

# Room for housing

Towards an integrated approach to the Dutch housing challenge



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# Foreword

*“The housing crisis offers opportunities. The opportunity to create a sustainable and long-term healthy living environment.”*

Housing shortage is not a new phenomenon in our country. As early as the nineteenth century, rapid population growth and urbanisation led to a housing shortage; the Housing Act of 1901 was supposed to put an end to this. In the years of rebuilding following World War II, housing construction was slow to take off. And in the 1980s, “no housing, no coronation” was the slogan of protesters calling attention to housing shortages.

The difference with the current housing crisis is the complexity of the challenge. Not only has not enough been built since the 2008 financial crisis, the population has grown and aged considerably during that period. However, the mismatch between supply and demand is only part of the problem. Labour market shortages and a lack of materials, a full power grid, addressing nitrogen issues, the need to build in a climate-proof manner: the list of delaying or complicating factors is almost endless.

But this crisis is offering opportunities too. The chance to take the approach to the next level. To build houses that can move with the changing requirements of generations. To develop neighbourhoods where living, working and leisure come together and where everyone can feel at home. And that in a landscape that combines the beauty of the delta with the robustness required by the changing climate. Not an easy challenge, but one with great rewards: a sustainable and long-term healthy living environment.

More than ever, it requires an integrated approach. The power of design can play an important role in this. Designers are ideally placed to bring people together and understand challenges in order to arrive at future scenarios together. Scenarios that in turn can lead to concrete projects in the here and now. Design-based research and, by extension, design-based development, are essential for future-proof area development.

Much of the knowledge needed to revive housing construction is available to us in-house at TU Delft. Be it circular materials, understanding the urban microclimate or the tools to put design-based thinking into practice. But that doesn't mean we can do everything ourselves. On the contrary. This Housing Vision therefore contains, above all, a call to work with us. To start building together, literally and figuratively, on the shared vision of how we want to and are able to live in our country in the future, and on the physical projects to implement this. For ourselves and for generations to come. Is there a nicer goal?

Prof. *ir.* Tim van der Hagen  
Rector Magnificus, TU Delft

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# Management summary

## Room for housing: towards an integrated approach to the Dutch housing challenge

The TU Delft Housing Vision Team, a multidisciplinary expert group, was established in 2023 by TU Delft's Rector Magnificus. Based on its knowledge, this team has arrived at the following recommendation on tackling the housing challenge in the Netherlands.

*Public authorities, clients and construction companies need to tackle the housing challenge in conjunction with the other major tasks and transitions. This approach should rely on the knowledge and design strength of knowledge institutions and the creative industry.*

We make a distinction between **four** possible courses of action and indicate concrete actions to address the housing challenge for municipalities, provinces, the national government, knowledge institutions and professionals.

1. **Spatial planning** should address room for housing in conjunction with the energy transition, the spatial adaptation to climate change and the transition to a circular economy.
  - Design-based research at regional and local level is an important means of addressing challenges in a coherent manner. This prevents a one-sided focus on the housing challenge, in which linkage opportunities will be missed, at the expense of public support and ultimately progress.
  - Between city and country are areas such as office parks, business parks and low-density residential areas. These areas offer a potential for increasing density and urban development and can therefore play an important role in the housing challenge.
  - Business and residential need not always be separate, but can instead be brought closer together in 'mixed-use' neighbourhoods, creating benefits for both.
  - For water safety in an urban environment, options in addition to raising dykes can be considered, such as space for water storage.

There is a task for **provinces and municipalities** to use design-based research in those areas in which major transitions with spatial footprint converge. Thus creating a future-proof foundation for the housing challenge in conjunction with other challenges.

**Municipalities** should thereby explore and support the development opportunities for 'intermediate areas', using spatial quality and urban development structure as the basis.

The juxtaposition of business and residential needs examples that work well. Here lies a task for **provinces and municipalities** with **knowledge institutions** to collaborate on pilot projects, and for **the government** to disseminate the insights and translate them into workable standards.

2. Increasing the density of **neighbourhoods** should go hand in hand with high-quality, climate-adaptive outdoor spaces and indoor public spaces.
  - Urban public spaces need to keep heat stress manageable, as well as flooding.
  - Jointly managed outdoor spaces can enhance resident engagement and neighbourhood livability.
  - Residents' initiatives can play an important role in neighbourhood social cohesion.

**The government** should explicitly commit to realising high-quality, climate-adaptive outdoor spaces, partly with agreements in the housing deals and partly with national standards for buildings and public spaces.

**Knowledge institutions** should support this with research, education and design guidelines.

**Municipalities** should provide more open spaces – indoors and outdoors – for community initiatives and offer residents' businesses security through long-term agreements and support.



3. **Residential buildings** should match the changing needs of residents for the long term.
- The housing supply should diversify not just in terms of size and price, but also in type and form, to do justice to the diversity of housing requirements.
  - Residential buildings should be long-term adaptable, so that dwellings can easily be split, merged or extended.
  - There should be more space for collective housing projects as a vital part of the housing supply.

**Municipalities, provinces and the government** should focus on a more diverse range of housing types and housing forms when managing the housing supply.

**The government** can increase the adaptability of existing dwellings by reviewing regulations surrounding the splitting and merging of dwellings.

**Knowledge institutes** can support both developments through research into types of housing and their translation into education and practice.

In order for the number of collective housing projects to grow, **the government** needs to better support them through appropriate regulations. Here, too, there is a role for **knowledge institutes** in knowledge development and knowledge sharing.

4. In the **construction sector**, the housing challenge can accelerate the transition to new, more sustainable and circular construction methods.
- Scaling up Industrial, Flexible and Demountable building (IFD) needs widespread collaboration from the construction sector, clients, designers, engineers and researchers.
  - IFD building should always be done with an eye for spatial quality and space for customisation.
  - The benefits of long-term adaptability of buildings for sustainability and value preservation should be echoed in the financing of these projects.

**The government and knowledge institutes** are the appropriate partners for setting up a platform in which all parties work together to scale up IFD building.

**Municipalities** should monitor spatial quality in IFD building projects together with **designers**.

**The government and municipalities** should value and support the ecological and social benefits of long-term adaptable building projects through taxation and land exploitation.

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# Introduction

## A vision of the future of housing in the Netherlands

Imagine. It is 2030. New homes are being built in abundance in the Netherlands. Most homes are manufactured industrially, in a factory, with circular and reusable structures and from recycled and 'bio-based' materials such as wood. Existing homes have largely been made more sustainable so that we meet national and international climate objectives.

The Netherlands in 2030 has a great diversity of housing forms and types to suit the different ways in which people in the Netherlands want to live and work together. There is choice. Young people can live independently again whenever they want. Elderly people can live in smaller dwellings if they wish. Moving house is not always necessary for them, as housing is flexibly built and can therefore be adapted to changing requirements. For those who do want to move, once again there is a diverse range of affordable rental and owner-occupied houses.

And it's not just the houses that will be different from what we are used to: streets, neighbourhoods, cities and regions will have also changed by then. In many neighbourhoods, residents are closely involved in the design of public spaces and the activities taking place in them. Citizens work together on collective projects and share spaces inside and outside the building. Streets, squares and public green spaces play a vital role in absorbing heavy rainfall and provide cooling during heatwaves, which are much more common now. Many neighbourhoods are climate-adaptive by 2030.

New housing estates and homes will emerge in unexpected places. Business parks have been transformed into vibrant neighbourhoods, in which living and working strengthen each other rather than get in the way. Major changes will also be seen throughout the Dutch Delta, with its coastal areas and river landscapes. Urban development, nature and water storage come together here in a changing, moving landscape. Thus, a new balance of new, and renewed, future-proof space for living has emerged throughout the Netherlands.

This vision of the future still seems like a distant dream today. Space for housing is too limited and this is causing major problems in society. There is talk of a housing shortage,<sup>1</sup> or even a housing crisis, in the Netherlands. The effects go beyond dissatisfaction with housing that is just too small.

The difficulties for young people in finding housing lead to unsafe situations, growing inequality and the postponement of important life decisions.<sup>2</sup> For vulnerable groups such as refugees, migrant workers and students, the shortage of suitable housing too often leads to unacceptable living conditions. Older people find themselves in a fix as they seek housing that better suits their new requirements. For the middle class, high housing costs affect livelihood security, which can lead to poverty.<sup>3</sup> The gap between those who do live affordably (mostly in owner-occupied housing), and those for whom housing costs are becoming unbearable (often households in the private rental sector) allows wealth inequality to rise.<sup>4</sup>

The disparity between the high quality of new housing and the lack of quality of many existing homes also creates inequality. There are still significant challenges in the existing housing stock, such as tackling damp and mould, poorly insulated homes, homes with poor foundations and neighbourhoods where the liveability and resilience of residents is under pressure.

This recommendation mainly focuses on the availability of sufficient affordable sustainable housing in pleasantly liveable neighbourhoods. If we continue to build new homes at the current pace, however, we are nowhere near finding a solution. The current shortfall of almost 400,000 homes is expected to increase in the coming years. This is partly due to a decline in building permits granted over the past two years. Even if we are able to build a further 1 million new homes by 2030, the housing shortage remains too great for a healthy housing market. A sharp increase in the construction of new housing is needed in combination with better use of the existing housing stock and more flexible types of housing.<sup>5</sup>

In this light, TU Delft has set up the Housing Vision Team,<sup>6</sup> a multidisciplinary and inter-faculty team, which, at the request of the Rector Magnificus, in 2023 held a widespread consultation surrounding how TU Delft's knowledge can contribute to solving the lack of affordable housing. The Vision Team didn't just look at a target number of new-build homes, but at how we can tackle the housing challenge in a way that will future-proof our public housing and our living environment.

The many discussions with experts within TU Delft and stakeholders outside TU Delft have led to an integrated recommendation with four coherent courses of action. These are concrete tools to show government, professionals and stakeholders what they can do to help overcome the housing shortage. We link concrete recommendations to each of these courses of action.

1 For example: <https://www.rijksoverheid.nl/onderwerpen/huurnwoning-zoeken/maatregelen-tegen-woningnood>

2 <https://www.nji.nl/op-jezelf-wonen/wat-zijn-gevolgen-van-de-onzekere-woningmarkt-voor-jongeren>

3 <https://www.dnb.nl/algemeen-nieuws/nieuwsberichten-2023/hoer-problemen-voor-huishoudens-opstapelen/>

4 Interdepartmental policy research on wealth inequality (IBO) (2022). *Licht uit, spot aan: vermogensongelijk* (Lights off, spotlight on: power inequality). Interdepartmental policy research on wealth inequality (IBO): The Hague.

5 <https://nieuws.nl/economie/20240229/hoogleraar-ambitie-van-bouw-bijna-miljoen-woningen-niet-haalbaar/>

6 Vision Teams are TU Delft projects to learn about perspectives on technologies that exist in society. TU Delft is at the forefront of developing technologies and informing society about those technologies and their applications. With vision teams, we want to understand concerns about the impact of technologies and explore how they can be better used for society. <https://www.tudelft.nl/over-tu-delft/strategie/vision-teams>



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# Reading guide

## A values-driven, integrated recommendation

Solving the housing shortage requires more than just new-build homes. There is a lack of suitable, affordable and future-proof housing and living space in the Netherlands. New homes must be suitable for changing living conditions and citizens' requirements. Four shared values emerged from the Housing Vision Team consultations, which should be guiding in addressing the housing challenge.

The residential and living environment must be...

... **climate-proof**. Our homes and living environment must contribute to a sustainable, circular and climate-neutral society and be resilient to the effects of the changing climate.

... **flexible**: adaptable to future wishes and requirements of people and society.

... **diverse** and inclusive: suitable for different housing preferences, life requirements and forms of cohabitation and not excluding anyone on account of income, wealth or other factors.

... of high **spatial quality**: long-term high quality which contributes to liveability and cultural value.

The diverse recommendations, which emerged from the consultations, can be categorised into four areas of creating, retaining, managing and utilising living spaces:

**Locations**, with the question where and how housing will be built.

**Districts and neighbourhoods**, with the question how living spaces and living environments go together locally.

**Types of housing**, with the question how living spaces are designed physically and organisationally.

**The construction**, with the question how living spaces are built and renovated.

We bring the values and domains together in four courses of action. Such a course of action is intended as a tool for action. It gives authorities, market participants, civil society and citizens direction over what they can do to help overcome the housing shortage. We link concrete recommendations to each of these courses of action at the end of the section. The four courses of action are:

1. **Future-proof spatial plans** that make better use of promising locations;
2. **Resilient neighbourhoods**, creating the physical and social preconditions for a long-term pleasant living and working environment;
3. **Variation in housing types**, responding to a variety of housing needs and requirements;
4. **Circular and modular design and construction** that accelerates the realisation and renovation of living spaces and makes them sustainable with lasting quality.

All courses of action show that the housing challenge is linked to other major challenges. Not only is it necessary to solve these in conjunction with each other, but it also offers new opportunities.

### Four courses of action and corresponding actions

The four courses of action with their corresponding measures are explained on the following pages. Each measure refers to (ongoing) research at TU Delft and is an invitation to contact the relevant researchers. We always conclude the sections with the courses of action with a (non-exhaustive) overview of concrete interventions to indicate *who* can act *how* to help solve the housing challenge.

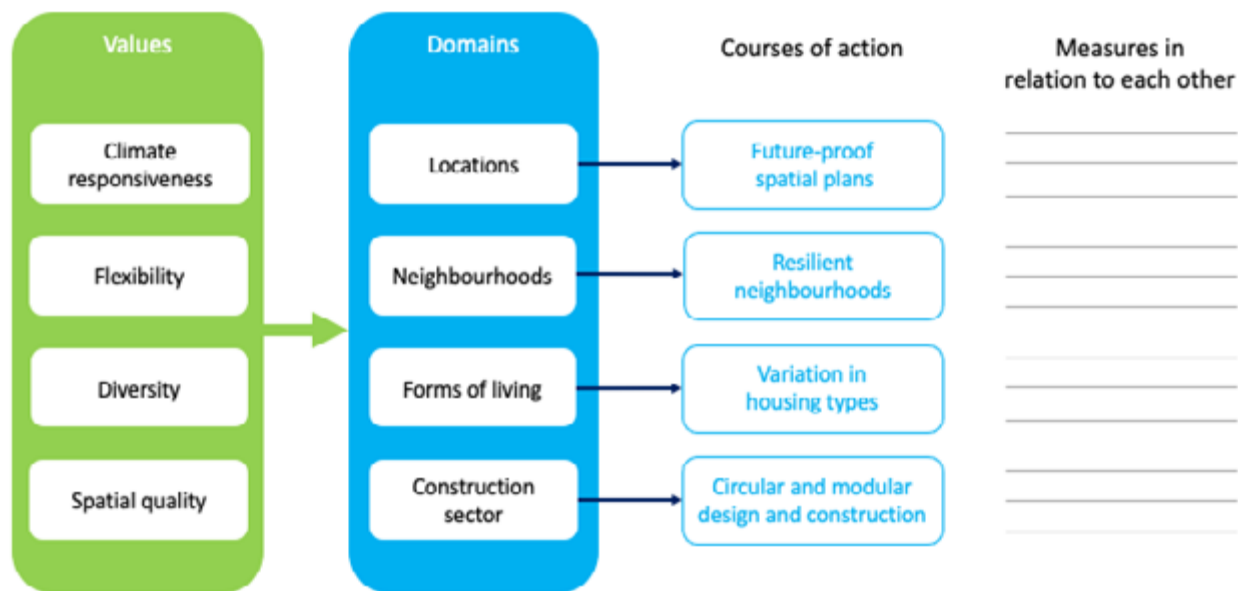


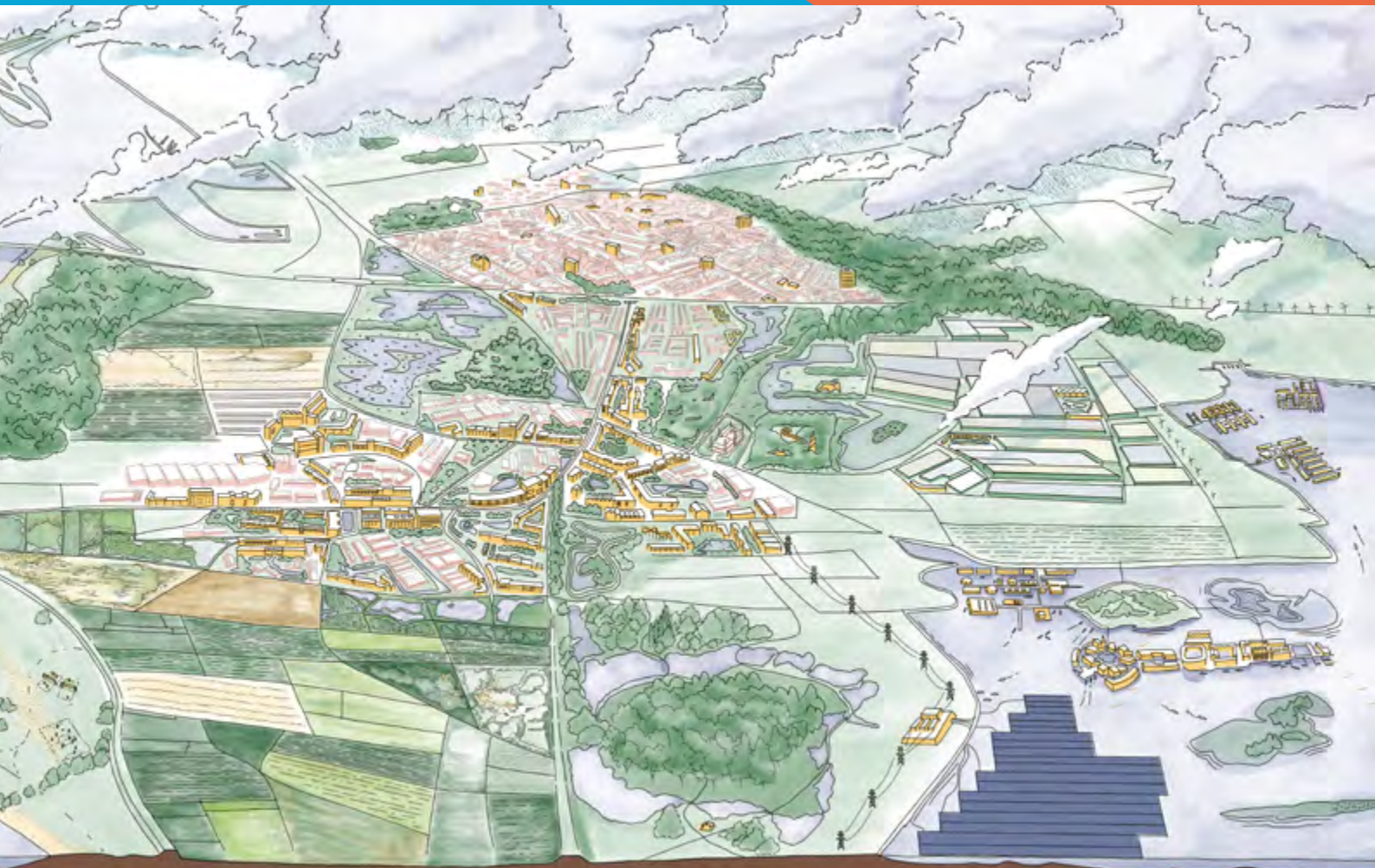
Figure 1, Values, domains, courses of action and measures in relation to each other



This report concludes with a plea. To turn the tide, more knowledge needs to be pooled and shared, and citizens, authorities, market participants, civil society and knowledge institutions such as TU Delft need to work together to make more space for housing. Because every m<sup>2</sup> counts.



# 1. Future-proof spatial plans



*“Spatial planning should address space for housing in conjunction with the energy transition, the spatial adaptation to climate change and the transition to a circular economy.”*

A series of major transitions needs space in the Netherlands. And space is a scarce commodity in this country. Building new housing is just one of the challenges which must be met in this lack of space. But how to tackle this?

# 1.1 Background

## Lack of space and mixing of functions

### Accumulation of space claims

The energy transition demands space for wind and solar energy. Climate change demands space for water storage. Livability and heat stress require additional trees and greenery. Changing mobility demands more space for cyclists and pedestrians, and then there is the desire for additional public space for playing children and congregating. And that while land use with current residential areas, business activities, agriculture and logistics are already putting too much pressure on water, soil and biodiversity.<sup>7</sup> This space simply isn't there. But the method of adding up space claims for individual sectors (residential; employment; agriculture; water) leads to a systematic overestimation of space requirements.<sup>8</sup> Municipalities are looking at how mixing of functions can be utilised, combining living, working and urban amenities.

The Future-Proof Construction initiative,<sup>9</sup> in which municipalities, builders, other market participants and civil society organisations participate, distinguishes between six themes for sustainable, future-proof housing: circularity, nature inclusivity and biodiversity, climate adaptation, energy, sustainable mobility, sustainable living environment. Studies such as *'De Stad van de Toekomst'* (The City of the Future) (2019)<sup>10</sup> consider these challenges simultaneously for a given area. In this study, ten

broadly compiled design teams developed integrated designs for five locations in the five major cities (Amsterdam, The Hague, Eindhoven, Rotterdam and Utrecht) to show how important transitions can have a place in the city. The aim is to have a future-proof city, one that is smart about housing, water, energy, mobility and encourages encounters and is a pleasant place for everyone to live and work. In a follow-up study, *'Ontwerpen vanuit de doorsnede'* (The cross-section of designs) (2022),<sup>11</sup> six design teams created designs for transformation areas in three Dutch and three Flemish cities, explicitly using three-dimensionality to view public space and buildings in conjunction with the ground. The designs combine, what the Dutch Ministry of the Interior and Kingdom Relations (BZK) defines in *'Mooi Nederland'* (Beautiful Netherlands) (2022),<sup>12</sup> the elements of spatial quality: perception value, use value and future value.

For both studies, 'design-based research' was chosen as a tool, where interdisciplinary teams from different organisations work together to interact with stakeholders in a 'policy-free environment'. At a very early stage, the design process was initiated with all necessary disciplines and crucial stakeholders, leading to a better understanding of the challenges, system knowledge of the site, technical constraints and opportunities for sustainability. The intention is to create designs for the future

7 Report by the Netherlands Environmental Assessment Agency (PBL): *Grote opgaven in een beperkte ruimte* (Major challenges in a limited space) (Netherlands Environmental Assessment Agency, 2021a)

8 Report by the Netherlands Environmental Assessment Agency: *De ongekende ruimte verkend* (The unknown space explored) (Netherlands Environmental Assessment Agency, 2003)

9 [www.toekomstbestendigbouwen.nl](http://www.toekomstbestendigbouwen.nl)

10 De Boer, H., Van der Wouden R. (2019). *De stad van de toekomst* (The city of the future). BNA. <https://bna.nl/documenten/de-stad-van-de-toekomst>

11 Duflos, M., De Boer, H., Dillon Peynado, T., Van Acker, M., Debrock, S. (2022) *Ontwerpen vanuit de doorsnede: de ondergrond als bouwsteen voor de toekomstbestendige stad* (The cross-section of designs: the surface as a building block for the future-proof city). *Mechelen: Public Space*.

12 Ministry of the Interior and Kingdom Relations (2022). *Mooi Nederland* programme. The Hague: Ministry of the Interior and Kingdom Relations (BZK).

and, from there, to use ‘backtracking’ to see what we can already do now.

It is notable that many teams, in addition to substantive plans, also give explicit attention in such studies to how to interact with each other and arrive at designs in this phase: ‘the process of arriving at’. For example, the team for the study in Utrecht created a dictionary to make sense of the various terms. At Ostend, the design team devised a comprehensive toolbox to make circular development a reality. A prominent part is a matrix with 30 design actions. Each design action contains action cards with design principles that act as tools for ‘interdisciplinary co-creation’. These studies can take place at different scales: neighbourhood, city and region. TU Delft was one of the initiators of the two studies, as well as of the following development.

Design-based research need not only lead to visions of the future and dialogue about them among stakeholders. The recently established knowledge and innovation platform ‘*Stedelijke Snelwegen en Ruimtelijke Ontwikkeling*’ (Urban Freeways and Spatial Development) launched an experimental approach under the heading of ‘design-based development’: beyond design-based research that must lead to a course of development and action. These include area development along the A12, a railway zone between The Hague and Zoetermeer, as well as along the A16 between the Van Brieneoord bridge and the Terbregseplein square in Rotterdam. The design-based research is an intermediate link in this regard – a step that follows after a values discussion with stakeholders, but precedes the social and economic assessment of scenarios from the design-based research and the corresponding funding and management method. This approach should lead to a concrete course of action for the area and its relationship with the

highway for involved stakeholders, including municipalities, the Ministries of Infrastructure and Water Management (I&W) and the Interior and Kingdom Relations (BZK) and area developers.

### Future-proof housing locations

In recent years, the Ministry of the Interior and Kingdom Relations has accelerated its efforts to find suitable building locations to address the Dutch housing shortage. Thirty-five signed regional housing deals together add up to the required number of homes by 2030.<sup>13</sup> In addition to the concrete number of houses to be built and transformed, the housing deals also contain other agreements, such as specific locations, the percentage of affordable housing and social housing, agreements on the accommodation of focus groups, as well as shared challenges such as the design of public space, the construction of roads and the redevelopment of neighbourhoods. Managing housing construction is inextricably linked to managing spatial planning. Decisions on additional housing location also require careful integrated spatial consideration because there can also be friction between these challenges.”<sup>14</sup>

In addition, looking for new locations continues to be relevant. Not all housing deals are based on ‘hard projects’. The 2022 ‘water and soil management’ letter to parliament warns that some building locations should be reviewed.<sup>15</sup> Transitions such as for energy and climate resilience can lead to different spatial choices.

To look at things from a different angle, TU Delft researcher Martijn Lugten’s work on the noise pollution people experience in the vicinity of airports is of interest. Local residents benefit from reducing aircraft noise. But to reduce nuisance, the design of homes, the materials used and the positioning of homes in relation to flight paths can also be considered to prevent

13 <https://www.volkshuisvestingnederland.nl/onderwerpen/woondeals>

14 Letter to Parliament on National Management in Spatial Planning dated 17 May 2022 (Ministry of the Interior and Kingdom Relations & Jonge, 2022)

15 Water and Soil Management letter to parliament dated 25 November 2022 (Harbers & Heijnen, 2022)

reflection of sound waves. “This is the first time that we are copying and adapting buildings to see how exactly that would affect aircraft noise”, says Martijn Lugten. Besides mathematical models, there are also test sites near Schiphol to measure how nuisance is perceived.<sup>16</sup>

## From compartmentalisation to combination glasses

In future-proof development and realisation, an integrated approach is crucial for the various challenges involved at a given location. This means that different disciplines and organisations must work together in what we call a ‘transdisciplinary’ collaboration. This presents a number of challenges.

Erasmus University Rotterdam and TU Delft are currently exploring the challenges and courses of action in integrated tasks and the pursuit of future-proof, resilient working methods and solutions in the infrastructure, area development and energy sectors through the Resilient Delta Institute.<sup>17</sup> In doing so, they recognise eight tensions:

1. Acting now ↔ Future-proofing
2. Classic project goals ↔ Broader values
3. Monofunctional ↔ Integrated
4. Project ↔ Programme
5. Policy ↔ Management
6. Existing practices ↔ New practices
7. Technical ↔ Social competences
8. Current training and research ↔ Market requirements

Transitions are not about tasks with one problem from one domain with one solution. Rather, they are tangles of questions, problem and solution combinations, pursued by different parties in the same physical environment. This means that in addition

to content, process also plays a crucial role. Different ‘vessels’, each with a focus from its own domain, its own budgets and ways of working, need to open up and professionals need to put on ‘combination glasses’ in addition to ‘sectoral glasses’. We also saw this in the design teams in ‘The City of the Future’ and ‘The cross-section of designs’, which looked for appropriate types of collaboration and thereby provided an interesting side effect to the studies. Organising around these issues crosses the boundaries of government and society, in what Geert Teisman calls ‘the in-between space’<sup>18</sup> between government, social organisations, businesses and citizens. Combining budgets by untying financial pots is a challenge. For instance, funding for water safety will be released through the Delta Programme, to be combined with budgets for heat stress prevention in locations across our country, as both problems can be tackled more effectively together.

## Successful collaboration

Working within integrated teams can be a real challenge due to the different personalities working together on an assignment. Even if everyone is striving for successful collaboration and impact. Each has their own language, routines, visions and priorities. To work together successfully, it is important that team members have the right competences in addition to their own substantive specialism. Thus, individuals must be able to empathise with other team members and their disciplines. We call this the ‘T-shaped professional’<sup>19</sup>. It can be interesting to appoint a separate member of staff to get to know each other better and encourage the collaboration, like an environment manager does for spatial challenges. Within the Resilient Delta Institute, the function of a ‘gluon’ was devised for this purpose by Nikki Brand within research teams.<sup>20</sup> The Gluon Researcher is a team member whose primary role is to bridge present ‘gaps’,

16 <https://www.tudelft.nl/stories/anders-bouwen-tegen-vliegtuiglawaai>

17 <https://convergence.nl/resilient-delta/>

18 Farewell address Prof. Ing. Geert Teismans, Erasmus University Rotterdam, 6 October 2023.

19 Moghadam, Y, Demirkan, H. and Spohrer, J. (2018) T-shaped professionals: Adaptive innovators. Business Expert Press: [town/city of publisher]

20 <https://convergence.nl/nl/transdisciplinary-research-breaking-barriers-and-building-delta-resilience-together/>

build understanding between the various groups and act as a unifying force, essentially serving as 'the glue' that binds the team together.<sup>21</sup>

21 <https://convergence.nl/nl/meet-the-gluon-researchers/>

# 1.2 Opportunities

## Spatial analyses and design-based research.

### **Opportunity 1: Intermediate areas, which are neither urban nor rural, have potential as sustainable development sites**

In search of suitable building locations for new housing, the debate has been going on for years about where to build and where definitely not to build. This discussion is often reduced to the choice between increasing the density of existing urban areas or building on 'greenfield' sites: undeveloped areas outside the city. Increasing density is seen as the more sustainable choice in this regard. No natural areas are affected and residents are less dependent on cars. Building in dense cities often tends to be complex, so housing can take longer to build and cost more.

Building on greenfield sites outside the city therefore has the advantage of being faster. There are fewer neighbours experiencing nuisance and construction materials can be brought in more easily. The downside is that this could lead to fewer nature reserves and fragmentation of the landscape if insufficient attention is paid to nature-inclusive construction. Attention to mobility is also important. If the site is not near a public transport stop, it could lead to more car traffic, resulting in more traffic jams and greenhouse gas emissions.

Is it that we have a choice between sustainable yet expensive and slow construction in the city, or faster and cheaper construction outside the city resulting in more damage to nature and climate? Researcher Alex Wandl argues that this is too

simplistic. His research indicates that many areas fall under the definition of 'territories-in-between', or intermediate areas, between city and country.<sup>22</sup> Some of these areas have a high mixture of different functions, making these areas interesting: they offer the advantages of the city (the proximity of living and working) and the benefits of rural areas (lower density and more space).

Such 'intermediate areas' lie, for example, along the relatively new A4 motorway in the north-west of Delft. In Den Hoorn, Wippolder and Harnaschpolder, there are large, monofunctional areas. Shopping centres, logistics and residential areas are located alongside these areas, with each plot using a large area of low building density. With good spatial planning, more housing with good spatial quality and a better mix of functions could be built here.

Another example is the edges of major cities, where they touch more rural, or less high-quality used areas, such as the area between The Hague and Westland, for example. Around Poeldijk and Monster, clusters of houses have sprung up next to greenhouses. This still mainly happens by block or sub-area, without a strong urban development structure. A different design approach would also allow for greater density here while simultaneously enhancing urban quality. The 'Panorama Local' initiative by the Board of Government Advisors with its search for design solutions for suburban areas is in line with this.<sup>23</sup>

22 Wandl, A. (2020). A Cross-case Comparison of Dispersed Urban Development in Europe. Delft: TU Delft <https://doi.org/10.7480/abe.2019.14.4340>

23 <https://www.collegevanrijksadviseurs.nl/projecten/panorama-lokaal>



An interesting network of small town centres and green areas can be found in the east of the country, for example around Arnhem and Nijmegen. The centres in particular offer opportunities for increasing density here, without affecting the quality of the environment.

The potential of such intermediate areas for housing is not yet sufficiently recognised, according to Wandl. There are opportunities here for more affordable and sustainable housing, with scope for diversity and experimentation. Which areas are suitable for this and how best to build here will require additional research, public discussions and built examples.

## **Opportunity 2: If planned well, housing and industry/manufacturing industry can be combined together to create sustainable, circular and liveable commuting areas**

Since the 1950s, we have seen industrial areas and residential environments becoming increasingly separated from each other in the Netherlands, as in many other European countries. In the post-war period, it was still common for small-scale manufacturing industry and medium-sized factories to be located in the city. The noise, local pollution and transport associated with these industries caused the creation of industrial areas outside cities or in other countries. This is justified when you realise how, to this day, a number of steel and chemical industries still cause health and environmental damage in their immediate surroundings. Large-scale polluting industry is therefore certainly not suitable for combining with residential environments in mixed-use areas.

In many other industries, however, new production methods are now much less noisy and no longer polluting. Under the right conditions these can be combined with residential areas. Birgit Hausleitner researches how the right rules, designs and mixing of functions can ensure that housing and different industries can coexist well (Hausleitner et al., 2022<sup>24</sup>). Proper distances, logistics zones and supply and return routes, as well as agreements on supplies and working hours, for example, must then be carefully considered.

Hausleitner sees two key aspects that make mixing housing and industry worthwhile for the future of housing in the Netherlands. Firstly, there are many unused spaces in and around traditional industrial parks. Thus, if we bring together the right industry with appropriate housing with good designs, industrial parks offer new development space. Businesses and residents can use the same public transport and facilities. And public space is used at all times of the day. Secondly, the correct mixture of functions offers opportunities for circularity and sustainability. Residual heat from businesses can be used to heat homes, locally generated electricity can be exchanged and used efficiently, and the proximity of living and working reduces commuting.

Such a mixture of functions obviously requires the right spatial conditions. Firstly, it is important to note that not all types of business activity will automatically work well in every location. Small-scale manufacturing industry and few inbound and outbound goods can be mixed well with housing, provided the expected nuisance (noise, air quality) falls within appropriate margins. Larger-scale industry involving a lot of transport needs more distance from housing. These two functions cannot then be on the same street. Access routes for the industrial functions should also be well separated from those of the residential ones in the layout of the area.

24 Hausleitner B., Hill A., Domenech T., Muñoz Sanz V. (2022) Urban Manufacturing for Circularity: Three Pathways to Move from Linear to Circular Cities. In: Amenta L., Russo M., van Timmeren A. (eds) *Regenerative Territories*. *GeoJournal Library*, vol. 128. Springer, Cham. [https://doi.org/10.1007/978-3-030-78536-9\\_5](https://doi.org/10.1007/978-3-030-78536-9_5)

There are opportunities in the smart use of height differences, for example where streets are located on dykes. One example is Schiedamseweg in Rotterdam, a street on a dyke that separates the port from a residential area. A high-density 'mixed-use' neighbourhood could emerge here, with manufacturing industry using the harbour quays while shops are located along the public road.

In all cases, it is important to provide appropriate logistics space. After all, in a circular economy, it is important that usable residual products and materials are reused as much as possible and with as high a value as possible. There needs to be space to store these materials temporarily.

### Opportunity 3: The Dutch deltas offer space for future-proof urban development

The topography of the Netherlands as a delta region makes us vulnerable to the effects of climate change. In low-lying polder areas, the consequences of flooding and drought are severe. Along the coast and major rivers, the risk of flooding increases. The old approach of pumping and raising dykes is no longer sufficient and must be combined in a spatial planning approach, in which water and soil are guiding (Harbers & Heijnen, 2022<sup>25</sup>).

These insights not only highlight the risks to existing habitats, but they also limit the space in which we can build future-proof new housing. A more frequent recommendation is therefore to stop building in coastal areas and along rivers.

In her research, Fransje Hooimeijer shows that urban developments can take place in the delta, provided that space is simultaneously made for water storage (Hooimeijer, *et al.*, 2022<sup>26</sup>). This means dealing with flood risks in a structurally different manner.

Currently, the risk of flooding is being reduced by reducing the possibility of flooding using high dykes. But a risk of what the consequences of a flood would be has also been calculated. Keeping these consequences in check will also keep the risk smaller. We will explain this with a case study.

Vlissingen doesn't want to raise the sea wall because it would damage the historic appearance and thereby the identity of the city. In a research project, Vlissingen and TU Delft have teamed up to investigate whether it is possible to guide the water from a storm in such a way that it doesn't cause any harm. It means that the spatial layout of the streets and a green area behind the dyke has adapted to this possibility, which will only happen very little. Localised flooding is no longer ruled out, but the effects are mitigated. This requires good interdisciplinary collaboration between urban planners and engineers. The research project developed an Assess & Design method which Hooimeijer applies when using spatial design as a research tool.

Hooimeijer underlines the importance of interdisciplinary design-based research for area development, where water and soil must be taken into account. If such research takes place at an early stage, it offers opportunities in two ways. On the one hand, the developed residential areas will be future-proofed. And on the other hand, this approach can identify areas where the right design allows building in flood-prone areas. This widens the choice of building locations and creates more space for housing.

25 Harbers, M., & Heijnen, V. (2022). Parliamentary letter on the role of Water and Soil in spatial planning. Retrieved from <https://www.rijksoverheid.nl/documenten/kamerstukken/2022/11/25/water-en-bodem-sturend>

26 Hooimeijer, F., Diaz, A., Bortolotti A., Ke, Q. J., Vander Heuven J., and Bicker J. (2022). Design & assessing the flood risk management paradigm shift: an interdisciplinary study of Vlissingen, the Netherlands. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability* Pages 1-22



# 1.3 Recommendations and tasks

## For future-proof spatial plans

**Spatial planning** should address space for housing in conjunction with the energy transition, the spatial adaptation to climate change and the transition to a circular economy.

- Design-based research at regional and local level is an important means of addressing challenges in a coherent manner. This prevents a one-sided focus on the housing challenge, in which linkage opportunities will be missed, at the expense of support and ultimately progress.
- Between city and country are areas such as office parks, business parks and low-density residential areas. These areas offer a potential for increasing density and urban development and can therefore play an important role in the housing challenge.
- Business and residential need not always be separate, but can instead be brought closer together in 'mixed-use' neighbourhoods, creating benefits for both.
- For water safety in an urban environment, options in addition to raising dykes can be considered, such as space for water storage.

We end each section with concrete tasks for local authorities, knowledge institutions and professionals to spur on action. To achieve future-proof spatial plans, we see the following tasks:

There is a task for **provinces and municipalities** to use design-based research in those areas in which major transitions with spatial footprint converge. They therefore lay a future-proof foundation for the housing challenge in conjunction with other challenges.

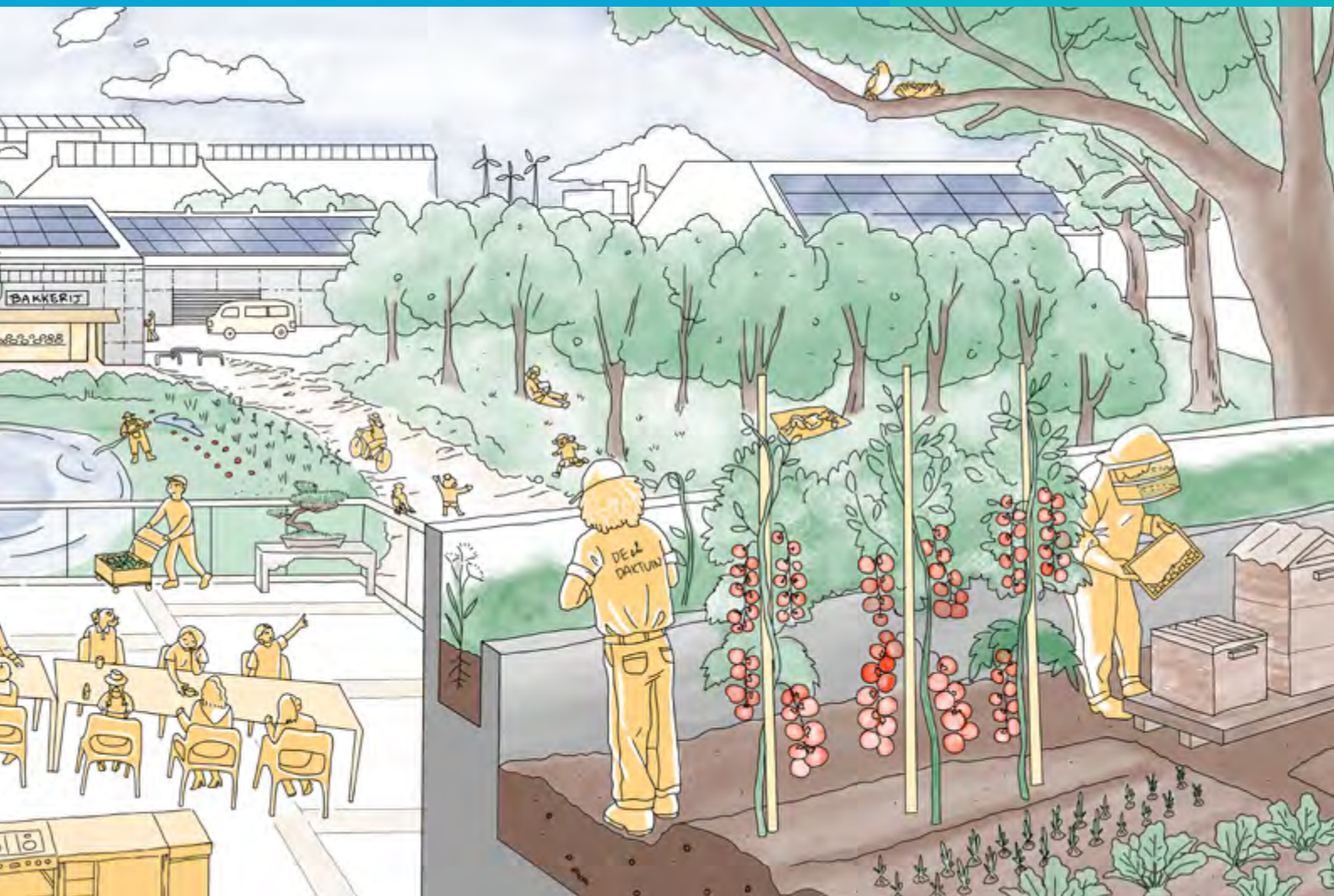
**Municipalities** should thereby explore and support the development opportunities for 'intermediate areas', using spatial quality and urban development structure as the basis.

The juxtaposition of business and residential needs examples that work well. Here lies a task for **provinces and municipalities** with **knowledge institutions** to collaborate on pilot projects, and for **the government** to disseminate the insights and translate them into workable standards.





## 2. Resilient neighbourhoods



*“Increasing the density of neighbourhoods must go hand in hand with high-quality, climate-adaptive outdoor spaces and indoor public spaces.”*

New housing offers opportunities for the design or redesign of communal outdoor and indoor spaces. In urban areas in particular, we see two matters that require more attention: the urban microclimate and social cohesion. In both matters, resilience is key: resilience to climate change and resilience to developments that affect the well-being of residents and the social fabric of neighbourhoods. Strengthening both types of resilience leads to resilient neighbourhoods.

# 2.1 Backgrounds

## A good living environment is an essential part of space for housing

New housing can be created by making better use of the existing housing stock,<sup>27</sup> but there is also a need for new homes. New-build homes will partly be built in and around existing neighbourhoods ('infill') and new neighbourhoods will be built ('expansion').

To address the housing shortage, the government has entered into 35 regional housing deals in which a number of houses to be built and transformed have been agreed for each region, along with corresponding agreements on specific locations, percentage of affordable housing and social housing and the accommodation of focus groups. The housing deals also describe joint projects, including the design of public spaces and the redevelopment of neighbourhoods.<sup>28</sup>

These new or redeveloped public spaces offer opportunities to address two major challenges in conjunction with housing: climate adaptation and social cohesion. An integrated approach here offers opportunities to make neighbourhoods strong, resilient and liveable in the long term.

### A liveable living environment

Residential areas in the Netherlands will face the effects of climate change more often in the coming years: coastal and river flooding, flooding from heavy rainfall, subsidence and salinisation from drought and periods of heat stress.<sup>29</sup>

27 Here, we need to refer to another place in the document where this is addressed. Course of action 3?

28 For an explanation of the housing deals and an overview by province, see: <https://www.volkshuisvestingnederland.nl/onderwerpen/woondeals>

29 For an overview of the expected effects of climate change and the resulting challenges for urban spaces, see: <https://klimaatadaptatienederland.nl/kennisdossiers/>



# Climate adaptation and the Climate Action Programme

At TU Delft, we combine our research, innovation and knowledge transfer on climate change in the Climate Action Programme.<sup>30</sup> The programme has four themes: Climate science, Climate change mitigation, Climate change adaptation and Climate change governance.

The third theme, 'climate adaptation', has much in common with the design of living space, from the building to the neighbourhood, the city and the delta. The breadth of the challenge is reflected in four TU Delft research projects, 'flagships', set up for the 'climate adaptation' theme:<sup>31</sup>

- '*Spatial planning of Future Deltaic Systems*' researches the interaction between the water system of coastal areas, rivers and urban areas. This is mainly a job for spatial planning.<sup>32</sup>
- '*Cool and Clean Buildings*' investigates the effects of heat on buildings and their users, in conjunction with increasing energy demand for cooling. This ties in with the design and technical engineering of buildings.<sup>33</sup>
- The other two flagship projects mainly focus on the scale of the city and the neighbourhood, and thereby the area of urban planning. '*Sponge Cities*'<sup>34</sup> looks at urban water management between drought and flooding and '*Cooling Cities*'<sup>35</sup> seeks ways of optimising the city's water balance in time and space through an interdisciplinary participatory approach (design, engineering, policy and citizens). Scientists within '*Cooling Cities*'<sup>36</sup> are also researching the physical processes related to urban heat and the effects of heat on liveability.

30 See <https://www.tudelft.nl/climate-action>

31 See <https://www.tudelft.nl/climate-action/onderzoeksthemas/aanpassing-aan-klimaatverandering>, contact Marjolein van Esch: <https://www.tudelft.nl/en/staff/m.m.e.vanesch/>

32 Flagship project '*Spatial Planning of Future Deltaic Systems*', contact Luca Iuorio <https://www.tudelft.nl/en/climate-action/research-themes/climate-change-adaptation>

33 Flagship project '*Cool and Clean Buildings*', contact Anne Marie Eijkelenboom: <https://www.tudelft.nl/en/staff/a.m.eijkelenboom/>

34 '*Sponge Cities*' flagship project, contact Juliana Concalves: <https://www.tudelft.nl/en/staff/j.e.goncalves/>

35 '*Cooling Cities*' flagship project, contact Arjen Droste: <https://www.tudelft.nl/staff/a.m.droste/>

36 '*Cooling Cities*' flagship project, contact Arjen Droste: <https://www.tudelft.nl/staff/a.m.droste/>

## Water management

Our water boards are a centuries-old institution dedicated to managing water. In the Netherlands, taking into account 'the water interest' already forms part of spatial plans. The Environment Act requires municipalities to include the water authority's views in their plans.<sup>37</sup> The question of what constitutes future-proof urban water management is evolving. In the parliamentary letter 'Water and soil management', Minister Harbers of the Ministry of Infrastructure and Water Management stresses that the water and soil system should be a guiding factor in choice of location for housing construction and the design of the area, neighbourhood or street.<sup>38</sup> The systemic changes required to achieve this have been underway in the Netherlands for some time. Rainwater is no longer simply drained through the sewer system, but is temporarily retained where possible and then infiltrated into the ground or delayed. More and more houses are also using rainwater as grey water via a separate system. However, the scale of climate change makes it necessary to look further, integrate new solutions and implement larger-scale spatial adaptations of outdoor spaces in the city.

Climate change can lead to lower groundwater levels resulting in foundation problems and subsiding homes, as well as lower home values and owners unable to afford climate measures.<sup>39</sup>

## Heat stress

While the importance of 'water' has been on the agenda for some time, the importance of a healthy urban climate has not yet received sufficient attention in practice. In addition to stronger rainfall, Dutch cities and some villages will experience more frequent and prolonged heat stress. Indeed, persistently warm periods will become more frequent, with urban areas warming up during the day and cooling insufficiently at night.<sup>40</sup> Heat stress directly affects people's health and well-being. It is therefore important to limit heat stress locally and provide enough 'cool spots' in the city where residents can stay when the temperature in their homes gets too high. This is another challenge to be solved in part in urban outdoor spaces. It is important to include in this the perceptions of residents and how they are able to cope with heat stress.

Research and strategies still too often continue to focus on the emergence and phenomenon of 'heat' on a larger scale and too little on the effects on people in the affected area.<sup>41</sup> A point of contact and clear responsibility for heat is also still missing.

## Social cohesion in the neighbourhood

In the recent report '*Grip: Het maatschappelijke belang van persoonlijke controle*' (Grip: The social importance of personal control), the Scientific Council for Government Policy (WRR) emphasises the importance of personal control, or 'grip' on one's own life:

37 [https://iplo.nl/thema/water/water-ruimte/beschermen-waterbelangen/?utm\\_source=hdwater&utm\\_medium=link&utm\\_campaign=waterenruimte](https://iplo.nl/thema/water/water-ruimte/beschermen-waterbelangen/?utm_source=hdwater&utm_medium=link&utm_campaign=waterenruimte)

38 'Water and soil management' letter to parliament p. 19 (Harbers & Heijnen, 2022)

39 ABN AMRO. (28 November 2023). Accumulation of climate risks and mapping out financial resources of vulnerable neighbourhoods in the housing market climate. [https://assets.ctfassets.net/1u811bvgvthc/5xd9o4LemKf4Iryn5clgEN/05316d09a6b7bd5bd45a13d453d03ace/Stapeling\\_klimaatri-s-co-s\\_en\\_financiele\\_draagkracht\\_op\\_de\\_woningmarkt-v5.pdf](https://assets.ctfassets.net/1u811bvgvthc/5xd9o4LemKf4Iryn5clgEN/05316d09a6b7bd5bd45a13d453d03ace/Stapeling_klimaatri-s-co-s_en_financiele_draagkracht_op_de_woningmarkt-v5.pdf) Accessed 6 March 2024.

40 See also research on the relationship of urban morphology and local microclimate: <https://www.tudelft.nl/stories/articles/nadenken-over-de-energie-vraag-van-morgen-in-nederlandse-steden-vandaag>

41 <https://research.tudelft.nl/en/publications/heatwave-vulnerability-across-different-spatial-scales-insights-f>

*Large groups of citizens, for example young people and households up to and including low middle-income earners, are experiencing insecurity and a lack of grip on their lives. When faced with insecurity and not feeling in control of their situation, it can affect their health and significantly reduce their life satisfaction. It can also be a source of social unease. Finally, there is evidence that a lack of grip experienced by someone is linked to world views and beliefs that are not conducive to the democratic rule of law.*<sup>42</sup>

The report links insecurity to the housing challenge in different ways. Firstly, insecurity arises if one cannot obtain the housing that suits one's basic needs. Insecurity can also arise when large-scale interventions take place in the physical environment, for example if a wind farm is planned nearby. Insecurity can also arise from developments in the social domain. If, for example, someone regularly experiences nuisance in the neighbourhood, this can be a source of feelings of threat and insecurity. Another source of insecurity is changes in the composition of the neighbourhood, for instance due to multiple occupancy dwellings, gentrification or the arrival of migrants: "You know who your neighbours were, but you don't know what neighbours you're going to get next."<sup>43</sup>

This shows that creating new living spaces needs to go hand in hand with ensuring a safe social living environment. That is a challenge that we believe is particularly important when increasing the density of neighbourhoods. A social, resilient living environment provides opportunities for interaction and connection. During the coronavirus crisis, we saw the

importance of not losing sight of each other in neighbourhoods. Increasing density offers opportunities, but requires a careful approach.

### Participation in the energy transition

The second theme of the TU Delft Climate Action programme – combating climate change (mitigation) – is also directly linked to preserving, improving and creating space for housing. It starts with making existing housing stock more sustainable. By 2030, 1.5 million homes must be made more sustainable.<sup>44</sup> That means making the homes energy-efficient, through good insulation against heat loss in winter and shade against heating in the summer. In addition, the houses must be heated with renewable energy, for example through a heat network or heat pumps.

Involving residents is an important part of this transition.<sup>45</sup> The plans and ambitions are there, but a lot still needs to be done to make this transition a reality.<sup>46</sup> The neighbourhoods can play an important part in this. Innovative solutions can be applied and evaluated gradually at this scale. Such solutions will be developed and tested in the low-regulation open-air laboratory 'The Green Village' on the TU Delft Campus.<sup>47 48</sup>

Residents can be actively involved in the energy transition at neighbourhood scale. This can extend beyond the provision of information and consultation evenings. If residents become joint owners of PV cells in the neighbourhood, or a local heat source, this can strengthen support and accelerate the energy transition.

42 'Grip: Het maatschappelijke belang van persoonlijke controle' (Grip: The social importance of personal control)(Scientific Council for Government Policy, 2023)

43 (Scientific Council for Government Policy, 2023), p. 54

44 <https://www.volkshuisvestingnederland.nl/onderwerpen/verduurzaming-eigen-woning>

45 <https://nplw.nl/participatiesamenwerken/participatieproces/default.aspx>

46 <https://www.pbl.nl/publicaties/overzicht-transitievisies-warmte>

47 For example, a solar heat network: <https://www.tudelft.nl/2020/tu-delft/bestaande-wijken-energieneutraal-dankzij-innovatief-zonnewarmtenet>

48 <https://www.tudelft.nl/innovatie-impact/home-of-innovation/special/wij-gaan-aantonen-dat-het-kan>

# 2.2 Opportunities

## Combine climate adaptation and energy transition with strengthening social cohesion in the neighbourhood

Shared outdoor spaces and collective indoor spaces in the neighbourhood offer opportunities to connect space for housing, climate adaptation, energy transition and social cohesion. New space for housing can thus strengthen the resilience and livability of existing neighbourhoods and increase support for increasing density.

Shared outdoor spaces, collective indoor spaces and participatory projects, including local renewable energy and energy storage initiatives, form a coherent approach to future-proofing living spaces for climate change. This approach incorporates both mitigation and adaptation strategies while promoting social cohesion. The synergy between these elements forms a self-reinforcing cycle that improves neighbourhoods in several dimensions.

### Opportunity 1: Outdoor communal spaces

Outdoor spaces created or improved together with new living spaces can contribute substantially to the climate resilience of the neighbourhood. If combined with jointly managed communal

parks, squares or gardens, this can simultaneously strengthen social cohesion in the neighbourhood.<sup>49</sup> These communal spaces contribute to climate adaptation by providing cool zones during heat waves,<sup>50</sup> increasing the overall resilience of the community. Cool places are important for city residents, especially if they live in homes that are not easy to keep cool.<sup>51 52</sup> These cool places do need to meet the requirements of people in the area. Therefore, it is important to design green and cooling outdoor spaces together with local residents.<sup>53</sup>

Ideally, local residents themselves play an active part in the decision-making process for the development and maintenance of these areas, so that they are tailored to their needs and a sense of ownership, unity and local governance is fostered.

Where outdoor space is suitable, collective management of outdoor space can transition to active use. For example, growing vegetables together in the communal outdoor space, or by using the space for cultural activities. This creates what are known as 'urban commons': resources shared by a local community.<sup>54</sup> In

49 (Feinberg, Ghorbani, & Herder, 2020)

50 At the Green Village on TU Delft's campus, research is being conducted into, among other things, how paved open spaces in the city can have a cooling effect: <https://www.tudelft.nl/stories/articles/hoemaakjeopenverharde-ruimte-in-de-stad-klimaatbestendig>

51 For example (Kluck et al., 2017; Kramer et al., 2023)

52 The Urban Forestry research project includes research into the effect of different tree species on the urban microclimate: <https://www.urbanforestry.nl> and <https://www.tudelft.nl/2020/tu-delft/klimaatarboretum-tu-delft>

53 The vulnerability of different population groups to urban heat stress has been demonstrated, but more research is needed in this area: (Ahmed, van Esch, & van der Hoeven, 2023)

54 For definitions and examples of the concept of 'urban commons', see, for example (Feinberg, Ghorbani, & Herder, 2021)

addition to existing squares and green spaces, urban 'residual spaces' also have potential for use as 'urban commons'.<sup>55</sup> Such 'urban commons' can have an important effect on social cohesion in the neighbourhood. It can increase residents' self-reliance, because when working together in neighbourhoods, residents have people around them who can help with other questions and problems, for example if you receive a letter from the government that you don't understand properly.

### **Opportunity 2: Collective indoor spaces**

Collective indoor spaces, such as community centres and shared facilities, act as crucial intersections for both social interaction and climate resilience. These spaces not only provide refuge during extreme weather conditions, but can also serve as educational centres for sustainable practices and climate awareness. Workshops and community events focused on energy efficiency, waste reduction and sustainable living can take place in these indoor spaces and become catalysts for positive environmental change and community ties.

Residents contribute to the direction and focus of these initiatives through local participation in decision-making processes, creating a sense of local pride, ownership and shared responsibility. In doing so, it is useful to distinguish between different levels of participation. A first step is to make spaces in the neighbourhood available for the neighbourhood, such as a library. A next step is to make spaces available for neighbourhood activities within such a library, community centre or other public building. If a residents' group is given the space to manage such a place and to programme activities, it ensures more active involvement of residents with the neighbourhood. The strongest effect on social cohesion can be expected from

those projects where residents jointly own an indoor and/or outdoor space and the activities taking place in it.<sup>56</sup>

### **Opportunity 3: Joint ventures and commercial activities**

Neighbourhood resilience also requires various local facilities. Local initiatives such as community centres and residents' businesses are essential for neighbourhood resilience.

There are many examples of vacant buildings in which residents' businesses have sprung up. We are also seeing a growing number of local energy companies, where residents invest together in sustainable local energy generation. Such resident companies are quite capable of reaching a wide target group in the neighbourhood. It seems that the impact on the neighbourhood is greater with these kinds of civic initiatives than with projects by traditional welfare organisations, for example. Despite this, there is still little policy from the government to support such long-term initiatives. Long-term support from the municipalities can make all the difference here to the neighbourhood's social cohesion.<sup>57</sup>

In addition to promoting social cohesion, residents' businesses and other local initiatives can also make the neighbourhood more resilient to climate change. Energy companies that have been set up locally can initiate sustainable behaviour and broaden support for the necessary changes.

'Urban commons' neighbourhood projects set up by residents, from urban agriculture and neighbourhood kitchens to energy companies, show time and again that they make the neighbourhood resilient, create widespread involvement and strengthen the sense of community.

55 <https://www.tudelft.nl/bk/onderzoek/research-stories/restruimtes-hebben-baat-bij-een-ontwerp-met-een-open-einde> <https://www.tudelft.nl/bk/onderzoek/research-stories/restruimtes-hebben-baat-bij-een-ontwerp-met-een-open-einde>

56 See next section

57 "Municipalities, engage in partnerships with residents' businesses in the neighbourhood" on Nuha Al Sader's thesis on "Entrepreneurial citizenship in urban regeneration". <https://www.tudelft.nl/bk/onderzoek/research-stories/gemeentes-ga-partnerschappen-aan-met-bewonersbedrijven-in-de-wijk>

# 2.3 Actions and tasks

## For resilient neighbourhoods

Increasing the density of **neighbourhoods** should go hand in hand with high-quality, climate-adaptive outdoor spaces and indoor public spaces.

- Urban public spaces need to keep heat stress manageable, as well as flooding.
- Jointly managed outdoor spaces can enhance resident engagement and neighbourhood livability.
- Residents' initiatives can play an important role in neighbourhood social cohesion.

We end each section with concrete tasks for local authorities, knowledge institutions and professionals to spur on action. To achieve resilient neighbourhoods, we see the following tasks:

**The government** should explicitly commit to realising high-quality, climate-adaptive outdoor spaces, partly with agreements in the housing deals and partly with national standards for buildings and public spaces.

**Knowledge institutions** should support this with research, education and design guidelines.

**Municipalities** should provide more open spaces – indoors and outdoors – for community initiatives and offer residents' businesses security through long-term agreements and support.

# Contributing to the public debate

TU Delft researchers often participate in the public debate. Below, as an example, is a summary of Peter Boelhouwer's essay "The housing crisis in the Netherlands: backgrounds and solutions".

TU Delft doesn't just do research and teaching. TU Delft researchers also participate in the public debate. A good example here is the essay "*De woningcrisis in Nederland; achtergronden en oplossingen*" (The housing crisis in the Netherlands: backgrounds and solutions) written by Prof. Peter Boelhouwer, professor of accommodation systems<sup>58</sup>. This essay was written in parallel with the Housing Vision Team's recommendation and is complementary to the four courses of action in this recommendation.

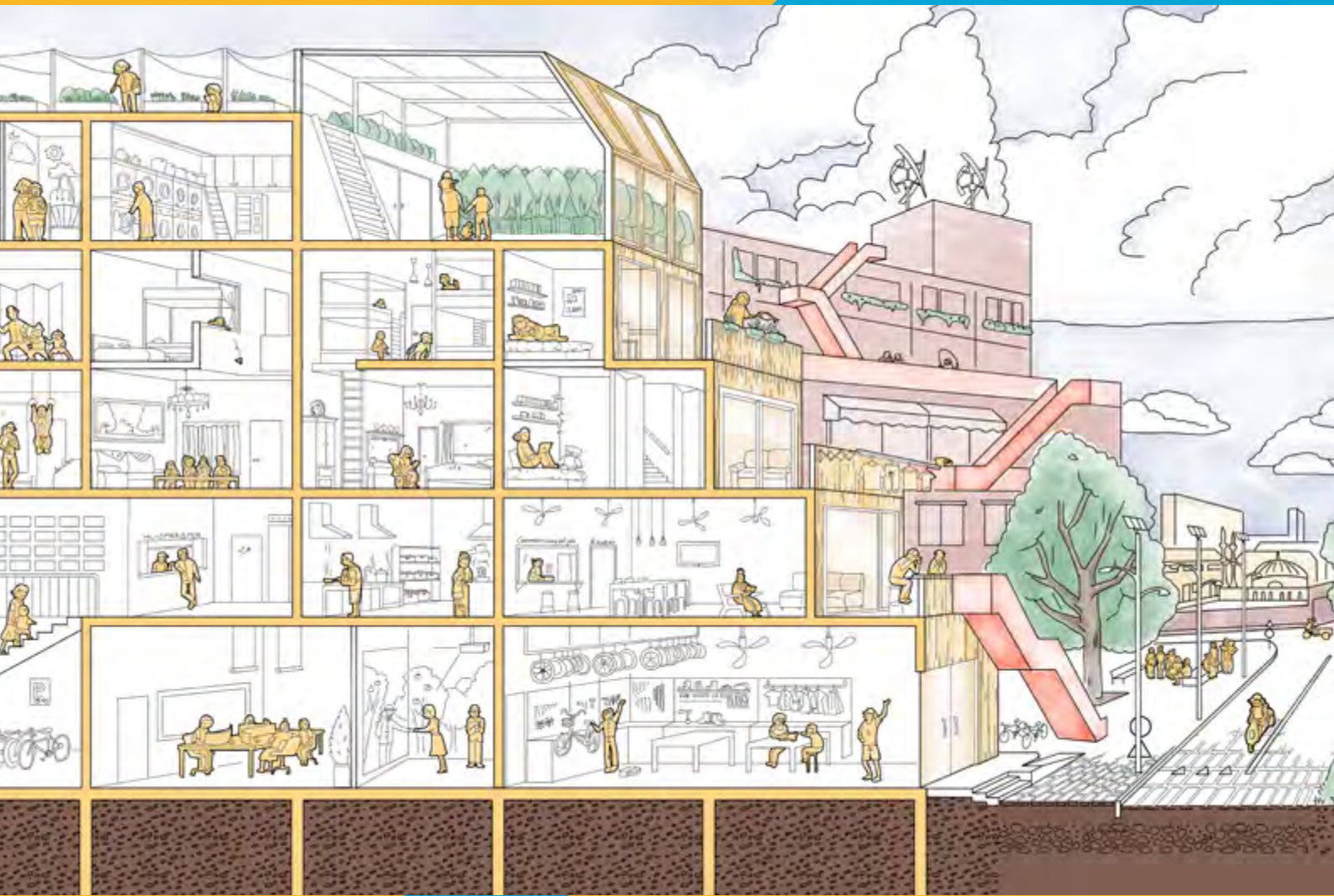
Peter Boelhouwer approaches the current housing crisis from a housing market perspective. He explains how the housing market works in the Netherlands and how it is linked to the welfare state. The essay offers an analysis of the main aspects of the housing challenge and how they arose. It pays plenty of attention to the housing shortage, the new start-up problem, the unfavourable position of middle-income earners, the lack of housing facilities suitable for older people and the affordability problem in the rental sector.

Boelhouwer argues for three interventions to address the existing shortage of adequate housing:

1. Politicians need to develop a vision of future accommodation in the Netherlands. Boelhouwer suggests as starting points:
  - Introduction of equal treatment between renting and buying (property-neutral housing policy).
  - Skimming value development of land due to change of use.
  - A politically set standard of affordability for low-income groups.
  - A governmental responsibility for housing market developments.
2. The government must regain control of public housing. This requires developing the right legal tools for effective policy and accelerating the process.
3. Tackling the housing crisis requires a substantial annual budget. Funding cannot come from housing consumers alone. Government support is necessary.

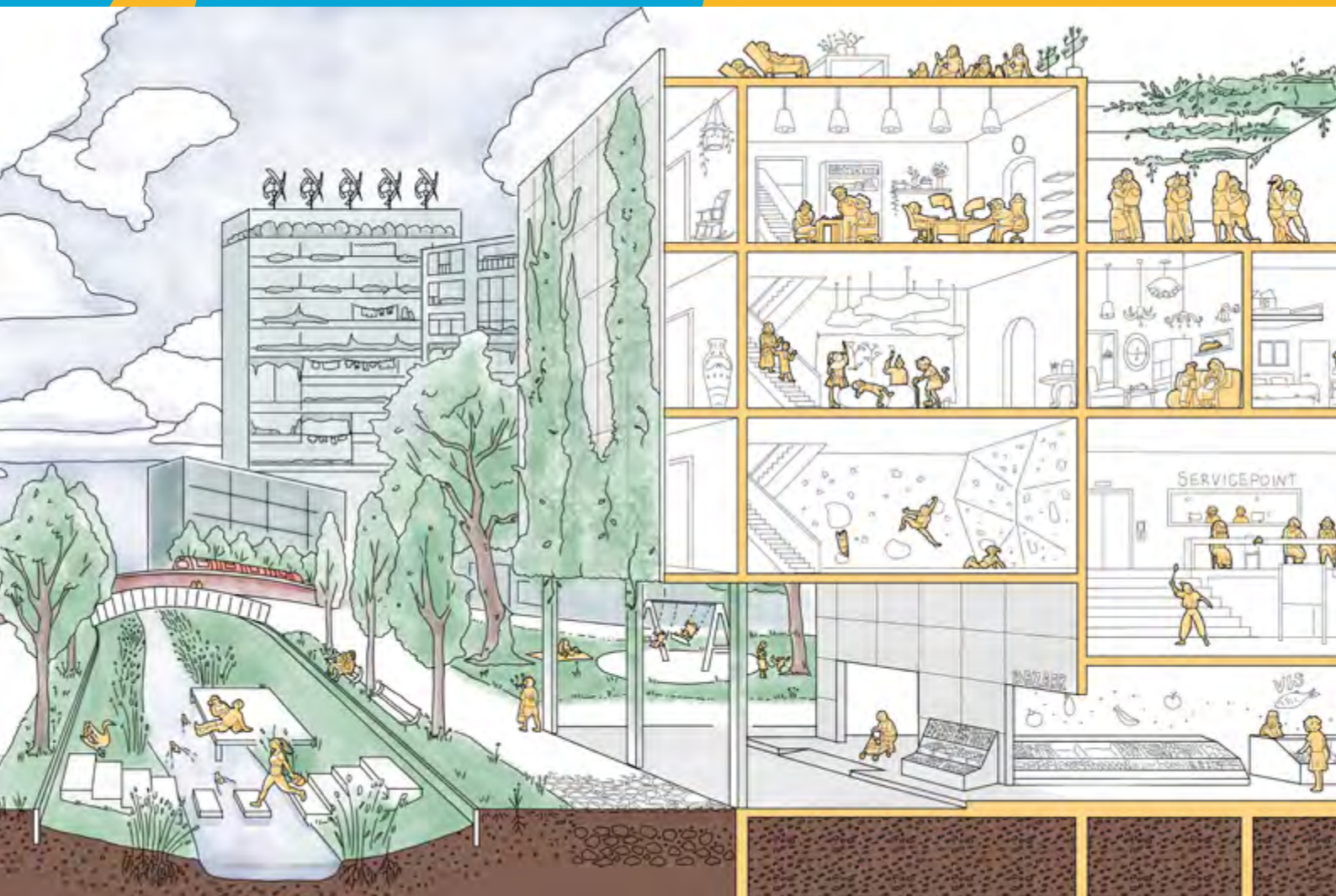
58 <https://www.tudelft.nl/bk/over-faculteit/afdelingen/management-in-the-built-environment/organisatie/leerstoelen/housing-systems>

59 Professor Peter Boelhouwer's full essay can be read on the Monitor Koopwoningmarkt website:  
<https://monitor-koopwoningmarkt.nl/2023/10/30/de-woningcrisis-in-nederland-achtergronden-en-oplossingen/>



### 3. Variation in housing types





*“More diverse, portable, divisible, mergeable and extendable. Housing should be adaptable to changing needs for the long term.”*

In the Housing and Construction Agenda, the national government (2022) has formulated ambitious goals: to build 1 million new homes by 2030, as well as make hundreds of thousands of homes more sustainable. These goals are very

challenging and require a lot of planning, participation and production capacity. The Netherlands will invest a lot of money and materials in achieving those goals in the coming years. At TU Delft, we see this as an excellent opportunity to create housing that meets future housing requirements, make the transition to a climate-neutral energy system and to a circular economy that stops using non-renewable raw materials and producing waste.

# 3.1 Backgrounds

## Suitable living spaces for future wishes and requirements

Population trends in the Netherlands are not linear or regular, but the trend is clear. Dutch society is in the midst of double ageing (more over-65s and more over-80s). This increases the pressure on care; more care is needed but there are fewer people to provide it.

The Netherlands is becoming more diverse and more crowded. That conclusion is drawn by the *State Committee Demographic Developments 2050* (2024). The committee concludes that for the Netherlands, moderate population growth towards 19 to 20 million inhabitants towards 2050 offers the best prospect of maintaining widespread prosperity. Lower growth inhibits the economy and higher growth sharpens the divisions in our society and undermines social cohesion.

### Various suitable housing options

No matter what demographic scenario: the Netherlands is becoming more diverse. On balance, migration creates population growth. Regardless of the scale of migration, Dutch society will have to relate to migrants. And vice versa: the same also applies to the newcomers themselves.

The proportion of single-person households is already 40% today and will only increase in the coming decades. Ageing isn't linear either. According to the State Committee, this will increase over the next 10 to 15 years, then stabilise and then decrease somewhat (State Committee Demographic Developments 2050, 2024).

Dutch households are getting smaller on average, but the housing area we use per person has only grown over the past century. In 1900, an average of eight people lived on 40m<sup>2</sup>, so 8m<sup>2</sup> person. Now we use 53m<sup>2</sup> per person on average in the Netherlands. This is not a plea to go back in time, but a call to think critically about the space we need. Could it be more efficient? Could it be smarter?

According to the State Committee, these developments call for a new culture of living and building. The housing challenge is all about improving the quality of life in the existing built environment. For this, housing is needed, aimed at a household composition that is constantly changing due to ageing, migration and an increase in the number of single-person households. The State Committee advocates facilitating more communal types of housing, so that care issues and social problems such as loneliness can also be addressed in this.

More flexibility is also needed, both in terms of location and type of construction. Existing housing construction can be used to create more homes, for example by adding a storey or splitting dwellings. New flexible and portable housing can offer solutions for places where use of the site is only possible temporarily or in situations where housing demand is temporary or insecure (e.g. labour migration, international students, asylum seekers, holders of residence permits or refugees from Ukraine).

Each of these types of housing will not solve the current housing crisis on its own, but combined, they can make a major contribution to future-proof living in the Netherlands. Besides expanding the housing stock, using existing housing space as efficiently as possible is also essential. For example, by accelerating flow in the housing market.

Building costs money and requires a lot of raw materials. Building flexibility into the housing stock can ensure that we do not use more material than is strictly necessary. By utilising existing buildings as much as possible and using bio-based building materials, a new building culture can also help to achieve sustainability objectives that put less pressure on the lack of space and raw materials.

Like the State Committee, the Planning Bureau for Liveability (PBL, 2021) also advocates greater diversity in housing types. The demographic trend towards more single-person households does not necessarily mean a changing housing preference for smaller homes. Due to blended families and co-parenting, housing needs on weekends or holidays can be very different from those during the week. Thanks to Covid, working from home has increased and is now becoming a permanent part of our working and living culture. Future-proof housing calls for the function of the home to be expanded to living, education, care and work spaces.

The plea to make better use of existing housing (Van Klaveren, Wassenberg, & Zonneveld, 2021<sup>60</sup>) does mean that there will be an adjustment challenge on top of the new-build construction challenge. Part of the housing stock will still need to be adapted to future quality and usage requirements. This demand for

adjustment competes with demand for new-build housing due to capacity in the construction sector (PBL, 2021<sup>61</sup>).

### Changing living requirements

Climate change also creates stringent requirements for our homes. Homes need to be more energy sustainable and, even better, generate new energy. At the same time, climate change may also require other adaptations to buildings. We need to use water more sparingly, drain excess water or put it to domestic use. Global warming is also making residential cooling increasingly relevant in the Netherlands. All this requires innovative technical installations. Those installations are becoming an increasingly more significant part of the home, as well as of the construction and maintenance costs.

60 Van Klaveren, S., Wassenberg, F., and Zonneveld, M. (2021). *Beter benutten bestaande woningbouw* (Better use of existing housing stock). The Hague: Platform31

61 PBL Netherlands Environmental Assessment Agency (2021). Living post-election. The housing shortage in the region is being resolved. The Hague: PBL

# 3.2 Opportunities

## Variation in housing types

### **Opportunity 1: Support diverse and flexible housing projects**

The living space being created now by new construction or renovation must fit (or be adaptable) to the, as of yet, largely unknown wishes and requirements of future generations of residents for a long time to come. Variation is therefore necessary. To do so, we need to build more diverse housing types and ensure that these homes are and remain adaptable. One-size-fits-all homes do not exist, but homes are often suitable for use by multiple types of households. From an international perspective, for example, the Netherlands has a lot of single-family terrace houses. The fact that families often no longer live here does not mean that this housing type is dated. This might show that we have too many of them and that we can use those millions of spacious single-family dwellings more efficiently.

Innovative and diverse housing typologies can make smaller homes more attractive and liveable. Making living spaces more responsive to residents' wishes and requirements can contribute to more efficient use of spaces. Many senior citizens want to live in a more suitable, yet affordable, manner, and preferably in their trusted environment.

Suitable living requires a different perspective on the use of spaces. Not all spaces need to be private. Sometimes it's good to share spaces that you don't often use, such as gardens,

storage spaces or guest bedrooms. Living space doesn't always have to be permanent either if the demand isn't there. This can apply to international students, migrant workers, and to holders of residence permits who need temporary accommodation in the phase between the reception centre (AZC) and obtaining permanent housing. Sharing can contribute to social contact, to mutual support and thereby to well-being.

### **Opportunity 2: Support collective and mixed housing initiatives**

In the Netherlands, we want to build more homes quickly. But if we build without thinking about the way in which we want to live together, we aren't resolving the housing market's fundamental problems. In addition to more good, affordable and sustainable homes, accommodation solutions should also strengthen social bonds and encourage care. Collaborative types of housing have the potential to satisfy all these conditions<sup>62</sup>.

Collective housing initiatives have grown over the past decades in response to a series of crises, in particular the worsening affordability and availability of homes, the deterioration of the environment, weakened care systems and loneliness. Compared to countries such as Sweden, Denmark and Austria, the Netherlands doesn't have a real tradition when it comes to collective types of housing, but is currently undergoing a cautious rise. Housing associations have been included in the Housing Act and various municipalities have action plans to

62 Diverse TU Delft experts have researched the impact of the changes in the elderly care system and its effects on housing. For example: <https://www.zorgsaamwonen.nl/expert/birgit-jurgenhake> <https://www.zorgsaamwonen.nl/artikel/geschied-wonen-voor-ouderen-twee-vliegen-een-klap>

support collective types of housing (City of Amsterdam (2019);<sup>63</sup> City of Rotterdam (2019).<sup>64</sup> Platform31 (2022)<sup>65</sup>).

The term collective housing includes a variety of models, such as co-housing, housing associations, Community Land Trusts (CLTs) and Ecovillages. Collective housing can be realised in new-build projects, but the transformation of existing buildings into collective housing is another promising development. The availability of underutilised or empty buildings such as schools, warehouses and farms in rural areas offers possibilities for groups of people to turn these buildings into collective housing, including a mixture of private dwellings and different types of shared indoor and outdoor spaces, such as guest rooms, workshops or a library (Czischke, Brysch, & Peute, 2023<sup>66</sup>).

Collective housing can also contribute to higher quality and better affordability than more conventional housing. If future residents are involved in the design, they can achieve a building design that meets all their requirements. The investments are often lower and the maintenance and management costs are also lower over time. Unlike housing construction projects that are organised top-down, future residents often come together to devise creative solutions. For example, by agreeing to complete shared spaces later or by making each resident responsible for completing their own home (Brysch, 2023<sup>67</sup>).

Collective housing can help to support residents requiring care or attention. Residents' groups can support each other in mixed projects in particular. For example, mixed housing in which

students and older people come into contact a few hours a week and housing projects in which young people and holders of residence permits are responsible for shared activities and management (Czischke & Huisman, 2018;<sup>68</sup> Van der Horst, 2024<sup>69</sup>).

### Opportunity 3: Ensuring long-term adaptability of housing

Adaptable homes can satisfy changing spatial needs and thereby reduce the need for relocation. Flexible housing calls for changes on different scales. When apartments can easily be linked and separated, they can adapt to changing requirements. That calls for smart design choices, detachability and future-proof adaptability of modules such as toilets, bathrooms and kitchens. In addition, adaptable homes place high demands on fire and sound insulation.

Portable homes can form a temporary shelter for various special target groups. This temporary type of housing is used in places awaiting transformation of the intended use.

Flexibility often requires higher investments at the beginning. Yet it is an investment that is more sustainable and financially more attractive over time because the building is able to meet the changing needs of residents for longer. Types of finance must take into account the costs and benefits during the entire lifecycle (and for flexible homes: several lifecycles) of homes. The management of flexible residential buildings is important too: is the flexible potential of a home or building actually being used or is it being forgotten about?

63 City of Amsterdam. (2019). Housing associations' action plan. City of Amsterdam: Amsterdam

64 City of Rotterdam. (2019). Cooperative housing action plan. City of Rotterdam

65 Platform31. (2022). Evaluation of Cooperative Housing Action Plan. Platform31 The Hague

66 Czischke, D., Peute, M., & Brysch, S. (2023). *Together. Ruimte voor Collectief Wonen* (Together. Space for Collective Housing). Rotterdam: NAI

67 Brysch, S. (2023). *Towards a new Existenzminimum: Defining principles for the co-design of affordable collaborative housing*. [Dissertation (TU Delft), Delft University of Technology]. A+BE | Architecture and the Built Environment. <https://doi.org/10.7480/abe.2023.23>

68 Czischke, D., Huisman, C. (2018). *Integration through Collaborative Housing? Dutch Starters and Refugees Forming Self-Managing Communities in Amsterdam In Urban Planning*, 3(4). <https://doi.org/10.17645/up.v3i4.1727>

69 Van der Horst, L. (2024). *Reimagining Home: a Qualitative Research on Innovative Flex Housing Partnerships and Subsidies for Empowering Status Holder Integration* [TU Delft graduation thesis]

Many flexible accommodation solutions are already being developed and offered at home and building level. The integration of projects in the existing environment and the design of the public space of flexible projects is a point for attention, but positive developments are visible there too. For example, Frits Palmboom, with support from the *Noord-Hollandse Bouwstroom (NH Bouwstroom* for short) and the *Federatie Ruimtelijke Kwaliteit*<sup>70</sup> (Federation of Spatial Quality), published a guide for the urban development quality of industrial housing construction. In November 2023, the Board of Government Advisors, in conjunction with the *Federatie Ruimtelijke Kwaliteit*, published an Architectonic framework.<sup>71</sup>

### Encourage Open Construction

The question how buildings can remain adaptable for the long term is nothing new. New-build housing still focuses too much on being one-time only. Reuse costs a vast amount of material and energy. Open Construction is a way of adapting buildings/residential buildings to the time in a responsible manner by making a clear distinction between the supporting structure, the façade, installations and the interior walls of a building.<sup>72</sup> New-build housing that isn't flexible or adaptable may now be cheaper, but in the future it will be more expensive due to necessary renovations being required early on. New-build housing is the renovation of the future. Our buildings must therefore be more adaptable, and that's possible by building in a more open manner.

As early as 1960, the architect N. John Habraken advocated the 'Open Construction' concept.<sup>73</sup> At that time, the focus of 'open construction' lay on the residents and their freedom to design their living environment. With all the challenges that the circular

economy, the energy transition and climate adaptation place on housing construction, the concept is now receiving a new relevance. Habraken's body of thought is very up to date and must be developed further.

To firmly embed Open Construction in society, more research must be conducted by the construction sector. Designers, government, clients and builders must join forces to optimally integrate industrialisation and digitisation in construction/installation. That's where the opportunities lie.

Supporting structures have a much longer lifespan and you don't simply demolish them after a few decades. Take a look at the canal houses in Amsterdam. Those structures have been standing there for centuries and are constantly being adapted. That value is undisputed. Implementing Open Construction now can mean a major innovation for our design and construction industries. It's more future-proof and promotes circularity and good reuse. A start can also be made to building appropriate housing for increasingly more diverse households, in all types, sizes and phases of life.

### Support the transformation from buildings to homes

Even if buildings haven't been built in an adaptable manner, it is possible to give them a new lease of life. When buildings haven't been built in accordance with the aforementioned Open Construction principles, it is still possible to give them a new lease of life. Such a transformation will probably be more challenging, but not impossible – especially not if those buildings are of social value, have heritage value or have been designated as a municipal or national monument.

70 <https://www.ruimtelijkekwaliteit.nl/informatief/publicaties/item?id=41>

71 <https://www.collegevanrijksadviseurs.nl/adviezen-publicaties/publicatie/2023/11/21/architectonisch-kader-ruimtelijke-kwaliteit-bij-industriele-woningbouw>

72 <https://www.openbuilding.co/manifesto>

73 Habraken, N.J. (1961). *De dragers en de mensen: Het einde van de massawoningbouw* (The carriers and the people: the end of mass house building). Amsterdam: Scheltema & Holkema

With support from the Ministry of the Interior and Kingdom Relations, TU Delft published the book '*Transformatie naar Woningen*' (Transformation into Homes).

This publication presents a range of possibilities to give existing, usually non-residential, buildings a future-proof housing function (Remoy, Van Bortel, Heurkens and Van Venrooij, 2024<sup>74</sup>).

Houses can be transformed too, by splitting or merging them, for example. New space for homes must be in keeping with future housing requirements, even if these change. If living space is diverse and flexible, this contributes to two major challenges: the transition to a climate-neutral energy system and to the use of circular raw materials.

74 Remoy, H., Van Bortel, G., Heurkens, E. and Van Venrooij, R. (2024). *Transformatie naar woningen* (Transformation into Homes). Delft: TU Delft Open.

# 3.3 Advice and tasks

## For creating diverse, flexible and adaptable living spaces

**Residential buildings** should match the changing needs of residents for the long term.

- The housing supply should diversify not just in terms of size and price, but also in type and form, to do justice to the diversity of housing requirements.
- Residential buildings should be long-term adaptable, so that dwellings can easily be split, merged or extended.
- There should be more space for collective housing projects as a vital part of the housing supply.

We end each section with concrete tasks for local authorities, knowledge institutions and professionals to spur on action. To achieve resilient neighbourhoods, we see the following tasks:

**Municipalities, provinces and the government** should focus on a more diverse range of housing types and housing forms when managing the housing supply.

**The government** can increase the adaptability of existing dwellings by reviewing regulations surrounding the splitting and merging of dwellings.

**Knowledge institutes** can support both developments through research into types of housing and their translation into education and practice.

In order for the number of collective housing projects to grow, **the government** needs to better support them through appropriate regulations. Here, too, there is a role for **knowledge institutes** in knowledge development and knowledge sharing.



# TU DELFT KNOWLEDGE CENTRES AND PARTNERSHIPS

TU Delft collaborates with others on the housing challenge in different knowledge centres and in partnerships. This is how we combine our knowledge. This Housing Vision contains, above all, a call to work with us. To start building together, literally and figuratively. Please find below partnerships in which we work.

- **The Housing Vision Team**  
Contact: [visionteamwonen@tudelft.nl](mailto:visionteamwonen@tudelft.nl)  
Website: <https://www.tudelft.nl/strategie/vision-teams/wonen>
- **TU Delft Circular Built Environment Hub**  
Website: [www.tudelft.nl/bk/onderzoek/onderzoeksthemas/circular-built-environment](http://www.tudelft.nl/bk/onderzoek/onderzoeksthemas/circular-built-environment)
- **TU Delft Colab Research, Knowledge hub on Collaborative Housing**  
Website: <https://co-lab-research.net>
- **1Mhomes**  
Website: <https://www.tudelft.nl/en/architecture-and-the-built-environment/research/research-at-bk-bouwkunde/1m-homes>
- **TU Delft Centre of Expertise for Housing Value**  
Website: [www.tudelft.nl/bk/samenwerken/kenniscentra/expertisecentrum-woningwaarde](http://www.tudelft.nl/bk/samenwerken/kenniscentra/expertisecentrum-woningwaarde)
- **TU Delft Design for Values**  
Website: [www.delftdesignforvalues.nl](http://www.delftdesignforvalues.nl)
- **Gebiedsontwikkeling.Nu platform**  
Participation with the *Stichting Kennis Gebiedsontwikkeling* (Foundation for Knowledge Area Development, SKG)  
Website: [www.gebiedsontwikkeling.nu](http://www.gebiedsontwikkeling.nu)
- **Resilient Delta**  
Part of Convergence, the partnership between TU Delft, Erasmus University Rotterdam and Erasmus MC.  
Website: [convergence.nl/resilient-delta](http://convergence.nl/resilient-delta)



# 4. Circular and modular design and construction



*“Radical changes are necessary in the construction industry to tackle the housing challenge, whilst simultaneously preventing climate change. A different approach to building can lead to a circular future.”*

The new building and renovation of homes is necessary in order to solve the housing shortage. The way in which we construct and renovate also requires attention. If the current way of building changes, this can also make an important contribution to the prevention of climate change and the reduction of our use of raw materials. A different approach to building can lead to a circular future.

# 4.1 Background

## Radical changes are needed to an outdated way of building

The construction of homes is a complex process in which building components, building materials, building processes, building companies, building regulations and the design of buildings are all connected and depend on each other. This becomes obvious as soon as a change in 'construction' is proposed. The renewed interest in timber construction is a perfect example of this. A seemingly small change in construction material always requires the construction companies to adopt a different construction process, and a different design of building components by designers and engineers should take into account that a wooden building responds differently to heat, cold and sound than a concrete or brick building. Many parties therefore need to adapt their way of working and acquire the correct knowledge.

Yet radical changes are necessary in the construction industry to reduce climate change, whilst at the same time tackling the housing challenge. The production of important building materials such as concrete and steel is very energy-intensive and causes a lot of harmful emissions. Transportation of materials to the construction site and further handling on the construction site are also a source of CO<sub>2</sub> emissions and nitrogen. The necessary transition to a circular economy requires the ability to recycle buildings and building components. The housing challenge benefits from this when the construction of homes becomes more efficient and thereby quicker and cheaper where possible.

### Circular construction

The Netherlands is on its way to a circular economy in which raw materials are reused.<sup>75</sup> This transition is a big job for the Dutch construction sector. After all, it is estimated to be responsible for 50% of the Netherlands' raw material consumption and a large proportion of all waste.<sup>76</sup>

*Circular construction requires the construction sector to transition. The emphasis lies on achieving high or higher-quality reuse in all sub-markets of the construction industry. Another way can be using bio-based materials, materials that are 'infinitely' available, such as wood, hemp, elephant grass etc. It means that a new market is emerging in which chain partners work together differently. A market with new technologies, in which other products and services are required. A financial incentive, innovative forms of funding and alternative forms of tender are required. Adaptation of legislation and regulations is vital. The aim of training courses will be to develop and disseminate new knowledge and skills. Circular Construction Economy Transition Plan, 2018<sup>77</sup>*

75 Circular Economy Implementation Plan (Ministry of Infrastructure and Water Management, 2020)

76 Circular Construction Economy Transition Plan (Nelissen et al., 2018)

77 Circular Construction Economy Transition Plan (Nelissen et al., 2018)

There are two principles of circular construction that strengthen each other: reuse of components and materials and the use of circular bio-based materials.

### Demountable construction

High-quality reuse of raw materials in the construction sector becomes possible when building components, when they are due for replacement, can easily be removed and the used building materials in that part of the building can easily be separated from each other and reused. Reuse of building components is preferential in this regard over reuse of building materials.<sup>78</sup> This doesn't just require innovation during the demolition process. After all, a building must already be designed on the drawing board in such a way that all components can easily be dismantled and reused later on.

### Bio-based materials

The use of natural materials is a different way of achieving circularity in the construction sector. Such 'bio-based' materials grow, can be harvested and used in the construction industry as support structures (e.g. wood) or insulation materials (e.g. mould filaments<sup>79</sup>). These materials store CO<sub>2</sub> during growth. As long as a bio-based material remains in the building, this therefore has a dampening effect on the construction sector's total CO<sub>2</sub> emissions.

As described in the Circular Construction transition plan, these two circular construction principles require good collaboration between all parties involved.<sup>80</sup> That applies just as much to new-build housing as to the renovation of existing housing stock.<sup>81</sup> There are also practical challenges. For example

'demountable construction' may require more preparation and involve more costs than conventional construction. And a light wood construction has less mass and can therefore be more permeable for heat and sound.

### Industrial, Flexible and Demountable construction

In the construction of new homes, the Ministry of the Interior and Kingdom Relations is dedicated to industrial, flexible and demountable construction (IFD), among other things<sup>82</sup>. In this regard, the benefits of circular, demountable construction come together with the benefits of fabricating major parts of buildings in a factory. The principle behind it is nothing new. Of course, components such as windows or technical installations have long been produced in the protected environment of a workshop and then installed on the construction site. What is new, however, is that major building components such as roofs, large façade elements or complete building modules with floors, walls, window frames, ceilings and façades are now pre-fabricated in a factory.

Industrial construction can considerably reduce the construction time on site. CO<sub>2</sub> and nitrogen emissions and noise nuisance on the construction site is also reduced. This type of construction does, however, require a considerable investment in the factory in which the components are manufactured.<sup>83</sup> In addition, serial production can lead to boring buildings. Examples from the rebuilding phase in the Netherlands are making many people doubt the industrial construction.

78 <https://www.rvo.nl/onderwerpen/r-ladder>

79 <https://www.tudelft.nl/stories/articles/de-nieuwe-binnenwand-demontabel-duurzaam-en-puur>

80 <https://www.tudelft.nl/stories/articles/patronen-doorbreken-voor-circulaire-bouw>

81 <https://www.tudelft.nl/stories/articles/stappen-maken-naar-circulair-renoveren>

82 <https://www.volkshuisvestingnederland.nl/onderwerpen/circulair-en-industrieel-bouwen>

83 *Economisch Instituut voor de Bouw*: Industrial construction and the construction labour market (*Economisch Instituut voor de Bouw*, 2023)

# 4.2 Opportunities

## Scale up!

The housing challenge and the necessary transitions in the construction sector can strengthen each other, especially now, but that requires a strong boost from the government and a widespread collaboration of different parties involved in the construction sector.

### Opportunity 1: build a collaborative platform for the scaling up IDF construction

If the construction sector in the Netherlands now dedicates itself to large-scale industrial, demountable and flexible construction, the major housing challenge could ensure that this construction method becomes profitable. The technical challenges require a widespread collaboration between construction companies, designers, engineers and clients. The government must give the necessary boosts and the knowledge institutes must support this transition with design knowledge, technical expertise, innovations and knowledge of change and participation processes.

Industrial, demountable and flexible construction can help with the housing challenge in four ways.

- Firstly, the construction period can be decreased. That does, however, require work planning to be designed differently.
- In areas where construction activities are hindered by the nitrogen problem, industrial construction can provide an answer. After all, less nitrogen is released locally for this construction method.

- When parts of buildings can be replaced it can postpone demolition, thereby extending the lifespan of the other building components. This can create longer value retention and thereby make alternative financing possible. Concrete solutions to make this possible are still lacking.
- IFD can ensure a shorter planning time. If industrially built houses can be stamped “complies with Building Decree” upon delivery from the factory, this will not require a separate permit test by the municipality. However, the spatial quality test still emphatically requires further elaboration.<sup>84</sup>

### Opportunity 2: serial construction with flexibility

The fear of monotony caused by industrial construction is certainly not unfounded. Ultimately, the same applies here as with traditionally built housing, which often enough leads to monotonous neighbourhoods: urban development integration is crucial for spatial quality. Frits Palmboom, in collaboration with the College of Government Advisors, provides an impetus to this end: “Housing isn’t just about individual residential enjoyment, but also determines the collective quality of life of neighbourhoods, cities and villages we live in.”<sup>85</sup> A modular design requires customisation in the right places to ensure variety and good spatial integration. The challenge here is dual: designers must deal well with the possibilities and limitations of industrial construction, and builders must allow customisation and variation.

84 Essay “De woningcrisis in Nederland. Achtergronden en oplossingen” (The housing crisis in the Netherlands. Backgrounds and solutions) (Boelhauer, 2023)

85 *Ruimtelijke kwaliteit bij fabrieksmatige woningbouw* (Spatial quality in factory-built housing) (Palmboom, 2023)

### Opportunity 3: financing appropriate circular lifecycles

Flexibility, circularity and adaptability sometimes require additional investments, many of which pay for themselves later. Conventional types of valuation and financing are not often geared to this. Sometimes the return (positive or negative) is not financial but has an effect on our society or environment. The government can help incentivise those future gains and losses through subsidy or taxation.

A more integrated, long-term view of investments, value and costs is necessary. All revenues and income over the total life cycles of a building and its constituent building components and materials must count, for example, by assuming the value, costs and revenues over the total life cycle of buildings, land and materials used when determining the WOZ value and in property operation calculations.

Concepts such as Total Costs of Ownership (TCO) and Life Cycle Costs (LCC) should become more common in financing and managing buildings. It is also important to include external costs, for example by taxing the CO<sub>2</sub> emissions associated with the construction and use of a building.

# 4.3 Advice and tasks

## For circular and modular construction and design

In the **construction sector**, the housing challenge can accelerate the transition to new, more sustainable and circular construction methods.

- Scaling up Industrial, Flexible and Demountable building (IFD) needs widespread collaboration from the construction sector, clients, designers, engineers and researchers.
- IFD building should always be done with an eye for spatial quality and space for customisation.
- The benefits of long-term adaptability of buildings for sustainability and value preservation should be echoed in the financing of these projects.

We end each section with concrete tasks for local authorities, knowledge institutions and professionals to spur on action. To realise a variety of housing types, we envisage the following tasks:

**The government and knowledge institutes** are the appropriate partners for setting up a platform in which all parties work together to scale up IFD building.

**Municipalities** should monitor spatial quality in IFD building projects together with **designers**.

**The government and municipalities** should value and support the ecological and social benefits of long-term adaptable building projects through taxation and land exploitation.





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# Afterword

# From future prospects to action

## Call to readers

Good and affordable housing for all: a future prospect that should become a reality as soon as possible. As a society, we face a huge and complex challenge. When we look back, we can see that this challenge has come to the fore as a matter of urgency several times in the last century as well, which means it is definitely not new. However, the context in which answers must be sought today is new, and seems unrulier than ever.

### **Not just one solution that's required, but many**

This recommendation aims to provide an overview of a multitude of perspectives and opportunities needed to find answers. It does not provide a conclusive answer. What the document makes clear is that actual steps require knowledge to be pooled and made available to everyone, from residents and home seekers to developers and builders, from research and education to housing associations and the government.

With this recommendation, TU Delft aims to take an important step to pool and share knowledge in support of all partners involved in making good working and living a reality. This publication contains references to research findings, books, websites and contact details. A lot of knowledge is not applied for too long. There is a lot of talking and writing, but too little knowledge sharing and pooling, collaboration, experimentation, learning and scaling up and eventual realisation.

New steps are needed, and, without question, we also need the government in this. It is for this reason that we also address this vision document first to policy makers at national, provincial and local levels. From the perspective of research and education at TU Delft, the authors of this recommendation put forward a number of courses of action to activate the knowledge and develop it into concrete proposals and solutions. Three concrete actions run like a thread through this recommendation.

### **1. Offer opportunities to a new generation of designers**

There is a lot of knowledge and, above all, ambition among our students to contribute to the housing issue. We train students to become innovative and engaged designers. Unfortunately, it is not easy for new generations of alumni to put their knowledge and skills into practice.

The Netherlands still has a great reputation beyond its borders as a country of innovative and high-quality housing construction. The reality today is that many builders and developers cling to tried-and-tested yet outdated design and implementation principles that do not answer today's questions.

Open appeals and design contests with implementation opportunities accessible to new generations of designers should be used to provide scope for innovation and experimentation. Housing associations also play a major role in this. In the past, innovation in housing construction mostly came about precisely through the commitment of corporations that were open to new ideas. If we want to live up to our past reputation again, a great deal of action is needed, but also possible!

### **2. Use design-based research at all scales**

The complexity and stratification of the housing challenge and the need for creativity, innovation and action calls for design-based research: from landscape and city to neighbourhood and home, from large-scale infrastructure to the smallest building detail. Critical exploration and analysis of the challenge of sustainable spatial planning and area development should be linked much more directly to concrete design and implementation proposals. At TU Delft, methods for this have long been set up and have proven to be quite useful. These need to be shared and applied more widely.

### **3. Set up a Housing Knowledge Centre**

TU Delft is keen to lead the way in setting up a Housing Knowledge Centre to pool and disseminate knowledge. The government and other parties are obviously required for this. The radical changes needed in spatial planning, design and construction can only come about with a broad alliance of partners. This is a major operation that cannot be left to the market alone, but requires a stronger role for other segments of society: government, citizens, communities, the entire civil society.

Here, too, are examples from the Netherlands' glorious history of planning, designing and realising our living environment. Consider the reconstruction and establishment of the Construction Centre as an open source of information. In our age of digitisation, data and AI, innovative ways can once again collect and make available all the relevant information to meet the major housing challenge.

## In conclusion

There is no single solution, but many are needed. Similarly, action is needed in lots of areas. With the three actions proposed above, we can collectively revive our country's reputation as a frontrunner in policy and design related to area development, housing construction and affordable housing. And take the necessary steps to achieve a good and affordable home for everyone in our country, in an attractive, healthy and safe living environment.

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# Experts

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