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SUFFICIENCY and CIRCULARITY

The two overlooked decarbonisation strategies in the 'Fit For 55' Package

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Highlights

- **Sufficiency policies** are a set of measures and daily practices that **avoid the demand for energy, materials, land, water, and other natural resources over the lifecycle of buildings and goods while delivering wellbeing for all within planetary boundaries**. Targets to reduce land take, like those set in Luxembourg and Germany, have led municipalities to prioritise multifamily buildings over single-family homes. Thus, reducing the floor area per capita in new buildings. Swiss cities, who have adopted the 2 000 watts society target, have succeeded in reducing energy demand of their buildings by adapting the floor area per capita to the size of the households. Requirements on bioclimatic design in the French building energy code have reduced energy demand by providing thermal comfort through passive solutions. Co-working and co-living buildings are also reducing the floor area per capita, while combatting loneliness, by increasing the shared areas while offering enough space for privacy and without reducing the comfort level.

- **Circularity principles** avoid the linear use of materials and goods by **applying some of the sufficiency principles at the product and construction materials levels**. Circularity aims at reducing the extraction of virgin materials by reusing, repurposing, and recycling used materials and by extending the life time of products. The implementation of circularity principles reduces embodied emissions as shown by the BedZed project where embodied emissions were reduced by 30% compared to a standard construction of a new settlement in the UK. Measures to avoid planned obsolescence by introducing reparability requirements, French law, to extend the lifetime of appliances and consumer electronics is also expected to reduce embodied emissions.

- Over the period 1990-2018, efficiency improvements and the increased penetration of renewables have reduced CO_2 emissions (in the use phase) from residential buildings by 29%. **Emissions reduction could have been much higher if sufficiency policies were included in the EU policies** targeting the decarbonisation of the building stock. The lack of sufficiency policies has increased emissions driven by the increase of the floor area per capita (i.e. heating).

- Member States with GDP per capita above the EU average are those with the highest floor area per capita. Consequently, the wealthiest countries have high shares of under occupied dwellings while EU countries with GDP per capita lower than the EU average have high shares of over-crowded dwellings. In 2018, floor area per capita in Denmark reached 58m² per person against 28m² per person in the Slovak republic, while it was below 20m² per person in Romania and the EU average was at 38m² per person. Importantly, **average floor area per capita in global scenarios, aiming at 1.5°C temperature target and a fully decarbonised global building stock by 2050, is at 35m² per person in scenarios with negative emissions** (IEA-NZE, 2021) **and at 30m² per person in scenarios without negative emissions** (Grubler et al. 2018).

- Over the same period, cumulative embodied emissions from the use of cement and steel for the construction and the renovation of residential and non-residential buildings were equivalent to 82% of the 2018 emissions in the use phase of residential buildings. The lack of requirements in EU policies to implement circularity principles in the construction sector combined to the lack of sufficiency measures have led to an extensive use of virgin materials and to an increase of mineral waste. Based on the data available, per capita **mineral waste from the construction and the demolition of buildings is above the EU average in most of the wealthiest EU countries where the construction rates were high**.

- ‘Fit For 55’ is the policy package that will either lock Europe’s buildings in carbon for ever or unleash the metamorphosis needed to decarbonise the EU built environment as buildings renovated and those constructed during the 2020-2030 decade are unlikely to be (re)-renovated before 2050. **Global scenarios aiming at 1.5°C target, without negative emissions, are sufficiency and circularity driven**. By 2050, emissions in the use phase of residential buildings could be five times lower if sufficiency policies are considered and floor area per capita adjusted to households’ size. The same year, embodied emissions could be almost close to zero if sufficiency policies and circularity principles are combined. Thus, making Europe’s building stock climate neutral, by 2050, is unlikely to occur if emissions reduction driven by sufficiency and circularity are left untapped.

Policy recommendations

A **full decarbonisation** of the EU building stock requires ensuring emissions reduction driven by **sufficiency and circularity** will not remain untapped. This can be done by:

1. Expanding the framework of 'Fit For 55' policy package from efficiency and renewable to the **SER (sufficiency, efficiency, and renewables) framework** (Figure 1).

2. Requiring through the EPBD **all new and existing buildings to be carbon neutral without further delay**. This requirement should include, i) scope 1 emissions which result from direct emissions from buildings, ii) scope 2 emissions which are due to electricity and heat production and iii) scope 3 emissions which relates to embodied emissions in construction materials.

3. Considering in the European Commission's modelling **the three scopes of emissions** listed above.

4. Requiring Member States to include in their renovation roadmaps:
   a. Measures **to reduce the floor area per capita**. Global scenarios aiming at 1.5°C, without negative emissions, suggest **30m² per capita** to reduce energy demand of dwellings and fully decarbonise the global building stock by 2050 (Grubler et al. 2018) .
   b. Measures to **prioritise the use of empty buildings over the construction of new ones**.
   c. Measures to allow for **adaptability of existing buildings** (i.e co-living, co-working...)
   d. Measures to allow shifting status **from ownership to usership** and to ease dwellings changes, specially in the social housing sector.

5. Introducing in the **taxation directive** requirements to **adjust property taxes to the floor area per capita**. The aim is to discourage, through higher taxation, the increase of floor area per capita above the one leading to a full decarbonisation of the EU building stock.

6. Introducing in **Ecodesign and the labelling directives** circularity requirements such as **durability and reparability requirements** to reduce embodied emissions of appliances and consumer electronics by extending their lifetime.

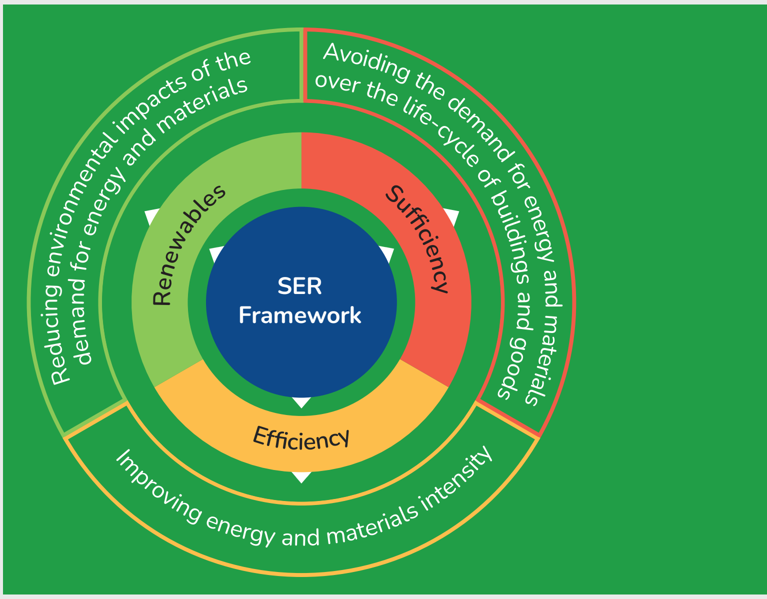
7. Revising the **Ecodesign methodology** to ensure **embodied emissions** are better considered when setting minimum energy performance requirements.

8. Introducing in the Construction Products Regulation **requirements on embodied emissions** and the no-data, no-market principle to remove from the EU market products for which embodied emissions are not made publicly available.

9. Including in the **European Building Observatory indicators** to assess progress in the implementation of **sufficiency and circularity** principles (i.e. floor area per capita, kg virgin materials per square meter...)

10. Making the indicative **land take goals**, included in the EU land take framework, **binding** at national level to avoid urban sprawl while limiting biodiversity losses.

FIGURE 1 SER Framework



Source: Beyond efficiency, sufficiency matters and should be first. Y. Saheb, Buildings and Cities Journal, 2021.

KEY POINT *The decarbonisation of the EU building stock requires combining sufficiency, efficiency, and renewable policies*

Quick guide

- Emissions from the built environment include:
  - Scope 1 emissions, also known as direct emissions, which are produced within building (i.e. emissions due to the use of gas for water and space heating or for cooking) and emissions from halocarbons and aerosols. However, data on the latter are scarce.
  - Scope 2 emissions, also known as indirect emissions, which are associated with off site generation of electricity and heat.
  - Scope 3 emissions, also known as embodied emissions, which are associated with the emissions embodied in the construction materials and goods.

Scope 1 and 2 emissions occur in the use phase of buildings while scope 3 emissions occur in the construction phase of buildings.

- Negative emissions occur when carbon dioxide is removed from the atmosphere by deliberate human activities and durably stored in geological, terrestrial, or ocean reservoirs (i.e. Carbon Capture and Storage (CCS))

- Direct rebound effect occurs when efficiency improvements are offset by other means leading to steady state or an increase of the overall energy consumption (i.e. increased floor area per capita, increased indoor temperature)

- Sufficiency policies include all the measures and daily practices which avoid the demand for energy, materials land, water, and other natural ressources over the lifecycle of buildings and goods, while delivering on the wellbeing for all, within planetary boundaries. (Saheb, 2021).

- Estimating the weight of each driver of emissions requires a decomposition analysis using the Logarithmic Mean Divisia Index (LMDI) method:

The following equation is used for decomposing scope 1 and 2 (direct + indirect) emissions:

CO_2 emissions = Population * (floor area/population) * (weather adjusted final energy/floor area) * (CO_2 emissions/weather adjusted final energy).

  - Floor area per capita captures the effect of sufficiency measures.
  - Weather adjusted final energy per floor area captures the effect of efficiency measures.
  - CO_2 emissions per weather adjusted final energy captures the effect of the penetration of renewables.

The following equation is used for decomposing scope 3 (embodied) emissions:

CO_2 emissions = Population * (floor area/population) * (weight of construction materials/floor area) * (CO_2 emissions/weight of construction materials)

  - Floor area per capita captures the effect of sufficiency measures.
  - Weight of materials per floor area captures materials intensity (the efficient use of materials through the implementation of circularity principles).
  - CO_2 emissions per weight of construction materials captures the effect of the use of renewable to produce construction materials.

- Illustrative pathways included in UNEP report entitled *Resource efficiency and climate change: Material efficiency strategies for a low-carbon future* are used to assess the impacts of including sufficiency and circularirty measures in EU policies. These pathways have different temperature goals as described below:
  - LED scenario, which aims at **1.5°C** of global warming by the end of the century.
  - SSP1-RCP 2.6 (Shared socio-economic pathway), which aims at a global warming **below 2°C** by the end of the century.
  - SSP1-NCP (Shared socio-economic pathway), which aims at **2°C** of global warming by the end of the century.
  - SSP2-NCP (Shared Socio-economic pathways), which is based on current policies and would lead to **more than 2°C** of global warming by the end of the century.

Drivers of CO_2 (direct and indirect) emissions in the built environment

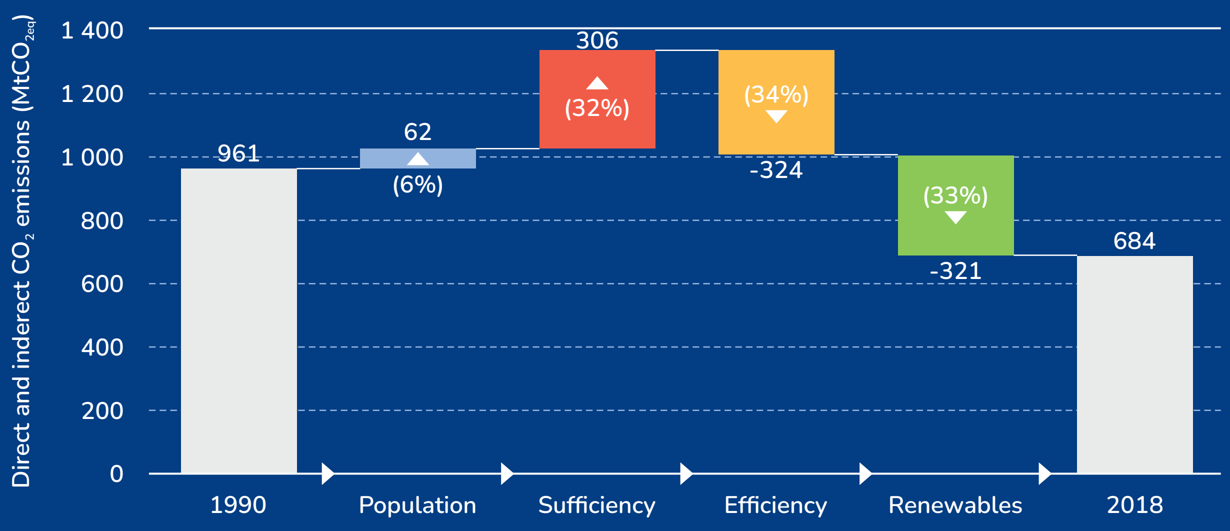
In 2018, the built environment was responsible for approximately 40% of the EU27+UK final energy consumption and 36% of their CO_2 (direct and indirect) emissions. The contribution of the built environment to EU+UK emissions is much higher if embodied emissions and those from halocarbons (refrigerant used in buildings) and aerosols could be included (Lamb et al. 2021).

The same year, final energy consumption of the EU27+UK built environment reached 18.25 EJ, out of which 65% was consumed by residential buildings (EUROSTAT, energy balances). This was equivalent to 1 131 $MtCO_2$ emissions out of which more than 60% were emissions from residential buildings. The construction of new buildings contributed an additional 93 $MtCO_2$ of embodied emissions (IEA-WEO, 2020).

Drivers of emissions in the built environment include changes in the floor area per capita, which results from the combined changes in the size of dwellings and households (Ellsworth-Krebs 2020), the efficiency level of the building envelope and appliances, which results from technological improvement, as well as the decarbonisation of the supply side, which results from the increased penetration of renewables.

Over the period 1990-2018, emissions from the built environment in the EU27+UK fell by 29% driven by an increase of efficiency improvement and an increase of the decarbonisation of the supply through the shift towards renewable. Efficiency and renewable contributed almost equally to reducing direct and indirect emissions of the built environment (Figure 2). However, the lack of sufficiency policies has led to an increase of the floor area per capita, which contributed with additional emissions. Thus, offsetting emissions reduction driven by efficiency improvements. Efficiency improvement reduced emissions by 324 $MtCO_2$, which is equivalent to 34% of 1990 emissions, while the lack of sufficiency measures increased emissions by 306 $MtCO_2$, which is equivalent to 32% of 1990 emissions (Figure 2).

FIGURE 2 Drivers of emissions of the built environment in the EU27+UK over the period 1990-2018



Source: Emissions of the built environment: cross scenario analysis through the lens of the SER framework (Saheb et al. 2021).

KEY POINT *The lack of sufficiency measures has offset emissions reduction due to efficiency improvements*

From efficiency and renewable framework to the SER framework

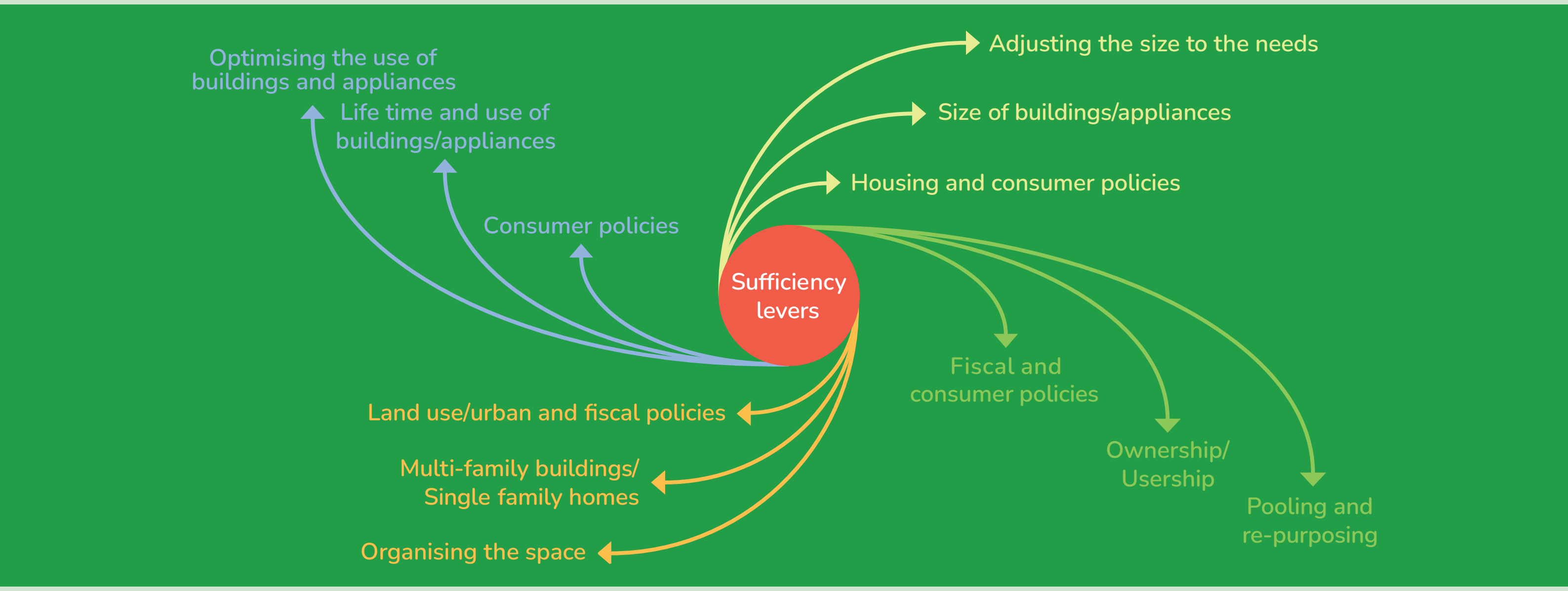
The impact of the increase of floor area per capita on the emissions of the built environment and the use of resources was flagged by scientists and researchers since the early nineties. (Sachs 1993) and (Princen 2003) considered the increase of resource use as a result of the lack of sufficiency measures. Sufficiency policies include all the measures and daily practices which avoid the demand for energy, materials land, water, and other natural ressources over the lifecycle of buildings and goods, while delivering on the wellbeing for all, within planetary boundaries (Saheb, 2021).

Literature suggests four sufficiency levers including (i) societal organisation such as the organisation of the space and human activities, (ii) the size of goods and equipment, (iii) their use, and (iv) the shift from ownership to usership (Cézard and Mourad 2019). When applied to the built environment, these four levers translate into the building typology (single-family homes vs. multifamily buildings); the size of dwellings as well as appliances and equipment; occupants' behaviour; and pooling the use of space and building services such as co-working and co-living places and centralised heating and cooling systems or shared laundry (Figure 3). Literature (Spangenberg and Lorek 2019) argues for combining sufficiency and efficiency measures to mitigate the direct rebound effect.

Expanding the current framework driven by efficiency and renewable to sufficiency is not new. The French NGO Negawatt developed, in 2003, the first energy scenario which includes sufficiency measures. This scenario was the first one to achieve drastic reduction in energy demand.

The three pillars of the SER framework include (i) sufficiency policies, which tackle the causes of the environmental impacts of human activities by avoiding the demand for energy services and their related materials, (ii) efficiency, which tackles the symptoms of the environmental impacts of human activities by reducing energy consumption in the use phase, and (iii) the renewable pillar, which tackles the consequences of the environmental impacts of human activities by reducing GHG emissions.

FIGURE 3 Sufficiency levers



Source: Beyond efficiency, sufficiency matters and should be first (Saheb, 2021).

KEY POINT *Sufficiency levers go beyond energy policies*

Sufficiency in practice

Sufficiency is not a new concept. It was introduced in the scientific literature more than 30 years ago. From an implementation perspective, several local authorities and some governments are leading by example by introducing in their policies measures to avoid the demand for energy, land and materials as shown in the selected examples below:

- **Land take targets in Germany and Luxembourg**: Land take is defined as the loss of undeveloped land to human-developed land. Germany set a goal of reducing the daily growth of the area used for human settlement and transport to 30 hectares per day by 2020, reduced from 129 hectares per day in 2000. The national Luxembourgish plan for sustainable development has set a target to limit the daily growth of the area used for human settlement and transport to one hectare per day by 2020 (European Commission 2016). Targets to reduce land take force local authorities to promote the construction of multi-family buildings with optimised use of floor area per capita compared to single-family homes, to re-purpose existing buildings and to optimise their use by adapting them to today's lifestyles (i.e. using schools for social and cultural activities when they are not used for schooling).

- **The 2000 watts society target adopted in Zurich** succeeded in reducing the floor area per capita by 10m² in residential buildings owned by the municipality by putting in place a platform for dwellings' exchange to adjust their size to the one of the households. The municipality is also exploring how teleworking and part-time jobs could contribute to reducing the floor area per capita in office buildings. Furthermore, the municipality set a maximum temperature of 21°C in public buildings and 18°C in the corridors of schools (Zurich Municipality 2008). The aim is to optimise the use of heating systems through behavior change.

- **The French 2012 building energy code** introduced requirements on bioclimatic design of new buildings. To meet this requirement developers and architects must include passive solutions when buildings are designed. The aim is to reduce heating, cooling, and lighting energy demand, which makes the implementation of the Nearly Zero Energy Building (NZEB) achievable. (Saheb. Y et.al 2013).

- **The German Living for help «Wohnen für Hilfe» project** creates living space for student through home sharing between students, families, elderly people, and institutions. One of the objectives of this project is to reduce the floor area per capita, which increased in Germany from 34,8m² in 1990 to 46,7m² in 2018. This increase is driven by the increase of one-person households composed of aging population, who often stay in their homes when children have moved out. The project allows students to save rent by helping their hosts in their daily life needs (i.e. shopping, cleaning) (Kiel Municipality 2010).

- **The French law on increasing the lifetime of household appliances and electronics products** requires, since February 2020, providing consumers information on the level of reparability of washing machines, smartphones, laptops, televisions and electric lawn mowers. The aim is to combat the planned obsolecence by ranking products based on the potential extension of their lifetime through reparation.

- **BedZed sourcing materials** reduced embodied emissions by 30% compared to standard construction of new settlement in the UK. BedZED sourced 3 404 tonnes of reclaimed and recycled materials, which is equivalent to 15% of the total materials used. BedZED's local sourcing strategy allowed sourcing 52% of the materials from within the target of 56 Km radius.

- **The emergence of the market of co-working/co-living places in Germany**. Companies like Rent24 operates 35 co-working and five co-living facilities in several cities across the country as well as in Amsterdam, Tel Aviv, London, New York, and Chicago. The firm is currently completing a project in Hamburg that will be its first combined co-working/co-living building. The facility comprises 7 500 m² spread across six floors of a formerly abandoned factory and includes co-working offices, micro-apartments, fitness studios, event rooms, bar, and supermarket. The company anticipates that the joint working and living spaces will appeal to technology-industry startups and the residential flats will be available for both short and long-term rental.

Circularity: The other overlooked climate mitigation strategy in 'Fit For 55' package

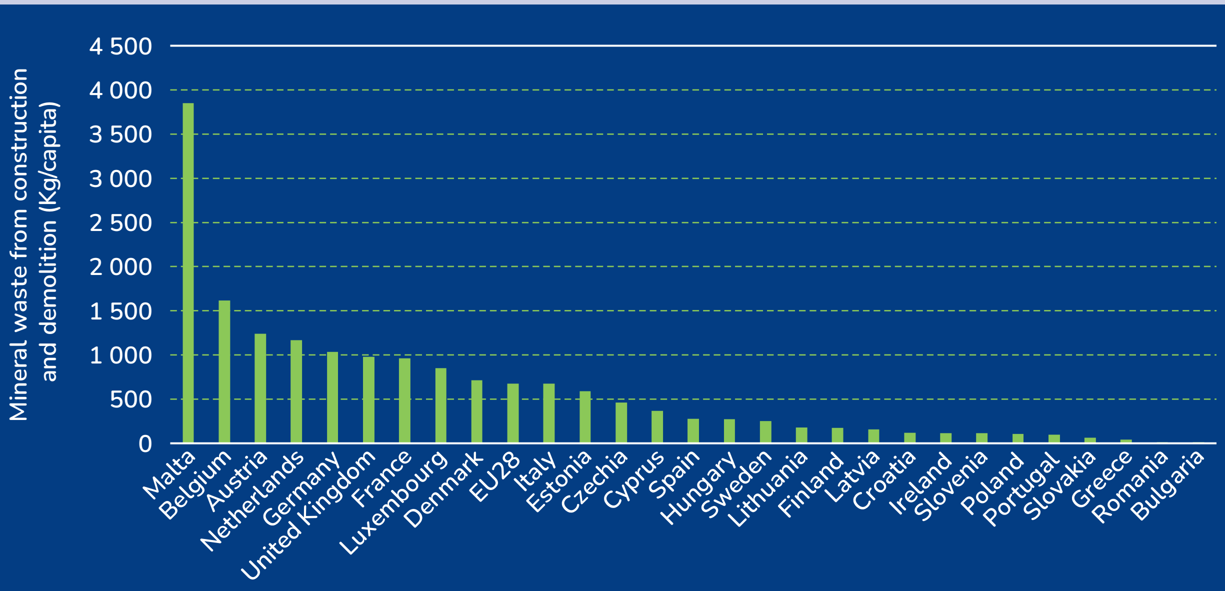
Circularity applies some of the sufficiency levers (i.e. avoiding the use of virgin materials by repurposing used materials) at the construction materials and the appliances and equipment levels. Reducing the floor area per capita through sufficiency measures will reduce the need for the extraction and use of raw materials in the largest sector consuming raw materials (World Economic Forum 2016). At the same time, by reducing the need for new virgin resources, circularity will reduce embodied emissions of the built environment.

The primary indicator used for assessing the climate impact of circularity is the material intensity (kg/m²), which is calculated as a ratio between the weight of virgin materials used and the floor area considered. The higher is the share of the re-used and recycled materials as well as the longer buildings and appliances are used, the lower will be the use of virgin materials used and thus the embodied emissions. The lower is the re-used and re-cycled materials, the higher will be the waste from construction and demolition of buildings.

There are great discrepancies between EU countries in the production of waste from the construction and the demolition of buildings. Given their low construction rates, Eastern European countries have the lowest per capita mineral waste from construction and demolition (kg/capita). Malta has the highest one, followed by EU countries with GDP per capita higher than the EU average (Figure 4). These countries are those with the highest construction and renovation rates.

In December 2015, the European Commission adopted the first Circular Economy Action Plan, which includes several initiatives to reduce waste and to increase the longevity of products and materials. This action plan has been updated in 2020. However, binding requirements on circularity are yet to come, especially in the built environment. Introducing sufficiency and circularity requirements in 'Fit For 55' package will contribute to reducing the environmental impact of the built environment as shown in global scenarios aiming at the 1.5°C target.

FIGURE 4 Mineral waste from construction and demolition in EU27+UK in 2018



Source: EUROSTAT.

KEY POINT *The highest shares of mineral waste from buildings occur in the wealthiest countries*

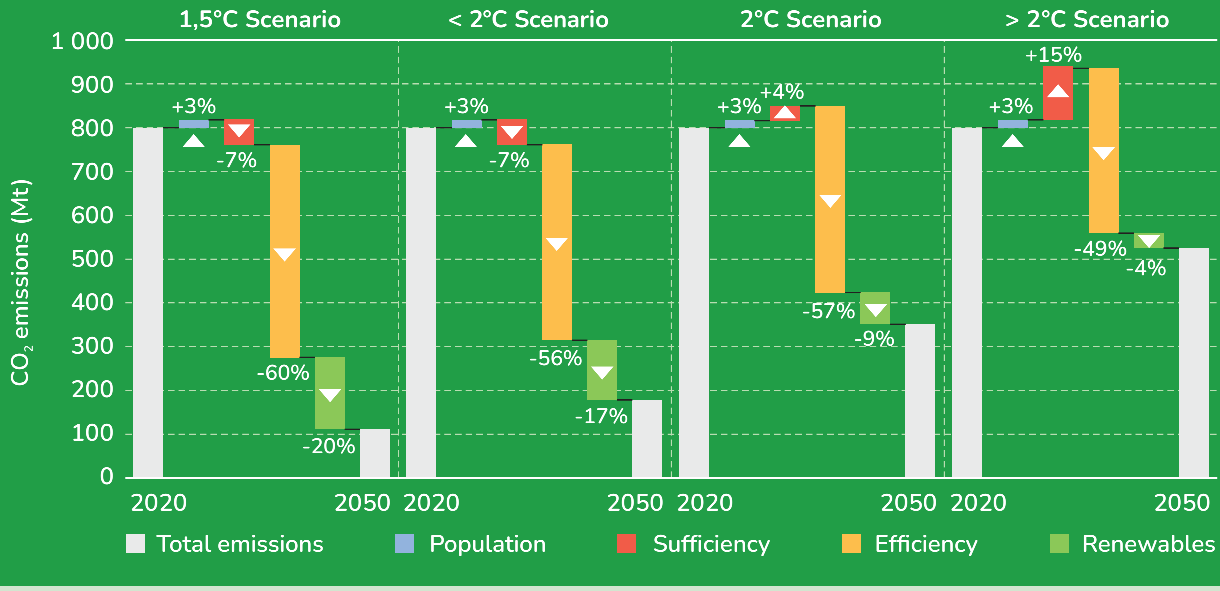
Scrutinising decarbonisation scenarios through the lens of the SER framework

The contribution of each pillar of the SER framework to the decarbonisation, in the use phase, of the EU27+UK residential buildings is assessed using a decomposition analysis for the three scopes of emissions and four published scenarios (IRP, 2020) with different temperature targets i) more than 2°C scenario, ii) 2°C scenario, iii) below 2°C scenario and iv) 1.5°C scenario (Figure 5 and 6).

The four scenarios considered assume different future trends in the construction of new buildings as well as in the design and the use of buildings. Typically, the scenario aiming at 1.5°C target is based on the assumption that by 2050 the share of single family homes, with high per capita floor area, will be reduced to 20% and buildings will be more intensively used through peer-to-peer lodging and adaptation of the existing building stock to allow for more shared dwellings. On the other hand, the more than 2°C scenario is based on the continuation of the current trend of the increased floor area per capita and renovation programmes, which do not require making dwellings easier to adapt to the evolution of the size of households. Furthermore, the four scenarios assume efficiency and renewable will play a major role in the decarbonisation of the building stock.

By 2050, emissions from residential buildings are projected to be above 500 $MtCO_2$ in the more than 2°C scenario, which corresponds to the current policies scenario. This level of emissions is only 23% less than emissions in 2018 (684 $MtCO_2$) as shown in Figure 2. In comparison, emissions from residential buildings will fell to 113 $MtCO_2$ in the 1.5°C target scenario. This is ten times less than those in 2018 and five times less than in the scenario leading to more than 2°C global warming by the end of the century (Figure 5). Importantly, the lack of sufficiency measures in the 2°C and the above 2°C scenarios lock the sufficiency potential which remains untapped over the lifetime of buildings. However, in the 1.5°C and the below 2°C scenarios, sufficiency contributes to reducing emissions. More aggressive sufficiency assumptions would increase emissions reduction in the use phase of buildings and limit the reliance on unproven technologies.

FIGURE 5 Contribution of each pillar of the SER framework to the decarbonisation of the built environment



Source: Emissions of the built environment: cross scenario analysis through the lens of the SER framework (Saheb et al. 2021).

KEY POINT *Sufficiency reduces emissions in the 1.5°C and <2°C scenario while in the 2°C and >2°c scenarios, the sufficiency potential is locked*

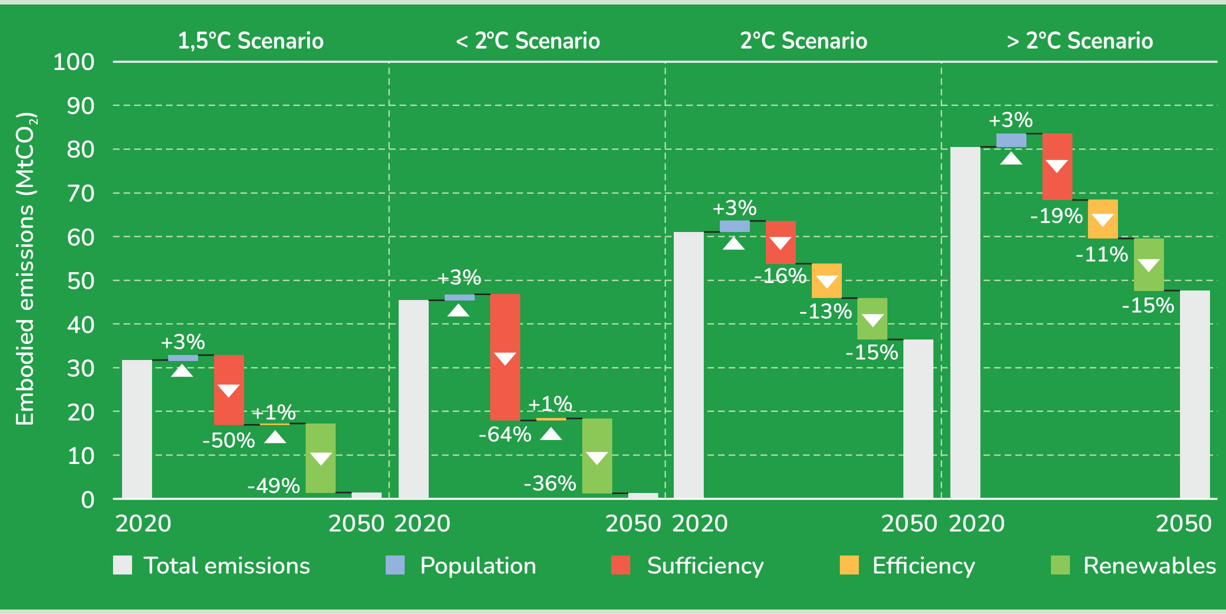
Circularity principles contribute to reducing embodied emissions. Material intensity is the indicator used to estimate the contribution of circularity to the decarbonisation of new buildings. Material intensity, also known as resource efficiency, is calculated as a ratio between the weight of the virgin material and the floor area (Kg/m²).

Using the four scenarios used previously for the use phase, the combined contribution of sufficiency and circularity to the decarbonisation of new buildings is estimated using a decomposition analysis of the embodied emissions. The results are provided for indication only and should be interpreted with caution as in the absence of data on the occupiers of new buildings, total population was used for the decomposition.

The assumption about the construction needs combined to the share of single-family homes play a major role in the 2050 embodied emissions. In the more than 2°C scenario, which corresponds to the current policies scenario, embodied emissions are more than double those in the 1.5°C scenario. Embodied emissions in the latter are estimated by 2050 slightly above 1MT CO_2 , which is extremely low (Figure 6). High embodied emissions reduction in the 1.5°C scenario is driven by assuming a high share of multi-family buildings in new construction, material substitution, optimised and purpose-specific design, more intensive use of buildings, extended life time of buildings and components, reuse of building components as well as intensive recycling of construction materials.

However, none of the strategies assumed in the 1.5°C scenario is included in the EU policy instruments targeting the decarbonisation of the built environment. Requirements to reduce embodied emissions remain absent from 'Fit For 55' package. In the absence of circularity requirements, the high shares of carbon intensive construction products in the EU market put the carbon neutrality objective out of reach. This is particularly true when it comes to the expected increase of zero energy buildings. In fact, emissions in the use phase from new buildings are expected to be around 20% against 80% of embodied emissions. The impact of embodied emissions in the overall buildings' emissions is exacerbated by the domino effect of the increase of the floor area per capita triggered by the lack of sufficiency policies. Overall, without aggressive sufficiency and circularity requirements in 'Fit For 55' policy package, it is likely that EU buildings will be locked in their embodied emissions.

FIGURE 6 Contribution of sufficiency and circularity to reducing embodied emissions in new buildings



Source: Emissions of the built environment: cross scenario analysis through the lens of the SER framework (Saheb et al. 2021).

KEY POINT *Combining sufficiency and circularity is needed to reduce embodied emissions*

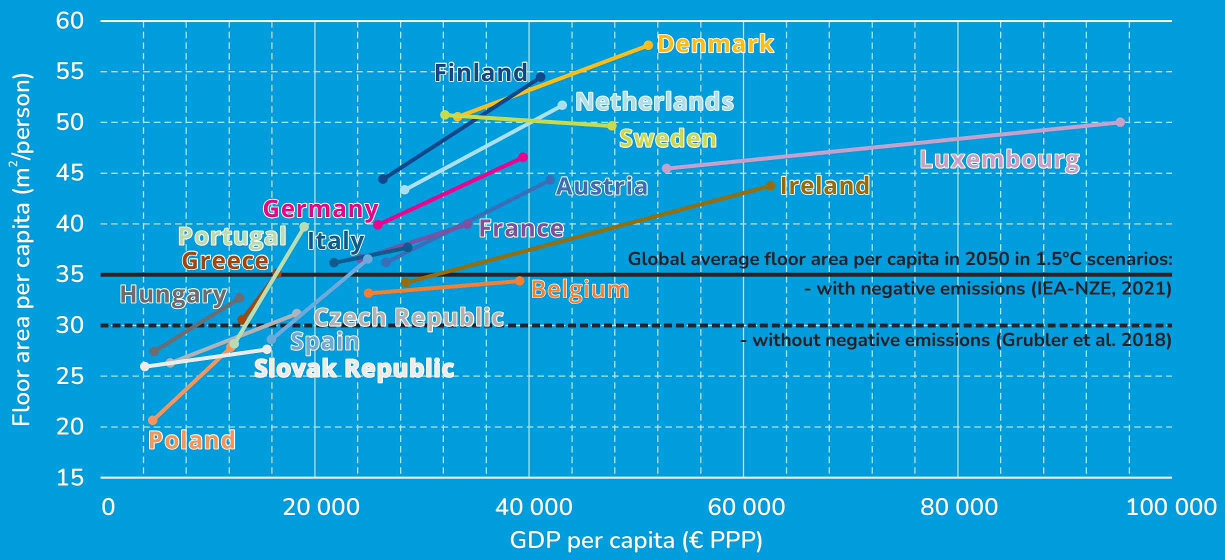
Assessing progress towards the implementation of sufficiency and circular economy measures

Floor area per capita is the main indicator used to assess the environmental impact of sufficiency policies in the use phase. Estimates of the climate impact of sufficiency policies, in the construction phase, combine floor area per capita and material intensity (kg of virgin materials per square metre). The former assesses the sufficiency impact while the latter assesses the circularity impact. In the absence of binding requirements on both sufficiency and circularity, comprehensive datasets to assess the potential contribution of sufficiency and circularity to reducing buildings' emissions is rather challenging. Overcoming this challenge, requires introducing the no-data, no-market principle in EU instruments.

As shown in the previous section, the increase of the floor area per capita rather than the population growth drives both operation and embodied emissions in buildings. Over the period 2000-2018, average floor area per capita in the EU increased by about 16%. The decrease in household size combined to Real Estate's race towards larger homes encouraged by urban sprawl have increased the floor area per dwellings leading to an increase of the floor area per capita in all EU countries. However, the most pronounced increases in the floor area per capita are observed in the wealthiest EU countries. With 58m² per person, Denmark is the least sufficient country while Romania, with its 20m² per person, is the most sufficient one. Importantly, today's EU average floor area per capita is at 38m², which is above the global average floor area per capita estimated in scenarios aiming at 1.5°C global warming by the end of the century and a full decarbonisation of the global building stock (Grubler et al. 2018) (IEA-NZE, 2021). (Figure 7).

Furthermore, more space leads to an increase of the number of appliances per dwellings (number of units/dwellings), which in turn increases the overall energy demand of households. Regulating floor space per capita can be done through property taxes and by introducing in the Energy Performance of Buildings Directive (EPBD) a cap on embodied and operation emissions for the overall dwelling to complement the current energy intensity indicator (kWh/m²), which does not limit the energy consumption, nor emissions, of the built environment.

FIGURE 7 Changes in Floor area and GDP per capita between 2000-2018 in selected MSs



Source: Floor area per capita (IEA) and GDP per capita (EUROSTAT).

KEY POINT *Floor area per capita in the wealthiest MSs is above the global average in scenarios aiming at 1.5°C target*

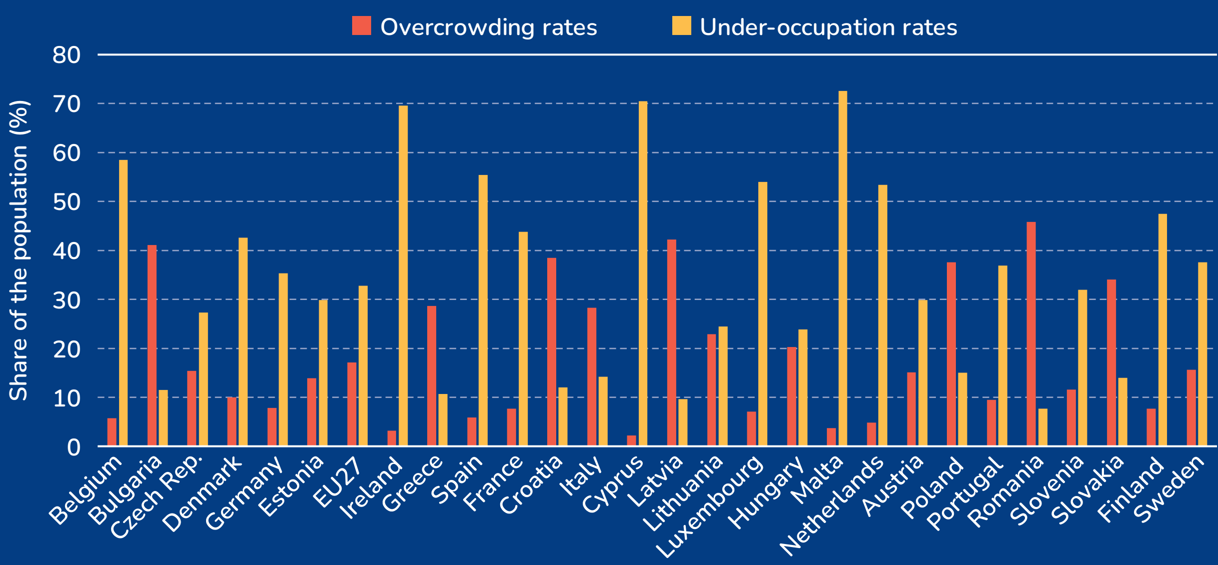
Into the future

From societal perspective, the increase of the floor area per capita, shown in the previous section, translates into an increase of the shares of under-occupied dwellings. This is particularly true for elders living in the wealthiest Member States (Figure 8). On the contrary, in countries with GDP per capita lower than the EU average, overcrowding is experienced (Figure 8). Both under-occupation and overcrowding have negative societal implications. Loneliness could lead to depression while the lack of space increases the risk of domestic violence. Leaving no one behind requires addressing also the societal implications of the lack of sufficiency measures in EU policy instruments.

Furthermore, the decarbonisation of the EU building stock will be out of reach if the sufficiency and circularity emissions reduction potentials are untapped during the current decade. This is particularly true given that the decarbonisation of the EU built environment will be driven by the renovation of residential buildings, which undergo major renovation, on average, once every 25 years. By 2050, 470 $MtCO_2$ could be locked in the built environment in the more than 2°C scenario, which is based on current policies. This is more than four times the emissions level that could be achieved under the 1.5°C scenario. Policies to tapping the full decarbonisation potential are therefore of high importance to avoid the lock-in-effect.

'Fit For 55' package is once-in-a-century opportunity to include in the EU instruments targeting the decarbonisation of the built environment sufficiency and circularity requirements. Shifting from the current policy framework driven by efficiency and renewables towards a more inclusive policy framework based on sufficiency, efficiency and renewable (SER) is a necessary step towards the decarbonisation of the EU economy. Including the relevant sufficiency and circularity requirements, in the EPBD, the Construction Product Regulation, Ecodesign and the labelling directives as well as in the taxation directive, is a prerequisite to decarbonise EU buildings. Moreover, making the EU land take framework binding and including land take requirements at national level will lead local authorities to prioritise repurposing existing buildings over the construction of new buildings and multi-family dwellings over single-family homes. Thus, allowing for a better consideration of sufficiency and circularity.

FIGURE 8 Share of the population living in over-crowded homes and in under-occupied ones in EU countries in 2018



Source: EUROSTAT.

KEY POINT *The highest shares of the EU population living in under-occupied dwellings live in the wealthiest MSs and the opposite occurs for over-crowded ones*

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