



Eurobarometer Qualitative Study

PUBLIC OPINION ON FUTURE INNOVATIONS, SCIENCE AND TECHNOLOGY

Aggregate Report June 2015

This study has been requested by the European Commission, Directorate-General for Research and Innovation and co-ordinated by Directorate-General for Communication.

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**Public opinion on future innovations,
science and technology**

Aggregate Report

Conducted by TNS Qual+ at the request of
the European Commission,
Directorate-General for Research and Innovation

Survey co-ordinated by the European Commission,
Directorate-General for Communication
(DG COMM "Strategy, Corporate Communication Actions
and Eurobarometer" Unit)

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Interview guide

Country Abbreviations

1. Czech Republic	CZ
2. Denmark	DK
3. Estonia	EE
4. Finland	FI
5. France	FR
6. Germany	DE
7. Greece	EL
8. Ireland	IE
9. Italy	IT
10. Malta	MT
11. The Netherlands	NL
12. Poland	PL
13. Portugal	PT
14. Romania	RO
15. Slovakia	SK
16. United Kingdom	UK

A. EXECUTIVE SUMMARY

The aim of this qualitative study is to get a better understanding of Europeans' opinion about the innovations brought about in society by science and technology. More specifically, its main objective is to test some innovations that could be applied 15 years from now in the everyday life of citizens in Europe in four different areas, and to understand participants' preferences and reactions in this regard. The four areas that were tested include: homes and living, health and healthcare, ubiquitous communication and interaction, the environment.

Semi-structured discussions ('focus groups') were conducted with small groups of citizens in 16 EU Member States. The first part of the discussion dealt with the general perceptions of scientific and technological innovations and spontaneous projections regarding tomorrow's society.

Then the main part of the discussion was dedicated to reactions and discussions of the participants about possible scenarios shaping the future. Each group of citizens was presented two out of four future scenarios. These scenarios were described in one page. Each scenario dealt with one of the following areas:

- 'homes and living'
- 'health and healthcare'
- 'ubiquitous communication and interaction'
- 'Environment'

Fieldwork consisted of a total of 96 focus groups conducted across 16 Member States.

General perceptions about scientific and technological innovations

Optimism about the future, but tempered by real concerns

Participants in all countries were positive about scientific and technological innovations. They could identify the many associated benefits such as improvements in their quality of life, shown in increased comfort and convenience, better communication means, safer and healthier lives and increased life expectancy. But as much as participants could identify the positive, they were **equally aware of drawbacks of scientific and technological innovations.** The drawbacks included privacy and data security concerns, unemployment, growing technological dependency and deskilling, worsening of relationships, social exclusion, a sedentary lifestyle, and effects on the environment. These themes recurred throughout each of the different scenarios presented. These findings are also corroborated by other, quantitative Eurobarometer survey data¹.

The widespread confidence in the benefits that science and technology will bring in the foreseeable future is therefore tempered by concern that these improvements to the quality of our lives will at the same time also worsen aspects of life that are currently on the top of many people's minds.

EB Special Public Perceptions of Science, Research and Innovation:
http://ec.europa.eu/public_opinion/archives/ebs/ebs_419_en.pdf

The **most important advances** in the last 15 years mentioned spontaneously by participants have been in the areas of communication, the transition to a digital society (including commerce), health and medical care, transport and the environment (including energy). However, **it was especially the Internet and mobile technology** that was foremost on participants' minds when commenting on the most important developments over the last 15 years.

Furthermore, people can readily imagine the scenarios which were presented. Indeed many regarded innovations as being already available, or at least in development.

Spontaneous projections on tomorrows' scientific and technological innovations

Across the different countries and groups, participants' **spontaneous projections of future innovations** that could be part of their daily lives in 2030, **focused particularly on two areas: homes and living, and health and healthcare.**

- **Homes and living:** further automation of household tasks and centralised control of home appliances, use of robots in the home to undertake household chores would be widespread, technical devices/gadgets would be more integrated and will make use of more advanced technologies like facial and voice recognition, homes would be more eco-friendly and people would live environmentally friendly lives, and more advanced security technologies would be introduced in the home.
- **Health and healthcare:** many of the diseases or conditions that are currently incurable will in future be treatable, people will be able to self-diagnose their illnesses at home, more powerful or efficient equipment for diagnosis and treatment of diseases will exist, organ donation will become obsolete, tele-consultations/Internet-consultations with doctors will be possible, and a more streamlined health system will exist.

Other areas also spontaneously mentioned by participants as areas in which they expect scientific and technological developments will happen, were **the environment/energy, transport and communications.**

When asked about the role technology should play in 2030 and how it should impact on their lives, participants sketched the following 'ideal' and 'worst-case' scenarios:

- **Ideal scenario:** Where scientific and technological innovations are truly designed to help people in current critical areas (for instance support for the disabled and elderly), ensuring increased safety and across-the-board energy saving, without becoming invasive or completely replacing humans. Life will be even simpler, better, timesaving, healthier, environmentally friendly and more gadgets and extensive automation will be part of everyday life. People will have more time to socialise, dedicate to pleasant activities, to travel. Life expectancy will increase.

- **Worst-case scenario:** Where machines replace humans, making people subservient and passive, taking away people's privacy while giving no benefits in return, and creating social isolation and total dependency on technology. More control over people, allowing them less freedom. Greater automation of work resulting in unemployment and deskilling. A widening gap between the rich and the poor as people have unequal access to scientific and technological innovation and the benefits thereof. Most feared aspect is a lack of control (dependence on technology, complete automation, deskilling), a lack of human contact, of privacy, and unemployment.

Reactions to future scientific and technological innovations in selected areas

Homes and living

Participants thought that the **scenario was technically realistic**, especially as some of the technology referred to already exist, although not all aspects were desirable because of the dehumanisation it suggests. Indeed **participants expressed very mixed views about this scenario**.

However, they acknowledged how aspects of the scenario, especially the **robot capacities of doing routine tasks**, could be to their benefit by **freeing up the time it takes to complete household chores**. This would be very convenient.

Participants felt very **positive about the energy saving ideas** contained in the scenario such as smart meters connected to a smart power grid, coated glass that automatically darkens to block excess sunlight.

However, participants were **very concerned about privacy and data storage**, especially the fact that a complete record and memory of their home events is kept online.

Some participants also thought that life would be too predictable if so tightly organised and controlled and they disliked the lack of choice/lack of autonomy presented in the scenario.

Participants generally held that many of these innovations, or their predecessors, already exist. For this reason there was no widespread surprise about the innovations, although the one innovation that some participants did express surprise over and that was not always seen as believable was the **home delivery of goods by drones**.

Health and healthcare

Participants regarded the innovations presented in this scenario as **believable and advanced, and could easily see their implementation in 2030**. Many of the innovations already exist to some extent (e.g. centralised health records, dietary advice, stem cell research, etc.) and participants were generally familiar with them.

Participants expressed mixed views about most aspects of the scenario – they could see the benefits, but also had some concerns. No innovation was fully accepted in its current form, (and apart from linking healthcare services to the supermarket) neither were they rejected outright.

They described the scenario as **impersonal and overly commercial**. This is especially because of the **link between supermarkets and healthcare**. **This aspect of the scenario was not seen as credible and widely disliked by participants.**

Objections to the different innovations were not based on their usefulness, but on predominantly three grounds:

- The link to the supermarket (perceived to be biased due to commercial interests) which overshadowed many of the positive aspects about the interventions that the participants identified.
- Data collection by supermarkets was of great concern because of the threat it would represent to privacy, and the idea of constant monitoring and surveillance it suggests.
- Considerations about whether people will be able to opt-in, or whether the scenario presented will be the only available option were also matter of concern. Participants clearly preferred being able to choose to be part of these innovations or not, for example taking part in home consultations with doctors when appropriate, but also being able to have a face-to-face appointment if they preferred.

Ubiquitous communication and interaction

Participants thought that **this scenario was realistic in the future** as it represents the further development of technology that already exists. For instance, communication-related innovations were seen as building on Skype.

Overall **participants expressed very negative views about this scenario** based mostly on a strong conviction that the innovations presented would lead to a significant limitation of freedom and individual liberty, as well as reduce the security of personal data. The positive aspects of holographic communication did not make up for participant's overall dislike for the rest of the scenario.

Indeed, participants **strongly disliked the constant monitoring and surveillance that the ubiquitous communication innovations imply**. They found this intimidating and an invasion of their privacy. Participants also expressed concerns about what the data will be used for and how secure it is. However, they were able to recognise the benefits that these innovations held for fighting crime and terrorism, managing large crowds, and regulating traffic.

Holographic communication was generally liked by participants (especially at home, for work, and for educational purposes) as it made communication easier and more interactive, especially with those who are far away. However, some did express concern about the potential loss of human contact and the possible impact of holographic communication on social relationships.

The **greatest barriers** to the implementation of innovations related to ubiquitous communication are the issues around privacy, surveillance, data use and data security.

Environment

This scenario was **positively received** as environmental protection was seen as important. Most of these measures were already known to participants and have been implemented to some degree (e.g. renewable energy, recycling, non-drinking water for non-contact uses, greenery planted on rooftops, etc.). The scenario is in line with current trends towards a more environmentally friendly lifestyle and sustainable development.

Despite the overall positive sentiment expressed by participants many thought the **scenario was utopian** and that it was unrealistic to think that all aspects of it would be achieved within the next 15 years.

A number of **barriers** to the acceptability of the scenario were identified: cultural barriers to changing behaviour, commitments from government and business to also make the necessary changes towards being more environmentally friendly, and the costs involved in implementing these measures.

Participants liked the ideas around renewable energy (that renewable energy is derived from solar panels and wind farms, energy efficiency in homes and cities, the recycling of waste, the conversion of waste into value-added by products). They also liked the idea of recycling materials and natural resources, although they did wonder whether it would be safe to use recycled material in construction and whether the water would be clean enough to drink.

When commenting on advanced farming methods, aspects such as the use of fewer chemicals and machines, and improved food safety were more likely to be seen as positive whereas aspects like satellite surveillance and larger-scale food production (including GMO food) were more likely to be the reasons for participants' reservations.

Participants generally disliked the geo-engineering aspects of the scenario (underground CO₂ storage and carbon ocean fertilization). Some found these ideas difficult to understand and potentially risky if something were to go wrong.

General consistency across age groups, education levels, and different Member States

The study reveals a general consistency across all age groups and education levels, and across different Member States.

In overall terms, people expressed similar hopes and concerns for the future in terms of what science and technology will bring – however the extent to which these views affected their overall view did differ.

Younger people tended to be the most concerned about the impact of technological advances replacing the need for people to do the same jobs.

People with lower levels of education, and by implication those people more likely to be in less highly skilled occupations and the types of manual work most likely to be replaced by new technologies were also most likely to express worries about these technologies putting people out of work.

Older people, while expressing the same concerns were often more worried about being "left behind" – technology advancing so quickly that they were unable to keep up with the skills required to take advantage of the benefits that it offers. Older people were just as concerned about being "side-lined" – being made redundant in a less literal sense. Having less control, less choice, being made to feel of no purpose even in their own homes. Older people were also more likely to be concerned about accessibility – not just intellectually but financially.

This was also a key differentiator between countries – the issue of accessibility tended to be the main factor distinguishing poorer and more affluent Member States. This was expressed more in terms of affordability – that gradually technology will become accessible only to the rich and that technological advances will worsen the already widening inequality gap. This was seen at both an individual level (not being to afford it) and national level (countries not being to invest in the necessary changes to infrastructure leading to inequality in healthcare systems between countries for example).

Older people also tended to be more concerned about the implications of these advances on data security. Younger people who have grown up in the digital age were just as likely to mention these concerns (more aware perhaps of the implications for data security) but tended to be less concerned about this in general than older people: they were instead more worried about specific (mis)usage of this data.

B. OBJECTIVES AND METHODOLOGY

Objectives

The aim of this qualitative study is to get a better understanding of Europeans' opinion about the innovations brought about by science and technology in society. More specifically its main objective is to test some innovations that could be applied 15 years from now in the everyday life of citizens in Europe in four different areas, and to understand their preferences and reactions in this regard. Four areas have been tested.

- Homes and living,
- Health and healthcare,
- Ubiquitous communication and interaction,
- The environment.

Methodology and sampling

Fieldwork consisted of a total of 96 focus groups, each approximately two and a half hours in length, conducted in each of the following 16 Member States:

- Czech Republic (Prague & Olomouc)
- Denmark (Copenhagen)
- Estonia (Tallinn)
- Finland (Espoo)
- France (Lille and Paris)
- Germany (Hamburg)
- Greece (Salonica)
- Ireland (Dublin)
- Italy (Milan)
- Malta (Mriehel)
- The Netherlands (Amsterdam)
- Poland (Warsaw & Łódź)
- Portugal (Lisbon)
- Romania (Bucharest)
- Slovakia (Bratislava)
- United Kingdom (London)

Six focus groups were conducted in each of the Member States.

The selection of countries was mostly done using the results of EB Special quantitative 2013 survey on *Responsible Research and Innovation (RRI), Science and Technology*² in order to cover different attitudes regarding sciences and technology. Using this survey enabled us to select four types of countries:

- A group of countries where the level of information and the interest in science is very high and that see as very positive the impact of science on society (compared with the EU average): Denmark, the Netherlands and the United Kingdom;

-A group of countries still significantly interested, informed in science matters and positive about the impact of science on society, but on a lower extent: Estonia, Germany, Ireland, France, Finland;

² The full report is available here: http://ec.europa.eu/public_opinion/archives/ebs/ebs_401_en.pdf

- A group of countries less informed and less interested in science and more divided about the positive impact of science on society: Greek, Poland and Slovakia:
- A group of countries low interested and informed about science and the lesser positive about the impact of science on society (compared with the EU average): Czech Republic, Italy, Malta, Portugal and Romania.

Respondent profile

The table below presents the composition of groups in each of the countries selected:

Group	Description
1	18-34 years old who finished their education between 17 and 22
2	20-34 years old who finished their education between 20 and 25
3	35-64 years old who finished their education before 18
4	35-64 years old who finished their education before 18
5	35-64 years old who finished their education after 18
6	35-64 years old who finished their education after 18

The detailed respondent profiles and group composition, as well as detail on the fieldwork dates are described in the technical report.

I. GENERAL PERCEPTIONS ABOUT SCIENTIFIC AND TECHNOLOGICAL INNOVATIONS

This chapter focuses on participants' general views about scientific and technological innovations in order to get an overall grasp of their opinion on this subject. Firstly, what **ideas, feelings and associations** come to their mind when thinking about these innovations? What **positive and negative aspects** do they tend to associate with innovations brought on by science and technology? Secondly, **looking back on recent years, which innovations do they think had the most impact on society and why?** What **positive and negative changes** did these scientific and technological innovations bring?

1.1 *General associations linked to the notion of scientific innovation*

Participants were asked what spontaneously came to mind when thinking about scientific and technological innovations. In other words, what ideas and feelings did it convey and what positive and negative associations did it bring to mind.

Science and technological innovation were often associated with discovery, modernisation and progress, although participants more frequently associated science with particular innovations occurred in recent years. Indeed, there was substantial overlap between participants' general associations and feelings about scientific and technological innovations, and their views on the most important innovations in the past fifteen years and the positive and negative impact of these developments. In light of this overlap this section provides the main findings related to participants' general associations and feelings, while the following section 1.2 discusses these in greater detail.

Scientific and technological innovations: main associations

Participants' general associations with scientific and technological innovations focused both on examples of innovations and examples of impact. These associations can be broadly grouped into the following main categories with selected examples of associations:

- Communication: mobile phones, the Internet, social media,
- Digitisation of society (including commerce): online shopping and banking, more efficiency, easy access to information and services, job losses due to automation and computerisation, social exclusion
- Healthcare/Medical advances: better medical equipment and better diagnostics and treatment of diseases
- Environment (including energy): renewable energy, new recycling techniques
- Homes and living: new types of insulation and construction materials, sophisticated home appliances, 3-D and flat televisions
- Transport: ABS and airbags on cars, better roads, better city trams
- Education: online archives and books, remote classes, online training

Associations with these seven main categories were quite widespread across countries.

In addition, other associations as military innovations/developments of new weaponry (EE, EL, PL, CZ, MT) and space technology travel (IE, EE) were also mentioned, but only in a minority of countries.

Scientific and technological innovations: main impacts

Participants in all countries were positive about scientific and technological innovations. They could identify the many associated benefits such as improvements in efficiency and in their quality of life, shown in increased comfort and convenience, more comfortable homes, easier and wider access to information and healthier and safer lives.

"It brings comfort, it relieves human troubles. In medicine it's remarkable, reassuring, it's all better at every level, quality of life, longevity." (FR, Group 3)

"Before, to send a letter you had to go to register it at the post office at a cost...today if you want to speak with a foreigner company, I look up their e-mail address and send them an e-mail. Today, he could be at his computer and reply straight away. Whereas before you had to go back to the post office for their reply." (MT, Group 3)

"There have been a number of technological developments with regard to cars that made it possible to bring down the number of road accidents...first, ABS [brakes], then the airbag and a few other things after that..." (PT, Group 5)

This finding is similar to the results of the 2013 *Eurobarometer survey on Responsible Research and Innovation (RRI), Science and Technology*³ where **most respondents agreed that science has a positive impact on society (77%)**, and the majority of respondents in each country thought this way.

But as much as participants could identify the positive, they were equally aware of some of the drawbacks of scientific and technological innovations. These drawbacks included technological dependence, loss of privacy, data security concerns, unemployment, social exclusion, a sedentary lifestyle, and effects on the environment.

"It's less human when it comes to robots, it eliminates the human side, and genetics, that can be bad if you are tampered with genes. It can make us dependent like the GPS in the car, no one knows out to read a map anymore! The day computers no longer work, no one will know how to do anything." (FR, Group 1)

³ The full report is available here : http://ec.europa.eu/public_opinion/archives/ebs/ebs_401_en.pdf

*"I'm worried about whether we can get things to be sustainable. We use more and more technology and I worry about a collapse of resources."
(DK, Group 2)*

"I think the worst negative is the amount of job losses through it. I see it myself at work. I've been there twenty years, and because of automated processes, a large amount of people have lost their jobs" (UK, Group 3

According to the 2013 Eurobarometer survey on *Responsible Research and Innovation (RRI), Science and Technology* **74% of respondents agreed that development in science and technology could have unforeseen negative side-effects on health and the environment.** Whether respondents are asked in qualitative or quantitative research about the impact of scientific and technological developments, they seemed equally aware of potentially positive and negative impacts.

1.2 The most important scientific and technological innovations observed over recent years

This discussion focuses on what participants spontaneously considered to be the most important scientific and technological advances over the last 15 years have taken place.

The **most important advances** mentioned across the countries have been in the areas of communication, the transition to a digital society (including commerce), health and medical care, transport and the environment (including energy).

However, **it was especially the Internet and mobile technology** that was foremost on participants' minds when commenting on the most important developments over the last 15 years.

*"(What are the innovations that have transformed society the most?)
Computers, telephones, communications." (FR, Group 4)*

Participants were able to discuss both the positive and negative impact that these scientific and technological advances have had. The **positive impacts generally related to:** efficiency, ease, freedom, comfort, speed, simplicity, modernisation, convenience, improved quality of life and a more environmentally friendly existence. The **negative impacts** generally related to: loss of socialisation skills/dehumanisation, data security concerns, unemployment/job losses due to the automation of work, loss of privacy/freedom, social exclusion, pressure to keep up with changes, laziness and deskilling as one forgets how to do certain tasks.

The following paragraphs set out in greater detail what participants across countries considered to be the most important of the last 15 years.

AREA: Communication
<p>EXAMPLES:</p> <p>The most significant developments in relation to communication were considered to be: Internet, smartphones and how these phones have changed and evolved in look, feel and functionality, and the substantial impact they had on daily life and how people communicate. Skype, social networks, Google, Wi-Fi, Wikipedia/iTunes, etc., were also mentioned as important innovations. (CZ, DK, DE, IE, EL, FR, IT, EE, MT, NL, PL, PT, RO, SK, FI, UK)</p> <p><i>"Everybody has a mobile phone right now and it's normal, and thanks to that contact[ing people] is easier, for the employer or the family, at any time." (PL, Group 3)</i></p> <p><i>"I can call my aunt who lives in Australia and actually see her. That used to be unimaginable." (IT, Group 1)</i></p> <p><i>"It's easier to research stuff ... you might be in the move, you hear something or you want to know more about something. It's easy to just Google it." (UK, Group 1)</i></p>

Positive and negative impacts

Positive	Negative
<p>Convenience, more comfort</p> <p>Better and faster communication/the world became a smaller place</p> <p>Easy access to information</p>	<p>More impersonal forms of communication/loss of social skills</p> <p>Loss/worsening of social relationships, loneliness, isolation</p> <p>Privacy and data protection concerns</p> <p>Alienation towards society, addiction</p> <p>Passive lifestyle</p>

The Internet and mobile phones/smartphones **make everyday life and work easier and more comfortable** (making calls, checking e-mail and social media, paying bills, shopping, simplification of personal daily life). (CZ, DK, DE, EE, IE, EL, FR, IT, MT, NL, PL, PT, RO, SK, FI, UK)

"The internet simplifies daily tasks. We can check our bank account, we can see which subway line we need to take. That's right thanks to the internet you can have online banking, no need to pay unnecessary charges anymore. With the internet you can break monopolies, everything to do with electricity, etc. With access to information, you can stay informed. Easy for consumers." (FR, Group 5)

"What we used to carry in a suitcase we can [now] carry in our pockets, in our mobile phones today!" (PT, Group 1)

They also lead to better and faster communication allowing people to better connect with others, the **world has become smaller** and **communication across the world takes place almost instantaneously**. (CZ, DK, DE, EE, IE, EL, FR, IT, MT, NL, PL, PT, RO, SK, FI, UK). People are able to work from home and hold meetings with people in different countries (CZ, DK, EE, IE, EL, FR, IT, MT, NL, PL, PT, SK, UK).

"It's made the world a smaller place ... you can have a video conference with someone in the other side of the world, rather than do it as a phone call or travel to see them." (UK, Group 2)

"It's easy to speak with someone who lives abroad...you can see your relatives via Skype...you can feel close to them...you can spend hours talking to them at no cost." (MT, Group 1)

There is also more **democratic engagement** – one is able to communicate with anyone – and open sharing of information and communication across the globe (DK, DE, IT, MT, FI, UK).

"The Internet [has had the most impact], because a totally new, more global perspective is opening up, information presenting diverse points of view can be acquired and you're not tied to one kind of TV broadcast or mainstream press..." (PL, Group 2)

"If you send an email to the president they will reply. Before we would not have imagined that we could communicate with the president or prime minister of Malta." (MT, Group 3)

The Internet and communication technology allows for **easier access to information** through, for example, Wikipedia and Google. (CZ, DK, DE, FR, IT, MT, NL, PT, RO, SK, FI, UK)

"I think it's a good thing because we can have access to information anywhere, at any time, anyhow. To read a book you just have to download it online, maybe some books aren't available in the stock and you have to study. The more information, the better." (RO, Group 3)

"It doesn't matter if you are looking for a self-help group or the man of your life. You can find everything on the Internet." (DE, Group 4)

A positive impact has been seen in the world of work as people **are able to work from home and hold meetings with people in different countries.** (CZ, DK, EL, FR, IT, MT, PL, SK)

"Nowadays public libraries are superfluous. You get all the information off the Internet." (DE, Group 3)

"Everybody has a mobile phone right now and it's normal, and thanks to that contact[ing people] is easier, for the employer or the family, at any time." (PL, Group 3)

However, leaps forward in the area of communication have also had negative impacts. For instance, the **art of 'real' communication is seen as suffering.** This affects aspects such as conversation, writing a letter, and also grammar skills and leads to more impersonal forms of communication and a loss of social skills/relationships. (CZ, DK, IE, FR, IT, MT, NL, PL, PT, RO, UK)

"Nowadays there are more children who have problems in speech development and their communication skills are limited. We are not talking enough to our children. Even in class is an interactive white board so verbal communication is being replaced with visual communication." (MT, Group 5)

"It's human contact, I think less human communication with people these days, because you see everyone's on their smartphones or mobile, people don't speak anymore." (UK, Group 4)

Loneliness, worsening of social relationships, alienation, and isolation were also mentioned as negative impacts of communication technology. Examples include children communicating virtually with others instead of face-to-face with their parents, people struggling to keep up with technology and new ways of communicating, and people coming to visit less because the ways through which they communicate have changed. (CZ, DK, DE, EE, IE, EL, IT, NL, PL, RO, SK, UK).

"It's more the loneliness. I'm at home with three kids and they're up in their bedrooms having full conversations with people in other bedrooms in other houses. They never come down or talk, whereas when we were kids you played together." (IE, Group 5)

"There are positives and negatives: you can talk to family far away. But people who live close to each other use this technology to do everything using the Internet, without seeing each other. There is loneliness despite it all, we're alone with our phones. Individualisation." (FR, Group 4)

"We are just avatars, we are what we claim to be but which we actually are not, we can pretend and build whole relationships on this false basis." (IT, Group 3)

Privacy concerns/loss of privacy was a major concern among participants (CZ, DK, DE, EE, IE, EL, IT, MT, NL, PL, PT, SK, UK) and some also felt that there was too much control and surveillance of peoples' activities (DK, DE, IE). Data protection concerns were also very prominent and participants were concerned about how secure their information is. (CZ, DK, DE, EE, IE, EL, FR, MT, PT, RO, SK, FI)

"Everything is in the cloud, but whose cloud is it?" (FI, Group 3)

"You can secure your data in better ways, for example in 'dropbox', but that means that others could also access it." (DK, Group 2)

"It's not only about cameras. You get controlled in the Internet as well. If you buy a (flight) ticket, everything gets collected. Hundreds of pieces of data for each passenger. That makes me sick. That's surveillance." (DE, Group 3)

On the other hand, in several countries participants expressed concerns about the fact that communication devices and social networks allow people access to work 24-hours a day which participants felt have had a negative impact on social and family life (due to never being unavailable).(DK, DE, EE, IE, EL, IT, MT, NL). These devices can also become addictive as people develop a fear of missing out (FOMO) (CZ, DE, IE, IT, NL, PT, RO, FI, UK), and they tend to over-consume on technical gadgets (EL, IT, MT, NL, PL, PT, UK).

"We are like machines, permanently at the office, always contactable, and we have limited time to ourselves." (MT, Group 6)

"I think with work e-mails and stuff, you know that I always feel that I have to reply to work e-mails even if I'm not in the office ... they're expecting you to reply.." (IE, Group 2)

*"My friends are checking their phones for messages every few minutes."
(NL, Group 5)*

*"It's like a drug: the more you get, the more you want. You panic when the connection fails; you feel lost."
(IT, Group 6)*

Laziness and a passive lifestyle (too little physical activity) were regarded as other negative impacts of the Internet and developments in communication technology. (CZ, DK, EE, EL, IT, MT, NL, PL, RO, SK)

*"The fact that children are on the computer a lot. I can remember when my child was little then there were hordes of children running around on the streets, in yards and gardens and they were playing. Now there's silence even in the summer. It is rare when you see children outside. Everyone is sitting inside and becoming estranged. No socializing. They live next door but communicate on the computer."
(EE, Group 5)*

*"Technology makes the brain lazier. It does the thinking for us."
(RO, Group 5)*

Finally, participants frequently mentioned that developments in communication technology, can lead to **social exclusion** and can be strenuous because of the need to permanently learn new things. (DK, DE, EE, FR, IT, MT, NL, PT, SK)

*"Especially elder people are locked out. They cannot keep up with all technological developments."
(NL, Group 3)*

*"Left behind, a hard time adapting. We're chasing something that is already obsolete. We're turning robots. Losing our values, our sociability"
(FR, Group 6)*

*"Today something comes out and tomorrow it is old."
(MT, Group 3)*

This finding resonates with one of the results of the 2013 *Eurobarometer survey on Responsible Research and Innovation (RRI), Science and Technology* survey where Europeans expressed concern about the speed of change in the field of science and technology and their potential for negative consequences: **62% thought that science makes their way of life change too quickly.**

AREA: Digitisation of society (including commerce)
<p>EXAMPLES:</p> <p>Closely related to the Internet and development in communication devices is the digitisation of society (the switch from analogue to digital, the variety of Apps for shopping and accessing services, credit cards, electronic ID cards/passports, etc.), digitisation of information (CDs, books, the cloud). Computers become such an integral part of everyday life. (CZ, DK, DE, EE, IE, FR, IT, MT, NL, PT, RO, SK, FI, UK)</p> <p><i>"We can do everything with Apps: banking, shopping, playing." (IT, Group 1)</i></p> <p><i>"You used to have to buy CDs, now you have Mp3 and you can store 1000 of them on a small device." (IT, Group 6)</i></p>

Positive and negative impacts

<u>Positive</u>	<u>Negative</u>
<p>More efficiency</p> <p>Easy access to information and services</p>	<p>Unemployment</p> <p>Loss of skills</p> <p>Social exclusion</p>

A positive impact of the transition to a digital society has been **improvements in efficiency**. Innovations in the last 15 years have enhanced productivity through making it possible to produce more goods, food and commodities. Additionally computers and Apps that save time and money are widely available, all of which has contributed to an improvement and simplification of work processes. (IE, EL, FR, IT, MT, NL, PL, PT, RO)

"It makes life easier, less time wasted. All these modern technologies are a great benefit, to get anything in the shortest time possible." (RO, Group 4)

E-services make it possible for that **information and data to be exchanged more easily, services are more easily accessible**, and shopping is possible for everyone (provided they have access to the necessary technology). (DE, EE, MT, NL, PL)

"Job hunting in the Internet, government departments, you access them through the internet. Everything is done through the Internet." (FR, Group 3)

"Internet banking. Digital tax declaration." (NL, Group 2)"

"The positive thing is that there is less running around and you can do a lot more during the day. In the past I would have had to go from one end of the town to the other and wouldn't have got anything done. Those e-services in particular. Back in the day I can imagine that there would have been at least 5 accountants, but now I can manage alone." (EE, Group 4)

However, a more digital society also requires fewer employees, which was seen by participants as having resulted in **unemployment**/job losses. (CZ, DK, DE, IE, EL, FR, IT, MT, NL, PL, PT, RO, SK, FI, UK)

"We can do things more efficiently. We just need fewer people to do those jobs." (NL, Group 2)

"Fewer jobs, things are increasingly automated, less labour." (FR, Group 1)

"The machines are going to take over the world and we're going to be just a spare part. You know, we're going to be exterminated if we're no longer of any good." (UK, Group 3)

Growing dependence on technology could also result in a **loss of skills** as people forget how to perform certain tasks. (CZ, DK, DE, EE, EL, FR, IT, NL, PT, RO, SK, FI, UK). Also, the services sector has become more impersonal through, for example, automated call centres (DK, DE, IT, MT, NL, PT, SK, UK).

"I just think that if the things you normally do yourself are taken over by a robot, you end up forgetting how to do them yourself." (DK, Group 1)

"Robotisation makes everything more impersonal and that means that old people will never see anyone and get lonely." (DK, Group 1)

"It has lost jobs though...in my day you picked up a phone and you dialled a number and you had somebody on the other end of the phone within 10 seconds – nowadays if you go to ring anybody, it's press number 1, press number 2..." (IE, Group 4)

The move to a digital society has also lead to **social exclusion** – the higher costs of technological innovations mean that it is not available to all and not everyone has the necessary skills to be able to use the technology. (CZ, DK, DE, EL, FR, IT, MT, NL, PT, FI, UK)

"Older people might not be able to follow such rapid developments." (FI, Group 5)

"I remember reading somewhere that 52% of people have got a smartphone, which, if you flip it for 48% of people haven't got smartphones, so I don't think it's that inclusive." (UK, Group 2)

AREA: Healthcare/Medical advances
<p>EXAMPLES:</p> <p>Advancements in the medical profession: better and less invasive diagnosis and treatment, new and better medical equipment and medicines (e.g. laser eye surgery and other non-invasive surgical practises, use of robotics in surgeries, stem cell research, new medicines and vaccines, etc.) (CZ, DK, DE, IE, EL, FR, IT, EE, MT, NL, PL, PT, RO, SK, FI, UK)</p> <p><i>“Previously you had to do X-ray. Today you do MRI which can diagnose faster and better.” (DE, Group 2)</i></p> <p><i>“Combination of science and technology, a lot of progress has been made in things like replacing heart valves or artificial organs.” (IT, Group 5)</i></p>

Positive and negative impacts

<u>Positive</u>	<u>Negative</u>
<p style="text-align: center;">Better preventive medicine and diagnosis of diseases</p> <p style="text-align: center;">Better treatment of diseases: better medical equipment, better and less invasive medicine</p> <p style="text-align: center;">New medicines and vaccines</p>	<p style="text-align: center;">Genetic diagnostics/cloning</p> <p style="text-align: center;">New ethical dilemmas</p> <p style="text-align: center;">Impact of technical innovations on public health</p>

Participants could easily identify the positive impacts that scientific and technological advances in healthcare have had. These have resulted in **increased quality of life** in the areas of preventive medicine and disease treatment (better medicine, better medical equipment, etc); people are healthier and their **life expectancy has increased**. (CZ, DK, DE, EE, IE, EL, FR, IT, MT, NL, PL, PT, RO, SK, FI, UK)

“I can say from personal experience, I had an eye operation. Back in the old days this required staying in bed for 2 weeks afterwards, someone told me, they had it done a couple of decades ago but for me...10 minutes after I was getting on the bus on my own and going home. It has developed a lot.” (EE, Group 4)

“Smart watches can measure your physical functions.” (DE, Group 4)

“Even now it has developed a lot. The doctor gets the patient’s whole past on the computer. Back than it was a real problem if they lost your patient file. Right now everything is written down, where you’ve been with what illness. Even all the medications you’ve ever been prescribed are written down there.” (EE, Group 5)

However, some participants did express concern about aspects such as **genetic treatment/cloning** which poses new ethical dilemmas (CZ, DK, EL, FR, UK), while others were concerned about the **impact of technological innovations on public health** (e.g. chemicals, air quality) (DE, EE, FR, MT, SK).

"I'm a little torn about whether you should treat diseases in that way. Should we change nature or let it run its course? I'm really having a hard time with that. Should we really change how we are built? Who decides who gets treatment?" (DK, Group 1)

"The air will be more polluted; we'll be eating foodstuffs full of chemicals." (CZ, Group 3)

"I was watching a Youtube channel and a professor was saying that the closest you put the mobile near your ear, the more you are 'cooking' your brain as it emits more radiation." (MT, Group 5)

AREA: Environment (including energy)
<p>EXAMPLES:</p> <p>Recycling has benefitted the environment (CZ, DK, EL, PT, FI)</p> <p>Renewable energy (such as wind energy, solar energy, etc.) (CZ, DK, EL, IT, MT, NL, PL, PT, RO, FI, UK)</p>

Positive and negative impacts

Positive	Negative
<p>Better recycling</p> <p>Renewable energy</p> <p>More environmentally friendly houses</p>	<p>Loss of natural resources (raw material, food, forests)</p> <p>Increased use of pesticides</p> <p>More pollution (water, air, excessive waste)</p>

Recycling has a **positive impact** on the environment because fewer resources are used. This has been made possible through the development of recycling systems. (DK, EE, EL, PT)

“Recycling saves resources and has individual and social benefits, thus ensuring that the environment is not destroyed and creating new products, cheaper products on the market, since recycled products are cheaper.” (EL, Group 4)

Clean energy saves resources and eases strain on the environment (DE, EL, IT, EE, PT, SK, UK). **New technologies in the construction industry** have made houses more environmentally friendly. (DK, NL, EL, MT, SK)

However, concern was also expressed that certain innovations have negatively impacted on the environment through increased pollution, loss of natural resources, global warming, loss of forests, **lack of natural food**, increased use of **pesticides** and **exposure to chemicals**. (CZ, EL, IT, MT, RO)

“Modern technology has very harmful waste which ends up in rivers and seas, too much waste! Such as silicon for example.” (EL, Group 4)

“I’m worried about whether we can get things to be sustainable. We use more and more and I worry about a collapse and lack of resources.” (DK, Group 2)

Similarly, scientific and technological advances were seen as having led to the creation of excessive waste and the **overconsumption of natural resources**. For instance, technology is not seen as having been 'built to last', which leads to more devices or appliances being used and discarded. In addition, as technology changes quickly devices become outdated just as fast which adds to waste. (CZ, DK, EL, MT, RO, UK)

"There is an eighth continent in the ocean: an island made of plastic." (CZ, Group 4)

AREA: Homes and living
<p>EXAMPLES:</p> <p>New types of insulation, new building construction materials and techniques, and energy efficient heating and air-conditioning (DK, EL, IT, MT, NL, PT, FI)</p> <p>Home automation – sophisticated home appliances, stair lifts, heating and air-conditioning system programmed from mobile phones, “smart grids”, etc. (DK, DE, FR, IT, MT, PT, RO, FI)</p> <p>Flat screen televisions/3-D television (EL, PL, SK)</p> <p>Robotisation of everyday life (private and in the workplace to automate physical work) (DK, IE, EL, DE, FR, PT, SK, FI)</p>

Positive and negative impacts

<u>Positive</u>	<u>Negative</u>
Simplification of everyday life	Loss of skills
More comfortable homes	Higher costs
More time to leisure activities	Less durable goods
Better materials and techniques in construction	

Scientific and technological innovations have had many positive impacts on homes and living, such as: relief in everyday life, **simplification of life/everyday activities, access to work and services from the comfort of your home**, life is easier and more comfortable and convenient, people have more time to themselves as a result of time savings through automation and electronic home appliances (CZ, DK, DE, EL, FR, IT, MT, NL, PL, PT, RO, SK, UK). "Smart grids" connect household technology together and make life easier. (DK, FR)

“Household appliances have made my life easier. My children are now grown up and they remind me of their childhood years when I had to wash by hand because we had no washing machine...for me it’s a success of technology.” (RO, group 5)

New home equipment is good for the elderly/handicapped, for example, stairlifts.

However, home automation and convenience has resulted in a certain level of deskilling. For example, ‘ready-made meals’ mean that people don’t know how to cook anymore (UK).

Some items are more expensive (e.g. hoovers) and are difficult to fix when something goes wrong. Household items are not built to last anymore, but break quite easily (UK, MT).

"Washing machines used to last ten, fifteen years. Now if you've got a five-year warranty, you're lucky if it lasts the five years." (UK, Group 4)

"Everything is disposable ... it is no longer worth fixing an appliance as it costs less to buy a new one." (MT, Group 5)

Similarly, buildings (including houses) are built with inexpensive and less durable products in order to reduce costs, but at the expense of long-term durability. (RO)

AREA: Transport
<p>EXAMPLES:</p> <p>Improvement of transport infrastructure and of the means of public transportation (sub-ways, city-trams, high-speed trains, faster and cheaper air travel, better roads) (IE, EL, FR, IT, MT). Electric cars, hybrid cars, ecological engines (CZ, DK, DE, EE, IE, EL, IT, MT, NL, PL, PT, RO, SK, FI, UK). GPS navigation systems (CZ, DK, EE, IE, IT, MT, NL, PT, RO, SK, FI) and GPS tracking (IE, MT, PT).</p> <p><i>"You can always find your way, without having to take a map with you, you can have all of that on your phone as well. I often use GPS to find out how long it will take me to get from one place to another and whether there are traffic jams on the way." (DK, Group 6)</i></p>

Positive and negative impacts

Positive	Negative
<p>Better transport infrastructure (road, bridges, tunnels)</p> <p>Better means of public transportation</p> <p>Safer cars (ABS, air bags, etc.)</p> <p>Electric cars and ecological engines</p> <p>GPS navigation systems</p>	<p>More pollution</p>

Scientific and technological innovations have resulted in better means of public transportation (better sub-way and city trams, better and cheaper air transport, etc.) (DK, IE, EL, IT, FR, SK, UK). In addition, new technologies in the construction industry made new types of bridges, tunnels, highways viable.

"The subway changed my life as instead of spending 50 minutes to go from home to work driving, I now spend 20 minutes by taking the subway." (EL, Group 1)

Cars were also regarded as safer, quicker and more environmentally friendly (CZ, DK, DE, EE, IE, EL, IT, MT, NL, PL, PT, RO, SK, UK), while navigation and travelling has been made easier with GPS applications (DK, IE, MT, NL, IT, PL, PT, RO).

"I'm thinking about all the safety systems such as blind spot-warning systems." (DE, Group 4)

"You used to leaf through Tuttocittà and road maps, now you have GPS." (IT, Group 3)

However, the increased use of cars has also resulted in more pollution which was regarded as a negative impact of technological development in transportation. (CZ, RO)

AREA: Education
<p>EXAMPLES:</p> <p>New educational methods and tools: interactive devices, online archives and books, remote classes, online training (CZ, DK, EL, IT, MT, FI, PT, RO, FI)</p>

Positive and negative impacts

Positive	Negative
<p>Access to more education opportunities</p> <p>New education methods and tools</p>	<p>Loss of skills (hand writing, memorising, etc)</p> <p>More difficult to build professional networks</p> <p>Social exclusion</p>

Access to long-distance education through remote classes or training course one can attend from home was regarded as a positive impact in the field of education. It gives people access to a larger variety of education without having to leave their homes and has led to innovations such as computer-based exams. (MT, IT, PL, PT, RO, FI, DK)

“There are training courses you can attend from home whenever you want, in the evening, on the weekend; they’re very helpful for working or older people.” (IT, Group 6)

Some participants expressed concern that technological innovations in education might adversely affect children or students. For example, students use their memories less, fail to acquire crucial skills such as writing by hand and mental arithmetic, are exposed to a lot more information of which the quality is difficult to discern, and might fail to develop a professional network as virtual education means that students never see one another. (DK, RO, MT, FI)

“Distance learning is great, but it shouldn’t be all there is. It’s important to get to know one another, especially when you have to create a network for when you’re working later in life. In order to be able to make use of one another, you have to get to know each other better.” (DK, Group 4)

“The downside in teaching and education [with virtual courses] is that it cannot be told with a feeling; instead it is just some light that you are watching and you cannot control what you’re doing.” (FI, Group 1)

AREA: Space technology and defence/military
<p>EXAMPLES:</p> <p>Space travel and space technology (ticket for trips to Mars, rockets, by-products like microwaves, etc.) (DK, IE, UK, EE)</p> <p>Drones and the development of new weaponry (UK)</p>

It is important to underline that this area was spontaneously mentioned only in a few countries unlike the other areas already discussed.

Positive and negative impacts

<u>Positive</u>	<u>Negative</u>
<p>Space travel accessible to general public</p> <p>Better military equipment/technology</p> <p>New military technology safer for soldiers</p>	<p>Wars could become more global and more destructive</p>

Participants had the impression that space technology does not always work as evidenced by space expeditions that have gone wrong in the past. (DK)

Positive and negative impacts

In a minority of cases, participants expressed concern about drones/non-pilot flying objects, and the advance of war technology and its possible uses. For instance, there was fear of war as wars can become more global and more destructive because of technological innovations, as well as a fear of the usage of technology for the wrong purposes. (EE, NL, PL, FI)

"It makes me think of drones and continually improved weapons. Multifunctional rockets, which are either detectable by radars or not." (PL, Group 6)

Differences by country

- Greece was the only country where participants' first associations were with healthcare when asked about innovations that had had the most impact on society, followed by innovations in communications technology. This is different from all other countries where communications technology was listed first, followed by healthcare.
- Slovakia was the only country that mentioned that although the trend to recycle is growing in the country, recycling is not yet routine for everyone.
- Denmark, Ireland, Estonia and the United Kingdom were the only countries that associated science and innovation with space technology.
- Estonia, Ireland, the Netherlands, the United Kingdom, Poland and Finland were the only countries that associated science and innovation with the military/warfare.

Differences by age and level of education for specific countries

- In the Czech Republic, Denmark, Finland, France and Poland older participants felt that innovations are moving too quickly for them to keep up and fully understand the developments. They fear being left behind.
- Scientific and technological innovations lead to unemployment or deskilling as a result of the automation of certain tasks. This was the view of especially older participants in Malta, France and the United Kingdom; as well as the medium to low education group in Portugal.
- Older participants in Ireland, Romania and the United Kingdom commented on the changes in the way in which people are communicating, with less face-to-face communication taking place.

II. SPONTANEOUS PROJECTIONS ON TOMORROWS SCIENTIFIC AND TECHNOLOGICAL INNOVATIONS

This chapter focuses on participants' spontaneous projections regarding the scientific and technological innovations that could be part of their daily lives in 2030. The focus is especially on the changes that are seen as beneficial and those that are judged as more negative or undesirable. The final section of the chapter discusses what participants imagined scientific and technological innovations would look like in four areas: what living at home will look like in the future; how people will take care of their health; how people will interact with each other and with machines; and how people will protect the environment in 2030.

2.1 *The scientific innovations expected to be part of peoples' daily lives in 2030 and their possible impact*

After having reflected on past years, participants were asked to turn to the future and to what they imagined society would look like in 15 years' time. Which innovations brought about by science and technology did they think would be part of their daily lives in the near future? What positive impacts would these innovations have on society (ideal scenario)? What negative impacts did they fear these innovations would have (worst-case scenario)?

Similar to the previous chapter, there is some overlap in participants' responses in this and the next section. This similarity is because participants' spontaneous projections of the future overlapped strongly with the four areas on which they were later prompted (homes and living, health and healthcare, ubiquitous communication and interaction, and the environment). The more detailed responses about specific innovations expected in each of these areas are therefore included in the next section in order to avoid duplication.

Across the different countries and groups, participants' spontaneous projections of future innovations that will be part of their lives **focused particularly on two areas:**

- **Homes and living:** participants expected the increased use of smart homes and energy-efficient solutions, and that robots will be used for domestic work. Examples of specific innovations included: more automation of household tasks, centralised control of home appliances, eco-friendly houses, 3-D printers voice-operated equipment, 3-D television.

"I can imagine robots doing all my shopping and housekeeping." (DE, Group 3)

- **Health and healthcare:** participants expected that diseases that are incurable today will in the future be diagnosed earlier on and cured, or that new treatments/medicine will be available. They also expected to be able to communicate with doctors over the Internet from home, and that phone Apps will exist for self-diagnosis. It was also thought that there would be advances in cloning and stem cell research, as opposed to having to wait for organ donation.

"I am hoping for the medicine to develop so that there will be no shortage of organs anymore. When you need something, then you can even add extra memory to yourself." (EE, Group 5)

According to the 2014 survey on Public perceptions of science, research and innovation⁴, **EU citizens considered Health and medical care and job creation the priorities for science and technological innovation over the next 15 years.** Over half of them believe that health and medical care should be the main priorities for science and technological innovation (55%) and around half of them think that it should be job creation (49%) The importance of health and healthcare as a priority area in the future was again illustrated in this qualitative study where one of the participants' main spontaneous projections of future innovations focused on health and healthcare. The importance of employment was also illustrated earlier on this report where participants identified unemployment as one of the negative consequences of the automation of work.

Other areas that were commonly mentioned by participants as areas in which they spontaneously thought scientific and technological developments would take place in the future included:

- **The environment/energy:** participants expected to be a greater use of renewable energy, and more efficient recycling and energy production technologies, as well as increased use of biodegradable materials, a paperless society, and more parks or artificial green areas in cities.

"Sorting and treatment of waste will become more advanced. Perhaps we will have robots taking care of the sorting." (FI, Group 6)

- **Transport:** the innovations most frequently mentioned were electric and self-driven cars. New types of planes and flying cars were also seen as possible innovations in the next 15 years. A minority of participants also mentioned space travel and the use of drones for civilian purposes such as deliveries.

"Traffic would be easier with suspended lanes, trams will be renewed in Bucharest...In 15 years everything will be electronic." (RO, Group 3)

- **Communication:** participants expected greater integration of IT, and that the different technologies would be better able to communicate with one another. In the case of ubiquitous communication and interaction, participants also envisaged a more negative scenario that might involve constant tracking and less face-to-face communication.

⁴ The full report is available here : http://ec.europa.eu/public_opinion/archives/ebs/ebs_419_en.pdf

"We would have an all-in-one mobile phone, one that has your insurance card, credit cards, gift cards, bus ticket and so on. That would be practical." (DK, Group 1)

Additional areas of future innovations that were mentioned, but by fewer participants, included the following:

- A cashless society / online shopping.
- A change in education systems resulting in more self-education or remote education.

Most of the negative feelings expressed by participants about the future of scientific and technological innovation were related to communication - in their view further innovation in this area will lead to increased surveillance and data collection, as well as isolation/loss of personal contacts and social exclusion.

"I think we will get to a stage where we will have less freedom due to lack of privacy. In the future each person will have a chip which will track their activities and whereabouts. More surveillance cameras will be introduced, especially in working environments, so that businessmen can track their workers." (MT, Group 4)

"We would not be talking to each other anymore. No more physical contact." (MT, Group 4)

There was also often in the majority of participating countries a **debate about** whether the changes expected from scientific and **technological development would make society more equal** or whether these changes would create a further divide between those who can afford this type of progress versus those who cannot.

"An elitist world: only a small group of the wealthy will be able to enjoy things." (FR, Group 5)

Participants were asked what their ideal scenario would look like in 2030, in other words what role should technology ideally play and how should it impact on their lives. Participants were also asked the opposite – what would a worst-case scenario look like that they would want to avoid? In line with their spontaneous responses the following figure summarises how participants envisaged these two scenarios.

IDEAL SCENARIO

Where scientific and technological innovations are truly designed to help people in current critical areas (for instance support for the disabled and elderly); ensuring increased safety and across-the-board energy saving, without becoming invasive or completely replacing humans.

Life will be even **simpler, better, timesaving, healthier, environmentally friendly & more gadgets and extensive automation of routine tasks will be part of everyday life.**

People will have more time to socialise, dedicate to pleasant activities, to travel.

Life expectancy will increase

WORST-CASE SCENARIO

Where machines replace humans, making people subservient and passive, taking away people's privacy while giving no benefits in return, and creating social isolation and absolute dependency on technology. More control over people, allowing them less freedom. Greater automation of work resulting in unemployment and deskilling. A widening gap between the rich and the poor as people have unequal access to scientific and technological innovation and the benefits thereof.

Most feared is a lack of control (dependence on technology, complete automation, deskilling), a lack of **human contact**, of **privacy, and unemployment.**

2.2 Expected innovations in selected areas

Participants were asked to reflect on possible future innovations in areas which would be presented to them later in the discussion: Homes and living, Health and healthcare, Ubiquitous communication and interaction and Environment. They were asked what innovations came to mind and what positive and negative impacts these innovations would have.

Homes and living

AREA: Homes and living
<p>EXAMPLES:</p> <p>Further automation of household tasks and centralised control of home appliances: advanced equipment in houses (automatic vacuum cleaners, 3-D television, invisible noise barriers, possibility to automatically change the colour of the walls, etc.), central control of home appliances, control of home settings when away from home. (CZ, DK, DE, EE, IE, EL, FR, IT, MT, NL, PL, PT, RO, SK, FI, UK)</p> <p><i>"Everything will operate automatically; washing machines, lights, everything will turn on and off automatically." (CZ, Group 2)</i></p> <p><i>"I think everything we use in the house at the moment will be connected. Like in some way there'll be some massive portal thing where you can switch on different lights in different rooms...they'll all [be] connected in some way. You'd probably be connected to whatever device that you have, like somebody saying you can turn the lights on when you're away on holiday or something." (IE, Group 1)</i></p> <p>Widespread use of robots in the home to undertake household chores. (CZ, DK, DE, EE, IE, NL, FR, MT, PL, PT, RO, FI)</p> <p><i>"I can imagine robots doing all my shopping and housekeeping." (DE, Group 3)</i></p> <p><i>"Robotics, by that time, the Bimby (Thermomix) will peel and do everything on its own, not only cooking but everthing else including house cleaning." (PT, Group 6)</i></p> <p>Home technical devices/gadgets would be more integrated and will make use of more advanced technologies like facial and voice recognition: for instance, mobile phones would be integrated with computers and the television and new technologies like voice or face recognition would be used to control equipment. (DK, DE, EE, IE, EL, FR, NL, PL, PT, FI, UK, RO); More advanced security technologies would be introduced in the home: iris and palm scanning, retina scanning, fingerprints, etc. (DK, FR, IT, MT, PT, PL, UK).</p> <p><i>"Your phone would become your remote for the entire home. So for example you are in the car, you could, sort of, tell your phone to tell your oven, like, you know, 'preheat the oven', or, you know, 'turn the heating down'." (UK, Group 2)</i></p> <p><i>"Finally you won't need to rummage in your bag for your house keys, the house recognises you through a camera system." (IT, Group 5)</i></p>

Homes would be more eco-friendly: houses would produce less waste because of better waste separation, houses would be more energy efficient and even produce their own energy, solar panels and water purifiers would be automatically part of the house, building materials would be more ecological. (EE, IE, EL, FR, MT, SK, PT, PL, RO, FI UK)

"There will be buildings that are autonomous. They will produce their own vegetables. They will be autonomous for those who live in them. Those buildings will produce their own energy." (EL, Group 3)

Positive and negative impacts

Positive	Negative
Ease, convenience, comfort Make life easier for the elderly	Laziness Deskilling Dependence on technology leading to vulnerability Data privacy Increasing inequality

Innovations in homes and living will make lives **easier, convenient, and more comfortable**. It will also save people time and money (CZ, DK, DE, EE, EL, NL, PL, PT, FI, UK, IT, IE, RO). Robots and the automation of homes will also **make life easier for the elderly, sick, or mobility impaired** (FR, IT, NL, FI, IE).

"The domestic robot will cook and clean for me and I will be able to lie down." (PL, Group 3)

"Residential comfort will have increased due to a smart home. Lights will switch off when you don't need them and the oven won't accidentally remain switched on." (FI, Group 2)

However, participants mentioned to fear that people would also become increasingly more passive and incapable of taking care of themselves without the assistance of devices, and a certain level of **deskilling** would occur. This would lead to **dependence on machines** and a diminishing role for humans (CZ, DK, DE, EE, IE, EL, FR, IT, MT, NL, PL, PT, FI, RO, SK, UK).

"You have no insight into how things work because everything is done automatically." (NL, Group 2)

Dependence on technology leads to vulnerability. Homes would become vulnerable in case of power cuts or lack of energy. The security of homes could subsequently be compromised and participants had questions about the reliability of these systems. (CZ, EE, FR, MT, NL, PL, PT, FI, UK)

"Everybody is totally dependent on technology. What if we have a technical breakdown or a cyberwar?" (NL, Group 1)

In several countries participants expressed concerns about **privacy** and **data protection** and about having **monotonous or boring lives** where little is left to the imagination and life is completely organised and controlled (CZ, DK, DE, IE, FR, IT, MT, NL, PL, PT, FI). They also expressed **concerns about laziness** and becoming housebound and isolated as a consequence of technological innovation (DE, IE, EE, MT, NL, PT, RO, SK, FI).

"I want human relationships not interacting with a robot." (IT, Group 2)

"Humans are meant to do things and communicate with each other. If all vanishes and we only communicate with machines we could end up having more mental problems." (FI, Group 5)

"Flashing lights and beeps everywhere. You're completely under control." (DE, Group 3)

"There will be less physical exercise and more overweight people." (NL, Group 3)

Finally, participants mentioned to be concerned about the social impact of increased technologies and the fear that it will lead to **increasing inequalities**, for example will the technology be accessible to everyone?, will people be able to afford it?, will older people struggle to master the technology? (CZ, DE, IE, EL, FR, IT, PT, UK)

Health and healthcare

AREA: Health and healthcare

EXAMPLES:

Many of the diseases currently incurable will be treatable, (e.g. new vaccines, new medicines, novel treatments, etc.). (CZ, DK, DE, EE, IE, EL, FR, MT, NL, PL, PT, RO, FI, UK)

"We'll live for a long time. They will be able to perform operations that are not currently possible. For those who are 100% deaf, there will be a system that allows them to perceive sounds. The same goes for eyes: there will be a camera that will enable the blind to see." (FR, Group 1)

Self-diagnose of illnesses at home (e.g. through a chip in the body, developments in genetic testing, etc.) (CZ, DK, DE, IE, EL, EE, PL, FI, SK, UK)

"You have this device, this box that gives you a health check-up based on your needs, maybe with control lights indicating when something is wrong." (IT, Group 4)

More powerful or efficient equipment for diagnosis and treatment of diseases will be available to ensure that treatment is as non-invasive as possible, and some of this treatment might even become automated and reduce the burden on the health system (e.g. robots to perform operations). (CZ, DK, IE, EL, FR, PL, PT, RO, SK, DE, FI, UK, NL)

"Having a blood test and analysing it might be easier, quicker and more specific." (FI, Group 2)

"Arriving at the hospital or any healthcare facility, getting into a machine and seeing what's happening inside one's body..." (PT, Group 1)

Organ donation will become obsolete because of the development of artificial organs, and genetic engineering. (DK, IE, FR, EE, MT, FI, DE, PL, RO, UK)

"It would be positive if we didn't have to make organ donations any more. That they could make all kinds of artificial materials that could replace them [with]. So that for example there would be no need to transplant a new liver. That they grow liver cells in a test tube and then you can inject them and the liver recovers. The same thing with [the] heart. Eye corneas as well." (EE, Group 5)

Tele-consultations/Internet-consultations with doctors will be possible, or it will be quicker and easier to consult with a doctor. (CZ, EE, NL, UK, FI, SK, PT, EL, FR); a **more streamlined health system** (e.g. centralised records, less bureaucratic healthcare, etc.). (FI, RO, PT, CZ, FR)

"If you could have appointments by Skype and then see the doctor...you already have telephone appointments, but you can actually see them, face-to-face, that's great for the elderly, or people that don't want to go out [to the doctor's rooms]. To actually be able to just look at a computer screen and see them [doctors] would be positive." (UK, Group 6)

Positive and negative impacts

Positive	Negative
Improved quality of life Increased life expectancy More control over one's health	Social and health consequences of longevity Ethics of certain treatments Costs leading to unequal access

Innovations in health and healthcare will lead to **improved quality of life** and **increased life expectancy** through early diagnosis, improved treatment, and possibility to cure currently incurable diseases. (CZ, DE, DK, EE, EL, IT, IE, FR, MT, NL, PL, PT, RO, SK, FI, UK)

"They will know immediately when something is wrong. So they can save people." (NL, group 1)

Individuals will have **more control over their health** through self-diagnosis, and through the convenience and comfort of consulting with doctors from home. (CZ, DE, EL, UK)

"We have body scanners that show diseases. Or I take a picture and send it to my doc and he sends back the diagnosis and a prescription for medicine." (Germany, group 4)

Despite these positive impacts some participants were concerned about the possible **decreasing access to doctors and the negative impact this might have on the diagnosis of illnesses**. The automation of healthcare (e.g. automation of diagnosis and treatment) could also lead to dehumanising the doctor-patient relationship. (IT, NL, EL, EE, PL older groups)

"Some people just need a good conversation." (NL, Group 4)

Some participants fear too that innovations in healthcare would mean that **healthcare becomes more expensive which could lead to unequal access** to these services. The costs were seen as likely to be prohibitive for those most in need. (DE, FR, PT, FI, UK)

"The best cures could be quite expensive so not everyone would be able to afford them which would increase the inequality in society." (FI, Group 5)

Some participants were also concerned about the **ethics around certain medical treatments** (e.g. genetic manipulation, IVF, and cloning), and a minority were even concerned that such advances could lead to genetic selection or eugenics. (IE, CZ, DK, FR, RO)

"Let's just assume that you could figure out everyone's genes. This could be abused, but you could also find out about diseases. In the worst case, it will lead to a form of racial hygiene." (DK, Group 5)

In addition to questions about the ethics around certain medical treatments, concerns were also mentioned about the **ethics of longevity**, the fact that although people might live longer their quality of life might in fact decrease (MT, NL, UK). In fact, **longevity was not accepted unquestionably** and some participants were also concerned about its possible social consequences. For instance, longevity might put pressure on the healthcare system, pensions, wages, the economy, and natural resources (DK, IE, RO). Others raised moral or ethical issues around keeping people alive for longer (FI, FR, DE). Medical advances might also change how people see themselves – some might not take care of their health anymore as they think that they will be treated later on (FI) while others might become obsessed with youth and perfection (FR) and others might become hypochondriacs because of constant health monitoring (DE).

Questions about privacy and possible surveillance were also asked – are medical records secure if they are centralised and electronically kept and if a chip is used for (self)diagnosis, does that open up the possibility of surveillance? (PT, EL, DK)

Ubiquitous communication and interaction

Although not mentioned in all groups, there seemed to be different views on the direction that technological innovations would take in this area.

For instance, some thought there would be even more gadgets in future and that there is still great potential for growth (NL, DE, RO), others thought there might be fewer innovations (UK), while yet a different view was there would be increasingly widespread use of existing devices and that behaviour would change in how we use these devices (FR).

AREA: Ubiquitous communication and interaction

EXAMPLES:

Holograms, artificial intelligence and telepathic communication will make **virtual visits a possibility**: people will not have to be present in a particular city in order to find work (decentralised living) and can meet with, or be close to others that live far away. Education could also take place in a virtual environment. (CZ, DK, EL, IT, FR, NL, PT, RO, SK, FI, EE, MT, UK, PL younger groups, PT younger groups)

"There is the possibility that direct communication is through a virtual environment, that you don't even leave home and then direct communication is when two avatars meet and...several books have been written about it." (EE, Group 4)

"Something that goes beyond video calls and doesn't require me to hold a heavy screen in front of me, for example hologram video calls." (IT, Group 5)

"Virtual communication will be more sensory. For example I have heard that even today the iPhone6 is capable of transmitting smell. So in 2030 it will be common." (SK, Group 6)

Development of the use of chips (e.g. as personal identification tools) / centralisation or linking of personal information. (PL, PT, UK, NL). This security would also extend to the idea of a **cashless society**. (DK, FR, NL, PL, PT, RO, UK)

"In 15 years there will probably be a chip in our bodies that we can use to pay. Developments are really fast." (DK, Group 6)

Positive and negative impacts

Positive	Negative
Personal and work life is easier Possibility to be closer to friends and family who are far way Remote work possibilities	Deterioration of social relationships / isolation Loss of privacy and freedom / increased surveillance Data security concerns

Advanced communication technologies will make **personal and work life easier** (e.g. remote work possibilities, virtual conferences, personal virtual visits with friends and family who are far away, etc.). (DK, DE, EL, PT, SK, FI, EE, CZ, IT)

“An embedded chip where you think something like, ‘I’m going to call this guy’ and you immediately start talking to him” (PT, Group 1)

A minority of participants could see the benefits of increased data collection. For instance, effective surveillance could play a role in combating crime (DK). And a chip containing personal information could make life simpler and easier, and save one time (e.g. using the chip to pay in a shop as it contains all one’s information, or having information centrally stored when applying for a grant) (PT, PL, UK, NL).

However, **increased data collection** through new communication technologies **might lead to increased surveillance** which participants were strongly against (DK, DE, IE, MT, PT, PL, FI, UK, CZ, EL, PL younger groups). They fear constantly being tracked and monitored with little to no regard for their privacy.

“I have this thing with surveillance, which is getting more and more extensive. I can’t really come up with anything good about it, but there might be a safety aspect in it.” (DK, Group 5)

“There’s technology out there that’s gathering information about you all the time, It’s looking to hone in on what you like and where you spend your time and what you do with your money. And so what they’ll do is they’ll target people that have spent a certain amount...they’ll target what they want and they will annoy you more. You’re just going to be pestered and pestered with advertising. And people are just trying to make money off you”. (IE, Group 2)

More developments in the field of communication technology could result in a **deterioration of social relationships**, less socialisation, less personal contacts with people, less face-to-face communication, and **isolation**. (CZ, DK, EE, IE, FR, IT, MT, NL, PL, PT, SK, FI)

"We will be increasingly isolated. There will be intrusions into our privacy. This already exists with hackers, credit cards and other data." (FR, Group 6)

Participants also strongly feared loss of privacy/freedom. (DK, IE, IT, MT, NL, PL, PT, RO, SK, FI, UK, PT)

"Institutions know everything about you. Everything is recorded and you do not have control over it." (NL, group 2)

"There'll be no such thing as anonymity or privacy because we'll be identified whenever we do anything." (UK, Group 6)

Some participants also mentioned to be concerned with data security - e.g. data exchange might be vulnerable to hackers. (CZ DE, DK, IE, FI).

Concern about the health risks associated with the increased use of technology was also mentioned by some participants (e.g. all the signals that surround people or increasing stress as people are connected all the time). (DK, DE, RO).

Environment

Instead of mentioning specific scientific and technological innovations, participants tended to focus more on the development of ways in which the environment could be protected as well as the popularisation of existing solutions.

AREA: Environment
<p>EXAMPLES:</p> <p>New and more effective energy production technologies (e.g. renewable energies such as wind and solar energy, hydrogen energy, etc.). (CZ, DK, DE, EE, IE, IT, NL, PL, PT, RO, FI, UK, FR)</p> <p><i>"If you look back 10 years, renewable energies were maximum 1%; nowadays we have 15-20%. [In] 15 years' [time], renewable power will be the common form." (DE, Group 1)</i></p> <p>More and better recycling (e.g. all material will be biodegradable, recycled products will be of higher quality and cheaper). (CZ, DK, DE, EE, IE, IT, NL, PL, PT, RO, UK, EL). More effective waste management/waste reduction strategies (e.g. effective waste separation strategies, automatic garbage collection in special collection units). (CZ, DE, EE, IE, EL, FR, FI, SK, PT, PL, IT)</p> <p><i>"I'd really like to hope that in 15 years they will come up with something that can recycle all...things. Let's take even our old computers or those simple plastic bags. The way things are right now they don't decompose or rot or do anything." (EE, Group 6)</i></p> <p><i>"The use of waste should be more efficient. Everything could be recycled." (FI, Group 6)</i></p> <p>Less pollution, especially because of innovations in the transportation sector (e.g. the widespread use of electric vehicles). (CZ, EE, DE, IT, MT, NL, PL, PT, SK, FR, RO, FI, UK)</p> <p><i>"Everyone will be driving electro-mobiles also; the effectiveness of engines will be higher." (CZ, Group 1)</i></p> <p>More environmentally friendly homes. (EE, IE, EL, FR, MT, PL, PT, RO, SK, FI, UK). More environmentally friendly production processes (e.g. appliances and devices will consume less energy, and production methods will be less resource intensive and more sustainable). (PT, RO)</p> <p><i>"We'll have sustainable production just by recycling and without having to use nature as a source for raw materials...more sustainable production that won't force us to kill so many animals and cut down so many trees..." (PT, Group 2)</i></p> <p>More green spaces in the cities (e.g. parks, rooftop gardens, or artificial green spaces). (EL, NL, MT, FR, PL, PT)</p> <p><i>"Clean and green cities, planted roof terraces. I hope this will take over cities..." (FR, Group 2)</i></p> <p>Better use of natural resources in the production of food. (IE, FR, IT, PT)</p>

Positive and negative impacts

Positive	Negative
<p style="text-align: center;">More environmentally friendly lives</p> <p style="text-align: center;">Better recycling</p> <p style="text-align: center;">Green energy,</p> <p style="text-align: center;">Less pollution</p> <p style="text-align: center;">Less production of waste</p>	<p style="text-align: center;">More waste</p> <p style="text-align: center;">More pollution</p> <p style="text-align: center;">Further environmental degradation</p>

Renewable energy and new technologies for recycling and waste management will result in **people living more environmentally friendly lives** characterised by less pollution, more sustainability, simplification, environmental protection and cost effectiveness. (CZ, DE, IT, DK, NL, EL, EE, IE, NL, PL, PT, RO, FI, UK)

"I believe we'll have less polluting plants, more electric cars or powered by another type of technology, we'll have a cleaner environment" (PT, Group 1)

"I'm thinking about renewable energy. This is definitively the future. The resources of the world can be used well." (DE, Group 1)

"An example, the hydrogen engine in the cars will be burning hydrogen and the exhaust will be oxygen, instead of polluting the atmosphere running a car will enrich it." (EL, Group 4)

Better recycling methods and more effective waste management will make our lives more sustainable.

"Sorting and treatment of waste will become more advanced. Perhaps we will have robots taking care of the sorting." (DE, Group 1)

"The trash will be converted into a form of energy." (EL, Group 2)

A barrier to the widespread use of these innovations was regarded as financial, rather than technological. In some countries participants expressed doubt about whether it would be possible to transition to renewable energy sources in the next 15 years because of: lack of governments' and businesses' commitment to environmentally friendly practices (FI, SK, DE, DK IE, UK) and because of the associated costs (e.g. who would pay for the necessary changes in infrastructure, and would more eco-friendly cars be affordable) (DK, FR).

"We would need to change a lot of our infrastructure and that is expensive. Who would pay for that? You need to think through." (UK, Group 6)

"I think there's no money in saving the environment but there's money in chopping it down to make things or to make medicines, I just can't see Governments, there's too much corruption....if you're going to make money from something you're only going to live for 70 years of whatever, you're going to be gone, you're not going to see the negative consequences." (IE, Group 2)

Increased technology might also lead to more pollution and further environmental degradation (e.g. new technologies might be developed that rely on scarce raw materials, more e-waste is created, over-exploitation of natural resources, decreasing ability to produce enough food and therefore an increase in synthetic and GM foods, new diseases, etc.). (CZ, SK, FR, RO, IE, EL, PL, FR, PT, UK, EE better educated older groups)

Differences by country, age and level of education

- It was only in Slovakia where participants were sceptical about whether the scientific and technological developments that they envisaged in the field of health and healthcare would materialise in their country in 15 years' time. They based their projection of how quickly things are likely to change in the future on how slowly they have changed in the past.
- In Italy, France, Estonia and Slovakia participants had difficulties predicting what scientific and technological innovations they expect to be part of their daily lives in 15 years. They tended to believe that the next 15 years are more likely to be marked by the extension or widespread adoption of existing technologies.
- Estonia and Poland were the only countries where participants associated the future of scientific and technological developments with military applications.
- Denmark, Ireland and the United Kingdom were the only countries where participants associated scientific and technological developments with space applications.
- In more than two-thirds of the countries participants thought that an increase in automation, for example as a result of robots taking over physical tasks at work place, would lead to unemployment. (CZ, IE, FR, IT, PL, EE, PT, RO, UK, EE)

- A cashless society / online shopping was mentioned in just over two-thirds of the countries as a future technological development. (DK, IE, FR, NL, PL, PT, RO, FI, UK)
- It was only in Denmark, Italy, Malta and Portugal where participants mentioned a change in the education systems resulting in more self-education or remote education as an area of future innovation.

In the 2014 survey on Public perceptions of science, research and innovation⁵, there were clear patterns in some of the answers provided to the survey questions based on education levels. The longer respondents remained in education the more likely they were to say that the environment and energy supply should be the main priorities when it comes to science and technology over the next 15 years. **These findings are different from this qualitative survey where these differences in education levels were not detected.**

⁵ The full report is available here : http://ec.europa.eu/public_opinion/archives/ebs/ebs_419_en.pdf

III. REACTIONS TO FUTURE SCIENTIFIC AND TECHNOLOGICAL INNOVATIONS IN SELECTED AREAS

The main objective of this qualitative Eurobarometer study was to **test a number of possible innovations** that could be applied in 15 years' time in the everyday lives of European citizens **in four selected areas**:

- homes and living
- health and healthcare
- ubiquitous communication and interaction, and
- the environment.

A scenario related to each theme and introducing possible innovations was presented during the focus groups in order to understand participants' preferences and reactions.

This chapter focuses on participants' reactions to the four scenarios and particularly discusses the following elements: How did they feel about each scenario and the innovations presented? What did they like or dislike? How acceptable were the scenarios? What barriers did they foresee in the implementation of these scenarios and what alternative innovations did they regard as perhaps more acceptable.

3.1 Homes and living

Here is the scenario that was presented to the participants⁶.

I'm going to read out a scenario that describes one possible future for society. The scenario I describe is possible but we don't know for certain whether it will happen. At the end we will discuss what you think of this scenario. This scenario relates to how living at home can look like in the future.

You are living in the year 2030. It's Tuesday morning and you are gently woken up by the voice of your Personal Robot Assistant, Pra. Pra brings you a cup of tea and goes through your schedule of appointments for today with you. On his build-in screen he plays a video message that a friend of yours in China sent while you were asleep.

Pra also inform you about the current situation of your stock of food. The sensor in the fridge has communicated to him that you are low on milk and running out of eggs, so Pra has made an on-line order for home delivery by the supermarket drone for these items. Pra always does this automatically for you, as you have given the clearance for him to do so in his controlling software.

Pra has learned to adapt his services according to your habits, and based on past actions Pra has built a profile of your preferences. In order to have the best personalized service, you have set the privacy settings of Pra to 'full record', which means that he keeps a complete memory of home recordings and the exchange of messages with you. This is also very convenient because you can ask Pra what went on at home on any particular day and Pra will instantaneously give you the information. All data that Pra's stores in his memory is kept on-line at the company's data servers. In this way his memory is not lost should he break down, and he can easily be replaced by another robot with the same personalized functionality.

While you eat breakfast, Pra tells you the news and the weather forecast: it will be sunny and warm!. The windows in your home are coated with a material that automatically darkens to block sunlight on hot days. This keeps your home cool in the summer. You don't use much energy for heating on cold days either because your home is well insulated. In addition, you produce some of your own energy: the roof of your building has solar panels. Via a smart meter you are connected to the power grid. This meter allows you and the power company to monitor exactly how much electricity you produce and consume, and the power company charges you less for electricity consumed during off-peak times.

Before you leave the house, you tell Pra that you would like him to arrange the cleaning of the house today. Today is convenient because all members of your family will be out of the house for work and leisure.

⁶ The four respective scenarios shown to the participants to the survey included a few photos to illustrate the scenario. These photos cannot be presented here due to copyrights.

Key observations relating to the scenario

Generally perceived as a **realistic** scenario because some of the technology already exists

Very mixed views about the scenario – positive and negative

Least liked: Robot as a personal assistant at home

- Acceptable: making life easier, doing routine tasks that frees up time
- Unacceptable: predictability, loss of privacy and self-determination, data stored off site, impersonal, physical presence of robot in house, some fear robots, lack of exercise and loneliness, lack of spontaneity, too expensive and therefore not realistic anyway

Most liked: idea of the smart house and the energy saving house

- Liked: smart meters connected to smart power grid, coated glass that helps with heat regulation, and solar panels

Most surprising / element least believed: some surprised by drones delivering shopping

Barriers: Cultural (acceptance of robot in personal space, dehumanisation), safety/privacy concerns (extent of data collected and maintained off site), emotional (fear of isolation), personal (life becomes too predictable and routine) and, financial (cost of installing the innovations)

Assessment of the scenario and innovations

First impressions

There were elements of the scenario that participants liked, disliked and felt ambivalent about. It is therefore not surprising that the words first associated with the scenario reflect this diversity of views.

Positive associations included descriptions such as: convenience, comfort, care free, time saving, practical, useful, evolution, ideal, more leisure time, assistance, cosy, simplification, relaxation, curious, exciting, freedom, efficiency, innovative, energy saving, pampering, and luxurious.

"It allows us to do other things, fun activities, because the house is well kept. Managing our day, we can do something else, save time. It leaves time to what you love, it's no fun doing household chores." (F1, Group 1)

Negative associations included descriptions such as: impersonal, disappointed, shocked, weird, emptiness, lack of control, lack of privacy, routine, dehumanisation, depression, oppressive, frightening, paternalistic, ridiculous, anxiety, automation, unrealistic, loneliness, sterile, boring, and lazy.

"The scenario abolishes man. That robot does not let you think, not doing, not planning, not organising, thus, it abolishes man." (EL, Group 6)

The reasons for these descriptions become clear in the discussion below of the different innovations presented in the scenario.

Overall assessment of the scenario

Participants thought that the **scenario was technically realistic**, especially as some of the technology referred to already exist, although not all aspects were desirable because of the dehumanisation it suggests.

"In my opinion all of this is actually realistic today, well, it is clearly very expensive but all of it is doable. But this is not a life that I would like to live in the future because so many of the activities in the day, they will go to robots, then basically you don't have anything else to do really." (EE, Group 1)

Some participants considered the scenario **socially unrealistic** because people have a social nature and will not want to live this way. (DK, FR, IT, FI)

"Unrealistic. It could very well be that some of these things are going to happen, but I don't think people will want to live like that, because people have a social nature." (DK, Group 1)

However, they **acknowledged how aspects of the scenario, especially the robot as a personal assistant at home**, could be to their benefit by **freeing up the time it takes to complete household chores**. This would be very convenient. They were also very **positive about the energy saving ideas** contained in the scenario.

"No more housework." (DE, Group 3)

"The whole chapter which deals with energy savings is good and realistic." (FI, Group 5)

Participants were **very concerned about privacy and data storage**, especially as information is kept online.

"It bothers me that he (the robot) can store all the information, all my dialogues, all of what I was doing inside my home, my private space!" (PT, Group 3)

They also thought that life would be too predictable if so tightly organised and controlled and they disliked the lack of choice/lack of autonomy presented in the scenario.

"Spontaneity is lost. Everything is organised in advance." (DE, Group 3)

"It suggests people want super-efficient lives, and I don't think people do. When I go home I don't want to be efficiently running around...putting everything in its place. Home is for living in." (UK, Group 4)

"What am I going to do with my brain – if there's somebody there doing my shopping, taking down what I need...what do I need my brain for. It would be total laziness; you'd end up being like a beetroot or a cabbage." (IE, Group 4)

Some participants were scared by the idea of a robot in their home.

"I would be afraid of the power and strength the robot has. What if it malfunctions and hurts someone? It's a machine after all." (CZ, Group 3)

Participants generally held that many of these innovations, or their predecessors, already exist. For this reason there was no widespread surprise about the innovations, although the one innovation that some participants did express surprise over and that was not always seen as believable was the **home delivery of goods by drones**.

Most liked innovations

Smart meters connected to a smart power grid (where the power company monitors a household's exact electricity consumption). Participants (in all countries) considered it a good idea as it saves money and energy. They also liked the idea of solar panels.

"Saving money on electricity is a great deal." (DE, Group 2)

"Everything that saves energy is good." (NL, group 5)

The coated glass that automatically darkens to block excess sunlight. Most (in all countries) liked this idea as it improves indoor comfort and enables a reduction in energy consumption. Some participants mentioned that it would be important for them to still be able to exercise control over their own environment if it becomes too dark or too light.

"It's nice because it's cool inside and I don't have to remember to draw the blinds when I leave in the morning." (PL, Group 2)

Personalised assistance with household chores. Participants acknowledged the potential to free up people's time (in all countries). Nevertheless in some countries (EE, IT, FR, MT, UK) participants expressed doubt about the efficiency of a robot doing these tasks, while others (CZ, DK, EL, NL) were very divided about the convenience of home chores being done by a robot. Participants also liked that such assistance has the potential to help those who are vulnerable, such as the elderly or sick.

"It's nicer to leave home, the robot will clean. I get back home and it's clean and tidy." (PL, Group 3)

"It could be really useful to people with physical problems, that's where it would be most helpful." (IT, Group 4)

Others thought it would be more acceptable to have a device or system which could do housework or other tasks in the same way as the robot, but which would be a bit smaller and would not look like a robot, or could even be a smart house with integrated systems. (FI, NL, UK, IE)

Participants expressed **mixed views about the smart fridge** and the automatic ordering of food online. Some were concerned that this would take the spontaneity and joy out of shopping and that people would not be able to change their needs and preferences.

"I enjoy going to the market and chatting with the lady that sells me good tomatoes." (CZ, Group 2)

"What I eat depends on my mood and shopping for food allows me to try new types of food and recipes." (MT, Group 2)

They also did not like that they would not be able to see what was bought, e.g. the robot could come back with rotten eggs. They also did not like relinquishing control of their financial expenditure (SK, DK, DE, PL, MT, FI, UK, FR, NL, CZ, IT, EE younger groups, RO older groups). In general, the idea of automatic ordering was what people more disliked in the smart fridge.

"I don't mind thinking. I could like being free of the manual work around home, dusting and such, but I can order eggs myself." (CZ, Group 6)

For some participants a compromise could be that only essential items such as bread and milk are bought automatically, or if suggestions were made of what shopping should be done instead of actual purchases. (NL, IT, DK, FR)

"I would only like it for the things you always need, like milk and water, but please not always the same diner on the same weekday for example." (NL, Group 3)

However, some aspects of the smart fridge were positively accepted by participants in several countries (SK, PT, PL, DE, FI, EL, DK, IT, RO younger groups, MT younger groups, NL younger groups, IE younger groups, EE younger groups): quantities and expiration dates are monitored, online ordering takes place which is time saving, and there is more rational and less impulsive shopping.

Least liked innovations

Participants (in all countries) **disliked the idea that all data are kept online** on an external server as they were concerned about the security of the data and the possibility of data theft (hacking) or misuse. In some countries the idea was strongly associated with complete surveillance which participants were opposed to (CZ, DK, DE, EE, EL, IE, PL).

"Everything that happens on my life is in the cloud? That's violation of my privacy." (NL, Group 4)

"The fact that the data is stored on servers and then it is so that someone is monitoring you all the time, what you are doing." (EE, Group 1)

The **keeping of a complete record or memory of their home events** (e.g. lack of **privacy**) was mentioned as a concern in all countries because of the possibility of monitoring people and of the idea of surveillance it suggests.

"Totally scary that all of this information about our lives will be stored without us knowing. I don't see the point of storing everything we do at home. I don't think that we're so busy that we don't know what we're doing." (FR, Group 3)

"I find it quite negative to keep a complete memory of home recordings and the exchange of messages. I wonder if they end up in the web for everybody to listen." (FI, Group 2)

However, there were some conditions under which the recording of data was regarded as acceptable:

- 1) for security reasons (e.g. when one is away on holiday) (PL, RO, CZ, FR);
- 2) in relation to the elderly, sick, or small children (e.g. as a record of what medicine they have been taking, enabling a quick response in case of danger) (SK, PL, FI); and
- 3) in the context of routine maintenance (e.g. notification if a pipe has burst) (RO).

What could be more acceptable for some was if the data would be stored on the internal hardware of the robot or somewhere else in the house where the owner can have full control. (DE, RO, FI, IE, IT, PT, FR, MT younger groups)

Participants also disliked what they perceived to be a **lack of choice / lack of autonomy** presented in the scenario: their lives are too organised, controlled and automated, the impression that people don't make their own decisions in

their own homes anymore, loss of spontaneity and creativity (SK, PT, PL, RO, DE, FI, UK, MT, NL, CZ, IE, IT, EE, FR).

"I don't like that everything is planned, predictable, and set up." (SK, Group 6)

"I don't like the idea – the fridge notifies, the robot orders and then it's delivered by a drone; now, come on! I want to do it by myself, at least the ordering." (SK, Group 6)

Many participants disliked the idea of a **personal robot assistant** (e.g. that helps with planning, personal messages, the weather forecast, wake-up calls) because it leads to too much automation and routine. They found the idea of a robot following them around unsettling and they already have other Apps or devices that perform these tasks that the robot might undertake. (SK, PT, PL, EL, UK, MT, NL, CZ, DK, EE)

"I think it scares me that something controls me, it might control the house, but controlling me ... when I want to see an e-mail, when I want to drink tea, when I want to get up." (PT, Group 1)

"It's like having a kind of policeman follow you around the house all the time saying – 'Do this, do that. You've marked a 10 o'clock appointment here.'" (PL, Group 2)

The robot was perceived as: 'cold' and lacking the 'warmth' of what is associated with home and family, a human shape for the robot was considered to be disconcerting, its proximity to people was disliked (too much in their personal space), and some expressed concerns over safety (that the robot would take over their lives and make all decisions for them). (SK, PT, RO, DE, NL, IT, DK, UK)

"I would be really annoyed by some robot always running around and talking to me. I don't need a buddy, especially when I already have a smart fridge. I don't need that." (DK, Group 6)

"A machine trying to look like a human won't work for me." (PT, Group 1)

Related to the dislike of having a personal robot assistant was participants' **concerns about what their role (the role of humans) in the household** will be if so many tasks are automated (SK, PT, IE, DK women). This also speaks to concerns about lack of physical exercise / laziness as a result of automation (NL, IE, IT, FR).

Concerns were also expressed about **possible isolation and loneliness** as the scenario creates the impression that the robot supersedes relationships with other people (PL, DE, FI, MT, NL, IT, DK). This was particularly expressed as a concern for the older people who live alone (DE).

"People will be isolated if everything is delivered at home. No personal contact anymore." (NL, Group 5)

"It's also very insular. There's no contact with the outside world at all, there's no need to go to shop, there's no need to hear some other human's voice in the radio telling you it's going to be sunny." (UK, Group 6)

"The robot should be an additional tool but not a replacement for real people and contacts. He should do all the things I have no time for." (DE, Group 4)

The **innovation that surprised some participants** and was not seen as believable by all was the **home delivery of goods by drones** because they were not very familiar with drones in general, or had never considered drones to be useful for non-military purposes. Some participants expressed more negative views: it could save time but shopping is an enjoyable experience and should not be taken away from people, drones could be used for spying, and drones might lead to unemployment, etc. (SK, PT, PL, RO, DE, FI, NL, CZ, IT, EE, FR, MT older groups, IT older groups). Some positive views included that: drones are able to make deliveries anytime during the day, they might be useful for the elderly or those who are ill, and drones could be time saving and practical if combined with the freedom to still go shopping in person. (DE, DK, EL, MT and IT younger groups)

"It's spooky. The drones know everything about us. Whether we are at home, what we are doing, etc. – there is no more privacy or data protection." (DE, group 3)

"I imagine drones delivering what you ordered on the Internet to your door, maybe on the very same day, reducing road traffic" (IT, group 5)

Barriers and acceptability

Participants mentioned a number of barriers to the acceptance of this scenario:

- Financial / cost (e.g. cost of installing the innovations which would mean that only the wealthy will be able to afford these changes) (SK, RO, DE, FI, IT, DK, EE). In particular the cost of the personal robot assistant (FI, UK, MT, IE, DK), and the energy saving insulation features (UK).

- Safety / privacy concerns (the extent of data collected and stored off site). (in all countries)
- Cultural (e.g. lack of acceptance of the robot in peoples' personal space, dehumanisation, traditionalists who might have a hard time adapting to the technology). (CZ, FR, EL, IT, SK, PT, FI, UK)
- Personal (loss of spontaneity/possibility to change routines, loss of decision-making power/self-determination) (CZ,DK, DE, EE, EL, IE, FR IT, MT, NL, PT, FI, UK)
- Emotional / social (e.g. fear of isolation, the impression that people don't need one another anymore, the feeling of being controlled and lacking, impression that an insular society is being created). (CZ, DK, DE, IT, SK, PL, PT, FI, UK)
- Technological – people will need to acquire some new skills to operate the technology and this might be a barrier especially for the elderly. (SK, EL)
- Religion, which will oppose the technology as it does with most innovations (RO)

Alternative scientific innovations

The following alternative scientific innovations were mentioned that participants thought would also be acceptable within the home environment:

- All home appliance should be wireless in future as cables do not look neat and tidy. (RO, FI)
- Appliances should be more compact to better fit people's living spaces. (RO)
- Entertainment like gaming, and health measurement or monitoring innovations. (DE)
- Robots and automatic devices could be produced which carry out outdoor chores like mowing the lawn. (FI)
- A robot to serve as a personal trainer and help participants to have a workout at home. (EL)
- The robot to inform participants on cultural events in the city. (EL)
- Glass that has built-in solar energy conversion, rather than separate solar panels. (UK)
- More innovations relating to household security. (CZ)
- A robot that would transform waste into something useful (a form of home recycling). (CZ)
- Innovations that would take care of window cleaning (CZ) and ironing (CZ, IT, EL).
- A robot acting as a financial consultant. (CZ, IT)
- A fully smart home that goes into 'standby' whenever you leave, thereby saving energy consumption and bills. (IE)
- More innovations in the area of water usage, for example a home that monitors ones water usage and automatically pipes in water for drinking, versus secondary uses. (IE)
- A special sensor that absorbs dusts through the air. (EE older group with higher education)

Differences by country, age and level of education

- There were a number of countries where participants' initial reaction to the scenario seemed particularly negative, although, with more reflection they were able to identify positive aspects. (CZ, SK, PL, EL, UK, IT)
- In Romania participants' initial responses were overwhelmingly positive, as opposed to the majority of countries where responses were more mixed.
- Romania was the only country where religion was mentioned as a possible barrier to the introduction of technological innovations.
- Slovakia was the only country where very few (only two) participants knew what a drone was and it was therefore difficult for them to imagine how home deliveries would work. They also thought that the scenario was unrealistic.
- The idea of using drones for the home delivery of goods was not taken very seriously in the Netherlands.
- The idea of the smart fridge was liked by younger groups in the following countries: Romania, Malta, the Netherlands and Ireland.
- In Poland and Malta young people were overall slightly more positive about the scenario than their older counterparts; while in Italy the older participants had a more favourable view of certain aspects of the scenario than the younger participants.
- In half of the countries participants expressed concerns about the implications of the scenario for their autonomy as they felt it might lead to a lack of control and less spontaneity. (DK, DE, EL, IE, IT, MT, NL, UK)
- In Estonia, a few participants with lower levels of education liked the idea of the robot being able to present important information and news.
- In possibility of robots completing household chores was not seen as very realistic in Estonia, Italy, Malta, France and the United Kingdom.
- The idea of a robot completing household chores left participants in some countries divided: the Netherlands, Czech Republic, Denmark, and Greece.

3.2 Health and healthcare

Here is the scenario that was presented to the participants.

I'm going to read out a scenario that describes one possible future for society. The scenario I describe is possible but we don't know for certain whether it will happen. At the end we will discuss what you think of this scenario. This scenario relates to how you and doctors can look after your health in the future.

You are living in the year 2030. Recently you received a message from the supermarket where you normally order your shopping on-line. They have noticed from your order profile that your choice of food purchases has changed, with an increased amount of sugary foods. As this is an early sign for diabetes, they suggest that you do a genetic test at your next visit, which you can buy at the pharma department of their store. The results of the test will become available while you shop and can be picked up at the counter.

The test produces a map of your genetic information and indeed indicates that you have a gene that gives you a 50% chance to develop diabetes in life. The test report gives you dietary advice for what type of foodstuffs you should eat to reduce the risk of you actually getting diabetes. The test report comes with a code that you can enter in your supermarket order profile, so that at your next order the supermarket can suggest you what foodstuffs to buy. An extra leaflet with relevant consumer products is also added to the report. This leaflet informs you that at the pharma section you can buy a wearable biochip; this is a self-adhesive patch that you can stick to your arm and which monitors your sugar levels.

The outcomes of the test indicate some other health risks and, in line with the retail protocol for such tests, it is suggested that you upload the results to your national health record. All citizens have a national health record, which can only be accessed by themselves and by their own doctors. The data of citizens are furthermore used in an anonymised way by medical researchers, who use this information to develop new medicines that can be tailored to the patient.

From your home, you have a video-call with the doctor who explains that the genetic test indicates some preventable diseases you might develop in future, and your doctor advises on how you can be healthy and reduce your chances of developing these diseases. With regard to the diabetes risk, the doctor asks you some questions and asks you to provide a blood sample. To provide the blood sample, you prick your finger and put a drop of blood into a sensor with a biochip. The biochip then analyses your blood and sends data electronically to your doctor. Using this information, the doctor informs you that you fortunately do not have diabetes. She advises you to follow the dietary advice as a matter of prevention and furthermore consider wearing the biochip just to monitor the situation. She reassures you that, in case you would develop diabetes, the disease can now be treated via stem cell therapy. This therapy takes a few cells from your body to grow healthy cells that can be placed back in your body, to ensure normal blood sugar levels.

In addition, based on the blood sample analysis, she also diagnoses that you have a minor bacterial infection. She asks you to submit another blood test electronically every 3 days for the next two weeks. She does not want to prescribe antibiotics for you because she can see from your genetic profile that your liver does not process them very well.

Key observations relating to the scenario

Ideas around **prevention were appreciated and generally liked**: e.g. genetic testing and dietary advice, although participants did have some reservations

Least liked:

- **Connection between health and supermarket** not liked at all – not credible, intrusive: the idea of constant monitoring and surveillance it suggests, conflict of interests; data collection by supermarkets represents a threat to privacy

Most liked:

- **Central storage of information although predominantly positive** – useful and easy access vs. possibility that information could be hacked
- **Genetic tests**
- **Stem cell** treatment liked, although participants had concerns around ethics and cost; not well understood in about one third of countries

Polarised

- Consulting with **doctor online** generally accepted, but **also mixed views** because of the fear that **this would become the only option available to people**
- **Biochip** - quick, comfortable diagnoses vs. surveillance

Barriers: supermarkets that might use information for sales, data privacy and security concerns, psychological and technological barriers as people are not used to these innovations.

Assessment of the scenario and innovations

First impressions

There were elements of the scenario that participants liked and disliked, and these preferences were expressed in the words used when they were first presented with the scenario.

Positive associations included descriptions such as: realistic, preventative, interesting, evolution, development, pioneering, convenience, ease, advanced, effective, longevity, improved self-knowledge, realistic, being prepared, useful, comfort, optimistic, safety, and accessibility.

"A direct link to your doctor, you get your results at home, no more wasting time in clinics." (RO, Group 1)

Negative associations included descriptions such as: humanity is missing, total control, people become hypochondriacs, scary, big brother, suspicion, vulnerability, impersonal, overly commercial, marketing, patronizing, terror, far-fetched, anxiety, and intrusion.

"That's horrific. I'm like a transparent man. I want to buy what I like. All this data collection is horrific." (DE, Group 3)

The reasons for these descriptions become clear in the discussion below of the different innovations presented in the scenario.

Overall assessment of the scenario

Participants regarded the innovations presented in this scenario as believable and advanced, and could easily see their implementation in 2030. Many of the innovations already exist to some extent and participants were generally familiar with them (e.g. centralised health records, dietary advice, stem cell research, etc.).

However, the scenario was also described as impersonal and overly commercial. This is especially because of the link between supermarkets and healthcare which was not seen as credible and widely disliked by participants.

Participants expressed mixed views about most aspects of the scenario – they could see the benefits, but also had some concerns. No innovation was fully accepted in its current form, (and apart from the link to the supermarket) neither were they rejected outright.

"The system is faster and well, in healthcare time saved also means more lives saved, that's how it is in real life. It depends on time how many people are cured. So this system is justified." (EE, Group 1)

"I think prevention is huge. If you can prevent these things from happening then that's great. If we can see it coming and then stop it." (IE, Group 1)

Objections to the different innovations were not based on their usefulness, but on predominantly three grounds:

- The link to the supermarket which overshadowed many of the positive aspects about the interventions that the participants identified.
- Concerns about data collection by supermarkets because of the threat it would represent to privacy, and the idea of constant monitoring and surveillance it suggests.
- Concerns about whether people will be able to opt-in, or whether the scenario presented will be the only available option. Participants clearly preferred being able to choose to be part of these innovations or not, for example taking part in home consultations when appropriate, but also being able to have a face-to-face appointment if they preferred.

"I do not like that they give you a leaflet with the list of things that you can buy as this is part of a market campaign. It is pushing and pushing the consumers ..." (MT, Group 6)

"It's scary! This is an invasion of our privacy." (PT, Group 1)

"There are just some things that the doctor needs to see and judge in person. In a video consultation you can only tell about symptom" (DK, Group 1)

"I don't want to get my results at the checkout. I don't want to know that I am 70% likely to get sick and nobody is there to support me emotionally." (DE, Group 2)

Most liked innovations

One of the most liked aspects of the scenario was the **centralised health data records** which can be accessed only by the patient and his/her doctor and which can be used in an anonymised way by researchers for medicine development. In two-thirds of the countries this innovation was positively received by the majority (EE, IT, NL, CZ, DK, EL, DE, PT, SK, MT, FR, IE). Participants liked the following aspects: that doctors can get all the information they need in one place, that it can be accessed quickly, medical researchers have an anonymous dataset that they can use, it encourages better cooperation between different specialists, etc. In countries where responses were more mixed (FI, RO) participants expressed the equal number of positive sentiments and concerns.

"It is extremely useful that medical researchers are able to develop new medicines by using citizens' anonymous data." (FI, Group 5)

"It is good to develop a national health records. It is good because the doctor will know everything about your health at any hour and moment." (EL, group 3)

Concerns about centralised health data records focused on data privacy, storage and security and for many these concerns need to be addressed in order to make the innovation completely acceptable in its current form.

"If all the data is stored centrally I would be afraid someone might sell my data to the pharmaceutical industry." (DE, Group 4)

"We've all have a national health record for a long time already. I even blocked it because it was accessible to a lot of institutions." (NL, Group 6)

The majority of participants were accepting the idea of medical consultations from their homes (tele medicine) (DK, IE, FR, EL, DE, IT, NL, CZ, PL, PT, RO, SK, UK), but there were also those who had more mixed views (FI), or who disliked the idea (EE, MT). The benefits of this innovation were seen as: a reduction in waiting times when a personal consultation is not necessary, it is useful for those who are less mobile or live in rural areas, not coming into contact with other sick people in the doctor's waiting rooms.

"To be honest...[it] saves time, because everybody has been to the doctor and everybody knows how much time it consumes. You have to get up earlier and wait for the appointment. And here we have practically immediate access." (PL, Group 2)

"A direct link to your doctor, you get your results at home, no more wasting time in clinics." (RO, Group 1)

However, even those who liked this idea **did not regard it as the most appropriate option in all circumstances**. For example, it might be an obstacle for the elderly who are not used to the technology, it dehumanises the doctor-patient relationship, it is not conducive to basic examinations such as taking someone's pulse, and these types of consultations should be optional.

"Probably OK when the news is not so serious, but when it is about something serious a screen is very impersonal." (NL, Group 1)

"There are just some things that the doctor needs to see and judge in person. In a video consultation you can only tell about symptom" (DK, Group 1)

"I am conscious about data protection ... what if the doctor is calling me in a public space? My issues will definitely not remain private" (MT, Group 6)

Innovations that focused on prevention were also generally well accepted by participants. They therefore, generally liked the idea of **genetic tests** that are affordable and available. Participants liked the possibility of early detection, that a complete picture of one's health is provided quickly and that the test would be cheaper than one taken at a pharmacy, etc.

"It is positive that these over the counter genetic tests are generally available during the shopping trips at a reasonable price since I'd like to do one of this." (FI, Group 2)

"Analysis is brought close. That you go and buy a test right away and then do it." (EE, Group 5)

But even in countries where the majority of participants liked this (CZ, IE, IT, FR, EE, PL, FI, UK, MT, NL, PT) **participants had some concerns**: whether a supermarket is the right place for this kind of test, whether data will be kept confidential, whether a cashier at a counter would be tasked with interpreting and conveying the results especially if the results are serious, and that people could become hypochondriacs.

"I believe that the issue of health is an issue for the doctor to know, so a doctor should suggest me to do a test or not, if I need it or not." (EL, Group 2)

"I do not like the fact that the blood test results should be retrieved over the counter. I feel that this is confidential information..." (MT, Group 4)

"I also thought about the poor cashier who has to handle people that have received some seriously bad news. Doctors learn how to handle that, but a cashier doesn't." (DK, Group 3)

"You will find out about all the illnesses. You make yourself sicker thinking about it. It is simpler to live when you don't know everything." (EE, Group 3)

Because of all these concerns in half of the countries participants were predominantly negative about this idea (DK, DE, EL, MT, NL, PT, RO, SK).

Participants generally liked receiving dietary advice for disease prevention. They thought that dietary advice is useful because: the link between poor nutrition and diseases is well-established, knowing what to eat requires a lot of research and getting advice will make things easier, someone might not notice that they are not consuming a variety of foods, etc.

"It is that they (supermarkets) try to educate people. They were not just giving treatment but preventing them with dietary measures. It is a good thing." (FI, Group 2)

Again in this case, even in countries where the majority of participants were positive about receiving dietary advice at supermarkets (FI, EE, EL, NL, DK, DE, PL, RO, MT, IE) and those where more mixed views were expressed (SK, FR, UK, IT young vs. old), they **expressed reservations about it**: they wouldn't trust the advice because of supermarkets' commercial interest in getting people to buy their products, they wouldn't like people telling them what to do (eat), and that the advice would be skewed if they were buying food for others or more unhealthy food because of a special occasion,

"They would recommend only their brands and products..." (CZ, Group 4)

"It is hard for me to think that a shop wants to prevent me from buying more ..." (RO, group 3)

"You also get a guilty conscience, because you might not have the healthiest lifestyle and when you're constantly reminded of that, that can lead to stress.", (DK, Group 1)

"But maybe I am not buying those candies for myself at all, but I have grandchildren and that is why I am at the store." (EE, Group 5)

More in particular, participants from Finland, the Czech Republic, as well as older participants from Italy thought that this intervention would be useless as the information already exists elsewhere, and it is often contradictory (fat is good for you, fat is bad for you...).

"Information about nutrition is often fragmentary and contradictory. Who decides what is healthy? It's very individual ..." (CZ, Group 2)

In some countries **stem cell research** was not well understood by all (NL, CZ, EE, PT, SK), but when it was understood most participants in all countries **liked the idea of stem cell therapy for organ repair**. Reasons for liking it included that this method will be able to cure many diseases.

I think it would be fantastic to be able to help people by giving them new organs made of stem cells." (DK, Group 1)

Reservations focused on ethical concerns (whether people should change nature or let it run its course), cost and whether people will become careless with their health because they know they can be cured with stem cell therapy.

Participants had **mixed views on the wearable biochips** for health monitoring and diagnosis. On the positive side it leads to quick, comfortable diagnosis; and therefore early interventions when required. It could also be useful for monitoring chronic conditions.

"[The] biochip is quite nice. If it shows that I have an increased risk of getting diabetes I might start following it." (FI, Group 4)

"The continuous monitoring is good, since blood sugar levels, blood pressure or cholesterol can jump up temporarily, simply as a result of stress we have at the doctors; because of this you are prescribed unnecessary medication." (CZ, Group 4)

However almost everywhere, participants disliked the idea of constant monitoring and were concerned about **data security** and **permanent surveillance**. These were also the reasons why the majority of respondents in Greece, France, Italy and Estonia rejected this innovation.

"We're chipped like dogs but who is the master?" (FR, Group 3)

"I don't know, having this thing stuck on me all the time ..." (IT, Group 2)

"In my opinion it is a little bit strange that every day, every second, every hour it is monitoring me all the time." (EE, Group 1)

Least liked innovations

There was widespread dislike among participants of the link between healthcare and the supermarket (DE, EL, IE, UK, FI, DK, CZ, PT, RO, EE, MT, FR, NL, IT, PL, SK). Supermarkets were not seen as credible providers of health information. They would want to maximise their profits. There were concerns about: misdiagnosis, manipulation by supermarkets in order to sell things they normally wouldn't, total control, and surveillance. Healthcare is treated like a business and the State allows health to become a private sector issue. Participants feared that a simple supermarket visit will result in life altering news about having a serious illness. They also found the monitoring of what they buy and the giving of advice by the supermarket as quite intrusive.

"On the one hand they want to sell spirits and cigarettes, and on the other they want to care for your health? That doesn't fit." (DE, Group 2)

"Yes, that gives me a stomach ache. That doesn't belong in to a supermarket. A supermarket should not tell me what I need. And no one should have access to my data unless I want them to." (DK, Group 3)

"It's a conflict of interests. Shops should never interfere with health." (NL, Group 1)

"It gives to me the impression that they want to control people, little by little: 'you have to eat this, eat that, sleep x amount of hours' I feel like saying 'Leave us alone'." (FR, Group 1)

"I do not like the idea of receiving a message from the supermarket after having checked your shopping profile. I do not like the fact that someone is delving into my personal life and telling me what I should or shouldn't buy." (MT, Group 4)

"Supermarkets don't have the competence. They are not doctors." (DE, Group 4)

In several countries, participants thought that this scenario was quite realistic in the future because many of these innovations already exist, and therefore were not particularly surprised by the innovations. However some ideas presented in the scenario were new to a great number of participants:

- Providing a blood sample at home / electronic blood tests (FI, DK, CZ, PT)
- That the retail market will be in close a relationship with health and medicine. (EE, FI, RO, MT)

- Biochips that measure your health status (DK, IT, RO), or the self-adhesive patch mechanism of the wearable biochip, not the chip itself (FI, SK)
- Stem cell therapy to the point where even diabetes can be cured (EE)
- Medicines that can be tailored to the patient (FI)
- Over-the-counter genetic tests (IT)
- Home medical consultations (IT)

Barriers and acceptability

- Supermarkets as the channel through which these interventions are delivered. Participants did not think supermarkets can provide the necessary quality of care and ensure the confidentiality of data. (all countries)
- Data concerns as the individual is constantly being monitored. There could easily be breaches in data security. The collecting of such vast amounts of information is also likely to face legal barriers. (EE, EL, FI, DK, PL, DK, RO)
- Psychological barriers for people who are used to and prefer human contact and are not familiar with the technology required for consultations from their homes. (all countries)
- Financial barriers, as these innovations are seen to be expensive and not available to ordinary people. (RO, SK group 3)
- Opposition from religious institutions who are generally opposed to technological developments. (RO)

Alternative scientific innovations

- A genetic test where a person's DNA will only be tested for genes related to diseases that they can actively do something about. (DK)
- A database where doctors would be able to cooperate and share their knowledge with each other. (DK)
- New cures for what are now incurable diseases. (CZ, RO)
- A portable device to keep at home and that will perform medical check-ups. (IT)
- A robot for disabled/sick people that will monitor their vital signs at home and that constantly communicates these results to healthcare personnel. (IT, RO)
- Remote communication between hospitals located in different parts of the world for 'global' consultations or diagnoses. (IT)
- Full body scans that could identify all health problems. (RO)
- Transplants or reconstruction of body parts for amputees using 3D printers or exoskeletons. (FR)
- The development of tools enabling the blind to regain their sight. (FR)

Differences by country, age and level of education

- Although the scenario was generally perceived to be realistic, in some countries participants were sceptical about whether all these interventions will be realisable by 2030. This is because of inequalities in their health systems and the scale of what needs to be achieved (e.g. setting up an online database) where these innovations do not exist yet. (MT, PT, SK older group, IT older groups)
- In their initial assessment of the scenario, participants from Germany and Greece seemed mostly sceptical and were guarded and uneasy about the scenario.
- Although excessive monitoring and surveillance was a widespread concern, it was only Danish respondents who articulated this as a sense of losing responsibility for one's own life. And it was particularly Dutch respondents who described uninvited health advice as being patronizing.
- Participants in the UK strongly disliked the idea of their medical records being made available for medical research and company profit. In other countries participants generally did not see it as a problem that their data would be used for medical research.
- In some countries stem cell research was not well understood by all (NL, CZ, EE, PT, SK) and in Slovakia genetic testing was not well understood by everyone.

- In the UK there was a marked difference in the initial responses to this scenario between medium / high education groups (groups 2 and 6) and medium / low education (group 3) group participants. Those in group 3 were much more positive about the scenario, while those on groups 2 and 6 were largely sceptical.
- The opposite was true in Finland where the higher education groups (groups 2 and 5) were more positive than the lower education groups (group 4)
- It seems to be especially in Italy and Ireland where initial responses differed between older and younger respondents – the younger ones were more positive about the scenario than older participants.
- In Poland the centralise health data record was received very negatively and largely rejected by participants because of data privacy concerns.

3.3 Ubiquitous communication and interaction

Here is the scenario that was presented to the participants.

I'm going to read out a scenario that describes one possible future for society. The scenario I describe is possible but we don't know for certain whether it will happen. At the end we will discuss what you think of this scenario. This scenario relates to how we can interact with each other and with machines via on-line and 'virtual' communications in the future.

In society, all people are connected to the internet all the time via mobile devices such as smart watches, exchanging information about their activities in real time. Satellites, sensors and cameras are able to keep track of the detailed location and movement of people and machines. This is also used by the authorities and companies.

For example, it helps the police to prevent and solve crime, as they can better identify the whereabouts of persons of interest, and anticipate crowd control problems. It also helps them to reroute traffic when mobility patterns predict traffic jams. For better monitoring, all cars have a GPS tracker and cameras routinely photograph license plates. If you drive carefully, this is recorded by the tracker and your insurance provider company will lower the price of your insurance. If you break the speed limit, or drive carelessly, you will automatically receive a fine from the police and also your insurance becomes more expensive.

In shopping malls, cameras track customers as they move around a store and they use this data to change the store layout and placement of goods. Many stores use facial recognition technology to identify customers. When you go to the department store for which you have a loyalty card, the cameras recognise your face, which is linked to your account and previous purchasing history. While you browse, you receive a message from the store notifying you of new products and discounts in-store that may be of interest to you. You can also link your loyalty account to your social network profile so that the store suggests gifts to your friends to buy for you.

Many of your family members and friends live far away from you. A common way of communicating with them is via holographic calls. Your home has a holographic projector that can project a 3D image of someone that contacts you. You can have the 3D image projected into your living room, but you can also put on your virtual reality glasses, so that you can see and interact with the other person in a virtual world where both you and the other person are projected into. Holographic communication is also regularly used for education and trainings via virtual courses, and at information stands in public places. It is furthermore a common feature at work, where it is used for instance for meetings with colleagues that work from home, or work at offices in other countries.

Key observations relating to the scenario

The scenario was regarded as **possible and realistic** in future and already exists to some extent, e.g. collection of preferences through store loyalty cards and online shopping, and facial recognition at airports. The proposed innovations were seen as an extension of what already exists.

The **scenario** was generally **negatively perceived**..

Least liked: Ubiquitous monitoring was perceived very negatively.

- Unacceptable: Tracking of machines and people with cameras, facial recognition technology and data collection by companies seen as virtual surveillance and invasion of privacy ('big brother' effect), persistent feeling of being controlled
- Acceptable: Most acceptable in the case of preventing crime, and for some participants also acceptable in traffic control

Most liked: Virtual reality

- Acceptable: Generally perceived positively because it mimics human interaction, and makes people feel more connected to others anywhere in the world

Barriers: Too much surveillance – at least people should be able to opt out

Assessment of the scenario and innovations

First impressions

In general, participants divided the scenario into two parts – ubiquitous communication and the virtual reality – and assessed the latter more positively. The negative spontaneous associations were based mostly on a strong conviction that the innovations presented would lead to a significant limitation of freedom and individual liberty, as well as reduce the security of personal data. The positive aspects of holographic communication did not make up for participants' overall dislike for the rest of the scenario.

Positive associations included descriptions such as: crime prevention, accident prevention, making communication easier, fun virtual interaction, time-saving, advanced, and more connected.

"An information source would be very helpful since today in museums or other attractions it's hard to find someone to talk to or give you a guided tour." (IT, Group 6)

Negative associations included descriptions such as: collapse of human relationships, loss of freedom and privacy, big brother, misuse of information, manipulation, horror, abuse, loss of identity, frightening, intimidating, restriction, labelling, inhuman, anxiety, fear, control, power, never alone, intrusive, eerie, illegal, and dangerous.

"It's like a technological dictatorship where it's not me who decides where I want to be recognised and what I want to be shown. Someone else decides that for me." (DK, Group 5)

Overall assessment of the scenario

Participants thought that this scenario was realistic in future as it represents the further development of technology that already exists. For instance, communication-related innovations were seen as building on Skype. People and traffic are already being tracked by cameras, data are collected about personal preferences through online shopping and 'cookie' settings on the computer.

"We aren't supposed to have cameras recording whatever happens in public roads!," (PT, Group 5)

"Many of these things already exist. It is very realistic. I went to City Center (shopping mall) and they gave me a keychain and everytime I pass an information stand it recognises me and my behaviour and gives me special offers." (FI, Group 1)

Participants strongly disliked the constant monitoring or surveillance that the ubiquitous communication innovations imply. They found this intimidating and an invasion of their privacy. Participants also expressed concerns about what the data will be used for and how secure it is.

"I think the scenario is too invasive...there is more scrutiny about your activities and whereabouts...there is lack of privacy and freedom." (MT, Group 3)

"With this scenario I get paranoia. Cameras everywhere, face recognition...I would feel scared of being hunted the whole time." (DE, Group 3)

"In terms of control it should be used by authorities for security purposes ...now, why is it the interest of insurance companies to use this information obtained by authorities? I think it will transcend the limits of what is reasonable!." (PT, Group 4)

However, they were able to recognise the benefits that these innovations held for fighting crime and terrorism, managing large crowds, and regulating traffic.

"It's good for security and bad for freedom." (PT, Group 2)

Holographic communication was generally liked by participants as it made communication easier and more interactive, especially with those who are far away.

"The holograms. That's positive. Because we can imagine that this person is closer to us than on the screen." (PL, Group 1)

Most liked innovations

Participants most liked the virtual reality aspects of the scenario as it generally brings people closer, and is more realistic than other forms of communication because one would be able to read facial expressions and body language. It was the only aspect to the scenario presented where participants did not feel that their privacy was being violated and where they felt they would be able to participate voluntarily.

"Tangible, realistic close-up facilitating communication." (PL, Group 4)

"The use of holograms conveys a sense of greater humanisation. It feels like the other person is standing right next to us" (PT, Group 5)

"Greater for those who have family members with small children in another country. They would not miss too much because they can watch the children growing." (DE, Group 1)

This type of communication was often seen as a natural evolution of current technologies.

"I also liked holographic calls. This simply is the next step after Skype. In the beginning there was the telephone, then video conferences and then the next logical step is holographs through a projector." (EE, Group 5)

However in some countries participants expressed concerns about the implications in terms of social relationships and were afraid it would result in a loss of human contact.

"I'm not at all excited about holograms: everyone ends up at home, we no longer need to go out. I work from home, I see my family from remotely, from home, without going out. I think it's a shame, we're not sharing. Or rather, we are, but with many people in an individual way." (FR, Group 4)

"I imagine this form of communication so invasive as to even substitute human contact, that's how it's going to end up." (IT, Group 5)

"People would become lazy and people-to-people contacts will be over" (PT, Group 2)

- At home (holographic calling): This aspect was very popular among participants in 10 of the 16 countries (CZ, DK, IE, DE, PL, EE, EL, PL, IE, FI, RO younger groups). It was regarded as a positive development in the field of communication and a new way of keeping in touch. But in the remaining countries participants expressed more mixed feelings. Although acknowledging the potential positive aspects they expressed concerns that this way of communicating could be impersonal and also lead to fewer face-to-face contacts.

"I like the idea that I can communicate with a friend who is living abroad and it will be as if he is right there beside me!" (EL, Group 2)

"The result will be that family members will not meet so often." (SK, Group 2)

- At work (virtual meetings with colleagues): This aspect was very positively received as a way for people who are far from one another to meet (CZ, DK, DE, NL, PL, EE, MT, IE, FI). It was seen as a way to save time and money, and it will be good for the environment as there will be less travelling for work. However, participants raised also some concerns about the use of holographic calls at work: it might isolate people more, such flexibility in terms of organising meetings might result in people working more when at home, and legal systems could be binding in terms of forcing people to conduct some meetings at the same physical place.

"Holographic calls are a great way to have a meeting with someone in China for example. It saves time, you travel less and you don't produce as much CO₂." (DK, Group 4)

"For example, this year we had a virtual Christmas party with the other offices. We reduced travelling costs and still had a good time together." (IT, Group 6)

- For education: Responses to the use of holographic communication in the field of education were more mixed. The majority of participants still liked this idea (CZ, DE, EL, IE, MT, EE, PL, RO), but more mixed views were evident (DK, IT, FI, UK) as well as those who disliked the idea (NL, SK). Participants could see the value of this approach both on its own or to supplement existing lectures: it will make education more accessible, and it will make learning more interactive for children and increase their level of engagement.

"There are courses which are online, only read the texts and nothing else...If it were in holographic format I think it would be more interactive, you could probably ask questions, not just read texts." (RO, Group 2)

Again, some reservations were expressed about this idea: whether it would be expensive and people might need more powerful Internet connections and whether virtual teaching could pedagogically be as efficient as face-to-face teaching.

"It's like a course on the Internet. It works less well." (NL, Group 3)

- In public places (virtual information stands): This possible application of holographic communication did not elicit a lot of reaction from participants. They struggled to picture how this might work and to assess its usefulness (CZ, NL, SK, FI, DK). Just as they weren't able to assess its usefulness, they were unable to imagine any negative aspects. They saw it as a positive development, such as providing information to tourists in museums, and acting as customer care agents (RO, IT, PL, EE, MT, DE). Participants from Portugal thought that the use of virtual information stands could lead to unemployment.

"An information source would be very helpful since today in museums or other attractions it's hard to find someone to talk to or give you a guided tour." (IT, Group 6)

Least liked innovations

The least liked innovation was ubiquitous monitoring (tracking of machines and people with satellites, trackers and cameras). Participants generally equated ubiquitous monitoring with ubiquitous control. Participants regarded it as a frightening invasion of privacy, and some even feared the emergence of a police state (CZ, DK, DE, EE, IE, EL, FR, MT, NL, PL, PT, RO, SK, FI, UK).

"It is frightening that there has been a discussion in Finland that cars would be implanted with GPS trackers. Wherever you move or drive to or go in general, someone will know. For me, it crosses some kind of line." (FI, Group 1)

"Who would guarantee that the gathered information will not end up in the wrong hands and it will not be used against the people? Because when they know where people are, then they actually know everything about people." (EE, Group 2)

"This identification of people is not acceptable, because wherever you are whatever you do; there will be information for you. This is violation of your privacy!" (EL, Group 2)

Despite this strong dislike, participants could see that such tracking might be useful for preventing or solving crimes, locating missing persons, crowd control, to a lesser extent traffic regulation or the monitoring of individual driving behaviour (CZ, EE, FR, IT, MT, NL, RO, PL, UK, PT, SK, FI, IE younger groups), and monitoring the sick (FR). However, participants were adamant that tracking could only be allowed in these instances, and not to follow people in their daily lives.

"Only for authorities for solving crimes, traffic jams." (NL, Group 3)

"If it is to serve the public purpose of higher security and to lower the crime rate, than yes. But when it comes to the aspects you are mentioning, which is the total deprivation of privacy, that's a very negative element." (PL, Group 4)

Participants from Finland thought that the scenario might be more acceptable if these measures were implemented only in certain places such as the airports and train stations where more security is needed. Participants from Denmark and the United Kingdom thought that the scenario might be more acceptable if people were to be given the opportunity to opt out of being tracked. Participants from Romania held that monitoring would be more acceptable if it is done at a wider, collective level rather than individual monitoring.

However, the idea of **automatic penalties** (fines) caused concern to participants in some countries. (DK, DE, EE, IE, EL)

"Who decides who is criminal? That is also precarious in democracy...this system is very, very dangerous." (DE, Group 3)

Facial recognition technology (in stores) was also generally disliked (CZ, FI, SK, DK, RO, IT, PL, EE, EL, FR, MT, IE, UK, PT, DE), although some had more mixed views (NL). Participants again expressed concerns around: data privacy, recording people without their prior consent, fear of the misuse of information, the lack of anonymity it allows them when they shop.

"It's like a technological dictatorship where it's not me who decides where I want to be recognised and what I want to be shown. Someone else decides that for me." (DK, Group 5)

Again they could see the value of facial recognition in preventing crime and terrorism (enabling societal safety), and these were the only acceptable uses (IE, IT, FR, MT, NL, PT, RO, SK, FI younger groups).

Participants from Finland and Portugal thought that this innovation would be more acceptable if it was based on voluntary participation.

"It should be used to prevent crime, to deny access to people with a police or criminal record." (IT, Group 3)

Participants had mixed views about data collection regarding personal preferences to be used by companies. Some disliked this innovation (FI, DK, IT, PL, EE, EL, FR, MT, PT, DE), while others had more mixed views (CZ, NL, RO, SK, UK). Participants' concerns included that: such data collection would be an intrusion of their privacy, the information might be misused, it interferes with their own decision-making, it would not leave room for their own creativity and spontaneity, it would put them under pressure to buy the suggested items, and it is an innovation that is meant for the benefit of companies not people.

"The adverts will be individually targeted so that they will control what the person will be doing...it is brain washing." (MT, Group 5)

However, some could see the benefits of this innovation: it would be interesting and convenient to receive information about sales that relate to your own preferences or those of someone you know, and shopping would be more convenient if no cards (loyalty or credit cards) were needed. Some participants thought that this scenario would be more acceptable if participation was voluntary (FI, NL, IT, EE, UK).

"In shops it should be optional and they shouldn't keep data [for] too long. (NL, Group 6)

Surprising / new

Although participants thought of this scenario as realistic, some did mention elements that surprised them or were new to them:

- Holographic communication (SK, DK, FI older groups)
- Using facial recognition in shops (CZ, DK, IE)

Barriers and acceptability

- **It is evident from the above discussion that the greatest barriers to the implementation of innovations related to ubiquitous communication are the issues around privacy, surveillance, data use and data security.**

Other barriers mentioned were:

- Cost: the technology required to implement this scenario (e.g. holographic communication) was seen as expensive and therefore accessible to a certain part of the population. (FI older groups)
- It was believed that the younger generation would be more accepting of this scenario as they are more accustomed to living public lives, and the tracking technology is already part of their existence. (CZ)
- Psychological barriers for those who are older, or other who are not used to the technology (CZ, IT), especially regarding holographic communication.
- Legal barriers, for example in the case of facial recognition that prescribes what data can be collected and how it can be used. (IT, MT)

Alternative scientific innovations

- Innovations that would be less controlling and gather less information. (FI)
- Innovations that would be controlled more by the user rather than by an anonymous entity. (FI)
- Devices that will react to voice control. (CZ)
- Cruise control for cars which would mean they are unable to exceed the speed limit. This would make surveillance unnecessary. (CZ, DK)
- Facial recognition at ATMs, banks, and other public offices. (IT)
- A lie detector (IT)
- The use of holographic communication for medical consultations. (UK)
- A system of benefits instead of penalties. (DE)

Differences by country, age and level of education

- Despite being opposed to encroachments on their privacy and to constant surveillance, participants from four countries mentioned that they had resigned themselves to such developments in future and that such developments were largely outside their control. (NL, RO, EE, SK)
- It was only participants from the Netherlands who pointed out that other technological innovations might mean that aspects of this current scenario will become irrelevant. For instance, as the trend to shop online increases, the idea of tracking customers as they move around the store becomes less relevant. And if self-driving cars will be developed in future and used widely, traffic jams and irresponsible driving will be prevented and there will be no need to control drivers.
- Italy was the only country where participants felt positive overall towards ubiquitous tracking and monitoring, provided that it was limited to public areas and did not take place in the private sphere (their homes).
- In Italy, France and Romania, and on a lesser extent Portugal and the UK, participants showed significant resistance to holographic calls because they feared that this would become the predominant form of communication and would discourage real-life relationships.
- In Ireland and Romania younger participants were more enthusiastic about the virtual reality aspects of the scenario than their older counterparts who felt scared and uncomfortable with this aspect.
- In Ireland, the younger participants were more accepting of being monitored than the older ones.

3.4 Environment

Here is the scenario that was presented to the participants.

I'm going to read out a scenario that describes one possible future for society. The scenario I describe is possible but we don't know for certain whether it will happen. At the end we will discuss what you think of this scenario. This scenario relates to how we can protect the environment in the future.

You are living in the year 2030 in the suburb of a city. Homes and cities have become very energy efficient and use and also produce clean, renewable energy, in particular via solar panels and small wind farms on rooftops. Buildings are made mostly from recycled construction and demolition waste, so that lesser raw materials are needed. This is important because raw materials have become scarce and costly. Households and cities produce very little waste generally, as there are many new ways for waste prevention and recycling. Citizens separate and recycle waste themselves, and every households has two water supply lines, one of drinking water quality, and a second one for non-contact uses such as toilet flushing and garden use. Households are connected to the city's closed-circuit water system. Via this system used drinking water is captured so that it can be used for non-contact purposes, and low-grade waste water is treated and sanitized so that it can be used again for the supply of drinking water to households.

There are also new ways for converting waste into value-added by-products. For example, bio refineries can turn agricultural residues and bio-waste into plastic and fuel.

In agriculture itself, farming management practices are tailored to use minimum amounts of inputs like machinery, labour, chemicals and water, in order to reduce environmental impacts. This is assisted by precisely monitoring the growth and health of crops and cattle with the help of high-resolution satellites and with biological and electronic sensors in the field. Such monitoring is furthermore used to improve food safety.

There are also global engineering initiatives to control the earth's temperature. For example, the emission of CO₂ into the atmosphere is reduced by large scale storage of CO₂ in underground geological formations such as oil and gas reservoirs, and by fertilizing stretches of the oceans that stimulates marine food production and thus draws CO₂ from the atmosphere. These initiatives are seen as effective intermediate solutions to slow down the increase in temperature until a complete turnaround towards fully sustainable living on earth is realized.

Key observations relating to the scenario

The **scenario** was **positively received as environmental protection was seen as priority**, but there was some scepticism about whether the scenario is achievable in the next 15 years

Most liked:

- Renewable energy,
- Recycling of waste,
- Some aspects of advanced farming

Least liked:

- **Underground storage** of CO₂ and **Carbon ocean fertilisation** (difficult to grasp, too big a risk if these interventions fail);
- **High tech farming** (where farmers are taken out of the equation)

Polarised:

- Some questions around quality of drinking water,
- Conversion of waste into value-added by products (e.g. building materials)

Barriers: Cultural barriers to changing behaviour, commitments from government and business to also make the changes, costs involved in implementing these measures

Assessment of the scenario and innovations

First impressions

Participants' first impressions were very positive as reflected in their word associations.

Positive associations included descriptions such as: climate protection, care for the environment, stops global warming, makes our lives better, optimism, sustainability, innovation, technology, efficiency, clean, idyllic, hope, improvement, necessary, sensible, very positive, healthy, clean, well-being, dream, innovation, quality of life, great, amazing, promising, and hopeful.

"It's all positive! Tell me where this is and I'm going there!" (PT, Group 5)

Negative associations included descriptions such as: not realisable, expensive, not realistic for all countries, too controlled, sci-fi, confusing, complicated, and unlikely.

"The natural development of nature will disappear. They want to start developing nature themselves, so it seems." (EE, Group 6)

Overall assessment of the scenario

This scenario was positively received as environmental protection was seen as important. Most of these measures were already known to participants and have been implemented to some degree (e.g. renewable energy, recycling, non-drinking water for non-contact uses, greenery planted on rooftops, etc.). The scenario is in line with current trends towards a more environmentally friendly lifestyle and sustainable development.

However, despite the overall positive sentiment expressed by participants many thought the scenario was utopian and that it was unrealistic to think that all aspects of it would be achieved within the next 15 years. Barriers related to cost and behaviour change was also raised by participants.

"It's great. Very good. Ecological. Viable. Renewable energy. I don't see anything negative. It shows genuine awareness." (FR, Group 5)

"Less waste, better quality of life, cleaner environment for us, for everyone." (EL, Group 4)

Participants liked the ideas around renewable energy, recycling and some aspects of advanced farming).

Participants did wonder whether it would be safe to use recycled material in construction and whether it would be safe to recycle water in the ways proposed.

They generally disliked the geo-engineering aspects and some found these ideas difficult to understand and potentially risky if something were to go wrong.

"CO₂ in the earth? That surprised me. It's not very obvious to me." (DK, Group 4)

"The more you fertilise, the more oxygen is depleted." (DE, Group 3)

Most liked innovations

Participants liked the suggestion that most energy is derived from renewable energy like solar panels and wind farms (DE, PT, EE, EL, CZ, IE, MT, FI, SK, RO, DK, PL, IT, NL, FR, UK). It enables the phasing out of nuclear power, it reduces costs, it facilitates the production of environmentally friendly energy and thereby reduces pollution, and it follows the trend of more sustainable development. Despite their support for this idea, some participants were concerned that this type of energy might not be enough to satisfy society's energy needs – not enough wind or sun – and that traditional sources of energy would still be needed (FI, CZ, RO, EE).

"Renewable energy makes us independent from electricity generated from coal and atom[ic] [energy]." (DE, Group 3)

"It's a first step. A lot of people are doing it. We are in the way." (NL, Group 2)

Despite widespread support for renewable energy, there were some concerns about wind farms (CZ, SK, MT, FR): they are too noisy, endanger birds, blow the fertile soil away, are not aesthetically pleasing, or the country might not be windy enough to make wind farms a viable option. A small minority also raised concerns about solar panels (CZ, SK, PL, FR, FI): the appropriateness in their national context as there might not be enough sun, the costs of production and installation, and that solar panels might be harmful to the environment because of how they are manufactured.

"What about when the polar nights [period of short days] start in Lapland? The solar panels are useless then." (FI, Group 6)

Similarly, participants liked the idea of energy efficiency in homes and cities (PT, CZ, FI, DK, NL, RO, IT, PL, EE, EL, MT, IE, UK, FR). It puts less pressure on the environment, saves resources, helps to create a more sustainable world, and will reduce peoples' energy bills and energy needs. In Poland and Malta participants raised concerns about the excessive unification of living space styles and the necessity to adhere to restrictive regulations and the impact on the aesthetics of cities. Slovakia was the only country that was much less positive about this aspect of the scenario than other countries – although participants felt positive about solar panels, they disliked the idea of wind farms and questioned their aesthetics and efficiency.

"I am positive because becoming more autonomous, spending less money as a resident and avoiding making an impact on the environment and its natural resource seems to be truly an evolution." (EL, Group 1)

The recycling of materials and natural resources (building/construction materials, water, etc.) was also generally positively received because it reduces the amount of waste and saves on resources. (CZ, DE, MT, EL, UK, DK, EE, NL, IT, PL, PT, RO, IE, SK)

"If I recycle everything I don't need to look for more raw materials, I can protect the environment." (IT, Group 6)

"How can you be against this? It's only sensitive to produce and consume in an efficient way so that nothing is wasted and a lot is reused". (NL, Group 5)

When mentioned specifically, the use of recycled material in construction was seen as positive (DE, PT, UK) because participants were in favour of using what already exists instead of raw materials.

"Buildings are constructed mostly out of recycled materials, out of the demolition of other buildings. I like the idea, it sounds interesting. I've heard about this, crushing concrete from old buildings to reuse it, they say it's better because there won't be any more trucks to dump concrete blocks in the fields." (RO, Group 4)

However, there were some who had more mixed views (FI, IE, SK, RO) or expressed reservations (PT, CZ, IT, PL, EE, UK): they wondered whether the recycled materials have the same quality and durability than raw materials, whether they will have some effect on one's health (e.g. plastic), and whether the products will be clean enough.

"There has to be some form of control and certification. It should be a regulated field." (IT, Group 6)

"It's a quality issue when building from construction waste. There could be toxic chemicals. No thank you." (FI, Group 1)

When specifically mentioning water recycling, some participants had positive views (NL, PL) and some disliked the idea (PT, FI, EE, EL, MT, IE, RO). On the one hand, the double circuit of water would be essential for saving on available drinking water, it would be beneficial and ecological not to have to purify all water that is used.

"The dual water system is interesting for me because not all water needs treatment to make it drinkable if it will be used for watering the garden, because the garden does not need such clean water. There are savings here as well." (PL, Group 1)

But on the other hand participants were concerned about the cleanliness of the drinking water, feared that the water would mix, feared that a person might accidentally use the wrong water, questioned whether the water would really be drinkable, and expressed concern about the expense that would need to be incurred to put the necessary infrastructure in place for such a system. A psychological barrier is evident here among some participants when it comes to the drinking of recycled water.

"We use to buy vegetables from a certain place which used second class water and the quality and taste of the vegetables was not very good." (MT, Group 5)

The recycling of waste as also positively received (DE, EE, CZ, IT, MT, PL, RO, FI, FR, SK, DK, NL, IE, UK): it reduces the amount of strain on the environment, it reduces the amount of waste, and it is in line with current ecological trends. Participants from Estonia mentioned that producers or companies should also take some responsibility for creating less waste by reducing excessive packaging.

"This is natural, nothing gets wasted in nature either." (CZ, Group 1)

Participants liked the innovations presented relating to the conversion of waste into value-added by products (e.g. bio refineries turning agricultural residues into plastic and fuel) (DE, PT, CZ, FI, SK, EE, MT, RO, PL, DK, IT, NL, EL, IE). They liked the idea of reducing the amount of waste and lessening the burden on the environment, and it is more sustainable. However, some expressed concerns about the production of plastic (PT, FI, SK, NL, IT, IE) due to the time it takes for plastic to decompose. Some participants had found this idea harder to grasp. (FI)

"Plastics pollute. They should be entirely taken out of the picture." (IT, Group 5)

Some participants found ideas around new farming management practices (minimum inputs/monitoring of crops and cattle with high-resolution satellites and sensors) harder to grasp or felt that they did not know enough about it to properly assess it (DE, CZ, SK, NL, RO, FI, MT). However, there were many positive assessments (CZ, FI, SK, DK, NL) while others had mixed (DE, EE, IE, EL, IT, FR, MT, FI) or negative views (PL, PT, UK): aspects such as the use of fewer chemicals and machines, and improved food safety were more likely to be seen as positive whereas aspects like satellite surveillance and larger-scale food production (including GMO food) were more likely to be the reasons for participants' reservations. Participants also expressed a number of reservations about the new farming management practices: the surveillance of animals and plants by satellites was considered unnecessary and less efficient than human surveillance (CZ, DK, IE, EL, FR, NL, PL, RO, SK, FI, UK), and it was felt that nature should not be tampered with through the introduction of these artificial processes (DE, IT, MT).

"I do not know whether a machine can respond effectively and control the health of cattle from a distance without examining the animal directly. I believe that farmers are still better at this job and as Greece is a livestock country, I would ask more about that." (EL, Group 1)

Others were concerned about possible electromagnetic fields that the satellites might emit that might be harmful to humans. A small minority wondered whether this technology would be available to smaller farms as it seems to only apply to large-scale commercial farms. They therefore also wondered whether smaller farms would exist in future if this scenario were to come true.

"The end of traditional agriculture. The end of a trade, so to speak, if all agriculture is monitored by satellites. This is in line with the standardisation of farming and know-how." (FR, Group 5)

In about a third of countries concern was expressed that using minimum labour input would lead to unemployment. (PT, IT, PL, IE, UK)

"There will be no farmers. Only machines." (PL, Group 1)

"Again the problem is the loss of jobs. I don't like it." (IT, Group 3)

Least liked innovations

The suggested innovations that participants least liked related to the two elements of geo-engineering.

- **Underground CO₂ storage**

Some participants found this aspect of the scenario hard to imagine / difficult to understand (CZ, SK, DK, MT, RO, EL, FR, PT). The majority had a negative view (DE, PT, CZ, FI, DK, NL, IT, PL, EE, RO, IE, UK, FR): it is a temporary solution as the CO₂ is still there but just not visible, the safety risks involved and consequences if something goes wrong outweighs any possible benefits, such innovations might also require international cooperation and it is unclear whether the political will exists. It was only in Malta where participants liked this part of the scenario because it would reduce the level of CO₂ in the atmosphere.

"This is not a solution; this is just hiding the problem underground, this is crazy." (CZ, Group 1)

"The aspirations are good, that they're trying to bring the carbon dioxide levels back to whatever nominal level they should be. But I think the method is risky. So it's like making this massive jail for carbon and if there's any kind of earth quake or anything goes wrong, it potentially ruptures and it all is released in one big whack at a later date. I think it's like storing nuclear waste in these concrete vaults but it will eventually find its way out, it's going to be flawed." (IE, Group 2)

Participants from Germany related this idea to another storage project which ended in disaster in Germany when radioactive material was stored underground in salt mines and water infiltrated and contaminated the stock.

- **Carbon ocean fertilization**

Again, some participants found this scenario hard to imagine or understand (CZ, DK, SK, NL, PL, PT, RO, EL, MT, FR). However, this time, this scenario was largely negatively assessed (DE, CZ, FI, RO, IT, EE, MT, IE, FR, PL, DK). Participants raised concerns about too much interference with nature, and some saw it as pollution as over-fertilization is responsible for fish dying. Participants from Greece seemed more positive about this aspect of the scenario than participants from other countries, although they also initially found this aspect difficult to understand.

There are some comparisons with the Baltic sea which had become very polluted by farming fertilizer (FI).

"The natural development of nature will disappear. They want to start developing nature themselves, so it seems." (EE, Group 6)

"When I read about algae getting large-scale treatment with fertiliser, I imagine fish with their bellies up." (DE, Group 4)

"It's perfectly possible to bind carbon monoxide to oceans. The Baltic sea is a good example of what can happen when you start fertilising the wrong way. What are the guarantees that the right plants and organisms start to grow?" (FI, Group 1)

Surprising / new

Aspects that participants found surprising or new included:

- Geo-engineering (CZ, SK, DK): underground CO₂ storage (PT, FI, DK, RO) and ocean fertilization (PT, CZ, FI, DK, EE)
- Monitoring crops with high resolution satellites and sensors (PT)
- Small wind farms on the rooftops (PT)
- Agriculture monitoring (CZ, SK, RO)

Barriers and acceptability

- Cost will be a prohibitive factor (DE, PT, CZ, DK, SK, PL, EE, IE, PT, RO, UK, FR, NL): initial investment is necessary to bring about the required changes in infrastructure. The current economic climate is not conducive to these types of investments at the moment (IE, PT). This might mean that only more affluent people will be able to afford to live in a more environmentally friendly manner.

"Solar panels, they cost, like, what was it, £13,000 to fit them to your house, and it takes you 25 years to save the money back. Most people aren't thinking 25 years ahead." (UK, Group 1)

- The required buy-in and behaviour change necessary at individual level (DE, PT, FI, SK, RO, PL, EE, MT, UK, FR): not everyone is willing to make these changes, e.g. recycle and save resources and some awareness raising might need to be done.

"This really goes against consumer culture today [because] general public is very indifferent. For example, to buy and throw away when something newer or better comes along. There isn't very much prestige in using old things." (DK, Group 2)

"A lot of the things are possible. But you mustn't forget the human component. Not everybody is ready to support this." (DE, Group 4)

"The general public is very indifferent. They will not do waste separation unless they get some financial motivation. For example, in the village where my parents live, people walk from their houses to a public plastic and paper container to separate the waste. But their motivation is not to protect nature, it's to not pay for their full container." (SK, Group 6)

- Resistance by other major role players (DE, IE, FR, PT, CZ, SK, DK, IT, MT, NL, FI, UK): this might include resistance from other countries, producers, energy lobbies, those with commercial interests, etc. Businesses would want people to buy more, and increased consumption leads to greater pollution. The innovations go against the culture of consumption. It would require a lot of engagement from politicians what was seen as difficult to be achieved.

"Companies would never invest in these kinds of projects; it would undermine their own interests." (IT, Group 3)

"It's like a good dream, but a dream. I just don't think that countries who depend on selling oil and coal would want a development like that." (DK, Group 4)

- This project would need a lot of political support. Political decisions-making takes long and there also need to be political will. (SK, PT, NL, FR)

Alternative scientific innovations

- More technologies focusing on the reduction of CO₂. (CZ)
- A 3D printer for houses as an efficient way to build houses, especially when raw materials are expensive. (FI)
- Changing the way the food industry works by increasing the amount of nutritious food products. (FI)
- More natural ways of becoming environmentally friendly, for example, introducing livestock to an area to restore the ecological balance. (FI)
- Tax benefits for those who invest in environmentally friendly innovations such as solar power and better insulation. (DK)
- Other renewable energy innovations, not just solar and wind energy. (NL)
- More advanced technologies to filter the air. (RO)
- Sea water desalination. (IT)
- More artificial greenery. (MT)
- Use of solar paint (photovoltaic paint). (MT)
- Use of electric and hybrid cars. (MT)
- Use of other disciplines like sociology or psychology to change behaviours (NL)

Differences by country, age and level of education

There was widespread similarity in responses across the different groups and countries and therefore very few differences can be noted.

- Some participants made a connection between the monitoring of farming practices and their general reservations about surveillance, as expressed in the other scenarios. This was one of their reasons for disliking this aspect of the scenario. (DK, CZ older groups)
- In some countries (EE, FR, IT, UK) there was a feeling of excessive structuring and control – that natural processes become too controlled and man-made.

"This text is very technical, it doesn't mention anything about values: sharing, trading, crafts, the world we'd like to hear, because we're afraid of where we're going. There are no emotions." (FR, Group 2)

- Slovakia was the only country that was much less positive about energy efficient homes compared to other countries – although participants felt positive about solar panels, they disliked the idea of wind farms and questioned their aesthetics and efficiency.

ANNEXES

EUROBAROMETER FOCUS GROUPS
PUBLIC OPINION TOWARDS FUTURE INNOVATIONS IN SCIENCE AND
TECHNOLOGY

DISCUSSION GUIDE

NOTE: as with all qualitative discussion guides, this document is not intended to be an exhaustive questionnaire, but rather an indication for the moderator of all the topics to be covered, the approximate time allocated to each area of discussion and some suggestions around possible areas of investigation. The discussion guide will be accompanied by an in-depth briefing of the moderators, to provide them with a full understanding of the research and its objectives.

1. <u>Warm-up and Context</u>	5 min.	Total : 5 min.
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- ✓ Moderator’s introduction
 - Introduce self ; present TNS
 - How a focus group works (moderator is independent; no right or wrong answer; personal opinion; confidentiality; audio/video recording; etc.)
 - Announce subject discussed:
Today we are going to talk about innovations brought about by science and technology. Together we are going to try to imagine tomorrow’s world and to explore some scenarios which could come about in the future.

- ✓ Respondents’ introduction
 - Name
 - Occupation
 - Hobbies, interests

2. <u>General perceptions of scientific and technological innovations</u>	20 min.	Total: 25 min.
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This section aims to lead the participants to the heart of the subject. We are trying to get an overall grasp of the opinions of the people present regarding the innovations brought about by science and technology, in order to present the background to the discussions of the two scenarios that will be put to the participants.

- ✓ Let’s first consider the idea of **scientific and technological innovation**.
 What does that make you think of? What ideas or associations come to mind?
 Anything else that comes to mind?
 [LIST THE SPONTANEOUS EVOCATIONS ON THE FLIP CHART]

- ✓ I would like each of you to give me a **word with a positive connotation** that comes spontaneously to mind when I mention scientific and technological innovation.
 [ROUNDTABLE]

Now, let’s repeat this exercise with a word that has a **more negative connotation**.
 [ROUNDTABLE]

- ✓ Thinking about the last 15 years, what examples of **innovations brought about by scientific and technological innovation** come to mind?
- ✓ Some innovations lead to deep-seated changes, not just from a technological or scientific point of view but for society as a whole. **What innovations do you think have had the most impact on society in recent years? Why do you think that?**

[FOR EACH INNOVATION]:

- What for you are the **positive impacts of these innovations and the changes they have brought?** Why?
- Can you also see some **negative impacts** from these innovations and to the changes they caused? Why? Ask again if no innovations are mentioned, focusing on the following themes:

[Innovations in...]

- Health/medical treatment
- Education/knowledge
- Living conditions/housing
- Transport
- Work/jobs
- Environmental protection
- Energy
- Personal data (+ data security)

3. <u>Spontaneous projections regarding tomorrow's society, particularly in the areas which will be tested in the two scenarios</u>	20 min.	Total: 45 min.
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Before introducing scenarios 1 & 2, the moderator will gather participants' spontaneous projections regarding the scientific and technological innovations that could be part of daily life in 2030. Attention will focus on the changes that are seen as beneficial and those judged as more negative or undesirable. The moderator will also focus the attention of participants on the two topics tackled in the scenarios they will discuss later.

[ASK THESE QUESTIONS BEFORE INTRODUCING SCENARIOS 1 & 2]

- ✓ I'd now like us to imagine our societies in fifteen years' time. What innovations have science and technology brought about? What **scientific or technological innovations could be part of your daily life tomorrow?**
 - In the ideal scenario, if everything goes as we would wish, **what will have changed for the better thanks to these types of innovations?**
 - [Spontaneous evocations, then ask again focusing on the two topics that will be tackled in the scenarios] [Focus on scientific and technological aspects]
 - On the other hand, **what might we fear? What would be the disaster scenario?**

- [Spontaneous evocations, then ask again focusing on the two topics that will be tackled in the scenarios] [Focus on scientific and technological aspects]

[LIST THE TOPICS ADDRESSED IN SCENARIOS 1/2/3/4]

- Topic 1: ‘The house of the future’ (how participants imagine their homes in 2030)
- Topic 2: ‘Health and health services’ (how participants will look after themselves in 2030 and how they will be monitored by their doctors)
- Topic 3: ‘Virtual communication and interactivity’ (how participants imagine interactions between individuals in 2030 and the relationship between man and machines)
- Topic 4: ‘Environment’ (how participants imagine that we will protect the environment in 2030)

4. <u>Introducing the two scenarios</u>	50 min. per scenario	Total: 145 min.
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Each scenario will be illustrated by some images depicting the innovations described in the text. The moderator distributes the scenario and reads it aloud to the participants.

[READ ‘SCENARIO 1’/ ‘SCENARIO 2’ ALOUD]

- ✓ Let’s start by talking about your first impressions of the scenario I’ve just introduced. I’d like each of you to give me **two words that best describe your general feeling about this scenario.**

[ROUNDTABLE, THE MODERATOR WRITES THE WORDS ON THE FLIP CHART]

[DISCUSSION OF THE TWO OR THREE WORDS MENTIONED MOST OFTEN]

- ✓ **Why** do you think this scenario is.... ?

*The moderator then asks each participant individually to **annotate the scenario text with the following signs to indicate their assessment of the various scientific and technological innovations described:***

+ describes the aspects that they like

- describes the aspects that they dislike

? For the aspects about which they have no opinion, either because they do not understand them or because they do not think that they represent scientific and technological innovations.

[THE TEXT ANNOTATED BY PARTICIPANTS WILL BE RECOVERED BY THE MODERATOR AT THE END OF THE DISCUSSION GROUP AND WILL BE USED IN ANONYMISED FORM FOR THE ANALYSIS. TELL THE PARTICIPANTS THAT THIS IS GOING TO HAPPEN]

[MODERATOR: BE SURE TO GATHER THE GENERAL IMPRESSIONS OF THE SCENARIO BEFORE TALKING MORE SPECIFICALLY ABOUT THE TECHNOLOGICAL INNOVATIONS DESCRIBED]

a) What **do you think about this scenario?**

- Do you think it seems **realistic**? Why?
- What **aspects did you like**? Why?
- What **aspects did you dislike**? Why?
- Would it be **accepted** by the majority of people? Why?
 - What **barriers** do you see to its adoption?
 - (cultural/ psychological/legal)

b) Are you **surprised** by the scientific and technological innovations described here?

- What are the aspects that you are familiar with and that you know?
- What aspects did you discover for the first time?

c) Do you think that the innovations described in this scenario are **useful**, either for you yourself or for other people?

- What aspects do you think are most useful? Why?
- What aspects do you think are least useful? Why?

d) Are there innovations described in this scenario that seem **unacceptable to you or which frighten you**? If so, which? Why?

- Under what conditions could these innovations be made more acceptable to you? What would be the alternatives?

Each innovation in the scenarios will be then summarised by the moderator and the participants will have to say how they assess this innovation, referring to their notes on the text (+/-/ ?).

[MODERATOR: REFER TO THE LIST PROVIDED FOR THIS SECTION]

[MODERATOR: [FOR EACH INNOVATION, FIRST ASK THE PARTICIPANTS HOW THEY ASSESS IT (+ OR -) → RAISING THEIR HANDS]

- Why do you like this innovation?
- Why do you dislike this innovation?

- What are the barriers or reasons for reluctance, if any, do you think that people might have about this innovation in particular?
 - Ask again: cultural/psychological/legal
 - Under what conditions could these barriers be overcome?

- Can you think of other innovations in the same area which would be more useful or more acceptable?

5. <u>Conclusion and round table</u>	5 min.	Total: 150 min.
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During our discussion, we have talked a lot about the innovations brought about by science and technology

- ✓ Have you changed your mind, one way or the other, since the start of the discussions? In what way?

If less negative:

- ✓ What aspects have had a positive influence on your opinion about sciences and technology?

If less positive:

- ✓ What aspects have had a negative influence on your opinion about sciences and technology?

***** Thank the participants and close the discussion *****

Text from scenarios

Theme 1: 'Homes and living'

I'm going to read out a scenario that describes one possible future for society. The scenario I describe is possible but we don't know for certain whether it will happen. At the end we will discuss what you think of this scenario. This scenario relates to how living at home can look like in the future.

You are living in the year 2030. It's Tuesday morning and you are gently woken up by the voice of your Personal Robot Assistant, Pra. Pra brings you a cup of tea and goes through your schedule of appointments for today with you. On his build-in screen he plays a video message that a friend of yours in China sent while you were asleep.

Pra also inform you about the current situation of your stock of food. The sensor in the fridge has communicated to him that you are low on milk and running out of eggs, so Pra has made an on-line order for home delivery by the supermarket drone for these items. Pra always does this automatically for you, as you have given the clearance for him to do so in his controlling software.

Pra has learned to adapt his services according to your habits, and based on past actions Pra has built a profile of your preferences. In order to have the best personalized service, you have set the privacy settings of Pra to 'full record', which means that he keeps a complete memory of home recordings and the exchange of messages with you. This is also very convenient because you can ask Pra what went on at home on any particular day and Pra will instantaneously give you the information.

All data that Pra's stores in his memory is kept on-line at the company's data servers. In this way his memory is not lost should he break down, and he can easily be replaced by another robot with the same personalized functionality.

While you eat breakfast, Pra tells you the news and the weather forecast: it will be sunny and warm!. The windows in your home are coated with a material that automatically darkens to block sunlight on hot days. This keeps your home cool in the summer. You don't use much energy for heating on cold days either because your home is well insulated. In addition, you produce some of your own energy: the roof of your building has solar panels. Via a smart meter you are connected to the power grid. This meter allows you and the power company to monitor exactly how much electricity you produce and consume, and the power company charges you less for electricity consumed during off-peak times.

Before you leave the house, you tell Pra that you would like him to arrange the cleaning of the house today. Today is convenient because all members of your family will be out of the house for work and leisure.

Theme 2: 'Health and healthcare'

I'm going to read out a scenario that describes one possible future for society. The scenario I describe is possible but we don't know for certain whether it will happen. At the end we will discuss what you think of this scenario. This scenario relates to how you and doctors can look after your health in the future.

You are living in the year 2030. Recently you received a message from the supermarket where you normally order your shopping on-line. They have noticed from your order profile that your choice of food purchases has changed, with an increased amount of sugary foods. As this is an early sign for diabetes, they suggest that you do a genetic test at your next visit, which you can buy at the pharma department of their store. The results of the test will become available while you shop and can be picked up at the counter.

The test produces a map of your genetic information and indeed indicates that you have a gene that gives you a 50% chance to develop diabetes in life. The test report gives you dietary advice for what type of foodstuffs you should eat to reduce the risk of you actually getting diabetes. The test report comes with a code that you can enter in your supermarket order profile, so that at your next order the supermarket can suggest you what foodstuffs to buy. An extra leaflet with relevant consumer products is also added to the report. This leaflet informs you that at the pharma section you can buy a wearable biochip; this is a self-adhesive patch that you can stick to your arm and which monitors your sugar levels.

The outcomes of the test indicate some other health risks and, in line with the retail protocol for such tests, it is suggested that you upload the results to your national health record. All citizens have a national health record, which can only be accessed by themselves and by their own doctors. The data of citizens are furthermore used in an anonymised way by medical researchers, who use this information to develop new medicines that can be tailored to the patient.

From your home, you have a video-call with the doctor who explains that the genetic test indicates some preventable diseases you might develop in future, and your doctor advises on how you can be healthy and reduce your chances of developing these diseases. With regard to the diabetes risk, the doctor asks you some questions and asks you to provide a blood sample. To provide the blood sample, you prick your finger and put a drop of blood into a sensor with a biochip. The biochip then analyses your blood and sends data electronically to your doctor. Using this information, the doctor informs you that you fortunately do not have diabetes. She advises you to follow the dietary advice as a matter of prevention and furthermore consider wearing the biochip just to monitor the situation. She reassures you that, in case you would develop diabetes, the disease can now be treated via stem cell therapy. This therapy takes a few cells from your body to grow healthy cells that can be placed back in your body, to ensure normal blood sugar levels.

In addition, based on the blood sample analysis, she also diagnoses that you have a minor bacterial infection. She asks you to submit another blood test electronically every 3 days for the next two weeks. She does not want to prescribe antibiotics for you because she can see from your genetic profile that your liver does not process them very well.

Theme 3: 'Ubiquitous communication and interaction'

I'm going to read out a scenario that describes one possible future for society. The scenario I describe is possible but we don't know for certain whether it will happen. At the end we will discuss what you think of this scenario. This scenario relates to how we can interact with each other and with machines via on-line and 'virtual' communications in the future.

In society, all people are connected to the internet all the time via mobile devices such as smart watches, exchanging information about their activities in real time. Satellites, sensors and cameras are able to keep track of the detailed location and movement of people and machines. This is also used by the authorities and companies.

For example, it helps the police to prevent and solve crime, as they can better identify the whereabouts of persons of interest, and anticipate crowd control problems. It also helps them to reroute traffic when mobility patterns predict traffic jams. For better monitoring, all cars have a GPS tracker and cameras routinely photograph license plates. If you drive carefully, this is recorded by the tracker and your insurance provider company will lower the price of your insurance. If you break the speed limit, or drive carelessly, you will automatically receive a fine from the police and also your insurance becomes more expensive.

In shopping malls, cameras track customers as they move around a store and they use this data to change the store layout and placement of goods. Many stores use facial recognition technology to identify customers. When you go to the department store for which you have a loyalty card, the cameras recognise your face, which is linked to your account and previous purchasing history. While you browse, you receive a message from the store notifying you of new products and discounts in-store that may be of interest to you. You can also link your loyalty account to your social network profile so that the store suggests gifts to your friends to buy for you.

Many of your family members and friends live far away from you. A common way of communicating with them is via holographic calls. Your home has a holographic projector that can project a 3D image of someone that contacts you. You can have the 3D image projected into your living room, but you can also put on your virtual reality glasses, so that you can see and interact with the other person in a virtual world where both you and the other person are projected into. Holographic communication is also regularly used for education and trainings via virtual courses, and at information stands in public places. It is furthermore a common feature at work, where it is used for instance for meetings with colleagues that work from home, or work at offices in other countries.

Theme 4: 'Environment'

I'm going to read out a scenario that describes one possible future for society. The scenario I describe is possible but we don't know for certain whether it will happen. At the end we will discuss what you think of this scenario. This scenario relates to how we can protect the environment in the future.

You are living in the year 2030 in the suburb of a city. Homes and cities have become very energy efficient and use and also produce clean, renewable energy, in particular via solar panels and small wind farms on rooftops. Buildings are made mostly from recycled construction and demolition waste, so that lesser raw materials are needed. This is important because raw materials have become scarce and costly. Households and cities produce very little waste generally, as there are many new ways for waste prevention and recycling. Citizens separate and recycle waste themselves, and every household has two water supply lines, one of drinking water quality, and a second one for non-contact uses such as toilet flushing and garden use. Households are connected to the city's closed-circuit water system. Via this system used drinking water is captured so that it can be used for non-contact purposes, and low-grade waste water is treated and sanitized so that it can be used again for the supply of drinking water to households.

There are also new ways for converting waste into value-added by-products. For example, biorefineries can turn agricultural residues and bio-waste into plastic and fuel.

In agriculture itself, farming management practices are tailored to use minimum amounts of inputs like machinery, labour, chemicals and water, in order to reduce environmental impacts. This is assisted by precisely monitoring the growth and health of crops and cattle with the help of high-resolution satellites and with biological and electronic sensors in the field. Such monitoring is furthermore used to improve food safety.

There are also global engineering initiatives to control the earth's temperature. For example, the emission of CO₂ into the atmosphere is reduced by large scale storage of CO₂ in underground geological formations such as oil and gas reservoirs, and by fertilizing stretches of the oceans that stimulates marine food production and thus draws CO₂ from the atmosphere. These initiatives are seen as effective intermediate solutions to slow down the increase in temperature until a complete turnaround towards fully sustainable living on earth is realized.