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Authors: Meletios Bimpizas-Pinis, Catia Cialani, Andrea Genovese, Leandro J. Llorente-González, Benjamin Lowe, Wasim Malek, Mario Pansera, Josep Pinyol, Mohammad Javad Ramezankhani

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1. Introduction

The general understanding of the notion of a circular economy (CE) is that of a change towards a sustainable and waste-free production and consumption paradigm (Lazarevic & Valve, 2017). Although the concept and main features of a CE are currently being contested among different interpretations (Kirchherr et al., 2017; Korhonen et al., 2018), the mainstream position depicts the required transformation as both a voluntarist and technical matter. This change is expected to be addressed by the implementation of innovative eco-efficient technologies and marginal modifications in people's behaviour as consumers, within the same refurbished growth-led market-based economic system (Corvellec et al., 2021; Hobson & Lynch, 2016). Therefore, the socio-political requirements, implications and consequences of such an economic paradigm change has been largely overlooked (Genovese & Pansera, 2021; Llorente-González & Vence, 2020; Lowe & Genovese, 2022).

As the idea of a transition towards a CE is currently shaping the development strategies for the next decades in many regions of the World, including the European Union (EU), there is a need to address the expected potential outcomes and its economic, social and ecological implications. At present, only a few studies have somewhat engaged with this issue, either by exploring a set of plausible "circular" future scenarios (Bauwens et al., 2020), developing alternative future images of sustainability/circularity for a specific territory (Fauré et al., 2019; Marjamaa & Mäkelä, 2022; Svenfelt et al., 2019) or conceptualising future institutional configurations of the sharing economy (Frenken, 2017).

These first conceptual exercises provide valuable insights on the expected shape of plausible future circular scenarios, which are built upon certain broad social and economic trends within the current market capitalist economy. However, the socio-political implications and outcomes of the proposed scenarios still remain to be further explored, especially as the role played by the social relations of production in shaping the alternative futures has not yet been taken into consideration (Lowe & Genovese, 2022). As a result, the envisaged eco-modernist efficiency-based futures do not clearly portray the ecological and social contradictions inherent to the capitalist growth imperative, while the fundamental social transformations (and conflicts) that would be required to deliver the more radical sufficiency-based futures still remain unaddressed.

In the previous deliverable (3.4) we have investigated different economic, environmental and social indicators, identifying their strengths and weaknesses when utilised to measure economic performance within what is generally understood as a CE. This report builds on this pre-existing work of reflecting on the conceptualisation of economic performance. Yet, if we accept that alternative circular futures may arise from different social relations of production (Lowe & Genovese, 2022), we should also consider the particular and diverse overarching societal goals to determine which perspectives to the notion of economic performance are more appropriate in each case.

Therefore, we first aim to contribute to the emergent discussion on the future of CE by introducing three conceptual dimensions that capture the expected key transformations in the social relations of production associated to different expected outcomes of the systemic paradigm shift. As a result, we derived a new comprehensive 9-scenario typology of alternative circularity

futures, which was further validated by a two-round session of feedback with experts. Secondly, we present a classification of the indicators analysed in Deliverable 3.4, taking into account their level of appropriateness as measure of economic performance in the context of the proposed future scenarios. Thirdly, the two scenarios that were identified as the most feasible and desirable future outcomes were applied as the basis for an interactive foresight activity with experts based on the methodology of Scenario Exploration Systems developed by the JRC (Bontoux et al., 2016). Finally, using the feedback collected from the performed sessions, we classify the different scenarios of the future CE by their fitness to different understandings of economic performance. This feedback allows us to observe how different definitions of economic performance can be associated with different outcomes in the materialisation of the CE.

This report proceeds as follows. After briefly explaining the methodology employed, we present the literature reviewed regarding future studies and, in particular, of future scenarios for the CE. In the fourth and fifth sections we derive new conceptual axes to build future scenarios capturing the dimension of change in the social relations of production, and we present and elaborate the resulting circular future scenarios. In the sixth section, we present further points for discussion derived from the consultation process and the Scenario Exploration System game performed with key experts and stakeholders. Then, we classify different assessment frameworks according to their suitability for measuring performance in each of the proposed scenarios. Finally, we present some general conclusions and reflections.

2. Methodology

In this report, we make use of the available literature on CE futures to build a classification framework of potential CE future scenarios, incorporating conceptual dimensions that account for the associated changes in the social relations of production.

2.1 Literature review on CE future scenarios

We began with a comprehensive literature review using Elsevier and Scopus databases, with the keywords “Circular Economy” and “Future* AND/OR Scenario*”. We reviewed more than 1400 abstracts and identified 39 peer-reviewed papers that were considered to be relevant to the subject, as they delved in some way into the conceptual analysis of future circular scenarios (and did not merely contained the words “future” or “scenarios” in other contexts). The initial aim was to understand several features of these studies. These included the overall goals of the study, timeframe, economic and geographical scope, typology of the scenarios (exploratory, predictive, experimental, normative), methodology, conceptual axes used to build the scenarios and, finally, the future scenarios identified.

The first outcome was that most of the reviewed literature focused on specific economic sectors or strategic materials to which circular strategies were expected to be applied. For example, Dong et al (2020) explored how China’s copper demand could be met in the upcoming century considering the consequences that might be associated with introduction of a new policy called “Green Fence” and introduce scenarios and analysis using a quantitative predictive method. In the same vein, Istrate et al. (2021) focused on energy recovery from municipal solid waste in Spain and introduced possible scenarios that could arise by 2030. Although this type of studies provided

many interesting insights on the empirical applications of the future scenario methodology, priority was given to those exploring circular futures conceptually and at the macroeconomic level.

2.2 Analytical framework and consultation process

The next step was to build an analytical framework based on the most relevant literature, using theoretical axes or dimensions to derive potential future scenarios from an economic theory perspective. The resulting framework was reviewed through a two-round consultation process with CE experts from different knowledge fields. First, a structured conversation was performed, in the context of a seminar consisting of a public presentation and discussion of the proposed conceptual axes. Second, an anonymous controlled survey was applied and responded by 17 members of the selected group of experts. This procedure was inspired by the Delphi method applied in other exploratory studies on CE (de Jesus et al. , 2019; Prieto-Sandoval et al., 2018), which has been considered within the futures literature as suitable when seeking to collect critical judgements from a multidisciplinary panel (Rodríguez et al., 2019).

These rounds of consultations were used to gather experts' opinions on whether the scenarios were desirable and/or plausible, to inquire about the relevance of the conceptual axes, and to further define the qualitative details of the resulting scenarios. The feedback was also applied to the selection of two scenarios (those respectively considered as most plausible and most desirable) to further develop their narratives and test them by means of a Scenario Exploration System interactive game (Bontoux et al., 2016). This led to a third round of feedback on the consistency and plausibility of the proposed framework. The Scenario Exploration System was played three times and each round involved a total of 21 individuals from academia, business, non-governmental organisations, and policy-making.

The Scenario Exploration System (SES)

The *Scenario Exploration System (SES)* is a simulation tool that allows exploring possible paths towards possible scenarios of the future. The performance of this game allows to stimulate engagement with experts, where they play the role of key stakeholders, such as established businesses, policymakers, civil society organisations, respected public figures, research organisations, or public voices as the media. The SES is a game developed under the Creative Commons licence by the Joint Research Centre of the European Commission that can be modified and adapted to explore different sets of scenarios (European Commission, 2022).

3. Circular futures: a review

The study of the future is gaining relevance in the academic sphere (Andersson, 2018; Beckert, 2016; Beckert & Bronk, 2018; Bell, 2017; Urry, 2016). This growing attention is rooted in the increasing concerns about the increasingly frequent environmental crises (Buell, 2009; Hickey-Moody et al., 2021; Walker, 2017). These theoretical concerns for imagined futures and scenarios is developed from many fields, including history (Andersson, 2018), anthropology (Appadurai, 1996; Bryant & Knight, 2019; Hastrup, 2013) and sociology (Adam & Groves, 2011; Tutton, 2017; Urry, 2016), among others. The main challenges of these studies is to understand how the future

is imagined, constructed, and finally transformed in a socially transformative element that shapes present societal action (Oomen et al., 2021). Therefore, future studies do not seek to predict the future, but to facilitate the formulation, implementation, and re-envision of socially desired futures (Dator, 2019).

3.1 Future studies and ecological economics

Images of the future are collective visions that define how the future is being imagined (Milkoreit, 2017). They are socially performative, as they shape social practices and the performance of reality, and therefore have the ability to actually influence future outcomes (Mangnus et al., 2021; Oomen et al., 2021). It is thus critical to actively understand and participate in defining what the future economy may look like using economic theory to produce credible and rigorous inquiry on the definition of potential futures (Beckert, 2016). To shape and influence the images of the future, academics and other stakeholders need to critically engage with the concept of social, economic and political imaginaries, to tackle the conceptual and organisational challenges posed to the liveability of the planet by the current economic system (Wright et al., 2013).

One of the most frequent methods to imagine the future is the construction of scenarios (Börjeson et al., 2006; Lord, 2016). Huss (1988, p. 377) defines the scenarios as narratives that describe a consistent set of factors which depict alternative sets of plausible future conditions. This approach addresses the weaknesses of extrapolative forecasts by including qualitative variables, predicting turning points, and connecting traditional forecasting with decision making. This technique produce extrapolations by using historic data and helps to predict potential future events and to support planning and the decision-making process (Huss, 1988; Kok et al., 2011; Lempert & Groves, 2010; Schoemaker, 1993; Vervoort et al., 2014).

One of the main characteristics of the use of scenarios in future studies is its ability to build and study images of the future, and how these images induce technological developments together with political, social and cultural changes (Bell, 2017). Therefore, the study of these images adopt a more politically active approach and has the potential to open up the construction of social imaginaries to a wider public, involving stakeholders and reshaping public priorities and the embedded long-term visions within public policy (Mangnus et al., 2021; Oomen et al., 2021).

There is currently scant literature devoted to the conceptualisation and theorisation of the future in the field of ecological economics (Bartolini & Sarracino, 2018; Belmonte-Ureña et al., 2021; Goodwin, 1994; Jansson, 2013), even though the necessity to imagine new models of development to create harmony between humankind and nature is crucial to the basic principles of this field of knowledge (Jansson, 2013). The existing literature focuses mainly on describing the unsustainable nature of the business-as-usual future scenario (Hagens, 2020) and the potential of new ideas such as the CE, green growth, degrowth, and sufficiency (Belmonte-Ureña et al., 2021; Jungell-Michelsson & Heikkurinen, 2022). Recently, some contributions have been made that open up the debate on what are the future scenarios that could arise after the emergence of the CE notion (Bauwens et al., 2020; Lowe & Genovese, 2022).

3.2 Future studies on CE

Although it has been more than a decade since the start of the discussion around the CE and its implications, a few studies have tried to frame the future scenarios that could arise from implementation of the CE initiatives (Bauwens et al., 2020; Rodríguez et al., 2019). Many studies focus on the microeconomic level of transition towards the CE and very few discuss the

fundamental reforms that could enable the transition at either microeconomic or macroeconomic level (Bauwens et al., 2020). Framing future scenarios for the CE leads to identifying the potential actions that are required to be taken in order to pave the way for a smooth transition towards the CE and mitigate possible risks.

Among the literature that discuss possible future scenarios for transition towards the CE, a few contributions stand out and lead the discourse: Bauwens et al. (2020), Calisto Friant et al. (2020, 2021), Fauré et al. (2019), and Svenfelt (2019). While valuable insights can be found in all of these approaches, the study conducted by Bauwens et al. (2020) offers particularly fertile ground for conceptual discussion, as it introduces a classification framework based on theoretical dimensions or *axes* that are employed to derive alternative extreme cases of future scenarios. The selected dimensions are political governance and the attitude towards technology and innovation, leading to four alternative CE futures, namely: planned circularity (centralised governance + low-tech innovations); circular modernism (centralised governance + high-tech innovations); bottom-up sufficiency (decentralised governance + low-tech innovations); and peer-to-peer circularity (decentralised governance + high-tech innovations) (Bauwens et al., 2020).

While the two dimensions selected by Bauwens et al. (2020) can indeed play a decisive role and the futures described are analytically interesting, some very relevant factors are overlooked in this approach. As pointed out by Lowe and Genovese (Lowe & Genovese, 2022), the framework does not shed light on the role played by the *relations of production* in shaping alternative futures. As such, Bauwens' classification assumes the current market capitalist economic structure as an immutable status quo within which a transition to a Circular Economy should happen. Thus, the futures depicted seem to buy into the “end of history” narrative (Fukuyama, 1992): whatever circular future we might have, it will be within the boundaries of a capitalist “liberal-democracy”.

Consequently, the framework proposed by Bauwens et al. (2020) leads to some debatable results. For instance, it does not offer a clear conceptual criterion to discriminate between high-tech CE scenarios in which decisions are centralised by multinational and large business, from those that are led by the State. Instead, all cases in which central State planning is determinant are considered to be based solely on coercion while no relevant role is given to high-tech innovation, thus making it difficult for the authors to assign a scenario to a case as significant as China's. The “planned circularity” scenario depicted by Bauwens et al. (2020) seems to better correspond to what Calisto Friant et al. (2020) described as a “fortress circularity” narrative or discourse, characterised by a top down imposition of resource efficiency, using a framing of scarcity to promote resource and population controls. Although departing from similar ideas, the notion of a “fortress circularity” future has two main conceptual advantages over that of a “planned circularity”. First, it does not need to rely on the debatable assumption that high-tech innovations would not also be a priority within a centrally planned circularity. Secondly, the notion of “fortress circularity” explicitly acknowledges the fact that a top down authoritarian governance can be carried out both by the State and by the action of large corporations (something especially evident in the Global South) (Friant et al., 2020).

Another shortcoming of the classification by Bauwens et al (2020) is the lack of a clear conceptual distinction that allows to differentiate between a future characterised by a citizen-based sharing economy from what has been described as a “platform capitalism” (Frenken, 2017; Lowe & Genovese, 2022), i.e. a future in which digital innovations are co-opted and controlled by large multinational firms. Although the authors recognise this issue, it is not clear how a collaborative

alternative to the platform scenario can be conceptually derived without incorporating to the analysis the logical requirement of a complete transformation in the social relations of production, involving radical changes in the ownership of knowledge and the means of production. In the same vein, the scenario referred to as "bottom-up sufficiency" also lacks historical and practical sense if the conflictive change in the current relations of production implied is overlooked in the theoretical framework.

The proposals from Fauré et al. (2019) and Svenfelt et al. (2019), albeit not specifically developed with Circular Economy in mind, but referring to "sustainable" futures in general, seem to adopt a more general view that allows to remediate some of these conceptual limitations. Indeed, these classification frameworks, while recognising the roles of governance and technology, do include additional dimensions. Notably, ownership and property rights (collective vs individual), along with the organisation/scale of production systems (large scale industrial operations vs small scale localised production) play a prominent role.

4. Development of a framework for the classification of CE scenarios

In this report, we present an enhanced futures' classification framework that seeks to address the conceptual limitations that were found in the existing literature (Table 1). These drawbacks, which have been described in detail in the previous section, are mainly related to the need to provide conceptual consistency to the circular future studies, by incorporating a theoretical dimension incorporating the transformations in the social relations of production that would be both expected and required to support the different future CE scenarios. To do so, we first built upon the work by Bauwens et al. (2020), Calisto Friant et al. (2020), Fauré et al. (2019) and Svenfelt et al. (2019), from which we identified the following relevant dimensions/axes:

- 1) Political governance (ranging from very decentralised to very centralised);
- 2) Nature of innovation and technology (ranging from convivial technologies to large scale industrial technologies);
- 3) Organisation/scale of production (ranging from very large global scale to very small local scale);

In this report we propose to incorporate, in line with Lowe and Genovese (2022), two additional conceptual axes:

- 4) Ownership of final goods (ranging from largely collective to largely individual)
- 5) Property/control of means of production (ranging from predominantly collective to predominantly private)

Axes 1) and 2) correspond almost entirely to those depicted in Bauwens et al. (2020). The main difference is that, in the dimension regarding the nature of the innovations deployed, the main focus is less on the level of technological complexity than on the convivial or industrial character of the technologies. We refer to convivial technologies as those socio-technical innovations that comply with the following 5 main characteristics (see Genovese and Pansera (2021)): relatedness (promotion of human relationships); accessibility (free and open-access); adaptability (independent usage); bio-interaction (useful to ecological cycles); and appropriateness (contextual and dependent on local knowledge).

Axis 3) seeks to reflect the essential difference between a CE characterised by the further extension of economies of scale and global value chains, on the one hand, and a CE based on the principle of proximity and the development of local capacities (Gallaud & Laperche, 2016), on the other.

The fourth and fifth axes incorporate two conceptual dimensions concerning ownership and property over the means of production. These key socio-economic dimensions have different implications on how the output of the productive process is socially distributed, and on the underlying configuration of the relations of production. The fourth axis, ownership of final goods, captures the degree of collectivisation in the access to consumption. The highest degree of collectivisation may occur either through extended civil association in consumer cooperatives or through generalised State ownership and provision of goods. The opposite case entails the predominance of individual private ownership of consumer goods, which implies that the market is the prevailing mechanism for the distribution of the social output. Welfare state can be seen as an intermediate case between individual and collective ownership, whereas the Washington Consensus model of minimal state (Chang, 2002; Mazzucato, 2013) could be considered an example of predominant individual ownership. It should also be noted that the extreme case of ownership collectivisation does not necessarily correspond to the concepts of “collaborative consumption” or “sharing economy” (Svenfelt et al., 2019). Although in such cases the access to the goods may indeed be shared by many individuals, those goods are ultimately property of the owner(s) of the company providing the service (as in the case of the “platform economy” described by Bauwens et al. (2020)).

The fifth axis refers to the ownership and control over the means of production, and again ranges between being predominantly collective or individual/private. By means of production we understand all the raw materials, instruments, machines, technologies and knowledge applied in the productive process (Marx, 1973). Private ownership and control of the means of production is, together with extended commodification of labour, one of the main features of the capitalist mode of production (Marx, 1992). The associated relations of production are those of exploitation based on the power imbalance between the owners of the means of production and the wage labour force. Therefore, the fifth axis can be interpreted as a measure of the balance of power between those in control of the means of production and those whose livelihoods depend primarily on their own workforce¹. At one extreme, production is mainly undertaken in order to obtain profits, which are largely captured by private companies. At the other, the means of production are collectively owned and managed either by worker cooperatives or under centralised State control, and therefore the main driver of the productive process is not profit but the satisfaction of social material needs.

Clearly, each dimension can be characterised by a continuum of configurations across the identified ranges. The combination of these 5 conceptual axes led to the definition of 9 future scenarios for the development of the CE). Although it is acknowledged that many other combinations may be possible in theory, the focus was placed on the extreme cases, aiming to build internally coherent and stable scenarios. For example, market-based scenarios combining private ownership with small/local scale of production were discarded, since it is expected that

¹ This category also includes self-employed workers when: 1) their subsistence depends on a limited number of clients (which in practice corresponds to an informal employment relationship) and/or; 2) a significant share of their income is dedicated to securing access to their basic working tools (rent and utilities, internet connection, software licences, virtual storage space, training courses, etc.).

their inherent dynamic will lead to the concentration of production, tending in the long run to a “large-scale” scenario.

Table 1: Mapped CE futures, conceptual axes and precedents.

D3.5 Futures	Conceptual axes					Precedent scenarios
	Nature of innovations	Political/Productive Governance	Scale of Production	Access/Ownership of Goods	Property of Means of Production	
MNE-led Modernist Circularity	High-tech (radical)	Centralized	Large/Global	Individual/Private	Private	Circular modernism (Bauwens et al, 2020); Technocentric circular economy (Calisto Friant et al, 2020)
Welfare-state Modernist Circularity	High-tech (radical)	Centralized	Large/Global	Individual/Mixed	Private	Circular economy in the welfare state (Svenfelt et al, 2019); Reformist circular society (Calisto Friant et al, 2020)
Landlord Fortress Circularity	High-tech (incremental)	Centralized	Large/Global	Collective/Private	Private	Fortress circular economy (Calisto Friant et al, 2020)
State-led Modernist Circularity	High-tech (incremental)	Centralized	Large/Global	Collective	Collective	
Platform P2P Circularity	High-tech (radical)	Decentralized	Local > Global	Collective/Private	Private	Peer-to-peer circularity (Bauwens et al, 2020)
Open-access P2P Circularity	High-tech (radical)	Decentralized	Local > Global	Collective	Collective	Peer-to-peer circularity (Bauwens et al, 2020)
Autarkic Fortress Circularity	Low-tech	Centralized	Large/Global	Collective	Collective	Planned circularity (Bauwens et al, 2020)
Convivial Eco-socialism	Low-tech	Decentralized	Small/Local	Collective	Collective	Transformational circular society (Calisto Friant et al, 2020); Bottom-up sufficiency (Bauwens et al, 2020); Local self-sufficiency (Svenfelt et al, 2019)
Free-market Insufficiency	Low-tech	Decentralized	Small/Local	Individual/Private	Private	

5. Description of future CE scenarios

From the literature on CE futures analysed and presented in the previous sections (Table 1), it was possible to identify four general types of scenarios: modernist, peer-to-peer, fortress and post-growth circularity. Taking these categories as a point of departure and applying the new proposed conceptual axes, we derived 9 specific scenarios, which are described as follows.

5.1 Modernist circularity scenarios

Circular modernist types of scenarios are those which are shaped by the presence of a centralised governance and a pre-eminence of high-tech innovations, as depicted by Bauwens et al. (2020). These future circular scenarios are based on an eco-modernist techno-centric narrative, which argues that nature can be protected by developing technology that is capable of effectively decoupling economic activity from resource use and environmental impact.

These scenarios are depicted in the literature as being led exclusively by private business initiative, with the public sector playing a secondary role as a mere facilitator, either through soft regulation or “corrective” taxing. In contrast, the key role of the public sector as political promoter and main

investor of material resources in technological innovation is often overlooked (Mazzucato, 2013). However, distinguishable future scenarios emerge when considering alternative arrangements with respect to ownership and control of social resources and means of production, embodied in different configurations of the role of the State and private business in leading the transition.

5.1.1 Multinational Enterprise-led Modernist Circularity scenario

The multinational enterprise-led modernist circularity (MMC) scenario is that in which the transition to a CE is mainly derived from the actions and decisions of a few large companies that operate at the global level. As such, they profit from economies of scale, innovations in logistics and ICTs, wage, tax and regulatory differences among countries, and preferential access to international financial markets. These large multinational companies understand circularity as a business opportunity and way of securing their profits in a context of resource scarcity, by being able to retain key materials within the global value chains under their control for as long as possible.

In this scenario, multinational companies are able to influence the policy sphere to shape the CE strategies and regulation towards a version of the CE that does not conflict with the way they envision their business activity and preserves their profit-driven and growth-led paradigm. Therefore, the role of national governments is limited to managing externalities by setting basic legal standards, and underpinning the transition through fiscal policies to deter the traditional lineal economic sectors already in crisis.

Citizens are largely responsible to recycle and prevent waste of the products that they purchase, while they have a small influence on the design and the reusability or the repairability of the products available in the market. Although democratic institutions are formally in place, the strong interference of business lobbies in political decision-making results in low levels of citizen representation and involvement. Moreover, the increasing economic dependence places local governments in a situation of relative weakness vis-à-vis transnational corporations, thus undermining the principle of national sovereignty.

5.1.2 Welfare State Modernist Circularity scenario

The Welfare State Modernist Circularity (WSMC) scenario has many elements in common with the “CE in the welfare state” case proposed by Svenfelt et al. (2019). Although large corporations still dominate the transition, the State has a more involved role not only in directing public investments to CE-related innovation but also in ensuring the provision of public goods and supporting collaborative ways of consumption. Therefore, public procurement is a relevant part of the overall demand for circular-based goods and services, which are nevertheless mainly provided by large private companies.

Therefore, the state actively seeks to make compatible private firms’ goals with the overall reduction of the environmental impact of the economy (Fauré et al., 2019; Svenfelt et al., 2019), and to organise redistribution mechanisms to ensure certain minimal conditions of social equality. The state also takes the initiative to enable the development of high-tech innovation and is responsible for coordinating and shaping economic activity through legislation and taxation to enforce environmental protection.

The WSMC model is characterised by a national scale of production. The means of production are privately owned, although in a context of cooperation with the state, new forms of hybrid

ownership can emerge that combine public and private elements to maximise societal welfare and enable high-tech innovations while minimising environmental impact.

5.1.3 State-led Modernist Circularity scenario

The SMC is a model of circularity where the state is the main actor that assumes the responsibility to drive the transition towards the CE, while promoting high levels of technological development. This model of circularity maintains key similarities with the vision of circularity developed in China, where state-owned companies and state agencies directly dictate measures to transition towards a CE (Fan & Fang, 2020; Mathews & Tan, 2016). The state also acts as a key enabler of innovation by developing eco-industrial parks that allow large centralised scale of production and innovation (Mathews & Tan, 2016).

The means of production in this model of circularity are largely owned by the state that controls the strategic sectors of the economy. However, this ownership is not absolute, as the state may allow the participation of private owners in the economy as well. The SMC can enable new dynamics in the ownership of final goods, while some goods can be privately owned, strategic goods are under control of the State to guarantee accessibility and social distribution. The SMC model of circularity is shaped by a scale of production that is at least national, as production is planned primarily to satisfy the internal demand of goods and services, yet public firms may also compete at the global level to obtain financial gains, take advantage of economies of scale and secure strategic markets and/or resources.

This model of circularity is shaped by the leading role of the State in controlling the economy and organising the production and consumption systems. With these actions, the state seeks to enable economic development in the short and in the long term and to ensure certain levels of social welfare while also achieving acceptable levels of environmental protection. The overarching role of a highly centralised state can also involve a set of major negative social implications, such as a lack of public participation in decision-making or the vulnerability of citizens to the State, which especially affects citizens from ethnic minorities, dissidents, or non-normative people, as members of the LGTBI+ community.

There are two stark examples of state-led schemes that depict what could be expected in transition towards the CE under the SMC scenario. The first one dates back to the era when the USSR designed a national scheme for recycling waste (Fedotkina et al., 2019). The focus was put on five materials: glass, textiles, tires, wastepaper, and polymeric materials. The Soviet Union-led program emphasised on standardisation in product design and unification in production and put forth centralised initiatives for waste collection and material processing to ensure widespread use of secondary materials. As a result, in the 1980s, the recycling rate for paper and glass bottles stood at 30% and 45% respectively and households and companies were actively involved in collection of recyclable waste (Fedotkina et al., 2019). In addition, in 1986, a new provision was introduced by the government that holds the producer responsible for developing new technologies and facilities for reusing or recycling products after their end-of-life period.

The second one is China's current approach for transition towards the CE as a national sustainable development strategy. The main aim of China's CE strategy is to tackle environmental degradation and resource scarcity (Su et al., 2013). The scheme covers several aspects of sustainable development at the national level including resource and waste management, energy efficiency and conservation, land management and soil protection, and water management. For monitoring the

progress, a framework of indicators is developed by the Chinese National Development and Reform Commission (NDRC) which is the body responsible for regulation and implementation of CE initiatives across the country (Mathews & Tan, 2011). More than a decade after the introduction of the law proclaiming the CE as a goal in China's strategic economic and social development plan in 2008, the government actively monitors the progress and refines the program periodically according to the developments at the regional scale.

5.2 *Peer-to-peer circularity scenarios*

This type of future scenarios involves a transition to CE based on technological innovations that enable a high level of decentralisation of both political governance and productive systems (Bauwens et al., 2020), through developments that increase interconnectivity, digitalisation, automatisisation, de-localisation and traceability. In this case, the control and property over the means of production is highly dependent on the type of access to certain key knowledge and digital developments, which can be in private hands that limit access to obtain a profit or may be open-source and thus enhance collaboration in their use and development.

5.2.1 *Open-access Peer-to-peer Circularity scenario*

The OP2PC scenario depicts a future in which generalised technical innovations on digitalisation and distributed production, together with socio-political developments in terms of collectivisation of both knowledge and means of production, allow for a 180° shift in the logic of *consumption* to *prosumption* and from *ownership of final goods* to *collective access to use/performance*. It should be noted that, as the main technologies still rely on economies of scale and there are no macro-level mechanisms to coordinate efforts towards an overall reduction in resource consumption, this future scenario may lead to rebound-effects due to the enhanced access to consumption goods (through platforms) and the massification of productive tools (such as 3D printers).

This sub-scenario may also combine the political decentralisation and digital collaborative open-source technologies of the collective peer-to-peer circularity, with a “general economic downscaling” (Friant et al., 2020), leading to sufficiency-based community-owned local productive systems. Collective ownership of the means of production materially supports both general citizen political involvement and economic inclusion and allows for the development of sufficiency-driven rather than profit-driven productive activities. Therefore, it prioritises the shorter loops of the value-retention hierarchy of CE (Friant et al., 2020; Reike et al., 2018).

5.2.2 *Platform Peer-to-peer Circularity scenario*

The PP2PC scenario is related to what has been described in the literature as *platform capitalism* (Frenken, 2017; Lowe & Genovese, 2022). It differs from the cooperative/collective peer-to-peer circularity future in that the main technical innovations in digitalisation that may enable the creation of a collaborative sharing economy are instead co-opted by large private corporations (Bauwens et al., 2020; Martin, 2016). As the ownership of both goods and the means of production remain under control of private companies that operate in a “winner-take-all” type of market (Bauwens et al., 2020), platform monopoly creation becomes the norm.

This economic trend is further aggravated by the high level of political decentralisation, as there are no political governance mechanisms that could operate on behalf of workers/consumers as a collective. As Bauwens et al. (2020) themselves pointed out, this could lead to “social issues, such

as increased labour market flexibility and an erosion of workers' rights (...) as well as a commodification of aspects of life that were previously beyond the reach of the market”.

5.3 Fortress circularity scenarios

This type of CE future scenarios is characterised by a high level of political centralisation together with the primacy of non-technological innovations, and therefore share some features with what has been depicted by Bauwens et al. (2020) as a “planned circularity” scenario. However, the authoritarian nature of the decision-making process and the primacy of coercive mechanisms over technological innovation makes it closer to what Calisto Friant et al. (Friant et al., 2020) described as a “fortress circularity” narrative, given that an authoritarian centralised governance could be led both by the State or by large corporations. Taking these factors into consideration, and applying the proposed analytical axes, two further sub-scenarios have been outlined: autarkic fortress circularity and free-market fortress circularity.

5.3.1 Autarkic Fortress Circularity scenario

At a first glance, the AFC scenario can be related to what Bauwens et al. (2020) labelled broadly as a “planned circularity”, in which the transition is “centrally piloted by the government via strong coercive measures”, rather than based on technological innovation. Nevertheless, in addition to the extended use of strict command-and-control regulations, the “fortress” character of this CE strategy lies in the fact that it is not driven by a real concern about reversing environmental damage, but responds to the notion of prevailing (or at least of not being relegated) in what is perceived as a context of fierce global competition for scarce key resources (Friant et al., 2020). The focus is therefore put on low-tech innovations in the larger material loops (Bauwens et al., 2020), population control, rationing and top-down resource efficiency (Friant et al., 2020). Income distribution and social justice may be addressed by the centralised governance, although only strictly within national borders (and regardless of the impact on income distribution and social justice in other territories).

In this scenario, the transition towards the CE is led by a primary governing body through top-down initiatives and schemes. As a result of this process, communities are expected to experience reduction in individual freedom of choice. Third, from the technological point of view, no substantial investment is required either for R&D activities or capital investment. In this case, the cost of knowledge transfer would be expected to be low.

This scenario is also close to the approach that has been described as “authoritarian environmentalism” (Bauwens et al, 2020), in which political decision-making is considered to be more effective when directed by a group of experts rather than relying on a democratic process. It has been argued that the shift towards this type of authoritarian structures is a risk that can result from the reluctance to envisage radical democratic alternatives to the current model of liberal democracy which, having been co-opted by the interests of corporations and subject to the logic of markets, is proving incapable of providing a solution to the most pressing social and ecological problems of the time (Shearman and Smith, 2007).

Under the AFC scenario, it is expected that the governing body will implement some top-down initiatives to pave the way for transition towards the CE. Some of the top-down actions are expected to be implemented by the governing body are listed here:

- Putting in place regulations on production and consumption patterns
- Legislating laws such as “right to repair” that ensures access to spare parts and technical information for a certain period of time, or establishing full producer responsibility programs to ensure the producers take the responsibility for post-consumption management of products
- Introducing taxes and/or caps on raw material consumption, emissions, and waste generation
- Banning the use of hazardous materials, plastic packaging, single-use products, etc.
- Setting standards and/or issuing certificates to beef up second-hand product markets and boost reuse policy by enhancing information about the quality of materials and products
- Identifying certain sectors that are most polluting or most resource-intensive and allocating more resources for technological innovations and investment in research and development activities

5.3.2 Landlord Fortress Circularity scenario

The LFC scenario is shaped by the action of a few large multinational companies that have successfully co-opted the strategic resources to produce key elements for the economy, such as electronic goods, batteries, or motorised vehicles. These large corporations maintain the ownership of both the products and the resources that are necessary to produce them. Consumers do not buy but lease, in a system where big companies are responsible for maintaining, repairing, and refurbishing their products to keep them operational. Therefore, profit is secured by companies not through production of new goods but by controlling the price of leasing these strategic products. Under this model of circularity, large firms become owners not only of the means of production but of the produced goods themselves, establishing social relationships with consumers which have several similarities to that of landlords and tenants.

The LFC model of circularity maintains key similarities with the MCM model of circularity, as the scale of production is global, and the means of production are privately owned by few large corporations. The difference between the MCM and the LFC models of circularity is that under the LFC model, big companies retain the ownership of their production and the materials needed for production, and consumers have access to these products through new systems of leases and rentals.

The LFC model of circularity is shaped by the co-optation of oligopolies of strategic materials and products necessary to develop essential economic activities. While the transition of the consumption systems from the buyer to lender paradigm allows to maintain the value of resources within the economy and effectively decrease the generation of waste, the control of key products by few companies can lead to an outcome where the market reproduces the same failures than the real estate market, as key products may become inaccessible due to activities as speculation and unfair pricing. These failures can be accentuated as ownership is centralised in a few hands and even buying some strategic products may become a new option for financial speculation, driving prices up and inequality. Although material recovery is expected to be very high under this paradigm, and even economic growth and environmental decoupling may become attainable goals, other elements such as social welfare and equality may decrease.

5.4 Post-growth circularity scenarios

The post-growth type of scenarios have been depicted as a combination of low-tech convivial innovations and a decentralised political governance, deriving into a general downscaling of production and a return to local and community based productive systems based on the principle of sufficiency (Bauwens et al., 2020; Friant et al., 2020). This radical transformation is theorised as the result of bottom-up initiatives stemming from direct civil political involvement. However, it remains unclear how this process of widespread democratisation would be materially sustained without a substantial change in the current prevailing relations of production. Therefore, we explored two alternative scenarios, one of them based on a complete socialisation of the resources and means of production, and the other linked to the effects of a further commoditization of the social relations of production.

5.4.1 Convivial Eco-socialism Circularity scenario

In practice, the CEC scenario retains many of the main features that were derived in the “bottom-up scenario” depicted by Bauwens et al. (2020) and the “transformational circular society” proposed by Friant et al. (2020). The main difference resides in the acknowledgement that a shift in the productive paradigm from market-based profit seeking to community-based self-sufficiency inevitably requires a radical change in the underlying relations of production.

A bottom-up sufficiency scenario would require that community-based decision-making is also materially supported by the collective ownership of the means of production (e.g. through worker cooperatives) and that it allows for the collective access to the social output (e.g. through consumer cooperatives). Therefore, it is the result of a consensual decision that may only be achieved once individuals relate to each other in a condition of mutual equality, without any material dependency ties such as those existing between owners and non-owners (either of means of production, real estate, financial capital, knowledge, etc.). This also implies breaking the ties of dependency between human groups, such as those produced through debt and exploitation contracts that imply the loss of sovereignty of peoples over their natural resources.

Although high-tech innovations in digitalisation and distributed production may be relevant in this scenario, it is mainly sustained in a revalorisation of local/indigenous knowledge, channelled through community based productive initiatives. Therefore, key innovations are not technical but organisational, involving the cooperation of all society members and the shift towards alternative economic objectives. Rather than pursuing monetary profit and social status derived from consumption, individuals seek to live more meaningful lives by collaborating with their immediate community in the construction of welfare and sufficiency.

5.4.2 Free-market insufficiency circularity scenario

The FIC describes a case in which a degrowth process is not related to the attainment of local self-sufficiency, but the result of relations of dependency and exploitation leading to poverty and under-development. This is the case of territories in which previous colonial ties were not broken in practice, and are still in place in the form of unequal economic relations with former colonial powers (neo-colonialism) mediated by the intervention of local oligarchies. Therefore, both resources and means of production are concentrated in the hands of transnational capitals and/or local elites, which mainly devote them to rent-seeking and profit-driven activities. As a result, the

distribution of social output is based on economic interests with little insertion into the local social and productive fabric, leading to strong inequalities and broken community ties.

The absence of mechanisms for social integration is both capitalised and promoted by local or foreign economic elites. In this case degrowth is not a choice emanating from free citizen participation, but is the material outcome of social relations of dominance and exploitation, and is associated with poverty and insufficiency. Given that general degrowth occurs as a consequence of the accumulation of capital by the elites owners of the means of production, this scenario could also be thought of as the peripheral counterpart of the eco-modernist profit-led scenarios in the core countries.

6. Feedback from CE experts and stakeholders

The resulting 9-scenario framework was presented to and debated with a group of multidisciplinary experts and CE stakeholders through a two-round consultation process. The main outcomes can be summarised as follows.

6.1 Debate with multidisciplinary experts

The proposed conceptual axes and 9-scenario narratives were validated by a consultation process that began with a presentation and open-feedback session held with members of ReTraCE consortium, together with other CE experts and stakeholders from business and academia. A survey was also designed and distributed to the experts, gathering 17 detailed responses that offered further insights regarding plausibility, desirability, drivers, barriers, expected environmental, economic and social outcomes and other general remarks about the 9-scenario framework.

Participants generally agreed that the proposed analytical axes were relevant and resulted in a comprehensive set of scenarios, although some respondents pointed out that the number of scenarios was too large and could be reduced. In particular, several experts pointed to the existence of fundamental similarities between the different types of market-led scenarios, suggesting they could be merged into one single scenario. This was especially the case of the Multinational-led Modernist circularity (MMC), the Platform Peer-to-peer circularity (PP2P), and the Landlord Fortress circularity (LFC) scenarios. These scenarios were also often singled out as portraying the most plausible continuity of the current state of affairs, which was mostly seen as an undesirable outcome both in environmental and social terms.

In contrast, the two centralized State-led scenarios (State-led Modernist circularity -SMC- and Autarkic Fortress circularity -AFC-) were not seen as redundant and prompted quite different reactions. While the SMC was generally viewed as an environmentally and socially desirable scenario (although some raised concerns about freedom of speech and legitimacy), the AFC was deemed by most respondents as socially undesirable and only partially desirable from an environmental perspective. Moreover, the AFC was considered in general as an implausible dystopian scenario (which many referred to as “eco-fascism”), the SMC was most frequently seen as a positive environment for the promotion of innovation, industrial symbiosis, collaboration, and social equality. Although SMC was generally viewed as more plausible than the AFC, it was at the same time considered less likely than the MMC and Welfare-state Modernist circularity (WMC)

scenarios, especially in Western market-based economies, as it would require a major political and cultural change.

The Convivial Eco-socialist circularity (CEC) scenario was considered the most desirable from an environmental and social perspective, as it combined the most radical political, cultural and economic changes towards an egalitarian and sustainable society. It was also deemed as one of the most unlikely scenarios, as it directly challenges the interests of large corporations and political and economic elites.

Finally, some experts suggested that the proposed scenarios may involve different implications and outcomes depending on the geographical scale of analysis (global, national, regional, etc). In this respect, it was also pointed out that the Free-market Insufficiency circularity (FIC), which was rated as one of the less desirable scenarios, could be interpreted as the peripheral counterpart of the accumulation of wealth in the most affluent economies.

6.2 SES game session

After all the scenarios were defined and reviewed through the experts' consultation process, one scenario was selected as the most feasible and another as the most desirable. Specifically, these scenarios were a combination of Multinational-led Modernist Circularity and Landlord Fortress Circularity for the scenario seen as the most plausible, and Convivial Eco-socialism as the most desirable. The different narratives of these scenarios were combined and adapted to the Scenario Exploration System (Bontoux et al., 2016), which was presented to and played by three groups, including a total of 21 stakeholders to obtain a final round of feedback. The Scenario Exploration System allowed the players to experiment different scenarios from key positions by using roleplaying and by transforming the scenarios into a narrativist style.

As mentioned, the most plausible scenario combined the Multinational-led Modernist Circularity and Landlord Fortress Circularity scenarios above, as both were seen as being built on similar premises and to be complementary to each other. The participants, after roleplaying this scenario, acknowledged that it was fairly realistic, as many of the trends were perceived as already taking place in the present socio-economic context. However, some participants raised concerns on the environmental feasibility of this scenario, and suggested that a scenario that maintains the economic growth imperative unquestioned cannot reach sustainability and prevent the worsening of climate change at the same time.

The reflections on this scenario opened up a debate among the participants on the rising social tensions emerging from the perceived disparities in the distribution of wealth and lack of social welfare. The rising inequality of this scenario raised significant opposition among many stakeholders. In this sense, some participants complained about the impossibility of modifying the predetermined long-term negative environmental trends through actions of resistance against the prevailing logic of the scenario. These concerns pointed to the necessity of incorporating to the SES some additional dynamic factors, such as the effect that stakeholder resistance and collaboration in the first phases of the game may have on the longer term trends.

The most preferred scenario, Convivial Eco-socialism, portrays a vision of the future shaped by low-tech and new reconfigurations of the economy where the satisfaction of societal needs through cooperation becomes the main priority. This scenario has been perceived by the participants as highly unfeasible, due to the opposition of the most powerful actors of society. This

scenario also generated doubts as it demands a radical change in the economy that would require a very high level of societal collaboration and trust, which is seen as very difficult to achieve. This scenario involves many changes in mainstream lifestyle that are seen as positive, especially in redefining the social role of work. However, other changes in the mainstream lifestyle are perceived as undesirable, especially among people in the global north, such as a reduction of intercontinental trade and consumption of foreign products.

7. Measuring economic performance in CE future scenarios

Based on the previous deliverable D3.4, we propose a framework to analyse economic performance that is composed of three categories. These categories are (1) resource efficiency, (2) environmental sustainability, and (3) wellbeing, and are based on the analysis of a set of twelve different indicators (Table 2) to measure economic performance, which allowed us to characterise the main priorities in alternative social configurations of the economic process. These three categories were defined using a set of twelve indicators related to the calculation of economic performance (Table 2). These indicators that define the notion of resource efficiency as an approach to economic performance are: (1) the National Circularity Gap, (2) the EU Resource Efficiency Scoreboard, and (3) the OECD Green Growth Indicators. The economic performance from a perspective of environmental sustainability is defined by; (4) Total Amount of Sulphur Dioxide Emissions, (5) Sustainable Development Indicators, (6) Environmental Performance Index (EPI), (7) Beyond GDP indicators. Finally, the indicators used to define the notion of economic performance from a wellbeing approach are; (8) Gross National Happiness (GNH) Index, (9) Canadian Index of Wellbeing (CIW), (10) Genuine Progress Indicator (GPI), (11) European Social Progress Index (ESPI), and (12) Size of the Informal Economy (as a percentage of GDP) (Table 2).

The idea of resource efficiency seeks to maximise the use of materials within the economy. A notion of economic performance based on the idea of resource-efficiency is aligned with five of the proposed scenarios. Those are (1) Multinational-led Modernist Circularity, (2) Welfare State Modernist Circularity, (3) Landlord Fortress Circularity, (4) Platform Capitalism, and (5) Free-Market Insufficiency (Table 3).

The idea of environmental sustainability seeks to minimise the environmental impact of the economy on the environment and to preserve the existing ecosystems. A notion of economic performance based on the idea of environmental sustainability is aligned with two scenarios. The (1) Autarkic fortress circularity, and the (2) Convivial eco-socialism. Also, the scenario of State-Led Modernist Circularity is equally aligned by the idea of environmental sustainability and wellbeing.

Finally, the idea of wellbeing seeks to prioritise meeting social needs. A notion of economic performance based on the idea of wellbeing is aligned with the scenario of Open-Access Peer-To-Peer Circularity, along with the scenario of State-Led Modernist Circularity, which is equally aligned with the idea of environmental sustainability and wellbeing.

Table 2: Comparison of alternative indicators/frameworks for measuring economic performance.

Indicator/framework	Elements measured	Link to CE economic performance
National Circularity Gap	Performance in recovering waste.	This indicator measures directly the gap in waste recovery.
EU Resource Efficiency Scoreboard	Multi-factor indicator, focused on Resource Productivity.	All the factors in this framework focus on either economic or environmental aspects. Additionally, some indicators include the economic value generated per unit of input used.
OECD Green Growth Indicators	Multi-factor indicator, focused on economic and environmental aspects.	All the factors in this framework focus on economic and environmental aspects. Additionally, some indicators include the economic value generated per unit of input used.
Amount of SO ₂ emission	Air emissions.	The CE is inclusive of social and environmental elements. This indicator measures the reduction of environmental externalities.
Sustainable Development Indicators	Climate change, energy, life under water, life on land, sustainable cities and communities.	The CE is inclusive of social and environmental elements. These indicators measure how effectively a nation is minimising environmental externalities.
Environmental protection Index	Environmental health and ecosystem vitality.	The CE is inclusive of social and environmental elements. This indicator attempts to measure how successfully a nation is taking care of its environmental health and ecosystem vitality.
Beyond GDP indicators	Expanded GDP, Environmental, Social and Welfare aspects.	The CE is inclusive of social and environmental elements. These indicators measure the attempts of a country to reduce ecological footprint and maintain its biodiversity.
Gross National Happiness	Multi-factor indicator, focus on wellbeing and environmental performance.	This indicator calculates the ability of a country to meet the conditions that allow happiness.
Canadian Index of Wellbeing	Multi-factor indicator, focus on wellbeing and environmental performance.	This indicator calculates the ability of a country to generate wellbeing among its citizens.
Genuine Progress indicator	Multi-factor indicator, focus on wellbeing and environmental performance.	This indicator calculates the ability of a country to generate wellbeing among its citizens.
European Social Progress Indicator	Multi-factor indicator, focus on wellbeing and environmental performance.	This indicator calculates the ability of a country to generate wellbeing among its citizens.
Size of the Informal Economy	Extent of labour outside the scope social protection, taxation or labour legislation.	This indicator measures how significant a nation's informal economy is.

Table 3: Adequacy of different approaches to measure economic performance according to the priorities of each scenario (1: Highest ; 3: Lowest).

Scenario	Resource Efficiency	Environmental Sustainability	Wellbeing
MNE-led Modernist Circularity	1	3	3
Welfare-State Modernist Circularity	1	2	2
State-led Modernist Circularity	2	2	1
Autarkic Fortress Circularity	2	2	2
Landlord Fortress Circularity	1	3	3
Open-access P2P Circularity	3	2	1
Platform P2P Circularity	1	2	3
Convivial Eco-Socialism	2	1	1
Free-market Insufficiency	2	3	3

8. Conclusions

The objective of this deliverable was to make a twofold contribution to the ongoing discussion on the future of the CE, by inquiring into the expected upcoming changes in the socio-economic structure and developing suitable tools to measure economic performance in alternative CE future scenarios. Although the existing literature on the subject is still scarce, it offers fertile ground for a critical study of the expected outcomes associated with the systemic paradigm shift. Yet, the socio-political implications of the scenarios that were devised so far remain to be further explored. Notably, they all assume the market capitalist economic structure as an immutable *status quo*, thus neglecting the role of potential changes in the social relations of production in shaping and conditioning the socio-economic structure and outcomes of the alternative futures.

Departing from the previous 4-scenario frameworks proposed by Bauwens et al. (2020), Friant et al. (2020), Fauré et al. (2019) and Svenfelt et al. (2019), we first derived a new comprehensive 9-scenario typology of alternative circularity futures, reflecting different configurations of the underlying social relations of production. This was done by incorporating into the analysis two further conceptual dimensions: ownership of final goods and property/control over the means of production. Both axes ranged from predominantly collective to mainly individual/private.

The proposed framework was further validated by a two-round session of feedback with multidisciplinary experts on CE. Following, the two scenarios that were considered as the most feasible and most desirable were applied to an interactive foresight activity with a set of relevant stakeholders, based on the methodology of Scenario Exploration Systems developed by the JRC (Bontoux et al., 2016). Finally, we proceeded to the classification of the CE indicators analysed in Deliverable 3.4, considering their level of appropriateness as measures of economic performance in the context of the proposed future scenarios.

It was expected that this novel framework would provide further clarity to some ambiguous and debatable results identified in the previous literature, due to their limited approach regarding alternative configurations of the socio-economic relations of production (Lowe and Genovese, 2022). For example, previous studies were unable to provide a solid conceptual ground to successfully incorporate future trajectories divergent from the liberal capitalist market system, such as the *sui generis* political and socio-economic system pursued by China. The usual misconception of identifying the Western capitalist economic system with the socio-political values of *de facto* democracy, prevents us from acknowledging both the authoritarian components underlying the social relations within market liberalism, and the capacity of centralised political power configurations to deliver socio-economic prosperity and resource efficiency through State-led systemic innovation.

Previous studies were also not able to establish a clear conceptual differentiation between contradictory future outcomes stemming from a shared initial configuration of the chosen variables. The lack of consideration of the concentration and centralisation dynamic of market structures under private property of the means of production (Baran & Sweezy, 1966; Brancaccio et al., 2018; Schumpeter, 1942; Shaikh, 1991) impedes a clear understanding of the specific conditions under which certain “desired” scenarios may “degenerate” into “dystopian” projections of the current *status quo*. This is the case, for instance, of the dichotomy between the high-tech collaborative and decentralised P2P scenarios and the oligopolistic P2P “platform capitalist” futures.

Finally, a third major shortcoming was identified in the existing literature. Namely, none of the previous approaches addressed the fundamental question of whether it is actually possible to conceive the most radical post-growth scenarios without assuming an equally radical transformation in the social relations of production (and thus in the core institutions associated with the capitalist mode of production: *private property* and *labour market*)?

Although the debate is still wide open, the proposed 9-scenario framework sought to provide a coherent response to all these conceptual issues. First, as three types of eco-modernist (high-tech + “top-down”) scenarios were clearly distinguished, namely market-led (MMC), state-led (SMC) and mixed (WSMC), it was possible to envisage different future trajectories responding to alternative roles of the State in the economy and the innovation process (Mazzucato, 2013). Therefore, the 9-scenario framework offered a clear criterion to understand how future modernist circular societies may diverge if current global trends are maintained. As a result, the future development of CE would be expected to be found closer to the MMC in the so-called ‘liberal market economies’² (such as Australia, the UK and the US), somewhere between the MMC and the WSMC in the ‘coordinated market economies’ (such as France, Germany, Japan and the

² According to the classification by Hall and Soskice (2001).

Scandinavian countries), and between the WSMS and the SMC in the so-called ‘socialist market economies’ (i.e. China).

Secondly, the proposed framework acknowledges that a planned “top-down” transition towards circularity can be led not only by the State but also by large private corporations (or both), and that each of these variants of CE futures may rely primarily on high or low-tech innovations. The three modernist-type scenarios are examples of the former case (top-down + high-tech) while the two introduced fortress-type scenarios (state-led AFC and firm-led LFC) should be understood as examples of the latter (top-down + low-tech). Since the five cases are built upon “top-down” initiative and control, all five cases may be considered to some extent as alternatives of an authoritarian approach to circularity (and not only those led primarily by the State). The identified differences lie mainly in the channels through which power is exerted and the mechanisms by which the benefits and losses of the paradigm change are socially distributed.

The inclusion of the social relations of production also allowed us to envisage different future developments for circular societies based on P2P technological innovations that promote political and economic decentralisation. A clear distinction has been made between the case in which the property and control over the key technologies and knowledge are held collectively (OP2PC) from that in which they are in private hands (PP2PC). In the first case, decentralised collective decision making is materially supported by the common control over the means of production, effectively resulting in equitable power relations (at least between those capable of understanding, using, and developing the key technologies). In the second scenario, the winner-take-all logic of the involved markets together with the private ownership of the key technologies derive into a “platform capitalism” (Frenken, 2017; Lowe & Genovese, 2022). Apparent collaboration in consumption conceals an unequal power relation in which high-tech oligopolies control every link of the key value chains, including the consumption phase, and can define prices and employment conditions virtually without any counterpart on behalf of workers/consumers, leading to deterioration of workers’ rights (Bauwens et al., 2020), income inequality and fragmentation of the social fabric.

A similar conclusion can be extracted from the study of those scenarios that combine a generalised downscaling of production with a focus on low-tech innovations (Convivial Eco-socialism circularity -CEC- and Free-Market Insufficiency circularity -FIC-). In particular, it was stressed that a democratic community-based bottom-up sufficiency scenario (CEC) would require collective ownership of the means of production (e.g. through worker cooperatives) and collective access to the social output (e.g. through consumer cooperatives), in order to guarantee that individuals relate to each other on mutual terms of equality in practice. If production and consumption in small integrated local communities remain to be mediated through private ownership of the basic means of livelihood, unequal relations of material dependence will continue to reproduce among their members (landlords/tenants, employers/employees, suppliers/customers, etc.), undermining the process of democratic community-based decision-making. At the other end, the FIC scenario can be understood as a call for attention about the romanticised vision that some promoters of the CE have of local communities that are forced by extreme deprivation to resort to practices labelled as "circular". In these cases, reduced consumption and intensive use of the available local resources do not stem from a community-based decision to shift towards “living with less” but are the result of unequal social relations based on the ownership of land and critical resources by local and foreign economic elites.

The proposed analytical axes were mostly regarded as relevant by the consulted experts and stakeholders, resulting in a comprehensive set of scenarios. However, some participants pointed out that the number of scenarios was too large and could be reduced, while others suggested that a geographical dimension may also be relevant to the analysis, in order to capture different impacts at the global, regional and national scale.

In terms of the expected environmental and social outcomes, while State-led and economic downscaling scenarios were generally considered to be more effective to tackle potential rebound effects and deliver greater social equality, they were also seen as the less plausible to occur given the current *status quo*. Also, stark differences were identified especially between the CEC, SMC and AFC future scenarios. The former was deemed as the most desirable scenario from a social and environmental perspective. However, due to the extent of the cultural and political change required it was also considered among the least plausible scenarios. The SMC was mostly interpreted as an environmentally and socially desirable scenario, yet some experts called attention to potential issues regarding freedom of speech and political legitimacy. The AFC was frequently labelled as a type of “eco-fascism” and was therefore generally considered as socially undesirable and with scarce positive environmental benefits.

The firm-led scenarios (MMC, PP2P and LFC) were mostly viewed as undesirable or only partially desirable from a social and environmental perspective, and at the same time were regarded as the most likely continuity of the current *status quo*. Many experts also pointed out that these scenarios shared several fundamental features, suggesting they could be merged into one overarching scenario in which social equity and environmental sustainability are subordinated to the requirements of profit. The WSMC scenario, which depicted a market-led approach to CE with a strong level of public coordination, was the only one that combined being generally regarded as plausible with relatively higher levels of social and environmental desirability.

Finally, the analysis showed that different configurations of the social relations of production may result in alternative societal goals and, therefore, require diverse tools to measure their economic performance. These findings are in line with previous literature that stresses the political biases and implications of the selection of environmental indicators (Bimpizas-Pinis et al., 2021; Lowe & Genovese, 2022; Rodríguez et al., 2019). In particular, it is acknowledged that resource efficiency will continue to be the priority in those scenarios built upon markets and led by large corporations, while environmental and social goals and metrics would be expected to gain relevance in those future CE scenarios based on cooperation and collective decision-making, ownership and accountability.

References

- Adam, B., & Groves, C. (2011). Futures tended: Care and future-oriented responsibility. *Bulletin of Science, Technology & Society*, 31(1), 17–27.
- Andersson, J. (2018). *The future of the world: Futurology, futurists, and the struggle for the post cold war imagination*. Oxford University Press.
- Appadurai, A. (1996). *Modernity at large: Cultural dimensions of globalization* (Vol. 1). U of Minnesota Press.
- Baran, P., & Sweezy, P. (1966). Monopoly Capital Monthly Review Press. *New York*.
- Bartolini, S., & Sarracino, F. (2018). Do people care about future generations? Derived preferences from happiness data. *Ecological Economics*, 143, 253–275.
- Bauwens, T., Hekkert, M., & Kirchherr, J. (2020). Circular futures: What Will They Look Like? *Ecological Economics*, 175, 106703.
- Beckert, J. (2016). *Imagined futures: Fictional expectations and capitalist dynamics*. Harvard University Press.
- Beckert, J., & Bronk, R. (2018). *Uncertain futures: Imaginaries, narratives, and calculation in the economy*. Oxford University Press.
- Bell, W. (2017). *Foundations of futures studies: History, purposes, and knowledge*. Routledge.
- Belmonte-Ureña, L. J., Plaza-Úbeda, J. A., Vazquez-Brust, D., & Yakovleva, N. (2021). Circular economy, degrowth and green growth as pathways for research on sustainable development goals: A global analysis and future agenda. *Ecological Economics*, 185, 107050.
- Bimpizas-Pinis, M., Bozhinovska, E., Genovese, A., Lowe, B., Pansera, M., Alberich, J. P., & Ramezankhani, M. J. (2021). Is efficiency enough for circular economy? *Resources, Conservation and Recycling*, 167, 105399. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0921344921000069>
- Bontoux, L., Bengtsson, D., Rosa, A., & Sweeney, J. A. (2016). The JRC scenario exploration system-from study to serious game. *Journal of Futures Studies*, 20(3), 93–108.
- Börjeson, L., Höjer, M., Dreborg, K.-H., Ekvall, T., & Finnveden, G. (2006). Scenario types and techniques: towards a user's guide. *Futures*, 38(7), 723–739.
- Brancaccio, E., Giammetti, R., Loppreite, M., & Puliga, M. (2018). Centralization of capital and financial crisis: A global network analysis of corporate control. *Structural Change and Economic Dynamics*, 45, 94–104.
- Bryant, R., & Knight, D. M. (2019). *The anthropology of the future*. Cambridge University Press.
- Buell, L. (2009). *The future of environmental criticism: Environmental crisis and literary imagination* (Vol. 52). John Wiley & Sons.
- Chang, H.-J. (2002). *Kicking away the ladder: development strategy in historical perspective*. Anthem Press.
- Corvellec, H., Stowell, A. F., & Johansson, N. (2021). Critiques of the circular economy. *Journal of Industrial Ecology*.
- Dator, J. (2019). What futures studies is, and is not. In *Jim Dator: A Noticer in Time* (pp. 3–5). Springer.

- de Jesus, A., Antunes, P., Santos, R., & Mendonça, S. (2019). Eco-innovation pathways to a circular economy: Envisioning priorities through a Delphi approach. *Journal of Cleaner Production*, 228, 1494–1513. <https://doi.org/10.1016/j.jclepro.2019.04.049>
- European Commission. (2022). The Scenario Exploration System (SES). Knowledge for Policy. Retrieved from https://knowledge4policy.ec.europa.eu/foresight/tool/scenario-exploration-system-ses_en
- Fan, Y., & Fang, C. (2020). Circular economy development in China-current situation, evaluation and policy implications. *Environmental Impact Assessment Review*, 84(June), 106441. <https://doi.org/10.1016/j.eiar.2020.106441>
- Fauré, E., Finnveden, G., & Gunnarsson-Östling, U. (2019). Four low-carbon futures for a Swedish society beyond GDP growth. *Journal of Cleaner Production*, 236, 117595.
- Fedotkina, O., Gorbashko, E., & Vatulkina, N. (2019). Circular economy in Russia: Drivers and barriers for waste management development. *Sustainability*, 11(20), 5837.
- Frenken, K. (2017). Political economies and environmental futures for the sharing economy. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 375(2095), 20160367.
- Friant, M. C., Vermeulen, W. J. V., & Salomone, R. (2020). A Typology of Circular Economy Discourses: Navigating the Diverse Visions of a Contested Paradigm. *Resources Conservation and Recycling*.
- Friant, M. C., Vermeulen, W. J. V., & Salomone, R. (2021). Analysing European Union circular economy policies: words versus actions. *Sustainable Production and Consumption*, 27, 337–353.
- Fukuyama, F. (1992). Capitalism & democracy: The missing link. *Journal of Democracy*, 3(3), 100–110.
- Gallaud, D., & Laperche, B. (2016). *Circular economy, industrial ecology and short supply chain*. John Wiley & Sons.
- Genovese, A., & Pansera, M. (2021). The Circular Economy at a Crossroads: Technocratic Eco-Modernism or Convivial Technology for Social Revolution? *Capitalism, Nature, Socialism*, 32(2), 95–113. <https://doi.org/10.1080/10455752.2020.1763414>
- Goodwin, N. (1994). A range of predictions for the future. *Ecological Economics*, 10(1), 15–20.
- Hagens, N. J. (2020). Economics for the future—Beyond the superorganism. *Ecological Economics*, 169, 106520.
- Hastrup, K. (2013). Anthropological contributions to the study of climate: past, present, future. *Wiley Interdisciplinary Reviews: Climate Change*, 4(4), 269–281.
- Hickey-Moody, A., Cutter-Mackenzie-Knowles, A., Rousell, D., & Hartley, S. (2021). Children's Carbon Cultures. *Cultural Studies ↔ Critical Methodologies*, 1532708621997582.
- Hobson, K., & Lynch, N. (2016). Diversifying and de-growing the circular economy: Radical social transformation in a resource-scarce world. *Futures*, 82, 15–25.
- Huss, W. R. (1988). A move toward scenario analysis. *International Journal of Forecasting*, 4(3), 377–388.
- Istrate, I.-R., Galvez-Martos, J.-L., & Dufour, J. (2021). The impact of incineration phase-out on municipal solid waste landfilling and life cycle environmental performance: Case study of

- Madrid, Spain. *Science of the Total Environment*, 755, 142537.
- Jansson, Å. (2013). Reaching for a sustainable, resilient urban future using the lens of ecosystem services. *Ecological Economics*, 86, 285–291.
- Jungell-Michelsson, J., & Heikkurinen, P. (2022). Sufficiency: A systematic literature review. *Ecological Economics*, 195, 107380.
- Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, 127(September), 221–232. <https://doi.org/10.1016/j.resconrec.2017.09.005>
- Kok, K., van Vliet, M., Bärlund, I., Dubel, A., & Sendzimir, J. (2011). Combining participative backcasting and exploratory scenario development: experiences from the SCENES project. *Technological Forecasting and Social Change*, 78(5), 835–851.
- Korhonen, J., Nuur, C., Feldmann, A., & Birkie, S. E. (2018). Circular economy as an essentially contested concept. *Journal of Cleaner Production*, 175, 544–552.
- Lazarevic, D., & Valve, H. (2017). Narrating expectations for the circular economy: Towards a common and contested European transition. *Energy Research & Social Science*, 31(February), 60–69. Retrieved from <http://dx.doi.org/10.1016/j.erss.2017.05.006>
- Lempert, R. J., & Groves, D. G. (2010). Identifying and evaluating robust adaptive policy responses to climate change for water management agencies in the American west. *Technological Forecasting and Social Change*, 77(6), 960–974.
- Llorente-González, L. J., & Vence, X. (2020). How labour-intensive is the circular economy? A policy-orientated structural analysis of the repair, reuse and recycling activities in the European Union. *Resources, Conservation & Recycling*, 162(November), 1–11. <https://doi.org/10.1016/j.resconrec.2020.105033>
- Lord, S., Helfgott, A., & Vervoort, J. M. (2016). Choosing diverse sets of plausible scenarios in multidimensional exploratory futures techniques. *Futures*, 77, 11–27.
- Lowe, B. H., & Genovese, A. (2022). What theories of value (could) underpin our circular futures? *Ecological Economics*, 195, 107382.
- Mangnus, A. C., Oomen, J. J., Vervoort, J. M., & Hajer, M. A. (2021). Futures literacy and the diversity of the future. *Futures*.
- Marjamaa, M., & Mäkelä, M. (2022). Images of the future for a circular economy: The case of Finland. *Futures*, 141, 102985.
- Martin, C. J. (2016). The sharing economy: A pathway to sustainability or a nightmarish form of neoliberal capitalism? *Ecological Economics*, 121, 149–159.
- Marx, K. (1973). *Grundrisse: foundations of the critique of political economy Penguin*. Harmondsworth.
- Marx, Karl. (1992). *Capital: volume III (Vol. 3)*. Penguin UK.
- Mathews, J. A., & Tan, H. (2011). Progress toward a circular economy in China: The drivers (and inhibitors) of eco-industrial initiative. *Journal of Industrial Ecology*, 15(3), 435–457.
- Mathews, J. A., & Tan, H. (2016). Circular economy: lessons from China. *Nature*, 531(7595), 440–442.
- Mazzucato, M. (2013). *The entrepreneurial state; debunking public vs. private sector myths (Anthem fro)*.

Anthem Press, cop.

- Milkoreit, M. (2017). Imaginary politics: Climate change and making the future. *Elementa: Science of the Anthropocene*, 5(62).
- Oomen, J., Hoffman, J., & Hajer, M. A. (2021). Techniques of futuring: On how imagined futures become socially performative. *European Journal of Social Theory*, 1–19.
- Prieto-Sandoval, V., Jaca, C., & Ormazabal, M. (2018). Towards a consensus on the circular economy. *Journal of Cleaner Production*, 179, 605–615.
- Reike, D., Vermeulen, W. J. V., & Witjes, S. (2018). The circular economy: New or Refurbished as CE 3.0? — Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options. *Resources, Conservation and Recycling*, 135(August 2017), 246–264. <https://doi.org/10.1016/j.resconrec.2017.08.027>
- Rodríguez, R. W., Pomponi, F., & D’Amico, B. (2019). Futures studies & the circular economy: an interdisciplinary approach to sustainable development. *Índice*, 39.
- Schoemaker, P. J. H. (1993). Multiple scenario development: Its conceptual and behavioral foundation. *Strategic Management Journal*, 14(3), 193–213.
- Schumpeter, J. A. (1942). *Capitalism, Socialism and Democracy*, Harper & Row. *New York*.
- Shaikh, A. (1991). Centralization and concentration of capital. *A Dictionary of Marxist Thought*, 76–77.
- Shearman, D., & Smith, J. (2007). *The climate change challenge and the failure of democracy*. Praeger.
- Su, B., Heshmati, A., Geng, Y., & Yu, X. (2013). A review of the circular economy in China: moving from rhetoric to implementation. *Journal of Cleaner Production*, 42(0), 215–227. <https://doi.org/10.1016/j.jclepro.2012.11.020>
- Svenfelt, Å., Alfredsson, E. C., Bradley, K., Fauré, E., Finnveden, G., Fuehrer, P., ... Malmqvist, T. (2019). Scenarios for sustainable futures beyond GDP growth 2050. *Futures*, 111, 1–14.
- Tutton, R. (2017). Wicked futures: Meaning, matter and the sociology of the future. *The Sociological Review*, 65(3), 478–492.
- Urry, J. (2016). *What is the Future?* John Wiley & Sons.
- Vervoort, J. M., Thornton, P. K., Kristjanson, P., Förch, W., Ericksen, P. J., Kok, K., ... Helfgott, A. E. S. (2014). Challenges to scenario-guided adaptive action on food security under climate change. *Global Environmental Change*, 28, 383–394.
- Walker, C. (2017). Embodying ‘the next generation’: Children’s everyday environmental activism in India and England. *Contemporary Social Science*, 12(1–2), 13–26.
- Wright, C., Nyberg, D., De Cock, C., & Whiteman, G. (2013). Future imaginings: organizing in response to climate change. *Organization*, 20(5), 647–658.