Build Up Skills NL

Analysis of the national status quo

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D2.4 Analysis of the national status quo

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Summary

The urgency to accelerate the energy transition is emphasized by the release of the European Commission's 'Fit for 55' package on 14 July 2021. This comprehensive package aims to align the EU's climate and energy legal framework with its 2050 climate neutrality target and the ambitious goal of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. The energy transition in the built environment is crucial for achieving the European energy and climate objectives for 2030 and 2050. To ensure success, it is of paramount importance that involved employees are equipped with the right skills.

In 2011, the establishment of the European BUILD UP Skills initiative and the creation of the National BUILD UP Skills Platform led to an initial status quo analysis of craftmanship for the energy transition in the built environment. This analysis aimed to identify the barriers and gaps between the current situation and future requirements for a larger number of qualified workers in the Dutch market. In addition, it focused on measures to facilitate decision-making for building owners to ensure that the construction and installation sector was prepared to achieve highly energy-efficient renovations and nearly zero-energy buildings (NZEBs). The analysis also included the evaluation of existing job profiles and qualifications within the construction and installation sector, with adjustments and new overlapping job profiles.

To stay in line with the evolving landscape of energy transition and to accelerate it in the Netherlands, the EU-funded BUS-NL project has updated the status quo analysis. The goal was to provide a comprehensive overview and insight into the status quo of craftsmanship for the energy transition of the built environment in the Netherlands. This report begins with a description of the policies related to energy transition, climate, biodiversity and circular economy in relation to the built environment in the Netherlands. It then discusses the required craftsmanship and education system regarding the transition to a healthy, sustainable, and climate-resilient built environment.

Key findings

Indicator	Value(s)
Number of current professionals in the construction sector	579.000
Current energy consumption in the Netherlands and in the built environment (2021)	Services 14 percent Households 23 percent Final energy usage decreased with 11% since 2010 Renewable heat accounted for 9.6% of household final heat consumption
2030 energy goals for the Netherlands and the expected	A 49% reduction in CO2 emissions by 2030 compared to 1990 and a 95% reduction in CO2 emissions by 2050 compared to 1990.

contribution of the construction sector	By 2050, 7 million homes and 1 million buildings will no longer use natural gas. Renovate 1.5 million existing homes by 2030 to phase out poor energy labels (E, F, G) Installation of 1 million hybrid heat pumps and the realization of 500,000 new connections to district heating in existing residential buildings.
Number of construction professionals to be trained to achieve 2030 energy goals	Nearly al construction professionals will need to be upskilled on one or more specialisms needed to achieve 2030 energy goals For the period 2022-2030, an influx of 140,000 labourers is expected in the cautious scenario and 175,000 in the dynamic scenario
Qualification needs in the Netherlands per education level	At higher education level (EQF 5-8) the transition needs upskilling in topics such as digitisation, circularity, business modelling and logistics. This to change primary processes and related businessmodels. In Secondary Vocational Education (VET) and professions related (EQF 1-4) the transition needs specialisation in related technologies such as heatpumps, solar, battery storage working with other materials (such as biobased ones) and working with digital tools.
Required qualification courses by EQF level and schemes, number of required trainers, training and accreditation structures for carrying out the trainings.	Due to the high number of involved technologies and professions involved, the plethora of transition recipes and lack of data the Dutch team has chosen not to quantify these elements in the Status Quo Analysis. Instead the team performed quantitative research focussing of getting insights in the Skillgaps for a broad range of specialisms (technical and non-technical skills) for professions involved.
The shortage of employees per field could not be properly quantified due to missing data and the complexity of the transition to sustain the built environment. Small changes in policies from the government or changes on how the construction sector addresses the transition are have a big impact on the expected shortages and related upskilling issues. For example in 2023 government policies implemented required rapid upskilling of 12.000 heatpump technicians. Due to change of government in 2024 this policy was changed and due to this the nr declined to less than 1000.	

Number of current professionals in the construction sector

In 2020, the number of employed individuals in the construction industry in the Netherlands was 579.000. After a decline from 2009, this number started to rise again from 2015. Additionally, the number of employed individuals is divided into general construction and project development, as well as specialized construction, with a notable increase in the number of workers in specialized construction. From 2025 to 2035, a stagnation in growth is expected, but an increase in the retirement age (State pension age) could influence this. Among the key professional groups are maintenance and installation technicians for insulation, heat distribution, electricity grids, and solar panels. With a focus on education and advisory roles, energy performance advisors will prove indispensable.

Current energy consumption in the Netherlands and in the built environment

The energy usage of the built environment in 2021 consists of the combined usage by Services (14 percent) and Households (23 percent), totalling 37 percent. This is a significant share of the total across all sectors. Final energy usage in the built environment for both Services and Households has decreased by 11 percent since 2010. These savings has been achieved through various factors, with improved insulation and more efficient space heating installations being the two primary causes. It is also becoming increasingly common to generate one's own energy, which is evident in the growing number of homes with heat pumps and solar panels. This contributes to the rising trend of renewable energy. In 2021, renewable heat accounted for 9.6% of household final heat consumption, up from 9.0% in 2020.

2030 energy goals for the Netherlands and the expected contribution of the construction sector

The objectives outlined in the law for the energy transition are as follows: a 49% reduction in CO2 emissions by 2030 compared to 1990 and a 95% reduction in CO2 emissions by 2050 compared to 1990. The 2030 goal has already been aligned with the European Green Deal, which aims for a 55% reduction in CO2 emissions by 2030 compared to 1990. Additionally, there is a specific commitment for the built environment in the Climate Agreement, stating that by 2050, 7 million homes and 1 million buildings will no longer use natural gas. The initial step is to renovate 1.5 million existing homes by 2030. There is also a strong focus on phasing out poor energy labels (E, F, G) and transitioning to sustainable installations, including the installation of 1 million hybrid heat pumps and the realization of 500,000 new connections to district heating in existing residential buildings.

Number of construction professionals to be trained to achieve 2030 energy goals

The forecast for the required future workforce distinguishes between the dynamic scenario and the cautious scenario, based on demographic and economic growth. In the dynamic scenario, a significant increase in the labour force in construction is expected in 2030 compared to 2018. In 2018, there were 445,000 workers, and it is projected to reach 481,000 in 2030. In the cautious scenario, this figure will be 451,000. Additionally, for the period 2022-2030, an influx of 140,000 labourers is expected in the cautious scenario and 175,000 in the dynamic scenario.

Qualification needs in the Netherlands per education level

Every year, nearly 500,000 students undertake training within the Secondary Vocational Education (VET). Of these, 14.1% pursue studies in the domain of Technology and Built Environment. The VET is segmented into four education levels: the initial level consists of entry programs, offering progression to basic vocational programs for practical execution at level 2. At Level 3, students are trained as independent professionals, making them widely applicable in their field of study. Level 4 is the highest education tier within VET, and graduates from this

level can work entirely autonomously, are versatile, and highly specialized. The qualification structure in VET is based on qualification dossiers; topics pertinent to the sustainability of the built environment have been incorporated over the past 10 years in the form of elective components. Presently, discussions are underway regarding further integration into the qualification dossiers themselves.

The "Climate Jobs in the Built Environment" forecast suggests that very few professions will experience significant job losses due to climate measures. The largest job losses are expected to occur in fossil energy production. For other professions, it is important, according to "Climate Jobs," that they continuously update their skills to keep pace with significant changes. This is especially true for professions that are specifically trained for one type of work, such as solar panel installers and smart meter installers (EQF 3-4). Furthermore, there is expected to be a significant increase in system construction/prefabrication. This shift means that more work will take place in factories and less on construction sites.

Higher education is divided into Higher Vocational Education (HBO) and Scientific Education (WO) sectors. It's possible to pursue an associate degree, a bachelor's degree, or a master's degree in higher education. The level of an associate degree (NLQF 5) is situated between that of an MBO-4 degree (NLQF 4) and an HBO bachelor's degree (NLQF 6). Both bachelor's and master's programs can be pursued at either an applied university or a traditional university. The sustainability of the built environment is a significant topic in lectureships, as well as in minors and master's programs. Both the shift to system construction/prefabrication and the shift to more and more circular construction have an impact on qualification needs. For example circular strategies and business models aimed at preserving and future-proofing existing buildings are linked to many different jobs such as software engineers, BIM programmers, data analysts, materials explorers, deconstruction auditors, urban miners, and asset/facility managers are necessary for the materials passport. The skills that require extra attention here include BIM and data analysis, building surveillance and quality assurance, systems thinking, and collaboration skills. As for product-as-a-service, one can think of jobs such as purchasers, asset managers, test engineers, technicians, and lease salespeople. For these roles, it's crucial to emphasize technical product knowledge, planning and management skills, knowledge of repairs, and sales expertise.

Key messages

In the Netherlands, the goals in the field of the energy transition are in line with the goals from the EU. Partly due to the efforts of PBL, RVO, all provinces, municipalities, and various market parties (such as Techniek Nederland), we have our data about the built environment well organized in the Netherlands. In the Netherlands, we are working hard on all fronts to achieve the objectives. However, analyses by RVO and PBL show that despite the clear and measurable interim goals, we still face challenges in fully achieving them.

In the Netherlands, there is currently a shortage of employees to shape and content the energy transition in the built environment. Plans are in place to address this, including an approach and budget. This is further elaborated in the "Aanvalsplan Techniek". In general, there is already a low influx of technically trained women, of whom 4 out of 5 technically trained women eventually choose a non-technical profession. In addition, there is a stuttering flow, limited lateral entry, and a high outflow of women working in the energy transition. To improve this, measures must be taken specifically aimed at increasing the share of women in the sector.

A lot is already happening in regular education. More guidance is desired. In all relevant courses at the secondary vocational, higher professional, and academic levels, attention is paid to the energy transition. Specialist courses are also available for all conceivable topics within the energy transition. It is necessary to work more intensively on stringent guidance on content within the existing educational structures so that the energy transition is properly covered everywhere it is relevant.

The current system benefits from several sectoral instruments to monitor market developments in terms of technology, skills requirements and training. Although as sustaining the built environment is involving multiple sectors it is recommended to share the best practices from these instruments and explore if other sectors can use the same instrument in order to get less fragmented datasets and insights.

List of acronyms and abbreviations

BCM: Billion Cubic Meters

BENG: Bijna Energieneutrale Gebouwen (Nearly Zero-Energy Buildings)

BUS: BUILD UP Skills

BUS-NL: BUILD UP Skills Netherlands

BZK: Ministry of the Interior and Kingdom Relations

CBS: Central Bureau of Statistics

CM: Consortium meeting

DAN-CE: Dutch Academics Network on Circular Economy

DCP: Communication and Dissemination Plan

EIB: Economic Institute for Construction

EIRES: Engineering for Sustainable Energy Systems

FME-(CWM): Association of Enterprises in the Metal, Electronics and Electrotechnical Industry and Related Sectors.

GWW: Civil Engineering, Road Construction and Hydraulic Engineering

HTNO: Dutch Language Education Researched

I & W: Ministry of Infrastructure and Water Management

KEV: Climate and Energy Exploration

KIA: Knowledge and Innovation Agenda

LNV: Ministry of Agriculture, Nature and Food Quality

MKI: Environmental cost indicator

MMIP: Multi-year Mission-driven Innovation Programs

MPG: Environmental Performance of Buildings / Environmental Performance Calculation

NL-GO: The National Lecturers Platform Built Environment

NLQF: Dutch Qualifications Framework

NQP: National Qualification Platform

NR: National Roadmap

NSQA: National Status Quo Analysis

NZEBs: Nearly Zero-Energy Buildings

OCW: Ministry of Education, Culture and Science

PBL: Netherlands Environmental Assessment Agency

PMT: Project Management Team

PPP: Public-Private Partnerships

SIA Governing Body: Part of the Netherlands Organisation for Scientific Research (NWO)

RVO: Netherlands Enterprise Agency

SBI: Standard Business Classification

SDG: Sustainable Development Goals

SQA: Status Quo Analysis

SZW: Ministry of Social Affairs and Employment

TNO: Netherlands Organisation for Applied Scientific Research

TO2: Applied Research Organizations

UWV: Employee Insurance Agency

VSNU: Association of Collaborating Dutch Universities

WENB: Employers' association for companies in the Energy, Telecom, Recycling and Environment sectors.

WP: Work package

WPL: WP leaders

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1. Introduction

On October 1, 2022, with financial support from the European Union, the EU-project BUS-NL was initiated. It is a follow-up to the first BUILD UP Skills project in the Netherlands, which began in 2011. Since 2011, various industries and EU-projects have collaborated to shape and define the necessary expertise for the energy transition in the built environment. The central question has always been: what does the expertise required to make the built environment more sustainable look like? In other words, what skills do people need to drive the energy transition in the built environment?

In 2011, an initial analysis and roadmap were created to clarify what needed to be done and by whom. The roadmap outlined 19 actions for the period from 2012 to 2020, covering initial education (education individuals undergo before entering the workforce, particularly at the VMBO, HBO, and WO levels) and Post-Initial Education (education pursued after completing an initial qualification). In 2022, this project received active follow-up through BUS-NL. BUS-NL's first task was to assess the progress made with the 19 action lines. Were all actions carried out? Did more happen than expected, or less? [Click here for the evaluation]

As the next step in BUS-NL, this analysis of the status quo report has been prepared. This is to gain insight into how our thinking about the skills needed for the energy transition has evolved over the past decade. What has happened in recent years, what aspects are progressing well, and where do improvements or accelerations need to be made? We also look ahead to the required expertise between 2022 and 2032 and explore the opportunities and challenges that lie ahead. This report begins with a description of policies related to the energy transition, climate, biodiversity, and circular economy in the built environment. It then delves into the education system in the Netherlands concerning the built environment and the energy transition. Finally, it addresses the gap between supply and demand in terms of skills. This is based on the 2030 objectives and the available workforce capable of achieving those objectives, focusing on the skill gap and the people available to realize the goals.

Based on the results of the "status quo analysis," BUS-NL will collaborate with its network in the second half of 2023 to create a roadmap for the period 2023-2030. This roadmap will outline how we can accelerate the development of the necessary expertise in the Netherlands.

Vision of BUS-NL

In a changing world, BUS-NL brings innovation to the required skills for anyone working on the sustainability of the built environment. We focus on skills needed for the four transition components: 'digitalization,' 'materialization,' 'climate adaptation,' and 'energy.' Active

collaboration and connection between various organizations involved in this mission are central to our approach.

Mission of BUS-NL

1. *We revitalize the 'National BUILD UP Skills Platform.' This is the network of stakeholders - from craftsmen to policymakers - involved in the sustainability of the built environment. We bring them together and organize meetings to make the wishes and needs of stakeholders throughout the construction sector transparent.*
2. *We create a BUILD UP Skills Roadmap for 2023-2030 to accelerate the transition. We do this by building on the initial Roadmap, bringing stakeholders together in workshops, and mapping the skills of all involved professional groups.*

2. Objectives and methodology

This report has been written to gain an 'overview and insight into' the current status of the energy transition in the built environment. It begins with a description of policies related to the energy transition, climate, biodiversity, and circular economy, with a focus on sustainability in the built environment. Subsequently, it delves into the educational system in the Netherlands concerning the built environment and the energy transition. Finally, it addresses the gap between demand and supply in terms of skills. This is based on the objectives for 2030 and the available workforce capable of achieving these goals. The primary focus is on the skill gap and the people available to realize the objectives.

This report was compiled using an integrated methodology, consisting of desk research of recent reports, media publications, and websites, supplemented with interviews and insights from interactive workshops. Through this approach, we have gathered a wide range of information, which has then been presented in a concise manner. For the analysis, monitoring data available in the Netherlands was used, sourced from organizations such as the Netherlands Environmental Assessment Agency (PBL), Netherlands Enterprise Agency (RVO), and other relevant parties. The draft report was subsequently discussed at the BUILD UP Skills-NL work conference on June 15, 2023. Personal opinions have been largely excluded.

Finally, the approach incorporated insights and methods from the field of transition science. This scientific domain has developed significant knowledge about the progression of transitions, drawing from the work of Drift.

3. National policies and strategies to contribute to EU's energy and climate objectives for 2030 in buildings

3.1 National policy and strategy for the built environment.

In the Netherlands, the Climate Act was adopted in May 2019, which came into effect on January 1, 2020. This law aligns with the climate agreements at the EU level. The objectives outlined in this law are: a 49% reduction in CO2 emissions by 2030 compared to 1990 and a 95% reduction in CO2 emissions by 2050 compared to 1990. The 2030 target has since been aligned with the European Green Deal, aiming for a 55% reduction in CO2 emissions by 2030 compared to 1990.

To achieve these CO2 reduction goals, the government, businesses, and civil society organizations in the Netherlands signed a Climate Agreement in June 2019. This agreement also includes commitments made among the parties involved. The national climate agreements are divided into five sectors: industry, mobility, the built environment, electricity, and agriculture & land use. For the built environment, the agreement in the Climate Agreement is that by 2050, 7 million homes and 1 million buildings will no longer use natural gas. As a first step, the first 1.5 million existing homes will be made more sustainable by 2030.

Figure 1. Climate agreement part of the Built Environment

The intended approach is to organize this neighbourhood by neighbourhood. Municipalities indicated in 2021 which neighbourhood would be addressed when. This is further shaped through collaboration between municipalities, water authorities, provinces, and the central government. This collaboration is reflected in initiatives such as the 'Aardgasvrije Wijken'

(Natural Gas-Free Neighbourhoods) program and the Regional Energy Strategies (RES). At the heart of the approach of the 'Aardgasvrije Wijken' program is the approach involving pilot projects and learning from each other.

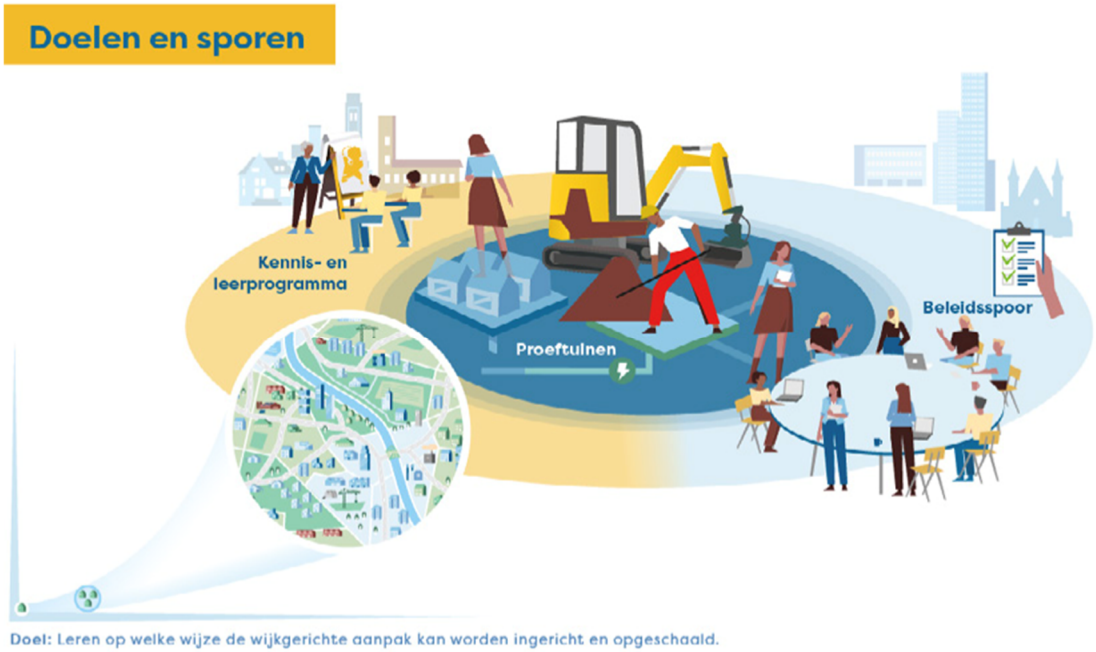

Figure 2. Learning-based approach and living labs in the Natural Gas-Free Neighbourhoods Programme

To achieve the goals in a timely manner, the pace of sustainability efforts in the built environment must be increased. In 2022, the policy program for accelerating sustainability in the built environment (PVGO) was established. Through five program lines, accelerated progress will be made toward a sustainable built environment. These five program lines focus on different aspects and scales within the built environment. These include an area-based approach (program line 1), individual homes (program line 2), commercial buildings (program line 3), resources and infrastructure (program line 4). In addition, there is an innovation approach that applies to all scales and components (program line 5). This involves promoting the expansion of the market for industrial construction and digitized processes, so that products of a higher (environmental) quality and lower costs can become the norm. The aim is to establish consistent high standards at the national level to encourage standardization, and support programs for demand aggregation and supply development will be introduced. Requirements related to circular, nature-inclusive, climate-resilient, and emission-free construction will be tightened and standardized.

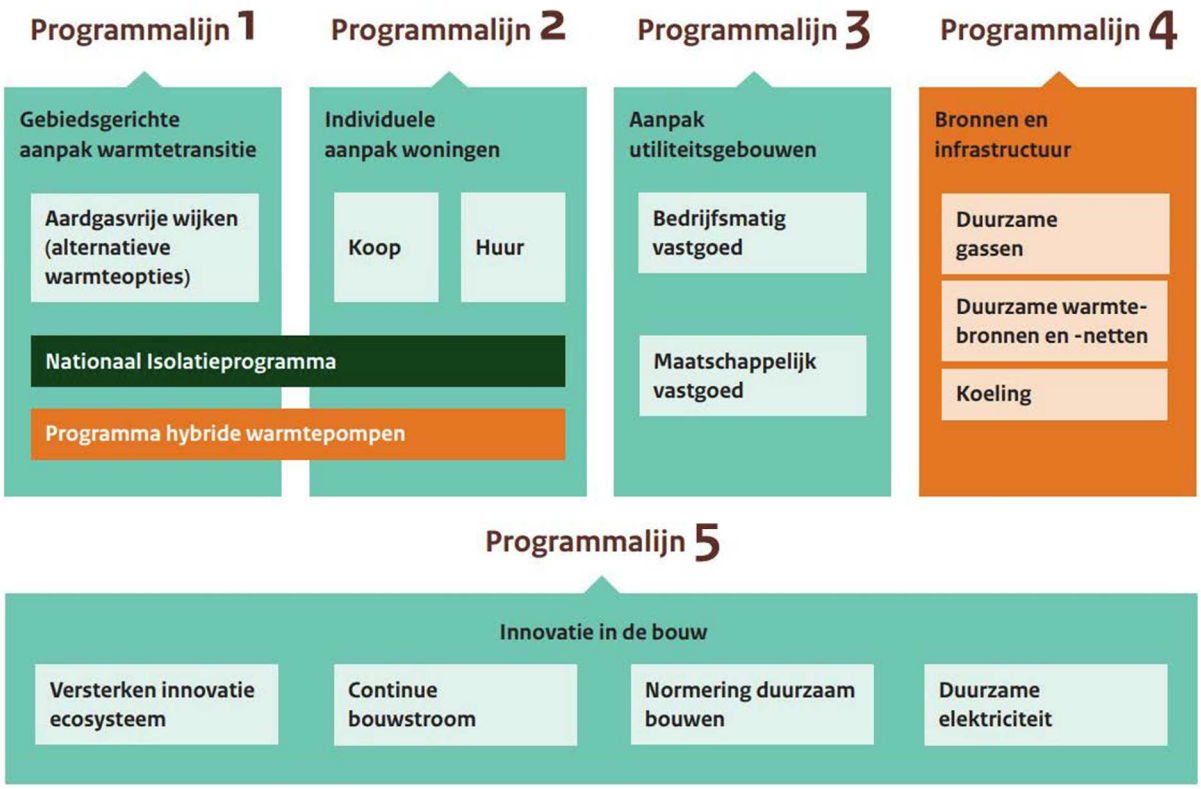

Figure 3. Program for accelerating sustainability in the built environment (PVGO), Source: BZK, 2022a

3.1.1 KIA Energy transition and sustainability

These objectives and elaborations described above concerning the built environment have also been incorporated into the approach of the top sectors and are articulated in one of the four main missions in the Netherlands: Energy Transition and Sustainability (further detailed in an MMIP). The implementation of this mission calls for affordable, socially and publicly supported, scalable solutions aimed at achieving a goal of a carbon-free built environment by 2050, where all buildings meet the (future) final standard. On the path to 2050, several interim goals have been set for 2030. By 2030, the goals include:

- Insulating 2.5 million homes, with an emphasis on phasing out poor energy labels (E, F, and G): 1.5 million owner-occupied homes and 1 million rental homes will be insulated to the Standard for Home Insulation.
- Phasing out poor labels in commercial buildings: By 2027, improving the sustainability of the 15% of buildings with the worst energy performance, energy label G, according to the new label classification, to at least energy label C (60,000 buildings). By 2030, improving the sustainability of buildings with energy label F according to the new label classification to at least energy label C (60,000 buildings).

- Transitioning to sustainable installations or a district heating network: Installing 1 million (hybrid) heat pumps in existing buildings. Achieving 500,000 new connections to a district heating network in existing buildings (in housing equivalents).
- Reducing the environmental impact of energy renovations by employing circular principles such as reducing the use of scarce and energy-intensive materials and extending the lifespan.
- Generating a minimum of 20% of local energy use sustainably within the built environment.
- Greater use of sustainable sources: Mixing in 1.6 billion cubic meters (BCM) of green gas, equivalent to a 2.9 megaton CO2 reduction by 2030.

To achieve a safe, healthy, and future-proof living environment by 2050, the design, construction, and technology sectors are simultaneously faced with (even) greater challenges. Therefore, the existing Mission B for the built environment is expanded into Mission B+ with the following additional objectives:

- Replacing and renovating tens of thousands of bridges, viaducts, and tunnels.
- Building 900,000 new homes by 2030.
- Significantly reducing greenhouse gas and nitrogen emissions by 2030.
- Achieving a 50% reduction in the use of primary raw materials by 2030.
- Climate-proofing the built environment by 2050.
- Establishing a construction economy that is nearly fully circular by 2050.

3.2. Goals regarding the use of digitalization and industrialization

In the process of making the built environment more sustainable, digitalization and industrialization play a significant role. Achieving the substantial transformation required for the built environment can only be realized through a strong focus on these two aspects

3.2.1 Digitalization

More and more construction and installation companies are working with data and digital systems. However, there is often a lack of coherence among these systems. They don't communicate effectively with each other, which is inefficient and hinders innovation, despite the significant challenges facing the industry. In the DigiDeal Built Environment, this issue is collectively addressed within the sector. The focus is on learning from each other, sharing knowledge, and innovating together. This means:

- Working towards the achievement of societal challenges, such as the energy transition.
- Improving the information position for business processes.

- Enabling professionals to work more effectively and with greater satisfaction.
- Solving complex problems through multidisciplinary approaches.

3.2.2 Industrialization

In addition to digitization, industrialization is of great importance. Achieving the significant task can only be accomplished when innovations can be implemented on a large scale. One of the programs that concretely addresses this is the 'Verbouwstromen' program. This program aims to develop scalable and predictable renovation flows that have the necessary pace and volume to achieve climate objectives by 2030 and towards 2050. 'Verbouwstromen' strengthens promising partnerships between demand and supply, focusing on a high-quality offering for home sustainability that can be integrated into specific implementation programs. It is practical and concrete.

3.3. Goals on circularity and biodiversity

In addition to focusing on climate goals, the policy also pays attention to circularity and biodiversity. Separate policy documents have been created for these.

3.3.1 Circular building economy

The Netherlands is committed to a fully circular construction economy by 2050. It means switching to a completely different and, above all, smarter way of designing, developing, and building using new circular strategies, innovative contract forms, bold business models, and sustainable materials within just under 30 years. Until 2030, the approach focuses on frontrunners: frontrunners in construction show what is already possible to build circularly. Based on the performance of current frontrunners in residential construction, the calculated MPG for the rest of the sector in 2030 would be 0.3 possible. This is more than half the current requirement of 0.8 from the Building Code. For the other product groups in construction and infrastructure, it should lead to a 50% reduction in the MPG by 2030.

To move towards a circular construction economy, roadmaps have been developed by the Circular Construction Economy Transition Team. These roadmaps have been worked out for a number of product groups within construction with a high impact:

- Houses (attached, flats and detached), new construction (B)
- Industrial halls and office buildings, new construction (U)
- Civil engineering works, step 1 concrete bridges and viaducts (GWW)
- Roads, step 1 asphalt roads (GWW)

One platform that is very actively shaping the achievement of a circular construction economy is 'Cirkelstad'. Cirkelstad is the platform for frontrunners in the circular and inclusive construction sector who want to do, learn and meet together. It is a collaboration between companies, cities and knowledge institutions.

Figure 4. Visualisation working method of 'Cirkelstad'

3.3.2 Biodiversity

This policy dossier is shaped by the LNV (Ministry of Agriculture, Nature and Food Quality). Nature in the built environment has more benefits besides biodiversity: Green mitigates effects of climate change such as flooding and heat stress. For example, nature stores water as a buffer. In a green environment, people go outside sooner, get more exercise, and meet each other more often. The implementation of the nature-inclusive building is currently decentralized. There are many examples of projects and programs in various cities and regions in the Netherlands.

One of the platforms in which this is taking shape is the KAN platform. Project developers, construction companies, and municipalities have joined forces in the KAN platform to jointly develop knowledge and share experiences in the field of climate adaptive building, combating flooding and heat stress, and increasing biodiversity and nature values. In doing so, the KAN platform focuses explicitly on new construction.

3.4 Concrete activities and intermediate targets for the built environment from the Ministry of the Interior and Kingdom Relations (BZK)

In addition to the above main goals and an approach in five program lines, concrete objectives have been developed in the Netherlands from BZK to help with interim monitoring and adjustments. These are:

- 2.5 million homes will be insulated (before 2030), of which 1.5 million are owner-occupied and 1.0 million are rented.
- Utility buildings will also be insulated; the goal is to insulate 120,000 buildings to at least label C. This will be done in two steps, 60,000 until 2027 and another 60,000 until 2030. The focus in both residential and utility buildings is on phasing out the worst energy labels E, F, and G.
- In addition, the aim is to switch to more sustainable installations or a heat network. While new buildings already use a heat pump or a connection to the heat network as standard, in existing housing construction, the central heating boiler is still the standard. By 2026, however, no new central heating boilers may be installed. This means that boilers in need of replacement will be replaced by a (hybrid) heat pump, for example.
- By 2030, 1 million hybrid heat pumps must be installed in existing housing and 500,000 new connections to a heat network must be realized in existing housing.
- Finally, more efforts will be made to blend green gas. The target is to blend 1.6 BCM[7] of green gas.

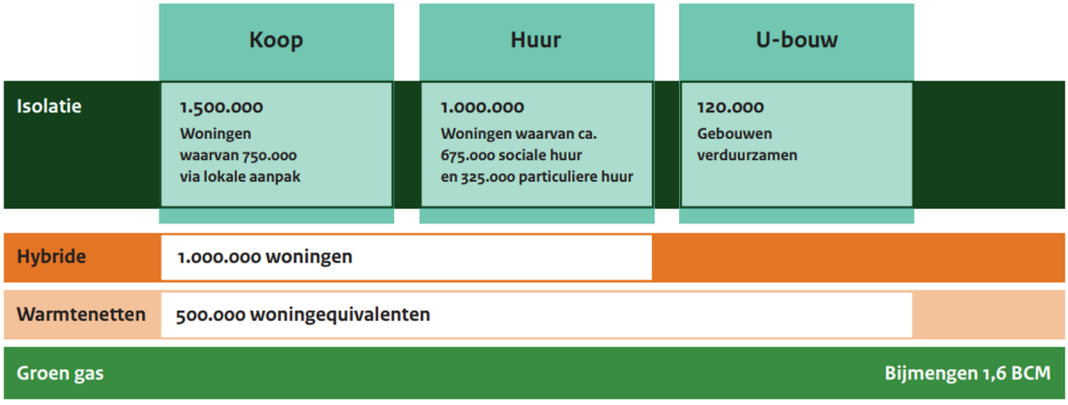

Figure 5. Intermediate goals for the built environment from the Ministry of the Interior and Kingdom Relations(BZK) for 2030, Source: BZK, 2022a

3.5 Regional Energy Strategies

To further implement the national goals, the regions in the Netherlands play an important role. Together, they look at how the energy transition can be realized in practice. So even

questions such as "At which residential area will there be a heat network?" are in the hands of the regions. Since 2019, 30 Dutch regions have been working on a 'regional energy strategy' (RES): they make plans for generating electricity from solar and wind energy in their region. The plans should be sufficient to generate 35 terawatt hours by 2030. Part of the RES is a Regional Heat Structure aimed at deploying supra-municipal heat sources for the municipal heat plans. The RES is a 'work in progress'; the draft version of the RESs appeared in 2020. In July 2021, the regions presented the RES 1.0. The regions are now developing the RES plans and will deliver a progress document of the RES 1.0 by mid-summer 2023, according to the agreed biennial cycle. PBL's monitoring around the Regional Energy Strategies shows that while there is progress, but that it is not yet in line with the desired realization.

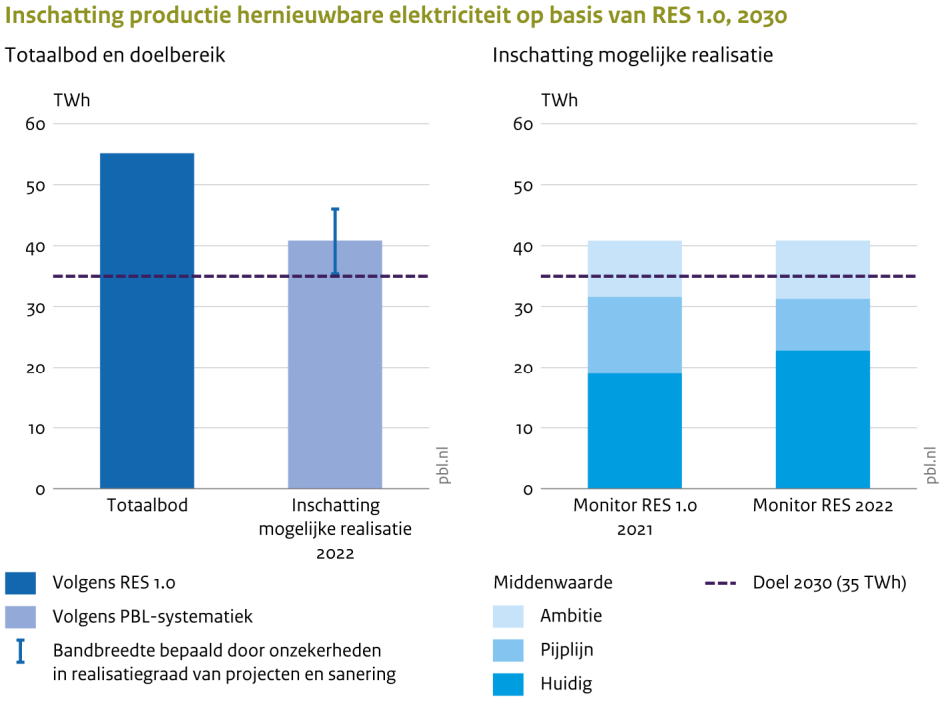

Figure 6. Estimation of renewable energy production

3.6 Conclusion targets

This chapter concludes that the goals in the Netherlands are in line with the EU's objectives and are elaborated in intermediate goals in several sub-areas. Intermediate goals that are also concrete enough to be measurable and appear feasible. At the same time, several signals show that implementation is still lagging behind the set goals.

4. Key data construction- and Energy sector

4.1 Data on the current stock of buildings in the Netherlands

There is a high level of detail regarding the number of both residential and utility buildings in the Netherlands. Below are some highlights of the stock data on the built environment. The numbers are sourced from the open data system of CBS and from the monitoring of sustainability in the built environment by RVO:

- In 2022, the housing stock increased by approximately 80,000 homes compared to 2021, resulting in a total of 8,045,580 homes in the Netherlands.
- The total number of households in 2022 is 8.1 million, with 3.2 million of them being single-person households. The average household size is 2.14 persons.
- New home construction in 2022 rose to approximately 80,000 homes per year.
- The ownership sector's share of the housing stock remains relatively constant: in 2022, the ownership sector accounted for 57%, the housing associations sector 29%, and private rentals 14%. The owner of 0.2% of the homes is unknown.
- The number of issued building permits in 2022 increased by 63,000 homes, although this is lower than in 2021, likely due to the nitrogen policy.
- The number of gas-free homes in 2020 was approximately 717,000, primarily consisting of new construction. Existing buildings accounted for a small percentage, around 8.7%.
- The total number of realized NZEBs homes up to 2020 is over 16,000, with the highest growth in the social housing sector.
- Vacancy is prevalent in various sectors of the service industry, with offices and shops experiencing the most. Economic growth has reduced vacancy, but structural vacancy still exists. In 2022, the average vacancy rate in the service sector was 7%.
- The withdrawal of square meters from the office stock further decreased in 2021. From 2012 to 2021, 69% of the withdrawn stock was repurposed, with residential conversion accounting for the largest share at 55%.

4.2 Data on the current stock of utility buildings

The total number of utility buildings in the Netherlands is about 480,000. Most utility buildings belong to the service sector. The utility area in the service sector is 420 million square meters. Industrial halls have the largest area, followed by offices and shops including supermarkets.

The construction of utility buildings increased by 8.5% in 2022. This growth is the result of a significant increase in building permits issued since 2016. It's noteworthy that in 2020 and 2021, more permits were granted for new buildings in the budget sector, particularly in education and healthcare. The majority of new utility construction still consists of distribution

centres and factory halls. This information is based on the most recent estimates from BouwKennis.

4.3 Energy labels and net-zero energy homes

4.3.1 Homes with a net-zero energy balance and gas connections

In the Netherlands, the challenge of achieving the goals described in Chapter 4 is significant. Research from organizations like the PBL indicates that all available tools must be utilized to reach these objectives. One of these tools focuses on reducing the use of natural gas in homes. In 2021, approximately 90% of all homes are still heated using natural gas. Among the homes still reliant on natural gas, the vast majority use individual central heating boilers as their primary heating system (82%). In addition to district heating (5.2%), there are also homes that are primarily heated using electricity or through a district heating network while still maintaining a central heating boiler; these homes are categorized as 'Other Non-Gas-Free' (1.8%). Around 7.3% of homes are gas-free. Gas-free homes are primarily heated using a district heating network or with the help of electricity. The majority of gas-free homes are connected to district heating (5.7%). Only 1.6% of homes are all-electric and gas-free. The KEV estimate assumes a growth to more than 23% natural gas-free homes in 2030[9].

The organization Stroomversnelling conducted an inventory of the number of Net Zero Energy (NZE) homes. An NZE home is highly insulated, equipped with energy-efficient systems and solar panels to generate energy. As a result, the tenant or owner typically has no energy bill for natural gas and electricity[10] at average usage levels. Regarding the heat source for NZE homes, the vast majority are *all-electric*, with only a small portion relying on district heating or other sources. The total number of realized NZE homes up to 2020 exceeds 16,000, with 30% of these being renovation projects. The majority of NZE homes are new construction. 75% of NZE homes are developed in the rental sector. In the new construction segment (both rental and ownership), NZE has a market share of over 5%. Stroomversnelling did not repeat the study in 2021.

4.3.2 Energy labels for homes

As of January 1, 2023, over 4.8 million homes have a finalized registered energy label, accounting for 61% of the housing stock. Approximately 33% of these have an A label. Extrapolated (through smart segmentation) to the entire stock, 70% of the housing stock has an energy label of C or better. The inventory of private landlords with fewer than 500 homes typically has the lowest labels among the housing stock, with approximately 33% being labeled as A.

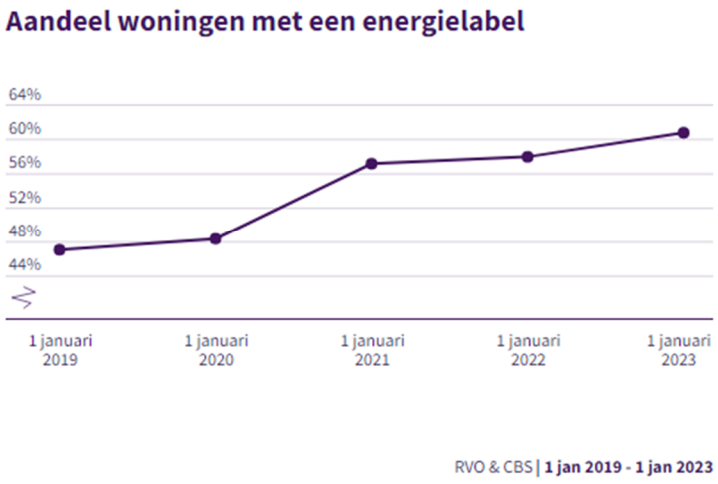

Figure 7. Share of homes with an energy label

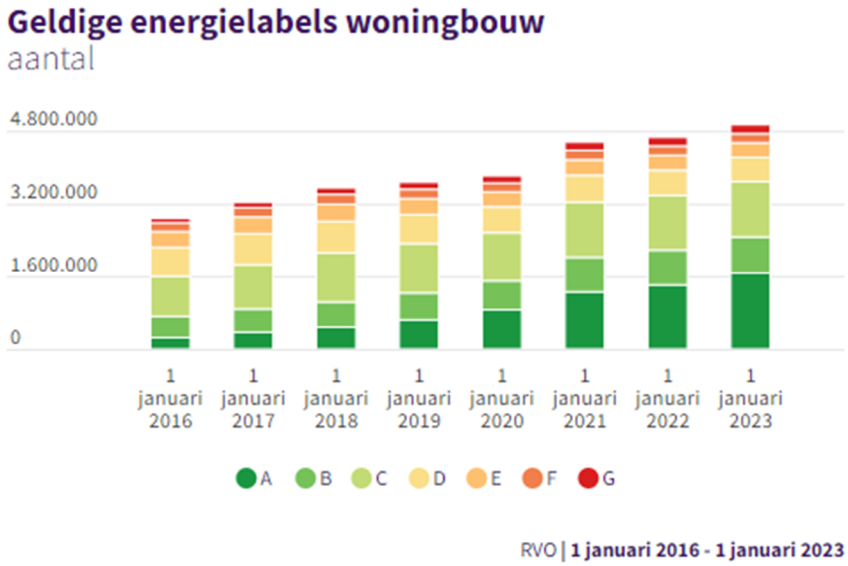

Figure 8. Valid energy labels for residential construction in the Netherlands for the period 2016-2023

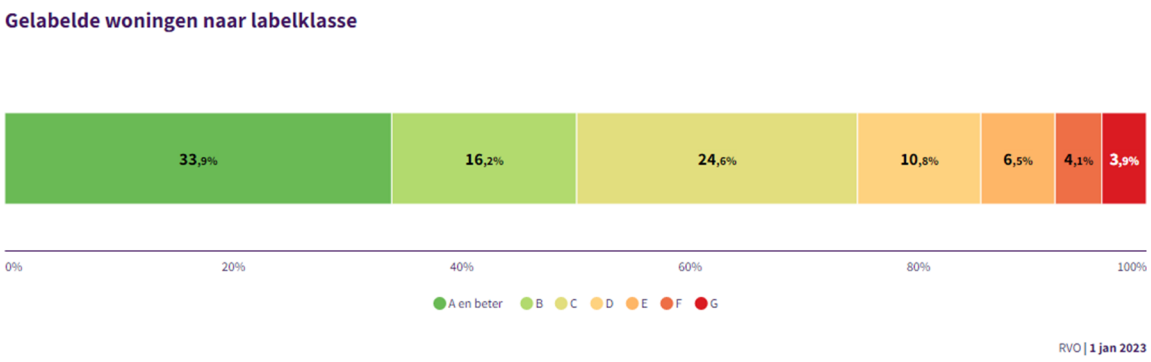

Figure 9. Labelled homes by label class in the Netherlands by 2023

4.3.3 Highlights Energy labels in the built environment

The number of label registrations in utility construction has grown significantly in recent years. In 2023, there are approximately 200,000 utility buildings with a label. Out of the total of 480,000 utility buildings, this represents about 42%. Of all registrations, 56.7% have label A. 7.8% have the lowest label, G.):

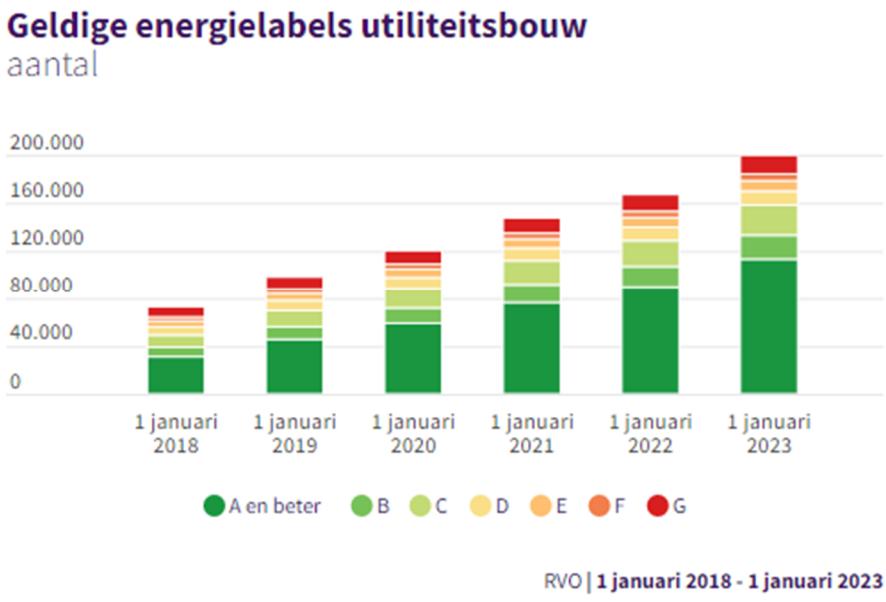

Figure 10. Valid energy labels for utility buildings in the Netherlands by 2023.

- Offices and shops have the highest number of energy label registrations. Over the past four years, the number of registered labels for these types of use has increased significantly.

- It is estimated that around 65,000 offices were required to meet the label C requirement by January 1, 2023. As of mid-2022, an estimated 31,000 offices (48%) had a label C or better. This means that as of 2023, over half of them still do not meet the requirement. The obligation is causing the share of at least label C to increase.

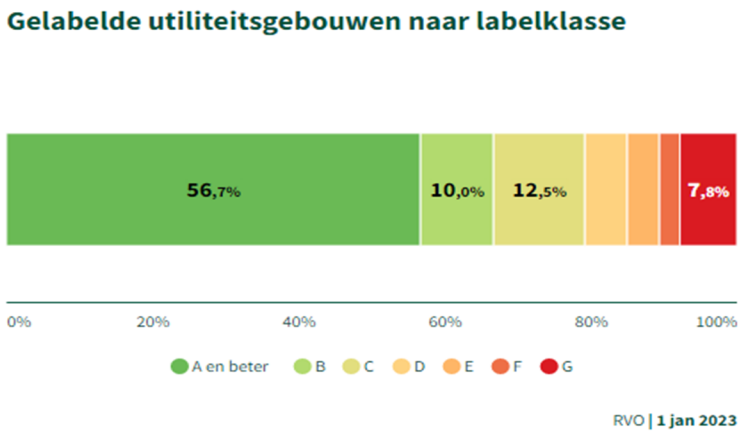

Figure 11. Labelled utility buildings by label class in the Netherlands by 2023

4.4 Energy use in the built environment

Monitoring the use of labels is obviously important. At the same time, we also want to understand the overall state of energy consumption in the built environment in the Netherlands. The RVO built environment monitor also provides a clear picture here, with the highlights being energy consumption in the Netherlands and in the built environment:

- Services and households together account for 37% of final energy consumption. The built environment thus plays a significant role in the overall energy consumption across all sectors.
- The final energy consumption of the built environment decreased since 2010 mainly due to improved insulation and more efficient space heating systems. However, the increasing building stock partially offsets these savings.
- Space heating is the primary energy application in households, with natural gas being the main energy source.
- In the service sector, the most energy is used for space heating, followed by lighting. Natural gas and electricity are the primary energy carriers.
- Household-related building energy consumption accounts for 90% of the final consumption. Natural gas consumption increased in 2021, presumably due to remote work related to COVID-19. In the service sector, there has been a decreasing trend in natural gas consumption since 2017, resulting in an overall decline in building-related energy consumption.

4.5 Conclusion

The conclusion in this chapter is that the data in the Netherlands on the number of buildings and the extent to which they are energy efficient is in order. However, it is also evident that with the current pace of the transition, the goals outlined in Chapter 4 are not being fully realized. Furthermore, the RVO Building Environment Sustainability Monitor shows that the Netherlands lags behind several other EU countries in this regard.

'Highlights of the Netherlands' performance in a European context:

- EU countries, except for France, achieved their national renewable energy targets for 2020. To meet its target, the Netherlands purchased a statistical transfer of over 49 PJ from Denmark for 100 million euros, making the Netherlands the largest recipient of statistical transfers among EU countries. Denmark is the largest donor with over 59 PJ.
- In 2020, the Netherlands reduced its greenhouse gas emissions by 24% compared to 1990. However, the Netherlands performs worse than the EU average in this regard.
- In comparison to the EU average, Dutch households paid a high price for natural gas in 2021 due to high taxes. The price Dutch households paid for electricity in 2021 was below the EU average.
- In the EU, 13% of materials are used in a circular manner. The Netherlands outperforms other EU countries with 31% circular material usage. A significant note here is that circular material usage in the Netherlands primarily consists of downcycling into low-grade fill material used in road construction."

5. Existing facilities in the field of Education and Training

In this chapter we start with a general description of the education system in the Netherlands. Here we put focus on education at the MBO, HBO, and WO levels. In the table below an overview of the extent to which the current system already addresses several topics for sustaining the built environment.

Table 1. Quick overview of how the education system addresses sustaining of the built environment

Topic	How current system it addresses
Skills for implementation of energy efficiency and renewable energy measures in buildings.	VET: in choiceparts HEI: in minors and masters CPD: in fragmented course supply
Skills for delivering building deep renovation, including through modular and industrialised solutions.	VET: not HEI: in minors and masters CPD: in fragmented course supply
Skills for new and existing nearly Zero Energy Buildings (nZEBs) and bridging the gap towards Zero Emission Buildings (ZEBs).	VET: in fragmented lessons HEI: in minors and masters CPD: in fragmented course supply
Skills for integration of renewable energy and efficient heating and cooling technologies, including in particular heat pumps roll-out; skills for installers to deliver heating and cooling upgrades as part of renovation projects.	VET: in choiceparts HEI: in minors and masters CPD: in well organized course supply
Skills related to whole life carbon (via the assessment of Global Warming Potential), circular construction and resource efficiency, and leveraging the Level(s) framework.	VET: not yet HEI: in minors and masters CPD: in fragmented course supply
digital skills supporting greater energy performance of buildings, in particular through an enhanced use of Building Information Modelling.	VET: in choice parts HEI: in minors and masters CPD: in quite well organised course supply
skills for upgrading the smartness of buildings for greater energy performance (based on the Smart Readiness Indicator), looking in particular at sensors, building controls and building management systems	VET: not yet HEI: in minors and masters CPD: in quite well organised course supply
skills for energy upgrade of historical (heritage) buildings	VET: not HEI: in examples in minors related to sustaining CPD: in fragmented course supply

5.1 The national initial education system

Initial education is viewed as the first, initial educational career before a person enters the labour market. It always involves full-time education. Initial education in the Netherlands includes primary education, secondary education, and higher education. These forms of education all provide opportunities for full-time education before entering the labour market.

Primary education in the Netherlands includes primary education and special primary education. The legal framework for primary education in the Netherlands is regulated by the Primary Education Act and the Expertise Centers Act. Primary education is intended for children around the age of 4 and serves as a stepping stone to secondary education in the Netherlands.

Secondary education in the Netherlands includes Preparatory Scientific Education (VWO), Higher General Secondary Education (HAVO), Preparatory Secondary Vocational Education (VMBO), Learning Support Education (LWOO) and Practical Education. The legal framework for secondary education has been regulated by the Secondary Education Act 2020 since Aug. 1, 2022.

After secondary education, students from VMBO can move on to Secondary Vocational Education (MBO) and students from VWO and HAVO can move on to Higher Education (HO), which includes Higher Vocational Education (HBO) and Scientific Education (WO). After completing MBO, HBO or WO, there is a wide range of continuing education in the Netherlands for further development as a professional.

5.1.1 Secondary Vocational Education

Secondary Vocational Education in the Netherlands prepares students for practical work, further education, and good citizenship. Students can enroll in Secondary Vocational Education (MBO) from the age of 16. Practical education is highly emphasized within MBO programs. To ensure this, there is direct collaboration with businesses, public institutions, and community organizations. In addition to entering the job market, MBO students also have the option to pursue further education within MBO or HBO (Higher Education). Nearly 500,000 students enroll in Secondary Vocational Education programs each year. Out of these, 14.1% specialize in the field of Technology and the Built Environment (TBE). The Ministry of Education, Culture, and Science is responsible for the funding and legal framework of Secondary Vocational Education.

In the Netherlands, Secondary Vocational Education is offered by Regional Training Centers (ROC) and Vocational Colleges. Regional Training Centers offer a wide range of programs covering various subjects such as Technology, Healthcare, Well-being, and Economics. Vocational Colleges, on the other hand, provide more specialized education focused on

specific professions within specific sectors, such as programs related to nutrition, nature, environment, shipping, and the graphic and design sector.

Secondary Vocational Education in the Netherlands is divided into four levels. The first level comprises entry-level programs, mainly designed for individuals without diplomas, offering a pathway to level 2. Level 2 consists of basic vocational training for practical work. After level 2, there is level 3, which trains students to become independent professionals and ensures they have broad skills within their field. Level 4 is the highest level, where students can work independently in their chosen profession, either in a versatile capacity or with a high level of specialization.

Within Secondary Vocational Education, there are two types of programs: the School-Based Learning Route (BOL) and the Work-Based Learning Route (BBL). Bol educates students through a set number of contact hours at school and (short-term) internships. These internships are designed to provide students with practical experience in addition to the theoretical knowledge gained during the scheduled contact hours. The BBL involves a contractual agreement with an employer, and students primarily work in practical settings during their education. They acquire theoretical knowledge through one day of school per week.

Providers of similar programs are organized into one of nine industry branch groups (BTG). These BTGs represent similar MBO programs and allow educational institutions to have sector-specific influence on national educational developments. Furthermore, these branch groups facilitate knowledge-sharing and collaboration. Programs related to construction professionals fall under the Technology and Built Environment branch group, which includes programs in construction, metalwork, electrical engineering, technology, and woodworking.

5.1.2 Qualification structure of Secondary Vocational Education

The qualification structure in Secondary Vocational Education consists of 180 qualification portfolios. These qualification portfolios are derived from the approximately 500 qualifications existing in the Netherlands. Qualifications with similar foundational knowledge are grouped together into one qualification portfolio.

Secondary Vocational Education programs in MBO are divided into three parts: Basic, Profile, and Elective sections. The basic part of the program consists of a generic component and a profession-specific component. The generic component is determined by the Ministry of Education, Culture and Science (OCW) and is the same for all MBO students, depending on their level. The profession-specific component is based on the comparable foundational knowledge from the qualifications within the qualification portfolio of the program. The profile section is intended to incorporate the specific knowledge of a qualification into the program. This is knowledge that does not fall under the comparable foundational knowledge

of the qualification portfolio. The elective section of the program is an expanding or deepening component. This section is not included in the qualification portfolio but is still part of the qualification structure. The choice of elective components offered is determined by the schools themselves.

The Cooperation Organization for Secondary Vocational Education and Business (SBB) is responsible for the Secondary Vocational Education Qualification Structure. On August 1, 2015, they took over this task from the knowledge centers for Secondary Vocational Education and business (KBB's). SBB is also responsible for the development of the qualification portfolios.

The development/update of a qualification portfolio occurs in phases. Initially, the business sector provides information about the job market through sector rooms. In the Technology and Built Environment sector room, the business sector represents the construction professionals. Once sufficient information has been provided about missing training for professions, the sector room may decide to instruct SBB to develop/update the qualification portfolio. At SBB, an independent assessment room conducts an entrance assessment. If it is approved, the development or update of the qualification portfolio begins. The sector room leads in selecting the experts and professionals involved in the process. During development and updating, the business sector assesses the recognizability of the profession and its practical feasibility for vocational training. Experts from the business sector and professionals from the education sector evaluate its feasibility for education and examination. After this process, the qualification portfolio will once again go through the assessment chamber of SBB and the sector chamber for approval before the SBB's general board approves it. Finally, the development or update of the qualification portfolio is formalized by the OCW (Ministry of Education, Culture and Science).

In the qualification structure register of SBB, you can find the entire qualification structure for Secondary Vocational Education, from qualifications to certificates and examination profiles: https://kwalificatie-mijn.s-bb.nl/Home

5.1.3 Ensuring the quality of education and qualification

In Secondary Vocational Education (MBO), students who successfully complete their entire program receive a diploma. The examination for this is conducted by the educational institution. For the basic part of the program, there are central examinations in Dutch, English, and Mathematics. As for examinations in the profile and elective sections, educational institutions either purchase their examinations from a certified examination provider or design their own examinations. If an educational institution designs its own examination, it must always be approved by an external party. In MBO, educational institutions are therefore responsible for accurately determining whether students meet the predetermined

qualifications as described in the qualification structure. They are also free to choose the method of instruction as long as it complies with the qualification portfolios.

In addition to obtaining an MBO diploma upon completing a program, it is also possible to receive an MBO certificate for a specific component of the program. Certificates can be earned for vocational and elective components of programs. The specific components for which certificates can be obtained are determined in the regulation on certificates in Secondary Vocational Education. The certificate system in MBO was established in the context of lifelong learning (LLO). The certificate system aims to facilitate educational institutions in offering easier and more flexible education to adults. When a certificate is associated with an elective component or a vocational component, it means that working individuals and job seekers can pursue these components separately for upskilling and reskilling purposes.

5.1.4 Practorates

Practorates are expertise platforms within MBO institutions where practice-based research takes place. Participants in the practorates include the practor and teacher-researchers. Additionally, collaboration occurs with teachers, students, and the business sector. The main goals of practorates are: "Disseminating knowledge and innovation and training for innovative craftsmanship." This goal also emphasizes the integration of education, research, and the business world. Practorates thus serve as a vital bridge between practice and education. They contribute to ensuring that innovations and new insights find their way into MBO education more quickly. Within the realm of practorates, there is a distinction between those focused on subject-matter innovation and those focused on educational innovation. Practorates oriented toward subject-matter innovation are particularly relevant when considering innovations.

5.1.5 Higher education

Higher education is regulated by the Higher Education and Scientific Research Act. This includes Higher Vocational Education (HBO) and Scientific Education (WO).

Higher Vocational Education in the Netherlands is provided by universities of applied sciences and private institutions. Scientific Education is provided by universities. It is possible to pursue an associate degree, bachelor's, or master's program in higher education. An associate degree program can be undertaken at a university of applied sciences. The level of an associate degree program (NLQF 5) falls between the level of an MBO-4 program (NLQF 4) and an HBO bachelor's program (NLQF 6). These programs are designed to increase the enrollment of MBO graduates and working professionals in Higher Vocational Education. The number of students

enrolled in associate degree programs has increased by 9.4% in the academic year 2022-2023, indicating that they are gaining more prominence within Higher Vocational Education.

Bachelor's and master's programs can be pursued at both a university of applied sciences and a university. The number of students in Higher Vocational Education is nearly 500,000, while in scientific education, it's approximately 340,000.

5.1.6 HBO providers and courses

Providers of higher education programs include universities of applied sciences and private institutions. Universities of applied sciences receive funding from the government, whereas private schools do not. Therefore, private schools often charge higher tuition fees to students. Higher education programs in the HBO relevant to professionals in the built environment are offered by various universities of applied sciences and private educators. These programs fall under the Beta Technology sector. Approximately 100,000 students participate in programs offered by universities of applied sciences in this sector, which is about 20% of the total number of students in universities of applied sciences. Within this sector, you can find programs such as Architecture and Built Environment.

For all HBO programs, so-called Educational Profiles have been established. These educational profiles describe what a graduate should possess in terms of basic knowledge and skills. An educational profile must meet various standards. These standards describe what an education should ensure in students:

1. Attain a solid theoretical foundation;
2. Acquire research skills that enable them to contribute to the development of the profession;
3. Possess sufficient professional craftmanship;
4. Develop professional ethics and social orientation befitting a responsible professional

The development and validation of an educational profile in HBO are carried out by a National Education Consultation (LOO). This process occurs in close consultation with a Sectoral Advisory Board (SAC). A SAC includes various universities of applied sciences representing different domains within the sector. The SAC for professionals in the built environment is the Sectoral Advisory Board for Higher Technical and Natural Sciences Education (HTNO). They are thus jointly responsible for programs in the built environment.

5.1.7 Professorships

Just as in MBO, practical research is also conducted in HBO in the Netherlands. This is primarily carried out by professorships led by lecturers. The goal of practical research is to maintain and improve the alignment between HBO education and the job market. Therefore, research focuses on the following three main points: 1. Enhancing the quality of HBO graduates, 2. Keeping education responsive, 3. Innovating professional practice. The approach to the research itself varies greatly depending on one research group and lecturer to another, but often the research is focused on a current topic and is short-cycle in nature. To ensure the quality of practical research, the role of a lecturer has been officially defined since 2017. This formalization provides a clear understanding of the requirements that a lecturer must meet. Furthermore, the SIA coordinating body works to further promote the quality and impact of practical research in HBO.

5.1.8 WO providers and courses

Providers of Scientific Education (WO) in the Netherlands are universities and similar institutions. Universities, in addition to education, are also involved in scientific research and thus serve a dual role in society. For programs in the built environment, one should primarily look at Technical Universities (TU). These universities offer programs in areas such as architecture, urban planning, civil engineering, biology, medicine, medical engineering, engineering, etc. In the Netherlands, there are 14 regular universities, of which 4 are Technical Universities. The 4 technical universities are: TU Delft, Eindhoven University of Technology, University of Twente, and Wageningen University.

To fully utilize technical knowledge in the Netherlands, the four Technical Universities collaborate extensively. Therefore, the four Technical Universities have formed a collaborative partnership known as the 4TU Federation. The 4TU Federation works on educating a sufficient number of high-quality engineers and technological designers, conducting internationally and socially relevant research, and promoting cooperation between research institutions, businesses, and the government. For research, there are 4TU centers. These centers conduct research on various topics. In the built environment field, a significant amount of research is conducted at the 4TU Centre for Built Environment and the 4TU Centre for Energy.

5.1.9 Providers and continuing education programs

Build Up Skills Advisor app

The BUILD UP Skills Advisor app is a free mobile application aimed at professionals in the technical installation industry and the construction sector. The app's goal is to support professionals in keeping up-to-date with their expertise, focusing on sustainable techniques

and soft skills. It offers various short-term e-learning modules (15-45 minutes). Users can also find references to additional e-learning training opportunities from various providers. In the near future, a self-assessment feature will be introduced for personalized further education advice.

The app is specifically designed to link further education opportunities with relevant techniques and professions in the sustainability of the built environment. The platform makes it easier for professionals to stay informed about rapidly changing developments in their field.

Leeroverzicht.nl

The Leeroverzicht website is an independent initiative of the National Government, trade unions, employer organizations, and training organizations. The platform is designed to support workers and job seekers in their lifelong learning process. It offers a comprehensive and objective overview of education in the Netherlands, ranging from practical learning and courses to legally recognized diplomas. The website also provides information about various financial schemes to fund these educations. Additionally, visitors can search for career counselors in their region for advice on study choices.

Techniekopleiding.nl

TechniekOpleiding.nl is a one-stop-shop platform focused on the field of technology. The platform serves as a central location for technicians, companies, newcomers, lateral entrants, and intermediaries for training and development issues. It offers personalized development advice, focusing on factors such as prior education, experience, motivation, and ambitions. The platform assists both employers and (future) employees in the technology sector by providing relevant training opportunities. It also plays a role in efficient retraining and advising on financing of training. Users can independently use the available technical training offerings without the intervention of advisors.

Vakmanschap Techniek

Vakmanschap Techniek is a platform for the installation industry, aimed at demonstrating professional competence. The platform is up-to-date with the latest developments and regulations and offers various professional routes for registration in the Craft Passport.

Central Register of Technology

The Central Register of Technology collects all qualifications and certificates of professional companies and professionals in the installation technology in a digital register. This makes it easy to demonstrate expertise to clients. In collaboration with social partners such as Techniek Nederland and FNV Metal, they have developed the 'Craft Passport' app. This app offers a reliable way for professionals to prove their competence. They collaborate with various

organizations in the technical and construction sector to keep their digital quality register and the Craft Passport app current and trustworthy.

The Royal Institute of Engineers (KIVI)
KIVI is the Dutch professional association for engineers and has more than 20,000 members. The institute functions as a dynamic platform for knowledge exchange and innovation. Additionally, KIVI offers career support through engineering coaches and organizes various activities such as lectures and company visits.

PAO
The PAO Foundation is an independent platform offering current knowledge about technology and management to professionals through various courses. The institute emphasizes the importance of lifelong learning and aims for directly applicable expertise. With more than 150 university-level and post-academic courses, PAOTM focuses on practical applicability in technology and management. The courses address a range of current issues, such as sustainability and water safety, and emphasize interaction and problem-solving.

5.2 Addressing sustainability in the current education system

5.2.1 General

In the current education system, there are many developments in the field of energy transition and the circular economy. This chapter will discuss the most important current developments and provide an overview of the current state of affairs.

For a general overview of the integration of sustainability in education, we would like to refer to the research conducted by Het Groene Brein in 2021. In collaboration with Coöperatie Leren voor Morgen, Het Groene Brein conducted an inventory of the current offerings of programs related to the energy transition and the Circular Economy in MBO (Secondary Vocational Education) as well as in HBO (Higher Vocational Education) and WO (Scientific Education). The core findings of this inventory indicate that there is a significant focus on sustainability in general and the energy transition in particular in both MBO, HBO, and WO. However, this is predominantly offered as specialized programs for students who consciously choose this path. It is either integrated into an elective course, a minor, or a master's program. The integration into existing programs followed by large groups of students is much less common

An overview of vocational education programs can be found on the Energy Transition and CE Education Map - MBO - Google My Maps.

An overview of programs in higher education (HBO and WO) can be found on the Education Map for Energy Transition and CE - HBO & WO - Google My Maps.

In addition to all the educational activities related to the energy transition, there are also more general initiatives from the education sector focused on the energy transition. Currently, the most prominent one is the approved Growth Fund LLO Katalysator, which aims to strengthen lifelong learning with a focus on the energy transition and the circular economy.

The LLO Katalysator is based on the concept of Lifelong Learning, which has long been on the education agenda, to provide a boost. The LLO Katalysator sees Lifelong Learning as a key factor for economic growth and, therefore, aims to provide what they see as a necessary boost. This boost should lead to a self-sustaining LLO ecosystem, allowing employees and employers to adapt effectively to the various transitions in today's society.

According to the LLO Katalysator, the current LLO system is inadequate to address the following four challenges. First, the current system lacks sufficient insight into the necessary skills and competencies for the future. Additionally, there are not enough opportunities to acquire these skills, public educational institutions are insufficiently prepared for LLO, and the learning culture is not sufficiently developed in the Netherlands. These four challenges directly lead to the four pillars of the LLO Katalysator:

1. Mapping the skills of the future.
2. Promoting LLO solutions for transitions.
3. Professionalizing educational providers for LLO.
4. Promoting the learning culture.

The LLO Katalysator will officially launch in 2023, with its initial focus on the energy and raw materials transition.

Below, we will delve more specifically into developments in MBO, HBO, and WO separately, with a focus on the built environment and the energy transition.

5.2.2 MBO: cooperation and agreements aimed at sustainability

In the Secondary Vocational Education sector (MBO), there is a long tradition of collaboration in the field of sustainability. In 2004, active teachers from MBO institutions established the national network 'Sustainable MBO'. Over the years, hundreds of teachers have been working together within this network to share knowledge and improve educational content.

In 2019, the 'MBO Climate Technology Program Offering Covenant' was signed. The goal of this covenant is to align MBO educational offerings with climate legislation. MBO programs are expected to focus on green skills, emphasizing the energy transition, circularity, and climate adaptation.

As a result of the 'MBO Climate Technology Program Offering Covenant,' the SBB (Foundation for Cooperation on Secondary Vocational Education, Training, and the Labour Market) has made it mandatory since 2021 to implement Energy Transition, Circular Economy, and Climate Adaptation (ECK) in newly developed or revised qualification profiles. The implementation of ECK is also assessed by accreditation bodies. ECK implementation starts with general knowledge about energy transition, circular economy, and climate adaptation, including awareness of resources, energy, and climate change. The ECK implementation also addresses more specific knowledge required for each profession. For example, after the revision of the qualification profile for an Electrical Installation Technician (Crebocode 25737), it was added that sustainability issues within the field of electrical installations should be recognized. There are also instances where more specific knowledge has been added to qualification profiles. For instance, a First-level Electrical Installation Technician for residential and utility buildings (Crebocode 23127) must now have knowledge of future technologies such as Heat and Power Coupling, Heat Pumps, Solar Panels, and Wind Energy. Each qualification profile must be renewed every four years. This means that ECK will be effectively implemented in every qualification profile in four years (by 2027).

In addition to the 'MBO Climate Technology Program Offering Covenant,' the Work Agenda 2023-2027 was published in February 2023. It emphasizes that MBO education plays a crucial role in the energy transition in the Netherlands. Therefore, it is of paramount importance that education remains current and adaptable. The Work Agenda aims to enhance innovation and research capabilities, for example, through teaching professorships. Furthermore, MBO educational institutions are required to outline how they intend to approach the energy transition and the significant challenges it presents. Consequently, there are already visible developments in program content and learning pathways. For instance, the Koning Willem I College is actively working on a sustainability program line that aligns with UNESCO principles.

5.2.3 MBO: certificates and electives focusing on the energy transition in the built environment

In Table 1, you can find an overview of elective components in Secondary Vocational Education (MBO) that strongly emphasize sustainability and energy-neutral construction and installation. It also indicates whether a certificate is associated with the elective component. Table 2 provides an overview of certificates relevant to the sustainability of the built environment, offered based on professional components of an education program. Tables 1 and 2 together provide an overview of certificates in MBO, with a specific focus on sustainability and the energy transition in the built environment. A comprehensive list of elective components and certificates in MBO can be found in the qualification structure register of SBB.

Table 2. Overview of elective courses in MBO within the Engineering and Built Environment Sector, with a focus on sustainability and the energy transition, and certificate availability

Code	Elective	Certificate
K1319	Hydrogen in the industry	No
K1318	Hydrogen technology in the built environment	No
K1142	Capacity impacts in heat pumps	Yes
K1102	Cooling technology for heat pump systems	Yes
K1084	Renewable energy	No
K1055	Energy-neutral design and construction	No
K0897	Sustainable craftsmanship in mechanical installations, suitable for level 4	No
K0896	Sustainable craftsmanship in electrical installations, suitable for level 4	No
K0895	Sustainable construction for construction site personnel	Yes
K0799	Sustainable craftsmanship in mechanical installations, suitable for level 2 and 3	No
K0798	Sustainable craftsmanship in electrical installations, suitable for level 2 and 3	No
K0676	Sustainable craftsmanship in mechanical installations	No
K0675	Sustainable craftsmanship in electrical installations	No
K0466	Specialized craftsmanship in sustainable construction	No
K0458	Sustainable construction for construction company management	No
K0027	Sustainable plastering	No
K0310 K0257 K0256	Roof and façade greening at levels 2, 3, and 4	No

Table 3. An overview of Certificates for vocational components in MBO with a specific focus on sustainability and the energy transition in the built environment and the corresponding qualification code

Code	Title Certificate	Qualification code (Crebo)
C0017	Advising on energy-saving measures	25296
C0093	Connecting components for sustainable energy technology	25737
C0041	Installing and commissioning hybrid heat pumps	25559
C0102	Optimizing mechanical installations	25821
C0026	Optimizing mechanical installations	25307
C0076	Establishing connections to low-voltage distribution networks	25273
C0032	Working on heat distribution networks	25267

Evident from inquiries with Wij Techniek, the development fund for the technical installation sector, it appears that despite active industry support, the implementation of the certification scheme falls short of expectations. The ROCs (Regional Training Centers) are encountering difficulties in incorporating and specifying the modular format of the certificates in their educational programs. Furthermore, the market is still relatively unfamiliar with these certificates. Several ROCs have addressed this issue by integrating the transition of the built environment into existing qualification profiles in alternative ways. This has led to the creation of new programs for Smart Energy (link to ROC Friese Poort) and System Integration. Additionally, several ROCs are collaborating to develop and deliver new offerings, such as the Energy College in the Northern Netherlands. Last but not least, a large number of ROCs are involved in Public-Private Partnerships through Regional Investment Fund projects and the recently launched Growth Fund LLO Katalysator. An example of a PPP specifically focused on sustainability and the energy transition is the Sustainability Factory in Dordrecht.

5.2.4 MBO: Practorates focused on the energy transition

The topics addressed by practorates vary significantly. There is a Citizenship Practorate, as well as a Cybersecurity Practorate. To facilitate practical research in the built environment and the energy transition, several practorates have been established. For instance, the Energy Transition Practorate is involved in retraining technicians to become energy technicians. They believe that the energy transition requires educational programs capable of teaching the latest techniques in collaboration with industry. To achieve this, they are exploring the development of an even more effective hybrid learning environment, further professionalizing instructors, and creating realistic job tasks for students. Another example is the Sustainability

and Energy Transition Practorate, which focuses on technical education in vocational training (MBO). They also emphasize the need for different types of technicians who can apply, construct, and install various new energy and construction concepts and technologies. Additionally, the Sustainability and Energy Transition Practorate aims to instill a continuous critical sustainability awareness among technicians and incorporate soft skills more effectively into education.

Other topics relevant to sustainable development of the built environment are also addressed. A noteworthy example is the Circular Regional Economy Practorate. This practorate is a collaboration between several universities, vocational schools, and local businesses and governments. Its goal is to develop a circular regional economy curriculum for the Flevoland region, intending for this curriculum to play a prominent role in all MBO learning pathways.

Other relevant practorates include:

- Hydrogen in the Industry
- Energy Transition & Smart Industry
- Energy Transition & Human Capital
- Sustainable Thinking, Sustainable Doing
- Circular Business & Smart Maintenance
- Entrepreneurial Learning with and from the SDGs in MBO

A complete list of all practorates can be found at https://www.practoraten.nl/.

5.2.5 Colleges: developments focused on energy transition

Also, developments are taking place in Higher Vocational Education. In 2016, the HTNO roadmap 2025 was established. The main action points of the roadmap include shaping the future of Science and Technology education and preparing engineers for the future. In 2019, an evaluation of the roadmap was conducted. The key findings from this evaluation were that the roadmap became outdated over time, and it was challenging to align it with the governance mechanisms of educational institutions. As a result of this evaluation, a pilot project for a continuous dialogue was initiated in 2022. This continuous dialogue is intended to replace the sector exploration that occurred every few years, with the aim of consistently working on action items and ensuring better continuity among these action points. The central question in the continuous dialogue is: *How can we, together with relevant stakeholders, facilitate the transitions that society demands from us?* This naturally revolves around the energy transition but also encompasses digitalization, resource depletion, and climate

developments. The continuous dialogue also addresses how to improve the intake of students in technical programs, despite a general decline in HBO enrollment.

In addition to the attention within HTNO, there are numerous master's and bachelor's programs specifically focused on the energy transition within HBO education. An overview of these programs can be found here.

5.2.6 Colleges: collaborations focused on energy transition

The collaborative initiative 'Regionaal bouwen aan Human Capital' by TKI Bouw en Techniek is another excellent example of how education actively engages with future skills. 'Regionaal bouwen aan Human Capital' is a partnership between various universities of applied sciences and vocational schools across the country. The central theme of the program is to establish stronger connections and knowledge sharing between education, the business sector, and knowledge partners. Currently, four regions are actively involved: the SPARK makers zone, the Bouwlab R&Do, Stichting Pioneering, and the Alfa College & Hanzehogeschool. Regionally, in collaboration with SMEs, clients, educational institutions, and knowledge partners, experiments are being conducted. These experiments focus on:

1. (Further) building up a learning community where SMEs, clients, educational partners, knowledge partners, the government, and other stakeholders share and co-create knowledge.
2. Increasing understanding of the impact of technical and social innovations on work and skills (gaps).
3. Developing approaches that strengthen (informal) learning and innovative behavior among employees.
4. Innovations in education and lateral entry development.
5. Developing approaches aimed at the adoption of technical and social innovations by SMEs.

The program commenced in early 2023, so this year will see the first collaborations and experiments taking place—a unique opportunity for BUS-NL in terms of collaboration.

One of the latest developments regarding craftsmanship in the sector is the launch of the 'Aanvalsplan Techniek,' officially known as the 'Aanvalsplan Arbeidsmarkttekorten Techniek, Bouw en Energie' in November 2022. The plan, launched by Techniek Nederland, Koninklijke Metaalunie, WENB, BouwendNederland, and FME, aims to address labour shortages in the Technology, Construction, and Energy sectors. To achieve this, three pillars have been established:

I. Attracting and retaining more people to work in technology, construction, and energy.

II. A productivity offensive through industrial and digital transformation of design, construction, technology, and industry.

III. Attracting talent from outside the sector.

Figure 12. "Aanvalsplan Techniek"

5.2.7 Colleges: lecturers focused on energy transition

Within the built environment, various professorships are also active. For example, 14 universities of applied sciences collaborate in the NL-GO professorship platform. This is a partnership of Built Environment programs in the Netherlands, with a focus on improving collaborations between professorships and regional partners.

Another professorship platform is the National Professorship Platform for Urban Energy. This includes, for instance, the Energy Transition professorship at Windesheim University of Applied Sciences. This professorship is actively engaged in accelerating the energy transition and related technologies. It collaborates with students and the business sector to find practical solutions that contribute to speeding up the energy transition.

The Circular Economy professorship platform received a follow-up in early 2023. This platform aims to connect professors and researchers involved in circular economy research. The goal of this connection is to accelerate the transition to a circular economy.

The examples mentioned above are all professorship platforms, which are collaborations of various professorships and professors on specific topics, often involving up to 30 professorships. In addition to these platforms, individual professorships are also active. An example of this is the Energy-Positive Neighborhood in Amsterdam-Noord. In this project, the Amsterdam University of Applied Sciences, in collaboration with Urban Technology, is working on generating and using sustainable energy in the neighborhood. This project is incorporated into the university's programs as a minor in Energy-Positive City, where students brainstorm possible solutions for the neighborhood.

5.2.8 Universities: Research

Universities are also heavily involved in the energy transition, both in research and education. For research, all universities have active policies, often structured through multiple chair groups and numerous departments. The Netherlands is globally renowned as one of the leaders in knowledge development in this field. Much of this is shaped by the research groups at universities and by TO2 institutions, such as TNO. Many of the chair groups are affiliated with research groups within their own university. Examples include EIRES at TU Eindhoven and the Copernicus Institute at Utrecht University. Many of the research groups focused on sustainable energy and sustainability are also part of the national research group SENSE.

Furthermore, Het Groene Brein is very active in connecting scientists with practical applications to generate breakthroughs in the energy transition and the circular economy. Finally, the DAN-CE network has been active in the field of the circular economy for several years.

5.2.9 Universities: Education

Within education, universities are also very active in the field of the energy transition. There are dozens of master's programs in this field, as well as numerous bachelor's programs and minors. An overview of the programs active in this area can be found here. Universities are also actively involved in recruiting and retraining higher-educated professionals, for example, through initiatives like EnergySwitch and the TU Delft Extension School.

5.2.10 Providers of further education

Providers of further education usually collaborate with experts from leading companies when creating new offerings. Once an innovation becomes well-integrated into the innovation ecosystem, regular coordination takes place with the relevant sectors regarding learning objectives, practical assignments, and examinations. If recognitions or certifications

are associated with the offering, providers usually adjust the offering based on this recognition or certification.

5.3. Initiatives from outside regular education

5.3.1 General

Outside of regular and private education, there are also many initiatives from employers, municipalities, and provinces that are primarily focused on the local or regional level. These initiatives aim, for example, to improve labour mobility between sectors, harness untapped labour potential, and support lifelong learning. The national government also focuses on this by providing subsidies specifically aimed at learning and development in small and medium-sized enterprises (SMEs), such as MKB!dee and SLIM (SZW). Furthermore, there are labour market initiatives funded by the UIA (Urban Innovative Actions), such as:

- House of Skills (Amsterdam)
- PassportforWork (Eindhoven)
- BRIDGE (Rotterdam), which includes the Construction sector.

Examples of local initiatives include:

- Reskilling by Brainport
- Market group for Construction, Technology, Circular & Energy Transition by the Municipality of Utrecht

There are also numerous collaborations focused on skills, such as the skills-first approach. This is an area of active development in the Netherlands as well, with initiatives like the Dutch version of World of Skills: https://worldskillsnetherlands.nl/skillstalents/.

6. Relevant projects construction skills

Table 4. Overview of relevant projects

Name	Skills	Period
BUS_N@W	*Addressing actions BUS-NL roadmap 2011-2021.*	*2013-2015*
BUStoB	*Addressing actions BUS-NL roadmap 2011-2021. This includes the delivery of 70 short e-learning modules.*	*March 2015- Aug 2018*
BUSLeague	*The aim of BUSLeague was to stimulate demand for skilled professionals to successfully collaborate on the energy transition. This in conjunction with capacity building to increase the number of skilled professionals in the value chain of design, operation and maintenance of BENG buildings. To this end, BUSLeague focuses on a combination of four elements: recognition of sustainability skills, awareness raising, capacity building and agenda setting for regulatory changes.*	*Sept 2020 – Febr 2023*
SEEtheSkills	*Making acquired skills visible to make them valid and valuable. Experimenting with sharing skill evidence in digital learning environments.*	*Jun 2021- May 2024*
BUS-GoCircular	*Expanding the analysis of skill gaps and qualification framework for skills needed to maintain the built environment in a circular way.*	*Sept 2021-Febr 2024*
ARISE	*Expand the analysis of skill gaps and qualification framework for skills needed to harness the power and added value of digitisation in maintaining the built environment.*	*Sept 2021-Febr 2024*

Sustainability Skills	*The aim of Sustainability Skills is to equip (future) workers with the skills, knowledge and attitudes they need to thrive in a circular, inclusive society. We connect educational institutions, businesses, research institutions and governments to collaborate on the learning that needs to take place in and between organisations to successfully navigate the circular transition.*	*2021-2024*
HouseOfSkills	*House of Skills designs skills-based programmes to solve staff shortages in tight sectors. Look more at skills than diplomas and increase the pool of potential employees. Then you will find and retain suitable people. Tools: Platform Mijnhouseofskills; The Passport Room; Care Scan*	*2017-2021-2022*
PassportForWork	*Passport for Work is an approach to help people distanced from the labour market find a sustainable job based on a fun and appealing mix of online tools, gamification, contemporary UI/UX design, applied market research and mobile & micro-learning. The approach is entirely based on a skills approach.*	*Jun 2019- Oct2022*

7. Skills gaps between the current situation and 2030 needs

In this chapter, we focus on the labour market, addressing both the current situation and the labour needs in the context of the energy transition. Specifically, we look at the demand for workers in sectors that are involved in the sustainability of the built environment. We start with an analysis of the current job market, and then delve deeper into the specific needs of the relevant sectors.

To achieve the energy targets for 2030 in the Netherlands, according to the cautious scenario, 452,000 construction professionals are required. The dynamic scenario even predicts a need for 481,000 construction professionals. These figures are based on the expected economic growth in the sector. However, it seems that these forecasts have not taken into account accelerated growth resulting from the sustainability of the built environment.

7.1 Current labour market in the Netherlands

In 2023, the working-age population in the Netherlands consists of just over 10 million people. The labour force in the Netherlands has increased by 1.7 million people since 2003. The expectation, when considering the potential labour force, is that the working-age population will continue to grow to 10.9 million people by 2025. However, after 2025, it is anticipated that there will be a stagnation in this growth, although an increase in the retirement age could still potentially contribute to further growth until around 2035.

7.1.1 Current state of workers in construction

Table 4 displays the number of employees and employed individuals in the Construction Industry (SBI 4), excluding Civil Engineering (SBI 42), in the Netherlands from 2009 to 2020. Employees include all individuals with an employment contract with a company based in the Netherlands. Employed individuals also encompass temporary staff, seconded personnel, and temporary agency workers.

Table 5. Employees and employed individuals in the Construction Industry (SBI 4): Excluding Civil Engineering (SBI 42), in the Netherlands. Source: CBS

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Employees x1.000	335	328	333	316	283	270	262	266	274	285	298	306
Employed individuals x1.000	516	503	495	478	453	447	448	465	490	516	546	579

According to the CBS, the number of employed individuals in the construction industry (SBI 4), excluding Civil Engineering (SBI 42), in the Netherlands was 579,000 in 2020, as seen in Table 4. After a decline in the number of persons employed from 2009, there has been an upward trend since 2015.

Table 5 presents the number of employed individuals (x1,000) in the Construction Industry (SBI 4), divided into General Construction and Project Development (SBI 41) and Specialized Construction (SBI 43).

Table 6. Employed individuals (x1,000) in the Construction Industry (SBI 4): broken down into General Construction and Project Development (SBI 41) and Specialized Construction (SBI 43). Bron: CBS

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
41 General construction and Project development	119	114	117	109	92	88	87	91	92	97	104	103
43 Specialised construction	182	177	175	168	157	156	159	168	175	186	202	214

7.2 Forecast of labour market developments

7.2.1 Forecast of employees in the technical installation industry

The Wij Techniek trend files provide a forecast of the total number of employees required to carry out work in the Technical Installation Industry (TI). The forecast takes into account expected economic growth. It exclusively focuses on employees in the Technical Installation Industry, delineated by examining only companies falling under the Collective Labour Agreement (CAO) for Metal & Technology - Technical Installation Companies. The forecast is presented in Table 6 and includes the recruitment needs of the Technical Installation Industry.

This forecast distinguishes between replacement demand and expansion demand. Replacement demand refers to employees who need to be replaced because other workers are leaving the sector. Expansion demand refers to additional employees required to keep pace with the expected economic growth of the industry.

Table 7. Forecast of the number of employees in the Technical Installation Industry (TI) including recruitment needs. Source: Wijtechniek.

	Current number of employees in TI	Replacement demand	Expansion demand	Total
2022	124.750	21.135	3.880	149.765
2023	125.910	22.690	2.710	151.310
2024	128.205	23.195	2.805	154.205
2025	130.215	23.920	2.730	156.865

It appears that this forecast does not take into account rapid growth due to the sustainability efforts in the built environment.

7.2.2 Forecast employees in the construction industry

The Economic Institute for Construction (EIB), commissioned by Royal Dutch Building Association (Koninklijk Bouwend Nederland), conducted a future exploration. This future exploration outlines two scenarios: a dynamic scenario and a cautious scenario. The dynamic scenario represents the forecast under favorable demographic and economic growth conditions, while the cautious scenario represents the forecast under less robust growth.

The expected annual growth in labour productivity in the construction industry is projected to be 1.5% in the dynamic scenario and 0.5% in the cautious scenario. The anticipated average annual growth in labour volume in the construction industry is 0.7% in the dynamic scenario and 0.4% in the cautious scenario.

In the dynamic scenario, significant growth in labour volume in construction is expected in 2030 compared to 2018. In 2018, the figure was 445,000 (different from the CBS due to

adjustments made by the EIB), and it is projected to reach approximately 481,000 by 2030. In the cautious scenario, there will be a very slight increase to around 451,000.

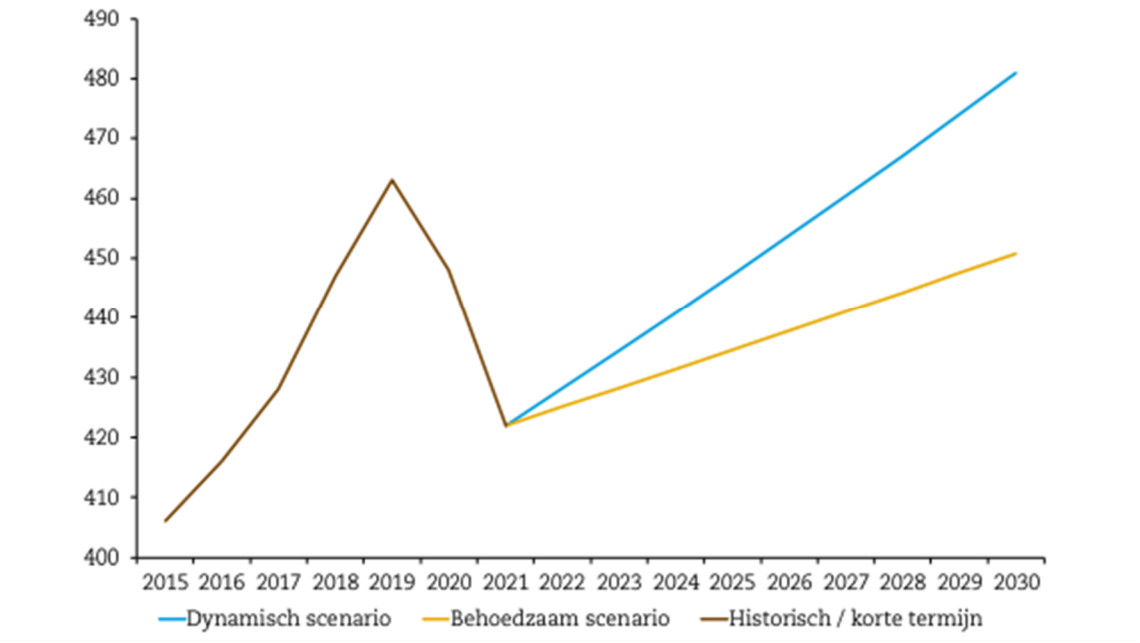

Figure 13. Volume of labour in the Netherlands by year, source: EIB

For the period 2022-2030, the EIB expects a required inflow for construction of 140,000 workers in the cautious scenario and 175,000 workers in the dynamic scenario.

	2018	2019	2020-2021	2022-2030	
				Behoedzaam	Dynamisch
Uitbreiding	19	16	-45	30	65
Vervanging	12	12	25	110	110
Totaal	**31**	**28**	**-20**	**140**	**175**

Figure 14. Inflow demand in the Netherlands for the period 2018 – 2030, source: EIB

In the period from 1998-2018, there has been a huge drop in the number of students taking construction-related courses at MBO. This decline is particularly visible in the number of students taking BBL courses. The economic downturn due to the recession from 2018 and reduced production in construction have been the main reasons for this.

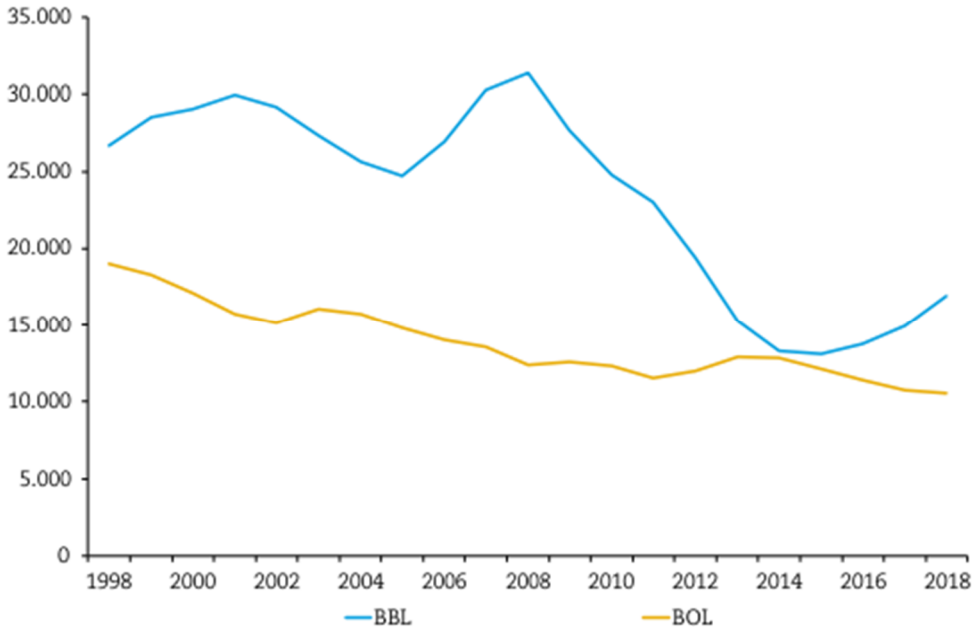

Figure 15. Number of MBO students in construction-related courses In the Netherlands for the period 1998 – 2018, source: DUO, EIB

It is expected that in the period 2022-2030, the influx of construction education students, both MBO, HBO and WO, will be 75,000 students in the cautious scenario and 85,000 students in the dynamic scenario. The labour supply increases not only because of the influx of apprentices from initial education, but also because of lateral entrants. It is expected that in the period 2022-2030, the total lateral inflow for the construction industry is 65,000 in the conservative scenario and 90,000 in the dynamic scenario.

	2018	2019	2020-2021	2022-2030	
				Behoedzaam	Dynamisch
Opleidingen	8½	9½	17	75	85
Zij-instroom	19½	20½	-39	65	90
Totaal	**28**	**30**	**-22**	**140**	**175**

Figure 16. Required labour supply in the Netherlands in the period from 2018 – 2030, source: EIB

In the Netherlands there are no detailed statistics on the current number of professionals in the building sector divided in groups of professions or crafts and EQF covering both “blue-collar” and “white collar workers”.

7.3 Need for employees arising from the energy transition.

7.3.1 Climate jobs

Earlier in this chapter, we discussed the current forecasts regarding workers in the construction industry, specifically the overall number of employees. In addition to these forecasts, it is interesting to examine which jobs will be specifically required to achieve climate measures. This question is answered in the government-published report titled "Climate Jobs in the Built Environment." Published by the UWV, this report identifies the professional groups needed to achieve the climate goals in the built environment. The publication not only outlines the necessary professional groups but also elaborates on the required knowledge and skills they must possess. The aim of this publication is to provide the sector with guidance for targeted labour market policies and the development of training programs for career changers.

Regarding the sustainability of the built environment, the "Climate Jobs in the Built Environment" publication distinguishes between existing residential construction, utility construction, new construction, and the transport of sustainable energy. This differentiation is relevant because each of these areas requires different professional groups and skills. For instance, new construction requires skilled workers who can deliver energy-neutral buildings, while simultaneously, professionals are needed for the maintenance of existing structures.

In the identification of the required professional groups, the "Climate Jobs" publication distinguishes between professions directly involved in construction and maintenance and those involved in the design phase, preparation, and project management. For the construction and maintenance of the most common climate measures in the built environment, activities such as insulation, ventilation, installation of solar panels and heat pumps, connecting homes to heating networks, and shutting off gas pipelines are mentioned. Important professional groups for these activities include insulators, carpenters, roofers, technicians (solar panels/heating networks, etc.), electricians, plumbers, air conditioning installers, and scaffolders. In addition to construction and maintenance, attention is also given to the design phase, preparation, and project management. For these climate measures, both technical and non-technical professionals are required. On the technical side, occupations such as designers, project managers, draftsmen, and structural engineers, as well as work preparers, site managers, and energy performance consultants, have been identified as crucial professions. These specialists may have expertise in fields such as civil engineering, installation and electrical engineering, civil engineering/road and water construction, and mechanical engineering. On the non-technical side, professions such as policy advisors, communication advisors, subsidy advisors, urban planners, spatial planning policy officers, permit issuers, and

procurement specialists have been identified. A complete overview of the identified professions and skills is available at:
https://www.werk.nl/imagesdxa/publicatie_klimaatbanen_in_de_gebouwde_omgeving_aanpassing_tcm95-435269.pdf
"Climate Jobs in the Built Environment" not only provides a description of the required professions and skills for climate measures but also offers a brief forecast of the employment implications of these measures. The forecast suggests that very few professions will experience significant job losses due to climate measures. The largest job losses are expected to occur in fossil energy production. For other professions, it is important, according to "Climate Jobs," that they continuously update their skills to keep pace with significant changes. This is especially true for professions that are specifically trained for one type of work, such as solar panel installers and smart meter installers. Furthermore, there is expected to be a significant increase in system construction/prefabrication. This shift means that more work will take place in factories and less on construction sites. This should provide an opportunity for the sector to target new demographics and fill labour market gaps. In addition to reaching out to these new demographics, it is also interesting for the sector to consider career changers. Through short training programs, it is possible to quickly teach the basic skills of a profession and address a significant demand from employers in a region. The publication provides a few examples of such career-change training programs. For instance, in Groningen, there is a training program for solar panel installers. With recruitment from the UWV, five classes were trained as solar panel installers in two years, with a job guarantee. During their training, students continued to receive their benefits, which was naturally a motivating factor. The installation sector is also working on the accelerated retraining of 12,000 central heating fitters into heat pump fitters.

7.3.2 The circular economy

In addition to the energy transition and the associated climate change, there is also a transition to a circular economy underway. This transition is also having an impact on the construction and installation sectors. Considerable knowledge has already been developed in this regard. In fact, in the report "Getting Started with the Circular Labour Market," experts, including the practor of the previously mentioned Circular Regional Economy practorate, explicitly state that the built environment will have a significant impact on the transition to a circular economy. They predict that there will likely be training shortages in the built environment to successfully achieve this transition.

Below, an overview is provided of these consequences. Attention is given to the different strategies and business models that will emerge as a result of the transition to a circular economy, as well as the jobs and skills that these strategies and business models may require.

Constructing houses and other buildings requires a vast amount of materials. These materials are often not infinitely available on our planet, so it is necessary that a large quantity of materials in the construction and installation sectors be reused. To address this process adequately, different jobs are required compared to those needed for the energy transition. Circle Economy has conducted an analysis of the implications for the built environment.

Circle Economy identifies two main strategies/business models for the built environment. The first main strategy focuses on existing construction and is defined as follows: "circular strategies and business models aimed at preserving and future-proofing existing buildings." This includes concepts like a materials passport, where the materials in buildings are documented and analyzed, allowing for potential reuse. Additionally, "product-as-a-service" will play a significant role. This means that manufacturers retain ownership of their products/materials, providing a strong incentive to extend product lifespans and enhance their reusability through disassembly. Several jobs are identified for this first strategy. Jobs such as software engineers, BIM programmers, data analysts, materials explorers, deconstruction auditors, urban miners, and asset/facility managers are necessary for the materials passport. The skills that require extra attention here include BIM and data analysis, building surveillance and quality assurance, systems thinking, and collaboration skills. As for product-as-a-service, one can think of jobs such as purchasers, asset managers, test engineers, technicians, and lease salespeople. For these roles, it's crucial to emphasize technical product knowledge, planning and management skills, knowledge of repairs, and sales expertise.

The second main strategy is identified as follows: "Circular strategies and business models that ensure that new construction projects meet the needs of the community without harming the planet." Examples of this include designing and building with bio-based materials and alternative forms of prefab, offsite, and modular construction. For bio-based construction, important roles include architects, engineers, eco-construction specialists, carpenters, and green wall installers. The skills they need to possess include material knowledge, innovative design, and a general awareness of sustainability. In addition to bio-based construction, offsite and modular construction are also interesting business models within circular construction. For this strategy, crucial professions identified include product developers, assemblers, supervisors, and technical managers. The skills they need to have are project management knowledge, digital skills, design skills, technical installation knowledge, and collaboration knowledge.

7.3.3 Skills needs

To achieve the EU's goal of a carbon-neutral building stock by 2050, and to ensure the successful progression and continuity of various transitions, it's crucial to address the skills gap in the areas of energy efficiency and transition. One of the objectives of BUS_NL was to

develop a 'skills mapping' that aligns the necessary skills and specializations with a profession, clarifying what's required to competently practice a profession. Once this has been clearly illustrated, it's possible to determine how these 'skills needs' can best be addressed. The method for skills mapping originated from the H2020 PROF/TRAC project and was later expanded in the NET-UBIEP, BUSLeague, Train4Sustain, and BUS-GoCircular projects. Building on this, BUS-NL has further developed, culminating in the delivery of the skills mapping report.

The following steps are essential for setting up a skills mapping:

- Mapping specializations:
    - o Specializations arising from technical innovations
    - o Social skills (focused on process, communication, finance, collaboration)
- Identifying relevant professions
- Mapping the required skill levels of each profession for every relevant specialization.
- Validation with experts

Upon completing these steps, an Excel table can be created, listing all professions and specializations. This can eventually be transformed into a pivot table, from which a chart can be derived.

For the skills mapping report, a radar chart, also known as a spider diagram, was chosen because it effectively represents the relationship between specializations and professions. Figure 17 provides an example of this. For a deeper understanding of the skills mapping you could read through Deliverable 2.2 skills mapping.

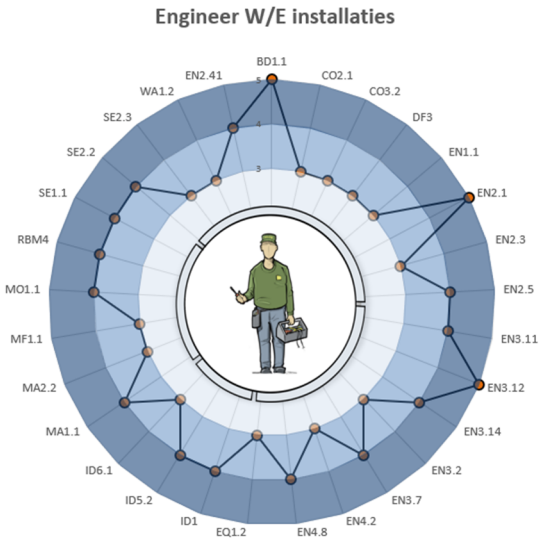

Figure 17. Example of finished radar chart for a skills mapping

7.3.4 Qualification needs

Our experience is that for all topics in the transition, there is naturally a qualification need. This "need" is only felt and becomes visible when the transition accelerates. We've found that for emerging innovations in the transition to a sustainable built environment, qualification needs naturally come up. Once the skill needs and the urgency/emergence from the transition are identified and discussed with involved sectors and stakeholder networks, the qualification needs naturally surface. Subsequently, these parties typically take the lead themselves in addressing these needs.

7.3.5 Monitoring needs

Predicting the future development of the market for the sustainability of existing buildings over the coming years remains challenging. What is indisputable is that the task is being taken up by an increasingly broad range of initiatives and now enjoys strong political support. It is also noticeable that the sustainability of the built environment will coincide with a wave of digitalization and the transition to a circular economy. However, when we look at the actual results achieved from 2008 to 2020, we see that the initiatives from this period have led us to a stable but unfortunately not accelerating market. Each year, one sustainability measure is implemented in 400,000 owner-occupied homes, and in 100,000 owner-occupied homes, there are two. This pattern has changed very little over the years (Construction Agenda 2017). Acceleration of market adoption is much needed, a recognition evident in the most recent initiatives.

Assuming that the goal to achieve a 'zero' built environment by 2050 holds, it becomes possible to outline more precise scenarios of future market development. This is in relation to various sustainability strategies and their impact on the labour market. There is a good chance that the sustainability of the built environment will follow Rogers' innovation curve. This is because, from a policy perspective, 2050 has been set as the 'ultimate' goal on the horizon.

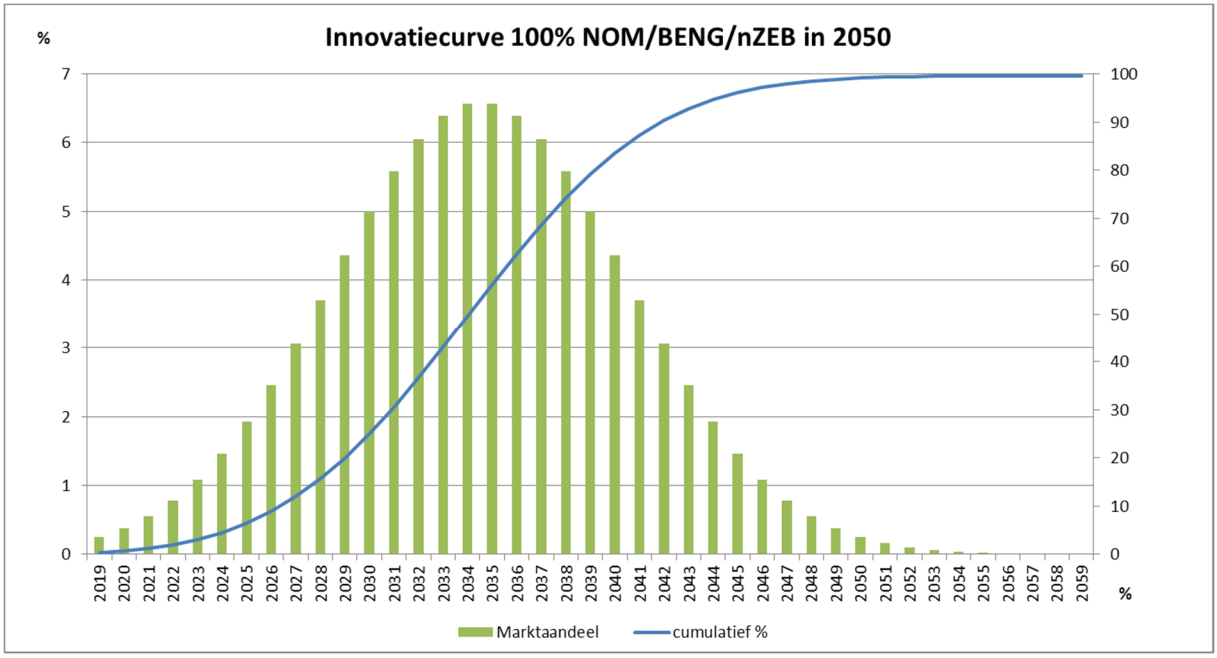

Figure 18. Example of an innovation curve with uniform market capacity growth

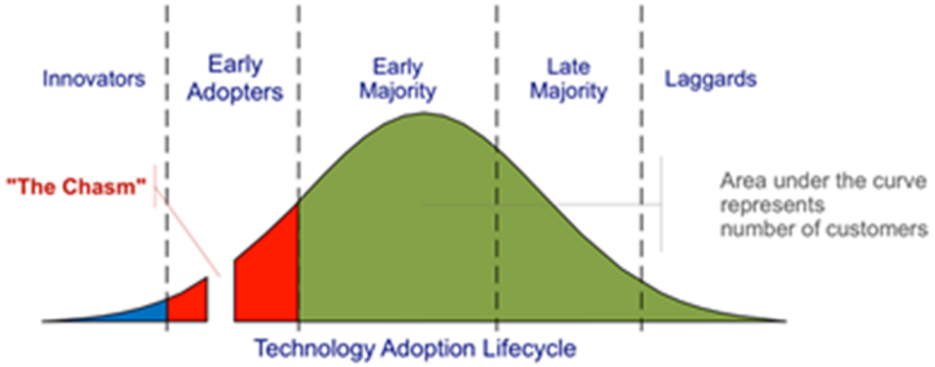

Figure 19. Rogers' innovation curve

The energy transition of the built environment is in the second part of the 'Early adopters phase,' where some measures are widely adopted by the early majority (such as solar panels

and retrofitting), while other measures are still at the beginning of rapid market growth (such as heat pumps). Experienced professionals make a difference in this phase. Customers need positive and reliable support in making choices. Spreading the pressure on the sector can be achieved by consciously aiming for a scenario of gradual growth instead of simply following the market. By gradually but very deliberately building the necessary capacity, the chance of accelerating adaptation increases. A prerequisite for doing this successfully is the collaboration and coordination of niches across regions and between existing companies. The advantage is that the industry demonstrates leadership, contributing to growth and acceleration. The downside is that without a crisis, mobilizing available resources from within and outside can be more challenging. To actively steer in this direction, we propose plotting the measures identified in BUILD UP SKILLS into an innovation curve within BUS-NL. An example of what this could look like is shown in the figure below.

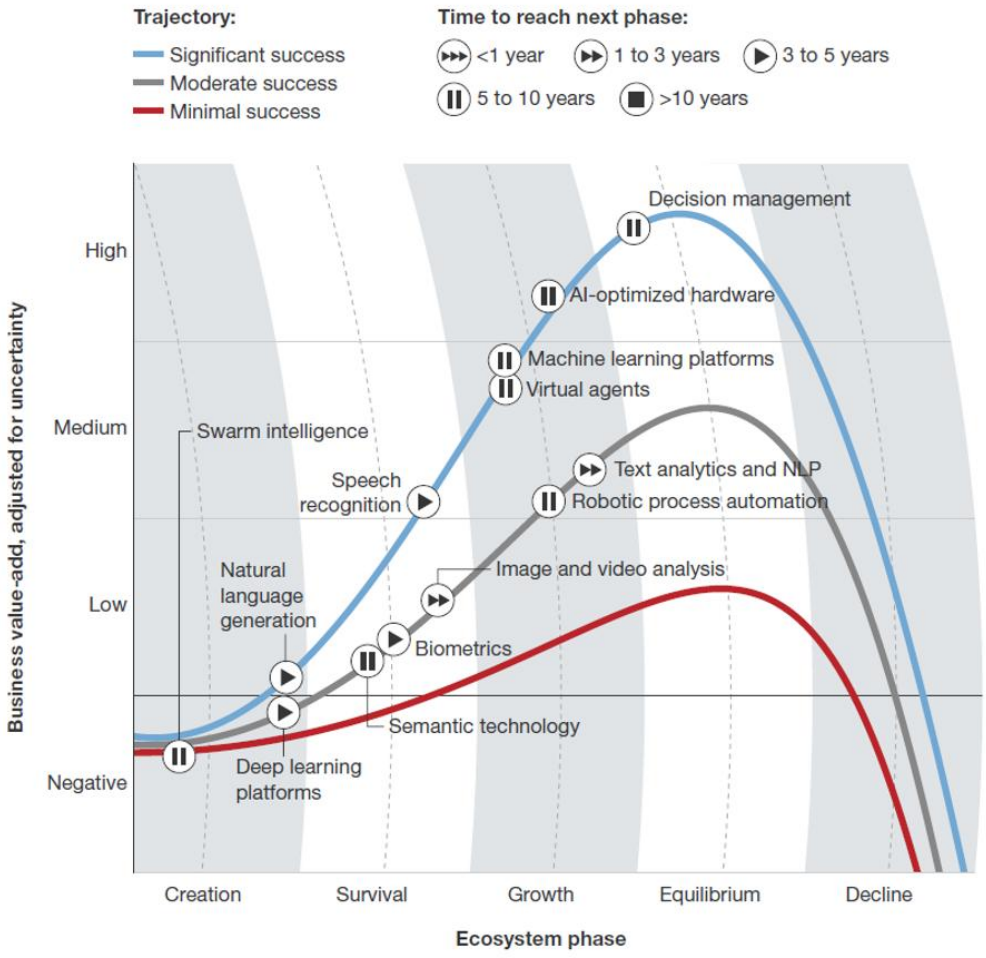

Figure 20. Innovation radar of artificial intelligence technologies Source: TechRadar, Q1 2017

8. Barriers

8.1 Analysis of barriers based on transition management studies

To achieve the climate agreements and the goals set for 2030 in the Netherlands, it is essential to carefully examine potential barriers to address them effectively. Based on transition management studies, certain elements have emerged that pose potential barriers to these climate objectives for 2030: language issues of migrating workers, fragmentation of the construction sector, lack of coordination between craftsmanship and professions, uncertain working conditions, and specific challenges for SMEs in accessing education and training.

8.1.1. General introduction to transition management

In this update of the current status in the Netherlands, there are many figures regarding goals and results. This provides a clear picture in relation to the existing goals, but not yet about the barriers, dynamics, and the phase in which the transition is situated. To shed light on the barriers, dynamics, and phases of the transition, we use Drift's model, the X-Curve. This X-Curve looks as follows.

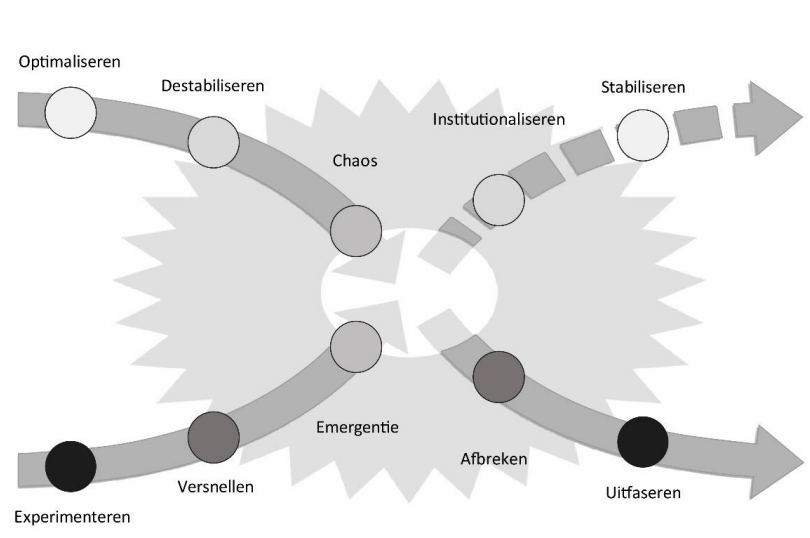

Figure 21. The X-curve from Drift's model

It represents the dynamics of a transition in general, with attention to both emerging factors to realize the transition and established factors that need to change or disappear for the transition to succeed. In short, the concepts in the x-curve indicate the following:

Table 8. Explanation of Drift's X-curve terms

Emerging	Established
Experiment	Optimize
Radically new doing - - Radically new thinking	Improving that which already exists - - No doubt, things are going well
Accelerate	Destabilize
Alternatives connect - - Visible and accessible	Incidents lead to urgency - - Fundamental discussion future/direction
Emergence	Chaos
New structures become apparent - - Transition no longer up for debate	Contradictions and uncertainties - - Competing interests and conflict
Institutionalize	Breaking down/ abort
The new normal (thinking and doing) - - Consolidate new structures	Shedding, letting go, and falling away of the former - - Established order losers visible
Stabilize	Phasing out
Detailing - - Optimalize	Say goodbye - - Dealing with loss

In short, the above table means that the established order has a lot of work to do in terms of transforming the existing model into a new model that aligns with the energy transition. The emerging players are already engaged in the energy transition and are a good fit for it. For these players, their first step is radical innovation, followed by forming alliances, and eventually growing to become the new normal. Each component involves various actions by the parties involved, which are further explained in the diagram below.

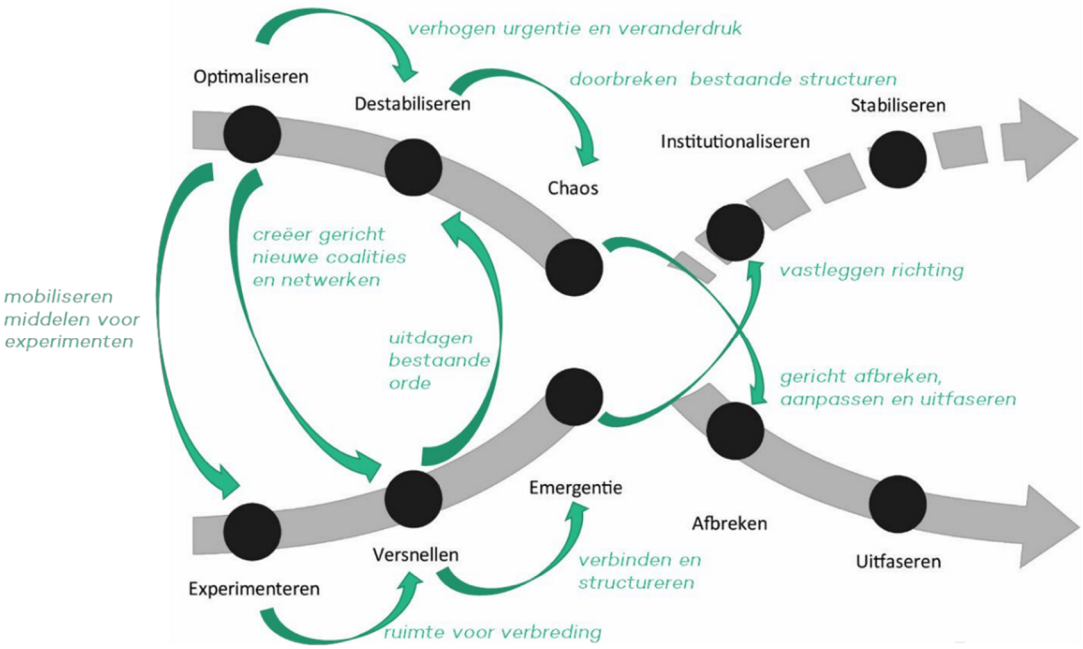

Figure 22. Adjusted model X-curve of Drift

Drift and other organizations have used this model to assess approximately where various transitions are located within this model. They have illustrated this for each transition by placing a dot on each component. A large dot indicates that the transition is currently in that phase. A small dot means that some progress has been made, but it is not significant yet. No dot means that nothing is happening in that aspect. Below, the state of the transitions is explained based on the X-Curve for the following transitions:

- Energy transition
- Climate adaptation
- Circular economy

8.1.2 Energy transition

The energy transition has been ongoing for many years, and a lot has already been achieved. It is evident that emerging initiatives are gaining momentum, and the established order is undergoing change. Drift has assessed the energy transition according to the phase of the transition as follows:

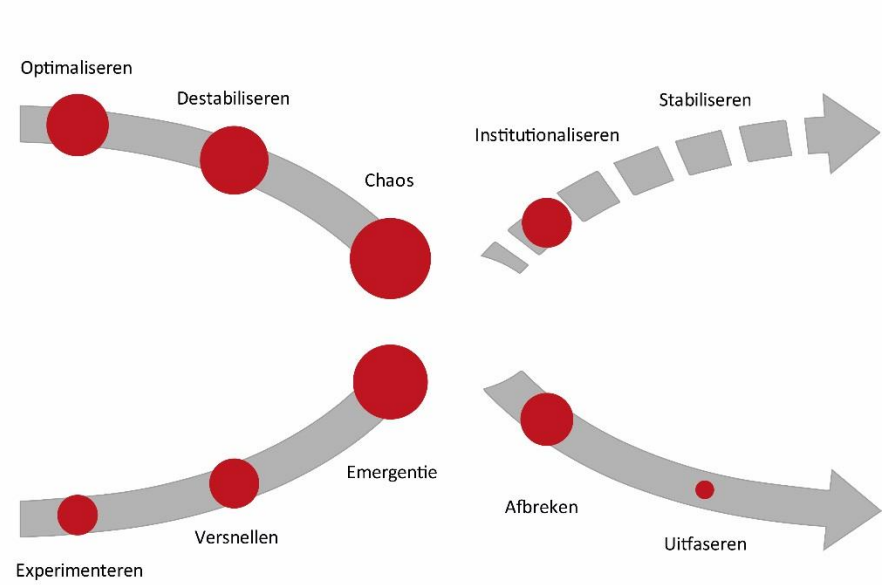

Figure 23. Assessment of Drift with the X-curve

In a nutshell, this means that the energy transition is currently in a phase characterized by chaos. Everything is in motion. Emerging initiatives and technologies are gaining a strong presence in the market. Established players are also undergoing changes, introducing products aligned with the energy transition while still offering their unchanged products. For instance, major energy companies like Shell, Exxon Mobil, and BP still heavily rely on fossil fuels while simultaneously investing in renewable energy sources like solar and wind. Governments are also found to be providing subsidies for both fossil fuels and renewable energy sources like solar and wind.

The main barriers in this phase revolve around breaking existing patterns, particularly in terms of investments. To truly advance the energy transition, governments and businesses must significantly redirect their investments, with the majority going towards sustainable energy and the corresponding technologies and networks (the same applies to investing in skilled labour). Another barrier lies in shaping legislation. Recent years have seen new legislation increasingly aligned with the energy transition, such as a ban on installing new central heating boilers by 2026. To further these efforts and extend them to other products, political courage and perseverance are required.

8.1.3 Climate adaptation

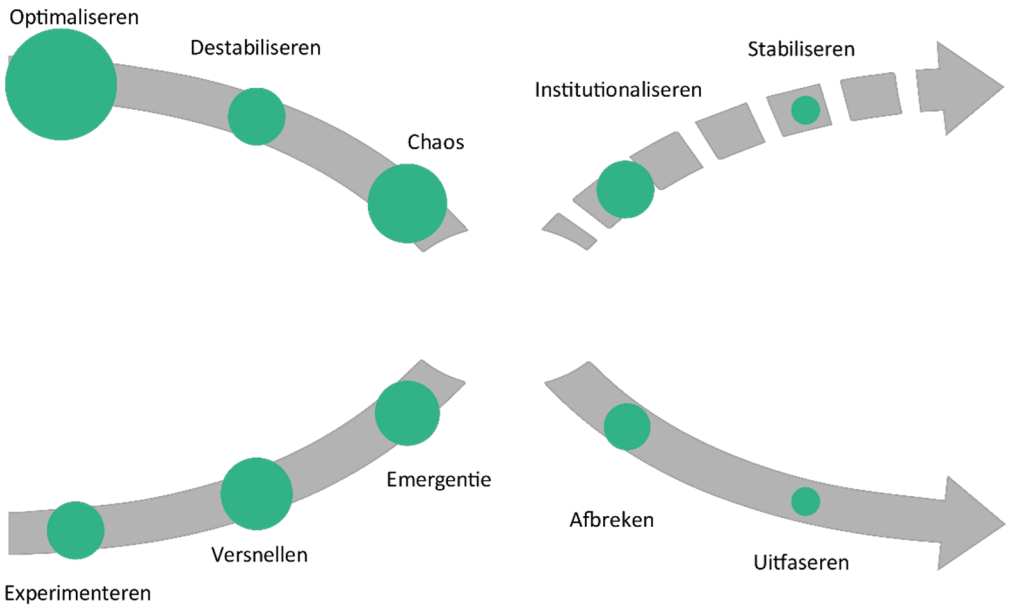

Figure 24. Drift's X-curve for climate adaptation

Regarding climate adaptation, we observe that the transition is not as advanced as in the overall energy transition. There are emerging initiatives, experiments are underway, and progress is being made. For example, think of the use of rain gardens and more green spaces in the construction of homes and offices. However, it is still in the emergent stage. Barriers here involve not only phasing out the existing but also building up the new. Products and services that effectively address climate adaptation need to gain more traction. Currently, water storage systems and the like are available in the market, but typically only on a small scale.

8.1.4 Circular economy

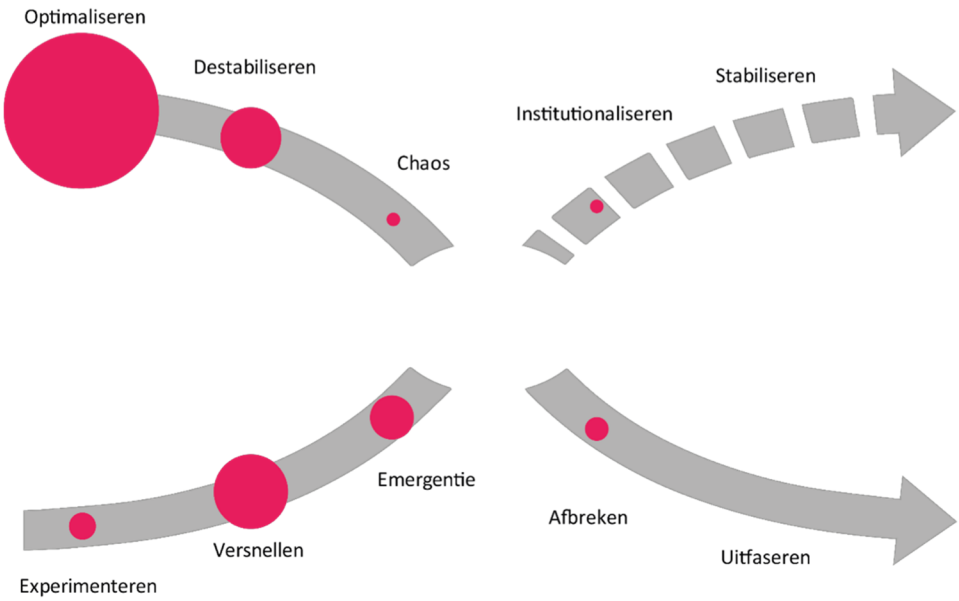

Figure 25. Drift's X-curve for circular economy

In the case of the Circular Economy, we see that the transition is at an earlier stage compared to climate adaptation. There is certainly recognition among policymakers, scientists, and leading companies that the linear model of the economy is under pressure. Some small yet noticeable steps have been taken, such as more product repairs and the direct reuse of materials from demolition in new homes and offices. The first buildings constructed entirely from materials once considered waste have already been built. However, it's not yet the case that all players in the construction sector are fully committed to the circular economy. Many innovations are still in the pilot phase, and the Integrated Circular Economy Report (ICER) from PBL also demonstrates that a measurable shift towards the circular economy has not yet been achieved. To make progress in this area, it's essential to introduce more stringent legislation and work on both the supply and demand for new circular services and products.

8.1.5 Synergy between the transitions

Interesting insights emerge when the various transitions are 'superimposed'. If we visualize the transition to a sustainable built environment as a wave (renovation wave), it is driven by factors such as the energy transition, the materials transition, the climate transition, and the digital transition. Even though each of these transitions has its own X-curve, there is significant

potential for synergy through cross-fertilization of technologies, innovations, networks, and the forms of transition management applied in the transition.

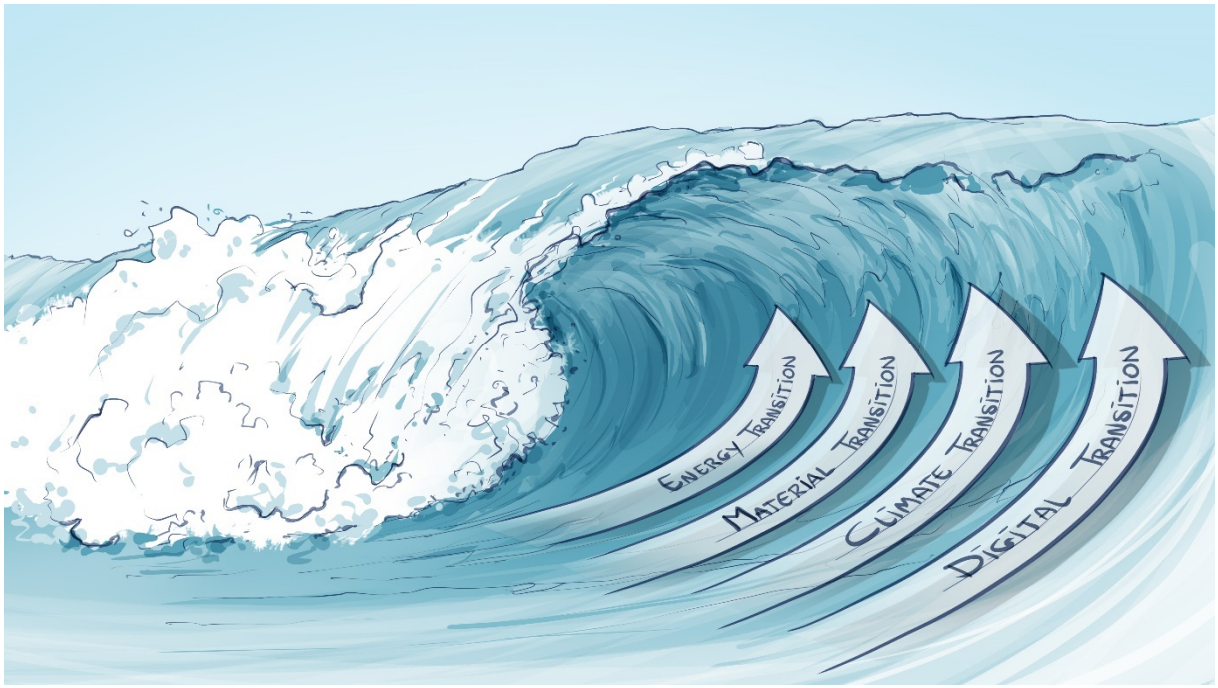

Figure 26. BUS-GoCircular 'drivers of the Renovation Wave'.

Practical Example 1: In the energy transition, it's essential to utilize low-grade heat sources and sustainable heat generators. In climate adaptation, it's important to capture and buffer rainfall peaks for times of drought and as an alternative for tap water (which saves energy in water purification). By using digital technologies, it's possible to ensure that the buffer capacity is available just before an expected rainfall peak. The organized buffer also proves to be a valuable source of low-grade heat for heat pumps.

Practical Example 2: In the materials transition, it's crucial to shift towards new business models, moving from linear to circular models. Because entrepreneur involvement is vital in this process, many organizational and business experts are actively shaping these business models, including designing new primary processes and associated organizational changes. In the energy transition, we observe that the absence of new business models and the profitability of existing ones hinder the acceleration of the energy transition. By connecting the energy transition with the materials transition, entrepreneurs' awareness changes, creating room for the necessary transformation. Conversely, the materials transition can learn a lot from the energy transition regarding making technical innovations market-ready.

8.2 Specific barriers

In section 8.1, we have described where we are approximately in the energy transition of the built environment in the Netherlands. This provides a general overview. Additionally, there are some specific barriers that play a role in the Netherlands. Here, we briefly elaborate on a few of them.

8.2.1 Grid congestion

In the Netherlands, there is an issue with grid congestion. This means that the electricity grid cannot handle everything, and electricity generated, for example, from solar panels cannot always be fed into the grid. Additionally, there is an increasing trend of grid connection requests being denied due to insufficient capacity.

Due to the growing grid congestion, not all projects for renewable electricity production, such as onshore wind and large-scale solar PV, can immediately obtain a connection. This has led to significantly fewer large-scale solar parks being realized in the past three years, even though they were in the pipeline. This problem is no longer occasional but has become a structural issue for both providers and consumers of electricity. Countries neighboring the Netherlands are also facing grid congestion problems.

8.2.2 Labour market and involvement of status holders

"In the Netherlands, there is currently a labour market shortage. To address this challenge, a robust plan has been devised: the 'Aanvalsplan Techniek'.

One of the points mentioned in this plan, which we emphasize here, is to better involve individuals with refugee status in the Netherlands in the work related to the energy transition. This not only contributes to advancing the transition but also represents a significant step for refugees in building a career in the Netherlands. The main challenge in this regard is to prevent bureaucratic complications for businesses and the high additional costs associated with hiring refugees. 'The possibilities to recruit well-trained technical professionals from the EU or through the knowledge migrant scheme from third countries are limited, and the salary threshold is too high for skilled workers at the vocational level.

8.2.3 Actions specifically aimed at involving women and young talent

In the Netherlands, men and women often choose traditional, gender-typical professions, especially when compared to other European countries. This also applies to the technical sectors in the Netherlands, where only 14% of the employees are women. At several points in the (educational) careers of girls and women, various influences and issues contribute to the low representation of women in the technical field in the Netherlands. Measures to make the

sector more attractive to women, therefore, need to intervene at the right time and in the right way.

The Gender & Energy expertise center, 75inQ, identified four obstacles in its research commissioned by the Topsector Energy, which explain the low participation of women in the energy sector. These are summarized in the image below:

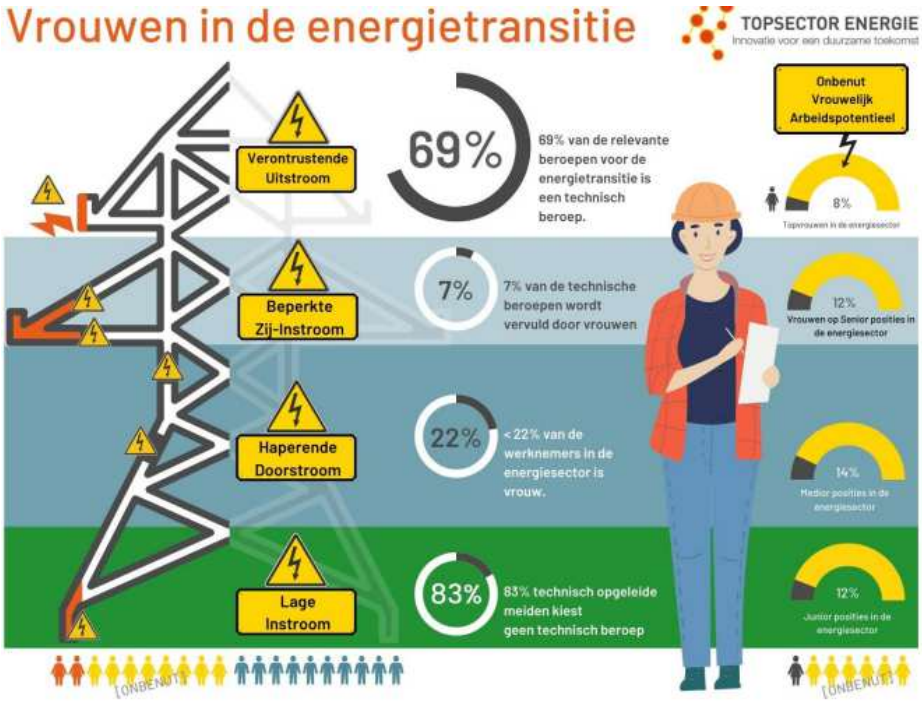

Figure 27. Percentage of women in the energy transition in the Netherlands, source: Report on Women in the Energy Transition by Mariëlle Feenstra, PhD & Anouk Creusen, MSc.

Among woman working in the energy transition, there is a:

- Low inflow: where 83 percent of woman with a technical education as background does not choose for a technical profession
- Disrupted flow: only 22 percent of workers in the energy sector are woman
- Limited lateral entry: where only 7 percent of technical professions is filled by woman
- High outflow: 69 percent of all relevant professions for the energy transition are technical professions

The low inflow can already be seen in the subject choices of students at around the age of 14 in secondary education, where, depending on the level, a maximum of 20% of technical

students are female. In the following paragraphs, several types of measures are discussed that are specifically aimed at increasing the proportion of women in the technology sector.

8.2.4 Starting early to break gender stereotypes

Existing measures aimed at intervening at the earliest stage to increase the participation of women in the technology sector often focus on raising awareness and preventing gender stereotypes in secondary education. There are measures related to:

- Specific teaching materials, guest lectures, and events
- Adaptation of general lessons and teaching materials
- Training teachers

There are educational packages and toolkits for teachers to increase awareness of gender stereotypes. Several parties also recommend that educational materials be adjusted to address gender stereotyping, although there are no government measures in place for this. It has recently been revealed that educational materials for economics students disproportionately feature men in typical professions and underrepresent women in the field in exercises and examples. This phenomenon is also present in educational materials for Dutch and mathematics in the first year of secondary school. Some publishers are consciously addressing this issue or have policies in place. Additionally, some school boards are focused on raising awareness among their teachers and educators. For example, they may organize teacher training sessions for career counselors on the topic of gender stereotyping in career advice. Particularly in the areas of information and career guidance, the percentage of girls choosing technology can be further increased.

8.2.5 Measures for school inflow and the education system

Existing measures to increase the inflow of girls into the field of technology mainly focus on schools and the existing education system. Several organizations are involved in addressing this issue. For example, there is VHTO, which aims to increase the participation of girls and women in STEM (Science, Technology, Engineering, and Mathematics) fields. They organize events like Girl's Day, in which Techniek Nederland also participates, and offer various guest lectures and interventions. There is an association for women in technology, and there are local initiatives as well, such as the Utrecht-based U Talent Girls Club WIN. (Government) campaigns to encourage more girls to choose a technical curriculum or pursue technical studies are somewhat helpful, but girls tend to drop out of the sector later on. Establishing alumni networks can also be beneficial, but the extent to which this is already implemented is unknown.

8.2.6 Measures for retaining women in the sector

To retain women in the sector, or even encourage them to work more hours, measures related to leave arrangements, childcare, and workplace culture are crucial.

The recent expansions of (partially paid) partner and parental leave are good examples of measures taken by society to promote the labour force participation of women in general. However, not all supportive measures are permanent or see consistent implementation; for instance, a labour tax reduction for dual-income families with children is being abolished, and plans for free childcare are being postponed. Meanwhile, expanding childcare options and school hours is a key recommendation from the Education Council to stimulate the participation of women in technology.

Other measures include the government's campaign 'Do you want to work more? Let it be known' and recommendations to address more women in job vacancy advertisements.

Finally, there are measures that employers can take in terms of corporate culture to retain women in the sector. This includes not only facilitating women's use of parental and caregiving leave policies but also encouraging men within an organization to do the same.

9. Conclusions

In this status quo analysis, we have delved extensively into a range of topics surrounding the energy transition in the built environment. We looked not only at the energy transition itself but also at related topics such as biodiversity and the circular economy. Our focus was both on the set goals and their realization, as well as the necessary education and skills to realize the transition. In broad terms, we draw the following conclusions:

1. **Objectives in order**

In the Netherlands, the goals in the field of the energy transition are in line with the goals from the EU, and these goals are clearly elaborated into interim objectives on various sub-domains. These interim goals are also so concrete that they are measurable.

2. **Data in order**

Partly due to the efforts of PBL, RVO, all provinces, municipalities, and various market parties (such as Techniek Nederland), we have our data well organized in the Netherlands. We know how many buildings there are and what energy label many of them have. We also know how much energy is being used, and more and more, which materials were used in construction.

3. **Implementation not yet in line with goals**

In the Netherlands, we are working hard on all fronts to achieve the objectives. However, analyses by RVO and PBL show that despite the clear and measurable interim goals, we still face challenges in fully achieving them. The goals remain realistic but require additional efforts from all involved parties. These steps are now in preparation.

4. **There are insufficient skilled people workers to shape the energy transition**

In realizing the energy transition, much attention is paid to techniques. Which heat pump is better than another? How much capacity does a solar panel have? However, the availability of sufficient skilled professionals to shape the energy transition is equally important. In the Netherlands, there is currently a shortage of employees to shape and content the energy transition in the built environment. Plans are in place to address this, including an approach and budget. This is further elaborated in the "Aanvalsplan Techniek". One factor that continues to maintain the shortages of skilled professionals in the energy transition is the striking effect that many men and women in the Netherlands opt for traditional, gender-typical professions. In general, there is already a low influx of technically trained women, of whom 4 out of 5 technically trained women eventually choose a non-technical profession. In addition, there is a stuttering flow, limited lateral entry, and a high outflow of women working in the energy transition. To improve this, measures must be taken specifically aimed at

increasing the share of women in the sector. Examples of these measures are: breaking gender stereotypes early on, measures for inflow at schools and the education system, and specific measures to retain women in the sector. For breaking gender stereotypes and increasing the inflow, secondary schools could be very influential by organizing guest lectures and interventions where technical women come to break stereotypes. Regarding the retention of women in the sector, one should quickly think of measures in the field of leave arrangements, childcare, and work culture. The goal should not be for women to have more time and understanding for this, but for this time allocation and responsibility to be shared more balanced with men.

5. **A lot is already happening in regular education. More guidance is desired.**

In all relevant courses at the secondary vocational, higher professional, and academic levels, attention is paid to the energy transition. Specialist courses are also available for all conceivable topics within the energy transition. So, anyone who wants to choose an education in one of the fields of transition has every opportunity to give substance to this. However, in regular courses without a sustainability profile, aspects of the energy transition are not always sufficiently covered. It is necessary to work more intensively on stringent guidance on content within the existing educational structures so that the energy transition is properly covered everywhere it is relevant. This is necessary to address the labour market shortage. At the same time, it is necessary that the inflow, especially of girls, in education around the built environment increases.

The current system benefits from several sectoral instruments to monitor market developments in terms of technology, skills requirements and training. Although as sustaining the built environment is involving multiple sectors it is recommended to share the best practices from these instruments and explore if other sectors can use the same instrument in order to get less fragmented datasets and insights.

6. **We have not yet passed the tipping point in the various transitions**

In the analysis and the description of the barriers, we also looked at models from transition science. These insights teach us that we are off to a good start for the energy transition in the broad sense, but we are now in one of the more difficult phases of the transition. The period in which chaos occurs (Figure 24). At the moment, there are both parties that oppose the energy transition and parties that want to accelerate the transition.

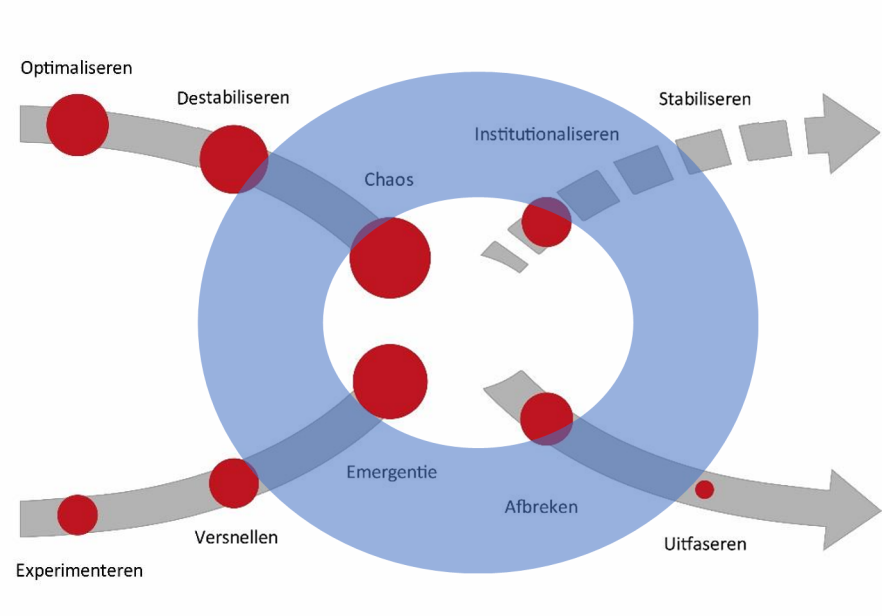

Figure 28. (Current) position in the energy transition according to Drift's X-curve

It is up to us as a society and as the BUS-NL network to make clear choices and ensure that we reach the tipping point to accelerate the energy transition faster. At that time, attention to the energy transition is enshrined in legislation, there are many more investments in sustainable energy than in fossil energy, there are enough people who can put the transition into practice with heart and soul, and education and refresher course providers are ready to educate everyone in this transition.

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Colophon

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