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What theories of value (could) underpin our circular futures?

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ABSTRACT

The transition to a circular economy is often presented as a straightforward, neutral and apolitical process, characterised by an implicit techno-optimistic and eco-modernist stance. However, in their recent paper on 'circular futures', Bauwens et al. (2020) illustrate that the circular economy is best understood as an umbrella term that might come to define very contrasting visions of sustainable development. Despite this, there continues to be a lack of discussion about the basic assumptions regarding social and economic structures on which the circular economy should be based, with research predominantly focusing on technical and practical questions. Therefore, in this conceptual paper, we assess the a priori compatibility of different plausible configurations of the circular economy with the principal theories of value found in mainstream and heterodox economics. We argue that these futures are themselves value articulating institutions that implicitly adhere to a theory of value even if this is not recognised. Moreover, given that theories of value go to the heart of how economies and societies function and reproduce themselves, we argue that circular economy research should recognise the importance of value and acknowledge how value theory might enable or contradict the visions of sustainable development articulated.

> "The economist, like everyone else, must concern himself [sic] with the ultimate aims of man."
>
> Alfred Marshall

1. Introduction

According to its proponents, the circular economy (CE) describes "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" (Kirchherr et al., 2017, pp.224–5). The core idea is that, rather than discarding products that can be potentially reused/recycled, they should be re-employed in a cascade of subsequent or feedback uses. Also, CE goes beyond the traditional waste prevention, reduction and recycling objectives and aims to inspire technological, organisational and social innovation and design across and within value chains (Andersen, 2007; Genovese et al., 2017). The CE is seen as a new paradigm that can square the circle of economy-society-nature interactions (Ellen MacArthur Foundation, 2012).

While the underlying theoretical foundation of the CE concept has been debated for some time and is rooted in a wide array of academic disciplines and fields (see, for example, Boulding, 1966; Daly, 1974a; Georgescu-Roegen, 1977; Pearce and Turner, 1990; Frosch and Gallopoulos, 1989), it has only recently broken through into public discourse. Despite the abundance of literature on the CE that is starting to appear (Schöggl et al., 2020), competing ideological views are framing the debate, ultimately producing different approaches to the transition towards a CE (Genovese and Pansera, 2021).

According to Korhonen et al. (2018), the CE might be defined as an essentially contested concept. Gallie (1956) postulated that a concept becomes essentially contested if there is agreement on the means and goals but disagreements on its definition, underpinning cornerstones and units of analysis. As such, the translation of the CE concept into practical initiatives might produce diverse outcomes: this is already apparent when looking at the plurality of pathways adopted in the transition towards a CE by different national and supra-national institutions. For instance, while the European Commission has promoted a

Abbreviations: Abstract Socially Necessary Labour Time, ASNLT; Circular economy, CE; Deliberative Monetary Valuation, DMV; Input-Output, I-O; Steady State Economy, SSE; Total Economic Value, TEV; Value Articulating Institutions, VAI.

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wide array of directives and flagship initiatives aimed at fostering a bottom-up transition towards the CE, the People's Republic of China has adopted a top-down approach by putting CE at the heart of its recent five-year plans as a national development strategy (McDowall et al., 2017). Starting from these already diverging implementations of CE initiatives, Bauwens et al. (2020) argue that a CE can be organised in contrasting ways according to variations in the innovations deployed and the configuration of the governance regimes adopted. As such, multiple 'circular futures' might be plausible.

Despite the name, much of the CE literature lacks any grounding in economic theory and economic logics: as Bauwens et al. (2020, p.1–2) argue, many current approaches to CE are conceptually underdeveloped and "overlook the fundamental systemic changes needed". CE proponents have tended to look at the engineering and technical implications of the concept while not addressing the economic dimension and the central socio-economic implications of changes to production and consumption practices (Zink and Geyer, 2017). This is all the more surprising, as Llorente-González and Vence (2020, p.2) recognise, given that present economic structures resulting from "two centuries of development driven by continuous accumulation sustained on a linear logic" clearly impose limitations and constraints on the transition to the CE. Therefore, if the transition to a CE requires a paradigm shift, solid economic foundations must be explored and developed.

Within this context, a dimension that has surprisingly been overlooked in the current CE debate is that of *value*. How we define and account for what is *valuable* reflects a worldview about how economic and environmental systems as a whole are orchestrated, interact and reproduce themselves. Whilst the idea of value may seem natural and therefore immutable, there are multiple conceptions regarding where value stems from and the institutions through which it should be articulated, and these conceptions (or theories of value) have profound practical implications (Farber et al., 2002; Pirgmaier, 2021).[1]

The central aim of this paper is to assess the a priori compatibility of the different plausible configurations of the CE with the principal theories of value found in mainstream and heterodox economics. After all, theories of value have formed the theoretical core of several major schools of economic thought; disagreements over theories of value still cause tensions between schools of economic thought, and, as such, might play an important role in shaping CE futures (Cole et al., 1991; Patterson, 1998). In addition, though, this paper will also argue that 'circular futures' portrayed in the literature are themselves *value articulating institutions* (VAIs) (Jacobs, 1997; Vatn, 2005, 2009) that, at least implicitly, adhere to a theory of value even if this is not understood or recognised.[2] Therefore, openly calling attention to the issue of value in the context of a CE, and in particular concerning the multiple plausible 'circular futures', is a fundamental task to be considered and one that should form the sine qua non of future CE-related research.

To this end, this paper goes on to develop a series of 'scorecards' for different plausible circular futures: these scorecards map how the underlying assumptions of circular futures enmesh with the underlying assumptions of theories of value, and in so doing, we hope this furthers rigorous assessment of the impacts and requirements of a transition to circularity.

An examination of the academic literature produced only two papers published in international peer-reviewed journals that discuss CE and theories of value (Kopnina, 2014; Doussoulin, 2019).[3] In particular, Doussoulin (2019) appears to provide the only attempt to characterise the mechanisms of the CE in terms of a specific theory of value; however, this paper does not acknowledge the plurality of circular futures introduced by Bauwens et al. (2020) and developed in what follows. Therefore, this paper is aiming to fill a clear research gap by providing the first attempt to link the CE discourse and theories of value.

The paper proceeds as follows. In the next section, we illustrate plausible circular futures and consider how these futures can act as VAIs. Then, in Section 3, we briefly examine the principal theories of value found in mainstream and heterodox economics. Following this, in Section 4, we bring these two elements together and discuss which theories of value might be most compatible with different visions of circularity and introduce the value scorecards which provide a visual depiction of this. Section 5 discusses the implications of these scorecards and how an awareness of value theory can help us articulate ambitious visions of a CE that move beyond dominant value narratives. Finally, Section 6 provides some concluding remarks and elaborates on future research avenues.

2. Plausible circular futures

While there is common agreement that the transition towards a CE could foster more sustainable futures, there is a lack of discussion about how a truly circular economic system should be organised. Most of the current literature on CE fails to openly acknowledge this, presenting the transition towards a CE as a straightforward, neutral and apolitical process, implicitly characterised by a techno-optimistic and eco-modernist stance (Genovese and Pansera, 2021). According to Korhonen et al. (2018), most CE work is conducted at the practical and technical levels, looking at material and energy flows in production-consumption systems. Emphasis is placed on metrics, tools and instruments; however, the basic assumptions concerning societal structures, production relationships, economic structure and underlying world-views which should be embedded in a CE are largely overlooked or unclear (Zink and Geyer, 2017; Friant et al., 2020).

Genovese and Pansera et al. (2021) openly acknowledge this issue, stating that, given the prevalent apolitical nature of the CE discourse, the transition could become an ideological battleground, which could lead to different, and contrasting, future scenarios, ranging from a technocratic and authoritarian solution to a bottom-up and community-based one, mainly depending on which technological solutions are adopted. Developing this argument further, thanks to a thought experiment, Bauwens et al. (2020) propose four different plausible scenarios for a circular future. According to them, the future configuration of a CE depends on two "key drivers of change": the nature of technologies deployed (high-tech or low-tech innovations) and the governance regime (centralised or decentralised). Based on these two dimensions, they identify, according to a two-by-two matrix, four plausible (but not mutually exclusive) scenarios ("circular modernism", "planned circularity", "bottom-up sufficiency", and "peer-to-peer circularity"), reinforcing the key concept that a CE could be organised in very contrasting ways.

The *circular modernism* scenario described by Bauwens et al. (2020) is the dominant conception of what currently constitutes the CE narrative. This scenario is reflective of an eco-modernist approach (Grunwald, 2018; Genovese and Pansera, 2020) in that technological innovation and market forces are viewed as being able to decouple resource use and carbon emissions from human development. As such, the scenario is

[1] In this paper, "theory/theories of value" and "value theory" are used interchangeably.

[2] Vatn (2009, p.2208) suggests that value articulating institutions - "meaningful rule structures facilitating value articulation" - define, amongst other things, who should participate, how they are supposed to participate, what counts as data, how information is conveyed and how conclusions are reached.

[3] The following search string was employed in the academic search engine Scopus (TITLE-ABS-KEY ("circular economy") AND TITLE-ABS-KEY ("theory of value" OR "value theory" OR "values theory")) AND (LIMIT-TO (DOCTYPE, "ar")).

compatible with the concept of 'green growth' given that it does not significantly call into question the high consumption and growth-orientated focus of western capitalist societies and the business models that they are based on (Smulders et al., 2014; Hickel and Kallis, 2020).

In a *planned circularity* scenario, the transition towards a CE is centrally piloted by the government through strong coercive measures. Governments develop command-and-control regulations (based on taxation, bans on certain materials, direct economic intervention and mandatory right-to-repair initiatives) to force state-owned and private businesses to engage in CE-inspired strategies. The way in which the Chinese have embraced CE illustrates this state-led approach through the adoption of CE as a national strategy in the framework of 5-year plans. Yet, this approach can also be characterised by eco-modernist assumptions, which identify economic growth as the ultimate aim of the economic system (Genovese and Pansera, 2021).

In a *bottom-up sufficiency* scenario, small-scale CE solutions are implemented at the local level; production mainly aims to satisfy the community's immediate needs, thus challenging surplus production and the principle of servicing export markets. The focus here is on a more radical interpretation of CE, which is critical of the eco-efficiency agenda and is based on several tenets from the degrowth literature (Hobson and Lynch, 2016; Schröder et al., 2019; Bauwens, 2021). The ultimate aim is not to boost resource productivity but rather dramatically reduce resource consumption and the extraction of virgin raw materials (Bimpizas-Pinis et al., 2021), while encouraging democratic participation and community-driven deliberation. Business models emphasise durability, repairability and "and a non-consumerist approach to marketing and sales"; the emphasis is on higher R strategies such as refuse, reduce and reuse; supply chains are shorter, and companies are smaller and less reliant on economies of scale (Bauwens, 2020, p.5).

In a *peer-to-peer circularity* scenario, the focus is on technologies (such as blockchain, 3D printing and internet platforms) enabling collaborative consumption. Given its reliance on servitisation, this scenario could be seen as related to the narratives of the "sharing economy" (Martin, 2016). Organisations and individuals shift their focus from *products* to *access to resources* through arrangements that could also be beneficial from an ecological point of view, thanks to higher asset utilisation.

While the above-mentioned contributions have had the merit to characterise CE as an umbrella term, which includes different narratives and conceptualisations, and is open to different future implementations, the debate on the topic is still fairly limited, with some key dimensions not having been considered thus far when describing future CE scenarios (Genovese and Pansera, 2021; Pansera et al., 2021).

For instance, the role of social relations of production[4] in shaping different visions of the CE has been neglected. The result of this has been the development of a CE discourse that does not question the underlying assumptions of capitalist economies, despite the inherent contradictions between the overarching objectives of the latter and the implications of an ambitious CE agenda (Bimpizas-Pinis et al., 2021; Genovese and Pansera, 2021). An example of this is the conflict between the emphasis on economic growth of the mainstream CE discourse and the problematic nature of this concept within the original formulations of CE (Hickel and Kallis, 2020). It is clear that different circular futures could arise in societies that are characterised by different types of social relations of production and different models of ownership and control of the means of production (Genovese and Pansera, 2021; Pansera et al., 2021).

Similarly, while the current literature acknowledges the role of different types of economic actors in the transition towards a CE, not much is said about how such a transition could shape capital concentration and centralisation. While there are arguments in favour of a bottom-up transition, which could favour lower levels of capital concentration and centralisation (such as, for instance, the emergence of democratically run SMEs, labour-managed firms and workers' co-operatives), the technological requirements for the implementation of CE practices on a wide scale could also foster the emergence of oligopolistic structures and high degrees of concentration and centralisation of capital (Genovese and Pansera, 2021).

Building on the two key drivers of change suggested by Bauwens et al. (2020), Fig. 1 summarises several additional dimensions that we suggest could, in combination, demarcate further circular scenarios. In addition to social relations of production and capital concentration, these include the desirability of economic growth, levels of democratic participation, the emphasis on competitive markets as vehicles for delivering allocative efficiency, and location of production and supply chains (local vs global). No doubt other dimensions could be added to this.

2.1. Circular futures as value articulating institutions

As conceptualised by Gasparatos (2010), different sustainability conceptualisations make different (explicit or implicit) assumptions regarding what is important to measure and how to measure it. These assumptions are structured sets of rules and typifications which, at the same time, constitute embedded value judgments. As a result, the outcome of such conceptualisations is far from being value-free and neutral.

In this sense, Gasparatos and Scolobig (2012) invoke the concept of Value Articulating Institutions in relation to sustainability conceptualisations. According to the seminal definition provided by Vatn (2005, p. 211), VAI define: (a) "who and in which capacity, i.e. in which role" should be considered during the decision-making process and (b) "what is considered relevant data and how data is to be handled".

In this sense, it can be argued that circular futures, as conceptualised by Bauwens et al. (2020), clearly meet the definition of VAI. Looking at the two main dimensions that these authors introduce to conceptualise and classify circular futures, the first one, governance regime, is clearly concerned with defining "who shall participate and on the basis of which capacity, in which role" when it comes to shaping the future implementation of CE policies and practices. Bauwens et al. (2020) recognise the existence of a continuum of governance solutions, spanning from a centralised one (where decision making is in the hands of national governments and large corporations) to a decentralised one (where community-based decision making is promoted).

On the other hand, the technology dimension is concerned with the types of solutions being adopted, distinguishing between a techno-optimistic perspective (in which the main societal goal is to maintain a growth-orientated consumer economy, through competitive market mechanisms, decoupled from environmental degradation) and a techno-sceptic one (emphasising the need to move away from resource-intensive, consumerist lifestyles and adapt to a resource descent pathway through the adoption of "low-tech" innovations). As further specified by Bauwens et al. (2020), this also clearly dictates the types of data that are needed to realise such transitions, the types of technologies that are needed to handle this data (with specific reference to artificial intelligence and big data techniques as opposed to more community-based and convivial types of decision-making processes) and the underpinning rationality of this process (based on individual versus socially constructed approaches).

3. Theories of value

Having reflected on different plausible circular futures, the theories of value that will be covered here are now introduced. These theories are illustrated in Fig. 2; they have been selected because they represent the principal currents of thought in mainstream and heterodox economics (see Dobb, 1973; Patterson, 1998; Farber et al., 2002). The distinction

[4] Social relations of production of a society give that society its fundamental character and make it, for example, a capitalist rather than some other kind of society.

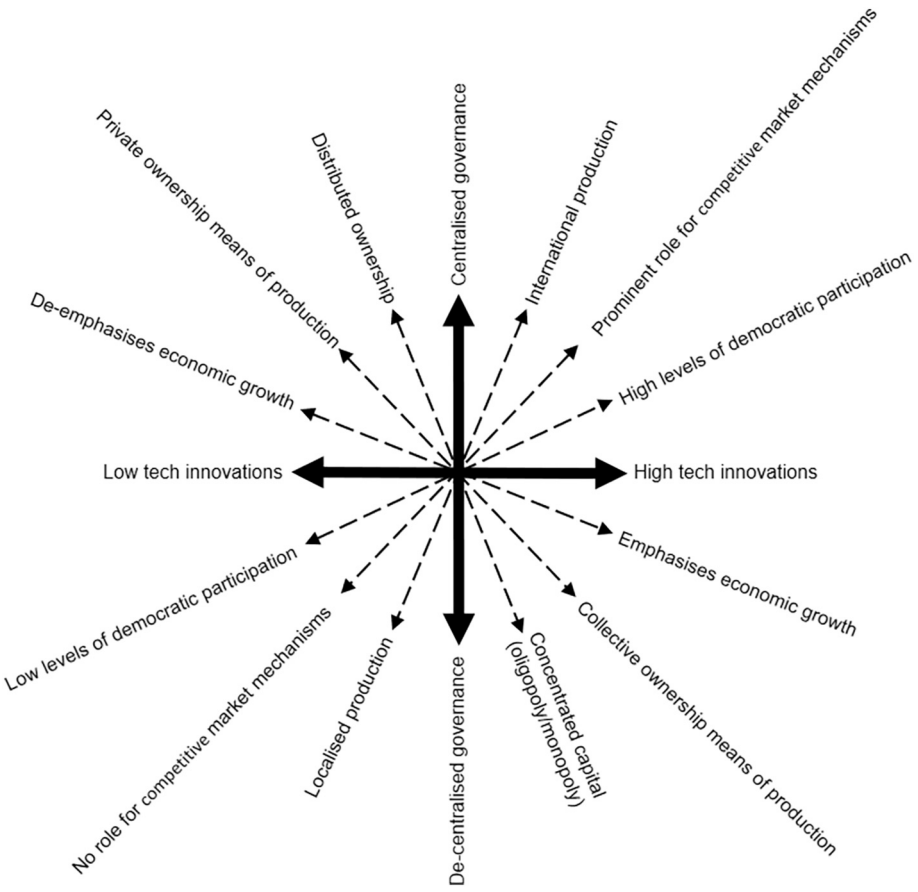

Fig. 1. Dimensions of plausible circular futures (adapted from Bauwens et al., 2020). The two key drivers of change proposed by Bauwens et al. (2020) are represented on the vertical and horizontal axes by solid lines; the additional dimensions suggested here are represented by dashed lines emerging from the origin. Dimensions are shown as polarities as a way of highlighting the spectra that could define plausible circular futures.

between *receiver* theories of value and *donor* theories of value referred to by Odum (1996) and Gasparatos and Scolobig (2012) has been adopted. Broadly, donor theories account for the objective resources utilised to produce an item or service; receiver theories link value to human demand. Elsewhere this dichotomy is also sometimes referred to as *cost of production* versus *subjective preference* (Patterson, 1998, 2002; Gasparatos, 2010). However, the donor/receiver categorisation is slightly more useful for two reasons: (a) receiver values include additional approaches beyond the utilitarianism conjured up by the reference to subjective preferences, and (b) cost of production can imply a financial or monetary aspect that does not apply to all of the approaches in this category.

Whilst Fig. 2 provides a sense of how the various theories *broadly* relate to one another and thus provides a guide to the reader, it masks profound differences in terms of the purpose and ambition of the different theories, which are beyond the scope of this paper. For instance, some theories exist to explain market prices, others focus on social relations, and others still examine social-ecological interdependencies. Moreover, some theories are descriptive, and some seek to be transformative.

These variations are also reflected in the understanding of *value* that the theories address. The traditional focus of value theory in economics has been on seeking an invariant unit to explain the source of *exchange value*, be that labour time, marginal utility or energy flows (Farber et al., 2002).[5] In other words, theories of value have sought to address "how… things with very different qualities – shoes and teapots – are made commensurable in 'free and equal' market exchange" (Pirgmaier, 2021, p.1). However, some contemporary approaches have sought to commensurate different units through an understanding of biophysical interdependencies without reference to market exchange: for example, Patterson's (2002) notion of *contributory value* (explained in what follows). In addition, other approaches focus more on *use value* (the satisfaction provided by the physical features of an item). Therefore, whilst we provide a brief overview of the key features and implications of each of the theories, this has been tailored so that it is relevant to the discussion in what follows; more comprehensive guides to the historical and philosophical foundations of the theories are provided by Dobb (1973), Patterson (1998), Farber et al. (2002), Martins (2013, 2016) and Pirgmaier (2021).

3.1. Receiver theories of value

The receiver theories of value covered here are neoclassical marginal utility theory, deliberative approaches to valuation and the Non-reductionist ecological economics associated with Nicholas Georgescu-Roegen and Herman Daly.

3.1.1. Neoclassical theory of value

The Neoclassical approach based on marginal utility theory has provided the canonical conception of value since the 'Marshallian Scissors' demand and supply diagram appeared at the end of the 19th

[5] As Pirgmaier (2021, p.1) states, this may sound simple but "it remains one of the biggest controversies in the history of economic thought."

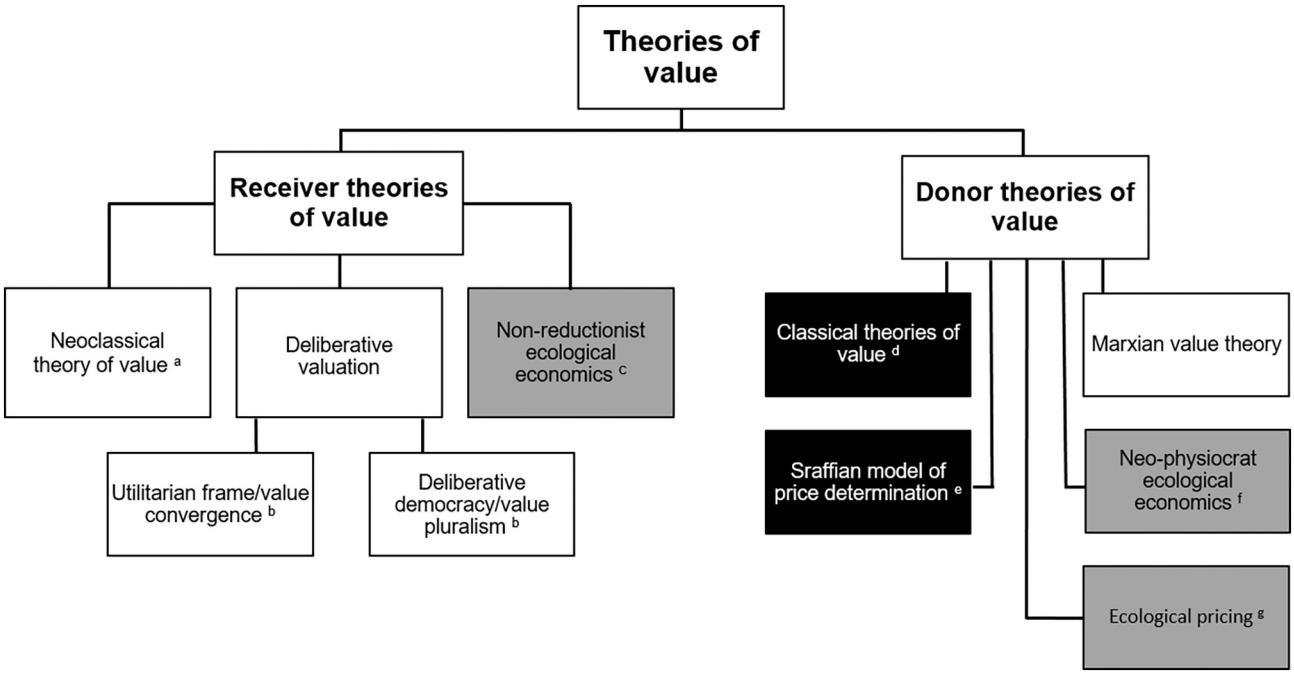

Fig. 2. Typology of theories of value. The theories of value in black boxes have been grouped together because they adopt a similar circular conception of the economy that revolves around a socio-economic process of continuous reproduction (Martins, 2016). The theories of value in grey boxes link value, in varying ways, to energy inputs. However, the tradition of economic thought advanced by Non-reductionist ecological economics ultimately understands value as 'enjoyment of life' (Daly, 1981). As such, even though low-entropy matter-energy is seen as the basis for 'enjoyment of life', the Non-reductionist ecological economics approach has been grouped alongside receiver theories of value. [a] For example, see Champ et al. (2003). [b] For a discussion of deliberative approaches, see Lo and Spash (2013). [c] For example, Georgescu-Roegen (1971) and Daly (1996). Following Hornborg (2014), we have labelled the approach of Georgescu-Roegen and Daly "Non-reductionist ecological economics". [d] Classical theories are understood here as including contributions from the French Physiocrats and the English classical tradition. For an overview, see Dobb (1973). [e] Sraffa (1960). [f] For example, Costanza (1980). Following Hornborg (2014), we have labelled the approach of Costanza "Neo-physiocrat ecological economics". [g] Patterson (1998, 2002, 2008).

century. From this perspective, exchange value emerges at the intersection of marginal benefit (demand) and marginal cost (supply) curves and is thus determined by utility (subjective individual preferences) and cost of production (scarcity).[6,7]

The model of consumer behaviour that underpins this approach assumes, on a priori grounds, that *homo economicus* exhibits clear, stable, fully rational and exogenously given preferences, which exist independently of the preferences of others. Furthermore, preferences, in general, are also subject to the principle of non-satiation (greater consumption leads to greater utility); individuals, therefore, are utility maximisers (and cost minimisers) and best characterised as calculating egoists who view the world predominantly through an instrumental and anthropocentric lens and act in light of perfect knowledge.[8]

When revealed through market exchange, preferences are expressed using money as the monistic numeraire, which is seen as a universal measure via which different values are made fully commensurable. According to this approach, the "fundamental economic 'problem' consists of optimally satisfying preferences" (consumers in this parlance are *sovereign*); this is achieved via competitive market mechanisms, which in turn deliver Pareto optimality (Farber et al., 2002, p.380). Where there are impediments to this functioning, such as public goods and externalities, non-market costs and benefits need to be internalised (and atomised) to ensure markets operate efficiently. When price signals reflect social benefit, this furthers what Spash (2013, p.356) refers to as the "strong and implicit ideology" behind the neoclassical approach, namely the potential for free markets to further democratic and free societies, as well as problem-solving technology.

In terms of key implications here, the principle of non-satiation, in conjunction with a focus on *relative* scarcity, suggests that so long as the *total* stock of capital is unchanged, infinite substitution between forms of capital (natural and man-made) is not ethically problematic and it does not compromise intergenerational equity and the desirability of infinite economic growth. Indeed, preferences and utility levels tomorrow are not seen as being influenced by preferences and utility levels today (Norton et al., 1998): individuals have a positive (high) time preference with consumption now preferred over consumption in the future as utility is discounted at an increasing rate the further into the future it occurs. Given the assumed stability of preferences, at its essence, this approach views the world as working "largely deterministically, moving from one equilibrium to another in relatively stable fashion, and [responding] to changes in constraints in a predictable fashion" (Farber et al., 2002, p.380).

3.1.2. Deliberative (monetary) valuation

Deliberative monetary valuation (DMV) was first developed in response to limitations with traditional stated preference methods used to elicit non-market values for the environment (Lo and Spash, 2013).

[6] The supply side of this equation is also understood subjectively: in Marshall's view, the real cost of production was defined by notions such as "efforts", "sacrifices" and "abstinence" (Bharadwaj, 1978).

[7] It is important to note that while the term "neoclassical" was first used by Thorstein Veblen to designate Alfred Marshall's principles of demand and supply, the term "neoclassical" was later used to designate an even more subjective theory of value than Marshall intended after Lionel Robbins criticised the idea of interpersonal comparisons of utility.

[8] In the Total Economic Value (TEV) conceptual taxonomy proposed by Pearce and Turner (1990), an individual's utility function can reflect a range of motivations including the value of knowing that environmental attributes continue to exist (existence value) and are available for others to use now (altruistic value) and in the future (bequest value). Therefore, TEV can include limited altruistic and intrinsic motivations as well.

Specifically, public participation based on small group discussions occurs before the value elicitation exercise to aid learning and *individual* preference formation and overcome cognitive limitations to stating preferences. Drawing on a utilitarian framing, these approaches produce values that converge on a single metric and are the product of instrumental rationality and orthodox economic logic (e.g. see Urama and Hodge, 2006; Alvarez-Farizo et al., 2007). Lo and Spash (2013) refer to these approaches as *preference economisation* DMV.

An alternative approach to DMV appeals to the theory of deliberative democracy and is often rooted in Habermas's discourse ethics (Habermas, 1984) and Dryzek's theory of discursive democracy (Dryzek, 1990). The focus of this approach is to engender a form of collective preferences, which are borne out of social or communicative rationality (Vatn, 2009). Individuals within these groups are viewed as citizens or stakeholders rather than utility maximisers, and the group-based nature of decision making is seen as encouraging consensus and compromise. What is more, this approach fosters the integration of non-utilitarian ethics (rights-based thinking), non-economic motives (e.g. social norms and procedural and distributional fairness) and plural values based on incommensurable or lexicographic preferences (Sagoff, 1998; Howarth and Wilson, 2006; Spash, 2008; Lo and Spash, 2013). Lo and Spash (2013) refer to these approaches as *preference moralisation* DMV. However, in this context, they are referred to simply as *deliberative valuation* to distinguish them from the neoclassical-based DMV.

3.1.3. Non-reductionist ecological economics

The Non-reductionist ecological economics of Georgescu-Roegen and Daly does not articulate a theory of value per se but rather presents a vision of a Steady-State Economy (SSE) which frames a particular conception of value.[9] An SSE adheres to the laws of thermodynamics (i.e. the throughput of low-entropy matter-energy) and the impossibility of complete recycling and has three central features: sustainable scale, just distribution and efficient allocation (Daly, 1974a; Georgescu-Roegen, 1979; Daly, 1992; Farley and Washington, 2018).

Sustainable scale refers to the imposition of ecological boundaries on the economic system that reflect the *absolute* scarcity of resources, thus ensuring that future generations are considered. A sustainable scale is to be implemented by adopting depletion quotas and birth licences to ensure constant stocks of people and artefacts (sustained by low throughput of matter-energy). A just distribution suggests limiting disparities in the distribution of income and wealth (and reductions to monopoly power): such a distribution is to be effected via distributive limits, including minimum and maximum incomes. Finally, as Farley and Washington (2018, p.443) recently clarified, an efficient allocation is defined as one which achieves "the greatest amount of useful services for the lowest ecological cost, as measured by throughput". Once scale and distribution have been addressed, efficiency is achieved via market mechanisms. However, Daly emphasises that this is "market with a *small m*, a limited tool for rationing resources, communicating information, and exchanging goods and services" (Daly, 2016, p.27, emphasis added; see also Kunkel, 2018). Where there are market failures and public goods, allocation is to be achieved via participatory democratic processes (Farley and Washington, 2018).

The reference to participatory processes points towards a cooperative understanding of human behaviour: humans are "capable of both altruism and egoism" (Farley and Washington, 2018, p.445) and best viewed "as persons-in-community, heavily influenced by their cultural milieu" (Daly and Cobb Jr., 1994 *cited in* Farley and Washington, 2018, p.445). Within this context, value is understood as enjoyment of life or psychic utility (Daly, 1981), hence why this approach has been classified as a receiver theory of value. Indeed, the ultimate goal of the economy is to satisfy needs ("basic psychological requirements") rather than just 'wants' (Farley and Washington, 2018, p.443).[10] However, low-entropy is seen as the basis for value, even if this is not a sufficient condition in its own right (Georgescu-Roegen, 1979). Moreover, the conception of value associated with an SSE is best understood in *use value* terms given that the focus of such an economy is simple commodity exchange, i.e. reproduction and qualitative development as opposed to growth and accumulation (Kunkel, 2018, p.97).

3.2. Donor theories of value

The donor theories of value covered here include those emanating from the classical tradition, Marxian value theory, Sraffa's neoRicardian model of price determination, Neo-physiocrat ecological economics and ecological pricing.

3.2.1. Classical theories of value

For classical theorists, value stemmed from objective inputs – in particular land and labour time – required to produce a commodity (Patterson, 1998). This was part of a fundamentally different view of the economy, not as a "one-way avenue that leads from 'Factors of Production' to 'Consumption Goods'", as Sraffa (1960, p.93) described neoclassical economics, but as a "circular process of reproduction that takes place within limits set by natural constraints" (Martins, 2016, p.33).

The Physiocratic school, led by Francois Quesnay (1694–1774), made an early contribution in this direction (Patterson, 1998) by theorising an economy of interdependent sectors, characterised by a circular flow of commodities. Natural resources (specifically, 'land') were seen as the sole source of all values; primary production from the agricultural sector was seen as the only source of a surplus, deriving its wealth directly from the land. The Physiocrats also employed land as a value numeraire, even if they did not construct a formal theory of value.

Adam Smith (1723–1790) showed that a "surplus originated from production in general and not from agricultural production alone" (Garegnani, 1984, p.293). Smith argued that a pure labour theory of value could be valid for pre-capitalist economies. However, the fundamental characteristic of capitalist economies is the interplay of different social classes that contribute to production. For this reason, with specific reference to capitalist economies, Smith proposed a cost of production theory of value, which explains the long-run exchange value of a commodity as the sum of wages, profits and rents required to produce it (Screpanti and Zamagni, 2005; Pirgmaier, 2021).

David Ricardo (1772–1823) noted a circularity in Smith's reasoning, as it seeks to explain prices by prices of land, labour and means of production. Also, he stated that profits are a residual income that remains after wages have been paid. Ricardo argued for a labour embodied theory of value also for capitalist economies, i.e. the concrete labour contained in commodities, thus rejecting the view that exchange value is governed by supply and demand (Pirgmaier, 2021).

Indeed, despite disagreements, as stated by Pirgmaier (2021, p.2), both Ricardo and Smith concur with an explanation of exchange value "at a level that underpins the fluctuations of supply and demand". Furthermore, in the classical conception, the reproduction, allocation and use of the social surplus (defined as that "part of production which is not necessary for the reproduction of the existing economic system" – Martins, 2013, p.227) are the key theoretical constructs (Garegnani, 1984; Kurz, 2003; Cesaratto, 2020). Where the social surplus is used for "productive activities, the economy flourishes…[whereas when it is

[9] Following Burkett (2003), Hornborg (2014, p.16) distinguishes two biophysical schools of thought that adhere to the laws of thermodynamics: the "Non-reductionist" ecological economics of Georgescu-Rogen (1971) and Daly (1996) and the "Neo-Physiocrat" ecological economics of Costanza (1980) covered in Section 3.2.4.

[10] This approach distinguishes between *absolute* and *relative* wants; unlike the neoclassical approach, only relative wants are infinite. However, relative wants cannot be universally satisfied via growth (Daly, 1992).

used for] gross luxuries, the economy and society enter into a stage of decadence" (Martins, 2016, p.36).

The classical focus on the social surplus was in stark contrast to the neoclassical preoccupation with scarcity and the optimal allocation of scarce resources. For classical theorists, scarcity was not universal to all forms of capital but instead a special case that applied to land and natural resources because they are not reproducible (Martins, 2016). In addition to giving greater prominence to the limited nature of natural resources, the effect of this divergence had additional implications. In the classical conception, manufactured capital can always be reproduced, and therefore prices are influenced by (or gravitate towards) the cost of production (Martins, 2016); by contrast, in the neoclassical approach, scarcity is the general case, and thus price is determined by recourse to demand and supply schedules (which in turn influences the cost of production).

Within the process of circular reproduction, human agents are not seen as utility maximisers but "creatures of habit whose utility level gets adapted to a given social situation, and…a given (customary) standard of living" (Martins, 2013, p.227). According to Martins (2016, p.36), this flows from an Aristotelian conception of happiness which suggests that human beings "become satisfied…with a finite number of basic commodities". Accordingly, economic growth becomes one "possibility amongst others" of improving living standards, including through distribution (taxes on rents and luxuries) so long as this does not impact the process of reproduction (Martins, 2013, p.229). The reference to a customary standard of living was understood as being more than that needed for physical survival, given that this was "essential for the reproduction of the economy and society" (Ibid, p.228).

Also, a distinctive characteristic of classical economists is that they took the socio-economic system as they found it, stratified in social classes – workers, landowners and capitalists (Kurz and Salvadori, 1998); therefore, they saw human agents as part of a social class, in a context where distribution is made according to social class, and social class springs from a given division of labour. As such, drawing on Heidegger's phenomenology, Martins (2016, p.37) suggests that classical theories of value are compatible with an ontological perspective that views the "human agent…as a Being-in-the-World, which means, amongst other things, being part of a broader whole".

3.2.2. Marxian value theory

Marx argued that value in a capitalist society is explained through abstract socially necessary labour time (ASNLT).

> "*The value of any commodity – and this is also of the commodities which capital consists of – is determined not by the necessary labour-time that it itself contains, but by the socially necessary labour-time required for its reproduction*" (Marx, 1990, Vol. 3: 238).

Rather than referring to 'labour' as a generic activity or social practice, 'socially necessary' labour identifies the average amount of labour time required to produce certain commodities within a given set of technological development conditions. As such, ASNLT is an average value that acknowledges the key role played by technological development, knowledge and skills in shaping value (Reuten, 2018). Also, abstract labour is labour that produces products with 'value' in the sense of universal exchangeability. Essentially, in the act of exchange, different kinds of individual labour become homogenised. If abstract labour represents the qualitative aspect of value, this can be quantified and measured through 'labour time' (Banaji, 1979). In other words, how much time it takes on average to produce a given commodity provides an explanation of the exchange value of that commodity. While inheriting the classical view of a socio-economic system stratified in social classes, Marx clarified that such stratification, and its power imbalances, are inherently embedded in capitalist production relationships. Wages received by workers provide them with purchasing power; this allows their reproduction. However, the difference between the ASNLT required for workers' reproduction and the labour-power expended in the capitalist process of production represents the very essence of capitalist exploitation.

Hence, while still offering an anthropocentric perspective and a commensurable view of value (based on a donor perspective and on physical inputs), compared to other classical theories of value, the major innovation in Marx's theory of value lies in the fact that abstract labour is a historical fact, specific to capitalism, as generalised wage-labour did not exist in previous societies (Smith, 2018; Pirgmaier, 2021). As such, the Marxian ToV provides a radical critique of capitalist value and valuation.

3.2.3. Sraffa model of price determination

Sraffa's neoRicardian model of price determination revived the classical circular (and reproductive) conception of the economy following the intervening neoclassical revolution (Sraffa, 1960).[11] In this macro-based model, exchange values are established by Input-Output (I—O) modelling and the solutions to a series of simultaneous linear equations which represent the circular flow of physical commodities in the economy, any one of which can be used as the numeraire.[12] As Farber et al. (2002, p.377) state, the Sraffian system "established conditions under which exchange ratios between commodities can be determined based on their use in production; i.e. a set of commodity prices that would exhaust the total product". The key point here is that socio-technical conditions of production, or alternatively, the costs of production of commodity inputs, determine exchange value and not reference to demand and supply schedules representing individuals' preferences (Judson, 1989).

Martinez-Alier (1995, p.78) argues that the underlying "political objective" of the Sraffian system is ultimately to show that the distribution between wages and profits "determines, from the supply side, the 'prices of production', together with the technical specificities of the production". As a result, the value of the capital stock is said to depend "on the results of distributional conflict between wage workers and capital owners" (Ibid, p.79).

3.2.4. Neo-physiocrat ecological economics

Neo-physiocrat ecological economics assumes that value has a biophysical basis in the energy used to produce goods and services. This mirrors both the Physiocratic school, who believed that land constituted the ultimate source of value, and the Ricardian embodied labour theory of value, which identified labour as the primary factor of production. Drawing on the physics of thermodynamics, at least at the global level, 'free' or 'available' energy from the sun is seen as the primary input into the system that explains production costs and therefore the value that

[11] Martins (2013) suggests that the Sraffa model is the first stage in the revival of the classical surplus theory; the second stage being the capabilities approach of Sen (1999) and Nussbaum (2000). The latter is relevant to determining the basic capabilities necessary to achieve human well-being and thus what remains can be understood as a social surplus.

[12] Although Sraffa made use of a *standard commodity* - "which is a mixed commodity, made up of the basic commodities necessary for the reproduction of the economy in a certain proportion" - to express exchange value (Martins, 2016, p.35).

humans assign to goods and services in the process of exchange.[13] Such an 'energy theory of value' was proposed by Costanza (1980, 1981a, 1981b) and Costanza and Herendeen (1984), who utilised I—O analysis to investigate the relationship between embodied energy (direct and indirect energy consumption) and market exchange values.[14,15]

As Burkett (2003, p.151) points out, Neo-physiocrats take a distinctly positive view of free markets and their function in providing "adequate measures of the true resource costs of production". From this perspective, environmental problems emerge because "markets for natural wealth are missing, incomplete, or imperfect. Apparently, if nature's use value were properly reduced to embodied energy and then properly measured by money, environmental problems would be automatically corrected" (Ibid, p.152).

3.2.5. *Ecological pricing*

The ecological pricing models developed by Patterson (1998, 2002, 2008) can be seen as a variation on the Neo-physiocrat approach. In a similar way to the work of Costanza, ecological pricing draws on I—O modelling and simultaneous equations to map biophysical interdependencies in the reference ecosystem. However, these interdependencies are inferred from energy *and* mass flows, and the resulting shadow prices are termed 'contributory values'. Contributory value reflects the backward and forward linkages between 'ecological entities' or 'compartments' and the contribution that they make to the existence of one another – "for example, plankton provides contributory value to a fish species, as it is a source of food for fish" (Patterson, 2008, p.143).

Unlike embodied-energy theories, there is no suggestion that contributory values will explain, and be adequately reflected in, market prices: as Patterson (2002, p.470) argues, whilst ecological prices "are important in defining market prices, they are by no means the only factors". Indeed, the notion of contributory value does not require a human valuer given that it "can be defined in terms of the 'needs' of non-human species", and as such, it can "be considered to be a more biocentric valuation concept" (Patterson, 2008, p.143). In addition, ecological pricing is less reliant on using solar energy as the numeraire (any commodity in the system under analysis can assume this role) (Patterson, 1998), and it can be applied to levels below the biosphere (Patterson, 2008). These differences lead Patterson (1998) to label his approach a "biophysical theory of value".

4. Which theories of value for which circular future?

To examine the compatibility between the circular futures and theories of value introduced in the preceding sections, we drew on the dimensions that Vatn (2009, p.2211) suggests when considering VAIs.[16] These dimensions – supplemented by relevant additions from Gasparatos (2010) and Hornborg (2014) – were used to produce a template that was applied to the theories of value described in the previous section. Consisting of eight dimensions, the completed template (framework) reveals the key differences between the theories and the traditions of economic thought that underpin them (Table 1). Following this, the framework was then applied to each of the circular futures, i.e. for each of the eight dimensions in the framework, the theory of value that best matched that aspect of the circular future in question was selected.[17] The result is a 'scorecard' for each future that sets out how the "meta principles" that Bauwens et al. (2020, p.3) use to characterise each of their scenarios enmesh with the currents contained within value theory. This procedure is summarised in Fig. 3.

It should be stressed that, just as Bauwens et al. (2020, p.2) recognise that their four futures are not mutually exclusive and represent "extreme cases of continuums", so too here some of the arguments presented may be reconciled across the different futures and particularly the hybrid scenarios that appear most likely. Also, where necessary (and where indicated), we have made some limited assumptions about the content of each future given that Bauwens et al. (2020) did not describe each one exhaustively.

4.1. *Circular modernism and value theory - sustaining growth*

Of the four futures Bauwens et al. (2020) put forward, the circular modernist future has the most evident association with a single theory of value, in this case, marginal utility theory. This is perhaps not surprising given that circular modernism essentially reflects the status quo in many capitalist countries whereby competitive market forces, technological progress and the macroeconomics of growth – all as we have seen hallmarks of marginal utility theory – go unquestioned. In this scenario, individuals are unbridled consumers without reference to a wider community or incentive system other than themselves. As such, transformations are supply-side focused and based on conventional business models which, as Bauwens et al. (2020 p.7) suggest, are "still largely compatible with the linear economy". The role of government is focused on setting minimum standards (for example, regarding eco-efficiency) and, we might surmise, correcting market failures and promoting value monism by extending the reach of individual preferences to cover environmental *goods* and *services* for which markets do not exist (Buchmann-Duck and Beazley, 2020).[18]

Table 2 presents the scorecard for circular modernism reflecting the preponderance of the neoclassical approach. In addition to marginal utility theory, though, Marxian value theory's *positive* (i.e. descriptive) function also particularly resonates in this context. Whilst Bauwens et al. (2020) do not explicitly describe circular modernism in terms of social forces and the exploitation of labour, nonetheless, Marxian value theory provides a radical critique of the capitalist market provisioning that underlies circular modernism (relevant groups, roles, forms of communication etc.) and in so doing provides the foundation for transition pathways towards more ambitious circular futures. Given its common emphasis on class struggle and distributional conflict, the Sraffian model could also be relevant here (Judson, 1998).

Finally, dimensions within Non-reductionist ecological economics

[13] Farber et al. (2002, p.382) suggest free energy has the following special characteristics which satisfy the criteria for a "primary" input: "Energy is ubiquitous. It is a property of all of the commodities produced in economic and ecological systems. While other commodities can provide alternative sources for the energy required to drive systems, the essential property of energy cannot be substituted for."

[14] Using an 87-sector I—O model of the United States economy for 1963, 1967 and 1973, Costanza (1980, 1981a, 1981b) and Costanza and Herendeen (1984) found a strong correlation ($R2 = 0.85–0.98$) between embodied energy and the market determined dollar value of sector output. The validity of this empirical finding has been questioned, for example, by Daly (1981).

[15] Hornborg (2014) suggested that Odum (1996) also forms part of Neo-physiocrat ecological economics. However, we disagree with this: Odum clearly described his EMERGY approach as a theory of "environmental value" not an economic theory of value. If anything, EMERGY is most similar to ecological pricing introduced in the next section; however, Odum did not describe EMERGY as a 'pricing procedure.'

[16] The dimensions concerning *rationality* and *interaction of agents* were particularly relevant in this context.

[17] The matching process was conducted by both members of the research team independently. The resulting scorecards for each circular future were then compared. In the case of a disagreement, members of the research team tried to resolve these through a conversation. Whenever doubts still persisted, the opinion of an independent external subject expert was sought. It is worth noting that disagreements occurred in less than 5% of the matching cases; the involvement of an external expert was needed on just three occasions.

[18] This omission arises because of public good characteristics and externalities and means that environmental goods and services often have no price, even though they clearly provide substantial benefit.

Table 1
Summary of main features of theories of value.

	Neoclassical theory of value	Deliberative valuation	Non-reductionist ecological economics	Classical theories of value	Marxian value theory	Sraffa's model of price determination	Neo-physiocrat ecological economics	Ecological pricing
Purpose	Description of and prescription for the status quo	Transformative	Transformative	Descriptive	Critique of capitalism - descriptive and transformative	Descriptive and transformative	Descriptive and weakly transformative	Transformative
Relevant groups (timeframe and geographical scale) [a]	Humans (present generation; disaggregated)	Humans representing themselves, their local communities, and potentially future generations	Humans (present and future generations) and non-humans	Social classes, landowners, farmers, owners of means of production and labourers	Social groups/ classes, owners of the means of production and labourers	Social groups/ classes, owners of the means of production and labourers	None. Focus is inputs of embodied energy	Ecological entities that contribute or receive value
Roles [a]	Individual consumer	Citizen or stakeholder representative	Persons in community; expert rule-setter (optimal scale) [f]	Human agent part of a "circular reproduction process that transcends the human individual" [h]	Participation mediated by power imbalances and social forces	Participation mediated by power imbalances and social forces	Participant is irrelevant	Participant is irrelevant
Value orientation of relevant stakeholders [b]	Egoistic, instrumental, anthropocentric	Altruistic, anthropocentric	Altruistic and egoistic; biocentric (optimal scale) [f]	Biocentric	Anthropocentric	Biocentric	Biocentric	Biocentric, intrinsic
Concept of value and rationality [b]	Receiver system of valuation; individual rationality (full); individual preferences	Receiver system of valuation; social rationality; social preferences; fair distribution [d]	Receiver system of valuation; individual rationality (bounded) and social rationality [f,g]	Donor system of valuation; cost of production	Donor system of valuation; cost of production	Donor system of valuation; cost of production	Donor system of valuation; cost of production	Donor system of valuation; cost of production
Value dimensions [a]	Commensurable	Commensurable and incommensurable (but weakly comparable) [e]	Commensurable (market allocation); incommensurable (setting optimal scale and allocation to correct market failures via participatory democratic processes) [f]	Commensurable (e.g. Ricardo's labour theory); weakly comparable (Physiocratic school)	Commensurable	Commensurable	Commensurable	Commensurable
Form of communication and principle of participation [a]	Individual actions revealed via market exchange	Small group negotiations/ deliberation	Wants revealed through market exchange; allocation to address market failures via participatory democratic processes	Institutions and customs [i]	Power structures, class conflict	Distributional conflict between wage-workers and capital owners [k]	Not relevant	Not relevant
Why are there environmental problems? [c]	Environmental costs are insufficiently internalised in market prices	Environmental policy does not reflect non-economic motives and non-utilitarian ethics [e]	Economic value generation generates entropy	Inefficient use and distribution of the surplus [j]	The capitalist mode of production generates environmental destruction	Unclear	Natural values such as embodied energy are insufficiently internalised in market prices	Failure to account for the biophysical roles that species play in natural ecosystems

[a] Dimensions from Vatn (2009).
[b] Dimensions adapted from Gasparatos (2010)
[c] Dimension (and column entries) adapted from Hornborg (2014).
[d] Regarding fair distribution, see Howarth and Wilson (2006).
[e] See Lo and Spash (2013).
[f] See Farley and Washington (2018).
[g] Whilst this approach equates value with 'enjoyment of life', ultimately enjoyment of life is viewed as having an ecological basis.
[h] Martins (2016, p.34).
[i] Martins (2013) discusses the role of institutions and customs in setting the subsistence wage.
[j] See Martins (2016).
[k] See Martinez-Alier (1995, p.78/9).

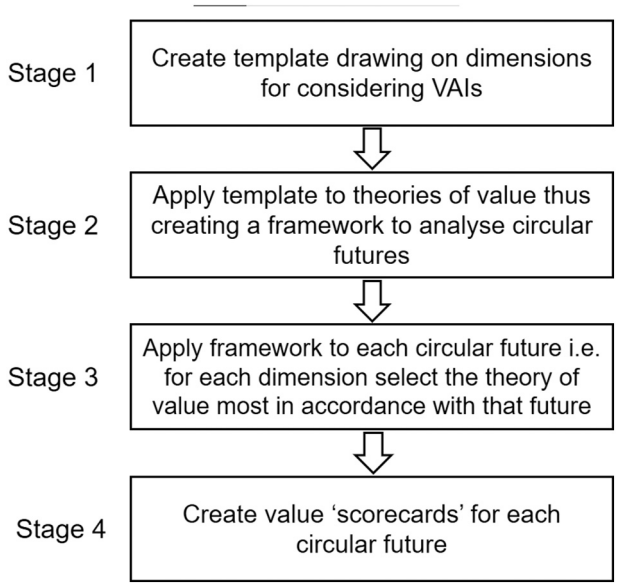

Fig. 3. Stages in mapping values theories to circular future.

are also relevant (albeit to a lesser degree) given that the economic system imagined by this approach is based on limited market allocation within ecological and distributive limits. As such, there is a common focus on the communicative and commensurating role of market mechanisms and a receiver system of value centred on the individual (albeit influenced by a cultural context).

4.2. Planned circularity and value theory - CE by command

The planned circularity future presents a scenario where governments impose strong coercive measures in favour of the transition towards a CE; in this situation, the role of the 'invisible hand' is supplanted to varying degrees by top-down planning and coordination. Therefore, in general, donor theories of value which do not focus on human participants and instead have a biocentric value orientation and commensurable value dimensions are particularly applicable in this context.

More specifically, a planned circularity future might take the shape of a 'command economy' (similar to the ones which have existed in the 20th-century), in which competitive market mechanisms play no role in the allocation of resources. Within these contexts, central planners attempted to construct inventories for natural resources, also depicting their interactions with production systems through *stock-flow* models. For instance, in the former Soviet Union, inventories recorded stocks of natural resources in physical units; in an attempt to enhance commensurability, stocks were then also recalculated into "comparable physical units" by taking into account differences in quality, concentration and other characteristics. Prominent examples of this were provided by stocks of fuels (which were inventoried in equivalent energy units) and attempts to assess the *embodied metal* content of infrastructures and equipment of the whole Soviet economy (Zusman, 1976). As stated by Thornton (1978) and Sathre and Grdzelishvili (2006), such approaches were not able to measure value, due to limited progress, at the time, in non-market valuation methods.

Therefore, for circular futures based on a 'command economy' framework, theories of value where allocation is based solely on physical calculations and where there is not a sympathetic view of competitive market mechanisms, such as Patterson's ecological pricing approach, may be most applicable. In general, within all types of planned circularity scenarios, appropriately modified Input-Output approaches (Leontief, 1986), which can show the connections of the economic system in its entirety, could also be relevant to coordinating material flows. The usefulness of an Input-Output framework within a planned economy was documented by Lange (1978), as also discussed by Lopes and Neder (2017).

However, planning may also be driven by a specific recognition of the incommensurability of different values and/or the entropic nature of energy and mass flows and thus the need to impose ecological limits for the economy to operate within (Daly, 1992). Therefore, dimensions within deliberative valuation and non-reductionist ecological economics, respectively, are also potentially relevant.

Where planning still involves a role for competitive market mechanisms (such as in contemporary China and Vietnam, or 20th-century examples of 'market socialism', such as Yugoslavia), then Sraffa's model of price determination would also be a compatible approach. As Patterson (1998) points out, whilst inputs and outputs are denominated in physical terms in the Sraffa model, this approach is nonetheless based on the circular flow of exchange value (which is subjective and reminiscent of neoclassical economics) and the production of surplus wealth (i.e. a system of accumulation).

Table 3 presents the scorecard for Planned Circularity.

4.3. Bottom-up sufficiency and value theory – embracing degrowth

In a bottom-up sufficiency scenario, the focus is on localised production to "[satisfy] needs rather than…[promote] wants" (Bauwens et al., 2020, p.6); a significant reduction in consumption and the extraction of virgin raw materials is foreseen. This scenario also takes a less optimistic view on the potential for technology to deliver the transition towards a CE, perhaps in part out of a recognition of the rebound effect and the scope for efficiency gains to ultimately give rise to demand increases (Zink and Geyer, 2017). As a result, it is conceivable that this scenario is more likely to focus on resilience and ecological integrity rather than cost-based notions of efficiency (Bimpizas-Pinis et al., 2021). Therefore, the fallibility of individual preferences is likely to be highlighted, along with an understanding of the environment, not as operating in a deterministic and stable fashion, but as characterised by critical thresholds and tipping points (Lenton et al., 2008).

Table 2
Circular modernism and theories of value.

Question	Neo-classical	Deliberative valuation	Non-reductionist	Classical	Marxian	Sraffa	Neo-physiocrats	Ecological pricing
Purpose	✔✔				✔✔		✔	
Relevant groups	✔✔			✔✔	✔✔	✔✔		
Roles	✔✔		✔		✔✔	✔✔		
Value orientation of stakeholders	✔✔				✔✔			
Concept of value and rationality	✔✔		✔					
Value dimensions	✔✔	✔✔	✔	✔	✔✔	✔✔	✔✔	✔✔
Communication and participation	✔✔		✔		✔✔	✔✔		
Why are there environmental problems?	✔✔				✔✔		✔	
SCORE out of 16	16	2	4	3	14	8	4	2

Legend: ✔✔ = highly consistent; ✔ = consistent.

Table 3
Planned circularity and theories of value.

Question	Neoclassical	Deliberative approaches	Non-reductionist	Classical	Marx	Sraffa	Neo-physiocrats	Ecological pricing
Purpose			✔✔			✔✔		✔✔
Relevant groups							✔✔	✔✔
Roles			✔				✔✔	✔✔
Value orientation of stakeholders			✔	✔✔		✔✔	✔✔	✔✔
Concept of value and rationality				✔✔	✔✔	✔✔	✔✔	✔✔
Value dimensions	✔✔	✔✔	✔✔	✔✔	✔✔	✔✔	✔✔	✔✔
Communication and participation			✔				✔✔	✔✔
Why are there environmental problems?		✔✔	✔✔		✔✔		✔✔	✔✔
SCORE out of 16	2	4	9	6	6	8	14	16

Legend: ✔✔ = highly consistent; ✔ = consistent.

Related to this point, a focus on resilience also presupposes a long-term perspective whereby a certain stock of natural resources (and the assimilative capacity of the environment) is maintained in its entirety across generations, thus safeguarding intergenerational equity. This is based on the understanding that needs tomorrow can be influenced by needs today (reversing neoclassical logic) and therefore that a low time preference is more appropriate; this is consistent with the explicit focus on future generations of non-reductionist ecological economics. It may also be consistent with ecological pricing, which takes account of the 'needs' of non-humans and does not require the presence of a human valuer.

In a context where economic growth is no longer privileged, theories of value that impose overall limits on the size of the economy and economic growth (such as non-reductionist ecological economics) may be the most compatible. Indeed, this scenario would likely recognise that low-entropy matter-energy is the ultimate input of, and constraint on, production (Georgescu-Roegen, 1973, pp. 53–54, 58); so, this implies that the economy will have to adjust to a "steady state" to ensure its own reproducibility (Daly, 1974b).

The de-emphasis of economic growth in this scenario is coupled with "political and economic relocalization [sic] through the decentralization [sic] of decision making…[thus creating] the conditions for direct participation and control in the decision-making process" (Bauwens et al., 2020, p.8). Individuals are "active citizens" within a civil society that promotes the transition and not "mere consumers or users" (Ibid, p.6). The concept of value most in keeping with a focus on participation and social rationality would appear to be deliberative valuation, with its emphasis on deliberative decision making, civic preferences (including fair distribution) and diverse (and incommensurable) values that go beyond economic considerations (Howarth and Wilson, 2006). As explained in Section 3, within these approaches, individuals are seen as citizens or stakeholders rather than utility maximisers, with group-based processes encouraging consensus and compromise for achieving procedural and distributional fairness. The classical conception of the human agent as part of a "circular reproduction process that transcends the human individual" may also be better aligned with futures based on bottom-up decision making (Martins, 2016, p.34).

Table 4 presents the scorecard for Bottom-up Sufficiency.

4.4. Peer-to-peer circularity and value theory – a sharing economy?

Suggesting which theories of value might be compatible with peer-to-peer circularity is not straightforward; this scenario falls somewhere between circular modernism and bottom-up sufficiency, and the compatibility of different value theories is dependent on the assumptions made, in particular, regarding ownership of the technology and servitised platforms that are the focus here.

On the one hand, if the sharing economy envisaged in this scenario is powered by platforms that are community-owned and which promote truly collaborative consumption, then peer-to-peer circularity may evidence reduced consumption in the shift towards *performance* rather than *ownership*, and individuals as *users*, not *consumers*. Therefore, revisiting the arguments made in the context of bottom-up sufficiency, the theories of value most relevant here may include those that do not accept the primacy of surplus value creation and perpetual economic growth. Therefore, Non-reductionist ecological economics and ecological pricing are both relevant. Similarly, the localisation and decentralization themes evident in bottom-up sufficiency are also evident to some degree in peer-to-peer circularity as new distributed production technology leads to the "democratization [sic] of manufacturing and the empowerment of consumers" (Bauwens et al., 2020, p.8). Therefore, again, deliberative valuation is also potentially relevant.

However, if peer-to-peer circularity is characterised by 'platform capitalism' (Srnicek, 2017), whereby the servitised platforms are owned by growth-driven organisations (as Bauwens et al., (2020, p.8) put it, if "sharing economy initiatives…[are] co-opted by large corporates"), and if the focus is on the technology itself rather than the service it provides, then this future could also be consistent with a status quo scenario focused on competitive market mechanisms and thus the neoclassical theory of value.

Given these divergent conceptions of a future characterised by peer-to-peer circularity, Table 5 reflects both the extent and tentative nature of the potential associations with the various theories of value.

5. Discussion

Fig. 4 summarises the analysis that has been undertaken here, which suggests that different circular futures are compatible with different

Table 4
Bottom-up sufficiency and theories of value.

Question	Neoclassical	Deliberative approaches	Non-reductionist	Classical	Marx	Sraffa	Neo-physiocrats	Ecological pricing
Purpose		✔✔	✔✔			✔✔	✔	✔✔
Relevant groups		✔✔	✔✔					
Roles		✔✔	✔✔	✔✔				
Value orientation of stakeholders		✔✔	✔	✔✔		✔✔	✔✔	✔✔
Concept of value and rationality		✔✔	✔					
Value dimensions		✔✔	✔✔					
Communication and participation		✔✔	✔✔					
Why are there environmental problems?		✔✔	✔✔		✔✔			✔✔
SCORE out of 16	0	16	14	4	2	4	3	6

Legend: ✔✔ = highly consistent; ✔ = consistent.

Table 5
Peer-to-peer circularity and theories of value.

Question	Neoclassical	Deliberative approaches	Non-reductionist	Classical	Marx	Sraffa	Neo-physiocrats	Ecological pricing
Purpose	✔	✔	✔		✔	✔	✔	✔
Relevant groups	✔	✔	✔	✔	✔	✔		
Roles	✔	✔	✔	✔	✔	✔		
Value orientation of stakeholders	✔	✔	✔	✔	✔	✔	✔	✔
Concept of value and rationality	✔	✔	✔					
Value dimensions	✔	✔	✔	✔	✔	✔	✔	✔
Communication and participation	✔	✔	✔		✔	✔		
Why are there environmental problems?	✔	✔	✔		✔		✔	✔
SCORE out of 16	8	8	8	4	7	6	4	4

Legend: ✔✔ = highly consistent; ✔ = consistent.

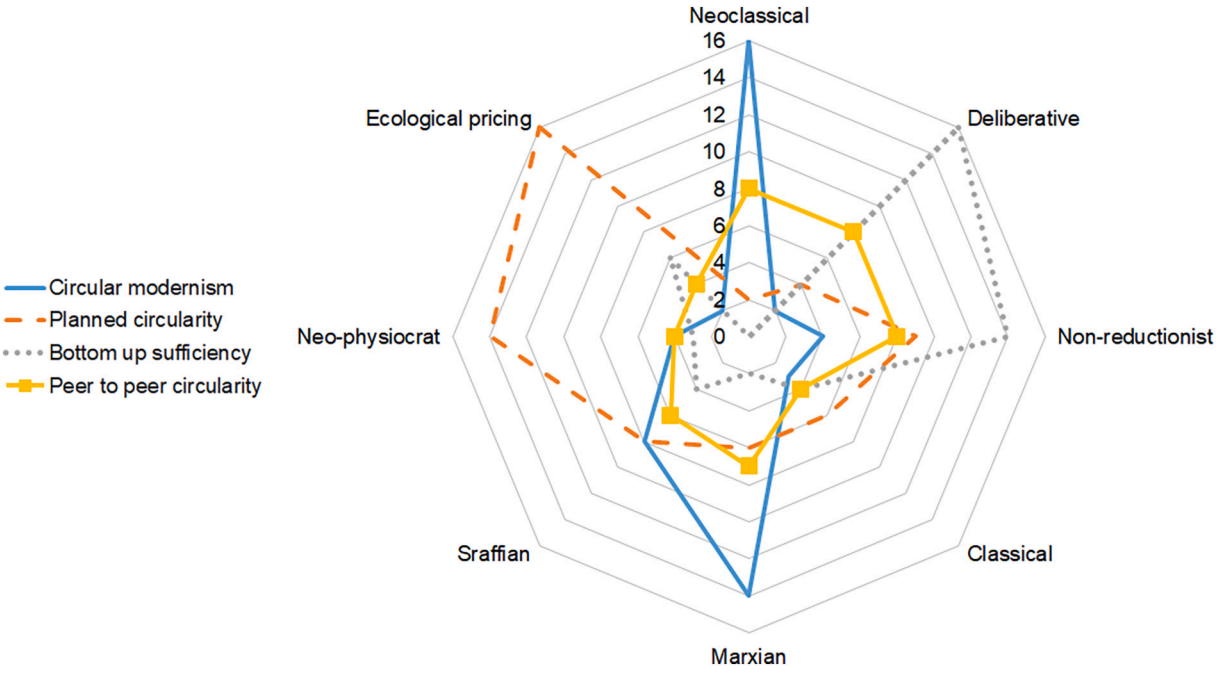

Fig. 4. Summary of theories of value relevant to each circular future. The scores assigned to each future (0–16) reflect the analysis presented in Tables 2-5.

theories of value and vice versa. In the case of circular modernism, marginal utility theory and Marxian value theory were most relevant (depending on whether the aim was to substantiate the status quo or decipher and surmount it); for planned circularity, it was donor theories of value that utilise objective inputs, and for bottom-up sufficiency, it was deliberative valuation and Non-reductionist ecological economics reflecting the de-emphasis on economic growth and the added emphasis placed on democratic participation. In the case of peer-to-peer circularity, it depended heavily on the assumptions regarding the nature of servitised platforms. This level of variation resonates with our conception of circular futures as VAIs.

Given that our analysis was predicated on the four futures proposed by Bauwens et al. (2020), concepts of value have by necessity been reduced to a second-order issue, i.e. one of fitting theory to predefined scenarios. In this context, one of the implications here for any forthcoming research into CE futures or imaginaries is that the underpinning theories of value need to be both fully explicit and consistent with the future being portrayed. One example suffices to illustrate this: in Bauwens et al. (2020, p.5), the notion of economic efficiency that is used to judge each of the four futures is only briefly defined as the "degree to which a scenario allocates resources to produce the highest possible welfare while minimizing [sic] costs". Now, the reference to allocative efficiency, in combination with the reference to welfare, *could* be indicative of a neoclassical theory of value. However, as we have seen, this would be contradictory to those futures, for example, embracing sufficiency and de-growth that are unlikely to view efficiency in terms of monetary costs. The guide that this paper offers as to the compatibility (or otherwise) of the different circular futures and theories of value is not meant to be exhaustive though; we have sought only to provide an outline that suggests broad areas of confluence. Moreover, as Bauwens et al. (2020) recognise, circular futures are not likely to fit neatly into one of the four options they provide; they will probably be hybrid scenarios, which will come to be defined by the multiple dimensions discussed. As such, the arguments advanced here will need to be revisited and expanded as these futures are further refined in different contexts and different historical phases.

However, the relevance of value theory to circular futures is not just about consistent foundations: drawing on a critical political economy perspective can enable future-orientated research to question the fundamental assumptions that underlie our current economic systems. These assumptions include not just where value comes from and how it is articulated and reproduced, but also what we mean, for instance, by cognate concepts such as 'efficiency', equitable distribution and human nature itself. Indeed, rather than acting as a second-order issue, theories of value can also shape (and constrain) the futures that we articulate and imagine, given that they inform our awareness of what is important, how we should act and the policies that we prescribe for achieving social-ecological transformations. For instance, the consequences of following the eight different theories screened here range from 'getting the prices right' for atomised ecosystem *goods* and *services* and focusing

eco-efficiency, to recognising the ecological connections that exist in nature as a whole, independent of a human valuer; from highlighting capital's exploitative appropriation of natural conditions (Burkett, 2003), to adhering to the laws of thermodynamics and striving for a post-material lifestyle.

In addition, though, given the power of theory to prescribe and proscribe our behaviour, it becomes crucial to expose theories that inhibit transitions to just and sustainable futures. Therefore, recognising that marginal utility theory has fuelled what Daly referred to as *growthmania* and thus provided the very rationale for a CE that is more than a mere cipher, then the theories of value we have highlighted provide guidance and inspiration for the transition to alternative futures that go beyond the limited horizons of circular modernism. In so doing, these theories can help fully define the "true north" that Bauwens et al. (2020, p.11) suggest their four futures provide and "steer society away from less desirable scenarios". As a result, we would argue that far from viewing theories of value as a dusty relic at the back of the drawer, the new and emerging concept of the CE should recognise the value of value theory not just in helping to fully articulate the futures that we aspire to design, but also thereby persuading people that these futures are worth striving for.

Nonetheless, any discussion of theory at the current moment in history when we are in the midst of a pressing environmental emergency risks the charge of engaging in ephemera rather than consequential, practical action. In this context, perhaps what the current research also indicates is that whilst theory is not transhistorical (i.e. it is borne of a particular moment in time), we are already in possession of a great cannon of value theory that can inspire action towards a wide range of (what some might consider) positive futures that we can already envisage. Therefore, perhaps more theory and theoretical evolution is not immediately necessary; perhaps we need to be working from a recognition that elements of different scenarios and how we achieve them may be compatible with multiple aspects of the existing theoretical toolkit. As a result, the future may be best defined not by value monism, but increasingly by a practical realisation that we can draw on multi-dimensional values (with multiple numeraires), and thereby incorporate different stakeholder perspectives and encourage methodological pluralism in the shift to an ambitious circular future (Lockwood, 1997; Martinez-Alier et al., 1998).

6. Conclusion

The transition to a CE is often assumed to be both free of challenges and controversies, and synonymous with an eco-modernist and techno-optimistic perspective which is, accordingly, advanced in technical and apolitical terms. However, as compellingly described by Bauwens et al. (2020), the CE is best understood as an umbrella term that might come to define contrasting visions of sustainable development. These visions (or futures) will likely have very different social and economic foundations, but this has often been neglected in the CE research conducted to date, and this includes how theories of value might contradict or enable these scenarios. Therefore, this conceptual paper has sought to articulate the potential congruence between the principal theories of value in mainstream and heterodox economics – the neoclassical approach based marginal utility theory, theories of value emanating from the classical tradition, Sraffa's Neo-Ricardian model of price determination, and theories of value based to varying degrees on energy flows – and different visions of the CE.

We hope that the brief outline presented prompts further inquiry into competing conceptions of a circular future and a recognition that circular futures are themselves VAIs that implicitly adhere to a conception of value even if this is not explicitly acknowledged. However, we suggest that this inquiry should commence from an understanding of value theory given that this goes to the heart of how societies evaluate trade-offs between environmental, social and economic goals, and thus has the potential to question the very foundations of the societies we wish to create.

The conceptual developments included in this paper suggest multiple avenues for further research. First of all, efforts could be devoted to combining some of the most promising theories of value presented in this paper, in order to develop multi-criteria and multi-dimensional approaches, which could be even more suitable for assessing and guiding the transition towards ambitious circular futures. Also, the wide implementation of CE initiatives in different contexts offers an opportunity to test future developments in the field of value theory through empirical studies directed towards analysing policy options. This would be aligned to the recommendation provided by Patterson (1998), regarding the need to relate theories of value to practical applications.

CRediT authorship contribution statement

Benjamin H. Lowe: Conceptualization, Writing – original draft, Writing – review & editing, Project administration, Visualization. **Andrea Genovese:** Conceptualization, Writing – original draft, Writing – review & editing, Project administration, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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