Mineral wool insulation and the road to a climate neutral Europe

A decarbonisation roadmap for Europe's mineral wool insulation industry

Executive summary

Mineral wool (glass- and stone wool) is the most commonly used type of building insulation in the EU, and represents a key enabler of the transition to a climate neutral building stock.

Our solutions boast high recyclability and fire safety, and their solid insulating properties ensure that buildings using mineral wool insulation are highly energy efficient, saving significantly more greenhouse gas emissions than the amount released during mineral wool's manufacturing, transportation, and end-of-life phases.

Reducing operational carbon – stemming from energy used for heating, cooling, hot water and lighting – should be the top priority for the EU building sector, particularly with respect to existing buildings where significant untapped potential remains. However, in order to reach a climate neutral building stock by 2050, embodied carbon of buildings – stemming from construction and demolition operations, as well as manufacturing and end-of-life treatment of materials – must also be tackled.

We are committed to becoming a net-zero carbon industry by 2050, and have already taken significant strides on this path, resulting in a fall of approximately 40% in the carbon intensity of mineral wool insulation products between 1990 and 2019.

This has been achieved through energy efficiency improvements, innovative product design, development of circular processes, as well as technology innovation at our plants to facilitate fuel switching, amongst other measures.

Nevertheless, further industry action is needed to transition towards a net-zero carbon mineral wool insulation sector. This paper assesses the decarbonisation levers at our disposal and outlines a broad range of potential solutions to further improve the energy efficiency of our operations, to increase the circularity of our products and to transition to low-carbon fuel sources.

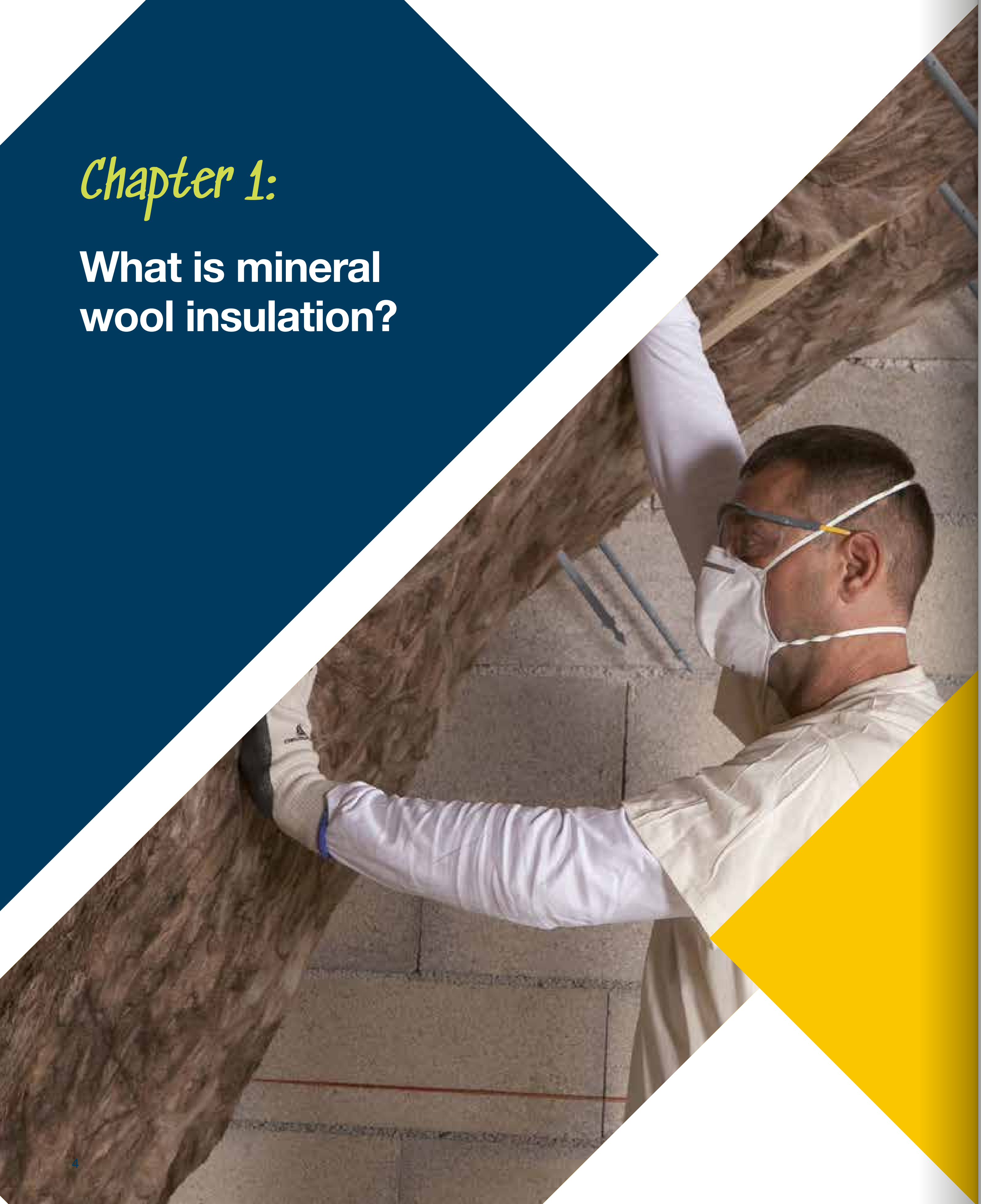
Whilst some decarbonisation measures can be adopted under current market and regulatory conditions, others are reliant on infrastructure development, policy changes and decarbonisation of the broader energy system.

The EU's ambitious climate agenda provides us with an unprecedented opportunity to ensure alignment of public and private sector efforts to decarbonise energy-intensive sectors like the mineral wool insulation industry.

To contribute to this discussion, the paper proposes policy measures that are needed to decarbonise the mineral wool insulation sector and the EU building stock as a whole.

Chapter 1:

What is mineral wool insulation?



What is mineral wool insulation?

Mineral wool insulation is a versatile product which improves the thermal performance of buildings, industrial processes, automotive, marine and off-shore applications, as well as a variety of speciality goods. Mineral wool insulation can be divided into two main categories in Europe – glass wool and stone wool. Glass wool is made from sand and recycled glass, the same ingredients used in objects such as glass bottles; stone wool is made mainly from volcanic rocks, like basalt, and an increasing share of recycled material formed into briquettes.

Mineral wool insulation is produced close to end-markets, thereby reducing transport distances and providing an important source of local employment. With over 70 manufacturing plants operating across 21 European countries, the mineral wool industry employs almost 25 thousand workers. Investments in renovation can create around 1.8 million additional jobs in our value chains in the next decade.[1]

Over **70** manufacturing plants across Europe.

Almost **25k** workers employed.

€10 billion/year of products sold across Europe.

Total sales of thermal insulation products in Europe are estimated to account for approximately €10 billion, and are expected to reach €13 billion by 2027. Mineral wool insulation is the most widely used category of building insulation in the EU, representing 58% of the European thermal insulation market.[2]

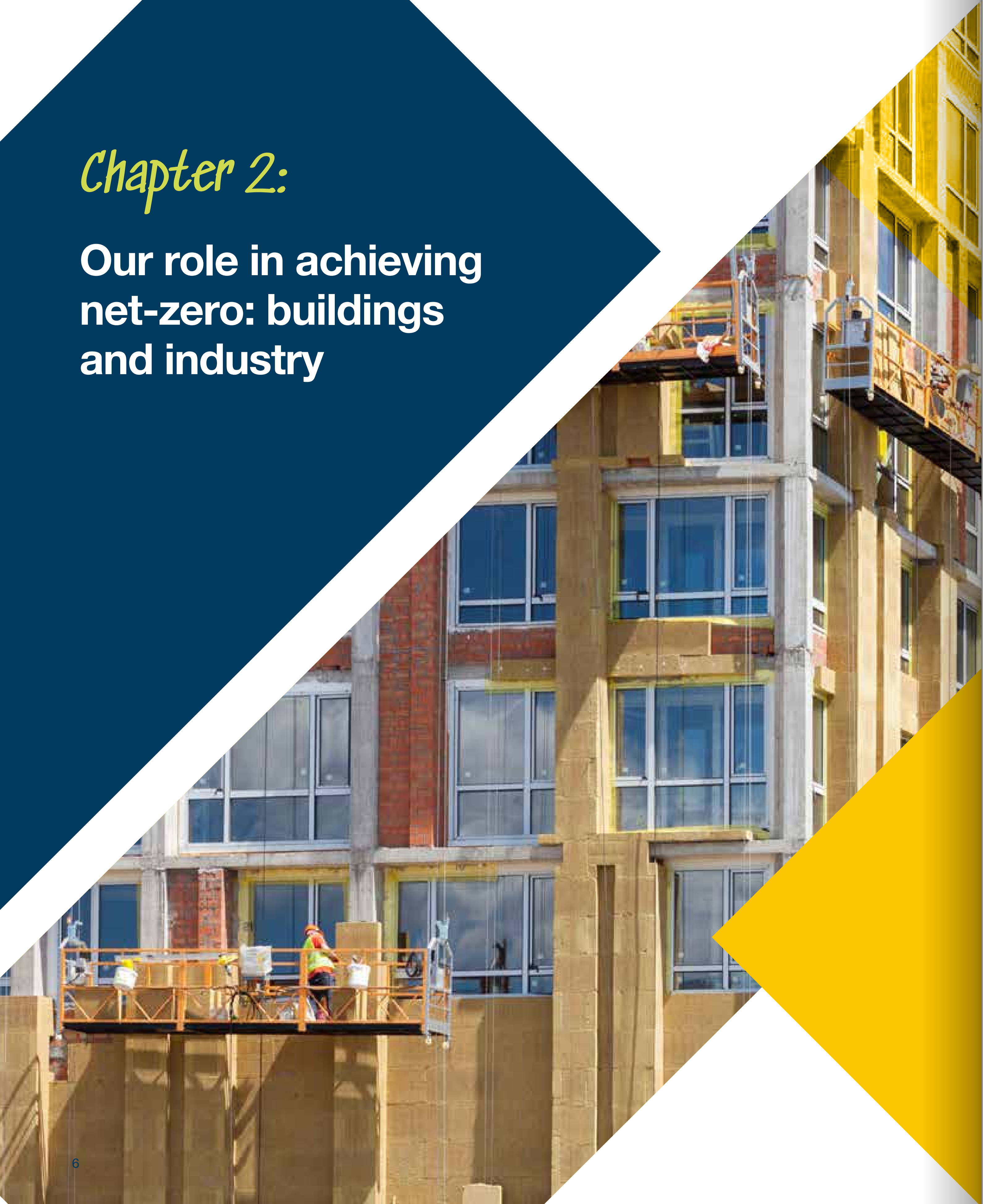
The market for mineral wool insulation is expected to increase significantly in the coming period. This is largely due to rising energy performance of buildings standards and market demand for products with good insulating properties, high recyclability, fire safety and compatibility with common structural products developed for thermal insulation[2].

1 European Commission (2021) EPBD Impact Assessment Report, see here.

2 JRC (2018), Competitive landscape of the EU's insulation materials industry for energy-efficient buildings (here).

Chapter 2:

Our role in achieving net-zero: buildings and industry



Our role in achieving net-zero: buildings and industry

Mineral wool insulation's potential to reduce emissions is greatest in the building and industrial sectors.

In industrial facilities, insulation represents about two thirds of the total energy and emission savings potential. What's more, the bulk of these savings can be achieved by investing in cost-effective insulation[3] with payback periods often lower than 12 months. This cost-effective insulation potential alone equals the annual industrial energy consumption of the Netherlands.[4]

Buildings use more energy and emit more greenhouse gas emissions than any other sector of the economy. Globally, almost half of energy demand for buildings was used for space and water heating in 2021.[5]

Buildings are part of the social fabric of our societies, and, if ignored, can worsen inequality. Buildings are the places where we live, sleep, work, study and spend up to 90% of our time. Their conditions directly affect our wellbeing. Insulation of dwellings not only protects households during cold spells, but also ensures thermal comfort during heat waves. Worryingly, many households in Europe are not able to live in comfortable and healthy houses, because they are not in a position to renovate them to a decent standard and/or because they cannot afford to adequately heat or cool their homes.

The majority of our buildings are old and energy-inefficient, with over half categorised in the three lowest energy classes (E, F and G).[6] Based on the current rate at which buildings are demolished, around 95% of today's buildings will still be standing in 2050.[7]

3 Cost-effective insulation is defined as insulation that minmises the sum of the costs of heat loss and the costs of insulation.

4 EiiF & Ecofys (2021) Climate protection with rapid payback: Energy and CO2 savings potential of industrial insulation in EU27 (available here).

5 IEA (2022), Tracking Buildings 2022 (here).

6 BPIE (2017), Factsheet: 97% of buildings in the EU need to be upgraded (here).

7 Eurima (2013), Mineral Wool – Putting Natural Resources to Work for the Benefit of our Planet (see here)

Mineral wool insulation makes it possible to reduce energy used for heating buildings, while creating a comfortable and healthy indoor environment.

Over a 50-year lifetime of a home, mineral wool insulation can save **100** times more greenhouse gas emissions than result from its manufacture.[8]

Prioritising energy efficiency in the building sector inter alia through better insulation is also a prerequisite for the rapid transition of other sectors, as it significantly reduces electricity demand, making it possible to deploy renewable electricity to accelerate decarbonisation. Applying the Energy Efficiency First principle in buildings reduces peak demand and brings flexibility to the power sector, as well-insulated buildings can better store energy, acting as thermal batteries for the grid. Investing in the renovation of our building stock is the most impactful way to reduce the EU's dependence on fossil fuel imports[9], all whilst lowering energy bills and creating local jobs.[10] It is estimated that deep renovation of Europe's worst performing buildings will lead to a 45% reduction in EU imports of Russian gas.[11]

8 Eurima (2013), Mineral Wool – Putting Natural Resources to Work for the Benefit of our Planet (here).

9 Ecofys (2014), Deep renovation of buildings: An effective way to decrease Europe's energy import dependency, see here

10 Renovate Europe (2020), Building Renovation: a kick-starter for the EU economy (see here).

11 Guidehouse (2022), Energy security impacts of renovating the EU's F and G class buildings (see here)

A whole life carbon approach

The total climate impact of buildings extends beyond the emissions released during its use-phase (operational carbon) and includes emissions released during the manufacturing, construction and end-of-life phases (embodied carbon). Decarbonisation of the EU building stock requires a holistic consideration of all these elements, or in other words, a 'whole life carbon' approach to tackling building emissions.

Embodied emissions represent around 15% of the total carbon footprint of EU's buildings.[12] As operational carbon of buildings is progressively reduced through increased energy efficiency and integration of renewables, embodied carbon will continue to grow in importance as a proportion of total emissions.

This is most evident when considering new buildings, as the EU's Energy Performance of Buildings Directive requires that all new buildings are constructed to a nearly zero energy building (nZEB) standard as of 2021.

12 Material Economics (2018), The Circular Economy: A powerful force for climate mitigation (see here).

For a typical newly constructed apartment building, the share of embodied carbon from materials and construction is 33% of the total lifecycle emissions, and this share can increase to almost 50% in an advanced nearly zero energy building.[13]

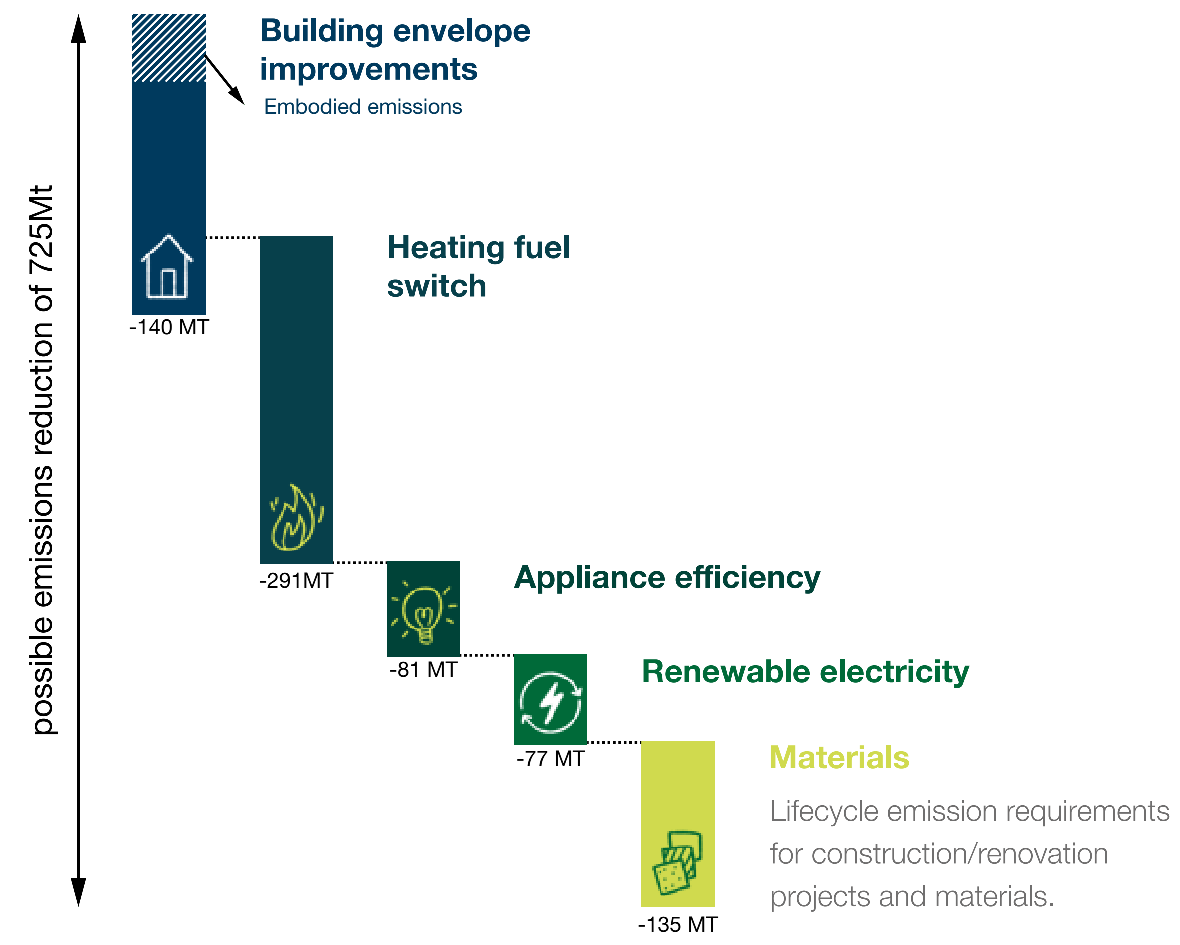
In a new apartment building the embodied carbon share ranges between **33-50%** of the total lifecycle emissions.

As EU countries accelerate efforts to decarbonise their energy systems, embodied carbon also represents a growing share of emissions in existing buildings. This is exemplified in countries like France, Sweden and Finland that can already boast energy mixes with relatively low levels of carbon intensity. Accordingly, these countries are at the forefront of policy initiatives to address the embodied emissions of buildings.

13 BPIE (2021), Whole-life Carbon: Challenges And Solutions For Highly Efficient And Climate-neutral Buildings (see here).

Mineral wool insulation represents approximately 8% of the embodied carbon of a typical newly constructed multi-family residential building[14], and around 3-6% of its total lifecycle CO2 emissions.[15] After only 6 months, the emission savings of a building insulated with mineral wool already outweigh these embodied emissions.[16] Nevertheless, the mineral wool insulation industry recognises its responsibility to significantly reduce these emissions to facilitate the transition to a carbon neutral building stock by 2050.

What does it take to decarbonise the EU building stock?



Eurima visualisation of data published by the European Climate Foundation[17]

14 Weiler, V., Harter, H., Eicker, U., (2017) Life cycle assessment of buildings and city quarters comparing demolition and reconstruction with refurbishment. Energy Build. 134, 319–328. doi:10.1016/j.enbuild.2016.11.004.

15 Karami, P., Al-Ayish, N., Gudmundsson, K., (2015) A comparative study of the environmental impact of Swedish residential buildings with vacuum insulation panels. Energy Build. 109, 183–194. doi:10.1016/j.enbuild.2015.10.031. Weiler et al. (2017) that also considered the building's end-of-life phase, found lower percentages.

16 Eurima (2013), Mineral Wool – Putting Natural Resources to Work for the Benefit of our Planet (here)

17 European Climate Foundation (2020) Zero Carbon Buildings 2050 (available here)

Chapter 3:

Moving towards a climate neutral industry

Moving towards a climate neutral industry

Carbon emissions of mineral wool insulation

The production of mineral wool is a high temperature energy intensive process. Consequently, most of the greenhouse gas (GHG) emissions associated with mineral wool insulation are emitted during the manufacturing stage, which involves melting recycled materials and raw materials such as rock, sand, limestone and soda ash, as well as fiberizing and curing. A recent study commissioned by the European Insulation Manufacturers Association (Eurima) conducted a full life cycle assessment of mineral wool insulation and found that the manufacturing stage typically represents 63% of its carbon footprint.[18] The extraction and processing of raw materials typically represents another 21%. Taken together, the product stage covers over four-fifths of our total GHG emissions.[18]

The carbon footprint of mineral wool across its life cycle

21%	Raw materials	Product stage
1%	Transport	
63%	Manufacturing	
3%	Packaging	
5%	Transport	Construction stage
5%	Construction & installation	
2%	Demolition, transport, waste processing, disposal	End-of-life stage

18 Results Vito NV 2019 study commissioned by Eurima "LCA calculations for Stone wool & Glass wool according to the new amendment draft EN 15804 + A2"

Our actions

Electrifying the melting process

While electric melting technology has been used in the sector for several decades, adoption has gained speed in recent years. In 2020, ROCKWOOL electrified Europe's largest stone wool melting furnace in its factory in Moss, Norway, which now emits approximately 80% less emissions than a conventional coke burning furnace. The new generation of electric melting technology also allows us to use greater amounts of waste material in the production process. Europe's largest glass wool electric melter, located in Orange, France, recycles all internal residues from the production line as well as external waste from deconstruction sites.

From 1990 to 2019: where we stand today

As European demand for thermal insulation products rose over the past two decades, so did the total lifecycle emissions produced by our sector. However, this rise in absolute terms should be viewed in the context of an overwhelmingly positive contribution to the carbon performance of EU buildings, given that buildings fitted with mineral wool insulation save significantly more emissions than the amount released during mineral wool's manufacturing, transportation and end-of-life processes.

During this period, manufacturers of mineral wool insulation have implemented a variety of measures to reduce the carbon footprint of our products.

Between 1990-2019 the carbon intensity of mineral wool insulation manufacturing has decreased by **~40%**.

As a result, the carbon intensity of manufacturing mineral wool insulation has decreased by approximately 40% between 1990 and 2019.[19]

This has been achieved through energy efficiency improvements, innovative product design, development of circular processes as well as technology innovation at our plants to facilitate fuel switching, amongst other measures.

Industrial symbiosis through the use of cullet from the container glass or flat glass businesses and through the use of blast

19 Guidehouse 2021 research commissioned by Eurima, showing the evolution of GHG intensity for the EU.

Our actions

Scaling up on-site renewables

Mineral wool manufacturing sites offer perfect locations for solar PV installations. In some of our plants, the whole available surface is covered with solar PV panels. The Knauf Insulation plant in Visé, Belgium houses one of the largest solar PV installations on an industrial building in the country, spanning over 10.000 m² of surface.

Transitioning to climate neutral biogas

Fuel-flexible melting technology has ensured that our plants can swiftly shift from coal to less carbon intensive fuels like natural gas or biogas. In 2020, this allowed ROCKWOOL's two Danish factories to transition from natural gas to certified climate-neutral biogas.

Boosting the share of recycled content in our products

To increase the share of recycled content in our products, we are continuously expanding the use of waste materials as feedstock for our manufacturing processes. The use of steel slag in stone wool production not only increases the share of recycled content in our products, but helps to decarbonise steel production as well. For glass wool, these recycling streams range from bottles and windshields to glazing, vials and neon tubes. In France, these efforts have allowed Saint-Gobain to increase the share of recycled content in glass wool up to 80%.

Our actions

Recycling internal waste

Saint-Gobain's Submerged Burner Melter (SBM) can recycle all internal waste from the stone wool line together with external mineral wool scrap collected from construction and demolition sites. In Ploiesti, Romania, where the SBM is powered by biomass, the technology has altogether reduced the factory's CO2 emissions by 30%.

Recovering waste from construction sites

Mineral wool is infinitely recyclable, and the number of established recycling schemes is rapidly expanding. ROCKWOOL's Rockcycle system will be available in 17 countries by the end of 2021. Following its long-running success in Sweden, last year Owens Corning Paroc introduced the REWOOL scheme in Finland, which will be expanded to other EU locations in the coming years. The Oxymelt recycling process developed by Saint-Gobain's at their plant in Orange, France has been running for over twenty years, and will now scale up to recycle 120'000 tonnes of glass by 2030.

Innovative product design

Traditionally, the binder used for the manufacturing of boards, rolls & slabs of mineral wool insulation is based on a phenol-formaldehyde resin. The binder accounts for a relatively small portion of total composition (2%-6% in weight) but its environmental impact can be significant. Over the past 10 years new binders have started to be used, and manufacturers have substituted petroleum based binders for bio-based ones. The results speak for themselves. Knauf Insulation's ECOSE bio-binder is 70% less energy-intensive to manufacture than traditional binders.

furnace slag for manufacturing mineral wool insulation has enabled our sector to considerably reduce the need for primary raw materials. In addition, it has further decreased GHG emissions thanks to the use of less carbonated raw materials and a reduction of energy consumption.

Glass cullet is an important resource representing up to 80% of the raw materials used in certain European glass wool plants.

By-products and waste streams from other industrial processes are used in stone wool production as a raw material, and represent a perfect example of industrial scale upcycling preventing the landfilling of low-value by-products and waste streams.

Over the past few decades, mineral wool insulation manufacturers have worked on developing and improving recycling

solutions for most of their production residues in closed loops or finding ways to recover them when closed loop recycling is not feasible. Local initiatives based on take-back schemes have been developed by the manufacturers, for the collection, reprocessing and recovery of mineral wool insulation off-cuts generated during construction projects, material generated during building renovation/demolition or in other manufacturing processes.

These off-cuts are often recycled into the process to make new products, but in some countries other recovery routes have been developed, such as recycling in the bricks industry or in the process of manufacturing ceiling tiles.

As a result of all these developments, we now use up to 60% recycled material for mineral wool insulation production.[20] This makes us less dependent on virgin raw materials, thereby reducing total lifecycle emissions of our products.

Our industry now uses up to **60%** recycled materials

Innovative process and product improvements have also helped to curb emissions.

In some cases the compression ratio has doubled, meaning that a product providing the same performance today has significantly reduced its environmental impact in the storage and transportation phase compared to 30 years ago.

Consecutive R&D breakthroughs in our production plants have led to improved fiberizing processes, allowing us to manufacture lower-density products with the same quality and thermal performance (R-value), thereby reducing our consumption of raw materials.

Replacement and upgrading of furnaces, improvements in furnace insulation and application of waste heat have helped to reduce our own energy consumption. Meanwhile, increasing use of renewable energy contracting and broader efforts to decarbonise the power sector have contributed to lower scope 2 emissions[21] in our industry. EU policies like the Emissions Trading Scheme and the Renewable Energy Directive have been instrumental in this regard.

Mineral wool industry's long history of providing environmental product declarations (EPD) allows us to better understand our lifecycle impact to identify additional improvement opportunities, particularly concerning indirect emissions that occur throughout our value chain (also known as scope 3 emissions). Many of the measures described are already lowering our scope 3 emissions. For example, electrification is reducing upstream emissions associated with cokeries, whilst our focus on recycling is reducing end-of-life emissions. In addition to reducing the need for virgin raw materials in our industry, we are also working with suppliers to lower the carbon intensity of the materials we continue to consume.

20 Eurima (2013) Mineral Wool – Putting Natural Resources to Work for the Benefit of our Planet (available here)

21 According to the Greenhouse Gas Protocol, Scope 1 emissions cover direct emissions from owned or controlled sources; Scope 2 emissions cover indirect emissions from the generation of purchased electricity, steam, heating and cooling; Scope 3 emissions include all other indirect emissions that occur in a company's value chain.

Our decarbonisation levers on the road to 2050

In the next decade, energy efficiency and circular economy will remain prominent decarbonisation levers in our industry. At the same time, as the EU energy mix evolves, there will be more opportunities for our industry to leverage alternative fuel sources. Consequently, this will increasingly become our most impactful decarbonisation lever. Where process emissions, stemming from the consumption and transformation of raw materials (in the melting process), cannot be fully abated using these three decarbonisation levers, alternative approaches need to be explored. Therefore, in the long-term, use of carbon capture, utilisation and storage (CCUS) technologies will be considered for addressing any remaining emissions.

Energy efficiency measures

A set of incremental improvements that can be achieved through a mix of efficiency measures including:

- Improvements in furnace insulation (e.g. to reduce heat losses)
- Application of waste heat recovery methods to the melting and curing processes (e.g. use residual heat from the melting furnaces to heat curing ovens)
- Replacements of older furnaces with more modern and efficient versions as part of the investment cycle for maintenance
- Further recovery of flue gas heat in the batch pre heating i.e. through increased input material temperature to make it easier to melt when it enters the furnace
- Use of excess heat for district heating of communities and nearby urban or industrial infrastructure
- Increase of glass cullet share in the melt
- Regular machinery maintenance

Benefits

- Companies are already implementing most of the measures listed
- These options are generally cost-effective, though with ranging pay-back times

Challenges

- A combination of measures is required to achieve higher energy savings potential, compared to other decarbonisation levers

Energy Efficiency

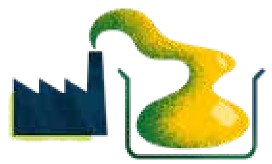
A set of incremental improvements that can be achieved through a mix of efficiency measures e.g. improvement in furnace insulation, application of waste heat recovery methods etc.

Circular Economy

This option can take various forms ranging from the utilisation of secondary raw materials to the recycling of post-consumer waste.

Alternative Fuel Sources

May include the following: electrification of the melting process, use of biogas, combustion of hydrogen.



Carbon Capture, Utilisation and Storage (CCUS)

Despite the technical challenges, CCUS has been included as an option to address emissions that cannot be addressed by other levers (e.g. process emissions).

Circular Economy

This option can take various forms ranging from the utilisation of secondary raw materials, through to establishing fully closed loop factories for the recycling of post-consumer waste.

By collecting and recycling mineral wool insulation products from customers, and minimizing the production of waste, companies can reduce the environmental impact of the products they provide over their entire lifecycle. This option also includes repairs, refurbishments and the general reuse of products and equipment.
For glass wool, about 1.2 tonnes of raw material is saved with every tonne of cullet (crushed glass that is ready for re-melting). Some plants already use more than 70% of recycled glass for glass wool production in Europe.

For stone wool, a certain percentage of the virgin stone can be replaced with upcycled waste materials from other industries. Stone wool waste generated in production, together with reclaimed stone wool from the market can be endlessly recycled. Some of this stone wool can be utilised without re-melting, resulting in a reduction of the carbon intensity of the manufacturing process by approximately 10%.

The circular economy option opens up opportunities for the recycling of materials, reductions in raw material usage and savings of both energy and GHG emissions.

Benefits

- As cullet melts at lower temperature than raw materials, for every 10% of cullet added to the furnace, 2-3% less energy is used per tonne of product manufactured

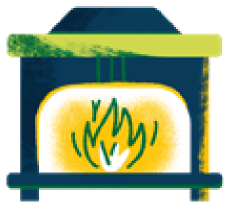
Challenges

- Development of circular business models depends on local (national) waste legislation and the availability of the appropriate recycling infrastructure.
- Waste collection remains a major obstacle.
- Good quality cullet is scarce and expensive, leading to a trade-off between cost, quality and emissions.
- For a number of installations, a significant proportion of the potential savings have already been realised, so the additional reduction potential is limited in these facilities.

Alternative Fuel Sources

The melting, fiberizing and curing processes are the most energy-intensive steps in the production of mineral wool insulation, and hence the ones with the highest potential of GHG reduction. Several alternative options can be explored with respect to decarbonisation of the process apart from electrification, since electricity is still mainly produced from fossil fuels. We consider the following decarbonisation options:

- Electrification e.g. through the use of submerged electric arc furnaces.
- Use of biogas instead of natural gas since once upgraded it has the same qualities and consists mainly of methane.
- Use of hydrogen instead of natural gas, which would be considered renewable if produced via electrolysis using renewable electricity or from natural gas in combination with carbon capture, utilisation and storage.



Electrification

A common decarbonisation option considered across the industry is electrification. Although this option does not eliminate indirect emissions, since electricity is still mainly produced from fossil fuels, it redirects emissions to electricity producers. If electricity is produced using renewables, the process will be more sustainable.

Electric furnaces show high potential for decarbonisation. All electric furnaces use electricity to provide heat. Electrification of the melting process can be done using submerged electric arc furnaces, applying resistive heating. Resistive heating makes use of electrodes that are inserted in the melt. Because of the high electric resistance of the materials, the electricity produces heat, which is used to melt the materials.

Benefits

- Compared to fossil fuel fired furnaces, full electric furnaces have higher energy efficiency.

Challenges

- Cost and availability of renewable electricity.
- For larger scale furnaces, the higher electricity price and lower lifetime compared to fossil fuel fired furnaces largely offsets the efficiency gain.
- An additional technical challenge to electric melting is that it is not suitable for high cullet ratios. Therefore, savings from a switch to carbon neutral electricity could partly be reduced by an increase in process emissions.

Biogas

Biogas can be upgraded to have the same qualities as regular natural gas (largely consisting of methane). In order to upgrade biogas, e.g. from digesters, into biomethane that is suitable for the natural gas grid, it needs to have the same calorific value as regular natural gas. This is done by removing impurities and CO2 from the gas. The biomethane can be used to substitute natural gas for the furnace and curing oven. In this case no major adjustments are needed. Replacing all currently used natural gas with biomethane would come with increased expenses but the emissions would be reduced to only the process emissions. Regular biogas supply is a problem, however. The currently available biogas supply would need to be scaled up significantly to be able to substitute the current natural gas demand.
Investments to adjust the production facilities would be minimised, but a separate biomethane supply infrastructure may be required.

Benefits

- Similar qualities to regular natural gas
- No major adjustments required for implementation
- Emissions reduction (emissions reduced to only process emissions)

Challenges

- Replacing natural gas with biomethane can be expensive
- Security of biogas supply (and scale up) could be an issue
- Potential is limited by quantities available

Hydrogen

Hydrogen has recently gained more traction in the mineral wool and glass industry. The option that is considered is hydrogen combustion instead of natural gas. To be considered a renewable option, hydrogen needs to be produced from electrolysis using renewable electricity (green hydrogen) or from natural gas in combination with carbon capture, utilization and storage to mitigate CO2 emissions (blue hydrogen).
It can have the advantage of cleaner combustion and no CO2 emissions. Questions that still need to be answered are how equipment design needs to be altered, especially when looking at the burners and how the different characteristics of hydrogen will affect the process and efficiency.
The availability of affordable hydrogen produced from renewable electricity (green hydrogen) or hydrogen produced from natural gas in combination with CCS (blue hydrogen), is currently also a major limiting factor.

Benefits

- Cleaner combustion
- No CO2 emissions

Challenges

- Higher flame temperature at 2200°C compared to 1900°C for natural gas
- Hydrogen has a non-luminous flame which makes it difficult to monitor
- The flame radiation is less effective, and the produced water from combustion may affect furnace operation
- Availability of affordable hydrogen
- Injecting more than 20% of hydrogen in the gas grid would require R&D and process adaptation to adapt furnace technology

Carbon Capture Utilisation and Storage

Process emissions cannot be avoided by an energy switch (see electrification options). Carbon capture, utilisation and storage, or CCUS, is an important emissions reduction technology that can be applied to address process emissions. After years of a declining investment pipeline, plans for more than 30 new integrated CCUS facilities have been announced since 2017, the vast majority of which are in the United States and Europe.

The low volumes of CO2 emissions, suggest this might not be a feasible option for mineral wool producers, however it could be a situational option for specific facilities, depending on location and proximity to CO2 transport infrastructure. The CCUS option might also create a disincentive to pursue other decarbonisation activities now.

Benefits

- Opportunity to mitigate process emissions that cannot be addressed through other decarbonisation levers e.g. alternative fuels

Challenges

- Requires extensive transport and long-term/secure storage infrastructure in order to be a large scale solution by 2050
- Space limitation, presence of acidic compounds, low CO2 concentration are some of the technical constraints
- Cost of technology and social acceptance remain key barriers to implementation

Quantifying the exact potential of each decarbonisation lever poses challenges, since the decarbonisation potential of any given measure is influenced by the starting point of the manufacturing facility in question, the energy mix of the country/region, the availability of waste management infrastructure etc. Nevertheless, the mineral wool insulation industry is continuously working on better understanding the potential of each decarbonisation lever and exploring how different measures can be combined at any given facility.

Key challenges to overcome

1. Cost and availability of alternative fuel sources

Whilst the availability of renewable energy sources has grown considerably and costs have fallen in recent years, this availability is not evenly spread across the EU, and the dominance of fossil fuels in the EU energy mix result in financial barriers preventing greater adoption of renewables in the mineral wool insulation sector.

The mineral wool insulation industry has established plants operating all across Europe. EU countries should be commended for reaching their collective 2020 renewable energy target. Nevertheless, the data shows that large variations remain across the continent[22], which inhibits the decarbonisation efforts of our plants located in countries with high carbon intensity in the energy system. The differences are even starker once broken down into specific energy sources, with the deployment of hydrogen infrastructure and availability of biogas confined to a handful of countries, mostly in North-West Europe[23].

The energy crisis triggered by Russia's invasion of Ukraine has shown that even countries that are transitioning towards renewables at a relatively fast pace are vulnerable to the volatility of the EU's gas market. Whilst renewables have improved the security of supply in these countries, industries operating there are nonetheless impacted by the current high electricity price, which in turn undermines their capacity to invest in technologies that enable fuel switching.

The cost of Europe's future energy system will partially depend on its size, with electricity grid investment set to rise exponentially to facilitate the expansion of transmission and distribution infrastructure. For this reason, the European Investment Bank has warned of the high potential cost of electrification, should governments fail to frontload energy efficiency investments in the next decade[24].

22 Eurostat (2021), Data Browser: Share of energy from renewable sources (available here).

23 Gas For Climate (2021), Extending the European Hydrogen Backbone (available here).

24 EIB (2021), Annual Investment Report 2020/2021 (available here).

25 EiiF & Ecofys (2021) Climate protection with rapid payback: Energy and CO2 savings potential of industrial insulation in EU27 (access here).

Fortunately, there is still significant energy efficiency potential of industrial insulation, representing approximately 40 Mt of annual cost-effective CO_2 savings[25]. Therefore, reducing the energy needs of European industry, amongst other sectors, is a pre-requisite for ensuring competitively priced renewable energy.

The energy potential of the industrial insulation accounts for **~40 Mt** of annual cost-effective CO_2 savings.

2. Enabling greater circularity in the construction sector

Today's challenge for the broader construction industry is the recovery of "post-consumer" waste generated during renovation or demolition/deconstruction projects, in order to stop landfilling valuable resources and to use these resources as secondary raw materials to substitute virgin non-renewable materials. The mineral wool insulation industry is actively working on technical solutions to answer this challenge and supports the mid-term ambition of banning landfilling for recyclable materials like mineral wool. It is evident that this will require an enabling regulatory framework that will stimulate the economics of waste recycling and address barriers to increase circularity while safeguarding the protection of workers. Eurima members are continuously cooperating within the value chain to address existing barriers and obstacles in a solution oriented approach.

We acknowledge that the Circular Economy Action Plan duly identifies a number of bottlenecks which need to be addressed to accelerate the move towards maximised circularity. The mineral wool insulation industry has identified the barriers that need further attention in this context.

The economical barrier: continued availability of landfill options, coupled with relatively low landfill prices, make it difficult for alternative recovery options to become economically viable. Very few EU countries have thus far committed to banning landfilling of recyclable materials with specific timelines, which are needed to drive the market for secondary raw materials and create business confidence to invest in greater recycling infrastructure.

The regulatory/administrative barrier: for the mineral wool insulation sector, waste from renovation projects going to recycling, that is not CLP exonerated[26], is subject to regulatory and administrative obligations that hamper their cross-border transport and recycling. This makes it difficult to bring such recyclable materials back into the loop. The simplification of these procedures and their fast tracking, while respecting their original objectives, would be necessary to create the proper conditions for the road to recycling.

The infrastructure barrier: over the past few decades, local initiatives based on take-back schemes have been developed by the manufacturers, for the collection, reprocessing and recovery of mineral wool insulation off-cuts generated during construction projects or in other manufacturing processes. However, the absence of sufficient sorting and separate collection schemes result in demolition and renovation waste often being contaminated and thus undermining recycling-processes. This hampers the industry's efforts to increase the use of recovered materials, as construction product manufacturers have to guarantee certain levels of performance and safety of their products, regardless of whether the products are generated out of primary or secondary raw materials. The EU waste framework currently lacks a harmonised method that tracks down materials and includes information on the content of construction products to encourage the use of non-toxic and recyclable materials.

26 Note Q of Annex VI of Regulation (EU) No 1272/2008 on Classification, Labelling and Packaging lists so called endpoints which are characteristics that mineral wool fibres need to fulfil to be exempted from being classified as a carcinogen at EU level. These endpoints can be shown via testing the fibres in vivo, in turn demonstrating compliance with the Note Q criteria. Mineral wool fibres produced by Eurima members are Note Q compliant.

3. Persisting technical barriers

A number of technical challenges must be overcome in order to fully leverage our decarbonisation levers. That is why the mineral wool insulation sector is prioritising technical innovation that enables fuel switching and more circular business models.

Electric melting and fuel flexible melting show great potential in reducing direct emissions in our plants, particularly in countries with an abundance of low carbon energy. Although electric melting and fuel flexible melting are proving impactful in terms of direct emission reduction, technical challenges remain.

Innovation is also key for increasing the circularity of our products, as technical barriers currently limit the amount of recycled content that can be used during the production process. Innovating our way out of these challenges is the only way to achieve carbon neutrality in the mineral wool insulation sector.

Chapter 4:

Policy recommendations

Policy recommendations

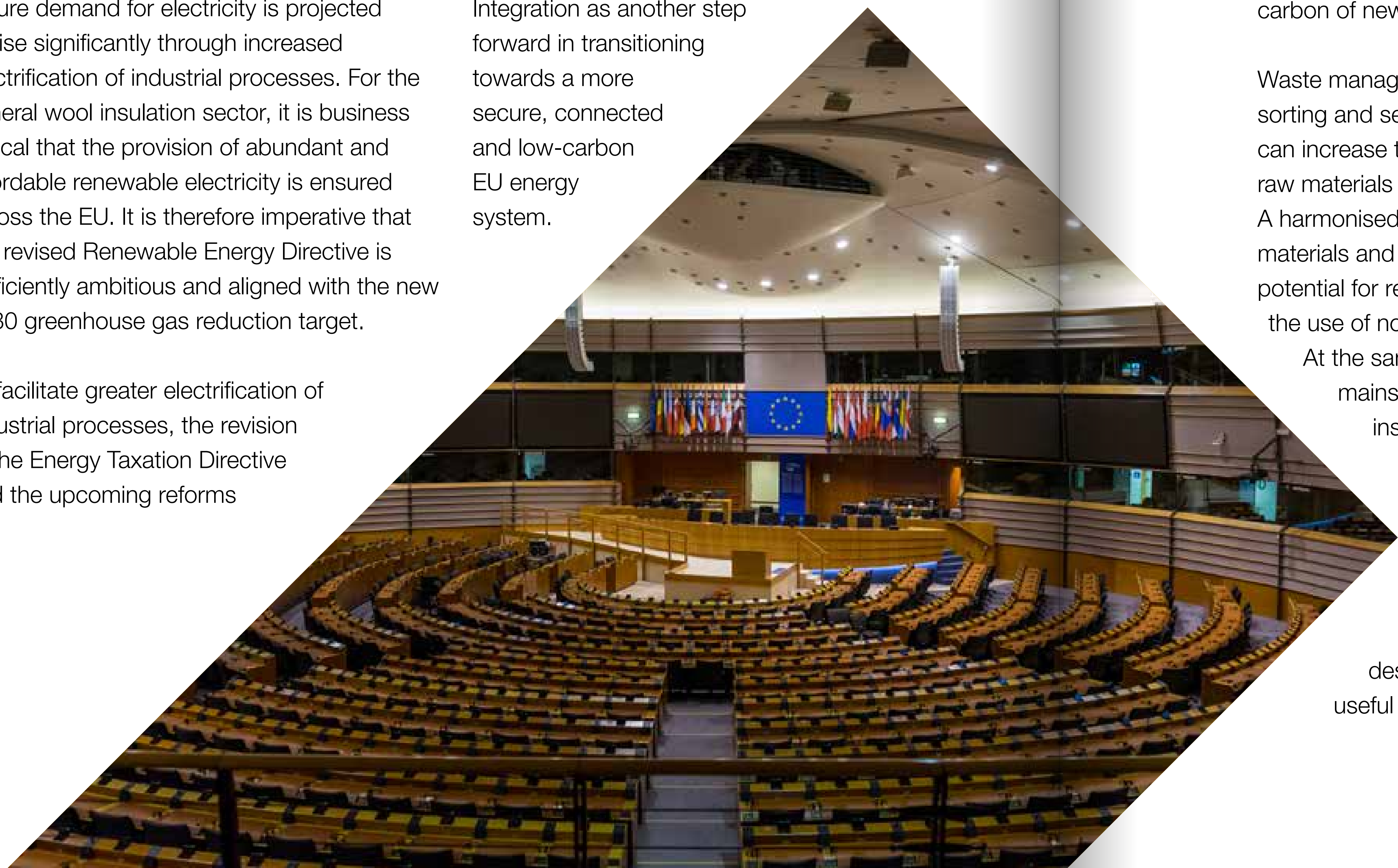
This report has shown that mineral wool insulation manufacturers have powerful decarbonisation levers available at their disposal to transition towards a net-zero carbon industry by 2050. The mineral wool insulation sector, and Europe's energy intensive industries more generally, require a clear and stable long-term policy framework that facilitates this transition. The European Green Deal provides an unprecedented opportunity to deliver such a policy framework. This means putting in place legal mechanisms that provide businesses with certainty over the long-term price of carbon and availability of clean energy, as well as the economic viability of circular business models and state support for breakthrough industrial technologies.

Ensure access to affordable and decarbonised energy

Future demand for electricity is projected to rise significantly through increased electrification of industrial processes. For the mineral wool insulation sector, it is business critical that the provision of abundant and affordable renewable electricity is ensured across the EU. It is therefore imperative that the revised Renewable Energy Directive is sufficiently ambitious and aligned with the new 2030 greenhouse gas reduction target.

To facilitate greater electrification of industrial processes, the revision of the Energy Taxation Directive and the upcoming reforms of gas market legislation should ensure that costs of decarbonised electricity rise in competitiveness when compared to fossil fuels. Europe's energy intensive industries would also benefit from greater long-term certainty on the future of the Emissions Trading Scheme and the newly established Carbon Border Adjustment Mechanism. Policy uncertainty in this area can lead to volatility in carbon prices, which in turn creates business uncertainty for companies investing in long-term decarbonisation measures.

In parallel, the Energy Efficiency Directive should continue to strengthen incentives for companies to implement energy management systems and take up recommendations in energy audits, thereby reducing the burden placed on the energy system during peak hours. Eurima welcomes the EU Strategies on Hydrogen and Energy System Integration as another step forward in transitioning towards a more secure, connected and low-carbon EU energy system.



Propose a circular economy action plan for the construction sector

Access to recycled materials is a precondition for increased circularity. But the current low costs of landfilling undermine the economic viability of alternative recovery options. Banning the landfilling of recyclable products (and discouraging the landfilling of non-recyclable products) or increasing landfill prices would create the right economic incentives to enable growing recycling capacity. A new circular economy action plan for the construction sector should tackle this by introducing a ban on the landfilling of recyclable materials and by facilitating the introduction of building material passports. Banning or taxing the demolition of buildings and mainstreaming the dismantling and deconstruction practices can also help lower the use of virgin materials and embodied carbon of new buildings.

Waste management systems with proper sorting and separate collection schemes can increase the availability of secondary raw materials by minimising contamination. A harmonised method of tracking down materials and chemicals that may restrict the potential for recycling would help to encourage the use of non-toxic and recyclable materials. At the same time, to accelerate and mainstream deconstruction practices, instead of demolition, the separate collection of waste at the deconstruction stage should become mandatory. The work conducted by the Commission, in close cooperation with industry, on design for deconstruction, is a useful step in this regard.

The declaration of recycled content using a harmonised definition in all construction products should be made mandatory as part of the revision of the Construction Products Regulation. Public authorities should lead the transition by introducing minimum recycled content requirements or zero waste requirements in their procurement rules.

Support research and innovation with targeted funding

Mission-oriented research and development (R&D) programmes for low-carbon technologies in energy-intensive industries are a must. This means providing sufficient support for designing and building demonstration plants at scale, as well as for their roll-out across the market.

The Innovation Fund under the EU ETS will need to support industrial low-carbon innovation to bridge the gap from pilot to demonstration phase. Green public procurement and contracts-for-difference can help ensure market uptake to bridge the gap from demonstration to commercialisation phase.

Finally, the new circular economy action plan should realign the interface between EU Chemicals Legislation (REACH and CLP) and the EU Waste Framework Directive to address regulatory/administrative barriers that would facilitate recycling without interfering with existing EU policy in the fields of environment and/or health & safety.

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