Framework for “Circularity by Design”

D1.1

dr V. (Vivian) Valencia, K.V. (Kari) Koppelmäki, dr O. (Oona) Morrow,
A.G.M. (Anke) de Vrieze MSc, dr C.P.A. (Coen) van Wagenberg, drs O.M.C. (Olga) van der Valk

WAGENINGEN
UNIVERSITY & RESEARCH

Framework for “Circularity by Design”

D1.1

Authors: Dr V. (Vivian) Valencia, K.V. (Kari) Koppelmäki [1], dr O. (Oona) Morrow, A.G.M. (Anke) de Vrieze MSc[2], dr C.P.A. (Coen) van Wagenberg, drs O.M.C. (Olga) van der Valk[3]

Institute: 1- PSG Farming Systems Ecology, 2- SSG Rural Sociology, 3- Wageningen Economic Research

This study was carried out by Wageningen University & Research, subsidised and funded by the Ministry of Agriculture, Nature & Food Quality and commissioned by the Investment Theme Connected Circularity.

Wageningen University & Research
Wageningen, April 2022

Public

Report 2276
DOI 10.18174/567904

WAGENINGEN
UNIVERSITY & RESEARCH

WFBR Project number: 6234182100
BAPS number: KB-40-004-001
Version: final
Reviewer: dr H.E.J. (Hilke) Bos-Brouwers
Approved by: dr.ir. H. (Henk) Wensink
Client: Wageningen University & Research
Commissioned and funded by: Investment Theme Connected Circularity
This report is: Public

The research that is documented in this report was conducted in an objective way by researchers who act impartial with respect to the client(s) and sponsor(s). This report can be downloaded for free at https://doi.org/10.18174/567904 or at www.wur.eu/wfbr (under publications).

PO box 17, 6700 AA Wageningen, The Netherlands, T + 31 (0)317 48 00 84, E info.wfbr@wur.nl, www.wur.eu/wfbr.

Contents

Summary **4**

1 Introduction **5**

2 Towards a circular society **8**

2.1 Socializing the Circular Economy 8
2.1.1 Cultural Change 8
2.1.2 Justice and Equity 9
2.1.3 Governance and Institutions 9
2.2 Circular economy requires a systemic approach 11
2.3 A transition to a circular economy requires interventions at deep leverage points 12
2.4 A framework for designing a circular society based on the "doughnut" and a "food systems approach" 13
2.4.1 The doughnut economy 13
2.4.2 A food systems approach 15
2.4.3 Deep leverage points: strategies for systemic transition towards a circular economy 16
2.4.4 Two examples of deep leverage points: Public procurement and "Orchestrators" 16

3 Next steps **18**

Literature **19**

Summary

The Circularity by Design flagship project of the WUR Investment Theme "Connected Circularity", aims to demonstrate the feasibility of circularity by design (CbD) concept within the context of the greater Amsterdam Metropolitan Area. An important dimension within CbD is governance at urban and challenge level. In this report, we propose a radical approach to circularity by adopting the concept of a *circular society*, and introducing the concept of the deep leverage points that are needed for systemic change. To make the transformation towards a regenerative society happen, mental models and paradigms need to change, and equity and redistribution of wealth promoted. Systemic changes, -transition-, by definition require radical changes in the way we view the world and take for granted how it currently functions. Such change goes beyond technological fixes; and touches our value and belief system. These socio-cultural aspects are mostly lacking in current discourses on circular economy. The concept of deep leverage points refers to slower but more rooted and impactful changes in society. Thus the term "design" entails the governance of processes towards circularity rather than circularity itself. We root *circularity by design* on the integration of three frameworks: the doughnut economy, a food systems approach, and the leverage points scale. The doughnut economy provides a vision for a safe operating space within planetary boundaries that places emphasis not on economic growth but rather on prosperity; while a food systems approach provides a methodology for mapping and navigating the doughnut economy by using a systemic approach and drawing from all dimensions of sustainability—economic, environmental and social. We draw attention to the need for targeting deep leverage points, which focus on design, and require institutional and value changes. Deep leverage points are in contrast with the technical and reductionists fixes (i.e., shallow points) that dominate interventions in the circular economy (CE).

1 Introduction

There is a growing need for circularity in currently disconnected food chains and materials segments (e.g. from agriculture, food processing , consumption, waste, chemicals and materials) and at various aggregation levels. Circularity addresses environmental and sustainability concerns. This requires knowledge on the synergies and trade-offs between individual circular systems to design interconnected circular systems that cross segments and aggregation levels, aiming to ensure optimal use and valorization of renewable biomass resources. 'By design' literally means intentionally and refers to intent, or purpose. The main research question is **how to transition from an urban bio-economy that is linear to circular by design**? Circularity is an attractive concept for urban areas as it contributes to more resource efficiency (less input and less outputs by better organisation of the system) as well as resilient and sustainable cities that are able to respond to climate change adaptation and mitigation challenges. Circularity by design adds a governance and decision-making dimension to the leading principles of a circular bio-economy (Van Zanten et al., 2019), which are currently mainly focussed on resources. It requires a true integrated design to enable the shift from linear (end-of-pipe solutions) to circular (prevention focussed). Circularity by design (CbD) asks us to think about the social as always intertwined with ecology and economy and includes justice, equity, governance and cultural aspects as well as technology and infrastructure. It follows the flows from the food & non-food biomass resources, the intermediate products (or, side flows / residues) that are removed and need to be (re)allocated for food, feed, biomaterials and soil destinations. CbD has a specific focus on the urban environment. We utilise the case of the City of Amsterdam and its circularity challenges to further refine the circular design approach.

Circularity is not an end in itself, but a means to an end. For the city of Amsterdam circularity is a means of becoming "... a home to thriving people in a thriving place, while respecting the wellbeing of all people and the health of the whole planet". The CbD framework begins with asking stakeholders to clarify why they are implementing circular economy approaches, what **intentions and values** undergird their plans and actions and what do they hope to achieve? The decision to foreground intent and design is informed by **deep leverage points** as "*places within a complex system [...] where a small shift in one thing can produce big changes in everything*" (Meadows, 1999). In the next layer, we ask stakeholders to consider the **governance** of their design, to identify who they are designing for or with, who will be impacted, and which stakeholders should be included. In the third and final layer we address in our design process the urban **agri-food system**, where we ask stakeholders to identify which part(s) of the system they are active in and how this effects other parts. At each stage of the design process, we invite stakeholders (the challenge owners) to look beyond their individual challenges, to consider the broader social, governance and food system they are embedded in.

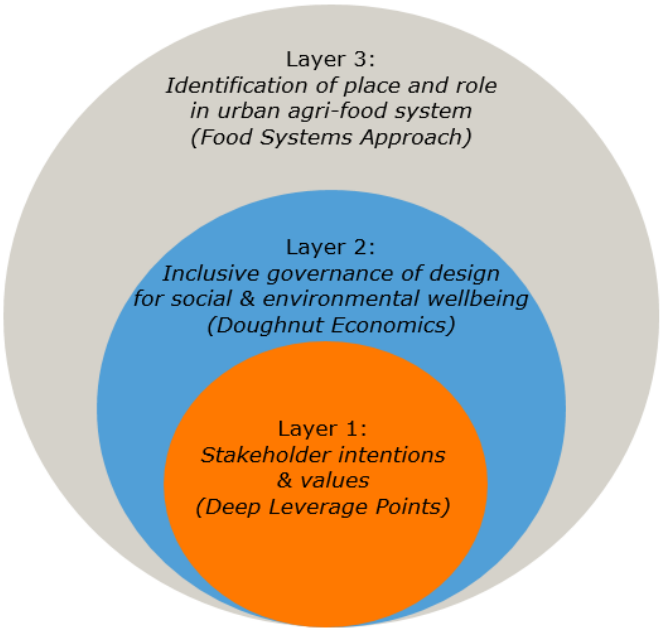

Figure 1 Visualisation of the CbD Framework governance dimension

The concept of circularity begins with acknowledging that the resources of our planet are not limitless, with the implication that transformation from a linear to circular usage of Earth's resources is required. The doughnut theory by Raworth's acknowledges these ecological boundaries (Raworth 2017), combing them with a social foundation to safeguard human basic needs, like food, water and housing, social equity and having a political voice, as set down in the nine United Nations sustainable development goals. This combination of social and ecological boundaries means that an economy that falls short of this minimal 'fair and good life' in some parts of the world, while creating wealth and consumerism for another part, will lead to an ecosystem that is unable to support human life for all generations to come.

The main principle of a sustainable society is its capacity to regenerate nature ecosystems and our position within; with a 're-design' of the socio-cultural systems that determine how we handle and use our social and ecological surroundings.

Merits and gaps of circular economy theories

The concept of a circular economy (CE) was first introduced to address the present and future sustainability of our society and planet. Emerging in response to the failures and shortcomings of linear food systems, CE is based on the principle of closing material and energy loops. Analogue with the definition of circular economy by Kirchherr et al. (2017, p.24), regenerative food systems can be considered "models which replace the 'end of life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations."
Although CE is just catching academic attention, it is not an entirely new concept; it builds on other disciplines such as industrial ecology, environmental science, and ecological economics (Lazarevic and Valve 2017). CE also lacks well-define boundaries, resulting in substantial overlap with other concepts such as Green Economy and Bioeconomy (D'Amato et al. 2017). While linked with a variety of concepts, in practice CE is mainly associated with efficient and sustainable waste management (Merli et al., 2018).

For their relevance for food system transformation and thus the governance framework towards circularity, we address three key gaps in current theories on circular economy. The first is the lack of a moral and ethical component. For rich nations to fit within the boundaries of the safe and just space of natural resources will require that they abandon growth as a policy objective and shift to economic models that reflect societal values (e.g., true pricing). This means that a fully CE is also inherently incompatible with the current economic system, so a circular food system needs reconsideration of normative questions regarding inequal relations and power in global foods systems, global justice, wellbeing and world-wide wealth redistribution (Friant et al, 2020). It is yet unclear how the concept of the Circular Economy will lead to greater social equality, in terms of financial, inter- and intra-generational equity, the promotion of diversity in all its forms, or equality of social opportunity (Murray et al., 2017). One implication is the need to consider cultural, social and political equity in the design of interventions, and the involvement of stakeholders to make this possible.

Second, not considering how socio-cultural systems determine the way we manage our surroundings is an omission repeatedly highlighted as a critical gap in the implementation and analysis of circular economy (Kirchherr et al., 2017; Pla-Julián and Guevara 2019; Merli et al. 2018; Hobson and Lynch 2016; Friant et al., 2020). Regarding society as a social system highlights this need for a systemic approach to understand the complexity of how individuals and their beliefs relate to a whole, be it a community of a global food system. A systemic approach is also conducive to manage the growing complexity and interdependency of the different spheres in society. In this case global food systems, a variety of cultural practices in production and consumptions, affect the wellbeing of urban citizens and the quality of life in rural areas all over the world. A holistic and systemic approach is needed to understand and assess the impacts of interventions towards circularity. To accelerate the transformation towards a circular economy, a governance framework may connect the small wins towards connected circularity through technological, organizational (e.g., reconfiguration of patterns of interaction), behavioral changes (e.g., in underlying norms and values and power structures), market and institutional changes (e.g., innovative business models, new regulatory frameworks). Small wins are building blocks towards transformation as they enable the visibility of achievements towards a shared dream, thus keeping the energy and inspiration alive.

Third and last, in a systemic approach different levels of intervention are considered according to their potential to generate change. Like the iceberg metaphor, interventions can be categorized for their change potential, ranging from a shallow reacting to events to the deepest level of relearning and reframing mental models (Davelaar, 2021). The interventions that can produce the largest and most meaningful societal change (deep leverage points) are also the most complex and most likely to generate resistance. These can take a long time to root, for example one generation. In other words, in order to engage and change the root causes of unsustainability in society in general, and food systems in particular, interventions need to target more powerful areas of change—also known as

deep leverage points—in addition to technical solutions, such as the ones that dominate the current circular economy (Abson et al. 2017). Addressing these gaps is fundamental to ensure that CE gains systemic validity, critical social relevance, and that its claims are achievable on a relevant scale to address the socio-ecological challenges of our times (Friant et al. 2020).

We focus on the three gaps because they carry important implications on efforts to redesign circular urban agri-food systems that are inter-connected and embedded in coherent governance processes that invite social learning. Agri-food systems are complex systems and require a systems approach that considers all activities related to food production and utilization (growing, harvesting, packing, processing, transporting, marketing, consumption and waste), as well as all the actors, activities and feedback among elements (Berkum et al., 2018). Finally, failing to focus on deep leverage points will leave us with interventions with limited potential to drive system wide transformation; currently, most interventions in agri-food systems are based on "shallow" leverage points, which focus on technical fixes, for example, which although important are insufficient (Dorninger et al. 2020).

In response to these shortcomings and gaps, more radical approaches are (re)emerging that argue for a circular economy rooted on "degrowth" in terms of revaluation of economic production and consumption in the wealthiest countries. Amsterdam Metropolitan Area (AMA) exemplifies this paradigm shift by betrothing the concept of circular economy with the "doughnut economy", which acknowledges that economic growth must occur within the constraints of planetary boundaries (Raworth 2017a). Circularity grounded on degrowth and planetary boundaries would complement current overemphasis on technological innovation and economic efficiency with sufficiency and social justice (Hobson et al., 2016). This is aligned with scholars and practitioners' call for a reconceptualization of the circular economy into what is now termed a ***circular society***. A circular society incorporates the circular economy with new concepts of value exchange, and with issues of equity and power. It extends circularity not only to material and energy flows, but also to how wealth, knowledge, technology, and power is circulated and redistributed throughout society (Friant et. al., 2020, p. 19); and it reconceptualizes the role of individuals as citizens in a society rather than simply as consumers in the economy.

In this report, we discuss the gaps in the circular economy concept, Section 2 "Towards a circular society" discusses the three gaps identified: 2.1 discusses the social dimension of CE; section 2.2. requires the need for a systemic approach; and section 2.3 discusses the need for deep leverage intervention points. In section 3, we define, develop and adopt the concept of circular society, propose a framework for circularity by design that moves beyond the circular economy, and discuss its implementation in the context of agri-food systems in an urban region, such as AMA. The purpose of this first report is to focus on the conceptual development of the circularity by design framework, while our next report will focus on the operationalization of the framework in the context of AMA and the Amsterdam living labs.

2 Towards a circular society

2.1 Socializing the Circular Economy

Numerous (missing) social aspects with implications for circular food systems have been identified in the literature. These include the everyday practices and behaviors of consumers and citizens; the ethics, norms, and values that drive economic practices and circular economy transitions; and the institutional and governance arrangements that shape CE agendas, sustainability behaviors, industry practices. There are broader concerns of social equity and intergenerational equity; intersectional social and environmental justice; and concerns about human rights, health, well-being and quality of life (Hobson and Lynch 2016; Murray et al. 2017; Winans et al. 2017; Friant et al. 2020). We address each of these themes below under 2.1.1 Cultural Change, 2.1.2 Justice and Equity, and 2.1.3 Governance and Political Considerations.

2.1.1 Cultural Change

> *"By overlooking social considerations, CE research is proposing a technological path to sustainability that many have criticized for being overly optimistic regarding the speed of technological transitions and the capacity of society to integrate disruptive innovations, which challenge vested interests. (...) This approach also fails to recognize the massive socio-cultural change that a CE entails by transforming consumption and production structures based on materialism, convenience, and ownership to ones based on collaborative consumption, sharing economies and use-value" (Friant et al. 2020, p. 11).*

Everyday social practices and consumption habits have developed around the decades-long 'routine' of 'make, take, and throw away' as normalizing practices that keep our current linear economy in place. Without addressing the socio-cultural dimensions of circularity, the most advanced technical and governance innovations will fail to achieve sustainability transformations (Hobson 2015). A just transition to circular society requires cultural change at all levels of society, from everyday consumption practices that shift from buying and owning to sharing, to deep rooted cultural ideals about what it means to live "a good life" and what consumption levels are sufficient to sustain this ideal (Friant et al., 2020; Holmes 2018). Cultural practices are incredibly diverse and vary from place to place. Without considering these, there is considerable risk of a 're-bound' effect as a result of inadequate interventions (e.g., increased consumption as a result of increased efficiency or lower cost), undoing sustainability gains achieved through circular economy innovations (Hobson 2015). The social practices that underpin our economy, and circular economy, are suffused with ethical and moral concerns about what is good, right, and common sense. They are informed by broader political and ontological concerns about the relationships between humans and nature, including the ethic of care. As Pla-Julián and Guevara (2019, p. 105) observe:

> *"The ethic of care helps to integrate many layers of relationships into our understanding of the environmental dimensions of human security. Through the lens of care the relationship between human beings and the biosphere (macro level) as well as households´ responsibilities (microlevel) that link care to the environment become evident".*

Bringing cultural change into our design and analysis of circular economy therefore requires a critical attention to the social and cultural values *already* embedded in our approaches to economy and circular economy. It also requires being explicit about the cultural values we seek to further, and an evaluation of the uneven impacts of circular economy policies interventions on process of cultural change. Cultural concerns have a particular relevance to realizing a transition to more circular food systems, as a great deal depends on dietary change and the ability of consumers to shift their everyday food practices toward more circular and sustainable routines, tastes, and practices. In the realm of food waste and organic waste, cultural change is also happening. Citizens and consumers shift their routines toward re-using food waste, sharing surplus food, and home and community composting. Cultural shifts in our relations with food and waste are critical for realizing more regenerative loops and keeping food at its highest and best social value.

2.1.2 Justice and Equity

While "equity and social justice can be said to be at the heart of the concept of sustainability" (Murray et al. 2017, p. 367), they remain at the periphery of circular economy practice and science. In their review, Kirchherr et al (2017) find that only 18% of circular economy definitions include social equity considerations. Social equity considerations are relevant to every aspect of circular economy, yet as Murray et al. (2017) write, "it is unclear how the concept of the Circular Economy will lead to greater social equality, in terms of inter- and intra-generational equity, gender, racial and religious equality and other diversity, financial equality, or in terms of equality of social opportunity. (p. 367)"
In circular economy innovations, these justice concerns lead to critical questions about labor conditions in CE enterprises (Pla-Julián and Guevara 2019), and critical conditions about "who controls CE technologies and patents, and how economic benefits should be distributed both within and between countries" (Friant et al. 2020 p. 11). Answering these kinds of questions is necessary to determine "whether CE will lead to more meaningful jobs, closer communities, greater social equity and global solidarity or rather to increased precarity, inequality, and neocolonialism" (Friant et al. 2020, p. 11).

Social equity cannot be an afterthought in circular economy design. Kirchherr et al. (2017) advise that circular economy practitioners, scientists, and policy makers state "social equity as one of its design variables, while starting to research its social equity impacts (p. 228)." This type of research is urgently needed, especially now that the European Commission has committed to a 'just transitions' framework for circular economy transitions as part of the EU Green Deal (EU 2020). Existing research on circular economy innovations in the sharing economy for example has found that 'sharing' resources through platform capitalism has increased inequalities (Schor 2017; Frenken and Schor 2017). These findings suggest that there can be significant inequalities around who leads circular economy innovation, who owns the technology, and how (economic, environmental, and social) benefits are distributed.

Within the literature we found few examples of circular economy innovations and frameworks that explicitly address social equity in circularity. The social circular economy highlights the opportunity for social enterprises in the circular economy, and "aims to inspire people to rethink, redesign and pursue a positive future with the belief that coupling the principles of the circular economy with social enterprise gives the right conditions to foster innovation and creativity, for a world with local solutions to meet societal, environmental and economic needs" (Robinson 2017, p. 2). A related approach is the social and solidarity economy which emphasizes social equity in labor and the governance (Moreau et al. 2017), and therefore encourages business models that can better facilitate this (e.g., social enterprise, worker cooperatives, etc.).

Economic actors in the social and solidarity economy are united around shared concerns and values which emphasize solidarity and mutual aid, placing people and planet before profit. Moreau et al. (2017) argue that "the principles and values put forward in the social and solidarity economy may enable the necessary social and institutional conditions to allow for higher material recovery, toward the desired transition (p. 498)" Equity and justice are already being pursued in the food system, through food aid (e.g. food banks, social groceries, community fridges, food not bombs) and alternative food networks (e.g. solidarity purchasing, community supported agriculture, food sharing, food cooperatives, and social enterprises in the food sector, food justice driven urban agriculture and community gardening, and global food sovereignty movements). While many of these social food projects have circular dimensions, around sharing and reusing surplus food, creating short food chains, composting, or reducing food waste (Davies et al. 2017), they are not often recognized as significant parts of a circular agri-food system.

2.1.3 Governance and Institutions

Merli et al. (2018) argue for "greater attention to strategies for social and institutional change, able to transform the upstream processes of production and consumption (p. 717)." Along similar lines without political reform, the degree of recycling in the economy, as measured in physical terms, will remain low both at regional and global levels." The principles of good practices in public administration

are often not in line with the required tasks from a transition manager (Braams et. al. 2021), missing out on opportunities to consider the social context for the transformation of economy.
Circular economy is being pursued internationally through circular economy policy at regional (e.g., European Commission), national (e.g., the Netherlands, China), and urban (e.g., City of Amsterdam) scales. However, there is very little public discussion, citizen engagement, or debate on how circular economy should be defined and implemented, or how the benefits (and potential burdens) will be distributed to ensure a just transition to circular society. Fratini et al. (2019) observe limited research on social identities, institutions, political transformation, or the active role that public authorities and citizens can take. Institutions are important in governing circular economy transitions because, they can "set the rules of the game, influencing expectations, values and actions, and determining the spectrum of economic activities. Understanding institutions contributes to unfolding knowledge about who bears the costs of externalities; the social (e.g., inequalities) and environmental impacts (e.g., air and water pollution). Institutional structures, particularly legislation, affect profitability and competitiveness, as they "delineate the costs that economic activities must be held accountable for" (Fratini 2019, p. 979). The current lack of attention to institutional conditions is "considered an important barrier to its contribution to socially just and environmentally desirable societal transitions" (Fratini et al., 2019; Moreau et al. 2017; Korhonen et al., 2018).

Cities cannot achieve circular transitions on their own or become isolated closed loop systems removed from their global foodsheds and rural hinterland. However, cities are essential actors in governing sustainability transitions because of their high consumption power, innovation capacity, and political power. They can also test and experiment with circular economy innovations, which may be implemented at a faster pace than changes in consumer behaviors and diets, industry practices, environmental regulations, and agricultural policies. Prendeville et al. (2018) describe a circular city as "a city that practices [circular economy] principles to close resource loops, in partnership with the city's stakeholders (citizens, community, business, and knowledge stakeholders), to realize its vision of a future proof city". Cities have influence over infrastructure and urban design, zoning and land use, public procurement, urban food policy, waste management, and public tender requirements – all of which can contribute to guiding a just circular economy transition to shorten food chains, circular urban and rural farming, and the reuse of urban waste streams. However so far, urban policy makers have relied too much on businesses (and business incentives) to drive implementation, had difficulty involving stakeholders to co-create circular city visions, and placed too great an emphasis on major urban stakeholders and on digital and data driven approaches (Prendeville et al., 2018; Fratini et al., 2019). There is tremendous potential in including citizens as more-than-consumers in a circular economy (Hobson and Lynch 2016), as well as involving grassroots sustainability innovations and civil society actors to co-define the aims and practices of a circular society.

Fratini et al. (2019) point to the important role of sociotechnical imaginaries as "collectively held institutionally stabilized and publicly performed visions of desirable futures". These shared understandings of social order as well as advances in science at technology dictate which circular economy policy "solutions" are imaginable or possible for cities. These sociotechnical imaginaries are shaped by a combination of material infrastructures and social norms, and political institutions. One common barrier to realizing transformative circular economy policies is a deep investment in the discourse of economic growth and efficiency (Hobson and Lynch 2016; Friant et al., 2020; Pla-Julián and Guevara 2019). This ideology comes into tension with social and environmental sustainability. However, this appears to be changing, at least in Amsterdam, where Kate Raworth's "doughnut economics" has been adopted to develop circular economy vision, criteria, and indicators that aim to help the city thrive within ecological limits while addressing social needs (City of Amsterdam, Circle Economy, and Raworth 2020). We see potential in the city of Amsterdam's circular economy strategy (2020-2025) (Gemeente Amsterdam 2020), and discuss these policy ambitions to reduce food waste, shorten food chains, and increase access to healthy and sustainable food in Section 3 "A framework for designing a circular society."

2.2 Circular economy requires a systemic approach

In food systems, several actors are involved and interconnected through activities and processes related to primary production, food processing, distribution, retail and consumption at multiple spatial and temporal scales (Berkum et al., 2018; Koppelmäki et al., n.d.). A reductionist approach, or merely studying the individual parts of the systems, is not sufficient for a system-wide transformation, as it does not recognize the multiple scales of operation and governance, nor the implications of how related biophysical flows and processes are interconnected at the food system level (Koppelmäki, Helenius, and Schulte, under review). Therefore, transformation towards a circular food system, requires a systems approach that recognizes the interlinkages between the ecological systems, infrastructure, and the social systems that make society function. It requires that all stakeholders involved in food system activities and processes participate (Kirchherr et al., 2017; Pla-Julián and Guevara 2019).

A systemic approach is underrepresented in the literature and in the implementation of CE. For example, a recent review revealed that only about 40% of 114 definitions for CE had a system perspective (Kirchherr et al., 2017). In most cases, CE is focusing on the micro perspective such as single products or sub systems of a larger system such as waste management. The need for a more holistic approach to CE is acknowledged by the institutions currently promoting or implementing CE (Sitra 2016; Ellen MacArthur Foundation 2019; European Commission 2020). However, while this need is recognized, most research is still not applying a holistic framework. Thus-far the focus continues to be on the environmental or economic performance of CE without including all three dimensions of sustainability (Geissdoerfer et al. 2017), or only on specific parts of system leading to a fragmented implementation of CE (Geissdoerfer et al. 2017; Kirchherr et al. 2017).

Urban food systems and infrastructures are linear by default, hence implementing CE to address agri-food system impacts is challenging as the options to close loops within the urban area are limited (Papangelou et al., 2020). Understanding how the urban metabolism is interconnected across spatial scales is fundamental to designing circular processes towards more sustainable agri-food systems. Environmental impacts of food production are substantial and are a major driver of the urban ecological footprint, even though the burden of environmental impacts is often experienced in places far from the urban areas where the food is consumed (Imhoff et al. 2004; Goldstein et al. 2017). People's dietary choices have an impact on demand and, therefore, cities can play a role in implementing policy and design interventions that have wide-reaching effects on the broader food systems (Goldstein et al. 2017). Achieving changes in food consumption practices also requires sociocultural change as described in Section 2.1.1 Cultural Change". Changing citizens values in how they engage with food systems is a *deep leverage point* (Section 2.3) with potential of wide system transformation.

More recently, a study by Desing et al. (2020) conceptualized CE using a systems approach. In their framework, a cascading top-down approach is introduced where environment is a non-negotiable layer. The second layer in this framework represents society, which is based on a normative consensus where human dignity and well-being is a goal for any human developed systems. Economy is the last layer and is conceptualized as providing ecosystem services within planetary boundaries (Fig 1). The authors argue that a transition towards a systemic and resource-based CE requires a paradigm shift and changes involving all social actors.

In the context of circular economy, design has mostly been confined to designing processes of individual products or business models (Lewandowski, 2016; EEA, 2017). The paradigm has been to meet the societal demands with new product designs that are required in the transition to CE (EEA, 2017). This requires understanding the links between products, business models, societal contexts and the governance affecting the products lifecycles. However, in addition to technological innovations, which is undeniably an important part of CE, changes in citizens' competencies, practices and world views, must also be changed (Jurgilevich et al. 2016).

2.3 A transition to a circular economy requires interventions at deep leverage points

The major incentives behind many studies and interventions in the circular economy are attaining economic benefits, followed by environmental benefits, whereas social and systemic implications are hardly addressed (Homrich et al. 2018; Geisendorf and Pietrulla 2018). Strategies for social and institutional changes to radically change consumption and production patterns are only marginally included in circular economy practices (Merli et al., 2018). If Europe is to achieve the EU's 2050 vision of living well within environmental limits, it must fundamentally transform its core societal systems of production and consumption, particularly those related to food, energy, mobility and the built environment (EEA, 2017, p. 6). Despite a growing realization of the need for a systemic change towards circular and sustainable urban systems, it is still unclear how to achieve such transformation. It involves a better understanding of how tradeoffs are negotiated and of the different worldviews and values that underpin them. (Angheloiu and Tennant 2020). In this section, we discuss "deep leverage points" to support the design of circular urban agri-food systems.
Sustainability science argues that failures to get on more sustainable trajectories are in large part due to a lack of science and politics engaging with the root causes of unsustainability. Many sustainability interventions—as is the case with interventions in the circular economy—target highly tangible but essentially weak leverage points (i.e., interventions with limited potential for transformational change).

We draw from the "leverage points" framework (see figure 2), that is inspired by systems thinking and focuses on transformational interventions (Meadows 1999; Abson et al. 2017; Fischer and Riechers 2019). This framework proposes that interventions for systemic change should target four leverage points: parameters, feedbacks, design and intent (Abson et al. 2017). Parameters are modifiable, mechanistic characteristics such as taxes, incentives and standards, or physical elements of a system, such as sizes of stocks or rates of material flows. Feedbacks are the interactions between elements within a system that drive internal dynamics (e.g., dampening or reinforcing feedback loops) or provide information regarding desired outcomes (e.g., effectiveness of a given incentive scheme). Design relates to the societal structures and institutions that manage feedbacks and parameters, such as information flows, rules, and power. Intent relates to the norms, values, goals, and world views of actors in a system of interest that shape the direction to which the system is oriented.

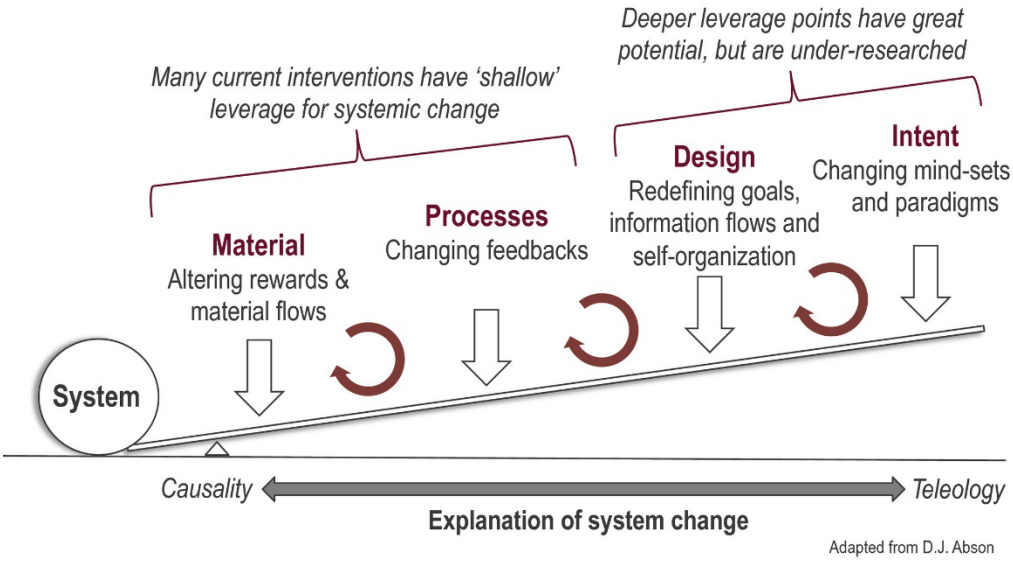

Figure 2 Deep leverage points (source: Fischer and Riechers, 2019)

Parameters and feedbacks are so-called **shallow leverage points**, or places where interventions are relatively easy to implement yet bring about little change to the overall functioning of the system. Design and intent are so-called **deep leverage points**, which might be more difficult to alter but potentially result in transformational change. Interventions that only involve shallow leverage points

are unlikely to bring transformative change if system characteristics remain unchanged (Dorninger et al. 2020). Only interventions that focus on both shallow and deep leverage points have the potential to bring about transformative change (Fischer and Riechers 2019). To initiate system wide transformative change, the goals of a system, its intent, and rules need to be addressed directly. In the circular economy, most efforts focus on closing material and energy loops and improving efficiency and performance—examples of shallow leverage points, e.g., parameters and feedbacks. Deep leverage points aim at changes in the socio-economic system of production and consumption. These include intent, - norms and values and goals of the actors involved-, and design (information flows, rules, power and self-organization).

As technical biophysical fixes constitute shallow leverage points, efforts are needed that look beyond redesigning waste streams or rechanneling biophysical and energy flows. Complementary deep leverage points encompass the design of institutions and social structures, as well as their intent (e.g., norms and values), for a system to support a needed systemic change that encompasses all three dimensions of sustainability.

2.4 A framework for designing a circular society based on the "doughnut" and a "food systems approach"

We propose a framework for circularity by design that combines the "doughnut economy" (Section 2.2), a "food systems approach" (Section 2.3), and leverage points framework (Section 2.3). The doughnut economy provides a vision for a safe operating space within planetary boundaries that places emphasis not on economic growth but rather on prosperity. A food systems approach provides a methodology for mapping and navigating the doughnut economy by using a systemic approach and drawing from all dimensions of sustainability—economic, environmental and social, while providing guidelines for how to apply deep leverage points (Section 3.4).

2.4.1 The doughnut economy

Raworth, creator of the "doughnut economy" framework, stated that our current economy is degenerative and divisive *by default*, resulting in enormous environmental challenges and increased social inequalities (Raworth 2017b). To address these challenges, we need to move to an economy that's regenerative and distributive *by design.* For Raworth, that starts with changing the goals: from endless growth to thriving in balance, or 'meeting the needs of all within the means of the planet' (Raworth 2017a). Her image of the economy takes the shape of a doughnut, formed by an outer ring representing the ecological ceiling and an inner ring representing the social foundation. If we cross the ecological ceiling, we overshoot and degenerate the life-support system of our planet. If we break the social foundation, we fall short on meeting the needs of all, resulting in inequality and injustice. The space in between the two rings, represents the safe and just space for humanity.
Along similar lines, Gibson-Graham, Cameron, and Healy (2013) have argued in 'Take Back the Economy' for the need to reframe 'the economy'. From "and ordered machine that governs our lives" (2013, p. 1) and "must be fueled by growth" (2013, p.3) to "*all* the things we do to ensure the material functioning and wellbeing of our households, communities and nations" (2013, p.4). The economy is thus created by our actions and made up of a wide variety practices that we engage in to ensure our social, material and environmental well-being.

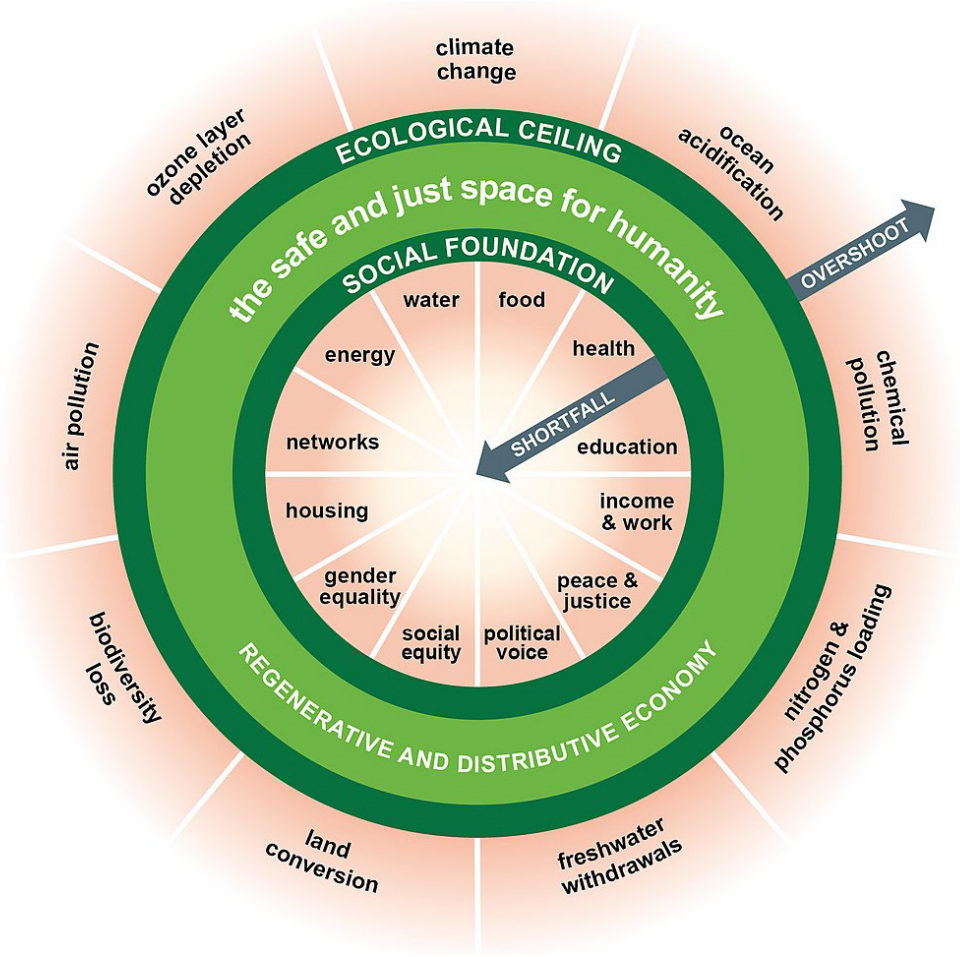

Figure 3 Doughnut Economy (Source: Raworth, 2017a)

To capture this diversity, Gibson-Graham, Cameron, and Healy (2013) introduce the language of 'diverse economies', represented in the image of an iceberg. Visible above the waterline are the practices that are part of 'the economy' in dominant conceptualizations: wage labor, producing for a market, in a capitalist firm. Below the waterline is the much wider range of economic practices we all engage in to ensure our material and physical wellbeing, including household labor, volunteering, sharing and bartering.

Following both Raworth's and Gibson-Graham's re-framings of the economy, also results a re-framing of ourselves as economic actors. From a narrow framing as consumers and 'rational economic man', we become diverse economic actors that participate in and shape the economy in multiple roles: we work for money, we volunteer, we care, we join organizations and start businesses, we save money and invest in our future and that of our children, and we might become politically active to make sure ours and others' needs are met through laws and regulations.

As Gibson-Graham succinctly summarized: "our economy is the outcome of the decisions we make and the actions we take" (2013, p. xiii). Taking back the economy to make our societies and environments thrive, involves ethical decision-making and ethical action. Gibson-Graham et al. (2013) have formulated six ethical considerations for an economy that sits within the 'safe and just space for humanity' of Raworth's doughnut, naming them 'community economies'. These six considerations are:

- *surviving* together well and equitable
- *distributing surplus* to enrich social and environmental health
- *encountering others* in ways that support their well-being as well as ours
- *consuming* sustainably
- *caring for* -maintaining, replenishing and growing – our natural and cultural *commons*; and
- *investing our wealth in future generations so that they can live well*

In summary, a *community economy* is "a space of decision making where we recognize and negotiate our interdependence with other humans, other species and our environment" (Gibson-Graham et al. 2013, p. xix)

A first step of our Circularity by Design (CbD) framework is thus to re-orient the purpose: from endless growth to 'thriving in balance', or 'surviving well together'. Bringing together Gibson-Graham's community economies and Raworth's doughnut economics has brought us a better understanding of an economy that is circular (or regenerative and distributive) *by design*—which literally means *intentionally* and refers to intent, or purpose. If we take the economy as the outcome of the decisions we make and the actions we take rather than a machine operated by the 'natural laws' of the market, *by design* means we put ethics (of regeneration and (re-)distribution) at the heart of our decisions and actions.
The six ethical considerations of Community Economies, in combination with the UN Sustainable Development goals can well serve as starting point.

2.4.2 A food systems approach

A food systems approach (FSA) is a sophisticated interdisciplinary framework for research and policymaking aimed at generating sustainable solutions for the supply of healthy food within environmental limits (Hammond and Dube 2012; Ericksen et al. 2010; Ingram 2011). Such a systemic approach is useful to analyze the systemic transformation that is required to attain alternative agri-food systems that meet nutritional and environmental needs. FSA looks at the outcomes of food system activities and processes in terms of food security (including nutrition), environment (e.g., biodiversity, climate), and socio-economic (e.g., income) components (Berkum et al, 2018; Ericksen et al. 2010). This framework acknowledges that achieving food and nutrition security requires looking more broadly than at either agricultural production or nutrition interventions alone. Unlike a focus on value chains or farming systems, FSA looks at the interactions within the food system and its socio-economic and biophysical component. The framework also provides a list of topics to consider in research and helps map vulnerabilities of agri-food systems to external impacts, such as climate change (Berkum et al., 2018; Ingram 2011).

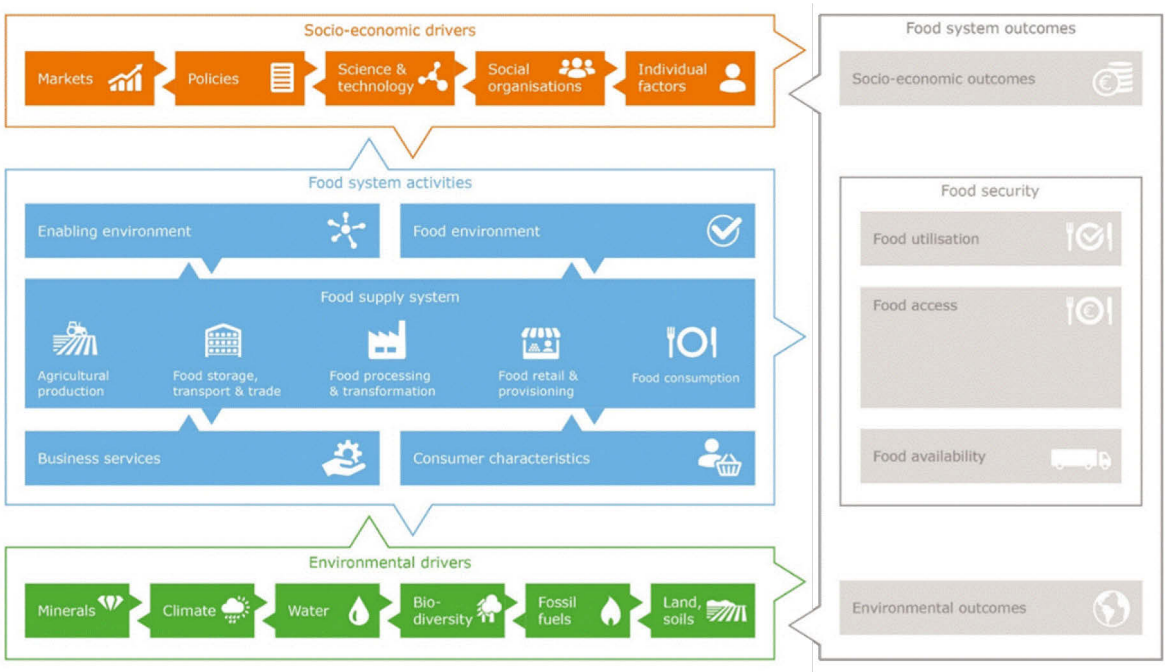

Figure 4 Applying a Food Systems Approach (Van Berkum et al., 2018)

We propose to draw from the FSA to incorporate systems thinking in CE. An FSA may elucidate how CE interventions may influence and potentially transform food systems across scales and sectors. An FSA may be used to map food systems, bringing to light all system components, interactions, and flows from the social, environmental, and economic perspectives. This would allow for an understanding of the potential, limitations and impact of different CE interventions in driving systemic

change. It would also enable key stakeholders, for example in the Amsterdam Municipality, to map policies and initiatives to support a coherent integration of efforts while identifying gaps, or neglected leverage points to support food system transformation.

2.4.3 Deep leverage points: strategies for systemic transition towards a circular economy

Potential strategies for transformational change that target deep leverage points include (1) re-connecting people to nature, (2) restructuring institutions, and (3) re-thinking how knowledge is created and used (Abson et al. 2017). For the first strategy, reconnecting people to nature, is bringing consumers to change consumption patterns towards circularity and with the intent to purchase products with a lower impact on the environment (e.g., climate, biodiversity, or water), instead of the cheapest products in which those external costs are not included in the consumer price. Another lever for connecting people to nature is the direct experience with nature and the growing season as it shapes attitudes and behaviors towards the environment, for example urban vegetable and fruit tree gardens. Careful planning and management of urban green infrastructure can also assist in re-connecting urban dwellers to natural environments.

On the second strategy, re-structuring institutions, circular values and attitudes need to be coupled with institutional structures that make it easy for people to behave sustainably. Institutions are defined as social structures that make societal interaction predictable and guide human action (Abson et al. 2017). They may be formal (laws, regulations, contracts) or informal (dietary customs, taboos, etiquette, the nuclear family), but can equally bind human interaction. There are several levers for institutional changes that range from the development of new institutions that are better suited to foster sustainability and solidarity; strengthening the capability to learn new ways thus continuously adapting current institutions; to purposeful destabilize unsustainable institutions. All require design of mechanisms of learning about the functioning and interdependency of the social structures and reflection on stability versus change, so not to lose important institutional elements such as knowledge, networks or actor capacity generated by hasty or uncontrolled institutional changes. Different strains of literature provide ideas about new institutions that aim to de-center growth and capitalist accumulation as the main reason of society, such as the social and solidarity economy (described in section 2.1.2 Justice and Equity). Evolving institutional conditions to support more solidarity-based production and consumption systems could lead to more resource-efficient activities. An example is a group of about 100 families who want to develop a housing project in the city of Amsterdam that is as self-sufficient as possible in food and energy by supporting its own production and closing loops and is affordable for all families regardless of their income. (Abson et al., 2017).
On the third strategy, re-thinking how knowledge is created and used, Abson et al. (2017) argue that much of human action is path dependent, building on the way things have been done previously and relying on established, often institutionalized, knowledge. Considering path dependencies in how we perceive and produce knowledge and questioning existing perceptions of legitimate knowledge in science and politics could be key levers for sustainability transformation.

2.4.4 Two examples of deep leverage points: Public procurement and "Orchestrators"

Two concrete examples of how to address deep leverage points that would support a systemic change towards circular agri-food systems in an urban setting are related to public procurement policies and "orchestrators".

Public procurement may constitute a powerful mechanism for public authorities to institute sustainability policies and exercise leadership on sustainable development, when including the social foundation of the circularity doughnut. The scale of public procurement amounts to roughly between 8 and 30% of a country's GDP; for example, in the European Union it comprises 16% of the GDP, while in OECD countries it ranges between 5 and 20% (Brammer and Walker 2011; OECD 2017). Given the scale of its importance in financial systems, public procurement can help shift agri-food systems towards circularity by leveraging the purchasing power of the state to restructure production and consumption patterns. Integrating CE principles in public procurement is one promising option to drive fundamental change (Witjes and Lozano 2016). Public procurement may drive systematic change

when public organizations demand better quality products in circular terms, circular products, or the use of business concepts that support CE. This way new products and services meeting circularity criteria may emerge. A study found that public procurement can promote circular economy and related business models by, for example, setting criteria and requirements for the extension of product life spans, efficiency and intensity of use, and efficient cycling of biological or technical materials (Alhola et al. 2019). The public procurement criteria would need to include criteria of social equity and justice regarding distribution of costs, wealth and power to be truly circular. Amsterdam Metropolitan Area, in Gemeente Amsterdam (2020), stated their ambition to practice circular public procurement. The target is to have 10% of the City's procurement circular by 2022 and a 100% circular by 2030; and that all of the City's invitations to tender in the build environment are circular by 2023. Amsterdam intends to support the development of new circular products and services by leveraging circular public procurement. Key sectors in which this is planned is the construction sector, where circular criteria will be used when working on building and in public spaces. One area that needs to be further developed in Amsterdam's Circularity strategy is the use of public procurement in the food and agriculture sector.

The "orchestrator" role comes from the field of industrial ecology, where the need was identified for a "matchmaker" who would act as a network orchestrator to facilitate new forms of interorganizational cooperation (Zaoual and Lecocq 2018), a clear social institution reform. Network orchestrators may facilitate the occurrence of closed loops within an ecosystem of organizations, thereby overcoming companies' difficulties in seeing the potential value creation associated with this kind of cooperation. Orchestrators may be third parties— that is external to the network of companies engaging in closing loops—who get different companies engaged in value creating cooperation, in many cases, regarding waste (Zaoual and Lecocq 2018; Zucchella and Previtali 2019). In this report, we borrow the concept of the orchestrator and expand its role beyond orchestrating firms to close waste and process loops. One limitation in the CE is a reductionist approach which is evidenced in the many disconnected and scattered CE interventions, across sectors and scales, that may be found in any city. In this case, rather than a private sector actor orchestrating activities among firms, the City of Amsterdam may play the role of orchestrator by mapping and connecting CE interventions. This way, the orchestrator role may create cohesion and increase the potential of large-scale change by connecting CE interventions to support collaboration.

3 Next steps

In this report, we have developed a conceptual framework for describing, explaining, and visioning transformation towards circular by design economies. Within the project, we will further develop these findings and provide insights on the circular economy governance landscape in the AMA region and delve on the applications of this framework on agri-food systems in the urban context. We will evaluate governance structures and instruments for change that can incentivize a transition towards a circular by design economy. To test these collected insights for their application on the urban and challenge level, the project team collaborates with AMS Institute and 4 selected challenges on circular living, food production, and waste management.

Literature

Abson, David J, Joern Fischer, Julia Leventon, Jens Newig, Thomas Schomerus, Ulli Vilsmaier, Henrik von Wehrden, et al. 2017. "Leverage Points for Sustainability Transformation." *Ambio* 46 (1): 30–39. https://doi.org/10.1007/s13280-016-0800-y.

Alhola, Katriina, Sven- Olof Ryding, Hanna Salmenperä, and Niels Juul Busch. 2019. "Exploiting the Potential of Public Procurement: Opportunities for Circular Economy." *Journal of Industrial Ecology* 23 (1): 96–109. https://doi.org/10.1111/jiec.12770.

Angheloiu, Corina, and Mike Tennant. 2020. "Urban Futures: Systemic or System Changing

Interventions? A Literature Review Using Meadows' Leverage Points as Analytical Framework." *Cities* 104 (September): 102808. https://doi.org/10.1016/j.cities.2020.102808.

Berkum, Siemen van, Just Dengerink, and Ruerd Ruben. 2018. "The Food Systems Approach: Sustainable Solutions for a Sufficient Supply of Healthy Food." *Wageningen Economic Research* 064: 32. https://doi.org/10.18174/451505.

Braams R. B., J. H. Wesseling, A. J. Meijer, M. P. Hekkert (2021) "Legitimizing transformative government: Aligning essential government tasks from transition literature with normative arguments about legitimacy from Public Administration traditions. Environmental Innovation and Societal Transitions, Volume 39, 2021, Pages 191-205, ISSN 2210-4224. https://doi.org/10.1016/j.eist.2021.04.004.

Brammer, Stephen, and Helen Walker. 2011. "Sustainable Procurement in the Public Sector: An International Comparative Study." *International Journal of Operations & Production Management* 31 (4): 452–76. https://doi.org/10.1108/01443571111119551.

City of Amsterdam, Circle Economy, and Kate Raworth. 2020. "Building Blocks for the New Strategy AMSTERDAM CIRCULAR 2020-2025," 1–56. www.circle-economy.com.

D'Amato, D., N. Droste, B. Allen, M. Kettunen, K. Lähtinen, J. Korhonen, P. Leskinen, B. D. Matthies, and A. Toppinen. 2017. "Green, Circular, Bio Economy: A Comparative Analysis of Sustainability Avenues." *Journal of Cleaner Production* 168 (December): 716–34. https://doi.org/10.1016/j.jclepro.2017.09.053.

Davelaar, D. Transformation for sustainability: a deep leverage points approach. *Sustain Sci* **16,** 727–747 (2021). https://doi.org/10.1007/s11625-020-00872-0

Davies, Anna R., Ferne Edwards, Brigida Marovelli, Oona Morrow, Monika Rut, and Marion Weymes. 2017. "Making Visible: Interrogating the Performance of Food Sharing across 100 Urban Areas." *Geoforum* 86 (November): 136–49. https://doi.org/10.1016/j.geoforum.2017.09.007.

Desing, Harald, Dunia Brunner, Fabian Takacs, Stéphane Nahrath, Karolin Frankenberger, and Roland Hischier. 2020. "A Circular Economy within the Planetary Boundaries: Towards a Resource-Based, Systemic Approach." *Resources, Conservation and Recycling* 155 (April). https://doi.org/10.1016/j.resconrec.2019.104673.

Dorninger, Christian, David J. Abson, Cristina I. Apetrei, Pim Derwort, Christopher D. Ives, Kathleen Klaniecki, David P.M. Lam, et al. 2020. "Leverage Points for Sustainability Transformation: A Review on Interventions in Food and Energy Systems." *Ecological Economics*. Elsevier B.V. https://doi.org/10.1016/j.ecolecon.2019.106570.

Ellen MacArthur Foundation. 2019. "Cities and Circular Economy for Food." https://www.ellenmacarthurfoundation.org/assets/downloads/Cities-and-Circular-Economy-forFood_280119.pdf%0Ahttps://www.ellenmacarthurfoundation.org/assets/downloads/Cities-andCircular-Economy-for-Food_EMF.pdf.

Ericksen, Polly J, Jane Dixon, Barling David, and Philip A Loring. 2010. "The Value of a Food System Approach." In . London: Earthscan.

EU. 2020. "A European Green Deal." *European Commission - European Commission*, no. December 2019. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.MacArth

European Commission. 2020. "A New Circular Economy Action Plan For a Cleaner and More Competitive

Europe. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions."

European Environmental Agency (EEA) (2017): "Circular by design. Products in the circular economy." EEA Report No 6/2017. ISSN 1977-8449

Fischer, Joern, and Maraja Riechers. 2019. "A Leverage Points Perspective on Sustainability." *People and Nature* 1 (1): 115–20. https://doi.org/10.1002/pan3.13 .

Fratini, Chiara Farné, Susse Georg, and Michael Søgaard Jørgensen. 2019. "Exploring Circular Economy Imaginaries in European Cities: A Research Agenda for the Governance of Urban Sustainability Transitions." *Journal of Cleaner Production* 228: 974–89. https://doi.org/10.1016/j.jclepro.2019.04.193.

Frenken, Koen, and Juliet Schor. 2017. "Putting the Sharing Economy into Perspective." *Environmental Innovation and Societal Transitions* 23 (June): 3–10. https://doi.org/10.1016/j.eist.2017.01.003.

Friant, Martin Calisto, Walter J.V. Vermeulen, and Roberta Salomone. 2020. "A Typology of Circular Economy Discourses : Navigating the Diverse Visions of a Contested Paradigm. Resources, Conservation and Recycling. Elsevier B.V. https://doi.org/10.1016/j.resconrec.2020.104917.

Geisendorf, Sylvie, and Felicitas Pietrulla. 2018. "The Circular Economy and Circular Economic Concepts—a Literature Analysis and Redefinition." *Thunderbird International Business Review* 60 (5): 771–82. https://doi.org/10.1002/tie.21924.

Geissdoerfer, Martin, Paulo Savaget, Nancy M.P. Bocken, and Erik Jan Hultink. 2017. "The Circular Economy – A New Sustainability Paradigm?" *Journal of Cleaner Production*. Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2016.12.048.

Gemeente Amsterdam. 2020. "Amsterdam Circular 2020-2025 Strategy," 1–30.
https://www.amsterdam.nl/bestuur-organisatie/volg-beleid/ambities/gezonde-duurzamestad/amsterdam-circulair-2020-2025/.

Gibson-Graham, J K, Jenny Cameron, and Stephen Healy. 2013. *An Ethical Guide for Transforming Our Communities*. University of Minnesota Press. www.jstor.org/stable/10.5749/j.ctt32bcgj.

Goldstein, Benjamin, Morten Birkved, John Fernández, and Michael Hauschild. 2017. "Surveying the Environmental Footprint of Urban Food Consumption." *Journal of Industrial Ecology* 21 (1): 151–65. https://doi.org/10.1111/jiec.12384.

Hammond, Ross A, and L. Dube. 2012. "A Systems Science Perspective and Transdisciplinary Models for Food and Nutrition Security." *Proceedings of the National Academy of Sciences* 109 (31): 12356–63. https://doi.org/10.1073/pnas.0913003109.

Hickel, Jason. 2018. "Is it possible to achieve a good life for all within planetary boundaries?" Third World Quarterly, DOI: 10.1080/01436597.2018.1535895

Hobson, Kersty. 2015. "Closing the Loop or Squaring the Circle? Locating Generative Spaces for the Circular Economy." *Progress in Human Geography* 40 (1): 0309132514566342-. https://doi.org/10.1177/0309132514566342.

Hobson, Kersty, and Nicholas Lynch. 2016. "Diversifying and De-Growing the Circular Economy: Radical Social Transformation in a Resource-Scarce World." *Futures* 82: 15–25. https://doi.org/10.1016/j.futures.2016.05.012.

Holmes, Helen. 2018. "New Spaces, Ordinary Practices: Circulating and Sharing within Diverse Economies of Provisioning." *Geoforum* 88 (January): 138–47. https://doi.org/10.1016/j.geoforum.2017.11.022.

Homrich, Aline Sacchi, Graziela Galvão, Lorena Gamboa Abadia, and Marly M. Carvalho. 2018. "The Circular Economy Umbrella: Trends and Gaps on Integrating Pathways." *Journal of Cleaner Production* 175: 525–43. https://doi.org/10.1016/j.jclepro.2017.11.064.

Imhoff, Marc L., Lahouari Bounoua, Taylor Ricketts, Colby Loucks, Robert Harriss, and William T. Lawrence. 2004. "Global Patterns in Human Consumption of Net Primary Production." *Nature* 429 (6994): 870–73. https://doi.org/10.1038/nature02619.

Ingram, John. 2011. "A Food Systems Approach to Researching Food Security and Its Interactions with Global Environmental Change." *Food Security* 3 (4): 417–31. https://doi.org/10.1007/s12571-0110149-9.

Jurgilevich, Alexandra, Traci Birge, Johanna Kentala-Lehtonen, Kaisa Korhonen-Kurki, Janna Pietikäinen, Laura Saikku, and Hanna Schösler. 2016. "Transition towards Circular Economy in the Food System." *Sustainability* 8 (1): 1–14. https://doi.org/10.3390/su8010069.

Kirchherr, Julian, Denise Reike, and Marko Hekkert. 2017. "Conceptualizing the Circular Economy: An Analysis of 114 Definitions." *Resources, Conservation and Recycling* 127 (April): 221–32. https://doi.org/10.1016/j.resconrec.2017.09.005.

Koppelmäki, K., J. Helenius, and R.P.O. Schulte. n.d. "Nested Circularity in Food Systems: A Nordic Case Study on Connecting Biomass, Nutrient and Energy Flows from Field Scale to Continent." *Resources, Conservation & Recycling*.

Korhonen, Jouni, Antero Honkasalo, and Jyri Seppälä. 2018. "Circular Economy: The Concept and Its Limitations." *Ecological Economics* 143: 37–46. https://doi.org/10.1016/j.ecolecon.2017.06.041.

Lazarevic, David, and Helena Valve. 2017. "Narrating Expectations for the Circular Economy: Towards a Common and Contested European Transition." *Energy Research and Social Science* 31 (September): 60–69. https://doi.org/10.1016/j.erss.2017.05.006.

Lewandowski, Mateusz. 2016. "Designing the Business Models for Circular Economy-towards the Conceptual Framework." *Sustainability (Switzerland)* 8 (1): 1–28. https://doi.org/10.3390/su8010043.

Meadows, Donella. 1999. *Leverage Points: Places to Intervene in a System*. *Hartland: The Sustainability Institute*. https://doi.org/10.1080/02604020600912897.

Merli, Roberto, Michele Preziosi, and Alessia Acampora. 2018. "How Do Scholars Approach the Circular Economy? A Systematic Literature Review." *Journal of Cleaner Production* 178: 703–22. https://doi.org/10.1016/j.jclepro.2017.12.112.

Moreau, Vincent, Marlyne Sahakian, Pascal van Griethuysen, and François Vuille. 2017. "Coming Full Circle: Why Social and Institutional Dimensions Matter for the Circular Economy." *Journal of Industrial Ecology* 21 (3): 497–506. https://doi.org/10.1111/jiec.12598.

Murray, Alan, Keith Skene, and Kathryn Haynes. 2017. "The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context." *Journal of Business Ethics* 140 (3): 369–80. https://doi.org/10.1007/s10551-015-2693-2.

OECD. 2017. "Size of Public Procurement." In *Government at a Glance 2017*. Paris. https://doi.org/10.1787/888933533131.

Papangelou, A., W.M.J. Achten, and E. Mathijs. 2020. "Phosphorus and Energy Flows through the Food System of Brussels Capital Region." *Resources, Conservation and Recycling* 156. https://doi.org/10.1016/j.resconrec.2020.104687.

Parrique, Timothée, Jonathan Barth, F.C. Briens, Christian Kerschner, Alejo Kraus-Polk, Anna Kuokkanen, and Joachim H Spangenberg. 2019. "Decoupling Debunked - Evidence and Argument against Green Growth as Sole Strategy for Sustainability." *European Environmental Bureau*. Brusse. https://www.tercerainformacion.es/sites/default/files/archivos/decoupling-debunked-full-foronline.pdf%0Awww.eeb.org%0Awww.eeb.org.

Pla-Julián, Isabel, and Sandra Guevara. 2019. "Is Circular Economy the Key to Transitioning towards Sustainable Development? Challenges from the Perspective of Care Ethics." *Futures* 105 (January): 67–77. https://doi.org/10.1016/j.futures.2018.09.001.

Prendeville, Sharon, Emma Cherim, and Nancy Bocken. 2018. "Circular Cities: Mapping Six Cities in Transition." *Environmental Innovation and Societal Transitions* 26 (March): 171–94. https://doi.org/10.1016/j.eist.2017.03.002.

Raworth, Kate. 2017a. "A Doughnut for the Anthropocene: Humanity's Compass in the 21st Century." *Lancet Planet Health*. Vol. 1. https://doi.org/10.1016/S2542-5196(17)30028-1.

Raworth, Kate. 2017b. "Why It's Time for Doughnut Economics." *IPPR Progressive Review* 24 (3): 217–22. https://doi.org/10.1111/newe.12058.

Robinson, Seigo. 2017. "Social Circular Economy: Opportunities for People, Planet and Profit." https://www.socialcirculareconomy.com/uploads/7/3/5/2/73522419/social_circular_economy.pdf

Sauvé, Sébastien; Sophie Bernard, and Pamela Sloan. 2016. "Environmental Sciences, Sustainable Development and Circular Economy: Alternative Concepts for Trans-Disciplinary Research." *Environmental Development* 17 (January): 48–56. https://doi.org/10.1016/j.envdev.2015.09.002.

Schor, Juliet. 2017. "Does the Sharing Economy Increase Inequality within the Eighty Percent?: Findings from a Qualitative Study of Platform Providers." *Cambridge Journal of Regions, Economy and Society, Cambridge Political Economy Society* 10 (2): 263–79. https://ideas.repec.org/a/oup/cjrecs/v10y2017i2p263-279..html.

Sitra. 2016. "Leading the Cycle." www.sitra.fi.

Ward, Shane M, Nicholas M Holden, Eoin P White, and Thomas L Oldfield. 2016. "The 'circular Economy' Applied to the Agriculture (Livestock Production) Sector – Discussion Paper." *Workshop on the Sustainability of the EU's Livestock Production Systems*, no. October 2018: 1–11. http://www.agrocycle.eu.

Winans, K., A. Kendall, and H. Deng. 2017. "The History and Current Applications of the Circular Economy Concept." *Renewable and Sustainable Energy Reviews*. https://doi.org/10.1016/j.rser.2016.09.123.

Witjes, Sjors, and Rodrigo Lozano. 2016. "Towards a More Circular Economy: Proposing a Framework Linking Sustainable Public Procurement and Sustainable Business Models." *Resources, Conservation and Recycling* 112 (January): 37–44. https://doi.org/10.1016/j.resconrec.2016.04.015.

Zaoual, Anne-Ryslène, and Xavier Lecocq. 2018. "Orchestrating Circularity within Industrial Ecosystems : LESSONS FROM ICONIC CASES IN THREE DIFFERENT COUNTRIES." *California Management Review* 60 (3): 133–56. https://doi.org/10.1177/0008125617752693.

Zanten, van, Hannah, Van Ittersum, Martin, Boer, Imke. 2019. The role of farm animals in a circular food system. *Global Food Security* (21): 18-22. https://doi.org/10.1016/j.gfs.2019.06.003

Zucchella, Antonella, and Pietro Previtali. 2019. "Circular Business Models for Sustainable Development: A 'Waste Is Food' Restorative Ecosystem." *Business Strategy and the Environment* 28 (2): 274–85. https://doi.org/10.1002/bse.2216.

To explore the potential of nature to improve the quality of life

Wageningen Food & Biobased Research
Bornse Weilanden 9
6708 WG Wageningen
The Netherlands
E info.wfbr@wur.nl
wur.nl/wfbr

Report 2276

The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 6,800 employees (6,000 fte) and 12,900 students, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.