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iKnow Delphi 2.0 / National Survey - Country Report Finland

iKnow Project – Word Package 5

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EXECUTIVE SUMMARY

Introduction

This report introduces key results concerning the Finland Country Survey of the iKNOW project. iKNOW is a new Blue Sky research and horizon scanning project launched by the European Commission led by Rafael Popper of the University of Manchester. The project includes seven other partners: FFRC/Finland, Z_punkt/Germany, Technology Centre/Czech Republic, RTC North/UK, ICTAF/Israel, Cyber Fox/Czech Republic and Mindcom/Finland.

"**Wild Cards** (WI) are situations/events with perceived low probability of occurrence but potentially high impact if they were to occur. **Weak Signals** (WE) are unclear observables warning us about the probability of future events (including Wild Cards). They implore us to consider alternative interpretations of an issue's evolution to gauge its potential impact." (www.iknowfutures.eu).

The project has involved 12 relevant themes in which wild cards and weak signals were created and tested in Country Surveys: 1) Health, 2) Food, Agriculture and Fisheries, and Biotechnology, 3) ICT - Information & communication technologies, 4) Nanosciences, nanotechnologies, materials & new production technologies, 5) Energy, 6) Environment (including climate change), 7) Transport (including aeronautics), 8) Socio-economic Sciences and the Humanities, 9) Space, 10) Security, 11) Capacities, and 12) Nuclear research.

In Finland wild cards and weak signals were sought for and analysed in two themes: *Food, Agriculture and Fisheries, and Biotechnology* and *Energy*.

Wild Cards - Theme: Food, Agriculture and Fisheries, and Biotechnology: 1) "A Killer Water Filter", 2) "Silent Seas", 3) "Agriculture runs out of phosphor due to algae biofuel production", 4) "Algae pathogen suddenly destroys new energy foundation of humankind", 5) "Terrorists take algae production plants to their main targets" **Theme Energy**: 1) "National energy grid disappears" 2) "Gas from Trash", 3) "Breakthrough in cold fusion leads to renaissance in energy markets", 4) "Cheap liquid fuel production from algae replaces oil by 2030", 5) "Thanks to algae Australia becomes biggest energy producer in the world"

Weak Signals - Theme Food, Agriculture and Fisheries, and Biotechnology: 1) Emergence of new agricultural methods for coping with climate change, 2) Consumption drives market capitalism, not saving, conserving or sparing, 3) Food consumers are steered towards healthier dietary choices, 4) Food markets became investment subject in previous credit crunch, 5) Bees be no more, less food than before. **Theme Energy:** 1) Many people are willing to pay more to get wind energy, 2) Obama's goal: One Million e-cars on the US streets by 2015, 3) Use of electric cars enhance national energy, 4) safety Algae production is a good way for carbon caption form atmosphere, 5) There are many new serious attempts to utilize new fossil fuel resources

In this country report we have made use of conventional statistics to describe the main features of Delphi/National Survey data quantitatively. 51 people answered to questions on wild cards and 38 to

questions on weak signals. All together respondents in Finland were 89. Finland's share of all respondents is 21 %. We consider Finnish expert activity very satisfying.

Method: Delphi / National Survey

The Delphi-method is a multi-round iterative expert survey, which includes feedback from panellists between different rounds. In principle it should be anonymous at least in one round. The iKnow project Delphi 2.0 / National Survey does not constitute a Delphi in itself, at least not in the traditional conception. However, the whole iKnow process, including workshops and interviews as well as the National Survey, forms a Delphi process. Looking at interest towards and expertise on a given phenomenon allows us to identify stakeholder groups for each theme.

Data processing

The starting point was a database in Excel format. There were two approaches to process data: SAS/Excel procedure by FFRC and Excel Template procedure by RP/UNIMAN. Both approaches produced statistical figures like Mean, Std. Deviation, etc. The FFRC procedure yielded a slightly greater number and the RP/UNIMAN approach more developed indices. SAS/Excel procedure gives information by all the data by stakeholder group. In addition, figures of correlation analysis are produced. The SAS/Excel procedure provides, for example, good material to prepare scientific articles. Both ways are useful and help to understand the phenomena better; we can talk about "data-processing triangulation".

Main results -The Most important Wild Cards (WIs)

The most important wild cards have been selected by ranking the importance of the mean value for the Finnish case. The following wild cards belong to the categories "high" or "critical": "*Universities close as research does not meet the needs of industry*", "*Soft 'EuroLanding' or 'Happy End' in Euro-Land*" or "*Rapid-Diagnosis-Machines*".

The abovementioned wild cards belong to themes which were not chosen for the analysis at the country level for Finland. Seven wild cards analysed in Finland Country Survey were included in the category "moderate" by their importance at country level:

"*A Killer Water Filter*", "*National energy grid disappears*", "*Gas from Trash*", "*Silent Seas*", "*Agriculture runs out of phosphor due to algae biofuel production*", "*Breakthrough in cold fusion leads to renaissance in energy markets*" and "*Algae pathogen suddenly destroys new energy foundation of humankind*".

Three wild cards in themes chosen for country level analysis in Finland belong in the category "low" (energy WI):

"*Cheap liquid fuel production from algae replaces oil by 2030*", "*Thanks to algae Australia becomes biggest energy producer in the world*" and "*Terrorists take algae production plants to their main targets*".

The three last mentioned wild cards were not very relevant from the Finnish point of view because effective algae production is probably not possible in Finland, whilst biomaterial in forest is much more important. Taking into account the role of Finland in the production of phosphate (Siilinjärvi mine and the coming Savukoski Sokli-mine), these wild cards can have some importance also for Finland, but none were included in the category 'high'.

The most important conclusion is that the ten wild cards chosen for focus or tested on country level in Finland were not "very relevant" but "moderately relevant". It is also important to pay attention to the wild cards that have been ranked "high" at EU-level, especially: "*European Commission scrap research support projects" and "Gas from Trash".*

The Most important Weak Signals (WEs)

The most important Weak Signals (ranking "high" or "critical" in importance at country level) are: *"Care Communities", "Emergence of new agricultural methods for coping with climate change", "Consumption drives market capitalism, not saving, conserving or sparing", "Many people are willing to pay more to get wind energy"* and "*Food consumers are steered towards healthier dietary choices".*

Four of the ten weak signals/tested in *Energy* and *Food, Agriculture and Fisheries, and Biotechnology* are included in the category "high": "*Emergence of new agricultural methods for coping with climate change", "Consumption drives market capitalism, not saving, conserving or sparing", "Many people are willing to pay more to get wind energy"* and "*Food consumers are steered towards healthier dietary choices".*

Five are included in the category "moderate": "*Food markets became investment subject in previous credit crunch", "Obama's goal: One Million e-cars on the US streets by 2015", "Use of electric cars enhance national energy safety", "Algae production is a good way for carbon caption form atmosphere", "Bees be no more, less food than before".*

Only one weak signal was below 2,5 (low importance) at country level (ranking 17th): *"There are many new serious attempts to utilize fossil fuel resources* ".

There are differences in importance for some weak signals between country level (Finland) and EU-level. The ten chosen weak signals were evaluated "very relevant" in the Finnish case.

Evaluation of the chosen WI-WEs

There are some wild cards and weak signals whose impact is at least moderate (in this case 3 or more in a scale of 1-5) in Finland, but preparedness of decision makers deal such a wild card low:

Wild Cards/WIs. The ***"A Killer Water Filter"*** wild card is very possible one and should deserve more attention. Its importance to Science, Technology and Innovation (STI) policy in Finland is moderate according to experts, but high in EU-level. Its likelihood is high both in the short and the long term. The most important ERA (European Research Area)-strategies are *"Promoting international cooperation in STI"* and "*Developing cross-national research programmes and priorities".* Wild card has potential impact in *"Environment & ecosystems", "Science, technology & innovation (STI) systems", "Economy",* and "*Social welfare".* For example, in Finland the company Kemira is a potential example

of how to utilize this wild card and acts as a signal indicating the wild card occurring. *"Kemira ensures that wastewater returned to nature is restored to its original purity"* (www.kemira.com).

"Gas from Trash". The production of this wild card is very 'possible', and more attention should be paid to it. The preparedness of decision-makers is low. The likelihood of its occurrence is high in the long term. *"Cross-national research programmes and priorities"* should be developed, by "*Strengthening research institutions' knowledge production*", *"Developing world-class research infrastructures and promoting international cooperation*" in STI. In Finland a context in which natural gas and gas from trash are combined and distributed in some pipelines already exists in the region of Kouvola (www.gasum.fi and http://www.kymenvesi.fi/). It indicates that in Finland natural gas and gas from Trash (and other biomaterial, like from forest) should be analysed at the same time.

The ***"Silent Seas"*** wild card's importance for STI-policy is "moderate" at country level and "high" at EU-level. The likelihood of occurrence in the short time is "moderate" and in the long-term "high". The preparedness of decision-makers is "low" both at country and EU-level. The most important strategies are *"Developing cross-national research programmes and priorities"*, and *"Promoting international cooperation in STI"*. This wild card will mainly impact "Environment & ecosystems", "Social welfare", and *"Policy and governance"*.

The ***"National energy grid disappears"*** wild card's importance for STI-policy is "moderate", its likelihood in the short term is "low", and in longer-term "moderate". Preparedness of decision-makers to deal with it is "low" in country and EU-level. The most important strategies are *"Developing cross-national research programmes and priorities"*, and *"Promoting international cooperation in STI"*. This wild card will mainly impact *"Physical infrastructure"* and secondly *"Environment & ecosystems"* and *"Economy"*. In Finland there are some new pilot eco-villages, which are outside the national energy grid, such as 'Kempeleen ekokortteli' (http://www.fortel.fi/components/ekokortteli). On September 2011 a pilot example of a future village, Tampereen Tulevaisuuskylä (www.tulevaisuukylä.net) was organised in Tampere.

Weak Signals / WEs. ***"Emergence of new agriculture methods for coping with climate change"***: Level of importance for STI policy in country level in Finland is "high (3.78)", in EU-level "high (4.33)." It has important implications in the future for "Environment & ecosystems" and "Economy". In Research and Technology Development (RTD)-strategies the most important ones are ""*Developing cross-national research programmes and priorities*", and "Sharing knowledge".

"Consumption drives market capitalism, not saving, conserving or sparing": Level of importance for STI policy in country level in Finland and EU-level is "high". This weak signal has important implications in the future firstly for "Economy" and secondly for "Environment & ecosystems" and "Social welfare". In RTD-strategies the most important ones are *"Strengthening research institutions' knowledge production"* and *"Developing cross-national research programmes and priorities"*.

"Many people are willing to pay more to get wind energy": Level of importance for STI policy in country level in Finland is "high (index 3.56)", in EU-level "moderate (index 3.44)." It has important implications in the future for *"Environment & ecosystems"* and *"Economy"*. Interviewees responded to this signal by stating, for example, that *"Renewables are promoted by public policy anyway"*, *"This is already happening in Europe"*, or "*Wind energy is creating a minor paradigm change in the field of energy"*.

"Food consumers are steered towards healthier dietary choices": Level of importance for STI policy in country level in Finland and EU-level is "moderate". This weak signal has important implications in the future for "*Social welfare*" and "*Economy*". In RTD-strategies the most important ones are firstly "*Developing cross-national research programmes and priorities*" and secondly "Strengthening research institutions' knowledge production" and "*Promoting international cooperation in STI*".

"Food markets became investment subject in previous credit crunch": Level of importance for STI policy in country level in Finland is "moderate", in EU-level "high". The most important implications of his wild card are for "*Economy*" and secondly for "*Security*" and "*Social welfare*". In RTD-strategies the most important are "*Sharing knowledge (open access and IP-management etc.), "Developing cross-national research programmes and priorities*", and "*Strengthening research institutions' knowledge production*".

"Obama's goal One Million e-cars on the US streets by 2015": Level of importance for STI policy in country level in Finland and EU-level is "moderate". It has important implications in the future for "Environment & ecosystems" and secondly for "Science technology & innovation (STI) systems" and "Economy". In RTD-strategies the most important ones are "*Developing cross-national research programmes and priorities*" and "*Sharing knowledge (open access and IP-management etc.).* In Finland, Valmet Automotive Inc. located in Uusikaupunki, is a producer of electric cars http://www.valmet-automotive.com).

"Use of electric cars enhance national energy safety": Level of importance for STI policy in Finland is "moderate" and in EU-level "high". Important impacts in the future include "Environment & ecosystems" and "Securities." In RTD-strategies the most important ones are "*Developing cross-national research programmes and priorities*" and "*Promoting international cooperation in STI*".

Conclusions

It is essential that policymakers react to the important impacts and effects estimated for the wild cards and weak signals, for example through strategic decision-making in line with Ansoff's approach. A lack of reaction or a wrong reaction might imply that competitors will take the market. When coupled with an active strategy of decision-making, these wild cards and weak signals may offer significant opportunities.

The results indicate which wild cards and weak signals are of greater importance, provide insight on the aspects policy-makers are not adequately prepared for, and give information that could help find the right policy to adopt in a situation where a given wild card or weak signal would become real. The results can still be considered preliminary, and discussion should continue until a final decision.

According to analysis in this report, the main wild cards for which attention should be paid are "*National energy grid disappears", "Gas from Trash", "Silent Seas*" and "*Algae pathogen suddenly destroys new energy foundation of humankind*" because their importance for science, technology and innovation (STI) policy in Finland (and also in EU-level) is moderate, but preparedness of decision-makers to deal with these is low.

The level of importance for STI-policy of almost all analysed weak signals is "high" or "moderate" in Finland (and also in EU-level). The following ones are of high importance in Finland (and EU-level):

"Emergence of new agricultural methods for coping with climate change", *"Consumption drives market capitalism, not saving, conserving or sparing"*, *"Many people are willing to pay more to get wind energy"* and *"Food consumers are steered towards healthier dietary choices"*. The next ones fall into the category "moderate" and it is important for decision-makers to take them into account: *"Food markets became investment subject in previous credit crunch"*, *"Obama's goal: One Million e-cars on the US streets by 2015"*, *"Use of electric cars enhance national energy safety"*, *"Algae production is a good way for carbon caption from atmosphere"* and *"Bees no more, less food than before"*.

It can also be argued that the human cognitive structure, the mind, is not able to analytically handle true wild cards and weak signals, such as the ones presented in this report. In practice this means, among other things, that besides the processed and analyzed wild cards and weak signals, there are still hidden wild cards and weak signals. The focus should be put on a continuous decision-making processes, which would enable proper reactions to those unexpected wild cards and weak signals outside his WI-WE analysis.

When realising expert surveys or Delphi, stakeholder groups are often called to participate. However, they are certainly not independent actors as they respond to particular interests of their sector or their own operational activities. In governance approaches extended peer communities of citizens, associations or so-called juries are often called to take part in order to provide more objectivity. In this iKnow Expert Survey, we can say that ID Group "Other" was independent. In the Finnish case we have more answers from the public than from the private sector.

According to the Finnish National Innovation Strategy (2008) more attention should be paid to demand-driven (or customer-driven) innovations (see Kaivo-oja & Santonen 2010, Kaivo-oja 2011a). In the same way as in Delphi or expert surveys, respondents in this survey were mostly public actors or belonged to the research sector (high education institutions). For this reason, it was not possible to analyze private actors' expert opinions reliably. According to a demand-driven innovation strategy, more information on market demand and the trends of customer behaviour should be available. This is the reason for possible uncertainties of the present analysis in the description of future possibilities.

The growth of the global economy and its impact on the prices of limited raw materials, such as oil and other minerals, have a great impact on Finland and Northern countries in general. This means, especially for Finland, that technology development in transportation systems (e.g. new cost-savings and other solutions) creates key conditions for the exploitation of Arctic natural resources. For example, these questions could have received better responses if more private representatives, for example in theme Energy, would have been involved in the process. In addition, Finland could play an important role in the development of arctic transport, energy, environmental, agricultural and food technology in the future. In Finland, the Parliamentary Committee for the Future produced a report titled *"Russia 2030 based on Contracts"* (editors Osmo Kuusi & Hanna Smith & Paula Tiihonen) in 2010. According to the committee *"Finland must draft a research and development programme for the development in Finland of Arctic transport, energy and environmental technology"*. Such a programme should also include themes on agriculture and food technology with a focus on the Northern Dimension. This would probably constitute a very important step in the vision of an EU Research Programme which would include Finland country targets.

1. INTRODUCTION

- This report introduces some key results of National Survey of iKNOW-project.
- iKNOW is a new blue sky research and horizon scanning project launched by the European Commission and led by Rafael Popper of the University of Manchester. The project includes seven other partners: FFRC/Finland, Z_punkt/Germany, Technology Centre/Czech Republic, RTC North/UK, ICTAF/Israel, Cyber Fox/Czech Republic and Mindcom/Finland.
- **Wild Cards** (WI) are situations/events with perceived low probability of occurrence but potentially high impact if they were to occur.
- **Weak Signals** (WE) are unclear observables warning us about the probability of future events (including Wild Cards). They implore us to consider alternative interpretations of an issue's evolution to gauge its potential impact." (www.iknowfutures.eu).
- The project has involved 12 relevant themes in which wild cards and weak signals were created and tested in Country Surveys.
- In Finland, the following themes were chosen:

Wild Cards -

Theme: Food, Agriculture and Fisheries, and Biotechnology

1. *"A Killer Water Filter"*
2. *"Silent Seas"*
3. *"Agriculture runs out of phosphor due to algae biofuel production"*
4. *"Algae pathogen suddenly destroys new energy foundation of humankind"*
5. *"Terrorists take algae production plants to their main targets"*

Theme: Energy

6. *"National energy grid disappears"*
7. *"Gas from Trash"*
8. *"Breakthrough in cold fusion leads to renaissance in energy markets"*
9. *"Cheap liquid fuel production from algae replaces oil by 2030"*
10. *"Thanks to algae Australia becomes biggest energy producer in the world"*

Weak Signals –

Theme: Food, Agriculture and Fisheries, and Biotechnology

1. *Emergence of new agricultural methods for coping with climate change*
2. *Consumption drives market capitalism, not saving, conserving or sparing*
3. *Food markets became investment subject in previous credit crunch*
4. *Food consumers are steered towards healthier dietary choices*
5. *Bees be no more, less food than before*

Theme: Energy

6. *Many people are willing to pay more to get wind energy*
7. *Obama's goal: One Million e-cars on the US streets by 2015*
8. *Use of electric cars enhance national energy safety*
9. *Algae production is a good way for carbon caption form atmosphere*
10. *There are many new serious attempts to utilize new fossil fuel resources*

- In this country report we have made use of conventional statistics to describe the main features of Delphi/National Survey data quantitatively.

This report introduces key results concerning the Finland Country Survey of iKNOW project. **iKNOW** is a new blue sky research and horizon scanning project launched by the European Commission led by Rafael Popper of the University of Manchester. The project includes seven other partners (FFRC/Finland, Z_punkt/Germany, Technology Centre/Czech Republic, RTC North/UK, ICTAF/Israel, Cyber Fox/Czech Republic and Mindcom/Finland). "***iKNOW*** *aims to advance knowledge and tools related to events and developments (e.g. wild cards and weak signals) potentially shaping and shaking the future of science, technology and innovation (STI). The project is primarily sponsored by the European Commission Directorate General for Research, as part of its Blue Sky initiatives, which are designed to create more proactive European research policy that will be capable of anticipating emerging issues, wild cards and weak signals (WI-WE).*" (www.iknowfutures.eu).

"Wild Cards (WI) are situations/events with perceived low probability of occurrence but potentially high impact if they were to occur. **Weak Signals** (WE) are unclear observables warning us about the probability of future events (including Wild Cards). They implore us to consider alternative interpretations of an issue's evolution to gauge its potential impact." (www.iknowfutures.eu).

Main partners of project are from Czech Republic, Finland, Germany, Israel and United Kingdom. The idea is that each partner and each Country Survey also represents a different reference group; Czech Republic - New member state potentially entering the Euro Zone, Finland - A Nordic country, Germany - Core EU member in the Euro Zone , Israel - An associated member of the EU, and United Kingdom - Core EU member outside the Euro Zone.

The project has involved 12 relevant themes in which wild cards and weak signals were identified and tested in Country Surveys:

1) Health, 2) Food, Agriculture and Fisheries, and Biotechnology, 3) ICT - Information & communication technologies, 4) Nanosciences, nanotechnologies, materials & new production technologies, 5) Energy, 6) Environment (including Climate Change), 7) Transport (including aeronautics), 8) Socio-economic Sciences and the Humanities, 9) Space, 10) Security, 11) Capacities, 12) Nuclear research.

For each Country Survey, ten wild cards and ten weak signals have been chosen according to two main themes (5+5 WI and 5+5 WE). In the Finnish case the themes chosen were a) *Food, Agriculture and Fisheries, and Biotechnology* and b) *Energy*.

List of WI and WE examined in Finland

Wild Cards

Theme: Food, Agriculture and Fisheries, and Biotechnology

1. *"A Killer Water Filter"*
   Novel materials promise better access to clean water around the world. By combining nano-technology with cheap materials such as cotton and tea bags, researchers have recently developed mobile water filters that can be manufactured very economically.

2. *"Silent Seas"*
   The world's fisheries continue to collapse although smart controls could help.

3. *"Agriculture runs out of phosphor due to algae biofuel production"*
   The production of large quantities of algae requires phosphor fertilizing. All available phosphor goes to algae production and agriculture, and especially developing countries start to severely suffer from scarcity of phosphor fertilizers.

4. *"Algae pathogen suddenly destroys new energy foundation of humankind"*
   Suddenly, a new type of airborne algae pathogen starts to spread and destroy the new energy foundation of humankind.

5. *"Terrorists take algae production plants to their main targets"*
   As oil sector is going down and algae is taking its place, new global geopolitical tensions arise. Ex-oil states drive terrorist attacks on algae.

Theme: Energy

6. *"National energy grid disappears"*
   Due to new domestic heating and electricity production innovation, households become self-sufficient in energy. Finally, there is no need for a national energy grid anymore.

7. *"Gas from Trash"*
   The future of factories producing gasoline, diesel, and jet fuel can be different. In the future they might be microscopic, and they might run on the garbage hydrocarbons that are all around us.

8. *"Breakthrough in cold fusion leads to renaissance in energy markets"*
   Suddenly scientists discover the way to do cold fusion which leads to renaissance in energy markets.

9. *"Cheap liquid fuel production from algae replaces oil by 2030"*
   By mid-2010's scientists in Europe discover new algae species from the Mediterranean which can be used very efficiently and very broadly in biofuel production. This allows the production of cheap energy with a very reduced level of pollution.

10. *"Thanks to algae Australia becomes biggest energy producer in the world"*
    Algae production begins around the world in all available sunny offshore areas, and in many inland bonds and lake areas by 2020's. Thanks to algae Australia becomes the biggest energy producer in the world.

Weak Signals

Theme: Food, Agriculture and Fisheries, and Biotechnology

1. *Emergence of new agricultural methods for coping with climate change*
   Currently new agricultural methods for coping with climate change are being piloted, including drought-resistant crops and new approaches to crop rotation and irrigation.

2. *Consumption drives market capitalism, not saving, conserving or sparing*
   Consumption drives market capitalism, not saving, conserving or sparing

3. *Food consumers are steered towards healthier dietary choices*
   Food consumers are steered towards healthier dietary choices by product labelling and by joint research activities.

4. *Food markets became investment subject in previous credit crunch*
   Furthermore, if a new credit crunch takes place the prices of grain, raw materials, and oil will probably go up in the same way as they did during the previous credit crunch.

5. *Bees be no more, less food than before*
   Reducing numbers of bees and other pollinating insects reaches catastrophic levels with widespread crop failure due to lack of pollination of plants. Natural herbivores are affected and go into decline, other insects also in deterioration.

Theme: Energy

6. *Many people are willing to pay more to get wind energy*
   Despite the fact that you can only get standard energy from a socket in your wall, many people are willing to pay more to get wind energy.

7. *Obama's goal: One Million e-cars on the US streets by 2015*

Electric cars have just started to be introduced in the U.S., and they cost thousands more than hybrids like the Prius. Plug-in hybrids can be cheaper, and they don't have range limitations that could limit the market sales.

8. *Use of electric cars enhance national energy safety*
   Use of electric cars enhances national energy safety because transportation becomes less dependent on only one form of energy - oil.

9. *Algae production is a good way for carbon caption form atmosphere*
   Algae is not only a carbon neutral form of biofuel energy production, but also a good way for carbon caption from the atmosphere.

10. *There are many new serious attempts to utilize new fossil fuel resources*
    There are many new serious attempts to utilize new fossil fuel resources. Countries and energy companies are constantly making new discoveries of new fossil fuel resources.

The main criteria for inviting experts to compose the Finnish Country panel has been set as relevant expertise in the specific field (*Food, Agriculture and Fisheries, and Biotechnology* or *Energy).* A recommendation to answer mainly to the two mentioned themes was formulated in the invitation to participate in the survey at the www.iknoefutures.eu website. Moreover, the respondents were also given the possibility to answer to other themes. Quite many respondents gave their input to wild cards and weak signals from other themes. This is also taken into account in this report, especially in Chapters 4.1 (The most important WIs) and 4.2 (The most important WEs)

Explanation for Statistical figures

In this country report we have made use of conventional statistics to describe the main features of the Delphi/National Survey data quantitatively. Values for central tendency, average/mean, median, mode and quartile (quartile and upper quartile is in attachment) have been calculated.

Arithmetic Mean is the sum of all measurements divided by the number of observations in the whole data set.

Mode is the most frequent value in the data set.

Median is the middle value that separates higher half from the lower half of whole data set.

Standard Deviation measures the dispersion, in other words, the spread of the values around the central tendency.

2. Method: iKnow Delphi 2.0 / National Survey

- The Delphi-method is a multi-round iterative expert survey, which includes feedback from panellists between different rounds.
- In principle it should be anonymous at least in one round. The iKnow project Delphi 2.0 / National Survey does not constitute a Delphi in itself, at least not in the traditional conception.
- However, the whole iKnow process, including workshops and interviews as well as the National Survey, forms a Delphi process.
- Looking at interest towards and expertise on a given phenomenon we can identify stakeholder groups for each theme.

The Delphi method is a multi-round expert survey. In the Delphi interview process, several iterative rounds of interviews take place. During the Delphi process, statistical and other kinds of feedback are given to experts by Delphi manager. The interviews are always carried out anonymously (e.g. Six 2002, Turoff 2002, Sackamn 1975, Myllylä 2007).

A so called Real Time Delphi (RT-Delphi) by Theodor (Ted) Gordon has also been developed, and it has been applied especially in the Millennium Project (Gordon 2002; 2007). The idea in the RT-Delphi is to utilize the internet environment so that respondents can check how others have answered and change their opinions during the answering period.

The iKNOW Delphi 2.0 process does not entirely match the abovementioned Delphi features. One reason for that can be found in the fact that it has not been possible to develop an internet-based answering and data-processing environment for the project. So, in practice, respondents could not change their opinions and could not see other respondents' answers.

If we consider the whole iKNOW process from the Delphi viewpoint, it can be classified as a Delphi process, which included many "interview" *rounds* (workshops, interviews and survey "Delphi 2.0/National Survey"). The feature of *anonymity* was last mentioned in the "Delphi 2.0/National Survey" round, while statistical and other *feedback* has been given to some extent in the iKnow website. We can see that iKnow's elements are similar to the European Union's best regional foresight Concepts (TKTT) developed in Finland and evaluated best in October 2010 (see Myllylä 2009, Marttinen & Kaivooja 2003). However, in TKTT, the most important stage is indicated in the interviews with employers at the beginning of the process.

Introduction structure of Delphi / National Survey data

In the Finnish case, respondents' expertise was greater than that at EU-level, especially with reference to *Food & Agriculture and Fisheries, and Biotechnology* and *Energy*, which were chosen as special themes for the Finnish Country panel.

In most areas of expertise the Finnish participants responding to the questionnaire were evaluated as higher than the EU average (Table 1). Finnish experts were selected for their expertise in agriculture

and biotechnology, and energy-related wild cards and weak signals (10 plus 10). The expertise of the Finnish panel (average value) was of 1.62 on a scale of 1-3 in agriculture and biotechnology, and of 1.78 in the field of energy. At EU level, the corresponding figures were 1.39 and 1.68 (scale of 1-3, where 1 = moderate, 2 = high, 3 = very high). The Finnish expertise was weaker than the EU average only in nano-technology, safety, and space-related themes. (The average value of EU expertise includes the evaluation of Czech Republic, Germany, Finland, Israel, and UK experts).

Table 1. Number of respondents by expertise.

Expertise: 1=moderate, 2=high, 3=very high									
Level Expertise	**Country level, Finland**						**EU-level**		
	N	**N WI**	**N WE**	**MEAN**	**Mean, WI**	**Mean, WE**	**MEAN**	**Mean, WI**	**Mean, WE**
1. Agriculture & bio-technology, FI	73	42	31	***1,62***	**1,60**	**1,65**	1,39	1,39	1,39
2. Capacities & infra-structure	54	33	21	*1,65*	1,67	1,62	1,43	1,44	1,43
3. Energy, FI	77	46	31	***1,78***	**1,85**	**1,68**	1,60	1,60	1,61
4. Environment	66	39	27	*1,88*	1,97	1,74	1,62	1,64	1,60
5. Nanotechnology	46	28	18	*1,33*	1,29	1,39	1,37	1,41	1,30
6. Nuclear	48	31	17	*1,35*	1,35	1,35	1,32	1,35	1,31
7. Health	49	30	19	*1,41*	1,40	1,42	1,39	1,42	1,36
8 ICT	54	34	20	*1,78*	1,60	1,75	1,67	1,39	1,56
9. Security	49	30	19	*1,59*	1,63	1,53	1,59	1,62	1,56
10. Social Sciences and Humanities	63	38	25	*2,02*	1,97	2,08	1,82	1,85	1,79
11. Space	43	27	16	*1,23*	1,19	1,31	1,32	1,35	1,28
12. Transport	49	30	19	*1,53*	1,57	1,47	1,49	1,46	1,52
Explanation: EU-level incl. Czech Republic, Finland, Germany, Israel, United Kingdom.									

Table 2 shows that 89 respondents took part in the Finnish Country Survey. 48 % of them were from academic sector, 34 % from public sector (we need to consider that academic actors also mainly belong to public actors), 11 % from Private sector, and 6 % belong to "Other". There were variations in this respect, in what percentage of respondents belonged to each stakeholder group for each country. Comparing to the average level, the biggest difference is in the private sector: the share of private sector respondents was 16 percentage points lower in Finland than in EU average (27 %). Similarly, there were about 14 percentage points more respondents from the public sector in Finland than in EU-level on average.

Table 2. Background/Stakeholders of respondents in Finland and at EU-level.

Level	**N**					
Stakeholders	**FI**	**CR**	**GE**	**IS**	**UK**	**All**
1.Academic actors (i.e. HEI)	43	6	5	28	107	189
-Higher education institutions (HEI) (1)						
2. Public actors (incl. public research organisations)	31	17	11	16	11	86
-Public research organisations (non-HEI) (2) -Research funding organisations (4) -Government organisations (Departments, Agencies, etc.) (5) -International Agencies (EU, UN, OECD, etc.) (6)						
3. Private actors (incl. private research organisations)	10	31	41	4	27	113
-Private research and innovation support organisations (3) -Private organisations (Corporations, Firms, SMEs) (7) -Consultancies and IT Services (8) -Associations representing commercial interests (9)						
4. Other interested actors (IGOs, NGOs, Media, Civil society, etc.)	5	12	5	4	4	30
-Non-governmental, not profit organisations (NGO)(10) -Media-corporate press (11) -Media – community/alternative press (12) -Civil society (13) -Other (not in list) (14)						
In total	89	66	62	52	149	418
Explanation: All/EU-level in this case Czech Republic, Finland, Germany, Israel, United Kingdom.						

3. DATA PROCESSING

- Starting point database in Excel-format
- Two lines to process data: SAS/Excel procedure by FFRC and Excel Template procedure by RP/UNIMAN
- Both approaches produced statistical figures like Mean, Std. Deviation, etc. The FFRC procedure yielded a slightly greater number and the RP/UNIMAN approach more developed indices
- SAS/Excel procedure gives information by all the data by stakeholder group. In addition, figures of correlation analysis are produced. The SAS/Excel procedure provides, for example, good material to prepare scientific articles
- Both ways are useful and help to understand the phenomena better; we can talk about "data processing triangulation."

The role of FFRC in the project was to realise the "Template" for the national surveys. Shaping the template before getting final data was not producing effective results. In order to understand which calculations could be done it was worth first to make data processing by SAS drives, producing basic Excel templates. In this text this data processing is named as SAS/Excel lines.

UNIMAN Templates, which describes data at Cross Country level is named as RP/Excel Template –process. In table 3, the main similarities and differences in such data processing by FFRC and UNIMAN are described.

iKnow Country Reports can get advantage of both SAS/Excel templates and RP/Excel Templates, in a complementary approach (see Table 3). The whole data processing of the iKnow project has involved:

1. Single WI-WEs,
2. Country level,
3. European level.

The country report should analyse single data with reference to WI-WEs at country level. We have also provided some information on the results at European level for benchmarking purposes.

As a general observation, we can note that there are not very big statistical differences between European and country level results. However some of those differences look interesting.

Table 3. Differences between SAS/Excel-Template and RP-UNIMAN/Excel-Template process.

	SAS/Excel Template	**RP/Excel Template**
Template producer	FFRC	RP-UNIMAN
Used main Programs	Via SAS procedure to Excel	Excel, Data need to be enter ed by countries
Statistical figures	N, Mean, Std Dev, Mode, Median, quartile, upper quartile	N, Mean, Std Dev, other indicators
Country analysis	Includes statistical figures above mentioned	Includes statistical figures above mentioned
EU-level analysis	Includes statistical figures above mentioned	Includes statistical figures above mentioned
ID, Stakeholders analysis	Classified in four groups	None
Impact analysis	Included	Included
Other	Correlation analyses of drives are presented (needed in scientific articles etc.)	Correlation analyses not possible.
Tables and pictures	Original main tables, different kind of figures are possible to prepare	The template format produces also figures
Summary	Gives information by all the data by stakeholder group, and concerning single wild cards and weak signals.	Gives information about single wild cards and weak signals.

If we consider the FFRC SAS/Excel procedure and the RP/UNIMAN Excel-Template procedure, we can talk about "data-processing triangulation" where different kinds of methods were used for the analysis. This will help us understand the phenomena under investigation better.

4. MAIN RESULTS

4.1 The Most important Wild Cards (WIs)

- The most important wild cards have been selected by ranking the importance of the mean value for the Finnish case. The following wild cards belong to the category "high" or "critical":
  - *Universities close as research does not meet the needs of industry*
  - *Soft 'EuroLanding' or 'Happy End' in EuroLand*
  - *Rapid-Diagnosis-Machines.*
- The group mentioned above does not contain wild cards which were chosen for the analysis at country-level for Finland. Seven were included in the category "moderate" by their importance at country-level:
  - *A Killer Water Filter*
  - *National energy grid disappears*
  - *Gas from Trash*
  - *Silent Seas*
  - *Agriculture runs out of phosphor due to algae biofuel production*
  - *Breakthrough in cold fusion leads to renaissance in energy markets*
  - *Algae pathogen suddenly destroys new energy foundation of humankind.*
- Three wild cards were included in the category "low" (energy WI):
  - *Cheap liquid fuel production from algae replaces oil by 2030*
  - *Thanks to algae Australia becomes biggest energy producer in the world*
  - *Terrorists take algae production plants to their main targets.*
- The three last mentioned wild cards were not very relevant from the Finnish point of view because effective algae production is probably not possible in Finland, whilst biomaterial production in forests is much more important and evaluated to be a feasible option for Finland with high forest coverage. When taking into account the role of Finland for the production of phosphate (Siilinjärvi mine and the up-coming Savukoski Sokli mine), these wild cards can have some importance also for Finland.
- The most important conclusion is that the ten wild cards chosen for focus or tested in Country level in Finland were not "very relevant" but "moderately relevant".
- It is also important to pay attention to the wild cards ranked "high" at EU-level, especially:
  - *European Commission scrap research support projects*
  - *Gas from Trash.*

According to the whole data at Country level, the most important Wild Cards are introduced according to their importance at country level in Table 4. Signals that have been recognised by at least three respondents (3 experts) are analysed. If a Wild Card has been chosen for investigation at country

level, even those with 2 or 1 respondents are considered. Three is the amount defined as a minimal number for which it is possible to keep anonymity in the course of a Delphi survey (e.g. Kuusi 2002). In this case, it is possible to take some statistical figures even if a high level of uncertainty is present.

Table 4. The most important Wild Cards (WIs) in Finland.

Question 4: What level of importance do you think this wild card would have for science, technology and innovation (STI) policy in Finland?								
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.								
			Country level					EU level
WE Category, ranking number by mean and signals name		Class	N	Mean	Std Dev	Mode	Median	Mean
Category >3,5 – "High or Critical"								
1.	**Universities close as research does not meet the needs of industry, 1611**	CAP	3	5,00	-	5	5,00	4,27
2.	**Soft "EuroLanding" or "Happy End" in EuroLand, 1618**	SSH	5	4,00	1,00	3	4,00	3,65
3.	**Rapid-Diagnosis-Machines, 1516**	HEA	7	3,86	0,69	4	4,00	3,10
Category 3,5>2,5 – "Moderate"								
4.	**Cyber Crusade: Massive e-sabotage by "hacktivists", 1684**	SSH	5	3,40	1,14	3	3,00	3,33
5.	**European Commission scrap research support projects (1610)**	CAP	3	3,33	1,15	4	4,00	4,19
6.	**End of Ageing (1514)**	HEA	7	3,29	0,95	4	4,00	3,7
7.	**Nano-lab inside your body (1461)**	ICT	4	3,25	1,71	-	3,25	3,21
8.	**Automatic learning through neuro-data transfer (1671)**	SSH	4	3,25	1,26	3	3,00	3,35
9.	**A Killer Water Filter (1541) FI**	AGR	14	3,21	0,70	3	3,00	3,55
10.	**National energy grid disappears (1632) FI**	ENE	15	3,20	1,08	2	3,00	2,97
11.	**Animal Experiments End (1699)**	HEA	5	3,20	0,84	3	3,00	3,55
12.	**3D media trustworthily copying reality (984)**	ICT	8	3,13	1,13	2	3,00	2,98
13.	**Gas from Trash (1625) FI**	ENE	16	3,06	1,29	2	3,00	3,60
14.	**Carbon crunch and the climate bubble, (1536)**	ENV	4	3,00	1,83	-	3,00	3,17
15.	**Silent Seas (1698) FI**	AGR	11	3,00	1,18	2	3,00	3,47
16.	**iBrain vs. Brain Point (1459)**	ICT	5	2,80	1,10	3	3,00	2,97
17.	**Do-It-Yourself (DIY) "wikiforesight" overtakes religion (1692)**	SSH	5	2,80	0,45	3	3,00	3,00
18.	**Cities are lunch for plastic bag-bugs (1619)**	ENV	3	2,67	0,56	3	3,00	2,86

19.	**Agriculture runs out of phosphor due to algae biofuel production (1628) FI**	AGR	14	2,64	1,28	4	3,00	2,89
20.	**Breakthrough in cold fusion leads to renaissance in energy markets (1626) FI**	ENE	14	2,57	1,40	1	3,00	3,27
21.	**Algae pathogen suddenly destroys new energy foundation of humankind (1722) FI**	AGR	2	2,50	2,12	-	2,50	2,45
22.	**Brain Capacity Testing (1517)**	HEA	6	2,50	0,84	2	2,00	2,64
Other – "Selected below 2,5"								
26.	**Cheap liquid fuel production from algae replaces oil by 2030 (1631) FI**	ENE	13	2,31	0,95	3	2,00	3,10
32.	**Thanks to algae Australia becomes biggest energy producer in the world (1723) FI**	ENE	10	1,70	0,95	1	1,00	2,18
34.	**Terrorists take algae production plants to their main targets (1629) FI**	AGR	12	1,58	0,67	1	1,50	2,44

Explanation:
-There are Wild Cards, which have got at least 3 respondents (FFRC-ICTAF meeting 22.7.2011). If a Wild Card has been chosen for investigation at country-level, even with 2 or 1 respondents (see wild card number 21./1500 above)
-(1611) = Wild Card's code number used for example in statistical analysis.
--FI = Wild Cards in Agriculture (Agr.) or Energy (En.), chosen to investigate in Delphi/National Survey in Finland.
-EU-level Mean: Mean from Question 4 "In the European Union level" by Czech Republic, Finland, Germany, Israel and United Kingdom answers.
-Wild Cards themes are 1 – Health, 2 - Food, Agriculture and Fisheries, and Biotechnology (AGR.), 3 - ICT - Information & communication technologies (ICT), 4 - Nanosciences, nanotechnologies, materials & new production technologies (NAN), 5 – Energy (ENE), 6 - Environment (including Climate Change) (ENV), 7 - Transport (including aeronautics) (Transp.) (TRA), 8 - Socio-economic Sciences and the Humanities (SSH), 9 – Space (SPA), 10 – Security (SEC), 11- Capacities (CAP), 12- Nuclear research (NUC).

The biggest differences (difference of at least 0,5) between Country level in Finland and EU were found in the following wild cards:

(1.) *Universities close as research does not meet the needs of industry* (1611 CAP),

(5.) *European Commission scrap research support projects* (1610 CAP)

(13.) *Gas from Trash* (1625 ENE) FI

(20.) *Breakthrough in cold fusion leads to renaissance in energy markets* (1626 ENE) FI

(26.) *Cheap liquid fuel production from algae replaces oil by 2030* (1631 ENE) FI

(34.) *Terrorists take algae production plants to their main targets* (1629 AGR) FI

The wild card "*Universities close as research does not meet the needs of industry*" has got a higher ranking for Finland (5,0) than at EU-level (4,27). By the way, both are high levels of importance. The reason can be found in the number of respondents and also in the current University reform in Finland, which might have had a certain influence on opinions and expert judgments. The "*European Commission scrap research support projects*" wild card is not at so high level in the ranking (3,33) with respect

to the EU-level (4,19), maybe because of the limited amount of answers at country level. The "*Gas from Trash*" wild card has got a "moderate" level for Finland (3,06), but a "high" level for The EU area (3,60). The "*Breakthrough in cold fusion leads to renaissance in energy markets*" wild card has been ranked at Country level by a value of 2,57 but at EU-level by a value of 3,27 (both belonging to the category "moderate"). Looking at Standard Deviation there are different opinions at Finnish Country level, which probably means that more analysis is needed, for example on how the background of respondents influences results. For the "*Cheap liquid fuel production from algae replaces oil by 2030*" wild card, there is quite a big difference between the level for Finland ("low", 2,31) and the EU-level ("moderate", 3,10). The "*Terrorists take algae production plants to their main targets*" wild card has been ranked in Finland at 1,58 and at U-level at 2,44 (both "low" levels).

The most important conclusion is that the ten wild cards chosen for focus or tested in Country level were not very relevant but moderately relevant in the Finnish case. There were three wild cards, which were not relevant at all in Finland:

"*Cheap liquid fuel production from algae replaces oil by 2030*" (1631 ENE) FI, "*Thanks to algae Australia becomes biggest energy producer in the world*" (1723 ENE) FI, "*Terrorists take algae production plants to their main targets*" (1629 AGR) FI.

Analysis by stakeholder groups

By examining the results at stakeholder level, we can see that there are not very big differences between Academic actors (ID Group 1), Public Sector (ID Group 2) and all data at country level (Table 5) except for the following: The biggest differences can be found for the wild cards "*Silent Seas*" (difference 0,67, scale 1-5) and "*Breakthroough in cold fusion leads to renaissance in energy markets*" (0,54), and "*Traditional European Medicine*" *(0,42)* for which the academic actors give more value to the single wild card than to the whole group. For the signal "*Rapid-Diagnosis-Machines*" the academic actors give less value to its single importance than to the whole group (difference 0,53). The differences between Public actors (ID Group 2) and the whole group can be hardly found except for "*Rapid-Diagnosis-Machine*", for which public actors give more value to the wild card than to the whole group (difference 0,47). There is also a remarkable difference between Private actors (ID Group 3) and the whole group for the wild card "*Gas from Trash*" for which public actors give more value to the wild card than to the whole group (difference 0,61).

Moreover, it would be useful to know the assessment about wild cards by more private actors, from which useful market information for demand-driven innovations and research could be found. This reflects the emphasis given in Finland's National Innovation Strategy (2009), see also Karjula & Myllylä (2006). It must be said that there are not enough answers to make this comparison for the exeption of the above mentioned wild card "*Gas from Trash*".

Table 5. The most important Wild Cards (WIs) in Finland by ID-group.

Question 4: What <u>level of importance</u> do you think this wild card would have for science, technology and innovation (STI) policy? (In your country)								
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.								
			Country level					**All Group**
WE Category, ranking number by mean and wild card's name, *>2,5 - "Moderate to Critical"*		Class	N	Mean	Std Dev	Mode	Median	Mean
ID Group 1: Academic actors (i.e.Higher education institutions, HEI))								
1.	**Soft "EuroLanding" or "Happy End" in EuroLand**		4	3,75	0,96	3	3,50	4,00
2.	**Silent Seas (1698) FI**	AGR	6	3,67	0,82	3	3,50	3,00
3.	**Nano-lab inside your body (1461)**	ICT	3	3,33	2,08	-	4,00	3,25
4.	**Rapid-Diagnosis-Machines (1616)**	HEA	3	3,33	0,58	3	3,00	3,86
5.	**National energy grid disappears (1632) FI**	ENE	9	3,33	1,00	3	3,00	3,20
6.	**Automatic learning through neuro-data transfer**		3	3,33	1,53	-	3,00	3,25
7.	**A Killer Water Filter (1541)**	AGR	7	3,29	0,76	3	3,00	3,21
8	**Cyber Crusade: Massive e-sabotage by "hacktivists" (1684)**	SSH	4	3,25	1,26	3	3,00	3,40
9.	**3D media trustworthily copying reality (984)**	ICT	4	3,25	1,50	2	3,00	3,13
10.	**Breakthrough in cold fusion leads to renaissance in energy markets (1626(FI**	ENE	9	3,11	1,36	3	3,00	2,57
11.	**Do-It-Yourself (DIY) "wikiforesight" overtakes religion (1692)**	SSH	4	3,00	-	3	3,00	2,80
12.	**Animal Experiments End (1699)**	HEA	3	3,00	1,00	-	3,00	3,20
13.	**Gas from Trash (1625)**	ENE	10	2,80	1,23	2	2,50	3,06
14.	**iBrain vs. Brain Point**		4	2,75	1,26	3	3,00	2,80
15.	**Traditional European Medicine**		3	2,67	0,58	3	3,00	2,25
16.	**Carbon crunch and the climate bubble (1536)**	ENV	3	2,67	2,08	-	2,00	3,00
17.	**Agriculture runs out of phosphor due to algae biofuel production (1628) FI**	AGR	6	2,67	1,37	1	3,00	2,64
ID Group 2: Public actors (incl. public research organisations) Public research organisations (non-HEI), Research funding organisations, Government organisations (Departments, Agencies, etc.), International Agencies (EU, UN, OECD, etc.).								
1.	**Rapid-Diagnosis-Machines (1516)**	HEA	3	4,33	0,58	4	4,00	3,86
2.	**End of Ageing (1514)**	HEA	4	3,25	0,96	4	3,50	3,29
3.	**A Killer Water Filter (1541) FI**	AGR	5	3,00	0,71	3	3,00	3,21
4.	**National energy grid disappears (1632)**	ENE	3	3,00	1,00	-	3,00	3,20
5.	**Agriculture runs out of phosphor due to algae biofuel production (1628)**	AGR	6	2,67	1,51	4	3,00	2,64

ID Group 3: Private actors (incl. private research organisations) ***Private research and innovation support organisations, Private organisations (Corporations, Firms, SMEs), Consultancies and IT Services, Associations representing commercial interests.***								
1.	**Gas from Trash (1625) FI**	ENE	3	3,67	1,53	-	4,00	3,06
ID Group 4: Other interested actors (IGOs, NGOs, Media, Civil society, etc.) ***Non-governmental, not profit organisations (NGO), Media-corporate press, Media – community/alternative press, Civil society, Other (not in list).***								
…	**Maximium respondents for each signal N=3, No that kind of signals >2,5**							

Explanation:
- There are wild cards, which have been recognised by at least 3 respondents. (FFRC-ICTAF meeting 22.7.2011. If a Wild Card has been chosen for investigation at country level, even with 2 or 1 respondents (1271) = Weak Signal code number used for example in statistical analysis.
- FI = Weak signal in agriculture or energy chosen to investigate in Delphi/National Survey in Finland.
- All Group: This means all data on Country level.
- 1 – Health, 2 - Food, Agriculture and Fisheries, and Biotechnology (AGR.), 3 - ICT - Information & communication technologies (ICT), 4 - Nanosciences, nanotechnologies, materials & new production technologies (NAN), 5 – Energy (ENE), 6 - Environment (including Climate Change) (ENV), 7 - Transport (including aeronautics) (Transp.) (TRA), 8 - Socio-economic Sciences and the Humanities (SSH), 9 – Space (SPA), 10 – Security (SEC), 11- Capacities (CAP), 12- Nuclear research (NUC).

4.2 The Most important Weak Signals (WEs)

- The most important Weak Signals (ranking by importance at country level "high" or "critical") are:
  - *Care Communities,*
  - *Emergence of new agricultural methods for coping with climate change,*
  - *Consumption drives market capitalism, not saving, conserving or sparing,*
  - *Many people are willing to pay more to get wind energy,*
  - *Food consumers are steered towards healthier dietary choices.*
- Four of chosen/tested ten wild cards in *Energy and Food, Agriculture and Fisheries, and Biotechnology* are included in the category "high":
  - *Emergence of new agricultural methods for coping with climate change*
  - *Consumption drives market capitalism, not saving, conserving or sparing*
  - *Many people are willing to pay more to get wind energy*
  - *Food consumers are steered towards healthier dietary choices*
- Five of them are included in the category "moderate":
  - *Food markets became investment subject in previous credit crunch*
  - *Obama's goal: One Million e-cars on the US streets by 2015*
  - *Use of electric cars enhance national energy safety*
  - *Algae production is a good way for carbon caption form atmosphere*
  - *Bees be no more, less food than before*
- Only one weak signal was below 2,5 (low importance) at country level:
  - *"There are many new serious attempts to utilize fossil fuel resources ".*

- There are differences in importance for some weak signals between Country level (Finland) and EU-level.
- The ten chosen weak signals were evaluated as "very relevant" in the Finnish case (except *"There are many new serious attempts to utilize fossil fuel resources"*).

In Table 6 the most important Weak Signals that have been answered by at least 3 respondents are introduced according to the whole data at Country level. If a Weak Signal has been chosen for investigation at country level, 2 or 1 respondents are enough.

According to the Country Survey in Finland the following weak signals belong to the category "high" or "critical":

1. *Care Communities* (1522 HEA)
2. *Emergence of new agricultural methods for coping with climate change* (1719 AGR) FI
3. *Consumption drives market capitalism, not saving, conserving or sparing* (1639 AGR) FI
4. *Many people are willing to pay more to get wind energy* (1633 ENE) FI
5. *Food consumers are steered towards healthier dietary choices* (1720 AGR) FI

We can also identify five of the most important weak signals, among those chosen for the analysis at country level, which belong to the category "moderate". Their ranking numbers, according to this analysis were:

6. *Food markets became investment subject in previous credit crunch* (1714 AGR) FI
7. *Obama's goal: One Million e-cars on the US streets by 2015* (1546 ENE) FI
8. *Use of electric cars enhance national energy safety* (1635 ENE) FI
9. *Algae production is a good way for carbon caption form atmosphere* (1634 ENE) FI
10. *Bees be no more, less food than before* (1637 AGR) FI

Table 6. The most important Weak Signals (WEs) in Finland.

Question 4: What level of importance do you think this weak signal would have for science, technology and innovation (STI) policy? (In your country)								
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.								
			Country level					**EU level**
WE Category, ranking number by mean and signals name		Class	N	Mean	Std Dev	Mode	Medi-an	Mean
Category >3,5 - "High or Critical"								
1.	**Care Communities (1522)**	HEA	3	4,00	-	4	4,0	2,95
2.	**Emergence of new agricultural meth-ods for coping with climate change (1719) FI**	AGR	9	3,78	0,97	4	4,0	4,21
3.	**Consumption drives market capitalism, not saving, conserving or sparing (1639) FI**	AGR	11	3,64	1,12	3	4,9	3,29
4.	**Many people are willing to pay more to get wind energy (1633) FI**	ENE	9	3,56	0,88	3	3,0	3,05
5.	**Food consumers are steered towards healthier dietary choices (1720) FI**	AGR	10	3,50	0,97	4	4,0	3,36
Category 3,5>2,5 - "Moderate"								
6.	**Food markets became investment sub-ject in previous credit crunch (1714) FI**	AGR	9	3,33	0,87	3	3,0	3,33
7.	**Obama's goal: One Million e-cars on the US streets by 2015 (1546) FI**	ENE	13	3,31	1,03	3	3,0	3,32
8.	**Use of electric cars enhance national energy safety (1635) FI**	ENE	10	3,30	1,34	4	3,5	3,25
9.	**Algae production is a good way for carbon caption form atmosphere (1634) FI**	ENE	8	3,00	0,53	3	3,0	3,29
10.	**Growing environmental legal class ac-tions on no-win no-fee basis (1640)**	ENV	3	3,00	1,0	-	3,0	3,67
11.	**Bees be no more, less food than before (1637) FI**	AGR	12	2,92	1,16	3	3,00	3,33
12	**Increasing Self-Medication (1520)**	HEA	4	2,75	0,96	2	2,50	3,00
13.	**Advances in portable and autonomous greenhouse units (1535)**	ENV	4	2,75	0,96	2	2,50	3,00
14	**Neuro-Enhancement**	HEA	4	2,50	1,29	-	2,50	2,77
15	**Mental Health from Retail Stores**	HEA	4	2,50	1,29	-	2,50	2,23
16.	**Emergence of secondary carbon finan-cial vehicles (1622)**	ENV	4	2,50	1,00	3	3,00	3,35
Other -"Selected below 2,5"								
17.	**There are many new serious attempts to utilize fossil fuel resources (1636) FI**	ENE	8	2,38	1,41	2	2,00	3,11

Explanation:
- There are signals, which has been responsible for at least 3 respondents. (FFRC-ICTAF meeting 22.7.2011. If a Wild Card has been chosen for investigation at country-level, even with 2 or 1 respondents (1271) = Weak Signal code number used for example in statistical analysis.
- FI = Weak signal in agriculture or energy chosen to investigate in Delphi/National Survey in Finland.
- EU-level Mean: Mean from Question 4 "In the European Union level" by Czech Republic, Finland, Germany, Israel and United Kingdom answers.
- 1 – Health, 2 - Food, Agriculture and Fisheries, and Biotechnology (AGR.), 3 - ICT - Information & communication technologies (ICT), 4 - Nanosciences, nanotechnologies, materials & new production technologies (NAN), 5 – Energy (ENE), 6 - Environment (including Climate Change) (ENV), 7 - Transport (including aeronautics) (Transp.) (TRA), 8 - Socio-economic Sciences and the Humanities (SSH), 9 – Space (SPA), 10 – Security (SEC), 11- Capacities (CAP), 12- Nuclear research (NUC).

Only one weak signal is below the mean of 2,5 with regard to importance at country level. This means that its importance is low. Its ranking number by the mentioned criteria is 17*:"There are many new serious attempts to utilize fossil fuel resources* "(1636) FI.

The greatest differences between country and EU level are for the following weak signals:

(1.) *Care Communities* (1522) (HEA)

(10.) *Growing environmental legal class actions on no-win no-fee basis* (1640 ENV)

(16.) *Emergence of secondary carbon financial vehicles* (1622 ENV).

The Finnish expert panel assesed *Care communities* importance as "high" (4,00), but for the EU-level the result is instead "moderate" (2,95). *Growing environmental legal class actions on no-win no-fee basis* is at country level "moderate" (3,00) but at EU-level "high" (3,67). The importance of the third weak signal "*Emergence of secondary carbon financial vehicles*" is assessed as "moderate" at both levels but their difference is quite high (0,83). The signal's importance is greater at EU level. It is possible that the limited amount of answers explains partly these differences; actually at country level there are only 3-4 respondents for each question.

The most important conclusion is that the ten weak signals chosen for Finland were then very relevant (for the exception of the last mentioned).

Analysis by stakeholder groups

By examining the results at stakeholder level, we can see that there are not very big differences between Academic actors (ID Group 1), Public Sectors (ID Group 2) and all data at country level (Table 7). The biggest differences can be found for the weak signals "*Emergence of new agricultural methods for coping with climate change*" (0,45- scale 1-5), and "*Consumption drives market capitalism, not saving, conserving or sparing*" (0,39) for which academic actors give less value for single signals than for all the group. For the signal "*Bees be no more, less food than before*" academic actors give more value for its single importance than for all the group (difference 0,28). Differences between Public actors (ID Group 2) and all the group can be hardly found. Moreover, it would be useful to know private actors' assessment about weak signals, from which useful market information for demand-driven innovations and research could be found. This reflects the emphasis given in Finland's National Innovation Strategy (2009). It must be said that there are not answers enough to make this comparison.

Table 7. The most important Weak Signals (WEs) in Finland by ID-goup.

Question 4: What level of importance do you think this weak signal would have for science, technology and innovation (STI) policy? (In your country)								
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.								
			Country level					**All Group**
WE Category, ranking number by mean and signals name, *>2,5 – "Moderate to Critical"*		Class	N	Mean	Std Dev	Mode	Medi-an	Mean
ID Group 1: Academic actors (i.e.Higher education institutions, HEI))								
1.	**Emergence of new agricultural meth-ods for coping with climate change (1719) FI**	AGR	3	3,33	0,58	3	3	3,78
2.	**Use of electric cars enhance national energy safety (1635) FI**	ENE	7	3,29	1,11	2	3	3,30
3.	**Consumption drives market capitalism, not saving, conserving or sparing (1639) FI**	AGR	4	3,25	1,50	2	3	3,64
4.	**Food consumers are steered towards healthier dietary choices (1720) FI**	AGR	4	3,25	0,96	4	3,5	3,50
5.	**Bees be no more, less food than before (1637) FI**	AGR	5	3,20	1,10	3	3	2,92
6.	**Many people are willing to pay more to get wind energy (1633) FI**	ENE	7	3,14	0,38	3	3	3,56
7.	**Algae production is a good way for carbon caption form atmosphere (1634) FI**	ENE	6	3,00	0,63	3	3	3,00
8.	**Food markets became investment sub-ject in previous credit crunch (1714) FI**	AGR	3	3,00	-	3	3	3,33
9.	**Obama's goal: One Million e-cars on the US streets by 2015 (1546) FI**	ENE	9	2,89	0,78	3	3	3,31
ID Group 2: Public actors (incl. public research organisations) Public research organisations (non-HEI), Research funding organisations, Government organi-sations (Departments, Agencies, etc.), International Agencies (EU, UN, OECD, etc.).								
1.	**Emergence of new agricultural meth-ods for coping with climate change (1719) FI**	AGR	6	4,00	1,10	4	4	3,78
2.	**Consumption drives market capitalism, not saving, conserving or sparing (1639) FI**	AGR	6	3,83	0,98	3	3,5	3,64
3.	**Food consumers are steered towards healthier dietary choices (1720) FI**	AGR	6	3,67	0,52	4	4	3,50
4.	**Food markets became investment sub-ject in previous credit crunch (1714) FI**	AGR	6	3,50	1,05	3	3,5	3,33

5.	**Bees be no more, less food than before (1637) FI**	AGR	7	2,71	1,25	3	3	2,92
ID Group 3: Private actors (incl. private research organisations) ***Private research and innovation support organisations, Private organisations (Corporations, Firms, SMEs), Consultancies and IT Services, Associations representing commercial interests.***								
	Maximium respondents for each signal N=1, 18 weak signal assessed							
ID Group 4: Other interested actors (IGOs, NGOs, Media, Civil society, etc.) ***Non-governmental, not profit organisations (NGO), Media-corporate press, Media - community/alternative press, Civil society, Other (not in list).***								
	Maximium respondents for each signal N=1, 4 weak signal assessed							

Explanation:
- There are signals, which has been responsible for at least 3 respondents. (FFRC-ICTAF meeting 22.7.2011. If a Wild Card has been chosen for investigation at country-level, even with 2 or 1 respondents (1271) = Weak Signal code number used for example in statistical analysis.
- FI = Weak signal in agriculture or energy chosen to investigate in Delphi/National Survey in Finland.
- All Group: This mean all data Country level.
- 1 – Health, 2 - Food, Agriculture and Fisheries, and Biotechnology (AGR.), 3 - ICT - Information & communication technologies (ICT), 4 - Nanosciences, nanotechnologies, materials & new production technologies (NAN), 5 – Energy (ENE), 6 - Environment (including Climate Change) (ENV), 7 - Transport (including aeronautics) (Transp.) (TRA), 8 - Socio-economic Sciences and the Humanities (SSH), 9 – Space (SPA), 10 – Security (SEC), 11- Capacities (CAP), 12- Nuclear research (NUC).

4.3 Evaluation of the chosen Wild Cards (WIs)

Food, Agriculture and Fisheries, and Biotechnology

4.3.1 Wild Card *"A Killer Water Filter"*

- The wild card "***A killer water filter***" is "moderate original", while the level of importance for the STI policy at country level is "moderate" and "high"at the EU-level.
- Likelihood of wild card *"A killer water filter"* occurrence, in the short and in the longer-term, is "high"
- Wild card's potential impact is at country level and at the EU-level the greatest for *"Environment & ecosystems; Science, technology&innovation(STI)systems, and Economy, EU level addition to this Social welfare"*
- Two the most relevant Research and Technology Development (RTD) strategies for this wild card are *"Promoting international cooperation in STI" and "Developing cross-national research programmes and priorities"*
- Level of preparedness of decisionmakers to deal this wild card is "moderate" in country level Finland and "low" in EU-level.
- According to respondents' comments, many existing signals indicate that such a wild card could happen.
- **To sum up/conclusions**: The "A Killer Water Filter" wild card is very possible to be produced and should deserve more attention. Its importance to STI policy is moderate in country level Finland according to experts, and high in EU-level. Likelihood of this occurring is high both in the short and the long term. The most important strategies are *"Promoting international cooperation in STI"* and *"Developing cross-national research programmes and priorities"*. Wild card's potential impact is *"Environment & ecosystems"*, *"Science, technology & innovation (STI) systems"*, *"Economy"*, and *"Social welfare"*. For example in Finland, the company Kemira is a potential example of how to utilize this wild card and signals which indicate its occurring. *"Kemira ensures that wastewater returned to nature is restored to its original purity"* (www.kemira.com).

"**A Killer Water Filter**" Wild Card description: "*Novel materials promise better access to clean water around the world. By combining nanotechnology with cheap materials such as cotton and tea bags, researchers have recently developed mobile water filters that can be manufactured very economically.*" (www.iknowfutures.eu).

First reaction, importance and occuring in the timeframes

The wild card "*A killer water filter*" is "moderate original", its level of importance for STI policy is "moderate" at country level Finland and "high" at EU-level (Table 8).

Table 8. Importance of Wild Cards: ***"A Killer Water Filter"****.*

(WI number 1541, Agriculture, Finland, Country Survey Finland)					
Answer options Q 3: 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev	Mode	Median
Question 1: How original is this wild card= 1.It is fairly well known 2.It is slightly original 3.It is moderately original 4.It is very original 5.It is too wild.	14	2,86	1,03	2	3,00
Q 3 Country level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	14	3,21	0,70	3	3,00
Q 3 EU level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	14	3,86	0,53	4	4,00

The likelihood of the wild card *"A killer water filter*" occurrence in the short and in the longer-term is "high" (Table 9).

Table 9. Probability/likelihood of this Wild Card "A Killer Water Filter" occurring in the following timeframes.

(WI number 1541, Agriculture, Finland, Country Survey Finland):						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Short-term (<5 years) Mean			Longer-term (5 years+)		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 2: Considering your views about the probability/likelihood of this event/situation occuring in the following timeframes, please indicate how much priority should be given to it in policy making?	14	3,64,	0,63	14	3,93	0,73

Strategies for improving the preparedness for this Wild Card, and level preparedness of decision-makers

The wild card's potential impact at country level Finland and at the EU-level is greatest for "*Environment & ecosystems, Science, technology&innovation(STI)systems, and Economy, EU level addition to this Social welfare"* (see Table 10 and Figure 1).

Table 10. Strategies for improving the preparedness for a given Wild Card ***"A Killer Water Filter"****.*

(WI number 1541, Agriculture, Finland, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Country level, Finland			EU-level		
		N	Mean	Std Dev	N	Mean	Std Dev
Q 4 Please assess the wild card's potential impact on…	1.Physical infrastructure	14	2,00	1,04	14	2,71	1,33
	2.Virtual infrastructure	14	1,29	0,61	14	1,43	0,65
	3.Social welfare	14	2,21	1,05	14	3,29	0,91
	4.Economy	14	2,36	1,15	14	2,86	1,23
	5.Security	14	2,36	1,34	14	3,00	1,24
	6.Policy and governance	12	1,67	0,98	13	2,23	1,09
	7.Environment & ecosystems	14	2,93	1,27	14	3,64	0,93
	8.Science, technology&innovation(STI)systems	14	2,71	1,07	14	3,07	1,00

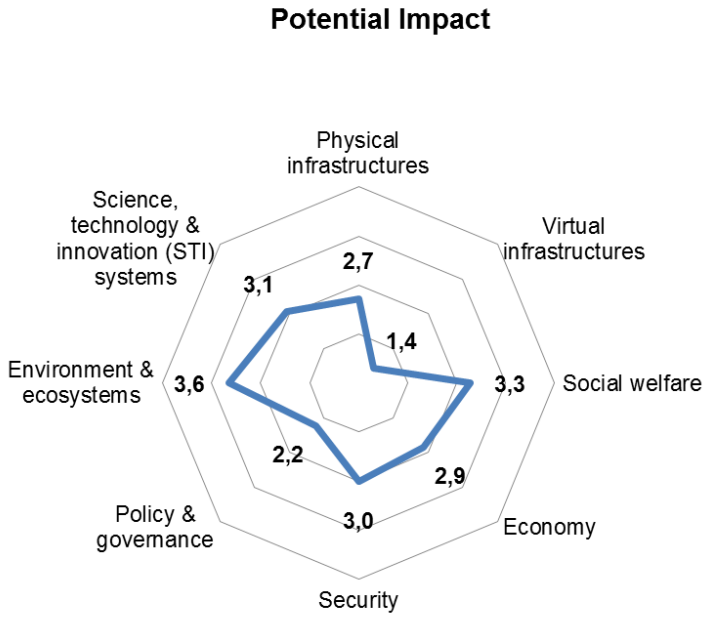

Figure 1. Potential impacts of WI ***"A Killer Water Filter"****.*

(Question 4. Please assess the wild card's potential impact on... Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.)

Two of the most relevant RTD strategies for this wild card are *"Promoting international cooperation in STI" and "Developing cross-national research programmes and priorities"* (Figure 2).

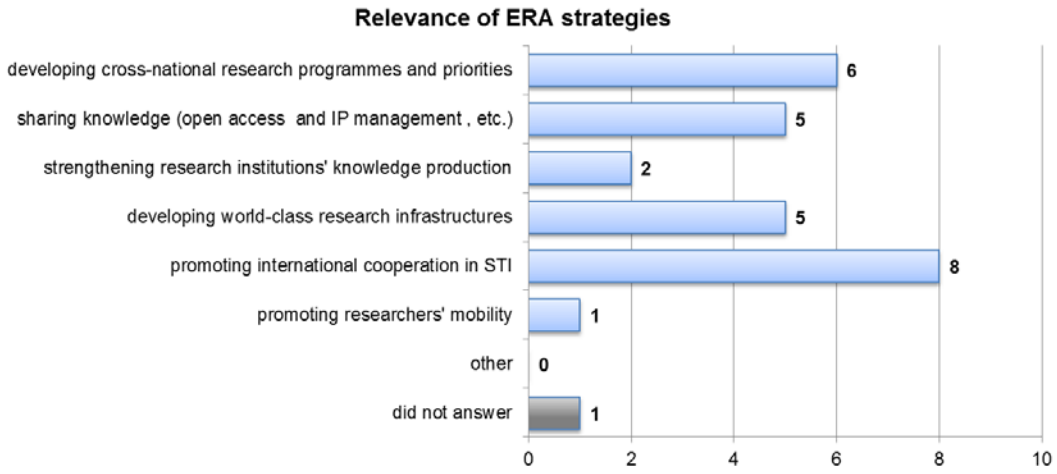

Figure 2. *Relevance of the ERA strategies - Wild Card* ***"A Killer Water Filter"****.*

(Question 6. Please select, from the list of research and technology development (RTD) strategies the two most relevant for ***improving preparedness for such a wild card:****)*

Among the 14 answers, four (28 %) provide advice on policy issues associated to this wild card. Recommendation were *Further research (N=2), Improved academic-industry links (2), Greater (international) cooperation (2),* and *Dissemination of findings (2)*. There were no specific comments about the above mentioned selection.

The level of preparedness of decision-makers at country level is "moderate" and at EU-level "low" (Table 11).

Table 11. *Level of preparedness of decision-makers to deal with* ***"A Killer Water Filter"****.*

(WI number 1541, Agriculture, Finland, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Country level			EU-level		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 5: Level of preparedness of decision-makers to deal with such a wild card: ("Name of the WI")	13	2,62	1,19	13	2,31	0,95

Looking at the comments containted in the box below, we can see that many existing signals indicate that such wild card could happen: For example *"Increasing problems with water quality."* Nanotechnology development is an example of the signals for the future.

Question 8: Can you think of any existing signals indicating that such wild card could happen? (WI 1541)

- *"There are many of them. Water as a resource will be very critical issue in the world."*
- *"Scarity of water is increasing globally."*
- *"Some news on development on technical filters."*
- *"Increasing problems with water quality."*
- *"The advancement in nanotechnology and water-related innovations."*

Question 9: Can you think of any future signals that would increase our knowledge about the likelihood of such a wild card? (WI 1541)

- *"Nanotechnology."*
- *"The shortage of clean water in developed countries."*

Interpretation and conclusions

"A Killer Water Filter" wild card is very potential and should deserve more attention. Its importance for STI policy is, according to experts, moderate at country level and high at EU-level. The likelihood of its occurrence is high in both the short and the long term. The most important strategies are *"Promoting international cooperation in STI"* and "*Developing cross-national research programmes and priorities"*. Wild card's potential impact is *"Environment & ecosystems"*, *"Science, technology & innovation (STI) systems"*, *"Economy"*, and "*Social welfare"*. For example in Finland the company Kemira is a potential example of how to utilize this wild card and signals which indicate its occurring. *"Kemira ensures that wastewater returned to nature is restored to its original purity"* (www.kemira.com).

4.3.2 Wild Card *"Silent Seas"*

- Wild card ***"Silent Seas"*** is "slightly original", its level of importance for STI policy in country level Finland is "moderate" in EU-level "high"
- Likelihood of wild card "Gas from Trash" occuring in the short term is "moderate", longer-term "high"
- Wild card's potential impact is in country level Finland and in the EU-level the greatest for *"Environment & ecosystems"*, *"Social welfare"* and *"Policy and governance"*
- Two the most relevant RTD strategies for this wild card are *"Developing cross-national research programmes and priorities"*, and *"Promoting international cooperation on STI"*
- Level of preparedness of decisionmakers in country level Finland and EU-level is "low" to deal this wild card.
- According to respondents' comments, some existing and future signals indicate that such wild card could happen – existing: *"The near disappering of some fish species"*; future: *"Harmful effects of fish-farming"*
- **To sum up/The conclusions**: *"Silent Seas"* wild card's importance for STI-policy is "moderate" in Country level, "high" in EU-level. Likelihood that it happens in a short time is "moderate", longer-term "high". Preparedness of decision-makers to deal with it is "low" both in Country and EU-level. The most important strategies are *"Developing cross-national research programmes and priorities"*, and *"Promoting international cooperation in STI"*. This wild card will mainly impact "*Environment & ecosystems*", "*Social welfare*", and *"Policy and governance"*.

"Silent Seas" Wild Card description: *"The world´s fisheries continue to collapse although smart controls could help."* (www.iknowfutures.eu).

First reaction, importance and occuring in the timeframes

The wild card *"Silent Seas"* is "slightly original", its level of importance for STI policy at country level is "moderate" and at EU-level "high"(Table 12).

Table 12. Importance of Wild Card ***"Silent Seas"****.*

(WI number 1698, Energy, Country Survey Finland)					
Answer options Q 3: 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev	Mode	Median
Question 1: How original is this wild card= 1.It is fairly well known 2.It is slightly original 3.It is moderately original 4.It is very original 5.It is too wild.	9	2,22	1,09	1	2,00
Q 3 Country level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	11	3,00	1,18	2	3,00
Q 3 EU level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	11	3,64	1,21	3	3,00

The likelihood of the occurrence of the wild card "Gas from Trash" is "moderate" in the short term and "high" in the long term (Table 13).

*Table 13. Probability/likelihood of this Wild Card "****Silent Seas****".*

(WI number 1698, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Short-term (<5 years) Mean			Longer-term (5 years+)		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 2: Considering your views about the probability/likelihood of this event/situation occuring in the following timeframes, please indicate how much priority should be given to it in policy making?	11	3,18	1,17	11	3,91	1,04

Strategies for improving the preparedness for this Wild Card, and level preparedness of decision-makers

Wild card's potential impact is in country level Finland and in the EU-level the greatest for *"Environment & ecosystems", "Social welfare" and "Policy and governance" (*see Table 14 and Figure 3*).*

Table 14. Strategies for improving the preparedness for a given Wild Card ***"Silent Seas"****.*

(WI number 1698, Energy, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Country level, Finland			EU-level		
		N	Mean	Std Dev	N	Mean	Std Dev
Q 4 Please assess the wild card's potential impact on…	1.Physical infrastructure	10	2,10	1,20	10	2,40	1,26
	2.Virtual infrastructure	10	1,30	0,48	10	1,50	0,71
	3.Social welfare	10	2,90	1,29	10	3,60	1,17
	4.Economy	10	2,50	1,35	10	3,10	1,10
	5.Security	10	2,50	1,27	10	2,80	1,23
	6.Policy and governance	10	2,80	1,40	10	3,30	1,42
	7.Environment & ecosystems	10	4,10	1,29	9	4,33	0,87
	8.Science, technology&innovation(STI)systems	10	2,70	1,25	10	2,80	1,14

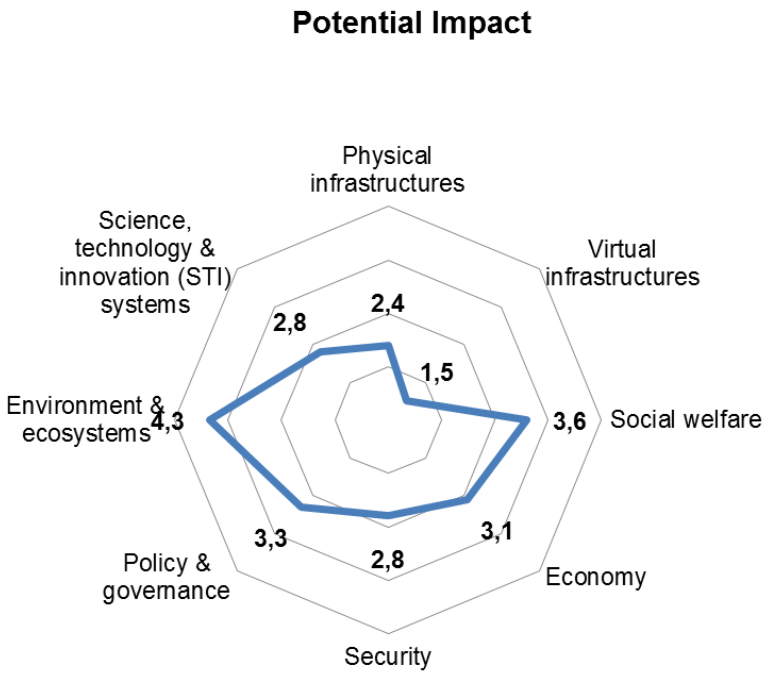

Figure 3. *Potential impacts of WI **"Silent Seas"**.*

(Question 4. Please assess the wild card's potential impact on. Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.)

Two of the most relevant RTD strategies for this wild card are "Developing cross-national research programmes and priorities", and "Promoting international cooperation on STI" (Figure 4).

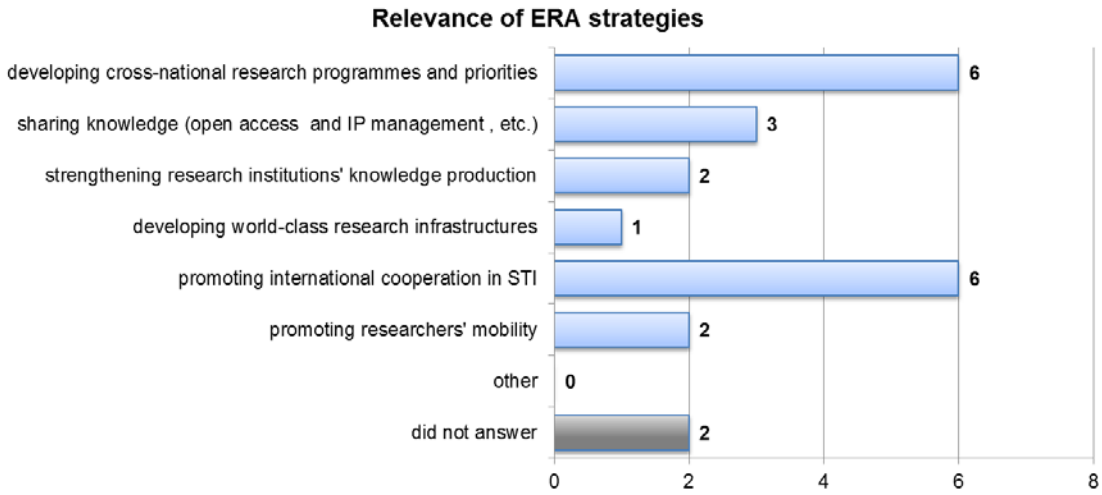

Figure 4. *Relevance of the ERA strategies - Wild Card "**Silent Seas**".*

*(Question 6. Please select, from the list of research and technology development (RTD) strategies the two most relevant for **improving preparedness for such a wild card:**)*

Among the 11 respondents, three (27 %) provided advice on policy issues associated to this wild card, of which the most important are "*Creation a new initiative*", and "*Policy shift.*" No comments were formulated to explain the above mentioned recommendations: "*This is happening and most possibly do not stop.*"

The level of preparedness of decision-makers at country level and EU-level is "low". (Table 15).

Table 15. Level of preparedness of decision-makers to deal with ***"Silent Seas"****.*

(WI number 1698, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Country level			EU-level		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 5: Level of <u>preparedness</u> of decision-makers to deal with such a wild card	9	1,89	0,78	8	2,00	0,76

According to respondents comments, some existing and future signals refer to: "*The near disappering of some fish species*" (existing); "*Harmful effects of fish-farming*" (future) *(Box below).*

Question 8: Can you think of any <u>existing signals indicating that such wild card could happen? (WI 1698)</u>

- *"The near disappereance of some fish species."*
- *"Over-fishing,pollution of marine environments,increasing radar activity and shipping."*

Question 9: Can you think of any <u>future signals</u> that would increase our knowledge about the likelihood of such a wild card? (WI 1698)

- *"Harmful effects of fish-farming."*

Interpretation and conclusions

The ***"Silent Seas"*** wild card's importance for STI-policy is "moderate" at Country level and "high" at EU-level. The likelihood of occurrence is "moderate" in the short and "high" in the long term. The preparedness of decision-makers is "low" both at Country and EU-level. The most important strategies are "*Developing cross-national research programmes and priorities*", and "*Promoting international cooperation in STI*". This wild card will mainly impact on "Environment & ecosystems", "Social welfare", and "*Policy and governance*".

4.3.3 Wild Card *"Agriculture runs out of phosphor due to algae biofuel production"*

- Wild card ***"Agriculture runs out of phosphor due to algae biofuel production" is "moderately original"***, level of importance for STI policy is "moderate" in country level Finland and EU-level.
- Likelihood of wild card occuring in the short term is "moderate", longer-term a little bit bigger, but still "moderate"

- Wild card's potential impact is in country level Finland and in the EU-level the greatest on *"Environment & ecosystems"*, *"Science, technology & innovation (STI) systems"*, *"Policy and governance"*, and *"Economy"*
- Two of the most relevant RTD strategies for this wild card are *"Developing cross-national research programmes and priorities"*, and *"Promoting international cooperation in STI"*
- Level of preparedness of decisionmakers to deal with this wild card is "low" in country level Finland and EU-level.
- According to respondents' comments, some existing signals indicate that such wild card could happen, for example *"Shortage of phospor, limitations"*; future signal *"Expanded algae based bioenergy production"*.
- **To sum up/The conclusions**: *"Agriculture runs out of phosphor due to algae biofuel production"* wild card's importance for STI-policy is moderate, likelihood that it happens in the short term is "low", longer-term "moderate". Preparedness of decision-makers to deal with it is "low" in Country level and EU-level. The most important strategies are *"Developing cross-national research programmes and priorities"*, and *"Promoting international cooperation in STI"*. This wild card will mainly impact *"Environment & ecosystems"*, *"Science, technology & innovation (STI) systems"* and third one *"Economy"* and *"Policy and governance"*.

*"**Agriculture runs out of phosphor due to algae biofuel production**"* Wild Card description: *"Production of large quatities of algae requires phosphor fertilizing. All available phosphor goes to algae production and agriculture especially in developing countries starts to severlly suffer from scarcity of phosphor fertilizes."* (www.iknowfutures.eu).

First reaction, importance and occuring in the timeframes

The wild card *"Agriculture runs out of phosphor due to algae biofuel production"* is "moderately original"; its level of importance for STI policy at country and EU-level is "moderate" (Table 16).

Table 16. *Importance of Wild Card* ***"Agriculture runs out of phosphor due to algae biofuel production"****.*

(WI number 1628, Agriculture, Country Survey Finland)					
Answer options Q 3: 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev	Mode	Median
Question 1: How original is this wild card= 1.It is fairly well known 2.It is slightly original 3.It is moderately original 4.It is very original 5.It is too wild.	14	3,29	1,20	4	3,50
Q 3 Country level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	14	2,64	1,28	4	3,00
Q 3 EU level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	14	3,14	1,29	3	3,00

The likelihood of the occurrence of this is "moderate" in the short term, in the long-term a little bit bigger, but still "moderate" (Table 17).

Table 17. *Probability/likelihood of this Wild Card* ***"Agriculture runs out of phosphor due to algae biofuel production".***

(WI number 1628, Agriculture, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Short-term (<5 years) Mean			Longer-term (5 years+)		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 2: Considering your views about the probability/likelihood of this event/situation occuring in the following timeframes, please indicate how much priority should be given to it in policy making?	14	2,50	1,02	14	3,29	1,14

Strategies for improving the preparedness for this Wild Card, and level preparedness of decision-makers

The wild card's potential impact is greater at country level and at the EU-level on *"Environment & ecosystems"*, *"Science, technology & innovation (STI) systems"*, *"Policy and governance"*, and *"Economy"* (see Table 18 and Figure 5).

Table 18. Strategies for improving the preparedness for a given Wild Card ***"Agriculture runs out of phosphor due to algae biofuel production".***

(WI number 1628, Agriculture, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Country level, Finland			EU-level		
		N	Mean	Std Dev	N	Mean	Std Dev
Q 4 Please assess the wild card's potential impact on…	1.Physical infrastructure	13	2,38	1,12	13	2,54	1,20
	2.Virtual infrastructure	13	1,38	0,65	13	1,38	0,65
	3.Social welfare	13	2,31	1,25	13	2,54	1,20
	4.Economy	13	2,62	1,33	13	2,92	1,26
	5.Security	13	2,54	1,05	13	2,69	1,11
	6.Policy and governance	13	2,62	1,19	13	2,92	1,19
	7.Environment & ecosystems	13	3,62	1,12	13	3,69	0,95
	8.Science, technology&innovation(STI)systems	13	3,00	1,00	13	3,08	1,04

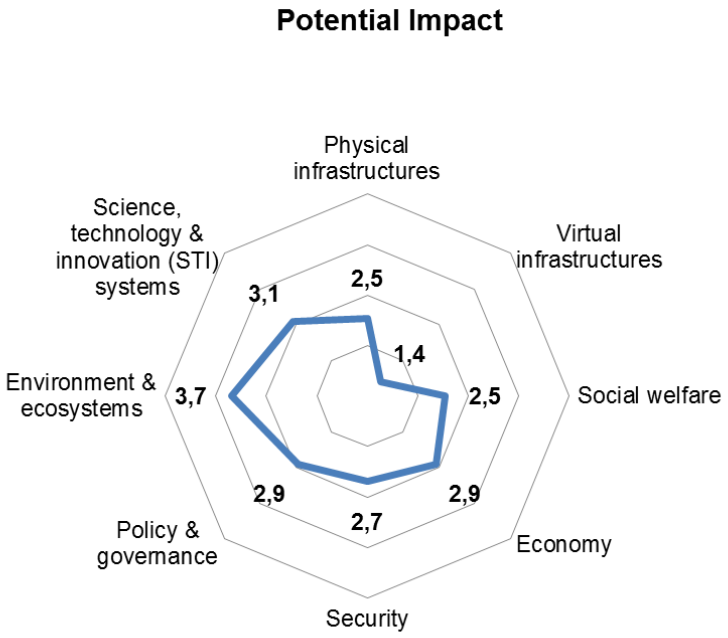

Figure 5. Potential impacts of WI ***"Agriculture runs out of phosphor due to algae biofuel production".***

(Question 4. Please assess the wild card's potential impact on... Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.)

Two of the most relevant RTD strategies for this wild card are *"Developing cross-national research programmes and priorities", and "Promoting international cooperation in STI"* (Figure 6).

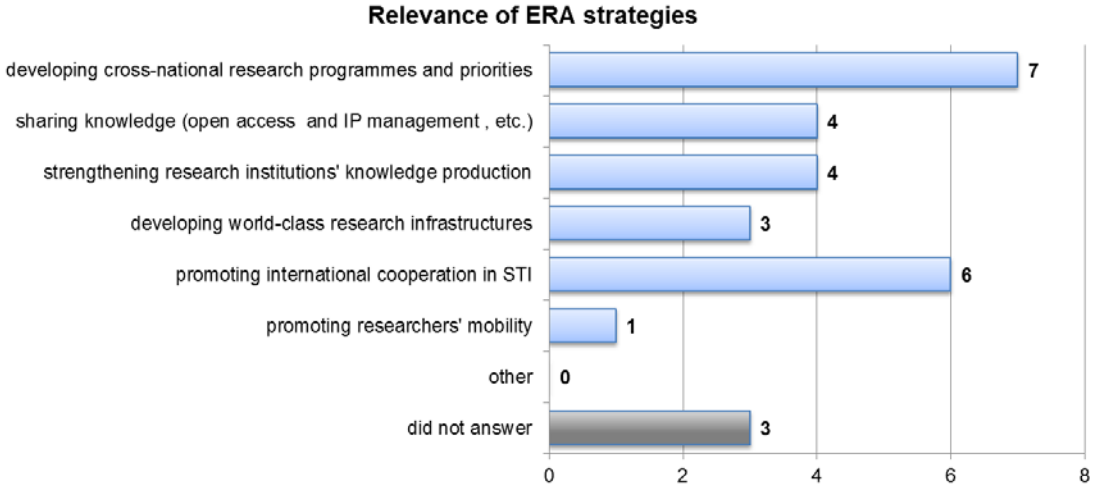

Figure 6. *Relevance of the ERA strategies - Wild Card* ***"Agriculture runs out of phosphor due to algae biofuel production".***

(Question 6. Please select, from the list of research and technology development (RTD) strategies the two most relevant for ***improving preparedness for such a wild card:****)*

From 11 answerers three (21 %) like to provide advice on policy issues associated to this wild card *"Agriculture runs out of phosphor due to algae biofuel production".*

Recommendation were *Policy shift* and *Incorporation findings in debates and strategies.* There were no comments to explain the contents of the abovementioned recommendation in more detail.

The level of preparedness of decision-makers to deal with this wild card at country and EU-level is "low" (Table 19).

Table 19. *Level of preparedness of decision-makers to deal with* ***"Agriculture runs out of phosphor due to algae biofuel production".***

(WI number 1628, Agriculture, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Country level			EU-level		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 5: Level of preparedness of decision-makers to deal with such a wild card	12	2,00	0,95	12	1,83	0,94

In the comments (box below), some existing signals indicate that such wild card could be produced, for example *"Shortage of phosphor, limitations."* There are also some future signals indicating that this wild card can occur, for example *"Expanded algae based bioenergy production."*

Question 8: Can you think of any existing signals indicating that such wild card could happen? (WI 1628)

- *"P is critical already now."*
- *"Probably just the opposite."*
- *"Shortage of phosphor, limitations."*
- *"P from human manure is not recovered efficiently."*
- *"Unsustainable use of phosphorus importance given to energy issues over food production (palm oil)."*

Question 9: Can you think of any future signals that would increase our knowledge about the likelihood of such a wild card? (WI 1628)

- *"Global agricultural development includes many such signals."*
- *"Expanded algae based bioenergy production."*
- *"Dry toilet movement."*

Interpretation and conclusions

"Agriculture runs out of phosphor due to algae biofuel production" wild card's importance for STI-policy is moderate, the likelihood of its occurrence is "low" in the short term while "moderate" in the long term. The preparedness of decision-makers to deal with it is "low" at both Country and EU-level. The most important strategies are *"Developing cross-national research programmes and priorities"*, and *"Promoting international cooperation in STI.* This wild card will mainly impact "*Environment & ecosystems,*" "*Science, technology & innovation (STI) systems,*" *"Economy"* and *"Policy and governance"*.

4.3.4 Wild Card *"Algae pathogen suddenly destroys new energy foundation of humankind"*

- Wild card ***"Algae pathogen suddenly destroys new energy foundation of humankind" is "very original",*** level of importance for STI policy in country level Finland and EU-level is "low"
- Likelihood of wild card occuring short-term is "low", longer-term "low"
- Wild card's potential impact is in both country level Finland and EU-level greatest on *"Environment & ecosystems."* *"Policy and governance,"* and *"Economy"*
- The most relevant RTD strategies for this wild card are "*Promoting international cooperation in STI,*" *"Developing cross-national research programmes and priorities,"* and *"Strengthening research institutions' knowledge production"*
- Level of preparedness of decisionmakers in country level Finland and EU-level is "none" to deal this wild card.
- There is some existing or future signals indicating that such wild card could happen, e.g. existing "*Monocultures have then risk, this goes also for algal monocultures*" or future *"Algal ecosystem research"*
- **To sum up/The conclusions**: *"Algae pathogen suddenly destroys new energy foundation of humankind"* wild card's importance for STI-policy is "low" in Country level and EU-level. Likelihood that it happens in the short or longer-term is "low". Preparedness of decision-

makers to deal with it is "none". The most important strategies are *"Promoting international cooperation in STI"*, and second one*"Developing cross-national research programmes and priorities"*, and *"Strengthening research institutions' knowledge production"*. This wild card will mainly impact on *"Environment & ecosystems"*, *"Security"*, *"Economy"*.

"Algae pathogen suddenly destroys new energy foundation of humankind" Wild Card description: *"Suddenly, a new type of airborne algae pathogen starts to spread destroy the new energy foundation of humankind."* (www.iknowfutures.eu).

First reaction, importance and occuring in the timeframes

The wild card *"Algae pathogen suddenly destroys new energy foundation of humankind"* is "very original", its level of importance for STI policy at country and EU-level is "low" (Table 20).

Table 20. *Importance of Wild Card* ***"Algae pathogen suddenly destroys new energy foundation of humankind"***.

(WI number 1722, Energy, Country Survey Finland)					
Answer options Q 3: 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev	Mode	Median
Question 1: How original is this wild card= 1.It is fairly well known 2.It is slightly original 3.It is moderately original 4.It is very original 5.It is too wild.	11	3,82	1,33	4	4,00
Q 3 Country level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	11	2,09	1,22	1	2
Q 3 EU level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	11	2,45	1,29	2	2,00

Likelihood of wild card occuring in the short term is "low", longer-term "low" (Table 21).

*Table 21. Probability/likelihood of this Wild Card **"Algae pathogen suddenly destroys new energy foundation of humankind"**.*

(WI number 1722, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Short-term (<5 years) Mean			Longer-term (5 years+)		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 2: Considering your views about the probability/likelihood of this event/situation occuring in the following timeframes, please indicate how much <u>priority</u> should be given to it in policy making?	12	1,75	0,87	12	1,58	1,08

Strategies for improving the preparedness for this Wild Card, and level preparedness of decision-makers

The wild card's potential impact is at country and EU-level greater for *"Environment & ecosystems", "Policy and governance", and "Economy" (see Table 22 and Figure 7).*

*Table 22. Strategies for improving the preparedness for a given Wild Card **"Algae pathogen suddenly destroys new energy foundation of humankind"**.*

(WI number 1722, Energy, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Country level, Finland			EU-level		
		N	Mean	Std Dev	N	Mean	Std Dev
Q 4 Please assess the wild card's potential impact on…	1.Physical infrastructure	11	2,09	1,38	11	2,45	1,44
	2.Virtual infrastructure	11	1,73	1,01	11	1,82	1,08
	3.Social welfare	11	2,33	1,12	11	2,73	1,01
	4.Economy	11	2,64	1,43	11	2,91	1,38
	5.Security	11	2,91	1,45	10	3,40	1,26
	6.Policy and governance	11	2,64	1,50	10	3,20	1,32
	7.Environment & ecosystems	11	3,27	1,74	10	3,80	1,62
	8.Science, technology&innovation(STI)systems	11	2,55	1,44	10	2,90	1,20

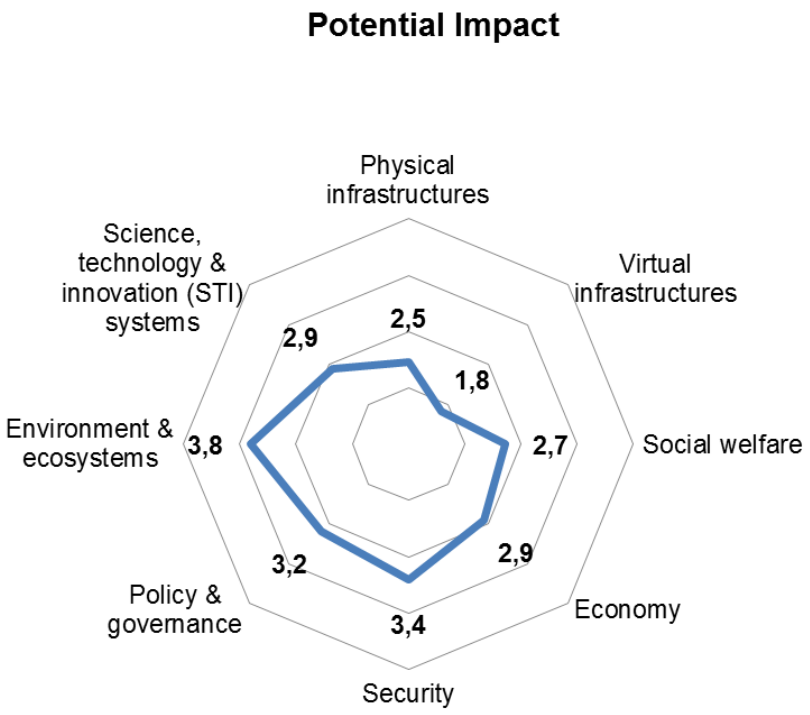

Figure 7. *Potential impacts of WI* ***"Algae pathogen suddenly destroys new energy foundation of humankind"****.*

(Question 4. Please assess the wild card's potential impact on... Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.)

The most relevant RTD strategies for this wild card are *"Promoting international cooperation in STI," "Developing cross-national research programmes and priorities,"* and *"Strengthening research institutions"* knowledge production" (Figure 8).

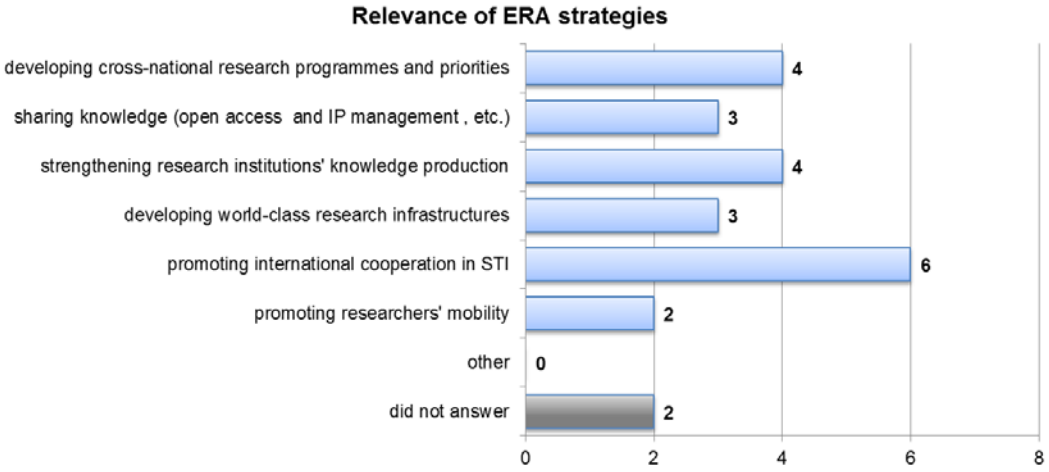

Figure 8. *Relevance of the ERA strategies - Wild Card "**"Algae pathogen suddenly destroys new energy foundation of humankind".***

*(Question 6. Please select, from the list of research and technology development (RTD) strategies the two most relevant for **improving preparedness for such a wild card:**)*

Among the 12 respondents, one (8 %) provided advice on policy issues. The recommendations were *"Incorporation findings in debates and strategies"*, *"Increased public spending"*, and *"Greater (international) cooperation"*. No comments were given to explain the abovementioned recommendations.

The level of preparedness of decision-makers at country and EU-level is "none".(Table 23).

Table 23. *Level of preparedness of decision-makers to deal with **"Algae pathogen suddenly destroys new energy foundation of humankind"**.*

(WI number 1722, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Country level			EU-level		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 5: Level of preparedness of decision-makers to deal with such a wild card: ("Name of the WI")	11	1,27	0,47	10	1,30	0,48

According to respondents' comments, some existing or future signals indicate that such wild card could happen, like existing *"Monocultures have then risk, this goes also for algal monocultures"* or future *"Algal ecosystem research" (box below).*

Question 8: Can you think of any existing signals indicating that such wild card could happen? (WI 1722)

- *"Some yes."*
- *"It is possible in a long run."*
- *"Rumours"*
- *"Monocultures have theri risk,this goes also for algal monocultures."*

Question 9: Can you think of any future signals that would increase our knowledge about the likelihood of such a wild card? (WI 1722)

- *"Not much."*
- *"Some minor example."*
- *"Algal ecosystem research."*

Interpretation and conclusions

The ***"Algae pathogen suddenly destroys new energy foundation of humankind"*** wild card's importance for STI-policy is "low" at both country and EU-level. The likelihood of occurrence in the short and long term is "low". The preparedness of decision-makers is "none". They should support *"Promoting international cooperation in STI"*, *"Developing cross-national research programmes and priorities"*, and "*Strengthening research institutions' knowledge production*". This wild card will mainly impact on "*Environment & ecosystems*", "*Security*", and "*Economy*".

4.3.5 Wild Card *"Terrorists take algae production plants to their main targets"*

- Wild card ***"Terrorists take algae production plants to their main targets"*** is "moderately original", level of importance for STI policy in country level Finland and EU-level is "low"
- Likelihood of wild card occuring in both the short and longer-term is "low"
- Wild card's potential impact is in country level Finland and in the EU-level greatest for "*Security*", "*Environment & ecosystems, and Economy*"
- The two most relevant RTD strategies for this wild card are "*Developing cross-national research programmes and priorities*" and "*Strengthening research institutions' knowledge production*"
- Level of preparedness of decisionmakers to deal with this wild card in country level Finland and EU-level is "low".
- According to respondents' comments, some existing signals may indicate that such wild card could happen – for example "*We are trying to find new ways to produce energy for renewable sources already*"
- **To sum up/The conclusions**: "*Terrorists take algae production plants to their main targets*" wild card's importance for STI-policy is "low" (or "moderate" in EU-level), likelihood that it happens in the short time is "low", longer-term "low". Preparedness of decision-makers to deal with it is "low" in both Country and EU-level. If there would do something for this, the most important should be "*Developing cross-national research programmes and priorities*", and "*Strengthening research institutions*", and "*Promoting international cooperation in STI*". This wild card will mainly impact "*Security*" and "*Environment & ecosystems*".

"Terrorists take algae production plants to their main targets" Wild Card description: *"As oil sector is going down and algae is taking its place, new global geopolitical tensions arise. Ex-oil states drive terrorist attacks on algae."* (www.iknowfutures.eu).

First reaction, importance and occuring in the timeframes

Wild card *"Terrorists take algae production plants to their main targets"* is "moderately original", its level of importance for STI policy in country level Finland and EU-level is "low" (Table 24).

Table 24. Importance of Wild Card ***"Terrorists take algae production plants to their main targets"****.*

(WI number 1629, Agriculture, Country Survey Finland)					
Answer options Q 3: 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev	Mode	Median
Question 1: How original is this wild card= 1.It is fairly well known 2.It is slightly original 3.It is moderately original 4.It is very original 5.It is too wild.	13	3,31	1,18	3	3,00
Q 3 Country level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	12	1,58	0,67	1	1,50
Q 3 EU level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	12	2,50	1,31	2	2,00

Likelihood of wild card occuring is "low" in the short and longer-term (Table 25).

Table 25. Probability/likelihood of this Wild Card ***"Terrorists take algae production plants to their main targets"****.*

(WI number 1629, Agriculture, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Short-term (<5 years) Mean			Longer-term (5 years+)		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 2: Considering your views about the probability/likelihood of this event/situation occuring in the following timeframes, please indicate how much priority should be given to it in policy making?	12	2,00	1,13	12	2,42	1,38

Strategies for improving the preparedness for this Wild Card, and level preparedness of decision-makers

The wild card's potential impact is at country level Finland and at EU-level greater for *"Security", "Environment & ecosystems,* and *Economy" (see Table 26 and Figure 9).*

Table 26. Strategies for improving the preparedness for a given Wild Card ***"Terrorists take algae production plants to their main targets"****.*

(WI number 1629, Agriculture, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Country level, Finland			EU-level		
		N	Mean	Std Dev	N	Mean	Std Dev
Q 4 Please assess the wild card's potential impact on…	1.Physical infrastructure	12	1,92	1,08	12	2,00	1,04
	2.Virtual infrastructure	12	1,50	0,80	12	1,50	0,80
	3.Social welfare	12	2,42	1,24	12	2,58	1,31
	4.Economy	12	2,58	1,00	11	2,64	1,21
	5.Security	12	3,42	1,51	12	3,50	1,51
	6.Policy and governance	12	2,33	1,30	12	2,42	1,31
	7.Environment & ecosystems	12	2,83	1,47	12	3,00	1,41
	8.Science, technology&innovation(STI)systems	12	2,25	1,14	12	2,42	1,16

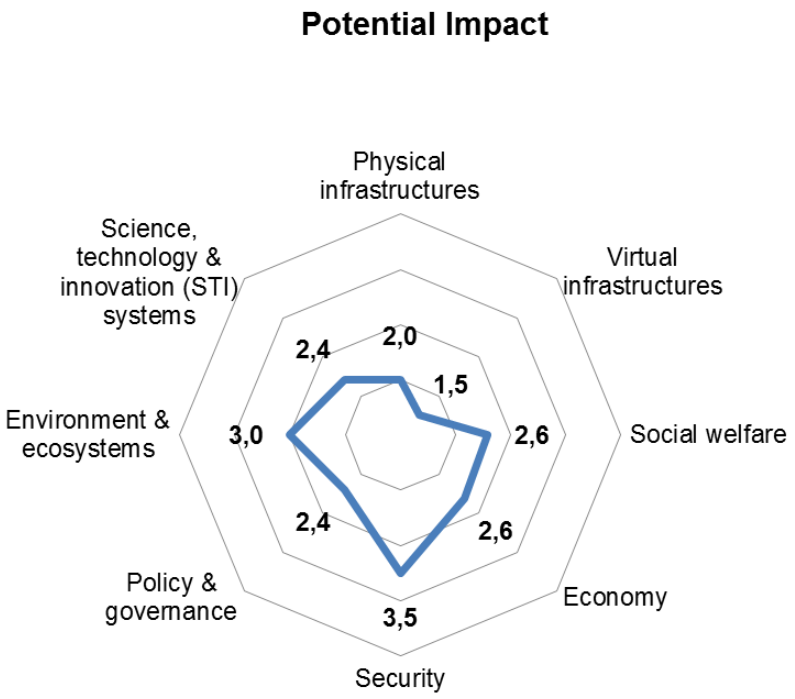

Figure 9. *Potential impacts of WI* ***"Terrorists take algae production plants to their main targets"****.*

(Question 4. Please assess the wild card's potential impact on... Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.)

Two most relevant RTD strategies for this wild card are "*Developing cross-national research programmes and priorities*" and "*Strengthening research institutions' knowledge production*" (Figure 10).

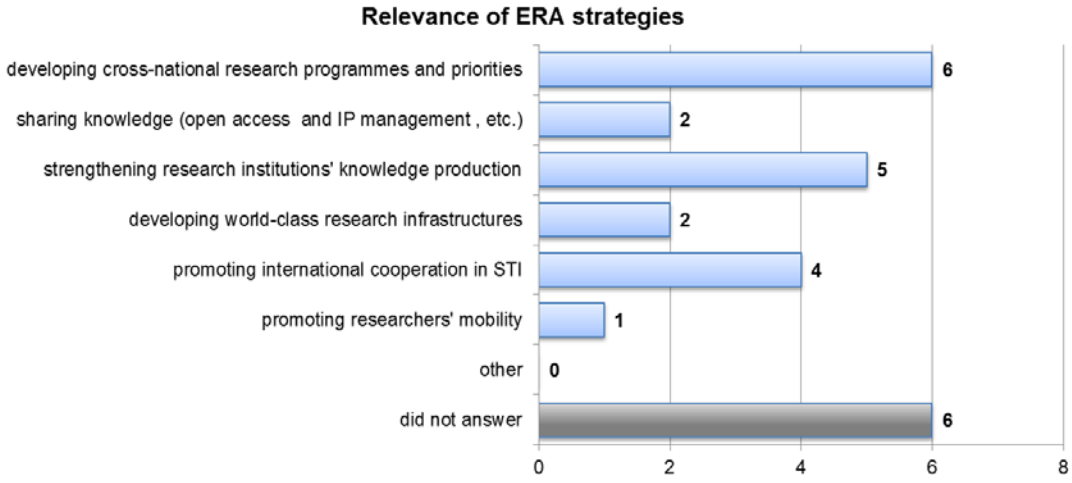

Figure 10. *Relevance of the ERA strategies - Wild Card* ***"Terrorists take algae production plants to their main targets"****.*

(Question 6. Please select, from the list of research and technology development (RTD) strategies the two most relevant for ***improving preparedness for such a wild card:****)*

Among the 11 respondents two (15 %) provided advice on policy issues associated to this wild card, the most important of which is "*Policy shift.*" There were no comments to explain the contents of the abovementioned recommendation in more detail.

The level of preparedness of decision-makers at country and EU-level is "low" (Table 27).

Table 27. *Level of preparedness of decision-makers to deal with Wild Card* ***"Terrorists take algae production plants to their main targets"****.*

(WI number 1629, Agriculture, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Country level			EU-level		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 5: Level of preparedness of decision-makers to deal with such a wild card: ("Name of the WI")	12	1,50	0,67	12	1,58	0,67

According to respondents' comments, only some existing signals indicate the possibility of occurrence of this wild card – for example "*We are trying to find new ways to produce energy for renewable sources already*". See more comments in the Box below.

Question 8: Can you think of any existing signals indicating that such wild card could happen? (WI 1629)

- *"Some,not so many."*
- *"We are trying to find new ways to produce energy for renewable sources already."*
- *"The techniques are there."*
- *"Terrorism sprouts from social inequalities and distrust."*

Question 9: Can you think of any future signals that would increase our knowledge about the likelihood of such a wild card? (WI 1629)

- *"Some,not so many."*
- *"More cases appear."*

Interpretation and conclusions

To sum up and draw some conclusions: ***"Terrorists take algae production plants to their main targets"*** wild card's importance for STI-policy is "low" (or "moderate" in EU-level), the likelihood of its occurrence in the short and long term is "low". The preparedness of decision-makers to deal it is "low" in both Country and EU-level. The most important policies could be *"Developing cross-national research programmes and priorities"*, *"Strengthening research institutions'*, and*"Promoting international cooperation in STI"*. This wild card will mainly impact *"Security"* and *"Environment & ecosystems"*.

Energy

4.3.6 Wild Card *"National energy grid disappears"*

- Wild card ***"National energy grid disappears"*** is "moderately original", its level of importance for STI policy in country level Finland and EU-level is "moderate"
- Likelihood of this wild card occurring in the short-term is "low", in longer-term "high"
- Wild card's potential impact is in country level Finland and in the EU-level greatest for *"Physical infrastructure"*, *Economy"*, and *"Environment & ecosystems"*
- Two most relevant RTD strategies for this wild card are *"Developing cross-national research programmes and priorities" and "Promoting international cooperation on STI"*
- Level of preparedness of decisionmakers to deal with this wild card is "low" in country level Finland and EU-level.
- According to respondents' comments, many existing signals indicate that such wild card could happen
- **To sum up/The conclusions**: *"National energy grid disappears"*. wild card's importance for STI-policy is "moderate", likelihood that it happens in the short term is "low", and longer-term "moderate". Preparedness of decision-makers to deal with it is "low" in both Country and EU-level. The most important ERA-strategies are *"Developing cross-national research programmes and priorities"* and *"Promoting international cooperation in STI"*. This wild

card will mainly impact *"Physical infrastructure," "Environment & ecosystems,"* and *"Economy"*.

"National energy grid disappears" *Wild Card description:* "Due to new domestic heating and electricity production innovation, households become self-sufficient in energy. Finally, there is no need anymore for national energy grid." *(www.iknowfutures.eu).*

First reaction, importance and occuring in the timeframes

The wild card *"National energy grid disappears"* is "moderately original", its level of importance for STI policy at country and EU-level is "moderate" (Table 28).

Table 28. Importance of Wild Card ***"National energy grid disappears"***.

(WI number 1632, Energy, Country Survey Finland)					
Answer options Q 3: 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev	Mode	Median
Question 1: How original is this wild card= 1.It is fairly well known 2.It is slightly original 3.It is moderately original 4.It is very original 5.It is too wild.	16	2,75	1,13	3	3,00
Q 3 Country level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	15	3,20	1,08	2	3,00
Q 3 EU level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	15	3,20	1,21	2	3,00

The likelihood of the occurrence of this wild card is in the short term "low", and in the long term "high" (Table 29).

Table 29. Probability/likelihood of this Wild Card ***"National energy grid disappears"***.

(WI number 1632, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Short-term (<5 years) Mean			Longer-term (5 years+)		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 2: Considering your views about the probability/likelihood of this event/situation occuring in the following timeframes, please indicate how much priority should be given to it in policy making?	16	2,31	1,20	16	3,00	1,21

Strategies for improving the preparedness for this Wild Card, and level preparedness of decision-makers

The wild card's potential impact is at country level and at the EU-level greater for *"Physical infrastructure"*, *"Economy"*, and *"Environment & ecosystems"* (see Table 30 and Figure 11).

Table 30. Strategies for improving the preparedness for a given Wild Card ***"National energy grid disappears"***.

(WI number 1632, Energy, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Country level, Finland			EU-level		
		N	Mean	Std Dev	N	Mean	Std Dev
Q 4 Please assess the wild card's potential impact on…	1.Physical infrastructure	15	4,00	1,00	15	3,53	1,06
	2.Virtual infrastructure	14	2,57	1,02	14	2,29	1,14
	3.Social welfare	15	2,60	1,06	15	2,53	1,13
	4.Economy	15	3,67	0,98	15	3,33	1,18
	5.Security	15	3,47	1,13	15	3,20	1,26
	6.Policy and governance	14	3,50	1,09	14	3,29	1,27
	7.Environment & ecosystems	15	3,67	1,05	15	3,53	1,06
	8.Science, technology&innovation(STI)systems	14	3,36	0,84	14	3,21	0,89

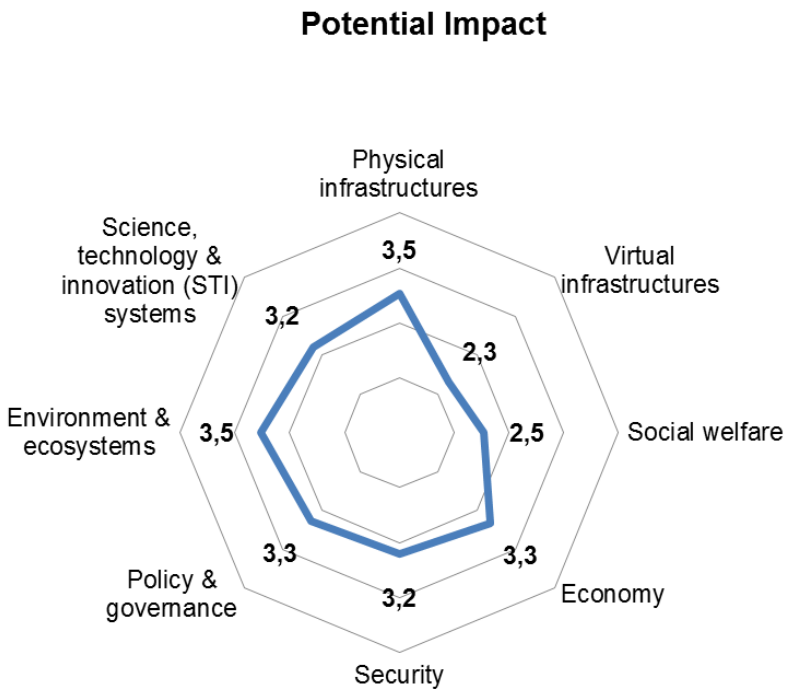

Figure 11. *Potential impacts of WI* ***"National energy grid disappears"****.*

(Question 4. Please assess the wild card's potential impact on. Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.)

Two most relevant RTD strategies for this wild card are *"Developing cross-national research programmes and priorities"* and *"Promoting international cooperation on STI"* (Figure 12).

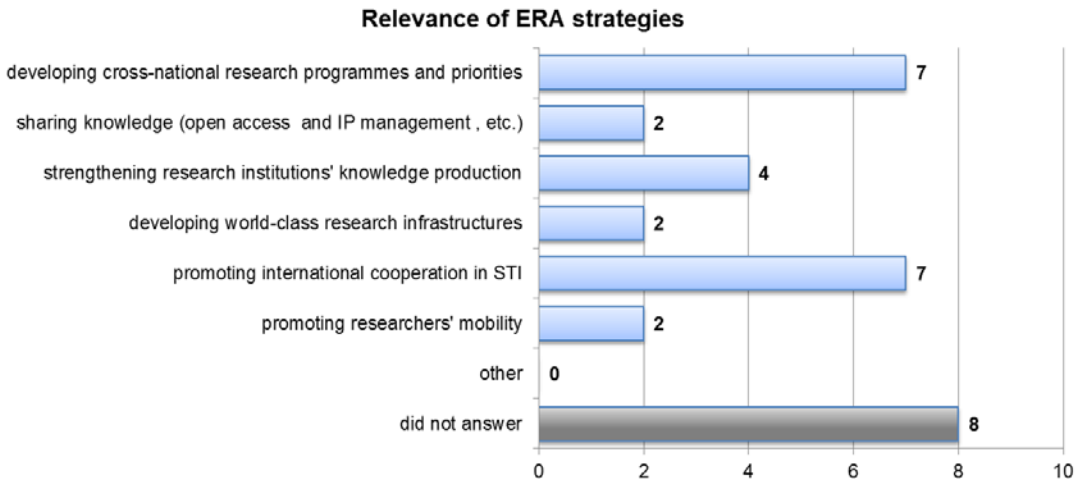

Figure 12. ***Relevance of the ERA strategies*** *- Wild Card* ***"National energy grid disappears"****.*

(Question 6. Please select, from the list of research and technology development (RTD) strategies the two most relevant for ***improving preparedness for such a wild card:****)*

Among the 13 answers three (19 %) provided advice on policy issues associated to this wild card, of which the most important is "*Creation a new initiative*", and "*Policy shift.*" There were no comments to explain the contents of the abovementioned recommendations in more detail.

The level of preparedness of decision-makers at country and EU-level is "low" (Table 31).

Table 31. Level of preparedness of decision-makers to deal with ***"National energy grid disappears"****.*

(WI number 1632, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Country level			EU-level		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 5: Level of <u>preparedness</u> of decision-makers to deal with such a wild card: ("Name of the WI")	12	2,00	0,95	12	2,33	0,78

According to respondents' comments, many existing signals indicate that such wild card could happen (see Box below). For example existing signal "*Passive and zero-energy buildings are increasing small-scale energy production is supported by the government*" and future signal "*Some major distruction of infrasystems due to natural disaster, war etc.*"

Question 8: Can you think of any <u>existing signals</u> indicating that such wild card could happen? (WI 1632)

- *"Some, but not so many"*
- *"Fuel cell research"*
- *"Not really, this is highly unlikely without some major distruction. The reason is,the national grids serves large users ,industries and cities. It is critical national infrastructure ,and the need for it depends on location of national power generation units."*
- *"High level of interest in micro-grids and distributed generation Advances is small scale power generation systems development of fuel cells."*
- *"Passive and zero-energy buildings are increasing small-scale energy production is supported by the government."*
- *"Smart meters passive energy houses."*

Question 9: Can you think of any <u>future signals</u> that would increase our knowledge about the likelihood of such a wild card? (WI 1632)

- *"Some,but not so many"*
- *"Need to procuce and consume locally."*
- *"Some major distruction of infrasystems due to natural disaster, war etc."*
- *"Increased amount of zero-energy buildings and offices.Increased amount of off-grid or micro-grid communities in locales where connection to national grid would be fully available cheap and well available form of small scale distributed power generation…"*

Interpretation and conclusions

"National energy grid disappears" wild card's importance for STI-policy is "moderate", the likelihood of its occurrence is "low" in the short term and "moderate" in the long term. The preparedness of decision-makers is "low" at both Country and EU-level. The most suitable ERA-strategies are "*Developing cross-national research programmes and priorities*", and "*Promoting international cooperation in STI*". This wild card will mainly impact "*Physical infrastructure*" and secondly on "*Environment & ecosystems*" and "*Economy*".

In Finland there are some new pilot eco-villages, which are outside of national energy grid, such as 'Kempeleen ekokortteli' (http://www.fortel.fi/components/ekokortteli). In September 2011 a pilot example of a future village, Tampereen Tulevaisuuskylä, was organised in Tampere which emphasized the need to poit to local productions. All energy used was produced by solar plants, and the production of food and furniture, as well as spaces for children, were fully natural or biological (www.tulevaisuukylä.net). Finland Futures Research Centre has taken part in the project through a photographic show and a related workshop (Sajeva and Koskinen), as a means to create better (http://rajapinnoilla.wordpress.com) understanding of human feelings and situations of happiness and misfortune in different cultures and contexts in the world, and of the aspects of life happiness depends upon for reaching future well-being and human development.

4.3.7 Wild Card *"Gas from Trash"*

- The wild card "***Gas from Trash***" is "slightly original", its level of importance for the STI policy at country level Finland is "moderate", while at EU-level it is "high"
- The likelihood of the wild card "*Gas from Trash*" occuring in the short term is "moderate", while occurring at longer-term is "high"
- The wild card's potential impact at country level for Finland and at EU-level is greatest for "*Environment & ecosystems, Economy, and Science, technology&innovation(STI)systems*"
- The most relevant RTD strategy for this wild card is "*Developing cross-national research programmes and priorities*"
- The level of preparedness of decision makers to deal with this wild card is "low" at country level for Finland and at EU-level.
- According to respondents' comments, many existing signals, like "*High oil price*" indicate that such wild card could happen
- **To sum up/The conclusions**: The production of this wild card "*Gas from Trush*" is very 'possible', and more attention should be paid to it. The preparedness of decision-makers is low. The likelihood of its occurrence is high in the long term. Cross-national research programmes and priorities should be developed by strengthening research institutions's knowledge production, developing world-class research infrastructures and promoting international cooperation in STI. In Finland a context in which natural gas and gas from trash are combined and distributed in some pipelines already exist in the region of Kouvola. It indicates that in Finland natural gas and gas from Trash (and other biomaterial, like from forest) should be analysed at the same time.

"***Gas from Trash***" Wild Card description: *"The future of factories, which make gasoline, diesel and jet fuel, can be different. In the future they may be microscopic, and they might run on the garbage hydrocarbons that are all around us."* (www.iknowfutures.eu).

First reaction, importance and occuring in the timeframes

Wild card *"Gas from Trash"* is "slightly original". Its level of importance for STI policy in country level Finland is "moderate", at EU-level "high" (Table 32).

Table 32. Importance of Wild Card ***"Gas from Trash"****.*

(WI number 1625, Energy, Country Survey Finland)					
Answer options Q 3: 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev	Mode	Median
Question 1: How original is this wild card= 1.It is fairly well known 2.It is slightly original 3.It is moderately original 4.It is very original 5.It is too wild.	17	2,12	0,93	2	2,00
Q 3 Country level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	16	3,06	1,29	2	3,00
Q 3 EU level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	16	3,56	1,09	3	3,00

Likelihood of wild card "Gas from Trash" occuring in the short term is "moderate", longer-term "high" (Table 33).

Table 33. Probability/likelihood of this Wild Card ***"Gas from Trash"*** *occuring in the following timeframes*

(WI number 1625, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Short-term (<5 years) Mean			Longer-term (5 years+)		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 2: Considering your views about the probability/likelihood of this event/situation occuring in the following timeframes, please indicate how much priority should be given to it in policy making?	16	3,06	1,06	15	3,80	0,94

Strategies for improving the preparedness for this Wild Card, and level preparedness of decision-makers

The wild card's potential impact is greater at country level Finland and in the EU-level for *"Environment & ecosystems, Economy and Science, technology&innovation(STI)systems"* (see Table 34 and Figure 13).

Table 34. Strategies for improving the preparedness for a given Wild Card ***"Gas from Trash"***.

(WI number 1625, Energy, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Country level, Finland			EU-level		
		N	Mean	Std Dev	N	Mean	Std Dev
Q 4 Please assess the wild card's potential impact on…	1.Physical infrastructure	16	2,88	1,02	16	3,13	0,56
	2.Virtual infrastructure	13	1,62	0,77	14	1,71	0,83
	3.Social welfare	15	2,80	1,01	15	2,93	1,03
	4.Economy	16	3,25	1,34	16	3,19	1,28
	5.Security	15	2,40	1,18	15	2,33	1,23
	6.Policy and governance	15	2,80	1,15	15	2,93	1,10
	7.Environment & ecosystems	16	4,00	1,03	16	4,13	0,89
	8.Science, technology&innovation(STI)systems	16	3,19	1,38	16	3,31	1,35

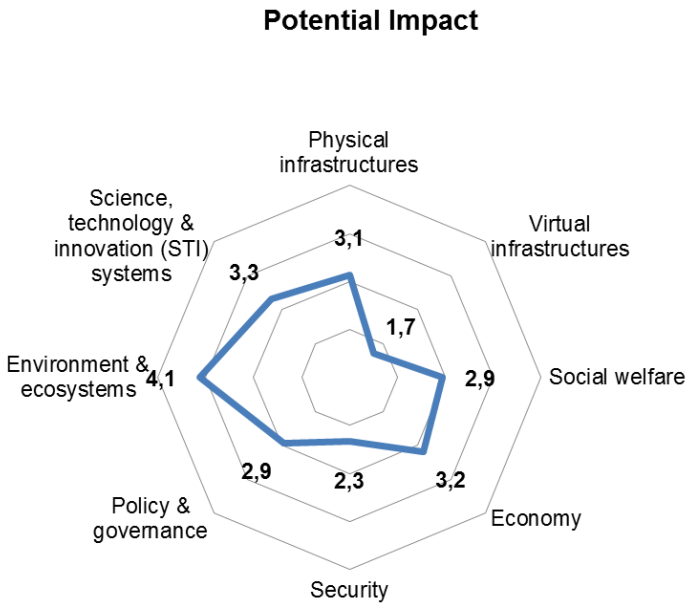

Figure 13. *Potential impacts of WI* ***"Gas from Trash"****.*

(Question 4. Please assess the wild card's potential impact on... Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.)

The most relevant RTD strategies for this wild card are *"Developing cross-national research programmes and priorities," "Strengthening research institutions' knowledge production," "World-class research infrastructures," "Promoting international cooperation in STI,"* and *"Sharing knowledge."* (Figure 14).

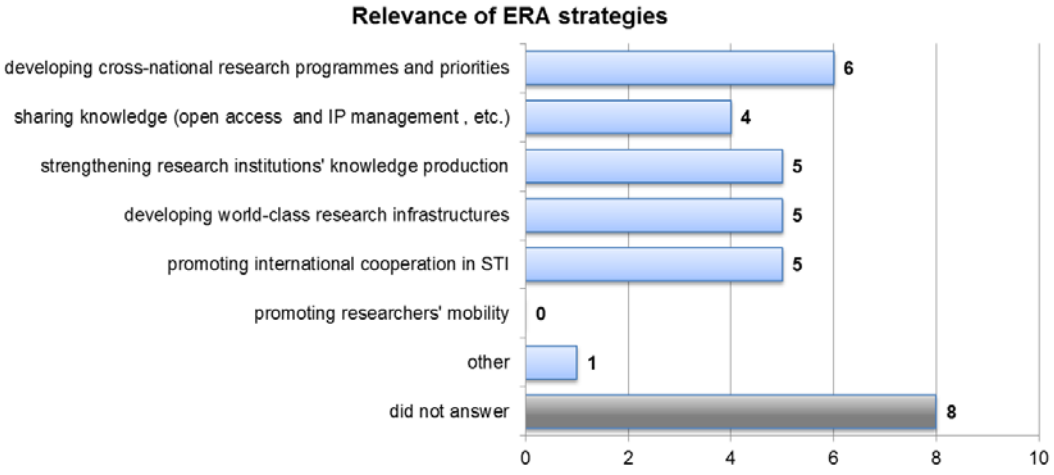

Figure 14. *Relevance of the ERA strategies - Wild Card "Gas from Trash".*

(Question 6. Please select, from the list of research and technology development (RTD) strategies the two most relevant for ***improving preparedness for such a wild card:****)*

From 16 answerers one (6 %) provided advice on policy issues associated to this wild card. Recommendations were *Policy shift*, *Human resource development*, and *Greater (international) cooperation*. There were no comments to explain the contents of the abovementioned recommendations in more detail.

Level of preparedness of decisionmakers to deal with this wild card in country level Finland and EU-level is "low" (Table 35).

Table 35. Level of preparedness of decision-makers to deal with ***"Gas from Trash"*** *Wild Card.*

(WI number 1625, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Country level			EU-level		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 5: Level of <u>preparedness</u> of decision-makers to deal with such a wild card: ("Name of the WI")	14	2,07	0,92	14	2,29	0,83

In the comments (box below), we can see that many existing signals indicate that such wild card could happen: European Renewable Strategy, high oil price, amount of trash, recent developments in nanotechnology and bioengineering, and the increasing role of waste energy source.

Question 8: Can you think of any <u>existing signals</u> indicating that such wild card could happen? (WI 1625)

- *"Energy issues and European Renewable Strategy includes many associat weak signals."*
- *"We just have to create new energy solutions"*
- *"Recent developments in nanotechnology and bioengineering. High oil price. Limitations of the oil reserves."*
- *"Amount of Trash"*
- *"The role of waste as energy source is increasing The development of nanotechnology can create small-scale solutions"*

Question 9: Can you think of any future signals that would increase our knowledge about the likelihood of such a wild card? (WI 1625)

- *"Waste problem must solved in some way.Here is a partial solution available."*
- *"Third generation nanotechnology."*
- *"Breakthrough in microbe programming and control that enables more sophisticated microbe based manufacturing."*

Interpretation and conclusions

The production of this wild card is very 'possible', and more attention should be paid to it. The preparedness of decision-makers is low. The likelihood of its occurrence is high in the long term. Cross-national research programmes and priorities should be developed by strengthening research institutions' knowledge production, developing world-class research infrastructures and promoting international cooperation in STI. In Finland a context in which natural gas and gas from trash are combined and distributed in some pipelines already exist in the region of Kouvola. It indicates that in Finland nat-

ural gas and gas from Trash (and other biomaterial, like from forest) should be analysed at the same time.

4.3.8 Wild Card *"Breakthrough in cold fusion leads to renaissance in energy markets"*

- The wild card "***Breakthrough in cold fusion leads to renaissance in energy markets***" is "slightly original", its level of importance for STI policy at country and EU-level is "moderate"
- The likelihood of the wild card occuring in the short term is "low", and "moderate" in longer-term
- Wild card's potential impact is in country level Finland and in the EU-level greatest for "*Environment & ecosystems, Economy, and.Science, technology&innovation(STI)systems*"
- The most relevant RTD strategies for this wild card are "*Strengthening research institutions' knowledge production,*" "*Developing word-class research infrastructures,*" and "*Promoting international cooperation in STI*"
- Level of preparedness of decisionmakers to deal with this wild card is "low" in country level Finland and "moderate" in EU-level.
- According to respondents' comments, many existing signals indicate that such wild card could happen
- **To sum up/The conclusions**: "*Breakthrough in cold fusion leads to renaissance in energy markets*" wild card's importance for STI-policy is moderate, likelihood that it happens in the short term is "low", in longer-term "moderate". Preparedness of decision-makers to deal with it is "low" in Country level and "moderate" in EU-level. The most important strategies are "*Strengthening research institutions' knowledge production*" "*Developing word-class research infrastructures*". This wild card will mainly impact "*Environment & ecosystems*", "*Economy*", and "*Science, technology & innovation (STI) systems*".

"***Breakthrough in cold fusion leads to renaissance in energy markets***" Wild Card description: "Suddenly scientists discover the way to do cold fusion which leads to renaissance in energy markets." (www.iknowfutures.eu).

First reaction, importance and occuring in the timeframes

The wild card "*Breakthrough in cold fusion leads to renaissance in energy markets*" is "slightly original", its level of importance for STI policy at country and EU-level is "moderate" (Table 36).

Table 36. Importance of Wild Card ***"Breakthrough in cold fusion leads to renaissance in energy markets"****.*

(WI number 1626, Agriculture, Country Survey Finland)					
Answer options Q 3: 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev	Mode	Median
Question 1: How original is this wild card= **1.It is fairly well known** 2.It is slightly original 3.It is moderately original 4.It is very original 5.It is too wild.	15	1,87	1,13	1	2,00
Q 3 Country level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	14	2,57	1,40	1	3,00
Q 3 EU level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	14	2,86	1,35	3	3,00

The likelihood of the occurrence of the wild card in the short-term is "low", while in the longer-term it is "moderate" (Table 37).

Table 37. Probability/likelihood of this Wild Card ***"Breakthrough in cold fusion leads to renaissance in energy markets"****.*

(WI number 1626, Agriculture, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Short-term (<5 years) Mean			Longer-term (5 years+)		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 2: Considering your views about the probability/likelihood of this event/situation occuring in the following timeframes, please indicate how much priority should be given to it in policy making?	13	2,00	0,91	13	2,69	1,18

Strategies for improving the preparedness for this Wild Card, and level preparedness of decision-makers

The wild card's potential impact is at country and EU-level greatest for "*Environment & ecosystems, Economy, and Science, technology & innovation(STI)systems*" (see Table 38 and Figure 15).

Table 38. ***"Breakthrough in cold fusion leads to renaissance in energy markets".***

(WI number 1626, Agriculture, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Country level, Finland			EU-level		
		N	Mean	Std Dev	N	Mean	Std Dev
Q 4 Please assess the wild card's potential impact on…	1.Physical infrastructure	12	3,17	1,03	12	3,42	0,90
	2.Virtual infrastructure	11	1,91	0,83	11	2,00	0,89
	3.Social welfare	12	3,00	1,13	11	3,09	1,14
	4.Economy	13	3,69	1,32	13	3,85	1,21
	5.Security	12	3,42	1,31	12	3,42	1,31
	6.Policy and governance	12	3,42	1,08	12	3,33	0,98
	7.Environment & ecosystems	13	4,00	1,15	13	4,08	0,95
	8.Science, technology&innovation(STI)systems	13	3,62	1,04	12	3,75	0,97

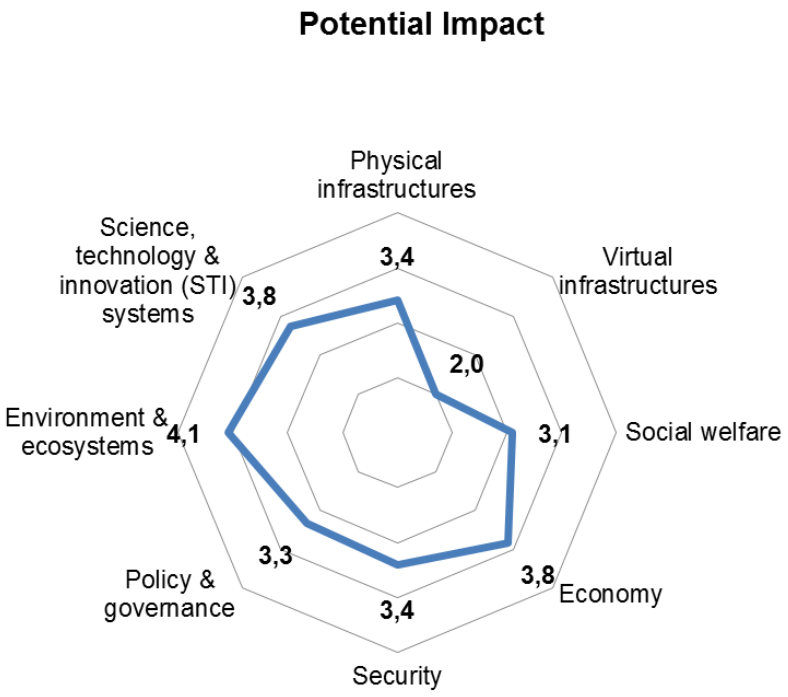

Figure 15. *Potential impacts of WI "Breakthrough in cold fusion leads to renaissance in energy markets".*

(Question 4. Please assess the wild card's potential impact on... Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.)

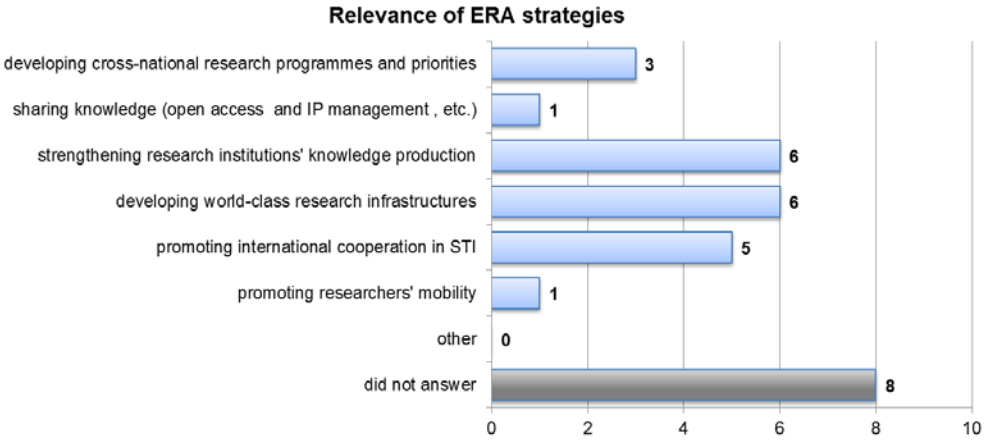

Figure 16. *Relevance of the ERA strategies - Wild Card* ***"Breakthrough in cold fusion leads to renaissance in energy markets".***

(Question 6. Please select, from the list of research and technology development (RTD) strategies the two most relevant for ***improving preparedness for such a wild card:****)*

Of 14 respondents, one (7 %) provided advice on policy issues associated to this wild card. The recommendations were *Policy shift*, and *Incorporation findings in debates and strategies*. There were no comments to explain the contents of the abovementioned recommendations in more detail.

The level of preparedness of decision-makers to deal with this wild card is "low" at country level Finland and "moderate" in EU-level. (Table 39).

Table 39. ***"Breakthrough in cold fusion leads to renaissance in energy markets".***

(WI number 1626, Agriculture, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Country level			EU-level		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 5: Level of preparedness of decision-makers to deal with such a wild card: ("Name of the WI")	10	2,40	0,97	10	2,70	0,82

Looking at the comments (box below), "many" existing signals indicate the possibility of this wild card to be produced. Among others *"Large-scale laser confinement test facility has just been opened in US."* A future signal that would increase our knowledge about the likelihood of such a wild card has been mentioned*: "Any clear proof that cold fusion is possible."*

Question 8: Can you think of any existing signals indicating that such wild card could happen? (WI 1626)

- *"Many"*
- *"Large-scale laser confinement test facility has just been opened in US."*
- *"No"*

Question 9: Can you think of any future signals that would increase our knowledge about the likelihood of such a wild card? (WI 1626)

- *"Many yes"*
- *"Any clear proof that cold fusion is possible."*

Interpretation and conclusions

This wild card's importance for STI-policy is moderate, the likelihood of its occurrence in the short term is "low", and in the long term "moderate". The preparedness of decision-makers to deal with this wild card is "low" at Country level and "moderate" at EU-level. The most important strategies are "*Strengthening research institutions' knowledge production" "Developing word-class research infrastructures*". This wild card will mainly impact "*Environment & ecosystems*", "*Economy*", and "*Science, technology & innovation (STI) systems*".

4.3.9 Wild Card *"Cheap liquid fuel production from algae replaces oil by 2030"*

- Wild card ***"Cheap liquid fuel production from algae replaces oil by 2030"*** is "moderately original", its level of importance for STI policy is "low" in country level Finland and "high" in EU-level
- Likelihood of this wild card occuring is "moderate" in the short term, and "high" in longer term.
- Wild card's potential impact is in country level Finland and in the EU-level greatest for "*Environment & ecosystems*", "*Economy*", and "*Science, technology & innovation(STI)systems*"
- The most relevant RTD strategies for this wild card are "*Strengthening research institutions' knowledge production*" and "*Developing word-class research infrastructures*"
- Level of preparedness of decisionmakers to deal with this wild card is "low" in country level Finland and EU-level.
- According to respondents' comments, some existing or future signals indicate that such wild card could happen, for instance "*Demand of biofuels is increasing; CO2 can be used to feed algaes: Lot of research going on*". About future signals: "*Increasing scarity of non-renewable resources 2030*"
- **To sum up/The conclusions**: *"Cheap liquid fuel production from algae replaces oil by 2030"* wild card's importance for STI-policy is "low" in country level and "high" in EU-level, likelihood that it happens in the short term is "low", longer-term "high". Preparedness of decision-makers to deal with it is "low" in both Country and EU-level. The most important strategies should be "*Strengthening research institutions*" and "*Developing word-class research infrastructures.*"

"Cheap liquid fuel production from algae replaces oil by 2030" Wild Card description: *"By mid-2010's scientists in Europe discover new algae species from Mediterranean Sea which can be used very efficiently and very broadly in biofuel production. This allows to get cheap energy with a very reduced level of pollution."* (www.iknowfutures.eu).

First reaction, importance and occuring in the timeframes

The wild card *"Cheap liquid fuel production from algae replaces oil by 2030"* is "moderately original", its level of importance for STI policy is "low" at country level and "high" at EU-level (Table 40).

Table 40. Importance of Wild Card ***"Cheap liquid fuel production from algae replaces oil by 2030"****.*

(WI number 1631, Energy, Country Survey Finland)					
Answer options Q 3: 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev	Mode	Median
Question 1: How original is this wild card= 1.It is fairly well known 2.It is slightly original 3.It is moderately original 4.It is very original 5.It is too wild.	14	2,57	1,02	2	2,50
Q 3 Country level, What <u>level of importance</u> do you think this wild card would have for science, technology and innovation (STI) policy?	13	2,31	0,95	3	2,00
Q 3 EU level, What <u>level of importance</u> do you think this wild card would have for science, technology and innovation (STI) policy?	13	3,54	0,97	4	4,00

The likelihood of the occurrence of this wild card is "moderate" in the short term and "high" in the long-term (Table 41).

Table 41. Probability/likelihood of this Wild Card ***"Cheap liquid fuel production from algae replaces oil by 2030"****.*

(WI number 1631, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Short-term (<5 years) Mean			Longer-term (5 years+)		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 2: Considering your views about the probability/likelihood of this event/situation occuring in the following timeframes, please indicate how much <u>priority</u> should be given to it in policy making?	13	2,54	1,13	13	3,92	0,86

Strategies for improving the preparedness for this Wild Card, and level preparedness of decision-makers

This wild card's potential impact is at country level and at the EU-level greater for *"Environment & ecosystems"*, *"Economy"*, and *"Science, technology&innovation(STI)systems"* (see Table 42 and Figure 17).

Table 42. Strategies for improving the preparedness for a given Wild Card ***"Cheap liquid fuel production from algae replaces oil by 2030"***.

(WI number 1631, Energy, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Country level, Finland			EU-level		
		N	Mean	Std Dev	N	Mean	Std Dev
Q 4 Please assess the wild card's potential impact on…	1.Physical infrastructure	11	2,64	1,21	11	3,27	1,01
	2.Virtual infrastructure	11	1,55	1,55	11	1,55	0,69
	3.Social welfare	11	2,18	0,98	11	2,55	1,04
	4.Economy	12	3,25	1,42	12	4,00	0,74
	5.Security	11	2,64	1,12	11	3,36	1,03
	6.Policy and governance	11	3,00	1,00	10	3,20	1,14
	7.Environment & ecosystems	12	3,33	1,37	12	4,17	0,72
	8.Science, technology&innovation(STI)systems	12	3,00	1,13	12	3,50	1,24

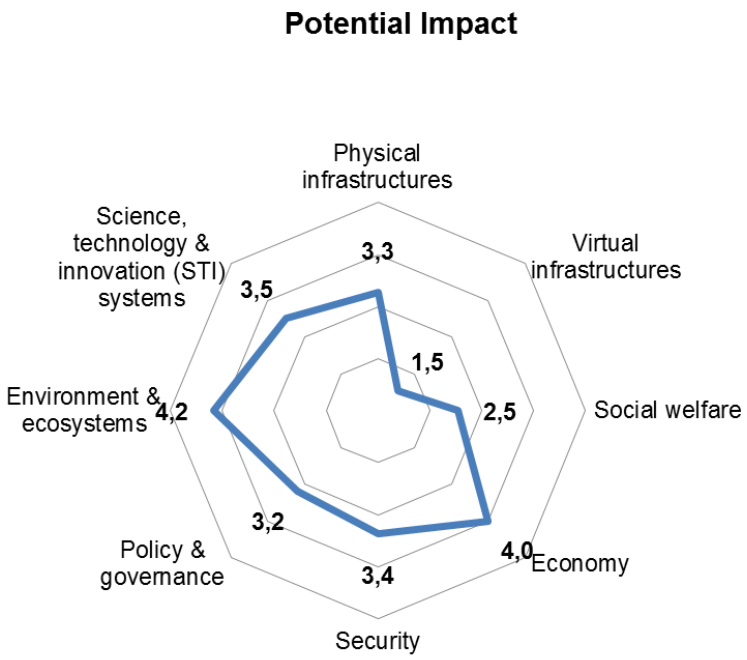

Figure 17. *Potential impacts of WI* ***"Cheap liquid fuel production from algae replaces oil by 2030"***.

(Question 4: Please assess the wild card's potential impact on... Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.)

The most relevant RTD strategies for this wild card are *"Strengthening research institutions' knowledge production"* and *"Developing word-class research infrastructures"* (Figure 18).

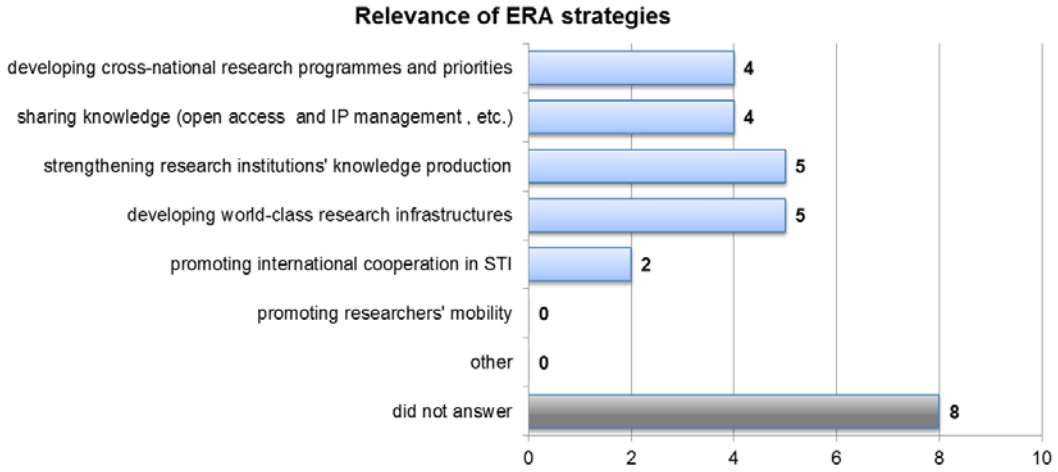

Figure 18. *Relevance of the ERA strategies - Wild Card* ***"Cheap liquid fuel production from algae replaces oil by 2030"***.

(Question 6. Please select, from the list of research and technology development (RTD) strategies the two most relevant for ***improving preparedness for such a wild card:****)*

No respondents provided advice on policy issues associated to this wild card. Level of preparedness of decisionmakers to deal with this wild card is "low" in country level Finland and EU-level (Table 43).

Table 43. *Level of preparedness of decision-makers to deal with Wild Card* ***"Cheap liq-uid fuel production from algae replaces oil by 2030"***.

(WI number 1631, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Country level			EU-level		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 5: Level of preparedness of decision-makers to deal with such a wild card: ("Name of the WI")	10	1,80	0,79	10	2,30	0,82

According to respondents' comments, some existing or future signals indicate that such wild card could happen, for instance *"Demand of biofuels is increasing; CO2 can be used to feed algaes: Lot of research going on"*. About future signals: *"Increasing scarity of non-renewable resources 2030"*. (see box below.).

Question 8: Can you think of any existing signals indicating that such wild card could happen? (WI 1631)

- *"Again, this a one of the psobble energy solution under investigation."*
- *"Advances in bio engineering Advances in the manipulation of single cell organisms."*
- *"Demand of biofuels is increasing CO2 can be used to feed algaes Lot of research going on."*

Question 9: Can you think of any future signals that would increase our knowledge about the likelihood of such a wild card? (WI 1631)

- *"Not so many."*
- *"Increasing scarity of non-renewable resources on 2030."*

Interpretation and conclusions

"Cheap liquid fuel production from algae replaces oil by 2030" wild card's importance for STI-policy is "low" at country level and "high" at the EU-level, the likelihood of its occurrence is "low" in the short term, while "high" in the long term. The related preparedness of decision-makers is "low" both at Country and EU-level. The most important strategies should be *"Strengthening research institutions"* and *"Developing word-class research infrastructures"*.

4.3.10 Wild Card *Thanks to algae "Australia becomes biggest energy producer in the world"*

- Wild card ***"Thanks to algae Australia becomes biggest energy producer in the world"*** is "moderately original", its level of importance for STI policy in country level Finland and EU-level is "low"
- Likelihood of wild card occuring in the short term is "low", in longer-term "moderate"
- Wild card's potential impact is in country level Finland and in the EU-level low for every options, the biggest (but low) its impact is for *"Environment & ecosystems," Science, technology&innovation(STI)systems,"* and *"Economy"*
- The most relevant RTD strategies for this wild card are *"Developing cross-national research programmes and priorities"* and *"Strengthening research institutions' knowledge production"*
- Level of preparedness of decisionmakers to deal this wild card is "low" in country level Finland and EU-level
- According to respondents comments, there are no existing or future signals indicating that such wild card could happen – except "Lot of research related to algae"
- **To sum up/The conclusions**: *"Thanks to algae Australia becomes biggest energy producer in the world"* wild card's importance for STI-policy is "low" both in Country and EU-level. Likelihood that it happens in the short term is "low" and in longer-term "moderate". Preparedness of decision-makers to deal with it is "low" both in Country and EU-level. *"Developing cross-national research programmes and priorities"* and *"Strengthening research institutions' knowledge production"* are the most important strategies to support this WI. This

wild card will mainly impact *"Environment & ecosystems", and "Science technology&innovation(STI)systems"* and "*Economy*," but its potential impact is low.

"Thanks to algae Australia becomes biggest energy producer in the world" Wild Card description: "Algae production begins around the world in all available sunny offshore areas, and in many inland bonds and lake areas by 2020's. Thanks to algae Australia becomes the biggest energy producer in the world." (www.iknowfutures.eu).

This wild card *"Thanks to algae Australia becomes biggest energy producer in the world"* is "moderately original" and its level of importance for STI policy is "low" at country and EU-level (Table 44).

Table 44. Importance of Wild Card ***"Thanks to algae Australia becomes biggest energy producer in the world"***

(WI number 1723, Energy, Country Survey Finland)					
Answer options Q 3: 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev	Mode	Median
Question 1: How original is this wild card= 1.It is fairly well known 2.It is slightly original 3.It is moderately original 4.It is very original 5.It is too wild.	15	3,13	1,1	3	3,00
Q 3 Country level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	13	1,54	0,88	1	1,00
Q 3 EU level, What level of importance do you think this wild card would have for science, technology and innovation (STI) policy?	13	2,38	1,39	1	2,00

The likelihood of the occurrence of the wild card is "low" in the short term and "moderate" in the long term (Table 45).

Table 45. Probability/likelihood of this Wild Card ***"Thanks to algae Australia becomes biggest energy producer in the world"****.*

(WI number 1723, Energy, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Short-term (<5 years) Mean			Longer-term (5 years+)		
		N	Mean	Std Dev	N	Mean	Std Dev
Question 2: Considering your views about the probability/likelihood of this event/situation occuring in the following timeframes, please indicate how much <u>priority</u> should be given to it in policy making?		12	1,75	0,97	12	2,83	1,11

Strategies for improving the preparedness for this Wild Card, and level preparedness of decision-makers

The wild card's potential impact is low at country and EU-level for every option, the highest (but still low) is for *"Environment & ecosystems," "Science, technology&innovation(STI)systems,"* and *"Economy"* (see Table 46 and Figure 19).

Table 46. Strategies for improving the preparedness for a given Wild Card ***"Thanks to algae Australia becomes biggest energy producer in the world"****.*

(WI number 1723, Energy, Country Survey Finland)							
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.							
		Country level, Finland			EU-level		
		N	Mean	Std Dev	N	Mean	Std Dev
Q 4 Please assess the wild card's potential impact on…	1.Physical infrastructure	13	1,46	0,78	13	2,08	1,04
	2.Virtual infrastructure	12	1,08	0,29	12	1,33	0,65
	3.Social welfare	12	1,58	0,67	11	2,09	0,83
	4.Economy	13	1,85	0,90	13	2,31	1,03
	5.Security	13	1,69	1,03	13	2,31	1,25
	6.Policy and governance	12	1,67	1,15	13	2,38	0,96
	7.Environment & ecosystems	13	2,31	1,11	13	2,85	1,34
	8.Science, technology&innovation(STI)systems	13	2,00	1,15	13	2,46	1,13

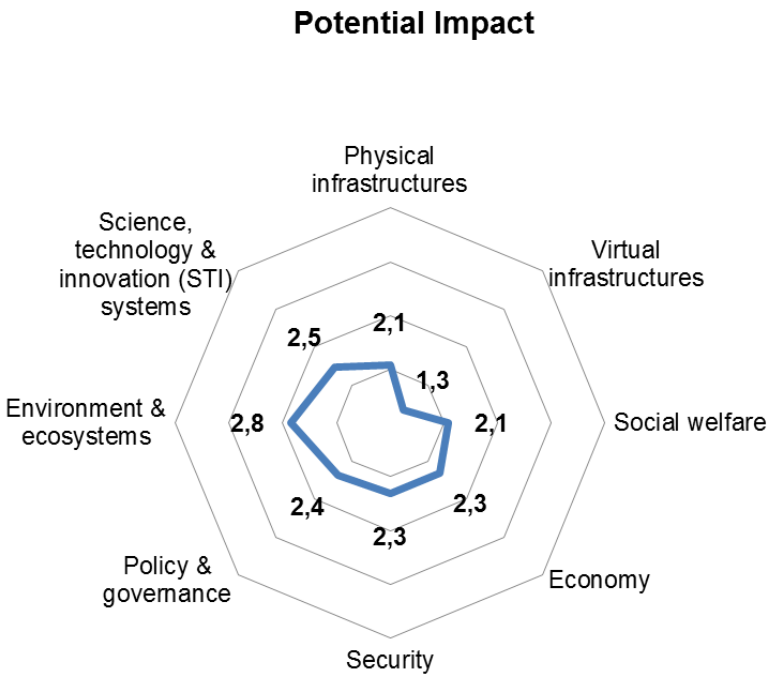

Figure 19. *Potential impacts of WI* ***"Thanks to algae Australia becomes biggest energy producer in the world"***

(Question 4. Please assess the wild card's potential impact on... Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.)

Two most relevant RTD strategies for this wild card are "*Developing cross-national research programmes and priorities*" and "*Strengthening research institutions' knowledge production*" (Figure 20).

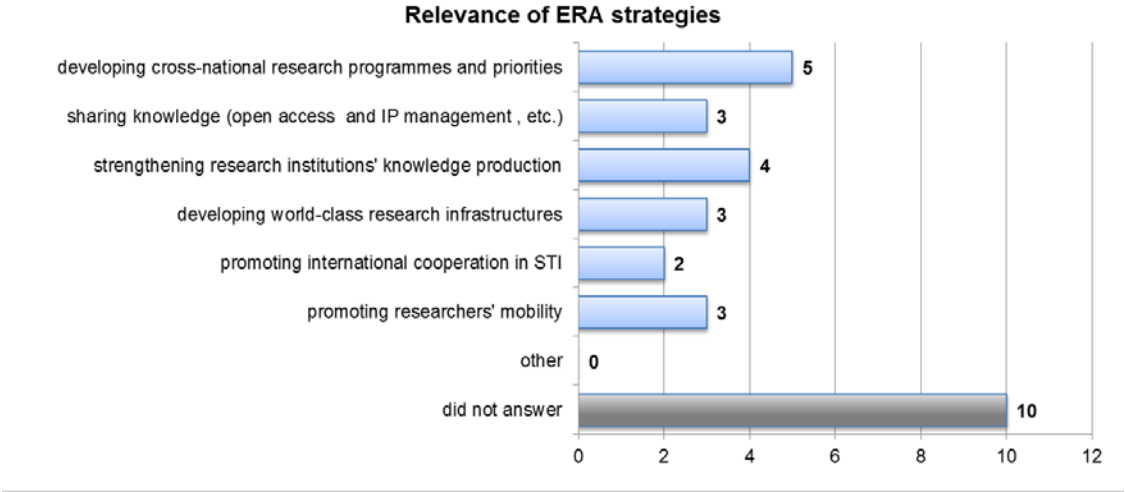

Figure 20. *Relevance of the ERA strategies - Wild Card* ***"Thanks to algae Australia becomes biggest energy producer in the world"***

(Question 6. Please select, from the list of research and technology development (RTD) strategies the two most relevant for improving preparedness for such a wild card:)

None of the respondents provided advice on the possible policy issues associated to this wild card. The level of preparedness of decision-makers at country level and EU-level is "low"(Table 47).

Table 47. *Level of preparedness of decision-makers to deal with* ***"Thanks to algae Australia becomes biggest energy producer in the world"***

(WI number 1723, Energy, Country Survey Finland)						
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.						
	Country level			EU-level		
	N	Mean	Std Dev	N	Mean	Std Dev
Question 5: Level of preparedness of decision-makers to deal with such a wild card:	9	1,56	0,73	9	1,56	0,73

According to respondents' comments, there are no existing or future signals indicating that such wild card could happen – except "Lot of research related to algae" comments (Box below).

Question 8: Can you think of any existing signals indicating that such wild card could happen? (WI 1723)

- *"Yes some"*
- *"No"*
- *"No"*
- *"Lot of research related to algae."*

Question 9: Can you think of any future signals that would increase our knowledge about the likelihood of such a wild card? (WI 1723)

- *"Not so many."*
- *"No,becauce algae can grow in all seas."*
- *"Yes"*

Interpretation and conclusions

"Thanks to algae Australia becomes biggest energy producer in the world" wild card's importance for STI-policy is "low" at country level and EU-level. The likelihood that it happens in the short term is "low" and in the long-term "moderate". The preparedness of decision-makers to deal with it is "low" both at country and EU-level. Support should be given to "*Developing cross-national research programmes and priorities*" and "*Strengthening research institutions' knowledge production*" if we want to prepare us to this wild card. This wild card will mainly impact "*Environment & ecosystems,*" "*Science technology&innovation(STI)systems,*" and "*Economy,*" but the potential impact is low.

4.4 Evaluation of the chosen Weak Signals

Food, Agriculture and Fisheries, and Biotechnology

4.4.1 Weak Signal *"Emergence of new agriculture methods for coping with climate change"*

- First reaction to ***"Emergence of new agriculture methods for coping with climate change": "It is fairly ambigious"***; main interpretation: "Potential continuation of important present issues in the future".
- Level of importance for STI policy in country level in Finland is "high (3,78)", in EU-level "high (4,33)"
- Important implications in the future include "Environment & ecosystems", and "Economy".
- In RTD (Research and Technology Development)-strategies the most important are "*Developing cross-national research programmes and priorities*" and "*Sharing knowledge*".

"Emergence of new agricultural methods for coping with climate change" Weak Signal description: "Currently new agricultural methods for coping with climate change are being piloted, included drought-resistant crops and new approaches to crop rotation and irrigation." (www.iknowfuture.eu)

First reaction, main interpretation, and importance

The first reaction to "*Emergence of new agriculture methods for coping with climate change*": "It is fairly ambigious"; the main interpretation was: "Potential continuation of important present issues in the future" (Table 48).

Table 48. Importance of Weak Signal (WE) "Emergence of new agriculture methods for coping with climate change".

Signal number 1719, Agriculture, Country Survey Finland)					
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev.	Mode	Median
Q 1 What is your <u>first reaction</u> to this weak signal? 1.Its meaning is fairly obvious 2.It is fairly ambiguous 3.Is is moderately ambiguous 4.It is highly ambiguous 5.It is completely bewilderging/confusing	10	1,80	1,14	1	1,00
Q 2 What is your <u>main interpretation</u> of this weak signal? 1.Potential continuation of important present issues in the future 2.Potential doscontinuation of important present issues/developments 3.Potential re-emergence of past issues 4.Potential emergence of new issues/developments 5.Other	10	(2,40)	(1,51)	1	2,00
Q 4 Country level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	9	3,78	0,97	4	4,00
Q 4 EU level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	9	4,33	0,71	4	4,00

A few comments support such interpretation of the signal, for example:

Question 3: Could you briefly comment on your choice of interpretation and tell us what makes this weak signal interesting? (WE 1719)

- *"Climate change can dramatically affect food production volumes."*
- *"We jsut have try to solve the problems that we have created and that requires completely new approach, they cannot be solved by smae lines of reasongin they were created, was is Einstein or somebody else who already long time ago brought this up. These questions are really bizarre and difficult to understand what actually is asked."*
- *"It is interesting because drought resistan crops might be realised by GMOs. Combatting climate change should involve natural methods. The future effects of GMOs are unknown. One known effects is the lack of natural selection for making the species stronger."*
- *"The arising problems are novel in the areas, at least in modern times. So there is only limited number of existing solutions."*

Important implications and improving RTD-strategies

Important implications in the future include "Environment & ecosystems", and "Economy". (see Figure 21).

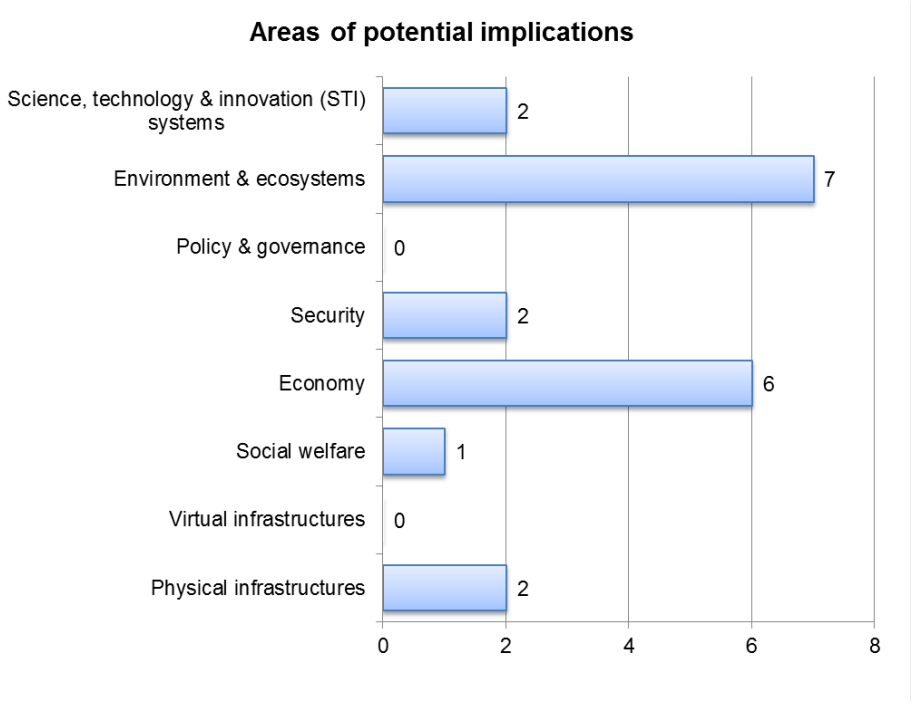

Figure 21. *Important implication in the future of Weak Signal* ***"Emergence of new agriculture methods for coping with climate change"***.

(Question 5: From the following categories, please select two where you think the weak signal's evolution could have ***important implications in the future****?)*

In RTD-strategies the most important are *"Developing cross-national research programmes and priorities"* and "*Sharing knowledge*" (Figure 22).

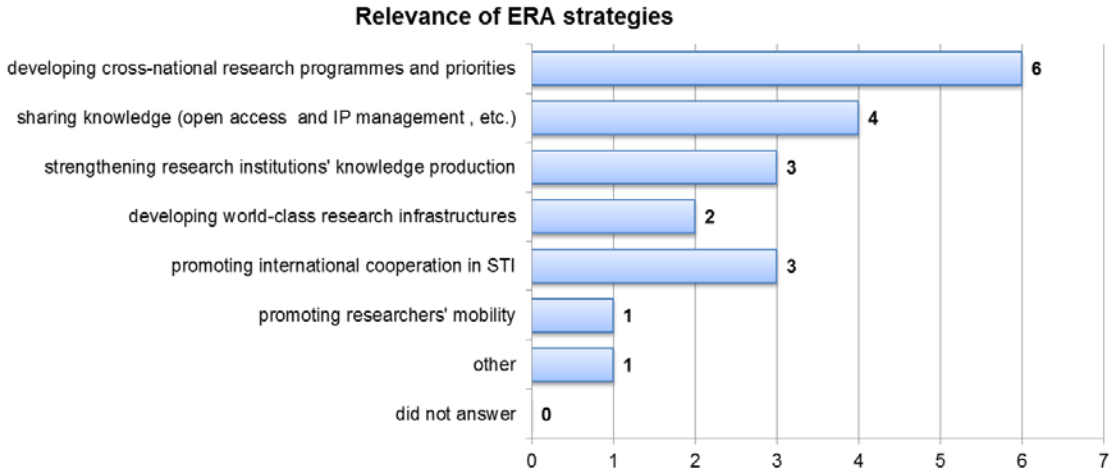

Figure 22. Relevance of the ERA strategies - Weak Signal ***"Emergence of new agriculture methods for coping with climate change"****.*

(Question 6: Please select, from the list of research and technology development (RTD) strategies, the two most relevant for ***improving understanding of this signal:****)*

Of 10 respondents two (20 %) provided advice on policy issues associated to this weak signal. Recommendation were "Incorporation findings in debates and strategies" (N=2) *"Policy shift" (1)* ,*"Further research" (1)*, and "Greater (international) cooperation" (1). There were no comments given on the abovementioned selections (next Box).

There have been description a low probalility and high impact event (wild card) associated to this signal:

Question 8a, Short description a low probalility and high impact event (wild card) associated to this signal? (WE 1719)

- *"Extreme reduction in yield levels ,detoriation of agricultural land=>lack of food and bioenergy"*
- *"Food wars, which probably are not so low probablility"*

Conclusions

The level of importance for STI policy of the weak signal ***"Emergence of new agriculture methods for coping with climate change"*** is "high (3,78)" at country level, and "high (4,33)" at EU-level. Important implications for the future are found in "Environment & ecosystems", and "Economy". The most important RTD-strategies are *"Developing cross-national research programmes and priorities"*, and "*Sharing knowledge*".

4.4.2 Weak Signal *"Consumption drives market capitalism, not saving, conserving or sparing"*

- First reaction to ***"Consumption drives market capitalism, not saving, conserving or sparing"*** is "It is fairly ambigious"; main interpretation: "Potential continuation of important present issues in the future".
- Level of importance for STI policy is "high" in country level in Finland and EU-level
- Important implications in the future include "*Economy*", "*Environment & ecosystems*," and "*Social welfare*"
- In RTD-strategies the most important are *"Strengthening research institutions' knowledge production"* and *"Developing cross-national research programmes and priorities."*

"Consumption drives market capitalism, not saving, conserving or sparing" Weak Signal description: *"Consumption drives market capitalism, not saving, conserving or sparing"* (www.iknowfuture.eu).

First reaction, main interpretation, and importance

First reaction to *"Consumption drives market capitalism, not saving, conserving or sparing"* is "It is fairly ambigious"; main interpretation: "Potential cintinuation of important present issues in the future" (Table 49). Level of importance for STI policy in country level in Finland and EU-level is "high".

Table 49. Importance of Weak Signal (WE) "Consumption drives market capitalism, not saving, conserving or sparing".

(Signal number 1639, Agriculture, Country Survey Finland)					
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev.	Mode	Median
Q 1 What is your <u>first reaction</u> to this weak signal? 1.Its meaning is fairly obvious 2.It is fairly ambiguous 3.Is is moderately ambiguous 4.It is highly ambiguous 5.It is completely bewilderging/confusing	11	2,09	1,14	1	2,00
Q 2 What is your <u>main interpretation</u> of this weak signal? 1.Potential continuation of important present issues in the future 2.Potential doscontinuation of important present issues/developments 3.Potential re-emergence of past issues 4.Potential emergence of new issues/developments 5.Other	11	(2,09)	(1,30)	1	2,00

Q 4 Country level, What level of importance do you think this weak signal would have for science, technology and innovation (STI) policy?	11	3,64	1,12	3	4,00
Q 4 EU level, What level of importance do you think this weak signal would have for science, technology and innovation (STI) policy?	11	3,55	1,21	2	4,00

There were a few comments regarding this signal, for example:

Question 3: Could you briefly comment on your choice of interpretation and tell us what makes this weak signal interesting? (1639)

- *"In food economy we already see turning point towards more sustainable food economy: consumers are looking more sustainable attributes in their food choices e.g. organic, local food etc."*
- *"The food market becomes more consumer-oriented"*
- *"Some significant sections of crucial production might drive themselves to developmental dead-ends, where re-establishing might require substantial policy interventions and investments."*

Important implications and improving RTD-strategies

The important implications for the future are identified firstly on "*Economy*", and secondly on "*Environment & ecosystems*" and "*Social welfare*" (see Figure 23).

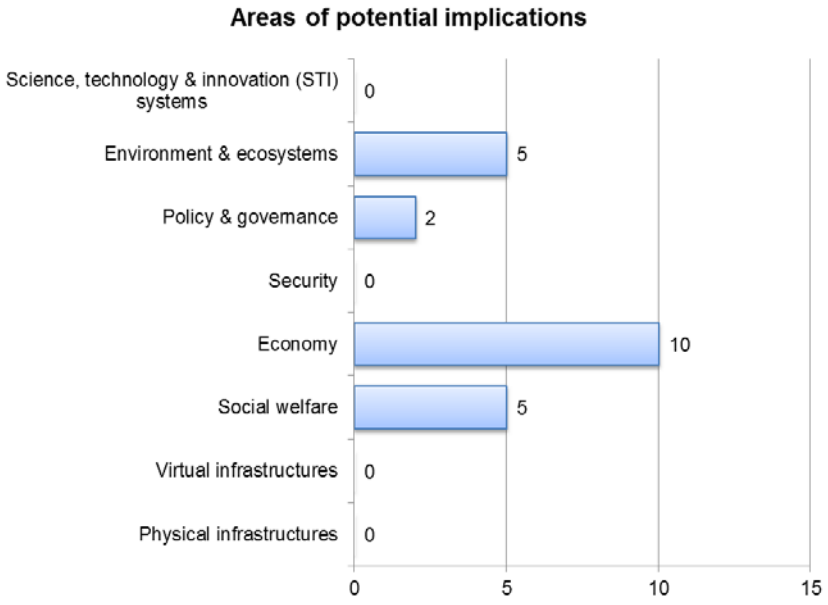

Figure 23. Important implication in the future of Weak Signal ***"Consumption drives market capitalism, not saving, conserving or sparing".***

(Question 5: From the following categories, please select two where you think the weak signal's evolution could have important ***implications in the future****?)*

In RTD-strategies the most important are *"Strengthening research institutions' knowledge production"* and *"Developing cross-national research programmes and priorities"* (Figure 24).

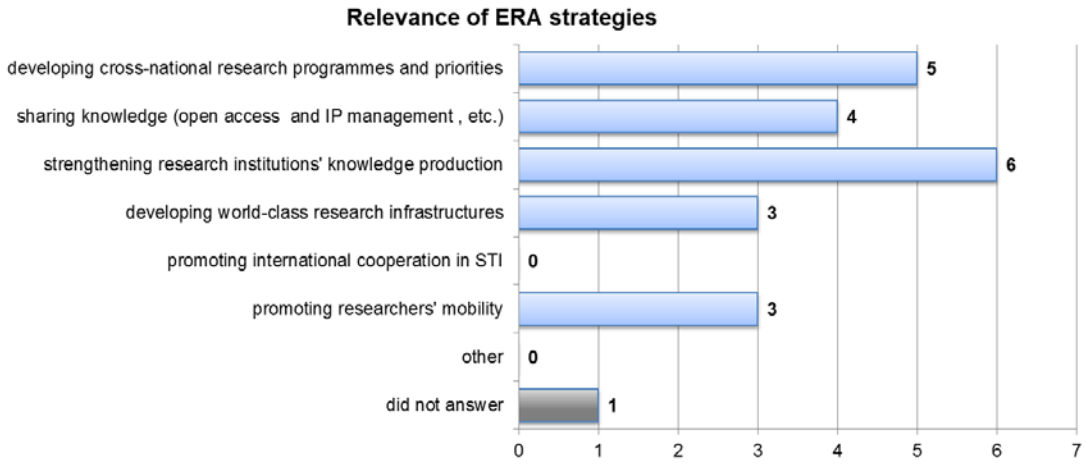

Figure 24. *Relevance of the ERA strategies - Weak Signal* ***"Consumption drives market capitalism, not saving, conserving or sparing"***

Question 6: Please select, from the list of research and technology development (RTD) strategies, the two most relevant for ***improving understanding of this signal:***

On a total of 11 respondents, one (9 %) provided advice on policy issues associated to this weak signal. the recommendations were *"Further research" (1), "Improved academic-Industry links" (1),* and *"Further foresight" (1).* There were no detailedcomments given regarding the abovementioned selections.

A low probalility and high impact event (wild card) associated to this signal was described:

Question 8a, Short description a low probalility and high impact event (wild card) associated to this signal? (WE 1639)

- *"Dramatic changes in food that is bein consumed. E.g.increase or decrease in the consumption of nature-conserving products.Changes in the production of energy."*

Conclusions

The level of importance for STI policy of the weak signal ***"Consumption drives market capitalism, not saving, conserving or sparing"*** is "high" at country and EU level. It has important implications in the future on *"Economy,"* *"Environment & ecosystems,"* and *"Social welfare"*. The most important RTD-strategies are *"Strengthening research institutions' knowledge production"* and *"Developing cross-national research programmes and priorities"*.

4.4.3 Weak Signal "*Food consumers are steered towards healthier dietary choices"*

- First reaction to ***"Food consumers are steered towards healthier dietary choices"*** "It is fairly ambigious"; main interpretation: "Potential continuation of important present issues in the future"
- Level of importance for STI policy in country level in Finland and EU-level is "moderate",
- Important implications in the future is "*Social welfare*", and "*Economy"*
- In the RTD-strategies the most important is *"Developing cross-national research programmes and priorities"*, second "Strengthening research institutions' knowledge production" and "*Promoting international cooperation in STI"*.

"Food consumers are steered towards healthier dietary choices" Weak Signal description: "Food consumers are steered towards healthier dietary choices by product labelling and by joint research activities." (www.iknowfuture.eu).

First reaction, main interpretation, and importance

First reaction to *"Food consumers are steered towards healthier dietary choices"* is "It is fairly ambigious"; main interpretation: "Potential continuation of important present issues in the future". Level of importance for STI policy is "moderate" in country level Finland and EU-level (Table 50).

Table 50. Importance of Weak Signal (WE) "Food consumers are steered towards healthier dietary choices"

(Signal number 1720, Agriculture, Country Survey Finland)					
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev.	Mode	Median
Q 1 What is your <u>first reaction</u> to this weak signal? 1.Its meaning is fairly obvious 2.It is fairly ambiguous 3.Is is moderately ambiguous 4.It is highly ambiguous 5.It is completely bewilderging/confusing	10	1,90	1,45	1	1,00
Q 2 What is your <u>main interpretation</u> of this weak signal? 1.Potential continuation of important present issues in the future 2.Potential doscontinuation of important present issues/developments 3.Potential re-emergence of past issues 4.Potential emergence of new issues/developments 5.Other	10	(1,60)	(1,07)	1	1,00

Q 4 Country level, What level of importance do you think this weak signal would have for science, technology and innovation (STI) policy?	10	3,50	0,71	4	4,00
Q 4 EU level, What level of importance do you think this weak signal would have for science, technology and innovation (STI) policy?	10	3,50	0,97	4	4,00

A few comments were given regarding this signal, for example:

Question 3: Could you briefly comment on your choice of interpretation and tell us what makes this weak signal interesting? (WE 1720)

- *"We need to develop more tools for consumers to choose healthier diet. "*
- *"Polarization between different food consumers will deepen. The amount of heath-conscious people will grow as will the amount of those that don't care at all what they are eating."*
- *"Overweight is a major problem in developed countries"*
- *"The food related health issues, dietary recommendations etc ahave been seriously questioned"*
- *"Food is so basic for human existence"*
- *"Someone claimed that Coca Cola was originally health drinks. There is a lot of misinformation that is in principle correct, but absolutely not relevant in their context/product."*

Important implications and improving RTD-strategies

This weak signal has important implications in the future on "*Social welfare*" and "*Economy*" (see Figure 25).

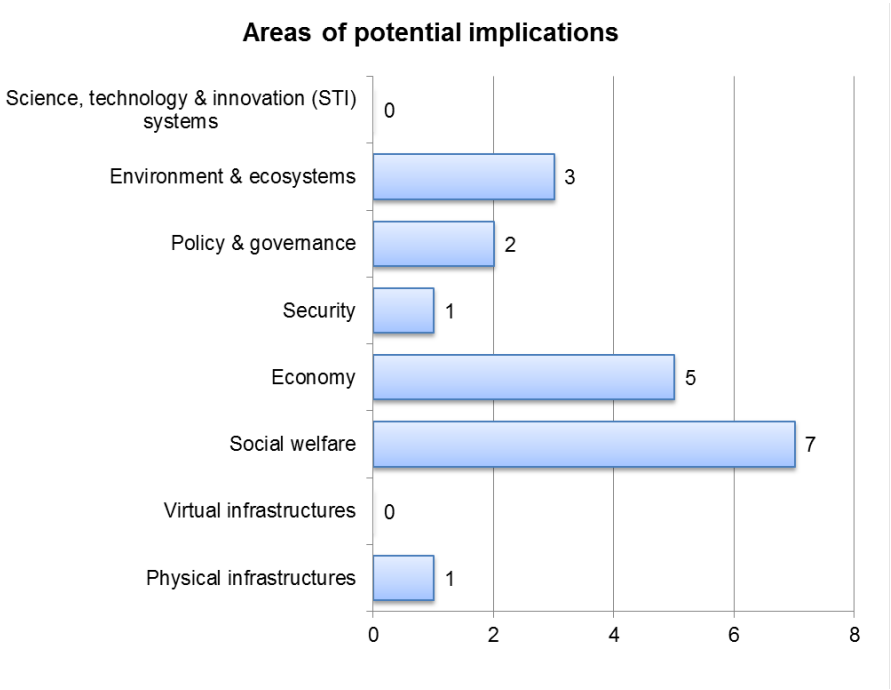

Figure 25. *Important implication in the future of Weak Signal* ***"Food consumers are steered towards healthier dietary choices"***.

(Question 5: From the following categories, please select two where you think the weak signal's evolution could have ***important implications in the future****?)*

The most important RTD-strategies are *"Developing cross-national research programmes and priorities," "Strengthening research institutions' knowledge production,"* and *"Promoting international cooperation in STI"* (Figure 26).

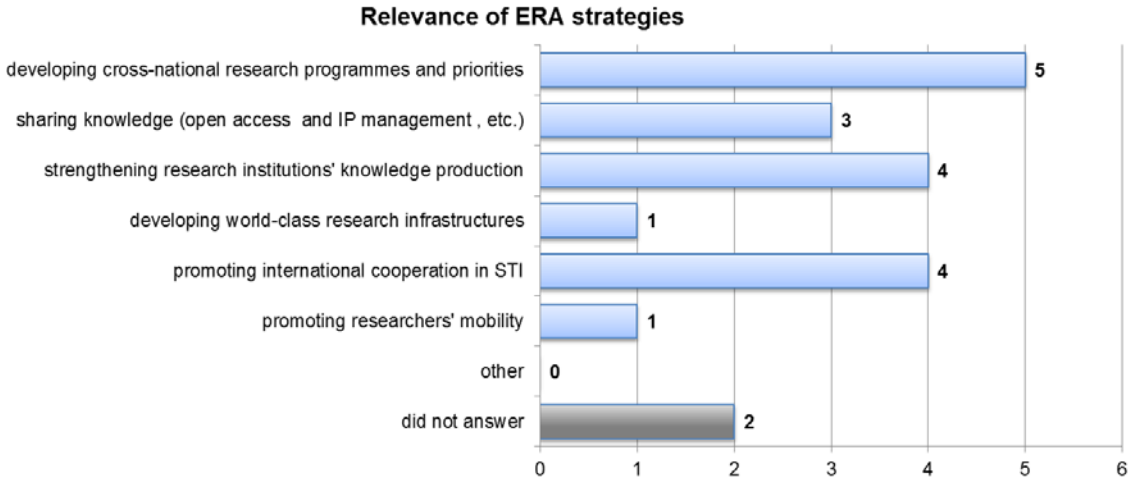

Figure 26. *Relevance of the ERA strategies - Weak Signal* ***"Food consumers are steered towards healthier dietary choices"***.

(Question 6: Please select, from the list of research and technology development (RTD) strategies, the two most relevant for ***improving understanding of this signal:****)*

Of 10 respondents, three (30 %) provided advice on policy issues associated to this weak signal. Recommendations were *"Policy shift" (2), "Further research" (2), and "Improved academic-Industry links" (2).* There were no comments given regarding the abovementioned selections.

A low probalility and high impact event (wild card) associated to this signal has been described:

Question 8a, Short description a low probalility and high impact event (wild card) associated to this signal? (WE 1720)

- *"People would be eating significantly more vegetables and less livestock products=>less hunger in the world.The health of people all over the world would be improved."*

Conclusions

The level of importance for STI policy of the weak signal ***"Food consumers are steered towards healthier dietary choices"*** is "moderate" at country and EU level. It has important implications in the future on "*Economy*" and "*Social welfare*". The most important RTD-strategies are firstly *"Developing cross-national research programmes and priorities,"* secondly *"Strengthening research institutions' knowledge production,"* and *"Promoting international cooperation in STI"*.

4.4.4 Weak Signal (Agriculture, Finland): *"Food markets became investment subject in previous credit crunch"*

- First reaction to ***"Food markets became investment subject in previous credit crunch"*** is "It is moderately ambigiuus"; main interpretation: "Potential emergence of new issues/developments".
- Level of importance for STI policy is "moderate" in Finland, and "high" in EU-level
- It has important implications in the future on "*Economy"* and secondly on "*Security"* and *"Social welfare"*
- The most important RTD-strategies are *"Sharing knowledge (open access and IP-management etc.),"* *"Developing cross-national research programmes and priorities,"* and *"Strengthening research institutions' knowledge production*".

"Food markets became investment subject in previous credit crunch" Weak Signal description: "Furthermore, if a credit crunch takes place at the same time, the prices of grain, raw materials and oil will probebly go up in the markets in the same way as they did during the previous credit crunch. "(www.iknowfuture.eu).

First reaction, main interpretation, and importance

First reaction to *"Food markets became investment subject in previous credit crunch"* is "It is moderately ambiguous"; main interpretation: "Potential emergence of new issues/developments" (Table 51). Level of importance for STI policy is "moderate" in country level in Finland and "high" in EU-level.

Table 51. Importance of Weak Signal (WE) "Food markets became investment subject in previous credit crunch".

(Signal number 1714, Agriculture, Country Survey Finland)					
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev.	Mode	Median
Q 1 What is your <u>first reaction</u> to this weak signal? 1.Its meaning is fairly obvious 2.It is fairly ambiguous 3.Is is moderately ambiguous 4.It is highly ambiguous 5.It is completely bewilderging/confusing	10	2,60	1,07	3	3,00
Q 2 What is your <u>main interpretation</u> of this weak signal? 1.Potential continuation of important present issues in the future 2.Potential doscontinuation of important present issues/developments 3.Potential re-emergence of past issues 4.Potential emergence of new issues/developments 5.Other	9	(3,00)	(1,22)	4	3,00
Q 4 Country level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	9	3,33	0,87	3	3,00
Q 4 EU level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	9	3,67	1,00	3	4,00

There were a few comments regarding this signal, for example:

Question 3: Could you briefly comment on your choice of interpretation and tell us what makes this weak signal interesting? (WE 1714)

- **"Food in general has central role of stabilising economy. Fluctuating food prices will have** *negative affect on stability."*
- *"The effect of speculation on prices of food is most likely short-lived. Increased prices will push the production up, additionally food cannot be stored for too log a time. With other raw materials the situation is a bit different."*
- *"It could increase fluctioations in the food prices."*
- *"Food used to be expensive, and might become again, even in EU. But wasn't that what WTO processes aimed for?"*

Important implications and improving RTD-strategies

It has important implications in the future on "*Economy*", and secondly on "*Security*" and "*Social welfare*" (see Figure 27).

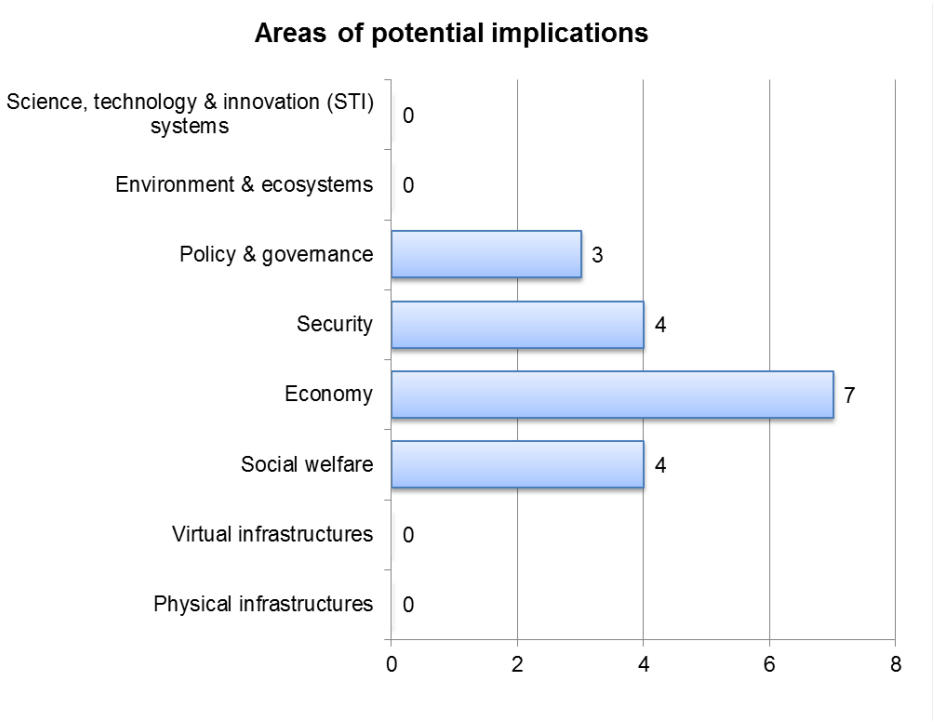

Figure 27. *Important implication in the future of Weak Signal* ***"Food markets became investment subject in previous credit crunch"***.

(Question 5: From the following categories, please select two where you think the weak signal's evolution could have ***important implications in the future?****)*

The most important RTD-strategies are *"Sharing knowledge (open access and IP-management etc.),"* *"Developing cross-national research programmes and priorities,"* and *"Strengthening research institutions' knowledge production"* (Figure 28).

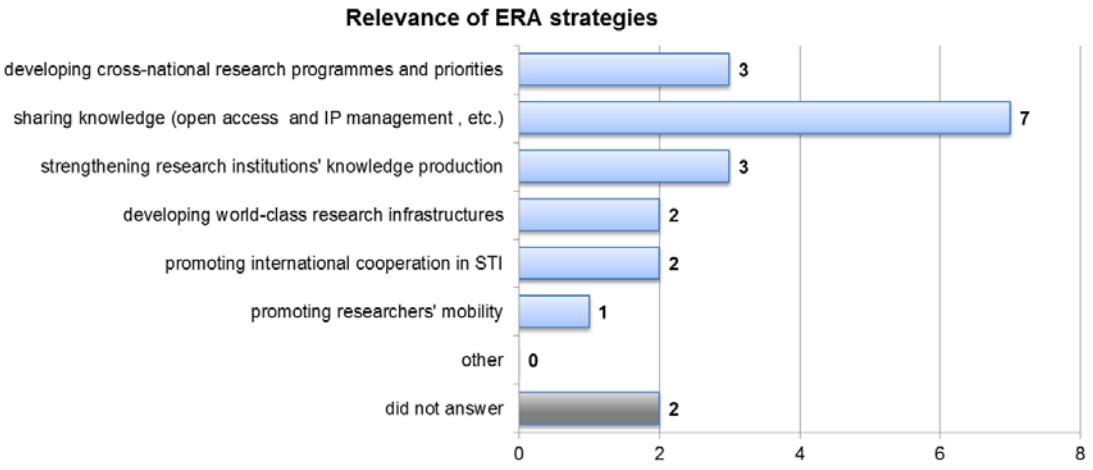

Figure 28. *Relevance of the ERA strategies - Weak Signal* ***"Food markets became investment subject in previous credit crunch"***.

(Question 6: Please select, from the list of research and technology development (RTD) strategies, the two most relevant for ***improving understanding of this signal:****)*

On a total of 10 respondents, three (30 %) provided advice on policy issues associated to this weak signal. Recommendations were *"Further research" (2), "Policy shift" (1), "Incorporation findings in debates and strategies"* (1), *"Human resource development" (1), "Improved academic-Industry links" (1), "Increased public spending" (1),* and *"Dissemination of findings"* (1). There were no further comments given on the abovementioned selections.

A low probalility and high impact event (wild card) associated to this signal was described:

Question 8a, Short description a low probalility and high impact event (wild card) associated to this signal? (WE 1714)

- *"Poor yield+increasing prices=>hunger would increase, poor people&countries would not have afford to eat."*

Conclusions

The level of importance for STI policy of the weak signal ***"Food markets became investment subject in previous credit crunch"*** is "moderate" at country level and "high" at Eu level. It has important implications in the future on "*Economy*," "*Security*," and "*Social welfare*." The most important RTD-strategies are *"Sharing knowledge (open access and IP-management etc.)," "Developing cross-national research programmes and priorities,"* and *"Strengthening research institutions' knowledge production."*

4.4.5 Weak Signal *"Bees be no more, less food than before"*

- First reaction to ***"Bees be no more, less food than before"*** is "It is fairly ambiguous"; main interpretation: "Potential continuation of important present issues in the future"
- Level of importance for STI policy in country and EU-level is "moderate"
- Important implications in the future on "Environment & ecosystems" and "Economy"
- The most important RTD-strategies are *"Developing cross-national research programmes and priorities"* and *"Strengthening research institutions' knowledge production."*

"Bees be no more, less food than before" *Weak Signal description:*

"Reducing numbers of bees and other pollinating insects reaches catastrophic levels with widespread crop failure due to lack of pollination of plants. Natural herbivores affected and go into decline but other insects also in deterioration.**"** (www.iknowfuture.eu).

First reaction, main interpretation, and importance

First reaction to *"Bees be no more, less food than before"* is "It is fairly ambiguous"; main interpretation: "Potential continuation of important present issues in the future" (Table 52). Level of importance for STI policy in country level in Finland and EU-level is "moderate".

Table 52. Importance of Weak Signal (WE) "Bees be no more, less food than before".

(Signal number 1637, Agriculture, Country Survey Finland)					
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev.	Mode	Median
Q 1 What is your <u>first reaction</u> to this weak signal? 1.Its meaning is fairly obvious 2.It is fairly ambiguous 3.Is is moderately ambiguous 4.It is highly ambiguous 5.It is completely bewilderging/confusing	12	2,25	1,29	1	2,00
Q 2 What is your <u>main interpretation</u> of this weak signal? 1.Potential continuation of important present issues in the future 2.Potential doscontinuation of important present issues/developments 3.Potential re-emergence of past issues 4.Potential emergence of new issues/developments 5.Other	11	(2,09)	(1,30)	1	2,00
Q 4 Country level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	12	2,92	1,16	3	3,00
Q 4 EU level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	12	3,35	1,06	3	3,00

A few comments regarding this signal were given, for example:

Question 3: Could you briefly comment on your choice of interpretation and tell us what makes this weak signal interesting? (WE 1637)

- *"Signal, if realized in full effect, would have huge impacts on the ecosystems. Commercial farming will always find ways around the problem, but this development could have very serious effects on the "wild nature".*
- *"The production of oilseeds may decrease"*
- *"This signal is crucial for the continuation of human existence. If the cause of declineof pollinating insects is the extensive mobile phone network - as isi suspected - there will an urgent need of adjustment and the imacts are far reaching since both individuals and societies have increasingly built up their dependence on the mobile phones"*
- *"Bees are as long as I know very important in the life cycle of the whole Earth"*
- *"Has impact on food security and wild+farm diversity."*

Important implications and improving RTD-strategies

This weak signal has important implications in the future on "Environment & ecosystems" and "Economy" (see Figure 29).

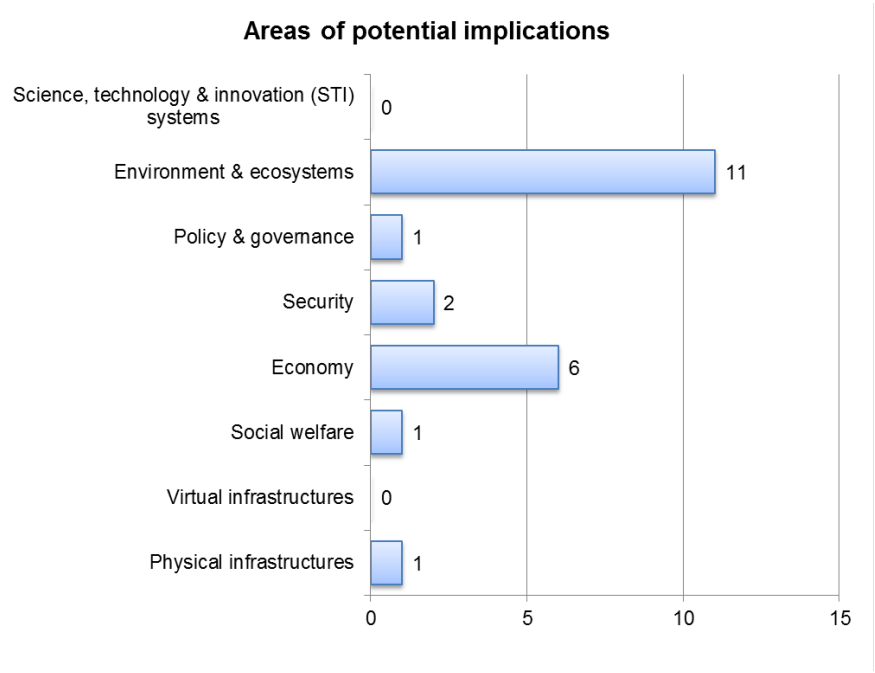

Figure 29. *Important implication in the future of Weak Signal* ***"Bees be no more, less food than before".***

(Question 5: From the following categories, please select two where you think the weak signal's evolution could have important implications in the future?)

The most important RTD-strategies are "*Developing cross-national research programmes and priorities*" and "*Strengthening research institutions' knowledge production*" (Figure 30).

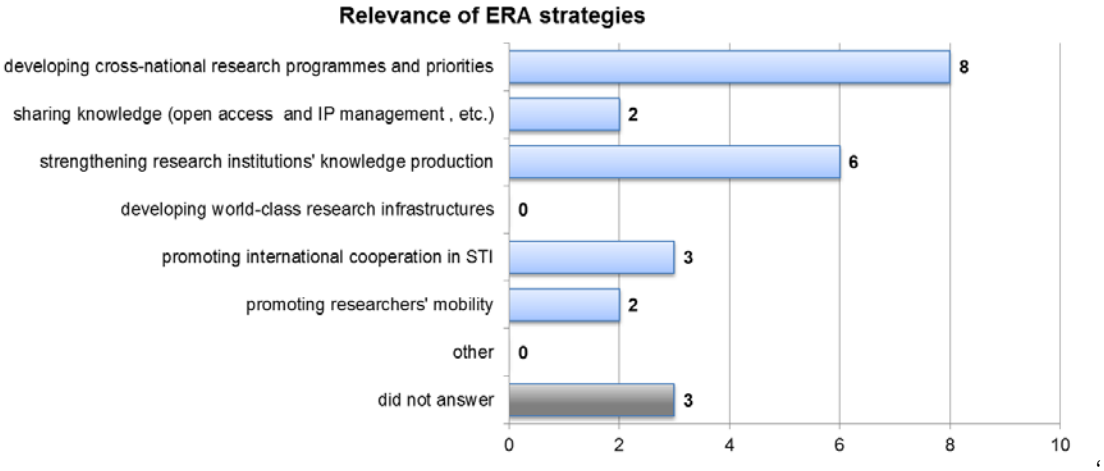

Figure 30. *Relevance of the ERA strategies - Weak Signal* ***"Bees be no more, less food than before".***

(Question 6: Please select, from the list of research and technology development (RTD) strategies, the two most relevant for improving understanding of this signal:)

Of 12 respondents, three (25 %) provided advice on policy issues associated to this weak signal. Recommendation were "*Further research*" *(2)*, "*Policy shift*" *(1)*, "*Incorporation findings in debates and strategies*" (1), "*Greater (international) cooperation*" (1), "*Establishment of new centre*" (1), "*Further foresight*" (1), and "*Dissemination of findings*" (1). No comments were given on abovementioned selections.

A low probalility and high impact event (wild card) associated to this signal was described:

Question 8a, Short description a low probalility and high impact event (wild card) associated to this signal? (WE 1637)

- *"Dramatic decrease in the production of certain crops. Followed by reduction in livestock production and nutrition."*

Conclusions

The level of importance for STI policy of the weak signal ***"Bees be no more, less food than before"*** is "moderate" at country and EU level. It has important implications in the future on "Environment & ecosystems" and "Economy". The most important RTD-strategies are "*Developing cross-national research programmes and priorities*" and "*Strengthening research institutions' knowledge production.*"

4.4.6 Weak Signal *"Many people are willing to pay more to get wind energy"*

- First reaction to ***"Many people are willing to pay more to get wind energy"*** is "It is fairly ambiguous"; main interpretation: *"Potential emergence of new issues/developments"*.
- Level of importance for STI policy in country level in Finland is "high (index 3,56)" and in EU-level "moderate (index 3.44)"
- It has important implications in the future on *"Physical infrastructure"* and *"Environment & ecosystems"*
- The most important RTD-strategies are *"Developing world-class research infrastructures,"* and secondly *"Promoting international cooperation in STI"* and "*Strengthening research institutions' knowledge production*."
- Respondents commented this signal by saying, for example: *"Renewables are promoted by public policy anyway," "This is already happening in Europe," or "Wind energy is creating a minor paradigm change in the field of energy."*

"Many people are willing to pay more to get wind energy" Weak Signal description:

"Despite the fact that you can only get standard energy from a soscet in your wall, many people are willing to pay more to get wind energy." (www.iknowfuture.eu).

First reaction, main interpretation, and importance

First reaction to "*Many people are willing to pay more to get wind energy"* is "It is fairly ambiguous"; main interpretation: *"Potential emergence of new issues/developments"* (Table 53). Level of importance for STI policy in country level Finland is "high (index 3,56)", in EU-level "moderate (index 3.44)".

Table 53. Importance of Weak Signal (WE) "Many people are willing to pay more to get wind energy"

(Signal number 1633, Energy, Country Survey Finland)					
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev.	Mode	Median
Q 1 What is your <u>first reaction</u> to this weak signal? 1.Its meaning is fairly obvious 2.It is fairly ambiguous 3.Is is moderately ambiguous 4.It is highly ambiguous 5.It is completely bewilderging/confusing	9	2,11	1,05	1	1,00

Q 2 What is your <u>main interpretation</u> of this weak signal? 1.Potential continuation of important present issues in the future 2.Potential doscontinuation of important present issues/developments 3.Potential re-emergence of past issues 4.Potential emergence of new issues/developments 5.Other	9	1,44	1,01	1	1,00
Q 4 Country level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	9	3,56	0,88	3	3,00
Q 4 EU level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	9	3,44	0,88	3	3,00

Respondents gave a few comments regarding this weak signal, for example:

Question 3: Could you briefly comment on your choice of interpretation and tell us what makes this weak signal interesting? ("Many people are willing to pay more to get wind energy" (WE 1633)

- *"This is already happening in Europe."*
- *"People are willing to pay for environmentally friendly energy production even if they can't get recognized for it by their peers (or neighbors)."*
- *"Wind energy is creating a minor paradigm change in the field of energy. It pushes the power systems to different direction of development compared to conventional technologies."*
- *"Renewables are promoted by public policy anyway. Consumers paying more to get wind energy may speed up wind power plants production."*
- *"In Finland the assumption is that 'the public opinion' calls for cheaper energy and nuclear power, and does not believe in wind - in continental Europe the atmosphere is different."*

Important implications and improving RTD-strategies

This weak signal has important implications in the future on "*Environment & ecosystems*" and "*Economy*" (see Figure 31).

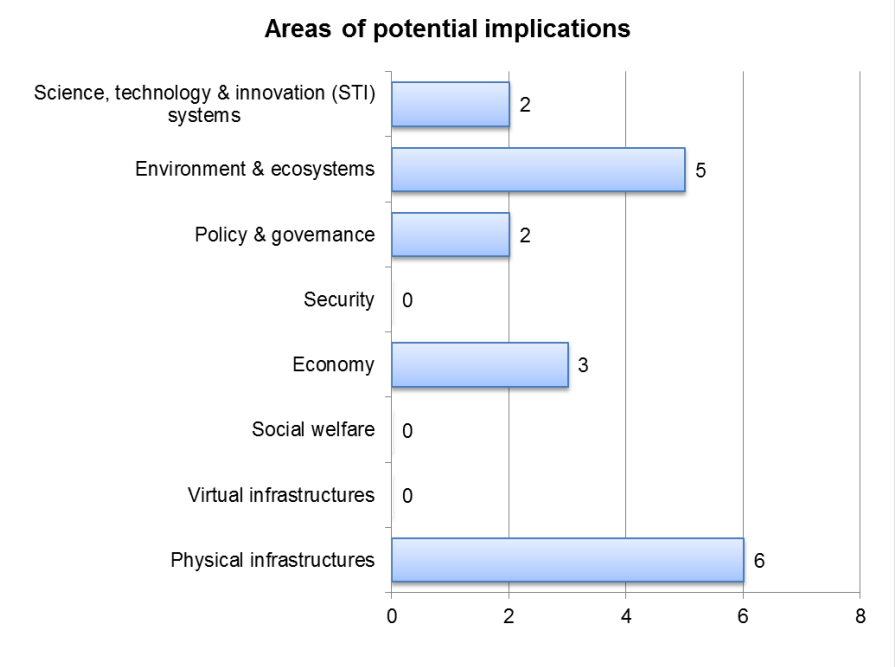

Figure 31. *Important implication in the future of Weak Signal "**Many people are willing to pay more to get wind energy**".*

*(Question 5: From the following categories, please select two where you think the weak signal's evolution could have **important implications in the future**?)*

The most important RTD-strategies are *"Developing world-class research infrastructures," "Strengthening research institutions' knowledge production,"* and *"Promoting international cooperation in STI"* (Figure 32).

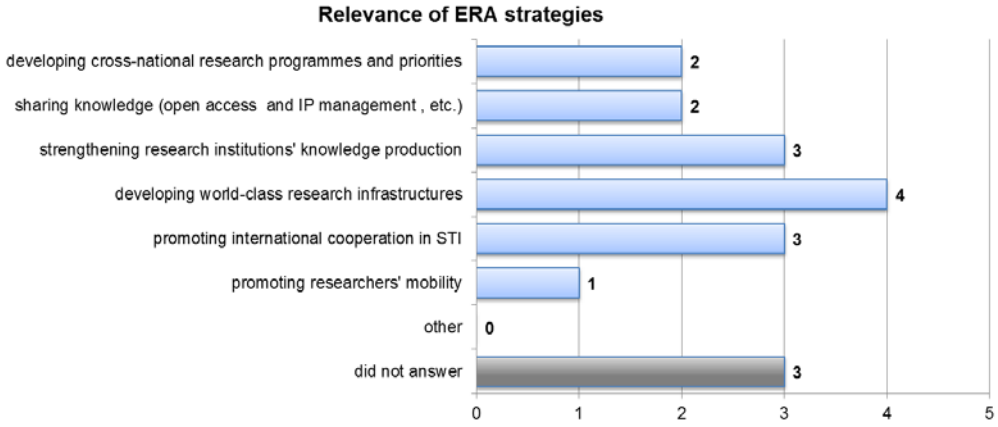

Figure 32. *Relevance of the ERA strategies - Weak Signal "**Many people are willing to pay more to get wind energy**"*

*(Question 6: Please select, from the list of research and technology development (RTD) strategies, the two most relevant for **improving understanding of this signal**)*

From 11 answerers two (22 %) like to provide advice on policy issues associated to this wild card. Recommendations were *"Policy shift" (N=1), "Creation of new initiative" (1),* and *"Further research,*

Increased public spending" (1). Respondents also commented on the abovementioned selections in the following manner:

Sub-Question 7b: Comments on selection "Yes" ("Would you like to provide advice on policy issues associated to this weak signal?" (WE 1633)

- *"Policy shift (could be a new initiative):Feed-in-Tariff (FIT) to be introduced, and installation of new windpower to be supported, which means some increase in public spending. First, of course, the fact should be widely disseminated in the media so that also political decision makers would all know it and understand its implications."*

A low probalility and high impact event (wild card) associated to this signal was described:

Question 8a, Short description a low probalility and high impact event (wild card) as sociated to this signal? (WE 1633)

- *"Breakthroughs in solar energy production that would make solar power much cheaper than what it is today might lower the interest for wind power."*
- *"Angry public debate, arguments about birds getting killed, landscapes being ruined, windpower being ridiculed-most likely a campaign silently and/or indirectly supported by the non-renewable energy production giants."*

Conclusions

The level of importance for STI policy of the weak signal ***"Many people are willing to pay more to get wind energy"*** is "high" at country level (index 3,56), and "moderate" at EU level (index 3,44). Important implications in the future are in the fields of "*Physical infrastructure*" and "*Environment & ecosystems.*" The most important RTD-strategies are "*Developing world-class research infrastructures,*" "*Promoting international cooperation in STI,*" and "*Strengthening research institutions' knowledge production.*"

4.4.7 Weak Signal *"Obama's goal: One Million e-cars on the US streets by 2015"*

- First reaction to ***"Obama's goal: One Million e-cars on the US streets by 2015"*** is "It is fairly ambiguous"; main interpretation: "Potential continuation of important present issues in the future".
- Level of importance for STI policy is "moderate" in country level in Finland and EU-level
- Important implications in the future include "*Environment & ecosystems*," "*Science, technology&innovation(STI)systems*" and "*Economy*".
- The most important RTD-strategies are "*Developing cross-national research programmes and priorities*" and "*Sharing knowledge (open access and IP-management etc.).*"

"Obama's goal: One Million e-cars on the US streets by 2015" Weak Signal description: "Electric cars have just started to be introduced in the U.S., and they cost thousands more than hybrids like the Prius. Plug-in hybrids can be cheaper, and they don't have the range limitations that could limit the market sales." (www.iknowfuture.eu).

First reaction, main interpretation, and importance

The first reaction to "*Obama's goal: One Million e-cars on the US streets by 2015*" is "It is fairly ambiguous"; main interpretation: "Potential continuation of important present issues in the future". Level of importance for STI policy in country and EU-level is "moderate" (Table 54).

Table 54. Importance of Weak Signal (WE) "Obama's goal: One Million e-cars on the US streets by 2015".

(Signal number 1546, Energy, Country Survey Finland)					
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev.	Mode	Median
Q 1 What is your <u>first reaction</u> to this weak signal? 1.Its meaning is fairly obvious 2.It is fairly ambiguous 3.Is is moderately ambiguous 4.It is highly ambiguous 5.It is completely bewilderging/confusing	16	2,19	1,28	1	2,00
Q 2 What is your <u>main interpretation</u> of this weak signal? 1.Potential continuation of important present issues in the future 2.Potential doscontinuation of important present issues/developments 3.Potential re-emergence of past issues 4.Potential emergence of new issues/developments 5.Other	14	(2,07)	(1,38)	1	1,00
Q 4 Country level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	13	3,31	1,03	3	3,00
Q 4 EU level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	13	3,38	0,96	3	3,00

Respondents gave a few comments regarding the signal, for example:

Question 3: Could you briefly comment on your choice of interpretation and tell us what makes this weak signal interesting? (1546)

- *"Number of E-cars will increase, especailly in urban traffic but later that expected because car is used not onlly for short distancies."*
- *"The oil is going to end up any way. How to deliver energy in other form. it looks like the electricity has a ready infrastructure. The difficulty is going to be how to produce the electricity. Germany is closing nuclear powerplants. My gues is solar power."*
- *"Move away from fossil liquid based energy carriers, but I think that this is not a weak signal. The topic has been discussed among experts for years and it is more just a question how rapid the change is"*
- *"The electric car was already introduced to US by GM, but the project was later scrapped by unknown reasons. Now the pressure comes from precidential level, and I see there to be a significant potential for success."*
- *"Rise of electric cars is possible in the (near) future if battery technology continues its development at the present rate and if ipolicy makers decide to contribute to the issue."*
- *"It is rather obvious that"*
- *"Private automobiles would continue (increasingly) governing our public space, land use would be further dispersed, public transport systems downgraded. It would help people continue with their bad habits of closing themselves off into their private cars. Also, energy consumption would continue to grow and an e-car could run on electricity produced by nuclear or coal power - hence, no climate change mitigation impact, quite the contrary - roads and highways would be built as before"*

Important implications and improving RTD-strategies

This signal has important implications in the future on "*Environment & ecosystems*," "*Science, technology&innovation (STI) systems*," and "*Economy*" (see Figure 33).

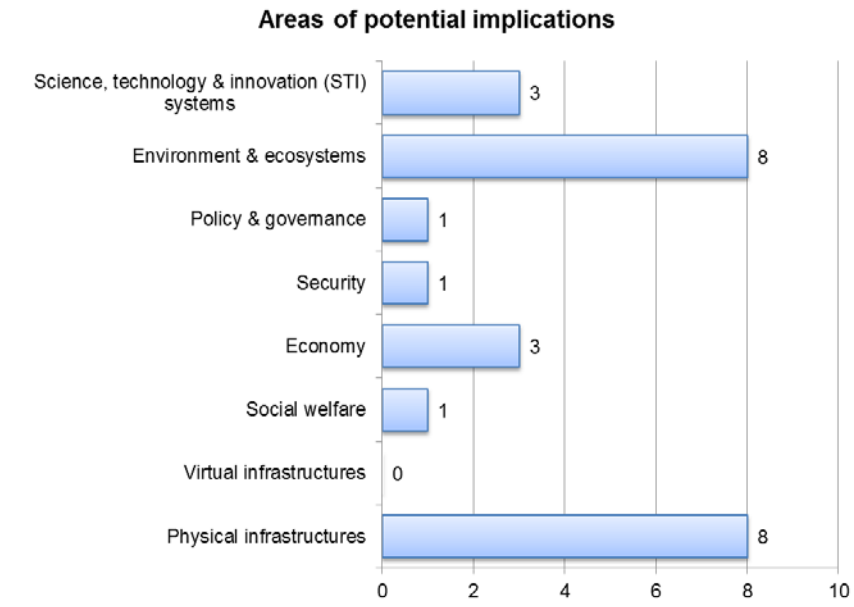

Figure 33. *Important implication in the future of Weak Signal* ***"Obama's goal One Million e-cars on the US streets by 2015"***.

(Question 5: From the following categories, please select two where you think the weak signal's evolution could have ***important implications in the future****?)*

The most important RTD-strategies are *"Developing cross-national research programmes and priorities"* and *"Sharing knowledge (open access and IP-management etc.)"* (Figure 34).

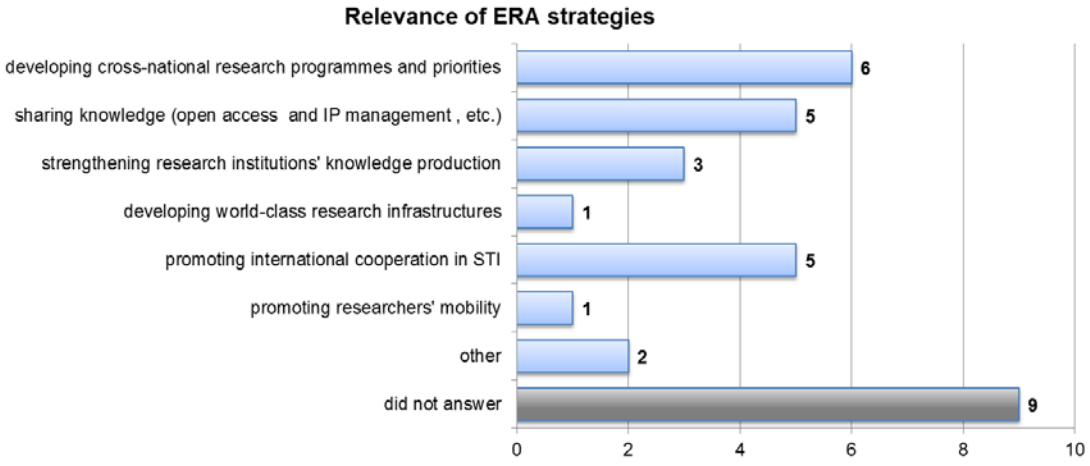

Figure 34. *Relevance of the ERA strategies - Weak Signal* ***"Obama's goal One Million e-cars on the US streets by 2015****.*

(Question 6: Please select, from the list of research and technology development (RTD) strategies, the two most relevant for ***improving understanding of this signal:*** *)*

Of the 14 answerers three (19 %) provided advice on policy issues associated to this weak signal. The recommendations were *"Policy shift" (N=1), "Further research" (1),* and *"Improved academic-industry links" (1).* Comments regarding the abovementioned selections were also provided:

Sub-Question 7b: Comments on selection "Yes" ("Would you like to provide advice on policy issues associated to this weak signal?" (WE 1546)

- *"By public supoort changes can be in e.g. public transport and goods delivery especially in urban regions"*
- *"Policy shift:reduction of investment in mobility infrastructure for private cars (only in public transport and non-motorized mobility)"*

Question 8a, Short description a low probalility and high impact event (wild card) associated to this signal? (WE 1546)

- *"No comments"*

Conclusions

The level of importance for STI policy of the weak signal ***"Obama's goal: One Million e-cars on the US streets by 2015"*** is, for Finland, at country level "moderate". Important implications in the future are "*Environment & ecosystems,*" "*Science, technology & innovation (STI) systems,*" and thirdly "*Economy.*" The most important RTD-strategies are "*Developing cross-national research programmes and priorities*" and "*Sharing knowledge (open access and IP-management etc.).*"

4.4.8 Weak Signal *"Use of electric cars enhance national energy safety"*

- First reaction to ***"Use of electric cars enhance national energy safety"*** is "*It is fairly ambiguous*"; main interpretation: "*Potential discontinuation of important present*".
- Level of importance for STI policy in country level Finland is "moderate", in EU-level "high"
- It has mportant implications in the future on "*Environment & ecosystems*" and "*Securities*." The most important RTD-strategies are "*Developing cross-national research programmes and priorities*" and "*Promoting international cooperation in STI.*"

"Use of electric cars enhance national energy safety" Signal description: Use of electric cars enhance national energy safety because transportation becomes less dependent on only one form of energy - oil. (www.iknowfuture.eu).

First reaction, main interpretation, and importance

First reaction to "*Use of electric cars enhance national energy safety*" is "*It is fairly ambious";* main interpretation: "*Potential discontinuation of important present*". Level of importance for STI policy in country level is "moderate", in EU-level "high" (Table 55).

Table 55. Importance of Weak Signal (WE) "Use of electric cars enhance national energy safety".

(Signal number 1635, Energy, Country Survey Finland)					
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev.	Mode	Median
Q 1 What is your <u>first reaction</u> to this weak signal? 1.Its meaning is fairly obvious 2.It is fairly ambiguous 3.Is is moderately ambiguous 4.It is highly ambiguous 5.It is completely bewilderging/confusing	9	2,00	1,41	1	1,00
Q 2 What is your <u>main interpretation</u> of this weak signal? 1.Potential continuation of important present issues in the future 2.Potential doscontinuation of important present issues/developments 3.Potential re-emergence of past issues 4.Potential emergence of new issues/developments 5.Other	10	(2,30)	(1,49)	1	1,00
Q 4 Country level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	10	3,30	1,34	4	3,50
Q 4 EU level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	10	3,70	1,25	4	4,00

A few comments regarding the signal were given, for example:

Question 3: Could you briefly comment on your choice of interpretation and tell us what makes this weak signal interesting? (1635)

- *"The main question here is how electericity is produced, which is a bigger issue than the question of electiric cars. And that is a national secutiry issue."*
- *"Electric car has a lot of potential, but there are many open questions still."*
- *"It reflects already the present situation!"*
- *"Bullshit. In the near-term future also electricity would be produced from fossil or nuclear materials - no safety! This is not a 'weak signal' this is a stupid political assumption. I assume that this would be understood and thus the 'signal' would be ignored."*

Important implications and improving RTD-strategies

It has mportant implications in the future on "*Environment & ecosystems*" and "*Securities*" (Figure 35).

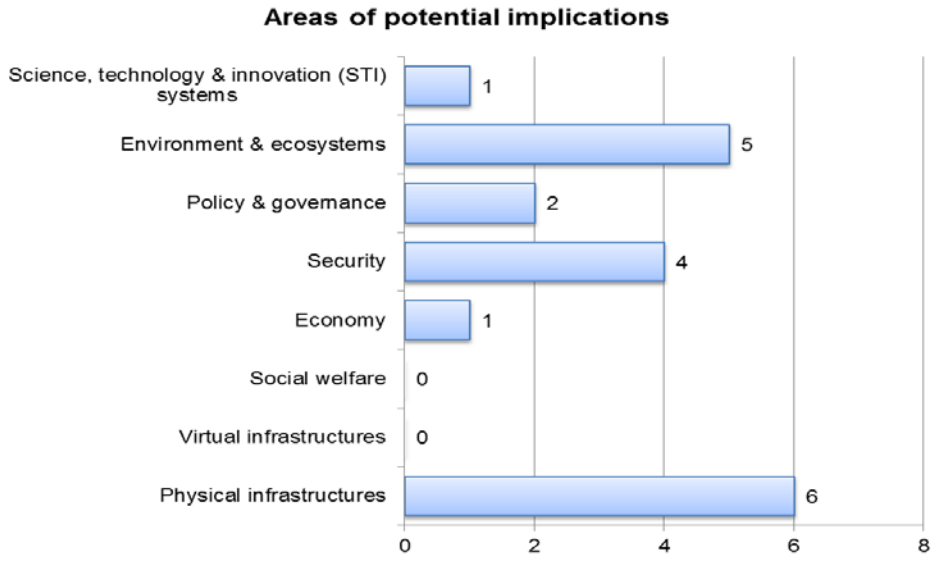

Figure 35. *Important implication in the future of Weak Signal* ***"Use of electric cars enhance national energy safety"****.*

(Question 5: From the following categories, please select two where you think the weak signal's evolution ***could have important implications in the future****?)*

The most important RTD-strategies are "*Developing cross-national research programmes and priorities*" and "*Promoting international cooperation in STI.*" (Figure 36).

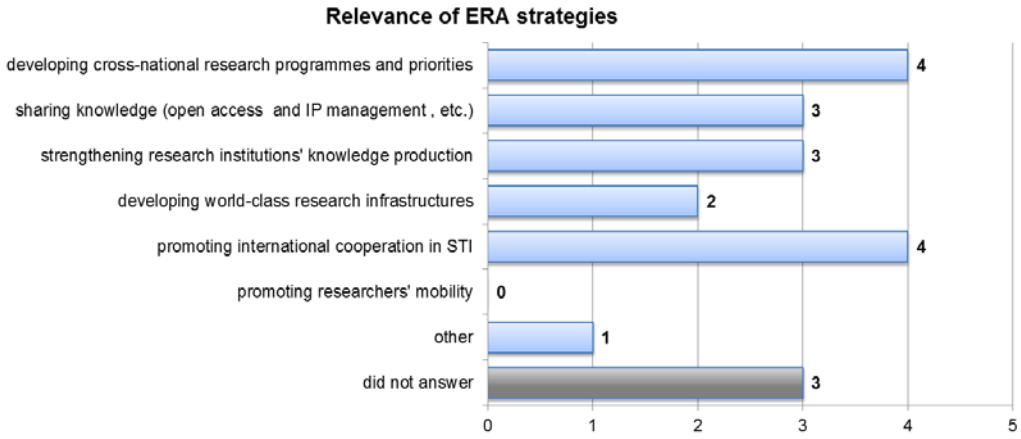

Figure 36. *Relevance of the ERA strategies - Weak Signal* ***"Use of electric cars enhance national energy safety"****.*

(Question 6: Please select, from the list of research and technology development (RTD) strategies, the two most relevant for ***improving understanding of this signal****)*

From 10 answerers, two (25 %) provided advice on policy issues associated to this weak signal. Recommendations were *"Further research" (N=2)*, *"Policy shift" (1)*, *"Improved academic-industry links" (1)*, and *"Dissemination of findings"(1)*. Following comments were also provided regarding this signal:

Sub-Question 7b: Comments on selection "Yes" ("Would you like to provide advice on policy issues associated to this weak signal?" (WE 1635)

- *"Only international cooperation will reinforced this signal."*
- *Question 8a, Short description a low probalility and high impact event (wild card) associated to this signal? (WE 1635)*
- *"No comments"*

Conclusions

The level of importance for STI policy of the weak signal ***"Use of electric cars enhance national energy safety"*** is "moderate" at country level and "high" at EU level. It has important implications in the future on "*Environment & ecosystems*" and "*Securities*." The most important RTD-strategies are *"Developing cross-national research programmes and priorities"* and *"Promoting international cooperation in STI."*

4.4.9 Weak Signal *"Algae production is a good way for carbon caption from atmosphere"*

- First reaction to *"Algae production is a good way for carbon caption from atmosphere"* is *"It is fairly ambiguous"*; main interpretation: "Potential emergence of new issues/developments"
- Level of importance for STI policy in country level in Finland is "moderate", in EU-level "high"
- It has mportant implications in the future on "*Environment & ecosystems*"
- The most important RTD-strategies are "*Developing world-class research infrastructures*" and "*Sharing knowledge*"
- According to respondents' comments *"If precautionary principle is not adhered to, and algae is use for CC without further research on long-term impacts, marine life could be distroyed, and global food chain could be in danger"*.

"Algae production is a good way for carbon caption from atmosphere" Weak Signal description: *"Algae is, not only a carbon neutral form of biofuel energy production, but also a good way for carbon caption form atmosphere."* (www.iknowfuture.eu).

First reaction, main interpretation, and importance

First reaction to "*Algae production is a good way for carbon caption from atmosphere*" is "It is fairly ambiguous"; main interpretation: "Potential emergence of new issues/developments" (Table 56). Level of importance for STI policy in country level in Finland is "moderate", in EU-level "high".

Table 56. Importance of Weak Signal (WE) "Algae production is a good way for carbon caption from atmosphere".

(Signal number 1634, Energy, Country Survey Finland)					
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev.	Mode	Median
Q 1 What is your <u>first reaction</u> to this weak signal? 1.Its meaning is fairly obvious 2.It is fairly ambiguous 3.Is is moderately ambiguous 4.It is highly ambiguous 5.It is completely bewilderging/confusing	9	2,11	1,05	1	2,00
Q 2 What is your <u>main interpretation</u> of this weak signal? 1.Potential continuation of important present issues in the future 2.Potential doscontinuation of important present issues/developments 3.Potential re-emergence of past issues 4.Potential emergence of new issues/developments 5.Other	9	(3,33)	(1,12)	4	4,0
Q 4 Country level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	8	3,00	0,53	3	3,00
Q 4 EU level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	8	3,75	0,46	4	4,00

According to comments concerning the interpretation of the signal, we can see that there is positive, negative and sceptical assesments to this signal:

Question 3: Could you briefly comment on your choice of interpretation and tell us what makes this weak signal interesting? (WE 1634)

- *"Sounds good but what could be the scale using algae for ths purpose? Whole Baltic Sea for example? Positive and negative effects are present here."*
- *"It is interesting because it describes a technology that solves two problems at once: it absorbs co2 and produces raw material for energy without displacing other important agricultural production (such as food production)."*
- *"Algie has the potential to significantly alter the settings of global energy business."*
- *"Discussion on climate change mitigation would find yet another excuse for not taking real action. CCS has already been the technology-solution that many have thought will solve the problem. We know it does not. Neither do algae."*

Important implications and improving RTD-strategies

It has important implications in the future on "*Environment & ecosystems*" (see Figure 37).

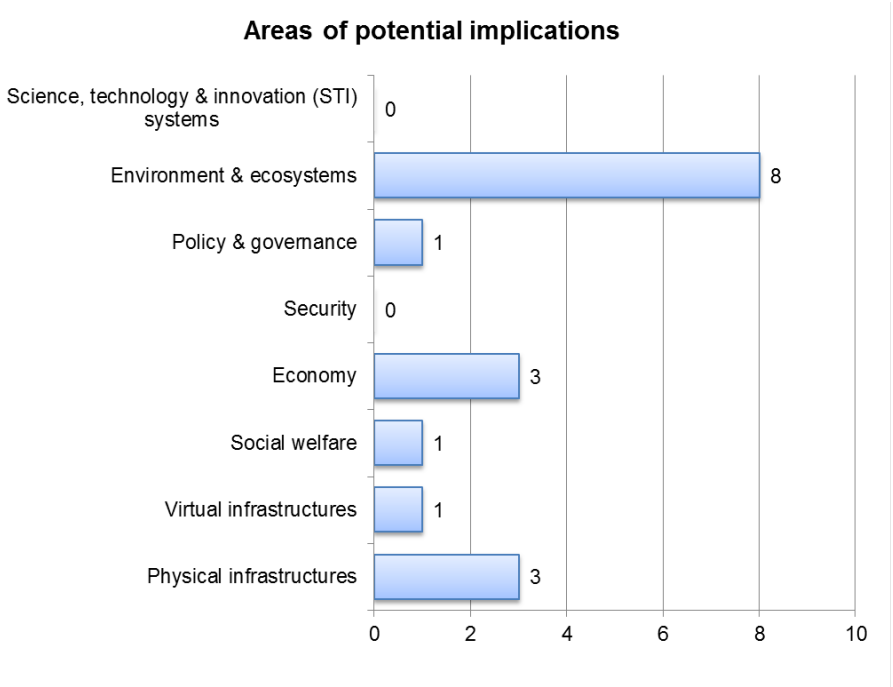

Figure 37. *Important implication in the future of Weak Signal "**Algae production is a good way for carbon caption from atmosphere**".*

*(Question 5: From the following categories, please select two where you think the weak signal's evolution could have **important implications in the future**?)*

The most important RTD-strategies are "*Developing world-class research infrastructures*" and "*Sharing knowledge*" (Figure 38).

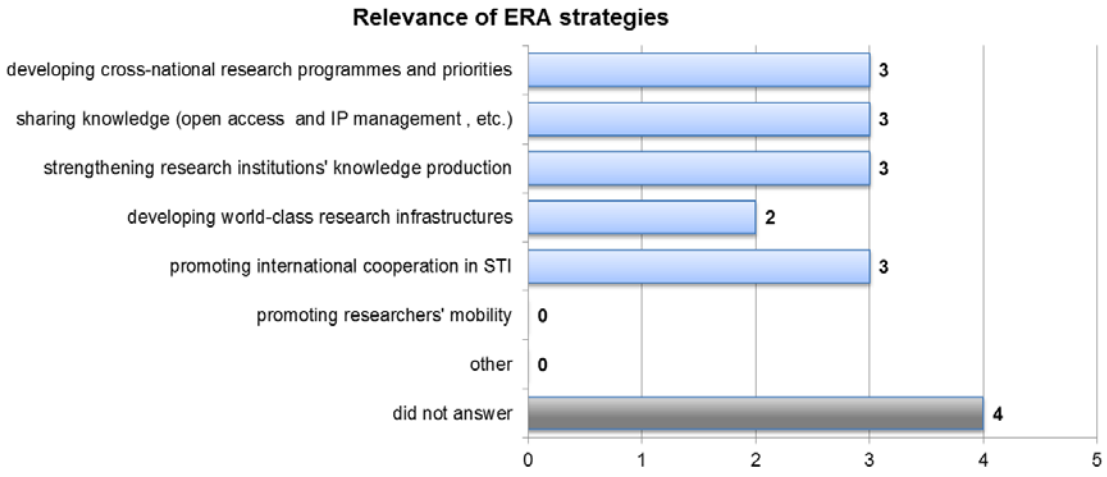

Figure 38. *Relevance of the ERA strategies - Weak Signal "**Algae production is a good way for carbon caption from atmosphere**".*

*(Question 6: Please select, from the list of research and technology development (RTD) strategies, the two most relevant for **improving understanding of this signal:***

From 11 answerers two (22 %) like to provide advice on policy issues associated to this wild card. Recommendations were *"Further research" (2), "Dissemenination of findings (2), "Creation of new initiative" (1).* No further comments were given regarding the abovementioned selections.

A low probalility and high impact event (wild card) associated to this signal was described:

Question 8a, Short description a low probalility and high impact event (wild card) associated to this signal? (WE 1634)

- *"If precautionary principle is not adhered to, and algae is use for CC without further research on long-term impacts,marine life could be distroyed, and global food chain could be in danger"*

Conclusions

The level of importance for STI policy of the weak signal ***"Algae production is a good way for carbon caption from atmosphere"*** is "moderate" at country level and "high" at EU level. Important implications in the future are in the field of *"Physical infrastructure"*. The most important RTD-strategies are "*Developing world-class research infrastructures*" and "*Sharing knowledge*." One respondent said that *"If precautionary principle is not adhered to, and algae is use for CC without further research on long-term impacts, marine life could be distroyed, and global food chain could be in danger."*

4.4.10 Weak Signal *"There are many new serious attempts to utilize new fossil fuel resources"*

- The first reaction to ***"There are many new serious attempts to utilize new fossil fuel resources"*** is "It is fairly ambiguous"; the main interpretation: "Potential continuation of important present issues in the future."
- The level of importance for STI policy at country level in Finland is "low", in EU-level "moderate"
- It has mportant implications in the future on "*Environment & ecosystems*" and "*Economy*." The most important RTD-strategies are *"Promoting international cooperation in STI"* and *"Strengthening research institutions' knowledge production."*

"There are many new serious attempts to utilize new fossil fuel resources." Weak Signal description: There are many new serious attempts to utilize new fossil fuel resources. Countries and energy companies are constantly making new discoveries of new fossil fuel resources. (www.iknowfuture.eu).

First reaction, main interpretation, and importance

The first reaction to "*There are many new serious attempts to utilize new fossil fuel resources*" is "It is fairly ambigious"; the main interpretation: "Potential continuation of important present issues in the future (Table 57). The level of importance for STI policy in country level in Finland is "low", in EU-level "moderate"

Table 57. Importance of Weak Signal (WE) "There are many new serious attempts to utilize new fossil fuel resources".

(Signal number 1636, Energy, Country Survey Finland)					
Answer options 1 = None, 2 = Low, 3 = Moderate, 4 = High, 5 = Critical.					
	N	Mean	Std Dev.	Mode	Median
Q 1 What is your <u>first reaction</u> to this weak signal? 1.Its meaning is fairly obvious 2.It is fairly ambiguous 3.Is is moderately ambiguous 4.It is highly ambiguous 5.It is completely bewilderging/confusing	8	2,00	1,20	1	1,50
Q 2 What is your <u>main interpretation</u> of this weak signal? 1.Potential continuation of important present issues in the future 2.Potential discontinuation of important present issues/developments 3.Potential re-emergence of past issues 4.Potential emergence of new issues/developments 5.Other	8	(1,88)	(1,36)	1	1,00
Q 4 Country level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	8	2,38	1,41	2	2,00
Q 4 EU level, What <u>level of importance</u> do you think this weak signal would have for science, technology and innovation (STI) policy?	8	3,13	1,13	2	3,00

A few comments were given regarding the signal, for example:

Question 3: Could you briefly comment on your choice of interpretation and tell us what makes this weak signal interesting? (WE 1636)

- *"Energy companies will do this at least next 40 years. The transition phase can be rather long when we change our whole energy system and also the production of goods made from oil."*
- *"Finland could also in the future play an important role in the development of the arctic transport, energy and environmental technology. In Finland, the Parliamentary Committee for the Future has produced during the year 2010 a report entitled "Russia 2030 based on Contracts" (editors Osmo Kuusi & Hanna Smith & Paula Tiihonen). In the context the Committee for the future has formed a statement: "Finland must draft a Research and Development Programme for the Development in Finland of Arctic Transport, Energy and Environmental Technology."*
- *"We are still married to fossil fuels, and there will be strong attempts to keep the related structures and functions operational."*
- *"Fossil fuels are used as long as it is economically beneficial."*

Important implications and improving RTD-strategies

The signal has important implications in the future on "*Environment & ecosystems*" and "*Economy*" (see Figure 39).

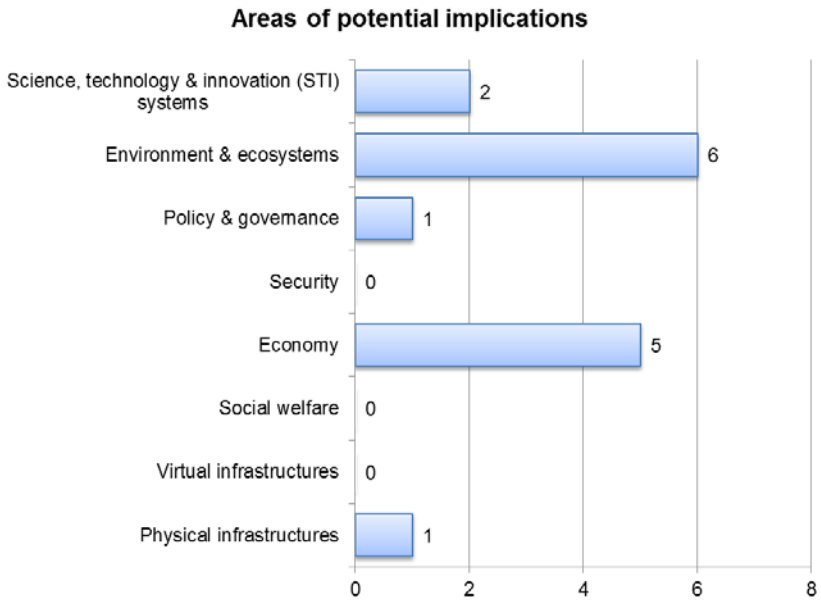

Figure 39. *Important implications in the future of Weak Signal* ***"There are many new serious attempts to utilize new fossil fuel resources"***.

(Question 5: From the following categories, please select two where you think the weak signal's evolution could have ***important implications in the future****?)*

The most important RTD-strategies are *"Promoting international cooperation in STI"* and *"Strengthening research institutions' knowledge production"* (Figure 40).

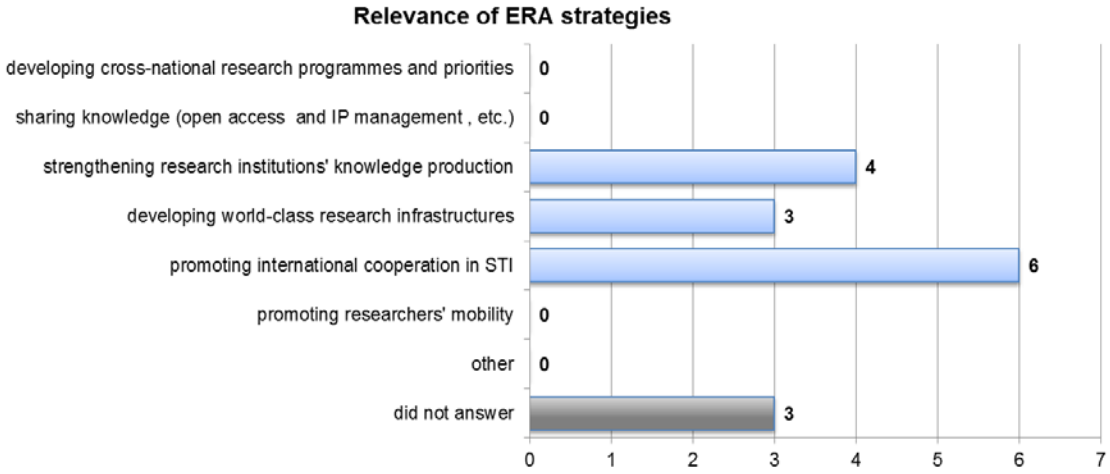

Figure 40. *Relevance of the ERA strategies - Weak Signal* ***"There are many new serious attempts to utilize new fossil fuel resources"***.

*(Question 6: Please select, from the list of research and technology development (RTD) strategies, the two most relevant for **improving understanding of this signal:**)*

On a total of 10 answerers two (25 %) provided advice on policy issues associated to this weak signal. Recommendations were *"Further research" (N=2), "Policy shift" (1), "Improved academic-industry links" (1),* and *"Dissemination of findings"(1).* Comments regarding the abovementioned selections were also given:

Sub-Question 7b: Comments on selection "Yes" ("Would you like to provide advice on policy issues associated to this weak signal?" (WE 1636)

- *"I am ready to do foresight and networking academic-industry-policy makers in this thema. Especially I want to do foresight what is the future of the North-East Passage and its impact to demand of arctic energy, environment and transportation technology. I would like to analyze, what is Finland and other EU-countries role in research and development new technology in this thema. I would like to mention that for example 60 % of world's icebrakers has done in Finland. One concrete question is for example to promote Aurora Borealis -ship, which has promoted to this day by EU 7.research framework (Germany is leader)."*

Question 8a, Short description a low probalility and high impact event (wild card) associated to this signal? (WE 1636)

- *"No comments"*

Conclusions

The level of importance for STI policy of the weak signal ***"There are many new serious attempts to utilize new fossil fuel resources"*** is "low" at country level and "moderate" in EU-level. It has important implications in the future on "*Environment & ecosystems*" and "*Economy*." The most important RTD-strategies are "*Promoting international cooperation in STI*" and "*Strengthening research institutions' knowledge production.*"

The Weak Signal "*There are many new serious attempts to utilize new fossil fuel resources*" is not so weak if we think about the very possible developments of the Finnish Technology in the Arctic Region. Some Finnish companies, such as Aker Arctic, a subsidiary of STX Finland, have been in fact lately in a key position: for example, the world's first oil transportation system operating in icy waters was introduced in the summer 2008 in Varandei, situated in the Pechora Sea in the nort-eastern part of Europe (Myllylä 2010b: 89).

5. CONCLUSIONS

It is essential that policy makers react to the important impacts and effects estimated for the wild cards and weak signals, for example through strategic decision-making inline with Ansoff's approach (Malaska, 2011, interview):. A lack of reaction or a wrong reaction might imply that competitors will take the market. When coupled with an active strategy of decision-making, these wild cards and weak signals may offer significant opportunities. The results indicate which wild cards and weak signals are of greater importance, provide insight on the aspects policy-makers are not adequately prepared for, and give information that could help find the right policy to adapt in a situation where a given wild card or weak signal would become real. The results can still be considered preliminary, and the discussion should continue until a final decision.

According to analysis in this report, the main wild cards for which attention should be paid are *"National energy grid disappears", "Gas from Trash", "Silent Seas" and "Algae pathogen suddenly destroys new energy foundation of humankind"* because their importance for science, technology and innovation (STI) policy in Finland (and also in EU-level) is moderate, but preparedness of decision-makers to deal with these is low.

The level of importance for STI policy of almost all analyzed weak signals is "high" or "moderate" in Finland (and also in EU-level). The following ones are of high importance in Finland (and EU-level): *"Emergence of new agricultural methods for coping with climate change", "Consumption drives market capitalism, not saving, conserving or sparing", "Many people are willing to pay more to get wind energy"* and *"Food consumers are steered towards healthier dietary choices."* The next ones fall into the category "moderate" and it is important for decision-makers to take them into account: *"Food markets became investment subject in previous credit crunch", "Obama's goal: One Million e-cars on the US streets by 2015", "Use of electric cars enhance national energy safety", "Algae production is a good way for carbon caption from atmosphere"* and *"Bees no more, less food than before."*

It can also be argued that the human cognitive structure, the mind, is not able to analytically handle true wild cards and weak signals, such as the ones presented in this report (Ilmola 2011, interview). In practice this means, among other things, that besides the processed and analyzed wild cards and weak signals, there are still other hidden wild cards and weak signals. The focus should be put on continuous decision-making processes, which would enable proper reactions to those unexpected wild cards and weak signals outside this WI-WE analysis.

The abovementioned can be reflected upon earlier research made on participatory governance processes that could enable the realization of 'joint integrated management' of complexity, which would be able to front systems in which decision-making might be urgent while uncertainty is very high (Sajeva and Masera, 2006; Sajeva; 2011). The complexity of systems is apparent in every occasion where the entirety of effects and the cause-effect propagation are not known or are known to be highly uncertain. A continuous governance process in which experts and stakeholders are engaged might be able to identify hidden wild cards and weak signals that remain unidentified by a first screening. The continuity of the process is of paramount importance.

When realising expert surveys or Delphi, stakeholder groups are often called to participate. However, they are certainly not independent actors as they respond to particular interests of their sector or their own operational activities. In governance approaches extended peer communities of citizens, associations, or so-called juries are often called to take part in order to provide more objectivity. In this iKnow Expert Survey, we can say that ID Group "Other" was independent. In the Finnish case we have more answers from the public than from the private sector group.

According to the Finnish National Innovation Strategy (2008), more attention should be paid to demand-driven (or customer-driven) innovations (see Kaivo-oja & Santonen 2010, Kaivo-oja 2011a; Karjula & Myllylä 2006). In the same way as in Delphi or expert surveys, respondents in this project were mostly public actors or belonged to the research sector (high education institutions). For this reason, it was not possible to analyze private actors' expert opinions reliably. According to a demand-driven innovation strategy, more information on market demand and the trends of customer behaviour should be available. This is the reason of possible uncertainties of the present analysis in the description of future possibilities.

For example, the increasing interest of the great powers in the northern areas shows that the North is moving from the periphery to a focal geopolitical and strategic point. U.S.A., Russia, Canada, and Norway have updated their strategies in the Arctic region since 2008. Finland's strategy for the Arctic was ready in the summer of 2010, and the preparation of EU Arctic strategy should also be a high-level political and topical issue.

The growth of the global economy and its impact on the prices of limited raw materials, such as oil and other minerals, have a great impact on Finland and Northern countries in general. This means, especially for Finland, that technology development in transportation systems (e.g. new cost-savings and other solutions) creates key conditions for the exploitation of Arctic natural resources. For example, these questions could have received better responses if more private representatives, for example in theme Energy, would have been involved in the process.

In addition, Finland could play an important role in the development of arctic transport, energy, environmental, agricultural and food technology in the future. In Finland, the Parliamentary Committee for the Future produced a report titled "Russia 2030 based on Contracts" (editors Osmo Kuusi & Hanna Smith & Paula Tiihonen; see also Myllylä 2010a) in 2010. According to the Committee "Finland must draft a research and development programme for the development in Finland of Arctic transport, energy and environmental technology". Such a programme should also include themes on agriculture and food technology with a focus on the Northern Dimension. This would probably constitute a very important step in the vision of an EU Research Programme which would include Finland country targets.

SOURCES

Literature

Ansoff, H.I. (1965). Corporate Strategy. McGraw. Hill, New Youk.

Gordon, Theodor J. (2007). State of the future 2007. 470 p. 8.10.2007. www.millennium-project.org

Gordon, T.J. (2002). The Delphi Method. AC/UNU Millennium Project. Futures Research Methodology V2.0.

Kaivo-oja, Jari (2011a). Futures of Innovation Systems and Systemic Innovation Systems: Towards Better Innovation Quality with New Innovation Management Tools. e-Book in press. Finland Futures Research Centre. University of Turku. Turku.

Kaivo-oja, J. (2011b). Weak Signals Analysis, Knowledge Management Theory and Systemic Sociocultural Transitions. Futures. The Journal of Policy, Planning and Futures Studies. Special Issue Paper. Accepted for publication. Special issue in edition process.

Kaivo-oja, J. & Teemu Santonen, T. (2010). Open Innovation in a Systemic Innovation Context: Analyzing Online Mass Innovation Process from Systemic Perspectives. In Torkkeli, M. (Ed.) Frontiers of Open Innovation. Lappeenranta University of Technology. Department of Industrial Management. Research Report 225. Lappeenranta, pp. 69-90.

Karjula, Kyösti & Yrjö Myllylä (2006). Vaurastuminen kansallisena velvollisuutena. Alueellisen yritys- ja innovaatiotoiminnan selvitysraportti. 106 p. Valtioneuvoston kanslian julkaisuja 12/2006.

Kuusi, Osmo (2002). Delfoi-menetelmä. Teoksessa Kamppinen, Matti, Osmo Kuusi ja Sari Söderlund (2002): Tulevaisuudentutkimus – Perusteet ja sovellukset, 204-225. Suomalaisen Kirjallisuuden Seura, Helsinki.

Mendonça, S., Cunha, M.P., Kaivo-oja, J. & Ruff, F. (2004) Wild Cards, Weak Signals and Organisational Improvisation, Futures. The Journal of Forecasting, Planning and Policy, Vol. 36, Issue 2, pp. 201-218.

Mendonca, Sandro, Cunha, Miquel Pina E., Ruff, Frank & Kaivo-oja, Jari (2009) Venturing into the Wilderness: Preparing for Wild Cards in the Civil Aircraft and Asset-management Industries. LRP Long Range Planning.. International Journal of Strategic Management 42 (2009), 23-41.

Myllylä, Yrjö (2010a). The Murmansk region's growing importance in the energy economy and logistics creates opportunities also for Finnish companies. In the book: Kuusi, Osmo & Hanna Smith & Paula Tiihonen (eds.) (2010). Russia 2030 based on contracts. Publication of the Committee for the Future 6/2010. 170-180.
<http://web.eduskunta.fi/dman/Document.phx?documentId=vy14010113558959&cmd=download>

Myllylä, Yrjö (2010b). The Growth Area of the Arctic Region and Baltic Sea in the focus of Finland's interests. 96 p. Ministry of Employment and the Economy, Regional Development 43/2010 (in Finnish, english summary). <http://www.tem.fi/files/27375/TEM_43_2010_netti.pdf>

Myllylä, Yrjö (2009). Työvoiman ja koulutuksen tarvetutkimus[1] (TKTT) 2008. Yhteenveto teknisten palveluiden työnantajahaastatteluista. Asiantuntijaraadin SWOT-analyysi 11.12.2008. 70 p. Varsinais-Suomen TE-keskuksen julkaisuja 1 / 2009. <http://www.luotain.fi/julkaisut/TkktTeknistenPalveluidenYhteenveto.pdf>

Myllylä, Yrjö (2008). Industrial, Logistic and Social Future of the Murmansk Region – Summary of the Doctoral Dissertation by Yrjö Myllylä. 64 p. Publications of the Ministry for Foreign Affairs of Finland 3/2008.

<http://aluekehitys.internetix.fi/fi/sisalto/uutiset/uutiset/ummurmanskkirja>

Sponsored by Cargotec, Aker Arctic Technology, Finstaship, Lapland Chamber of Commerce, Municipality of Salla, Barents Group Ltd and Management & Transportation Experts Matrex Oy

Myllylä, Yrjö (2006). The future of Murmansk Oblast assessed by three Delphi panels. Fennia 184:1, 59-73.

<http://ojs.tsv.fi/index.php/fennia/article/view/3732/3523>

National Innovation Strategy (Kansallinen innovaatiostrategia) (2008). 51 p. Ministry of Economic and Employment of Finland, Helsingki 2008. <http://www.tem.fi/index.phtml?l=en&s=2411>

Sackman, H. (1975). Delphi Critique, The RAND Corporation. 146 p. Lexington Books, Toronto.

Turoff, Murray (2002). The Policy Delphi. In the book: Linstone, H. ja M. Turoff (toim.): The Delphi method: techniques an applications. Digital version. 15.11.2005.

Sajeva, M. (2011). Security, quality of life and development. A holistic approach. Accepted for publication, under printing in the Social Indicators Research, an International and Interdisciplinary Journal for Quality-of-Life Measurement, Springer, 2011.

Sajeva, Maurizio, Yrjö Myllylä & Jari Kaivo-oja (2011). iKnow project – WP7. Case Study report Finland. August 2011, Draft. 41 p. Finland's Futures Research Centre, University of Turku.

Sajeva, M. (2010). Security and development. A holistic approach.- Paper presented at the Futures Conference 2010 – Security in Futures – Security in Change - University of Turku – Finland Futures Research Centre – 3,4, June, 2010.

Sajeva, M. and Michael LaBelle (2010). Risks and governance in the transition process towards post-carbon societies - "Seventh Framework Programme - Collaborative Project "Pathways for carbon transitions (PACT)"- Project number 225503- Workpackage 4 - Transition towards post-carbon society – April 2010.

Sajeva, M. And Marecelo Masera (2006). A strategic approach to risk governance of critical infrastructures. Sajeva, Maurizio; Masera, Marcelo. (2006). International Journal of Critical Infrastructures 2006 - Vol. 2, No.4 pp. 379 – 395.

Masera, M., Y. Wijnia, L. de Vries, C. Kuenzi., M. Sajeva, M. Wejnen; (2006); Governing risks in the European electricity system; in Critical Infrastructures at Risk - Securing the European Electric Power System (January 2006, Springer Verlag).

Interviews

Malaska, Pentti, Professor (em.) of Management Science and Operations Research, Turku School of Economics, and Honorary Member of The Club of Rome, 19.8.2011.

Ilmola, Leena, Senior Researcher, 19.8.2011, (Game Changers Project, IIASA).

[1] TKTT-concepts is the best regional foresight practice in EU, Developed among us by Centre for Economic Development, Unemployment and Environment http://www.ely-keskus.fi/en/frontpage/Sivut/default.aspx & RD Aluekehitys Oy www.rdmarketinfo.net in Finland, for further information http://arenas.itcilo.org/en/home.

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