Merja Lang, Joni Karjalainen & Sirkka Heinonen

Glocal Insights to Neo-Carbon Energy and Its Forerunners

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VTT
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FINLAND FUTURES RESEARCH CENTRE
Turku School of Economics
FI-20014 University of Turku

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

Tel. +358 2 333 9530

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

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PREFACE

Any balanced assessment of the climate science and evidence accepts that climate change, driven primarily by human carbon emissions, is happening faster and more extensively than anticipated. In this context, scientists have long been concerned about the extreme "tipping point" risks of the climate system; non-linear positive feedbacks which trigger rapid, irreversible and catastrophic change.

These feedbacks are now kicking in. For example, in the Arctic and the Antarctic as accelerating warming melts sea ice and releases methane. We are also witnessing increasingly unstable jet streams, radically changing weather patterns, degradation of coral reefs from increased ocean temperatures and acidity, accelerating global temperature increase, and much more.

The social disruption and economic consequences are already devastating, leading to extensive forced migration and economic collapse in some countries. The refugee crisis engulfing Europe, emanating from Syria and North Africa, is fundamentally climate change driven and a precursor of greater conflict ahead. Major centres of economic activity, such as the Pearl River Delta, the Mekong River Delta and other parts of Southeast Asia are now under threat from climate-induced sea level rise.

The Paris Climate Agreement requires countries participating to hold global average temperature to "*well below 2°C above pre-industrial levels and to pursue efforts to limit the increase to 1.5°C*". Without rapid carbon emission reductions far greater than Paris commitments, the planet will become ungovernable as dangerous climate change is happening at the 1.2°C increase, already experienced.

Most dangerously, the climate impact of investments made today do not manifest themselves for decades to come. If we wait for catastrophe to happen, as we are doing, it will be too late to act.

Climate change, though, is only one of a number of critical, inter-related, issues now confronting the global community, for example, the peaking of affordable oil supply, food and water security, which threaten the sustainability of humanity and emphasise the need for new energy systems.

The transformation to a Neo-Carbon economy is unprecedented, the greatest investment opportunity the world has ever seen. We have the technology, the expertise and wealth to make it happen if this potential can be unleashed. What we lack is time, and the maturity, in many parts of the world, to set aside political ideologies and corporate vested interests to cooperate in the public interest. In John Maynard Keynes' words: "*The difficulty lies not in the new ideas, but in escaping from the old ones*".

Hence the importance of this report, "*Glocal Insights to Neo-Carbon Energy and its Forerunners*" which seeks to identify, via weak signals, scenarios, pioneers and other foresight, where innovation may come from globally to break the resistance to change within our established economic systems, and how we might realise the enormous opportunities this transformation presents.

Identifying leverage points to accelerate this process, as the Report does, is a major step forward.

I commend it to you.

Ian Dunlop
Member of The Club of Rome, Climate and Energy activist
Formerly Chair Australian Coal Association, CEO Australian Institute of Company Directors
Sydney, Australia
February 2017

EXECUTIVE SUMMARY

This paper presents the results of an international survey on the forerunners of renewable energy. The survey was constructed in the Neo-Carbon Energy project, one of the strategic research openings of Tekes – the Finnish Funding Agency for Innovation. The foresight part of the project is conducted at Finland Futures Research Centre (FFRC). This survey explores the futures of an economy, based on a new renewable energy system in a peer-to-peer society 2050. The global meta-scenarios were reflected with a local and regional context in the survey to provide glocal insights. ***The results are used to modify and deepen the global meta-scenarios, and to contextualize them in different countries, particularly in the Neo-Carbon Energy project's target countries: Kenya, Tanzania, South Africa, China, Korea and Australia. Respondents from USA, Latin America and Europe were also included***.

The aim of the survey was to identify possible pioneers for each of the four transformational neo-carbon energy scenarios. Moreover, the possibility, probability and desirability of the scenarios was also evaluated by the respondents. ***The questionnaire addressed an international expert community of futurists, energy experts and entrepreneurs working on energy questions and societal change***, which consists of members of the Club of Rome, the Millennium Project and national level energy and innovation networks. In total, the questionnaire was sent to 160 recipients in 14 countries. The response rate was 29% with 39 respondents. Almost all respondents saw at least one of the scenarios possible in their local context, and the majority felt so about several scenarios. Value-Driven Techemoths 2050 scenario was seen as the most probable scenario, whereas ***Radical Startups 2050 and New Consciousness 2050, both based on deep ecology, were seen as the preferred scenarios***.

Underlying these changes is a gradually growing consciousness of ecological threats. The spirit described in the Startups scenario can be found in other types of organisations: ***an entrepreneurial mind is needed also when starting a social experiment or a movement.*** As for aspiring startups, their radicality lies in the nature of the technology, in innovative business models, or their power in disrupting the market. With regard to Value-Driven Techemoths, some large companies are seen to have potential of turning into value-driven, but many also questioned their abilities. An analysis of the do-it-yourself mentality proved interesting: the "DIY" was seen as a mentality, activism, learning, a statement, business, fun, and even a necessity. Being a DIY energy entrepreneur or dealing with energy issues is not reserved for men only – East African respondents named entrepreneurs, of which several were

women. Beyond engineering, in order to make their innovations spread, training is needed for other skills too: marketing, design thinking, accounting, and so forth. Ecological constraints are increasingly acknowledged by religious and spiritual movements. While this is beginning to push industrial change, for others this may imply adopting more traditional lifestyles.

Governmental support is crucial as an enabler: this includes soft measures (capacity-building, institutional support and networking), economic incentives or legal and regulatory measures. This means ending the dependence on coal, less regulation and taxation, and incentives that steer towards the production and consumption of renewables. While ideas or STI policies should not merely be replicated, ***for lessons learned it could be useful to look what those governments have done that already have combined cultural and societal strengths while enabling technological development***. At a more simple stage, there are social practices in place in one country that are unknown elsewhere. Innovative business models linked to a technology, too, may at the moment only be in place in certain regions. ***Some respondents did discuss cross-sectoral linkages from renewable energy, such as solar and wind in linkage with the constructions and transport sector or mentioned novel energy services that are emerging from digitalisation***. The use of solar energy in industry was mentioned in linkage with the mining sector. Across regions, "closed" grids were perceived to hold back the innovations by startup entrepreneurs, DIY engineers and large companies.

Pioneers nurture a sense of urgency for the change, and at the same time, they seem to realise that work and employment could in a growing degree emerge from renewable energy and digitalisation. ***If we want to see a neo-carbon future where decentralised and democratised energy prosumerism is a positive trend, support needs to be given to those pioneers who are identified as making that future – locally and regionally.*** Indeed, the survey findings could be used as material for outlining more concise and detailed regional strategies and for re-visiting economic or development visions. It could also be worth defining which innovations and social practices exactly have the highest potential of being radical or disruptive innovation to enable a truly transformative pathway to a solar and wind powered society. ***Only a few responses yet mentioned next generation technologies that support a 100% renewable energy system based on solar and wind. Therefore, this leaves considerable space for future innovation and competition to emerge in various niches***.

1. INTRODUCTION TO THE NEO-CARBON ENERGY SCENARIOS AND THEIR FORERUNNERS

Neo-carbon society 2050 and its renewable energy system

The aim of the Neo-Carbon Energy project is to study and develop a neo-carbon energy system, as a form or a 100% renewable energy based energy system. Especially solar and wind energy are increasingly used to produce electricity, and energy storages balance the intermittency of variable renewable energy. With the so-called power-to-X technologies, electricity that is generated from renewables is transformed into new applications and end products such as synthetic chemicals, gases, and liquids. ***Transforming societies into one where energy – not only electricity – is emission-free, cost-effective and independent, based on (increasingly decentralised) renewable energy, can be called "neo-carbonisation"*** (Breyer 2016, Breyer et al. 2015)**.** The concept of neo-carbonisation (new relation to carbon – not as emission of CO2 but rather as raw material for other processes) is building on the rethinking of the concept of growth as neo-growth. Malaska (2010) launched the idea of neo-growth as growth that is much based on services, immaterial growth and not wasting resources.

Depending on the renewable energy resources available in a particular region, the optimal technological set-up of a future 100% renewable energy based system may vary (see e.g. Bogdanov and Breyer 2016, Noel et al. 2016, Barasa 2016)**.** Generally speaking, a distributed way of energy production and consumption by individuals and communities supports a radically less hierarchical society. The social and power structure of society may to a growing degree stem from the grassroots, as decentralised production of material goods, digital manufacturing, such as the use of 3D printers, also becomes increasingly common. To outline and depict such development trajectories, four transformational meta-scenarios have been constructed on neo-carbon societies until 2050 (Heinonen, Karjalainen and Ruotsalainen 2016). These scenarios were made in the foresight part of the Tekes funded Neo-Carbon Energy Project.[1] The scenarios were constructed on the basis of a horizon scanning phase where special emphasis was paid to emerging issues and weak signals.

[1] The Neo-Carbon Energy project (2014-2017) is conducted by VTT (co-ordinator), Lappeenranta University of Technology LUT, and Finland Futures Research Centre FFRC, University of Turku. The foresight part (WP1) of the Neo-Carbon Energy Project is headed by Prof. Sirkka Heinonen at Finland Futures Research Centre (FFRC) in co-operation with VTT and LUT during the years 2014-2017. For more information, see webpages www.neocarbonenergy.fi and www.utu.fi/en/units/ffrc/research/projects/energy/Pages/neo-fore.aspx

According to Lesca & Lesca (2014), ***weak signals are at the heart of anticipation. They can be conceived as first signs or symptoms of coming change. They are seeds of change, present today*** (Heinonen & Hiltunen 2012). Weak signals point to emerging issues that may strengthen or not. By definition, they embody a lot of uncertainty, while revealing fresh insights. Hiltunen (2010) even claims that the most important knowledge of the future is embedded in weak signals. The construction of scenarios based on identified emerging issues is prone to open up avenues for scenarios that are different from business-as-usual scenarios. To make the scenarios even bolder and more exploratory, the scenario category of "transformation" was chosen.[2]

The two axes that underpin all these four transformative scenarios are ecological awareness (x-axis) and the manifestation of the peer-to-peer ethos (y-axis).

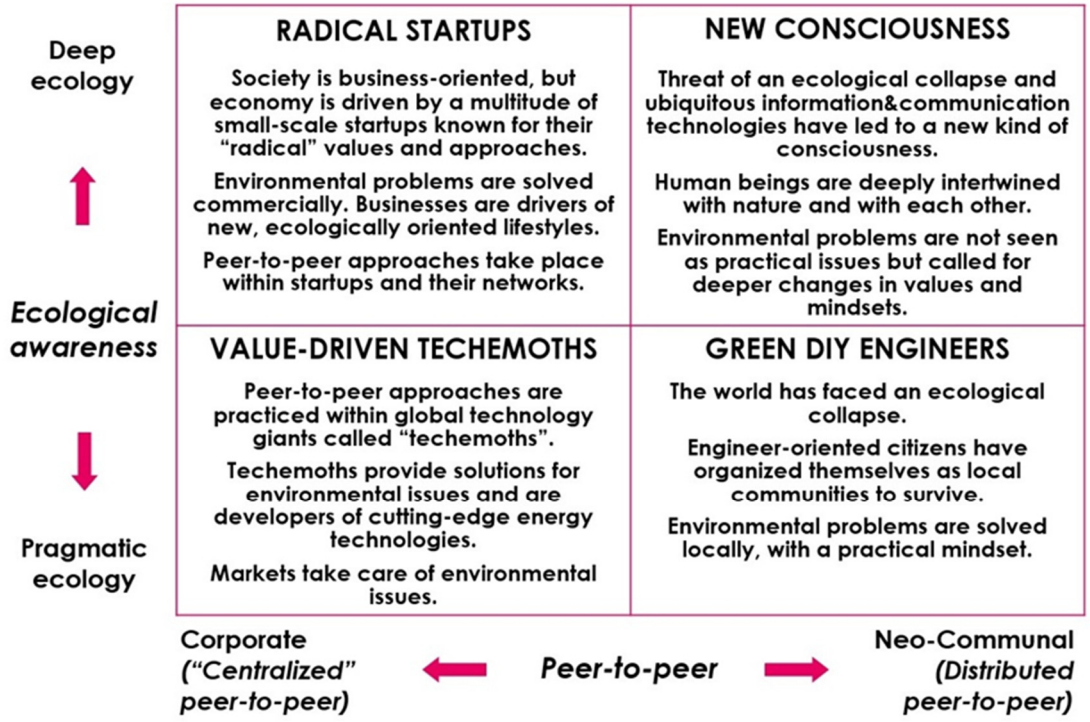

Figure 1. Four transformative scenarios 2050 for Neo-Carbon Energy.

In the ***Radical Startups scenario***, economy is driven by networks of startup companies. There are no clear lines between work and leisure. Energy production is highly distributed, and many startups specialise in energy, including energy services. In the ***Value-Driven Techemoths scenario***, economy is dominated by technology giants, so-called "techemoths" that offer resources, facilities, and platforms for self-organising employees.

[2] According to Jim Dator, the scenarios can be divided into one of the four scenario archetypes: growth, collapse, disciplined society, and transformation (Dator 2009). The Neo-Carbon Energy project adopted an experimental methodological approach by making all four scenarios as transformative.

They invest in bold R&D projects, especially in energy, and develop energy infrastructure. In the ***Green DIY Engineers scenario***, society is organized around thriving local communities due to an extensive ecological collapse. Do-It-Yourself economy and practical mindsets flourish, and smart scarcity provides many communities relative abundance. Energy is produced mostly locally and communities are largely self-sufficient. In the ***New Consciousness scenario***, society is organised as global collaboration and it openly provides resources and information. Humans share a collective consciousness thanks to omnipresent communications, virtual reality, and brain-to-brain communications. Energy systems are both distributed and centralised (Breyer, Heinonen, and Ruotsalainen 2017).

These four scenarios, as so-called meta-scenarios, provide a holistic framework to explore the energy transition and to describe the Neo-Carbon Energy world in 2050. The meta-scenarios are generic, universal and global. The energy transformation, anticipated to be global, and expected to shape our future society, economy and its culture, is tested throughout the project by using different foresight tools (Heinonen et al. 2016; 2015) and further different regional (and local) perspectives. In this working paper, ***we explore glocal insights. Being glocal, or glocalisation, describes how people relate linguistically, culturally, and cognitively to one another and to the institutions they inhabit in times of change*** (Robertson 1995). Glocalisation means combining global drivers, impacts and elements with local and regional features and context. This survey connects the meta-scenarios with local insights and explores how local initiatives are shaping the broader narrative of an emerging energy transformation. The energy transformation may be realised in different ways dependent on the particular local, national and regional context and dynamics, and also interpreted differently in diverse settings. Rather than a uniform recipe, the transformation can be politically more state-led, market-led, technology-led or citizen-led, as argued by the scholars who have studied energy transformation (Scoones, Leach and Newell 2016). One-size-fits-all approach to science, technology and innovation (STI) policies are one of the best recipes to failure (Arocena and Sutz 2012). These aspirations pose interesting questions for the future role of the state (Mazzucato 2015). There are even considerations on how a renewable energy led transformation may over time shape energy geopolitics, which traditionally has mainly focused on fossil fuels (Scholten and Bosman 2016).

Why do forerunners matter?

Actions and decisions are made by characters in real-life. These different actors in society can make scenarios to be realized (Wangel 2011a). In scenario-building, adding actors to scenarios can be conducted in multiple ways (Wangel 2011b). In their work, Similä et al. (2016) have provided one analysis on how actors can be added into a Neo-Carbon

powered energy future. In the transformative scenarios that are mentioned above, the actors described have become central actors in society and their activities mainstream. However, many actors that resemble them, already exist to some extent in today's societies. Therefore, they can be considered pioneers of these futures images who are paving the way into a sustainable Neo-Carbon future. The key idea and hypothesis in this survey is that ***futures knowledge can be obtained by identifying these forerunners and learning from them proactively.***

Understanding pioneers can thus be used as futures knowledge in the same way as weak signals. To continue what was discussed about the weak signals in the preceding chapter, Hiltunen (2013, 65) defines weak signals as "signals of emerging changes that can become something great – or not." According to our claim, pioneers may also be starting something big – or not. They may launch some ideas and activities that are today in the margins but may grow into the mainstream in the future – or not. By identifying and observing pioneers, glimpses of a possible future world and society are visible. The main difference between weak signals and pioneers is that weak signals are unlimited in numbers, whereas pioneers are rather few.

The concept of a pioneer origins from the military vocabulary, but Oxford English Dictionary defines it as "*a person who is among the first to research and develop a new area of knowledge or activity; or develop or be the first to use or apply (a new method, area of knowledge, or activity*)". A pioneer is a determined explorer of new innovation or possibilities. An often synonymously used term is a forerunner, a "*person or thing that precedes the coming or development of someone or something else*", as defined by Oxford English Dictionary. This is a more static definition, as such an actor might not be aware of being a forerunner in something. A pioneer is determinately looking for an opportunity for change. Pioneers are individuals or communities that are ready to tackle all obstacles of adopting new technology or innovations and by doing so, create space for new social practices and demand for new products in the markets that are needed for the new ideas to spread. According to our view, pioneers are futures conscious since they have the intention of creating futures. This is in line with one of the three main principles of futures studies and futures orientation "Future can be affected" by Amara (1980). Pioneers are paving the way to futures.

Pioneers have interested researchers' thinking for some decades already. In the 1950s Beal, Bohlen and Rogers (1957) studied the diffusion of purchase patterns of hybrid seed corn by farmers, and observed a pattern that Rogers later (1962) generalised as a "Diffusion of Innovation Model". The model describes how a new product or innovation is adopted or

accepted according to different adopter groups. The process of adoption over time is illustrated as a classical normal distribution. The model indicates that the first group of people to use a new product is called "innovators," followed by "early adopters". Next come the "early majority" and "late majority", and the last group to eventually adopt a product are called "laggards". ***Both innovators and early-adopters can be seen as pioneers.***

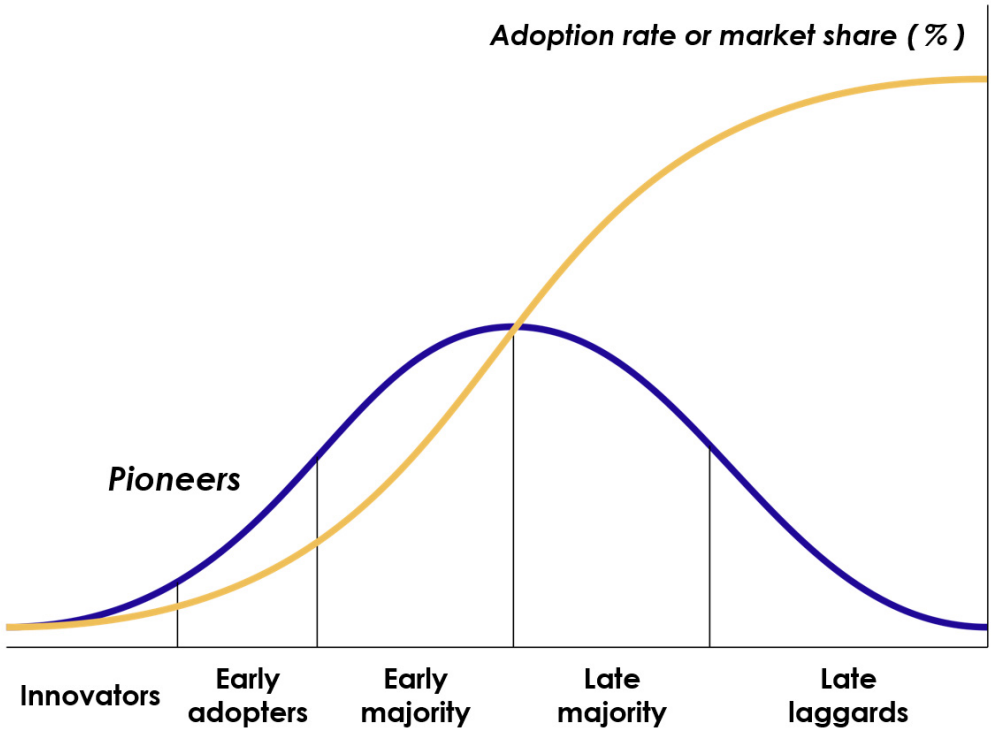

Figure 2. Innovation diffusion curve (adapted from Wikimedia Commons)

Not all innovations always get adopted at first place nor do all innovations adopted by early adopters get accepted by the majority (see Fig. 1). There are various reasons to that. Most importantly, as Rogers (1962) states, the innovation must be of value in itself, the communication channels functional, the timing right and the social system supportive. In our case, ***a renewable energy based system is currently highly desirable, and according to both scientists and a growing majority, it is urgently needed. However, there have been disagreements about the precise technological set-up and an entirely renewable energy based energy system is not yet well-known.*** In order to self-sustain, an innovation must be widely accepted and eventually reach the critical mass. (Ibid.) The key issue with pioneers is that, as Gladwell (2000) points out, in order to create a major change, you only need a few people to start it. A "tipping point" is the point where the critical mass adopts an idea /product and it starts to spread like a virus. From a futures studies' point of view, the key question is, how to support those pioneers, whose actions lead into a preferred future and what can be learned from them.

Pioneers can also refer to entire industries or countries as actors. According to Heinonen (2003) by observing countries or communities that have successfully adopted and implemented new technologies, new approaches to policy-making and societal planning can be found. The idea behind this *cultural pioneer analysis* is that high level of technology as well as rate and quality of technological innovation, combined with achievements in the culture and economy, put different cultures on a pedestal in different times. These ***cultural avant-garde civilisations accumulate and radiate cultural information to the rest of the world***. As an example, Heinonen gives the ancient Roman and Greek cultures that are considered as the basis of today's Western societies. To analyse different pioneering cultures today, the key question is "what should we do in order to understand and measure different cultural patterns and related views in order to understand indicators and parameters of change within a human community" (Heinonen 2003, 98). By observing pioneers and pioneering cultures, we will learn about the dynamics of techno-economic and socio-cultural change.

Social engineering, incentives, campaigns and nudging are methods to influence the context where individuals operate and try to initiate their "epidemics". Some countries manage to do this more efficiently than others. The aim of the pioneer analysis is to detect early seeds of change and prime movers, as well as analyse *positrends and negatrends*[3]. This means anticipating the possible positive and negative impacts of issues that are not yet well understood, in order to dig deeper in identifying cultural change and those that manage to take advantage of it. The aim is to "identify technological innovations and trends that are likely to influence or point to future development for analysis and to assess their significance from a socio-cultural perspective". In this study, ***a pioneer is understood as a forerunner of change for sustainability. They can be individuals, companies, organisations, communities, or even countries or cultures.*** By highlighting pioneers and their activities, projected paths and possible future worlds are lit and brought into discussion.

[3] Positrend' refers to growing trends especially in information technology that are likely to have a positive impact on individuals' lives and the functioning of communities and society in the future. The term 'negatrend" describes undesired developments and disruptive influences brought by the advancement and use of technology. (Heinonen 2003). The main point in applying analysis of posi- and negatrends with a view to pioneers as actors is to emphasise multidimensional technology foresight i.e. paying attention to both positive and negative impacts and implications of new issues.

2. GLOCAL INSIGHTS TO NEO-CARBON ENERGY AND ITS FORERUNNERS – THE RESULTS

As a part of the Neo-Carbon Energy Scenarios, described in the previous chapter, ***a questionnaire on the local insights and forerunners of Neo-Carbon Energy was conducted in August 2016***. The questionnaire addressed an international expert community that consists of members of the Club of Rome[4], the Millennium Project[5] and a network of national level experts. Most members of this international network are futurists or energy experts who are working on energy questions and/or societal change. The countries analysed in the Neo-Carbon Energy Project are Kenya, Tanzania, South Africa, China, Korea and Australia. In addition, Argentina and Chile have emerged as appropriate case countries for the project. It has to be borne in mind that some of the experts, particularly from the Millennium Project and Club or Rome, answered from the point of view of their own country or an entire continent that they represent. This was permitted and even encouraged in the survey. The survey was sent to some representatives located in the USA and Europe as well. In total, the questionnaire was sent to 143 recipients in 14 countries in summer 2016.[6]

In order for the respondents to be able to evaluate the scenarios, the working paper on the scenarios was sent to them in advance. ***The transformative scenarios 2050 can be read here in full length: https://www.utu.fi/fi/yksikot/ffrc/tutkimus/hankkeet/Documents/NeoCarbon-WP1-1-2016.pdf***. In total, 39 experts responded (~24%).

The questionnaire is qualitative and descriptive in nature. The experts were asked to evaluate, which of the scenarios are possible in the context or their country or region; which

[4] Further information on the Club of Rome to be found at www.clubofrome.org. The Club of Rome is an organisation of individuals who share a common concern for the future of humanity and strive to make a difference. Its members are notable scientists, economists, businessmen, high level civil servants and former heads of state from around the world.

[5] Further information on the Millennium Project to be found at www.millennium-project.org. The Millennium project is an independent non-profit global participatory futures research think tank of futurists, scholars, business planners, and policy makers who work for international organisations, governments, corporations, non-governmental organisations, and universities.

[6] The survey was planned, conducted and its results were analysed in a core team of the foresight part of the Neo-Carbon Energy project. Ms Merja Lang, a Millennium Project Intern at FFRC, executed the survey under the supervision by Sirkka Heinonen and Joni Karjalainen who also participated in writing the analysis and the working paper. The data will also contribute to Lang's master's thesis in the Master's Programme in Futures Studies at the University of Turku. The contribution of Karjalainen to the report throughout played a major role. There was also one respondent from Finland as a test respondent to check the survey questionnaire both technically and substance-wise. The responses received were included in the survey results as an equal contribution to the survey.

is the most probable; which one is the most preferred; and to elaborate on their choices. They were also asked to identify existing or potential forerunners in their own context. Each respondent answered in total 17 questions, of which three concerned each specific scenario and gave insights of their applicability in the local context: ***what makes a startup radical, how values show in a company's work, what motivates do-it-yourself engineers and how lifestyle can be expressed through energy choices?*** The respondents also gave their insights on how the society could better support those who are pioneering the neo-carbon solutions.[7]

The responses concerning each scenario are presented in this chapter in the following way. Each sub-chapter presents the given scenario text that was provided to the respondents in the survey form. They first present ***the results of an identification of relevant actors across countries and regions*** for each scenario (who is radical, which company is value-driven, who are green DIY engineers, or manifest new consciousness?). The respondents described ***the qualities of these actors*** and analysed ***what would make a particular scenario scale up***. Finally, the respondents were asked to compare the scenarios and decide, if they perceived them as ***possible, probable and/or preferable in their own context***. The research team ***identified the main themes emerging from the respondents' answers,*** which has been used to organise the text. Furthermore, the responses have been grouped ***across four regions: Sub-Saharan Africa, East Asia, Australia, and other countries***. The final group of other countries does not constitute a single geographical region.

This analysis aims to give insights ***on the different ways that respondents across the world currently perceive the status and potential for energy transformation*** in its multiple forms. The socio-cultural Neo-Carbon Energy scenarios 2050 were used to provoke futures-oriented thinking as seeds for future change that are already in the present. The survey allowed the scenarios to be contextualised, reflected and interpreted by individuals across the world who are familiar with prevalent local narratives, needs, and emerging trends. A concrete aim of this foresight exercise has been to also test these scenarios. They have been used as instruments of science communication. Thus, they provide a discussion tool on energy and social change, in order to yield understanding on how different stakeholders and citizens globally view the plausibility of the transformative scenarios, and ***what do they perceive as the preferred future for their own society***. It is important to bear in mind that scenarios are not predictions of the future, but insightful illustrations and narratives for possibly unfolding futures.

[7] See Appendix 2 for the whole questionnaire.

2.1 Glocal views on Radical Startups 2050

Radical Startups Scenario in a nutshell

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

The industrial structure changes radically, and drives the developments in the energy sector. The penetration of local energy solutions is driven by startup companies. Energy systems move towards distributed and prosumerist type of behavior. Consumers self-produce a major part of their energy. Power-to-gas and other energy storage technology breakthroughs are led by small and medium-scale solutions. Biomass use is consumer-driven and can be characterized as "small and medium-scale circular economy". Electricity transmission between areas is interconnected but with limitations.

Figure 3. Radical startups 2050 scenario (Heinonen, Karjalainen & Ruotsalainen 2016).[8]

The first set of questions in the survey regarded the Radical Startups 2050 scenario.[9] The respondents first identified actors in their local contexts that correspond to the radical startups described in the scenarios. Then, they were asked to elaborate the radical nature of the actor: what makes it radical, and stand out from the others. Thirdly, respondents gave their views and insights on how the society could support the efforts of these actors in order to make them flourish. The answers were clustered into groups, after which a common denominator was denoted to each cluster to highlight the differences between the clusters.

Who is radical?

A great majority of respondents identified forerunners for this scenario: Out of 39 respondents 36 respondent identified a "radical startup" type of company in their local context. Three respondents did not identify radical startups in their country / local context. As a reason to this, an Australian respondent described "the climate mostly unsupportive (Respondent #3)". The other two gave no answer.

[8] In the "Radical Startups Scenario in a nutshell" text above, the second paragraph about energy has been slightly modified from the survey text provided, due to a technical mistake. The responses highlight the local nature of the solutions more than the original scenario narrative about radical startups.

[9] See Appendix 2 for the whole questionnaire.

The named startups varied in their nature. ***The majority of respondents named a technology company whose products relate to renewable energy: batteries, solar panels, mini-grids, solar tiles for roofs, portable biogas units for organic waste treatment, and energy efficient drinkable super meals.*** The second largest group was companies that produce materials or biofuels: microbial fertilizers, nutrient recycling, calcium carbonate made from CO2, or that give consultancy in renewable energy issues. The third group was those that provide services with "a new angle: ecological travel agencies, community-based food production, transport solutions that use mobile internet, makerspaces, and mobile internet developers in general. Some respondents had a wider view on how to understand the essence of the radical startups scenario. Two respondents named social experiments / movements as examples of forerunners: the off-grid movement and communal living. Also a scientific research centre, some cooperatives, public transport systems, mass-media, middle and high school, political leaders were named. A similar type of radical, yet problem-solving mentality, as described in the scenario, can be found in other types of organisations, too.

What is radical?

Regarding the question on what makes the identified startup radical, there were again four approaches chosen. ***Majority of respondents emphasised the radicality of the technology or innovation the company produces or offers.*** Most of those companies were solar technology companies and are expected to be "one of the leaders in solar technology" (Respondent #14). A company operating in the field of nutrient recycling was described as creating a "new industry" (Respondent #6). As one respondent describes: the company offers radical solutions in conservative market (Respondent #17). In other words, radicality refers to new, emerging products.

A ***second group of respondents approached the question of radicality differently and saw it to be embedded in the innovative business models***. An illustrative example comes from Kenya, where the company (M-Kopa) introduced a mobile mode of credit and payment so that also people in the remote, rural areas are able to buy solar panels and related services.

A ***third group emphasised the impacts on society*** as being radical. Radical startups disrupt the need for a nationwide centralised electricity grid, provide new abilities for community food systems, or are in general going to disrupt the market they are operating in. Some of the identified startups are heading to become global market leaders, particularly those not directly operating in the sustainability sector. Some startups on the other hand are those aiming to provide energy to the poor communities. These startups help people to take back

control over power supply, claim energy sovereignty, and end dependency on biomass. Eventually, particularly in the poorer, rural areas, all this is claimed to result in improved health and education status of people. Their solutions are also stated to save money, which is seen as essential for those who only have little.

An interesting aspect of 'radical' was mentioned by ***the fourth group that emphasised the new thinking that comes along with their actions***: these pioneers live and lead by example, bring people and experts together, or challenge capitalism and bring about new, alternative values and environmental awareness, like the off-grid movement, for example. An example offered is "Commonground" that is "an Intentional Social Change community, established in the 1980s, "comprising social activists exploring their best collective contribution to the creation of a just, nonviolent and sustainable world". Their radicality is epitomised by their integrity commitment – to live by example – to actually be the change they want see in the world, unlike those networks of futurists and academics who acknowledge the need for radical change, yet do little more than study and comment on change movements." (Respondent #5).

What would make them flourish?

In order to make the radical startups flourish, an enabling environment must be accomplished. On who should be active on this, the respondents were like-minded. ***Action is needed from the government, private investors, customers and the companies themselves.*** The role of government is that of an enabler: less regulation and taxation, ending the dependence on coal, more incubating and real acceleration programs, pricing carbon, opening the national grids, offering economic incentives, making data open, making wise education policies and overall visionary policy-making. Several respondents criticised governments for the lack of foresight and vision in their innovation and energy policies. "Policies need to change as fast as the innovation happen", a Kenyan respondent (#25) states.

There should be public and private funding available, and particularly local investors. In the context of East Africa, the investment often comes from development funding, and respondents would hope to see more venture capital invested. Access to loans are also critical, for both companies and customers. It was also mentioned that "the investors should have confidence" (Respondent #19) – the change is not always fast, but it is evident.

Many respondents see the consumer side lagging behind in the development. People are too satisfied with the current (unsustainable) products and services. Awareness raising, education and a new mindset are needed in order to establish demand for new products

and services. Also companies must be fit for the future: they must have a supportive corporate culture, be reasonable with their pricing, and have correct technology and know-how.

Some respondents felt that startup culture is already vivid in their country. As an Australian respondent summarizes "they already flourish, provided they succeed in prototyping and have some worthy of investment" (Respondent #22).

Radical Startups in South Africa, Tanzania and Kenya

The respondents from South Africa, Tanzania and Kenya identified several forerunners of the Radical Startups 2050 Scenario. South African **AgriProtein** offers nutrient recycling, and **Solarus** solar power. The Tanzanian respondents named private (mostly solar) energy companies, **Juabar Inc., Solar grid Tanzania, M-Power off-grid electricity, Mobisol Tanzania, Sepon Ltd, Aweta,** and **Jamii Power.** The Kenyan respondents also listed energy companies: **Strauss Energy Kenya, Skylon Global Company, M-Kopa,** and **Solar World EA Ltd, Solafrique.** M-Kopa was mentioned several times. **Energy for Development Network** initiates private sector projects to increase access to energy in rural areas by developing replicable business models to supply energy.

The radical nature of these forerunners lies either in the nature of the technology or in innovative business models that enable electrification of remote, rural and often poor areas through affordable solar power. AgriProtein "is leading a new industry called nutrient recycling" (Respondent #6); Solarus "seeks to address affordable energy access by enabling access to hybrid solar technology" (Respondent #16). Juabar uses solar to power a network of entrepreneurs who do various kinds of business through a lease mode. Solar Grid Tanzania installs solar systems in rural areas and thus help to improve the health and education status of Tanzanians. Also schools and hospitals use their products. M-Power also offers off-grid technology for the rural areas and thus makes the communities less dependent on biomass. Jamii Power offers smart mini-grid systems that are powered by renewable energy sources such as solar, wind, biomass and hydro. These companies are radical as they provide smart energy alternatives that compete the on-grid government service provider TANESCO.

Strauss Energy Kenya has introduced solar PV integrated roof tiles which help to save money in the construction phase: "In Kenya the initial cost of an energy system is the critical selling point" (Respondent #15). Skylon Global Company is seen as radical because it electrifies rural areas. Energy for Development Network forms cooperatives that install mini-grids in a central hub and sell power to the businesses located at the hub, households, schools, health centres. They also harvest rain water, sell it, and act as a

micro-finance institution. "This model brings together a number of radical innovations that have currently gripped East Africa and has combined them to increase the efficiency and sustainability of distributing energy" (Respondent #26). M-Kopa's radical nature lies not only in the nature of its "multi-functional gadget using solar photo voltaic panes to conserve energy in the gadget to power lighting and radio services" but also in the innovative business model that combines a network of entrepreneurs as retailers and a credit scheme that "allows consumers to own and use the gadget on deposit and easy-to-pay loan instalments" (Respondent #29.) Also Solafrique has a distribution model that has never been implemented in Africa. This model, too, eliminates the need for a centralised grid system. Solar World EA Ltd have developed a specialised solar water heating company with its own manufacturing and assembly capacity, what according to the respondent makes it radical.

Regarding the support needed from society, the respondents crave for two measures above others: policy support and capital. Financial support should come both from the government and from private venture capitalists, and less in proportion from the NGOs and through development funding. "More confidence from the investors" is needed (Respondent #16) as well as incubators and acceleration programs. Renewable energy should be subsidised. Innovation policies should also be up to date: "Policies need to change as fast as the innovations happen" (Respondent #25). Also the national grid should be opened and energy market deregulated.

However, also education is needed, as it is crucial "to increase the awareness" (Respondent #30). What needs to change is "the mindset of the people and our leaders included. Global problems are evolving into more modern trends, our local governments in Africa are too slow in changing with the technological trends, they are still stuck on doing things the old ways" (Respondent #38).

Radical Startups in East Asia

In total, there were 7 respondents from East Asia, 4 from China, one from Hong Kong and two from South Korea. The companies identified from China were **DiDi Enterprise Solutions** (an online transaction platform), **Xiaomi Inc**. (Electronics manufacturer), the mulberry fishpond (artificial ecosystem) and the online industry as a whole as the most active area of innovation and entrepreneurship. The respondent from Hong Kong did not consider this scenario relevant in their local context.

One of the Korean respondents named a cooperative that deals with environmental problems, as a radical startup. The other Korean respondent described a difficult situation

in which the ecological enterprises have been in Korea. Since the price of gas went down, many of them had to close down.

Respondents' describe the 'radical' aspect of the identified companies in the following way. The Chinese respondents emphasised the fast growth of the companies: DiDi Enterprise solutions has grown fast and is now the world's second largest online transaction platform. The company has successfully reduced transportation cost, improved private income, and eased the traffic congestion through Internet technology and sharing economy. Xiaomi also represents a company that has managed to establish itself fast among the already established companies on the market such as Huawei and Lenovo. The company is aiming not only to be the number one brand in China, but to expand globally. Internet based startups make, according to a respondent, the fastest growing industry and the Chinese government is supporting this development, too. A different aspect of radicality was offered by one Chinese respondent who had identified the mulberry fishpond as a radical startup. According to the respondent, the radicality lies in the innovation that combines fish farming, silkworms, fertilizers, and that together form an ecosystem that provide fresh fish for human consumption.

In Korea, some startups had launched town building projects which adopted new renewable technologies including solar photovoltaics (PVs) and geothermal power. They tried to create an entirely new model of "town" and lifestyle of self-sufficient prosumers' community. Now most eco-businesses are based on small techs or parts and materials, which would be included to a larger new energy system. But they, according to the respondent, lack the radical aspect and can rather be considered as social enterprises. Identified cooperatives, on the other hand, teach people how to do farming but also "enrich understanding on how important sustainability is for the well-being of future generations" (Respondent #23).

Regarding support for the startups, the Chinese respondents felt that the companies are doing quite well without governmental support, and that if there was support, it should be market-driven. In general terms, the role of the government is to strengthen the network security and norms. Rather, it is the companies that should make sure that their pricing is on the right level, and as for the fishponds, to have correct know-how and materials. In the case of Hong Kong, the government was recommended to open up the two unconnected electricity grids, the "Hong Kong island" one owned by Hongkong Electric and the "rest of Hong Kong" owned by China Lights and Power. Otherwise, power production continues to be in hands of only two companies, and radical startups cannot emerge in the energy sector.

Radical Startups in Australia

The Australian respondents identified several different forerunners of the "Radical Startups 2050" scenario. Notable is that two respondents identified none and four named a forerunner other than a company, such as **Jose Ramos and makerspace, Bellbunya and Commonground** (communities), and **Off-grid Movement.** The companies identified are either solar technology companies such as **Sunwiz, AAE AgriEnergy and Tractile. BioBowser Renewable Technologies** produces portable biogas units for biowaste.

As the nature of the actors identified varies, so does their 'radicality'. It can have a social nature, such as the makerspace that connects makers focused on 3D printing; Commonground members that live by example and are like the change they want to see in the world; or the off-grid movement that has gone from individuals and farms to now encompassing whole communities working towards going completely off-grid. This radicality changes the attitudes of people. As the respondent describes, the radicality is manifested as "people taking back control as it is about environmental responsibility" (Respondent #22).

On the technological side, the potential of these startups is emphasised in the responses: Sunwiz has attracted foreign competition due to its performance particularly in the remote areas. AAE Agrienergy offers radical solutions to a conservative market: solar power for agriculture. Biobowser offers "an innovative solution to the management of organic waste for businesses and households" (Respondent #18). Tractile did fundraising and product development independently and [they] have introduced solar tiles for roofing, which is "a new idea with tremendous potential" (Respondent #20).

The views were relatively unanimous with regard to support from society. An answer given by several respondents was the government obligation to end the coal dependency and transferring the subsidies to renewable energy. Also, there should be a greater commitment to innovation from various levels of Government (Respondent #14).

Lack of vision was another fault of the government that should change: "the inability to envisage a plausible post-capitalist, post-growth, world operating system" (Respondent #5). The awareness of the government and government funding to the renewable energy sources should be increased (Respondent #18, Respondent #20).

One respondent felt that radical startups already flourish "provided they succeed in prototyping and have something worthy of investment, and that they can easily relocate to startup hubs elsewhere in Asia" (Respondent #22).

Radical Startups in other countries

The other respondents mentioned four American companies, **Excellatron, Calera, Aurora Biofuels, and Johansson Global Technology (JGT),** are perceived to have radical new technology that can change the energy game. They are coming from unique, highly creative and very serious inventors who have situational awareness both of markets and of core technology principles. With enough support, any one of them could add value and drive a market-based transition. Excellatron and JGT have a high efficiency heat-to-electricity capability, Excellatron provides a rechargeable battery, which has an energy density 5-10 times better compared to the best Chinese batteries now available. Calera and Aurora have pioneering ways to recycle CO2, to construction material, fish food and car fuel, all that are considered much more economic than carbon sequestration. (Respondent #8). **Solar Impulse 2** is a solar aircraft that flew around the world (Respondent #7). **Sustentator** is devoted to providing pragmatic and sustainable RE solutions, especially solar panels, wind generators, solar installations or thermal-tanks. Its blog has over 1.1 million followers and an online shop of ecological products (Respondent #32).

Growing Power in Milwaukee, Wisconsin is a non-profit organisation and land trust that provides local, diverse people with the ability to produce nutritious food and to create community food systems (Respondent #9). **GOiENER** is a cooperative that operates on the generation and consumption of renewable energy (Respondent #24). Similarly, local cooperative organisations in Latin America that provide power generation were identified as radical startups (Respondent #13). **Duara Travels** is a company, which is aiming for more equitable and localized travel experiences, as an online service that gives access to everyday life in Africa, Asia and Latin America. **Ambronite,** a healthy meal replacement protein shake is marketed to "creative and ambitious individuals who deserve the best possible food to live their life to the fullest". (Respondent #1). The company argues that the food we consume has a critical impact on health, productivity and happiness.

The respondents from other countries suggest that more innovators need to be committed to this type of social innovation. Furthermore, innovative startups need to be supported, connected successfully to (venture) capital as well as other resources that they need for their projects. One respondent suggested authorities to adopt a market-driven approach that encourages innovation and new business models that serve "real needs and interests". Another respondent underscored that the mission of radical startups could be further aided, if the lobbying of global energy companies as producers and distributors was better monitored and controlled.

Figure 4. Juabar Inc. was one of the radical startups identified by the survey respondents. Juabar Inc. is a startup that operates a solar kiosk business model in Tanzania. Their service lets locals charge their phone from their mobile kiosk, which is powered by solar energy, employing a network of local entrepreneurs.

2.2 Glocal views on Value-Driven Techemots 2050

Value-Driven Techemoths Scenario in a nutshell

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

Tech companies develop energy technologies and produce energy, mainly in solar and wind but biomass is also used. Companies provide products and services that reduce CO2 emissions. Energy solutions vary from company to company according to their different needs. Demand for energy is high, but ubiquitous smart technologies somewhat mitigate consumption and corporation-scale neo-carbon system neutralises emissions. Inequality causes waste of energy. Energy education is provided mainly by tech companies. Smart technologies are not evenly distributed. Infrastructure is often in relatively poor condition outside tech campuses. Citizens are not committed "by heart" to energy issues. They assume that energy issues are taken care of by somewhere else, as "automated".

Figure 5. Value-driven techemoths 2050 scenario (Heinonen, Karjalainen & Ruotsalainen 2016)

The second set of questions regarded the Value Driven Techemoths 2050 Scenario. The respondents first identified actors in their local contexts that more or less correspond to the value-driven techemoths that are described in the scenario. Then, they were asked to elaborate on how the values show in the company's work. Thirdly, respondents gave their views on how the society could support the efforts of these actors to make them interested in investing in the development of renewable energy based solutions and services. The answers were clustered into groups, and a common denominator was assigned to each cluster to highlight the differences between them.

Who is value-driven?

Out of 39 respondents, 6 did not identify any value-driven techemoths in their local context. The rest identified one or more. The identified actors were clustered into groups by their nature: GM, Ford, Toyota, Exxon, Boeing, Huawei, Lenovo, Samsung, LG, PHP Billington, Unilever, Google, IBM, and Philips. Many of these companies have started affiliates, support startups or have established businesses around renewable energy, even though the core business was elsewhere.

Another group was traditional energy producers and distributors: Neste Oil, Origin Energy, Powershop, Energex and Ergon, Shell, PJM, Exxaro, Kenya Power Company, Edeanor and ISA. Also many of them have shown interest in renewable energy production, though the core business is still in the non-renewables.

Some respondents identified local renewable energy companies as value-driven techemoths: Panax Geotherm, Sky Solar Holding Co, Epuron, M-Kopa, Gamesa, Mumias Sugar Company, D-light Solar Company and Mobisol. Particularly many African respondents mentioned telecommunications companies; they form a group of their own. Finally, in a group of responses, the scenario was interpreted in a more loose way. The Mondragon conglomerate (workers' cooperative, based in Basque Country), Sunshine Coast Council (public sector) in Australia, and China's environmental protection company were mentioned.

How do values show in the company's work?

The respondents approached the question on how the values show in the company's work differently. Many saw the company's values as being currently negative: they lobby to block climate change legislation and to protect their market position, they operate across the world, but their sustainability reports are written in the headquarters, they control all energy distribution in a given country. Overall, many of these companies and their internal actions are perceived as a challenge to the energy transition: how to get them on board and how to shift their cultures?

The biggest group of respondents, however, described the values in the identified companies as positive. These values relate to *internal values:* they may have nice, corporate working conditions or they might have given a nickname to their employees. Many companies ***show an interest in the sustainable energy production***: They have moved from traditional electricity towards solar; they are actively participating in joint renewable energy initiatives; "though being traditional the company is reinventing itself to take advantage of new technology"; they manage a huge solar farm; they have developed spin-off companies in the eco-business area such as battery enterprises; their smart energy solutions improve productivity; and they use their biomass waste to start a by-product bio-fuel production in the country.

Some companies' values establish themselves in the *way* ***they operate with their customers or the surrounding communities*** as a whole: they offer consumers tech-based transparency; they have opened financial services even in the remotest areas; they attract major

investment in long-term energy supply; and finally, a company has developed mobile money that benefits those with less financial opportunities.

A small group of respondents named companies whose business is in the renewables. Many of these respondents see it as a value-statement in itself that the company has chosen to contribute to the transition to renewable energy. ***But values show in their work in other ways too:*** their solutions are cheap and thus available for many; they have partnerships with different organisations and companies and they raise awareness about clean energy; they sponsor students to take master's degree in renewable energy; they have teamed up with others to attack large international companies, they have developed a system to distribute their solar products throughout the country and to make the payments with mobile money. Finally, the renewable energy that they produce is often cheaper than the energy over the on-grid energy supply provided by the government, which makes it thus available and affordable also for people in the poorer areas.

A fourth group of respondents associated the impact of the company with its values: A company has a strong position in the market, or even a sweeping influence on global businesses; the company has massive resources; the company has revolutionised the communication and business environment; the company helps customers and other industries to reduce energy consumption by leading green solutions; they are likely to tap into other sectors of business; the company works together with a university for biomass power generation technology development. It is not necessarily clear, how the companies mentioned in this group, will turn into value-driven techemoths. As one respondent summarises: "It's too early to say how the values in this company merge [Energex and Ergon] and will play out in regard to the scenario you describe" (Respondent #5).

What would make large companies develop products and services based on renewable energy?

As in the case for start-ups, again the role of governments as enablers and supporters is seen as essential. A vast majority of the answers list government actions needed: carbon tax, subsidies, investment in green technologies, policy support in general, tax breaks, access to finance, good environment for auctioning, fast tracks for renewable producers, access to national grids, right incentives, grants that support early stage projects, more openings to private sector initiatives, investment in research and development (R&D), public-private partnerships (PPPs) in investment and production, favourable legal environment, availability of expertise, reliable statistics, and rewarding companies who produce renewable energy.

The role of the public is seen as more significant in the case of techemoths than in the case of startups: there should be social pressure, customer pressure, change in public attitudes, more demand and higher awareness. Particularly in East African countries, the low penetration of on-grid energy supplied by the government to rural areas and its (poor) reliability means that there is a great need for new technology, which is why the governments should not stand in their way.

One group of answers referred to ***circumstances*** where the motivation could emerge: increase in oil price, realism about the climate change, following megatrends, technological advances, global demand for green economic development and finally: energy scarcity. Clearly one such "circumstance" is the business logic: profit, low development cost, saving costs, economic viability, return calculations and strong financial returns for shareholders – they all would clearly motivate these companies.

Value-driven Techemoths in South Africa, Tanzania and Kenya

In the cases of Kenya and Tanzania, there was a relatively shared view on who are the techemoths in East Africa: the telecommunications companies. Out of 14 respondents from these two countries, 7 respondents answered **Vodacom** or **Safaricom Kenya**. **M-Kopa** that was already introduced as a radical startup, was selected also as a forerunner of this scenario, as it is a spin-off of Safaricom. One Tanzanian respondent did not identify any value-driven techemoth in the country; one respondent named "the solar power" industry in general. The Kenyan respondents identified also **Kenya Power** as a techemoth for this scenario. One respondent pointed out that most of the techemoths operating in the country are multinational companies and not local ones. An interesting example of a local company was identified by another Kenyan respondent: **Mumias Sugar Company** produces biofuels out of sugar. One South African respondent identified the mining company **Exxaro** as a value-driven techemoth; but the other South African respondent did not identify any.

The values were seen to show in the company's work in different ways: Exxaro is actively participating in renewable energy initiatives, both to ensure security of supply for its own mining operation and to reduce its carbon footprint. Some solar power companies in Tanzania have also partnered with traditional energy development organization which does awareness creation on renewable energy. Some companies have also sponsored students to take master's degree in renewable energy in different countries in America.

Vodacom is described to be available everywhere in Tanzania, having nice working conditions, and to be using solar electricity to power some of its towers. Safaricom has launched a pay-as-you-go pico-solar system called M-Kopa, targeting homes in rural areas where grid electricity is not available. The company has also earlier developed mobile money system M-Pesa in order to cater to its customers. One respondent describes Safaricom as "an innovative company, they would most likely tap into other sectors that promise "great profits" (Respondent #26). Another respondent described Safaricom as "a clear example of techemoths using their unlimited resources to offer value across industries" (Respondent #31).

A clearly different company from the others mentioned is Mumias Sugar Company, said to be the only sugar company that has made use of its biomass waste materials to start a by-product bio-fuel production in the country. The ethanol is used for heating and lighting.

Kenya Power was also given as an example of a techemoth. However, a respondent describes it in negative terms: they control prices and how and when people receive power.

As for what is needed for the techemoths to be interested in renewable energy products and services, the answers are similar to those from other respondents: profit, carbon tax, willingness to change, policy incentives, tax breaks, subsidising renewables, low development costs, directives from the governments and international organisations, demand from customers, grants, public-private-partnerships, availability of expertise. The only area-specific aspect on how to create motivation is the availability and access to micro-credit, which respondents from other areas did not mention.

Value-Driven Techemoths in East Asia

Five out of seven respondents from the East-Asian region identified forerunners for the "Value-Driven Techemoths 2050" scenario. The South Korean companies mentioned were steel and iron manufacturer **POSCO**, **Samsung** and **LG** that all have "neo-energy part or ecoenterprises" (Respondent #27).

The Chinese companies identified were mainly gigantic electronics manufacturers: **Huawei, Gree Electric Appliances, Haier,** and **Lenovo**. One respondent identified **China's environmental protection company** as a forerunner for the scenario. Also **Alibaba Group**, an online retailer and **Tencent**, a holding company whose subsidiaries provide media, entertainment, internet and mobile phone value-added services and operate online advertising services, were identified.

Huawei's values show in the smart energy solutions that improve productivity. It has also joined efforts with industry-leading partners to provide customised solutions for energy enterprises. Huawei's mission is also to eliminate the digital wide gap and make broad band accessible for all. Alibaba Group was chosen as a future techemoth due to its fast growth and "sweeping influence on the global businesses" (Respondent #11). Internally values show for example in the custom of calling the employees with a nickname "Ali-people". China's environmental protection company develops ecological technologies together with universities (recycling of heavy metals, energy from biomass etc.)

LG and Samsung both have developed spin-offs, specialised companies strongly linked to the mother companies. Samsung SDI and LG Chemical focus both in developing new batteries to pave way to the energy transition.

As for what would make companies interested in developing products and services on renewable energy, the respondents gave very similar answers to those from other regions: Policy support, increase in oil price, energy scarcity, global demand, customer pressure, more market surveys, more funding, investment and resources. A respondent from South Korea pointed out that simply an awareness of fighting climate change and the related energy transition as a megatrend would make the companies invest in related solutions.

Value-Driven Techemoths in Australia

The Australian respondents named mainly energy companies as forerunners of the "Value-Driven Techemoths 2050" scenario. **Origin Energy** is a traditional, leading energy company in the country. Another energy giant is the merger of **Energex and Ergon**. **Powershop** is a smaller and greener rival. **Panax Geothermal** is a geothermal technology company. **Epuron** introduces itself as the leading renewable energy company in Australia. Other big industry where respondents identified large companies that could be seen as "techemoths" were mining companies, even though they do not produce from renewables. One mining company named was **BHP Billiton.** A different type of answer is given by one respondent that has identified a public sector institution, **Sunshine Coast Council** as a forerunner of the scenario.

Values show in their work differently. According to the respondent, Origin Energy is now turning from traditional electricity to solar. Powershop offers consumers "tech-based transparency" (Respondent #3). All energy is chosen through an app and usage is visible on the app. "Large energy firms are beginning to take notice of these smaller disrupters" (ibid.). BHP Billiton is according to the respondent "reinventing itself to take advantage of

new technology" (Respondent #14). Regarding the merger of Energex and Ergon, the respondent feels it is too early to say how the values will develop. However, the goal of the government-driven merger was to leverage scale to invest in new technologies such as battery storage, solar generation and smart meters. Panax Geothermal has been able to attract major investment in long-term energy supply. Epuron on the other hand has advanced technology that allows solar systems to be integrated with diesel or gas generators, an important feature for mining and utility clients. The example of the Sunshine Coast Council is different due to its public nature. The council took on development and management of huge solar farms to provide power to the population. "The council is already providing all the basic amenities from housing to leisure to education, and the energy sector is just an extention of these", the Respondent #20 describes the essence of this "techemoth."

As motivation for these companies to develop services and products on renewable energy, the respondents gave very similar answers than those from other countries: Cost of supplies, government support, change in attitude (in companies) subsidies, targets, mandates, accountability, **government initiative,** leading by example (both leading companies and public actors), access to finance and return of investment and prioritization.

Value-Driven Techemoths in other countries

The respondents from other countries listed large traditional energy companies, car manufacturers and emerging renewable energy companies.

Large energy companies, such as **Neste Oil** in Finland, have been perceived to make attempts for sustainability and to have set up sustainability policies, but some of these attempts have been of limited impact. (Respondent #1). Similar cautions were expressed about **Shell, Exxon** and **Boeing** that were identified as very important actors, but who were not "living up to their potential" or seen to "draw their sustainability reports in their headquarters". **Dupont,** a multi-national chemicals and health care company was seen as "positive or neutral". (Respondent #8). **ISA** from Colombia has been growing and combining more operations for energy generation, transmission and distribution, and expanded to other countries. In the US, **PJM Interconnections LLC** is a regional transmission organization (RTO) and a leading electric utility.

In the automotive industry, **GM, Ford** and **Toyota** are lead players. All of these players are seen as potential agents of progress, but highly dependent on smaller partners for

creative options and on partnerships with government or regulators to define them the context, and do market design. It is seen that these large companies will have a role to play even if high numbers of novel startups emerge. The **Mondragon Corporation** based in the Basque region of Spain, which has a philosophy of participation and solidarity was mentioned, as well as "old style company towns that provided everything" (Respondent #9).

ABENGOA has applied innovative technology solutions for sustainability in the energy and environment sectors, by generating electricity from renewable resources, converting biomass into biofuels and producing drinking water from sea water. **GAMESA** is a technological leader in the wind industry and a global company operating in 55 countries. In addition to wind constructions phase, the company also provides the wind turbine operation and maintenance services (Respondent #24).

In Argentina, **Sky Solar Holdings Co** teamed up with Enarsa, the public sector power company, to build a 20-megawatt solar complex in San Juan province for about $70 million. Spain's **Solaria Energia** & **Medio Ambiente SA** and local developer **Aldar SA** also have similar agreements, following a state tender in 2013 to counter large international solar energy companies.

These respondents mention that a favourable legal framework and an environment with the right incentives can push these companies further. Investments by the large companies in research, development and innovation (R&D&I) are seen as important factors, which could lead to the creation of new energy products and processes. One respondent suggests that the ***techemoths can also partner with local producers***. Even energy-intensive industries like mining can benefit from distributed solar power. In high altitude areas where there is a high [solar] insolation, the conditions are perfect for large companies too. One respondent mentions the necessity to develop local skills and companies. This aspect may be one area, where large companies need to place further consideration.

Figure 6. Alibaba Group is a Chinese e-commerce techemoth, which nicknames its employees as Ali people. Alibaba Group is engaged in c2c, b2c, and b2b trade.

2.3 Glocal views on Green DIY Engineers 2050

Green Do-It-Yourself (DIY) Engineers Scenario in a nutshell

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

GREEN DIY ENGINEERS

Local wind, solar and biomass are the main sources of energy. Energy is used as little as possible. Energy solutions vary greatly from community to community. Some communities are off-grid. Energy technologies have to be built using local resources mainly. Scarcity drives towards more diverse energy pallet compared to other scenarios. Local democracy ensures rational decisions and enforces commitment to decisions considering energy.

Figure 7. Green DIY engineers 2050 scenario (Heinonen, Karjalainen & Ruotsalainen 2016),

The third set of questions regarded the Green DIY Engineers 2050 scenario. The respondents first identified actors in their local contexts that correspond to the green DIY engineers described in the scenario. Then, they were asked to elaborate the motivations of these actors. Thirdly, the respondents gave their views and insights on how society could support these actors' efforts. The given answers were clustered into groups and a common denominator was identified to each cluster to highlight the differences between them.

Who is a green DIY engineer?

34 out of 39 respondents were able to identify a forerunner for the Green DIY 2050 scenario in their local context. 2 respondents did not find this scenario relevant for their context. This does not mean that these kinds of actors would not exist in these areas; the respondents may have considered the scenario narrative as a whole and therefore found no one suitable. One respondent mentioned that there are "DIY eco-engineers" in Korea, but that DIY engineers might struggle in a collapsed economy.

In comparison to the two previous actors, startups and techemoths, the nature of these identified engineers varied more. The 34 identified green DIY engineers were grouped in 6 groups: ***1) Non-governmental organisations (NGOs) and Think and Do Tanks, 2) alternative experiments or communities, 3) universities and other schools or research institutes, 4) DIY***

renewable energy producers (individuals), 5) companies (and their representatives) and 6) cultures. Individual producers and companies overlap and many actors could be placed in several of these groups. However, in the company group there are also other companies than energy related ones. These two groups form the largest group of answers. Six respondents named an alternative experiments or communities, some based on activism, lifestyle or even public effort: urban gardening movement, transition town movement, several eco-villages in planning or already existing.

An interesting view to the Green DIY Engineers scenario was taken by those who saw this mode of operating as characteristics of entire cultures. According to one respondent, the Australian culture is based on DIY mentality. Another respondent identified the Bushmen culture to be based on this.

What motivates Green DIY Engineers

A way of describing the motivations reported in the answers underlying the DIY Engineers actions is to see ***DIY as mentality, DIY as activism, DIY as learning, DIY as a statement, DIY as business, DIY as fun, and DIY as a necessity***. DIY as mentality would cover those answers that see DIY as a cultural feature, like in the Australian view. At the same time, in the case of Bushmen, their DIY mentality could also be seen as rising from necessity. For NGOs and social experiments, DIY could be seen as a form of activism, like in the case of Finnish NGO Dodo that has pioneered urban farming, in order to raise awareness about the origin of food, carbon footprint of food production, and use of public spaces. DIY as a statement could be seen as the underlying motivation for those social experiments where a community or village showcases an alternative lifestyle that is made technologically possible. DIY can also be about business, as is the case for companies and individuals that produce energy for others. This does not mean, however, that money would necessarily be the ultimate motivating power for those entrepreneurs or prosumers. DIY means having fun for those makerspaces such as Home of China Electronics DIY that according to the respondent is fun-seeking and where makers meet and showcase their work. In the case of universities, research institutes and schools, DIY can be seen as a learning method. What students want to learn, depends of course on values embedded in the curricula. Ultimately, the motivations behind DIY activities are thus ***values, money, enthusiasm and need for energy***.

How can society support Green DIY Engineers?

Regarding the support needed from the society, the respondents had a wider variety of answers than related to the two previous scenarios. Also DIY engineers are seen to be in need of ***governmental support***: ceasing to subsidise coal and gas companies, opening energy sector, motivating local actors, removing obstacles, creating a more relaxed and free environment to develop, recognising achievements and learning from what works, reducing red tape, and investment in technology transfer and technology development. However, more is expected ***from society as a whole***: 7 respondents pointed out that people should buy the products these DIY engineers produce and thus create demand. When not creating direct support, many respondent suggested that these DIY engineers should get recognition in a form of awards and belief in their solutions and innovations. Funding was seen as an important form of public support, though not as often as in the case of the previous two scenarios. Also the third sector was seen as a platform where such models should be promoted. ***The role of education*** was mentioned as an important way of support: reinforcing higher education in engineering, better linked education and business sectors, incorporating renewable energy in education curricula, and providing the engineers with other important skills needed for disseminating their solutions: design thinking, marketing, accounting etc.

Four respondents felt that DIY engineers ***do not need any further support***. They either already are well supported or the engineers are seen as autonomous actors that do what they do. In this view the question is rather: how to make society be motivated to adopt new innovations?

Green DIY Engineers in South Africa, Tanzania and Kenya

The respondents from Tanzania, Kenya and South Africa identified several forerunners for the Green DIY Engineers scenario. Only one respondent out of 15 respondents did not identify any. The two South African respondents identified two different types of DIY Engineer communities: **SolarTurtle – Ugesi Gold**, a renewable energy social business focusing on rural and informal settlement electrification and the **Sustainability Institute**, situated Lynedoch Ecovillage that provides a space for people to explore an approach to creating a more equitable society. The institute cooperates with the University of Stellenbosch.

The social aspect was important in the answers from Kenya and Tanzania. **Kibera Lighting Project** trains young people living in the Kibera slum in Nairobi, Kenya to assemble portable solar lamps out of locally available materials. A Tanzanian respondent identified

the makers of efficient cooking stoves as forerunners: the stoves help to mitigate deforestation. **Juabar Inc**, a Tanzanian company that runs solar-powered mobile phone charging stations that was already introduced previously as a radical startup, is seen as a forerunner for this scenario, too.

There were several female innovators mentioned: **Chebet Lesan** and her **MOTO Charcoal** has identified a process of making charcoal from urban waste. **Diana Mbogo** managed to transform her DIY skills into a business and now provides cheaper alternative energy options to businesses in Tanzania and **Christina**, whose last name a respondent did not mention, also sells charcoal briquettes made out of waste.

Bob Harries Engineering Ltd specialises in mechanical and electrical wind systems. Harries started his company after he had first installed wind pump for his own farm and then started to provide wind systems to neighbouring farms too. **David Kinyua** is an engineer that helps to electrify rural off-grid villages with a Pico-Hydro system. Another named Kenyan forerunner was **Kariuki Kiragu**, an architect "who believes in creating closed loop communities that generate their own energy, food and economic systems" (Respondent #26). Tanzanian **Laurian Mchau**, an innovator and manufacturer of wind turbines, biomass fuels, electrochemical power as well as hybrid systems for wind and solar, was also mentioned as a forerunner for this scenario.

The respondents named also some communities as DIY Engineers, such as **Tanzania Renewable Energy Business Incubator (TAREBI)** and **Kitonyoni off-grid rural market village** in Makueni County, Kenya, that was electrified with the assistance of **Energy for Development Network** and **the engineers at the Jomo Kenyatta University**.

The motives of these forerunners can be classified under values (environment, women empowerment), necessity (electrifying urban poor and rural poor), and money (income generation, job creation). In comparison to other areas, in this region technology enthusiasm was a less important source of motivation. The only DIY engineer identified that was described to get their motivation from technology as such was Laurian Mchau who was presented as a "technology enthusiast committed in outing his theoretical knowledge in practical applications" (Respondent #28). For the others, the main motive was of social, economic and/or ecological nature.

Regarding the support needed from the society 8 respondents out of 15 mentioned "buying their products" as a good way to support DIY Engineers. One respondent added also the importance of not only buying but also becoming a brand ambassador (Respondent #39).

Governmental support was mentioned only three times: as creating a favourable regulatory environment, opening the energy sector, government advocacy for such models, technology transfers and curricula for schools that contain renewable energy. One respondent felt that the government should shift its thinking in relation to how it measures "success" and "efficiency". Access to capital was mentioned only twice. The third sector was seen to have a role in promoting the innovations.

One respondent saw recognitions and awards as a good way to show support.

Green DIY Engineers in East Asia

Four out of seven respondents identified a forerunner for the Green DIY 2050 Scenario in their local contexts. The nature of the four presented DIY Engineers varies a great deal. **Tiancunlu community of Haidian District in Beijing** is a culturally valuable area currently going through a renovation and trying to revitalize its economy while preserving its uniqueness. This is an effort which demands social collaboration from the residents. Another community with a very different nature is the **Home of China Electronics DIY.** It is a DIY community with registered members wanting to showcase their work: solar-powered lamps, desktops, electronic amplifiers etc. A third example from China is **a public official** who renovated his house and installed solar panels and now produces his own electricity.

The Korean respondent suggested **Pul-mu agriculture technology school** as a forerunner. In this school, students learn how to do farming by using diverse innovative technologies. As for the motivations behind the actions of these DIY Engineers, they differ greatly. The respondent describes the mentality in the Home of China Electronics DIY as following: "For example, the one who made the solar-powered lamps said that he made the lamp simply for pleasure". It is about fun and enthusiasm over technology as such. In the Tianculu case, the motivations are cultural, social and economic. The public official that went solar reported that he "got retired from work and felt that the fees for electricity are relevantly high and he decided to look for relevant references and start experimenting for his plan" (Respondent #35). The Pul-mu school aims at societal impacts: the student that graduate from the school remain in the rural area and make the area better by becoming activists, engineers and government officials and help the communities through introducing innovative farming technologies.

Regarding the public support for the DIY engineers the Chinese respondents felt that the connection between the society and DIY communities was rather loose. In Hong Kong, there was a feeling that DIY engineers are neither encouraged nor supported (Respondent #37). Or inversely: it should be even more so. The DIY engineers of Tianculu

community should get a "more relaxed and free environment to develop" (Respondent #10). The Home of China Electronics DIY is "a community who enjoy themselves". These DIY engineers neither seek to make profit nor establish fame. Thus the question should be, as the respondent points out, rather: how to motivate the community to direct their efforts into developing solutions around renewable energy? According to the respondent, funds such as Alibaba (a giant online retailer introduced in the Value-Driven Techemoths 2050 chapter) could be an incentive. Another solution could be crowd-funding as suggested by another respondent. A third suggestion on how to support them, would be to offer club space and expertise for the DIY Engineers.

Green DIY Engineers in Australia

The Australian respondents identified 7 forerunners for the Green DIY Engineers Scenario. In comparison to the answers from other regions, the Australian answers were more culturally or socially oriented. **Dada Paramatananda**, an individual "trying to create free energy using meditation" was the answer furthest away from a traditional engineer interested in technological development. **Crystal Waters Community** is also a community experimenting alternative lifestyles developing permaculture, off-grid energy, democratic principles and small businesses. Another example of alternative lifestyles is the **Byron Bay area**, known for its deep green, artistic and spiritual communities. One respondent describes the Australian culture as a whole as a DIY culture: "Individuals are raised this way […] A typical Australian is raised to respect nature and their land. They are financially conservative and family-minded. They take care of their environment, their mates and their family. They are resourceful and well-educated and mindful of their consumption (Respondent #3). As an example of a small group of DIY engineers, this respondent names **Grey Army**.

Community based initiative, thought approaching more a traditional engineering projects is the **COREM Initiative** in Mullumbimby, where the residents formed a community to make the town run with renewables again. Another similar effort is currently taking place in **Tyalgum community** with their **Temby Energy** initiative. A future model for such initiatives could be **RegenVillages,** a Denmark based architectural firm's concept for "Tesla of eco-villages", as referred by Respondent #18.

One respondent identified a more traditional Green DIY Engineer: **Dean Stehling,** CEO of **CIH Solar**, who "has been researching and implementing solar energy systems for over 25 years. He lives in a part of Australia where the environment has been devastated by coal mines and he wanted to explore alternatives" (Respondent #14).

These DIY communities and individuals are all motivated by values particularly. These DIY engineers are worried about coal mines, deprivation of the environment and climate change. They are interested in democracy, equity and spiritual values. For them DIY is most of all activism and a statement.

How then to support such initiatives? Two respondents feel that society already does support them, for example through buying their products. Four respondents want governmental action: reducing red tape, connecting education with business, offering seed money and most importantly, end coal-dependency and subsidies. One respondent feels that the public should be better aware of new, proofed, ecological living concepts.

Figure 8. Crystal Waters Community is pioneer as the world's first permaculture village.

Green DIY Engineers in other countries

There are several examples in other countries. In Austria, a farmer built a local district heating system, which was first fuelled by waste wood from the farmer's own forest but one that now also incinerates garden waste of his clients, mostly single family villas (Respondent #7). In Finland, ecological DIY thinking is pushed by environmental NGOs and communities, such as **Dodo ry** or **urban gardening initiatives**, motivated by a sense of community, promotion of organic farming, alternative lifestyles and sustainable values (Respondent #1). In contrast, **the Kalahari Bushmen** in southern Africa are seen just trying to keep their clans alive from day to day.

One respondent suggested that to maintain high tech (e.g. televisions or PCs) under harsh conditions, like described in the Green DIY scenario, is extreme science fiction and requires breakthroughs and security far beyond anything now in the pipeline, such as the **DARPA tabletop semiconductor factory initiative** or on-going **NASA research** on how to build minimal workable ecologies (Respondent #8). Communities such as **Transition Towns** and the ideas of **Rocky Mountain Institute (RMI)** could be aided by technologies not yet existing, such as 3D local printing of needed solar and other energy producing and storing items (Respondent #9).

The respondents said that recognizing the value of people and a change in mindset, which moves DIY ideas from "hippie" to mainstream, are needed. In education, and especially higher education, engineering and creative skills could be reinforced. Rapid innovation and new product development in required materials and technology need to be encouraged. It must also be ensured that technology is widely used and adopted. For example in Argentina, the lack of information and communication about sustainable energy alternatives, together with the necessity of venture capital, were seen as the main barriers, rather than technological bottlenecks or underdevelopment.

2.4 Glocal views on New Consciousness 2050

New Consciousness Scenario in a nutshell

Threat of an ecological collapse and ubiquitous information & communication technologies have led to a new kind of consciousness. Human beings are deeply intertwined with nature and with each other. They do not conceive themselves as separate individuals but form a "global brain". The world is connected by a global super-grid. Environmental problems are not seen as practical issues, but calling for deeper changes in values and mindsets.

NEW CONSCIOUSNESS

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

Figure 9. New consciousness 2050 scenario (Heinonen, Karjalainen & Ruotsalainen 2016).

The fourth set of questions concerned the New Consciousness 2050 scenario. The respondents were first asked to identify factors in their local contexts that drive new consciousness. Then, they were asked to identify actors in their local contexts that pioneer in new consciousness. Thirdly, the respondents were asked to think about energy as a personal issue through elaborating on how a citizen can express their lifestyle through energy solutions and choices. The given answers were clustered into groups and a common denominator was identified to each cluster to highlight the differences between them. Most of the respondents perceived New Consciousness as ecological consciousness. However, there were other interpretations, too.

What drives new consciousness?

A vast majority of respondents identified ***environmental degradation*** as the key driver for new consciousness in the country. Related to that, many respondents named health problems deriving from environmental problems as key drivers: climate change, lack of clean drinking water, and pollution of air are starting to have an impact in the lives of people. Another important driver is the ***economy***. The opportunity to save costs is an important factor in switching to renewable energy: scarcity of biomass in some areas and unexpected oil spikes that make energy prices "skyrocket" make alternatives attractive.

Economy can be seen as a driver also in a different way: new thinking streams in a country in areas, where economic activity is most vivid, such as the Shenzhen Economic Development Zone in China, as one Chinese respondent suggests (Respondent #36). ***Politics*** is also a factor, in positive and negative terms: Some are tired with their federal government; governments also change culture through policies, such as by imposing minimal energy building standards for new buildings. One respondent said that new consciousness can also rise from the fear of global politics.

Diffusion of technology can also create new consciousness. The availability of mobile phones has changed the lives of people in the poor, rural areas too. Also success stories and example of others change views: the emergence of successful entrepreneurs, local home owners who build zero-energy houses, and beneficiaries of alternative energy projects.

Some respondents gave ***cultural reasons*** for rising new consciousness. This is captured in one of the answers: "Being tired of living just to pay bills, being tired of living stressful life, being tired of just functioning and not living". New consciousness can also spread through efforts of an organisation, like Quakers that hold a "truly cosmopolitan and open view on human potential and spirit", as suggested by Respondent #8.

Four respondents feel that there is ***no new consciousness in sight***, ***even though,*** theoretically, ***they feel it should already be there***.

Who pioneer new consciousness?

In comparison to the other scenarios, the majority of forerunners in this scenario are clearly representing the civil society. The respondents name ***individuals, NGO's, movements and spiritual communities***. However, also ***universities and research communities***, ***interest groups*** and ***the media*** are seen to have a big role in driving new consciousness. The ***state*** and ***business*** are not without a role either: many respondents see that public officials and institutions such as schools have a role in it, too. Particularly the African respondents see that companies also spread new consciousness through their energy business and a growing offer of renewable energy: "In most cases technology based companies are the key actors pioneering the rise of alternative energy" (Respondent #39).

The individuals named cover famous actors, environmentalists and public figures. Futures studies programmes are seen as an important way of how new consciousness spreads, which is not unexpected as there are many futurists among the respondents. The NGOs listed are mainly environmental organisations, such as the ***Greenpeace*** and ***local WWF offices***. However, there are also ***community empowerment organisations***, ***women groups,***

climate coalitions and ***youth groups***. Among the movements the respondents name those actors that have appeared in their answers also concerning the other scenarios: ***the permaculture movement***, ***eco-villages*** and other ***off-grid*** experiments. In China, the ***"Internet plus" movement*** promotes digitalization and is seen as a potential forerunner for this scenario. For those from the most secular societies, it may come as a surprise that also ***religious groups*** are seen as driving new consciousness: ***The Roman Catholic Church*** or ***other local churches*** are identified as local drivers in several answers, particularly in the African countries.

How can citizens express their lifestyles through energy solutions?

Regarding the question on how citizens can express their lifestyles through energy solutions and choices, the respondents gave four different types of answers: 1) citizens can reduce energy consumption in their energy choices and everyday decision-making points on traffic, waste etc.; 2) citizens can consume green products and services: products of factories that run on renewables, that help to save energy or even private investment. 3) Citizens can "go solar"(Respondent #2) and produce the energy they use by themselves; 4) being politically active and vote for those that drive change; and 5) expressing values by joining NGOs or interest groups or by being active on social media and building networks. Going green can also mean respect for traditions: in the Korean context, for example, this can mean a "conservative lifestyle in which people try to make harmony in nature" (Respondent #23).

New Consciousness in South Africa, Tanzania and Kenya

In the African context, two drivers for new consciousness were above others: high price of energy and the environmental degradation. On the one hand renewable energy is seen as a way to cut costs, particularly in a situation where changes in oil prices affect people's financial situation negatively. Overall, there is currently a scarcity of energy and power cuts are regular, regardless of the high price of the energy, which makes people look for alternatives. In addition, as reported by several respondents, in countries where the majority of people live off the land and agriculture, a changing climate, whose effects are getting more severe, aggravated by worsening deforestation and water shortages, are making people aware of the urgency for alternatives.

However, also other interesting drivers were identified. The mere availability of renewable energy technologies and emergence of successful entrepreneurs on that field, together with the success stories of beneficiaries, drive new consciousness. Availability of other

technologies have contributed to the change. Namely, the availability of mobile phones has changed the patterns of how people make decisions and get informed of the alternatives (Respondent #29).

The two South African respondents identified the same pioneer of new consciousness: **the Sustainability Institute,** "an international living and learning centre providing learning experiences in ecology, community and spirit". The other respondents also named **the Project 90 by 2030**, an NGO with an "ambition of bringing about significant (90%) change by South Africans in how we engage with earth systems" and an environmentalist and the director of the leading South African environmental law firm, **Cormac Cullinan.**

The Tanzanian and Kenyan respondents gave similar answers: Energy ministries and related organisations; interest groups of alternative energy, NGOs, church organisations, community based groups, and renewable energy companies.

Groups representing renewable energy **TAREA (Tanzania Renewable Energy Association)**, **Tanzania Traditional Energy Development Organisation, Energy Water Utilities Regulatory Authority EWURA**, **Tanzania Renewable Energy Business Incubator** and Tanzania's **Rural Energy Agency (REA).** Also **the Tanzanian Ministry of Energy** got a mention. **Justin Mungure** from Makumira University in Arusha, an expert in the field ecological degradation, was identified as an advocate for hydropower. Another individual named is **Patrick E. Ngowi**, who is a Tanzanian businessperson, entrepreneur and an environmentalist. He is the founder and chairperson of clean investment company called **Helvetic Group.** An interesting actor is also **Buni Innovation Hub**, "which fosters innovation and technology entrepreneurship through capacity building, mentoring programs and community empowerment" (http://buni.or.tz/about).

Tanzanian respondents identified also some civil society actors: agriculturalists, environmentalists in general and NGOs **Oikos East Africa** and **ACCRA Tanzania**. In Tanzania, also some churches are seen as pioneers of new consciousness, such as **Roman Catholic Church** and **Moravian Church of Tanzania**. There is also an interesting effort to drive new consciousness among children. **Ubongo Kids** is a Tanzanian edutainment cartoon made by Ubongo Media that teaches science to children in East Africa.

In Kenya, also different actors related to renewable energy got mentioned: **the Ministry of Energy**, **Association of Energy Professionals**, **Kenya Association of Manufacturers** and **Kenya Climate Innovation Center (KCIC).** Several NGOs were also identified as forerunners: **Lighting Manyattas Initiative**, **Clean Stoves**, **Community Education and Empowerment Centre (CEEC),** nature conservation and empowerment organisation

Green Belt Movement (GBM), **Mandeleo Ya Wanawake**, a non-profit voluntary women's organisation with a mission to improve the quality of life of the rural communities. Other actors mentioned on a general level were religious organisations, politicians, business associations, community based organisations, local and political leaders, church organisations and women and youth groups. Three companies got mentioned too**: Total Kenya** that initiated an eco-challenge with the aim of planting 100 million trees every year, **M-Kopa** who designed micro-credits for solar (see also: Radical Startups / Value-Driven Techemoths scenario), and **D-light** that offer affordable lighting solutions.

Regarding how to express lifestyles, the respondents analysed ways, how ***being energy independent*** would impact people's lives. Energy independence can be the result of having more financial means: those with more money can have more clean and expensive energy sources and can choose more. Those that do live off-grid are generally less reliant on the formal energy infrastructure. One respondent also hopes that those that can, should express their satisfaction and dissatisfaction regarding their energy choices on social media. Renewable energy can also be seen to power traditional lifestyles: rural farmers only need two cows for a functioning biogas system, which can power all their cooking and lighting. Home solar system can provide power for other needs at home and there is "no need to wait for a main grid" (Respondent #38).

Otherwise the respondents saw the opportunity to express lifestyles through saving energy and by doing green choices: supporting the producers of sustainable goods and services; energy efficient housing and buildings and companies in general that use renewable energy in their production. One Kenyan respondent also promoted a vegan lifestyle as a good way of expressing energy choices in everyday life.

New Consciousness in East Asia

In the Chinese answers for drivers for new consciousness, the polluted air was mentioned by 3 out of 5 respondents. "Air pollution and frequency of dust storm. They make people sick" (Respondent #11). One respondent emphasised the connectedness of people in the new consciousness scenario: in their view **Shenzhen Economic Development Zone** is a pioneer due to its "systematic reform, emancipating the mind and opening up to the outside world in China" (Respondent #36). Similarly the **"Internet+ Movement"** was seen as spreading new consciousness through its efforts of promoting digitalisation.

In the Chinese answers the organisations spreading new consciousness were predominantly interest groups of renewable energies such as **China Wind Energy**

Association and **China Photovoltaic Industry Association,** and environmental NGO's such as **Friends of Nature** and **Citizens' Environmental Movement in City. The green economy institute of Beijing Normal University** got also mentioned. Also some movie stars were named: **Yiyan Jiang**, **Xun Zhou, Bingbing Fan, and Chen Li** are the faces of the new open China and seen as pioneering in new consciousness.

Both in Korea and in Hong Kong, anti-nuclear movement has been successful in making the search for alternatives happen, and is thus seen as pioneers of new consciousness by two respondents. In Hong Kong, "greenhouse gases and CO2 emissions are already issues. (Respondent #37). Another Korean respondent was more pessimistic: "I agree eco-religion-like minds could emerge in the future. But I cannot find its signal in Korea" (Respondent #27).

The other pioneers were more conventional: environmental organisations such as **WWF, Greenpeace, Green Korea United, and Korean Federation for Environmental Movement.**

Regarding how people can express their lifestyles, a vast majority of respondents described methods on how to save energy in everyday life: by using public transport or car pooling, use less frequently electronic devices, choose clean technologies and treat their waste responsibly. One Korean respondent emphasised that people can also adopt a "conservative lifestyle in which people try to in harmony with nature" (Respondent #23). Active participation was also raised as means of expressing lifestyles: by participating in environmental protection activities, as was suggested by a Chinese respondent, or by joining NGOs or interest groups to lobby for support from the public, as stated by the respondent from Hong Kong.

New Consciousness in Australia

The Australian respondents gave mainly three types of answers to the questions regarding the drivers of new consciousness in the country: 1) ***politics*****:** "fatigue with federal government" (Respondent #2), "fear of global politics" (Respondent #18); 2) ***degradation of environment***: "damage to the land cause by coal mining, deforestation challenging local flora and fauna and indigenous animals" (Respondent #3), "most of our population is congregated in a small area, but most of what we believe makes our country fantastic is located elsewhere and has traditionally been exploited for its natural resources because we weren't paying attention" (Respondent #35), "unbridled development, deforestation and unsustainable practices on micro and macro levels" (Respondent #20), and the notion that there is ***limited or no new consciousness*** in sight: "Limited new

consciousness beyond green minority (Respondent #17), "There is very little "new consciousness" in Australia" (Respondent #21).

One respondent felt that there is "energy consciousness" and "solar installations have become normalised", but still only a "marginal concern with regional carrying capacity – and the need for carrying capacity based regional planning [..] implying consciousness of the impact of one's diet and water consumption in particular on land-use" (Respondent #5). An interesting point of view was raised by another respondent that felt that water is the issue that drives new consciousness, as it is seen as sacred and personal. "Perhaps we could reframe the energy debates adopting the thinking around water?" (Respondent #22).

Regarding the pioneers of new consciousness in Australia, the respondents named mainly futures studies programs (3 respondents), NGOs and local community organisations, and movements (such as **Beyond Zero**, **Climate for Action, the Wilderness Society**, **Get up**, **permaculture movement, an ecovillage at Currumbin** and **Byron Bay communities**) (4 respondents). **Ananda Mela** was given as an example of a spiritual group pioneering new consciousness. Also two individuals were named: **Murray Lane** and **Peter Garret.** Lane has developed a "Carrying Capacity Dashboard for assessment of local carrying capacity" (Respondent #5). Garret is a musician and former environmental minister.

The answers regarding the ways how citizens can express their lifestyle through energy solutions and choices were very rich. Some answers were conventional: saving energy, going solar and off-grid or voting with wallets for the sustainable energy option, and voting political leaders. But there were many other views too. One respondent raised the power of TV in turning individual choices into trends, like in the case of ***Grand Designs*** that presents off-grid houses often with distinct architecture. "There are trends towards moving from the city to the country to be more self-sufficient and home supply companies are stocking more vertical farming and self-sufficiency supplies" (Respondent #3).

A countering view to the desirability of the trend to move to the countryside is the view that "the most effective thing that citizens can do is to take the initiative to collaboratively develop compact, car-free, walkable, multi-functional townscapes within walking distance of food growing areas an industrial-ecology clusters, to minimise energy-consuming commuting, long haul food transport and industrial waste. This will require citizens to lobby state and municipal government to encourage and enable such "rurbanisation" to occur" (Respondent #5).

Another interesting view on how to "vote with wallet" is ethical investment: "people are beginning to move their investment away from firms that support environmental destruction" (Respondent #3).

New Consciousness in other countries

The respondents in other countries saw that a new consciousness is driven by climate change impacts, sustainable consumption and production (Respondent #24). Also rising energy prices were seen as a factor. One respondent stated that the key to this scenario is people "truly reaching beyond their immediate neighbourhood" to the extent of "thinking globally, act locally".

The state acts consciously, when a **government** imposes minimal energy building standards for all new buildings. So do **the local home owners** who want zero energy buildings (Respondent #7). **Deepak Chopra** is an American, Indian-born doctor who lectures about consciousness. **Quakers** are motivated by a truly cosmopolitan and open view of human potential and spirit. There is also **the space movement** which has a will to strive for more progress and is driven by curiosity, even if there are "depressing factors which reduce both its effectiveness and its authenticity in the US at present".

The previously mentioned DIY-driven **Transition Towns** in the US and the UK are seen to be underpinned by their consciousness. **Interbioestrategia, Fundación Argentina de Recursos Naturales (FARN)**, **Vida Silvestre**, **Renace Argentina** are examples of organisations that promote environmental awareness, conservation and actions in Argentina.

It is mentioned that people need to feel that the danger is close to them – to conceive that an environmentally damaging issue has a social dimension. Such issues include water pollution or negative impacts from chemicals used in agricultural production. Recycling could be mainstreamed, if there was pressure. Individuals at home and in their professions, schools, neighbourhood actors and business actors, local government, and media can all act consciously. **Finnish people** were mentioned to have a relatively good record on effective resource use in their personal life. Consciousness can be supported with policies that motivate mindset change. In a broader scale, these changes together could push sustainable consumption in mobility, energy and waste management, towards a circular economy approach.

Figure 10. Local citizens, non-governmental organisations, labour unions and other social groups coming together for ecological and social justice in Rio de Janeiro, Brazil. Cúpula dos povos – the People's Summit brought together environmental and social movements and was organised independent of the UN-led Rio+20 Conference.

2.5 Views on possible, probable and preferred Neo-Carbon Energy Futures

In the final section of the questionnaire, the respondents were asked to elaborate on which scenarios they find possible, probable and preferred in their local contexts. The respondents were allowed to choose several possible scenarios. They were also asked to state reasons for their choices. The neo-carbon energy scenarios are global scenarios, while the respondents' responses are evaluations of the scenarios in local or regional contexts. Thus, like explained in the Introduction, the results are glocal insights.

Possible scenarios

The answers to the question were organised first according to the amount of scenarios they held possible in their contexts and then according to the combinations of possible scenarios. Then, the arguments behind these choices were classified in groups that follow a PESTE classification. ***Overall, the scenarios were all held possible by almost equal amount of respondents.*** None of the responders found none of the scenarios possible. Radical Startups 2050 Scenario was held possible by the most of the respondents, 24; Value-Driven Techemots 2050 Scenario by 22 respondents, Green DIY Engineers 2050 Scenario by 21 respondents and New Consciousness by 17 respondents.

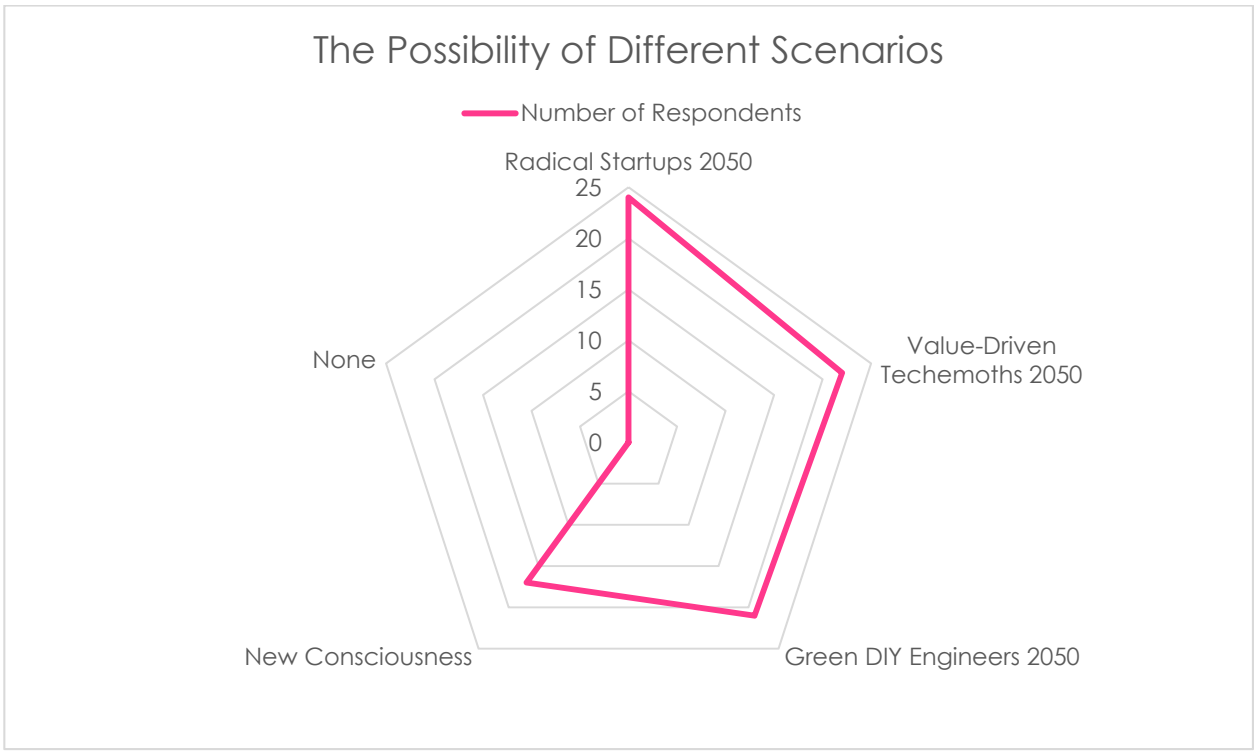

Figure 11. The viewed possibility of different scenarios among the respondents.

Notable is that ***respondents from a same country mostly had very different views regarding the possibility of different scenarios***. Out of 39 respondents, 8 felt that all four are possible. Three were seen possible by 5 respondents. A vast majority of respondents found two scenarios possible (17). Nine respondents felt that only one scenario is possible.

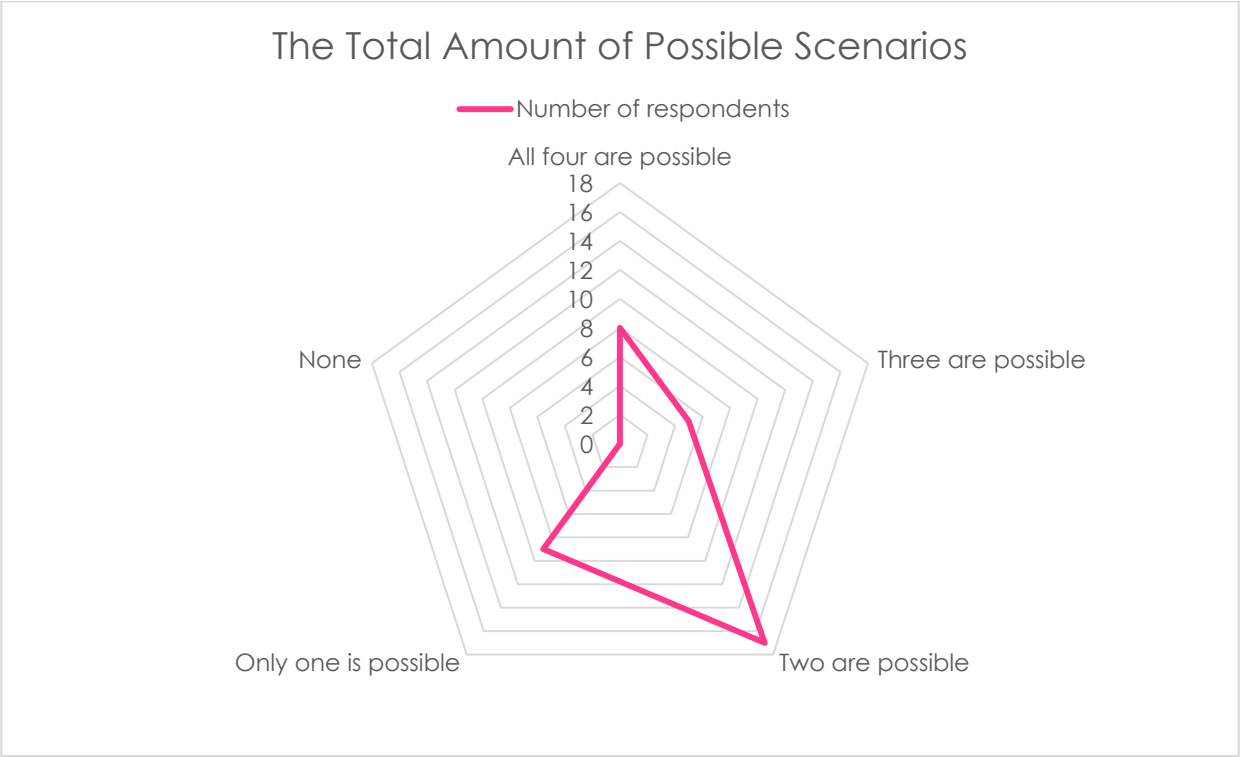

Figure 12. The Total Amount of Possible Scenarios.

The combinations of scenarios held possible varied greatly. ***All four*** were held as possible by respondents from Finland (1), Australia (2), South Africa (1), Kenya (2), Spain (1) and China (1). ***Those that held three scenarios possible, had different combinations***: The respondents from China and Tanzania found the set of Radical Startups 2050, Value-Driven Techemoths 2050 and New Consciousness 2050 possible. A South African respondent found possible the scenarios with Radical Start-ups, Green DIY Engineers and New Consciousness. Radical Startups 2050, Value-Driven Techemoths 2050 and Green DIY Engineers 2050 was a combination of possible scenarios for respondents from Australia (1) and Kenya (1).

Most respondents found two scenarios as being possible and again, the combination of them varied. Scenarios with Radical Startups and Green DIY engineers were seen as possible by the respondents from USA, Kenya (2) and China. Scenarios with Radical Startups and Value-Driven Techemoths on the other hand were seen possible by respondents from Tanzania (2) and Australia. The scenarios with Radical Startups and New Consciousness were held possible by respondents from Australia (1) and Kenya (2). Respondents

representing Latin-America (1), Tanzania (1), Switzerland (1) and Australia (1) found Green DIY Engineers and New Consciousness to be possible in their local context. The Value-Driven Techemoths and New Consciousness scenarios were seen possible by one Tanzanian respondent.

Out of those that found ***only one scenario was possible***, respondents from Australia (1), China (1), Hong Kong (1) and Korea (1) found Value-Driven Techemoths a possible scenario. Respondents from Argentina (1) and Australia (1) and South Korea (1) saw Green DIY Engineers as possible. Radical Startups was the only possible scenario for the respondents from Argentina (1) and China (1). None of the respondents in this group saw New Consciousness as the only possible scenario.

The respondents approached their choices from different angles. Eight respondents gave ***cultural reasons*** for their choices, particularly if they saw Green DIY Engineers as a possible scenario: the nature of people, their habits and customs are seen as factors that make a scenario seem more possible than others, as illustrated in the following quotes.

> "*Most Koreans are well educated in science and technology. They like to do anything by themselves and to make challengeable experiments.*" Respondent #23, (Green DIY Engineers).
>
> "*Australia has always been a country of inventive individuals. Aboriginals learned how to survive under harsh condition for thousands of years, and the white settlers were also very hard working and inventive. This tradition could be carried through the 21st century, where we potentially face the largest threat ever to our survival.*" Respondent #20, (Green DIY Engineers)
>
> "*New Consciousness and Radical Startups are possible because Kenyans are very entrepreneurial and the startup community is thriving.*" Respondent #25
>
> "*Very individualistic country with direct democracy – people are used to decide everything.*" Respondent #7, Switzerland (Green DIY Engineers 2050, New Consciousness 2050.)

Economic reasons were the most common: 13 respondents argued their choices with economic reasons, particularly those that saw Value-Driven Techemoths 2050 and Radical Startups 2050 as a possible scenario.

> "*We have a business environment that encourages radical start-ups and innovation ecosystem*" Respondent #22, Australia. (Radical Startups 2050, Value-Driven Techemoths 2050, Green DIY Engineers 2050)

"*Commercial prospects*" Respondent #17, Australia. (Radical Startups 2050, Value-Driven Techemoths 2050)

"*Currently there are many new startups which have emerged with good solutions for the society. It's a matter of time them to profit and build upon what they just started*" Respondent #12 (Radical Startups 2050, Value-Driven Techemoths 2050)

"*People would love to get value for money.*" Respondent 28, Kenya. (Radical Startups 2050, Value-Driven Techemoths 2050, Green DIY Engineers 2050)

Those approaching the question of possibility from the point of view of ***political reasons***, saw the current political structure as enabling some scenarios more than others. Also dissatisfaction with current politics and urgency of different political goals were seen to catalyse some scenarios.

"*In different levels, but all the 4 scenarios are possible in my country, depending on how the legal and technological frameworks develop.* Respondent #24, Spain." (Radical Startups 2050, Value-Driven Techemoths 2050, Green DIY Engineers 2050, New Consciousness 2050)

"*Priority needs are: job creation/improved livelihoods/poverty alleviation, addressing inequality. Potential exists for innovative action, mind shift and social enterprise.*" Respondent #16, South Africa. (Radical Startups 2050, Green DIY Engineers 2050, New Consciousness 2050)

"*Radical startups and Green DIY engineers will most probably increase as people get more fed up with existing systems.* " Respondent #26, Kenya (Radical Startups 2050, Green DIY Engineers 2050)

The political climate will support what is existing but mining firms hold too much power in Australia to allow large-scale change without a fight. Change in Australia will come from the people – not the government." Respondent #3, Australia. (Value-Driven Techemoths 2050, Green DIY Engineers 2050)

Probable scenarios

Out of 39 respondents ***the majority (18) found Value-Driven Techemoths 2050 as the most probable scenario in their local context***. The respondents represented different countries and thus this scenario is possibly the most global among the respondents. Radical Startups 2050 was seen as the most probable scenario by 10 respondents, of which 7 are from African countries. Green DIY Engineers 2050 scenario was the most probable in views of 5 respondents and New Consciousness 2050 was identified as the most probable by 4 respondents. Two respondents out of 39 did not find any of the scenarios probable in their local contexts (Australia, China).

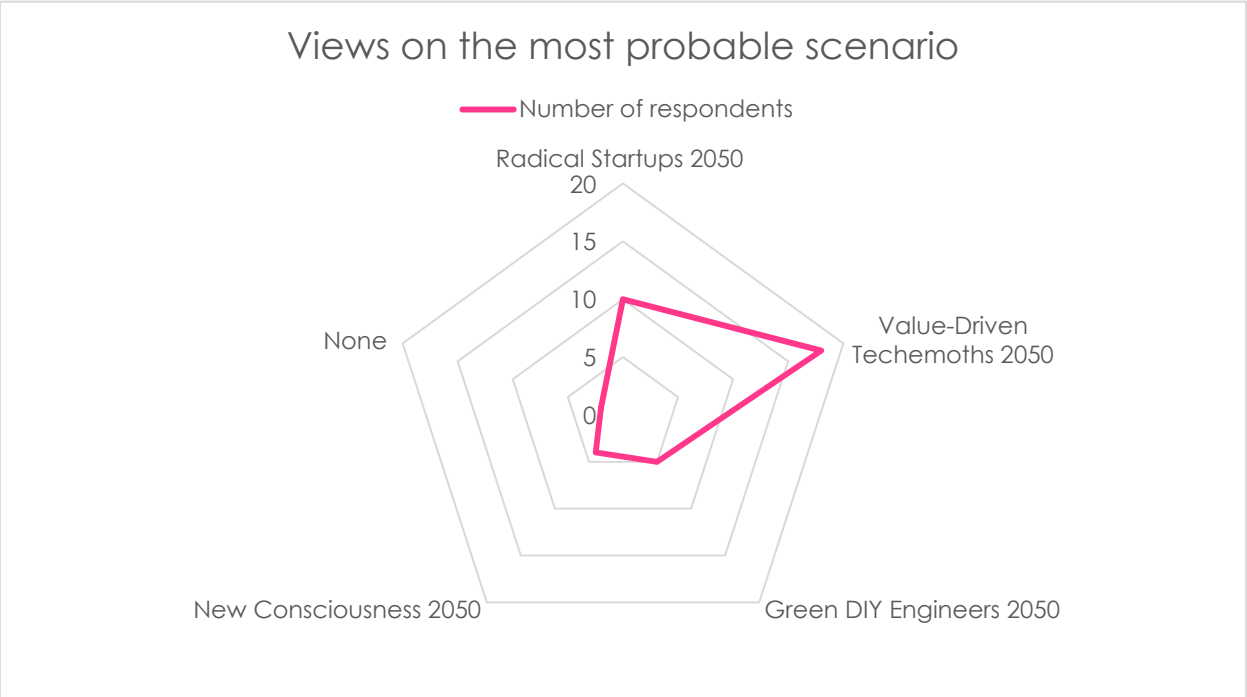

Figure 13. View on the most probable scenario by the respondents.

The views of different respondents from the same countries on which scenario is the most probable varied depending on how society was reflected overall in the other responses. Those, for example, that emphasised the big influence of large companies in the Australian society held Value-Driven Techemoths 2050 Scenario as the most probable, whereas those that were close to permaculture or off-grid movements, often saw Green DIY Engineers as the most probable scenario. None of the Australians found Radical Startups 2050 scenario the most probable.

All the African respondents, however, were relatively unanimous: they thought that the most probable scenario is either Radical Startups or Value-Driven Techemoths. Many saw the two

actors as following each other on a timeline: ***one day startups become techemoths, or techemoths give birth to new startups under their umbrella***.

The East Asian respondents also place their bets for different candidates. The Chinese respondents all have a different view: one is for Radical Startups, another for Green DIY Engineers, the third for Value-Driven Techemoths and the fourth feels none of them is probable. The respondent from Hong Kong thinks Value-Driven Techemoths and New Consciousness are the most probable. The Korean respondents are equally of different opinion: one for Green DIY Engineers and another for Value-Driven Techemoths.

The reasoning behind the choices can again be classified in groups of political, economic, societal and cultural reasons. Societal and cultural reasons overlap in many cases and could be placed in either group. Regarding the ***political aspects*** that led the respondents choose a scenario over another, the political structure was seen as an enabler, for better and for worse, as illustrated in the following quotes:

> "*The power of the conservative parties and big capital*" Respondent #2, Australia. (Value-Driven Techemoths 2050)
>
> "*The failure of the public sector and the conventional private sector to bring about the necessary transition*". Respondent #6, South Africa (Radical Startups 2050)
>
> "*To my understanding, the role of the government in the four scenarios is described to be minimal. This is least possible to happen in China. The central government wouldn't lose control over the country*." Respondent #11, China (None of the scenarios)

Economic aspects in society were raised by four respondents, mostly regarding the viewed probability of Value-Driven Techemoths 2050 Scenario, as illustrated in the following quotes:

> "*In China, because of system reasons, large enterprises, especially large state-owned enterprises rather than small businesses are economically and technologically powerful.*" Respondent #10, China. (Value-Driven Techemoths 2050)
>
> "*The leading companies in renewable energy sources have been growing in the last decade and it seems they will continue becoming global companies.*" Respondent #24, Spain. (Value-Driven Techemoths 2050)
>
> "*Geography, economic structure*." Respondent #17, Australia. (Value-Driven Techemoths 2050)

Cultural aspects were given by a majority of the respondents. In many of the answers an important emphasis was given to how the country sees itself and its inhabitants.

> *"Australia still sees itself as a small power at the mercy of forces bigger than ourselves. Without powerful new leaders, who are not yet in evidence, this will not change".* Respondent #14, Australia. (Value-Driven Techemoths 2050)

> *"Kenyans are very entrepreneurial and it's a growing economy.* Respondent #15, Kenya. (Radical Startups 2050)

> *"Ordinary citizens still believe in "natural hierarchy/leadership", and the average person will most likely expect solutions from a higher power/authority, rather than being proactive and personally responsible.* Respondent #20, Australia (Value-Driven Techemoths 2050)

> *"Path dependence of fast economic development and related social system in Korea would support the second scenario. Especially East Asian culture like Confucianism would help the Korean society keep a well-structured hierarchic societal fabric". R*espondent #27, South Korea. (Value-Driven Techemoths 2050)

> *"Lazy thinking, focus on short-term, individualism, lack of a community spirit (outside of sport)"* Respondent #21 *Australia*. (None of the scenarios)

Close to the cultural aspects raised are the ***societal reasons*** given by the respondents, particularly those from East African countries, as captured in the following quotes:

> *"Low per capita income. Low level of education. Less scientific research in this area.*" Respondent #4, Tanzania (Value-Driven Techemoths 2050)

> *"Many youth who are starting up companies and exploring entrepreneurship. This creates new curiosities and create community and locally related solutions."* Respondent #19, Kenya (Radical Startups 2050)

> *"The young people in the country have been actively engaging in entrepreneurship and thinking of new ways to do things."* Respondent #26, Kenya. (Radical Startups 2050)

> *"There is already a way in which the startups are driving the society. […] They have also showed changes in the society and also changed some of the rural areas to town centers.* Respondents #28, Tanzania. (Radical Startups 2050)

Finally, there is the group of respondents that view that the ecological crisis push certain scenarios to be the most probable scenario:

> *"My choice is based on an understanding of the limits to growth faced by all countries – and the inevitability of crisis scenarios developing on both the financial and ecological fronts (particularly climate change) in the coming decades. Such crises will either compel a radical rethink or trigger massively violent and destructive scenarios."* Respondent #5, Australia. (New Consciousness 2050)

> *"Unless one makes radical assumptions about consciousness, we are now on a very hard course towards disaster. Since there is no hope without the consciousness side, and since consciousness has a more solid foundation then the others do… I am flipping a coin here, but this one seems best."* Respondent #8, USA. (New Consciousness 2050)

> *"I think the younger generation take global warming more serious. They believe they can fix the stuff up of previous generations. And thus creating green technologies."* Respondent #18, Australia. (Green DIY Engineers 2050)

Preferred scenarios

A clear preference can be found in the respondents' views on the preferred scenario. ***28 out of 39 respondents (one respondent picked two) chose a scenario based on deep ecology: the majority, 16 respondents, preferred New Consciousness 2050 scenario and 12 Radical Startups 2050 scenario***. The scenario, which the majority viewed as the most probable scenario for their local contexts, the Value-Driven Techemoths 2050, was the most attractive scenario only for 8 respondents. Green DIY Engineers was preferred by 4 respondents.

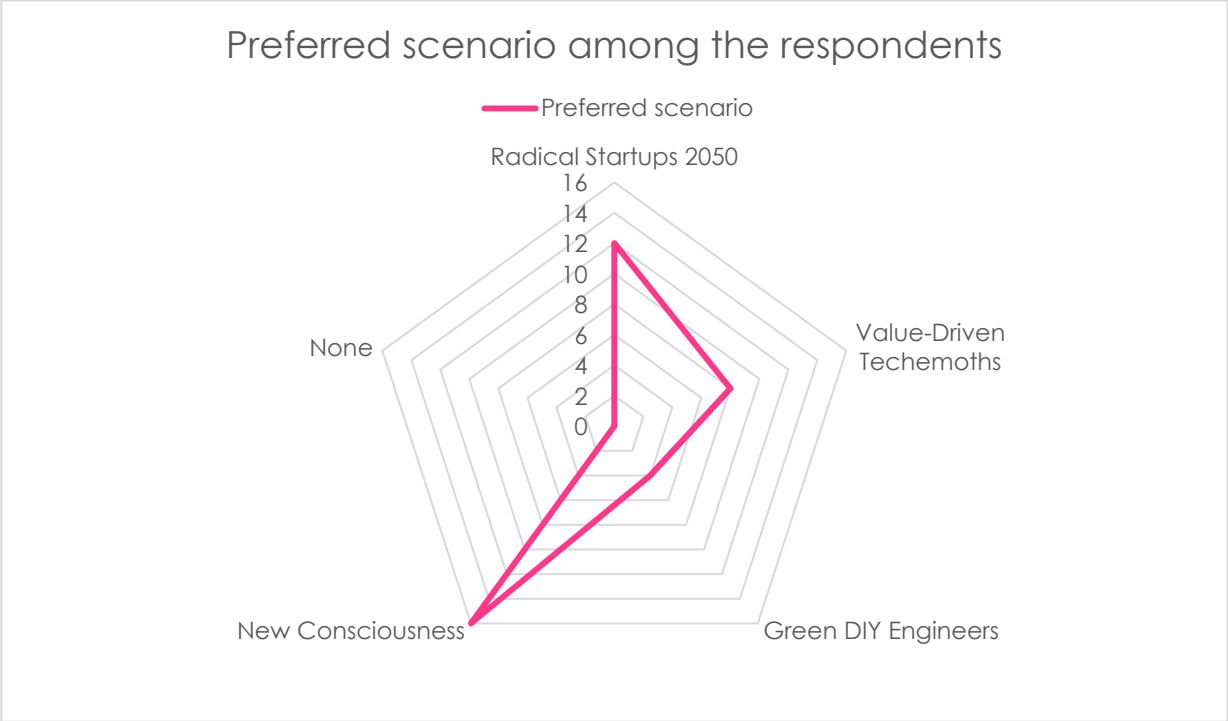

Figure 14. Preferred scenario by the respondents.

Geographically there were some clear tendencies in some regions, although none of the regions was unanimous. The African respondents clearly preferred market-driven change, Radical Startups 2050 and Value-Driven Techemoths 2050. This may be due to the fact that many respondents themselves are operating close to renewable energy companies or innovations, and they observe the potential of these actors from the spot. The East Asian respondents were all for different scenarios for different reasons. Australian respondents all chose a scenario based on deep ecology: three respondents chose the Radical Startups 2050 Scenario and six the New Consciousness 2050 Scenario.

Table 1. Preferred scenarios by the respondents from Kenya, Tanzania and South Africa.

Country	Radical Startups	Value-Driven Techemoths	Green DIY Engineers	New Consciousness
Kenya	**x**			
Kenya	**x**			
Kenya	**x**			
Kenya				**x**
Kenya				**x**
Kenya		**x**		
Kenya		**x**		

Kenya			x	
South Africa		x		
South Africa	x			
Tanzania		x		
Tanzania		x		
Tanzania		x		
Tanzania	x			
Tanzania				x
Tanzania				x

Table 2. Preferred scenarios by the respondents from China, Hong Kong and South Korea.

Country	Radical Startups	Value-Driven Techemoths	Green DIY Engineers	New Consciousness
China				x
China		x		
China				x
China	x			x
Hong Kong		x		
South Korea			x	
South Korea	x			

Table 3. Preferred scenarios by the respondents from Australia.

Country	Radical Startups	Value-Driven Techemoths	Green DIY Engineers	New Consciousness
Australia				x
Australia				x
Australia				x
Australia				x
Australia				x
Australia				x
Australia	x			
Australia	x			
Australia	x			

Table 4. Preferred scenarios by the respondents from other countries/regions.

Country or Region	Radical Startups	Value-Driven Techemoths	Green DIY Engineers	New Consciousness
Finland				**x**
USA				**x**
USA	**x**			
Switzerland				**x**
Spain				**x**
Argentina	**x**			
Argentina			**x**	
Latin America			**x**	

Most respondents based their evaluation of which scenario they prefer on assessment of the ability of the actors in the scenario to bring about ***profound change*** efficiently**.** This was an important reasoning particularly for those preferring New Consciousness 2050 Scenario: the scenario is the basis for the other scenarios to happen.

> *"A new consciousness challenges the actor within all firms and is the most sustainable. It doesn't cost any money and achieves the greatest structural (and economic) change."* Respondent #3, Australia. (New Consciousness 2050)

> *"A changed consciousness would secure the most stable sustainable outcome. Actions and plans would be aligned and consistent, with cutting edge, swift and efficient solutions. Talking about issues would be cut down to minimum, freeing up time and energy for constructive action."* Respondent #20, Australia (New Consciousness 2050)

> *"The change towards sustainability should start in a change of values and lifestyles"* Respondent #24, Spain. (New Consciousness 2050)

> *"When citizens are empowered to care and be sensitive to issues that can help make our world a better place, finding tailor made solutions to our specific problems can never be an issue: we kind of become instant innovators hence making us better Green DIY Engineers. Additionally, when people are informed they will tend to appreciate more alternative energy solutions provided to them by Radical Startups and Value-Driven Techemoths hence making the solution delivery process less complicated.* Respondent #39 Tanzania. (New Consciousness 2050)

Similar line of thinking was used to argue for other scenarios, too:

> *"This is preferable because it is a business oriented solution thus needing little to no support from government, which is the slowest actor in any ecosystem. With a market driven effort, most of society's problems would be solved.* Respondent #31, Kenya (Radical Startups)

> *Likely to address many issues through shaping of markets.* Respondent #17, Australia. (Radical Startups)

> "*Multiple individual initiatives give many more options to solve all energy problems.*" Respondent #34, Latin America. (Green DIY Engineers 2050)

> "*An Innovation and Technology Bureau (i.e. "ministry") was set up in November 2015. The "ministry['s]" main task is to map up the strategy and implementation measure to facilitate Hong Kong's transition into a technology-intensive Knowledge-based Economy.*" Respondent #37, Hong Kong. (Value-driven Techemoths 2050)

In some of the arguments also the ***criticality of change*** was emphasised.

> "*Any sustainable change in the society first requires a change in mind-set. The current problems can't be addressed by technology alone, which has been the focus. A change in mind-set would reduce overreliance on traditional biomass, increase access to renewables and especially sensitize people on the need to make this shift.* Respondent #26, Kenya. (New Consciousness 2050)

> "*Growing deforestation and soil erosion as well as greater vulnerability to climate change (droughts alternating with increased cases of flooding) are early indications of possible partial ecological collapse in significant parts of the country. Green DIY scenario with increased local community participation provides a viable option for survival of vulnerable communities.* Respondent #33, Kenya. (Green DIY Engineers 2050)

Those preferring Value Driven Techemoths 2050 Scenario mainly based their argument on ***economic reasons*****:** the resources that large companies have to push for change, as illustrated in the following quotes:

> "*Techemoths have access to more capital to facilitate the necessary transition*." Respondent #6, South Africa. (Value-Driven Techemoths 2050)

> "*It is the creativity that techemoths are equipped with and the financial capacity to work towards the end. Techemoths are aiming for sustainable development.*

The only means to achieve the goal is to protect the environment. If the ecosystem collapses, there will be no long-term profitability for businesses. Respondent #11, China. (Value-Driven Techemoths, 2050)

"*There are more opportunities to be exploited but due to lack of capacity locally to implement such initiative, entrepreneurs would rely on other big companies. To ensure sustainability, the big companies have to build the capacity of local companies.*" Respondent #38, Kenya. (Value-Driven Techemoths 2050)

Finally, many arguments were based on ***cultural added value*** that make a scenario particularly suitable for a specific context.

"*Population who is familiar with science and technology; government which has passion to provide funding on citizen science.*" Respondent #23, South Korea. (Green DIY Engineers)

"*Our isolation and relative innovativeness make us ideally placed to achieve this scenario, if we can get out of our own way.*" Respondent #14, Australia. (New Consciousness)

"*It corresponds to our history and culture – but it is difficult to make it happen*". Respondent #7, Switzerland. (New Consciousness 2050)

"*To me self-control, self-esteem, open mind and self-regulation are the elements that make new consciousness preferable for China. These traits can make public to think and try new methods and keep going until the final result.*" Respondent #35, China (New Consciousness 2050)

"*Because, due to cultural reasons (social inertia, individualism, consumerism) Argentina is a society that needs to be shaken to breakdown with well entrenched practices in most domains of social life.* Respondent #32, Argentina. (Radical Startups 2050)

3. CONCLUSIONS

Regarding the **Radical Startups 2050 Scenario**, respondents approached the pioneers from different perspectives: the nature of radicality was perceived differently, as was the nature of what is a "startup" in some cases, too. The spirit described in the Startups scenario can be found in other types of organisations: ***entrepreneurial mind is needed also when starting a social experiment or a movement***. Not only do startups use radical business models, introduce radical technology or disrupt markets, but they also bring about new thinking and set examples to others. In order to support these actors, the state is seen as a key player. ***The role of government is that of an enabler: less regulation and taxation, ending the dependence on coal, and providing incentives that steer towards production and consumption of renewables***.

The African respondents named mainly solar energy companies as forerunners. ***The radical nature of these forerunners lies either in the nature of the technology or in innovative business models*** that enable electrification of remote, rural and often poor areas through affordable solar power. The Chinese respondents named startups whose ***radicality lies in their power in the market***. The business as such did not necessarily touch renewable energy or other ecological issues. They also expected less support from the government and felt that the major responsibility is with the startups themselves to succeed. The Australian respondents had a wider interpretation for the scenario: many of them identified an actor other than a company as a forerunner for the scenario. The African and Chinese respondents were market-oriented in their views; ***the Australian respondents emphasised values in their answers and called for a new sustainable vision for the country***.

A vast majority of respondents identified a forerunner for the **Value-Driven Techemoth 2050 scenario**. However, their approaches differed in terms of how they viewed the "value-drivenness" of these actors. Some named ***big companies with a potential of turning into value-driven; others identified simply large companies in their contexts but remained dubious about the values and if they will change***. Many respondents, particularly those from the African context, emphasised the positive impacts a company can have on the rural areas and people living there. The respondents from the East Asian context especially emphasised the influence of these companies on the markets and the ability to take over when the opportunity rises.

In comparison to the support needed for the startups, according to the respondents, more is needed from the public. Governmental support is needed, but the public has to create

pressure for that to happen. The best motivation for companies to be interested in investing in the development of renewable products and services is the business logic itself: profit and saving costs. The Australian respondents, however, felt that it is particularly an issue of governmental initiative to make the change.

Regarding the **Green DIY Engineers 2050 scenario**, the respondents had generally a wider interpretation for the nature of these actors. Some named DIY communities and entrepreneurs working on the renewable energy solutions. Particularly respondents from the East African region named ***individual entrepreneurs, of which several were women. Indeed, being an entrepreneur or dealing with energy issues is not reserved for men only***. However, also different types of actors were named, too. Even some cultures as such were seen as being based on DIY mentality, such as the Australian culture and the Bushman culture. The way of describing the motivations behind the DIY activities and attitudes is to view ***DIY as mentality, DIY as activism, DIY as learning, DIY as a statement, DIY as business, DIY as fun, and DIY as a necessity. In other words: values, money, enthusiasm and need for energy***.

The respondents saw the role of the government and the society as important in supporting these actors. An interesting point was made that ***the role of education is also essential: not only is right curricula to produce innovation needed, but these engineers need training for other skills too, in order to make their innovations spread: marketing, design thinking, accounting etc.*** Those DIY engineers that are into maker culture as such should be given incentives such as awards, grants and competitions to direct their talent and efforts into developing products that enhance sustainability.

The biggest driver for the **New Consciousness 2050 scenario** is according to the majority of respondents environmental degradation. As the consequences of climate change and pollution are becoming visible and impact people's lives, ecological attitudes are becoming more widespread. However, new consciousness is seen as being spread by deliberate efforts too. ***Religious and spiritual movements are seen to pioneer this scenario, which can come as a surprise for those living in the most secular societies.*** All in all, unlike in the other scenarios the pioneers in this scenario are actors representing the civil society. Notable is the view that "new" consciousness can also be seen as adopting traditional lifestyles too, such as the old Korean tradition of living in harmony with nature.

As for the views on **which scenarios are possible and which is the most probable and preferred**, there were some clear tendencies among the responses. Firstly, almost all respondents saw at least one of the scenarios possible in their local context, and the majority felt so about several scenarios. The respondents' own background and worldviews impact how they viewed different scenarios: respondents from the same region had in most

cases very different views and reasoning behind their choices. However, the views on the probability and preference had more in common across regions and respondents: ***Value-Driven Techemoths 2050 scenario was seen as the most probable scenario by the most, whereas those based on deep ecology, Radical Startups 2050 and New Consciousness 2050, were seen as the preferred scenarios***. The reasons behind the choices differed from cultural to political and economic reasons, but they indicate that changes in the status quo are needed. Especially the state and large companies are seen as gatekeepers in the system. Achieving change was seen as a crucial goal and the respondents hoped that change would be achieved swiftly.

4. DISCUSSION

The results of this questionnaire imply a number of things. First of all, the notions of preferability and those of probability contradict each other. ***Most respondents would like to see either of the two scenarios that are based on deep ecology to be realised in the future. However, the majority thought that Value Driven Techemoths 2050 is the most probable scenario*** for their local contexts. Those that preferred this scenario were optimistic that this is good news, as the resources of these techemoths are vast and they can drive change faster than governments, which were seen as the weakest link and being too slow. On the other hand, for those preferring New Consciousness 2050 scenario, it was ***the very foundation on which any change need to be based on: new consciousness creates new demand and new markets***. At the same time, in most cases the reported support needed for different actors was expected particularly from the government. This raises the question of where the change should start from: From the policy-makers' decisions? Individual activism? From the markets?

The answer is: everywhere. The point of the Tipping Point and innovation diffusion model, which apply to any products, services or ideas, is that you only need a few to start the change and the rest will follow, if the circumstances make it possible. The motivation of the early adopters or the majority might be fully different from those that create new innovation. This, however, may make it difficult for policy-makers to create right incentives that steer the change into the preferred direction and thus the overcoming the challenge cannot be left to governmental initiative alone. As governmental support is still crucial, the identification of ***the actions of those governments that have been able to combine cultural and societal strengths and enabling technological development are important lessons learned.***

Moreover, there is one very concrete bottleneck regarding any of these scenarios that according to the respondents needs governmental attention: the electricity grid. In East Africa, the national grids are neither comprehensive nor entirely liberalized. This represents both a threat and an opportunity for the development of new products and services. Most of the radical startups identified are working on solutions in the off-grid areas. However, how well such technological solutions serve in contexts where the national grid does cater for the energy services, is another question. This was mentioned in the answers of the respondents from other regions too: ***closed grids do not create incentives for the startup entrepreneurs, DIY engineers nor for large companies***. This makes the off-grid experiments in Australia, Kenya and Tanzania interesting showcases to be observed more in detail.

The responses are indicative of potential changes in the local economic, social and cultural landscapes. They reflect contemporary understanding of needs, emerging innovations and of adopting and adapting to solar, wind, and related renewable energy technologies. A single response to the survey identifies needs to be addressed and already provides insights of a local transformation, but is unable to cover the entire spectrum of potential changes. But when answers are analysed collectively and their elements combined, they provide a more comprehensive ***outline of a future image that is increasingly different from the present day – especially when one pays attention to previously unheard views***. The results may not explicitly pinpoint how an individual actor should change behaviour, but it does imply what kinds of actors might be valued in a future society. In reality, the different actors may even be dependent on each other. One respondent mentioned that in the worst case of climate disaster, DIY communities could hopefully use those advanced technologies that have been developed by the techemoths.

A social practice in one country can be unknown elsewhere, or innovative business models surrounding a technology may be in place only in certain regions. For example, the use of solar energy in industry was mentioned in linkage with the mining sector. And indeed, solar mining has emerged as a practice in recent years for example in Chile, thanks to the fall in the price of solar, a supportive domestic policy environment and the interest of companies to lower their energy costs.

Some respondents also discussed cross-sectoral linkages from renewable energy, such as solar and wind in linkage with the constructions and transport sector or novel energy services from digitalisation. Indeed, ***examples of solar-integrated solutions and services are emerging, where solar photovoltaics is no more retrofitted but an integral part of the design phase. Rather than installing a panel on the roof of a house, it becomes interwoven as a glass in a window, as a tile on a rooftop, or a part of wearable technology in clothing***. It is interesting that only a few responses mentioned next generation technologies that support a 100% renewable energy system based on solar and wind. There is considerable space for future innovation and competition could be emerging in niches – also in the industrial scale.

Pioneers are sometimes frowned upon. Emerging initiatives may introduce novel values, require unorthodox or unforeseen combinations of skills, and promote a novel working culture. The state can use ***soft measures*** by being sensitive to related emerging needs, removing "red tape", and by providing help in nurturing an innovative culture and being supportive of small-scale experiments. This can also include resourcing institutional linkages and networks that help in catalysing an enabling innovation and business environment. The state can also introduce ***economic incentives*** or ***hard measures*** such as legal or policy

changes to directly influence the market environment, which helps the uptake of prosumerist energy solutions. Innovation funds, venture capitalists and large companies can play their part as being test beds and in scaling-up the ideas of emerging entrepreneurs. Overall, the responses support previous research and views that ***technologies alone cannot be assumed to solve social problems. People, in different roles and positions in society, will push and nudge the innovation system towards a certain direction***.

Further research is warranted on the specific measures that need to be introduced in particular regions to contextualise these preliminary findings in a more advanced way. The findings of this survey ***could be used as a basis in outlining more detailed regional strategies and re-visiting economic or development visions. It could also be worth defining clearly with other expert groups, what innovations and social practices exactly are considered to have potential for radical or disruptive innovation on the pathway to a solar and wind powered society***. This could also help in creating an increasingly polyphonic debate about renewable energy based futures. By studying solar and wind as individual technologies, we may miss sight of interesting innovations that are based on increasingly decentralised business models and ignore the importance of values and needs that underpin the urge that is driving the creation of such solutions.

Moreover, some interesting observations based on the survey results can be taken for further consideration. ***The sense of urgency for the change needed is nurtured by the pioneers. The goal of earning a livelihood is a natural driver for action, but for many actors the motivation for contributing to such empowering change that brings along quality of life, equality, self-actualisation, and harmony with nature is even stronger.*** The pioneers seem to realise that work and employment will be in a growing degree with the renewable energy and digitalisation sectors. Consequently, products and services focused on them will be increasingly in demand. The missing link is, however, often the lack of appropriate education. Education of especially women and youth, with novel combinations of skills, will be in a key position to support various visionary groups and movements to utilise science and knowledge, research and development, foresight and vision for improving the wellbeing and equality in society and in their geographic contexts.

Pioneers are expected to empower and democratise energy use and production. If we want to see a neo-carbon future where decentralised and democratised energy prosumerism is a positrend, pointing to a preferred future, support should be given to those pioneering actors who are identified as making that future – locally and regionally. As regards the posi- and negatrend analysis in connection with identifying pioneers, several

points must be borne in mind. What is considered a positrend or a negatrend is dependent on the analyser's point of view, background and cultural context as well as on timing. A trend or phenomenon that is for someone a positive issue or is expected to provide positive results, may not be so for another observer***. Something that is considered positive at the moment may change over time and other development trajectories so that it will no longer represent a positive feature. Moreover, something is a positrend if its impacts are anticipated to be positive, even though its manifestation at the current moment were not regarded as something very positive.*** Pioneers are actors that can strengthen weak signals or topics and practices that have the strong potential of having positive impacts in the future. A key challenge in this is how to identify such pioneers that have the potential of creating positive futures, and to support them proactively.

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APPENDIX 1. List of Respondents

The respondents of the survey are listed here in alphabetical order according to their last names.

Bezold	Clement
Binamungu	Alpheus
Botta	Marta
Brass	Charles
Brent	Alan
Cordeiro	José
Courtney	Nichola
Gicheru	Lois
Gutierrez	Miguel
Hong	Sungjoo
Inayatullah	Sohail
Jin	Zhoyjing
Johnston	Ron
Kagiri	Eva
Kapolon	John Masai
Karekezi	Stephen
Lengyel	Miguel
Lung	Alan
Malaki	Basil
Maneno	Said
Martin	Brenda
Mwakatage	Sithole Edwin
Mochelle	Richard
Njuguna	Paul
Nkuya	Janet
Odegi	Hellen
Oito	Lloyd
Park	Seongwon
Qi	Yuan
Shayo	Geofrey
Schulze	Sonja
Stahel	Walter
Stenholm	Noora
Suter	Keith
Sykes-Kelleher	Anita
Tianci	Zhou
Werbos	Paul
Zheng	Zhao
Zugasti	Ibon

APPENDIX 2. The Survey Questionnaire

Dear Expert,

Welcome to the international questionnaire of the Neo-Carbon Energy research project and its foresight process. More information about the project: http://www.neocarbonenergy.fi/solution/

We are approaching you as an expert of your country/continent/organisation.

Neo-Carbon Energy is a breakthrough solution for a new energy system. By using innovative technologies we turn solar and wind power to reliable energy sources. This means highly cost-effective and 100% emission-free energy for our planet. Not only energy production, but the whole-of-society will be affected by this new energy system.

Our research studies what are the economic, political, cultural and social changes that are driven by renewable energy and emerging issues, such as co-creativity, ecological lifestyles and prosumerism. Radically new innovations, services and social practices could emerge from an energy system based on renewable energy that provides a basis for the future development of a networked society and economy.

We would very much like to know your ideas and comments concerning our Neo-Carbon Energy Scenarios 2050. These energy-related scenarios are socio-cultural and study how in different ways a radical transformation can take place.

We are especially interested in the forerunners and early adopters who are already leading the change.

The results of the questionnaire will be used to modify and deepen the scenarios, and to contextualise them in your country. Your answers will be highly appreciated.

Your answers will be dealt with anonymously. Answering this will take you around 15-30 minutes.

Among the respondents, one will be provided with an access (entrance, accommodation) to the International Futures Conference "Futures of a Complex World" to be held in Turku, Finland in June 2017, organised by Finland Futures Research Centre. See more: http://www.futuresconference.fi/2017

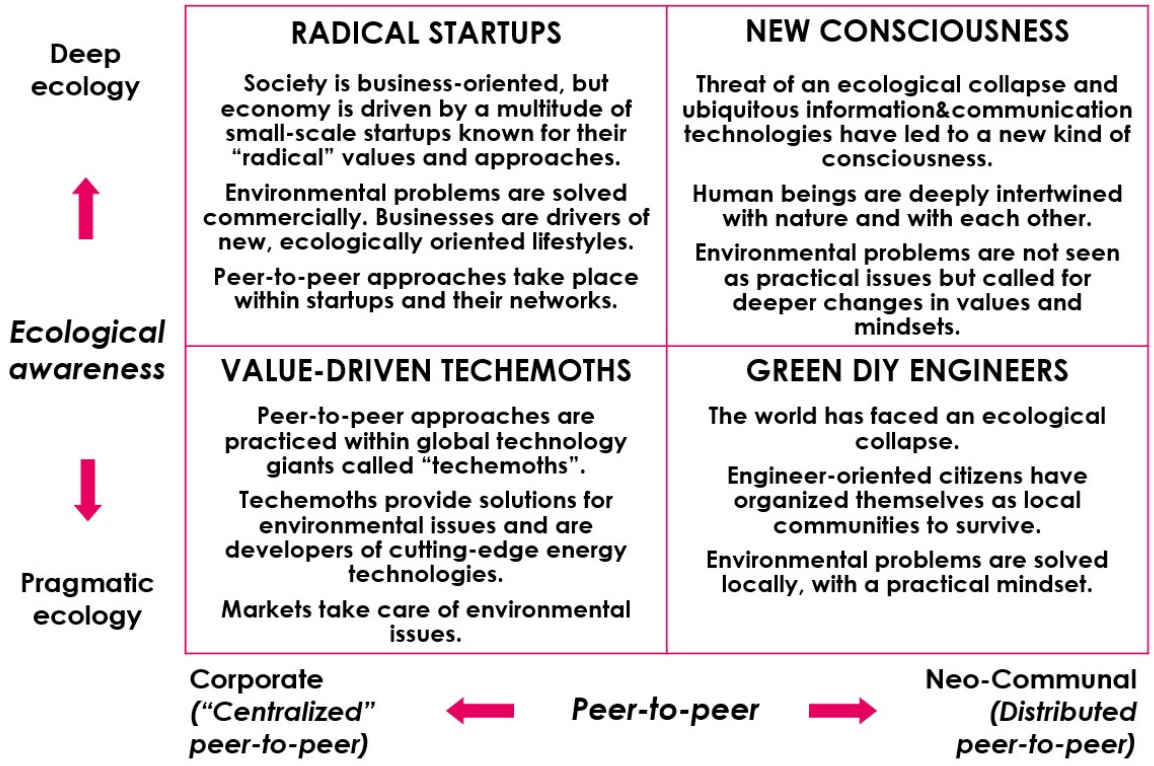
In any questions or technical issues, please approach: joni.karjalainen(at)utu.fi.

Please read the scenarios:

The full versions that were sent to you in advance are available for download at http://www.utu.fi/fi/yksikot/ffrc/tutkimus/hankkeet/Documents/NeoCarbon-WP1-1-2016.pdf

There is a short version of each scenario in the beginning of each section in the questionnaire to serve as a reminder, but it is worthwhile to have the full version open in case you haven't read them yet.

Transformative scenarios for Neo-Carbon Energy 2050



Your Geographical Context

Please indicate the country / continent your answers relate to:

Answer: _____

Radical Startups 2050

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

The industrial structure changes radically, and drives the developments in the energy sector. The penetration of local energy solutions is driven by startup companies. Energy systems move towards distributed and prosumerist type of behavior. Consumers self-produce a major part of their energy. Power-to-gas and other energy storage technology breakthroughs are led by small and medium-scale solutions. Biomass use is consumer-driven and can be characterized as "small and medium-scale circular economy". Electricity transmission between areas is interconnected but with limitations.[10]

Bearing this scenario in mind, please think about actors today (companies, individuals...) that might indicate the forthcoming change described in the scenario.

1. **Identify at least one "radical startup" in your country:**

Answer:

2. **Describe one of these startups more in detail. Explain what makes this startup especially radical:**

Answer:

3. **What would need to change in your country for radical startups to flourish?**

Answer:

[10] The second paragraph written above has been slightly changed from the original survey text. For details, see ch 2.1, Fig. 3 "Radical Startups Scenario in a nutshell".

Value-driven Techemoths 2050

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

Tech companies develop energy technologies and produce energy, mainly in solar and wind but biomass is also used. Companies provide products and services that reduce CO2 emissions. Energy solutions vary from company to company according to their different needs. Demand for energy is high, but ubiquitous smart technologies somewhat mitigate consumption and corporation-scale neo-carbon system neutralizes emissions. Inequality causes waste of energy. Energy education is provided mainly by tech companies. Smart technologies are not evenly distributed. Infrastructure is often in relatively poor condition outside tech campuses. Citizens are not committed "by heart" to energy issues. They assume that energy issues are taken care of by somewhere else, are "automated".

Bearing this scenario in mind, please think about actors today (companies, individuals...) that might indicate the forthcoming change described in the scenario.

4. Identify at least one "Value-Driven Techemoth" in your country:

Answer:

5. Describe one of these techemoths more in detail. Explain how the values show in the company's work:

Answer:

6. What would make the large companies in your country develop products and services based on renewable energy?

Answer:

Green Do-It-Yourself Engineers 2050

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

Local wind, solar and biomass are the main sources of energy. Energy is used as little as possible. Energy solutions vary greatly from community to community. Some communities are off-grid. Energy technologies have to be built using local resources mainly. Scarcity drives towards more diverse energy pallet compared to other scenarios. Local democracy ensures rational decisions and enforces commitment to decisions considering energy.

Bearing this scenario in mind, please think about actors today (companies, individuals...) that might indicate the forthcoming change described in the scenario.

7. **Identify at least one "Green Do-It-Yourself Engineer" (individual, group or community):**

Answer:

8. **Describe one of these DIY engineers more in detail. What motivates him/her/them?**

Answer:

9. **How can society support these DIY engineers?**

Answer:

New Consciousness 2050

Threat of an ecological collapse and ubiquitous information & communication technologies have led to a new kind of consciousness. Human beings are deeply intertwined with nature and with each other. They do not conceive themselves as separate individuals but form a "global brain". The world is connected by a global super-grid. Environmental problems are not seen as practical issues, but calling for deeper changes in values and mindsets.

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

Bearing this scenario in mind, please think about actors today (companies, individuals...) that might indicate the forthcoming change described in the scenario.

10. Explain what local issue drives "new consciousness" in your country:

Answer:

11. List actors (organisations, communities, movements, individuals) who pioneer in new consciousness in your country:

Answer:

12. Think about energy as a personal issue. How can a citizen express their lifestyle through energy solutions and choices?

Answer:

Possible, probable, preferred?

13. Which scenarios are possible for your country for 2050? Mark with X. (You can choose more than one.)

__ "Radical Startups 2050"

__ "Value-Driven Techemoths 2050"

__ "Green DIY Engineers 2050"

__ "New Consciousness 2050"

13a. Why:

Answer:

14. Which scenario is the most probable for your country for 2050?

__ "Radical Startups 2050"

__ "Value-Driven Techemoths 2050"

__ "Green DIY Engineers 2050"

__ "New Consciousness 2050"

__ None of the above.

14a. Which factors in your country (culture, society, history...) support your choice?

Answer:

15. a. Which scenario is the most preferred for your country for 2050?

__ "Radical Startups 2050"

__ "Value-Driven Techemoths 2050"

__ "Green DIY Engineers 2050"

__ "New Consciousness 2050"

15 b. Explain which elements in this scenario make it preferable for your society?

Answer:

Background

This information is used for statistical purposes and is not linked to your answers.

**** = Required answer***

First Name *:

Last Name *:

Age:

Gender:

Country *:

Occupation *:

Education (Select completed degree, mark "X") *:

__ Primary-level education

__ Secondary-level education

__ Bachelor's degree

__ Master's degree

__ Professional degree

__ Doctorate degree

16 What is your interest in the Neo-Carbon Energy project and related solutions? Mark with 'X'. You can choose several.

__ Exchange of information: receiving reports, etc.

__ New business models: starting an own business

__ Technology development

__ Conducting own research on similar or related topics

__ Policy relevance

__ Other (write here):

17 Any other comments or ideas you would like to share concerning the scenarios or this questionnaire?

Answer:

Thank you very much for your input!

Your answers will be used for further development of the scenarios.

To receive the research findings and a possibility to access the International Futures Conference, please provide your email address:

_____

APPENDIX 3. Classifications of the Responses

The responses to the survey are classified here into thematic subgroups.

Table 1. Types of startups named.

Technology/products	**Fuels/materials**	**Services**
• Litium batteries • Solar aviation • Small electronics • Integrating energy generating technology into the basic building materials. • Solar panels • Portable, light weight, flat packed and easy to assemble biogas units for organic waste treatment and off-grid energy production • Solar energy and waste for energy • solar tiles for roofs • renewable energy [mainly solar?] • Solar panels • solar panels • solar panes and minigrids • Mining companies are starting to use solar power • offgrid electricity • solar power • wind and solar power • Drinkable super meal	• Calcium Carbonate, made from CO2 • Biofuels • Nutrient recycling • Services based on small scale solar solutions • Solar energy consultancy • Microbial and fertilizer products • Fishpond, artificial ecosystem	• Travel agency, social enterprise • Community food systems • Transport solutions that uses mobile internet • Maker space • mobile internet the most active industry for radical startup
Social experiments	**Other answers**	
• Communal living • Off-grid movement	• Not existing, climate unsupportive • Private companies • Scientific Research Center • Local cooperative organizations for power distribution • public transport system • mass-media • middle and high school • local political leaders • co-operatives that deal with environmental problems	

Table 2. What makes this startup especially radical?

New technology / innovation	**New business models**	**New thinking / brings people together**
• new industry based on nutrient recycling • new technology • solar tiles: tremendous potential. Did fundraising and their product development independently • radical solution in conservative market • has the potential to be one of the leaders in solar technology, big ones follow. Focuses particularly on rural and remote Australia • introduction of new technology [solar tile], price close to the traditional solution [normal tile] • creativity and innovativeness	• different business model • new b2b business models • innovative solution to management of organic waste • solar energy to rural areas; easy-to-pay loan installments • develops replicable business models to supply energy in rural areas	• they live by example • connect experts with stakeholders • people taking back control of power • cooperative finding alternatives to growth-orientation and capitalism by disseminating the importance of alternative values
Radical impacts on the society • eliminates the need for a centralized grid system • provides new abilities to community food systems • rapid growth and market leadership based on internet technology and sharing economy • rapid growth, strategic target to expand globally • producing solar panels /smart energy for the rural areas • affordable energy access to hybrid solar technology • Reclaiming energy sovereignty • increases environmental awareness • installing solar systems in rural areas and thus improve health and education status of the people • changes the society; biomass dependency ends • helps to save money and generate your own energy	**Other:** • A mining company using solar power = surprising • community-like radical startups are considered as social enterprises; startups are innovative and techno-centric meaning in public minds. Most eco-businesses lack the radical aspect of a networked economy	

Table 3. What would need to change in your country for radical startups to flourish?

Government funding	**Government policies**	**Private funding**
• investment from government • government support • government funding	• Decreased regulation and taxation for small entrepreneurs • government reliance on coal • policy for enabling environment • vision impairment • tax situation – no taxes before a startup is profitable • authorities to adopt market-driven approaches that encourage innovation and new business models • funds embezzlement by the government • more incubating and real acceleration programs • withdrawing subsidies from coal and giving them to renewables • government mindset about the future energy • government policy • price on carbon • plagiarism • finance, regulation and competitive space • grid capacity: more capacity for private companies in the national grid • detect and control the lobbying of global companies, producers and distributors of energy • the mindset from economic growth into alternative strategies for inclusive3 and sustainable growth • Legal framework • economic incentives • more innovators • regulation. policies need to change as fast as the innovations happen. • opening the grids • government should strengthen the network security and norms • regulation to require all new buildings to incorporate solar water heaters • increased energy prices • incubate space • infrastructure in the rural areas • a change in policy: full deregulation of the energy market • training and certifying solar technicians • more focused and improved energy policy • lack of foresight, laws emerging ad hoc – basis • availability of open data • Favourable polices and legal framework to ensure that any available incentives whether fiscal or monetary reaches to the intended beneficiaries.	• more venture capital • capital • confidence from the investors • capital • initial capital for proof of concept • local investment instead of NGO development cooperation • funding • private sector support and entrepreneurship • lack of venture capital • access to loans (both entrepreneurs and customers) • establishment of local companies

Awareness and attitudes • attitude • socio-cultural attitudes • increased awareness • education to increase the awareness • lack of support and attention for part of the population • Mindset of the people and our leaders included.	**Company focused** • corporate culture • reasonable pricing of the products • greater commitment to innovation from various levels of government • energy subsidies and policy incentives for embedded supply • correct technology and know-how • they already do, provided they succeed in prototyping and have something worthy of investment	

Table 4. Types of "techemoths" identified.

Traditional energy companies (producers, distributors)	**Renewable energy companies**	**Large corporations**
• Neste oil, energy company, oil refinery • Origin energy, energy company • Powershop, power company • Power supply companies merger (Energex & Ergon) • Exxaro, energy company • PJM, leading electric utility system • Shell • Kenya Power Company • Edenor, electricity distribution company • ISA, power distributor • The big energy producers	• Panax Geotherm • Sky Solar Holdings Co • Epuron, renewable energy • M-Kopa • Gamesa, wind power company • Mumias Sugar Company • D-light Solar company • Mobisol	• Big companies partnering with small, GM, Ford, Toyota, Exxon, Boeing • Huawei, Telecommunications equipment manufacturer • Alibaba Group, Online retail • Gree Lextric Appliances, Home appliance manufacturer • Huawei Technologies • Lenovo Group (electronics manufacturer) • POSCO, a steel and iron company • Edesur, power company • SAMSUNG • LG • Huawei • Haier, small electronics, home appliances • BHP Billiton, natural resources • Most are multinationals (Unilever, Google, IBM, Philips etc.)

Telecommunications	Other	None
• Vodacom • Safaricom • Safaricom Lyd. Telecom company • Safaricom • Safaricom	• Movement, Transition Towns • Workers cooperative, Basque Mondragon conglomerate • Sunshine Coast Council, local administration • China's environmental protection company	• none • none. • None • none • None • None, the big companies are mining companies and not producing anything renewable

Table 5. How do the values show in the company's work?

Shows negative values currently	Shows positive values currently
• Currently lobbying to block climate change legislation and to protect their position in the market. • It refines, manufactures and markets its products locally but the sustainability report is drawn up by the headquarters • It controls all distribution • The challenge is to take the fossil-fuel based techemoths into energy transition programs and shifting cultures	• It has moved from traditional electricity to now toward solar • It is actively participating in joint renewable energy initiatives (although it is a mining company) • They offer consumers tech-based transparency • Nice corporate working conditions • Their smart energy solutions improve productivity • They distinguish their employees by nicknaming them as "Ali people". • This traditional company is reinventing itself to take advantage of new technology • Partners with industries to customize solutions and solve challenges regarding energy • It has opened up financial services even in the remotest areas • It attracts major investment in long-term energy supply • They took on development and management of huge solar farms and thus took responsibility for future electricity needs of the people. The council is already providing all the public services and energy is just an extention of these. • They have developed spinoff companies in the eco-business area, such as battery enterprises. Most of big businesses have a strong emphasis on an eco-friendly transition mainly because of the disruptive aspect of new energy renovation. • Principal mobile company established a small-scale solar distribution company through mobile-based micro-credit system • The company uses its biomass waste to start a by-product bio-fuel production in the country. • They developed mobile money. A clear example of techmoths using their unlimited resources to offer value across industries.

The business is about renewables	**They have a big impact**
• Use solar to power to some of its towers • It provides off-grid power • Global technological leader in the wind industry • They provide unique solar power kits and a wide range of solar products. They also offer cheap solar solutions. They have partnerships with different organisations and companies and raises awareness about clean energy. It sponsors students to take masters in renewable energy. • It has teamed up with others to attack large international solar energy companies and builds a 20-megawatt solar complex • D light have developed a system to distribute their solar products through the country. They select entrepreneurs and build their capacity to manage their own enterprises and also provide some credit facilities in advance to enable the entrepreneurs to stock D light products. the entrepreneurs in return pass on this knowledge to the users. The products tend to last for longer period because the consumers are aware on how the product work and are able to carry out basic troubleshooting • Mobisol combines solar energy with an affordable payment plan via mobile phone, comprehensive customer service and innovative remote monitoring technology. This company not only fosters startup(s) technological solutions, it also holds strong its employees and clients values. Mobisol has invested enough resources towards creating awareness in communities to recognize alternative energies over the on-grid energy supply provided by governments which is expensive.	• Strong position in the market area • Company has a sweeping influence on global businesses and ambition or vision to expand its business and influences • It has revolutionized the communication and business environment with its mobile solutions • The most value they bring is in their resources • The company is a global leading provider of information and telecom solutions, and they have held the largest number of patents in the country. In response to the global challenge of climate change, the company helps customers and other industries to reduce energy consumption and carbon dioxide emission by leading green solutions. • Although the company has mostly been involved in Tele technology, they have been diversifying their business portfolio to create platforms for different services, e.g. finance and quite recently public security. They are likely to tap into other sectors. • The company and the university jointly develop straw direct combustion of biomass power generation technology. • It has been growing and combining more operations for energy generation, transmission and distribution. • Too early to say

Table 6. What would make large companies develop products and services based on renewable energy?

Governmental support	**Public demand / awareness**
• national policies • Government support • targets • carbon tax • government policy • mandates • subsidies • subsidies • government policy and initiative • new policies by the government • investing in green technologies • accountability • policy support • investing in research and development • policy incentives • tax breaks • access to finance • financial resources prioritized in a new manner • charging taxes of fossil fuel power production • Creating good environment for auctioning • subsidizing or rewarding companies producing green energy • Fast tracks for renewable producers in terms of environmental impact assessment and water user rights permits. • grants supporting early stage project development • forced directives from government or international organizations • national policy • access to the national grids • right incentives • more investment into the renewable energy • more funding and research resources • more openings to private sector initiatives • Investment in r&d • favorable legal framework • availability of specialized renewable energy expertise • policy changes making it profitable to invest in renewables • collecting reliable statistics • public-private partnerships in investment and production • energy policies, tax and costs of services • security of electricity supply from the current utility • government policy incentivizing renewables	• Social pressure • customer pressure • change in attitude • expansion of consciousness • demand from consumers • more demand from the public • awareness among citizens • Unreliable national grid has been a major challenge for businesses as well as for individuals households. • 1. Low penetration of on-grid energy supplied by the government to rural areas and even to upcoming urban areas that are already in need of energy. 2. Load shedding which is a common probem with on-grid energy suppliers 3. Un realiability in supply of the ordinary energy 4. High cost of installations and maintainance of traditional energy options 5. On grid users are often subjected to the terms or policies of the local utility, which in most cases control payment rate increases

Systemic	**Business related**
• increase in oil price • realism about the climate change • following megatrends • technological advances • global demand for green economic development • energy scarcity	• more market survey in detail • Economic viability • profit • market that pushes towards new products • return calculations • Example of forerunners • strong financial returns for shareholders • Forerunners must use their influence more • awareness creating on a cost benefit angle • partnering with local producers • If it saves costs • high profits and low development costs • cost of battery cells • access to mobile-based micro-credit system

Table 7. Identified "Green DIY Engineers"

NGO's / Think and do tanks	**Alternative experiments / communities**
• Environmental NGOs and communities such as Dodo ry • Rocky Mountain Institute • The Home of China Electronics DIY	• Urban gardening initiatives • Transition towns • Regenvillages aims to create the tesla of eco-villages • COREM initiative in Mullumbimby. COREM is a not for profit, volunteer run, community action group • Denvy energy; Tyalgum community, Byron bay • Tiancunlu Community of Haidian district • cristal waters community
Universities / other schools / research institutes	**DIY Renewable energy producers**
• The sustainability Institute, University of Stellenbosch • Pul-mu agriculture technology school • DARPA tabletop semiconductor factory initiative	• a public [officer] who rebuilt his house and use the solar panel to gather the sunlight and transferred to the electricity for his own supply • Laurian mchau, [a self-styled researcher, innovator and manufacturer of the propellers which he uses as parts in making windmill generators.] • David Kinyua • Wind mills in Uruguay • A farmer who built a local district heating system which was fueled by waste wood and garden waste
Other DIY	**Companies**
• Biohacking • Efficient cooking stove • dada Paramatananda	• Ugesi Gold. Renewable energy social business focusing on rural an informal settlement electrification. SolartTurtle

	• Grey Army (Domestic service) • awtea (wind energy and solar water pump), • Juabar Inc. • Bob Harries Engineering Ltd • Kariuki Kiragu, bomakazi systems • Dean Stehling from CIH solar • ABENGOA • Solar Urbano • Bernard from TAREBI • Moto Charcoal by Chebet Lesan • Christine is a producer of charcoal briquettes from waste materials • Diana Mbogo, Diana a student from the University of Dar es Salaam who is also the founder of Millenium Engineers Ltd, an alternative energy company operating in Dar es Salaam
Culture • Kalahari bushmen • A dominant culture in Australia	• I cannot identify any • I am not sure that who can represent this kind of DIY engineers for a collapsed economy. But that does not mean there are no DIY eco-engineers in Korea.

Table 8. Sources of motivation.

Values	**Money**
• organic production and communities • trying to create free energy using meditation • respect for nature and the land, financially conservative, family-minded, take care of their environment, they are resourceful and well-educated and mindfuld of their consumption, political, progressive and vocal • motivated to mitigate deforestation • community action • Aims to give power to those that are powerless today • Getting people prepared for peak energy and reversing climate change • Exploring alternatives • A vision for a sustainable future, energy independence, moving away from extractive approaches to living • Energy for development • locally available materials to provide lighting to the slum • attempt to live off-grid, create small businesses, recycle everything • applying innovative technology solution for sustainability in the energy and environment sectors, generating electricity from renewable resources, converting biomass	• revitalizing regional ecomy, living conditions and preserving its unique identity • Losing business turned the focus • job creation • income generation • He got retired from his work and felt that the fees for electricity are relevantly high • Simplifying pumping the water for agriculture • providing cheaper, alternative energy options to businesses in Tanzania •

into biofuels, producing derinking water from the sea water • improving the world and empowering people • Thriving families and reduced burden on local and national governments • to provide an integral public good • protecting environment • alternative lifestylers, motivated by deep green, artistic and spiritual values • advocates for creating a shared economy, equality for all and ecological building • help the communities better by introducing innovative farming technologies • her motivation comes from the fact that people are cutting down trees for firewood and to produce charcoal. The cutting down of trees has a great impact on our rivers, causes erosion and other impacts. This in return reduces the potential for hydro power production.	
Technological enthusiasm • Fun-seeking and showcasing their work • outing his theoretical knowledge in practical application. Generally a technology enthusiast. • Student works	**Need for energy** • community-owned renewable energy project • Survival • need to provide the local community with energy services that are otherwise not available • solving customer problems • First producing energy for their own use, then to the neighbors too

Table 9. How can society support these DIY engineers?

Government policies	**Society as a whole**
• favourable regulatory environment: remobe regulatory impediments, cease subsidizing coal and gas companies • ensure that technology is widely used and adopted • opening the energy sector • encourage rapid innovation and new product development • motivating local actors, developing scalability for sustainable energy production • removing obstacles • more relaxed and free environment to develop • government advocating for such models • being informed about future needs • recognizing achievements and learning from what works • cutting the addiction to coal • by shifting its thinking regarding measuring success and efficiency	• purchasing the product and sensitization to other communities • promotion of such models by 3rd sector actors • By becoming direct consumers of products made • by buying their products • crowd funding from citizens • By buying their products • by supporting the products and using the new things • by buying their products and services • adopting new technologies and experimenting on their projects or homes • The society can support her work through the use of eco-friendly charcoal and also adopting similar approches

• reduce red tape • investment in technology transfer and technology development so that the DIY engineers can have more sources of information as well as manpower assistance. • club or salons for DIY engineers, providing useful references, websites, recruit experts	
Awareness raising • Change in mindset of people, from hippie to mainstream • needs to work and spiritual ideas more acceptable • Recognition and awards • supporting local production and awarding new innovation • recognize the value of people and emphasize education and creativity • raising citizen awareness of the gains of sustainable energy, lack of information and communication is the main barrier • The best way the society can support these ideas is to first believe in the solutions these DIY engineers create. The society should advance these engineers creations by rewarding them well, they need to not only to be better customers but also good brand ambassadors of their creations.	**Funding** • provide seed funding • access to capital • loans or subsidies • financial institution bying into such models • Grants
Education • reinforcing higher education in engineering studies • better link education and business • incorporating renewable energy education in public and private curricula • DIY engineers should be identified and educated on important skills like design thinking, marketing, accounting etc.	**What support?** • society does already • the connection to the society is minimal: see neither profits nor fame. The question should be: how to motivate the society to these equipments for renewable energy • society very much appreciate their help and contribution • They are not encouraged nor supported

Table 10. Explain what local issue drives new consciousness in your country.

Environmental deprivation	**Health**	**Economy**
• Damage to the land caused by coal mining, deforestation challenging local flora and fauna and indigenous animals. • The requirement for a 'just' transition to a green economy • Citizens' environmental movement in city • Understanding climate effects, rising tariffs from coal-supplied	• Health threat • anti-nuclear movement • The haze in China which cause lung cancer. • The campaigns that "new consciousness" groups carry out on issues that common	• Cost saving • Recent oil spike that drove the cost of everything sky high and the realization and feeling of helplessness of the country in view of fossil fuel costs in the future and the turmoil associated with it. • Shenzhen Economic Development Zone

electricity, awareness of the world ones children will inherit. • Install the knowledge of environmental needs in all social strata of the community. • Unbridled development, deforestation and unsustainable practices on micro and macro levels are burning concerns in the community, which is very popular with both visitors and sea changers. • Climate change as more than 80% of Tanzanian depend in agriculture • Issue driven by these groups include: anti-nuclear power, green house gases, Co2 emission etc • Environmental reawakening • Water shortages due to deforestation of water towers • Deforestation , land degradation and climate change • Water is the issue that drives new consciousness here. Water is seen as sacred and personal. • Deforestation as Kenya is an agricultural country and the cutting down of trees has led to a change of fortune for the farmers in our country • Limited 'new consciousness' beyond a green minority • Change in the climatic patterns is one of the issues driving 'new consciousness' in Tanzania and its neighboring countries. All these negative changes can collectively be attributed to agressive human behavior such as deforestation.	people feel may have a direct negative impact on their daily lives, • aggravating air pollution and the frequency of dust storm. It is because they make people sick.	• power cutoffs and high charges for power • Rising energy prices, climate change impacts, sustainable consumption and production • The decline of forests and need for other energies. Traditional energies are more expensive yet demand for energy is growing/ • High cost of electricity has made people to think about other cheaper alternative. The fact that a higher percentage of the population do not access modern lighting and cooking solutions is attractive investors to invest in decentralized energy solutions to meet the needs of the marginalized groups.
Culture • Being tired of living just to pay bills, being tired of living stressful life, being tired of just functioning and not living. • What motivates Quakers is a truly cosmopolitan and open view of human potential and spirit. What motivates the space movement is a will to make more progress and curiosity, though there are depressing factors which reduce both its effectiveness and its authenticity in the US at present. • there is growing consciousness in USA but it takes many forms.	**Politics** • Fatigue to federal government • the government imposes minimal energy building standards for all new buildings • Mainly fear of global politics.	**Diffusion of technology** • The availability of mobile telephone • Availability and simplicity of use • Emergence of successful entrepreneurs and companies in the country • local home owners build zero-energy houses • Energy consciousness is not such a new issue in Australia. Solar installations have become normalised. A newer and still marginal concern is with regional

• Visible impact of current lifestyle e.g link to health, environment, food security, cost of living, etc.		carrying capacity - and the need for carrying capacity based regional planning. • The success stories of alternative energy beneficiaries is the other factor driving the new wave of consciousness in Tanzania today. •
No sign of new consciousness • No one yet. Access to cheap energy overlooked. • There is very little "new consciousness" in Australia • But I cannot find its signal in Korea.		

Table 11. List actors (organisations, communities, movements, individuals) who pioneer in new consciousness in your country):

Individuals:	**Universities / institutes**	**NGO's**
• Famous actors: YiYan Jiang, Xun Zhou, BingBing Fan, Chen Li • Cormac Cullinan, environmentalist and a lawyer • Peter Garrett (musician and former environmental minister) • Christine Loh (now Under Secretary for Environment of the HKSAR Government)	• futurists groups such as the futures foundation • the university of the sunshine coast futures program • Murray Lane is at the forefront, having developed a 'Carrying Capacity Dashboard' for assessment of local carrying capacity, taking multiple land-use variables into account, including energy. • The Sustainability Institute • Sustainability Institute • Green economy institute of Beijing Normal University • Futures Studies departments at universities • Futures Foundation Australia • Strathmore Energy Research Center • Prof. Izael Da Silva of Strathmore University, who has been a champion for the RE industry in Kenya	• TAREA - Tanzania Renewable Energy Association • NGOs, not for profits, local community organisations • Beyond Zero, Climate for action, the Wilderness society • ACCRA Tanzania • OIKOS East Africa • Friends of Nature • Clean stoves is a company that work to create awareness in use of energy efficient stoves for household in the country side • Civil Societies • Project 90 by 2030 • Greenpeace • Environmental protection NGO's in Hong Kong • Green Korea United, The Korean Federation for Environmental Movement • Lighting Manyattas Initiative • Many environmental and grass-roots organizations at the local and state levels.

		• Interbioestrategia • Fundación Argentina de Recursos Naturales (FARN) • Vida Silvestre • Renace Argentina • tanzania renewable energy association(TAREA) • World Wildlife Fund • Green Peace • 'Get Up' campaign organization • Community Education and Empowerment Centre (CEEC) • List of Hong Kong based NGOs: http://www.epd.gov.hk/epd/english/links/local/link_greengroups.html
Movements / experiments /alternative lifestyles • Byron Bay communities • space movement • permaculture movement • self sustaining communities • The Ecovillage at Currumbin • "Internet plus" movements in China. The concept of "Internet plus" is the use of information communication technology and the Internet platform, promote the integration between the Internet and traditional industries depth, its essence is transboundary, to create a new developmental ecology. Under this background, upgrading and transformation will become the only way for • Agriculturalists, Environmentalist • Maendeleo Ya Wanawake which promotes community-based tree planting and associated energy efficiency options (efficient cookstoves etc) • Green belt movement • neighborhood • Women and Youth Groups • Local social leaders	**Spiritual communities** • spiritual groups like Ananda Mela • Roman Catholic Church • Moravian Church of Tanzania • Quakers • Religious organizations - though in many instances negatively, religious organizations sometimes play a positive role in transforming people's thinking • Church Organizations • Community Based Organizations	**Interest groups** • Rural Energy Agency of Tanzania • Justin Mungure for Hydropower • China Wind Energy Association • Chinese Renewable Energy Association • China Photovoltaic Industry Association • Association of Energy Professionals • Kenya Assosiaction of Manufacturers

Public actors	**Media**	**Business**
• TaTEDO - Tanzania Traditional Energy Development Organisation • Tanzania Ministry of Energy • Government Ministry of Energy, Energy regulatory commission • State • Christine Loh (now Under Secretary for Environment of the HKSAR Government) • School local government • Basque Government • Political Leaders • rural energy agency (REA) • Politicians - exercise as much control as religious organizations • energy and water utilities regulatory authority(EWURA) • NSW • The government's hand in also mobilizing and encouraging its citizens to consider alternative energy sources also can not be ignored through its Public-Private Partnership initiatives. • A lot of international organizations are also keen on investing, funding and supporting businesses with a focus on prividing alternative energy to the community.	• media • Ubongo kids • Media - the media has a high impact on changing the way people think	• Business Associations • corporate social responsibility arms of national companies. • Geothermal Development Corporation, KENGEN, Kenya Power • tanzania renewable energy business incubator(tarebi) • Tanzania renewable energy business incubator(TAREBI), • Ngowi of Helvetic Group • Kenya Climate Innovation Center • NGOWI OF HELVENIC GROUP, , BUNI • Institutions and companies are pioneers in Spain in terms of sustainable consciousness Renewable energy supporting organizations and companies • Total Kenya are sponsoring a programme on eco challenge focusing on environmental friendly technologies, Mkopa solar companies offering credit to their customers, D light offering affordable lighintg solutions • In most cases technology based companies are the key actors pioneering the rise of alternative energy. In the case of 'M-Kopa' services loaning solar devices to people of low income at flexible terms, this is driven by a tele communication company 'Safaricom'. There are several startup businesses and other SME's who are also playing an active role in monetizing their energy solution ventures.

Table 12. Think about energy as a personal issue. How can a citizen express their lifestyle through energy solutions and choices?

Saving energy	**Consuming green**
• do what they can to reduce energy • recycling • use public transportation as much as possible • If you have to use your car, embrace the concept of carpooling or ride sharing. You can tweet your friends to see if there is anyone heading in the same direction and give them a lift. use as less frequently electronic devices as possible to reduce energy usage and the number of times of charging the devices • By saving and using energy efficiently. By creating energy efficient housing and buildings. • Start by adopting low-cost efficiency options at home (efficient cookstove, efficiency lighting, fireless cooker, etc), at work (efficient lighting, sensors that control lighting) and then move on on higher cost options that ensures self-sufficiency (solar water heater, small-scale tree farm). Adopt vegan lifestyles that promotes both health and reduce green house emissions in its footprint. • mainly by reducing the grey energy, do not buy new goods (cars, electronic, clothes) but have existing repaired and upgraded. • Reducing energy consumption • Essentially through his/her concern to save critical energies (such as power and gas) at home but essentially in public ambits • By reducing on the amount of waste they generate. Consciously buying from companies that have incorporated sustainable processes in their activities. Even a simple thing as switching off the lights when one is not in a room can save on energy • I believe we have become more conscious energy users (turning off lights, equipment etc) at home and work	• Citizens are also beginning to ask questions of their super-funds, there are trends towards ethical super investments, people are beginning to move their investments away from firms that support environmental destruction. • the most effective thing that citizens can do is to take the initiative to collaboratively develop compact, car-free, walkable, multi-functional townscapes within walking distance of food growing areas and industrial-ecology clusters - to minimise energy-consuming commuting, long haul food transport & industrial waste. • .endorse the products made by the factories powered with wind or solar energies • OUR CUSTOMERS AT JUABAR EXPRESS THEIR LIFESTYLE BY CHARGING AT SOLAR HUBS, WATCHING FOOTBALL MATCHES AND PLAYING VIDEO GAMES AT THESE HUBS. • Citizens should be consumer of green products and to participate in environmental protection activities. • By being an living example of not wasting energy and using locally available energy system sources • sustainable mobility, electricity, thermal, waste, food and consumption choices made, support for producers of sustainable goods and services, calling for policy that can drive all of the above • People with high income tends to use more clean, portable and relatively expensive sources of energy, • By making a conscious choice on where you buy your energy from, and choosing options that do not increase energy demand • People who are informed on energy opportunities make right choices on energy services that are safe and meet their needs. With clean energy sources people would choose to live clean, healthy and more productive. Limited choices or none of it forces people to use what is available despite the dangers posed. • Improving energy efficiency, besides using solar panel, local storage, electric vehicles, and self-driving cars. • By using clean energy products in the house,

	• Through sustainable consumption, including mobility, energy and waste management towards a circular economy approach. • People can already vote with their hip pockets, buying products that have less packaging, small carbon footprint/locally made, install solar panels and rain water tanks. People do have more power than they recognize. • encourage sustainable building practices which improve quality of life for occupants and help to reduce on-going operation costs. Most residents have little or no electricity bills • there are now a wide range of options through which consumers can purchase their energy, and Australians are voting with their wallets and choosing the most sustainable of these options
Prosuming energy • go solar • off-grid becoming a trend through TV-programs • There are trends towards moving from the city to the country to be more self-sufficient and home supply companies are stocking more vertical farming and self-sufficiency supplies. • Less reliance on the formal/conventional energy infrastructure • choose clean technologies over traditional ones for home use once options are available • Individuals can instal solar panels if they can afford them and if their local authority permits. • Most of the rural forks are small scale farmers who own a small piece of land. Instead of relying on the mains, there is a potential in harnessing renewable energy to power their lifestyle. For instance, a bio gas system from only two cows, can power all your cooking and lighting needs for the rest of your life. A Home solar system can provide power for lighting, a TV set, a radio, a fridge or deep freezer. This can be combined with a wind system. The household will be energy sustainable and no need to wait for a main grid. • With improved energy supply, we will see less cutting down of trees for firewood and related uses that have a direct impact on the environment. Cheaper energy solutions will encourage 24 hour economies in parts of the continent where life stops as soon as the	**Being politically active** • vote of political leaders who share these values • This will require citizens to lobby state and municipal govt to encourage and enable such 'rurbanisation' to occur

sunsets to sleep, this will indirectly have an economic impact in the income of citizens thus help solve the problem of poverty. More jobs will be created as a result on shift basis as it is already happening in other countries. • By encouraging more people to harvest wind and solar energy we will have helped reduce on the negative impact of hydro power facilities. Hydropower facilities can have large environmental impacts by changing the environment and affecting land use, homes, and natural habitats in the dam area.	
Expressing values • It is individual responsibility but should result in a collective action • Citizens are free to join NGOs or business/professional groups to lobby for support from the public, the HKSAR Government and from business for support • Conservative lifestyle in which people try to make harmony in nature • social media, this happen when a certain issue arises and people are not happy about it or it mighty be impressing thing .people will express their views through social media and will attract more visitors to give their views on the related topic. • By pointing out companies that pollute the environment • Intelligence, focus and realism in reacting adaptively to the real larger needs, and efforts and dialogue to build the networks, is the main focus.	

Table 13. Possible and why?

All four:	• People like to leave decisionmaking and development into the hands of policymakers and/or companies. On the other hand, there is definitely potential for local level change, but this requires better education and awareness, as well as a social trend (through social media perhaps). **(Finland)** • all are possible scenarios **(Australia)** • There are no indicators suggesting that any are impossible **(Australia)** • They are all necessary to ensure the necessary transition of the economy, and society **(South Africa)** • There are already a few living examples that have had a huge impact **(Kenya)** • In different levels, but all the 4 scenarios are possible in my country, depending on how the legal and technological frameworks develop. **(Spain)** • With adequate and alternative sources of clean energy people are able to make choices that suit them in terms of affordability, reliability, availability and safety. With the fast growing ICT development - increased use of internet for social media and business transactions, there will be greater exchange of information about energy services and goods to the extent that consumers and traders will be able to make inquiries across the globe and make orders for purchases as already being experienced. Companies would be willing to set up the factories to manufacture energy products, accessories and services anywhere in the world where production costs are low because customers wouldn't be bound by trade and cross border barriers. By 2050, value-driven techemoths will be an ideal business model in Kenya because consumers will be more interested on those energy products and services that add value to their lives, and it is only well established companies which understand local energy needs and have the value addition capacities to innovate using available technologies that will have the capacity to play this role. The techemoths will produce the energy and use the technologically supported backward and forward linkages to distribute the energy products and services to the larger population across the globe. **(Kenya)** • With the development and the current problems in **China**, I think the government and as well as the public will pay more attention to our eco system and try to find matching solutions to the specific questions
Three	**Startups, techemoths, consciousness** • Actually, I don't think any scenario other than disaster is possible if it is just the **US** alone. "It takes a village." All nations have crucial weaknesses, and only by more effective collaboration can we transcend them enough even to stay alive, in the face of the life-or-death impending crises in this sector. It also takes mutual support of all three sectors emphasized here. • Because when properly implemented and supported in all aspect of culture, economic and social issues is possible. Value driven techemoths 2050 can be possible if the outside companies invest within the country. Green DIY Engineers 2050 can be a problem because the technology innovation to many society members is still low and much work needed to make this scenario possible. **(Tanzania)**
	Startups, engineers, consciousness • Priority needs are: job creation/improved livelihoods/povery alleviation, addressing inequality. Potential exists for innovative action, mind shift and social enterprise. **(South Africa)**

	Startups, techemoths and engineers • We have a business environment that encourages radical start-ups and innovation ecosystems. The Deep Ecology philosophy would not be as strong here as, say, New Zealand. We have Value-driven Techemoths here already but with a different set of values and commitments to fossil fuel energies. Given the right incentives these could switch to renewables over the period in question. **Australia** has seen the emergence of community gardening, local consumption, co-working and growing interest in off-grid living. I don't see this as becoming a dominant model. • People would love to get value for money. **(Kenya)**
2 possible	**Startups and Engineers** • N/A (USA) • Changing mindsets requires some radical shift in those who are able to do so e.g politicians, media etc. The likeliness of this happening is not that high, especially as most of these people are not necessarily suffering from issues related to energy poverty - which would be one of the main drivers for change. Radical startups and Green DIY engineers will most probably increase as people get more fed-up with existing systems. **(Kenya)** • These two scenarios are dependent on individuals who have the will to build their businesses and solutions in order to solve a problem in society. They rarely need government policy or support to begin.**(Kenya)** • With the rapid development of **China**'s economy and society, more and more people are conscious and have the ability to participate in entrepreneurship and environmental causes.
	Startups and Techemoths • Currently there are many new startups which have emerged with good solutions for the society. Its a matter of time for them to profit and build upon what they just started **(Tanzania)** • Commercial prospects (Australia) • radical startups and value driven techemoths have already emerged to change the way energy is obtained here in tanzania. renewable energy technology is driven by value driven techemonths as they are funding many projects of renewable energy as well as research and development studies on renewable energy.like the total company has already funded the awango lamps to rural schools an in many hospitals. we still have long to go in order to develop green DIY as well as consciousnesses of the people by 2050. engineers here are not focused on doing things for future but prefer things that will pay in short terms. this is mainly because most of the graduates are expected to generate money for their families since most of the families are still in very poor standards. this leaves the engineers with no option rather than seeking for job at least to be able to earn life. New Consciousness 2050 , the awareness is not likely to much compelling up to 2050 since most of tanzanians up to now have no access to power(24% of the total population have access to electric power).this means most of the **tanzanians** populations is unconscious.
	Techemoths and Engineers • The political climate will support what is existing but mining firms hold too muc power in Australia to allow large-scale change without a fight. Change in **Australia** will come from the people - not the government • Ecological mind-sets still embryonic in **Kenya**

	Startups and Consciousness • We are not big enough to Techemoths, nor large enough to support individual engineers **(Australia)** • Radical start-ups will create new untapped energies. The new consciousness will enable people to understand the need for green energy. It clearly creates an understanding of the future of energy **(Kenya)** • New consciousness and radical startup are possible because **Kenyans** are very entrepreneurial the startup community is thriving. Consumers are also becoming more aware of the good products in the market
	Engineers and consciousness • Decentralized and distributed scenarios are fundamental to the future with local energy prosumers. **(Latin America)** • Green DIY Engineers and New Consciousness tends to bring energy authority and responsibility in respect to environmental consciousness back to citizens. Global citizens should develope the innovative culture of being engineers of their own problems; we should be solution providers. We should be responsible for championing a cleaner, safer and better world. **(Tanzania)**
	Engineers and Consciousness • very individualistic country with direct democracy - people are used to decide everything **(Switzerland)** • Even though people still like to 'stick their head into the sand', the pressure of living is overwhelming and there will be major 'drop out' movement. Many of the young generation are beyond retail therapy, meaning their have different values, acquiring wealth is not necessarily collecting stuff anymore and putting more pressure on environment. Food will be another major shift, people will be getting more aware of what they are putting in their bodies. The age of eating chemicals and animals will come to an end, thus creating new business opportunities and a shift in living. New consciousness is related to a greener approach. **(Australia)**
	Techemoths and New consciousness • Level of education is at the right pace increasing, but, there is little support to individuals in implementing their ideas **(TZ)**
Only 1 possible	**Value-driven techemoths** • The growing influence of domestic technological companies and their vision to see themselves as a community. The scenario can only be realized on condition that a close cooperation between the central government and techemoths is established. (China) • Big corporations run **Australia** (including the media) • The established large firms in **Korea** would continue to take most of initiatives for a change. • N/A **(Hong Kong)** **Engineers** • It provides a bridge between decisions with local actors **(Argentina)** • **Australia** have always been a country of inventive individuals. Aboriginals learned how to survive under harsh conditions for thousands of years, and the white settlers were also very hard working and inventive. This tradition could be carried through into the 21st century, where we potentially face the largest threat ever to our survival. The question is, whether the consumer society of abundance and the "nanny state" substantially altered this natural propensity. • Most of **Koreans** are well educated in science and technology. They like to do anything by themselves and to make challengeable experiments.

	Radical startup • Because entrepreneurship is strong in general in the country and is becoming quite rapidly stronger on the issue of renewable sources of energy **(Argentina)** • N/A **(China)**

Cultural reasons	• Most of **Koreans** are well educated in science and technology. They like to do anything by themselves and to make challengeable experiments. • **Australia** have always been a country of inventive individuals. Aboriginals learned how to survive under harsh conditions for thousands of years, and the white settlers were also very hard working and inventive. This tradition could be carried through into the 21st century, where we potentially face the largest threat ever to our survival. The question is, whether the consumer society of abundance and the "nanny state" substantially altered this natural propensity. • People like to leave decisionmaking and development into the hands of policymakers and/or companies. On the other hand, there is definitely potential for local level change, but this requires better education and awareness, as well as a social trend (through social media perhaps). **(Finland)** • DIY as well as consciousnesses of the people by 2050. engineers here are not focused on doing things for future but prefer things that will pay in short terms. this is mainly because most of the graduates are expected to generate money for their families since most of the families are still in very poor standards. this leaves the engineers with no option rather than seeking for job at least to be able to earn life. New Consciousness 2050 , the awareness is not likely to much compelling up to 2050 since most of tanzanians up to now have no access to power(24% of the total population have access to electric power).this means most of the **tanzanians** populations is unconscious. • Ecological mind-sets still embryonic in **Kenya** • New consciousness and radical startup are possible because **Kenyans** are very entrepreneurial the startup community is thriving. Consumers are also becoming more aware of the good products in the market • very individualistic country with direct democracy - people are used to decide everything **(Switzerland)** • Even though people still like to 'stick their head into the sand', the pressure of living is overwhelming and there will be major 'drop out' movement. Many of the young generation are beyond retail therapy, meaning their have different values, acquiring wealth is not necessarily collecting stuff anymore and putting more pressure on environment. Food will be another major shift, people will be getting more aware of what they are putting in their bodies. The age of eating chemicals and animals will come to an end, thus creating new business opportunities and a shift in living. New consciousness is related to a greener approach. **(Australia)**
Economic reasons	• By 2050, value-driven techemoths will be an ideal business model in Kenya because consumers will be more interested on those energy products and services that add value to their lives, and it is only well established companies which understand local energy needs and have the value addition capacities to innovate using available technologies that will have the capacity to play this role. The techemoths will produce the energy and use the technologically supported backward and forward linkages to distribute the energy products and services to the larger population across the globe. **(Kenya)**

	• CURRENTLY THERE ARE MANY NEW STARTUPS WHICH HAVE EMERGED WITH GOOD SOLUTIONS FOR THE SOCIETY. ITS A MATTER OF TIME FOR THEM TO PROFIT AND BUILD UPON WHAT THEY JUST STARTED **(Tanzania)** • We have a business environment that encourages radical start-ups and innovation ecosystems. **(Autralia)** • Commercial prospects (Australia) • radical startups and value driven techemoths have already emerged to change the way energy is obtained here in **tanzania**. renewable energy technology is driven by value driven techemonths as they are funding many projects of renewable energy as well as research and development studies on renewable energy.like the total company has already funded the awango lamps to rural schools an in many hospitals. • Because when properly implemented and supported in all aspect of culture, economic and social issues is possible. Value driven techemoths 2050 can be possible if the outside companies invest within the country. Green DIY Engineers 2050 can be a problem because the technology innovation to many society members is still low and much work needed to make this scenario possible. **(Tanzania)** • These two scenarios are dependent on individuals who have the will to build their businesses and solutions in order to solve a problem in society. They rarely need government policy or support to begin.**(Kenya)** • With the rapid development of **China**'s economy and society, more and more people are conscious and have the ability to participate in entrepreneurship and environmental causes. • We are not big enough to Techemoths, nor large enough to support individual engineers **(Australia)** • The growing influence of domestic technological companies and their vision to see themselves as a community. The scenario can only be realized on condition that a close cooperation between the central government and techemoths is established. (China) • Big corporations run **Australia** (including the media) • The established large firms in **Korea** would continue to take most of initiatives for a change. • Because entrepreneurship is strong in general in the country and is becoming quite rapidly stronger on the issue of renewable sources of energy **(Argentina)** • People would love to get value for money. **(Kenya)**
<u>Political reasons</u>	• In different levels, but all the 4 scenarios are possible in my country, depending on how the legal and technological frameworks develop. **(Spain)** • Priority needs are: job creation/improved livelihoods/povery alleviation, addressing inequality. Potential exists for innovative action, mind shift and social enterprise. **(South Africa)** • Radical startups and Green DIY engineers will most probably increase as people get more fed-up with existing systems. **(Kenya)** • The political climate will support what is existing but mining firms hold too muc power in Australia to allow large-scale change without a fight. Change in **Australia** will come from the people - not the government • Green DIY Engineers and New Consciousness tends to bring energy authority and responsibility in respect to environmental consciousness back to citizens. Global citizens should develope the innovative culture of being engineers of their own problems; we should be solution providers. We should be responsible for championing a cleaner, safer and better world. **(Tanzania)**

Table 13. Scenarios help probable. Respondents by country.

Country: Probable scenario	Argentina: Value-Driven Techemoth Argentina: Radical Startups Australia: Value-Driven Techemoth Australia: New Consciousness Australia: Value-Driven Techemoths Australia: Green DIY Engineers Australia: Value-Driven Techemoths Australia: Green DIY Engineers Australia: Value-Driven Techemoths Australia: None of the above Australia: Value Driven Techemoths China: Value-Driven Techemoths China: None of the above China: Green DIY Engineer China: Radical Startups Finland: Value-Driven Techemoths Hong Kong: Value-Driven Techemoths, New Consciousness Kenya: Radical Startups Kenya: Radical Startups Kenya: Radical Startups Kenya: Radical Startups Kenya: Value-Driven Techemoths Kenya: Value-Driven Techemoths Kenya: Value-Driven Techemoths Kenya: Value-Driven Techemoths Latin America: New Consciousness South Africa: Radical Startup South Africa: Value Driven Techemoth South Korea: Green DIY Engineers South Korea: Value-Driven Techmoths Spain: Value Driven Techemoths Switzerland: Green DIY Engineer Tanzania: Value-Driven Techemoths Tanzania: Value-Driven Techemoths Tanzania: Value-Driven Techemoths Tanzania: Radical Startups Tanzania: Radical Startups USA: New Consciousness USA: Radical Startups

Table 14. Reasons behind the choices for "scenario held probable"

Political	**Economic**
• Power of the conservative parties and big capital (Australia, Value-Driven Techemoths 2050) • The failure of the public sector and the conventional private sector to bring about the necessary transition (South Africa, Radical Startups 2050) • The role of the government in the four scenarios is described to be minimal. This is least possible to happen in **China** the central government wouldn't lose its control over the country. (None of the above) • Lack of transparency in corporate governance and its relations with governments and opinion formers (Argentina, Value-Driven Techemoths 2050)	• In China, because the system reason, large enterprises, especially large state-ownde enterprises than small businesses is more economic and technical strenght. (Value-Driven Techemoths) • Geography, economic structure (Australia, Value-Driven Techemoths 2050) • The leading companies in renewable energy sources have been growin in the last decade and it seems they will continue becoming global companies (Spain, Value-Driven Techemoths 2050) • There is an enabling ecosystem for supporting startups. As consumers become more aware of clean products. they demand for the products and they demand creates a vibrant startup community (Kenya, Radical Startups 2050)
Cultural	**Societal**
• Culture, society and history (Australia, Green DIY Engineers 2050) • Culture and history of being independent, decentralised political and economic structure, distrust to foreign ideas (and immigration) (Switzerland, Green DIY Engineers 2050) • **Kenyans** are very entrepreneurial and it's a growing economy (Radical Startups) • Culture and society in general, the freedom people have, political stability (Tanzania, Value-Driven Techemoths 2050) • **Australia** still sees itself as a small power at the mercy of forces bigger than ourselves. Without powerful new leaders, who are not yet in evidence, this will not change. (Value-Driven Techemoths 2050) • The slowness of public consciousness in relation to sustainability (South Africa, Value-Driven Techemoths 2050) • Ordinary citizens still believe in "natural hierarchy/leadership", and the average person will most likely expect solutions from a higher power/authority, rather than being proactive and personally responsible. At least this way there will be guaranteed tangible results (Value-Driven Techemoths 2050, Australia) • Lazy thinking, focus on short-term, individualism, lack of community spirit (ouside of sport) (Australia, None of the above) • Industry, pride in historical major engineering achievements, culture of entrepreneurship, societal pressures on	• Low per capita income, low level of education, less scientific research in this area, (Tanzania, Value-Driven Techemoths 2050) • There will be decentralized sustainable energy advances; and individuals, families and communities banding togethes is possible (Kenya, Radical Startups 2050) • Many youth who are starting up companies and exploring entrepreneurship. This creates new curiosities and create community and locally related solutions (Kenya, Radical Startups 2050) • The young people in the country have been actively engaging in entrepreneurship and thinking of new ways to do things. There is a great shift from doing traditional businesses e.g. merchandising to developing new businesses that serve the BOP. The government policy drive to support young people in entrepreneurship could also contribute to this (Kenya, Radical Startups 2050) • There is already a way in which the startups are driving the society. The large increase of startups in the energy sector is by 2013 records. They have also showed changes in the society and also changes some of the rural areas to town centres. (Tanzania, Radical Startups) • Culture, society, entrepreneurshop and consumption. (Kenya, Value-Driven Techemoths 2050) • Because currently there are more local and small scale companies who participate in

business and government to get serious about SDGs, particularly in our weak areas of climate change and environmental issues (Australia, Value-Driven Techemoths 2050) • Society and history (South Korea, Green DIY Engineers 2050) • Path dependence of fast economic development and related social system in Korea would support the second scenario. Especially east Asian culture like Confusianism would help the Korean society keep a well-structured hierarchic societal fabric. (Value-Driven Techemoths 2050)	renewable energy business and culture, society, history and economic situation of **Tanzania** can allow this **radical startups 2050 possible** • Culture and society. Our society is headed towards being a fully entrepreneurial society (Kenya, Radical Startups 2050) • The values and consciousness of young people (kids and teens) about taking care of the environment, supported by a quite widespread in the development of related new technologies or new practices concerning conventional technologies (Radical Startups, Argentina) • Community driven initiatives and deep ecology mindsets still embryonic (Kenya, Green DIY Engineers 2050) • More examples of DIY engineers were reported in China. More and more people are getting interested with DIY programs. In my point of view, the "radical startups" and "value-driven" can't accomplish by single person. Consier with the large amount of population in China, the full conscous of the public need time to fulfil. (China, Green DIY Engineers 2050) • Global trends, national strategies and policies, economic and social development needs (China, Radical Startups) • There are existing New Consciousness Groups in **Hong Kong**. There's a complete personal and economic freedom in Hong Kong. The activities of these groups will continue without restrictions. Whether the "activism" could eventually evolve into "Value-Driven techemoths 2050" is uncertain in the absence of favorable government policy and market condition. (Value-driven Techemoths 2050, New Consciousness 2050) • Society (Kenya, Value-Driven Techemoths) • In Tanzania today, we are still at a stage where we are still realizing more emergence of radical startups. These radical startups are still struggling to get attention of Value Driven Techemoths, we can be hopeful that more value driven techemoths will soon be more responsive and supportive. There is also much empowerment that still needs to be done in order for citizens to realize their full potential towards becoming Green DIY Engineers. The same applies to new consciousness, citizens still need to be made aware of the dire consequences we are bound to face if we dont pay attention to environmental conservation, use of alternative energy and other related solutions. (Tanzania, Value-Driven Techemoths 2050)

Environmental • My choice is based on an understanding of the limits to growth faced by all countries – and the inevitability of crisis scenarios developing on both the financial and ecological fronts (particularly climate change) in the coming decades. Such crises will either compel a radical rethink or trigger massively violent and destructive scenarios (Australia, New Consciousness 2050) • Unless one makes radical assumptions about consciousness, we are now on a very hard course towards disaster. Since there is no hope without the consciousness side, and since consciousness has a more solid foundation then the others do.. I am flipping a coin here, but this one seems best (USA, New Consciousness 2050) • I think the younger generation take global warming more serious. They believe they can fix the stuff up of previous generations. And thus creating green technologies. (Australia, Green DIY Engineers 2050) • Environmental reawakening (New Consciousness 2050, Latin America)	

Table 15. Scenario preferences by country

Country: Probable scenario	Argentina: Green DIY Engineers 2050 Argentina: Radical Startups 2050 Australia: Radical Startups 2050 Australia: New Consciousness 2050 Australia: New Consciousness 2050 Australia: New Consciousness 2050 Australia: Radical Startups 2050 Australia: New Consciousness 2050 Australia: New Consciousness 2050 Australia: New Consciousness 2050 Australia: Radical Startups 2050 China: New Consciousness 2050 China: Value-Driven Techemoths 2050 China: New Consciousness 2050 China: Radical Startups 2050, New Consciousness 2050 Finland: New Consciousness Hong Kong: Value-driven Techemoths 2050 Kenya: Radical Startups 2050 Kenya: Radical Startups 2050 Kenya: New Consciousness 2050 Kenya: New Consciousness 2050 Kenya: Value-Driven Techemoths 2050 Kenya: Radical Startups 2050 Kenya: Green DIY Engineers 2050

	Kenya: Value-Driven Techemoths 2050 Latin America: Green DIY Engineers 2050 South Africa: Value-Driven Techemoths 2050 South Africa: Radical Startups 2050 South Korea: Green DIY Engineers 2050 South Korea: Radical Startups 2050 Spain: New Consciousness 2050 Switzerland: New Consciousness 2050 Tanzania: Value-driven Techemoths Tanzania: Value-Driven Techemoths 2050 Tanzania: New Consciousness 2050 Tanzania: Value-Driven Techemoths 2050 Tanzania: Radical Startups 2050 Tanzania: New Consciousness 2050 USA: New Consciousness 2050 USA: Radical Startups 2050

Table 16. Stated reasons behind the "preferred scenario"

Profound change

- This would help the country to acknowledge other environmental and social issues on a more broad level and would assist in a longterm change towards a more equitable, sustainable and wealthy society. (Finland)
- A new consciousness challenges the actors within all firms and is the most sustainable. It doesn't cost money and achieves the greatest structural (and economic) change. (Australia)
- As I see it a preferable new consciousness scenario must be one that embraces a new paradigm - beyond the current win-lose competitive market, to a collaborative, mutually responsible, win-win paradigm, that embraces the planet as an interconnected whole, a cosmopolitan society, that no longer politically segregates your 'society' from mine, that no longer has us contributing to energy wasteful military defences and weapons development. (Australia)
- Being a multicultural society, the next generation will be more inclusive and learn from other cultures. I have observed that the Hindu way of living is an acceptable way of living for the younger generation, without being attached to that philosophy. Mindful and conscious living seems to be a way of living for the younger generation. Understanding the 'old' ways of living with a new approach, nature is part of us and we are part of nature.
  With the current political circus, people will look for inspirational leadership.(Australia)
- Changed consciousness would secure the most stable sustainable outcome. Actions and plans would be aligned and consistent, with cutting edge, sift and efficient solutions. Talking about issues would be cut down to minimum, freeing up time and energy for constructive action. (Australia)
- The change towards sustainability should start in a change of values and lifestyles.(Spain)
- This will help to bring radical change from the decision makers to the normal people. Changing the minds of the people will bring change in energy decision from national level to individual level. Changing the minds will create a path way for other scenarios to work better without putting much effort. (Tanzania)
- Multitude of small scale startups and the way the business done. (Tanzania)
- This is preferable because it is a business oriented solution thus needing little to no support from government which is the slowest actor in any Eco system. With a market driven effort, most of society's problems would be solved. (Kenya, radical startups)
- Multiple individual initiatives give many more options to solve all energy problems. (Latin America)

- When citizens are empowered to care and be sensitive to issues that can help make our world a better place, finding tailor made solutions to our specific problems can never be an issue; we kind of become instant innovators hence making us better Green DIY Engineers. Additionally, when people are informed they will tend to appreciate more alternative energy solutions provided to them by Radical Startups and Value-Driven Techemoths hence making the solution delivery process less complicated. (Tanzania, New Consciousness)

Economic reasons

- Techemoths have access to more capital to facilitate the necessary transition (South Africa)
- It is the creativity that techemoths are equipped with and the financial capability to work towards the end. Techemoths are aiming for sustainable development. The only means to achieve the goal is to protect the environment. If the ecosystem collapses, there will be no long-term profitability for businesses. (China)
- HOW THE SOCIETY IS STRUCTURED, DEMOGRAPHICALLY- NUMBER OF PEOPLE AND AREA AVAILABLE. MAN POWER NEEDED, LEVEL OF ECONOMY & PEACE MAKE THE ENVIRONMENT FIT FOR THE QUICKER EMERGENCE OF STARTUPS TO HUGE SUCCESS.
- Radical Startups 2050 like many David vrs. some Goliats; Value-Drive because is only owners value. New Consciousness is too romantic (Argentina)
- We have a strong start-up ecosystem and enough sun to power the world. Science and technology advances, big data and the Square Kilometre Array all point to Australia having greater capability to produce more localised energy solutions. Community interests in environmental issues would be supportive of efficient, affordable, local energy supply. There is also considerable concern in some areas at the aesthetics of engineering infrastructure and a strong cultural and creative industries sector. The architecturally designed sites would add to the cultural richness of Australian life whilst providing a functional service. The investor and corporate aim for high financial returns would be achieved in this scenario and that has been a concern expressed by some Australian companies, despite growing citizen interests in ethical and sustainable investing, particularly through Superannuation options. (Radical Startups)
- It supports all of the country's priority needs (as I see them) - fast enough and with the least possible unforeseen negative consequence. (Radical Startups, South Africa)
- High demand of clean products will change the ball game for both start ups and techemoths (New Consciousness)
- Horizontally networked economy could be a preferable alternative and a charming vision for the Korean economy.
- There are more opportunities to be exploited but due to lack of capacity locally to implement such initiative, entrepreneurs would rely on other big players. To ensure sustainability, the big companies have to build the capacity of local companies (Kenya, Value-Driven Techemoths)

Cultural added value

- Population who is familiar with science and technology; government which has passion to provide funding on citizen science (South Korea, DIY)
- Our isolation and relative innovativeness make us ideally placed to achieve this scenario, if we can get out of our own way (Australia, New Consciousness)
- Likely to address many issues through shaping of markets (Australia)
- Many youth who are starting up companies and exploring entrepreneurship.
  This creates new curiosities and create community and locally related solutions (Kenya)
- Radical startups: the energy of innovation - Australia as being different, not England
- Switzerland: it corresponds to our history and culture - but is difficult to make it happen
- Because, due cultural reasons (social inertia, individualism, consumerism), Argentina is a society that needs to be shaken to breakdown with well entrenched practices in most domains of social life. (Radical Startups)

- To me self-control, self – esteem, open mind and self-regulation are the elements make new consciousness preferable for China. These traits can make public to think and try new methods and keep going until the final result.
- An Innovation and Technology Bureau (i.e. "ministry") was set up in November 2015. The "ministry" main task is to map up the strategy and implementation measure to facilitate Hong Kong's transition into a technology-intensive Knowledge-based Economy. Nothing in the mandate exclude Hong Kong to cooperate with European and other international companies to make use of the superior fundamental business conditions in Hong Kong* start "Value-Driven Techemoths" in Hong Kong to exploit the mainland China under "One Country, Two Systems" -- a political condition and commitment which is strongly supported by the Central Government in Beijing, China. (*e.g. access to the China Market, rule of law, transparency and predictability of government procedures, intellectual property rights protection etc.)

Criticality (Environmental):

- Any sustainable change in the society first requires a change in mind-set. The current problems can't be addressed by technology alone, which has been the focus. A change in mind-set would reduce overreliance on traditional biomass, increase access to renewables and especially sensitive people on the need to make this shift. (Kenya)
- Growing deforestation and soil erosion as well as greater vulnerability to climate change (droughts alternating with increased cases of flooding) are early indications of possible partial ecological collapse in significant parts of the country. Green DIY scenario with increased local community participation provides a viable option for survival of vulnerable communities. (Tanzania)

Other:

- Radical startups: individual and communal use of new technologies; cooperative development of those (USA)
- I have a problem with the choices. Most preferred is the combination of three. No one choice by itself is plausible or sustainable in my view. (USA)
- The ability of the construction of civil society and individuals (China)

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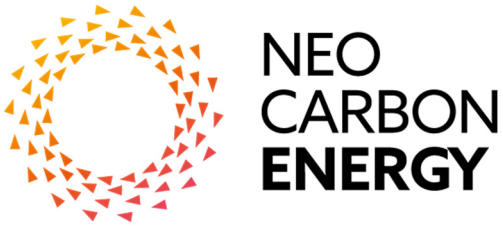

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