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Research article

Green Systems for a Grey Society

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Abstract

The current research relates to the application of circular systems in the built environment. As of most projects related to the built environment (BE), and as it much fits in the framework of the circular economy (CE), this study will be applied for social well-being (WB) (goal no. 3 and No. 11 of the SDGs) for a particular age group. Sustainability is a delicate issue, for which sustainable construction should be the front-of-mind of any relevant company. Regarding older adults (OAs) as focusing populations, action plans must be carefully thought out; since sustainability is even more crucial for building a healthy environment for OAs. For this purpose, circular systems are promising. However, for an action plan to take effect, studying the various influential aspects, such as the support systems, locations, access to needed resources, government and community intervention, among others, are necessary. Therefore, this study aims to define and emphasise the role of parties such as investors and housing corporations to put a win-win effort in this specific field. At the same time, authorities could engage in a new or revised set of policies (the next phase). For this article, the three main components are:

1. The problems and the cruciality of the circular frameworks.
2. A short overview of the particularity of the senior citizens,
3. The significance of the circular systems for the built environment for older adults,

Finally, the leading case study focuses on the population aged 65 years and above in the Netherlands.

Keywords: Housing for Older Adults; Circular Systems; Sustainable Built Environment; construction sector; living circumstance

Introduction

Inside bustling cities, buildings and their surroundings are occupied by young individuals and the elderly population. The elderly community comprises some groups of individuals with unique needs relative to the more vibrant society. Therefore, addressing the state of the prevailing conditions within which the elderly live is required, which will have a current and a future impact. Adults ageing around 65 comprise typically more or less healthy and still active people (Parisi et al. [1]). However, most seniors of about 80 years and older are vulnerable to various negative experiences such as illnesses, both physiological and mental (dementia), increased frailty, among other outcomes (Rhoades et al.,; Di Ciaula et al., ; Jing et al., ; Machado De Jesus et al., [2-5]). As an excessive instance, the ESA-AA (2015) reports, "falls (and the consequent fractures) constitute a significant indicator of increasing frailty and loss of independence and mobility in older people. One-third of people over the age of 65 who live in the community fall each year, and this proportion increases to 50% of those aged 80 years and older. Such observations show the degree of vulnerability in the elderly population as it pertains to reduced independence, whether in mobility or other primary functions. Further, critical insight is gained regarding the need to restructure prevailing living conditions to accommodate the diverse and unique needs of the senior citizens (AG A2, [6]). Thus, the adaptability of their living circumstance with these needs is crucial. However, facilitating their homes is not the only instance for this modelling/remodelling; effectively designing and sustainably materializing the houses can also significantly improve their life conditions (Tsunetsugu ; Miyazaki ; Song et al., [7-9]).

Universal Recognition and Requirements

Although it has yet, a long way to go (EPA; WGBC; SCE, [10-12]), recognition of the devastating influence of humanity's reckless activities and their provocation in the past brought a blessing light and inspirational hope (EPA, 2020; Hudson, 2020). The environment is in urgent need of help, thereby demanding more than just theoretical discussions; the implication is that there is a need for robust strategies with appropriate enforcement

measures. Another positive observation is that these actions show considerable improvements. Table 1. displays an example of these action plans related to the Clean Air Act in the US, 1990-2020 (roughly showing the results in 2010 and 2020).

Table 1: The 1990 Clean Air Act Amendments Prevent.

	Adult Mortality-particles	Asthma Exacerbation	Chronic Bronchitis	Emergency Room Visits	Heart Disease-Acute Myocardial Infarction	Infant Mortality-particles	Lost Work Days	Mortality – ozone	School Loss Days
The year 2010 (in cases)	160,000	1,700,000	54,000	86,000	130,000	230	13,000,000	4300	3,200,000
The year 2020(in cases)	230,000	2,400,000	75,000	120,000	200,000	280	17,000,000	7100	5,400,000

*The health benefits of the Clean Air Act programs that reduce levels of fine particles and ozone (EPA, 2020)

In line with this example, the legislative act of the European Union also proves the necessity and efficiency of similar action plans. Similarly, the official journal of the EU (2016) reports the achievement of considerable progress in the field of anthropogenic air emissions and air quality over the past 20 years. These include the extensive events of the statement from "the Commission of 21st September 2005" entitled TSAP (Thematic Strategy on Air Pollution). According to the OJEU (2016), the Directive 2001/81/EC has been instrumental in the progress by setting caps on Members States' between 1990 and 2010 achieved a reduction of 82% of the SO2 (sulphur dioxide), 47% of NOx (nitrogen oxides), 56% of the NMVOC (non-methane volatile organic compounds) and 28% of the NH3 (ammonia) in the Union. Although these reductions had a negative impact, recognition is helpful and the starting point for revision. Reconnaissance of the past experiences will improve the programs. For example, within the EU, the 7th Environment Action Program is geared toward preventing the harmful effects of reductions which is part of the program's long term objective (Table 2).

Table 2: Emission reduction commitment for SO2, NOx and NMVOC. The reduction commitments have the year 2005 as the base year, and for road transport, apply to emissions calculated based on fuels sold (adapted from OJEU, 2016).

Member state	SO2 reduction compared with 2005		NOx reduction compared with 2005		NMVOC reduction compared with 2005	
	For any year from 2020 to 2029	For any year from 2030	For any year from 2020 to 2029	For any year from 2030	For any year from 2020 to 2029	For any year from 2030
Netherlands	28%	53%	45%	61%	8%	15%
Belgium	43%	66%	41%	59%	21%	35%
Germany	21%	58%	39%	65%	13%	28%
UK	59%	88%	55%	73%	32%	39%
EU 28	59%	79%	42%	63%	28%	40%

One of the positive outcomes of these recognitions is a global movement in the building sector (BPIE, [13],CGP, [14]; BPIE, 2018). This evolution originates from the Silent Spring of Rachell Carson (1962), UN Conference on Human Environment (1972), the WCED and the well-known Brundtland Report (1987). From there comes the Earth Summit conference in Rio de Janeiro (1992), formulation of the Kyoto Protocol (1997), World Sumit for Sustainable Development in Johannesburg (2002), the "Inconvenient Truth" of Al Gore (2006), the Paris Agreement (2015), Morocco Conference (2016), among others. Due to the severe impacts, these protocols and agreements need immediate responses in the form of strategies to tackle the problems. At the same time, law enforcement should guarantee the accurate performance of practical policies. Despite a slow adaption, the movement toward acting on the agreements among parties has intensified the need to propose sustainable measures toward protecting the environment.

A good example is the national renovation strategy which is part of the EU action plans and is under the directive of several European governments (BPIE, 2018). This remodelling strategy proves the appreciation and application of sustainability indicators and their effectiveness in their design and practice (BPIE, [13]; BPIE, 2018; IGBC, [15]; EC, 2018). A case in point, Ireland (2017-2020) has established a Behavioral Economics Unit to explore the real motivations and drivers in decision making about renovations (DCCIE, [16]). The planning and implementation of the national renovation strategies started in 2012 in an agreement under the Energy Efficiency Directive (EED). The said agreement obliged governments, based on Article 4, to present their strategies in 2014. Hence, every three years, updates of the strategy were needed, although, from the 28 members that agreed, only 18 submitted their revised plan in 2017 (BPIE, 2018).

The idea of renovating the EU started in 2011 following the European Commission (EC) initiation for reducing energy consumption in buildings. These EC movements were flower power for sustainability, resulting in creating a cross-sectoral organisation in 1998 called the EuroACE (European Alliance of Companies for Energy Efficiency in Buildings). In turn, Euro ACE launched the Renovate Europe Campain (REC) in 2011. These plans are likely to promote social benefit; however, mainly in the long-term compared to the short-term (WGBC, [11]). Although these strategies are frontiers in converting the theory and discussions on the environment into action and depend significantly on local conditions, they benefit from their experiences while innovative theories progress. Similarly, in the BE, for some areas that are still lacking proper setup, they can benefit from the mentioned experiences without taking all the steps from the beginning to the end. For example, the housing for OAs that need thoughtful considerations in the policies, strategies, and action plans, decision making could profit from other fields. Housing for senior citizens needs a crucial revision of traditional planning towards more environmentally responsible programs and acting strategies(Figure 1,2).

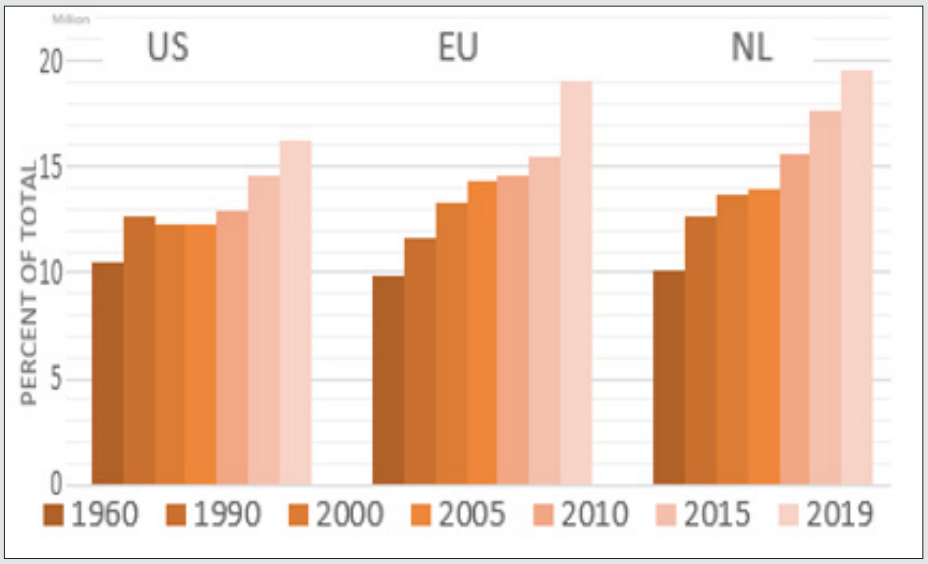

Figure 1:

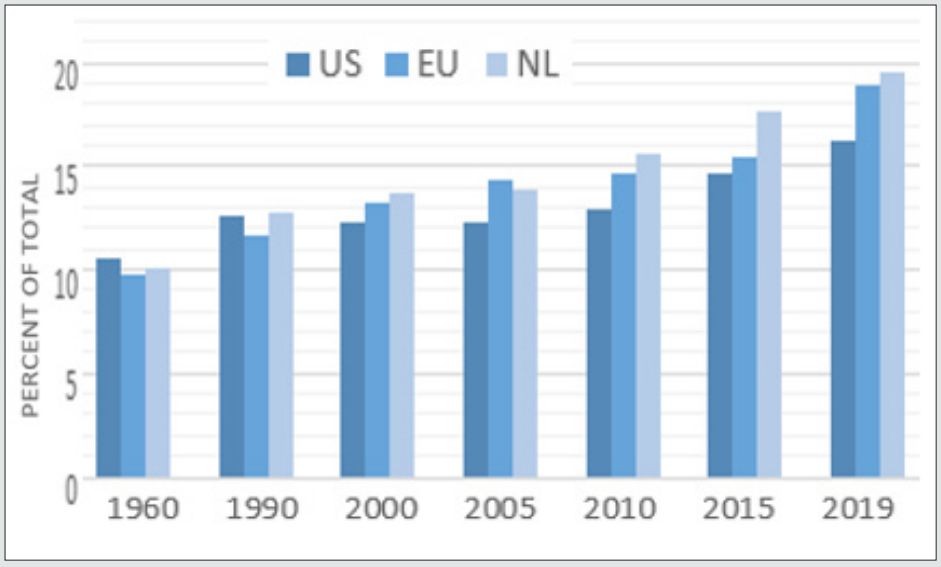

Figure 2: (a & b), The upward number of OAs in the NL (compared to the US and the EU region).

A Particular Community Inside the Extensive Viewpoint

Because of the integration of some factors such as improvements in the healthcare systems and a higher living standard, the number of older adults (OA) increases (Welte et al., [17]; UN, [18]; Dudel et al., [19]). For example, in the United States, the rise in total life expectancy from 1960 to 2010 was 9% (Medina et al., [20]); further, Medina et al. [20] forecasts that the surge will continue to 2060 but a 6%, making a total rise of 16% compared to that of 1960. The

US Census Bureau (2015) reported that the proportion of the US population aged 65 and older will increase from 16% in 2014 to 21,4 in 2050 and 24% in 2060 (Colby and Ortman [21]). However, based on the European Commission's report, this number in the EU region will rise from 18% in 2013 to 30% in 2060 (Davies, [22]) (Table 3).

Table 3: The rise in the population aged 65 and above in the US, EU, and the Netherlands.

	1960	1990	2000	2005	1010	2015	2019	2060
US	16469470	31521853	34801176	36383151	40155435	46950237	53206334	94676000
EU	34029300	56766527	67400323	73156433	77963571	85538662	91576481	1.56E+08
NL	1023435	1903049	2163016	2306595	2564997	3035666	3398161	5392216

However, Dutch statistics (CBS, 2018; CBS, 2020) show that 3,159,000 inhabitants of the Netherlands in 2017 and 3,159,660 in 2019 were older than 65 years. While in 2012, the RIVM predicted an increase of approximately 4,5 million for OAs in 2050 (RIVM/ CVTV, [23]), CBS [24] data showed that by 2050 more than 4800000 people in the Netherlands will be 65 years and older. Other countries confirm the growing trend in the number of OAs (Ekamper, Smits; Spijker, Mohammadi et al., [25-28]; Di Ciaula et al., [3]).

Yet, CBS predicted that 27,5% of the society in 2060 would belong to the ODs. Hence, some other sources, such as Population Pyramid (2020), presented an even higher percentage (28,1%) for this group in 2060. The BVZ (2020) reports that the number of individuals 65 years and older in the Netherlands will grow to about 4,8 million in 2040. Beets (2011) also stated that one-third of the Dutch population in 2040 would be 65 years and older. Figure 3. demonstrates this growing number from 1996 t0 2019. Moreover, Table 4 shows the continuity in the year 2000, 2019, and 2050, distinguishing between females and males (particularly in the Netherlands).

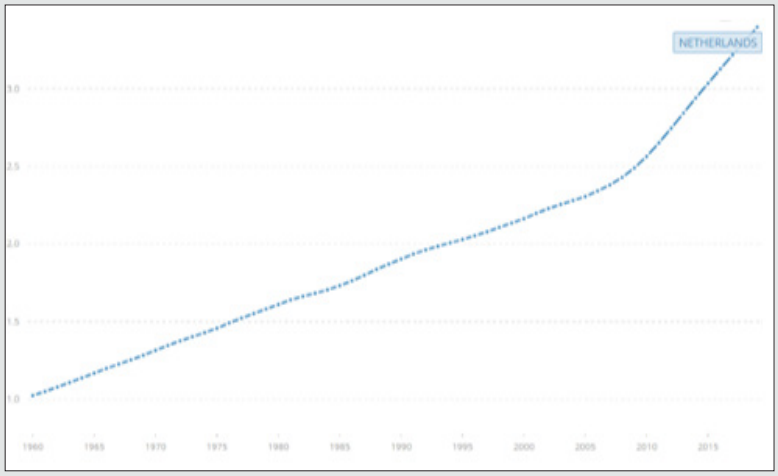

Figure 3: Population ages 65 and above – The Netherlands in 1996- 2019 (The World Bank Data, IBRD- IDA 2020).

Table 4: Population ages 65 and above – The Netherlands in 2000, 2019, and 2050.

Populations ages 65 and above					
The year 2000		The year 2019		The year 2050	
2.163.016		3.398.161		4.876.000	
Female	Male	Female	Male	Female	Male
1275053	887961	1825541	1572629	2610000	2266000

*Based on the data provided by CBS (2019)

For comprehensive insight regarding the construction industry, the housing sector represents an excellent example of an area of need among OAs that needs to be addressed. According to the BVZ (2020), in 2040, about 2.5 million older adults will live in their own houses (doubling the numbers of 2015), and between 150000 to 200000 of them will be inhabitants of care- houses. Thus, the number of homes required for senior citizens increases, but there is a massive shortage of future institutions. Nevertheless, the Netherlands has an exemplary record when it comes to taking care of OAs. Smits et al. [26] noted that almost 18% of individuals older than 65 receive professional home care in the Netherlands, which is the highest rate compared to other European countries. However, projections show that by 2040, up to 80.000 new places in Dutch care- houses will be required. Due to the financial limitations, around 140000 of the 65 plus individuals do not live in proper residences (BVZ, 2020). The implication is that they require at

least a remodelling of their houses to support the various needs that come along with ageing. Remodelling is vital because, although nursing home utilisation in the Netherlands is among the highest in OECD countries (Alders et al.,), seniors prefer to live in their own houses. Hence, for many reasons, primarily to fulfil its citizens' preferences, the Dutch government seeks solutions for supporting seniors concerning improving their living conditions through sustainable construction practices (Van Hoof et al., [29]).

Across studies, healthcare systems are shifting from hospital-centric to community-centric (i.e., primarily home-centric) to achieve high-quality and cost-effective End-Of-Life (EOL) care (Laville et al., [30]; Bainbridge et al., [31]; Mohammadi et al., 2018). In addition to new policies (such as the NEN 1010:2015) for senior citizens' living circumstances, practical outcomes of research on informatics and ergonomics in the housing expose the need for adjustments in elderly individuals' homes these new systems. Therefore, the remodelling may incorporate reconfigurations that, in turn, require extra construction works. Again, the latter attracts attention because, based on SCP and CBS, "The elderly aged 80 or older living independently are less likely to have (chronic) medical conditions than people in nursing and care homes. Certain disorders occur just as often among people in care institutions" (CBS, [18]). Table 5 shows a distinction of the two broad categories for the ODs who live at home from those being taken care of in care-houses (i.e. includes all sorts) in the Netherlands. All of these proves the requirement of plenty of modern strategies and practical solutions in the OAs related BE.

Table 5: the quantity of Older Adults residing in two different types of living circumstances (data adopted from Actiz, 2020).

Number of 65 and above			
At home		In institutional care	
2015	2040	2015	2040
1.200.000	2.5 00.000	120	150.000 - 200.000

However, this growing number is not the only influential element for decision-makers. Psychological loads that result from the lifestyle and the need for proper living conditions for this particular age group undermine their overall quality of life (Newson et al., [32]; Bherer et al., [33]; Wang et al., [34]). The health-related subjects of the impact of the living environment on the elderly have been substantially studied (Welte et al., 2009; van Hoof et al., [35]; Rechel, 2013; Mohammadi et al., 2012). There is consensus among scholars that modelling/remodelling the BE for such the elderly, not only the environmental component of sustainability is essential, but its social component is crucial (SPP-EU, [36]; Nakanishi et al., [37]). Planners need to adopt the circular systems mindset to address the needs of the elderly when it comes to ensuring that the BE promotes well-being across the various dimensions of their lives. For example, through sustainable construction, the elderly will be saved from the hazardous nature of pollution, thereby experiencing healthy ageing.

Step forwarding For Advancing A Linear Movement

In general, circular Systems (CS) and building practices mainly entail operative and feasible components of effective strategies vastly concerning the natural environment. Taking care of the future generation is recommended, but providing a healthy living environment for them does not mean neglecting the current society such as OAs. The well-being of OAs is crucial to society; this is also because they are likely to guide the younger generation through advice and mentorship (Parisi et al., [1]). Likewise, the well-being (WB) of the entire human community is achieved when there is sufficient focus on the needs of the elderly and those of the younger generation; component 3 of the GSDs (UN, [18]) is also evident. Lenzi et al. [38] stated that "The investigation of the determinants of human well-being has always been one of the main scopes of economic theory. The definition of WB itself, however, evolved." In a circular system, social well-being (SWB) and economic growth run parallel to each other. In a previous study, Stiglitz et al. [39] expressed that "Purely economic measures, mostly represented by income growth, have been progressively integrated by other indicators of quality of life which, taken together, contribute to the individual's self-perception and overall WB". For any society, social wellness is judged based on the capacity to address the needs across the different population segments within which OAs are part.

Of course, WB is itself a separate and vast area of research with various categories. Retrospectively, Easterl in (1973) pointed out a tension between objective (economic) and subjective WB; his seminal work has been mentioned as the root of scientific debate on this subject (Veneri, [40]). However, indications show a relatively recent political interest in SWB subject (Lenzi et al., [38]). In these regards, an optimistic and straightforward association between income growth and SWB has been proven (Ferrara et al., 2019). Determining the link between SWB, the economy, and living spaces (i.e. circumstances, natural and the built environment) is met with great complexity. In themselves, the three different but interconnected subjects are large research areas, thereby demanding the application of the rigorous process to determine causality. Studies such as Graham (2012) discussed new transportation and reshaped this paradox of SWB into a spatial setting. With a similar approach but through a different scale of the domain, Sørensen (2014) connects the WB in part to the population density of the urban areas in certain situations.; he concludes that the density influences the WB. Thus due to the sensitivity of OAs, the mentioned influences should be well-considered. Hence, exposure to the impact of diverse factors from one location to another adds to the critical attention in planning such societies. These are visible complexities in assessing the needs of OAs, while the entire issues in this regard are much more than the visible ones. Lenzi et al. [38] discussed one aspect of these complexities focusing on the mechanisms associated with individual residential units and individuals' SWB. Although these are very important and, on a

general level, interrelated to the subject, they go beyond the defined scope. However, their significant outcomes could be deducted and transformed into the research frame as they fit within the CE structure's social sustainability component. For these purposes, first, rather than main differences, similarities of sustainable development (SD) and the CE will be considered.

Sustainable Solutions and Circular Economy

While its origin is not entirely known, carbon is the earth's major building block (Brack, [41]; Smith et al., [41]) and even the main ingredient of the entire universe (Henning et al., [43]; Marsteller, B. E., 2007; Muradov, [44]; Moskowitz, [45]). However, products of carbon that are driving support for the revolutionary developments of technologies (Conforti et al. [46], Shahnoori et al., 2007; Ritchie et al.,[47]) are also responsible for causing severe problems on and around the Earth (Aslanove et al.,[48]; Visagie et al. [49]; Priyant Mark et al., [50]).

The causes for the transition in the built environment

The Global Carbon dioxide emissions from fossil fuel sources grew by 2,7% in 2018, presenting a 1,6% increase compared to 2017 (APA, [51]). Due to its enormous impact, the BE alongside environmental issues has been vastly studied. Fossil- based materials are accountable for nearly 40% of all energy-related CO2 discharge and a significant fraction of embodied carbon (Blok et al., [52]). The construction industry substantially hinges on fossil fuel-intensive materials (Korsh et al., [53]). The BI has an enormous volume of material flow in the global economy (Glass et al., [54]). Based on Yeheyis et al. (2013), the building sector consumes 32% of the global resources, including 12% of water and up to 40% of energy. Previous studies (e.g., GBCA 2009, Yeheyis et al., 2013) also noted that traditionally, about 40% of all raw materials from the earth and 25% of natural wood are cast-off for construction. According to an update by the WGBC [55], currently, the industry accounts for 36% of the world's energy use and 39% of global energy-related carbon emissions. Approximately 30% of the extraction of natural resources also goes for charging this industry (Frits Benachio et al., [38]). Hence, CCAP (2018) also recounts the 40% of the energy consumption to buildings, thus causing an environmental burden that is, if not more, as important as the economic costs. Still, problems and subsequent impacts are rising. For example, the International Energy Agency (IEA) estimates that with the current principles, the CO2 emission will double by 2050 (IEA, 2014). According to UN-IRP (2017), from 1970 to 2017, the use of the materials has more than tripled and could double again by 2050. Hence, some studies (Rockström et al., [56]; Steffen et al., 2015, UN-IRP, 2017) "have calculated that *four out of nine planetary boundaries have been surpassed, irreversibly changing the functioning of major Earth system processes (such as climate)*". Such levels and ways of implementing technology, which is supposed to be invented for humanity's comfort, have enormous toll and consequences both currently and in the future. According to the United Nations, 54% of the world's populations live in urban areas, which will grow up to 66% by 2050 (UN, 2014; WTA, 2018). The latter means a rising living standard (Bringezu [57]), an increase of use instead of produce, and a massive dispersion of waste. The consequences are felt more in the environment because the BE demands an even larger volume of materials flow. Therefore, it is evident that these traditional approaches should stop in advance, paving the way for proper practical strategies need to come forward.

Towards Solution Finding, The Transition Mode

The lack of natural resources, harmful emissions, pollutions of air, sea, water cause the earth to reach a momentous extend. Therefore, robust mitigation methods are crucial. One of these emerging responses to pollution is the Circular Economy (CE), a paradigm shift (Benachio et al., 2020). The incorporation of sustainability in practice in the last two decades was not equally efficient as the debates were. However, the evolving circularity based on the experiences as outcomes of these debates embodies inherent potentials.

In a CE, the drawbacks of a process are also opportunities. Concentrating on the BE, the materialization of buildings is a good case. In this regard, various aspects involving the procedure, from the raw materials extraction, first transportation, refinement, second transportation, manufacturing, and energy and emission related to the entire processes and a twofold economic value are essential. A CS for the Building Industry (BI) goals includes new meanings, for example:

a. Minimising energy consumption goes for the next step for zero, and even for positive energy

b. Waste minimisation covers the fact that waste is a new source of materials,

c. Low carbon emission aims at seeing carbon as a source for other applications (Cruz Rios et al., 2019)

Although sustainability and the CE are mostly aligned, studies show some confusion between the CE and SD. For instance, the primary CE does not offer a great deal of concern about future generations and social justice. The main goal in the CE involves economic prosperity achieved through environmental quality (Kirchherr et al.,; SCE, [12]). With its traditional definition, SD emphasises the responsibility and care for the natural resources, air and water contamination for both the current and the next generation (Meadows et al., Shahnoori et al., Okeke et al. [58]; Cornescu et al.). However, some particular issues, such as bio-diversity, were not sufficiently addressed in the conventional SD (Rockstrom et al., [56]; Jackson, [59]; WWF,; Geissdoerfer et al.,). Studies (Ceballos et al.,; UN-IRP,) discover that the drastic decrease of biodiversity in the last thirty years resulted from "*a combination of habitat loss, overexploitation and pollution.* They (Ceballos et al.,; UN-IRP,) conclude that the mentioned changes radically harmed the ecosystems. These issues showed that a transition towards more sustainable socio-technical systems is necessary (WBCSD,; Markard et al., [60]). Hence, the provided bases of the SD have not been taken entirely into action (Banerjee and Duflo, [61]). In addition to

these, critical economic concerns attract a lot of attention (Jckson, [59]; Sachs, [62]; Geissdoerfer et al., [54]). The given background and experiencing the shortages that undermine the efficiency of sustainability are the causes of the emerging concept of the CE (Brennan et al., [63]; EC,; Lieder et al., [64]) for the BE. Although the differences between the CE and SD remain imprecise, the study of Geissdoerfer et al. [54] presents them; some are shown in Figures 4, 5.

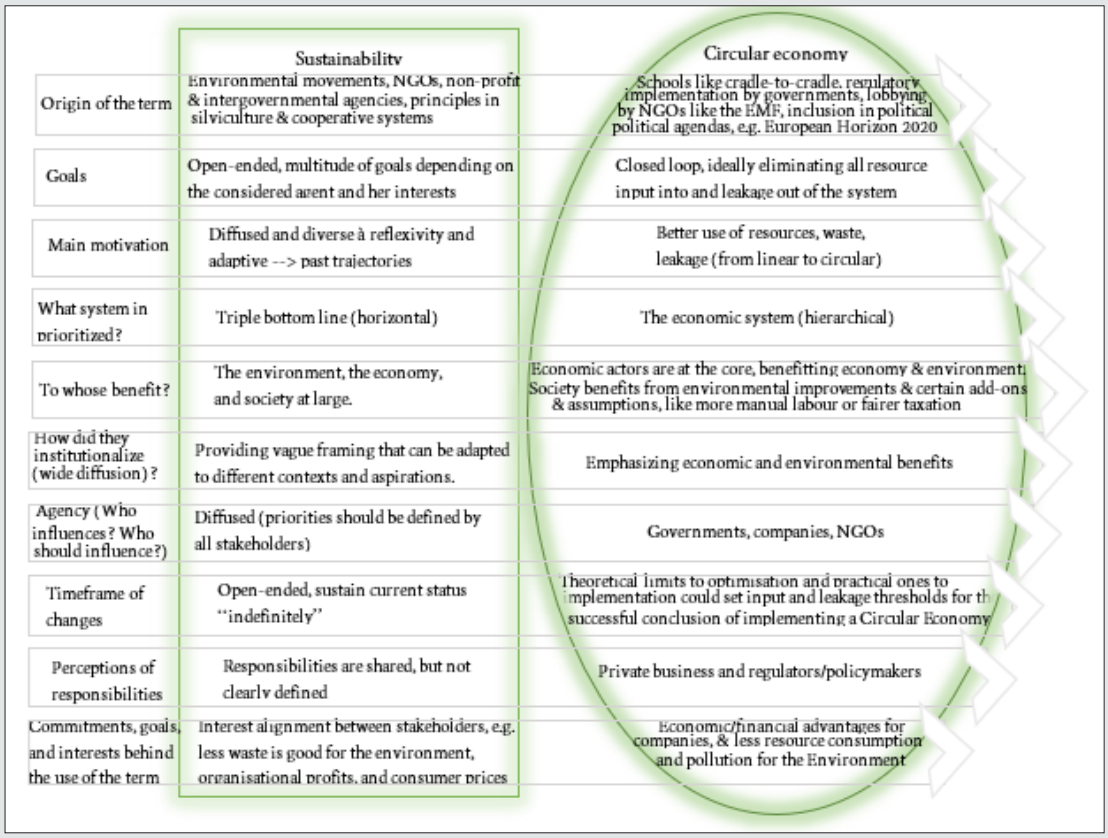

Figure 4: The differences between sustainability and the CE based on the selection of Geissdoerfer et al., 2017.

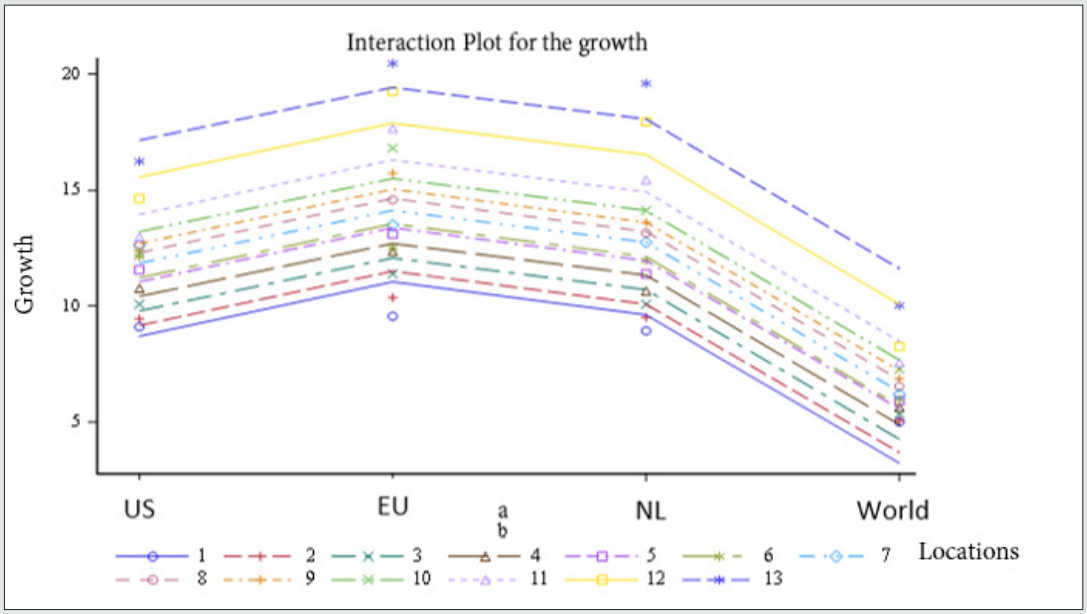

Figure 5: The interaction effect of the four lands and years-1 to 13 indicate the year 1960, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, 2005, 2010, 2015, and 2019.

This transition of the linear to the circular in the BE in some particular areas is exciting. For example, in evaluating the housing for senior citizens, both the influential components of the environment and social (including SW) gain weight. Unlike sustainability, the CE covers the two mentioned components for the housing of OAs due to their economic potentials. Thus, the CE makes the sustainability of the BE for OAs possible. Hence, to achieve the Paris Agreement target of limiting global warming to as close as possible to 1.5˚C integration of all the segments of the building market, including the BE for OAs, is required; this, in turn, is only possible through working in the CE framework (Hoogzad, [65]).

Analysis and Discussion

The importance and concerns about the older adults have also been emphasised in Section/Article 23 of the New Agenda in the Introduction of the Declaration and Goal number 2 section 2.2., Goal number 11 section 11.2, and section 11.7 (UN-SD, [66]).

Recapitulation regarding the housing for OAs

The importance and concerns about the older adults have also been emphasised in Section/Article 23 of the New Agenda in the Introduction of the Declaration and Goal number 2 section 2.2., Goal number 11 section 11.2, and section 11.7 (UN-SD,[66]).

Recapitulation regarding the housing for OAs

To analyse the difference between the four groups, using SPSS version 25, we have applied one-way ANOVA. The calculated F statistic is equal to 13.65, a relatively high value with the significance of p-value equal to 0.0001 that is again significantly lower than 0.05. Therefore, at more than 99% confidence, the null hypothesis, "there is no difference between the means," can be rejected. We can conclude that there is a statistically significant difference between at least two of them.

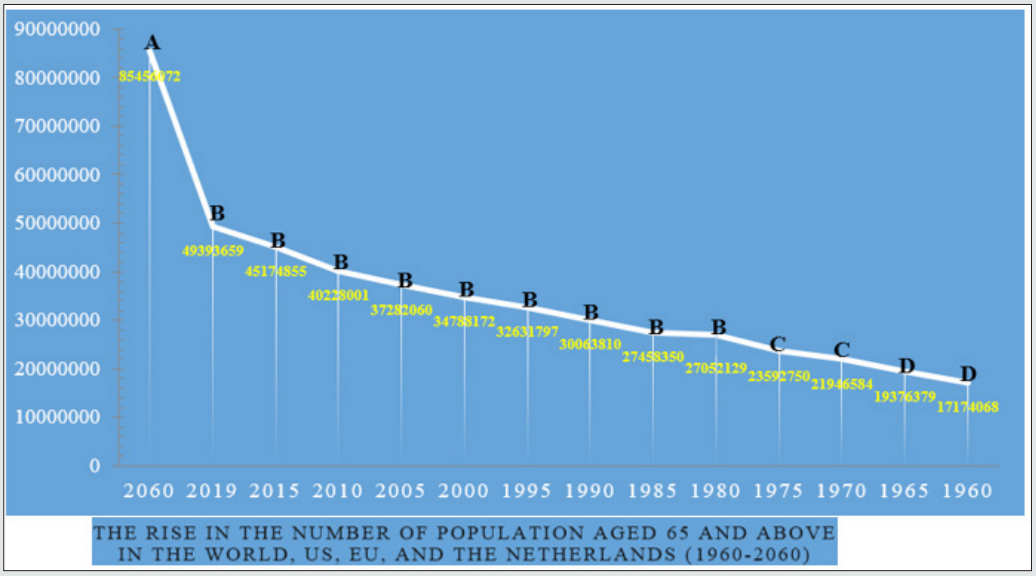

Figure 6: The rise in the mean of the population aged 65 and above in the US, EU, and the Netherlands (1960-2060).

To see whether the differences between means come from the interaction effect of the two variables, land and year, we have applied two-factors ANOVA. As shown in Figure 6, all dashed lines for the years are parallel, showing zero interaction effect.

As can be seen, the highest growth is related to the year 2060, and the lowest increase is associated with 1960. The letter A, B, C, and D indicate the significant relations between the means of related years. The growth is continuing during the years 1970 and 1975. A meaningful relationship can be seen from 1980 to 2019 that indicates a consistent trend in growing in this time interval, and this is the base for future growth. The outcomes of the research of 2015/16 conducted by the SCP collaborated by the CBS practically proved that living at home was more efficient for the health of OAs than being placed in institutional care (CBS, [24]). In the Netherlands, the Dutch government has set plans to build 75000 houses each year (Snijders,), while about 95000- 115000 dwellings are needed annually, assuming a peak of about 235000 in the year 2021. The estimated shortage at the beginning of 2019 was 263000 (about 3.4 of the housing stock), which continues to 200000 for the year 3030. However, in the coming two years, the government states that an extra 44000 suitable homes per year are needed (GN, 2020), which is lower than the numbers projected by other sources. In a similar study, Van Hoof et al. [85] emphasised the inequality between the increase in the number of OAs and the development of new houses and institutional care settings. Further, the number of homes and places needed, for example, in 2017, for more than 700000 elderly, only 100000 residential care and nursing home facilities were prepared (Van Hoof et al.,). Yet, the given statistics only encompass individuals aged 80 and above.

Regarding the housing situation for OAs, the number of people in this age group increases at a higher pace. Therefore, it is evident that a large volume of favourable living settings is necessary.

However, the second notification about the construction systems applied for senior citizens relates to qualifying and upgrading current houses. The objective is to adjust the existing homes to the relevant findings of the cutting edge technologies and the updated policies (GN, 2020). Thus, extensive construction work associated with upgrading the housing standards for this community is needed, which is also a significant emphasis for the Dutch Government (GN, 2010). Uniquely, the desire for OAs to stay in their homes relates to the previous experiences as opposed to it being a current trend. Due to the housing shortage after WWII, the government had regulated policies to nudge OAs to move to elderly homes and care-houses (Alders et al., 2015). These policies had a pretty long-lasting effect that could only varnish in recent decades, and only then the natural desire of living in their own homes became visible. Preferring to live in houses rather than in care-houses is observable in some other societies like in the US. According to Roberts et al. [67], approximately 58% of the OA population belongs to the age group of 65 to 75, which is also the most capable group living independently in their houses. Based on the study of Mather et al., by the year 2060, around 25% of American will be ages 65 and older. Roberts et al. [67] further stated that approximately 78% of householders aged 65 and older in US-owned homes. Alders et al. state that some OAs to go for institutional care were the low standard of the houses, which is also changing towards a higher quality by the remodelling programs and gradually assembly of the modern technologies in the residences. The emphasis of preference of a house over the institutional care is not the focus of this research; however, it underlines a direction that is important in the CE and for applying CSs in exploring opportunities of positive change as it pertains to the living circumstance of OAs.

Restatement of Discussion on Css And The SD

Sustainable solutions for SWB in a healthy environment for OAs' WB fit the earth's capacity to cope with the environmental consequences and, yet, inherent significant advantages. Fulfilling the requirements for the WB in the current situation and the future generations is of the rewards above. Regarding the outcomes of the sustainability strategies in practice across the world, especially in the last two decades, using CSs is the most appropriate way of achieving the goals. In an abstract view regarding the BE for OAs, energy consumption, emission, and waste dispersion are slightly different from those for the rest of society.

Despite the environmental and social potentials that the CSs offer by virtue of the economic enhancement, they attract the proper attention of businesses and corporations, at least, more rapidly. To have a healthy planet, referring to the scale of green building, is immature, and a broader perspective of sustainability on the upper level of urban and even economic is required (Mussinelli et al.,). Studies such as Della Torre et al. [68] emphasised the need to focus on harmonising green perceptions with the intentions of the 2030 UN Agenda for SD, the NSDS (i.e. Strategia Nazionale per lo Sostenibile in Italian) and the outlines of the SD Foundation and the Green City Network. In association with the construction industry, there is an urgent need to remodel the current thinking, decision-making, design, construction, and maintenance of the built environment. As an essential outcome of all of these discussions, it is clear that novel solutions for the BE that could directly go into practice or act as support for the method based on CE would fit in the frame of updated SD are crucial.

SNBCEI [69] stated that the EU construction sector currently employs 18 million people and produces 9% of the GPD (Gross Domestic Product). Hence, it consumes half of the entire material extracted and generates one-third of the waste in the EU countries. Therefore, the construction sector appears a vital industry for the operation of the CE (Debacker et al., [69]) in the entire EU zone and even throughout the world. Regarding the enormous dimensions of the material flow and the striving for energy, the idea of the dematerialisation of buildings and similar solutions become even more crucial (Glass et al., [54]). Other approaches within the CE framework, such as Material Passports, also help secure value for material use (Luscuere, [70, 71]). All of these fit very well in CSs. Based on CSs, everything is a resource for something else (Mcdonough et al., [72]; McDonough,). Hence, CE and CSs are doors to solve the problem of economic losses. Many companies that deal with failures in the processes that simultaneously impact the environment without any financial benefits (Coffr., 2019) seem to be attracted to the CE's potentials (TNO, BNA, NL Ingenieurs, Coffr., Finhouse2019 …). Figures 7,8 shows the scheme for emerging CSs [73-80].

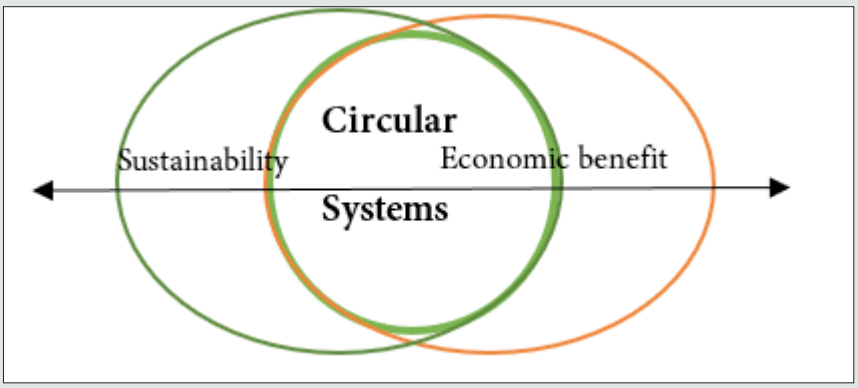

Figure 7: Inclusiveness of the emerging Circular systems to contain the economic benefits in a sustainable context.

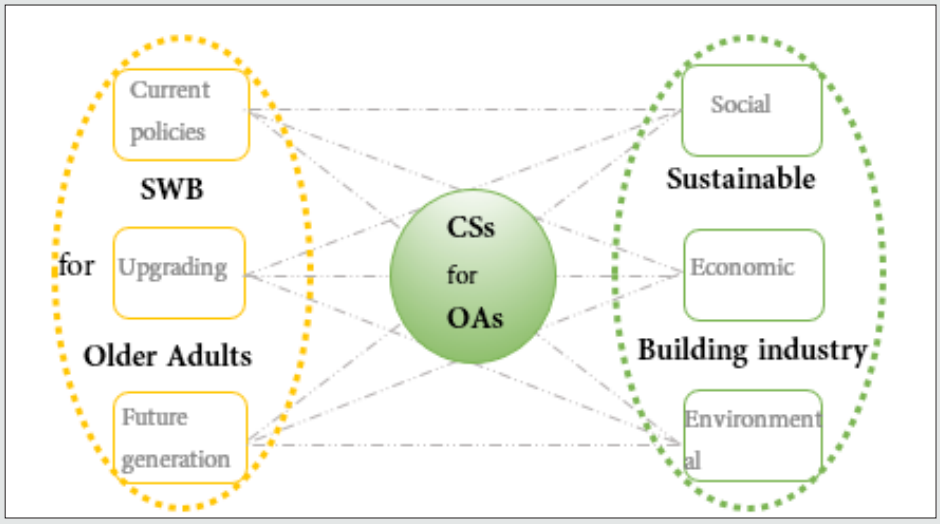

Figure 8: coherence of the Cirular Systems as a core covering solutions for a sustainable housing for older adults.

Summary and Conclusion

The prediction of doubling the impacts on the environment by 2050 is a call for emergency rectifications. Hence, if the role of BE in the environmental burden has been identified as significant, by controlling these issues, nature will crucially improve. The OAs society covers a relatively high percentage of the population, seemingly 19.5 % in 2019 and 26.24% in 2050 in the Netherlands (data from the CBS, 2020). The related influences on the building industry become more significant. The matter that was previously discussed shows that, first, the SWB emphasises on CSs for OAs. Hence, with the high level of complexity of the internal elements and their interplaying, a strong covering strategy is conditional in SWB for the BE. Earlier examples in the content of this research showed that comprehensive strategy and action plans that may not even have positive results transmit inherent potentials and lessons for the next generation of development for modern and revolutionary methods [81-85].

Finally, the subject of the current article is a segment of broader research that starts with literature study and research in the statistics of the housing context for the senior citizens and the current state of problems in the construction industry concerning the environment [86-89]. The main point here is a logical discussion to prove the significance of the circular systems and the influence of the BE for senior citizens on the building sector. Thus, in summary, it is inevitable that:

a. Historical changes in the materials consumption need a thoughtful revision; in this regard, the current systems require a revolutionary reconfiguration

b. Circular systems not only are helpful but also could provide practical solutions for the built environment. The attracting attention of the relevant organisations and companies are proofs of their limitless capacities [90,91].

c. Except for a few influential differences, senior citizens comprise a growing population at a similar rate of growth; this is observable not only in the Netherlands but also in the neighbouring markets

d. Older adults related buildings have a significant impact on the building sector; this effect will even intensify for the year 2025 and 2050

e. Regulating policies for modern fields in the built environment are step forwarding; therefore, they require quick, comprehensive, and periodical revisions

f. Implementing CSs for the construction and reconstruction, modelling and remodelling of the built environment for OAs are highly efficient and crucial, offering plenty of benefits for the stakeholders

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