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Restoring the holistic circular economy for socio-ecological equilibrium with Boulding

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Introduction

All too often, circular economists imply the novelty of their approaches, forgetting that for most of human history, customary cultures worked organically with implicit circular economies. More recently the literature mostly disregards the original conception generated and named within a holistic vision aiming at a socio-ecological equilibrium. This concept goes back at least half a century, to Kenneth Ewart Boulding (1966, 1972), at the time of the first public awareness of the planetary impact of economic activity — notably with *Silent Spring* (Carson, 1962). “This will be a small, closed, limited, planetary society, almost certainly dependent on solar energy for its inputs or power, and it will have to recycle virtually all its materials into a circular economy, in which the dumps become the mines” (Boulding, 1972, p. 22-23). We will call this founding circular economy the holistic circular economy for socio-ecological equilibrium (HCE-E).

Across the next half century, this Boulding’s HCE-E has been disregarded. Firstly it has been disqualified, both by economists and ecologists, for its mistake of ignoring the second entropy law identified at the same time by Georgescu-Roegen (1971). This law shows that, as for energy, material is disintegrating gradually, at each usage, thus it can be indefinitely recycled (Pearce & Turner, 1990; Spash, 2013). Secondly, it has been criticised by economists, as it questioned the growth’s logic of the conventional economy. Thirdly, it was unacceptable for many ecologists, as it was expressed in an economist perspective, dealing with capitals, even natural ones. Furthermore Boulding had then been reproached for not participating enough in the debate between steady state and degrowth (Spash, 2013).

Thus, even if HCE-E was anchored in an ecological and holistic vision of the future, Boulding failed to convince, in his time, when the ecologists were about stating the impact of the economic activity on nature, facing the economists’ active resistance. These efforts took nearly half a century before the environmental impact of economic activity was finally taken for granted (Savy et al., 2019).

In the meantime, Boulding’s work was reappropriated by the theorists of the economy of resources and environment, stripped from his holistic and ecological vision, into an economic concept for growth. Focused on maintaining the classical growth economy, but taking care of the renewal capacities and staying within the Earth capacity of assimilation, this economic trend proposed to mobilise innovation technologies of substitution (Faucheux & Noël, Jean-François, 1995, p. 45). Thus, when issues of resource scarcity and waste management appeared, Pearce and Turner (1990, p. ch2)

denuded the Boulding's HCE-E from its holistic and ecological vision, so they accused him of considering "environment as a waste sink", because of its mistake about the second entropy law. Then, they reinterpreted and reappropriated the concept in intensifying the "flows of material and energy", adding material valorisation in energy – maybe the worst downcycling process, clearly not circular. Despite their criticism to Boulding, they assigned to the environment an instrumental role for the economy, as assimilator of waste, supplier of resources, and also of directly usable well-being. Then Braungart and Mc Donough (2002) reappropriated the "dumps become mines" (Boulding, 1972) into "Cradle to Cradle™", a technical loop's trade mark.

Finally, in the 2010s, this new circular economy of optimisation presuming economic growth, mostly technical, always fragmented, started to receive an increasing attention. It was adopted in Asia and Europe, with a framework law in China since 2008, and was promoted worldwide by the Ellen McArthur Foundation (2012, 2013, 2014) aiming at decoupling economic growth from environmental impacts. We will call this new circular economy, the fragmented and technical circular economy for growth (FCE-G).

However, at the end of this half century, even if the present literature is mainly focused on the FCE-G, the circular economy definition is still in debate (Savy et al., 2019). Kirchherr et al. (Kirchherr et al., 2017, 2023) with 95 different definitions in 2017, then 221 definitions in 2023. The present literature mainly focused on the FCE-G. Some more radical papers are advocating a more holistic and less technical circular economy (Friant et al., 2020). FCE-G is criticised for having a limited conceptual grounding, and a lack of consistency on how it can contribute to sustainable development. It is argued that sustainability has neither been integrated into this FCE-G application in practice, nor as persistent in research (Velenturf & Purnell, 2021). A recent trend calls for a sustainable and systemic approach, but remains in a still fragmented, and mostly technical perspective, focusing on technical loops, mostly limited to the reuse and recycling ones, neglecting the others, reduction and recovery (Kirchherr et al., 2017, 2023). Notably, the recent literature on the systemic approach of circular economy highlights the lack of social dimension and calls for cooperation, interdisciplinarity, for a societal change (Savy, 2023).

In this context, the purpose of the present communication is to restore the ontological principles of this HCE-E of Boulding, to explain why they are crucial for a sustainable circular economy, and to propose ways towards such a holistic circular economy, with the Minimalonomics (Sarkar, 2022) and the circles of sustainability approach (James, 2022).

1-The ontological principles of the Boulding's circular economy

The HCE-E grows roots in the multidimensionality of its founder, Kenneth Ewart Boulding. Boulding was born in 1910 at Liverpool, and died in 1996 in Colorado. He has an interdisciplinary knowledge, having studied chemistry, politics, philosophy and economy, at Oxford, Chicago, Harvard and Edinburgh. He became a well-known professor in the USA, in economics, politics, pacifist research, and human sciences. He was also an activist pacifist quaker. Thus, the HCE-E emerged from the Boulding's holistic and ecologic perspective of the world, criticising the growth logic of the classic economy, and leading to his interdisciplinary general theory of systems.

Holistic perspective leading to a socio-ecological equilibrium

The HCE-E comes from Boulding's holistic perspective of the world, with different levels of systems, open to each other, necessarily in a dynamic of exchange to maintain a dynamic equilibrium, in the closed global system of the planet. Boulding places the sphere of the economics – the “set of all objects, people, organisations, and so on, [...] of the system of exchange” (Boulding, 1966, p. 3) – within the biosphere – “the sphere of the man and his activities” (Boulding, 1968a, p. 1). Boulding argues that the biosphere also consists of three other spheres: the spheres of materials, of energy, and of knowledge – “the whole cognitive structure, which includes valuations and motivations as well as images of the factual world” (Boulding, 1966, p. 5). The sustainability of the biosphere results from the interactions' dynamic between these four spheres. Boulding argues that “at some point. [...] we must get [the notion of ecological equilibrium] across that society is a great pond, and just as in a pond fish, [...] all interact to form a reasonably stable equilibrium of populations” (Boulding, 1968a, p. 3).

Economic system as the human part biosphere's system of exchange

The problem is that the sphere of economy disregards its systemic condition as a part of the biosphere, in aiming at growing, instead of the biosphere's equilibrium. Realising his systemic condition, human “man must find his place in a cyclical ecological system which is capable of continuous reproduction of material form even though it cannot escape having inputs of energy” (Boulding, 1966, p. 7-8). To remain the systemic condition of the economic system in a closed biosphere, Boulding warned about the limited reservoirs of anything, either for extraction or for waste. As the recklessness, exploitative and violent behaviour in “cowboy's dream of illimitable plains”, that is not compatible with a closed biosphere (Boulding, 1966): “the existing type of linear economy, which runs from mines to dumps, cannot go on forever” (Boulding, 1972, p. 22-23). He called for a closed or “spaceship” or circular economy, in which the Earth has been regarded as a single spaceship, with limited resources. It means the necessity for treating resource-use as cyclical, that we “will have to recycle virtually all its materials into a circular economy, in which the dumps become the mines” (Boulding, 1972, p. 22-23).

Growth economic system cannot lead to a socio-ecological equilibrium

The systemic perspective of Boulding makes him one of the first institutionalist dissidents of the classical economics, in questioning the logic of growth production leading to necessary growth consumption (Boulding, 1945, 1949, 1957). He argues that “it is the capital stock from which we derive satisfactions, not from the additions to it (production) or the subtractions from it (consumption) [...] the objective of economic policy should not be to maximise consumption or production, but rather to minimise it, i.e. to enable us to maintain our capital stock with as little consumption or production as possible” (Boulding, 1949, in Daly, 1981). Boulding was notably critical of the concept of planned obsolescence, waste involved with it and how our obsession with production and consumption excludes the state's role on regulation of durability of products. Thus, Boulding's vision of a closed circular economy projected a steady-state process away from consumerism, towards a socio-ecological dynamic equilibrium (Boulding, 1966).

Circular economy to maintain and enrich biodiversity with human well-being

Boulding notes that a linear economy is led by the growth of production with the gross domestic product (GDP) as success factor. Instead of no sustainable growing of consumption to expand production, Boulding proposes a circular economy. A circular economy's system of exchange is led by maintaining environmental biodiversity, including the social well-being. Boulding's circular economy is a "system of exchange" where "throughput [... is indeed ...] to be minimised [. Its] success [is...] measured by the nature, extent, quality, and complexity of the total stock [including human well-being] (Boulding, 1966, p.8). Even if he made the mistake of the possibility of recycling material indefinitely, his concept was completely anchored in a frugal perspective, non-compatible with a growth economy.

Societal transformation and the role of knowledge

Reintroducing the integration of the economic system, in the sociosphere, Boulding argues that going towards this spaceship economy, implies a deep societal transformation. "... mankind will face a fundamental transition" (Boulding, 1972, p. 22-23). The reason why is that "the kind of organization, ethic, and conduct which may be quite appropriate to a great plane are quite inappropriate for the crowded and precarious conditions of a spaceship" (Boulding, 1968b, p. 321). Thus, this fundamental transformation to HCE-E, he called for, relies on the entire society, including the future generations, their rights, and their welfare. And the way to do that "is to point out that the welfare of the individual depends on the extent to which he can identify himself with others, [...] not only with a community in space but also with a community extending over time ..." (Boulding, 1966, p. 10).

Sharing information and systemic interdisciplinary thinking to make the change

Finally, Boulding argues that knowledge and sharing information are crucial in the society of a circular economy. He proposes that the knowledge should replace the GDP as the main indicator of human development. "The cumulation of knowledge, [...] is the key to human development of all kinds, especially to economic development" (Boulding, 1966, p.8). This system of knowledge exchange is also crucial for the multiple and complex interactions implied for a HCE-E.

Indeed, this complex HCE-E calls for systemic thinking more than disciplinary thinking. Thus, assessing that "... sociosphere itself is a unity, and offers a single system to be studied. [...] with] different social scientists [studying] from different points of view" (1968a, p. 1), Boulding proposed "... a framework of general theory to enable specialist to catch relevant communications from others" (Boulding, 1956, p.199). Thus, Boulding relied on sharing systemic knowledge in order to change the logic of human development, from material growth, towards biodiversity and well-being growth, by means of interdisciplinarity.

These ontological principles of the Boulding's HCE-E are particularly relevant in the contemporary world and the further development of modern consumption theory. Above all, they are crucial to understand that a FCG-G can't be sustainable.

2- No-growth and holistic circular economy towards sustainability

Since the industrial revolution, mass production and mindless consumption have been amplified in an exponential rate (Andrews, 2015). Now that the impact of the economic activity on Earth is recognised, efforts to repair and recycle are emerging with a FCE-G. The popular concept of ‘resource efficiency’ could not demonstrate any convincing evidence of both producers and consumers making significantly lesser use of resources (Schröder et al., 2019). So it is necessary to radically reduce the consumption per capita of global resources within the planet’s carrying capacity (Suárez-Eiroa et al., 2019, 2021), especially in developed countries responsible for disproportionate overconsumption of natural resources (Wiedmann et al., 2020). However, FCE-G stays in perspective of economic growth implying increasing consumption, that is essentially incompatible with sustainability.

Economic growth and technology can’t lead to sustainability

The Pearce and Turner’s FCE-G resonated with one of the Brundtland report’s principles (1987), arguing that the economic growth could go hand in hand with improvement of environmental resources. Nowadays, FCE-G is predominantly perceived as a manner to maximise economic and environmental benefits, by means of technical solutions, and mostly recycling (Korhonen et al., 2018). Though Georgescu-Roegen (1971) shows – as we saw before – that recycling can’t be infinite. Then Grosse demonstrates that, recycling, whatever its rate, can only save time – some decades, maybe a century, but not more–, and only if GDP doesn’t increase more than 1% per year (2010, 2023). Thus, it’s clear that recycling cannot make a growth economic system sustainable (Schröder et al., 2019). Moreover, FCE-G aims at adding reverse material flows to the economy, and cost saving by ecofriendly measures may lead to more consumption (Bocken & Short, 2016; Chitnis et al., 2013; Velenturf et al., 2019).

However, the FCE-G hardly recognises changing consumption patterns, staying focused on technological development. Thus, instead of leading to sustainability, it could reinforce the myth of indefinite economic growth (Kirchherr et al., 2017; Korhonen et al., 2018). Therefore, neither a growth economic system, nor technology, can lead FCE-G towards a sustainable socio-ecologic dynamic equilibrium.

A necessary holistic change of the socio-ecological system

Brundtland (1987) established interdependencies between the environment, society and economy, with eradication of poverty as a prerequisite for preventing ecological disaster. She argued that in high-income countries, education, and public participation must change the social values and attitudes, to address resource-guzzling lifestyles, and preserve the biosphere. Thus, it is not technology but rather social interventions that are the prime drivers for change. Indeed, reducing waste generation and natural resource’s extraction are expected to benefit humans and the ecosystem, but social benefits are often limited to generating employment (Stahel, 2016).

However, FCE-G is paying primary attention to economic perspectives, and overlooking environmental quality, but hardly addressing social equity to the benefit of current and future generations (Atanasovska et al., 2022; Geissdoerfer et al., 2017; Kirchherr et al., 2017; Valencia et al., 2023; Velenturf & Purnell, 2021). A transformation leading to a socio-ecological equilibrium needs a holistic approach, not only fragmented technological cycles, because the entire society is concerned. It is

important to alter value framework of FCE-G by addressing the changing social values and emphasising on societal preferences.

Finally, to be sustainable, a transition towards a circular economy needs changes, from various stakeholders towards an economically viable (as compared to cheap primary materials), technically realistic (efficient resource recovery), socially fair, and ecologically sustainable sociosphere. It requires a paradigm shift from FCE-G towards HCE-E, widening its present scope from mere closed-loop recycling, short-term monetary gains, and optimisation to maintain the myth of a growth economy, to inclusive social well-being, rich biodiversity and environmental quality.

3-Ways towards a holistic circular economy for ecological economics

Today, FCE-G must move to a holist and no-growth HCE-E. Some more radical theorists have drawn some leads of this model. Friant et al (2020) have called them the transformative circular society. However, there are few models that have been developed so far to make the change from FCE-G to HCE-E. Actually, driving this complex change is not easy, notably in front of the heavy, even violent, resistance of a powerful system structured to maintain itself.

Self-organizing transition governance

The trend of transition governance (Loorbach, 2007) shows that a societal transformation for sustainability, implying to rebuild our system as a whole, can't be piloted by our institutions. Instead of changing the system they belong to, directly concerned by its dismantling, institutions tend to maintain themselves and the system. This societal transformation for sustainability emerges from self-organising forces. Hebinck et al., (2022) suggest a pilotage through arenas, distinct from the institutions – State or market–, gathering the multiple stakeholders in each local situation. These members, engaged and experimented to this transition must act in a self-organising way, instead of hierarchically leading, to prevent from institutions resistance. They should take the decision, led by the aim of the sustainability change, to choose and support the sustainable initiatives, and help them to aggregate themselves, in bottom-up movements.

Circles of Sustainability's approach

James observes that FCE-G, as defined by Korhonen et al. (2018), is still a “linear [but more complex] ... throughput flow [..., a] pseudo-holism in equilibrium-based approach [...] that remains in the hegemonic paradigm of neoliberal economics” (2022, p. 1214). James argues that “an alternative conception of circular economy needs to be embedded as social as a whole” and a “full deliberative assessment” is necessary at the “four main phases in the movement of goods – production, exchange, consumption and reproduction” FCE-G diagram of Korhonen or Ellen Mc Arthur's (2022, p. 1216). James proposes, at each phase, to add “interrogative circles” about the four main dimensions of a social life – ecologic, economic, politic and cultural – “working through questions of how the circular economy will contribute to social [...] living well”. This interrogative circle opens some subdomain's dialogic themes about practices, with as examples: for economics, production & resourcing, or labour & welfare; for ecology, material & energy, or habitat & settlement; for politics,

organisation & governance, or ethics & accountability; and for culture, identity & engagement, or emotional wellbeing & health. Moreover, James proposes to mobilise the system dynamics' method of sustainability assessment to guide complex production/reproduction project, relating the four phases to the use of resources – water, energy, materials and labour (Forrester, 1969). And he proposes another further step, in using the DPSIR model, identifying the driving forces, pressures, states, impacts, and responses that are relevant to the project (Hettelingh et al., 2009).

Minimalonomics

Sarkar (2022) observes the total lack of sustainability dimension, of the FCE-G, leading to an economic growth perspective. He notices that material, energy and water prints are just increasing heavily, because of hyper-consumption, increased by planned obsolescence. Moreover, he observes the limits of “repair, reuse, refurbish, and recycling”, their needs for more energy, plus the lack of efficient regulation, and the lack of proof that FCE-G can decouple the economic growth from its ecological impact. Thus, Sarkar identifies the threat of a FCE-G, as a worrying continuation of linear economy, “[perpetuating] a belief in indefinite economic growth [...] without questioning the role of the neoliberal growth philosophy” (2022, p. 4). Therefore, Sarkar proposes to reintegrate the FCE-G in sustainability, towards what we call a HFC-E. To do so, he mobilises the de-growth, sustainable perspectives, and minimalism, of the ecological economics' trend. Finally, he mobilises the soft nudges of behavioural economics, and experimental methodology to lead the transformation, towards this global concept, the Minimalonomics.

Conclusion

This communication has restored the holistic circular economy for socio-ecological equilibrium with Boulding. It has shown the necessity for a sustainable circular economy to move away from a growth economy's logic and adopt a holistic approach aiming at a socio-ecological equilibrium. It has proposed some leads to move from FCE-G towards HCE-E. In doing so, it contributes to the post-growth and transitions studies literatures, and calls for further research, to develop this avenue on a sustainable circular economy. Field research could be developed, to show how self-organising initiatives are already working in this direction, and may have been for a long time (Sarkar, 2022; Savy, 2019). More research is also needed about the future, the welfare of this generation and the next, questioning time-discounting, and uncertainty-discounting (Rodríguez et al., 2020).

Research may also be developed on education as Boulding worried about: “... when we have something to teach, who will teach the teachers? ” (Boulding, 1968b, p. 321). It's a challenge especially to “develop an image of the world system which is at the same time realistic and also not so threatening to the folk cultures within which the school systems are embedded, so that they will revolt and seek to divert formal education once again into traditional channels ...” (Boulding, 1968b, p. 319).

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References

- Andrews, D. (2015). The circular economy, design thinking and education for sustainability. *Local Economy: The Journal of the Local Economy Policy Unit*, 30(3), 305-315. <https://doi.org/10.1177/0269094215578226>
- Atanasovska, I., Choudhary, S., Koh, L., Ketikidis, P. H., & Solomon, A. (2022). Research gaps and future directions on social value stemming from circular economy practices in agri-food industrial parks: Insights from a systematic literature review. *Journal of Cleaner Production*, 354, 131753. <https://doi.org/10.1016/j.jclepro.2022.131753>
- Bocken, N. M. P., & Short, S. W. (2016). Towards a sufficiency-driven business model: Experiences and opportunities. *Environmental Innovation and Societal Transitions*, 18, 41-61. <https://doi.org/10.1016/j.eist.2015.07.010>
- Boulding, K. E. (1945). The consumption concept in economic theory. *The American Economic Review*, 35(2), 1-14.
- Boulding, K. E. (1949). Income or welfare. *The Review of Economic Studies*, 17(2), 77-86. <https://academic.oup.com/restud/article-abstract/17/2/77/1567378>
- Boulding, K. E. (1957). *Institutional Economics—A new look on Institutionalism*. 47(2, Papers and Proceedings of the Sixty-eighth Annual Meeting of the American Economic Association (May, 1957)), 1-12.
- Boulding, K. E. (1966). The Economics of the Coming Spaceship Earth. In *In H. Jarrett (ed.) Environmental Quality in a Growing Economy* (Johns Hopkins University Press, p. 3-14).
- Boulding, K. E. (1968a). Education for spaceship Earth. *Social Education*, 32(7), 316-323.
- Boulding, K. E. (1968b). What Can We Know and Teach About Social Systems? In *Social Science Education Consortium Newsletter*. Social Science Education Consortium, Inc. <https://eric.ed.gov/?id=ED041792>
- Boulding, K. E. (1972). The Future of Personal Responsibility. *American Behavioral Scientist*, 15(3), 329-359. <https://doi.org/10.1177/000276427201500303>
- Brundtland, G. H. (1987). *Our common future world commission on environment and development*. <http://ir.harambeeuniversity.edu.et/bitstream/handle/123456789/604/Our%20Common%20Future%20World%20Commission%20on%20Environment%20andDevelopment.pdf?sequence=1&isAllowed=y>
- Carson, R. (1962). *Silent spring* (Penguin Books).
- Chitnis, M., Sorrell, S., Druckman, A., Firth, S. K., & Jackson, T. (2013). Turning lights into flights: Estimating direct and indirect rebound effects for UK households. *Energy policy*, 55, 234-250. <https://www.sciencedirect.com/science/article/pii/S0301421512010531>
- Daly, H. E. (1981). Reflections on Boulding's 'income or welfare'. *Journal of Social and Biological Structures*, 4(2), 158-162. [https://doi.org/10.1016/0140-1750\(81\)80025-5](https://doi.org/10.1016/0140-1750(81)80025-5)
- Ellen McArthur Foundation. (2012). *Towards the Circular Economy—Vol1- Economic and business rationale for an accelerated transition*. <https://ellenmacarthurfoundation.org/towards-the-circular-economy-vol-1-an-economic-and-business-rationale-for-an>
- Ellen McArthur Foundation. (2013). *Towards the Circular Economy—Vol-2 Opportunities for the consumer goods sector* (p. 112). <https://ellenmacarthurfoundation.org/towards-the-circular-economy-vol-2-opportunities-for-the-consumer-goods>
- Ellen McArthur Foundation. (2014). *Towards the Circular Economy-Vol3- Accelerating the scale-up across supply chains* (p. 41). <https://ellenmacarthurfoundation.org/towards-the-circular-economy-vol-3-accelerating-the-scale-up-across-global>
- Faucheux, S. & Noël, Jean-François. (1995). *Économie des ressources naturelles et de l'environnement* (Armand Colin). Armand Colin.
- Forrester, J. W. (1969). *Urban Dynamics* (Pegasus communications).
-

-
- 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*, *161*, 104917. <https://doi.org/10.1016/j.resconrec.2020.104917>
- Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). *The Circular Economy – a new sustainability paradigm?* *143*(under review), 757-768. <https://doi.org/10.1016/j.jclepro.2016.12.048>
- Georgescu-Roegen, N. (1971). *The Economic Law and the Entropy Process*. Cambridge, MA.
- Grosse, F. (2010). Is recycling “part of the solution”? The role of recycling in an expanding society and a world of finite resources. *SAPI EN. S. Surveys and Perspectives Integrating Environment and Society*, *3.1*. <https://journals.openedition.org/sapiens/906>
- Grosse, F. (2023). Le défi de l'économie circulaire. Pour une nouvelle approche. *Futuribles*, *455*(4), 33-48. <https://doi.org/10.3917/futur.455.0033>
- Hebinck, A., Diercks, G., von Wirth, T., Beers, P., Barsties, L., Buchel, S., Greer, R., Steenbergen, F., & Loorbach, D. (2022). An actionable understanding of societal transitions: The X-curve framework. *Sustainability Science*, *17*(3), 1009-1021. <https://doi.org/10.1007/s11625-021-01084-w>
- Hettelingh, J.-P., De Vries, B. J. M., & Hordijk, L. (2009). Integrated Assessment. In J. J. Boersema & L. Reijnders (Éds.), *Principles of Environmental Sciences* (p. 385-420). Springer Netherlands. https://doi.org/10.1007/978-1-4020-9158-2_19
- James, P. (2022). Re-embedding the circular economy in Circles of Social Life: Beyond the self-repairing (and still-rapacious) economy. *Local Environment*, *27*(10-11), 1208-1224. <https://doi.org/10.1080/13549839.2022.2040469>
- Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, *127*, 221-232. <https://doi.org/10.1016/j.resconrec.2017.09.005>
- Kirchherr, J., Yang, N.-H. N., Schulze-Spüntrup, F., Heerink, M. J., & Hartley, K. (2023). Conceptualizing the Circular Economy (Revisited): An Analysis of 221 Definitions. *Resources, Conservation and Recycling*, *194*, 107001. <https://doi.org/10.1016/j.resconrec.2023.107001>
- Korhonen, J., Nuur, C., Feldmann, A., & Birkie, S. E. (2018). Circular economy as an essentially contested concept. *Journal of Cleaner Production*, *175*, 544-552. <https://doi.org/10.1016/j.jclepro.2017.12.111>
- Loorbach, D. (2007). *Transition management. New mode of governance for sustainable development*. International Books.
- McDonough, W., & Braungart, M. (2002). *Cradle to cradle : Créer et recycler à l'infini*. Alternatives éditions.
- Pearce, D. W., & Turner, R. K. (1990). *Economics of natural resources and the environment*. Johns Hopkins University Press.
- Rodríguez, R. W., Pomponi, F., Webster, K., & D'Amico, B. (2020). The future of the circular economy and the circular economy of the future. *Built Environment Project and Asset Management*, *10*(4), 529-546. <https://doi.org/10.1108/BEPAM-07-2019-0063>
- Sarkar, A. (2022). Minimalonomics: A novel economic model to address environmental sustainability and earth's carrying capacity. *Journal of Cleaner Production*, *371*, 133663. <https://doi.org/10.1016/j.jclepro.2022.133663>
- Savy, A.-C. (2019). *How transition towards circular economy is organising? Experience of a collective of alternative organisations [Quel mode d'organisation pour la transition vers l'économie circulaire? L'expérience d'un collectif d'organisations alternatives]*. <https://ideas.repec.org/p/hal/journal/hal-02556201.html>
- Savy, A.-C. (2023). L'apport de Boulding à une transition systémique vers une économie circulaire. *Congrès du RIODD 2023-Changer ou s'effondrer?* <https://hal.science/hal-04256728/>
-

-
- Savy, A.-C., N'diaye, M., & Kessari, M.-E. (2019). Le dispositif français de transition vers l'économie circulaire institutionnalise-t-il un concept? Une analyse transversale de discours. *Technologie et innovation*, 4(2), 1-25.
- Schröder, P., Bengtsson, M., Cohen, M., Dewick, P., Hofstetter, J., & Sarkis, J. (2019). Degrowth within—Aligning circular economy and strong sustainability narratives. *Resources, Conservation and Recycling*, 146, 190-191. <https://www.sciencedirect.com/science/article/pii/S0921344919301429>
- Spash, C. L. (2013). *The Ecological Economics of Boulding's Spaceship Earth*. Institute for the Environment and Regional Development - Vienna; SRE discussions.
- Stahel, W. R. (2016). Circular economy: A new relationship with our goods and material would save resources and energy and create local jobs. *Nature Publishing Group*, 531, 435-438.
- Suárez-Eiroa, B., Fernández, E., & Méndez, G. (2021). Integration of the circular economy paradigm under the just and safe operating space narrative: Twelve operational principles based on circularity, sustainability and resilience. *Journal of Cleaner Production*, 322, 129071. <https://doi.org/10.1016/j.jclepro.2021.129071>
- Suárez-Eiroa, B., Fernández, E., Méndez-Martínez, G., & Soto-Oñate, D. (2019). Operational principles of circular economy for sustainable development: Linking theory and practice. *Journal of cleaner production*, 214, 952-961. <https://www.sciencedirect.com/science/article/pii/S0959652618340009>
- Valencia, M., Bocken, N., Loaiza, C., & De Jaeger, S. (2023). The socioeconomics of the circular economy. *Journal of Cleaner Production*, 137082. <https://doi.org/10.1016/j.jclepro.2023.137082>
- Velenturf, A. P. M., Archer, S. A., Gomes, H. I., Christgen, B., Lag-Brotons, A. J., & Purnell, P. (2019). Circular economy and the matter of integrated resources. *Science of the Total Environment*, 689, 963-969. <https://doi.org/10.1016/j.scitotenv.2019.06.449>
- Velenturf, A. P. M., & Purnell, P. (2021). Principles for a sustainable circular economy. *Sustainable Production and Consumption*, 27, 1437-1457. <https://doi.org/10.1016/j.spc.2021.02.018>
- Velenturf, A. P., & Purnell, P. (2021). Principles for a sustainable circular economy. *Sustainable Production and Consumption*, 27, 1437-1457. <https://www.sciencedirect.com/science/article/pii/S2352550921000567>
- Wiedmann, T., Lenzen, M., Keyßer, L. T., & Steinberger, J. K. (2020). Scientists' warning on affluence. *Nature communications*, 11(1), 3107. <https://www.nature.com/articles/s41467-020-16941-y>
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