

# A Transdisciplinary Approach to an Ethical Circular Economy

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**Abstract:** The circular economy has emerged as an alternative paradigm for the management of resources to drive sustainable development that contrasts with the linear model of the materials economy. As the theory has been gaining traction around the world, real world applications of the circular economy have had unique, unexpected challenges and mixed results. A weakness of the circular economy, as it is commonly applied, is that it does not sufficiently address the social dimension of sustainable development, and therefore undermines the effectiveness of circular economy as a sustainability tool. The inclusion of social sustainability in circular economy principles can create the most beneficial and successful holistic sustainability strategies, as evidenced through real world examples in the private sector and in urban platforms. To remedy the discrepancy between circular economy and holistic sustainability, it is proposed that an ethical circular economy be developed, that integrates human wellbeing to work towards achieving the sustainable development goals, as the globally-accepted ethical framework. The ethical circular economy brings a sustainability science lens to the traditional application of circular economy and calls for improving social value when implementing circular economy solutions. Arizona State University is working to integrate this new approach into the creation of circular economy solutions in regions throughout the world and is calling for a new research, education and practice agenda to advance the potential of the ethical circular economy as a sustainability tool.

**Keywords:** Circular Economy, Ethical Circular Economy, Sustainable Development Goals, Sustainable Development.

## 1. Introduction

The circular economy (CE) has emerged as an alternative paradigm for the management of resources to drive sustainable development that contrasts with the linear materials economy model of extract-consume-dispose that has characterized economic activity since the industrial revolution [1]. As defined in the United Nations' report, *Our Common Future*, sustainable development is defined as development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs [2]. While the linear economy stresses the environment, and risks the economic and social foundation of the global system, a circular economy is one that is restorative and regenerative by design, and which aims to keep products, components, and materials at their highest utility and value at all times [3].

A promising approach in the pursuit of sustainable development, the circular economy incorporates concepts and design principles from several schools of thought to encourage the creation of closed-loop resource systems and equitable, healthy, productive societies. While it has been gaining traction as a sustainability strategy, circular economy theory is not always easily translated into tangible systems and sometimes falls short of its societal goals. Examples of circular economy

in practice do not always broad, socially desirable outcomes and sometimes also diverge from the principles of circular economy theory. A modified approach in circular economy theory and implementation is needed to reconcile the disparity between theory and practice.

The most recent revision of the United Nations sustainable development goals (SDGs) and agenda call for action “in areas of critical importance for humanity and the planet:

- People – we are determined to end poverty and hunger, in all their forms and dimensions, and to ensure that all human beings can fulfil their potential in dignity and equality and in a healthy environment.
- Planet - we are determined to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations.
- Prosperity - we are determined to ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature.
- Peace - we are determined to foster peaceful, just and inclusive societies which are free from fear and violence. There can be no sustainable development without peace and no peace without sustainable development.
- Partnership - we are determined to mobilize the means required to implement this Agenda through a revitalized Global Partnership for Sustainable Development, based on a spirit of strengthened global solidarity, focused in particular on the needs of the poorest and most vulnerable and with the participation of all countries, all stakeholders and all people [4].

The 17 global goals (and 169 associated targets) emphasize the triple bottom line approach to development that requires the environment, the economy, and society to simultaneously benefit, and also demonstrate the inherently ethical nature of the pursuit of sustainability. Social issues including equity, empowerment, education, health, social protection, and job opportunities are highlighted as top priority areas along with environmental issues. In fact, more than half (8 out of 17) of the SDGs are focused directly on these social issues. Having been developed by the UN, the SDGs are the best representation of where the world needs to prioritize action for creating a prosperous future for all and provide a good framework by which to assess the effectiveness of a circular economy solution as being a desirable sustainable solution.

It is proposed that this modified approach to CE reconciles this disparity and works towards achieving the sustainable development goals, and can be termed the Ethical Circular Economy. It incorporates research, methods, and knowledge from social, environmental and economic dimensions and has the goal of creating an overall benefit to society. The ethical circular economy approach differs from other circular economy theories and methods by recognizing that current circular economy strategies lack effective integration of social processes and structures that must play an integral role in implementing circular strategies in order to deliver sustainable outcomes. Therefore, in order to achieve the ethical goals of sustainable development, the social dimension needs to be more explicitly integrated into the development of circular economy solutions. Existing frameworks for circular economy intend to be inclusive of social dimension in principal, but real-world implementation efforts have by-and-large focused on material and energy synergies in the design phase, rather than also impacting local social conditions and relationships. Many applications of CE that have been designed in this way have had limited success, when success is defined as improving overall well-being for today’s generations and future generations.

Net positive is an emerging concept [5] that describes a new way of doing, measuring, and reporting business practices that recognizes the importance of putting holistic sustainability and ethics at the core of business strategy. To be “net positive” means to create an overall greater benefit for society through more positive impact on the community and the planet (called the “handprint”) compared to the negative impact (the “footprint”) [5]. While it was initiated as a business concept, it can be applied toward evaluating sustainability strategies in general. As the goal of circular economy transitions is to improve the overall well-being of humans and the environment, all circular

economy strategies should aim to be net positive [5]. Hence, a net positive framework is proposed in assessing the sustainability impact of an ethical circular economy.

The ethical circular economy offers a strategy that allows human and cultural social interactions to drive the transition to circular economies, in addition to restoring balanced resource flows. When developed and applied in this way, the circular economy concept can be more effectively used to strive towards sustainable and prosperous futures for the world and its inhabitants.

## 2. Background

The circular economy offers a platform for societies to rethink their material and energy use in ways that align with natural cycles. The current materials economy is a “take-make-dispose” system that transforms valuable resources into waste and attempts to impose an unnatural, and temporary, linear process upon cyclic natural systems. The system is problematic simply because it is unrealistic - the planet and its systems operate in cycles, and the “linear” processes imposed on them by humans are, in reality, producing waste that is destructive and persistent to Earth’s systems as it cycles. As a result, chemicals and materials with valuable properties accumulate in landfills while societies expend energy to extract virgin resources from finite supplies. Energetic and material value from discarded products gets allocated towards degradation instead of utility. A circular economy, in contrast, maximizes utility of valuable materials through closed-loop systems. Energy and resources provide functional utility in multiple or infinite life cycles when used as raw material for something else at the end of its current life. A transition to a circular economy can enable society to practice conscious development in a way that more intelligently couples economic growth with the use and reuse of finite resources. Circular economy supports and, in turn, is supported by frameworks for developing a resilient global human system that thrives in the longer term [3]. When coupled with a sustainable systems perspective, a circular economy can support synergistic growth with the natural systems of the finite planet.

Today’s evolving concept of a circular economy has emerged from the integration of several schools of thought and academic disciplines, each emphasizing the necessity of working cyclically. The original contributions can be drawn back to Walter Stahel’s work in the 1980’s, and the development of the closed loop economy, as described in *The Product Life Factor* [6,3]. While the following list is not exhaustive of additional CE theory contributors, the most notable and significant contributions have come from the development of the Hannover Principles [7], industrial ecology [8], Cradle to Cradle™ [9], biomimicry, and The Natural Step [10,11] each described in more detail below.

### 2.1. The Hannover Principles

While planning for the 2000 World’s Fair, the City of Hannover, Germany, decided to tackle the difficult issue of imagining and encouraging a sustainable future by theming EXPO 2000 as “Humanity, Nature and Technology.” To ensure that all construction and preparation for the Fair represented the City’s commitment to sustainable development, the planners commissioned 9 design principles to inform international design competitions for constructing the event. Known as “The Hannover Principles,” these guidelines aimed to provide a platform for designers to adapt their work towards sustainable ends for the environment and for humanity. The principles emphasize the rights of humanity and nature to co-exist, recognizing the relationship between spirit and matter, the responsible use of natural resources, and the importance of continuous improvement through sharing of knowledge [7].

### 2.2. Industrial Ecology and Symbiosis

Many of the original concepts behind the circular economy first appeared in *Industrial Ecology*, by Thomas Graedel and Braden Allenby in 1995 [8]. Industrial ecology has been defined as a “systems-based, multidisciplinary discourse that seeks to understand emergent behavior of complex integrated human-natural systems” [12]. Essentially, industrial ecology presents a way of looking at industrial systems as man-made versions of natural ecosystems. Industrial symbiosis has been integrated into systems where the waste products of one industry are used as raw materials or for others. Just as “waste” products in natural systems are used as food or nutrients for other agents in a food web, industrial ecosystems cooperate in industrial symbiosis through exchange of byproducts, resources and infrastructures that are able to achieve greater economic and environmental benefits than if they were acting alone [8,12].

### 2.3. Biomimicry

Biomimicry is a new science that studies nature’s models and then emulates these forms, processes, systems and strategies to solve human problems [13]. While one of the earliest examples of biomimicry is Leonardo da Vinci’s designs for a flying machine, the scientific discipline was more recently popularized in the 1980s and applied to development of products like replaceable carpet tiles (modeled after forest leaves) and Velcro (modeled after burrs). More recently, biomimicry practitioners have been applying the approach at many scales, “from biota to biosphere,” and positioning biomimicry as a critical tool for realizing the circular economy.

### 2.4. Cradle to Cradle™

Cradle to Cradle™ is a design philosophy [9] that considers all material involved in industrial and commercial processes to be nutrients, which can therefore be utilized in a closed-loop system where there is no waste. Cradle to Cradle™ (C2C) models typically categorize materials used in manufacturing processes as biological or technical nutrients, where all materials can be returned to the earth as biological nutrients after use, or re-enter the industrial system as a technical nutrient (C2C™ product standard). C2C™ emphasizes more than the elimination of waste and improving resource efficiency. One of its three principles is to “celebrate diversity,” which is described as using social fairness, encouraging stakeholder engagement, supporting local biodiversity, and cultivating creativity through technology diversity. C2C™ practitioners place a special emphasis on materials, especially with respect to chemistry, in an effort to eliminate harmful chemicals from buildings and products.

### 2.5. The Natural Step

The Natural Step is an international not-for-profit organization dedicated to education, advisory work, system change initiatives, innovation and research in pursuit of sustainable development [10,11]. The Natural Step works with diverse organizations to apply its Framework for Strategic Sustainable Development. In this framework, a sustainable society is defined as one in which nature is not subject to systematically increasing:

- Concentrations of substances extracted from the earth’s crust,
- Concentrations of substances produced by society,
- Degradation by physical means, and, in that society,
- People are not subject to conditions that systematically undermine their capacity to meet their needs.

These system conditions describe The Natural Step’s principles for moving towards a sustainable society.

## 3. Principles of the Circular Economy

While the circular economy concept remains embedded within its historic disciplines, each with its distinctive applications and goals, momentum is growing for the distinction of the circular economy as an integrating theory and practice [3]. Organizations like the Ellen MacArthur Foundation, the

World Economic Forum, McKinsey and Company, and the Closed Loop Fund, among others, have pioneered a new generation of circular economy work that aims to apply the theory in sustainable development planning. These emerging practices recognize and encompass past contributions to the concept, while establishing standardized principles that define the circular economy as an independent theory. The traditional principles of CE, described by the Ellen MacArthur Foundation [3] and drawing heavily from the work of McDonough and Braungart [7,9] are defined below.

### 3.1. Five Foundational CE Principles

The Ellen MacArthur Foundation [3], which draws from the work of McDonough and Braungart [7,9] describe the circular economy with the following principles:

1. Design out waste - Waste can be designed out by embracing the idea that “waste is food.” All components of products should be designed for continuous reuse in consecutive life cycles by being treated as biological nutrients, to be returned to the earth in a productive capacity, or as technical nutrients that can be used again with minimal energy loss and highest retention of quality.
2. Build resilience through diversity - Diverse systems with many connections and scales are more able to withstand shocks and disturbances and maintain or return to their original condition. Conversely, systems built for efficiency tend to be fragile and weak when subject to stressors and shocks.
3. Work towards using energy from renewable sources - The use of nonrenewable energy sources is a linear economy practice in action. Limited raw material is extracted for use, completely depleted, often adding destructive by-products into the environment. A restorative, circular economy requires being powered by energy sources that are completely renewable and can be continuously reused within the system. Circular economy systems have lower energy requirements than linear systems, and are therefore more conducive to being powered by renewable energy sources.
4. Think in systems - It is important to understand how parts influence one another within a whole, and how the parts interact with the fundamental nature of the whole system. Elements of a system must be considered in their environmental and social contexts, and elements are intricately interlinked and interdependent. Systems are characterized by feedback loops, and these feedback mechanisms, combined with the complexity of relationships, will lead to emergent properties and unintended consequences. Effective circular economy models are applied system-wide, and an understanding of how systems behave is crucial to successful application.
5. Think in cascades - Additional value can be obtained from biological materials when they are cascaded, or sequentially re-used, through multiple applications. Cascading materials refers to putting them to different uses at the end of their lives across different value streams and extracting their stored energy and material coherence. Thinking in cascades also encourages considering entire biological organisms for their use as materials, instead of just a portion and creating waste out of the rest.

An important characteristic of circular economy systems is that they couple economic growth and development and the consumption of finite resources in a more intelligent, more sustainable way [14]. This synergistic approach promises to be mutually beneficial for the economy and the environment when successfully applied. The potential benefits of “going circular” include optimizing the use of materials, realizing new revenue streams, enhancing stakeholder relationships, and mitigating risk from future policy and industry shocks [15]. Research suggests that it has immense job creation and innovation potential, and an estimated savings of \$1 trillion a year can be realized from global dematerialization [3].

The term *successfully applied* in the context of circular economy strategies for sustainability, can be ambiguous. The sustainable development goals call for ending poverty in all of its forms, ensuring

healthy lives, and achieving gender equality among other social welfare goals and sustainable, reliable resource use [4]. The foundational principles, as well as the concepts from preceding schools, acknowledge that to be considered a success, circular economy has to meet social welfare goals, in addition to environmental and economic benefits. In addition to using renewable energy and designing products for recovery, Cradle to Cradle<sup>TM</sup> includes the importance of equity and human well-being through “honoring social fairness and human dignity” and “continuous and aspirational” improvement as central characteristics of the principles. The Hannover Principles explicitly emphasize the balance between nature and human society as well, with guidelines that command responsibility for the relationship between design decisions and human well-being and require constant improvement through the sharing of knowledge [7].” The Natural Step’s fourth system condition, that “people must not be subject to conditions that systematically undermine their capacity to meet their needs,” [10, p.10-15] emphasizes that environmental goals cannot compromise the capabilities of people to live meaningful lives.

However, the foundational principles alone do not provide any mechanisms for which to ensure the social dimension is effectively integrated into the design of circular economy implementations. Consequently, attempts at applying circular economy theory to real-world systems often focus more heavily on material and energy exchanges, while sometimes creating unintended negative impacts in the process. In these cases, it is possible to close resource loops while creating or contributing to processes that either retain social imbalance or can even be socially destructive, such as exacerbating wealth disparities by creating technology-centric closed loops systems that only the rich can buy into. In some cases, transitioning to circular source loops can marginalize underrepresented social groups who relied on components of the linear system to survive. Additionally, there can be closed-loop supply chains that ignore or perpetuate the problem with low wages or underage employment in developing countries. While principle #4 “thinking in systems,” [3] calls for considering elements in their social contexts and recognizes the interdependence of environmental and human dimensions, it provides no techniques for bringing a systems perspective that is inclusive of social systems to life in design strategies. The following discussion describes how the various ways circular economy is applied in real-world contexts today, and how the traditional paradigm of circular economy misses opportunities for creating positive social value and how including the social value can enhance the impact of the circular economy.

#### 4. Circular Economy in Practice

The concept of circular economy has been applied in a variety of contexts as a means of transforming our current systems to be more sustainable. Systems can be circularized on different scales and with different kinds of boundaries. Two common ways that circular economy is applied is within dynamic manufacturing systems, defined by supply chains, or within static urban platforms, defined by geographic boundaries. In both cases, the end goal is to gain an economic benefit while simultaneously reducing the impact of production or development on the environment. These systems are often focused on using waste and energy as raw material as inputs for other processes, while social impacts, capital, structures and processes are often excluded. Additionally, these systems interact to create, use, and dispose of resources as humans carry out their daily lives. Examples of circular economy in supply chains and circular economy within geographic regions are explored below to identify where social impacts are missed and how the circular economy can be enhanced with inclusion of social dimension considerations.

#### 5. Circular Economy in Supply Chains

Circular economy has exploded as a business strategy in recent times. Prominent reports and case studies that promote the potential of the circular economy to deliver win-win situations for the environment and the economy have moved circular economy into the private sector mainstream. Large corporations are embracing the concept as a way to meet their environmental obligations without sacrificing shareholder value. In most examples, circular economy in supply chains is

focused heavily on product stewardship and design-for-environment strategies. For instance, circular economy strategies in private industry might consist of take-back programs or leasing programs, in which the manufacturer creates products that are easy to disassemble, and maintain an internal responsibility for re-utilizing material through successive life cycles. Because of the material focus of most circular economy strategies in supply chains, very few organizations tie social conditions into their circular economy strategies. The ones that do, however, are able to create higher levels of competitive advantage *while* creating social benefit, in addition to environmental and economic benefit. By integrating this third dimension, firms are able to use circular economy to create holistically sustainable supply chains, and bring greater benefit to their business through increased competitive advantage, reputation, and legitimacy. Examples of social processes being integrated in circular supply chains may include creating new and reliable income streams for impoverished nations or divesting from manufacturers with unethical working conditions and investing in those with positive working conditions. Interface, Inc. and Royal Philips are two large corporations who have adopted the circular economy as part of their corporate sustainability strategies. They are examined below to highlight the different approaches to integrating their social initiatives within their CE strategies.

#### 5.1. Interface, Inc. (4.1.1)

Interface, Inc., a global carpet manufacturer, is one of the most well-known and celebrated examples of adopting circular economy into supply chains as a sustainability strategy [10,16]. Interface began its sustainability journey in 1994, with an epiphany by its owner Ray C. Anderson and his subsequent inspired vision to transform Interface into a catalyst for changing the industrial sector to be restorative, instead of degrading. To do this, Interface committed to shifting from linear processes to cyclical ones and defined seven strategies to help make this shift [16]. The seven strategies include: (1) eliminate waste, (2) make emissions benign, (3) use renewable energy, (4) close loops, (5) utilize resource efficient transportation, (6) sensitize stakeholders, and (7) redesign commerce [17]. The restructuring of Interface has been an enormous success and a tremendous win for the case for sustainable business. With this new model, Interface was able to position itself as a leader in sustainability and the carpet industry, as well as radically change the norms in the industry. The seven Interface strategies are notably more heavily focused on the environmental impacts of carpet manufacturing, implying that social considerations were under-represented, in its integration of circular economy. However, Interface's mission is "to be the first company, that, by its deeds, shows the entire industrial world what sustainability is, in all its dimensions: people, process, product, place and profits [17]. Wanting to hold true to its commitment, Interface officially adopted a social sustainability program in 2000 focused on the development of programs and processes that promote social interaction and cultural enrichment. Its emphasis is on protecting the vulnerable, respecting social diversity, and ensuring that we all put priority on social capital (Interface.com 2015), and defined Interface's Core Values as: (1) human rights, (2) labor standards, (3) environment, and (4) ethical practices (Interface.com 2015). In including these social components, Interface's circular economy is enhanced to promote higher standards of living in its manufacturing companies around the world.

#### 5.2 Royal Philips

While sustainability reports are widespread in large corporations today, those who incorporate social impacts in their sustainability reporting are leading the way in using business as a force for good. Technology giant Royal Philips has adopted circular economy as part of its sustainability strategy [18] as well and performs extensive refurbishment and recycling activities to keep materials cycling in beneficial forms. Philips also has a Social Responsibility program, although it is presented as separate from its circular economy strategy [18], which is considered their environmental strategy. The Social Responsibility program includes social investing, stakeholder engagement, improving people's lives, and supplier sustainability. Why should the social program be considered separate from a circular economy strategy? Doing so implies that Philips can employ a circular economy

without ensuring it creates positive social value for the communities that are relevant. A circular economy strategy siloed into an “Environmental Initiative” means that Philips can have a “successful” circular economy, without meeting its social commitments, and vice versa. Philips can recycle and refurbish all of its materials, but those materials might be supplied by other entities with environmentally destructive methods and hugely unjust working practices and conditions. A circular economy separated from the social dimension is incomplete. By marrying the environmental components and social components of circular economy, circular economy is a holistic tool for sustainable development, inclusive of the natural environment and its people.

These examples demonstrate how circular economy is more commonly used as only an environmental and economic strategy when applied in supply chains, and also how the incorporation of the social dimension can enhance the sustainability impact of CE in industry. The emphasis on the environmental components of CE highlights the disconnect between application of CE and the pursuit of sustainable development.

## 6. Circular Economy in Urban Platforms (4.2)

Circular economy has also been used as a sustainable development approach by defining circular economies with geographic boundaries. Governments, such as China, or NGO's, like the Green Alliance Circular Economy Task Force in the UK, have begun to adopt circular economy as a policy tool for development plans. In urban development, circular economy can be applied at a variety of scales and are accordingly manifested in different forms, such as eco-industrial parks, Eco-cities, or more general development guidelines. Eco-industrial parks are industrial parks in which organizations cooperate to efficiently share resources through synergies created between the waste products and raw materials of industries located within the park. The most well-known example is Kalundborg in Denmark [19] in which a highly effective and productive industrial symbiosis has evolved and has allowed for large reductions in overall resource use while realizing huge economic benefit. Eco-cities are broadly defined as ecologically healthy cities and imply urban centers that are developed to have a reduced impact on the environment [20]. When applying circular economy at the community level like this, social components of the system are inevitably impacted by the disruptive nature of changing the system. By ignoring these impacts in the design of community circular economies, attempts at circular economy can be ineffective, undermine the ability for humans to meet their own needs, and miss opportunities to improve the community's overall sustainability.

Eco-Cities provide a useful case study for understanding the social implications of CE at the urban scale because they have been gaining momentum as a potential solution for rapid development challenges, but have remained controversial. At their best, Eco-cities exemplify the future of a sustainable society that maintains high quality of lives for massive global populations through intelligent infrastructure, super efficient resource use and re-use, and clean energy sources. Masdar City in the United Arab Emirates [21] and Songdo International Business District (IBD) in South Korea are two of the highest profile examples of such smart, green cities [22] that highlight different ways in which ignoring social factors can lead to circular economy failures.

### 6.1 Masdar City (4.2.1)

Masdar City is a planned eco-city in Abu-Dhabi that is using circular economy principles, such as reliance on renewable energy and designing out waste to become an entirely carbon-neutral, zero-waste city; home to 40,000 residents and host an additional 50,000 member community of academics, researchers, start-up companies and investors [23]. Masdar City claims to have officially adopted the triple-bottom-line definition of sustainability, placing equal importance on the well-being of environment, economic, and social dimensions of the city [21]. However, Masdar's sustainability performance has been heavily criticized for being weak in the social dimension. Some fear that it will become a luxury development for the rich, and the technology-centric – a secluded metropolis that only furthers the division between wealthy and impoverished communities [24]. If this is the case, Masdar City demonstrates how circular economy in practice can actively contribute to



significant sustainability challenges – wealth disparity and social marginalization – rather than working towards an equitable and prosperous society. Circular economy that works to exacerbate societal problems that undermine the ability for people to meet their needs is a failure of the circular economy to deliver sustainable solutions. A stronger social lens and consideration of the social impacts of creating such a development may have foreseen some of these challenges and allowed for Masdar City to catalyze social change for the better by including these marginalized groups.

#### 6.2 Songdo International Business District (4.2.1)

Songdo International Business District (IBD), or New Songdo City, is a new smart, “ubiquitous” city being built on 1,500 acres of reclaimed land in Incheon, South Korea. Songdo City’s commitment to “encourage and foster sustainable design practices by incorporating the latest design standards and technologies that reduce energy consumption, increase energy efficiency, utilize recycled and natural materials and generate clean or renewable energy” reflects circular economy principles of designing out waste and using renewable energy sources [22]. Songdo IBD’s ambitious design goals for sustainability in six diverse sectors (open space, transportation, water, carbon emissions, material flows and recycling, and city operations) demonstrate a plan that thinks in systems and works towards resilience in the material and physical realms. However, it has been observed by many that Songdo is currently finding it difficult attracting permanent residents and businesses, giving rise to criticism about technology’s limited ability to solve complex problems and speculation that smart-cities may not be desirable to live in. Songdo City’s struggle to attract permanent business tenants and residents may reflect that people simply find it unappealing to live in such a highly-monitored and technological community, or that they have no desire to relocate there because they have no familial or relationship ties to it. The oversight of people’s innate desire to have connection to their community demonstrates that Songdo City was not designed with regard to social conditions crucial to sustainable development. The example of Songdo City [25] highlights a different failing of a circular economy strategy that does not incorporate social factors than the failing found in Masdar. In the case of Songdo City, circular economy strategies were a failure because the lack of consideration to social conditions led to a society that did not meet all of its residents’ needs for a prosperous life.

Defining the circular economy by geographic boundaries has the potential to be a powerful and effective way of creating and implementing sustainable CE solutions. It encourages the use of local resources and capital, and can have the advantage of shared goals and values for stakeholders in the system that share a local culture. In order to realize the full potential and also work towards sustainable societies, it is imperative to recognize the role that social structures play in the circular economy and include them in the design of new systems.

In all of the ways that circular economy is implemented in the real world, there is a clear emphasis on the environmental and economic components of creating cyclical systems. Neglecting the social components has huge implications for sustainable development. By ignoring the social dimension, CE is incomplete as an approach for sustainability. Intentionally including the social dimension and appreciating its interconnectivity to the rest of the circular systems will not only enhance the sustainable benefit of circular economy, but also create more effective and successful circular economy systems.

### 7. The Ethical Circular Economy

The five foundational principles are crucial, but fall short of describing the sustainable systems-approach that is needed when designing the implementation strategy of a *sustainable* or *ethical* circular economy. An ethical circular economy can be defined as “one that is socially balanced, and environmentally restorative and regenerative by design.” To remedy this shortcoming, a 6th principle is proposed, focusing on creating net positive social value as complementary to the five foundational principles, to realize an ethical circular economy. Ethics is the branch of philosophy that deals with question of right and wrong human action in the world [26]. The goal of sustainable development is inherently an ethical pursuit, as the objective implies moral responsibility for the quality of life of

current and future generations. The inclusion of the social value principle when designing circular economy solutions ensures that the implementation of circular economy will be explicitly effective in working towards holistic and ethical sustainable development by including the positive and negative impacts of solutions. In addition to the five EMF principles, the 6th principle states: *Improve social value* - the outcome of a circular economy should be improved social welfare and quality of life for the people impacted by the circular system. The improvement of social value through circular economy is enabled by including social systems and processes in the circularization of the system. The ethical circular economy changes the goal of circular economy from realizing eco-efficiencies to providing social benefit to societies through improved livelihoods and healthier environmental and economic conditions. By including a social value principle in the definition of circular economy, the social components and environmental components of CSR programs requires that initiatives for sustainability are inclusive of human welfare, in addition to ecological health.

In urban development strategies, the social value principle requires that circular economy includes institutional, cultural and welfare considerations, so that circular economy can avoid the unintended negative social impacts demonstrated in Masdar City [21, 23]. The ethical circular economy calls for other organizations to follow the robust sustainability approach of *Interface*, and requires that the social and environmental components of the *Philips CSR* strategy be integrated. The ethical circular economy recognizes that the dynamic supply chains of product delivery systems interact with, and impact the urban platforms of cities to create thermodynamic and physical impacts through the movement and consumption of resources, but also that these structures have implications on quality of human life. Furthermore, the inclusion of cultural and social dimensions will provide information necessary to create the conditions that people want to live and thrive in.

One reason that the social value principle is not naturally included, despite the inclusive focus of the founding principles and preceding schools of thought, is that the social sciences and cultural components are less represented in most entities designing circular economies. Social factors are also more sensitive and less predictable under pressure, and have historically been undervalued. This makes implementing the social value principle a significant undertaking; it requires a different way of planning, designing, executing and evaluating circular economy strategies. Social scientists need to be included in the conversation, in addition to as many stakeholders, such as cultural groups, income levels, and political groups, as necessary. In addition, the impacts of social construction and knowledge transfer have demonstrated significant influence on the outcome of circular economy interventions. Lastly, CE will most effectively integrate the sixth principle if it is impact focused, or maintain a goal to create an overall positive impact on society. Integrating perspectives and methods from the social sciences in addition to the technical sciences in the design of circular economies can help effectively incorporate the social value principle into circular systems. The three important components to include when designing ethical circular economies are: (1) stakeholder engagement and knowledge sharing, (2) consideration of social and cultural processes and structures, and (3) maintaining an impact focus.

## 8. Stakeholder Engagement and Knowledge Sharing

Stakeholder engagement and collaboration are vitally important for effective implementation of the ethical circular economy for two main reasons: (1) it allows for diverse perspectives and groups to be represented, and (2) it allows for enhanced degrees of knowledge sharing and an increased level of knowledge integrated into strategies. Traditional circular economy applications are focused on resource flows – the movement and matching of materials, energy, and money. *Knowledge flows* are underappreciated resources that play a vital role in how circular economies are implemented. As evidenced in industrial ecology literature, knowledge flows have been found to be equally as, or more important than energy, material, and financial flows in building successful circular economies [27]. Despite the prevailing focus on the physical and monetary flows, research in industrial symbiosis has found that knowledge flows must be appropriately matched to create beneficial and effective resource exchanges. Effective collaboration and information sharing is equally as essential in effective

industrial symbiosis networks as geographic co-location [27]. In other words, groups of individuals must have a way to come together and exchange information about their wastes, surpluses, and needs to identify circular economy opportunities in the first place. Furthermore, by including a diverse and inclusive set of stakeholders, underserved communities have a way to influence the system design while introducing knowledge that outside scientists and researchers may not know. It also allows for all cultural considerations to be included in the design, so that circular economy is not used in a way that degrades important cultural values. This is a very important component in ensuring that circular economy implementation is meeting the needs of the people of the region. In this way, effective stakeholder engagement can enhance both the social and technical components of the circular economy.

Knowledge sharing between diverse stakeholder groups allows for trust and relationship to be built between individuals, organizations, community groups, and other relevant entities. Circular economy is dependent on trust and intimate relationships to foster effective and innovative collaboration, and information sharing promotes the development and strengthening of organic relationships [28]. The creation of platforms for information sharing to encourage collaboration and self-motivated cooperation between groups will also expand relationship networks and build trust. Therefore, plans for circular economy developments should include a phase of creating such platforms for the CE to be designed on.

A collaborative platform such as this can facilitate inter-stakeholder discussions to identify shared challenges, solutions and barriers to circular economy implementation, as well as allow vulnerable groups to share unique concerns and needs. Collaborative platforms can also promote tacit knowledge transfer and creation, which is conducive to encouraging collective creativity and innovative problem solving needed for transformational circular transitions. Tacit knowledge is knowledge that is difficult to share with other individuals through verbalizing or documenting, and is shared instead through application and context, and so requires accessible collaborative processes. The exchange of tacit knowledge can be hugely beneficial in the innovative brainstorming and design phase of circular economy and other sustainable development approaches. Integration of stakeholder engagement and the importance of knowledge flows in the creation of the ethical circular economy provides a mechanism for which innovative solutions can be created through collective strategies while recognizing the necessity of human communication for cooperative action.

## 9. The Social Construction of a Circular Economy

The ethical circular economy emphasizes that social processes and structures must be integrated into design of circular economy strategies with as much weight as energy and material processes in order to be successful. Social processes have strong influence on the way social-ecological systems respond to change and therefore impact the way circular economy development strategies are implemented and executed [29]. Emphasizing the construction of social systems as strongly as material and energy systems in the design of circular economies serves a two-fold purpose: one being that improved social sustainability is an ultimate goal of circular economy and the processes and structures that comprise this dimension should be included in strategies to ensure appropriate outcomes. Secondly, social conditions themselves play a crucial role in CE development. It is important to recognize that circular economies are implemented by people – people interacting and acting cooperatively and collectively. Since trusted relationships and knowledge sharing is so important in the development of productive resource exchanges, the social conditions of a community must encourage collaborative and productive relationships to form.

The institutions, policies, and the overall culture of a community profoundly influence the success of circular economy implementation, because institutional and political arrangements often hinder or help sustainable development efforts through implicit incentives that drive collective human behavior [30]. The institutional analysis and development framework, developed by Elinor Ostrom, is a useful tool that can be used to identify and analyze interactions between the physical environmental and the sociocultural and institutional realms of a system [31]. Incorporating this and other institutional analysis methods can improve circular economy strategies by better

understanding and predicting the collective human actions and responses that may affect transitions to circular economies. By requiring identification of all relevant actors, the positions and information they hold, and possible actions and outcomes, it can point out specific players and opportunities within the larger society that will have a significant role or be impacted by circular economy [31].

An additional component of the social construction of the circular economy is the understanding that transitioning from a linear to a circular economy is quite disruptive to social structures, as it often involves changing the way people earn their livelihoods and interact with the resources they consume. Despite its beneficial intentions, a transition tends to have some immediate negative impact for some stakeholders. For example, drastically minimizing the amount of trash sent to the landfill, while beneficial for the environment, might mean a loss of jobs for waste haulers and landfill operators. In some developing countries, closing a landfill means eliminating the sole source of income for individuals who make a living selling salvaged recyclable material. Understanding and recognizing these disruptive impacts can allow implementers to design the circular economy in a way that includes solutions to these problems. Former landfill operators or recycled material sellers can be the primary source of labor for an eco-industrial park sited on a closed landfill. In this case, circular economy creates meaningful work in a sustainable industry for impoverished or marginalized individuals, avoiding the creation of social externalities while simultaneously creating social and economic benefit to the community. Such an approach allows for a new circular system to gracefully integrate with or completely replace the old.

Designing circular economy systems with social construction in mind also allows the system to capitalize on available social capital and to identify and take advantage of opportunities for social synergies that advance sustainable development efforts. In a linear economy, wealth creation is heavily subsidized by extraction of natural resources. Moving to a circular economy, innovation, circular-production efficiency, and labor input must replace this subsidy. As a farmer partners with microbes and plant “waste” to build soil, a circular economy that recognizes finite resources relies on human ingenuity in partnership with biomimetic processes to build economic value. This has major social implications with regards to education, human behavior, social systems and even religion. *What roles do culture and religious teachings about materialism play in accelerating or inhibiting the transition to a circular economy? Similar to recent movements within religious institutions to advocate for renewable energy as a faith-based responsibility to care for creation, can the social will to move to a circular economy rest in the aisles of congregations?* Indeed, given the fundamental nature of the changes that circular economy would create in today’s socio-economic systems, social capital would largely impact, and be impacted by, the transition to a circular economy. Integrating social construction thus allows for the circular economy to guide more than just the physical components of sustainable urban development. When the circular economy concept pervades social institutions, there is greater opportunity for accelerating and developing holistic sustainable solutions.

## 10. Impact Focus

The social value principle requires that the ethical circular economy maintain a goal of creating an overall positive impact within the society where it is implemented. An impact focus ensures that the “Net Positive” component remains the outcome of circular economy transitions, and that CE is always working towards creating beneficial outcomes for humans and the environment. Focusing on the impact means more than just the balance of environmental and economic costs and benefits. It must include the impacts that circular economy systems have on human well-being and livelihoods, and requires an inventory of the positive and negative impacts in all three dimensions. As a stand-alone concept, the net positive movement is developing methods for accounting and weighing positive and negative impacts to determine an overall “net position.” As a circular economy principle, maintaining an impact focus ensures that circular economy strategies are beneficial to society and that the focus is always on actual outcomes, even in the inevitable situation that a holistic assessment of positive and negative impacts is not possible. It creates an outlook that steps away from

the complexity of interrelated components of a circular system and focuses on the overall effect circularity is having on the targeted region.

An impact-focused CE approach brings the concept more readily to developing countries. Much research and practice of circular economy has been done in developed countries, leaving out the regions in the most need and who could therefore benefit the most from the circular economy. The bias towards the developed countries tends to skew circular economy objectives towards ends that may not be universally accepted. For example, most traditional CE developments strive for decreasing the environmental footprint of consumption - appropriate for developed countries. However, a sustainable society strives for improving the livelihoods of those in poverty and decreasing vast inequalities. In the case of many developing countries, sustainable development may allow for a trade-off of *increased* consumption and a higher environmental footprint for improved well-being and livelihoods. The circular economy must be framed and applied in a way that allows for different needs of different countries. Developing such CE systems requires very different approaches for regions of different needs and challenges. A net positive perspective can help CE align with the goal of global sustainability.

In sum, incorporating the sixth principle into CE models to deliver ethical circular economy solutions requires the integration of stakeholders, effective mechanisms for transferring knowledge, consideration and analysis of social construction in design phases, and an overall impact focus. A key way to accomplish these complex requirements is to diversify the expertise brought to circular economy solutions. While it is important to let the technical expertise guide the design as is the case in most existing examples, it is equally important to include knowledge and methods from underrepresented disciplines such as human and organization behavior, institutional analysis, human well-being, and other social sciences. It is also necessary to include stakeholders from the community that represent the cultural, social, and economic needs, opportunities, and challenges of the people affected by the circular economy. The next section discusses how the relatively new field of sustainability science is developing some promising methods for achieving the ethical circular economy, and how Arizona State University is using its unique resources to implement the enhanced circular economy to create sustainable solutions around the world.

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