THE HOUSING WE NEED

FOR THE FUTURE WE WANT

GREEN PAPER - JULY 2026

ARTELIA BPIE no objectives rise VELUX

The case for activating Europe's existing building stock

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Executive summary

Europe is facing four interconnected crises: unaffordable housing, unhealthy homes, energy and resource insecurity, and climate and biodiversity breakdown. Each is considerable in its own right, yet they share a common thread. Europe's buildings sit at the intersection of all four, which makes the built environment not only part of the problem but also a decisive part of the solution. The EU faces a significant housing gap, with an estimated need for more than 2 million additional dwellings per year to meet the current demand[1]. At the same time, buildings account for 40% of final energy use and 36% of energy-related greenhouse gas emissions in the EU, with 75% of the existing building stock remaining energy inefficient[2]. Poor housing comes at a cost for the health of the European population, with a third of Europeans being exposed to unhealthy indoor climate conditions[3].

Europe's housing challenge is not simply to build more homes, but to ensure access to affordable, adequate and healthy housing that matches people's needs and circumstances[4]. It is becoming increasingly evident that new construction alone cannot solve the affordable housing crisis, as it is not merely a market mismatch. Moreover, new buildings require substantially more materials and resources than renovating and making better use of existing homes. This poses a fundamental question about how Europe should approach these interconnected challenges and whether the solutions could be found in what has already been built.

Most of the buildings Europe will rely on in 2050 are already standing, with around 85% of today's building stock expected to remain in use[5]. Yet the current distribution of the existing building stock does not fully match the needs of the population, with large shares of homes being underoccupied or overcrowded, while most of the stock is in desperate need of energy and comfort upgrades. Making better use of Europe's existing building stock can help address the housing and climate challenges while also strengthening resilience and making Europe more robust and future-ready in the face of energy, resource and geopolitical turmoil.

This green paper is an invitation to discuss how Europe can better use its existing buildings. It presents a technical and theoretical analysis of the potential of renovation, including the reuse of vacant homes and the conversion of unused buildings into housing, which unlock more floor space without new construction.

The paper proposes a spectrum of measures to better use the European building stock and investigates their impact on reducing embodied and operational emissions, as well as resource consumption.

The result of the analysis is the Impact Framework, a prioritisation hierarchy showing how buildings can achieve substantial reductions in carbon emissions and resource use.

Renovate first. Work with what is already standing. Resize, reclaim, repurpose, refine and reshape, before reaching for heavier interventions. These strategies unlock capacity, cut energy demand, improve living conditions, and reduce emissions without the material burden of new construction.

Then extend. Unlock the attic. Build up. Build out. Use these measures where renovation alone cannot meet demand, and where existing structures can support additional capacity without starting from scratch.

Build new only as a last resort. When new construction is genuinely needed, it should be compact and designed under sufficiency principles. Conventional construction should be treated as the reference case Europe is deliberately moving away from, not the standard to continue.

Applying the proposed Impact Framework to the eligible European building stock reveals that existing buildings hold the potential to meet housing needs while reducing emissions, resource use, energy dependency, and public health costs at the same time.

Between 50 and 107 million homes could be created, housing an additional 120–250 million people in areas where supply is limited and demand is highest.

Applying the proposed better-use measures could provide enough housing capacity to meet the demand, even in the most constrained markets, reducing or avoiding the need for new construction. Just as importantly, they can expand the range of housing options available, helping to better match existing homes with people's housing needs.

A better use of the existing building stock avoids between 3.9 and 19 billion tonnes of CO_2 over the next fifty years. The better-use measures could cut the construction industry's footprint by up to 32% over that period. At the European level[6], the savings equals 2 to 11% of all emissions across every sector of the EU economy. The upper end equals the emissions of France. Or Spain. Or every car on every European road combined. Assuming deep energy renovations are triggered in all buildings undergoing these measures, additional emissions of 4 to 5.5 $btCO_2eq$ can be avoided.

Moreover, between 5.8 and 13 Gt of material use can be avoided through better use of the existing building stock. Reducing material consumption will avoid unnecessary pressure on the ecosystems and prevent further biodiversity loss.

01

Europe's housing future at a crossroads

Europe's housing future at a crossroads

Europe's building stock sits at the intersection of four interconnected crises shaping the continent's environmental, economic and social landscape: a climate and biodiversity crisis, an energy and resource crisis, an affordable housing crisis, and an indoor health crisis. Buildings are both a major contributor to these challenges and an important leverage point for integrated solutions (see Figure 1).

Climate and biodiversity crisis. There is an urgent need to reduce pressure on land, ecosystems and the atmosphere. The built environment drives 36% of Europe's CO2 emissions, 50% of its raw material extraction, 37.5% of its waste generation and is also an important driver of land use and biodiversity loss[7]. A Danish study showed that 95% of construction-related biodiversity impacts occur off-site, rather than on the building plot itself[8]. Resource consumption accounts for over 90% of the damage to biodiversity caused by construction[9], and is therefore a strong indicator of environmental harm. Most emissions from buildings originate from the use phase, in particular heating, cooling and electricity demand. At the same time, embodied emissions from the production of materials, construction and end of life of buildings typically make up 20-30% of the building's total carbon emissions, but in low operational carbon buildings this figure is 50% or even higher[10].

Energy and resource crisis. Buildings are responsible for 40% of EU's energy use and therefore directly influence the EU's dependence on energy systems and infrastructure[11]. Reducing energy demand in buildings is essential not only for climate mitigation, but also for limiting exposure to energy price volatility and supply disruptions. At the same time, the sector accounts for about half of all extracted materials in the EU[12]. This creates growing exposure to resource constraints and supply chain vulnerabilities, particularly for energy-intensive materials such as cement and steel.

Housing crisis. The European Commission estimates the EU needs more than 2 million housing units per year, around one third more than what is currently being built[13, 14]. A significant part of the problem stems from misallocation of existing space: 20% of existing dwellings are underoccupied[13,14], while 16.8% are overcrowded[15]. As to newly-built homes at market price, they are increasingly unaffordable and many low-income households remain priced out. Housing costs now exceed 40% of disposable income for nearly 10% of EU urban households, while house prices rose by 53% between 2015 and 2024[16]. Building more homes increases the quantity of available dwellings, but does not automatically deliver affordable, secure and well-located homes to meet households' needs.

Health crisis. Today, over 40 million of Europeans are unable to keep their homes warm and live in energy poverty[17]. One in three Europeans is exposed to an indoor climate hazard at home, be it excess noise, damp and mould, lack of daylight or excess cold[4]. Poor housing comes at a substantial cost for society in the form of public health expenses (for e.g. asthma or depression), sick days or lost learning at school. A Eurofound study found that upgrading unhealthy housing across the EU could achieve payback within two years, while delivering €194 billion in societal benefits through reduced absenteeism and healthcare costs[18].

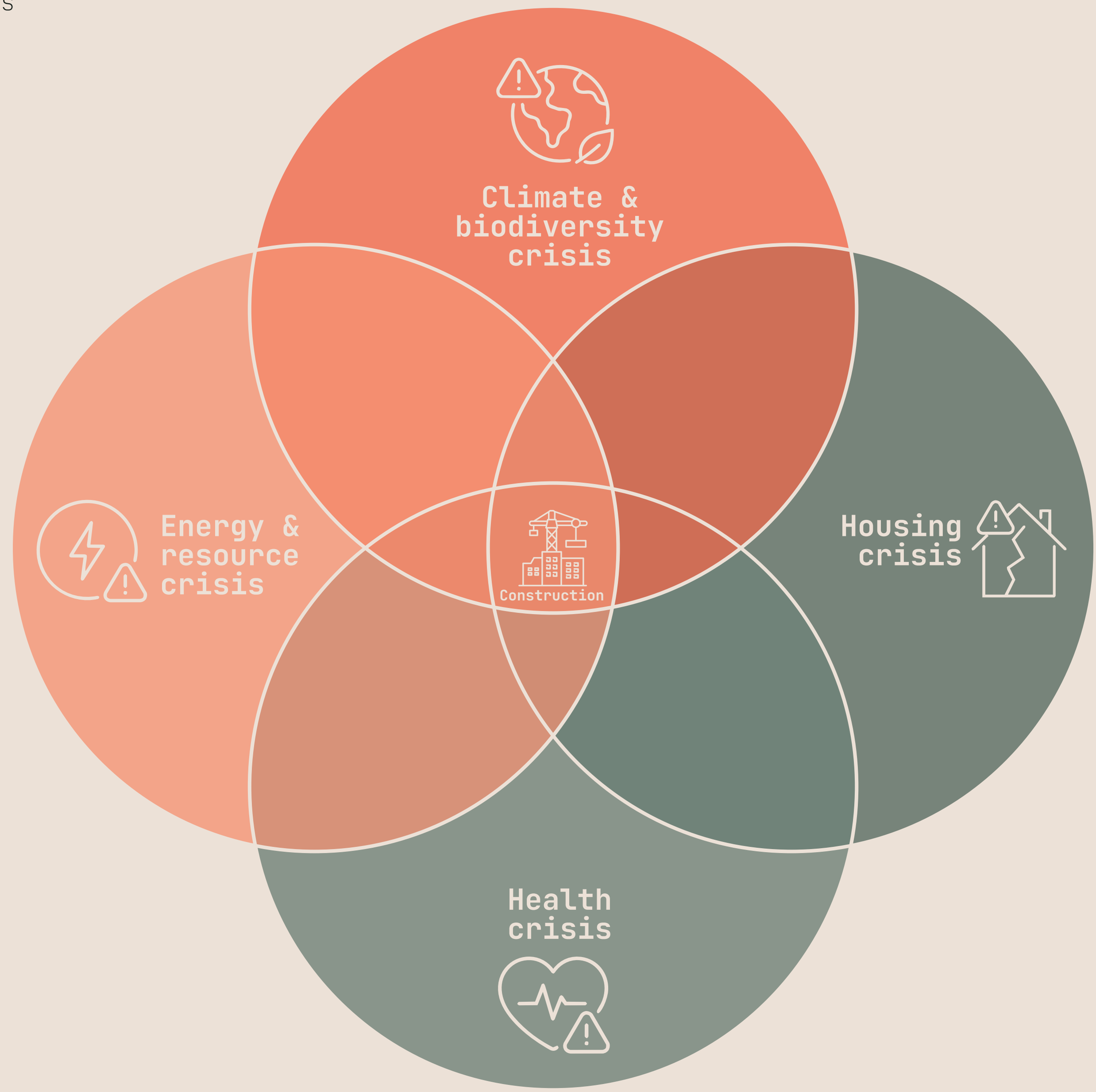
New buildings are significantly more energy-efficient today than they were a few decades ago, yet the absolute energy consumption of the EU building stock has not decreased since the mid-2000s due to floor area growth and rebound effects[19]. Thanks to the shift to more efficient or renewable energy sources, the CO_2 emissions of the EU building stock have declined by 21% between 2015 and 2023; yet, the climate neutrality pathway would have required a reduction of nearly 32% over the same period[20]. In parallel, the building industry's material consumption keeps growing[21], and so does its impact on biodiversity. Despite important efforts to reduce energy consumption and carbon emissions, progress remains insufficient resulting in growing economic and social costs for households[20]. The real question is not how Europe can build its way out of these crises, but how they can be addressed simultaneously through an integrated approach.

How can Europe create the housing we need for the future we want? How can the industry reduce emissions, biodiversity loss, resource use, and energy dependency, while increasing access to affordable housing and enabling better health and wellbeing for everyone?

Europe's housing sector sits at the intersection of four connected crises: climate and biodiversity breakdown, energy and resource dependency, housing inequality, and unhealthy homes.

Figure 1.

The construction industry at the intersection of four interconnected crises



02

The buildings are already here

The buildings are already here

The four crises outlined in the previous chapter (climate change, resource depletion, housing affordability, and public health) are often addressed through siloed policy frameworks and sectoral interventions. Yet they are deeply interconnected and, to a significant extent, rooted in the same patterns of production, consumption, and use of the built environment. Responses that focus on a single objective risk shifting burdens from one domain to another, while failing to address the underlying drivers of these crises.

This chapter argues that a more systemic approach is needed, one that combines efficiency and sufficiency. While efficiency aims to deliver the same services with fewer resources and lower emissions, sufficiency addresses the scale and nature of demand itself, seeking to meet human needs within planetary boundaries. Neither approach is enough on its own[22] (see Figures 2 and 3).

Efficiency improvements can be undermined by rebound effects, where gains in performance are offset by increased consumption, larger dwelling sizes or higher overall resource use. Conversely, sufficiency strategies that focus solely on reducing demand without improving the performance of buildings may fail to deliver the emissions reductions, comfort levels, and affordability gains required at scale.

Together, efficiency and sufficiency offer a complementary framework for reducing environmental impacts while simultaneously improving affordability, resilience, and quality of life.

Figure 2. **Efficiency vs. Sufficiency**

Today, efficiency and sufficiency are often understood as two separate and even competing approaches. They are treated as if one must be chosen over the other, rather than seen as complementary parts of the same transition.

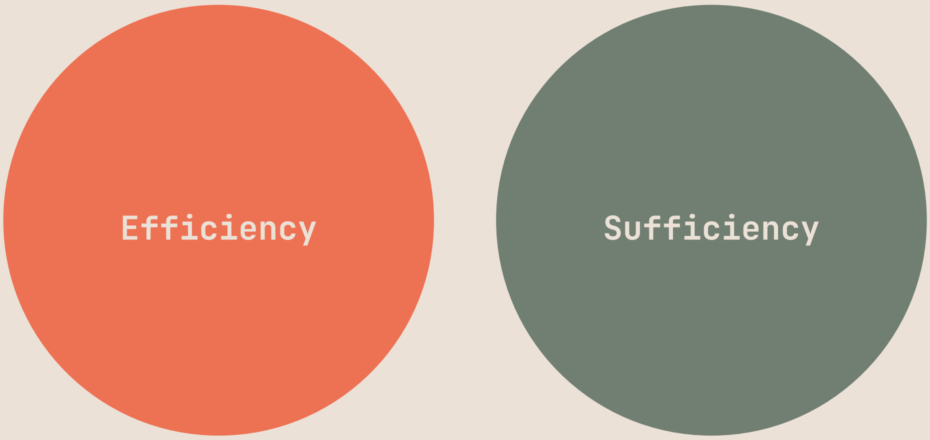
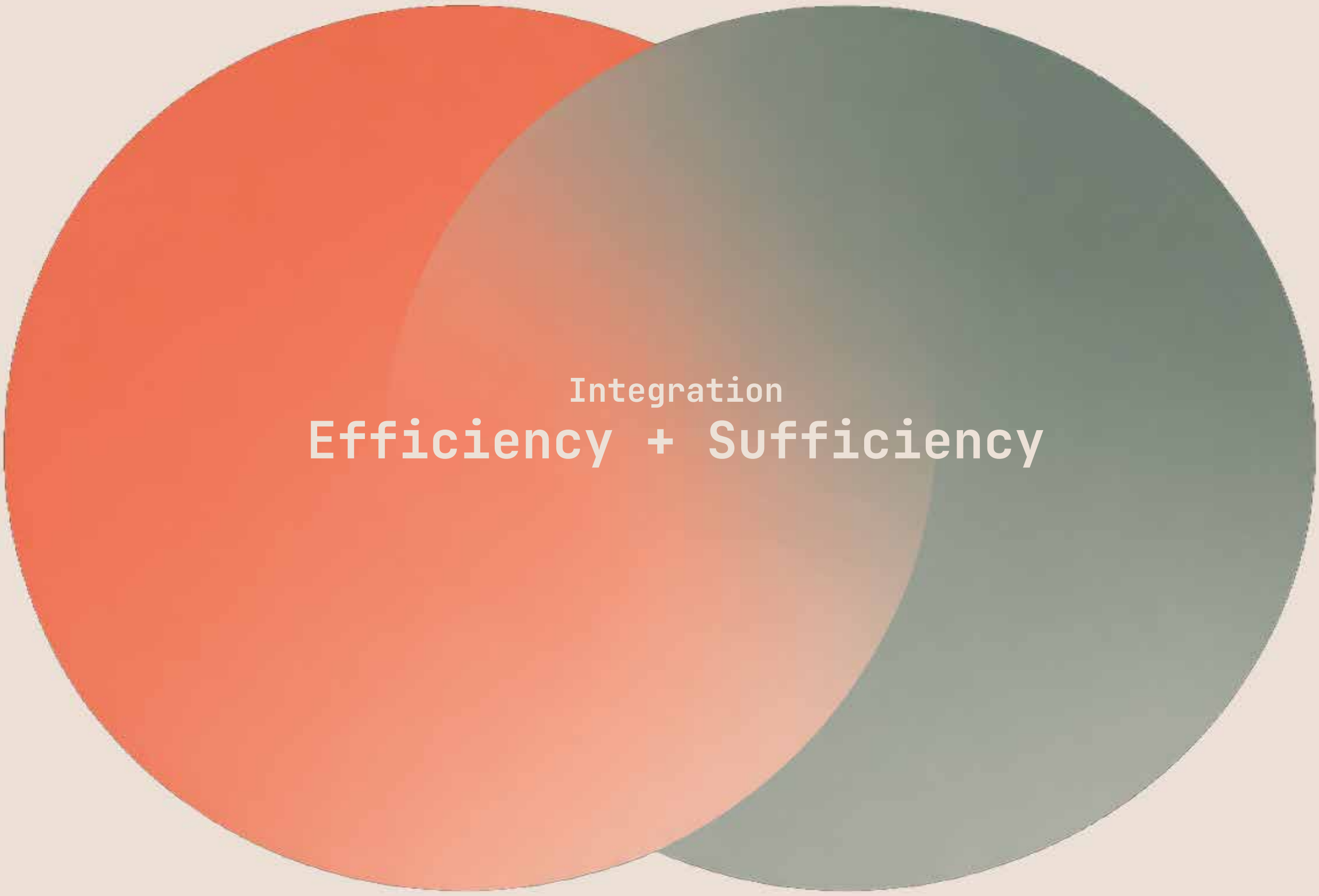


Figure 3. **Integration = Efficiency + Sufficiency**

In reality, efficiency and sufficiency need to be understood together. Efficiency helps us use resources better, while sufficiency helps us reduce unnecessary demand. Alone, each approach is incomplete. But when integrated, they support one another and create a stronger pathway toward real sustainability.



Recent scientific and policy developments increasingly recognise this dual approach. The latest IPCC assessment identifies sufficiency as a core pillar of climate mitigation alongside energy efficiency and renewable energy deployment[23]. In the same vein, the European Commission Staff Working Document "Supporting life-cycle approaches to decarbonise European buildings" argues that sufficiency policies in the building sector have the potential to effectively address the climate, environmental and housing crises all at once[24]. Applied to buildings, this implies shifting attention from the continuous expansion of the built environment towards maximising the value, performance, and utilisation of the existing building stock.

Indeed, while the building industry has been focusing on innovating around new buildings, bringing incremental efficiency gains to new construction, the largest structural challenge is the stock that already exists. The roughly 1% of the stock added new each year generates 18% of the annual building stock emissions in the EU, while the remaining 99% of buildings account for around 82% of building stock's annual emissions[24]. This brings to light two key realities: new construction is disproportionately carbon-intensive, while the existing stock remains the dominant source of ongoing emissions (see Figure 4).

Rather than treating buildings primarily as assets to be replaced, the challenge thus becomes how to adapt, reuse, renovate, and share what already exists in ways that respond to multiple societal needs at once. In this perspective, efficiency and sufficiency are not competing strategies but mutually reinforcing pathways for addressing Europe's multiple crises within ecological limits.

82%

Emissions from the existing building stock: operation, maintenance, repair and renovation.

Existing buildings

18%

Embodied emissions from new construction

New construction

Figure 4.
CO_2 Emissions by building source

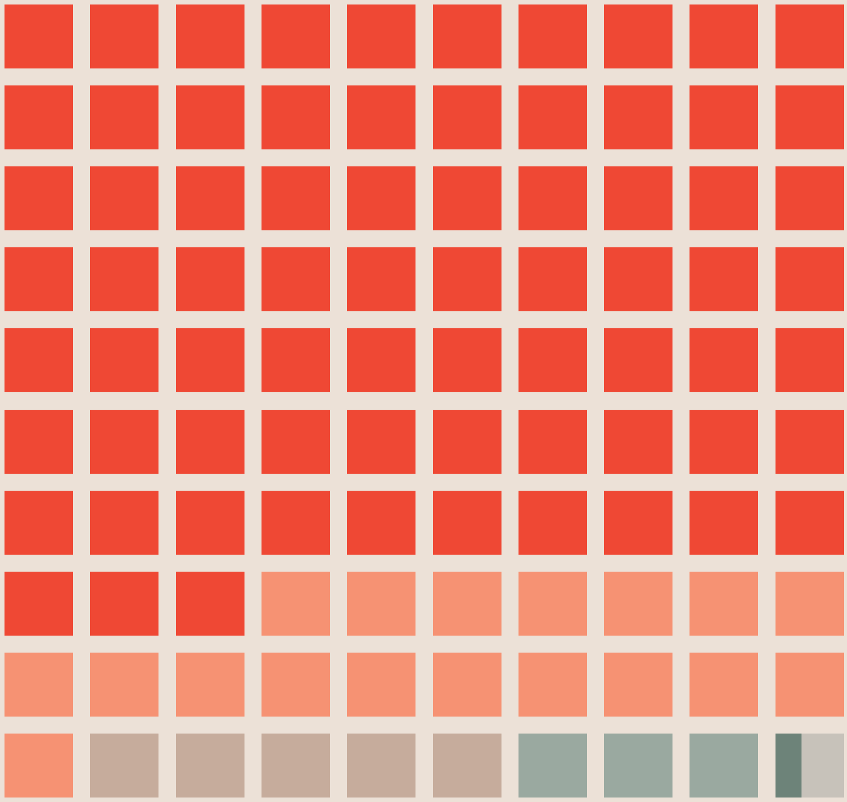
Operational emissions from existing buildings
73%

Embodied emissions from new construction
18%

Maintenance and repair of existing buildings
5%

Materials used in renovation and refurbishment
3%

Demolition and end-of-life processes
<1%



The following chapters take this proposition seriously by exploring the potential of integrating efficiency and sufficiency. The analysis begins with the buildings Europe already has, and with the many ways existing homes can be repaired, reclaimed, adapted, shared, extended or reinvented. The focus is not simply on increasing the number of dwellings, but on understanding how existing buildings can be better used before new construction becomes necessary.

It asks how each intervention could be applied across the existing stock of Europe, and what each could deliver across four crises at once: lower emissions and less pressure on nature, reduced energy and material use, more affordable homes, and healthier places to live.

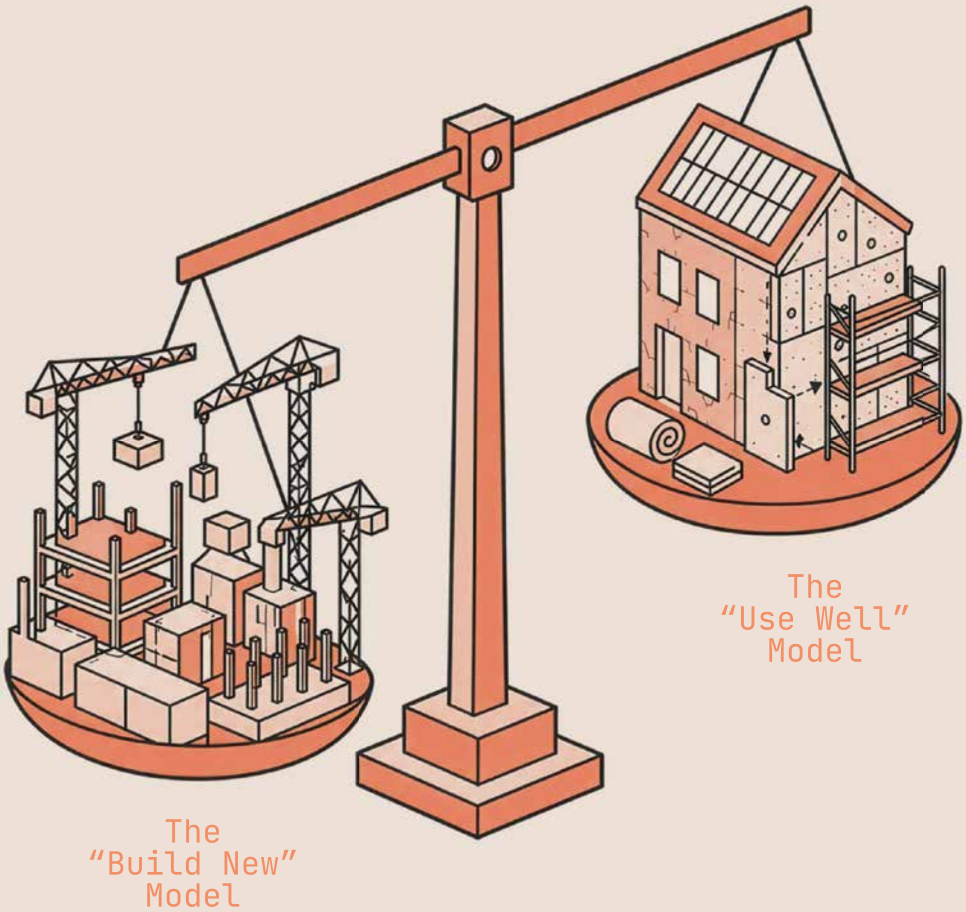
At the centre of this approach is a simple shift in perspective. Europe's existing building stock should not be treated as a limitation, but as a reserve (see Figure 5).

What if we saw the existing building stock as a reserve, of homes that could be unlocked, of carbon that does not need to be emitted again, of materials that have already been paid for once, and of opportunities to improve lives and living conditions?

A strategy built on constant addition only deepens the crisis we aim to solve. A great opportunity lies in optimising the existing footprint for health, affordability and the planet.

Figure 5. **The Danger of Constant Addition**.

Building our way out of today's challenges risks deepening the very problems we aim to solve. New construction requires significant amounts of energy and raw materials, which can increase Europe's geopolitical dependency while adding pressure on ecosystems. A more resilient path to security begins with reducing demand and making better use of what already exists.



03

A spectrum of measures

A spectrum of measures

Nine “better-use measures” have been identified and modelled, ranging from energy efficiency upgrades, reconfiguration and reallocation through to compact new construction. They are grouped into three families: Renovate, Extend and Build new.

Renovate

Reshape refers to the spatial reconfiguration and adaptation of underused dwellings to better align housing size and layout with changing demographic and social needs. The measure seeks to improve occupancy efficiency and functionality within the existing residential stock by redistributing available space. This can involve splitting large underoccupied houses into smaller apartments, merging adjacent units for larger households, adding independent annexes, or reorganising internal layouts to accommodate different household structures. Reshaping responds to demographic shifts such as ageing populations, smaller household sizes, or multi-generational living arrangements, while reducing under-occupation. Material interventions may range from moderate to substantial depending on the extent of spatial reconfiguration required.

Examples include subdividing a large single-family house into two or three flats once the children have moved out, combining two small adjacent apartments for a growing family, or carving a self-contained annex out of an oversized ground floor for an elderly parent.

Refine refers to the renovation and refurbishment of existing residential buildings to improve energy efficiency, indoor environmental quality, occupant wellbeing, and climate responsiveness without fundamentally altering the building layout. This measure targets buildings in need of an upgrade on energy performance and therefore requires only light renovation interventions. Typical measures include upgrades to insulation, windows, ventilation systems, shading devices, heating systems, or interior finishes aimed at improving comfort, resilience, and health conditions. Since no major structural or spatial changes are assumed, interventions are comparatively low in material intensity and disruption. Refine extends the useful life and quality of existing housing, preventing the risk of physical deterioration, vacancy, and subsequent demolition and replacement with new construction.

Examples include insulating and reglazing, improving ventilation and fitting external shading to a 1970s house prone to overheating, or bringing a damp, hard-to-heat flat up to standard with better airtightness and a heat pump.

Reclaim refers to the activation of vacant residential properties through renovation or refurbishment to bring them back onto the housing market. This measure targets homes that are already designed for residential use but remain empty due to obsolescence, neglect, ownership issues, or inadequate quality standards. The approach assumes that buildings are generally suitable for habitation and therefore do not require major spatial reconfiguration or changes to the internal layout. Instead, medium-scale renovation interventions are undertaken to restore functionality, improve comfort, and enhance energy performance, typically upgrading buildings with average performance levels. Reclaiming vacant housing can provide relatively rapid additional housing supply while avoiding land consumption and avoiding new construction.

Examples include refurbishing abandoned rural homes, renovating long-term vacant apartments, or restoring unused social housing units for reoccupation. Limitations may include hidden structural deterioration, moisture damage, outdated building services, contamination, fragmented ownership structures, or high renovation costs relative to local market value, particularly in depopulating regions.

Repurpose refers to the conversion of vacant or underused non-residential buildings into housing through a change of use. This measure involves adapting existing structures such as offices, retail buildings, schools, or industrial facilities to accommodate residential functions. Because these buildings were not originally designed for habitation, repurposing typically requires substantial material interventions, including changes to the internal layout, circulation, daylight access, ventilation, plumbing, fire safety systems, and acoustic performance. For the building-level quantification, repurposing is assumed to include deep energy renovation of buildings with poor energy performance, thereby improving both operational efficiency and habitability. The measure can theoretically be applied across the entire non-residential building stock, offering significant potential for urban regeneration and land-saving densification. However, technical limitations may constrain feasibility, including inadequate floor depths for residential daylight requirements, limited structural adaptability, insufficient ceiling heights, presence of hazardous substances, or difficulties complying with residential fire safety and accessibility standards.

Resize refers to behavioural and organisational measures that increase the intensity of use of the existing residential stock without requiring material alterations to buildings. Rather than changing the physical structure, resize optimises how housing space is occupied and shared. Measures include home-swapping, co-living arrangements, multi-generational living, shared occupancy, or matching underoccupied dwellings with households in need of space. Resize aims to reduce housing underuse while supporting affordability, social cohesion, and resource efficiency. Since no construction activity is involved, the measure has minimal embodied carbon investment and can often be implemented rapidly through policy incentives, match-making platforms, or community initiatives.

Examples include elderly residents sharing homes with students, families exchanging homes to better match household size, or cooperative living models where facilities are shared among residents. Although material constraints are minimal, implementation may face social and institutional barriers such as privacy concerns, legal and tenancy restrictions, cultural preferences for individual living, mismatches between location and housing demand, or a lack of policies supporting shared occupancy models, swaps, downsizing and rightsizing.

Extend

Attic conversion refers to the transformation of unused lofts or attic spaces into habitable residential areas. This measure makes use of existing underutilised volume within the building envelope to create additional living space without expanding the building footprint. Attic conversions can accommodate new bedrooms, studios, or independent apartments, thereby increasing residential capacity and flexibility within the existing stock. Interventions typically include thermal insulation upgrades and installation of roof windows. Technical limitations may include ceiling height and angle or inadequate load-bearing structure.

Examples include converting an unused pitched roof above a city apartment block into a top-floor flat, turning a house loft into an extra bedroom or home office, or insulating and adding roof windows to bring a cold, empty attic into daily use.

Build up refers to the vertical extension of existing buildings through the addition of one or more storeys. This measure increases residential capacity and density while avoiding additional land consumption, making it particularly relevant in urban areas with limited development space. Vertical extensions may involve adding lightweight rooftop apartments, modular prefabricated units, or entirely new floors above existing structures. Build-up projects are combined with energy renovation of the existing building envelope and technical systems, improving overall building performance alongside densification.

Examples include adding a lightweight timber storey of rooftop apartments to a flat-roofed 1960s block, raising a two-storey terrace by one floor, or placing prefabricated modular units on top of a supermarket or car park.

Build out refers to the horizontal extension of existing residential buildings through additions that expand the building footprint. This measure enables households to adapt dwellings to evolving spatial needs while intensifying use of existing plots and infrastructure. Horizontal extensions may include rear or side extensions, annexes, enclosed courtyards, or additional units connected to the existing structure.

Build-out interventions can support changing household compositions, ageing in place, multi-generational living, or the creation of additional housing units.

Examples include a rear extension that lets a family stay in a home they have outgrown, a side annex for a multi-generational household, or a small infill unit added to the plot of an existing house. Limitations may include plot size restrictions, loss of outdoor or permeable surfaces, zoning regulations.

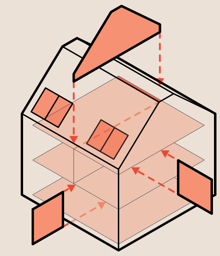
Build new

Compact new build refers to the construction of new compact residential buildings on brownfield sites or through infill development within already urbanised areas. This measure focuses on densification within the existing urban footprint by utilising vacant, underused, or residual land, such as former industrial sites, parking areas, vacant lots, or gaps within neighbourhoods. The approach aims to increase housing supply while limiting land consumption and making more efficient use of existing infrastructure and public services. New-build sufficiency strategies typically prioritise compact forms, resource-efficient construction, mixed-use integration, and reduced dwelling sizes while maintaining liveability and accessibility.

Examples include compact apartments on a former industrial site, infill housing slotted into a gap between existing buildings, or homes built over a surface car park near transit (see Figure 6).

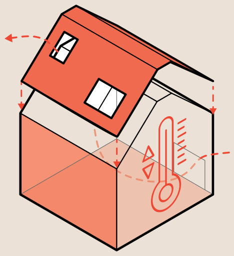
Figure 6. **The spectrum of measures: from renovation to new build**

Renovate



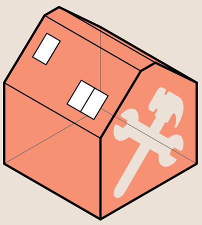
Reshape

Reconfigure underused dwellings to match household needs. Split large homes, merge units, or reorganise layouts. Responds to ageing populations, smaller households, and multi-generational living.



Refine

Energy upgrade of residential buildings. Upgrades to insulation, windows, ventilation, shading, and heating. Improves comfort and health without layout change or heavy material investment.

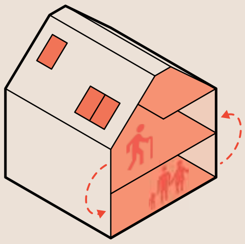


Reclaim

Place vacant residential properties back into use. Medium renovation restores functionality, comfort, and energy performance without major spatial changes. Quickly adds housing capacity without consuming new land.

Repurpose

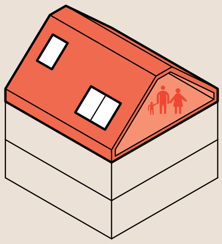
Convert vacant non-residential buildings (offices, retail, schools, industry) into housing. Includes deep energy renovation. Requires new layouts, plumbing, daylight access, and fire safety. Limited by floor depths and structural adaptability.



Resize

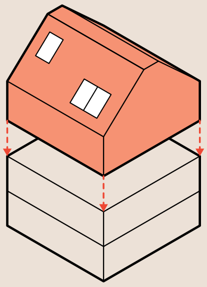
Use existing housing more intensively without construction. Home-swapping, co-living, shared occupancy, and matching underoccupied homes with households needing space. Minimal embodied carbon. Faces social and legal barriers.

Extend



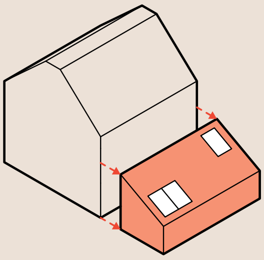
Attic Conversion

Transform unused attics into habitable space within the existing envelope. Adds bedrooms, studios, apartments, or workspaces. Typically includes insulation and roof windows. Limited by ceiling height and load-bearing capacity.



Build Up

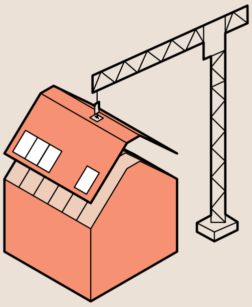
Vertical extension by adding storeys to existing buildings. Lightweight rooftop apartments, modular units, or new floors. Combined with envelope and systems renovation. Densifies without using new land.



Build Out

Horizontal extension that expands the building footprint. Rear or side additions, annexes, courtyards, or new connected units. Supports changing households and ageing in place. Limited by plot size and zoning.

Build new



Compact New Build

New compact homes on brownfield and infill sites within already urbanised areas, such as vacant lots, former industrial land, and residual plots. Prioritises compact forms, mixed use, and smaller dwellings while sparing greenfield.

04

Methodological approach for quantifying the potential

Methodological approach for quantifying the potential

The measures discussed in the previous section form the pool of better-use measures assessed in this analysis to estimate their potential at the scale of the EU building stock as alternatives to conventional residential new construction.

Building-level assumptions

The embodied carbon emissions and material consumption from applying the measures are first calculated at building level, drawing on a dataset of over 10,000 archetypes representing the EU building stock developed as part of a large-scale study for the EU Commission[10]. This set of archetypes is the most comprehensive and detailed representation of the EU building stock currently available and includes the LCA modelling of existing buildings, refurbishment variants and new built construction. The measures described in the above chapter (i.e. repurpose, reclaim, reshape, etc.) are defined according to the material interventions they require and the effects these interventions have on: (a) material consumption and associated embodied carbon emissions, (b) the intensity of floor area use, and (c) operational carbon emissions over the building lifecycle. Life-cycle impacts were calculated in accordance with EN 15978 using a 50-year Reference Study Period (RSP).

The assessment does not account for future grid decarbonisation, technological developments, or changes in production processes. Embodied emissions are therefore estimated using current and historical emission factors and reflect present-day production conditions. Table 1 provides a summary of the assumed requirements for spatial reconfiguration, material interventions to the building fabric and structure, and the extent and depth of energy performance improvements to the building envelope and technical systems associated with each measure.

Operational carbon emissions are calculated using a simplified approach. For the existing EU building stock, average operational emissions of 26 $kgCO_2eq/m^2$/year are assumed, corresponding to 1,300 $kgCO_2eq/m^2$ over a reference study period (RSP) of 50 years. For comparison, new buildings are assumed to have average operational emissions of 5 $kgCO_2eq/m^2$/year, equivalent to 250 $kgCO_2eq/m^2$ over the same period.

The assumption of 26 $kgCO_2eq/m^2/year$ for the existing EU residential stock is derived from EU-27 residential operational GHG emissions 2021 reported by Balaras et al.[25] (540.22 $MtCO_2eq$ in 2021) divided by EU residential floor area estimated by the EU Building Stock Observatory[26]. For new low-carbon residential buildings, an operational emissions intensity of 5 $kgCO_2eq/m^2/year$ is assumed, informed by benchmarks from a DGNB/BPIE report[27], Danish whole-life-carbon benchmarks for new buildings[28], and JRC zero-emission building threshold examples[29]. The operational emissions intensities are assumed to remain constant throughout the reference study period and therefore reflect present-day emissions conditions rather than projected decarbonisation of the energy system.

While attic conversions, vertical extensions (build-up), and horizontal extensions (build-out) do not directly improve the existing building, they often create an opportunity for wider renovation works. As a result, these measures can trigger upgrades to the building fabric and technical systems, delivering additional operational carbon savings alongside the added floor area (see Table 1).

Table 1: **Building level definitions, assumptions and archetype-modelling results providing operational and embodied CO_2 emissions per m^2**

Measure	Description of the building level measure	Modelling description
New Build Compact Infill / brownfield	New constructions following sustainable construction and sufficiency principles, e.g. lightweight structures, high energy performance and use intensity	Low carbon and sufficiency-led building practise using lightweight timber and low-carbon materials. Achieves high spatial efficiency
Build Out Lateral extension to existing	Adding a lightweight structure adjacent to an existing building, high energy performance	Building out with a new structure (mass timber) attached to the original building aiming at very good energy performance
Build Up Vertical extension on existing	Building up with a new lightweight structure realising a high energy performance	Building up with a new structure (mass timber) on top of the original building aiming at very good energy performance
Attic conversion Unlocking the roof space	Intervention to the building's attic layout, including lightweight structure, partitioning, roof insulation and windows, high energy performance	Unlocking the attic via intervention to building's internal (attic) layout with light structure (timber) and roof renovation (adding windows) aiming at very good energy performance
Resize No physical intervention	No material interventions applied to the building	No physical intervention modelled
Refine Energy upgrade	No need to change internal layout, Minor material interventions are applied corresponding to energy performance renovation	Refining existing building in need of energy upgrade, assuming no interventions to internal layout
Reshape Medium renovation reconfigure	Minor interventions to existing layout; medium energy performance renovation	Reconfiguration of existing building with average energy efficiency, minor interventions to internal layout (splitting, merging, layout change), assuming medium size intervention
Reclaim Medium renovation fit for purpose	Reclaiming existing building with average energy efficiency, assuming the vacant building is largely fit for purpose	No need to change internal layout; Minor material interventions are applied corresponding to medium energy performance renovation
Repurpose Deep renovation change of use	Repurposing of existing building with low energy performance, internal layout change and material intervention to building elements, deep renovation	Substantial interventions required to internal partitions, floors, roofs, façades, change building's internal layout for new use, assuming deep energy renovation in the process

% reduction of operational emissions of the existing (parts of the) buildings	Operational emissions after the intervention over a 50-year period ($kgCO_2eq/m^2$)	Archetype model-based embodied emissions ($kgCO_2eq/m^2$)	Archetype model-based embodied material use (kg per m^2)
–	250	474	1.477
–	250	261	805
–	250	257	676
–	250	175	283
–	1,300	0	0
25%	975	107	305
50%	650	200	318
50%	650	186	308
75%	325	227	349

Assumptions for upscaling building-level results to the EU stock

To assess the theoretical and technical potential of implementing these measures across the building stock, it is necessary to identify the conditions under which each measure can be applied. These conditions vary by measure and can be technical, legal, demographic, social or economic.

Technical conditions include, for example, roof geometry for attic conversions or the load bearing capacity of a building to accommodate additional storeys. Legal or regulatory conditions are relevant for reclaiming vacant or underused non-residential buildings for conversion into housing. Social constraints relate to behavioural and cultural aspects, including the willingness of occupants to share, swap, or sublet living space (see Table 2). While multiple constraints typically apply simultaneously across all measures, the analysis focuses on identifying the most relevant constraints that determine the applicability rate of each intervention.

The assessment includes all relevant eligibility criteria identified through a literature review to estimate the share of the building stock that could technically accommodate each measure.[30,31] The residential building stock has an area of 21 billion m^2. The ranges represent the level of uncertainty implied in this kind of analysis used to estimate the potential minimum and maximum impact of the measures. The upscaled potential represents a technical and socio-economic eligibility assessment. It does not account for demographic or urbanisation trends nor local housing market dynamics (i.e. housing supply and demand) as no EU-wide spatial dataset was identified that would allow such an analysis.

No robust EU-wide eligibility rate could be established for horizontal extensions. Unlike vertical extensions, their feasibility depends less on structural capacity and more on plot conditions, planning rules, available land, and household preferences. As a practical proxy, the eligibility rate for vertical extensions of single-family homes was applied instead. This corresponds to about 16% of single-family homes, or roughly 6% of the total residential building stock.

Rather than treating the measures as separate, isolated actions, the analysis examines how they interact and can be combined across the European building stock. Some

Table 2: **Assumptions used to upscale building level emissions to the building stock level**

Measure	Eligible reference stock	Eligible floor area expressed in % of residential stock	Impact on living space (addition, better use, improve)
New Build Compact Infill / brownfield	Brownfields sites are available to construct the size of about 4% of the existing residential stock floor area	4%	100% of the eligible area is added, equal to 4% of the residential stock
Build Out Lateral extension to existing	6% of the residential stock is eligible and suitable for horizontal (lateral) extension	6%	10%-15% of the eligible area is added, equal to 1% - 6% of the residential stock
Build Up Vertical extension on existing	16% of the residential buildings are eligible for building up further floors	16%	15%-20% of the eligible area is added, equal to 2% - 3% of the residential stock
Attic conversion Unlocking the roof space	3%-11% of the residential buildings is eligible for attic conversions	3-11%	15%-20% of the eligible area is added, equal to 0% - 2% of the residential stock
Resize No physical intervention	Existing literature on willingness to share, swap and sublet suggests that 22% of the residential stock area is eligible to this measure	22%	No floor area is added. The better use results in additional dwellings with an area of 4% of the residential stock
Refine Energy upgrade	By refining indoor comfort 11% of the existing residential stock would significantly lower risk of vacancy or allow inhabitants to keep their homes comfortable	11%	No floor area is added. The refinement extends building lifetimes, avoiding new dwellings equal to 1% of the residential stock
Reshape Medium renovation reconfigure	15%-35% of the floor area in existing residential buildings is eligible to undergo this measure	15-35%	No floor area is added. Better use of existing space creates additional dwellings equal to 3 to 7% of the residential stock
Reclaim Medium renovation fit for purpose	Vacant residential buildings eligible to be reclaimed make up a floor area ranging from 3% to 12%	3-12%	100% of the eligible area is added, so 3% - 12% of the residential stock
Repurpose Deep renovation change of use	8%-40% of the non-residential buildings are vacant and eligible for repurposing into housing	1-6%	100% of the eligible area is added, so 1% - 6% of the residential stock

measures are complementary and may be implemented together. For example, a vacant building may first need to be restored, adapted, and subsequently upgraded to improve its energy performance. An underused dwelling may be renovated and reconfigured to accommodate additional households more efficiently.

Other measures are alternatives. For example, both reshaping and resizing (e.g. sharing and home swapping) address underused living space but they differ in their underlying mechanisms (reconfiguration versus behavioural change) and in the types of households and dwelling situations they target. Their potentials are therefore not simply added together, as this would imply counting the same housing capacity more than once.

The analysis also assumes that the better use of buildings is combined with energy efficiency improvements. This is important because more intensive use can increase the amount of space that is heated, cooled, or otherwise serviced. Energy renovation is therefore treated as part of the better use strategy, not as a separate add-on.

Using these assumptions, the potential impact of the measures is assessed by combining expectations about the building-level impact, uptake, combination, and achieved energy performance. The uptake refers to the extent to which each intervention is applied across the building stock and is largely determined by the technical feasibility of the interventions given the different building types. Combination describes how often interventions are implemented together as integrated renovation and better-use packages. Energy performance describes whether standard or advanced energy improvements are achieved.

The analysis assumes a current EU residential floor-area use intensity of 46 m^2 per person and an average occupancy of 2.3 persons per dwelling, based on EU Building Stock Observatory data. The implementation of the measures assumes a decrease in average use intensity to 35 m^2 per person, representing a more efficient use of existing space.

05

Not all housing solutions are equal

Not all housing solutions are equal

Not all ways of creating housing have the same environmental impact.

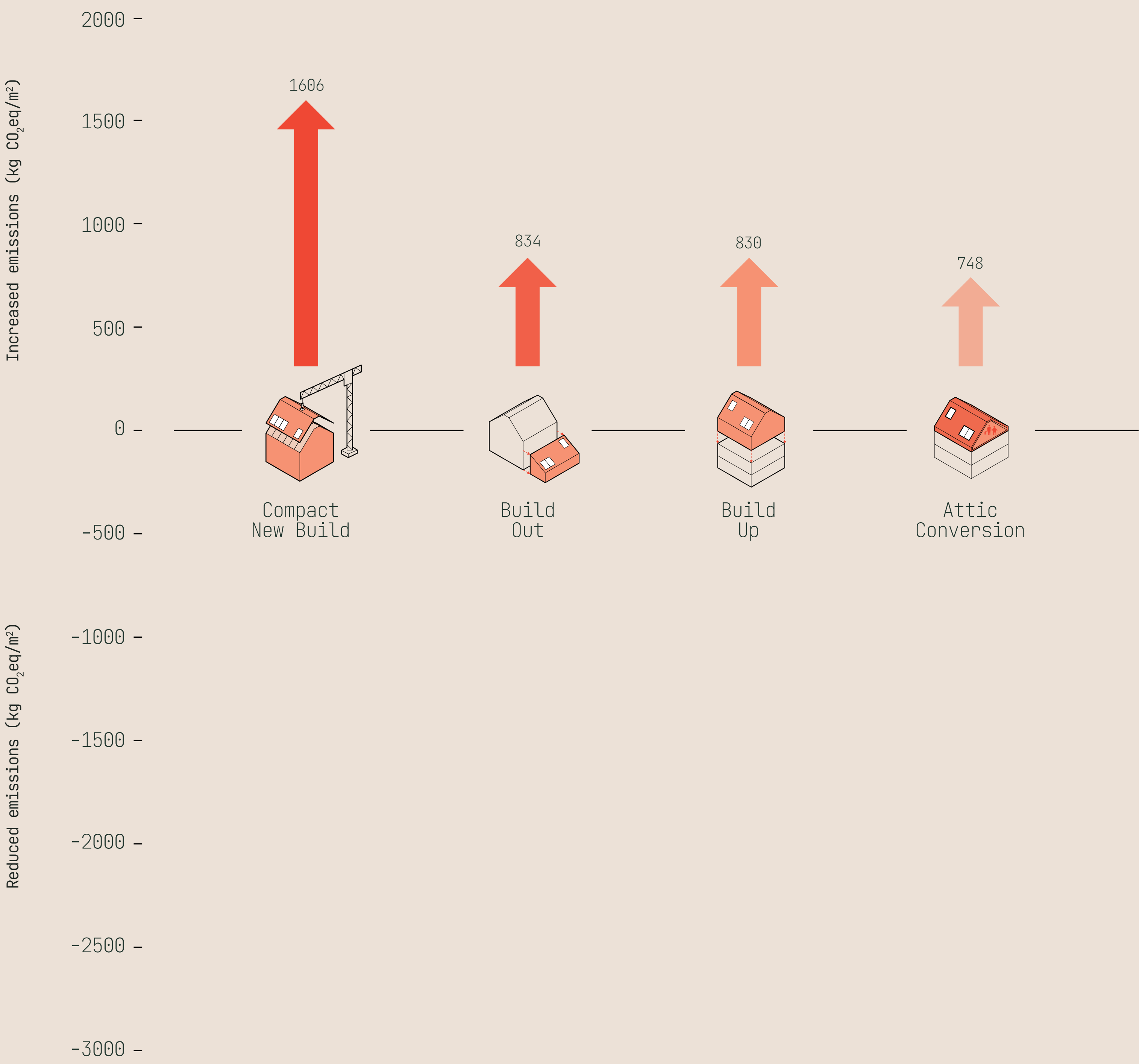
New construction adds floor area, but it also adds emissions, material and energy demand, and thereby increases pressure on land and ecosystems. Extensions also add capacity, but still require additional materials and resources.

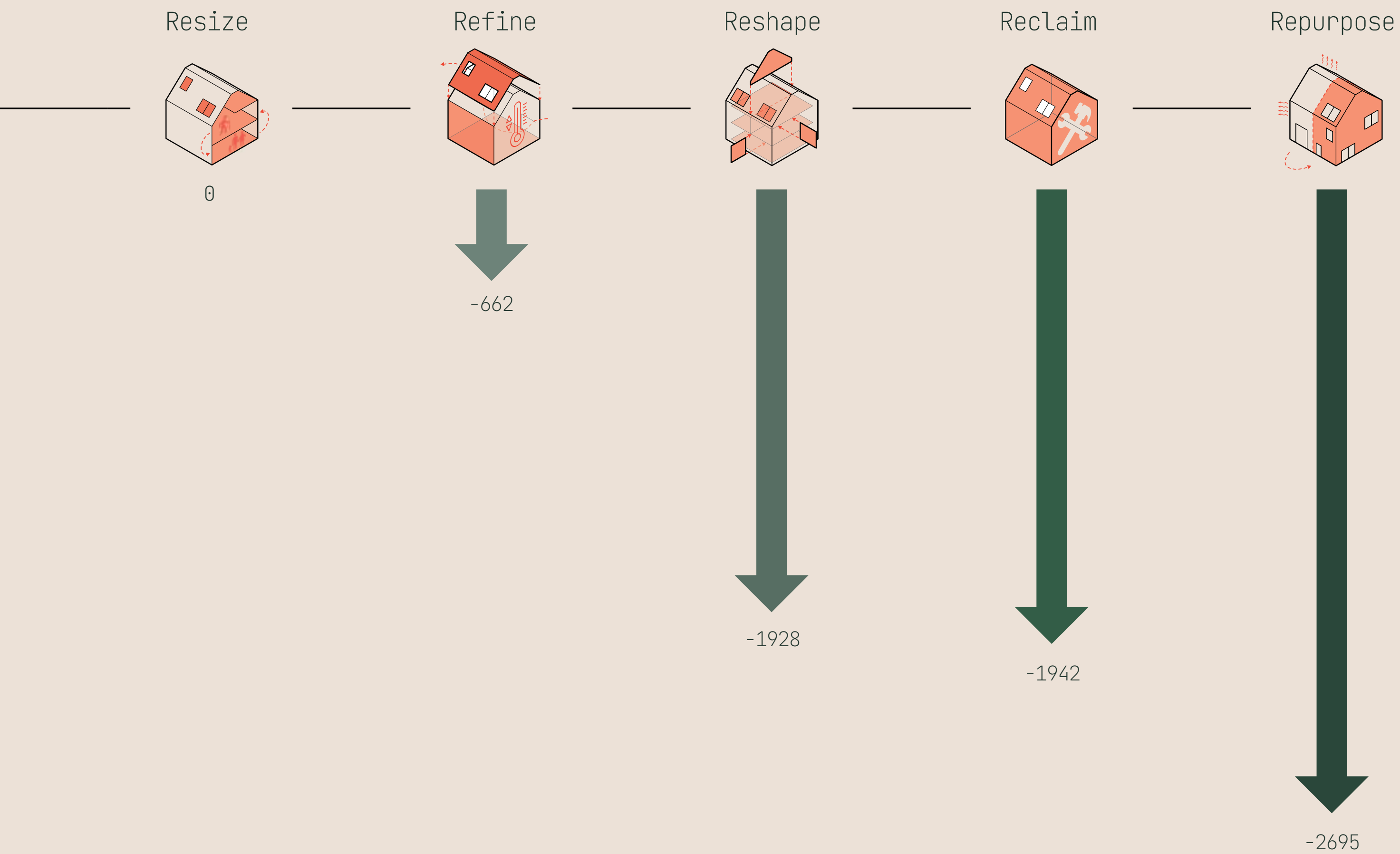
Renovation, by contrast, creates capacity by unlocking value in the existing stock. It avoids most of the material demand of new construction, and has the potential to reduce operational energy and improve the quality of the homes people already live in.

Two interventions can deliver comparable carbon reductions while placing very different demands on raw materials, and thus on land and ecosystems. For this reason, material use is treated here as a proxy for these off-site impacts. Every tonne of material brought into a building carries impacts upstream, through extraction, processing, and transport, and downstream, through waste and end of life. Reducing material demand therefore lowers pressure across several planetary boundaries at once, in particular climate and biodiversity, rather than shifting the burden from one to another.

The contrast becomes clear when measures that deliver the same housing capacity are compared side by side (see Figures 7, 8 and 9). Reshaping an underused existing dwelling, for instance, requires roughly five times less material than compact new construction. Both measures use material and add upfront carbon emissions, but when renovation measures are combined with energy efficiency improvements, this cost is typically offset within a relatively short carbon payback period of around 3 to 7 years.

Figure 7 - **Total lifecycle CO_2 emissions results from the nine measures**




Resize
Refine
Reshape
Reclaim
Repurpose
0
-662
-1928
-1942
-2695

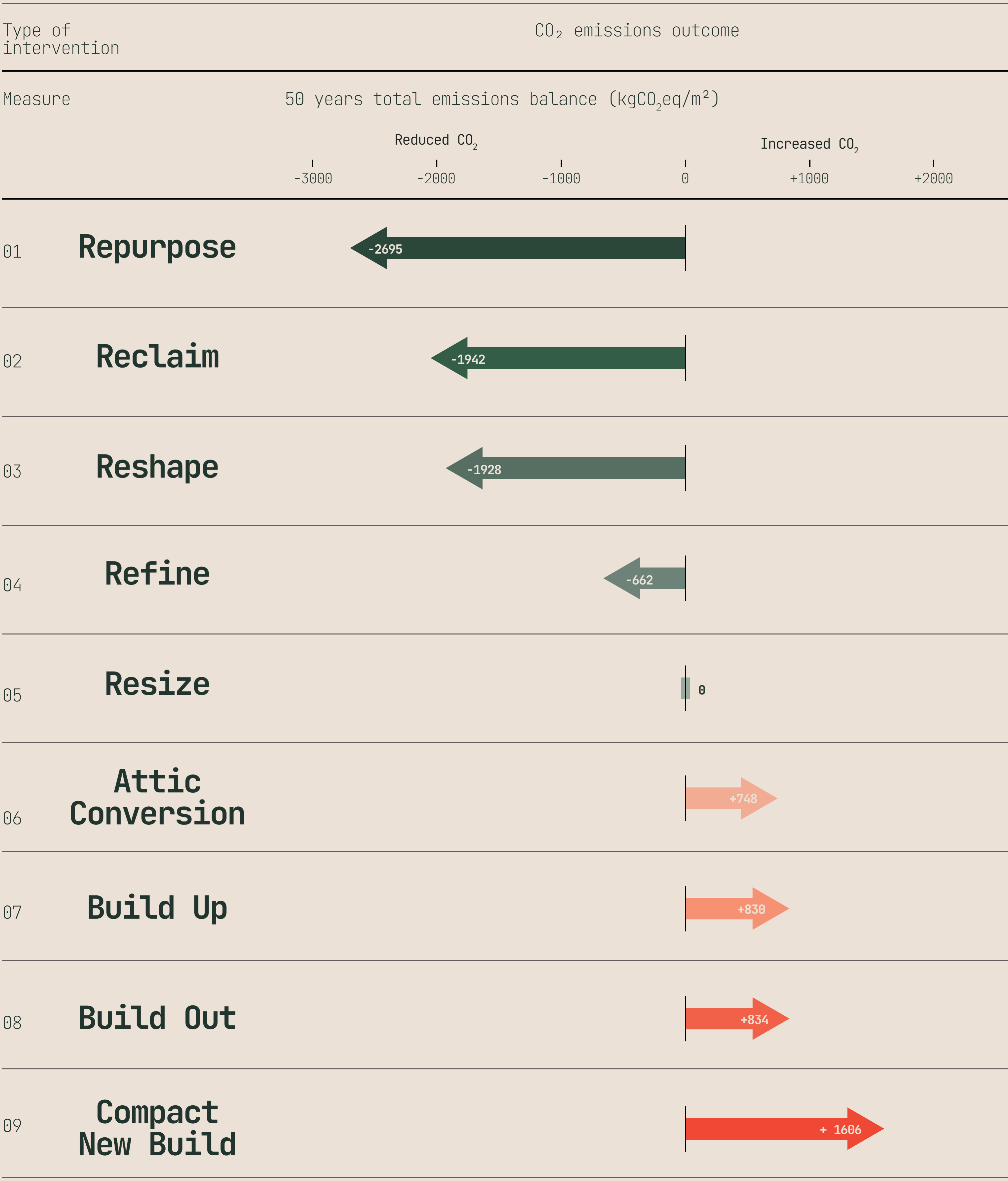
The operational savings accumulate over the lifetime of the building and can repay the initial carbon investment many times over. The materials themselves, however, cannot be recovered in the same way. Once extracted and installed, they represent a permanent draw on finite resources, regardless of how the building performs in use. Low material intensity is therefore valuable in itself, and not only as a means to lower operational emissions.

The evidence presented here shows that a single metric is not enough to compare housing solutions. Carbon captures only part of the picture. It does not distinguish between a saving achieved by working with existing buildings and the same saving achieved through additional material extraction, land use, and expansion of the built environment. Assessing each measure against both emissions reductions and material demand makes these trade-offs visible.

This combined perspective forms the basis of the hierarchy presented in the following chapter, which prioritises measures according to the greatest impact achieved with the least resource use.

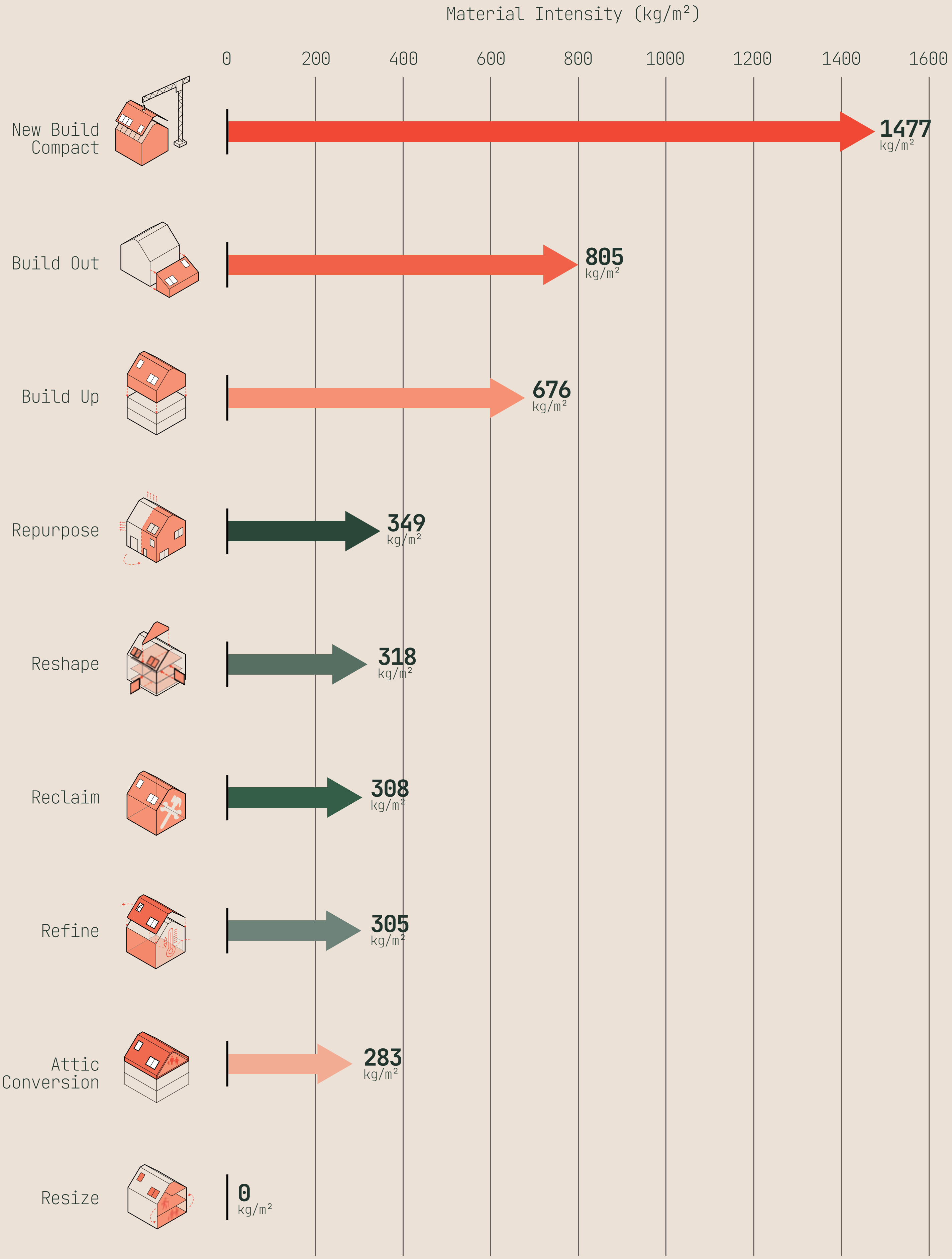
Housing solutions must be measured not only by the carbon they save, but by the resources they demand, the land they affect, and the ecosystems they disturb. An integrated approach reveals what carbon alone cannot: whether we are truly reducing pressure on the planet, or merely shifting it from the atmosphere to the living world.

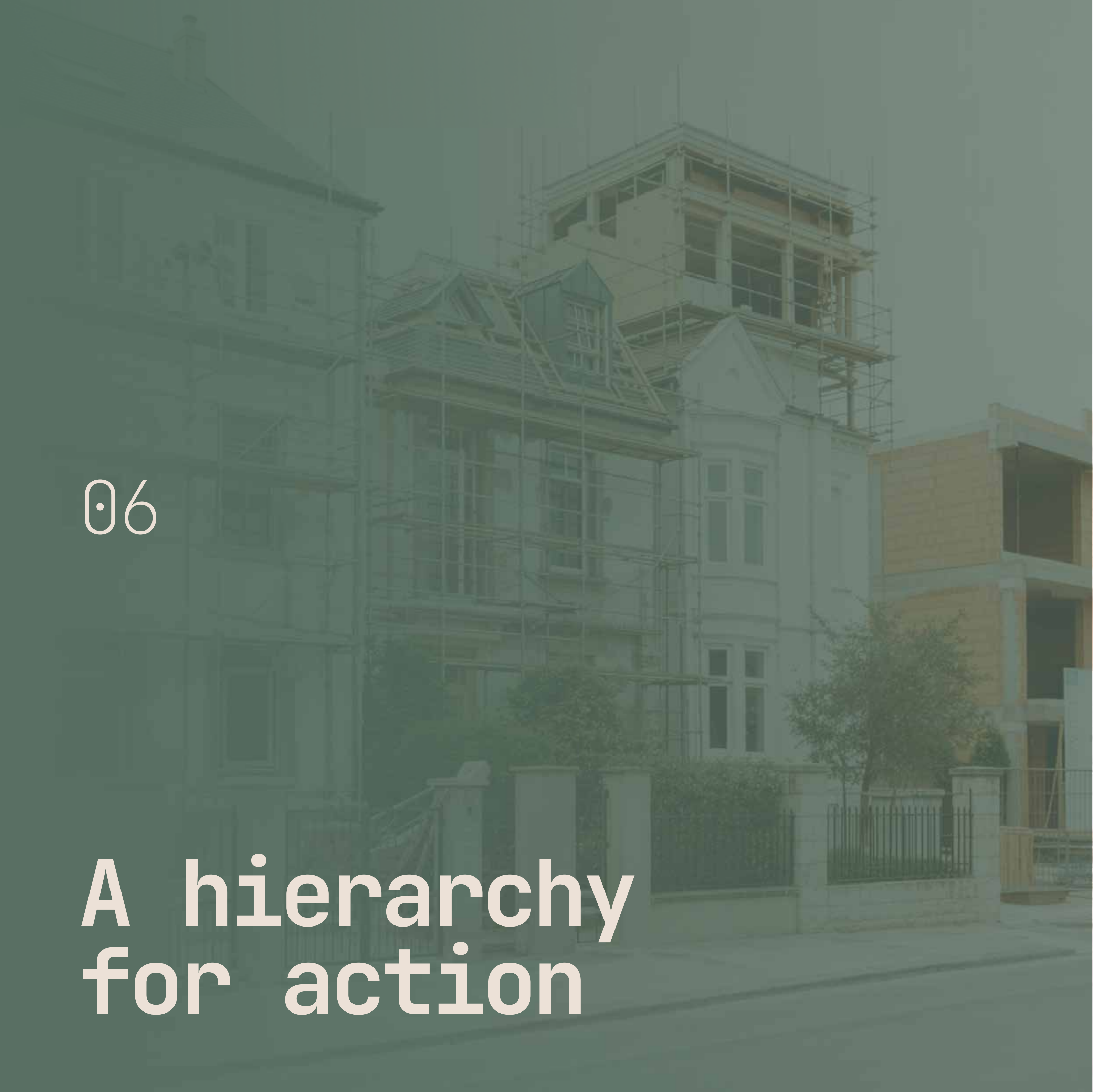
Figure 8 - **Total lifecycle CO_2 emissions results from the nine measures**



Intervention footprint		Impact		
Material Intensity	Material Emissions	Energy consumption, before	Energy consumption, after	Carbon payback period
349 kg/m^2	**227** kgCO_2eq/m^2	**187** kWh/m^2/year	**47** kWh/m^2/year	**3.9** years
318 kg/m^2	**200** kgCO_2eq/m^2	**204** kWh/m^2/year	**102** kWh/m^2/year	**4.7** years
308 kg/m^2	**186** kgCO_2eq/m^2	**204** kWh/m^2/year	**102** kWh/m^2/year	**4.4** years
305 kg/m^2	**107** kgCO_2eq/m^2	**209** kWh/m^2/year	**157** kWh/m^2/year	**7.0** years
0 kg/m^2	**0** kgCO_2eq/m^2	**157** kWh/m^2/year	**157** kWh/m^2/year	**-** years
283 kg/m^2	**175** kgCO_2eq/m^2	**-** kWh/m^2/year	**39** kWh/m^2/year	**-** years
676 kg/m^2	**257** kgCO_2eq/m^2	**-** kWh/m^2/year	**39** kWh/m^2/year	**-** years
805 kg/m^2	**261** kgCO_2eq/m^2	**-** kWh/m^2/year	**39** kWh/m^2/year	**-** years
1477 kg/m^2	**474** kgCO_2eq/m^2	**-** kWh/m^2/year	**77** kWh/m^2/year	**-** years

Figure 9.
Resource use per square metre across the nine measures





06

A hierarchy for action

A hierarchy for action

Placing the nine measures in a matrix of material intensity versus climate impact produces a clear hierarchy of priority actions.

The matrix highlights the direction the industry must move towards: interventions that combine low material use with high emissions reductions. It evaluates each measure against both dimensions simultaneously, making the lower-left quadrant the most desirable outcome (see Figures 10 and 11 below).

Figure 10. **Material intensity versus climate impact: the four quadrant assessment matrix.**

The matrix provides a guide for assessing interventions, helping identify which profiles should be prioritised to reduce whole-life carbon emissions while limiting material use.

01.Least preferred profile
High material use with added emissions.

02.Less preferred profile
Lower material use, but still added emissions.

03.Transitional profile
Reduced emissions, but with high material use.

04.Desired target profile
Reduced emissions with low material use. This is where future building interventions should aim.

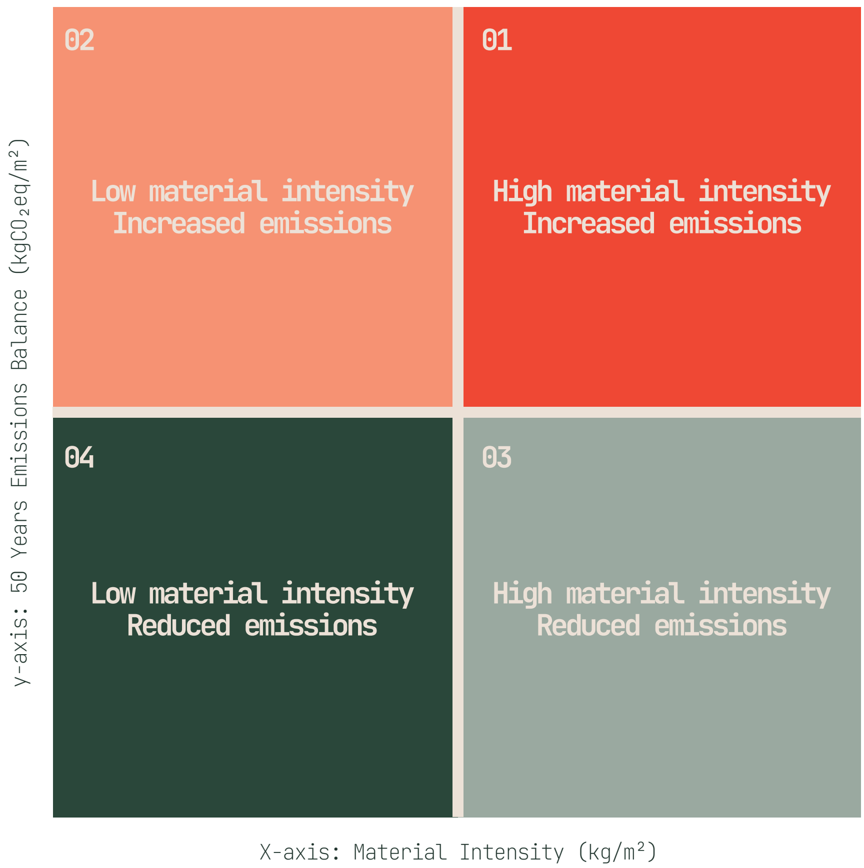
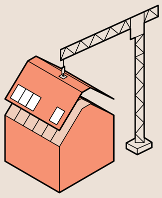
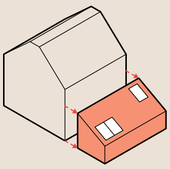


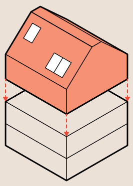
Figure 11: **Nine housing measures placed on the material intensity versus climate impact matrix**



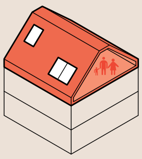
01
Compact New Build
+1606 $kgCO_2eq/m^2$
+1477 kg/m^2



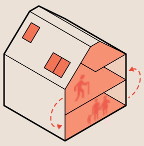
02
Build Out
+834 $kgCO_2eq/m^2$
+805 kg/m^2



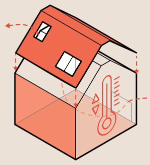
03
Build Up
+830 $kgCO_2eq/m^2$
+676 kg/m^2



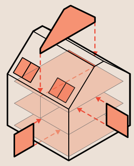
04
Attic Conversion
+748 $kgCO_2eq/m^2$
+283 kg/m^2



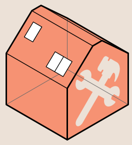
05
Resize
0 $kgCO_2eq/m^2$
0 kg/m^2



06
Refine
-662 $kgCO_2eq/m^2$
+305 kg/m^2

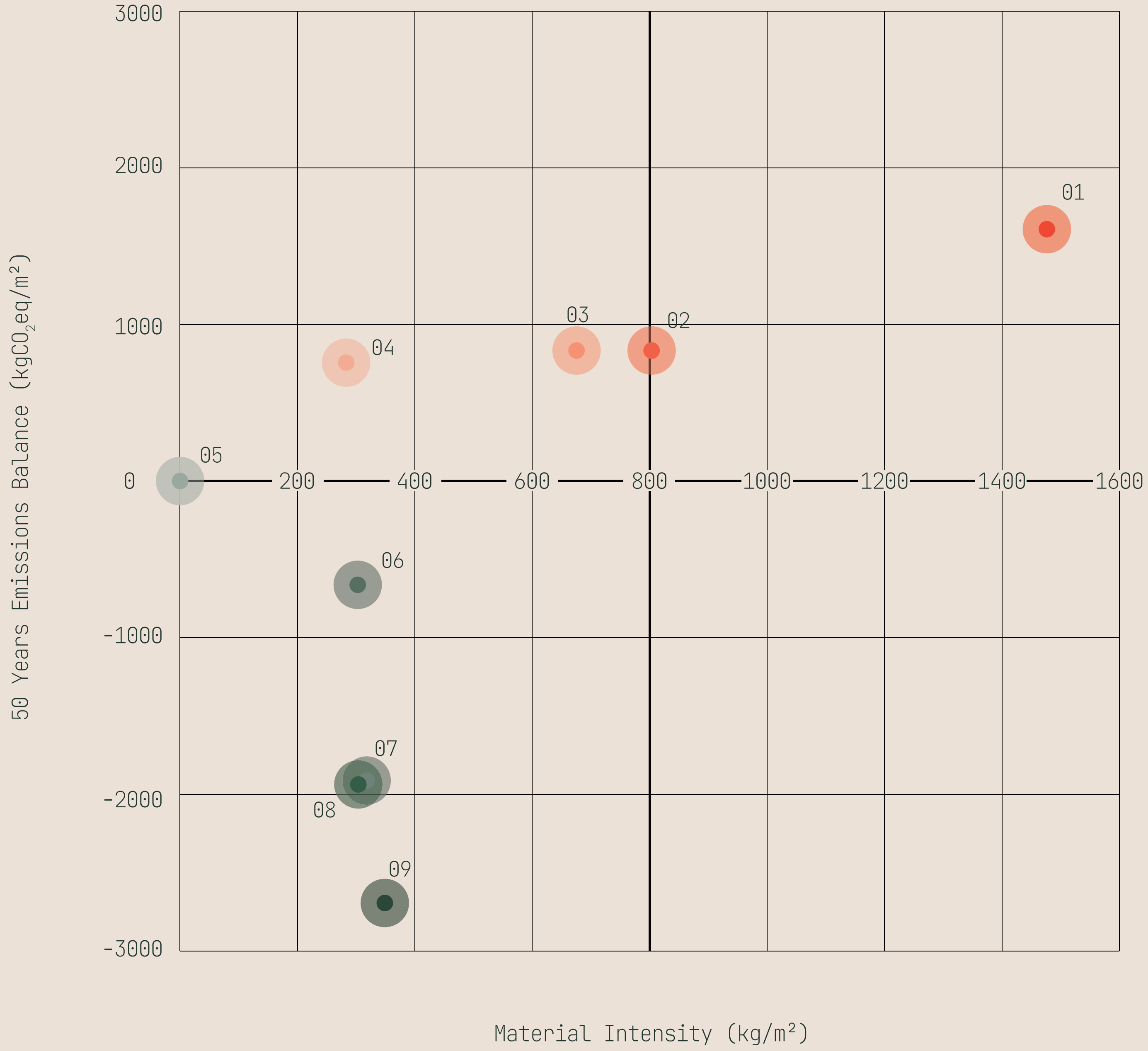


07
Reshape
-1928 $kgCO_2eq/m^2$
+318 kg/m^2



08
Reclaim
-1942 $kgCO_2eq/m^2$
+308 kg/m^2

09
Repurpose
-2695 $kgCO_2eq/m^2$
+349 kg/m^2


3000
2000
1000
0
-1000
-2000
-3000
200
400
600
800
1000
1200
1400
1600
01
02
03
04
05
06
07
08
09
50 Years Emissions Balance (kgCO2eq/m²)
Material Intensity (kg/m²)

The matrix helps translate this variation into a clear order for action. It shows where the greatest leverage sits in the existing building stock, and which types of intervention should be prioritised before more material intensive options are considered. This hierarchy (Figure 12) serves as a guide rather than a universal rule. While it holds at a system level, the exact impact of each intervention will always vary depending on context.

The three families of measures are ordered by their relative impact on emission reduction.

Renovate first. Work with what is already standing. Resize, reclaim, repurpose, refine, reshape. These measures create homes, fix homes, and improve homes by acting on the existing buildings. They unlock capacity, cut operational energy, improve living conditions, and extend the lifetime of buildings, all with much less material demand than new construction. These measures should be prioritised before more resource-intensive interventions are considered.

Then extend. Attic Conversion. Build up. Build out. These measures add capacity to existing structures. They require new materials, but far less than building from scratch, and they keep the existing building in service. Extend where renovation cannot meet demand on its own.

Build new only as a last resort. Compact biobased first. Conventional mineral last. Even the best new construction adds material demand and emissions that did not previously exist. Conventional mineral construction performs worst and should be treated as the reference case we are deliberately moving away from.

As described in the previous chapter, assessing each measure against both the emissions it avoids and the materials it requires reveals trade-offs that carbon alone conceals. The matrix translates that dual perspective into the Impact Framework (Figure 13).

Figure 12.
Hierarchy of building interventions ranked by environmental impact

Renovation interventions
have the lowest CO_2 and material footprint, with the highest potential for emission savings.

Extension interventions
have medium carbon impacts, low material intensity, and limited potential for emission savings.

New-build interventions
have the highest carbon emissions and material intensity; both emissions and square metres are additional, with no emission savings

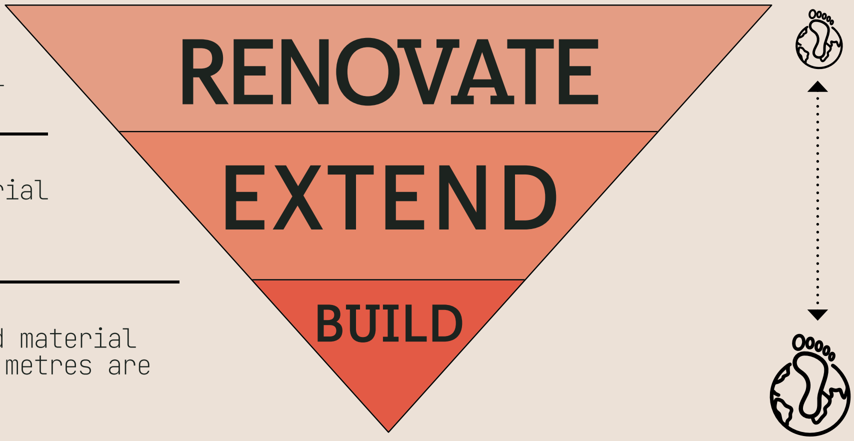
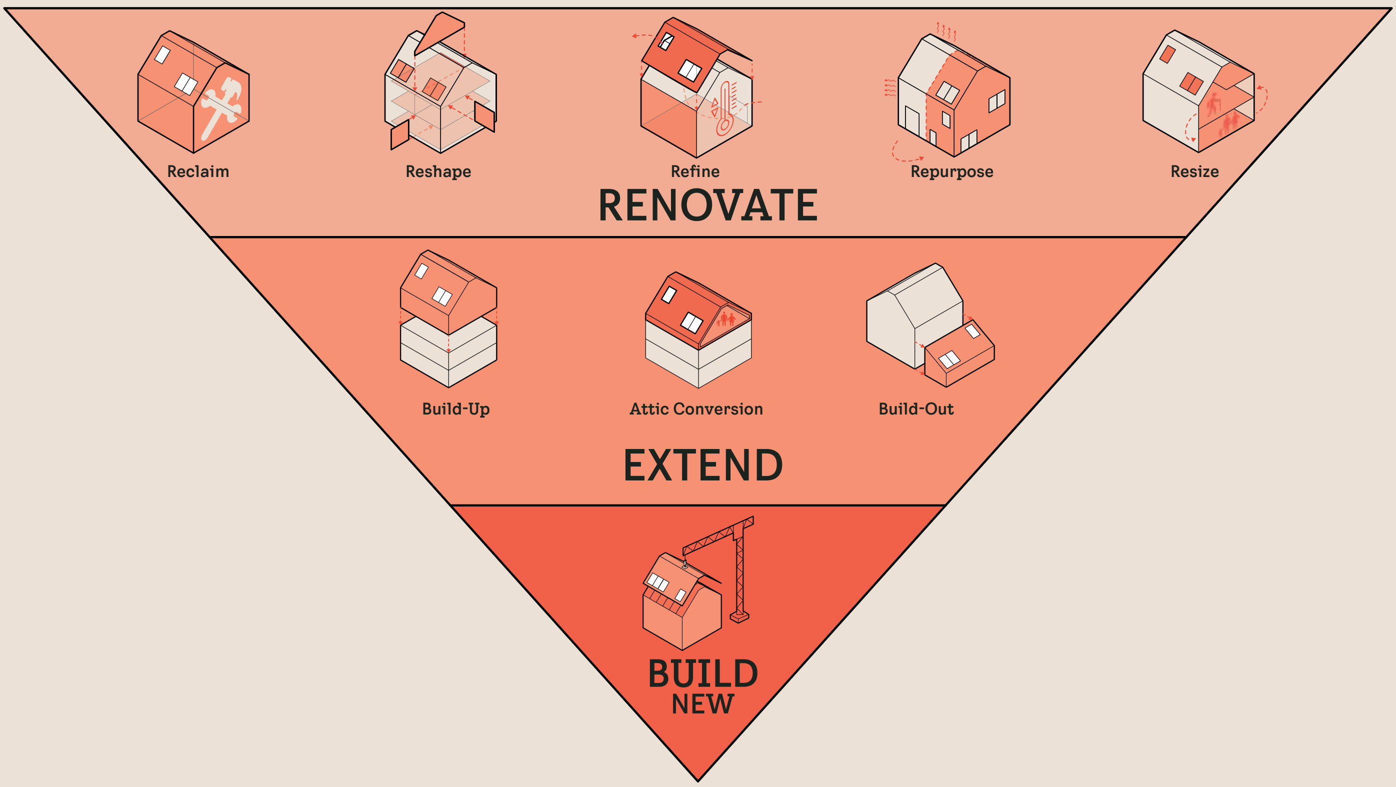


Figure 13.
Impact Framework: building measures ranked across three tiers of environmental impact

The Impact Framework



07

Estimating the potential of using buildings better at the European scale

Estimating the potential of using buildings better at the European scale

Without these better-use measures, Europe continues to respond to housing demand mainly through new construction. Floor area grows, and with it come higher material demand, embodied emissions, land pressure, infrastructure needs, and energy dependency.

The current pathway does not guarantee affordability or access. It also leaves much of the existing building stock largely unchanged, meaning the health, comfort, and energy burdens of poor housing continue.

With Europe applying the better-use measures, existing buildings are treated as the first resource for meeting housing need. Vacant, damaged, outdated, underused, or non-residential buildings are reactivated, refined, repurposed, adapted, extended, shared, swapped, or reshaped depending on context. New construction is only used where the better use interventions cannot meet the remaining need. When it happens, it is assumed to be compact and lower impact.

The assessment results present an alternative approach for Europe to respond to the interconnected crises. The current response continues to treat housing demand mainly as a need for more construction. Instead, the response developed in this analysis treats the existing building stock as a critical resource, asking how much Europe can achieve by renovating, reactivating, adapting, sharing, and extending what already exists before adding new buildings. The potential of the suggested alternative response is explored below.

Matching the housing supply to what Europe needs, with what already stands

The analysis identifies a potential of 50 to 107 million additional homes could be unlocked from the existing building stock — without breaking ground or pouring new foundations on greenfield land (Figure 14). This corresponds to an additional 4–9 billion m^2 of residential floor area and housing 115 to 246 million people through better use of existing buildings (Figures 15-16). At the upper end of the estimate, the potential is equivalent to adding a housing stock comparable in size to the combined housing stock of Germany, France, and Italy, without opening a single new development site.

While this potential cannot be fully realised in practice due to demographic, technical, economic, and cultural constraints, it also does not need to be. Even against estimates of a housing shortfall of 22 million dwellings by 2035[29], the capacity embedded in the existing building stock exceeds the gap many times over. In principle, Europe's housing needs could be met through better use of what already stands.

Importantly, the scale of the potential demonstrates two things. First, better-use measures alone could provide sufficient housing capacity, also in markets experiencing the most acute housing supply shortages, thereby reducing or avoiding the need for new construction. Second, better-use measures do not only increase housing capacity and improve the existing building stock, they also increase the diversity of housing options available. This is particularly relevant because

Europe's housing crisis is not simply a shortage of supply, but also a mismatch between the housing that is available and the housing people need.

Many households are unable to move to a dwelling that better matches their circumstances: families may struggle to find larger homes within their community, while older people often remain in homes that are too large, inaccessible, energy inefficient, or costly to maintain because suitable alternatives are unavailable or unaffordable nearby.

Better use does not only add supply, it adds supply that can be faster and cheaper to deliver. Reuse can remove the largest cost layers of housing production: the land is bought, the structure is standing, the façade is paid for. Evidence from completed conversion projects across the EU shows that homes can be delivered at cost comparable to, or lower than, the equivalent new construction, in some cases 20% cheaper[40].

The benefits continue after people move in. Because all better-use measures are combined with energy renovation, the homes they deliver are not only cheaper to create but also cheaper to operate. The modelled interventions reduce operational energy demand in existing buildings by 25–75%, lowering household energy bills. This is particularly relevant at a time when more than 40 million Europeans are unable to keep their homes adequately warm[17]. Affordability is not only a question of rent or mortgage payments; it is the total cost of living in a home. By reducing both housing and energy costs, better use of the existing building stock addresses affordability on multiple fronts.

Housing affordability does not follow from housing supply in general. Market mechanisms of supply and demand alone do not necessarily deliver affordable homes. Affordability comes from a needs-based approach that provides the right type of housing, in the right place, and at the right scale.

This implies a shift from a purely supply-driven model to a demand-oriented perspective. Rather than building housing units that sell best on the market, the focus shifts to creating housing units where and how they can fulfil a diverse, locally context dependent needs that will provide long-term resilience to its residence in times of multiple crises.

This can mean smaller homes where households have shrunk. It can mean reclaimed homes where buildings sit empty. It

Europe can create up to 107 million dwellings in the areas where they are most needed, increasing housing supply into places that are currently unaffordable for the many, **reducing energy poverty through warmer homes**, and cutting emissions by using the buildings, infrastructure, and neighbourhoods already in place.

Europe can create the homes it needs by opening up the places that have become hardest to afford.

107

million dwellings could be unlocked with far less material demand, because reuse and renovation need much less than building from scratch.

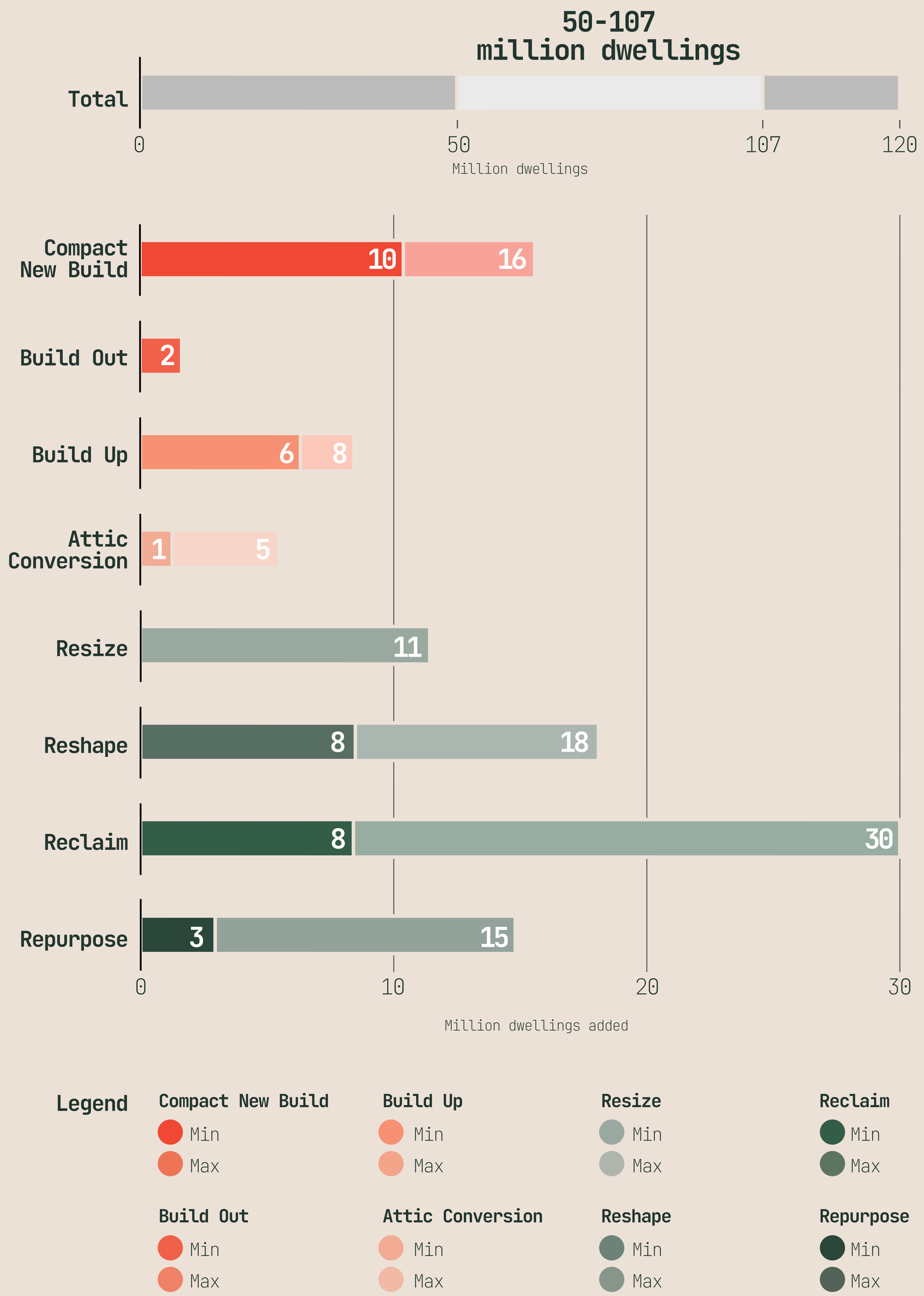
30

million dwellings could be unlocked through Reclaim alone. This equals 29% of the maximum potential for new dwellings.

31-75

million dwellings could be created through renovation alone, without any new construction or extensions, helping to tackle energy poverty through warmer, healthier homes and lower energy bills

Figure 14. - **Potential additional dwellings activated**



Europe can unlock up to **9 billion m² of housing space** without expanding outward. That is equivalent to **adding one third of Europe's entire building floor space again** by making better use of existing buildings, brownfields, and already-developed land, **thereby increasing supply without worsening urban sprawl and the associated environmental damage.**

The future of housing in Europe does not require more land. It requires better use of the places we already share.

4-9

billion m² of housing space are already waiting to be unlocked. This is equal to adding around one third of Europe's entire building floor space again, but within and around what is already built.

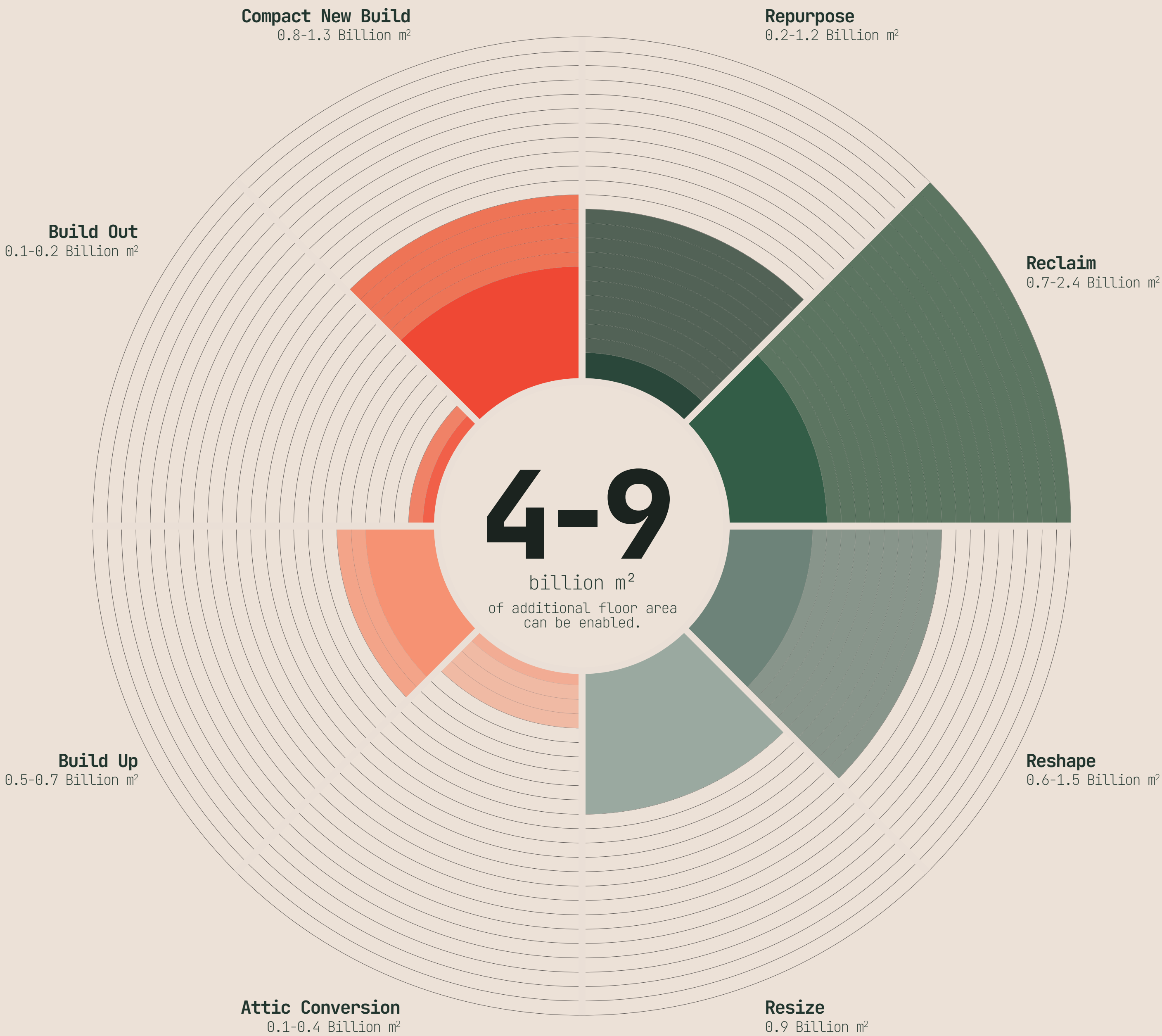
100%

of what EU's housing needs can be unlocked within these measures. The housing supply Europe needs is not waiting in greenfields. It is already in existing buildings, brownfields, and land we have already developed.

25

million people can be housed for every 1 billion m² already built housing unlocked.
6 million people can be housed for each 1% of the existing stock unlocked.

Figure 15. - **Potential additional residential floor area activated.**



Legend.

Compact New Build
- Min
- Max

Build Up
- Min
- Max

Resize
- Min
- Max

Reclaim
- Min
- Max

Build Out
- Min
- Max

Attic Conversion
- Min
- Max

Reshape
- Min
- Max

Repurpose
- Min
- Max

can mean repurposed homes where offices stand half used. Subdivided homes where one person occupies the space of four.

The better-use measures deliver supply where the demand actually is, at the scale the affordability crisis requires. When the right supply expands at this scale, helped by strong regulatory safeguards, rents and prices respond. Housing stops being a scarcity to ration and starts being a stock to share more equitably. This is essential if housing is to be treated first and foremost as a home and a fundamental right.

Up to 246 million additional people could be accommodated within Europe's existing building stock, equivalent to more than half of the EU population. Europe needs 22 million more homes over the next decade. The data shows we could unlock 2-5 times more housing capacity just by using what already exists. Meaning Europe can reduce poor living conditions, increase housing supply, and cut energy demand through the same renovation effort.

Europe already has the space to meet its housing need, improve lives, and cut energy demand.

246

million people could be housed in the max scenario. That is equal to more than half of the entire EU population.

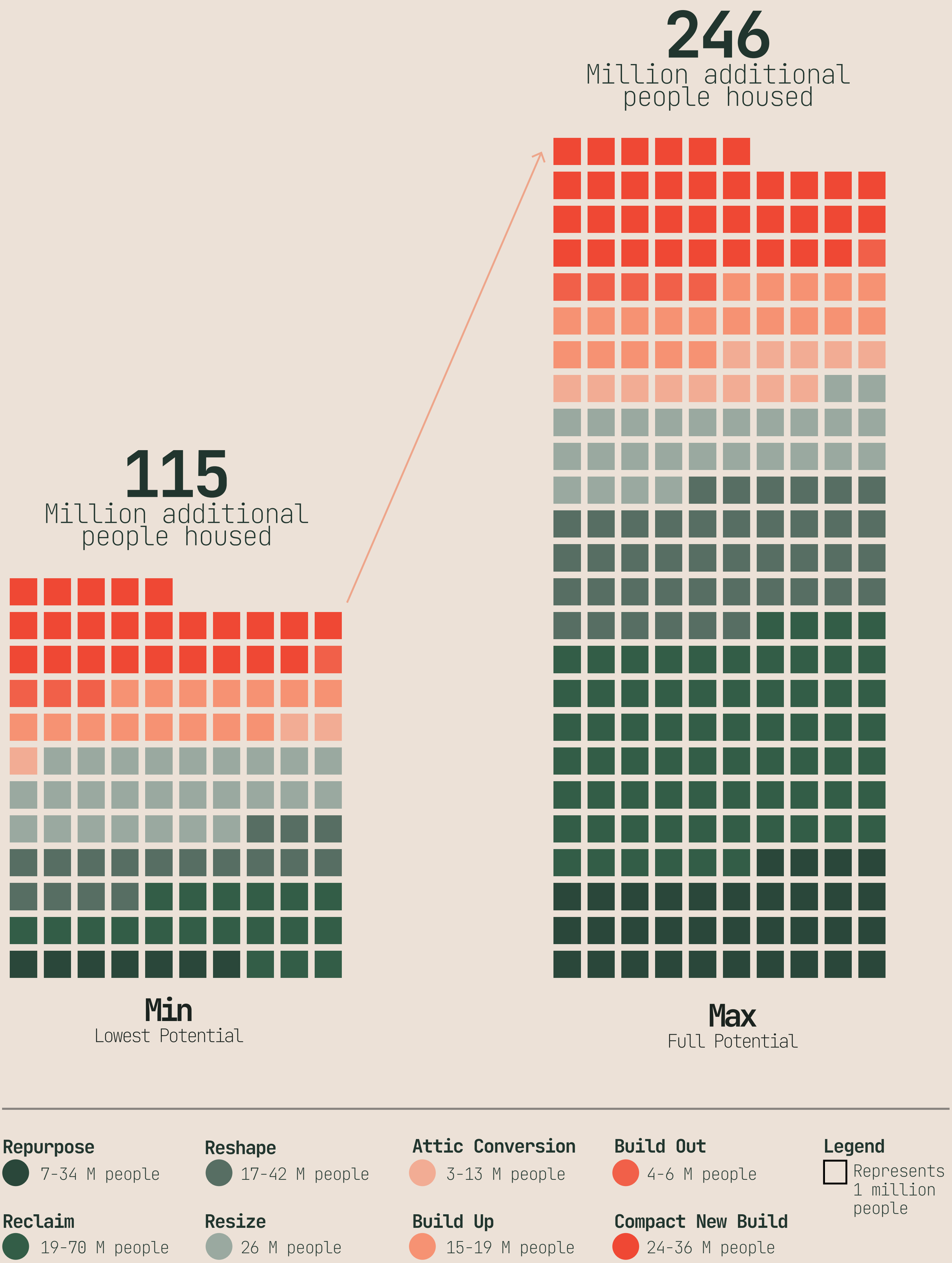
22

million homes are needed across Europe over the next decade, according to the European Commission. This data shows we could unlock up to 2-5 times more housing capacity by using what already exists.

>80%

of the housing potential is in the existing building stock much of which also needs energy upgrades. Europe can therefore unlock housing capacity, improve wellbeing, and cut energy demand through the same renovation effort.

Figure 16. - **Potential additional people housed through the interventions.**



Carbon savings on the scale of a major European economy

Better use of the existing building stock could avoid between 3.9 and 19 billion tonnes of CO_2eq over the next fifty years. This corresponds to annual savings of 78 to 382 million tonnes of CO_2eq, equivalent to reducing the whole-life carbon footprint of the European building sector by 8–32% every year (See figure 17).

At the EU level, these savings represent approximately 2–11% of annual economy-wide emissions. At the upper end of the range, the annual savings are comparable to the total emissions of a major European economy such as France.

The largest share of the mitigation potential comes from measures that improve and make better use of the existing building stock. Resize, reshape, and refine together account for the majority of total savings. Resize measures achieve large reductions by making more efficient use of existing floor area and avoiding the embodied emissions associated with new construction. Reshape measures deliver substantial savings through a combination of improved space utilisation and reduced operational emissions. Refine measures contribute primarily through energy renovations that lower operational emissions while extending the useful life of buildings.

By implementing these measures at full potential, **Europe could avoid 19.1 billion tonnes of CO_2eq** over 50 years, **equal to one third of current building-stock emissions.** And the clearest finding is this: **75% of that potential comes from renovation measures.**

The most powerful climate change mitigation tool in construction is the building that already exists

19.1

Billion tonnes of CO_2eq could be avoided over 50 years by implementing these measures.

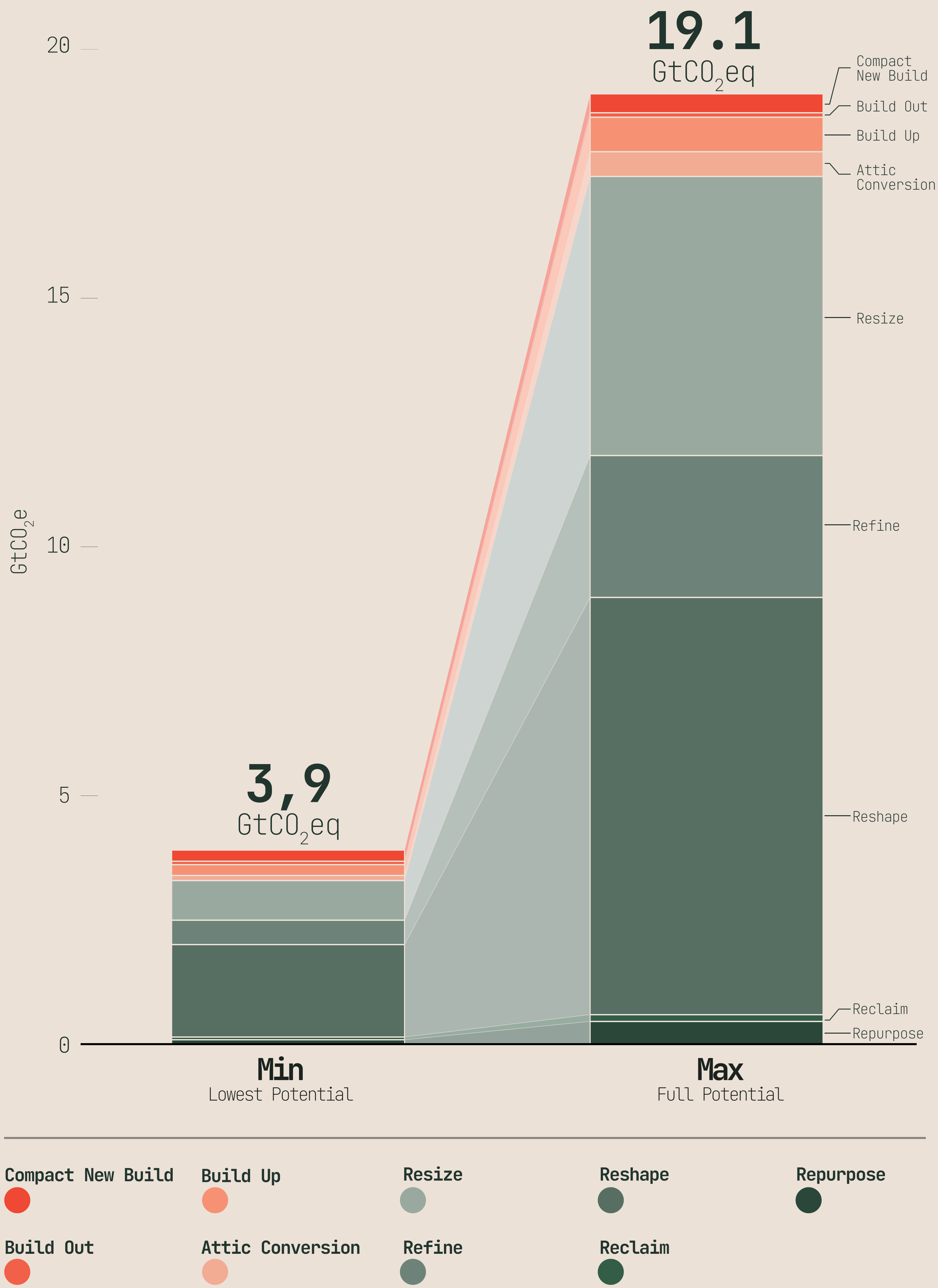
8-32%

of current European building-stock emissions could be avoided by implementing these measures at full potential.

+75%

of all potential avoided emissions come from renovation measures: repurpose, reclaim, reshape, refine and resize.

Figure 17. - **Range of total avoided embodied and operational emissions over 50 years relative to an unrenovated building stock and new build**



Resources kept in the ground

Better use of the existing building stock could avoid between 5.8 and 13 Gt of material use compared with a pathway that meets housing demand through conventional new construction. (see Figure 18).

Measures that act on already occupied living space, such as reshaping and resizing homes, as well as the reclaiming of vacant buildings show the lowest material requirements per square metre, as they primarily adapt existing spaces rather than creating new ones.

By contrast, extensions and new construction require additional structures and therefore higher material inputs. The results show that material savings are greatest where housing needs can be met by reusing and adapting existing space rather than expanding the building stock.

The most resilient construction strategy is not only to find better materials. It is to reduce the need for new materials in the first place.

13

Gt of potential material use could be avoided by implementing sufficiency measures at full potential across Europe's building stock.

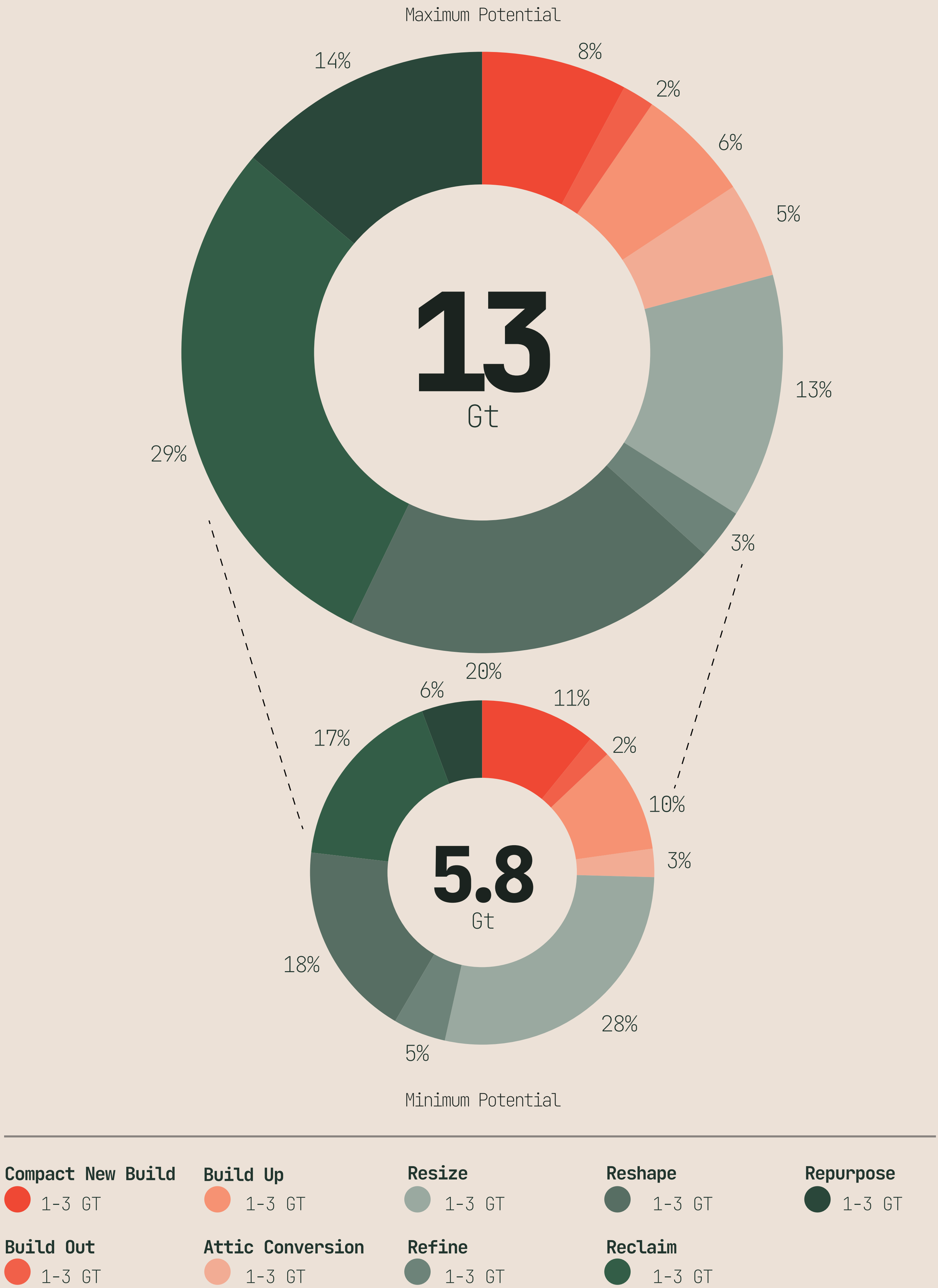
75%

of the total avoided material use comes from renovation-first measures: repurpose, reclaim, reshape, refine, and resize.

2x

At full implementation, the avoided material use is equivalent to around two years of Europe's total material consumption

Figure 18. - **Material use avoided by sufficiency measures**



Energy efficiency measures triggered

Beyond avoiding material use, embodied emissions and operational emissions, sufficiency measures can also have important indirect benefits of triggering wider energy renovations.

For example, unlocking the attic and vertical extensions, create additional living space with relatively low embodied impacts, but their broader effect is often to prompt renovation of the remainder of the building. This can lead to upgrades of the building fabric and technical systems, delivering additional operational carbon savings alongside the added floor area.

Assuming deep energy renovations are triggered in all buildings undergoing the extend interventions, an additional 3.9 to 5.5 GtCO_2eq could be avoided.

Living Attic /
VELUX Group 2026

Healthier homes for the many

A renovated home is a cheaper home to run, a healthier home to live in, and a lighter burden on the health system.

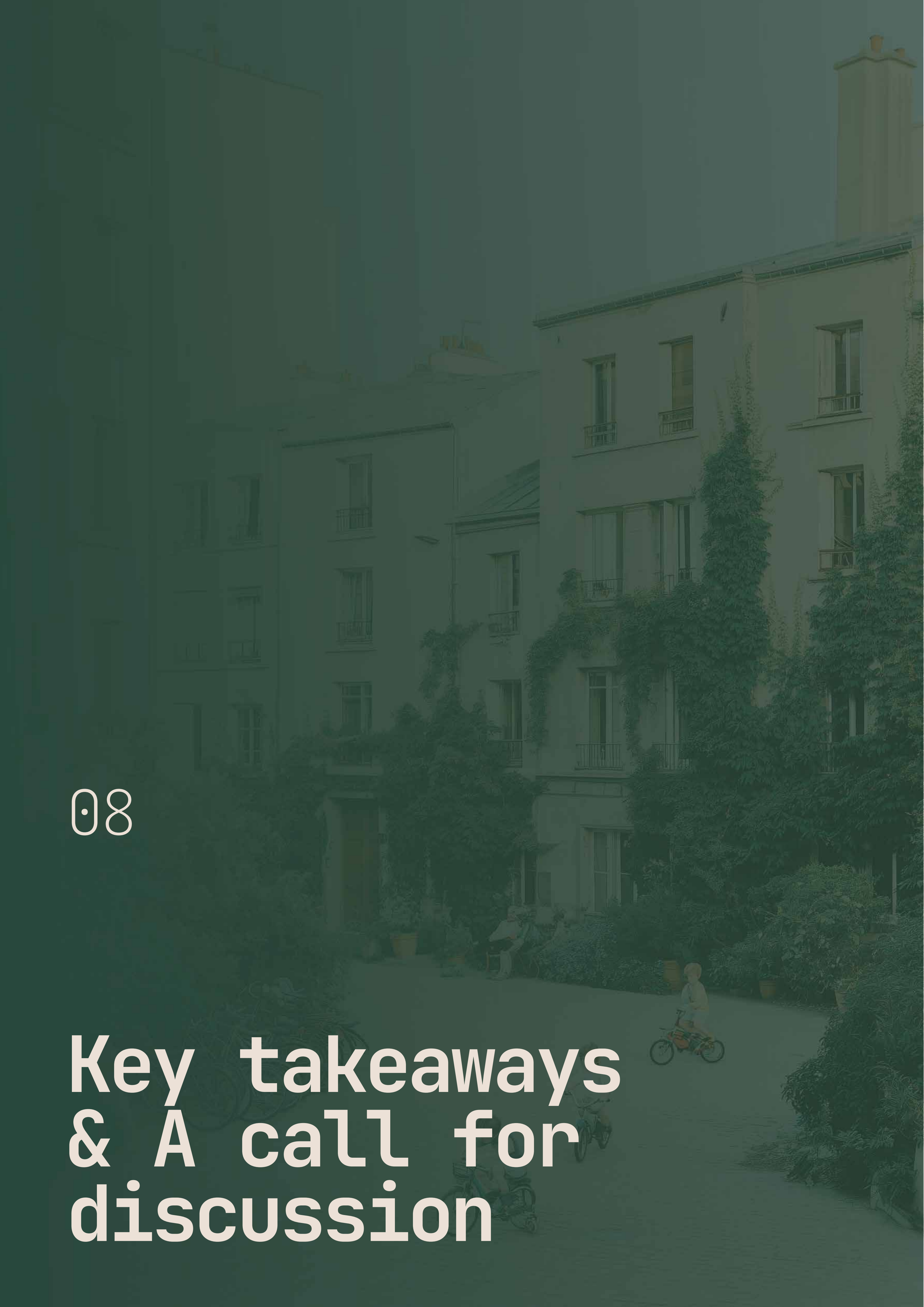
The health burden of poor housing is significant, and so are the savings from fixing it. One in three European children lives in a home that is damp, dark, cold or noisy, and one in three Europeans is exposed to at least one indoor climate hazard at home[41]. These are the buildings that are primarily targeted and improved by the better-use measures.

Living in a damp or mouldy home raises the likelihood of asthma by around 40%, and an estimated 2.2 million asthma cases in Europe are attributable to indoor dampness[42]. Indoor cold contributes to more than 38,000 excess winter deaths per year across eleven European countries[43].

Children exposed to multiple housing hazards are over four times more likely to report poor health, and building-related illness costs European children nearly two million missed school days every year[41].

These impacts carry significant costs for society and public budgets. Inadequate housing costs EU economies €194 billion per year through higher healthcare expenditure, social service costs, and lost productivity[18].

Improving the existing housing stock is therefore one of the most effective ways to simultaneously reduce health inequalities, public spending and household vulnerability.



08

Key takeaways & A call for discussion

Key Takeaways

Efficiency and sufficiency, taken together, provide a credible pathway for the European building industry to move beyond harm reduction towards systemic transformation and a net positive contribution. This shifts the focus from relative improvements, making new construction incrementally less carbon-intensive or more efficient, to a fundamentally different starting point: how much housing, comfort, health, and social value can be generated from the buildings, materials, land, and infrastructure already in place. The takeaways demonstrate that the existing stock is not a constraint on Europe's future, but its foundation.

01. Sufficiency and efficiency as core mitigation tools

The potential shows that sufficiency and efficiency are not secondary measures, but among Europe's most powerful mitigation levers. Their combined effect delivers significant benefits across emissions, energy use, materials, land, housing, cost, and health. Crucially, they act not on isolated policy objectives, but on the structural drivers: how buildings are occupied and valued, adapted, shared, renovated, and maintained.

02. Renovation is the most impactful lever

The better-use measures could avoid between 3.9 and 19.1 billion tonnes CO_2eq over 50 years.The decisive share of the emission saving potential comes from renovation-led measures: repurpose, reclaim, reshape, and refine. Together, these interventions account for roughly 75% of the total mitigation potential. This is because renovation reduces emissions from the existing stock, while new construction adds new floor area, and with it, additional upfront carbon, material demand, and long-term energy use.

The contrast is clear in the results: renovation delivers most CO_2 savings with relatively low material intensity and short carbon payback times, whereas new construction pathways increase built floor area before any operational benefits are realised.

03
Better-use measures unlock housing at the scale of nations

The results show that Europe does not need more floor area as the default response to housing need, but rather to unlock, redistribute, and adapt the space already built. Better use of the existing stock could release up to 107 million additional dwellings and house as many as 245 million people, more than half the EU population, without breaking new ground. This potential arises from an estimated 4 to 9 billion m^2 already available in vacant homes, underoccupied dwellings, unused attics, oversized houses, obsolete offices, and convertible non-residential buildings. Against a housing need of around 22 million homes over the next decade, the existing stock contains two to five times the required housing potential. Europe does not lack built space. It lacks the systems, incentives, policies, and practices to use that space well.

04
Demand reduction is a strategy for resource security and resilience

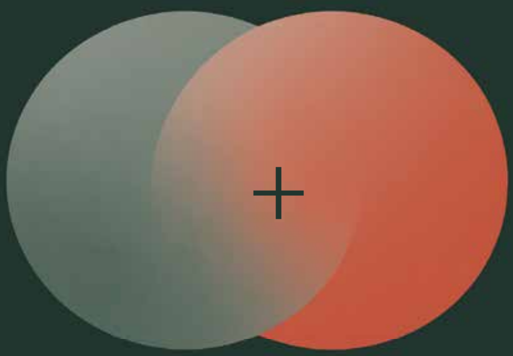
Better use of buildings is a strategic resource policy. The benefits of reducing material use by 5.8 to 13 gigatonnes also extend to reduced energy, emissions, land use, biodiversity loss, and exposure to global resource constraints. Each avoided tonne reduces dependence on volatile and energy-intensive supply chains. Europe's most secure resource is the one it does not need to extract, its most secure energy is the energy it does not need to generate, and its most resilient building stock is the one already standing, if it is used well.

05
Better-use measures mean healthier homes

Better use of existing buildings can improve living conditions and deliver on the dream of a modern home. Refine, reclaim, reshape, and repurpose upgrade insulation, ventilation, daylight, heating, and comfort as part of the process. These measures unlock housing capacity and improve living conditions at the same time, instead of adding new buildings beside a stock that still needs to be fixed. This means the carbon, energy, housing and health pathways are not separate. They can be delivered through the same renovation strategy. Efficiency improves thermal performance, indoor climate, ventilation, and energy use. Sufficiency makes sure these improvements are directed towards the homes and households where they create the greatest social value. The result is not just a lower-carbon building stock. It is a healthier one, that fulfill the needs and dreams of millions families.

06
Affordability depends on how the existing stock is used, not just how much is built

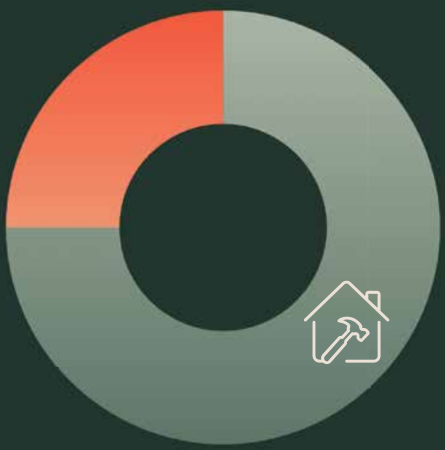
Housing affordability cannot be solved by supply expansion alone. Housing costs already exceed 40% of disposable income for nearly one in ten EU urban households, while prices rose by 53% between 2015 and 2024 despite continued construction. Building more, on its own, has not delivered affordability. Better use of the existing stock instead provides housing where people already need to live, close to infrastructure, services, jobs, and communities. Better-use measures can deliver homes faster, and at or below the cost of equivalent new construction, in some cases significantly cheaper. When combined with energy renovation, they also reduce running costs, cutting operational energy demand by 25–75%. Importantly, affordability is not only a question of supply volumes, but also of size, location, quality, and alignment with household needs. The Green Paper therefore suggests placing the existing stock at the centre of affordability policy, alongside targeted new construction where necessary.



01

Sufficiency and efficiency as core mitigation tools

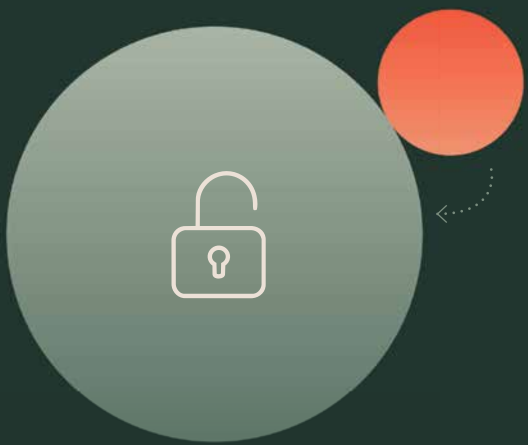
These are not soft add-ons but two of Europe's most powerful climate tools. They target the root drivers of demand and deliver wins across emissions, energy, materials, housing, cost, and health at once.



02

Renovation is the most impactful lever

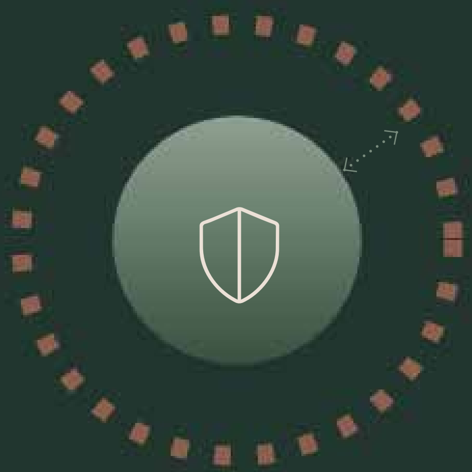
The better-use measures can save up to 19.1 billion tonnes CO_2eq over 50 years. Roughly 75% of the mitigation potential lies in renovating the existing stock. Renovation pays back its embodied carbon within a few years.



03

Better-use measures unlock housing at the scale of nations

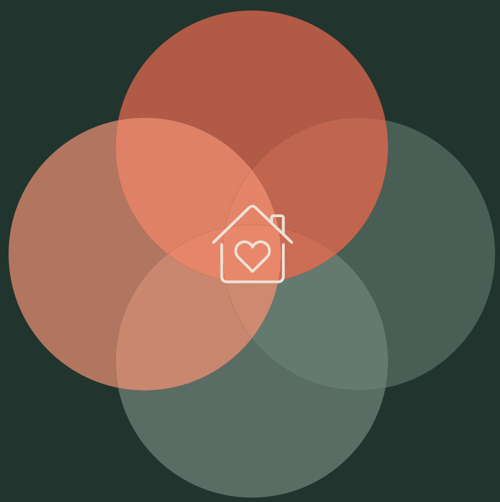
Vacant homes, empty offices, unused attics, and oversized houses could house up to 245 million people, two to five times what Europe needs this decade. The problem is not a lack of space. It is a lack of policy to unlock it.



04

Demand reduction is a strategy for resource security and resilience

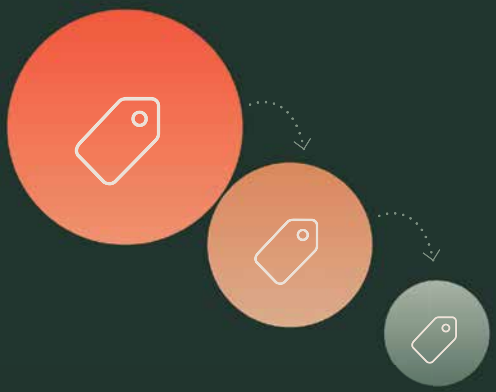
Better-use measures avoid 5.8 to 13 gigatonnes of materials, easing pressure on ecosystems and cutting Europe’s dependence on volatile global supply chains. The cheapest, safest resource is the one you never extract.



05

Better-use measures mean healthier homes

The renovations that create new dwellings also often upgrade insulation, ventilation, and daylight. One strategy, four wins: carbon, energy, housing, health. Not to mention, delivering on a dream home for the many.



06

Affordability depends on how the existing stock is used, not just how much is built

Prices rose 53% in a decade despite continued construction. Building more has not delivered affordability. Better-use measures deliver homes faster, often cheaper, where people actually need to live, and cut energy bills by 25 to 75%.

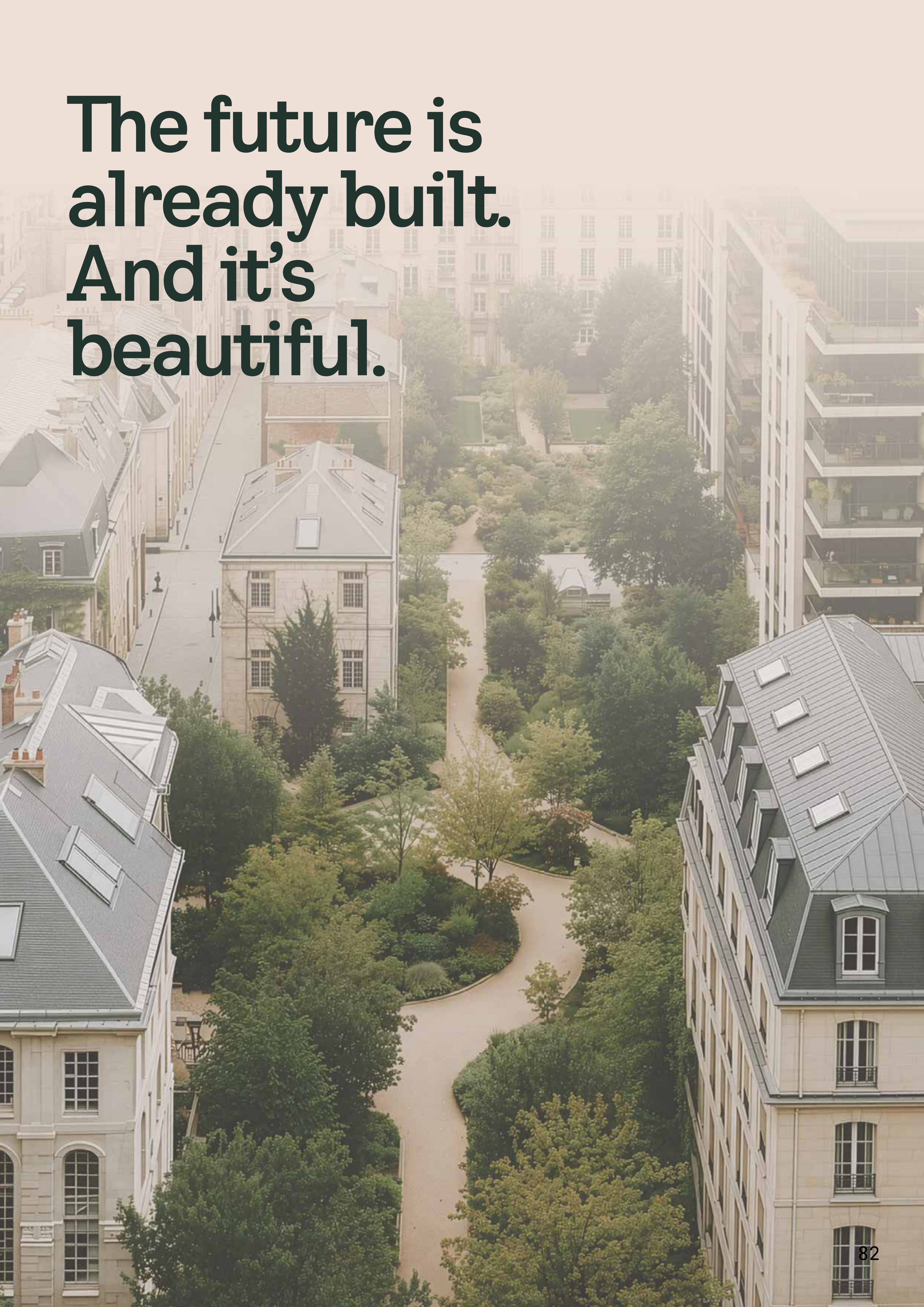
A call for discussion

Building, and especially housing policy, sits at the crossroads of multiple, and often competing, political agendas and interests. As result, progress is rarely transformative. Responses to climate change, and more recently to the housing crisis, have been incremental and relying on technological improvements and short-term responses to individual challenges rather than addressing their common root causes. This Green Paper argues that a more systemic approach is needed, one that combines efficiency and sufficiency to simultaneously address housing affordability, climate change, resource consumption, energy security, and public health.

The analysis presented here is a first step. The Green Paper is an assessment of the theoretical and technical potential of better using the existing European building stock. Realising this potential in practice will depend on overcoming significant economic, social, cultural, regulatory, and technical barriers. The findings are therefore an invitation to further explore what is possible and to design the policies, business models, financing mechanisms, and social innovations needed to unlock this potential. The paper is a call for dialogue between policymakers, industry, researchers, financial institutions, and civil society. Further work will be needed to assess implementation pathways, costs, biodiversity impacts, distributional effects, and the wider societal implications of scaling these measures across Europe.

The main finding nevertheless remains clear: the existing building stock is not a constraint but one of our greatest assets. By prioritising the interventions that deliver the greatest social and environmental value with the lowest resource demand, the building sector can move beyond harm reduction towards becoming a net-positive contributor. It can help provide homes for millions, reduce emissions and resource consumption, strengthen resilience in a period of growing geopolitical and environmental uncertainty, and improve health and quality of life. In doing so, the European building industry can move from being part of the problem to becoming an essential part of the solution.

The future is already built. And it's beautiful.



References

(01) European Commission (2025). The European Affordable Housing Plan. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52025DC1025

(02) European Commission (2024). Energy Performance of Building Directive. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401275

(03) RAND Europe (2022). Healthy Homes Barometer 2022. Sustainable buildings for a resilient society. https://contenthub.velux.com/api/public/content/4463d-e6285-7d455_downloadOriginal?v=e8192d10

(04) European Commission (2025). Understanding the housing crisis. https://housing.ec.europa.eu/document/download/2ad4c9f2-602b-43ba-9ed9-ef2ee059cf97_en?filename=0_1.pdf

(05) European Commission (2020). A Renovation Wave for Europe – Greening our buildings, creating jobs, improving lives. https://eur-lex.europa.eu/legal-content/EN/T/?qid=1603122220757&uri=CELEX:52020DC0662

(06) IEA (2023). How much CO2 do countries in Europe emit? https://www.iea.org/regions/europe/emissions

(07) European Commission (2023). Transition pathway for Construction. https://ec.europa.eu/docsroom/documents/53854

(08) AP Pension, PensionDanmark, Aaen Engineering, Concito, Oiko, Plantary Responsibility Foundation, Sweco, Upstream Partners (2025). Biodiversitetspåvirkning fra 50 byggerier: Forslag til metode og baseline for måling af byggeriets biodiversitetspåvirkning i hele værdikæden [Biodiversity impact from 50 buildings: Proposal for method and baseline for measuring the biodiversity impact of construction across the entire value chain]. https://planetaryresponsibility.org/wp-content/uploads/BBV-rapport-juli-2025.pdf

(09) Steinmann et al. (2017). Resource Footprints are Good Proxies of Environmental Damage. https://doi.org/10.1021/acs.est.7b00698

(10) Ramboll, BPIE, KU Leuven, TU Graz, Aalborg University, Politecnico di Milano, IIASA (2025). Analysis of life-cycle greenhouse gas emissions of EU buildings and construction. https://op.europa.eu/en/publication-detail/-/publication/162e53c2-61f2-11f0-bf4e-01aa75ed71a1/language-en

(11) European Commission (2025). In focus: Reaching the EU's energy efficiency target. https://energy.ec.europa.eu/news/focus-reaching-eus-energy-efficiency-target-2025-07-15_en

(12) European Commission (2020). A new Circular Economy Action Plan for a cleaner and more competitive Europe. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0098

(13) European Commission (2025). The European Affordable Housing Plan. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52025DC1025

(14) Joint Research Centre (2025). Housing investment needs in the EU. https://publications.jrc.ec.europa.eu/repository/handle/JRC144703

(15) Eurostat (2025). 16.9% of people in EU lived in overcrowded households. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20251222-1

(16) Eurostat (2025). Housing in Europe 2025 edition. https://ec.europa.eu/eurostat/web/interactive-publications/housing-2025#housing-cost

(17) European Commission (2024). Energy poverty. https://energy.ec.europa.eu/topics/markets-and-consumers/energy-consumers-and-prosumers/energy-poverty_en

(18) Eurofound (2016). Inadequate housing in Europe: Costs and consequences. https://assets.eurofound.europa.eu/f/279033/af59974785/ef1604en_0.pdf

(19) Odyssee-Mure (2021) Energy efficiency trends in buildings in the EU, https://www.odyssee-mure.eu/publications/policy-brief/buildings-energy-efficiency-trends.html

(20) BPIE (2026). EU Buildings Climate Tracker 4th edition – On and off: buildings at the crossroads of the energy and climate crisis. https://www.bpie.eu/publication/eu-buildings-climatetracker-4th-edition/

(21) European Environment Agency (2024). From data to decisions: material footprints in European policy making. https://www.eea.europa.eu/en/analysis/publications/material-footprints-in-european-policy-making

(22) BPIE & Ramboll (2024). Sufficiency in the building sector. https://op.europa.eu/en/publication-detail/-/publication/da276a27-b2b7-11ef-acb1-01aa75ed71a1/language-en

(23) IPCC (2022) Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter09.pdf

(24) European Commission (2026) Supporting life-cycle approaches to decarbonise European buildings. https://environment.ec.europa.eu/publications/commission-staff-working-document-supporting-life-cycle-approaches-decarbonise-european-buildings_en

(25) Balaras et al. (2023). Carbon and greenhouse gas emissions from electricity consumption in European Union buildings. https://doi.org/10.3390/buildings14010071

(26) European Commission, Directorate-General for Energy. (n.d.). EU Building Stock Observatory. https://energy.ec.europa.eu/topics/energy-efficiency/energy-performance-buildings/eu-building-stock-observatory_en

(27) Deutsche Gesellschaft für Nachhaltiges Bauen & Buildings Performance Institute Europe. (2025). Life-cycle based assessment of buildings: An analysis of 28 residential buildings with regard to climate impact and costs in Germany. https://www.bpie.eu/publication/life-cycle-based-assessment-of-buildings-an-analysis-of-28-residential-buildings-with-regard-to-climate-impact-and-costs-in-germany/

(28) Danish Building Research Institute, Aalborg University. (2021). Whole life carbon assessment of 60 buildings: Possibilities to develop benchmark values for LCA of buildings (BUILD Report 2021:12). https://vbn.aau.dk/ws/portalfiles/portal/414195632/BUILD_Report_2021_12.pdf

(29) Joint Research Centre (2022). Defining zero-emission buildings: Review of current and future national approaches. https://publications.jrc.ec.europa.eu/repository/handle/JRC129612

(30) Technische Universität Darmstadt, ISP Eduard Pestel Institut für Systemforschung e.V., VHT Institut für Leichtbau, Trockenbau und Holzbau (2019). Deutschlandstudie 2019: Wohnraumpotenziale in urbanen Lagen. Aufstockung und Umnutzung von Nichtwohngebäuden [Housing potential in urban areas. Adding floors and repurposing non-residential buildings]. https://www.dgfm.de/fileadmin/downloads/01_Wohnungsbaupolitik/Studien/20190227-Deutschlandstudie/Deutschlandstudie_2019_Langfassung.pdf

(31) Bundeinstitut für Bau-, Stadt- und Raumfoschung (2023). Unterstützung von Suffizienzansätzen im Gebäudebereich [Supporting sufficiency approaches in the building sector]. https://www.bbsr.bund.de/BBSR/DE/veroeffentlichungen/bbsr-online/2023/bbsr-online-09-2023.html

(32) SP Eduard Pestel Institut für Systemforschung (2021). Potenziale zur Wohneigentumsbildung durch die Umnutzung von Nichtwohngebäuden und die Ertüchtigung bisher unoder untergenutzter Bestandsgebäude [Potential for homeownership through the conversion of non-residential buildings and the upgrading of previously unused or underutilized existing buildings]. https://bak.de/wp-content/uploads/2021/11/Studie-Pestel-zur-Wohneigentumsbildung-durch-Umnutzung_06.10.2021.pdf

(33) Colliers Deutschland, Garbe Institutional Capital, PwC Deutschland (2024). Obsoleszenzrisiken von Büroimmobilien Wohnen und Life Science als Ausweg? [Obsolescence risks of office properties: Housing and life sciences as a way out?] https://www.colliers.de/nachnutzungspotenziale-bueroimmobilien/

(34) 34 Eurostat (2024). Living conditions in Europe – housing. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Living_conditions_in_Europe_-_housing

(35) Thomas et al. (2017). Energy sufficiency policy: How to limit energy consumption and per capita dwelling size in a decent way. https://www.ifeu.de/fileadmin/uploads/1-230-17_Thomas_et_al._final.pdf

(36) European Environmental Bureau. (2024). Sufficiency: Moving beyond efficiency in the built environment. https://eeb.org/wp-content/uploads/2024/09/Sufficiency-factsheet-EEB-2024.pdf

(37) Promotoit. (2023). Roof renovation proves its effectiveness in the energy performance of individual homes. https://batinfo.com/en/actuality/the-renovation-of-roofs-proves-its-efficiency-in-the-energy-performance-of-individual-houses_25453

(38) Promotoit (2020). Maîtrise foncière, densification et aménagement des combles [Land control, densification and attic conversion]. https://www.promotoit.fr/wp-content/uploads/Maitrise-fonciere-densification-et-amenagement-des-combles-estimation-du-potentiel-de-combles-amenageables-.pdf

(39) Ellen MacArthur Foundation (2024). Building prosperity: Unlocking the potential of a nature-positive, circular economy for Europe: Technical appendix. Analysis and modelling by Systemiq. https://content.ellenmacarthurfoundation.org/m/539900214727e4bc/original/Building-Prosperity-Modelling-Technical-Appendix.pdf

(40) BPIE (2025): Conversion of offices into affordable housing. https://www.bpie.eu/publication/conversion-of-offices-into-affordable-housing-a-report-by-bpie-for-dg-environment/

(41) RAND Europe (2019). Healthy Homes Barometer 2019: Growing up in (un) healthy buildings. https://www.researchgate.net/publication/336552557_Healthy_Homes_Barometer_2019_Growing_up_in_unhealthy_buildings

(42) European Environment Agency (2024). Indoor environment: mould and dampness. https://www.eea.europa.eu/en/analysis/publications/beating-chronic-respiratory-disease/indoor-environment-mould-and-dampness

(43) World Health Organization (2011). Environmental burden of disease associated with inadequate housing. https://www.who.int/publications/i/item/9789289057899

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