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# Images of the future for a circular economy: The case of Finland

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ABSTRACT

A transition from a linear to a circular economy (CE) is one of the key solutions to the sustainability crisis. A CE requires new mental models and insights, especially of a desirable future towards which to move. A CE aims at making better use of resources and jointly considers economic, environmental and social sustainability aspects in the long run. The objective of this study is to develop alternative images of the future for CE in Finland in 2050. The study was performed using qualitative research methods and covers extensive data from 61 interviews with experts. We analysed the data using qualitative content analysis. Four alternative images of the future were generated: A circular success story, A circle of disaster, Local circles, and Structural, regulated circularity. This study contributes to the CE literature by using a futures studies approach and describing alternative futures for a CE through images of the future. By creating alternative futures, one can better reflect on and discuss future possibilities. Our images of the future provide insights to achieve a CE both in Finland and globally.

## 1. Introduction

A circular economy (CE) is an alternative socio-techno-economic approach and a tool upon which humanity focuses a considerable number of expectations, hopes and resources to take the world towards sustainable futures. A widespread consensus exists that the current linear economic model, together with its unsustainable production and consumption practices, contributes to environmental destruction, social inequality and long-term economic instability (Korhonen et al., 2018; Millar et al., 2019). The scale and scope of the current and future sustainability challenges are massive. For instance, human activity has already dangerously exceeded four out of nine planetary boundary categories: change of biosphere integrity, climate change, biogeochemical flows and land-system change (Rockström et al., 2009; Steffen et al., 2015). In terms of biodiversity, population sizes of birds, mammals, fish, reptiles and amphibians have reduced, with an average drop of 68%, during 1970–2014 (World Wildlife Fund, 2018). In addition, the world's global resource extraction in four categories (biomass, fossil fuels, metal ores and non-metallic minerals) increased from 30 billion tons to 90 billion tons from 1970 to 2020 and is expected to double to a staggering 180 billion tons by 2050 (International Resource Panel et al., 2017, p. 29-45).

In a CE, the use of natural resources must be reduced, materials and commodities must be designed to last over many usage cycles while preserving their value, and waste must be minimised (Geissdoerfer et al., 2017; Ghisellini et al., 2016). From a systemic perspective, a transition from a linear economy to a CE requires fundamental consideration of biophysical planetary boundaries and resources because they create the grounds and limits for operations and life in general on planet Earth (Desing et al., 2020). Scientific

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evidence and forecasts since the 1970s, such as *Limits to Growth* (Meadows et al., 1972), have conveyed a similar message about the impossibility of exponential economic and population growth on a planet of limited resources.

The CE is a widely researched topic, with its main research lines concentrated on three levels – micro, meso and macro (Merli et al., 2018). Micro-level studies focus on the CE in companies or among consumers, whereas meso studies focus on industrial parks and the CE (Ghisellini et al., 2016; Merli et al., 2018). Macro-level studies on the CE address either a city, region or country and focus on socio-economic dynamics (Ghisellini et al., 2016; Merli et al., 2018). What is currently missing from CE discussions is research related to long-term perspectives and futures (Bauwens et al., 2020; Geissdoerfer et al., 2017; Kirchherr et al., 2017). This is considered challenging because it may result in a lack of vision for the future and CE implementation without foresight and attention to, for example, future generations (Millar et al., 2019).

Although the CE is a popular research topic, we found only a few peer-reviewed journal articles that have addressed or touched upon the futures of the CE. First, Bauwens et al. (2020) performed a literature review and applied a 2×2 scenario method to demonstrate that circular futures can be organised in many ways and that the most preferable scenario comprised the development of product reuse and sharing practices, enabling technologies, governance of multi-level institutions and change away from consumerist lifestyles. Second, circular futures have been explored from the perspective of fast-moving consumer goods using an inductive scenario planning methodology (Kuzmina et al., 2019). Third, in the search for sustainable futures beyond economic growth in 2050 (Svenfelt et al., 2019) and the future of sustainable lifestyles in 2050 (Mont et al., 2014), the CE was sidelined as a scenario in both studies.

CE is also widely discussed outside academia by, for example, the EU and Ellen MacArthur Foundation. As to discussions of circular futures in non-peer-reviewed publications, in an OECD report, Bibas et al. (2021) calculated policy scenarios' impact on use of materials, GDP and air emissions. Similarly, in a Club of Rome report, three CE scenarios focused, as their names suggested, on different aspects of CE (renewable energy, energy efficiency and material efficiency) and included calculations on the effects on $CO_2$ emissions, employment and the economy (Wijkman & Skånberg, 2017). In Finland, two research institutions have created scenarios for a CE: Kaskinen and Parkkinen (2018) studied Finland in 2030 and Urashima et al. (2020) explored Finland and Japan in 2050. In addition, Heinonen and Karjalainen (2019) studied electrification of a peer-to-peer society, identifying one scenario (Green do-it-yourself engineers 2050) based on a CE.

However, more research on alternative circular futures is required (Bauwens et al., 2020). First, research considering long-term futures is called for since a large part of studies examine medium-term future (e.g. Kuzmina et al., 2019) or the future is not tied to any time horizon (e.g. Bauwens et al., 2020). Second, explicating prior research on sustainability aspects of CE has remained scarce (Bauwens et al., 2020), although the interlinkedness between sustainability and CE has been recognised (Geissdoerfer et al., 2017; Schöggl et al., 2020). In addition, there is a need for understanding different empirical, larger region-specific applications of CE and using different methods in addition to commonly used scenarios (Kuzmina et al., 2019). All in all, CE research on futures is still very scarce in quantity and therefore more theoretical and empirical studies are needed. As Kuhmonen (2017, p. 217) points out, for any attempt to modify or control alternative futures, futures need to be envisioned and formulated first.

To respond to this research gap, this article focuses on long-time perspective and sustainability on a country level. The objective of the study is to examine images of the future for the CE in a country context, Finland, in 2050. To fulfil our objective, our exact research question is this: What are CE professionals' expectations of the state of the things to come regarding the CE in Finland in 2050? Using the concept of an 'image of the future', we refer to certain expectations of the state of things to come at some future time and the horizon for alternative end states of certain developments (Bell & Mau, 1971; Kuhmonen & Kuhmonen, 2015; Polak, 1973). Therefore, we limit our study to a specific moment in time and to the state of affairs at that particular future point (2050), and not to certain development pathways or scenarios leading to that point in time. Our study focuses on Finland since it aims to be a global frontrunner in the CE and thus provides a relevant research context to understand developments around the CE phenomenon in the long term. The strategic target set by the government of Finland is that by year 2025, Finland will be the world's leading CE country (Finnish Government, 2019), with the CE intended as the new basis for the economy by 2035 (Ministry of the Environment, 2021). In addition, Finland is reportedly the first country in the world to set a limit on the use of absolute natural resources by 2035 (Ministry of the Environment, 2021). Currently, the CE accounts for approximately 5% of Finland's GDP and holds promise of an annual growth potential of 2–3 billion euros alone in a few sectors by 2030 (Ministry of Environment, 2021), creating 75,000 jobs (Wijkman & Skåneberg, 2017). Although our research context is Finland, the images are relevant for other countries and give food for thought for developing CEs in the country context.

The study contributes to the CE literature by using a futures studies approach and describing the alternative futures of the CE through images of the future. Understanding alternative futures is vital to promoting the CE and to solving global grand challenges. As we created the images of the future with inspiration of Polak's (1973) model, we can show that to reach an optimistic CE, we require both structural, global changes and actions by all kinds of actors, i.e. individuals. In this study, we promote the view that major changes in all sectors and levels of society and several areas of life are needed to promote a CE.

The paper is structured as follows. In the next section, we present our literature review, which includes two important concepts: the CE and images of the future. In the third section, we describe the methods of data collection and analysis. After that, we present the results for the four images of the future. Finally, we provide a discussion in Section 5, together with the limitations of the study and suggestions for future research. Section 6 concludes the study.

## 2. Literature review

### 2.1. CE and sustainability

Since a systemic shift from a linear economy to a CE has been presented as a solution to sustainability challenges, this section discusses the CE and its relationship with sustainability. Currently, the concept of the CE is considered somewhat contradictory.[1] It has been described as an alternative to the linear economic model, an industrial system (Ellen McArthur Foundation, 2012), a production and consumption system (Ghisellini et al., 2016), a tool towards sustainable development (Geissdoerfer et al., 2017), a new school of thought in sustainable development (Murray et al., 2017), a material and energy flow model (Millar et al., 2019) or an archetype of sustainable business models, among other things (Bocken et al., 2014). In addition, it has a myriad of different definitions and core concepts, as well as various linkages to sustainable development (see Table 1). Sustainable development is defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development, 1987, p. 3) and comprises the three pillars: economic, environmental and social (Ghisellini et al., 2016).

The extant literature has acknowledged that the CE itself and its relationship with sustainable development require a scientific approach, more coherence and conceptual clarification (see e.g. Korhonen et al., 2018; Millar et al., 2019; Velenturf & Purnell, 2021). Interestingly, Kirchherr et al. (2017) demonstrated in their review of 114 CE definitions that only 11% included an explicit reference to sustainability, 13% explicitly acknowledged all three dimensions of sustainable development and, surprisingly, linked to our research, a mere 1% considered the dimension of time or future generations. Simultaneously, on the practical level, it has been argued that CE and 17 sustainable development goals (SDGs) (United Nations, 2015) are strongly interlinked, and CE practices have a potential to directly achieve a considerable number of SDG targets either directly or indirectly (Schroeder et al., 2019; Velenturf & Purnell, 2021). Moreover, Millar et al. (2019, p. 14) have highlighted time perspective, stating that if the CE is a model for sustainable development, it should address the issues of economic prosperity, environmental quality and social equality in the short, medium and long terms. Next, we will go through each dimension of sustainability in the CE.

Kirchherr et al. (2017) have argued that economic aspects attract the most attention in CE research. In general, CE is considered to increase economic growth, innovations, product development and business opportunities (Ellen MacArthur Foundation, 2012); produce efficiency gains; affect input reduction (Geissdoerfer et al., 2017); and reduce energy use, manage material waste and control emissions, environmental legislation, and taxation and insurance costs (Korhonen et al., 2018). Moreover, new markets can be found for the value of materials and resources, a circular image attracts investment and there are positive possibilities for organisations in relation to image and green market potential (Korhonen et al., 2018). While SDG goal 8 (decent work and economic growth) explicitly indicates that the CE refers to economic growth; however, it has been debated whether continuous economic growth can co-exist with the process of protecting the environment and enhancing global social equity (see e.g. Millar et al., 2019).

Discussions around the CE and economic activities include the idea that economic growth and resource use can be decoupled from each other. There are some indications of this; for example, Ghisellini et al. (2016) demonstrated absolute and relative decoupling in some countries and sectors, including Sweden for fossil fuel consumption and Slovakia for municipal waste production. Similarly, Drummond et al. (2021) found evidence of absolute decoupling of $CO_2$ emissions from economic growth in the UK and Finland since 2010. In contrast to earlier findings, Korhonen et al. (2018) argued that reduced environmental impacts can only be achieved through reduced production and changed consumption, whereas Millar et al. (2019) argued that, in its current form, the CE is a more sustainable model than the linear economic model but maintains a connection with virgin resources for continuous growth. Velenturf and Purnell (2021) referred to a strong sustainability perspective, suggesting a shift in terms of economic focus and the concept of success away from short-term economic GDP measures; in a sustainable CE, the purpose of the economy is to organise resources for enhancing and maintaining social wellbeing and environmental quality.

With regards to the environmental side of the CE, environmental wins are characterised by reduced resource extraction and pollution; resource circulation over many rounds, reduced energy and virgin material input, and reduced emissions and wastes (Geissdoerfer et al., 2017; Korhonen et al., 2018). However, the researchers recognised that the CE literature often simplifies the environmental aspects of waste, resource input and emission output, excluding other issues such as biodiversity loss and land use (Geissdoerfer et al., 2017). Similarly, Schöggl et al. (2020) confirmed that only certain areas, such as resource use, waste and $CO_2$ emissions, are given attention, whereas other environmental topics are overshadowed. In terms of recycling, due to biophysical reasons, such as the laws of thermodynamics, closed material loops are theoretically and practically impossible (see e.g. Korhonen et al., 2018; Millar et al., 2019). Therefore, Millar et al. (2019) claimed that the CE's detrimental environmental impacts can be the same as those in a linear economy but occurring over a longer period of time. Equally importantly, Velenturf and Purnell (2021, p. 1447) have suggested, in terms of environmental quality, the use of resources within planetary boundaries and an increase in natural capital across generations.

Calls to include social aspects more explicitly in studies focusing on CE have been made (Buch et al., 2018; Geissdoerfer et al., 2017; Murray et al., 2017). In terms of a social CE, job creation, fairer taxation and an enhanced sense of community, participation and cooperation due to a sharing economy have been mentioned as possible social benefits (Ellen MacArthur Foundation, 2012; Korhonen et al., 2018). In addition, as owning and consuming changes as a result of the sharing economy, a new consumption culture and

[1] For a review of the roots and origins of the concepts, please refer to the review by Ghisellini et al. (2016) and for a review of similar concepts, please refer to Kalmykova et al. (2018).

**Table 1**
CE definitions, core descriptions and links to sustainable development.

| Source | Definition | Core description of the CE | CE's relationship with sustainable development (SD) |
|---|---|---|---|
| Ellen MacArthur Foundation (2012, p. 7) | 'An industrial system that is restorative or regenerative by intention and design. It replaces the "end-of-life" concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.' | Industrial system | Not specified in the definition |
| Geissdoerfer et al. (2017, p. 766) | 'Regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling.' | Regenerative system | Not specified in the definition |
| Kirchherr et al. (2017, p. 225) | 'An economic system that is based on business models which replace the "end-of-life" concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations.' | Economic system | CE aims to accomplish SD |
| Korhonen et al. (2018, p. 39) | 'CE is an economy constructed from societal production-consumption systems that maximizes the service produced from the linear nature-society-nature material and energy throughput flow. This is done by using cyclical materials flows, renewable energy sources and cascading-type energy flows. Successful CE contributes to all the three dimensions of sustainable development. CE limits the throughput flow to a level that nature tolerates and utilises ecosystem cycles in economic cycles by respecting their natural reproduction rates.' | An economy constructed from societal production-consumption systems | Successful CE contributes to all three dimensions of SD |
| Prieto-Sandoval et al. (2018, p. 610) | 'Economic system that represents a change of paradigm in the way that human society is interrelated with nature and aims to prevent the depletion of resources, close energy and material loops, and facilitate sustainable development through its implementation at the micro (enterprises and consumers), meso (economic agents, integrated in symbiosis) and macro (city, regions and governments) levels. Attaining this circular model requires cyclical and regenerative environmental innovations in the way society legislates, produces and consumes.' | Economic system | CE facilitates SD through its implementation |
| Desing et al. (2020, p. 8) | 'The CE is a model adopting a resource-based and systemic view, aiming at taking into account all the variables of the system Earth, in order to maintain its viability for human beings. It serves the society to achieve wellbeing within the physical limits and planetary boundaries. It achieves that through technology and business model innovation, which provide the goods and services required by society, leading to long-term economic prosperity. These goods and services are powered by renewable energy and rely on materials which are either renewable through biological processes or can be safely kept in the technosphere, requiring minimum raw material extraction and ensuring safe disposal or inevitable waste and dispersion in the environment. CE builds on and manages the sustainably available resources and optimises their utilisation through minimizing entropy production, slow cycles and resource and energy efficiency.' | A model with a resource-based and systemic view | CE builds on and manages the sustainably available resources and optimises their utilisation |
| Velenturf and Purnell (2021, p. 1447) | express sustainable CE through sustainable circular society: 'An equitable society that maintains environmental quality and economic prosperity for current and future generations'. | A sustainable circular society | Not specified in the definition |

changing lifestyles are expected to arise, with their positive social implications (Geissdoerfer et al., 2017; Korhonen et al., 2018). In terms of social sustainability issues, criticism has focused on the need for greater emphasis on social equality; intra- and intergenerational equity; gender, racial and religious equality; other forms of diversity; financial equality; and equality of social opportunities (Murray et al., 2017, p. 376; Velenturf & Purnell, 2021). Velenturf and Purnell (2021) added social foundations, as outlined in the SDGs, to the evaluation of a CE. Moreover, among many authors, Schöggl et al. (2020) have argued that it is essential that all societal actors at all levels act in a circular way. Velenturf and Purnell (2021) concluded that a sustainable CE requires major changes in lifestyles and cultures and is only successful when co-created together through the participatory actions and involvement of citizens.

To sum up, CE research has increasingly been linked to sustainability. We have bound and clarified these discussions with the aim of creating the basis and understanding for sustainability in a CE. In particular, we wanted to emphasise the role of social sustainability in CE. On the basis of the definitions presented in Table 1, we have formulated our own definition of sustainable CE: A sustainable CE is a restorative and regenerative economic system within the planetary boundaries. It aims for sustainable development at micro, meso and macro levels, which means radical changes in current production and consumption patterns. This includes the optimisation of resource use. A sustainable CE means creating environmental quality, economic prosperity and social equity for current and future generations.

### 2.2. Images of the future

Rubin (2013) highlighted the theoretical basis of images of the future by arguing that, throughout known history, it has been a human characteristic to want to know about the future and to hold and develop images of the future, both consciously and unconsciously. Some of the images are socially and mutually shared, while some are personal. Rubin (2013, p. 40) described the content of the images of the future thus: 'Composed of beliefs, expectations, opinions, and assumptions of what the future might be like, images of the future therefore are systemic by nature: they are formed from knowledge and flavoured with imagination.' Images of the future combine a mosaic of information and knowledge from the past, observations and perceptions from the present and social and cultural features, values, preferences, needs and expectations of 'normality' (Rubin, 2013, p. 40). Images of the future '.emerge as hopes, fears, and expectations, and therefore influence decision making, choices, behaviour, and action.' (Rubin, 2013, p. 40).

Futures studies offer several ways to categorise and create images of the future. One of the first was introduced by Fred Polak (1973, p. 17), who categorised images of the future according to worldview into essence ('unchangeable course of events') and influence ('possibility of human intervention'). Essence and influence can range from optimism to pessimism, thus creating four different images of the future (Table 2).

To understand social change as it guides decision making and direct actions, it is essential to examine images of the future (Author et al., 2020; Bell & Mau, 1971; Polak, 1973; Rubin, 2013). Kuhmonen (2017, p. 217) links images of the future to 'envisioning, structuring, crystallising and parallelizing divergent views through a process of extracting some alternatives available in the state space'. While creating images of the future, even the desirable ones, positive images are especially important. Polak (1973) pointed out that societies retain their vitality only as long as they retain their ability to reform and maintain a positive image of the future. Desing et al. (2020) have paid attention to the psychological perspective, emphasising that visions (i.e. preferred images) are important because expectations and ideals perform political work in linking the current time point, development and imagined futures. Images of the future assist in understanding the consequences of present actions while providing insights into what the future in general might be like (Rubin, 2013). Mäkelä et al. (2020) emphasised that the analysis of images of the future is implicitly an analysis, interpretation and synthesis of expectations that simultaneously transform and shape the future in the direction they describe.

In summary, we have described the anatomy and the meaning of images of the future and presented Polaks model. Through images of the future, we are able to show insights into what lies ahead and to specifically create an understanding of the (desired) future direction and its connection to present-day actions and decision making.

## 3. Methodology

### 3.1. Data collection

The data were collected using semi-structured expert interviews (Eriksson & Kovalainen, 2016). The interviewees were identified from pioneering CE organisations at the local, regional, national or international level in Finland since a CE requires wide societal-level changes. We interviewed members of various organisations, such as companies in various lines of businesses and of different sizes; cities and municipalities; regional actors; research, innovation and support organisations; industry organisations; and ministries. Altogether, 61 CE interviews were conducted between May 2019 and June 2020 (see Table 3).

We paid particular attention to ensuring that the interviews covered a wide, representative range across the CE as well as sustainability-related expertise from economic, ecological, social and other areas, as well as covering public and private sectors (see Table 4). The experts interviewed had a central role and perspective in promoting the CE, and they possessed insightful information regarding the current and future states of the CE in Finnish society.

The interview themes comprised the CE and sustainable development, key factors influencing macro environment of the CE at present and in the future, cooperation in the CE and possibilities and challenges tackled in the CE in the year 2050. Twenty-two interviews were conducted face-to-face and 39 online. The length of the interviews varied from 31 to 110 minutes, totalling over 71 hours of material. All interview data were tape-recorded and transcribed verbatim. The transcribed data consisted of 723 pages.

**Table 2**
Polak's categorisation for images of the future (Polak, 1973; see also Kaboli & Tapio, 2018).

| | | Influence | |
|---|---|---|---|
| | | Optimism | Pessimism |
| Essence | Optimism | The world is a naturally good place. Human beings can make it a better place. | The world is a naturally good place. Humans have no control over the course of events. |
| | Pessimism | The world tends to decline toward evil; human beings are able to influence and combat this trend. | Chaos is unavoidable. Humans have no control over or ability to affect it. |

**Table 3**
Interview data.

| Type of organisation | Characteristics | Interviews and interviewee positions | Duration (min) | Length (pages) |
|---|---|---|---|---|
| Companies (14 organisations) | Architecture and engineering; Clothing and second-hand clothing industry; Construction, engineering, design and consultancy; Environmental management; ICT; Investment; management consultancy; Real estate; Silviculture and forestry products; Urban farming; Waste management | Fifteen interviews (one interview with two interviewees): eight CEOs/directors, six specialists/managers and one advisor | 31–96 | 153 |
| Cities and municipalities (4 organisations) | Cities/municipalities with 30,000–300,000 residents | Eight interviews: four directors, four specialists/managers | 52–88 | 79 |
| Regional actors (5 organisations) | Organisation for art-based and creative city culture development; Eco-industrial park; Regional councils; Urban city district | Ten interviews (one interview with two interviewees): seven CEOs/directors and three managers | 49–110 | 123 |
| Research, innovation and support organisations (6 organisations) | Development organisation; Governmental funding body for scientific research; Governmental organisation for innovation funding and trade; Independent public foundation; Research institutions | Nine interviews: four directors and five specialists | 64–84 | 115 |
| Finnish industry organisations (5 organisations) | Chemical industry; Construction industry; Municipalities; Technology industry; Textile and fashion industries | Nine interviews: four directors, two managers and three advisors | 48–90 | 118 |
| Ministries and others (4 organisations) | Agriculture and forestry; Environment; Economic affairs and employment; European parliament | Ten interviews (one interview with two interviewees): two directors, three specialists/managers, four advisors and one other | 52–110 | 135 |
| **Total: 38 organisations** | | **61 interviews** | **71 h 14 min** | **723** |

**Table 4**
Expertise matrix.

| | Political expertise | Ecological expertise | Social expertise | Technological expertise | Economic expertise | Cultural expertise |
|---|---|---|---|---|---|---|
| Public sector organisations | 5 | 3 | 3 | 4 | 2 | 1 |
| Private sector organisations | 2 | 3 | 2 | 8 | 3 | 2 |
| **Total of 38 organisations** | | | | | | |

### *3.2. Data analysis and construction of the images of the future*

With regards to the method of analysing the data, qualitative content analysis was chosen because its fundamental aim is to describe clearly the content of a phenomenon (Tuomi & Sarajärvi, 2009). Both authors performed analysis of the data. Our data analysis consisted of two phases.

The first phase was reading the data and the categorisation of the data by coding. Following the tradition often used in futures studies (Mäkelä et al., 2020), the PESTEC framework was used, with its six dimensions—political, environmental, social, technological, economic and cultural—to categorise the data. PESTEC provides users with an idea of the factors influencing the macro environment of an organisation, industry or phenomenon (Mäkelä et al., 2020; Yüksel, 2012). For the coding, we used the qualitative data analysis software ATLAS.ti. The codes were based on the PESTEC framework and its six categories. For example, in the case of the economic category, we coded sentences and expressions relating to the national and international economic situation, direction of development, competition, markets, the economy and business models. Some code themes, such as environmental taxes, were

multidimensional and classified under several categories. After a first round of reading and categorising the data, we re-read the codes and reduced them to core words and phrases to obtain a more manageable grip on the data. Next, more specific themes were generated under each main category to highlight the differences and to separate nuances.

The second phase was the construction of the images of the future for a CE by using the codes from the data. From the data, we noticed two clear extremes: positive and negative futures. The interviewees talked about either optimistically on the environmental problems that we have been able to solve in the future or very pessimistically of the global environmental problems and their consequences resulting from our inaction. Furthermore, we realised that the data consisted of two images in between the two extremes. In these occasions, the interviewees discussed incremental CE improvements to various fields of life. From this preliminary idea of four images, we started to organise the data to four coherent images of the future. The creation of the images was an iterative process where we were moving back and forth between data and theoretical concepts. Especially Polak (1973) provided inspiration and, specifically, we utilised general distinctions and elements of his images. However, detailed content of our images was derived organically from the data.

We organised our data to a four-square where the "axes" were the society and the societal structures and individuals. In the society and societal "axis", in the one end, we gathered the aspects of the data that supported CE and in the other end, aspects that hindered CE. The same applies to the role of individuals[2]. From this final categorisation, we created four distinct narrative images of the future.

Synthetisation of material to images of the future was performed by relying on the researchers' judgement. Tentative images were also presented to a team of business researchers in the CE and sustainability to validate results. The researchers' insights regarding the future directions of the CE were in line with our results; however, minor calibration was performed on the basis of feedback from the researchers.

## 4. Results

### 4.1. Summary of the results

This section presents images of the future in the form of narratives for the CE in Finland in 2050. All images were designed to be different from each other, logical and consistent. Our images of the future are based on certain basic assumptions shared by the researchers and the experts. For example, Finland will continue to be an independent and democratic welfare state. From the global perspective, Finland will have a good standard of living. The population will have declined slightly to 5.4 million by the year 2050 and the elderly will be more heavily represented in the demographic structure (Statistics Finland, 2021). Urbanisation will continue, focusing primarily on the largest Helsinki-Turku-Tampere urban areas in Southern Finland. Technological development will continue. In general, we pay attention to the macro perspective in Finland without outlining the future of cities, rural areas or different industries separately. Furthermore, on a global scale, the world will continue to be interconnected and Finland will still be a member of the EU. Having expressed these basic assumptions explicitly, we next provide a summary table of images of the future (Table 5) based on the PESTEC dimensions and the role of circulation.

In the following subsections, each image of the future is described by focusing first on the political and environmental dimensions, then on the economic and technological dimensions and finally on the social and cultural dimensions. The dimensions are considered especially from the point of view of Finnish society. The only exceptions are the political and environmental dimensions. Finnish national political decisions are affected by the international decisions (especially those from the EU). Similarly, the global state of the environment will affect the state of the environment in Finland.

### 4.2. Circular success story

In 2050, CE principles and activities have been fully adopted and, in Finland, people talk about the CE simply as the normal economy, excluding the prefix 'circular'. There are no more waste disposal sites or landfills, and only reusable resources exist. International politics and accustomed regulation create frameworks and smartly support and enable the CE. The most significant global environmental problems have been brought under control with the help of technology. Carbon neutrality and even negativity have been made possible in Finland by carbon capture from the air, renewable energy self-sufficiency, strengthened carbon sinks and the circulation of carbon for example for materials, food and fuel. Biodiversity and the richness of nature have begun to recover due to regenerative actions, the optimisation of natural resources and compensations. Among other things, problems associated with plastics have been addressed. Economic activity is adapted to the carrying capacity of the planet, as outlined in detail in the quote below:

> *I believe we are forced to balance this, our lives, with the carrying capacity of this planet. In a way, as a result of this circular economy and other good things, by 2050 we will have a very different ability to manage it, the balance. Or we will have been able to balance our own needs, as humanity, with these, with the planet's bearing capacity. Whether it is materials or raw materials or energy or health or whatever. (Industry organisation representative)*

Finnish companies are measured by harmonised indicators and metrics; in addition to financial bookkeeping, there is also a

[2] In Polak's model, the four-square is divided into essence (worldview) and influence (capability of humans to influence) (see Table 2). We interpreted essence in our case as the role of society and societal structures. Influence, for that matter, in our case was closer to Polak's model's influence.

**Table 5**
Summary table of images of the future.

| U | Circular success story | Circle of disaster | Local circles | Structural, regulated circularity |
|---|---|---|---|---|
| Political | Supported by global international politics and regulation | International politics fails | Weak regulation in support of the CE | EU-level regulation supports the CE |
| Environmental | Environmental problems addressed | Environmental problems dominate | Local solutions for environmental problems | Environmental problems mostly under control |
| Social | Cross-silo collaboration, active citizens | Minimum amount of collaboration, individualism blossoms | Local collaboration | Collaboration at the top level (i.e. decision-makers) |
| Technological | Technology harnessed to address environmental problems. CE technology develops and matures | Technological development is not strong | Large-scale technological development is not strong: start-up level technological development thrives | Technological development is strong |
| Economic | CE | Linear economy | Mix of a linear economy and a CE | Mix of a linear economy and a CE |
| Cultural | Sharing and peer economy is accepted | No one is interested in CE | Consumers are active | Consumers are uncertain |
| Circulation | Everything circulates (materials, components, products) | Some waste is recycled | Some materials and chemicals are circulating, consumers share products | Circulation of various materials is effective |

corresponding statutory set of indicators for environmental and social impacts. The everyday life and earning logic of companies are in line with the CE, and all materials circulate several times, creating turnover and business. Businesses based on services, digital platforms and solutions, proactive service and maintenance, modular design, reuse, lifecycle extension, leasing, lending and repairing provide a strong foundation for business models. Even chemicals and wood fibres can be leased. New companies, innovations and jobs are constantly being created, and the CE arises within industrial ecosystems. A change in the earning logic of companies is described through the example below:

> *The company earns when it moves me when I want to move. Or it makes sure I have a means of communication without me having to buy all these gimmicks in the world. Or it takes care of my health and adequate nutrition, so that what one gets as one's food, for example, can be very different depending on the life situation. So the whole concept and paradigm has changed. (Representative of ministries and governmental bodies)*

Digitalisation, artificial intelligence and automation are part of the CE. For example, one Finnish speciality is the control over the cycle of clothing by a piece of smart wire that tracks the materials used for making the clothes, the number of washes and the number of uses. Robots and chemical recycling separate different materials in sorting centres. Digital platforms can be used to track, control, manage, exchange and increase the value of materials. In addition, biological control has taken big leaps, and living organisms like bacteria and viruses can be used to break down, fix or generate things for the benefit of people. In Finland, climatic aspects and sustainable use of natural resources are considered everywhere: in energy production, land use planning and the built environment, mobility solutions, food production, agriculture and forestry, and everyday life. For example, the building of new premises is minimised and emphasis is set on preserving old buildings and modifying them intelligently and safely for new uses. Thus, Finland's future is almost built already. Material passports and only sustainable building materials are used in building new things. The construction technology has been renewed and everything can be clicked, disassembled, reconnected and rebuilt like Lego bricks.

In Finland, the CE has its own twist and a bold recipe and starting points: wellbeing and good economic prosperity are achieved at a fraction of the use of natural resources in the past decades. An estimation of the required level of usage was considered:

> *. when simulations have been made on how much our lifestyles consume natural resources, it's something like 40 tons per capita per year. And that a sustainable level would be maybe 8 tons. We need to shrink it to one-fifth. (Representative of cities and municipalities)*

Among the interviewees, even tighter perspectives were suggested:

*So one-tenth of the existing resources should achieve the same wellbeing and output.* (Representative of ministries and governmental bodies)

Various urban greens and vegetation thrive, with rural wetlands, pollinated fields and food production having their own defined areas in Finland. Livestock production has decreased, leaving fields increasingly for other uses. Technology, such as vertical farming, enables novel methods of food production and supports agriculture; food loss and nutrient cycles are mastered with the help of digitalisation. The whole Finnish education system supports the CE, starting from the day-care level. The culture of ownership and the relationship to goods has changed into a mentality of renting, repairing, exchanging, sharing, buying services and valuing old things. People value timeless commodities. Renting clothes is popular, and the young are no longer aware of the idea of fast fashion. People use sustainable solutions for mobility: walking, cycling, public transportation, mobility-as-a-service, hyperfast trains, fossil-free driving, autonomic cars, and car-sharing systems. The batteries of electric vehicles are actively recycled. Tailor-made mobility solutions exist for different cities and some cities even have car-free centres. Cooperation is at the heart of the CE: things are produced, co-created and orchestrated together across sectoral, industrial and geographical boundaries. People are very creative and positive about the future and believe they can further shape it to maximise wellbeing. With new models of cooperation and partnership and active people, new social innovations emerge.

### 4.3. Circle of disaster

In this image, the CE has not achieved a strong position. The world's major economic powers are politically differentiated and economies are partially closed and operating in a linear, protectionist manner. With regards to the use of natural resources and a CE, no international or national common vision or contractual and regulatory framework has been reached. The use of natural resources, materials and energy continues to grow tremendously, driven by global population growth and the need for shelter and food. The world is in the midst of an intensifying eco-disaster: rising temperatures, oceans full of plastic garbage and with very little life, and floods, storms and shrinking biodiversity are affecting the environment and people's health, security and daily lives. Wars and civil unrest are common, and refugees are pressing against the borders of Europe. Dark thoughts are associated with this:

> *The basic notion is that billions of people are set to move due to destruction of their habitats and we need to be sure that if we here in Europe want to keep a grip on this kind of thing then we need to be ready to kill a lot of people. (Regional actor representative)*

As a resource-poor region, Europe, including Finland, is increasingly dependent on international trade. Price levels for essential raw materials are high. The materials and minerals under the Earth's crust are not left alone but companies use them heavily, for example, for building even stronger and material-intensive buildings to withstand the increased humidity and heat of properties caused by the changing climate. Finnish companies fail to develop big new circular innovations and businesses from industrial side-streams, as described in the following quote:

> *… most of the material flows are eventually lost, perhaps to landfills or the environment, or by burning valuable raw materials. (Regional actor representative)*

If something promising is produced, commercialisation for international markets fails. Technologically, developing new non-renewable energy solutions and energy storage has not been successful, and Finland is still energy dependent on other countries. Digitalisation requires greater electrification of society and increased energy demand. Waste, non-recyclable products and biomass are incinerated for energy in large-scale power plants in Finland. Mobility is achieved primarily using private cars: car owning and their usage is on the rise.

Sustainable business is not trending in Finland, and Finnish people's consumption behaviour is based on quick satisfaction and short-term desires. People tend to continue owning things instead of renting or leasing them. Individualism blossoms. People are worried about themselves and sometimes even their neighbours, but solidarity does not cover larger regions or neighbouring countries:

> *We don't really have solidarity and we don't truly think about each other. I'm sorry, but my basic bet is that hell is going on here. (Regional actor representative)*

Individualism maintains the silos of different sectors, levels and fields in Finland. Public administration, the corporate sector and the third sector are far apart and unable to solve problems together. The situation is the same for international cooperation: only the minimum level of collaboration takes place. No one is interested or remembers the ideas of a CE.

### 4.4. Local circles

In this image of the future, Finnish consumers have taken the lead in the CE. A demand for products and solutions exists in accordance with the CE, and the supply of companies meets this need to some extent. Hyperglobalisation has shifted to a smaller, environmentally conscious everyday life, as described below:

> *There has been a change of mindset. Being international or in a constant rush are no longer attractive. Rather, maybe more of a responsible and smaller everyday life, from which we must then draw wellbeing. (Industry organisation representative)*

The climate has warmed by more than 1.5° due to the inability to find adequate solutions at the global level. Internationally and nationally, the use of regulation and various instruments such as taxation to support the CE are small and weak or are always one step behind. In addition, the circularity and recycling obligations of companies at the legislative level are mainly minimal.

Finland has not achieved changes in the use of natural resources: four times the use of Earth's carrying capacity continues. Certain Finnish regions, municipalities and cities have succeeded in creating neighbourhoods based on CE principles, closed-cycle CE areas, industrial symbiosis parks, CE villages and various CE projects. However, these are rare. In some places or areas, for example, renewable energy is produced in new ways that exceed energy consumption; in addition, materials and even chemicals circulate several times in use. However, this has not scaled to a larger level. The business of large companies is mainly based on the linear economy, while CE only has an assisting role in value-creation processes. Companies require actions and measures:

> *Both small and large companies have questions and challenges, and the fact that companies dare to take steps to change requires the support of the government as well as the EU: financial support and investment support. (Company representative)*

Finnish CE business remains primarily in the start-up category. Resources are required for technological specialisation, but green finance does not meet the factors of the required scale and only a few companies break through to markets. Recycling works considerably well, and, as before, the reduced amount of waste is taken to a landfill.

Finnish consumers are enthusiastic about lifestyles based on circularity and sharing and have a strong will to promote those. Furniture, toys, sports equipment and textiles, everything circulates around, and people use various local and neighbourhood digital platforms and libraries for exchange channels. Mindsets and values have changed:

*Simple, timeless clothes and things. And we would appreciate those things that we have; appreciation for food and for goods that there are. (Company representative)*

Moderate self-sufficiency in energy and food production through a home, housing association, district or village is considered important in Finland. Natural materials are used in the construction of small houses. For housing, energy-efficient and low-carbon solutions are important from the economic and environmental perspectives. With environmental awareness and changing consumption patterns, for example, mobility and travel are concentrated in nearby areas and remote working is popular. Small communities, neighbourhoods and individual businesses are collaborating enormously in the reuse of goods and materials and are innovating imaginatively; these, however, are not developing to a broader level.

### 4.5. Structural, regulated circularity

This image highlights the structures, in particular, the political system and the related innovation system, with its evolving technologies, that focus on promoting the CE. Pandemics hit rather often and require state-led control. The old legislation has been dismantled and replaced by new regulations supporting the CE. Strict regulation and development of a CE are linked closely together:

*I argue that the legislation in 2050 will be quite different from that of today. If it were like it is now, then we would have not made any sensible progress. But only with new legislation, coercion and that kind of thing. (Industry organisation representative)*

Strong EU-level control and strong national political control, taxation and regulation create a framework for the CE in Finland and, at times, heavy regulation repress Finnish consumers. With the help of environmental technology and innovations, environmental problems in Finland can be managed and regulated, and, partly through technology exports, there is also a positive environmental impact abroad. Despite the prevention measures, the warming climate makes agriculture, for example, a lottery: the years vary from very good to poor. However, many challenges related to food and nutrient cycles have been addressed through technology.

Developing a CE in Finland is considered laborious and bureaucratic because it involves different identification methods, technologies and measurements, and a CE does not evoke positive connotations. Large Finnish companies have special low-carbon and CE strategies; for example, machine and equipment design involves consideration of the life cycle of the product. Some business models in the CE are successful but not enough to change the paradigm of the economy. The economy is a mixture of linear economy and CE. Sustainability and recycling are pursued so effectively and on behalf of the administration that they occasionally turn upside down: recycling of non-essential materials takes up so much energy that it is no longer environmentally and economically sustainable. Material taxation is increased, as described by one interviewee:

*… this change should be brought about by raising taxation on the use of materials and reducing the work involved. Of course, that should be done at the EU level. (Regional actor representative)*

Overall, however, resource efficiency and energy efficiency have reduced the use of natural resources to a more sustainable path in Finland; however, there is still a lot to do to reach a truly environmentally sustainable level. Know-how and competencies in relation to manufacturing and, specifically, manufacturing products in a more non-toxic and resource-efficient manner have increased. Material flows can be better managed, and waste is separated and mainly utilised. Public procurement is harnessed to support the CE. In addition, some jobs are created in the CE in Finland, and some companies have found significant export channels for their tailor-made CE technological solutions.

The tradition of ownership has not been abandoned on a large scale; Finns have difficulty letting go of their cultural habits, which are also dictated by geography:

*These are the societal things that we have. we don't have a terribly strong tradition of ownership in Finland. They have not properly … so, I'm a user of these shared cars and goods myself, but on a large scale, they haven't caught fire. I don't know whether I should believe that perhaps they have in 50 years. On the other hand, these work in cities; however, on a global scale, we have pretty small cities. (Industry organisation representative)*

The economy dictates consumers' decision making; Finnish people chase low prices and ownership of goods while ignoring environmental or social aspects. People are not inclined to major lifestyle changes and, for example, the building of urban CE industrial parks causes the 'not in my backyard' phenomenon. Dialogue, cooperation and sharing good CE practices remain at the top level in large companies and public administration, but do not spread to Finland's significant small- and medium-sized enterprise sector and consumer level. Developing solutions for the consumer interface that people find useful is difficult. Solutions for mobility are controlled via a stick, not a carrot; congestion charges for car driving cause resistance, for example. Pandemics make people to stay at home and spend time on digital work and services.

## 5. Discussion

The increased research interest in and popularity of the CE as a key answer to the sustainability crisis has continued (Ghisellini et al., 2016), while, surprisingly, future perspectives in relation to the CE have remained insufficiently covered (Bauwens et al., 2020). Our study contributes to the CE literature by using a futures studies approach and describes the alternative futures of the CE through images of the future. As Kuhmonen (2017) has argued, the future cannot be predicted but it is possible to take a stand regarding its existence and features with the assistance of images of the future. Similarly, Svenfelt et al. (2019) have claimed that alternative futures

need to become visible because they affect our cognitive perceptions of the realm of possibilities in the future, and thus, influence today's decision making.

The main contribution of our research is to identify the alternative futures of the CE through images of the future. Understanding the alternative futures is vital to promoting CE and solving global grand challenges. Our images show that in order to make the transition to a sustainable CE, operations need to change at different levels of society; for example, both regulation and business models need to support the CE. At the same time as the economic model needs to be transformed into a CE, a sustainable transition is also needed in energy, transportation and food systems with which the CE is strongly intertwined and connected. In all of these, the development of technology is vital. Change must take place simultaneously at the level of society as a whole and at the level of individuals. As to individuals, our values and lifestyles need to support a CE. Socio-cultural change is challenging because it demands changes in everyday life. Changes should not be seen as only negative; instead, giving up old patterns should be seen as a way of creating something totally new. Currently, there are signs of changes in values, such as the Friday for Future initiative of Greta Thunberg and flight shaming in Sweden.

In the following sections, we will further discuss our results from three perspectives. First, we discuss our findings in comparison to our research question. Second, we will consider the dimensions of sustainability of each image. Third, we will compare our results with the previous literature.

Our research question asked, 'What are CE professionals' expectations of the state of things to come regarding a sustainable CE in Finland in 2050?' The CE professionals had several expectations of a sustainable CE in Finland in 2050. These varied from extreme optimism to extreme pessimism, as was portrayed in our images of the possible futures. Typical to these expectations was that each professional discussed the future from their own and often rather narrow perspective. One expert focused on the future of mobility while another discussed the future of the agri-food system. It was then the task of the researchers to connect these narrower perspectives into coherent images of the future. With regards to the prevalence of these images of the future in our data, it varied between the images but the building blocks existed in the data. The first image ('A circular success story') is a true collage of the ideas presented in the interviews. In this case in particular, each interviewee focused on a rather narrow perspective. The extreme pessimistic views of the second image ('A circle of disaster') were clear in almost every interview. The interviewees were unanimous in the idea that we are doomed unless we change course. The last two images ('Local circles' and 'Structural, regulated circularity') consisted of rather realistic expectations. The examples the interviewees gave were highly probable. This made us as researchers realise that bold thinking about futures is very difficult even for experts.

A sustainable CE considers economic, environmental and social dimensions equally (Millar et al., 2019; Velenturf & Purnell, 2021). Our images of the future place different emphasis on the different dimensions of sustainability. In the first image, the optimistic image, all sustainable CE dimensions receive a balanced consideration in a sustainable circular society. The economic model is a CE, major global environmental problems have been solved and the people are an active part of the CE society. In the second image, only the economic dimension gains attention, as is often seen in the CE literature (see e.g. Kirchherr et al., 2017). Environmental problems remain unsolved because international regulations have failed. In the social dimension, only individualism blossoms. The third image holds promise for the equal balancing of sustainability dimensions but, in the end, economic gains remain paramount, followed by the social and environmental dimensions. The role of the social dimension is emphasised in this image because the role of various local CE applications is significant. The last image emphasised in particular the environmental and economic sides of sustainability, excluding the social dimension because the role of individual consumers is rather insignificant. The last image also corresponds well with the previous CE literature, where there is a strong emphasis on environmental and economic dimensions (e.g. Schöggl et al., 2020).

When comparing our results to the sparce previous circular futures studies, we both confirm the previous findings and bring new aspects to the discussion. Our first image is strongly in line with Svenfelt et al. (2019), Urashima et al. (2020) and Kaskinen and Parkkinen (2018). Svenfelt et al. (2019) anticipated sustainable futures beyond GDP growth in Sweden with one scenario called 'CE in the welfare state'. Their scenario was based on a strong role played by the government and supporting industries, commodities based on services as well as the disassembly and reuse of products, reduced extraction of natural resources and changed lifestyles and consumption, focusing on exclusive services and leisure activities. The Transformation scenario of Urashima et al. (2020) focuses on strong technological development but also acknowledges the role of consumers. Furthermore, the one preferred scenario in Kaskinen and Parkkinen (2018) is similar to that of our first image.

Our second image of the future is unique; pessimistic CE futures have not been depicted thus far in the literature. We think that it is important to envisage pessimistic futures to understand where we do not want to end up in the future. Our second image has some similarities with the Stagnation scenario of Urashima et al. (2020). However, the starting point of their scenario is a weak economic situation, whereas we started with unsolved global problems. The third image has numerous shared features, such as non-consumerism and active citizens, with the scenario called 'Local self-sufficiency' by Svenfelt et al. (2019) and echoed to a limited extent the circular future scenario of bottom-up sufficiency in Bauwens et al. (2020), concentrated on self-sufficient local communities and innovative small firms. Similarly, in the Agility scenario of Urashima et al. (2020), the lack of a regulatory framework is mentioned but the authors failed to acknowledge the role of consumers, focusing instead on small-scale company ecosystems. Our third image also resembles the 'Green do-it-yourself engineers 2050' scenario of Heinonen and Karjalainen (2019). In their scenario, localism and DIY are the key, whereas our image highlights small-scale actors, including small and medium enterprises.

With regards to the fourth image, similar findings can be found from a circular future scenario called 'Planned circularity' (Bauwens et al., 2020), which stresses government control and adoption of citizens to circular practices, even against their will. Once more, Urashima et al. (2020) mentioned the role of strong legislation and the role of the public section in their Expansion scenario but describe companies' CE improvements as only incremental.

Every study has its limitations, and this applies to ours as well. Our study is based on a large dataset of expert interviews, which

suited the aim of this study well. Following the ideas of Polak (1973), it is important to gather the opinions of consumers and citizens at large. This limitation was reduced in our research by the fact that we also asked the experts about their actions as consumers and private citizens. Although there are studies that apply a CE at the country or even company level, we would encourage further studies in the contexts of other countries and studies on larger geographical areas, such as Europe or the EU. The transition to a CE requires systemic changes, and a true CE is difficult to achieve in the context of only one country. Yet another important limitation of our study was the creation of images of the future loosely based on Polak's categorization of the images. There are various ways of constructing images none of which is more suitable than the other. With our rich data, various other images of the future would have been possible.

## 6. Conclusions

The objective of our paper was to develop images of the future for a CE in Finland in 2050. On the basis of 61 expert interviews, we created four images of the future. The circular success story is literally the success story of a sustainable CE, in which the whole economy is a CE and major global environmental problems have been solved. The circle of disaster is a pessimistic CE image, in which society focuses on individualism and the promotion of individuals' private interests without trying to solve global challenges. Local circularity is an image of the future of a small-scale CE, in which circularity is promoted in villages and in industrial ecosystems but high-level CE implementations are lacking. In the structural, regulated circularity, the CE is controlled by the actions of governments and large-scale businesses, which causes scepticism among consumers.

Our study showed the CE to be an economic system that comprises more than just the management of material flows and minimising of waste. A sustainable CE permeates everything in our society, and we urgently need a more profound change in regulation, technology, industries, the economy, business models, education, cities and municipalities, workplaces, homes, production, consumption, commodities and behaviour. Most profoundly, as Desing et al. (2020) have suggested, we need a change in the way we see the world to take next steps towards circularity.

As Nylén (2019) summarises this challenge: 'Transforming the current unsustainable economic model is perhaps the most complex problem of our time.' Our findings, in the form of images of the future, demonstrated that a CE can have numerous futures with varying degrees of sustainability, and it can also have many forms and contexts. The future may unfold like one of our example images, may be a mix of those or may surprise us with something completely different. It is now time to decide which future(s) we want to achieve and to start making decisions and taking actions towards it.

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## Declaration of Competing Interest

None

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