly efficient net-zero buildings. Cooperation on energy issues in Latin America was seen as an uncertainty, with Chile having negative experiences in the recent past in fallen gas agreements with Argentina. While such issues could logically make Chile favour energy independence, **in the New Consciousness future it was seen that the cooperation in the energy sector in the continent would somehow deepen.**

In listing ideas on companies and public organisations, it was anticipated that old organisations lose their significance. **Direct, horizontal governance becomes increasingly prevailing.** Chile, which is now known as a mining country, would even have **deep ecological mining**. Companies will be increasingly tolerant for work-life flexibility. If development can be more local, the CO₂ emissions could be reduced by working remotely from home to reduce unnecessary transport and traffic jams. As this scenario is a mesh of a global, empathic vision and high interconnectedness, an interesting question was raised, namely: what remains local in a deeply interconnected world?

In the 2nd circle, key actors are listed. The participants emphasized the significance of **social enterprises, Local Quality of Life Council** and **Local Energy Councils**. These Local Energy Councils could support the prosumerist revolution. There are also companies that repair solar panels. As a new organisation, **Chile was recommended to establish a Ministry of Science, Technology and Innovation**. An Ombudsman could represent the interests of the public and address any complaints, mismanagement, or breach of rights. The Ministry of Energy and the Ministry of Environment have an important role.

PESTEC Table

Table 4. PESTEC table of Group 4 on “Integrated and Diverse Society” for Chile in 2050.

PESTEC	2050 Integrated and Diverse Society					Surprise factors / Black swans
P olitical	Local councils for life quality improvement	Binding, horizontal tools of engagement	Human capital	New indicators of the economic value of development	Expansive laboratories in education	Climate change catastrophe Anarchy
E conomic	Sustainability focused business models	Economic diversification	Social enterprises Industry	Strengthened local economies	Long-term industrial economic development plans	
S ocial	Integrated society	Education at the heart of social development	Social entrepreneurship	Universal access		
T echnological	Open data on biology and resources	Democratic access to technology	Citizen laboratories	Development of ICTs for education	Attractiveness Capturing knowledge	
E nvironmental/ E nergy	Energy technologies with low impacts	Extended, comprehensive liability	Environmental monitoring and remediation	Standards Restrict polluting technologies	Residues as resources Zero-waste	
C ultural/ C ustomer/ C itizen	Appreciation of science, experiments, and reflection	Appreciation of diversity	Rapprochement of regional cultural development	Capacity for dialogue Tolerance	Integration of economic studies with socio-cultural visions	

In the PESTEC phase, the group worked to focus its futures image for Chile, and chose to focus on an **Integrated and Diverse Society 2050**. Politically, there will be horizontal tools to engage citizens that bind the state policy-making. New indicators express what is in the future understood as the value of “development” and align the field of economics with socio-cultural visions. The human capital is higher than today. Local councils for life quality improvement ensure livelihoods are improved. Chile’s economy in 2050 would be diversified, and driven by sustainability focused business models that drive a long-term economic development plans for industrialisation, epitomised by socially-minded companies. This drive for a more integrated society has been driven by education and universal and democratic access to technology, culture and science. This is supported by information and communication technologies (ICTs) in a meaningful way.

Environmentally, **organisations and companies carry an extended, comprehensive liability of the environmental impacts of their actions**. This is supported by standards and environmental monitoring that ban polluting technologies that restore environment to a good condition. The energy technologies in use also have low environmental impacts. Culturally, diversity is cherished – the society

has a capacity and tolerance for dialogue, reflexivity and experimentation. Citizens can experiment in laboratories, and there is open data on bio and resources.

Black Swans

As black swans, the group discussed two issues. The social dynamics of the increasing autonomy and horizontal decision-making. One unexpected **consequence as an extreme manifestation of a peer-to-peer society could be a certain type of anarchy or chaos**, if old hierarchies were to erode and there would be no novel institutional structures that emerge to replace them. Another possibility, one which collapse the positive trend towards emerging consciousness would be the **climate change catastrophe**. This could be interpreted to signify that value change emerges too late.

Reflections

The group considered that a value shift towards new consciousness would mark quite a change from the Chile of today. In recent years, ICTs and social media seem not to have increased the virtues of civic consciousness and collective action, but they were perceived to have rather increased the distance between human beings, each in their own corner of society, and even exaggerated negligence. Therefore, a culture of peer-to-peer, citizen-driven change was considered a challenge. As one remedy, horizontal and enabling modes of political participation, including e-participation, to bring democracy back to the people were suggested. However, transforming political structures cannot typically be resolved with technology alone. It requires a deeper cultural shift towards civic engagement.

Chile's political history paints quite a particular context for such discussion. The coup d'état of Salvador Allende's democratically elected socialist government in 1973 was followed by a right-wing military rule, which lasted until the year 1990. In Chile, the past couple of decades have marked an era of steady economic growth and increasing public spending into social welfare programmes, including education. Nevertheless, the neoliberal thinking is an intellectual undercurrent that influences Chile's political discourse even today. Therefore, a peer-to-peer future of a diverse and integrated society is an inspiring ideal, but at least two observations can be made. Firstly, certain caveats would have to be acknowledged in a process of cultural learning towards such modes of collaboration. This emphasizes the issues of integration, inclusiveness, and trust, which were mentioned also in group 4's work. Secondly, a bottom-up transformation towards 100% renewable energy implies that ownership models, too, are community-driven, and without such a social mood, it is more likely that technological change is dominated by large economic players. It could, therefore, make sense for the social movements to think of open initiatives for adopting renewable energy more locally in a peer-to-peer fashion, to direct the economic gains of these emerging technologies for local or regional purposes. Perhaps this could be expedited with appropriate educational modules that encourage universal access to technology (something mentioned by the group), for all citizens.

4. CONCLUSIONS

In this report, we have discussed a neo-carbon powered future – based on 100 percent renewable energy – for Chile, with the aid of four transformative socio-cultural scenarios, each of which depicts a different kind of a transformation pathway for the country by 2050, and through the results of the Futures Clinique. An analysis of the Futures Clinique results suggests that local cultural, social and institutional factors are crucial in regards to the applicability of such scenarios in the new context. Furthermore, desirable outcomes can be reached, if they are supported with a conducive political and economic environment and related decisions. By using the transformative scenarios as a basis for debate, it was possible to identify in parallel both opportunities and challenges regarding energy transition, as well as single out special issues pertaining particularly to Chile.

Certain scenario elements or issues were considered unsuitable to the Chilean context. A scenario setting was deemed somehow unfit or considered challenging in the larger setting of people's values or behaviour. In other issues, consensus was found more easily. A potential scenario with the dominance of large companies, coined in one of the scenarios as "value-driven techemoths", if underpinned by inequalities, was unanimously considered a negative state of affairs. In turn, the Green DIY scenario narrative suggests social sprawl into small communities and tribe-like societies as a result of a continuum of environmental disasters. This was not perceived as a probable (or even a possible) future because centralized mode of living is so profoundly a part of the Chilean culture today. Such observations are important because they also reveal some of the issues that are not being questioned at the moment.

Value-driven change towards deep ecological consciousness was seen to require a lot of work. However, because of the magnitude of the challenge, it was also considered important. Too pragmatic an attitude would inevitably subject the environment to the ideals of "progress". This is a useful remark, considering a scenario where high shares of renewable energy are adopted in the coming years for reasons that are not solely environmental. All energy technologies have environmental impacts and unless they are considered, it is unlikely that environmental protection will be maximised. When the participants spoke of a value-driven change, they did not only address the environment and its protection. They also underscored the significance of transforming social dynamics, and the necessity of creating a culture of cooperation, trust and working together across sectoral or institutional interests. Lack of trust, either as a reflection of societal structures of today's Chile, or related to personal motives, hinders the uptake of new innovations or changing habits.

Collaboration across sectors and multi-disciplinary approaches are necessary when tackling complex issues, and this is something that needs to be addressed in the Chilean society, decision-making and economic life. It is even possible that a peer-to-peer society cannot function properly without the

fundamental aspect of trust and respect to one's fellow citizens and public organisations. This is a important consideration, when thinking of the prerequisites for the realisation of the scenarios in general. If a neo-carbon energy society, where energy supply is decentralised and production accessible to all citizens alike is to take foot in the coming years, the Chilean society will need to ensure collective trust between the enabling and regulating authorities, and their citizens as fellow prosumers.

It is intriguing how the scenario exercise in the Chilean context discussed the issues of energy production and distribution in a very coherent and unified voice with fairly little emphasis in the technologies or the sector development itself, but concentrated largely on the broader socio-economic phenomena such as inequality, the diversification of the country's economy, or values and culture of cooperation. This underlines the complexity of energy as a topic per se, and even more the complexity of a fundamental transformation of a sector in a very resource-dependent country. The opportunity of the renewable energy revolution is entwined into the structure and norms of the society as a whole, and therefore its potential unfolding touches upon many sectors and actors.

We noticed that the question of a post-copper era is topical now. One evident reason is the fact that the prices of minerals have been low for several years now, which has hurt Chile's economy. Excitingly, renewable energy was even suggested as a potential substitute for the country's famous mining industry, and something that, if harnessed, could be investigated further as a part of the country's long-term economic strategy. There was discussion on the ability of Chile to harness the renewable energy opportunity and to go as far as become a 100% renewable energy powered country. At the same time, the clinique seemed to confirm one of our hypotheses. Namely, it was accepted that in a business-as-usual scenario, primarily large foreign companies would seize the emerging economic opportunities of the renewable energy sector. Consequently, while the uptake of renewable energy could supply Chile's future economy and resolve some of its energy challenges, without conscious development of Chilean skills and capabilities in this sector, Chile's own ability to benefit from the development of the renewable energy sector itself and related value-additive activities could be limited.

Therefore, it is not entirely unambiguous to define whether Chile can be considered as a solar energy pioneer. Can Chile be considered a pioneer, or is it only adapting to a fast changing global solar energy business environment? In fact, virtually all of the project developers and investors are currently international. While adding new electricity generation capacity to the grid, it is giving out the resources it holds, without actively developing knowledge of this technology sector. Our research team merely found it slightly surprising that a scenario where Chilean-based companies could dominate the business in the long-term future, had not even seemed to occur to the clinique's experts¹². This issue was discussed mostly indirectly, as none of the participants directly raised the question of ownership. In

¹² We may only speculate, if this has to do with Chile's economic history and the country's political economy.

this case, we are not discussing the issue of ownership strictly in narrow economic terms, but more broadly thinking of ownership as *the endogenous knowledge capacities and skills to benefit* of the economic activities in a knowledge-based society in the global world.

In the process, fairly few concrete steps were yet provided into how the identified objectives can be reached. If left as a one-off exercise, scenario-building can be considered as something not likely leading to preferred results, at least in the eyes of the participants – and in terms of immediate gains. Some of the participants noted that the timing for the Futures Clinique was opportune, and even suggested that the Futures Clinique should serve as a launch for the country and the key stakeholders to start thinking more strategically on how the country should anticipate its solar-led energy transformation. In the future, it could be interesting to study how countries that are in a similar situation as Chile, or other Latin American countries like Uruguay, Cuba, and Costa Rica – are taking up and adapting to the emerging revolution towards renewable energy. Can certain countries – for instance small countries – be pioneers and show the way for countries considered giants in traditional terms? The project's research team aims to elaborate further the possibilities of what conclusions to draw and how to make most of tailor-made scenarios for each context and case country.

We would also like to raise some critical remarks. One of the limitations of a one-day workshop is the short timeframe, which makes it difficult to open up all the assumptions that guide a scenario process. This could lead to the process of scenario-building being initially misinterpreted as a subjective endeavour, rather than something that is based on the evidence over a rather lengthy period of time. Besides this, when research is conducted in a multi-lingual environment, also the issue of multiple reproduction is evident and the essence of each unique idea can be lost. The conversation and thinking process in groups typically forms the richest part of the exercise, but the post-it pads that are used for documentation are a restrictive tool in capturing the essence of each idea entirely. For a research team, objective analysis is basically impossible. Nevertheless, the clinique provides an abundant pool of qualitative data that should be used in further research and analysis work. Now, a niche selection is made based on an unidentified process of decision making. In the Chilean context, it might be beneficial to elaborate the scenarios and emphasize particular aspects that correspond better with the local situation even further. On the other hand, this exercise provided valuable information on the process of adapting scenarios into environments different from "ours". The given tentative scenarios can be seen as meta-scenarios which have different interpretations, potential and implications for transformation in different cultures and geographical settings. The Green Do-It-Yourself 2050 scenario, for example, can perhaps be easier imagined in the context of Finnish culture (where "doing it yourself" mentality and living off the nature in small communities have historically defined the Finnish culture) whereas similar traits do not automatically translate into Chile.

Finally, future cooperation with Chilean experts would benefit both parties and function as an encouragement to intensify collaboration. Finland Futures Research Centre is positive towards the opportunity of having Chile as a case study country in the Neo-Carbon Energy research project, and in other research, education, and foresight and innovation-related initiatives as well. The country provides an excellent and timely example on how the energy transition is enabled, by whom, and with what sort of policy tools and players around. Most importantly, the exercise provided information on the type of a socio-cultural shift is required in order for the energy transformation to succeed. FFRC follows and supports a sustainable energy transition. As for starters, Chile needs a long-term, decisive, and yet flexible vision, that understand the complex nature of the nexus of energy, society, culture and economy.

REFERENCES

- Amara, R. (1981) The Futures Field: Searching for Definitions and Boundaries. *The Futurist* 15 (1): 25–29.
- Barbosa, Larissa – de Souza, Noel Simas – Bogdanov, Dmitrii – Vainikka, Pasi & Breyer, Christian (2017) Hydro, wind and solar power as a base for a 100% renewable energy supply for South and Central America, *PLoS ONE* 12(3):e0173820, <https://doi.org/10.1371/journal.pone.0173820> Retrieved April 12, 2017.
- Benedikter, R. & Siepmann, K. (eds.) (2015) *Chile in transition: Prospects and challenges for Latin America's forerunner of development*, Springer Books, 217 p.
- Bell, Wendell (1997) *Foundations of Futures Studies, Volume 1: Human Sciences for a New Era*, Transaction Publishers, 408 p.
- Boston, Jonathan (2017) *Governing for the Future. Designing Democratic Institutions for a Better Tomorrow. Public Policy and Governance Vol 25*. Emerald Group. Bingley.
- Boucher, M. (2015) Decentralized Energy: Prospects, Justice, and Transition. *Energy Research & Social Science* 11, 288–293. <https://doi.org/10.1016/j.erss.2015.10.006>
- Breyer, C. – Heinonen, S. & Ruotsalainen, J. (2016) New Consciousness: A societal and energetic vision for rebalancing humankind within the limits of planet Earth. *Technological Forecasting and Social Change*. Article in press.
- Cuhls, K. (2016) Mental Time Travel in foresight processes – Cases and applications. *Futures* 86: 118–135 <https://doi.org/10.1016/j.futures.2016.05.008>
- Dator J. (2009) Alternative Futures at the Manoa School, *Journal of Futures Studies*, November 2009, 14(2): 1–18.
- Day, George S. & Schoemaker, Paul J. H. (2006). *Peripheral Vision Detecting the Weak Signals That Will Make or Break Your Company*. Harvard Business School Press, Boston.
- Dezem, Vanessa & Quiroga, Javiera (2016) Chile Has So Much Solar Energy It's Giving It Away for Free. *Bloomberg*. June 1, 2016. <http://www.bloomberg.com/news/articles/2016-06-01/chile-has-so-much-solar-energy-it-s-giving-it-away-for-free>. Retrieved September 24, 2016.
- EY (2016) RECAI Renewable Energy Country Attractiveness Index. 47. EY. [http://www.ey.com/Publication/vwLUAssets/EY-RECAI-47-May-2016/\\$FILE/EY-RECAI-47-May-2016.pdf](http://www.ey.com/Publication/vwLUAssets/EY-RECAI-47-May-2016/$FILE/EY-RECAI-47-May-2016.pdf).
- Glenn, J. – Florescu E. et al. (2015) *The 2015–16 State of the Future*. The Millennium Project, Washington DC.
- Glenn, Jerome & Gordon, Theodore (2009) *Futures Research Methodology Version 3.0*. Washington DC. <http://www.millennium-project.org/millennium/FRM-V3.html>
- Gobierno de Chile (2015) *Energía 2050: Política Energética de Chile*. Ministerio de Energía, Santiago de Chile. www.sec.cl/sitioweb/baners/LIBRO-ENERGIA-2050.pdf and <http://www.energia2050.cl/en/> Retrieved February 16, 2017.
- Heinberg R. & Friedly, D. (2016) *Our Renewable Future: Laying The Path For One Hundred Percent Clean Energy*. Washington DC: Island Press.

- Heinonen, S. (2013) *The Dance of the Black Swans. The Concept and Manifestations. In: Black Swans – What Will Change the World Next? Entries from the writing contest of the Committee for the Future of the Parliament of Finland*, p. 20-40.
- Heinonen, S. & Ruotsalainen, J. (2013) Futures Clinique – method for promoting futures learning and provoking radical futures. *European Journal of Futures Research*, 15:7, DOI 10.1007/s40309-013-0007-4, 11 p. <http://link.springer.com/article/10.1007%2Fs40309-013-0007-4>.
- Heinonen, Sirkka – Karjalainen, Joni & Ruotsalainen, Juho (2015) Towards the third industrial revolution. NEOCARBON ENERGY project Future Clinique I “Creating the Third Industrial Revolution” 6.5.2015 FFRC eBook 6/2015. Finland Futures Research Centre, University of Turku. 74 p. ISBN 978-952-249-394-1, ISSN 1797-1322. <https://www.utu.fi/fi/yksikot/ffrc/julkaisut/etutu/Documents/FFRC-eBook-6-2015.pdf>
- Heinonen, Sirkka, Karjalainen, Joni & Ruotsalainen, Juho (2016a) Radical Transformation in a Distributed Society - Neo-Carbon Energy Scenarios 2050 <http://www.utu.fi/fi/yksikot/ffrc/tutkimus/hankkeet/Documents/NeoCarbon-WP1-1-2016.pdf>
- Heinonen, Sirkka – Minkkinen, Matti – Karjalainen, Joni & Inayatullah, Sohail (2016b) Testing transformative energy scenarios through causal layered analysis gaming, *Technological Forecasting and Social Change* (Article in press), <https://doi.org/10.1016/j.techfore.2016.10.011>
- Heinonen, S. (2016a) Futures Provocation For the Futures Clinique On Neo-Carbon Energy World - What Opportunities for Chile? Finland Futures Research Centre FFRC/UTU & Consejo Chileno de Prospectiva y Estrategia (CChPE), Futures Clinique 24th Oct 2016 Chilean Intellectual Property Institute INAPI, Santiago de Chile, Chile, 61 ppt.
- Heinonen, S. (2016b) Finland: Experience in Foresight - Importance of Forward-Looking Public Policy. La Prospectiva y las políticas Públicas. La experiencia de Finlandia. “Seminario internacional prospectiva y estrategia para el desarrollo del Chile del 2030” in Santiago 26.10.2016, 48 ppt.
- Heinonen, Sirkka – Karjalainen, Joni – Helle, Aino & Nisula, Sakari (2016c) Argentinian Energy Landscapes. Case Study of the Neo-Carbon Energy Project. FFRC eBOOK 12/2016. Finland Futures Research Centre, University of Turku. 84 p. ISBN 978-952-249-469-6, ISSN 1797-1322. http://www.utu.fi/fi/yksikot/ffrc/julkaisut/e-tutu/Documents/FFRC-eBook_12-2016.pdf
- Heinonen, Sirkka – Karjalainen, Joni – Parkkinen, Marjukka & Ruotsalainen, Juho (2017) Clean Disruption for Abundant Futures. Neo-Carbon Energy Futures Clinique III. FFRC eBOOK 2/2017. Finland Futures Research Centre, University of Turku. 84 p. ISBN 978-952-249-474-0, ISSN 1797-1322. http://www.utu.fi/fi/yksikot/ffrc/julkaisut/e-tutu/Documents/FFRC-eBook_2-2017.pdf
- Hiltunen, Elina & Heinonen, Sirkka (2012) Creative Foresight Space and the Futures Window: Using Visual Weak Signals to Enhance Anticipation and Innovation. *Futures*, 44, 248-256.
- Jungk R. & Müllert, N. (1987) *Future workshops: how to create desirable futures*. Institute for Social Inventions, London.
- Kelly, Kevin (2016) *The Inevitable. Understanding the 12 Technological Forces That Will Shape Our Future*. New York.
- Lang, Merja – Karjalainen, Joni & Heinonen, Sirkka (2016) Glocal Insights to Neo-Carbon Energy and Its Forerunners. NEO-CARBON ENERGY WP1 Working Paper 4/2016. Finland Futures Research Centre, ISBN 978-952-249-429-0, 112 p. www.utu.fi/fi/yksikot/ffrc/tutkimus/hankkeet/Documents/NeoCarbon-WP1-4-2016.pdf
- Lord, B. (2014) *Art & Energy: How Culture Changes*. The AAM Press, Arlington.

- Lösch, A. & Schneider, C. (2016) Transforming power/knowledge apparatuses: the smart grid in the German energy transition. *Innovation: The European Journal of Social Science Research*, DOI: 10.1080/13511610.2016.1154783.
- Malaska, Pentti (2010) *A More Innovative Direction Has Been Ignored*. In: Understanding Neogrowth – An Invitation to Sustainable Productivity. TeliaSonera Finland Plc. Helsinki, p. 200–210. http://www.sonera.fi/media/13069ab55806de22e8955bc2a3f1afeab17b28bd/Understanding_Neogrowth.pdf
- Masini, Eleonora (1993) *Why Futures Studies?* Grey Seal, London.
- Mendoza, L. R. (2015) Transformación: de la adaptación inconsciente a la anticipación consciente. In *Planeación Prospectiva Estratégica. Teorías, metodologías y buenas prácticas en América Latina*. Mexico D.F.: Universidad Nacional Autónoma de México. ISBN UNAM: 978-607-02-6715-4.
- Naam, R. (2011) Smaller, cheaper, faster: Does Moore's law apply to solar cells? *Scientific American*, <http://blogs.scientificamerican.com/guest-blog/smaller-cheaper-faster-does-moores-law-apply-to-solar-cells/>. Retrieved August 31, 2016.
- Neo-Carbon Energy. www.neocarbonenergy.fi
- Neo-Carbon Energy – Neo-Carbon Enabling Neo-Growth Society – Transformative Energy Futures 2050, <http://utu.fi/en/units/ffrc/research/projects/energy/Pages/neo-fore.aspx>
- Neo-Carbon Energy – Internet of Energy Simulation Tool. <http://neocarbonenergy.fi/internetofenergy/>
- Nurmela, J. (2013) Tulevaisuusverstas ja uusia "verstashenkisiä" tulevaisuuden muovaamisen menetelmiä, p. 213–217. In: Kuusi, Osmo – Bergman, Timo & Salminen, Hazel (2013) *Miten tutkimme tulevaisuuksia?* Acta Futura Fennica no 5. Helsinki. (in Finnish)
- Miller, Clark A. – Richter, Jennifer & O'Leary, Jason (2015) Socio-energy systems design: A policy framework for energy transitions, *Energy Research & Social Science*. 6, pp. 29–40.
- O'Toole, Gavin (2010) *Politics Latin America: 2nd Edition*, Routledge.
- Parkkinen, M. & Heinonen, S. (2016) Insights on urban tomorrows – Expert survey on futures of liveable cities. Finland Futures Research Centre. ENCORE Research Project Working Paper. 1/2016. https://www.utu.fi/fi/yksikot/ffrc/tutkimus/hankkeet/Documents/ENCORE_working_paper_1_2016.pdf
- Rifkin, J. (2011) *The Third Industrial Revolution. How Lateral Power is Transforming Energy, the Economy, and the World*. Palgrave Macmillan, New York.
- Rifkin, J. (2014) *The Zero Marginal Cost Society. The Internet Of Things, The Collaborative Commons, And The Eclipse Of Capitalism*. Palgrave MacMillan, New York.
- Ryghaug, Marianne & Toftaker, Marit (2014) A transformative practice? Meaning, competence, and material aspects of driving electric cars in Norway. *Nature and Culture*. 9 (2).
- Salovaara, Kaisa – Makkonen, Mari – Gore, Olga & Honkapuro, Samuli (2016) Electricity Markets Framework in Neo-Carbon Energy 2050 Scenarios. Neo-Carbon Energy WP1 Working Paper 3/2016. Lappeenranta University of Technology: Lappeenranta <http://www.utu.fi/fi/yksikot/ffrc/tutkimus/hankkeet/Documents/NeoCarbon-WP1-3-2016.pdf>
- Sanders, Philip (2016) Chile Energy Auction Gives Bachelet a Success to Boast About. Bloomberg News 18.8.2016. <https://www.bloomberg.com/news/articles/2016-08-18/chile-s-energy-industry-a-spot-of-light-in-a-darkening-economy> Retrieved April 3, 2017.

- Scoones, Ian – Leach, Melissa & Newell, Peter (eds.) (2015) *The Politics of Green Transformations*. Abingdon, Oxon, Routledge.
- Similä, Lassi & Koljonen, Tiina (2016) Towards actor-based Neo-Carbon scenarios. Neo-Carbon Energy WP1 Working Paper 2/2016. VTT Technical Research Centre of Finland: Espoo <http://www.utu.fi/fi/yksikot/ffrc/tutkimus/hankkeet/Documents/NeoCarbon-WP1-2-2016.pdf>
- Sovacool, Benjamin K. & Brossmann, B. (2010) Symbolic convergence and the hydrogen economy. *Energy Policy* 38, 1999–2012.
- Sovacool, Benjamin K. (2014) Diversity: Energy studies need social science. *Nature*. 511, p. 529–530 (31 July 2014) doi:10.1038/511529a
- Stirling, A. (2014) Transforming power: Social science and the politics of energy choices. *Energy Research & Social Science*. 1 (2014) 83–95.
- Taleb, Nassim Nicolas (2010) *The Black Swan. The Impact of the Highly Improbable*. Random House, New York.
- UN DESA (2017) Chile: Total Population – Probabilistic Scenario, in World Population Prospects: The 2017 Revision. United Nations, Department of Economic and Social Affairs, Population Division <https://esa.un.org/unpd/wpp/Graphs/DemographicProfiles/> Retrieved June 28, 2017.
- Watershed Conference, Vatican City, Rome, 21–23 March 2017, <http://worldwatervalues.org/> and <http://www.rsvpwatershed.info> Retrieved April 14, 2017.
- World Bank (2013) Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for Resilience. Washington DC ; World Bank, 254 p. <http://www.worldbank.org/en/topic/climatechange/publication/turn-down-the-heat-climate-extremes-regional-impacts-resilience> and <http://documents.worldbank.org/curated/en/975911468163736818/Turn-down-the-heat-climate-extremes-regional-impacts-and-the-case-for-resilience-full-report> Retrieved April 14, 2017.
- Wu, F. F. – Varaiya, P. P. & Hui, R. S. Y. (2015) Smart Grids with Intelligent Periphery: An Architecture for the Energy Internet. *Engineering* 1:4, 436–446, DOI 10.15302/J-ENG-2015111.



FUTURES CLINIQUE

Neo-Carbon Energy World – What Opportunities for Chile?

24th October 2016, 8:30 AM – 5:00 PM

The Chilean Intellectual Property Institute INAPI

Av. Libertador Bernardo O'Higgins 194, 18th Floor, Santiago, Chile.

Organized by Finland Futures Research Centre (FFRC), University of Turku, Finland & Consejo Chileno de Prospectiva y Estrategia (CChPE)

WHY?

In order to reduce greenhouse gas emissions to mitigate climate change, non-conventional and innovative ways to produce and manage renewable energy are needed. The aim is to openly explore new possible energy futures where society is increasingly based on ecological awareness, corporate responsibility, peer-to-peer society and prosumerism (consumers becoming producers, for example by producing their own energy via solar panels). Innovations and new growth opportunities emerge from decentralized renewable energy and digitalization.

WHAT AND HOW?

Futures Clinique is a workshop designed to explore and promote transformational futures, using several foresight methods and tools to address disruptive innovations. Participants will strengthen their futures thinking. No previous knowledge of foresight methods is required.

FOR WHOM?

All those interested in futures studies and sustainable energy possibilities for Chile, such as policy makers, urban planners, researchers, authorities, energy sector companies, private sector representatives, graduate/post-graduate students, journalists, and civil society organizations.

PROGRAM

Coffee 8:30

Opening words 9:00

Mrs. Paola Aceituno, CChPE/Sr. Gonzalo Rivas, Consejo Chileno Innovación para el Desarrollo

Futures Provocation 9:15

The importance of strategic foresight and Neo-Carbon Energy Scenarios

Professor Sirkka Heinonen, Finland Futures Research Centre, University of Turku

Futures Window 10:15

Visualizing weak signals as food for imagining sustainable energy futures

Introduction to the Group working 10:30

Collaborative Foresight for Neo-Carbon Energy Scenarios

SESSION I: Futures Wheel 11:00

The peer-to-peer energy transition is explored through four transformational scenarios in the year 2050 (Radical Startups, Value-Driven Techemoths, Green DIY Engineers, and New Consciousness)

Lunch 13:00

Coffee 14:30

SESSION II: Futures Table (PESTEC) 14:30

Cross-Fertilization of Results 15:30

Conclusion 16:30

Contact for participation and for inquiries:

Paula Castro, CChPE, castrosenfeld@gmail.com

Information on the Neo-Carbon Energy Project:

Prof. Sirkka Heinonen, sirkka.heinonen@utu.fi

Project researcher Noora Vähäkari, noora.vahakari@utu.fi

<http://www.neocarbonenergy.fi/>

<https://www.utu.fi/en/units/ffrc/research/projects/energy/Pages/neo-fore.aspx>



APPENDIX 2. PARTICIPANTS



EVENTO FUTURES CLINIQUE

“Neo-Carbon Energy Futures: What Opportunities for Chile?.

Lunes 24 Octubre, 2016, Salón Eventos INAPI

Santiago, Chile.

PARTICIPANTS BY GROUPS

Radical Startups (Group 1)

Patricio Valdivia, CORFO

Sallamarja Mäenpää, FINPRO

Paula Jadue, SYMNETICS

Javier Bustos, Ministerio Energía

Marcela Araneda, Desarrolla Biobío

Jaime Alvarez, CNID

Value-Driven Techemoths (Group 2)

Grecia Perez de Arce, Cochilco

Nicola Borregaard, Ministerio Energía

Felipe Welch, INAPI

Diego Lizana, Agencia Chilena de Eficiencia Energética

Susana Coper, Universidad Austral

Carlos Finat, ACERA

Tomás Gómez, Observatorio de Ciudades, Universidad Católica

Green DIY Engineers (Group 3)

Leonardo Ramírez, Ministerio de Medio Ambiente

David Pozo, Universidad Católica de Chile

Claudio Huepe, Centro de Energía y Desarrollo Sustentable, UDP

Rosana Brantes, Cochilco

Patricio Bofill, Ministerio Energía

Ángel Caviedes, Ministerio Energía

New Consciousness (Group 4)

Mauro Tesei, CORFO

Carla Alvial, Centro de Investigación Social, UDP

Raúl Frías, SYMNETICS

Marcelo Ramírez, Subsecretaría de Desarrollo Regional

Soledad Quiroz, Universidad Santo Tomás

Waldo Bustamante, CEDEUS, Universidad Católica

Leonardo Muñoz, CNID

Other attendants to the event, who did not stay for the working groups:

Juan Pablo Contreras, CNID

Paula Solar, Universidad Andrés Bello

Sergio Bitar, Consejo Chileno de Prospectiva y Estrategia

Manuel Tobar

Carlos Benavides



RECENT FFRC eBOOKS

- 2/2017 Heinonen, Sirkka - Karjalainen, Joni - Parkkinen, Marjukka & Ruotsalainen, Juho: Clean Disruption for Abundant Futures. Neo-Carbon Energy Futures Clinique III.
- 1/2017 Hario, Pasi - Parkkinen, Marjukka - Siivonen, Katriina & Tuittila, Satu: Historian museoon Turkuun. Osallisuusverstasprosessin tulokset.
- 12/2016 Heinonen, Sirkka - Karjalainen, Joni - Helle, Aino & Nisula, Sakari: Argentinian Energy Landscapes. Case Study of the Neo-Carbon Energy Project.
- 11/2016 Ruotsalainen, Juho - Heinonen, Sirkka - Karjalainen, Joni - Parkkinen, Marjukka - Laurén Leena-Maija & Salminen Hazel: The Fuzzy Futures of Neo-Carbon Work. Neo-Carbon Futures Clinique II.
- 10/2016 Apostol, Oana: Sustainability Best Practices. Benchmarking Results of the SUSTIS Project.
- 9/2016 Heikkilä, Katariina: Perspectives to Sustainability In The Shipbuilding Network. Interview Results of the SUSTIS Project.
- 8/2016 Kurki, Sofi - Pura, Minna & Wilenius, Markku: RE-acting the Future. New Ways to Work: The Case of Reaktor.
- 7/2016 Ruotsalainen, Juho & Heinonen, Sirkka: Intiimi journalismi. Diginatiivit mediat tulevaisuuden journalismin edelläkävijöinä.
- 6/2016 Höyssä, Maria - Aalto, Hanna-Kaisa - Kurki, Sofi - Minkkinen, Matti - Siivonen, Katriina - Tapio, Petri - Wilenius, Markku & Arvonon, Anne (eds.) Coolest Student Papers at Finland Futures Research Centre 2015-2016. Tulevaisuuden tutkimuskeskuksen valittuja opiskelijatöitä 2015-2016.
- 5/2016 Hietanen, Olli & Saarimaa, Riikka: VOIMAKAS - elinvoimaa puutarhasektorin uudistamiseen ja kasvuun -tulevaisuusverstaiden tulokset.

FFRC eBOOK 3/2017

Heinonen, Sirkka - Vähäkari, Noora & Karjalainen, Joni

NEO-CARBON ENERGY WORLD - WHAT OPPORTUNITIES FOR CHILE? Neo-Carbon Energy Futures Clinique IV

ISBN 978-952-249-476-4

ISSN 1797-1322