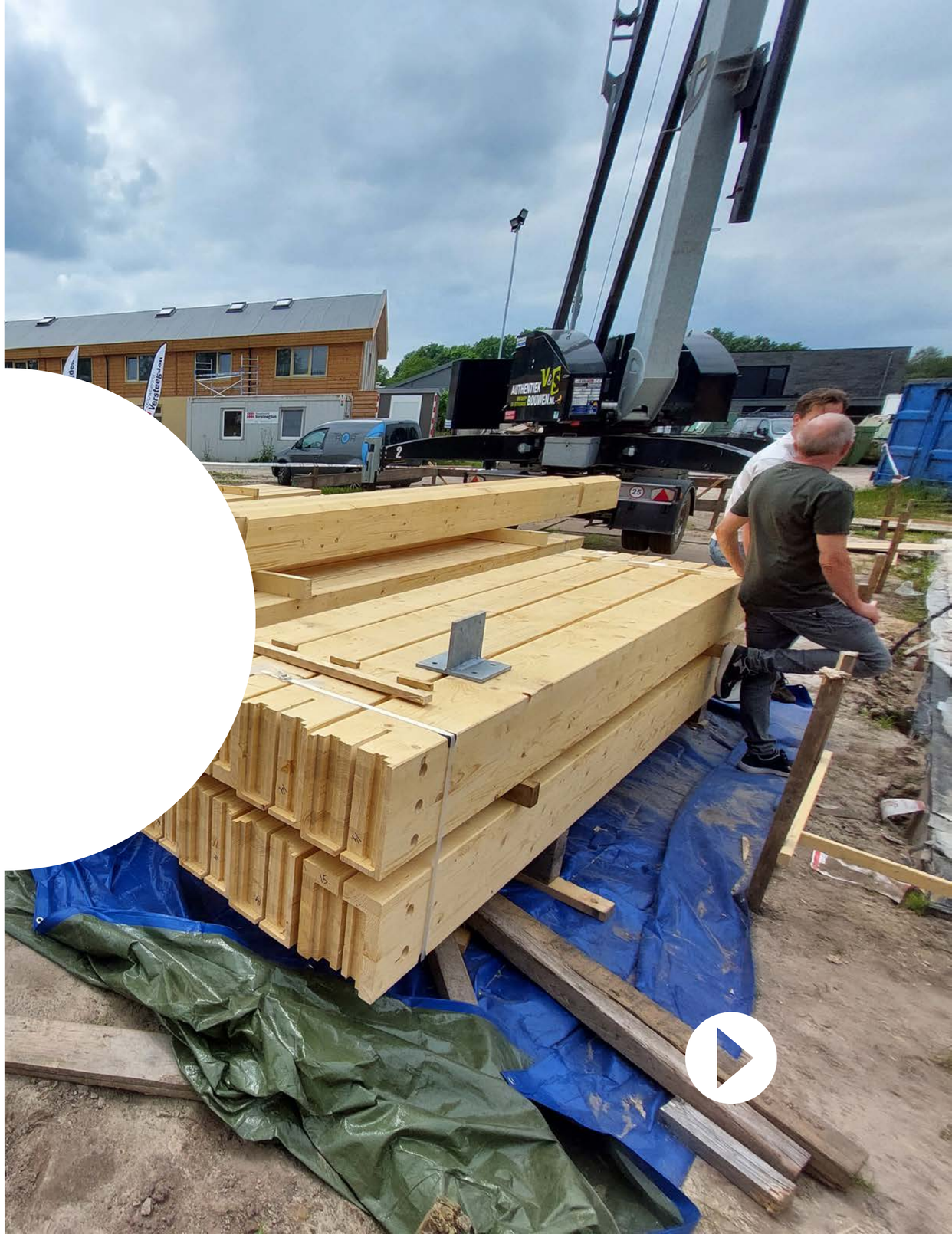
BUILDING FOR THE FUTURE

DEVELOPING HOMES WITH SUSTAINABLE MATERIALS

JUNE 2025



Council
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Council for the Environment and Infrastructure (Rli)
Bezuidenhoutseweg 30
P.O. Box 20906
2500 EX The Hague
The Netherlands
info@rli.nl
www.rli.nl

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Note: The Dutch version of the advisory report contains an additional analytical section.

SUMMARY

For a number of years now, many people in the Netherlands have not had access to suitable, affordable housing. The government has therefore set itself the target of building 100,000 new homes per year over the coming period. In this advisory report, the Council for the Environment and Infrastructure (Rli) looks at how this target can be combined with reducing carbon emissions in the construction sector. We focus on the opportunities to lower carbon emissions in housing construction by using alternative building materials. The fact is that a significant proportion of Dutch carbon emissions come from the use of conventional materials such as concrete and steel to build homes. We believe that a rapid transition to the use of sustainable, climate-friendly building materials is essential – if only because the European Union (EU) plans to limit carbon emissions from new homes built from 2030. Continuing to build homes using conventional materials for too long will place the Netherlands at risk of a new construction crisis.

Five strategies for the transition to sustainable construction

In this advisory report, we identify five sustainability strategies to make the necessary switch to the use of sustainable materials:

- Using *fewer building materials*, for example by choosing to subdivide or add storeys to existing homes or build smaller homes.
- Using *fewer and/or lighter technical installations* to heat, cool and ventilate a home (‘low-installation building’).

- *Reusing* building materials and using recycled raw materials, for example by using all or parts of concrete slabs or steel beams from a demolished building in a new building or by recovering raw materials from a demolished building for high-quality reuse.
- Using *bio-based building materials*, such as materials made from wood or fibre plants.
- Using *low-carbon versions* of conventional building materials, such as more sustainable concrete or 'green' steel.

Combined, these five sustainability strategies substantially reduce material-related carbon emissions in housing construction and increase the supply security of building materials.

Many parties in the construction chain are awaiting direction from the government

A small proportion of the parties in the construction chain already work mainly with sustainable materials. A larger group is taking substantial steps towards sustainable material use. However, the majority of companies are awaiting guidance. They need stronger intervention than the very limited existing government control. In recent years, government authorities have worked with market operators to launch several initiatives aimed at gaining knowledge and experience of the use of sustainable materials in housing construction. The initiatives are active at national, regional and municipal level. However well intentioned, the practical downside of regional and municipal initiatives is that they often result in requirements that exceed the statutory minimum. This is an unwelcome development for the construction industry.

Prefabricated buildings create opportunities to improve sustainability

A growing number of housing factories have appeared in recent years. These factories produce housing modules or entire homes to a common design, which are then transported and can be quickly assembled on site. Prefabricated housing has several advantages from a sustainability perspective. For example, this construction method ensures more economical use of building materials. There is also less construction waste and fewer transport movements are required. In addition, prefabricated construction offers better opportunities for reusing and recycling materials and for using bio-based materials.

Prefabricated construction also leads to significantly higher labour productivity, which is a major plus given the current labour market shortages.

Sustainable construction costs the same or only slightly more than conventional construction and does not take longer

There is a perception among politicians, the financial sector and many parties in the construction chain that building homes with sustainable materials costs significantly more than building with conventional materials. Our advisory report concludes that this is not the case. While sustainable construction does cost slightly more on average than conventional construction, this is not always true of prefabricated low and medium-rise buildings. For single-family houses and apartment buildings up to four

storeys, costs can be competitive or even lower than those of conventional construction. The construction time is also shorter in many cases, bringing down costs. However, switching to using sustainable building materials does mean that builders need to learn new ways of working – which requires extra time in the initial phase and therefore extra money. But practice shows that once this step has been taken, the construction process is not necessarily longer and can even be shorter. The latter certainly applies to prefabricated timber construction.
Where the use of sustainable materials leads to an increase in construction costs, this does not affect the pricing of the completed homes. This is because the market price is mainly determined by what people are willing and able to pay for a property.

We also expect the difference in price between sustainable and conventional building materials to decrease once sustainable materials become more widely used. The impact will be intensified if, at the same time, EU policies to reduce industrial carbon emissions lead to an increase in the price of conventional building materials.

Several factors are currently obstructing the transition
A number of factors are currently preventing many parties in the construction chain from making the switch to using sustainable materials.

No clear-cut central government standard for the environmental performance of homes
In recent years, central government has failed to tighten the statutory standard for the environmental performance of buildings – including carbon emissions due to building materials. As a result, builders have no incentive to build more sustainably. Moreover, the calculation that builders need to make in order to meet the standard is so complex that many are unable to use it.
The government's unambitious energy consumption standard for housing also inhibits improvements to the use of sustainable materials in construction. For example, existing government policy offers no reward for low-installation building.

Municipal environmental and planning policy is based on conventional building materials
There are also barriers to building with sustainable materials at municipal level. For example, municipal physical environment plans often use building plot dimensions and building heights that are not geared towards the use of sustainable building materials. Furthermore, municipal visual quality plans often prescribe the use of non-durable materials such as brick.

Standardisation and certification are based on conventional building materials
The existing standards and certificates that apply to building materials are based on the use of conventional materials. This places new, sustainable building materials at a disadvantage at the assessment stage.

No financial incentives for the use of sustainable materials
Setting the right financial conditions can promote the use of sustainable materials in housing construction. No such incentives exist at present; in fact the situation is quite the reverse. For instance, the House of Representatives recently resolved to abolish the tax arrangement that allowed discounted mortgage interest for sustainably built homes. There is also no policy (apart from some initiatives in relation to 'carbon credits') to make sustainable building materials more financially attractive than conventional building materials.

Low willingness to change within the construction chain and lack of skills
Builders generally tend to shy away from risk. This is understandable, however it has a negative impact on the use of sustainable building materials. Commissioning parties that want to build with sustainable materials often struggle to find contractors who are willing to execute their plans.
A lack of collaboration between parties in the construction chain is another barrier to the use of sustainable materials. Building with new materials requires new skills and coordinated activities, however collaboration and mutual learning are not currently the norm in the construction chain. Builders also do not learn this in their training.

Conclusions
Our analysis resulted in a number of conclusions, which we summarise below.

Threat of a new construction crisis
A rapid transition to sustainable construction is essential in order to comply with the rules and standards that the EU plans to impose from 2030 as part of its climate policy. Time is running out. Continuing to build homes in the Netherlands using conventional materials for too long will place our country at risk of a new construction crisis. Demand for sustainably designed housing will need to increase in the short term. More and more investors are also demanding sustainably built homes.

A combination of standards and pricing mechanisms is needed
To get parties in the construction chain moving and stimulate demand for sustainable materials, we believe central government needs to impose a combination of standards and pricing mechanisms.

- Central government has failed to set *standards* to ensure the sustainability of construction in recent years. This is about to change thanks to the updated EU Energy Performance of Buildings Directive. From 2030, EU Member States will be required to start managing the climate impact of homes throughout their life cycle, including material-related carbon emissions, in the form of a roadmap. The roadmap to be drawn up by the Dutch central government needs to guide parties in the construction chain through a step-by-step transition to the use of sustainable building materials.

- In addition to the roadmap, central government could apply *pricing mechanisms* to carbon emissions associated with the use of conventional building materials in housing construction. Specifically, we envisage a levy that increases over time, linked to the difference between the mandatory limit and the more ambitious target from the above-mentioned roadmap. A levy is a tool that has no major drawbacks.

Collaboration, innovation and scaling-up are essential for success
Innovation will be an important contributing factor in the required scaling-up of building with sustainable materials. The Netherlands has a high capacity for prefabricated housing construction, which goes hand in hand with sustainable construction. This capacity needs to be exploited more fully.
The potential for learning in the construction industry is also key to a successful transition. Senior secondary vocational and higher professional education courses are not currently designed to deal with new materials, the reuse of materials and detachable construction.
Innovation programmes and agreements between commissioning parties and parties in the construction chain can provide the scope to experiment needed in order to make progress in this area. The essential scaling-up also requires targeted innovation and industrial policies, with a focus on recovering building components and raw materials through circular demolition and high-quality recycling. The further development and scaling-up of bio-based production chains is also key. This will help to increase the supply security of building materials.

Recommendations
In this advisory report, we make four recommendations to central government, decentralised authorities and parties in the construction chain to improve the use of sustainable materials in housing construction.

1. Bring Dutch regulations in line with EU policy
Parties in the construction chain need clarity on the EU rules that will apply from 2030 to the use of sustainable materials. As part of the updated EU Energy Performance of Buildings Directive (EPBD IV), the government will need to draw up a national roadmap that sets limits and targets for material-related carbon emissions. We recommend that a more ambitious limit is set for 2030 than the current standard, which is easily achievable. We also recommend that the standards should distinguish between low and medium-rise buildings on the one hand, and high-rise buildings, which have a larger carbon footprint, on the other.

2. Introduce a levy as an incentive for the more sustainable use of materials in housing construction
Demand from commissioning parties for sustainably built homes needs to increase in order to achieve a steady transition to building with sustainable materials. Central government could help to stimulate this demand.
We recommend introducing a levy on unsustainably or insufficiently sustainably built homes in 2030 that will increase over time. This levy will need to be borne by the party applying for planning permission (the landowner or developer). The levy we envisage would need to apply to

homes granted planning permission from 2030 that do not meet the targets set in the national roadmap.

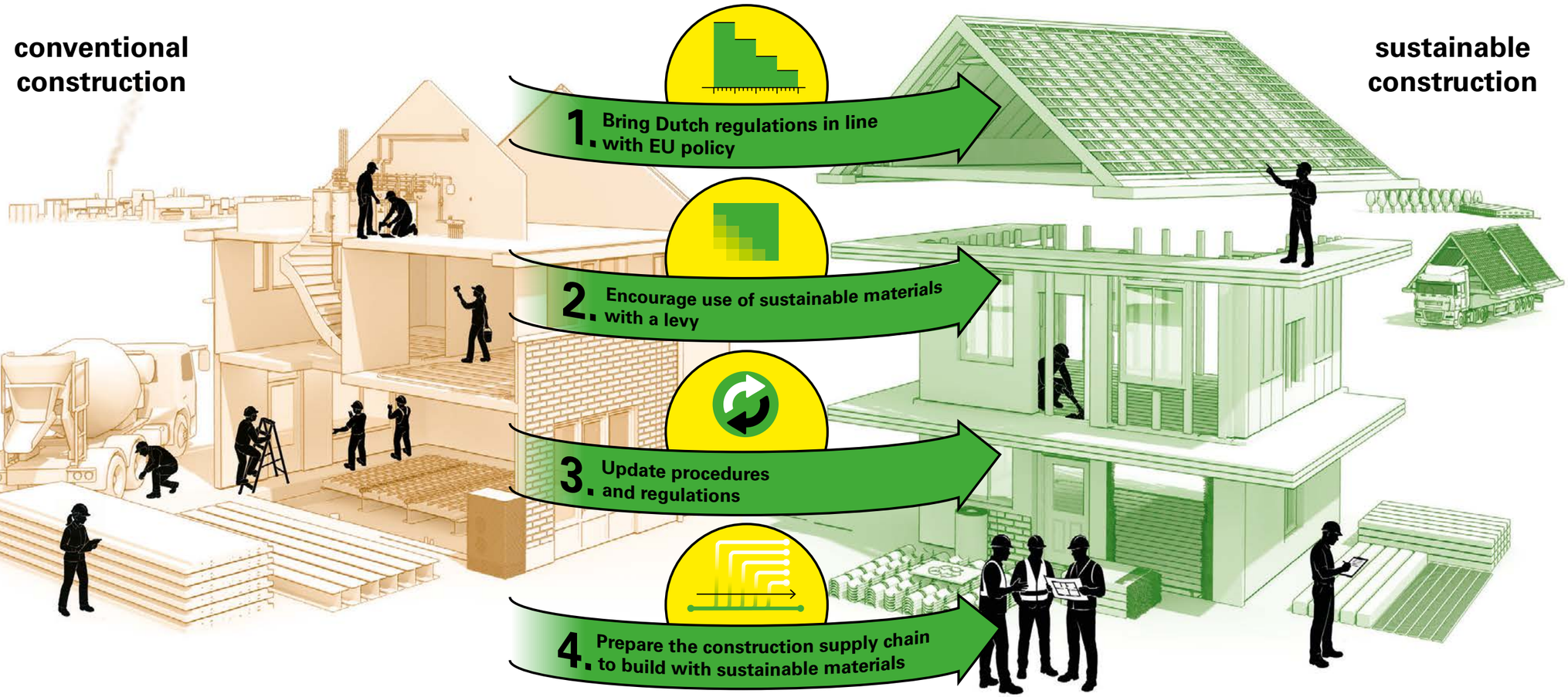
3. Update procedures and regulations
A successful transition to the use of sustainable materials requires changes to government building regulations. We advise central government to ensure greater transparency when it comes to the actions of standards and certification committees for new building materials, with more input from manufacturers of sustainable materials and independent experts.
We also advise central government to ensure that government regulations on housing construction promote smaller-scale building, low-installation building, the reuse of materials and components, and the use of bio-based building materials and sustainable versions of conventional building materials.
We advise municipalities to ensure that municipal environmental and planning policy, urban planning and visual quality plans, as well as area development policy and land-use policy, facilitate and encourage housing construction using sustainable materials.

4. Prepare the construction chain to build with sustainable materials
Central government will need to prepare the construction chain for the standards that will become part of the national roadmap for reducing carbon emissions from new homes. In turn, the construction chain will need to ensure that all parties involved adopt the new (in some cases digital) skills and routines associated with the use of sustainable building materials.

Specifically, we advise central government, property developers, housing associations, prefabricated construction firms and municipalities to reach agreements on the construction of sustainable prefabricated low and mid-rise housing. We also advise central government to ensure that there is scope for innovation and experimentation for scaling up the use of bio-based building materials. Finally, we advise central government to make agreements with industry organisations to support SMEs so that workers can receive further training in sustainable building methods and materials and the possibilities of prefabricated construction.

Figure 1 on the next page shows the four recommendations.

Figure 1: Recommendations in the advisory report



ADVISORY REPORT

1 INTRODUCTION

For a number of years now, many people in the Netherlands have not had access to suitable, affordable housing. Solving this problem is a matter of urgency. Central government rightly wants to substantially increase the pace of housing construction.

However, the Council for the Environment and Infrastructure (Rli) believes that this increased pace of construction must not come at the expense of quality and sustainability. The acceleration of housing construction requires a responsible approach that minimises the resulting carbon emissions, to ensure that more and more people in the Netherlands are able to live in suitable, affordable and sustainable housing in the future.

In this advisory report, we explore how this goal can be achieved. How can we build large numbers of affordable homes at the same time as reducing carbon emissions in construction?[1]

1 For the sake of readability, we avoid the term 'CO_2 equivalent emissions' in this advisory report. Instead we simply refer to 'CO_2 emissions' or 'carbon emissions'. This includes emissions of other greenhouse gases, such as nitrous oxide and methane.

1.1 The importance of a sustainable approach to the construction challenge

In 2022, the government resolved to exercise greater control over public housing. The aim was to build large numbers of new affordable homes in a short time. The bar was set at 100,000 new homes a year, starting in 2024 (BZK, 2022).

The huge construction challenge the Netherlands has since faced requires efforts in many areas. For example, the planning permission process will need to become faster. Large-scale building sites will also need to be made available and large quantities of *building materials* will need to be supplied.

The latter aspect is the reason behind this Rli advisory report. We have approached this subject from the point of view of sustainability. We believe it is important to link the urgent construction challenge with the equally urgent transition to building with sustainable materials that have the lowest possible carbon emissions.

The Netherlands aims to be climate neutral by 2050, with net zero greenhouse gas emissions. To achieve that goal, we need to take a serious approach to the transition to the use of sustainable building materials right now. Carbon emissions from the use of materials in construction are often higher than people think (see box).

Relationship between the use of building materials and carbon emissions

Since 2021, new-build homes have been required to meet stricter standards on the energy consumption of homes in the *occupation phase*. Measures that can be taken in order to comply with these standards include effective home insulation and energy-efficient heating, cooling and ventilation systems. Homes in which these measures have been implemented therefore have much lower carbon emissions.

However, the *construction phase* of new homes still involves significant carbon emissions as a result of both the production and transport of building materials and their use on site or at the housing factory. These material-related emissions are considerable: around 11% of the total carbon emissions in the Netherlands comes from the use of materials in the built environment, and a significant proportion of this comes from housing construction. The Netherlands therefore needs to reduce these carbon emissions if it is to meet its climate goals.

EU intervention

Up until now, the Dutch government has done little to reduce carbon emissions associated with the production, transport and use of building materials. However, the European Union (EU) is planning targeted intervention in this area in the coming years. For example, the EU plans to impose requirements on carbon emissions of new homes from 2030 through an updated Energy Performance of Buildings Directive[2]. By

2 This is the fourth Energy Performance of Buildings Directive (EPBD IV).

adopting a '*Whole Life Carbon* approach', the EU aims to reduce emissions of CO_2 and other greenhouse gases throughout the life of a building: (a) raw material extraction, (b) construction, (c) use, (d) demolition and (e) disposal of the demolition material. The rules will focus on reducing carbon emissions during occupation as well as during the prior construction of buildings. Every EU Member State will be required to draw up a roadmap by the end of 2027 with increasingly tightened limits[3] and targets for carbon emissions. The final goal is a climate-neutral construction chain by 2050.

Elsewhere, the EU plans to use its Emissions Trading Scheme (ETS)[4] to gradually reduce carbon emissions from steel and concrete plants. It will also introduce more rules to direct investors, who play an important role in financing and prefinancing housing projects, towards sustainable choices in the composition of their financial portfolio.

The EU regulations are already casting a long shadow. Companies in the construction sector realise that in order to prepare for the situation from 2030 onwards, they will need to switch to using alternative building materials in good time.

3 EPBD IV, Article 7.5 speaks about "limit values". In this report we simply refer to limits and targets.
4 ETS stands for Emissions Trading System. The EU introduced this system in 2005 to regulate the right of European companies to emit greenhouse gases such as carbon dioxide. One emission allowance allows a company to emit one tonne of carbon dioxide. The number of available allowances is limited and decreases every year. When companies emit more carbon dioxide than they have allowances for, they must buy additional allowances. This encourages them to limit their carbon emissions as much as possible.

Autonomous developments in the market

It should be noted that there is a growing preference for sustainable building materials prompted not by EU intervention, but instead based on risk assessments.

For example, financial markets have tended to value sustainable housing projects higher in recent years because (a) there is less risk that demand for such housing will decline over time, and (b) such housing is more likely to deliver social benefits in terms of aspects such as a green and healthy living environment (CRa, 2025a).

Market players in the construction industry are also becoming increasingly aware that a switch to alternative building materials (including reuse of materials) is inevitable in the long run due to the increasing scarcity of conventional building materials such as sand and gravel (of which there is a dwindling global supply) and growing uncertainty regarding the availability of some critical materials (due to geopolitical developments).

Competition with other construction targets

The transition to housing construction with sustainable materials must take place in a context where there are many other major construction challenges. These include the renovation of existing housing (such as modernising, subdividing, addition of storeys to houses[5] and repurposing buildings, etc.), the maintenance of existing infrastructure (such as repairing roads, bridges, locks, dams, tunnels and viaducts) and the transition to a new energy system (such as strengthening the power grid, installing wind

5 This involves constructing one or more additional storeys on top of an existing building.

turbines and solar panels). The labour force required to carry out all this work is scarce, placing the different challenges in competition with each other.
Significant investment by grid operators in the energy transition means that faster progress is being made in this than in other areas. From this point of view too, there is a strong interest in a sustainable approach to meeting housing construction targets. A switch to housing construction using sustainable materials is in many cases accompanied by a higher proportion of prefabricated construction. This not only increases productivity, but also makes working in construction more attractive due to better working conditions.

1.2 Scale of the housing construction challenge

It is difficult to pinpoint exactly how many new homes need to be built in the period up to 2035. A number that has been frequently mentioned in this context is 980,000 (IBO, 2024). However, the number of homes needed does not fully reflect the number of new homes to be built. Additional housing units can also be created through other measures, such as addition of storeys to houses or subdividing existing housing as mentioned above, converting vacant office buildings, encouraging people to move up the housing ladder and attaching fiscal benefits to subletting.

Nevertheless, a large portion of the required residential accommodation will need to be created by building new homes. And in the period after that, from 2035 to 2050, there will be a need to build a similar number of houses to accommodate the projected population growth and household fragmentation (Staatscommissie demografische ontwikkelingen 2050, 2024). These houses will need to comply with the carbon emission limits and targets in force at that time. This is another reason why we feel it is relevant to draw attention to the importance of sustainable material use in housing construction through this advisory report.

1.3 Main question of this advisory report

At present, the Dutch government does not actively encourage building with sustainable materials. This seems to stem from the perception among many policymakers that sustainable construction costs more and takes longer than traditional construction.

It is, of course, important that sustainability improvements in housing construction do not lead to a slower construction process and/or higher construction costs. After all, the main purpose of the construction targets is to ensure the rapid availability of affordable new housing. However, it would be a missed opportunity if the government were to avoid actively promoting sustainable building materials in housing construction for fear of adverse effects of which there are few to none in practice. It is therefore essential to gain insight into the *real impact in time and money* of the transition to sustainable building materials. We also need to look at how to *avoid or minimise* any foreseeable delays and cost increases.

It is also important to bear in mind that the Dutch housing sector cannot avoid the switch to sustainable construction in the long term anyway,

given the aforementioned limits and targets for carbon emissions that will apply to new homes from 2030 under the new EU Energy Performance of Buildings Directive.

In view of this, our advisory report focuses on the following question: *What conditions does the government need to create to promote a shift towards the use of sustainable building materials that goes hand in hand with the creation of large numbers of affordable new homes?*

1.4 Scope

This advisory report focuses specifically on the use of materials in the construction of *new homes*. We therefore do not look at the use of materials in renovating the *existing* housing stock. We recognise that the renovation challenge also involves the use of large quantities of building materials. However, we expect a transition in the use of materials to construct new homes to have a knock-on effect on the use of materials to renovate existing homes (and possibly also to construct office and commercial buildings).

A second distinction in this advisory report concerns the environmental impact we examine in relation to the use of materials in new construction. Our focus lies on CO_2 (and similar greenhouse gas) emissions. We do this (a) because the climate challenge is urgent, (b) because the Netherlands is not on track to meet the targets set in the Dutch Climate Act (PBL, 2024), and (c) because the EU plans to focus on carbon emissions.

We are aware that the environmental impact of material use in the construction of new homes extends beyond carbon emissions to aspects such as resource depletion, acidification, particulate matter and nitrogen emissions, health effects of indoor building materials and so on. These are relevant factors, which must rightly be taken into account when calculating the environmental performance of homes. Nevertheless, this advisory report focuses primarily on the urgent issue of reducing carbon emissions.

1.5 Structure of this report

The rest of this advisory report is structured as follows.

- In Chapter 2, we clarify what 'sustainable use of materials' entails and what strategies can be followed to achieve this.
- In Chapter 3, we outline a number of developments that show that the transition to sustainable construction is already a factor that plays a role in practice.
- In Chapter 4, we explore the extent to which homes made of sustainable materials are affordable and quick to build.
- In Chapter 5, we highlight six factors that are currently still impeding the transition to the use of sustainable building materials.
- Finally, in Chapter 6, we set out our conclusions and make a number of specific recommendations to central government, municipalities and the parties in the construction chain.

2 SUSTAINABLE USE OF MATERIALS: FIVE STRATEGIES

In this chapter, we give a precise definition of what we mean by ‘sustainable use of materials’. We have identified five different strategies: (1) using fewer building materials, (2) using fewer and/or lighter installations for heating, cooling and ventilation, (3) re-using building materials, (4) using bio-based building materials and (5) using low-carbon versions of conventional building materials. We describe the extent to which each of these strategies contribute to reducing carbon emissions, the extent to which they are already used in housing construction, and the obstacles involved. Finally, we outline what the combined deployment of the strategies can achieve in terms of carbon reduction.

2.1 Using less building material

Using less building material can significantly reduce carbon emissions when constructing housing. There are several ways to implement this sustainable strategy.

Firstly, the amount of materials used can be reduced through the *more efficient use of existing housing stock*. Concrete options in this context include (a) subdividing or adding storey to existing housing (CRa, 2022), (b) creating additional residential accommodation by converting vacant office, healthcare and education buildings and farms into residential complexes (EIB, 2024), (c) distributing existing residential accommodation more effectively, for example through relocation contributions and (d) making better use of existing residential accommodation by attaching fiscal benefits to subletting.

The amount of material used can also be reduced by building *smaller* houses. Dutch citizens currently still enjoy a relatively large amount of living space, with an average floor area of 53m^2 per occupant (CBS, 2018). By comparison: Flemish citizens have an average living space of 47m^2 per person, German citizens 46m^2 and British citizens 44m^2. The generous floor area per occupant in the Netherlands is partly due to the large number of single-person households. Building methods in the Netherlands also play a role: our housing stock consists of almost 60% townhouses and only 20% apartments. This percentage of apartments is almost the lowest in Europe.[6] However, the need for apartments is high and is also increasing. This is due to a decades-long decline in the size of households in the Netherlands (from an average of over 3.2 people in 1970 to 2.14 in 2021) and a steady rise in the number of single-person households (CBS, 2021), which means that this group now accounts for 29% of housing demand (Staatscommisie demografische ontwikkelingen 2050, 2024).
There are therefore plenty of opportunities in the Netherlands to opt for smaller homes, which require less building material, when building new homes on a large scale. There is also potential to opt for more multi-family dwellings, in which households live in relatively small apartments but have access to communal areas and facilities.[7] Such housing concepts are attractive to students, but also offer other possibilities such as combining care for the elderly.[8]

Finally, *adaptable construction* (also known as 'adaptive construction') can also help to reduce the amount of materials used. Accommodating possible future changes in the use of a building at the building design and construction stage means that a home can be subdivided or extended relatively easily and using fewer materials, or an office building can be more easily transformed (DGBC et al., 2024).

In recent years, experience has already been gained of several of the options mentioned here. For example, the subdivision and addition of storeys to houses and the conversion of office buildings into homes. According to the Economic Institute for the Construction Industry, there is potential to create 120,000 housing units in this way by 2030 under the existing policies and around 157,000 housing units with additional policies

6 Only northern Macedonia and Ireland have a lower percentage of apartments than the Netherlands. Source: Staatscommissie demografische ontwikkelingen 2050 (2024).

7 Multi-family dwellings (*Mehrfamilienhäuser*) are a much more common form of housing in Germany than in the Netherlands

8 An informative source in this context is Cobouw podcast no. 94 *'Betaalbaar wonen doe je zo'* (How to make housing affordable) of 13 December 2023 (Cobouw, 2023).

– including changes in legislation (EIB, 2024). Smaller homes are also already being built in practice. Particularly in large cities, we are currently seeing an increase in the number of studios that have a limited living area, but are made comfortable by means of a clever layout (Cobouw, 2023). Other initiatives, such as encouraging older people to move on to smaller homes and adaptive construction, have so far been slower to take off.

2.2 Using fewer and/or lighter technical installations

'Low-installation building' is a second strategy to reduce carbon emissions in housing construction. The production of technical installations for heating, cooling and ventilation contributes significantly to the carbon emissions (around 10%) of a home (Copper8 et al., 2023).[9] which means that considerable reductions can be achieved by using fewer technical installations and/or smaller installations. Other measures can be used to ensure sufficient cooling and heating of the home, such as adding a thermal, insulating layer around the home, airtight construction, using higher quality window frames and insulation, using a sun-oriented design, installing sun blinds and balanced ventilation (Lente-akkoord 2.0, 2024a; Kennisinstituut KERN, 2025).

Low-installation construction not only means lower carbon emissions from the production of installations. Once a low-installation home is occupied, the carbon emissions from the *use* of installations are also reduced.[10]

Low-installation building is an attractive strategy in terms of costs. As technical installations account for as much as 20-40% of the cost of constructing a home, using fewer and/or lighter installations results in substantial savings. These savings can offset the additional cost of alternative cooling and heating measures. On top of this, lighter installations have lower maintenance and replacement costs.

Although people are slowly but surely becoming more aware of the option to construct homes with fewer and/or lighter installations (sometimes under the name of 'passive house construction' or 'low-tech construction'), adoption of this strategy is still limited in the Netherlands.[11] At present, installations in smaller homes are often even too large (Spring Agreement 2.0, 2024a). This is partly due to the fairly extreme standards in place in the Netherlands to ensure a comfortable temperature in cold conditions, which cannot be met without the help of installations (Transitieteam Circulaire Bouweconomie, 2025).[12] The STOER Advisory Group (2025) also notes that existing regulations are having the undesirable effect of blocking the construction of low-installation housing.

9 Technical installations are also responsible for around 16% of the environmental impact of a home, including through the use of critical raw materials.

10 An additional benefit of smaller and fewer installations is less dependence on critical materials.

11 The Netherlands differs in this respect from Belgium and particularly Germany. In Germany, around 10% of all homes are already being built according to a low-installation approach.

12 These strict standards are part of the Structures (Living Environment) Decree (*Besluit bouwwerken leefomgeving*, Bbl).

The subject of low-installation building has not yet been broached in the NZEB, the current regulations governing energy consumption in homes. This a missed opportunity not only to reduce carbon emissions, but also to reduce household energy bills and grid congestion.

The regulations should also place a greater focus on the *service life* of technical installations. Installations currently need to be replaced every 20 years on average. Extending the service life can save costs as well as reduce the environmental and climate impact of installations (Transitieteam Circulaire Bouweconomie, 2025).

2.3 Reusing building materials

A third strategy to reduce carbon emissions in housing construction is to reuse building components and building materials. This can be done in several ways.

The most common method of reuse is the crushing of concrete and brick, after which it is used as a foundation for road construction (Bodemrichtlijn.nl, 2024). The vast majority of concrete and brick from demolished buildings in the Netherlands is recovered in this way. However, this is not an optimal form of recycling and is considered *low-grade reuse*.[13]

Substantial carbon reductions are only achieved through *high-quality reuse*. According to the PBL (PBL, 2023), the rate of high-quality reuse in the Dutch construction industry is just 8%.

High-quality reuse can be achieved in several ways:

- One option is to reuse all or part of building components in a new building. Concrete slabs, for example, can often be reused. The foundation and skeleton frame of an old building can also be reused for a new building. This can significantly reduce carbon emissions, as the construction of a building is the most CO_2-intensive phase.[14]
- Another option is to use recovered materials as raw materials for the production of new building materials.[15] For example, techniques are being developed for recovering sand and gravel from concrete to serve as raw material for new concrete.
- Steel can also be reused. This is relatively common in the construction of housing as well as offices, schools, factories and the like. For these buildings, over 70% of the steel needed is provided by high-grade recycling, which it should be noted is still fairly energy intensive (EIB & Metabolic, 2022).

Most other materials are difficult to reuse in practice. Existing buildings (including homes) are not usually designed to be disassembled, so it takes a lot of time and effort to detach building components undamaged for future

13 Materials from construction and demolition are currently 95% recycled (PBL, 2023). This reuse is often low grade, also known as downcycling.

14 According to the Dutch Green Building Council (DGBC, 2021), emissions would be reduced by around 60%.

15 Not every form of reuse is automatically positive, as shown by the use of steel slag from blast furnaces as a raw material for building materials (Follow the Money, 2025).

reuse. The use of toxic substances in construction can also hinder reuse (De Rooij, 2023). Moreover, one-to-one reuse is basically only possible on a larger scale if construction companies have access to information about the components and materials available in existing homes and when these homes will be demolished. Companies can then take into account the availability of materials for high-quality reuse when designing new homes (Copper8 & Metabolic, 2023).[16] This approach requires a digital materials database that does not currently exist, but for which Madaster is a first step (Madaster, 2025).

Another practical obstacle to the reuse of building materials is currently certification and quality guarantees for reclaimed components. For example, it is often difficult to obtain certificates and guarantees for the load-bearing capacity of a reclaimed concrete girder (AT Osborne, 2021).

What is more, reusing components and materials often works out slightly more expensive than working with new components and materials. The main reason for this is that reuse is more labour intensive. For example, the circular demolition of building components that are not 'detachable' together takes a relatively large amount of time and effort. The same applies to the use of demolished components and materials in the design and realisation phases. A 2022 study (conducted on the basis of three specific projects) estimated the additional cost of circular demolition and construction at between 1.7% and 7% compared to conventional demolition and construction (Copper8 et al., 2022).

The various barriers discussed above mean that the large-scale use of reused and recycled materials has so far been limited. In order to get things moving, the market called on the Minister of Infrastructure and Water Management and the Minister of Housing and Spatial Planning in early 2025 to make circular demolition mandatory (Betonakkoord et al., 2025).

2.4 Using bio-based building materials

A fourth strategy to reduce CO_2 emissions in housing construction is using bio-based building materials. Bio-based building materials are made from natural, renewable raw materials. These are mostly building materials made of wood and/or fibre plants.[17]

Wood

The use of wood to build homes is nothing new. For centuries, wood was the main building material until it was superseded – at least in the Netherlands – by stone, brick, concrete and steel. The use of wood in housing construction has recently become popular again. For example, timber frame structures have been rediscovered as an excellent

16 A good example is the Prinsenhof A provincial office building in Arnhem, in which building components have been reused. See: https://www.gelderland.nl/themas/duurzaamheid/circulaire-economie/prinsenhof

17 Bio-based building materials can sometimes contain animal raw materials, such as fungi and bacteria. Although these often evoke negative associations, in bio-based buildings they frequently actually contribute to a building's ability to repair itself. For more information, see https://www.collegevanrijksadviseurs.nl/projecten/nieuwe-bouwcultuur/voorbeeldprojecten/wat-is-biobased-bouwen

construction method for sustainable housing construction. This technique involves using a skeleton of studs and beams to take over the load-bearing function of the walls.
Wood can also form the basis of building products such as cross-laminated timber or glued laminated timber (glulam), which provide an alternative to steel and concrete.
Wood for housing construction purposes is mainly imported from Scandinavia, Germany and Austria (PBL, 2023).

As timber houses are mainly *prefabricated* in housing factories, they can quickly be assembled on site. This reduces on-site carbon emissions as well as potentially reducing the construction process to a few months or even weeks (Horsting & Woltjer, 2024), resulting in lower production costs. Recent examples show that prefabricated timber homes can be marketed at a competitive price (Cirkelstad et al., 2024).[18]

Yet timber construction is not currently the default choice, due to wildly fluctuating timber prices and also a lack of standardisation in the material itself.

Incidentally, timber is currently used not only for the construction of ground-level homes or single-storey apartment complexes, but also for high-rise buildings. Buildings of six or more floors often involve hybrid construction, using partly bio-based materials and partly conventional materials.

Fibre plants
Nowadays, fibre plants such as flax, hemp, straw and elephant grass[19] are increasingly being processed into insulation and panel materials. The plants appear to be easy to grow in the Netherlands. Growing fibre plants has the added benefits of (a) providing farmers with an alternative revenue model and (b) potentially benefiting nature and biodiversity restoration (WUR, 2024).

Climate and health benefits
The use of bio-based materials such as wood and fibre plants in housing construction allows temporary carbon capture. Using these materials can therefore help to achieve climate goals.[20]
An additional effect of using bio-based materials is that they contain fewer toxic substances. This offers health benefits for both the builders who work with the materials and the people who move into the homes after construction (WUR, 2024).

Scaling up to unlock potential
Since 2023, central government has encouraged both the cultivation of bio-based materials and their processing into building materials through the

18 See also Chapter 4, Section 4.1.

19 Elephant grass is a collective name for several varieties of grass, which are a favourite food of elephants. The variety *miscanthus gigantues* is suitable for the production of building materials such as panel material and is also used as a cement substitute in the production of low-carbon concrete.
20 See also Chapter 5.

National Approach to Bio-based Building (BZK, 2023). Thanks in part to this incentive approach (and the accompanying €200 million budget), interest in the use of bio-based materials in housing construction is currently high. Central government supports providers of bio-based building materials in a number of ways, including in the certification of their products and in securing private funding for the development of bio-based products.

Bio-based materials have the potential to meet around 20% of the demand for building materials in housing construction (Copper8 et al., 2023). For the time being, the use of bio-based materials is mainly limited to wood. The Netherlands has not yet scaled up fibre plant production and processing to a sufficient level.

2.5 Using low-carbon versions of conventional building materials

A fifth strategy to reduce carbon emissions in housing construction is to use more sustainable versions of conventional building materials such as concrete, steel, glass wool and mineral wool, flat glass and brick. The standard, unsustainable versions of these materials currently account for 90% of all materials used in housing construction. Combined, conventional building materials also account for 80% of carbon emissions in the construction process (Copper8 & Metabolic, 2023). Making the production of these materials more sustainable (and faster) can therefore significantly reduce carbon emissions in housing construction.

For several years, the EU has been taking steps to reduce emissions from the production process of conventional building materials. Many companies producing these building materials are covered by the EU emissions trading system ETS (European Union, 2003). This system limits the right of companies to emit carbon by issuing emission allowances. The number of available allowances is limited and steadily lowered as 4.4% is withdrawn from the market every year. The emission allocation available to companies is therefore slowly but surely decreasing.

Influenced in part by the ETS, manufacturers of building materials are increasing their focus on making production more sustainable. Evidence of this includes agreements signed by the parties along the concrete and steel value chains on making their practices more sustainable (Betonakkoord, 2024; Bouwakkoord Staal, 2023). Although these agreements have led to some good results, they have not yet had a significant impact:

- The concrete industry is experimenting with low-carbon cement substitutes. For example, sustainable concrete is being used to construct parts of two residential towers in the ‘KJ The Hague’ project, significantly reducing carbon emissions. To date, however, few others have followed this example.
- ‘Concrete hollow core slabs’ are now available on the market. These are concrete slabs that require less raw material due to their central cavities (‘hollow cores’), but that otherwise have similar properties to solid concrete slabs. However, demand for this alternative product in the construction industry is currently still low.

- Initial exploratory studies are being carried out into the production of steel using green hydrogen. This requires substantial investment in blast furnaces. Nevertheless, this method of steel production is still very rarely found at international level.

In conclusion, we are seeing the beginnings of a movement towards making conventional building materials more sustainable. With a limited number of exceptions, however, this still rarely translates into the use of more sustainable materials in new homes. The sustainability of concrete and steel is not being improved fast enough to meet the targets set by the relevant sectors (Metabolic & DGBC, 2023). A complicating factor here is that cement and steel production largely takes place outside the Netherlands (Copper8 et al., 2023). As mentioned in Section 2.3, however, a large percentage of the steel used in construction is reused.

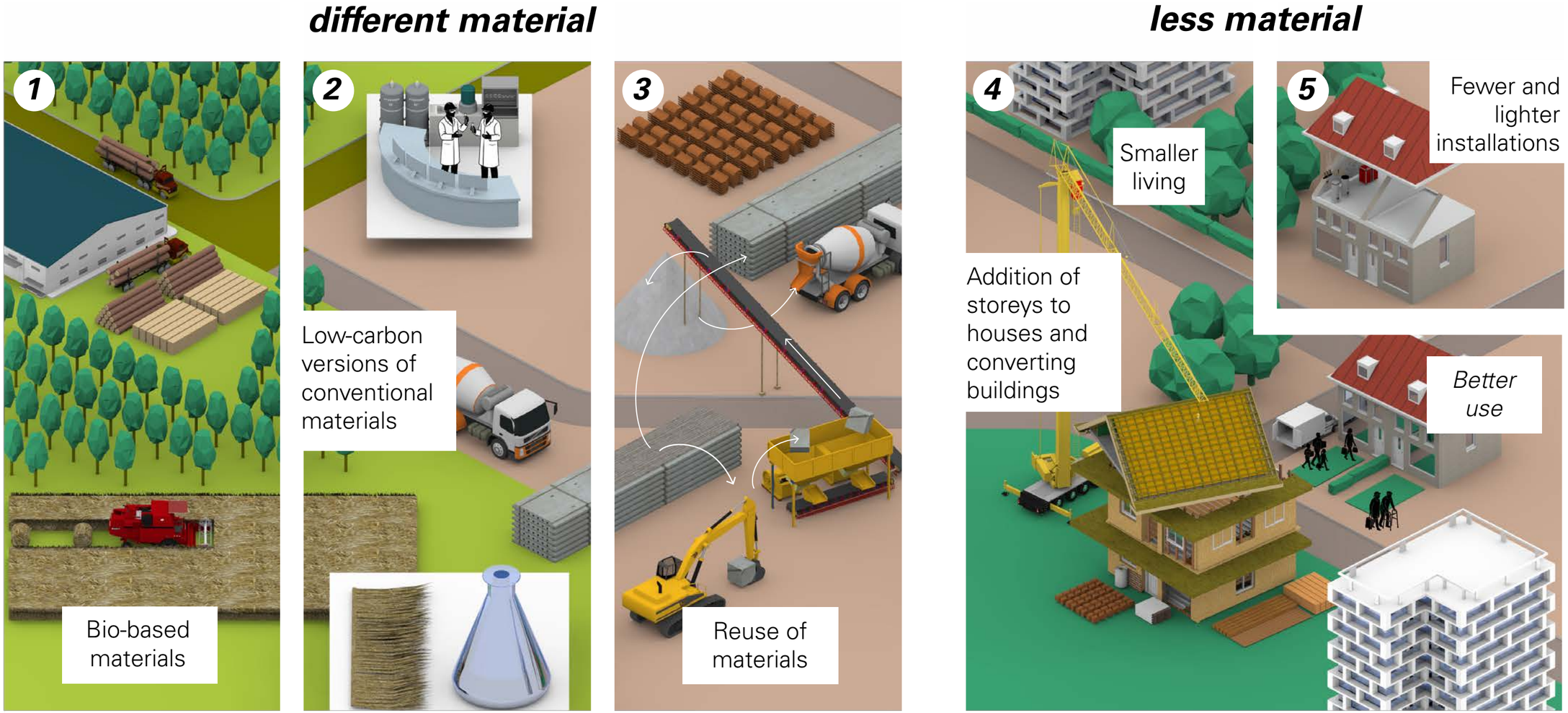
2.6 Conclusion: deploying a combination of strategies will lead to substantial CO_2 reductions

If the five strategies discussed in this chapter are all put into practice, housing construction will be transformed. As Figure 2 shows, the result is a wider variety of building materials and sources. This shift in the use of materials will translate into a wider spectrum of housing construction techniques. Building with more sustainable concrete is similar to the current conventional building method. However, low-installation building and building with bio-based and/or recycled materials require different construction techniques. Building smaller also requires adjustments, particularly when it comes to design.

Each of the five sustainability strategies, applied separately, results in relatively limited carbon reductions. When combined, however, the strategies can make a real difference. All the strategies discussed must therefore be implemented in order to substantially reduce carbon emissions in housing construction.
Based on various sources, it is possible to estimate the potential carbon reductions that can be achieved for each strategy in the period up to 2035.[21] This reveals that three of the five strategies can potentially help to achieve carbon reductions in the short term, namely: (1) building smaller, addition of storeys to houses and converting buildings (16.5%), (2) using bio-based building materials (9.5%) and sustainable versions of conventional building materials (8.5 to 19.4%, depending on the speed of sustainability improvements).
In practice, we see that these three strategies are already being followed. Further efforts are still needed to instigate the use of reused and recycled materials as well as low-installation building, which requires changes in regulations and building philosophy.

21 Copper8 & Metabolic (2023, p. 19) have estimated the carbon reductions that can be achieved up to and including 2035 with the various materials strategies, assuming a total building target of 900,000 new homes. For each strategy, they give an indication of the potential carbon reductions that can be achieved in housing construction compared to 1990 carbon emissions in housing construction. The strategies on which the researchers based their estimates do not correspond entirely to those discussed in this chapter. We derived the carbon reduction for installations from the brochure Woningconcepten en hun prestaties (Housing concepts and their performance) (Cirkelstad et al., 2024), from which we took the average difference in kg of CO_2 emissions with and without installations. That difference amounts to 11% in carbon emissions.

Figure 2: Five sustainability strategies



3 CURRENT USE OF SUSTAINABLE MATERIALS IN NEW HOUSING CONSTRUCTION

In this chapter, we outline a number of developments that show that the transition to sustainable construction is already well underway in practice. For example, the use of sustainable materials in housing construction is growing and the number of sustainably built homes is steadily increasing. Several initiatives have also been undertaken by government authorities and market players. Moreover, prefabricated homes lend themselves well to the use of sustainable materials. However, a full transition to the use of sustainable materials is yet to be achieved; the necessary scaling-up has thus far failed to materialise.

3.1 Sustainability among parties in the construction chain

A substantial proportion of the construction chain is now moving towards the more sustainable use of materials in housing construction. This includes parties at all levels of the chain, from developers, corporations, municipalities and investors to designers, building material manufacturers

and builders. The extent to which this process translates into concrete sustainability performance still varies widely:

- A small proportion of the parties in the construction chain work *exclusively* with sustainable materials. In the construction projects of these pioneers, only the foundations are still made of non-sustainable materials.
- A significant number of the parties in the chain, responsible for an estimated 5-10% of new homes, are taking substantial *steps* to ensure that their use of materials is sustainable.
- A large group of parties in the chain who are lagging behind recognise the need for change, but are still awaiting further government guidance before taking concrete steps.

Below, we explain what the various parties in the chain are doing to make their use of materials more sustainable. In some cases, the parties are intrinsically motivated to take measures while in others they are spurred to action by existing or imminent European regulations.

Financial sector: sustainable investment is becoming more and more important

Most new construction projects in the Netherlands (an estimated 80%) rely on financing or prefinancing from large investors such as institutional investors, pension funds and banks. This financing runs into many billions of euros each year.

However, investors are generally unwilling to take too much risk. They assess investment proposals based on historical data on expected returns and risks. For example, pension funds within the EU have developed their own measurement standard for assessing the risks surrounding investments in sustainable real estate: the Carbon Risk Real Estate Monitor or CRREM. Most projects using new bio-based materials that are unknown to investors fail this risk check. One of the reasons for this is a lack of clarity regarding the fire safety risks associated with timber construction.[22] Some financial frontrunners use their own assessment methods – these parties actually consider bio-based buildings to be lower risk than conventional buildings.[23]

These frontrunners were, until recently, the exception, however the financial sector has placed a much stronger focus on green investments since the introduction of EU regulation in this area. The financial sector has now taken huge steps towards making its investment policies more sustainable. A point of no return has essentially been reached. For this reason, more than 200 investors from across Europe, with combined assets of €6.6 trillion, called on the European Commission in early 2025 to maintain the package of sustainability measures above all else. This call was prompted by the Commission's ad hoc announcement that it planned to water down certain sustainability measures due to current geopolitical tensions. However, the

22 Insurers and risk assessors consider wood to be a fire hazard. However, the fire safety of wooden buildings largely depends on the construction technique used and additional measures. The process of translating this into adapted fire safety standards is still ongoing (see also Chapter 5).

23 The Ministry of the Interior and Kingdom Relations took the initiative in 2021 to investigate the fire safety of timber buildings and instruct a NEN committee to set national standards (ARUP, 2025).

financial institutions argued that this would harm their competitive position (Institutional Investors Group on Climate Change, 2025).

The main regulations and directives in the EU package of sustainability measures are as follows:

- the Taxonomy Regulation, a regulation that introduces a classification system ('taxonomy') by which business activities can be classified as 'sustainable';
- the Corporate Sustainability Reporting Directive (CSRD), a directive that requires companies to report on their sustainability performance using predefined criteria;
- the Corporate Sustainability Due Diligence Directive (CSDDD), which is an extension of the CSRD and requires companies to establish improvement processes based on sustainability reporting metrics; and
- the Sustainable Finance Disclosure Regulation (SFDR), a regulation that requires financial market participants to disclose information about their sustainability policies and be transparent about their implementation.

For now, the main practical aspect of investors' focus on property sustainability is their efforts to reduce the 'use-related' carbon emissions of buildings. As a result, they primarily finance the construction of energy-efficient homes that have low carbon emissions in the occupation phase. This one-sided focus on reducing carbon emissions in the occupation phase is due to the relative shortage of projects that deliver substantial carbon reductions *in the construction phase* through the use of sustainable materials.

It should be noted that our conversations with investors have revealed that many of them are thinking about taking further steps, including focusing on construction projects using mainly sustainable materials. What will help is that the EU is likely to intervene more robustly in this area in the coming years, through the phased implementation of the provisions in the previously mentioned CSRD, CSDDD and SFDR.

Commissioning parties and large construction firms: a focus on carbon reduction

Large property developers and construction companies are also strongly influenced by EU statutory regulations such as the CSRD.[24] In addition, they will soon be faced with Dutch legislation stemming from the EU's updated Energy Performance of Buildings Directive, EPBD IV. Driven by this regulation, commissioning parties and construction firms are increasingly focusing their sustainability strategies on reducing the carbon footprint of their operations. This means that it will no longer be enough for them to concentrate solely on reducing 'use-related' carbon emissions. They will need to ensure that they also reduce carbon emissions from the use of materials in the construction phase of their projects.

Some of these companies do their own carbon accounting. This gives them a good understanding of the carbon emissions associated with the materials they use, enabling them to report on this in accordance with the CSRD. The

24 Large companies that are subject to the CSRD meet two of the following three indicators: (1) more than 250 employees, (2) more than €50 million turnover per year, (3) more than €25 million on the balance sheet.

reporting obligation of large companies extends to subcontractors, whose carbon performance must be included in reports on construction projects.[25]

Our conversations with representatives of some of the larger market players in the construction sector revealed that they are increasingly focusing on EU statutory rules. While they are still required to comply with Dutch building standards for the energy and environmental performance of homes, such as the standards for near zero-energy buildings (NZEB) and the standards for the environmental performance of buildings (EPB), they perceive these as playing less of a guiding role.

Within the commissioning party category, housing investors who invest in the construction of mid-range rented accommodation on behalf of pension funds are an interesting group. They operate these rented homes for around 20 years until they are sold. Because these parties are responsible for the housing over a longer period, they focus on a higher level of sustainability during construction than required under the Dutch regulations. Their aim is to prevent the homes from losing value over time due to failure to meet the latest European sustainability requirements.

Finally, housing associations are an important group. This sector is subject to tight financial regulations and is expected to contribute to many different societal goals. Although this sometimes limits their options, some frontrunners are increasingly gearing their building policies towards reducing carbon emissions in both the occupation phase and the construction phase of homes. Because housing associations own homes for a long time, often as long as 50 to 75 years, they tend to focus on reducing the energy consumption of existing homes. Less attention is generally paid to the use of sustainable building materials – although there is also evidence of progress in this area, with at least 40 housing associations actively engaged in timber construction (Duurzaam Gebouwd, 2023).

Examples of housing associations that use sustainable construction processes

- *Woonstad Rotterdam* recently commissioned a housing complex built of wood in the Pendrecht district. The 12-storey building consists of 82 mid-market rented apartments. The architect developed a new timber joint construction for this project. The supporting structure was produced in Austria and transported to Rotterdam in sixty trucks. The project incurred additional costs, however a favourable financing arrangement meant that the residential complex turned out to be little more expensive than similar conventionally built housing complexes.
- *Wonion*, a housing association based in Ulft, carries out building and renovation activities almost exclusively using sustainable materials. The association works with contractors and construction companies from the local region, with whom it has established long-term partnerships. The decision to build sustainable homes is partly driven by financial considerations: Wonion has found sustainably built homes,

25 The original plan was to also impose a reporting obligation on larger SMEs with 250 or more employees under the CSRD from 2026. However, the European Commission withdrew this obligation in February 2025, for reasons of international competition and to reduce the regulatory burden.

including their operation and maintenance, to be the cheapest option over their entire lifespan.

Architects, small construction firms, structural engineers, installers: new solutions

The design principles that apply to the use of sustainable materials differ from those that apply to conventional construction. In practice, we see that this leads to a different, much more intensive collaboration between the parties involved in the construction chain than in conventional construction. This is necessary because architects, structural engineers, builders and installers rely on each other when devising new design methods and their impact.

In addition to the group of large construction companies just mentioned, there is a growing group of smaller construction companies that explicitly focus on sustainable construction. Some of these are new companies that view sustainable use of materials as a core element of their business model, and some are existing family businesses. These companies are taking steps towards a transition and increasingly working with sustainable building materials.

From their position 'at the front end' of the construction chain, architects play an important role in this. They are the go-to people when it comes to (a) devising new ways of applying sustainable, bio-based materials in housing construction, (b) exploring new ways of using less material, incorporating lighter installations and reusing material, and (c) demonstrating the potential for the use of new bio-based or other materials. The design phase, in short, plays a crucial role in developing alternative construction methods.

Architects are currently placing a strong focus on timber construction in their housing designs.

3.2 Government and market initiatives

In recent years, government authorities and market operators have launched several initiatives in order to jointly gain knowledge and experience of the use of sustainable materials in housing construction. The aim is to use this knowledge and experience as a basis to set up building projects with ambitions that are higher than the statutory sustainability targets. The initiatives use different sustainability strategies to pursue this goal, a number of which are explained below.

City Deal on Circular and Conceptual Building

A now completed initiative is the City Deal on Circular and Conceptual Building.[26] Within this initiative, eight municipalities, three provinces, central government plus a number of knowledge institutions, architects and construction companies worked together on three themes between 2022 and 2024: (1) encouraging building with bio-based materials that capture carbon, (2) exploring opportunities for prefabricated housing construction

26 See City Deal Circulair & Conceptueel Bouwen (2022).

(with a view to increasing construction speed and quality and reducing construction waste) and (3) working on new financing and valuation models for sustainably built properties. The City Deal on Future-proof Area Development is a follow-up to this initiative.

The New Normal

Cirkelstad, a national cooperative of frontrunners in the construction sector, launched 'The New Normal' programme in late 2023 with six major commissioning parties, six construction companies and a permanent core team of consultancy firms.[27] Cooperation within this programme is aimed at creating a common language and uniform measurement methods for circular construction. The framework that has been developed shows construction project initiators what adjustments they can make and which performance levels can be achieved. The developed standard provides initiators with tools for making sustainability choices.

Covenant on Future-proof Construction

The 'Convenant on Future-proof Constructions' is an initiative by five decentralised authorities: the provinces of Utrecht, North-Holland, Flevoland and South-Holland and the Amsterdam Metropolitan Area (Toekomstbestendig bouwen.nl, 2024). The covenant focuses on linking sustainability ambitions in housing construction in terms of carbon reduction, circularity, use of renewable energy and nature inclusiveness. More than 150 organisations have now signed up to the covenant, including many municipalities. Signatories commit to a minimum performance level for new housing projects (bronze) and strive for higher levels of ambition (silver and gold).

Circular Industrial Construction Spring Agreement 2.0

In 2022, five sector organisations (NEPROM, Aedes, Bouwend Nederland, IVBN and WoningbouwersNL)[28] took the initiative of drawing up a 'Circular Industrial Construction Spring Agreement 2.0'. Within this agreement, parties are working together to increase the practical feasibility and scalability of circular housing construction. Frontrunners within the industry associations are carrying out pilot projects. The knowledge gained from these projects will be disseminated within the construction sector to drive innovation (Lente-akkoord 2.0, 2024b).

Paris-Proof methodology

The Dutch Green Building Council (DGBC), a national civil society organisation dedicated to future-proofing the built environment, introduced the 'Paris-Proof methodology' a few years back.[29] The methodology aims to achieve a built environment that fits within the goals of the Paris Climate Agreement. To do this, carbon emissions from the construction process and materials used will need to be limited to a set maximum and carbon emissions from the energy use of completed buildings reduced by

27 See Het Nieuwe Normaal (The New Normal) (2024).

28 NEPROM is the sector organisation of socially responsible property developers and area developers in the Netherlands. Aedes is the national sector association of housing associations in the Netherlands. Bouwend Nederland is the sector organisation of construction and infrastructure companies in the Netherlands. IVBN is an interest organisation of institutional real estate investors. Finally, WoningBouwersNL is an association of housing specialists.

29 See https://www.dgbc.nl/wat-wij-doen/paris-proof/

two-thirds. A ‘Paris-Proof material-related indicator’ has been developed to monitor material-related emissions. This indicator has also been included in initiatives discussed above, such as The New Normal and the ‘Covenant on Future-proof Building’, and in the ‘Building on Rotterdam’ programme, which we explain below.

Initiatives at regional and municipal level

Recent years have also seen the development of low-carbon and circular housing construction initiatives at regional and municipal level. We discuss three of these initiatives below:

- *Green Arnhem-Nijmegen Metropolitan Region circular*. The Green Arnhem-Nijmegen Metropolitan Region, an alliance of 17 municipalities, focuses on making construction circular. In practice, this is realised by reusing components, recycling recovered raw materials and using bio-based building materials. Aims are formulated at project level in consultation with contracting parties and builders. In the case of some projects, 45% of the materials used already consist of recycled or bio-based materials.
- *Building on Rotterdam*. In the programme ‘Building on Rotterdam: Measures to Continue Construction in 2023-2026’, the municipality of Rotterdam set itself the goal of meeting housing targets within a self-imposed carbon emissions ceiling. The programme refers to the previously mentioned Paris-Proof methodology. The city wants to be ready for future regulations and not risk a future construction freeze. To achieve this, the municipality entered into discussions with a large number of designers and builders. The aim is to jointly determine how and under what conditions the housing targets can be met within the set limits.
- *Timber construction in the Amsterdam Metropolitan Area*. The Amsterdam Metropolitan Area (Metropoolregio Amsterdam, MRA) has set itself the goal of realising 20% of housing production using wood and other bio-based materials from 2025. This ambition is laid down in an agreement signed by 140 parties and 25 real estate partners. The agreement came about through an intensive collaboration between government authorities, knowledge institutions and market operators. The aim is for homes in the region to be built faster and more sustainably from now on. This is expected to substantially reduce both carbon and nitrogen emissions (MRA, 2021).[30]

Critical note: decentralised initiatives can lead to unworkable requirements above the statutory minimum

Decentralised initiatives to encourage housing construction with sustainable materials, some of which we discussed above, are driven by noble motives. It is also understandable that local administrators choose to take action. Housing construction is the perfect example of a local issue and members of the municipal executive recognise the urgent need to combat climate change. The agreements and covenants fill the void left by the lack of ambitious national standards.

30 The Green Deal Covenant for Timber Construction estimates nitrogen emissions at zero due to lighter materials, fewer movements on the construction site and the use of prefabricated components (MRA, 2021).

Nevertheless, we have some concerns about decentralised initiatives to make housing more sustainable as they may have the effect of imposing differing building requirements that exceed the statutory minimum in municipalities and regions.[31] The result is a hotchpotch of building regulations across the Netherlands. For construction companies, which often operate in several regions, it is impossible to respond to all these individual requirements as this significantly increases the process costs. And in many cases it is also not technically feasible to incorporate local requirements into housing designs. This is especially true for prefabricated homes. We therefore believe that measures should be taken to stop decentralised initiatives from leading to building regulations that exceed the statutory minimum.

3.3 Prefabricated homes

Recently, numerous parties in the construction chain have invested in housing factories. These factories produce housing modules or entire homes to a common design, which are then transported and can be quickly assembled on site. Several versions of a housing concept can often be produced, which can vary in volume, layout and facade cladding.

31 It is important to note that we are not referring here to the selection criteria used by decentralised authorities in procurement and tenders. These criteria are designed to challenge construction companies to push their limits. This element of voluntariness is missing from the decentralised building regulations we express concerns about here.

The production capacity for prefabricated homes is considerable, although yet to be fully tapped. Around 14,000 and 13,000 prefabricated homes were completed in 2023 and 2024 respectively (Rutten, 2024).

Efficiency benefits of prefabricated housing construction

Prefabricated housing construction, also known as industrial housing construction, offers numerous efficiency benefits. It means that homes can be built faster and building materials used more economically. A higher per-employee output can also be achieved in housing factories. In that respect, the factories offer a solution to the labour shortage in the construction sector, which is only expected to worsen in the future. Prefabricated housing construction also provides attractive working conditions and interesting new jobs, particularly through the digitalisation of the design and production process and performance monitoring of the homes that are build (EIB, 2023a).

Sustainability benefits of prefabricated housing construction

Prefabricated housing construction also offers sustainability benefits. For example, it involves less construction waste, fewer transport movements and significantly lower nitrogen and carbon emissions. In addition, prefabricated construction offers better opportunities for reusing and recycling materials, for using bio-based materials (particularly wood) and for integrating detachable building components (see box).

Prefabricated homes score higher for sustainability

Cirkelstad et al. (2024) have listed the environmental performance of 46 prefabricated housing concepts, including material-related carbon emissions and carbon storage. They looked at the extent to which the housing concepts comply with the statutory environmental performance standard for buildings (EPB), the extent to which the building components used are detachable, the extent to which the building materials are reusable or recyclable, and the extent to which bio-based materials have been used. The results show that the prefabricated housing concepts score substantially better than the statutory standard. While the current statutory EPB standard for homes is 0.8, single-family homes score between 0.29 and 0.67 and multi-family dwellings (apartments) between 0.39 and 0.68 (Cirkelstad et al., 2024).

The average carbon emissions for a prefabricated home are 187 kg of CO_2 per square metre of gross floor area. As Table 1 below shows, single-family homes score better than this average, with 164 kg of carbon emissions. Multi-family dwellings, on the other hand, score higher than the average, with 230 kg of carbon emissions. The emissions are therefore substantially lower than the average emissions for housing construction, i.e. 340 kg of CO_2 per square metre (Stichting W/E Adviseurs, 2023a).

Table 1 also shows that prefabricated homes capture CO_2 in bio-based material. On average, the homes capture 155 kg of CO_2 per square metre with no significant difference between single-family and multi-family dwellings. It is worth mentioning that some homes capture more CO_2 per square metre than they emit (Cirkelstad et al., 2024).[32]

Tabel 1: Carbon emissions and carbon capture in prefabricated homes

	Average emissions in kg of CO_2 per m^2 of gross floor area	Average emissions in kg of CO_2 per m^2 usable floor area (conversion factor 1/0.85)	Average carbon captured in material in kg of CO_2 per m^2
Single-family homes (prefabricated)	164	193	148
Multi-person homes (prefabricated)	230	271	171
Conventional housing construction	340	400	N.v.t.

In these examples, carbon emissions were calculated using gross floor area, while upcoming European regulations call for calculations based on usable floor area. The difference is that the latter calculation does not include walls, pillars and stairwells. A conversion factor used to get from gross floor area to usable floor area is 0.85. In other words, in a home with a gross floor area of 100m^2, the usable floor area is 85m^2.

Sources: Cirkelstad et al., 2024; Stichting W/E Adviseurs, 2023a

32 When calculating the total carbon emissions of a home, the carbon captured in the building materials used cannot be deducted from the carbon emitted during the construction process. Under the rules currently in force, carbon emissions and carbon capture must be recorded separately.

Prefabricated housing construction has the potential to significantly reduce carbon emissions, as prefabricated construction is well suited to timber construction and other forms of bio-based construction.[33] Currently, prefabricated construction is already estimated to deliver carbon reductions of 25% to 50% compared to conventional construction (Copper8, 2024; WUR, 2024). Greater reductions are expected as materials become more sustainable due to innovation and scaling-up.

Architectural quality of prefabricated homes

A point to consider with prefabricated construction is that this building process can lead to uniformity. There is a risk of creating neighbourhoods made up of homes of poor spatial and architectural quality (Palmboom, 2023; FRK & CRa, 2024). Given that prefabricated housing concepts can be produced in several variants, this risk is avoidable. However, it is important the urban design process pays sufficient attention to the urban integration and architectural quality of the homes (FRK & CRa, 2024).

33 Thanks to precise, computer-controlled sawing machines, timber construction offers many structural and architectural possibilities. The best-known forms of timber construction are timber frame construction and modular construction. Composite timber products are also used such as cross-laminated timber, laminated veneer lumber and glued laminated timber. These products are often consist of spruce, pine and fir veneer layers that are glued together, making the wood more rigid and suitable for a wider range of uses. For more information, see: https://circulairebouweconomie.nl/dossier/houtbouw/

Optimal use of production potential

The Schoof government recognises the potential of prefabricated housing construction. The government programme states a goal of ensuring that half of new homes are prefabricated by 2030 (Kabinet-Schoof, 2024). Gideon, an initiative of sustainability professionals from the construction industry, estimates the total capacity of existing housing factories in the Netherlands at around 50,000 homes per year. This number is achievable, according to Gideon, provided current housing factories are sufficiently scaled up and their production capacity is fully utilised (Gideon, 2024). The government target just mentioned could then be met even before 2030.

If this target is to be achieved, the production capacity of housing factories needs to be better utilised. In practice, however, it is proving difficult to organise a steady construction flow. One of the reasons for this is that construction plans are frequently delayed by objections to the granting of permits and congestion on the power grid. Prefabricated construction is also hampered in many cases by inappropriate, specific requirements imposed by municipalities, often in relation to urban planning. On top of that, market demand for prefabricated housing remains sluggish. The housing association sector and the Conceptual Building Network have jointly launched the 'The Construction Flow' programme ('*De Bouwstroom*'), through which housing associations, municipalities and prefabricated construction firms seek to create conditions for steady demand, allowing a more consistent use of production capacity.

3.4 Conclusion: plenty of potential, but no scaling-up yet

As we have shown in this chapter, many property developers, architects and construction companies have taken serious steps towards the more sustainable use of materials in housing construction in recent years. A small proportion of them are already putting their commitment to sustainable construction into daily practice by building exclusively with sustainable materials.

A large number of parties in the construction chain have also to some extent adopted one or more of the strategies for sustainable material use in housing construction discussed in Chapter 2. In many cases, this involves the use of bio-based building materials – a concept that is highly compatible with prefabricated housing construction.

However, the vast majority of parties in the construction industry are not yet ready to make the switch to sustainable material use. Not enough is being done to scale up efforts in this area.
In Chapter 5, we look at why this is. But first, in Chapter 4, we explore the extent to which homes made of sustainable materials are affordable and quick to build.

4 THE IMPACT OF SUSTAINABLE CONSTRUCTION IN TIME AND MONEY

Are many people, including policymakers, right in thinking that sustainable construction is expensive and complicated? We establish in this chapter that this is not the case. While sustainable construction does cost slightly more on average than conventional construction, this is not true for many prefabricated low and medium-rise buildings. The construction time is also actually shorter in many cases, bringing down costs. What's more, both the cost and pace of housing construction appear to depend to only a limited extent on the building materials and pace of construction. Factors that play a much more decisive role are land prices and the duration of the preceding area development process. On top of that, the cost price of a home differs from the market price of a home. The latter is simply determined by what prospective buyers are willing to pay for a property.

4.1 The cost of building homes with sustainable materials

We assessed the accuracy of the perception among politicians, parties in the financial sector and the construction industry that building homes with sustainable materials costs significantly more than building with conventional materials.

Based on the information currently available, it is not yet possible to provide an overall picture of the costs associated with the various forms of sustainable construction. The reason for this is that some forms of sustainable construction (such as low-installation and reuse-based construction) are still so rare that there are very few robust figures for these forms.[34] Prefabricated timber construction is already relatively common, however, accounting for 5.2% of new homes built (Luijkx, 2024). Some conclusions can therefore be reached about whether the costs involved in this form of construction are higher than when using conventional materials (Alba Concepts et al., 2024).

Timber construction can be competitive, particularly in the case of prefabricated low and medium-rise buildings

For timber construction[35], construction costs are generally up to around 10% higher than the cost of conventional construction. However, the costs fall within a large range. Roughly speaking, a distinction can be made between (a) timber high-rise buildings, which involve higher additional costs, and (b) timber low and medium-rise buildings, for which the costs can be competitive or sometimes even lower than those of conventional building options.

Constructing prefabricated timber low-rise houses for the social housing sector costs on average 4% more than constructing conventional homes. Timber frame construction is interesting here from a cost perspective: within a limited research population, ground-level homes built using this technique have been found to be up to 10% cheaper than conventionally built alternatives (Luijkx, 2024). For timber medium-rise buildings (housing complexes up to around five storeys), this form of construction is also slightly (2%) cheaper than its conventional counterpart.[36]

For timber high-rise buildings (from around six storeys and more)[37], costs are 10-20% higher than conventional high-rise buildings, with outliers of up to 30% (Luijkx, 2024; Alba Concepts et al., 2024). In a number of cases, these are ambitious first attempts (firsts of a kind) that have simply paid the price of a learning curve.

Why are some sustainable building options more expensive?

The higher costs that can be associated with wooden high-rise buildings are due to several factors (Alba Concepts et al., 2024). Firstly, additional construction expertise often needs to be acquired to implement the

34 The lack of detailed cost information on certain forms of sustainable construction is also due to the fact that several sustainability strategies are often applied simultaneously within a single construction project (Cirkelstad et al., 2024).

35 In this advisory report, the term ‘timber construction’ refers to situations in which the supporting structure of a building is made of wood. A distinction can be made here between load-bearing structures based on timber frame construction, cross-laminated timber and other techniques.

36 The timber medium-rise buildings referred to here concern 3D timber frame constructions.

37 The specific construction technique used here involves 2D elements or cross-laminated timber. These materials predominantly come from Scandinavia, Germany or Austria and are often still more expensive, partly because production and market chains to the Netherlands are still developing.

new techniques. This entails higher consultancy costs for architecture, construction and building physics. In addition, insurers who are not yet familiar with the exact risks involved often impose more stringent structural requirements than necessary on fire safety, sound insulation, vibration and aesthetics. Meeting these requirements leads to an average increase of 1-5% in construction costs. The process of constructing timber apartment buildings also involves several parties who charge risk premiums on the full construction costs: the module builder, the contractor, the subcontractor and the main contractor (IGG Bouweconomie, 2023).

Higher prices of sustainable building materials have only a limited impact on construction costs

Choosing sustainable building materials, which are often still slightly more expensive than conventional alternatives, has only a limited impact on the cost of constructing a home. This is because around half of the construction cost of a house is made up of labour costs. On top of that, a significant proportion of the material costs of building a home consists of kitchen, plumbing, finishing and installation costs. And those costs are the same for sustainably built and conventionally built homes. Consequently, decisions such as opting for a sustainable insulation material have only a minor impact on the construction cost as a whole – the overall construction cost – as Figure 3 later in this chapter also shows.

Nevertheless, many builders do not opt for sustainable versions of products such as insulation materials (Natuur en Milieu, 2025). The negligible price difference does not appear to be persuasive. A striking example, discussed at a meeting organised as part of this advisory process, concerns a manufacturer of a sustainable concrete variant that halves carbon emissions. The producer markets this product at an additional cost of 3% over conventional concrete. Whereas the market price for concrete is around €100 per 1,000 kg, this concrete variant therefore costs only €3 per tonne of concrete more than its conventional counterpart. The price difference is almost non-existent. In practice, however, the manufacturer claims that sales of this concrete variant are very low. Even a small price difference is apparently too much for many parties, taking into account that the construction sector is generally fairly conservative, partly due to strict safety standards and high failure costs.[38]

It is therefore important that sustainable and conventional building materials continue to converge in terms of price levels. Many sustainable building materials are currently still produced on a relatively small scale. As production scales up, costs can be expected to fall. And with conventional building materials such as steel and concrete set to rise in price as a result of EU regulations, we foresee that building material prices will eventually no longer have an impact on the cost of sustainable construction.

Moreover, both conventional and sustainable building materials have seen steady price increases over the past decades. Prices have risen sharply since 2020 (CBS, 2025). This is true not only for steel, concrete and brick, which have substantially increased in price due to the energy crisis

38 See also Chapter 5, Section 5.5.

(ABN AMRO, 2023), but also for wood thanks to growing demand. However, the slowdown in construction has recently led to some reduction in prices across the board.[39]

4.2 The pace of building homes with sustainable materials

There is a perception among many policymakers and other stakeholders that sustainable construction also cannot compete with conventional construction when it comes to the speed at which homes can be built. The assumption that building with sustainable materials takes longer may be linked to the government's sense of urgency in attempting to build large numbers of new homes at a rapid pace, coupled with the fear that every additional requirement imposed on housing construction will lead to delays.

These fears appear to be justified to some extent. Switching to using more sustainable materials and learning new practices will take extra time at the design and construction stage. But practice shows that once this step has been taken, the construction process is not necessarily longer and can even be shorter. This is certainly the case for prefabricated construction using sustainable materials. For example, producing housing components to a common design and assembling them on site is generally considerably faster than conventional construction. This is especially true for timber construction. Wood is lighter, easier to transport, easier and less risky to handle and does not require drying time. Assembling a prefabricated home on an electrified construction site can be very quick, sometimes taking just a few days, and has the advantage of zero nitrogen emissions, which may also speed up the process. It is worth noting that prefabricated construction can also be used in combination with precast concrete construction.

39 See https://www.houtwereld.nl/partnerbericht/prijzen-voor-hout-en-bouwmaterialen-dalen-voor-het-eerst-in-tien-jaar/

4.3 Influence of area development processes and land prices

Given the existing perception that sustainable construction takes longer and costs more, it is important to have a clear picture of the factors that determine how long it takes to complete a home and a precise breakdown of the completion costs.

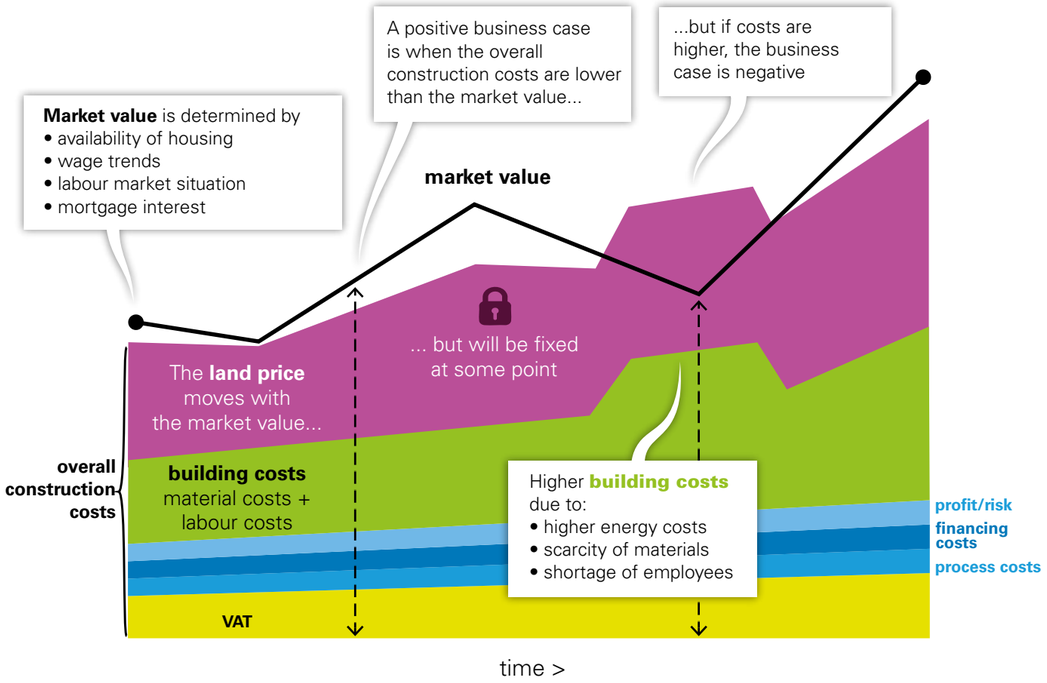
The time it takes to build a home is often only a relatively small part of the entire process of completing a home. The preceding *area development process* has a much larger impact on the completion time. The same applies to housing construction costs, which only make up a limited part of the total completion costs. Various other cost items have a bigger impact. We explain below.

Factors that determine the completion time of a home

There are extremely few sites in the Netherlands where housing can be built without any preparation. Particularly if the ambition is to build large numbers of homes, the actual construction phase is preceded by an extensive area development process. During this process, agreements are reached on numbers and types of homes, infrastructure and facilities to be built and the corresponding cost allocation between the landowners

involved and the municipality. It is a complex process that takes a long time – usually several years. Whereas it takes less than a year on average to construct the homes themselves, with some prefabricated homes being built within a week. The fact that a sustainable home can often be built slightly faster than a conventional one therefore has very limited impact on the duration of the entire completion process. Intervention would need to focus on the front end of the process to achieve a serious increase in speed.

Figuur 3: Development of overall construction costs in relation to the market value of a home



Factors that determine the cost of building a home

Similarly, material and labour costs make up only a relatively small proportion of the total cost of building a home. This total cost is determined by factors such as profit and risk premiums, process costs, financing costs and a contribution to the cost of preparing the site for building. All the costs are also subject to 21% VAT. On top of this there is the land price, which is also subject to VAT (see Figure 3).

As can be seen from Figure 3, the share of any additional costs of sustainable construction compared to conventional construction is often relatively small compared to the share of the other costs just mentioned, such as VAT and land price. Recent research (IBO, 2024) shows that land value as a share of house value (the 'land ratio') can exceed 50% in the Netherlands. The land ratio varies widely, however, and is significantly lower for a housing association home (around 20%).[40] For an owner-occupied home in the high-end segment bought with no additional costs payable by the purchaser, the land ratio can even exceed 60% of the house value. In such cases, the 'residual' land value is calculated by subtracting the construction costs from the market value of the property (Stadkwadraat et al., 2023). The land value therefore often moves with the development of the housing market. If house prices rise, the land value rises along with them.[41]

40 For housing association homes, the land ratio is determined normatively based on policy documents on land prices from municipalities.

41 If costs such as those of materials and wages increase faster than the market prices of homes, the residual land value can still be lower.

As a result, developers' business cases and thus the feasibility of housing development depend to a large extent on land value appreciation (see box).

High land value may be a barrier to housing development
Land traders have a long tradition of strategic land acquisitions, sometimes holding land in their portfolio for decades in the hope that the land will be designated to be used for housing construction. After all, such a change of use leads to a substantial increase in land value. The private party in question can then make a nice profit. However, these jumps in value due to change of use can sometimes impede the area development process (IBO, 2024). If land has been traded several times before a party takes possession of it with the intention to build, there may have been multiple gains in the interim. The purchased land has then become so expensive that there is often insufficient money available in the area development process to prepare the site for building and to construct infrastructure and facilities. This puts pressure on both the business cases of property developers involved and the municipality's management of the site.

Factors that determine the market value of a home
The market value of a home is largely determined by what prospective buyers are willing to pay for an owner-occupied home. It does not matter whether the home is a new or existing property. What people are willing to pay is determined by cyclical factors such as wage trends, the situation in the labour market, the ratio of supply to demand and current mortgage interest rates (Rabobank, 2025).

The development of market value is therefore largely independent of the construction cost and land price of a home. If construction costs remain the same, the land price moves with the market value. Any additional costs associated with building with sustainable materials therefore do not affect the market value of a home, but merely result in a lower land price. However, a commissioning party's or developer's business case can go into negative equity during the process from design to implementation due to factors such as falling house prices or rising construction costs. This can place pressure on area development and housing construction in the short or long term (Stauttener, 2024).

For rented housing in the affordable segment, rents are regulated. Different conditions therefore apply to the construction of new rented housing when it comes to absorbing any additional costs of sustainable materials. Housing associations rely heavily on the availability of affordable land for their production of new social and mid-market rented housing. This land is often not available.[42] According to the Housing Associations Authority, the ability to build affordable rented housing is dependent on housing associations reaching early agreements with municipalities and commercial developers on land holdings and the programming of desired new construction, based on realistic planning (Autoriteit woningcorporaties, 2025).

42 This is because municipalities no longer pursue an active land-use policy and market operators do not take into account lower land prices for association housing in their land acquisitions.

4.4 Conclusion: affordable, fast and sustainable construction is possible

The perception that sustainable construction costs more and takes longer than conventional construction is inaccurate. Firstly, the differences in construction costs and pace of construction are lower than expected in practice. Secondly, the cost and speed of housing construction appear to be determined largely by other factors. New homes may be slightly more expensive in certain situations due to the use of sustainable materials, but the price difference will become smaller or even non-existent over time. In addition, the pace of housing construction is determined not so much by the materials used, but mainly by the length of area development and planning processes.

In this context, the most notable finding from our analysis is that certain sustainable forms of low and medium-rise buildings can already be constructed faster and at a lower cost than their conventionally built counterparts. This is especially true of prefabricated timber housing. By contrast, high-rise timber buildings are still slightly, or in some cases a lot, more expensive.[43] But these are almost all first-of-a-kind buildings, the additional cost of which we expect to decrease with growing demand.

The cost and pace of sustainable construction is therefore not an obstacle to the transition to the use of alternative building materials, which is so important from a climate perspective. Yet, as we described in Chapter 3, the vast majority of parties in the construction industry are not yet willing to make this switch. The required scaling-up of sustainable building projects is slow to materialise. In Chapter 5, we discuss the barriers parties in the construction chain face in making the transition.

43 Woonstad Rotterdam's Valckensteyn apartment building is a case in point. This is a 12-storey residential building in the mid-market rented segment with a cross-laminated timber supporting structure.

5 BARRIERS TO IMPROVING SUSTAINABILITY IN HOUSING CONSTRUCTION

Although parties in the construction chain realise that a transition to sustainable material use is inevitable in the long run, many of them do not yet know how to make this switch on their own. In this chapter, we look at six factors that form a barrier to the transition: (1) the absence of ambitious government policy, (2) a lack of transparency in the standardisation and certification of building materials, (3) municipal environmental policies that are still geared to the use of conventional building materials, (4) the lack of appropriate financial incentives, (5) risk-avoiding behaviour of builders and contractors and (6) the vulnerability of production and market chains for sustainable building materials.

5.1 Absence of ambitious government policy

Lack of ambition in national laws and regulations

National legislation largely guides the choices parties in the construction chain make in terms of materials used. This means that, by introducing

targeted policies, central government can steer the use of materials in construction in the right direction. However, it has so far made little attempt to do so.

In recent years, central government has focused on the energy performance of homes, in other words energy consumption *in the occupation phase* of homes, by imposing statutory standards for near zero-energy buildings (NZEB). The aim was to improve the energy performance of homes, thereby reducing carbon emissions, through modifications such as installing better insulation and heat pumps. This has been largely successful. However, the government has failed to simultaneously tighten statutory standards for the environmental performance of buildings (EPB) *in the construction phase* of housing, in other words the standards that determine aspects such as the maximum material-related carbon emissions.

The majority of builders meet the current EPB standard of 0.8 without too much difficulty when building new housing. According to research, the EPB standard could feasibly be tightened to 0.5 for most types of housing without significantly changing the way they are built (EIB, 2023b). However, the government has resolved not to tighten the standard further. It fears that the standard could still be too high for some builders, potentially resulting in fewer homes becoming available. The lower standard means that there is no incentive for builders to make the materials they use in homes more sustainable. As a result, demand for sustainable building materials remains weak. The Minister of Housing and Spatial Planning has indicated that a decision will be taken during 2025 on whether the EPB standard will be further tightened (BZK, 2025).

Shortcomings in the EPB and NZEB standards

If we take a closer look at central government's implementation of the EPB standard, we can see that four aspects of the standard are insufficient to reduce carbon emissions in the construction phase:

- Firstly, the current EPB standard is not well suited to managing the climate impact of using non-sustainable building materials in the short term. The reason for this is that the government's current standard focuses on the average environmental impact over the entire lifespan of a home (to which a standard period of 75 years applies). This includes (a) both climate indicators and other environmental indicators and (b) all life stages of the home combined (construction, use, demolition and disposal). Greenhouse gas emissions due to the use of materials in the construction phase can thus be offset by favourable expectations regarding environmental impact in later phases. The important distinction between carbon reduction in the construction phase and later environmental performance is therefore blurred in the current standard. After all, carbon emissions avoided at an earlier stage are more important than emissions avoided at a later stage when it comes to climate change mitigation (Transitieteam Circulaire Bouweconomie, 2023).[44]
- Secondly, the current EPB standard is not easy to use in practice. The complex calculation methodology and the multitude of indicators make it difficult for many stakeholders in the construction chain to calculate the consequences of decisions on the use of materials and how they can

44 We refer to the Intergovernmental Panel on Climate Change (IPCC).

improve the environmental performance of the homes they build in a cost-effective way (Stichting W/E adviseurs, 2023b).

- Thirdly, the current EPB standard offers very little reward for the high-quality reuse of materials and raw materials. The current EPB standard also does not promote detachable construction.[45]
- Fourthly, the calculation method of the current EPB standard allows scope to include assumptions about future reuse of building materials beyond the theoretical end of life (75 years) of a home. In practice, this leads to far-reaching assumptions about long-term reuse. In this respect, the Netherlands deviates from EU rules,[46] which stipulate that scenarios in relation to materials and components after the lifespan of a home are for information purposes only and are not part of the calculation.

The NZEB standards applied by the Dutch government to the energy consumption of homes also lack ambition. For example, the NZEB standards offer no reward for low-installation building (involving fewer or lighter installations; see Chapter 2). In fact, by setting far-reaching requirements, they are more likely to discourage this method of construction.

45 A review of the EPB in 2023 found that bio-based building materials performed unexpectedly poorly. Reasons for this included the assessment of particulate matter released by drying timber and land use as a measure of soil quality degradation (Tiekstra, 2024). Adjustments were subsequently made to the calculation methodology that improved the performance of bio-based materials. However, such unexpected results give an indication of the complexity of the system and indicators used.

46 This specifically concerns the rules that apply under the EN-15804 standard.

Lack of enforcement

The lack of ambition in government policy on the use of sustainable materials is also reflected in the absence of proper enforcement. In particular, the EPB scores of residential properties are not properly reviewed in practice. This review should be carried out when the municipal building permit is issued and on completion of a home. However, many municipalities lack the necessary knowledge and capacity to perform such reviews.

The difference between the review of EPB scores and the more professional review of NZEB standards is significant. The new Quality Assurance (Building Sector) Act should change this, but there are no signs as yet that EPB standards are now being better enforced.

5.2 Lack of transparency in standardisation and certification of building materials

The existing standards and certificates that apply to building materials are essentially still based on the properties of conventional materials. New, sustainable materials must therefore meet requirements devised for conventional materials. As a result, sustainable building materials are subject to an unfair assessment, making them harder to market than their conventional counterparts. This situation is preventing a large-scale transition to the use of sustainable materials. We explain below.

Inadequate and slow standardisation and certification of new building materials

The standardisation and certification of building materials has for many years been carried out by special standardisation and certification committees. Large, established materials manufacturers and industry organisations have traditionally dominated these committees. These are well-organised parties with the necessary capacity to serve on such committees. However, they often have limited knowledge of new, sustainable building materials. They also have a commercial conflict of interests. As a result, the composition of the committees is often one-sided, with little scope for input from independent experts or new manufacturers.

In practice, the imbalance in standards and certification committees between established and new manufacturers delays the admission of sustainable building materials to the market. The fact that conventional construction is taken as a starting point means that standards and review systems are designed in line with the properties of conventional materials. One example of standards that are a barrier to sustainable construction is the temperature requirements under the Structures (Living Environment) Decree (Bbl) mentioned in Chapter 2, which make low-installation building difficult (see box).

The standards that apply to homes are based on installations that are too heavy

The statutory energy standards that apply to homes do not take into account the option of building a home with fewer or lighter technical installations. When using sustainable building materials, however, installing heating installation in every single room is not always necessary and leads to unnecessary costs and avoidable carbon emissions (Vereniging Circulair Friesland, 2024). Such standards need to be reassessed in light of the shift towards the use of sustainable materials. This is not yet happening.

In some cases, the existing standard-setting procedure for building materials results in sustainable materials being excluded from the market altogether. A recent example is the tightening of fire safety standards for solid timber construction, which came about under the coordination of the NEN (see box).

Are the fire safety standards for solid timber construction unnecessarily stringent?

The recently drafted new fire safety requirements for solid timber construction are the source of much debate. The rise in prices caused by the requirements, which would need to apply to timber buildings of seven or more storeys, would price solid timber construction immediately out of the market. According to a coalition of timber construction firms,

building code experts and the Association of Fire Safety Advisers, the authors of the tightened fire safety standards relied on unsound source material that fails to take into account the material properties of solid timber (Cobouw, 2025).

The case surrounding the unsound standards for timber construction points to a more general issue: the need to align existing housing construction standards and procedures with the use of sustainable building materials. New standards are required that take into account the product features of new building materials so that they can be used to their full potential.

Lack of transparency on the environmental impact benefits of sustainable materials

Since 2013, Stichting NMD has stored up-to-date information on the environmental performance of building products in its Dutch Environmental Database. The EPB standard for the environmental performance of buildings discussed above is guiding for the scores. As we have explained, however, this standard is unambitious. It is difficult to properly identify the environmental impact benefits of sustainable building materials using this type of standard. Research by Wageningen University confirms this: the Dutch Environmental Database lacks a public, transparent calculation tool for comparing the environmental impact of bio-based versus conventional building products (WUR, 2024).

In terms of transparency, the Dutch Environmental Database differs from the systems used in countries such as Germany, where all information on building products is freely accessible and interested parties can download the relevant database in full to make their own comparisons. The Dutch Environmental Database can only be accessed by licence holders for an annual fee. The 'viewer' recently launched by Stichting NMD is a step in the right direction, but does not yet provide the transparency needed. As also advocated by the STOER Advisory Group (2025), the database and associated calculation methods should be accessible to all.

To offer complete transparency on the environmental performance of building products, it is important to have access to the *life cycle assessments* for these products. It is in these assessments that the environmental impact benefits of bio-based building products in particular are hidden. However, the life cycle assessments of sustainable building materials are not transparent to all due to the poor accessibility of the database. Another effect of this is that many building products are sold that give the outward appearance, based on manufacturer information, of being sustainable but are not necessarily sustainable in practice (WUR, 2024). Plus, drawing up a life cycle assessment is expensive. This situation is a barrier to the large-scale use of sustainable building materials.[47] The same applies to building materials that are produced in other European countries and have already been tried and tested there, such as timber construction components from Germany and Austria. Product certifications from these

47 The National Approach to Bio-based Building provides for reimbursement of the costs of drawing up a life cycle assessment for new Dutch bio-based products.

countries are not valid in the Netherlands and must first be made suitable to be included in the Dutch Environmental Database dataset by carrying out additional research and incurring associated costs.[48]

5.3 Municipal environmental and planning policy and land-use policy is based on conventional building materials

There are also numerous barriers to building with new materials at municipal level. For example, municipal environmental policies are often still based on conventional building materials and many physical environment plans use building plot dimensions and building heights that are not tailored to the thicker walls and greater storey heights associated with the use of bio-based insulation materials and timber construction. Plot regulations are also not always in line with the possibilities of timber construction. Furthermore, municipal visual quality plans often prescribe the use of non-durable materials such as brick.

When determining land prices, municipalities also still frequently work with construction costs calculated on the basis of conventional building materials. This often places sustainable builders at a disadvantage, particularly in the case of high-rise projects, where the real costs of using timber and other sustainability strategies can be significantly higher than in a conventional business case.[49] What happens is that many municipalities calculate the value of land on which homes will be built by taking the market value of a home and subtracting the construction costs (Stec Group, 2020). This is the 'residual land valuation' discussed above. The land value therefore fluctuates with the house value. Where the construction costs of sustainable homes are higher than those of conventionally built homes, this means that municipalities are faced with slightly lower land prices.[50] However, this is not usually the case at present. Municipal departments often prioritise other issues over building with sustainable materials. This will only change if central government sets stricter standards.

5.4 Lack of appropriate financial incentives

Setting the right financial conditions can promote the use of sustainable materials in housing construction. However, financial incentives must be designed to steer construction companies in the right direction. That is not currently the case. We give a number of examples below.

Mortgage benefit for sustainably built homes hampered by tax rules

To increase demand for sustainable homes, some banks have developed mortgages in recent years that offer interest rate discounts on the purchase of homes built using sustainable materials. The discount was paid from a green fund, which provided an attractive option for private individuals to invest tax-free. In the meantime, however, the House of Representatives resolved to limit the tax exemption for green funds from 1 January 2025

48 It should be noted that this situation could potentially improve, as the European Construction Products Regulation is set to harmonise product data from 2030.
49 See Chapter 4.
50 It also means that a landowner who already owned the land before the start of construction should expect a slightly lower average return on the land.

and eliminate it completely from 2027 (Tweede Kamer, 2024). This move is expected to lead to a sharp drop in the capital invested in green funds, which will reduce the number of sustainable construction projects that can be financed (RVO, 2024).

Material prices do not take into account costs to society
As we explained in Chapter 4, sustainable building materials are often still slightly more expensive than conventional building materials. In this context, we already discussed the example of more sustainable concrete, which costs around 3% more than conventional concrete. There is little to no demand for this concrete. This shows that even a small additional cost is a barrier for construction companies, which are often highly cost-driven and risk averse. The underlying problem here is that the social costs of using unsustainable building materials, including carbon emissions during their production phase, are not factored into the price of the material.

Material prices also do not take into account benefits to society
Conversely, the fact that the social benefits of building with sustainable materials are not factored into a discount on the price of these materials acts as a financial disincentive.

The social benefits of sustainable materials could feasibly be reflected in the costs of a construction project by other means, for example using a *carbon credit system*. Several parties are experimenting with accounting methods to factor carbon captured in building materials into the business case in this way.[51] The policy context in relation to carbon capture, the accompanying market and the calculation and reporting protocols are rapidly evolving at present. A recent Whitepaper provides a good overview of the current situation (Copper8 & Climate Cleanup, 2025).

The potential of carbon credits as a tool is widely recognised. The Ministry of Climate Policy and Green Growth's *Carbon Removal Roadmap* (KGG, 2025) provides a framework for this, while the Ministry of Agriculture, Fisheries, Food Security and Nature funded the successful 'Fibre Plant Incentive' pilot project, which focused on providing Dutch construction stored carbon credits.[52] The Netherlands Scientific Climate Council also recognises the potential of 'temporary' carbon capture in building materials, but on the condition that this is accompanied by targeted ancillary policy to balance the carbon accounts (WKR, 2024). On the initiative of parties from the construction chain, a protocol has been developed that provides a reliable framework for quantifying and certifying the net carbon capture benefit of construction projects (Climate Cleanup Foundation, 2024). The carbon credit market is key to improving the business case for farmers switching to fibre plant production as a feedstock for bio-based building materials.

The translation of other societal benefits of building with sustainable materials (such as a healthy working and living environment and energy savings) into financial instruments is currently a long way off.

51 For example, Ballast Nedam has issued carbon credits based on its Natuurhuis housing concept.
52 See https://www.nationaalgroenfonds.nl/nieuws/pilot-stimulering-vezelteelten-volledig-budget-benut/

The total cost of ownership approach is still rarely adopted

Business cases in housing construction often relate to the short term, ending on the completion of a property. This does not make sense, given the long lifespan of a home.

However, there are exceptions: parties in the construction chain that are looking for ways to factor long-term returns into their business cases and into their choice of building materials.

- One example is *housing investors*, who rent out houses for around 20 years before selling them. Interviews we conducted show that they rate the residual value of a home built with sustainable materials higher in their accounts than a conventional home.
- Some *housing associations* also take the future value of homes into account in their decision-making. Alongside maintenance and renovation costs, they also look at the potentially positive impact of sustainable building materials on the health of occupants and the living environment, as well as possible value retention of materials and building components at the end of a home's life. These parties are not just interested in short-term financial returns, but also long-term ESG returns. For now, however, this kind of total cost of ownership perspective in housing projects is the exception rather than the rule.

5.5 Limited scope for change in the construction chain

The construction chain consists of a wide variety of parties, ranging from commissioning parties and builders to designers and municipalities. Each party forms a link in the construction chain and has its own role within it. A successful transition to using sustainable materials is therefore dependent on each party learning how to deal with these materials within their role. Not every party has the same capacity to make this transition. There are major differences, particularly among construction companies. For instance, there are dozens of large construction firms that have a lot of scope for innovation, while thousands of small companies can only afford to take limited action. In between is a group of several hundred medium-sized operators. This wide variety of players complicates the chain-wide innovation needed to make the use of materials more sustainable. We explain this below.

Regulation leads to risk aversion

Building regulations in the Netherlands are very detailed and extensive. The rules are designed to ensure high quality construction and safety. Structures must be able to last a long time and the risk of fire or collapse must be minimised. After all, the costs of failure are high, both financially and in terms of reputational damage. The main risk-bearers are the builders, contractors and subcontractors, which explains why many builders are risk averse.

Builders' tendency to avoid risk is understandable, but it often has a negative impact on the use of sustainable building materials. Commissioning parties that want to build with sustainable materials often struggle to find contractors who are willing to execute their plans. In some cases, commissioning parties abandon their sustainable ambitions because contractors persuade them to rethink.

Limited cooperation and development of new skills within the construction chain

Parties in the construction chain only work together to a limited extent. They mostly fulfil their roles separately, in relative isolation from other parties in the chain. The lack of cooperation is a barrier to the transition to more sustainable use of materials, which – as we showed in Chapter 3 – requires the commitment of various parties, particularly in the design phase. This is because these materials often have different properties to conventional building materials and thus require different working methods and more closely coordinated activities. Experimentation, learning, innovation and knowledge sharing are required to establish the necessary new routines (CRa, 2025b). Timber frame construction and processing reclaimed materials require different skills and activities than the installation of concrete floor panels or bricklaying.[53]

Particularly in the early stages of sustainable construction, more intensive cooperation between the parties in the construction chain is needed in order to get used to the new routines. In many areas, a different way of working to the decades-long usual approach needs to become the standard. Collaboration and mutual learning are not currently the norm in the construction industry and ability to innovate is limited. This must change if the transition to using more sustainable materials is to be successful.

Of course, it is also important that training for jobs in the construction sector focuses on new materials and reusing existing materials. In senior secondary vocational education, we still see little development in this area. The focus of vocational and professional training is still very much on conventional building materials.[54] The Dutch National Knowledge Centre for Bio-based Construction and Building Balance are working together to develop a 'bio-based construction' learning pathway aimed at both senior secondary vocational education and higher professional education. A first optional component with the title 'Bio-based construction in the built environment' will be available for senior secondary vocational education from January 2025.[55]

Smaller construction firms have access to limited financial and human resources

An additional problem is that smaller construction firms often have limited financial and human resources to acquire knowledge about new construction materials and to master the associated working methods. This is inhibiting the necessary transition to more sustainable, innovative materials.

Digitalisation as a prerequisite for using sustainable materials

Digitalisation, data sharing and 3D design are also key aspects of the transition to sustainable construction. They are important for design,

53 Several directors of construction companies mention cooperation in the chain as an item to be addressed in this regard. Source: Cobouw podcast 'Bouwers van morgen' (Builders of tomorrow), episodes 2 and 3 (Cobouw, 2024a; 2024b).

54 See https://www.mbostart.nl/mbobouw/

55 See https://www.smartcirculair.com/nieuw-in-2025-keuzedeel-biobased-bouwen-in-de-gebouwde-omgeving/

construction and management processes of sustainable homes, as well as for planning procedures and for reusing materials and components at the end of a home's lifespan. The necessary digital infrastructure is not yet in place. The Housing Construction Scaling-up and Innovation Programme (VRO, 2024) provides a useful framework to take this development forward. This programme focuses on improving the planning and construction process.

Digitalisation has also been a focus within area development for some time. Digital applications are essential to make planning procedures faster and more transparent. The delivery of the Digital Built Environment System in June 2024 and the Administrative Agreement on the Digital Built Environment 2027 are important steps in the right direction. The industry needs to start using the system now to reap the benefits of large-scale digital collaboration and truly accelerate the planning process for construction projects.

Digitalisation of the construction process is also important for the further industrialisation of construction. Prefabricated housing construction requires digitalisation of the procurement process for the custom manufacture of building materials and components. For some of the examples of sustainable housing construction we discuss in Part 2 of the Dutch version of this report, timber building components have come precisely tailored to requirements from factories in Austria and have been fitted on site to the millimetre.

5.6 Sustainable material production chains are still vulnerable

In the previous chapters, we pointed out that sustainable building materials often still cost slightly more than conventional materials. The main reason for this is that many of these products are still at the beginning of their development in terms of scale of use and innovation process. This applies to bio-based products and the associated market chains, but also to sustainable versions of conventional building materials. Production facilities are often still small and sales channels, marketing and information provision often still limited. In addition to the barriers surrounding certification, standardisation and regulation described earlier, these newcomers have to compete with a building materials market where large established manufacturers have a turnover of billions of euros.

In order to mature into a fully fledged producer of sustainable building materials after initial market entry, start-ups need to overcome considerable hurdles. First of all, they need to raise seed capital to build market chains and sales. Regular lending is not set up to support new markets. And government investment programmes focus mainly on high-tech innovations on a macro scale. The generally low-tech innovations in the building materials world fall outside this scope.

Once in operation, producers of new sustainable building materials are vulnerable to changes in raw material suppliers and customers for a prolonged period. At the same time, they need to invest in scaling up, innovating and increasing efficiency. Threats at this stage are (a) lack of demand for sustainable building materials due to factors such as shortfalls in regulations and (b) the counterforce of established interests in the

building materials industry. In short, market conditions are far from optimal for start-up producers of sustainable building materials. The right conditions and requirements for new production chains and an associated building culture to develop are lacking.

5.7 Conclusion: much remains to be done by both the government and the construction industry

The use of sustainable materials in housing construction is currently not being scaled up sufficiently because the government is (a) placing too little focus on carbon reduction in the use of materials in housing construction and (b) neglecting innovative developments in the construction chain within its innovation and sector policy, allowing (c) established interests of conventional materials producers to continue to dominate the market. Existing government regulations and financial arrangements do not yet work in favour of the transition to building with sustainable materials.

Both national government and the municipalities will need to introduce more targeted measures to encourage parties in the construction chain to take the right steps. And reviewing bodies will need to learn how to assess products such as bio-based or recycled building materials. At the same time, the necessary transition to building with sustainable materials requires greater cooperation between parties in the construction chain in learning new skills.

In short, there is still work to be done. In Chapter 6, we make a number of recommendations to central government, decentralised authorities and parties in the construction chain to take concrete measures.

6 CONCLUSIONS AND RECOMMENDATIONS

We feel positive about the opportunities before us to take the transition to the use of sustainable materials to the next level and ensure a robust, future-proof construction chain. There is still work to be done to make the transition to sustainable construction a success. Given the Dutch and European climate targets and the contribution that housing construction needs to make to achieving them, we must seize the opportunity presented by the acceleration of the current housing construction challenge to encourage the switch to sustainable materials. Thus avoiding the risk of a construction crisis in a few years' time.
We set out our conclusions on the conditions for success in Section 6.1. In Section 6.2, we then go on to formulate our recommendations to central government, decentralised authorities and the parties in the construction chain.

6.1 Conclusions: conditions for success

6.1.1 Targeted promotion of the use of sustainable building materials is crucial

We are optimistic about the potential for a transition to the use of sustainable materials in housing construction. However, we note in this

advisory report that this will not happen by itself. While a motivated vanguard of construction firms demonstrates every day that homes can indeed be built with sustainable materials, the vast majority of parties in the construction chain are waiting to see how things will pan out. They are awaiting clear guidance from the government. The longer that guidance is not forthcoming, the harder it becomes to achieve the transition in time.

It is important to switch to using sustainable building materials in the short term for several reasons. Firstly, the transition represents an important *opportunity*. The switch to sustainable materials goes hand in hand with a switch to prefabricated housing construction, resulting in higher labour productivity and creating attractive jobs in the construction sector. The use of sustainable building materials also provides additional benefits, such as a clean and healthy living environment, prospects for agriculture and positive effects on the health of those who build the houses or live in them.

The transition to the use of sustainable materials is also *necessary* because the use of materials in construction has a significant climate impact. This impact must be reduced if the Netherlands is to achieve its goal of climate neutrality by 2050. From 2030 onwards, the EU plans to tighten controls on carbon emissions from homes. The financial sector is also increasingly making the financing of construction projects subject to the requirement that the completed homes perform well in terms of carbon emissions. Investors no longer want to put capital into homes that do not meet climate requirements.

Overall, if we want to avoid a housing crisis in the near future, a transition to the use of sustainable building materials is essential in the short term. This means that demand for housing built with sustainable materials will need to be stimulated through targeted government policy. For a further explanation of the specific measures required, see our conclusions below.

6.1.2 Regulate: obligation to focus on the climate impact of homes

Commissioning parties and other parties in the construction chain currently rarely opt to use sustainable materials to build houses. To get the parties moving and stimulate demand for sustainable materials, central government needs a combination of *standards* (see below) and *pricing mechanisms* (see Section 6.1.3).[56]

Regulation is important in construction. As construction projects are long term, often taking eight to ten years, parties in the construction chain need a consistent and predictable government policy. Tightening building standards from time to time is part of this process. The government has failed to do this in recent years. For example, a previously proposed tightening of the standards for the environmental performance of buildings (EPB) did not go ahead.

This is about to change thanks to the updated EU Energy Performance of Buildings Directive, the EPBD IV. From 2030, EU Member States will be required to start managing the climate impact of homes throughout their life

56 The importance of standards and pricing mechanisms in this context is emphasised by ABDTOPConsult (2023) and Wilbrink & Butler (2024), among others.

cycle in the form of a roadmap. This approach relates to carbon emissions during both the construction and occupation of homes. EU Member States must publish their roadmap by 1 January 2027. The roadmap should set limits and targets for carbon emissions per square metre of usable floor area, which must be periodically tightened, with the ultimate goal of a fully climate-neutral construction chain by 2050. The EU will oversee that Member States are sufficiently ambitious in implementing the roadmap.

The roadmap to be drawn up by the Dutch central government should guide parties in the construction chain through a step-by-step transition to the use of sustainable building materials. At the moment, it is not yet clear what the Dutch roadmap will look like. This clarity is needed in the near future to give parties in the construction chain sufficient time to prepare themselves for the situation from 2030 onwards.

The 2030 standard will need to be sufficiently ambitious to meet the goal of climate neutrality by 2050. If the government is not ambitious enough when setting limits and targets for the first period on the roadmap, it risks the need for a steep phase-out process further down the road, which many construction companies will be unable to able to meet by that time. This could result in a construction crisis. At the same time, the government must avoid making the roadmap so ambitious from the outset that a substantial proportion of constructions companies are not able to meet it by 2030. Given the Economic Institute for the Construction Industry's estimate that an EPB standard of 0.5 is possible for most types of housing (EIB, 2023b), a carbon limit that corresponds to that standard seems feasible for 2030.

Furthermore, the problem that the current government control on the climate impact of housing unintentionally encourages construction companies to build bigger needs to be addressed when formulating the 2030 standard. The indicator the government uses to measure the carbon emissions of homes is the issue here, as it looks at emissions per square metre of usable floor area. For builders, this means they can reduce emissions per square metre by building bigger. However, this actually increases overall emissions.

It should be noted that the updated EU directive allows for differentiation between building types when setting standards. This is relevant because, due to the need for a stronger structure, high-rise buildings lead to higher carbon emissions per square metre than low-rise and medium-rise buildings. It therefore makes sense to use different limit and target values for high-rise buildings. This is important for housing associations, which face a significant building challenge in inner-city areas, where limited space makes higher building inevitable.

6.1.3 Pricing mechanisms: national levy to further stimulate the construction chain

Central government could conceivably set broad limits and targets in the initial phase of the roadmap just discussed. This would ensure that the entire construction chain can continue to build. The risk, however, is that a steep phase-out process will be needed further down the road, which some of the construction chain will experience as a construction freeze. A possible solution in addition to the roadmap is to place a price tag

on the carbon emissions associated with building materials in housing construction. This could be exactly the additional impetus the construction chain needs, and could consist of a levy that increases over time, linked to the difference between the mandatory limit and the more ambitious target from the previously mentioned roadmap. The levy could be borne by the party submitting a permit under the Environment and Planning Act for a construction project, or by the commissioning party (see Figure 4).

Figure 4: CO_2 reduction pathway for a combined roadmap and levy approach

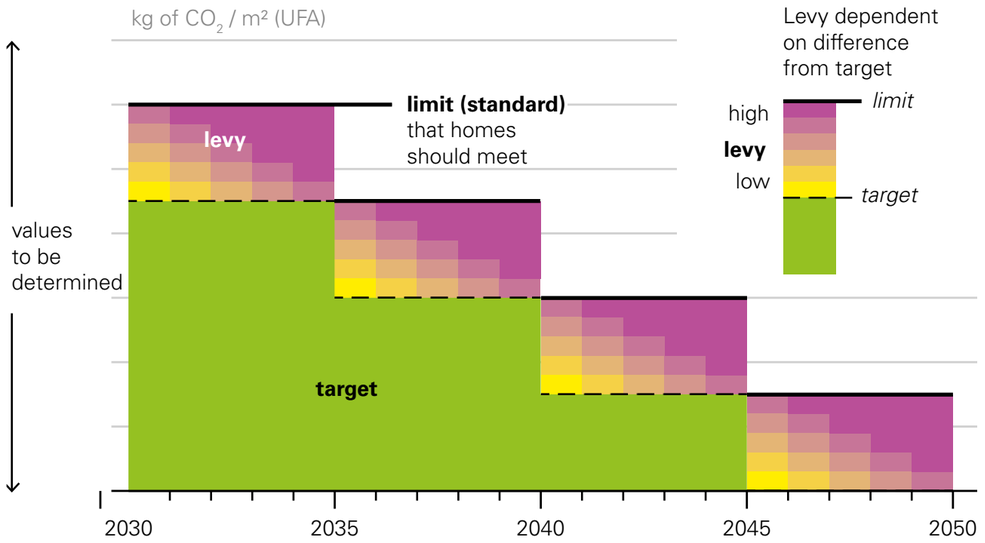


Figure 4 gives an indication of what the combination of increasingly ambitious limits and targets and a steadily increasing levy could look like. The limit and target values provide long-term clarity. At the same time, the levy helps to (a) ensure a level playing field in the long term for improving sustainability and (b) create sufficient demand in the short term for sustainable building materials.

The levy referred to here can be an effective tool for several reasons, without major drawbacks:

- The levy provides a financial incentive to build with sustainable materials.
- Unlike ambitious limits, the levy does not lead to a construction freeze. Housing construction can still go ahead, but in cases where targets are not met, at a slightly higher cost.
- For a building project that fails to meet the targets, the levy results in slightly higher construction costs and therefore a lower residual land value. As such, the levy mainly comes at the expense of landowners' and developers' land profit.
- At the same time, the levy will have a dampening effect on land prices, which will drop immediately the moment the levy is announced. Prospective buyers will translate the likelihood of higher construction costs into the maximum price they are willing to pay for building land.
- The levy will also not have a negative impact on housing affordability because the market price of housing is primarily determined by what people are willing and able to pay.

- Provided the levy is announced promptly, it will offer the market timely and long-term clarity. Parties in the construction chain will then have sufficient time to prepare for it.
- Linking the levy to achievable limits and targets means that the vast majority of the construction chain will be able to build within the target values. In practice, the levy will then only be imposed to a limited extent.
- Once demand for sustainable housing grows as a result of the (announced) levy, the construction of this housing will become less expensive due to scale-up effects, automatically speeding up the transition to sustainable construction.

6.1.4 Removing significant barriers

The combination of instruments proposed here (limit and target values and a levy) will trigger demand for the use of sustainable materials in housing construction, providing the guidance we identified as lacking in Chapter 5. In addition, both instruments combined address the lack of effective financial incentives in the current government governance. This will enable parties in the construction chain to take an important step towards the necessary transition.

Nevertheless, the fact remains that many of the existing rules and market conditions are still geared towards conventional housing construction. As a result, parties in the construction chain encounter a number of barriers when using sustainable materials, as we discussed in Chapter 5: (1) standardisation and certification based on building with conventional materials, (2) municipal environmental and planning policy that is still geared towards conventional building methods, (3) a low willingness within the construction chain to use unfamiliar materials and techniques and (4) vulnerability of production chains of sustainable building materials. It is important to remove these barriers.

The above barriers, added to the incorrect but nevertheless dominant perception that sustainable construction involves high additional costs, are currently leading most parties in the construction chain to adopt a wait-and-see approach.

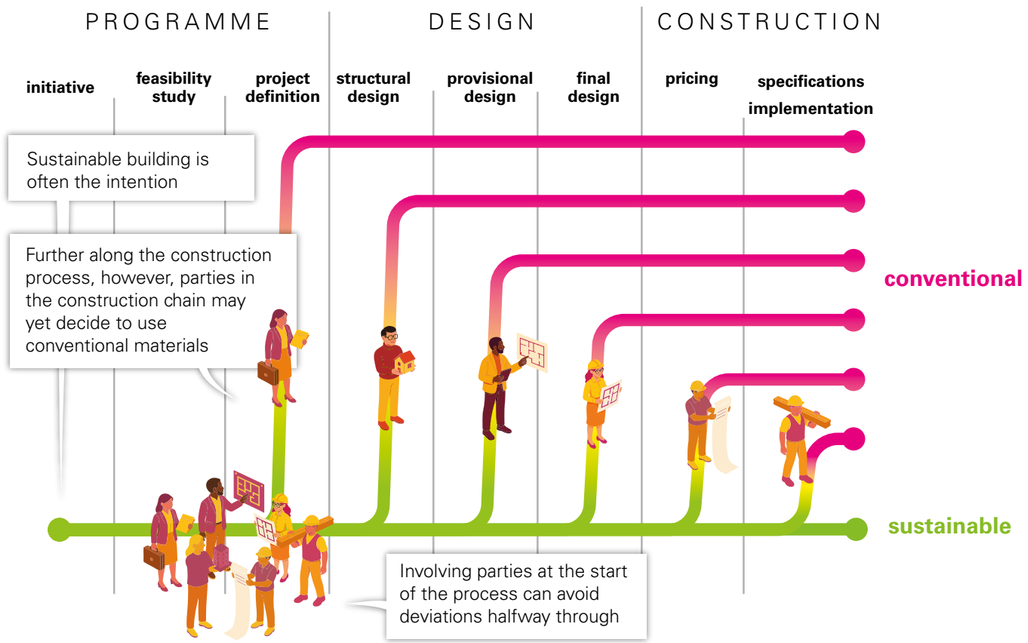
6.1.5 Collaboration and innovation are essential for success

The fact that frontrunners within the construction chain are already succeeding, in spite of the barriers just mentioned, in building homes with sustainable materials – and in some cases at competitive prices – says something about the intrinsic motivation of these parties. A key condition for success is that all stakeholders, from commissioning party to municipality, are willing to think in terms of possibilities and solutions. It is currently often the case that if one party in the sequence of decisions in the construction chain objects to construction with sustainable materials, the project does not go ahead in that form and those involved bounce back to the usual routines (see Figure 5).

In light of stagnating incidents of this kind, it is important to note that the transition to sustainable materials can also be a gradual process. Switching from concrete to timber construction is a fundamental transition, but switching from conventional concrete to a sustainable concrete variant

does not immediately require different construction skills or a modified house design.

Figuur 5: Decision moments in the construction chain that affect choice of material



Essential conditions for success when it comes to cooperation and innovation are:

- *Better utilisation of prefabricated construction* will contribute significantly to expanding construction with sustainable materials. Capacity for prefabricated housing construction, which generally performs significantly better in terms of sustainability, is both substantial and underutilised. Prefabricated low-rise and medium-rise buildings can in some cases already be built at competitive or even lower costs.
- *Price trends* are another crucial factor. We expect the difference in price between housing construction with sustainable and conventional materials to fall in the coming years. Sustainable materials will become cheaper as their production and use are scaled up. Reliable certification of carbon captured in building materials is also a potential contributing factor. At the same time, conventional building materials will become more expensive, partly due to the effect of the EU CO_2 emissions trading system (ETS).
- *Sufficient potential for learning in the construction industry* is also key to a successful transition. Parties will need to be able to deal with a wider range of building materials and building methods. In addition to concrete, steel and brick, increasing use will be made of bio-based materials and recycled components. Smaller buildings and low-installation building will also become more common. In addition, with a view to future reuse of materials, parties in the construction sector will need to learn to take detachable construction into consideration. This will require adjustments and innovation throughout the construction chain, including digitalisation. Senior secondary vocational and higher professional

education courses will need to be equipped to deal with new materials and sustainability strategies.

- *Innovation programmes and agreements* between commissioning parties and other parties in the construction chain can provide the scope to experiment needed in order to make progress in this area. However, measures will be required to prevent local agreements between authorities and construction firms from acquiring the status of municipal requirements that exceed the statutory minimum. The alternative is a potential hotchpotch of differing building regulations in the Netherlands.
- *Security of supply of building materials* is a precondition for sustainable construction. In this area, we see opportunities in recovering building components and raw materials through circular demolition and high-quality recycling. The further development and scaling-up of bio-based production chains is also key. This will require targeted innovation and industrial policies, and it is also important to further tighten the links between construction, agriculture and manufacturing, based on a common interest.
- Finally, more *attention should be paid to the future occupants* of sustainably built homes. The high pressure in the current housing market places prospective occupiers in a weak position to make their own demands. But not everyone will experience living in bio-based, small or low-installation housing in the same way. For example, the perception of living comfort can vary widely (Lente-akkoord 2.0, 2023). It is important to obtain greater clarity on this. A focus should also be placed on the health impact of building materials. We have heard quite some noises about the potentially positive impact of bio-based materials on the health of builders and occupants, but there is currently little hard evidence. A stronger focus on the impact of sustainable building materials can promote the transition to sustainable construction.

6.2 Recommendations: specific measures to take

In this section, we make a number of recommendations to central government, the decentralised authorities and parties in the construction chain to increase the use of sustainable materials in housing construction. Our recommendations include four categories of measures: (1) harmonising, (2) pricing mechanisms, (3) updating procedures and rules, and (4) collaborating and learning in the construction chain. Below, we explain the specific measures we recommend for each category.

Recommendation 1. Bring Dutch regulations in line with EU policy

We advise central government to provide parties in the construction chain with greater clarity on the regulations that will apply to the use of sustainable materials in the period 2030-2050. To this end, central government will need to bring Dutch regulations in line with the updated EU Energy Performance of Buildings Directive, EPBD IV. This means that, by 2027, it must draw up a national roadmap that sets progressively tighter limits and targets for carbon emissions from new homes, in both the construction phase (‘material-related emissions’) and in the occupation phase (‘use-related emissions’).

Specifically, we recommend that central government act as follows:

- When drafting the national roadmap, use the EPBD IV Directive as a benchmark and express the limits and targets for newly built homes in kg of CO_2 per square metre of usable floor area, as is done in France and Denmark. Use the carbon emission indicators from the current NZEB and EPB standards for this purpose.
- To start with (for the year 2030), set the limit that construction companies must remain below at a standard that is already easily achievable for the majority of parties in the construction chain, in other words a kg CO_2/m^2 (UFA) value equivalent to an EPB standard of 0.5. When setting targets, make use of initiatives such as The New Normal and the Paris-Proof methodology to see what is feasible for a substantial part of the market.
- The standards should distinguish between low and medium-rise buildings on the one hand, and high-rise buildings, which have a larger carbon footprint, on the other. Also provide an additional instrument that values building smaller, to remove the perverse incentive that encourages building bigger.
- In the calculations, do not include expectations as to the CO_2 performance of building materials at the end of the 50-year theoretical lifespan of a home assumed in the EPBD IV Directive.

Recommendation 2. Introduce a levy as an incentive for the more sustainable use of materials in housing construction

Demand from commissioning parties for sustainably built homes needs to increase in order to achieve a steady transition to building with sustainable materials. In our view, central government should help to stimulate this demand. We therefore recommend introducing a *levy on unsustainably or insufficiently sustainably built* homes by 2030 that will increase over time, to be paid by the party applying for the permit under the Environment and Planning Act (the landowner or developer).

The levy we envisage would need to apply to homes granted planning permission from 2030 that do not meet the targets set in the national roadmap. The threshold for the levy therefore follows from the roadmap. The amount of the levy must depend on the extent to which the environmental performance of a home (expressed in kg of CO_2 emissions per m^2 of usable floor area) deviates from the target, as visualised above in Figure 4.

We expect a levy of 2 to 4% of the sale value of a home to be enough to give landowners and developers sufficient financial incentive to commission homes that use sustainable materials. A more detailed assessment of the financial implications must be carried out to determine the exact amount of the levy needed to create a level playing field and increase demand for homes made of sustainable materials.

The levy should be laid down in the Structures (Living Environment) Decree.

Recommendation 3. Update procedures and regulations

A successful transition to the use of sustainable building materials requires changes to government building regulations. The ball is in the court of both central government and the municipalities.
Central government will need to take greater control of the Dutch Environmental Database and of standards and certification committees, to ensure that manufacturers of sustainable building materials and independent experts can also sit on these committees and participate in the assessment of building materials and their life cycle and in decision-making on the admission of these materials to the market.
In turn, municipalities will need to ensure that their environmental and planning policies, land policies and permitting processes do not hinder, but rather facilitate and encourage the use of sustainable building materials.

Our specific recommendations are:

- Central government: improve governance in relation to the standards and certification committees that influence the market approval and performance calculations of new building materials. Ensure that these bodies operate *more transparently*, with more input from sustainable material manufacturers and *independent* experts, so that sustainable building materials obtain full access to the market.
- Central government: in anticipation of European harmonisation of the life cycle assessment of building materials, make the Dutch market more accessible to sustainable building materials from abroad. To this end, make the certification of these materials suitable for inclusion in the Dutch Environmental Database.
- Central government: ensure that government regulations on housing construction promote smaller-scale building, low-installation building, the reuse of materials and components, and the use of bio-based building materials and sustainable versions of conventional building materials. With a view to future reuse, make detachable construction mandatory and work with parties in the construction chain to develop a system for quality guarantees and certification of recovered components.
- Municipalities: ensure that municipal environmental policy, urban planning and visual quality plans, as well as area development policy and land-use policy, facilitate and encourage housing construction using sustainable materials. Prevent the development of municipal requirements that are stricter than the limits mentioned in recommendation 1.
- Central government and municipalities: invest in the professional assessment of the carbon emissions of building designs and completed homes. To this end, train permit authorities to work with an assessment system (similar to the system for assessing NZEB standards). At the same time, invest in sufficient enforcement capacity.

Recommendation 4. Prepare the construction chain to build with sustainable materials

Central government will need to prepare the construction chain for the national roadmap for reducing carbon emissions from new homes, which will be drawn up in the coming period.
In turn, the construction chain will need to make efforts to ensure that all parties involved adopt the new (in some cases digital) skills and routines associated with the use of sustainable building materials.
To create the right conditions for the further transition to sustainable building, in compliance with the National Approach to Bio-based Building, it is also important to (a) increase the involvement of economic sectors that are related to making housing construction more sustainable, such as agriculture (as a supplier of bio-based raw materials), the processing industry (to process these raw materials into building materials) and the capital market (to finance these initiatives), and (b) increase knowledge about the wider impact of sustainable building.

Our specific recommendations are:

- Central government, property developers, housing associations, prefabricated construction firms and municipalities: create conditions for building sustainable prefabricated low and medium-rise housing. Reach agreements and include existing construction flows.
- Central government: ensure that there is scope for innovation and experimentation for scaling up the use of bio-based building materials. The Innovation and Scaling-up Housing Construction (2025-2030) programme, the City Deal on Future-proof Building and the National Approach to Bio-based Building already offer good incentives to this end.
- Parties in the construction chain: adopt sustainable building materials as a starting point in the design phase. The success of the transition to sustainable construction depends on greater coordination between property developers, municipalities, architects, structural engineers, builders and installers in the first instance.
- Parties in the construction chain: invest in digitalising processes, when it comes to both designing and producing homes and shortening procedures.
- Central government: make agreements with industry organisations to support SME construction companies so that workers can receive further training in sustainable building methods and materials and the possibilities of prefabricated construction. Agreements on this could form part of the Building Materials Agreement, which is scheduled for summer 2025.
- Central government and parties in the construction chain: provide support and qualification dossiers, or accreditation of senior secondary vocational and higher professional education curricula that focus on building with sustainable materials.
- Central government and sector organisations: strengthen links to other sectors that are related to making housing construction more sustainable (such as agriculture, the processing industry and the capital market) to establish a permanent and productive context for the further transition to sustainable construction.

- Central government: organise research into the wider impact of sustainable construction. What are the experiences of occupants of sustainable buildings? What advantages and disadvantages do they experience and what impact does this have on their living comfort? What impact does the use of sustainable materials in housing construction have on the health of the living environment, occupants and construction workers?

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APPENDICES

GLOSSARY

In this appendix, we briefly explain a number of construction-related terms used in this report. The explanations are partly based on the DGBC's *Sustainable Building Dictionary*.[57]

Adaptable construction

Adaptable construction, also known as 'adaptive construction', is a building method that takes into account the possible future need to use the building in a different way both in the building design and during the construction phase. For example, measures are taken that make it relatively easy to subdivide or extend a home.

NZEB

NZEB stands for nearly zero-energy buildings. The NZEB standards used by the Dutch government are the Dutch translation of the EU Energy Performance of Buildings Directive (EPBD). The standards relate to energy consumption in the occupation phase of buildings.

57 See https://www.dgbc.nl/woordenboek/

Structures (Living Environment) Decree

The Structures (Living Environment) Decree (Besluit bouwwerken leefomgeving, Bbl) contains rules to ensure the safety and durability of buildings, as well as the health of people working and living in them. The Bbl also contains rules for carrying out construction and demolition works.

Bio-based building materials

Bio-based building materials are made from natural, renewable raw materials. These are mostly materials made of wood or fibre plants. Flax, hemp, straw and elephant grass are fibre plants that are frequently used in bio-based building materials.

Construction chain

The construction chain consists of all parties involved in the construction process. This includes investors, developers, associations, municipalities, designers, structural engineers, installers, building material producers and builders.

Greenhouse gases

Greenhouse gas emissions are a major cause of climate change. Examples of greenhouse gases found in our atmosphere are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and ozone (O_3).

Gross floor area

The gross floor area (GFA) of a building reflects the number of square metres covered by a building, including walls, pillars and stairwells. See also *usable floor area*.

Carbon credits

Carbon credits – also known as CO_2 certificates – are tradable certificates that represent the reduction, avoidance or removal of one tonne of CO_2 equivalent. Carbon credits have a monetary value.

CO_2 emissions trading system/ETS

The EU CO_2 Emissions Trading System, often referred to by the abbreviation ETS, is a system the European Union introduced in 2005 to regulate the right of European companies to emit greenhouse gases such as CO_2. One emission allowance allows a company to emit one tonne of greenhouse gases. Emission allowances can be bought and sold. The number of available allowances is limited and declining, slowly but surely reducing companies' emission allocation.

Carbon reduction

Carbon reduction is the reduction of CO_2 emissions.

Corporate Sustainability Reporting Directive

The Corporate Sustainability Reporting Directive (CSRD) is an EU directive that requires large companies to report on their sustainability, social policy and governance using predefined criteria.

Energy Performance of Buildings Directive

The Energy Performance of Buildings Directive (EPBD) is an EU directive aimed at improving the energy performance of buildings.

Prefabricated construction

In prefabricated housing construction, also referred to as *industrial housing construction*, housing components or complete homes are produced to a common design in a production facility. After transport, the housing components or homes can be quickly assembled on the construction site.

Use-related emissions

Use-related emissions are the amounts of CO_2 released during the *occupation phase* of homes, for example from heating, cooling and ventilation.

Usable floor area

The usable floor area (UFA) of a building reflects the number of square metres covered by a building. Unlike when calculating the gross floor area (GFA), the UFA does not include walls, pillars and stairwells.

Low-installation building

Low-installation building means using fewer and/or lighter technical installations to heat, cool and ventilate a home.

Life cycle assessment

A life cycle assessment identifies the environmental impacts of a building product or building installation. This includes material and energy consumption, raw material extraction and recycling options.

Detachability

The detachability of a building is the extent to which building components and materials can be taken apart, making them eligible for reuse.

Material-related emissions

Material-related emissions are the amounts of CO_2 released during the construction phase of housing, in other words from the production and transport of building materials and from the use of these materials on site or in the housing factory.

Environmental performance of buildings

The environmental performance of buildings (EPB for short) indicates the environmental impact of the materials used in a building. Environmental performance calculations take into account CO_2 emissions, soil eutrophication and the release of substances that can have negative effects on human health.

Dutch Environmental Database

The Dutch Environmental Database is a database that has been used to store up-to-date information on the environmental performance of buildings and building products since 2013.

Residual land valuation

Residual land valuation is a method of determining the value of the land on which a home stands. The method involves calculating the difference between the expected market value of a home and the expected costs required to build that home.

Overall construction cost

The overall construction cost is the sum of all costs that need to be incurred in order to carry out a construction project. This includes both construction costs and land costs.

Sustainable Finance Disclosure Regulation

The Sustainable Finance Disclosure Regulation (SFDR) is an EU regulation that requires financial market participants to disclose information about their sustainability policies and be transparent about how they implement these policies.

Taxonomy Regulation

The EU Taxonomy Regulation contains a classification system by which business activities can be classified as ‘sustainable’.

Total cost of ownership

Total cost of ownership is the total short-term and long-term costs involved in purchasing and owning a home. This includes costs of energy use, home maintenance, replacing installations or building modifications.

Whole Life Carbon approach

The Whole Life Carbon approach for the built environment is a European Commission policy project designed to reduce emissions of CO_2 and other greenhouse gases throughout the life of a building: (a) raw material extraction, (b) construction, (c) use, (d) demolition and (e) disposal of the demolition material. The rules will focus on reducing emissions during occupation as well as during the construction of buildings. The Whole Life Carbon approach stems from the updated Energy Performance of Buildings Directive (EPBD IV).

RESPONSIBILITY AND ACKNOWLEDGEMENT

Composition of the Council

C.M. (Karin) Sluis, Council member Rli and committee chair

J.A. (Jeanet) van Antwerpen, Council member Rli

A. (Annemarie) van Doorn, external committee member (founder of the Social Value Foundation and former director and founder of the Dutch Green Building Council)

G. (Gerard) Roemers MSc, external committee member (Programme Developer at the AMS Institute and former director of Cities & Built Environment, Metabolic)

Composition of the project team

Dr B. (Bas) Waterhout, Project leader

T.A. (Thomas) Dillon Peynado, Project officer, from 15 April 2024

S.A.H. (Sonja) Middendorp, Project support officer

Dr G.M. (Geert) Munnichs, Project officer

Consultees

David Anink, W/E adviseurs duurzaam bouwen

Jelmer Alberts, Bouwend Nederland

Christopher Baan, Ministerie van Binnenlandse Zaken en Koninkrijksrelaties

Jeroen Bart, Techniek Nederland

Thomas van Belzen, Cobouw

Rikkert Besselse, Rabobank

Jan van Beuningen, Ministerie van Volkshuisvesting en Ruimtelijke Ordening

Lian Blok, College van Rijksadviseurs

Harry Boeschoten, Staatsbosbeheer

Michiel Boesveld, Ministerie van Volkshuisvesting en Ruimtelijke Ordening

Sybren Bosch, Copper8

Claudia Bouwens, NEPROM

Daphne Braal, Dutch Green Building Council

Dirk Breedveld, Ministerie van Volkshuisvesting en Ruimtelijke Ordening

Jacqueline Cramer, Betonakkoord en Bouwakkoord Staal

Jeroen Derkx, InvestNL

Pauline van Dijk, Provincie Zuid-Holland

Robert Dijksterhuis, Ministerie van Binnenlandse Zaken en Koninkrijksrelaties

Andy van den Dobbelsteen, TU Delft

Onno Dwars, Ballast Nedam

Steve Goossens, APG

Roy Gosenshuis, Triodos

Jan Willem van de Groep, Building Balance

Jan-Willem Groot, Nationale Milieudatabase

Rienke Groot, College van Rijksadviseurs

Vincent Gruis, TU Delft

Tom van Haaren, Gemeente Rotterdam

Atto Harsta, De Bouwcampus

Emma Hartholt, Ministerie van Volkshuisvesting en Ruimtelijke Ordening
Ruben Heezen, Bouwend Nederland
Kitty de Heiden, Triodos
Michel Heijdra, Ministerie van Klimaat en Groene Groei
Bart van den Heuvel, Building Balance
Annius Hoornstra, The Positive Lab
Simone Huijbregts, College van Rijksadviseurs
Jan Kadijk, Dutch Green Building Council
Lena Knappers, College van Rijksadviseurs
Nicoline Kok, College van Rijksadviseurs
Marjolein Koningen, Gemeente Almere
Rianne Koster, Triodos
Erwin van der Krabben, Radboud Universiteit
Chris Kuijpers, Ministerie van Volkshuisvesting en Ruimtelijke Ordening
Guido La Rose, Gemeente Tilburg
Mantijn van Leeuwen, NIBE
Thijs Luijkx, IJKX b.v./Watkostdebouwvaneenhuurwoning
Bouwe Meijer, Ministerie van Volkshuisvesting en Ruimtelijke Ordening
Jeroen Mens, Platform31
Martin Mooij, Dutch Green Building Council
Robert Mullink, Groene Metropoolregio Arnhem-Nijmegen
William van Niekerk, TKI Bouw en Techniek
Laetitia Nossek, Dutch Green Building Council
Hanna Lára Pálsdóttir, Ministerie van Volkshuisvesting en Ruimtelijke Ordening
Steven van Polen, Planbureau voor de Leefomgeving
Raimondo Otten, Inexeon
Steven Rietberg, Triodos
Mattijs Rommelse, Gemeente Rotterdam
Carla Rongen, Hogeschool Arnhem-Nijmegen
Trudy Rood, Planbureau voor de Leefomgeving
Niels Ruijter, NVTB
Paul de Ruiter, Paul de Ruiter Architects
Marjet Rutten, Gideon Building Transition
Marrit van der Schaar, Provincie Utrecht
Thijn Schouten, Ministerie van Binnenlandse Zaken en Koninkrijksrelaties
Gerda van der Singel, Miedema Bouwmaterialen
Liesbeth Spies, Aedes
Abdessamad Srour, Bouwend Nederland
Theo Stauttener, Stadkwadraat
Wouter Streefkerk, Gemeente Rotterdam
Anne van Stijn, Aedes
Harriet Tiemens, Groene Metropoolregio Arnhem-Nijmegen
Daan Vanhouten, Ministerie van Volkshuisvesting en Ruimtelijke Ordening
Arno Visser, Bouwend Nederland
Francesco Veenstra, College van Rijksadviseurs
Laurens de Vrijer, Techniek Nederland
Henk Wanningen, Staatsbosbeheer
Derk Welling, APG
Sander Woertman, NEPROM
Lucas Wouters, APG
Ruben Zonnevijlle, Dutch Green Building Council

Expert meetings on 21 May 2024

Commissioning parties

Erik Bouwens, De Alliantie

Rik Hartog, Bolton Bouw

Jagoda Krzystanek, Gemeente Amersfoort

Maaike Perenboom, Synchroon

Timothy Prescott, Bouwinvest

Materials producers and suppliers

Ronald Balvers, GP Groot

Anja Buchwald, ASCEM

Emmanuel Laugs, Ekoplus Ecologische bouwstoffen

Rogier van Mensvoort, Isovlas

Sander Rutten, Building Balance

Thies van der Wal, VBI

Builders and designers

Gerard Bac, Heembouw

Arend van de Beek, Lagemaat

Rob Doomen, Pieters Bouwtechniek

Dick van Ginkel, TBI Woonlab

Réno Mol, Finch Buildings

Menno Rubbens, CEPEZED

Wietse de Vries, Bouwgroep Dijkstra Draisma

Working visit on 10 June 2024, woningfabriek Heijmans, Heerenveen

Joost van Asch, Heijmans Woningbouw B.V.

Harwil de Jonge, Heijmans Woningbouw B.V.

Pim Ketelaars, Heijmans Woningbouw B.V.

Working visit on 10 June 2024, Miedema Bouwmaterialen, Leeuwarden

Paul Hoekstra, Miedema Bouwmaterialen

Marthijs Roorda, Green Inclusive

Sietse Ros, Miedema Bouwmaterialen

Gerda van der Singel, Miedema Bouwmaterialen

Werner Valk, DW Bouw

Loraine Westerneng, Green Inclusive

Expert interviews on 10 July 2024

Housing associations

Robbert Groeneveld, Woonstad Rotterdam

Gerrolt Ooijman, Wonion

Housing investors

Irmine van der Geest, Amvest

Ingrid Hulshoff, Achmea

Banks/financiers

Leontien de Waal, ABN-AMRO

Expert meeting on 9 October 2024

Erik Bouwens, De Alliantie

Dick van Ginkel, TBI Woonlab

Atto Harsta, De Bouwcampus

Tom Jongen, Royal BAM Group nv

Sebastiaan Knepper, Gemeente Delft

Maarten Markus, AM

Tim Vermeend, Urban Climate Architects

Jelle Weever, Weever Bouw

Sander Woertman, NEPROM

Departmental contact group

Niek Hazendonk, Ministerie van Landbouw, Visserij, Voedselzekerheid en Natuur

Allard Lambers, Ministerie van Infrastructuur en Waterstaat

Bouwe Meijer, Ministerie van Volkshuisvesting en Ruimtelijke Ordening

Peter Oei, Ministerie van Landbouw, Visserij, Voedselzekerheid en Natuur

Hanna Lára Pálsdóttir, Ministerie van Volkshuisvesting en Ruimtelijke Ordening

Jaap Stokking, Ministerie van Economische Zaken

Reviewers

Cecile van Oppen, Copper8 (advisory report, October 2024 version)

Francesco Veenstra, College van Rijksadviseurs (advisory report, January 2025 version)

OVERVIEW OF PUBLICATIONS

2025

Working together to do better: recommendations for national policy on the physical environment in the Caribbean Netherlands. [‘Samen naar beter: aanbevelingen voor het rijksbeleid voor het fysieke domein in Caribisch Nederland’]. June 2025 (Rli 2025/02)

Failure and recovery: towards an effective approach to problems within the living environment. [‘Falen en opstaan: naar een doeltreffende aanpak van problemen in de leefomgeving’]. May 2025 (Rli 2025/01)

2024

Meaningful government: promoting wellbeing. [‘Waardevol regeren: sturen op brede welvaart’]. July 2024 (Rli 2024/04)

Judging the right balance: juridification in the living environment. [‘Met recht balanceren: juridisering in de leefomgeving’]. June 2024 (Rli 2024/03)

Spatial planning in a changing climate. [‘Ruimtelijke ordening in een veranderd klimaat’]. June 2024 (Rli 2024/02)

Firm Foundations: recommendations for a National Approach to the Problem of Unsound Foundations. [‘Goed gefundeerd: advies om te komen tot een nationale aanpak van funderingsproblematiek’]. February 2024 (Rli 2024/01)

2023

Systemic failure in policy on the living environment: a problem exploration. [‘Systeemfalen in het leefomgevingsbeleid: een probleemverkenning’]. December 2023 (Rli 2023/08)

Bridging the implementation gap: tackling factors impeding policy for the physical living environment. [‘De uitvoering aan zet: omgaan met belemmeringen bij de uitvoering van beleid voor de fysieke leefomgeving’]. December 2023 (Rli 2023/07)

Phasing out the throw-away society. [‘Weg van de wegwerpmaatschappij’]. November 2023 (Rli 2023/05)

Working together: opting for future-proof business parks [‘Samen werken: kiezen voor toekomstbestendige bedrijventerreinen’]. October 2023 (Rli 2023/04)

Good Water, Good Policy. [‘Goed water goed geregeld’]. May 2023 (Rli 2023/02)

Every region counts! A new approach to regional disparities [‘Elke regio telt! Een nieuwe aanpak van verschillen tussen regio’s’]. March 2023 (Rli 2023/01)

2022

Finance in transition: towards an active role for the financial sector in a sustainable economy [‘Financiering in transitie: naar een actieve rol van de financiële sector in een duurzame economie’]. December 2022 (Rli 2022/05)

Towards a sustainable food system: a position paper on the framework law. December 2022 (Rli/EEAC)

Splitting the atom, splitting opinion? Decision-making on nuclear energy based on values [‘Splijtstof? Besluiten over kernenergie vanuit waarden’]. September 2022 (Rli 2022/04)

Providing shelter: maximising the performance of housing associations [‘Onderdak bieden: sturen op prestaties van woningcorporaties’]. May 2022 (Rli 2022/03)

Nature-inclusive Netherlands, Nature Everywhere and for Everyone. [‘Natuurinclusief Nederland. Natuur overal en voor iedereen’]. March 2022 (Rli 2022/01)

2021

Farmers with a future. [‘Boeren met toekomst’]. December 2021 (Rli 2021/06)

Give direction, make space! [‘Geef richting, maak ruimte!’]. November 2021 (Rli 2021/05)

Investing in sustainable growth. [‘Investeren in duurzame groei’]. October 2021 (Rli 2021/04)

Towards an integrated accessibility policy. [‘Naar een integraal bereikbaarheidsbeleid’]. February 2021 (Rli 2021/03)

Digitally Sustainable. [‘Digitaal duurzaam’]. February 2021 (Rli 2021/02)

Hydrogen: the missing link. [‘Waterstof: de ontbrekende schakel’]. January 2021 (Rli 2021/01)

2020

Access to the city: how public amenities, housing and transport are the key for citizens. [‘Toegang tot de stad: hoe publieke voorzieningen, wonen en vervoer de sleutel voor burgers vormen’]. October 2020 (Rli 2020/06)

Stop land subsidence in peat meadow areas: the ‘Green Heart’ area as an example. [‘Stop bodemdaling in veenweidegebieden: Het Groene Hart als voorbeeld’]. September 2020 (Rli 2020/05)

Green Recovery. [‘Groen uit de crisis’]. July 2020 (Rli 2020/04)

Changing Tracks: Towards Better International Passenger Transport by Train. [‘Verzet de wissel: naar beter internationaal reizigersvervoer per trein’]. July 2020 (Rli 2020/03)

Soils for Sustainability. [‘De Bodem bereikt?!’]. June 2020 (Rli 2020/02)

A Grip on Hazardous Substances. [‘Greep op gevaarlijke stoffen’]. February 2020 (Rli 2020/01)

Original title
Bouwen met toekomst: werken aan woningen van duurzame materialen

Copy editing (dutch version)
Saskia van As, Tekstkantoor van As, Amsterdam, The Netherlands

Infographics
Frédérik Ruys, Vizualism, Utrecht, The Netherlands (Pages 11, 25, 41, 58, 60)

Photo credits
Cover: Thomas Dillon Peynado
Page 5: Branko de Lang / ANP
Page 17: René van den Berg / ANP
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Page 44: Marcel Krijgsman / ANP / Hollandse Hoogte
Page 55: Finch Buildings / M'DAM Monnickendam

Graphic design
Jenneke Drupsteen, Graphic Design, The Hague, The Netherlands

Publication RIi 2025/03
June 2025

Translation
Acolad, Maastricht, The Netherlands

Preferred citation
Council for the Environment and Infrastructure (2025). Building for the Future: Developing Homes with Sustainable Materials. The Hague, The Netherlands.

ISBN 978-90-83469-76-8
NUR740