BUILDINGS & CITIES

Technological efficiency limitations to climate mitigation: why sufficiency is necessary

SYNTHESIS PAPER

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ABSTRACT

A key global challenge of the United Nations' 2015 Paris Agreement is to constrain global warming to 1.5°C. This critique of the 'Buildings Breakthrough' agenda draws on existing literature and asks whether a technological approach to limiting greenhouse gas (GHG) emissions from the built environment is adequate to meet the Agreement's objectives. Efforts to reduce emissions within this sector have focused upon clean technology (cleantech), *e.g.* clean energy, efficiency and circularity. Could sufficiency policies with a demand-side perspective have a significant role? Although the Intergovernmental Panel on Climate Change (IPCC) emphasised that the aggressive and immediate introduction of sufficiency policies was necessary to attain the Agreement, the importance of sufficiency in constraining growth of the building stock and (per capita) floor area is not yet part of the policy mix. Such policies are urgently needed to complement cleantech approaches, which form the focus of the so-called 'Breakthrough Agenda'. The implication for the construction sector in the Global North is a shift away from new build toward long-term stewardship and adaptation of the built environment. For the Global South, growth of the built environment is needed to accommodate population growth and urbanisation, but requires an approach emphasising sufficiency in space, services and accessibility.

POLICY RELEVANCE

The direction taken by the 'Buildings Breakthrough' will have critical implications for buildings, infrastructure and construction, and the sector's contribution to climate mitigation and other global challenges. Policies based upon clean technologies and resource efficiency alone are likely to fall short of the stated ambitions to limit GHG emissions because efficiency gains are often offset by growth in floor area and built-up land. Therefore, additional policies and measures are needed to constrain material-driven growth and consumption carbon, with sufficiency at the forefront. This synthesis paper illustrates how the principle of avoiding and reducing demand for materials and land, hitherto largely overlooked in policy settings, may be applied at various scales, ranging from urban to precincts, and to buildings.

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1. INTRODUCTION

COP27 provided a renewed focus on the importance of the buildings and construction sector in limiting global warming to 1.5°C by 2050, while halving emissions by 2030 (UNEP 2022a). A report by the Global Alliance for Buildings and Construction (GlobalABC) (2022) highlighted the inadequacy of current efforts that are based upon increased energy efficiency; gross floor area had grown by 11% between 2015 and 2021, namely 24 billion m^2—equivalent to the total land area of buildings in Germany, France and the Netherlands. This growth in construction, which outpaces that in population and progress in energy efficiency and intensity (Figure 1), is predicted to increase until 2060, equivalent to adding the carbon footprint of another New York City every 34 days, or that of Paris every week (UN DESA 2018). Despite the likely devastating impacts on climate, biodiversity and pollution, and other Sustainable Development Goals (SDGs), governments and industry appear to accept this increasing footprint, expected to be concentrated in China, India, Africa and, alarmingly, the US (Oxford Economics 2021). They continue to be 'bedazzled by energy efficiency' (de Decker 2018), while Inger Anderson, head of the United Nations Environment Programme (UNEP), plans to 'put energy efficiency into that footprint' (UNEP 2022a).

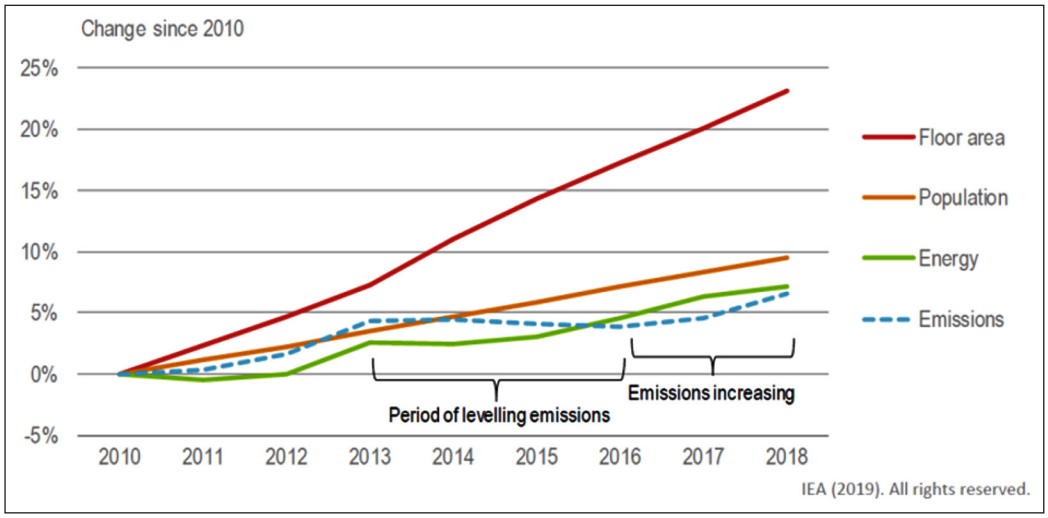

Figure 1: Changes in floor area, population, buildings sector energy use and energy-related emissions globally.

Source: GlobalABC (2019: 9).

The 'Breakthrough Agenda', launched at Glasgow COP26 (UK COP26 2021), aimed to strengthen international cooperation on decarbonisation of high-emitting sectors by accelerating:

> the development and deployment of the clean technologies and sustainable solutions needed to meet our Paris Agreement goals, ensuring they are affordable and accessible for all

by a global target date of 2030. Beginning with Paris COP21, and launched at COP26 by a coalition of 45 world leaders representing over 70% of global gross domestic product (GDP), the 'Breakthrough Effect' has been strongly promoted by SYSTEMIQ (2021, 2023) 'to accelerate the net-zero transition' by focusing on engineering and technological tipping points for low-carbon solutions. Beyond tackling climate change alone, the ambition is 'to catalyse the growth of markets, jobs, and economic development globally [...]'. For the power sector, the 'Breakthrough' would be:

> Clean power is the most affordable and reliable option for all countries to meet their power needs efficiently by 2030.

For road transport, zero-emission vehicles would be the new norm. For steel, near-zero emission steel would be the preferred choice. For hydrogen, affordable and low carbon hydrogen would be globally available by 2023 (UK COP26 2021).

Although related to some of the above focus topics, the critical buildings and construction sector as a whole was strangely omitted from the original Agenda. To address this anomaly, France announced in June 2022 that it would co-lead with Morocco a new 'Buildings Breakthrough' target,

alongside other willing governments. Subsequently, a France–Morocco-led ministerial meeting, intended to advance the 'Breakthrough', was held at COP27 (UNEP 2022a). Those discussions, to be followed by a meeting of global construction ministers in 2023, indicated that the focus will be upon cleantech, especially as the Agenda will be under the joint leadership of the Clean Energy Ministerial and Mission Innovation (CEM 2023).

While cleantech and its innovation plays a role in decarbonising the buildings and construction sector, the important contribution of resource use and 'consumption carbon' may be overlooked. The latter includes the carbon associated with the consumption of goods and services by inhabitants of a city, with the carbon 'embodied' in building products, materials and construction of space being of special importance to this discussion (C40 Cities 2018). The EEA (2021) emphasised this point:

> The European Green Deal and other political initiatives for a sustainable future require not only technological change but also changes in consumption and social practices.

This brings us to the concept of 'sufficiency', which seeks to avoid demand and consumption of energy, materials, land and other natural resources, while ensuring wellbeing for all within planetary boundaries. According to the IPCC (2022: 9–9), implementing sufficiency and demand-side measures can reduce the dependence of climate mitigation on technological solutions. Moreover, this can reduce global GHG emissions in sectors such as buildings and land transport by 40–70% by 2050 compared with baseline scenarios, while some regions and socio-economic groups require additional energy and resources (IPCC 2023: 28–29).

Therefore, the main research questions are as follows:

- Are the 'Buildings Breakthrough' and related cleantech approaches capable of achieving their objectives alone?
- Should sufficiency complement cleantech policies to enable the built environment to meet the Paris Agreement of limiting warming to 1.5°C?

This synthesis paper seeks to address this question in two ways. First, by highlighting global imperatives, such as the need to constrain growth in material stocks while reducing poverty and inequity. Second, by examining current thinking, trends and approaches, including decoupling, resource efficiency and circularity, to assess their relative ability to meet the challenges.

In this regard, a study of a recent White Paper helps to understand the application of such thinking to the built environment and urban areas, while revealing important gaps related to unequal distribution of global resources. Using a research method known as 'philosophical conceptualisation' (Meredith 1993), an effort is then made to extend current thinking and policies towards a sustainable built environment with fresh insights, which may also enable the 'Breakthrough' to be more effective.

The paper is structured as follows. The next section provides a brief overview of the global imperatives and the current state of knowledge. Section 3 then critiques current doctrines and approaches that form the background to the 'Breakthrough Agenda', and reflects on whether they may fall short of meeting the global challenges. Section 4 provides a more in-depth critique of those approaches that impinge upon the built environment and urban areas, focusing upon the White Paper. The need for global rebalancing in resource use is highlighted in section 5, while section 6 considers the transformative ability of sufficiency and fairness policies when applied to the built environment. The implications for current approaches and the 'Breakthrough Agenda', which are focused on cleantech, are discussed in section 7, leading to the concluding section 8 and specific recommendations.

2. GLOBAL IMPERATIVES AND CHALLENGES

According to the IPCC (2022), 'aggressive and immediate mitigation policies with rapid and deep changes in demand' are necessary to limit global warming to 1.5°C and bend downward the

upward trajectory of the warming curve by 2025. It highlighted the urgent need to introduce sufficiency policies that have the potential for dramatic reductions in greenhouse gas (GHG) emissions. Sufficiency differs from efficiency, which involves marginal, short-term, incremental and technological improvements (Princen 2003). Sufficiency measures are especially important in limiting growth in floor area per capita, especially in the Global North (IPCC 2022: 9–4). Of special relevance to this paper, 'sufficiency addresses the issue of a fair consumption of space and resources' (IPCC 2022: 9–8). Moreover, as explained by Saheb (2021a), sufficiency should come first within a sufficiency–efficiency–renewables (SER) policy package.

Although resource consumption is not usually reflected in emissions reporting, recognition of consumption carbon is increasing (C40 Cities 2018, 2019). Emissions gap reports have consistently highlighted the inequity of consumption carbon and the massive shift required by higher income societies, supported by research by Wiedmann *et al.* (2020), Hickel & Slameršak (2022) and others. While 'advancing zero-carbon technologies' and 'applying zero-emissions technologies' in its key recommendations, the *2022 Emission Gap Report* acknowledges the imperative to 'reduce excess floor area' to decrease emissions in the building sector (UNEP 2022b: 49):

> the greater the extent of new floor area that is constructed, the more materials are required, and the higher are the embodied emissions. [...] Minimising the amount of floor area which is well above the area to meet basic needs, can have a large effect on emissions in the sector.

The continuing build-up of large material stocks, which have grown 23-fold in the 21st century, was highlighted by Circle Economy (2023), while Haberl *et al.* (2022: 9) identified this as 'a currently neglected driver of energy use and emissions'. Their research has revealed that settlement and infrastructure patterns, including their extent and spatial layout (density and form), influence energy use and GHG emissions almost as much as economic activity. Larger floor size and more space between destinations raise energy demand and emissions (including embodied) in buildings, transport and other infrastructures. The importance of urban land use and the built environment in shaping urban GHG emissions was also reinforced by the IPCC (2022: 8–30).

According to O'Neill *et al.* (2018), and related to the sufficiency concept, stocks of critical natural capital must be maintained (within the planetary boundaries) while, at the same time, stocks of critical human and social capital must also be maintained (within basic needs). The authors explain that 'provisioning systems', comprising physical and social systems, mediate the relationship between biophysical resource use and social outcomes.

The challenge, then, is to meet social needs (not wants) in an equitable manner, while avoiding and dramatically reducing and rebalancing resource consumption and GHG emissions. In this regard, Morrissey & Heidkamp (2022: 262) noted the perplexing dilemma facing policymakers: 'How can climate change mitigation and sufficient levels of development and poverty alleviation be delivered simultaneously?' Mitigation strategies, involving dramatic cuts in emissions, constraining urban growth, and finding less resource-intensive building and infrastructure solutions, need to be balanced with ensuring societal wellbeing and equitable access to services.

3. CURRENT DOCTRINES AND APPROACHES

3.1 FAITH IN RESOURCE EFFICIENCY, 'DECOUPLING' AND CIRCULARITY

Organisations such as the International Resource Panel (IRP), GlobalABC and SYSTEMIQ acknowledge the need to rethink economic systems and reduce overconsumption. SYSTEMIQ is an influential system-change company. It seeks to help transform the five systems of energy, nature and food, materials, urban areas, and finance in order to create a better economy. It argues that:

> the multiple environmental crises of climate change, biodiversity loss, and pollution are all connected to *inefficient* use of resources.
>
> (SYSTEMIQ 2022b: 6, added emphasis)

With a similar economic focus, the Global Commission on Economy and Climate, via its flagship project, the New Climate Economy (NCE), examines whether and how climate policy can be made compatible with strong economic performance. The NCE (2018: 10) claims:

> we are entering a new era of economic growth, which is strong, sustainable, balanced, and inclusive, driven by rapid technological innovation, sustainable infrastructure investment, and increased resource productivity.

No mention is made of seeking to avoid or minimise the use of resources. Alarmingly, such approaches continue to ignore the warnings of Rees (1999, 2009) and others from the Global Footprint Network (Kitzes *et al.* 2008):

> Today's global society essentially equates sustainability with maintaining growth through technological innovation and greater material and economic efficiency. [...] When absolute reductions are required, more efficient growth is anathema.
> (Rees 2009: 304, 306)

Faith continues to be placed in resource efficiency, 'green growth' and a 'circular economy' (CE), with a belief that economic growth may be 'decoupled' from environmental impacts (Ness 2020). According to the IRP (2019: 28–29):

> Achieving decoupling is possible and can deliver substantial social and environmental benefits [...] while also supporting economic growth and human wellbeing.

It is claimed that improved resource productivity can lead to *relative* decoupling of wellbeing from resource use:

> Moreover, environmental pressures fall, achieving *absolute* decoupling of environmental impacts from economic growth and resource use [...] through absolute reductions in high income countries.

Such assertions, however, have been dismissed by organisations such as the European Environmental Agency (EEA) (2021), which pointed out that any successes are only in relative and not absolute terms. Moreover, while circularity may extend the life of some products and hence reduce resource extraction, it is ineffective when demand continues to increase (Spash 2021a; Skene 2018).

Nevertheless, resource efficiency—including circularity—continues to dominate thinking. IRP co-chairs Potočnik & Teixeira (2022) have argued that climate targets could be achievable, while improving wellbeing via the 'indispensable missing piece' of resource efficiency strategies. High-income countries should reduce their resource use while aiming to maintain or increase wellbeing through 'absolute decoupling', with continued economic growth still firmly in the picture. With the right resource efficiency and sustainable production and policies in place, IRP modelling reportedly showed that by 2060, 'economies could still grow even with a 25% reduction in global resources use' (Potočnik & Teixeira 2022: 9; IRP 2019).

Note: Janez Potočnik, a much respected economist and former Slovenian politician, is seen as a highly influential player and economist within the context of this paper, due to positions including IRP (co-chair), SYTEMIQ (partner) and former EU Commissioner for the Environment. He has strongly promoted resource productivity (a major step forward), while steadfastly adhering to a belief in decoupling—although signs of a shift in his thinking of late, as noted below, may signal a wider change within the international arena.

3.2 SIGNS OF A SHIFT IN THINKING

More recently, Potočnik & Wijkman (2022: 18) acknowledge that although resource efficiency is part of the answer:

> it is no panacea [...] most of the gains have so far been cancelled out by the sheer increases in the volumes of consumption.

In addition, the authors begin to question the prevailing economic growth paradigm and modify the understanding of decoupling. Whilst traditional definitions of growth are largely based upon material intensive production and consumption, the authors refer to:

> a decoupling of growing quality of life from resource use through 'provisioning system optimisation' and circular economy.

There is a subtle shift to focus economies on 'optimising the systems that deliver our needs' for human health and wellbeing, including nutrition (healthy food), mobility, housing (built environment) and consumer goods. For the first time, we also find a questioning of predictions for material-driven growth:

> If nothing radical is done, resource use will at least double again by 2060. The consequences for the climate, vital ecosystems, and biodiversity will be devastating.

At last, *sufficiency* is mentioned:

> The long-term goal has to be an economy where sufficiency is at the core [...] to deliver human wellbeing while decoupling from resource use and its environmental impacts.

Pointedly, Potočnik & Wijkman (2022: 6) have made a subtle but telling adjustment to the IPCC's (2022) definition, by changing 'avoiding demand' to 'decoupling'. This may reveal an unwillingness to embrace demand-side solutions.

Despite recognising the limitations of resource efficiency and the importance of sufficiency, Potočnik & Wijkman (2022: 17) proceed to argue for resource efficiency in provisioning systems, under the banner of 'systemic material efficiency'. On the other hand, they acknowledge that the system-based approach:

> will not only address the supply side of the current economic system, but also the *demand* side—existing (over)consumption and wasteful use of natural resources.

In addition, and of relevance to the built environment, the CE is viewed in a systemic manner, 'to reduce not only waste but also space and material wastefulness within the systems'. These messages were repeated at a COP27 side event, which highlighted 'systemic resource efficiency' and CE, when Potočnik once again stressed the need to find ways to achieve decoupling. On the hand, IPCC co-chair Jim Skea was a lone voice in advocating sufficiency (IISD 2022).

Nevertheless, there is a promising new emphasis on the need to save resources at scale, beyond the current focus on electrification and greening energy systems. It has been admitted that such strategies:

> will be inefficient, and not fast enough, without complementary system optimisation to provide social functions using fewer resources in the first place.
>
> (Potočnik & Wijkman 2022: 12)

Although termed as 'resource efficiency' rather than 'sufficiency', it may nevertheless signal an important change of direction. This message was reinforced by Wijkman (2023: n.p.), who stressed that:

> green technology is not an automatic fix to sustainability [and] we must accept that there are limits to the growth in our material consumption. [...] In the long run, we need to have a debate about 'what is just right' (sufficiency).

3.3 SUFFICIENCY AND CIRCULARITY

In its latest report, Circle Economy (2023: 9) observed an alarming decrease in circularity, which now stands at 7.2%, and puts forward a 'shared' and 'bold' vision, based upon three key priorities to guide implementation: reduce, regenerate and redistribute. Of particular interest, reduce involves moving:

from efficiency to sufficiency, resilience and adaptiveness. A CE must push for a cultural shift to prioritise immaterial ways to fulfill needs.

This requires wellbeing to be seen as the primary indicator of economic progress, while recommending that national governments should establish 'consumption-based footprint reduction targets'. It is encouraging to see that 'narrow strategies', to reduce material and energy use, now form one of the 'key levers' towards a CE—although sufficiency is seen as using materials more efficiently, rather than not at all. This is evident from 'circular actions for the built environment', which comprise (yet again) *energy efficiency*, prioritising circular materials and approaches, making the most of what exists, and reusing waste.

While fully supporting the CE concept, Bocken *et al.* (2022: 2-3) have sought to have a stronger focus on concepts of sufficiency and 'making do with less'. Thus, they propose to build upon the concept of CE by proposing a 'complementary perspective': the 'Sufficiency-based Circular Economy'. However, the authors believe that 'circular economy potentially offers a way to decouple environmental impacts from economic growth'. In addition, they see 'the underlying economic logic for a sufficiency-based business model is to incentivise consumers to use less'. Similar to Raworth (2017), they express a wish 'to build a thriving society and environment regardless of economic growth'. Such an approach, though, is contrary to those who argue against the feasibility of decoupling and who promote concepts such as 'degrowth' and 'post-growth' (Mastini *et al.* 2021; Sandberg *et al.* 2019; Spash 2021a). Sufficiency may be debased by its positioning within the continued economic growth paradigm, and its importance diminished when it should be 'first' within a SER framework and paired with circularity in a policy package (Saheb 2021a, 2021b).

4. 'EFFICIENT AND BALANCED' URBAN AREAS: A CRITIQUE

4.1 RESOURCE-EFFICIENT URBAN AREAS

Despite the encouraging signs of a move towards absolute resource reduction and sufficiency, a recent White Paper by SYSTEMIQ is again based upon resource efficiency and decoupling. This has been selected for closer examination because of widespread support from the IRP, Club of Rome, Laudes Foundation, World Green Building Council, World Resources Institute, *etc.* Again, SYSTEMIQ partner Potočnik looms large. Arguably, the paper can be seen to represent the current state of thinking, especially within the EU.

Although recognising that urban areas are responsible for most of Europe's emissions, it makes the bold claim that 'cities and urban areas are already more resource-efficient than any other form of settlement', in terms of the built environment or mobility (SYSTEMIQ 2022a: 16). The White Paper also identifies the systemic problem of inefficient use of space as leading to excess material consumption and emissions, which do not 'efficiently' deliver societal wellbeing. 'More efficient and balanced use of space' via more compact forms of development is seen as important for reducing building and infrastructure emissions, including those related to materials and land use. As the paper highlights, Europe's urban land consumption is still growing at an alarming rate: between 2012 and 2018, its urban areas grew by 4646 km^2 (SYSTEMIQ 2022a). Earlier, the EEA (2006) pointed out that since the mid-1950s, the total surface area of cities in the EU had increased by 78%, while the population had grown by just 33%.

The so-called 'paradigm shift' promoted by the White Paper involves 'changing the way we use space in urban areas, towns and suburbs' to 'enable more people to live in vibrant neighbourhoods that reduce over-consumption of energy, materials and land' (SYSTEMIQ 2022a: 16). Although using existing floor space 20% more efficiently may reduce the current construction of 15 million new dwellings per year, the White Paper falls short of policies and actions that may directly restrain the growth of new buildings, floor space and infrastructure.

However, the emphasis on repurposing and adapting under-occupied buildings, as an alternative to new construction and 'land take', aligns well with the concept of 'sufficiency' as highlighted by the IPCC (2022). It is surprising, therefore, to find that sufficiency is mentioned only once in the entire 61-page document. Once again, SYSTEMIQ's dogged reliance is upon both resource efficiency and 'decoupling resource use from economic prosperity' (SYSTEMIQ 2022a: 8).

4.2 RESHAPING THE BUILT ENVIRONMENT

The White Paper calls for a 'reshaping' of Europe's built environment, while dismissing assertions that European cities are already built and using the pretext of growth in immigration: 'Both population growth and shrinkage dynamics can be leveraged to reshape for efficiency' (SYSTEMIQ 2022a: 27). Looking at new building over the course of one year, it makes a first attempt at quantifying the improvement potential in terms of GHG emissions; it finds:

> the massive benefit and urgency of including space efficiency in any climate strategy. [...] Emissions from the construction of buildings and roads, as well as from operational energy, could be reduced by 45% if all new housing demand was met in the form of efficient neighbourhoods [...].
>
> (SYSTEMIQ 2022a: 27)

Accordingly, the White Paper envisages large-scale transformations:

> The investment opportunity of turning sprawled areas into more efficient, connected hubs, on the one hand, and improving already efficient, compact area into balanced areas with green space, and natural cooling solutions [...] should be enormous.
>
> (SYSTEMIQ 2022a: 11)

Whilst occupying and repurposing vacant space is certainly required, one may question whether a major 'paradigm shift' and reshaping of Europe's existing urban areas, especially within its wealthier cities, is entirely justified—despite 'an accelerating trend' of migration into Europe, within Europe and within countries. The 'extensive reshaping' of the built environment may itself increase consumption carbon, via an initial spike in resource consumption with associated embodied and operational emissions. Furthermore, by avoiding any mention of sufficiency, the White Paper infers continued economic growth. On the other hand, 'challenging growth may be imperative if we are to achieve rapid far-reaching system change', especially in the context of the Global North (Hayward & Roy 2019: 163; Sandberg *et al*. 2019).

4.3 IMPLICATIONS FOR THE GLOBAL SOUTH

While clearly focused upon European cities, the White Paper lacks any global perspective. The objective of achieving 'vibrant', 'high-quality' neighbourhoods within the Global North, with '15-minute' access to services and nature, may pale into insignificance when compared with the desperate circumstances of those struggling to survive within congested, crowded and polluted cities of the Global South (Swapan *et al*. 2017). Similar views of 'sustainable urban development', though, have been expressed by organisations such as the World Urban Forum (WUF) (2022), Local Governments for Sustainability (ICLEI 2021) and the Marrakech Partnership (2021). The latter's idyllic Climate Action Pathway for Human Settlements 'to make sustainable living second nature' includes:

> It's 2050 and urban life has never been better. Despite more people living in towns than ever before, the world's towns and cities are now healthy, affordable and inclusive [...] new buildings now create only a fraction of the carbon footprint they once had. [...] As well as requiring less energy to build and maintain, contemporary infrastructure actively encourages people to adopt sustainable habits, such as walking to work. Residents are highly animated by these changes because they can see the everyday benefits they bring.

On the other hand, such visions of a sustainable future have been described as 'depoliticised techno-economist utopias that never deliver' (Sultana 2022: 2). As Roy (2005: 147) pointed out, planners must learn to work with 'exceptions to the order of formal urbanisation' within burgeoning megacities of the Global South. Global support and investment should aim:

> to harness and enable informal practices and institutions in cities related to housing, waste, energy, water and sanitation to reduce resource use and mitigate climate change.
>
> (IPCC 2022: 8–6).

5. GLOBAL REBALANCING OF RESOURCE CONSUMPTION

5.1 THE NEED TO SHRINK AND SHARE

As acknowledged by the IRP (2019), unsustainable use of material resources—especially by the North—lies at the heart of the triple planetary crisis of climate change, biodiversity loss and pollution. It saw the solution, though, as implementing *resource efficiency* and sustainable consumption and production policies, which:

> promotes stronger economic growth, improves well-being, helps to support more equal distribution of income, and reduces resource use across countries.
> (IRP 2019: 19)

Co-chairs Potočnik & Teixeira (2022: 18) also acknowledged the great inequity in access to resources:

> wealthy nations pursue their ambitions at the expense of others. A more stable and sustainably prosperous future demands a transition to an era of responsible resource use.

While:

> decreasing material footprints in high-consuming countries [...] and maintaining a fair share of resource use for low-income countries

may sound promising, there is little evidence of a concerted push to 'shrink' absolute levels of consumption.

This need for rebalancing of resource use, previously highlighted in Agenda 2021 (UN 1992) and emphasised by Schmidt-Bleek (1993) was reinforced by the *Emission Gap Report* (UNEP 2020) (Figure 2). The wealthiest 10% of humanity must reduce their consumption emissions by 90%, while the poorest 50% could initially increase their consumption to meet their needs—a strategy known as 'contraction and convergence' (Meyer 2000) or 'shrink and share' (Kitzes *et al.* 2008; Rees 1999; Ness 2022b). Such strategies were reinforced by IRP co-chairs Potočnik & Teixeira (2022: 8):

> resource use to meet growing human needs in emerging and developing countries should be balanced by absolute reductions in resource use in developed economies.

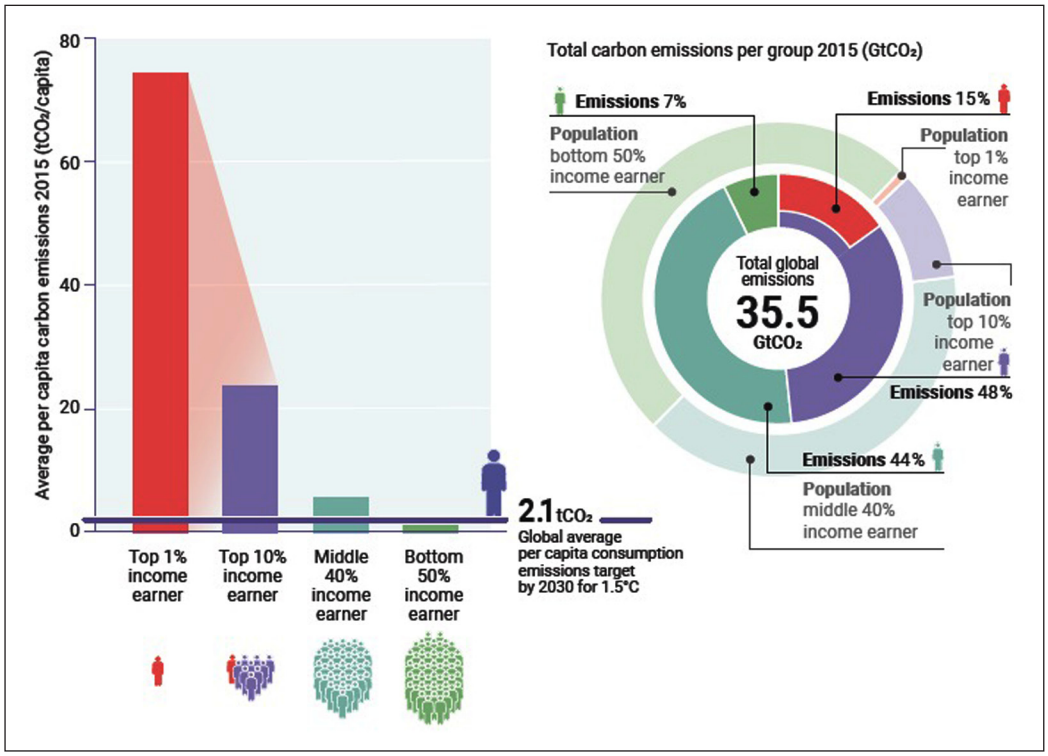

Figure 2: Per capita and absolute CO_2 consumption emissions by four global income groups for 2015.
Source: UNEP (2020: xxv).

Teng *et al.* (2011: 134) highlighted the unequal allocation of carbon emission space in the atmosphere, with such space having been excessively occupied by countries of the global North: 'Carbon equity should be an urgency and priority in the climate agenda.' Extending this research, Alcaraz *et al.* (2018) developed a model for distribution of the global carbon budget, based upon the criteria of equity while also accounting for different historical responsibilities. This clearly shows that countries of the Global North, including the US, EU and Australia, face a greatly reduced carbon budget with drastic reductions in their emissions, whereas those of the Global South could delay their peak emissions and later begin a gradual reduction. This is akin to the 'contraction and convergence strategy' first highlighted by Schmidt-Bleek (1993).

However, whilst burgeoning population and urbanisation in the Global South demand increased resources, the Global North continues to add floor area at an alarming rate. Thus, proposals and policies to boost climate progress in wealthier regions such as Europe, including 'efficient and balanced space use', should be viewed in the context of not only 'stark inequalities' within Europe but also the wider system context of the Global South. According to the International System Change Compass:

> Our policies must support adaptation and mitigation efforts across the world, and spur the necessary changes abroad. [...] This includes taking responsibility for the impact of our consumption in third countries.
>
> (SYSTEMIQ 2022b: 4)

Whilst this may be highly laudable, and the 'compass' recognises 'massive floor area growth', the importance of demand-side mitigation efforts, and the inadequacy of incremental efficiency gains, reliance is still placed upon 'higher material and energy efficiency in buildings', 'clean energy sources' and 'a transition to a low-carbon, circular built environment'. Although it advocates 'impact footprints related to consumption', the report lacks the required emphasis on avoiding and constraining demand for resources, especially by high-consuming regions of Europe.

5.2 GLOBAL EQUITY AND EMPOWERMENT

In terms of global equity, as argued by Mamphale Ramphale, co-president of the Club of Rome, the questions of who uses extracted resources, where and for what purpose must be made explicit. While strongly criticising excessive exploitation and wastage of material resources by the Global North, she asserted that materials should be used where they have most value in ensuring wellbeing (WRF-IRP 2022). In this regard, 'use value' is defined by the theory of thermodynamics as 'materials or energy with low entropy, *based upon capacity to deliver human needs*' (Georgescu-Roegen 1973: 47, added emphases). Thus, we can differentiate between 'superfluous consumption' and that which 'satisfies human needs' (Wiedmann *et al.* 2020), or between 'luxury emissions' and 'survival emissions' (Sultana 2022). This raises ethical issues about 'who gets what, and for what ends?' (Spash 2021a).

Furthermore, international policymaking bodies have been criticised as reflecting colonial, hegemonic and non-inclusive power structures, which devalue expert voices from marginalised populations and disregard 'the right to the city' and 'distributive justice' (Roy 2005; Sultana 2022; Hickel *et al.* 2022; Ness 2022a). Similarly, IPCC modelling and scenarios have been criticised by Saheb *et al.* (2022) as reflecting 'a very Western vision of the world' that anticipates continued economic growth in the North, while Hickel & Slameršak (2022) argue that these will perpetuate global inequalities. In the right direction, the *Earth4All* report of the Club of Rome (2022) seeks to tackle inequality, poverty and the need for empowerment—a message reinforced by Ghosh *et al.* (2022) who explained how climate responsibility should be fairly assigned.

6. TOWARDS A SUFFICIENT BUILT ENVIRONMENT

How could sufficiency policies enable wellbeing for all, equitable access to urban services and dramatic cuts in GHG emissions via less resource-intensive solutions for buildings and infrastructure? How can unbalanced growth in demand for floor space and infrastructure be addressed?

At the urban scale, the IPCC (2022: 8–91) and others have asserted that planning of urban settlements and cities may avoid or reduce demand for resources and minimise emissions by means of compact urban form, lowered use of materials, related cross-sector integration, light-weighting and the perennial resource efficiency. But do such strategies go far enough? While compact urban form may reduce travel, biodiversity loss and 'land take' (EEA 2006, 2016), this is often depicted as high rise visions of the '15 minute' or '10-minute city', as in the case of a 125-acre development for Seoul (WEF 2021). On the other hand, Pomponi *et al.* (2021) have pointed out that building taller is not the most effective way to meet growing demand for urban space: increased urban density *without* increased height can reduce life cycle GHG emissions while maximising population capacity. Meanwhile, many adhere to the conventional logic that large cities are more resource efficient and provide the greatest opportunity for emissions reduction (UN 2019), while failing to heed the advice of Rees (2009: 308) who urged:

> The overall goal of future planning should be to reduce the ecological footprint of the built environment.

Clearly, some means of constraining and rebalancing the demand for urban built form is required that may embrace sufficiency principles. A way forward has emerged via the notions of consumption carbon and carbon budgeting, especially on a per capita basis.

The ground-breaking report by C40 Cities (2018) on carbon accounting highlighted the need for final consumers in cities to be responsible and accountable for their 'consumption carbon' (including embodied), whereas cities may currently make the misleading claim that they are 'carbon neutral', based upon their operating, territorial emissions while neglecting consumption carbon. Emissions from building and infrastructure construction were expected to form the largest category (21%) of consumption-based emissions for C40 Cities up to 2050, requiring 'serious action [...] in this area' (C40 Cities 2019: 8). While the carbon 'embodied' in construction is increasingly recognised, attention is still mainly directed at the selection of low-carbon materials and emissions intensity per unit of floor area, which fails to constrain building size and floor area (Habert *et al.* 2020). Net-zero guidelines, though, now require consumption-based emissions to be taken into account, with direct and indirect emissions being included in net zero targets (ISO 2022).

Sufficiency interventions, therefore, offer a means of avoiding or reducing gross and per capita growth in floor space, and hence both operational and consumption carbon, while still meeting needs in a fair manner. Most interest has focused upon housing, such as downsizing per capita living space and prioritising cohousing, optimising and sharing the use of buildings, and their adaptation and reuse (Saheb 2021a). Taking a wider, urban planning perspective, trade-offs for achieving smaller per capita living space may be gained by links to various kinds of local infrastructures and green spaces that permit active family lifestyles beyond the confines of one's home. Furthermore, sufficiency can be applied to commercial, government and other building types and, as Gaspard *et al.* (2023: 12) pointed out, a low-carbon sufficiency-based scenario would entail 'a massive shift from new build to adapting existing buildings'. Huang *et al.* (2022) highlighted the significance of 'build with less', energy-saving refurbishment of existing buildings, digitalisation and work-from-home in enabling carbon neutrality at an urban precinct level. In addition, refurbishment, adaptation, retrofit and greater utilisation of existing stock can save on carbon otherwise generated by new construction. As noted by Ness (2021: 112), better management and stewardship of a stock of assets over their life can also lead to great sufficiency, resource efficiency and cost-effectiveness.

Previous investigations (HM Treasury 2013) affirmed that most carbon could be saved during the upfront, early decision phase, including whether to build less or not at all (Figure 3). Although such approaches are relatively new to the construction sector, the 'no build' strategy appears at the forefront of Strategy 1 in a recent 'circular building design toolkit', while aiming to avoid 'the intense material use linked to the construction of a new building' (Arup & EMF 2022: n.p.). For example, digitalisation and remote transactions may reduce the need for new buildings and infrastructure (IEA 2021), especially in smart precincts (Ness & Xing 2022). Although more contentious and requiring deeper consideration, sufficiency and social justice policies may challenge the 'use value'

and construction of new commercial structures and the like, whereby resources may be better allocated to serve higher value, social and community needs such as affordable housing and adapting existing stock (Ness 2022a).

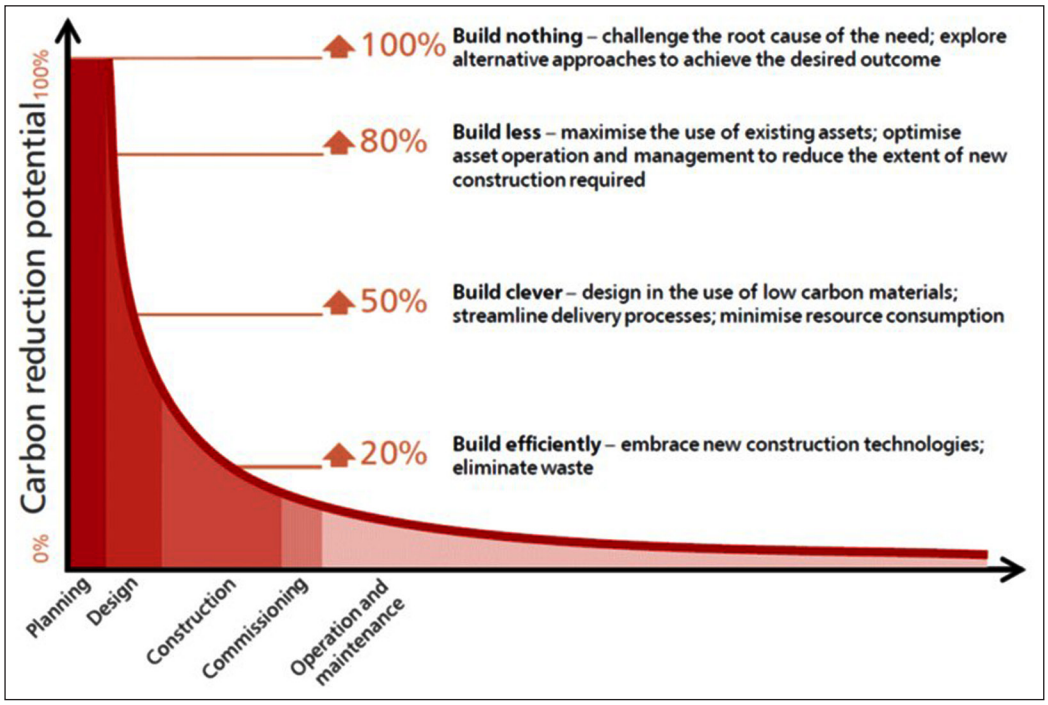

Figure 3: Carbon reduction potential.

Source: HM Treasury (2013) and Green Construction Board, reproduced under the terms of the Crown Copyright 2013.

Many of the above issues were recognised in the 'Graz Declaration for Climate Protection in the Built Environment' (SBE19 2019), which also engages with wider societal aims expressed in the UN's SDGs. One of the key statements is that 'specific GHG emission targets and budgets are needed for the construction and property sectors', which also 'need to be scalable (both top-down and bottom-up) for construction products, buildings, cities, building stocks', with clearly defined timeframes to deliver net-zero GHG emission levels by or before 2050. In this regard, Steininger *et al.* (2020) and Habert *et al.* (2020) have explained how sectoral and even building-related carbon budgets may be used to constrain over-building, while C40 Cities & Arup (2022) have shown how this could be implemented. In addition, per capita carbon allocations, or per capita shares of the planetary boundary, may direct more attention to what is built, for whom and where (O'Neill *et al.* 2018; Alcaraz *et al.* 2018; Teng *et al.* 2011). It will also be important to track the global increase in floor area, to identify where it is located (the North or South), to examine the building types and cause, and to promote more research on ways that floor area and consumption carbon may be reduced (Arehart *et al.* 2021).

7. FINDINGS AND DISCUSSION

The origins and theme of the 'Breakthrough Agenda', launched at Glasgow COP26, can be traced to SYSTEMIQ and its reports on accelerating the net-zero transition, the International System Change Compass, and efficient and balanced space use (UK COP26 2021; SYSTEMIQ 2021, 2022a, 2022b, 2023). It is closely related to the Green New Deal in seeking to create a green, low-carbon and CE (Mastini *et al.* 2021). This may infer that current resource-consuming economic growth can continue in the guise of 'a green capitalist economy' and 'green growth' (Spash 2021b), while 'the jolly green giant of renewable energy' is substituted for fossil fuels (Skene 2018).

The Breakthrough Agenda aims 'to accelerate the development and deployment of clean technologies and sustainable solutions', while ensuring they are affordable and accessible to all. It seeks to halve global emissions by 2030 via key clean technologies. With its emphasis upon extensive use of solar panels, wind turbines, accompanied by other technologies and a 'steep uptick' in investment (Klaasen & Steffen 2023), it projects a 'hi-tech' vision of the future. As Hindin (2023: 1) observed, technological innovations are expected to:

> completely offset endlessly increasing consumption [...] on a finite planet, despite substantial evidence to the contrary.

Over 20 years previously, Rees (1999: 211–213) had asked:

> How can we reconcile the expected use of 'much more' of everything with growing evidence that global carrying capacity has already been exceeded. [...] There is no getting around the fact that material consumption is at the heart of the sustainability crisis.

There is a risk, though, that the importance of consumption carbon and constraining the excessive demand for energy, material, land and water resources may be overlooked. This applies not only to the buildings and construction sector, but also to other high-emitting sectors. For example, the steel 'breakthrough' involves increasing:

> the number of near-zero emissions steel plants in operation and under development, and total global near-zero emission steel capacity

rather than examining ways to avoid or reduce the consumption of resources used in production. Similarly, more 'zero-emissions vehicles are the new normal [...] by 2030', without considering the need to reduce the number of vehicles and roads (UK COP26 2021). With regard to the built environment, it is no surprise that the emphasis is again on resource and energy efficiency.

While reports such as GlobalABC (2022) and research by Haberl *et al.* (2022) have highlighted the impact of growth in building stock and emissions, this is usually taken for granted, with little effort to consider scenarios involving less material growth. As shown by the White Paper (SYSTEMIQ 2022a), the emphasis remains upon efficiency of energy and other resources, with 'more efficient and balanced use of space', reflecting continued faith in 'decoupling' environmental impacts from economic growth. Although the White Paper has many positive proposals, including better utilisation of existing space, the terms 'degrowth', 'post growth' and even 'sufficiency' seem to be deliberately avoided, as in reports of the IRP and others. Signalling a possible shift, Potočnik (WRF-IRP 2022) highlighted 'blind spots' in policymaking: a resource perspective was lacking, as well as attention to the demand side and to fairness and equity. He also admitted that 'efficiency should be complemented by sufficiency'.

Meanwhile, Western values appear to dominate the prevailing vision of compact, 'vibrant', and '15-minute' neighbourhoods and cities, overlooking the serious humanitarian crises experienced by inhabitants of megacities in the Global South. We have seen how policies and scenarios advocated by international organisations are often dominated by the North (Saheb *et al.* 2022), with a major structural shift in power relations being required to bring the vulnerable to the table in an equal or lead role. As a promising sign, Potočnik & Teixeira (2022: 19) have recognised that:

> current resource patterns still reflect the shadows of an imperialist world, requiring a transition to an era of responsible resource use in which benefits are more equally shared.

To return to the research question, though, the key findings of this paper reveal that a focus on cleantech (which includes clean energy and efficiency) is not enough to achieve decarbonisation of the high-emitting buildings and construction sector. To meet the Paris Agreement and limit warming to 1.5°C (UNFCCC 2015), means of constraining and redistributing growth in the sector must be included within a wider ambit, which includes sufficiency policies and measures. That would constitute a real 'Breakthrough', enabling the transformative change sought by the IPCC (2022) rather than incremental improvements.

8. CONCLUSIONS

Due to the importance of the buildings and construction sector in responding to the global challenges of climate change, biodiversity loss, pollution and inequity, the agenda determined for the 'Buildings Breakthrough' will be critical for future policy directions.

Without diminishing the significance of cleantech, the following were found:

- Such measures are unlikely by themselves to constrain global warming to 1.5°C. As the IPCC (2022: 9–4) emphasised:

  > implementing sufficiency measures that limit growth in floor area per capita, particularly in developed regions, reduces the dependence of climate mitigation on technological solutions.

  It claimed that sufficiency may capture up to 17% of the global mitigation potential, while complementing the role played by efficiency, circularity and renewables: As Saheb (2021b) highlighted, sufficiency and circularity are 'the two overlooked decarbonisation strategies [...]'. In this regard:

  > demand-side measures and new ways of end-use service provision can reduce global emissions in end use sectors by 40–70% by 2050, while being consistent with improving basic wellbeing for all.
  >
  > (IPCC 2022: SPM-44; 2023)

- Research has shown that:

  > gains in technological energy efficiency have been more than offset by increasingly consumptive ways of life and political systems that aim for economic growth [...].
  >
  > (Darby 2007: 113)

  At the same time, there is a growing recognition by leading industry organisations that increases in urban growth and building floor area may negate any gains from energy efficiency and intensity. However, reports such as GlobalABC (2022) indicate that policymakers and the industry may lack the will to respond to this challenge.

- Rather than a sole focus upon cleantech, including resource efficiency, it is imperative that constraining material-driven growth and consumption carbon is addressed during the proposed 'Buildings Breakthrough' meeting of all global construction ministers, co-convened by France–Morocco. Given that the agenda is likely to retain the original focus, a complementary and supporting agenda should at least be established to avoid and reduce demand for energy and material resources, while reducing consumption carbon—with sufficiency, social justice and global equity at the forefront. Arguably, this is within the scope of the 'Breakthrough', which aims to accelerate the development and deployment of 'sustainable solutions' in addition to clean technologies. It would also enable the initiative to respond not only to climate change, but also to other SDGs, including biodiversity loss, poverty and inequity.
- Similar implications may arise for other 'Breakthrough' sectors and reports emanating from SYSTEMIQ (2021, 2023), which focus solely upon clean energy, engineering technologies and innovations, with objectives of continued economic growth and market dynamics. Again, there appears to be no recognition of consumption carbon in the pursuit of low-carbon solutions.

UN Secretary-General António Guterres has announced that he will convene a 'Climate Ambition Summit' in September 2023. Leaders from governments, business, cities and regions, civil society, and finance must step up: 'They must come with new, tangible and credible climate action to accelerate the pace of change' (UN 2022). Similarly, the proposed 2023 'Buildings Breakthrough' ministerial should surely embrace the new opportunity provided by sufficiency, beginning with the need to reduce energy demand that is so strongly advocated by the French president and his counterparts. Rather than merely relying upon energy efficiency and renewables for decarbonisation, it will be important 'to consider and review the landscape: are we working on the right issues?', as was highlighted during the 'Breakthrough' ministerial at COP27 (UNEP 2022a).

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COMPETING INTERESTS

The author has no competing interests to declare.

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