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Sovereign Analysis

Is the EU on Track for 2050 'Net Zero'?

CANDRIAM
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25 years of ESG

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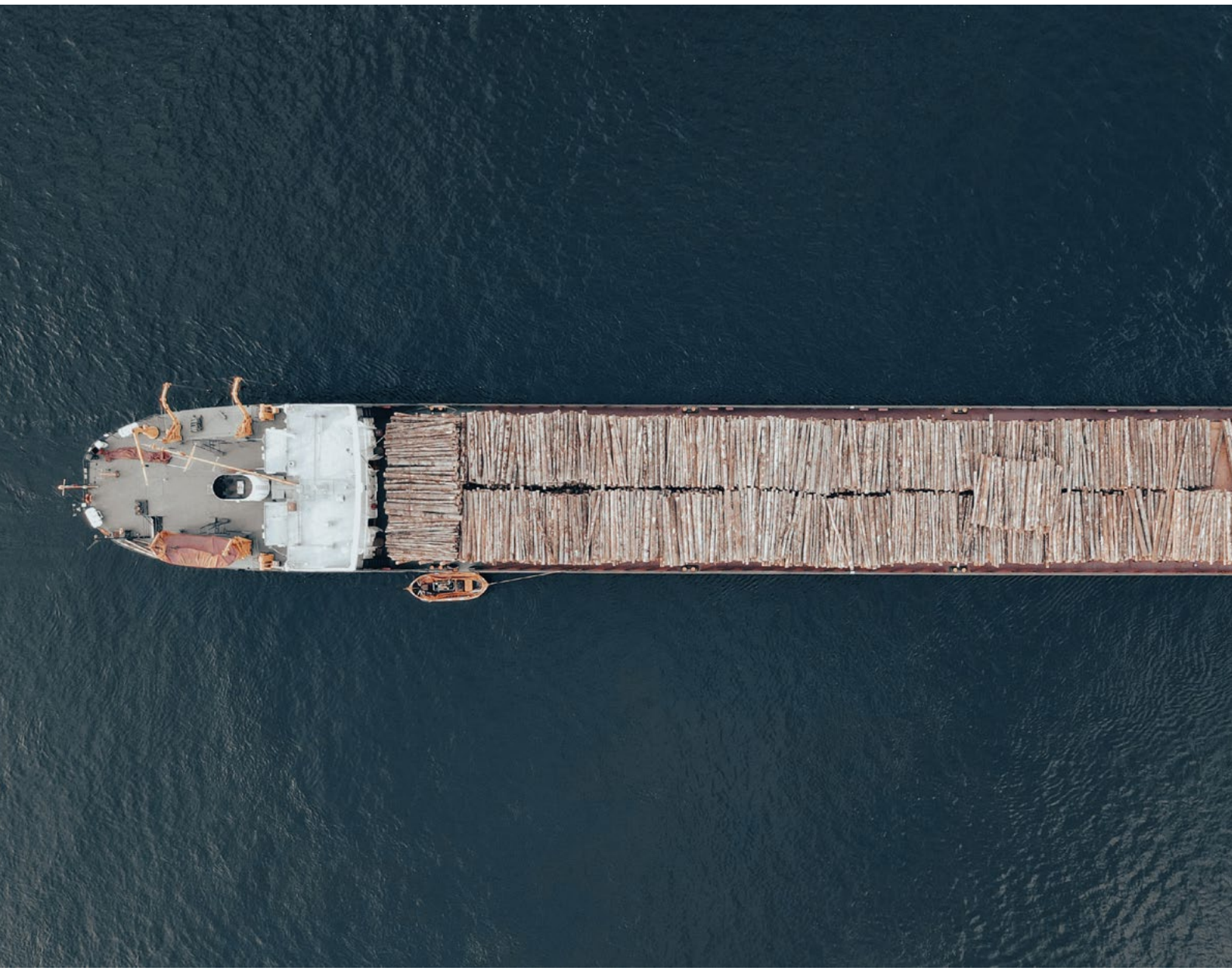
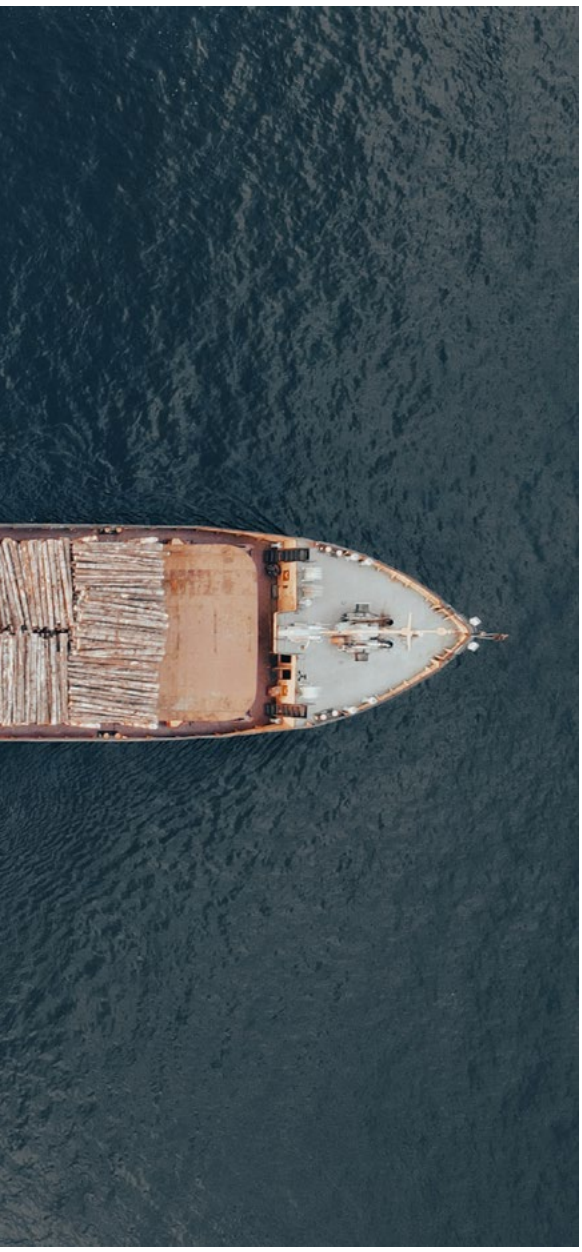


Key Takeaways – Balancing the Equation



In formalizing its 2050 carbon neutrality commitment, the EU Roadmap 2050 specifies goals and a roadmap for target emissions reductions and removals, scenarios, interim goals for 2030, and five-yearly progress reviews. While breakdowns of these targets by country are not yet set, the body of data available is already overwhelming. To create a manageable picture for investors, we discuss some of the assumptions and some of the key changes needed.

Every net zero scenario in the EU Plan assumes some level of carbon capture. We all look forward to these new technologies – ***but the only large-scale carbon capture technology currently in place is our forests***. This means every scenario requires that we halt deforestation within the EU, increase reforestation, and create new forests (afforestation).

Balancing carbon capture in the calculation is that hot topic, reducing Greenhouse Gas emissions. Energy generation is obviously the key, followed by transport. Analysing the EU plans and scenarios suggests that while paths will differ by member nation, overall, **residential housing represents an important opportunity**. Today, 75% of housing stock has poor energy performance. EU models project that by 2050 less than one-fourth of the housing stock will have been created after 2021.

Repeat – by 2050, less than one-fourth of the housing stock will have been constructed under whatever new emission regulations or technologies may be envisioned.

The recently-concluded COP26 *UN Climate Change Conference* demonstrated worldwide agreement on the climate change problem. But we already heard agreement on the problem in Paris in 2016. What we need now is agreement on the solutions.

With the EU currently in the lead globally in establishing a path to net zero, the investment risks and opportunities are emerging more clearly. But if 'no man is an island', neither is the EU insulated from the global economic and social effects of climate change, as suggested by our Candriam model on sustainable trade. If the EU and other large trading blocks evade their moral imperative not to export their environmental problems, smaller economies will suffer more, but prevailing winds will blow some of those problems back to the developed world. Climate knows no national borders.

"Climate change is the biggest challenge of our time. The European Green Deal sets the example for the world: boosting the economy, improving people's health and quality of life, protecting our nature, and leaving no one behind. However, the transition towards climate neutrality cannot be achieved through environmental policies alone. It will require strong collaboration between all stakeholders regarding investments, research and innovation to upend the status quo."

- Vincent Hamelink, CIO, Candriam

The EU Carbon Plan: Twists in the Road to 2050?

We are in the throes of a second Industrial Revolution. The first Industrial Revolution was brown, fuelled by coal and other fossil fuels. The 21st century Industrial Revolution will be powered by green energy. So far, the geographic path is similar – 'Western' countries will lead the transition, while the rest of the world might struggle. A major difference is that technologically at least, China will be among the early nations to enter the new age. Another difference is the tremendous interconnection among economies in this new era.

The effects of this second Industrial Revolution are foreshadowed by those of the current coronavirus crisis. Some countries are slowly returning to normalcy, but the global situation is dire – globally, the full vaccination rate is a mere 33%.[1] During the first Industrial Revolution it was an advantage to industrialise while the competition was still relying on manufacture by hand. Today, we are global. For example, the Covid-19 virus can mutate freely and no one is safe until everyone is safe. A country may gain some temporary sense of normalcy, but only until the next vaccine-resistant mutation. The climate crisis is the same. Some countries will be less affected initially, but once the world starts seeing climate refugees on a large scale as well as conflicts for resources, that normalcy will not last for very long.

It is essential to keep in mind that even our ambitious zero-emission plans only aim to halt the *increase* of Greenhouse Gasses (GHGs) in the atmosphere. Many have already accepted that climate-related natural disasters will become more numerous and more intense. We are seeing this in real time. Temperature records are being broken every year and enormous forest fires have become commonplace. We are feeling the unintended consequences of past actions in the form of Covid-19, crop failures, and supply-chain disruptions across the industrial sectors. These consequences have become *grey swans*.

It is not surprising that long-term models fail to include the possibility of tipping points and ecosystem collapse -- which would make the existing models irrelevant. The plans now in place were established to minimise disruption to economies and to the population at large. Avoiding tipping points – inherently unpredictable and difficult to reverse -- means that plans will have to be revised. To avoid 'terra incognita', we need nothing short of a total and fundamental transformation of our socio-economic system.

Unexpected disruptions will undoubtedly arise. Instead of trying to reassess after the fact, might it be useful to abandon our complacency? The fable of the boiling frog is apt. We risk sitting in slowly warming water until we boil alive.

Recent crises and the responses to them are a dress rehearsal of things to come. Nations seem not to understand that humankind is in this together, and the issue is not solved when rich countries have enough vaccines. Economies cannot be complacent about a 2°C-plus warming. This would generate natural disasters of much greater magnitude, occurring at an even greater frequency than we suffer today. The WWF estimates that humanity has reduced populations of wildlife by 60% since 1970.[2]

Food and water shortages will likely lead to tensions, climate refugees, and international conflict.

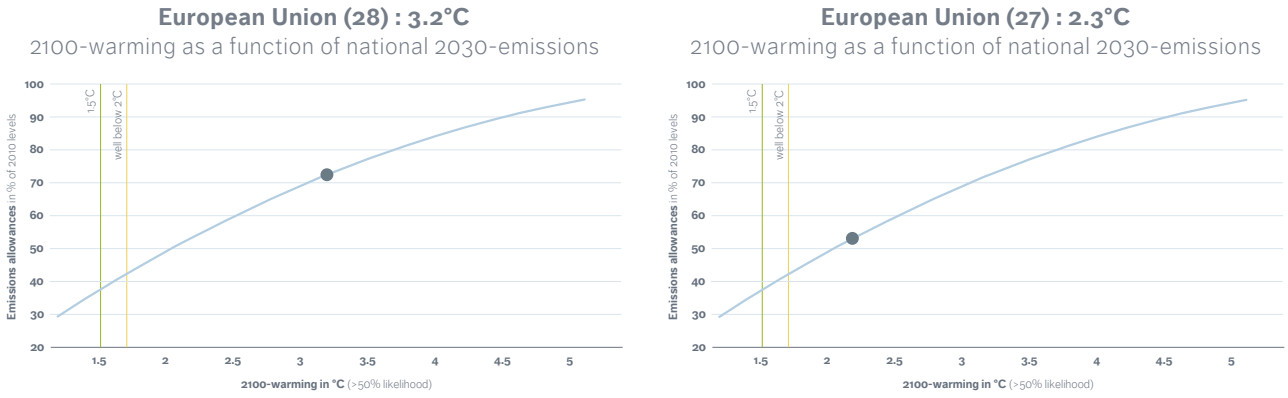
The coronavirus does not respect borders, nor will any future pandemic. If left free to mutate in regions without vaccines, Covid-19 will undoubtedly develop new variants which can break through existing vaccines, rendering vaccination in China and the West merely a temporary reprieve for the populations of wealthy governments.

Climate does not respect national borders either. The actions of individual countries will matter little unless there is concerted global action. As with the Covid-19 vaccines, **transfers of technology, capital, and wealth will be needed within each country, each continent, and globally, in order for the climate crisis to be averted**.

In the run-up to the 26th UN Climate Change Conference of November 2021, the European Union published its upgraded ambition to become carbon-neutral by 2050. This is very timely with respect to the 2021 *Sixth Assessment Report by the IPCC*[3] and its scientific conclusions, as well as addressing the insufficiency of the EU's previous commitments.

The European Union has been the most proactive of the three economic superpowers in planning for reduction of its Greenhouse Gas emissions, while targets from the US and China lack specificity. However, even in the EU, Nationally Determined Contributions (NDCs) by each member state and the EU as a whole remain insufficient to bring the Union in line with warming below 2°C by 2100, let alone limit the region's contribution to the 1.5°C pathway. Although member states' NDC updates are still in process, the EU as a whole has made a step in a positive direction.

Figure 1: EU GHG Targets – Previous and Updates



Source: Robiou du Pont, Y. et al. Warming assessment of the bottom-up Paris Agreement emissions pledges. Nature Communications 7, (2018), available at https://doi.org/10.1038/s41467-018-07223-9

The basic net carbon equation is simple. The EU produces and consumes energy, emitting carbon dioxide and other greenhouse gasses into the atmosphere. A portion of these GHGs are absorbed by its forests, the so-called carbon sink. The updated goals and analysis outline ways to further decrease the carbon intensity of production and increase the GHG efficiency of consumption, while maintaining the carbon sink more or less at current levels.

Balancing the equation is *not* simple. The updated plans are backed by a 2018 In-Depth Analysis,[5] as well as the 2020 Impact Analysis[6] and its technical appendix,[7] detailing the issues and the possible pathways to achieve the new goal. Taken together, the documents present the top-down picture of the possible pathways to EU carbon-neutrality.

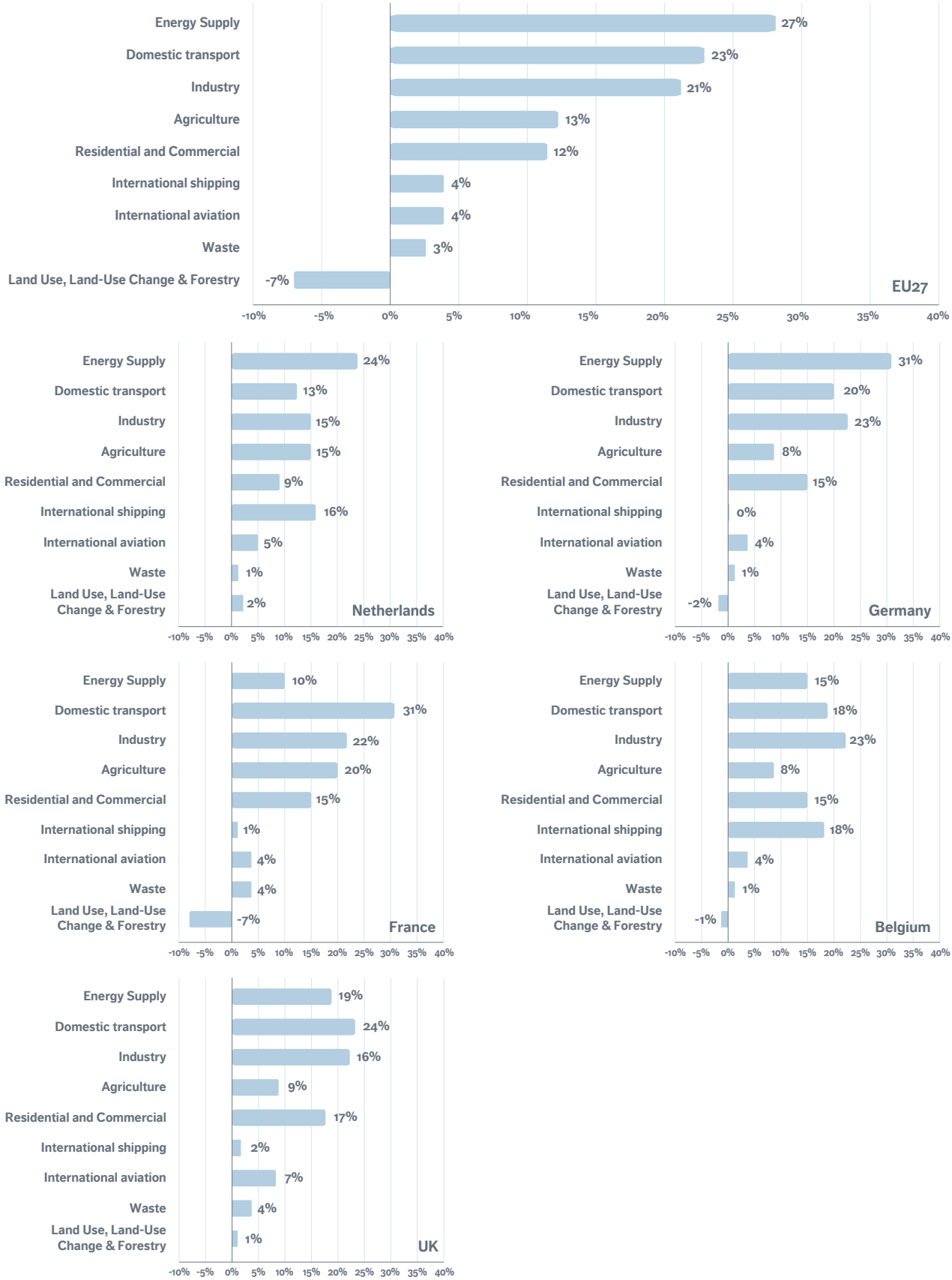
The analyses employed by the EU are comprehensive and backed by a robust set of models, or at least as robust as any long-term projections can be when incorporating such a vast amount of variables. The detail and complexity of the problems addressed by the reports can feel overwhelming to interpret. Yet, only the modelling results are truly new. Most of the other results are updates, improvements, and refinements of trends and issues already under consideration. We think it is useful to outline the most important elements and the key problem areas in order to put the new EU plans into perspective.

The EU documents outline model projections for multiple scenarios which could lead the EU to achieve the updated goals, as well as the tools available. At the time of this writing, the breakdown within individual countries is not yet available, so we examine several elements that our analysis shows will be key to the success of the plans. It is also useful top consider what a Sovereign Sustainability model can tell us about where selected countries are, and what the trends in these countries can show about the future focus of the changes that are coming. We use our own **proprietary model** for this.

The countries that we chose for analysis had diverse temperature equivalents before the updates to individual Nationally Determined Contributions (NDCs) – the old target for Belgium was 3.2°C, the Netherlands at 2.9°C, Germany at 3°C, and France at 2.6°C.[8] We await the new NDC targets. While the UK is no longer a member of the EU, its geographical proximity and historical similarities make it illustrative. Of course the UK was included in the previous EU NDC, with a temperature equivalent target at the time of 3.2°C. The UK has already updated its NDC to a more-ambitious 1.6°C equivalent.[9]

Figure 2: GHG Emissions by Source, EU 27 and Selected Countries

Percentage of Total - 2019



Source: European Environment Agency, EEA[10]

Before we explore the main elements of the energy transition, it is useful to see which sectors are the main contributors to GHG emissions. Not all Greenhouse Gasses are created equal. Some, such as methane, contribute a much more powerful greenhouse effect than others, but for ease of presentation all emissions have been converted to CO_2 equivalents.

Even countries with similar level of economic development have different emissions profiles, requiring different transition pathways on their way to net zero (Figure 2). While transport and agriculture in particular deserve standalone analyses beyond the scope of this paper, ***electrification of economies means that energy supply is the most important sector for transformation, even though it is not uniformly the greatest emitter at present***. It would be counter-productive in the overall equation to electrify home heating, then supply that increased electricity demand with new coal-fired plants.

Land and forests as a net carbon *emitter* is a worrying proposition. Some soils emit CO_2 when farmed or developed. Geography and legacy in land use have caused positive net emissions in some EU countries from their land use, or from changes in their land use, and from the forestry sector. Further, when farmland is created from forest, the change hits both sides of the net carbon equation – a new source of GHGs is created, while some of the carbon sink is destroyed. Hopefully mostly a legacy in the EU, this two-fold impairment in land use continues in parts of Amazonia. Geography cannot be changed, but land use and management can.

To navigate the EU roadmap, we outline the most significant elements of energy generation, energy use, the future of the 'carbon sink', and the social implications of the energy transition. In climate change, there is no island. *Global* action is necessary for the *internal* proposals of the EU to be successful.

The Candriam Sovereign Sustainability Model

Throughout our analysis, we will refer to our Candriam Sovereign Sustainability Model. This model incorporates multi-year series of 470 Factors for each country. The model is fed by a rich database, aiding our understanding of complex issues. Beyond the overall Sustainability Score for a country, we can compare individual Factors, groups of Factors, or Issues across countries or regions. These components of our model offer tremendous insight on individual elements which we wish to study further, as in this document. We use both the data and the model insights in our Candriam investment processes.

Stepping inside the Model:* 'Strong Sustainability' *means Natural Capital Stands Apart

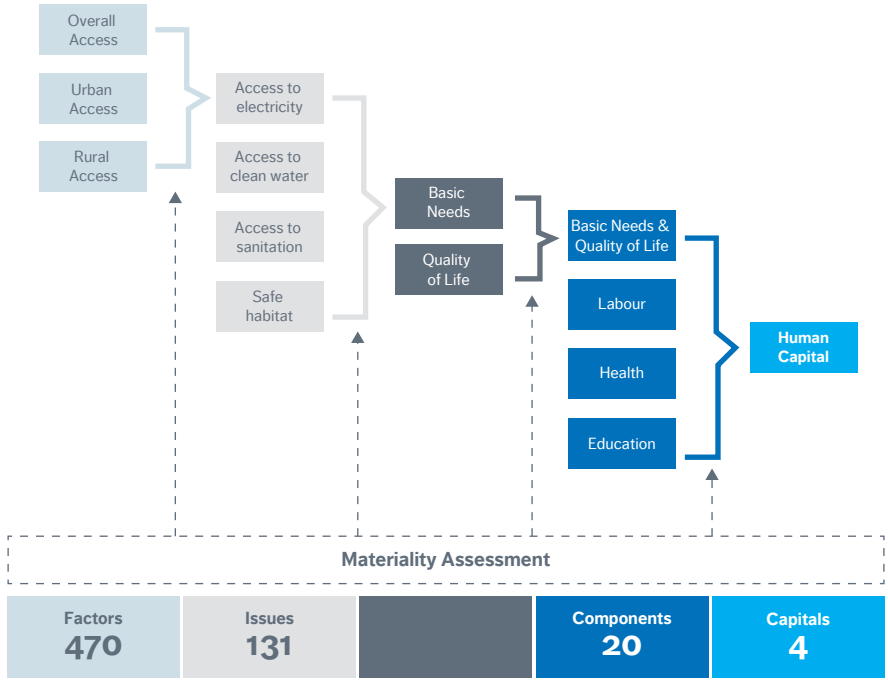
Candriam has been analysing and scoring Sovereign Sustainability since 2009. The third version of our model moved us beyond the traditional four-capital-pillar framework by recognizing that **Natural Capital is both *finite*, and *non-substitutable*** for Human, Social, or Economic Capital.

The increased weighting of natural capital in our overall country score affects country rankings versus our previous models – and versus the way other models might rank nations.

For our full philosophy and approach to Sovereign Sustainability, download our paper, '***Natural Capital vs the Nature of Capital***'.

Candriam Sustainability Score and the Four Capital Pillars

Natural Capital Score x (average of Human + Social + Economic Capital scores)



Example above is for Illustration purposes only. Actual taxonomy may vary in different model versions.

Source: Candriam

Energy Generation and Supply

Development comes at a cost. Given the structure of European economies and the historically high usage of fossil fuels to generate energy, developed countries as a whole are not performing very well in this category. The flip side of this problem is the opportunities it presents.

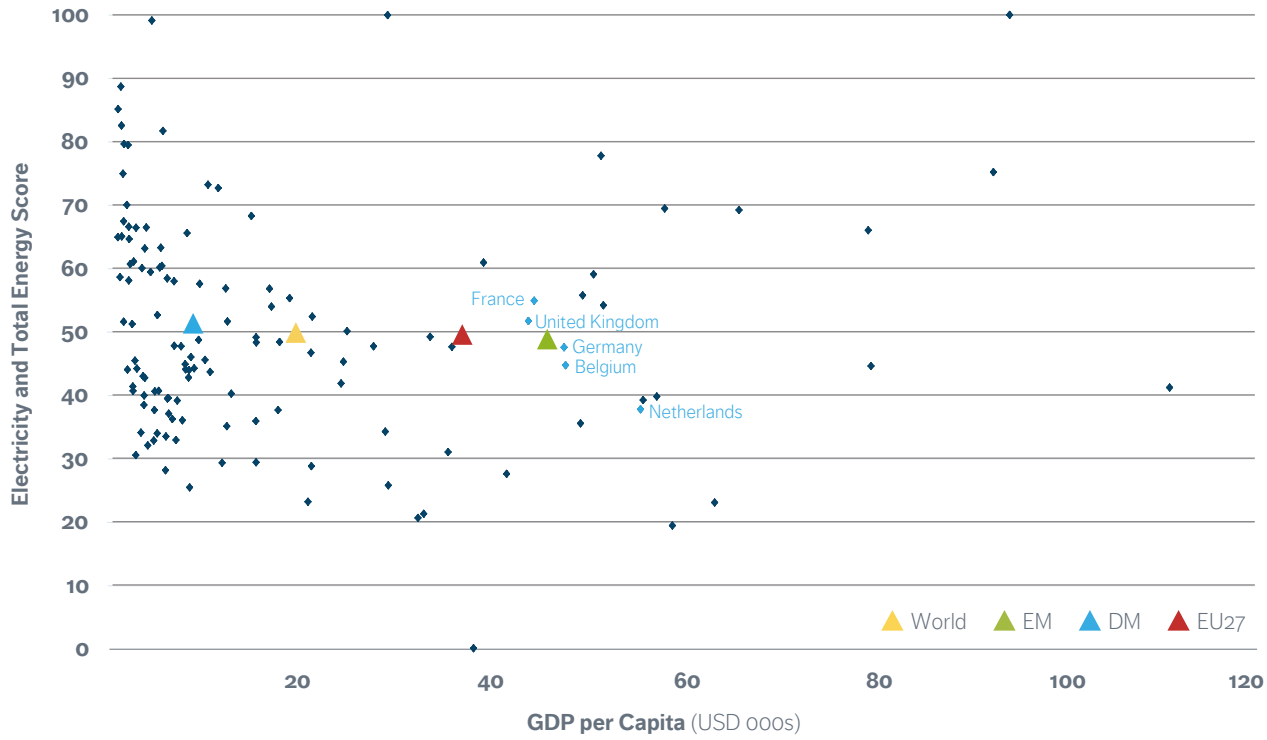
To analyse production and the overall balance of energy in these economies, we employ our proprietary Sovereign Sustainability model (see box). This framework compares the materiality of each element to others within the same Component of energy transition. Our model analyses energy transition in terms of the *overall energy balance* (including electricity), the efficiency of production and consumption, as well as the installed capacity of renewable energy sources. For clarity, Eurostat defines 'energy balance' as the relative importance of fuels in their contribution to the economy, and uses it as the starting point to construct energy indicators and analyse energy efficiency.

Further, we analyse the *regulatory framework* of each of these three elements -- energy/electricity balance, efficiency of energy use, and renewables capacity. We also take into account any stranded assets that a country might have -- and thus might be tempted to continue using.

We illustrate our analyses in part with publicly available data, which readers may use to develop their own opinions.

Figure 3: Electricity and Total Energy Balance

GDP per Capita



The energy balance shows the relative importance of the fuels in used in an economy. The energy balance is the starting point for other indicators and for analyses of energy efficiency.

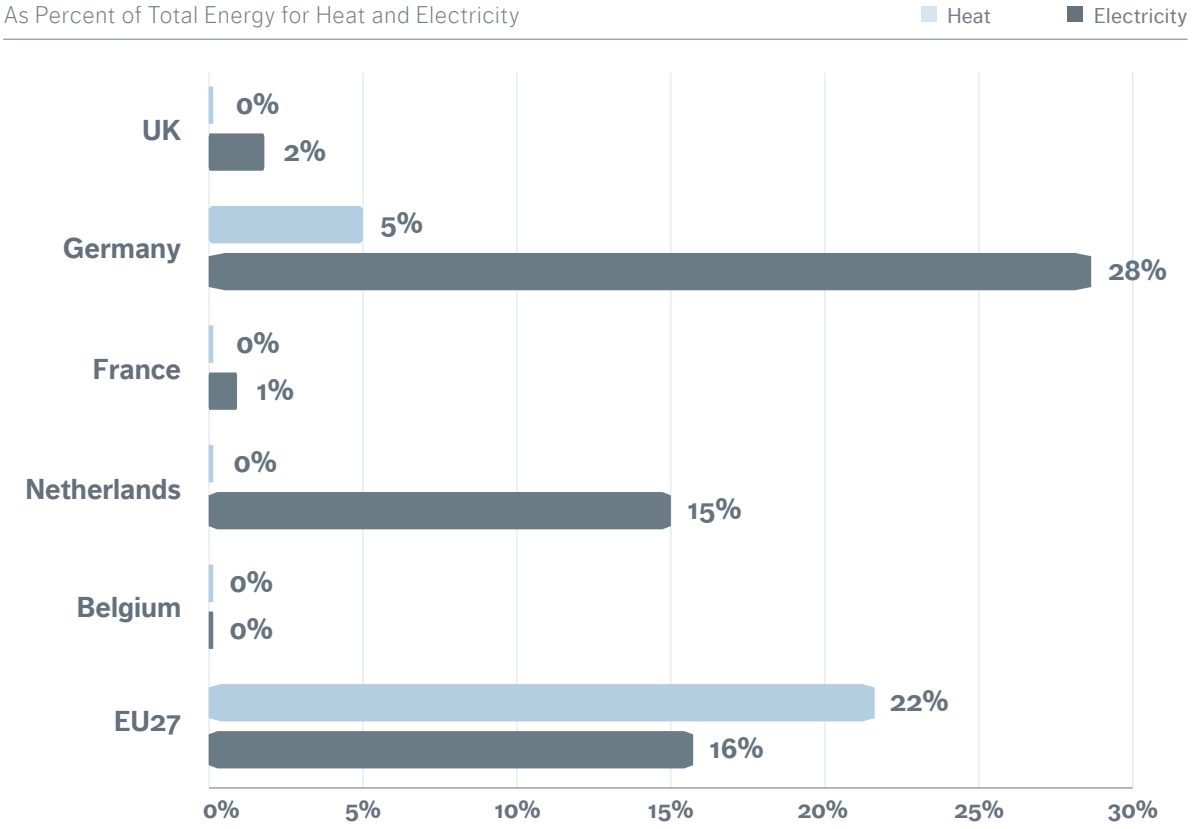
Source: Candriam Sovereign Sustainability Model, 2021

Belgium and the Netherlands score as laggards in our Electricity and Total Energy Balance model, while France and the UK score better overall. The above-average result for France is partially due to its traditionally high proportion of nuclear power, which reduced reliance on fossil fuels in energy production. The phasing-out of coal for electricity production and heat has been a major source of emissions reduction for developed countries, including EU members.

The fuel mix remains notably dependant on fossil fuels. This mix affects the country energy balance score in our model, as well as their potential and capability to continue decarbonising their energy systems. Since the energy system is the largest emitter of Greenhouse Gasses, decarbonisation of electricity and heat production offers the greatest potential to decrease emissions going forward.

Figure 4: Solid Fossil Fuels Usage (eg, Coal)

As Percent of Total Energy for Heat and Electricity



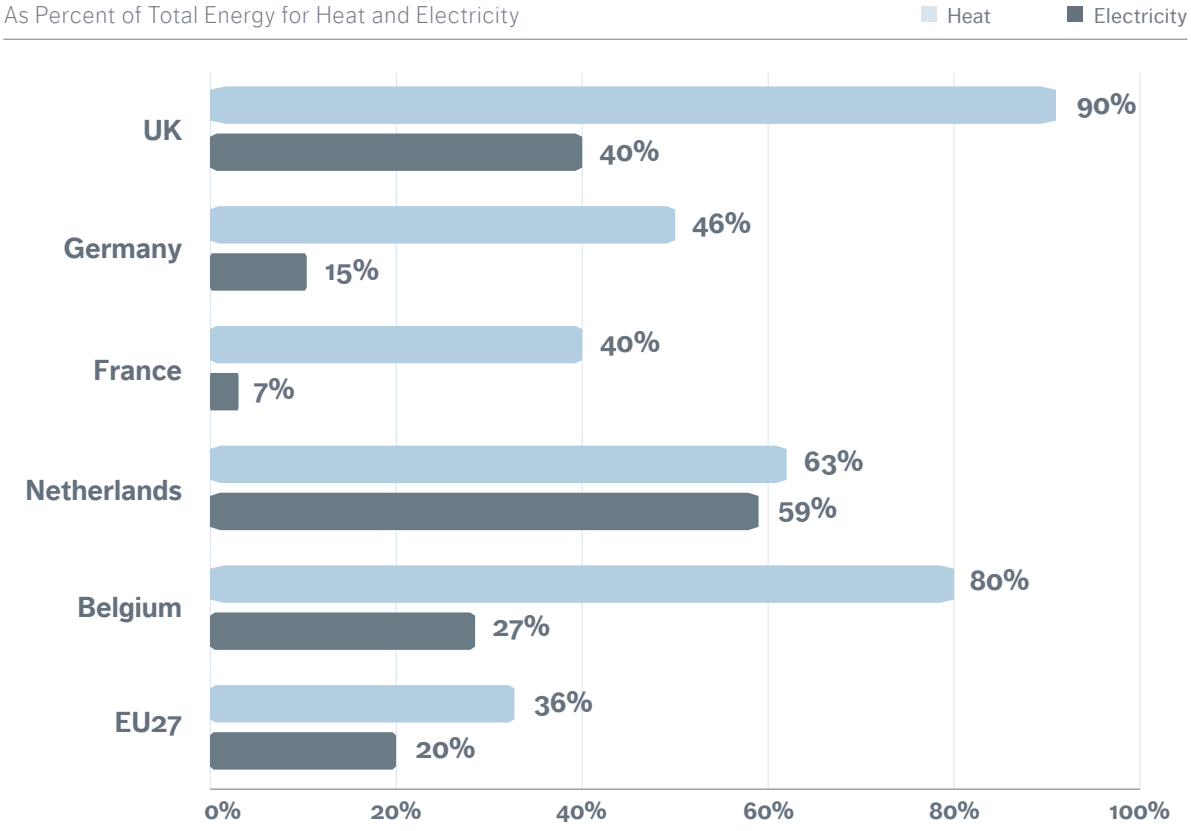
Source: Eurostat[11]

Solid fossil fuels (ie, coal) are more prevalent in the generation of heat across the EU 27, but this is not the case for the leading countries that we spotlight in this report. In Germany, phasing out the last remnants of coal use is also a political issue, as some remaining coal mining regions have been based on this business for a long time. The other EU countries in our focus sample, as well as the UK, have moved on from solid fossil fuels.

Much more progress in needed in Germany, but there lies also a big opportunity -- the transition away from solid fossil fuels offers an obvious path to further reduce emissions. The EU is taking measures to limit coal usage, such as the most recent decision by European courts this year to fine Poland EUR 500,000 per day until it ceases exploitation of an open coal mine.[12]

Figure 5: Natural Gas Usage

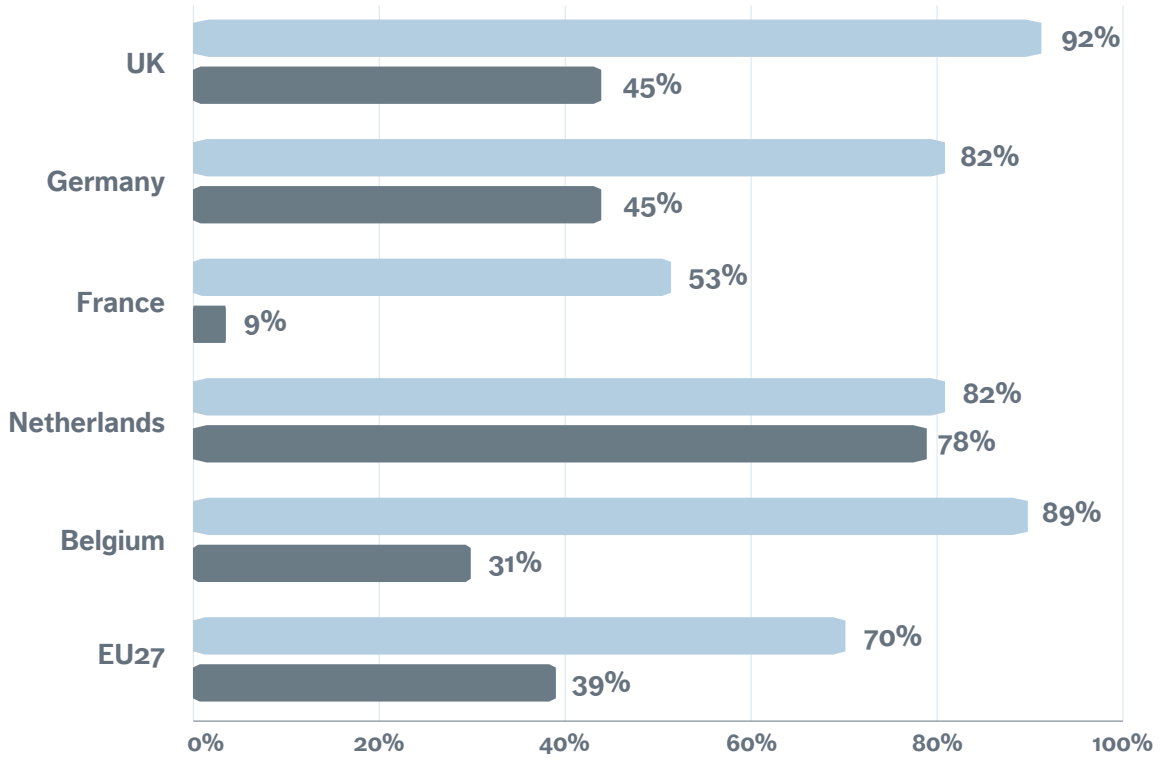
As Percent of Total Energy for Heat and Electricity



Source: Eurostat[13]

Figure 6: Fossil Energy

As Percent of Total Energy for Heat and Electricity



Source: Eurostat[14]

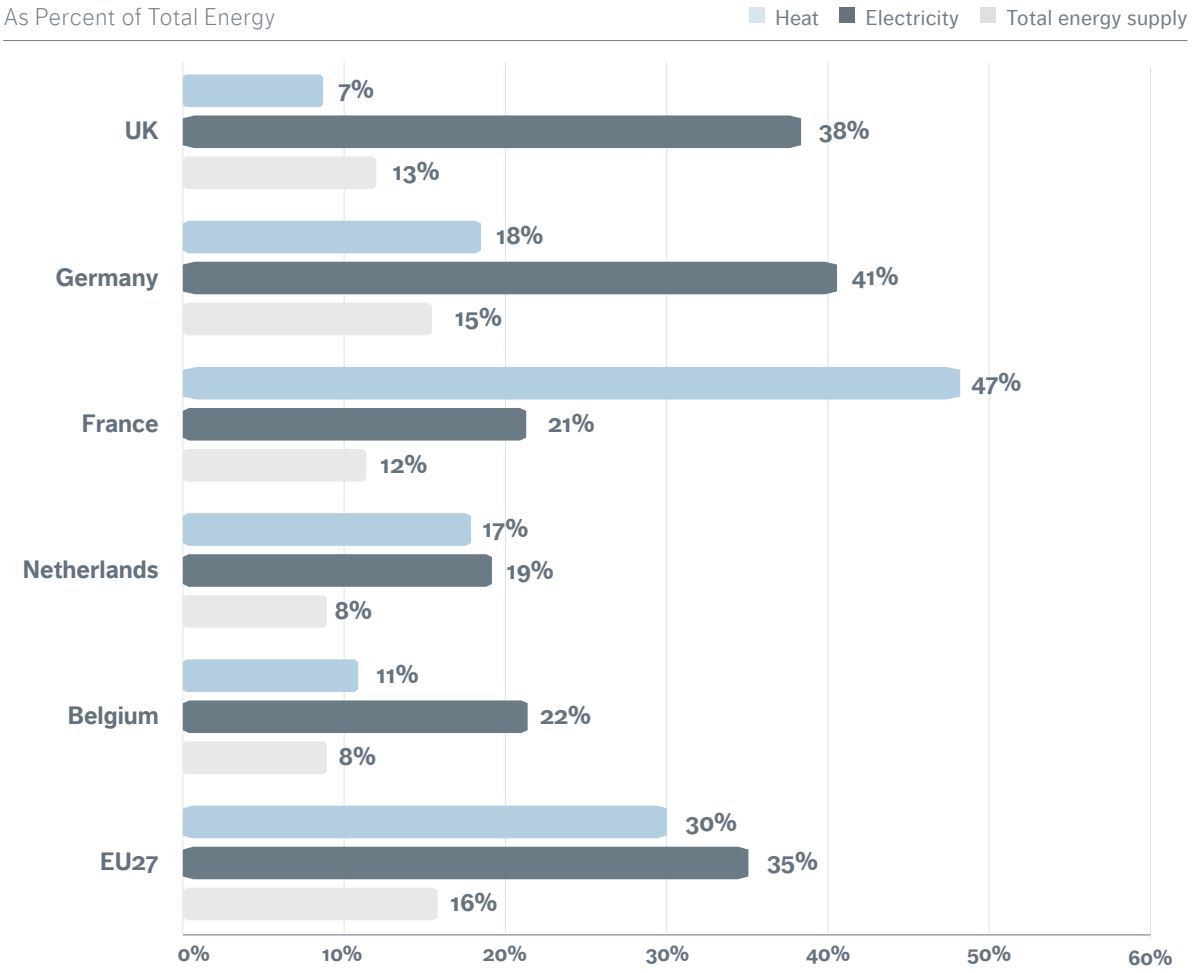
The enduring problem is the usage of Natural Gas, especially for home heating. While not as acute on the level of EU 27, in countries such as Belgium, the Netherlands, and especially the UK, the use of natural gas in heating is a significant GHG emitter. Just recently Germany and the Biden administration in the US managed to reach an agreement on the Nord Stream 2 gas pipeline.[15] The concerns reflect the energy and national security implications for both Ukraine and the EU. As a major new piece of infrastructure that may 'tie' Germany to natural gas for the foreseeable future, Nord Stream 2 presents a major decarbonisation challenge as well.

The overall reliance on fossil fuels for electricity and heat generation is significant. Relative to the EU 27 average, France uses a significantly smaller percentage of fossil fuels in its mix, while the Netherlands exceeds the regional averages for fossil fuel use in both electricity and heat generation. Belgium, Germany and the comparison country UK seem to have more work to do on the generation of heat rather than electricity.

How is France able to do achieve its better balance? *Nuclear energy*. Nuclear power contributed around 70% of French electricity in 2019.[16] The nuclear issue has been very controversial in Germany, where there has been a long debate on the extension of the life of its existing nuclear power plants, while across Europe new nuclear facilities are frowned upon at best. With nuclear power generation fraught with political danger, the EU as a whole is turning to renewables.

Figure 7: Renewable Energy and Biofuels

As Percent of Total Energy



Source: Eurostat

While all member states are turning to renewables for electricity, heat, and overall energy supply, they are at different stages of implementation. The Netherlands and Belgium, in particular, are falling behind their close peer group and the EU 27 averages across all three energy categories shown in the Figures. France is advancing well in the use of renewables and biofuels for heat generation, and has so far managed to meet new electricity demand with mostly renewable sources. This explains much of the relatively strong score for France in our Candriam Energy Balance model (Figure 3).

Regulation can facilitate and incentivise renewable capacity. In this regard, the Netherlands is the laggard of the EU peer group, scoring just 80/100 on the Renewable Energy category of the Regulatory Indicators for Sustainable Energy (RISE), one of the indices which we also incorporate in our Candriam model scores.[17] Of our focus countries, the Netherlands has the only RISE score below the EU average of 83.5/100.[18] The country shows a particular weakness in energy counterparty risk, such as utilities transparency and monitoring. It also has the weakest energy legal framework within the four, as well as relatively lower regulatory and financial incentives.

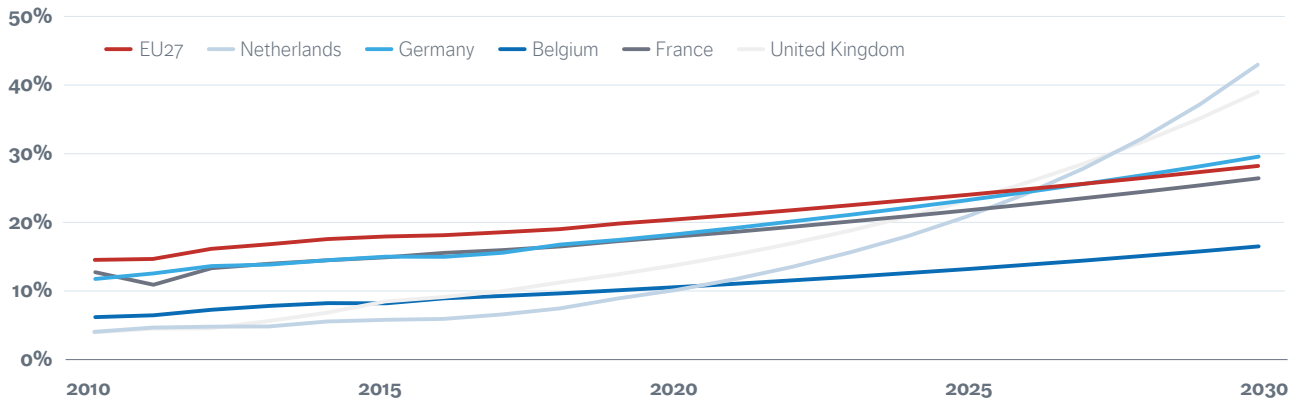
Belgium scores 85/100 on its RISE score, also on weak regulatory and financial incentives, although the legal framework for renewable energy is in place. France scores a bit better at 87, although plagued by relatively weak energy network connections and use scores. Germany, at 97, is strong on all sub-indicators, and outscores even the UK's score of 94/100.

For any nation, regulatory and financial incentives can involve a variety of initiatives. Cost-efficiency in renewables technology requires competition. A competitive market can be encouraged through a schedule for future bids/auctions for renewable energy power purchase agreements with a clear process, tariffs that are indexed to inflation, and transparent monitoring of projects which were awarded power purchase agreements through these auctions. To encourage technological development, tariffs could be set at different rates for different technologies. Early adopters of a promising renewable technology can be assisted initially, until economies of scale can bring overall costs down.

As of 2019, the EU 27 and the member states have made progress in building out renewable energy capacity, but some are still short of the declared 2020 targets. Even had these old-plan 2020 targets been achieved, these levels would still be insufficient milestones on the path to net zero emissions by 2050. Extrapolating the capacity building rates of the last five years, we have projected where the countries would be in 2030. **The old EU emissions plan called for renewables to provide 32% of overall energy production, while the new 2050 carbon neutrality[19] commitment calls for up to 40% renewable energy** in some scenarios. As the Figure shows, there is a lot of work to be done.

Figure 8: Share of Energy from Renewables

Percent of gross final energy consumption - projections after 2019



Source: EEA, Candriam estimates

The Netherlands built capacity aggressively in the last couple of years. At this pace, it could transform from a regional laggard to become the EU 27 leader if it implements the necessary regulatory and financial incentives. The others in our four-nation sample, particularly Belgium, need to significantly expand renewable capacity to meet their 2050 decarbonisation targets. For the EU 27 as a whole, the current rate of capacity expansion is insufficient to meet the 2050 plans.

The buildout requirement is particularly significant in electricity production. Electricity demand is projected to double in most 2050 decarbonisation scenarios[20] because of the need to electrify transport, industry, and the residential sector. The expectation of electricity savings in services and agriculture is predicated on efficiency of use.[21]

Of the renewable technologies currently available, wind appears to dominate, followed closely by solar photovoltaics. Since weather determines the capacity utilization rate of a solar or wind farm, capacity must increase at twice of the rate of electricity demand.[22] Accommodating such expansion requires storage solutions. Expansion also requires a decentralised grid, so that households can contribute to solar power generation and distribution.

In Germany, implementation is already underway and is gaining in popularity.[23] This is made easier by the fact that the grids are outdated and need investment to cope with any form of increase in electricity transmission.[24] Germany presents a series of contrasts in its energy generation. On the one hand, the centralised energy mix uses the most coal among its peer group (Figure 4), but at the same time it is amongst the leaders in decentralised implementation of renewables. This seems to be a viable way forward, as large-scale storage solutions have not developed as quickly as expected.

Storage solutions of other types are being developed. One example is pumped hydro, in which excess electricity is used to pump water back into a reservoir. When weather causes wind and solar production to fall short of demand, the water is released to generate electricity.

The EU scenarios envisage that by 2030 batteries will equal and then surpass pumped hydro capacity as a means of electricity storage.[25] The projections envision a major expansion of alternative fuels after 2030. The main source would be 'green hydrogen', using 'blue hydrogen' from natural gas as a stepping stone to support the renewable hydrogen market in the early stages.[26]

The road to new technologies is rarely straight. Scientific studies[27] indicate that methane leaks in the process of making hydrogen from natural gas could be even more polluting than simply burning natural gas, even if the CO2 emitted during production is captured. In storage, new battery technologies such as sodium-ion[28] technology could make battery production more competitive relative to alternative storage methods. For example hydrogen, expected to be a competing technology in transportation and other sectors, requires additional infrastructure.

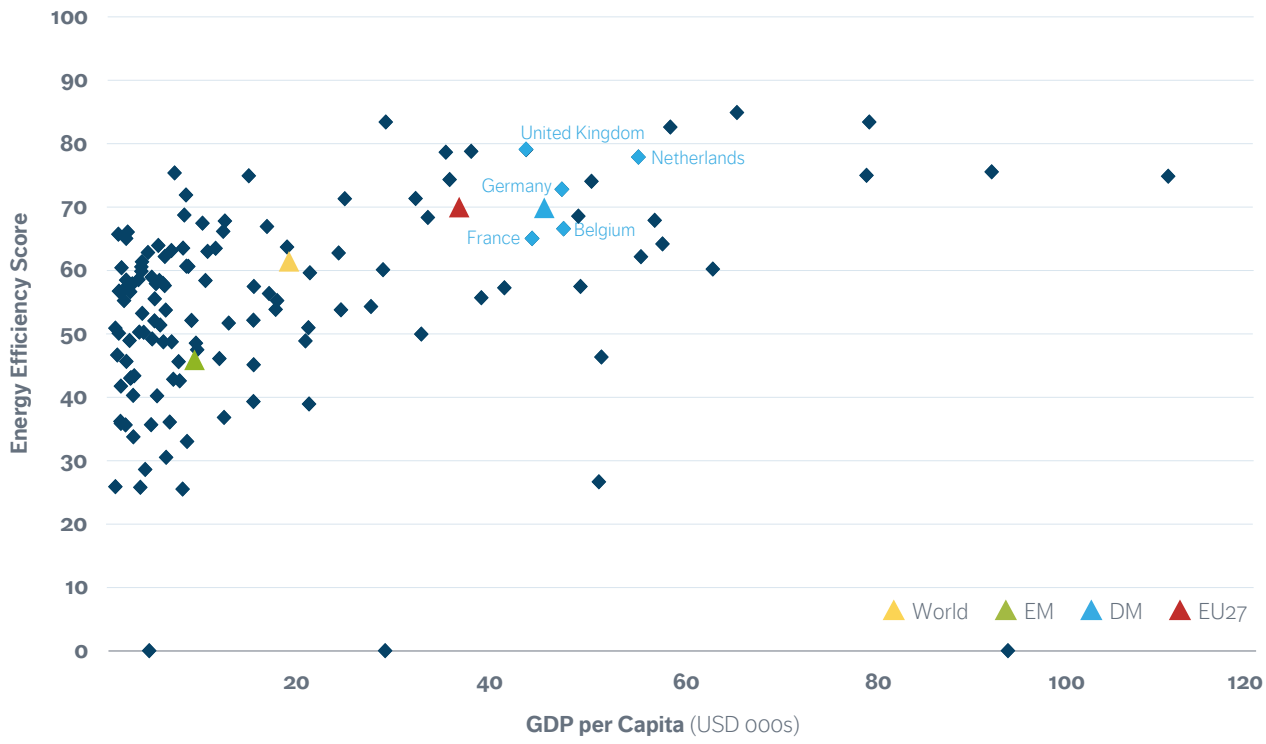
Energy Uses and Demand

Electricity production, and the fuel mix for overall *energy production*, are complex. The other side of the equation, the *demand for energy* and the *efficiency of energy* usage in particular, also warrant close examination of their role in reducing Greenhouse Gas emissions. Analysing individual sectors within individual nations is beyond the scope of this paper, and we leave a nuanced look at these to the sector specialists. A top-down view can identify some of the problem spots and the sustainability modelling challenges within the EU and our sample countries.

Our Candriam Sovereign Sustainability model incorporates data on the regulatory environment and its success in encouraging efficiency in energy use and in energy production. The model also includes data on national efficiency and sector efficiency within all the countries we analyse globally.

Figure 9: Energy Efficiency Score

Candriam Sovereign Sustainability Model

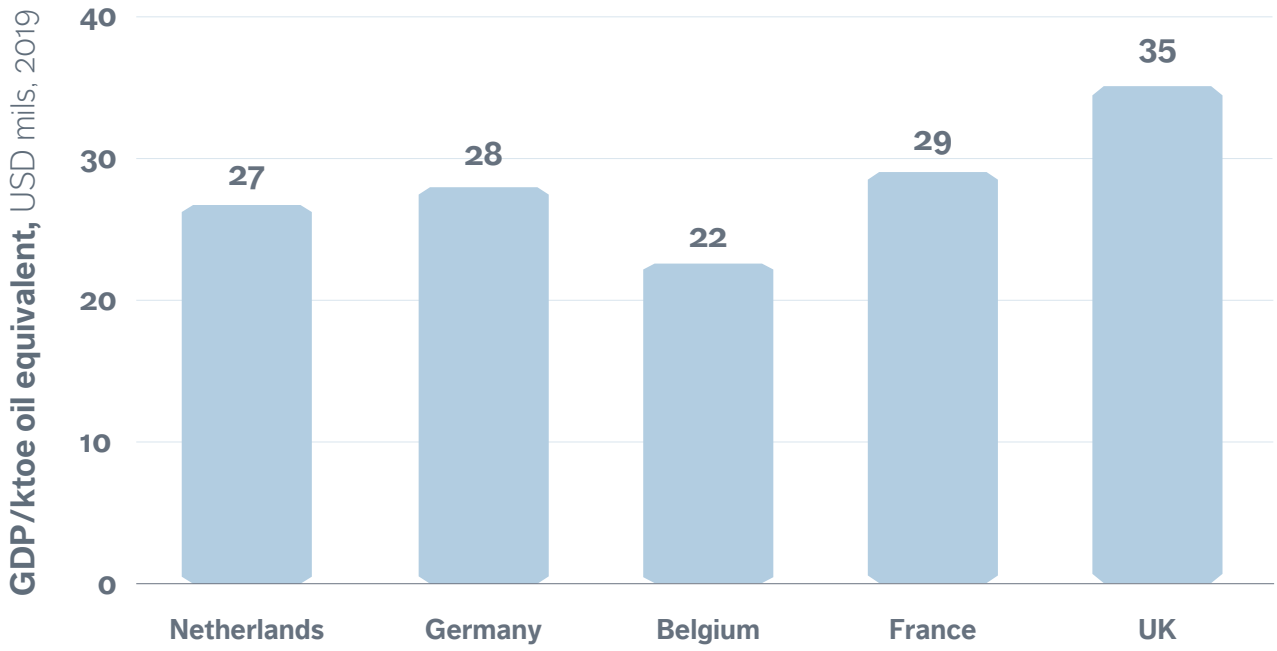


Source: Candriam

The proprietary model results in Figure 9 show the UK and the Netherlands leading the sample group in overall energy efficiency, followed by Germany, with Belgium and France being the peer group laggards. Several publicly available metrics are also available to gauge energy efficiency of countries and sectors within them, such as those from the World Bank.

Using public data in Figure 10, we calculate energy productivity for the sample group of countries, using GDP per kiloton of oil equivalent (ktoe). Since GDP data and total energy data taken together might be harder to interpret due to timing differences of release of these statistics, we have taken the 2019 GDP (in constant 2010 USD millions), as well as 2019 total energy consumed in industry, transport, services and other sectors such as agriculture and fishing. We exclude energy usage by households to compare the peer group:

Figure 10: Commercial Energy Productivity



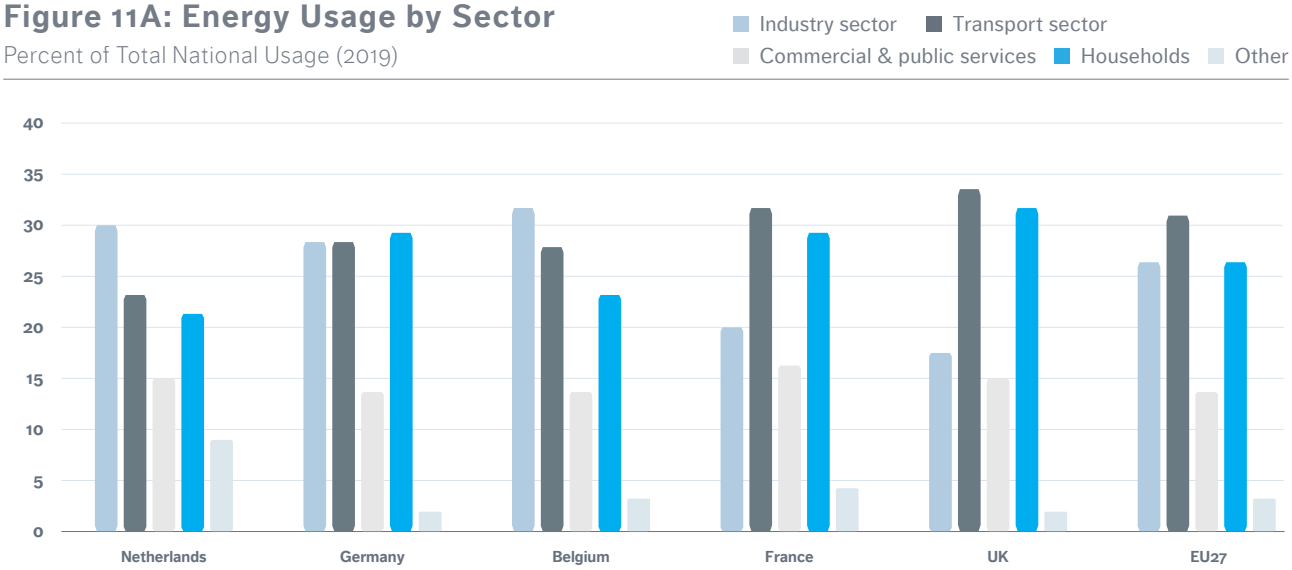
Source: World Bank, EEA

On this metric, the UK outperforms any of the EU sample nations. Belgium is again a laggard, while here France scores as the most efficient among the EU sample group. Obviously, this measure depends on the nature of value creation in an economy, as services consume less energy per unit of GDP created, with some heavy industry such as aluminium production and petrochemicals at the energy-intense end of the spectrum.

We also examined the proportionate energy *usage* of main consuming sectors within our sample countries, such as Transport and Households (Figure 11A). We juxtaposed *regulation* designed to encourage efficiency within each sector (Figure 11B) with each nation's overall efficiency score.

Figure 11A: Energy Usage by Sector

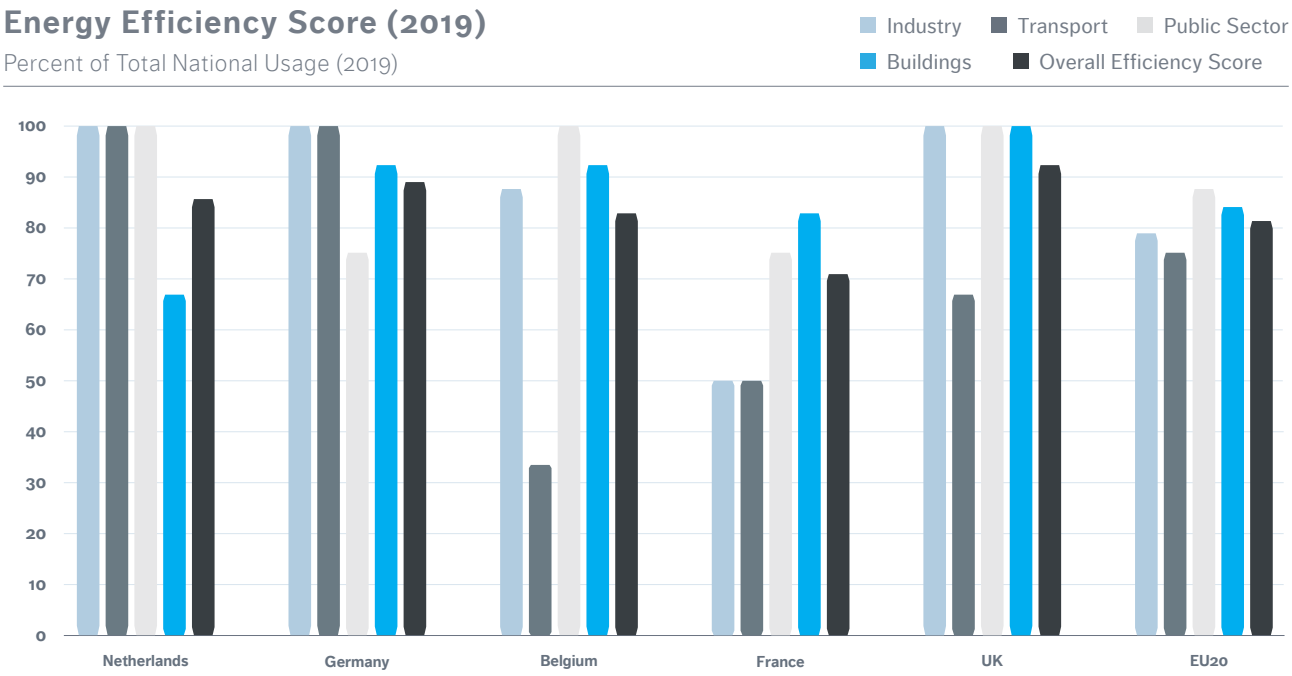
Percent of Total National Usage (2019)



Source: EEA[29], https://ec.europa.eu/eurostat/web/energy/data/energy-balances

Figure 11B: Regulation Encouraging Energy Efficiency by Sector and Overall National Energy Efficiency Score (2019)

Percent of Total National Usage (2019)



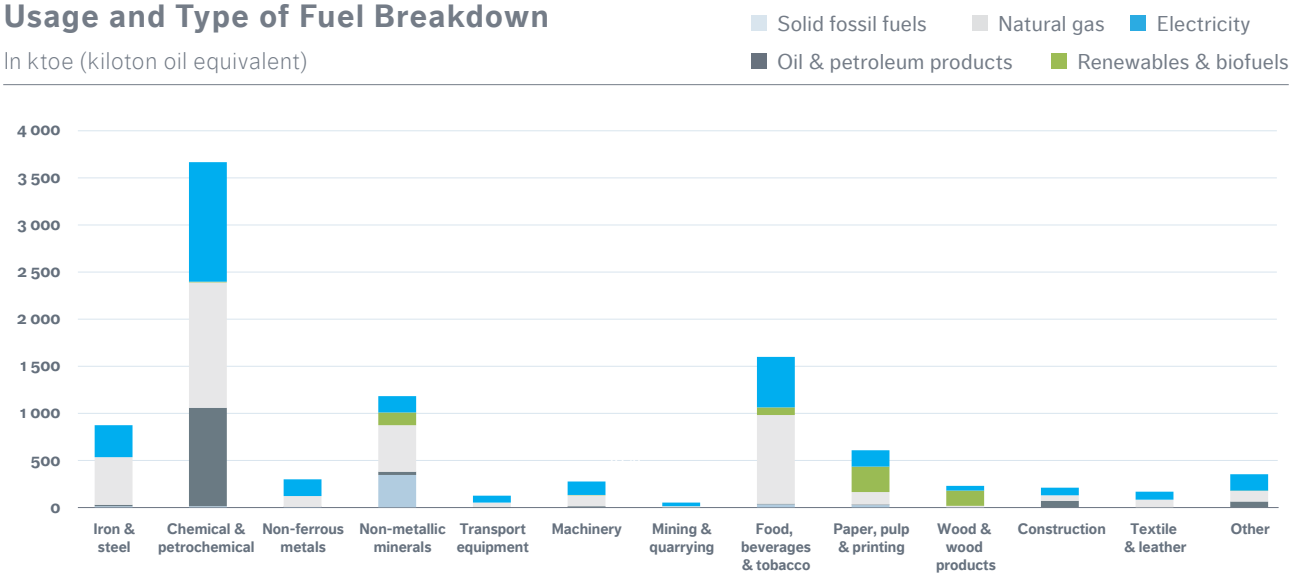
Source: RISE, https://rise.esmap.org/analytics

Of course 'Industry' is a diverse sector, with diverse energy use. Amongst the four EU example countries, Belgium's Industry sector is proportionately the largest energy users, while France's is the smallest among the four.

Turning to the regulation to encourage energy efficiency in industry, France seems the most deficient, followed by Belgium. Since the industrial sector in France is a relatively lower energy user and the industrial sector in Belgium is a relatively high energy user, the case of Belgium is more interesting.

Figure 12: Belgium Industrial Sector Energy Usage and Type of Fuel Breakdown

In ktoe (kiloton oil equivalent)



Source: EEA

Within Belgian industry, by far the greatest energy consumer is the chemicals industry. The electrification of this sector is relatively the highest within Belgian industry, but the reliance on natural gas is significant. Potential technology improvements to migrate to electricity from natural gas could be a solution going forward for the sector, as oil and petroleum products are at least partially used as raw material and not all as energy.

The energy usage by these sectors reflects not only the inherent energy-intensity of the sector, but also the weight of these sectors within Belgian industry. More than 65 % of the added value generated[30] in Belgium is made up by five sectors – chemicals (16%), food and beverages (15%), pharmaceuticals (14%), metals (13 %) and non-metallic minerals and plastics (9%).

Flanders has petrochemical infrastructure, know-how and competencies which are unrivalled in Europe. Thirteen of the world's 20 largest petrochemical enterprises have operations in Belgium. Antwerp hosts the largest cluster of petrochemical facilities in Europe, and second-largest in the world. Flanders encourages the sector with incubators with knowledge launch pads, industrial clusters and research centres, as well as high end infrastructure.[31] This offers an opportunity for Belgium to be a leader in decarbonisation of the chemicals sector.

The EU Taxonomy of sustainable activities offers investor guidance to evaluate whether new projects incorporate environmental costs. Furthermore, it is a way to ensure that capital deployed has a neutral or even positive long-term impact on the goal of achieving net-zero Greenhouse Gas emissions.

The food and beverage sector could also benefit from some migration from natural gas to electricity. Belgium uses natural gas for as much as 80% of its heat (Figure 5).While not as polluting as coal, natural gas nevertheless generates significant GHG emissions.

The non-metallic minerals sector - glass, cement, clay bricks, ceramics - is the last major sector in Belgium to use solid fossil fuels, so further strengthening of regulation could prevent proportionately higher emissions. Investor pressure on cement manufacturing emissions is

rising, questioning the viability of these industries unless they adopt new processes.[32] Technology for carbon-free cement production has been attracting attention,[33] and it could benefit Belgium to be at the forefront of these advances, hopefully sharing technology within the EU.[34]

The transport sector should be a source of significant energy efficiencies, with increasing vehicle fuel efficiency standards and a proposed EU ban on new fossil-fuel cars proposed for discussion in July, 2021.[35] Regulation seems to be the weakest in Belgium, where company cars are commonplace and cost-effective for employers and employees, followed by France. Conversely, Germany and the Netherlands have excelled in this regard. The Netherlands transport sector consumes the relatively smallest proportion of total energy needs among our sample, while in France and Belgium insufficient regulation for energy efficiency has at least in part contributed to the outsize energy usage.

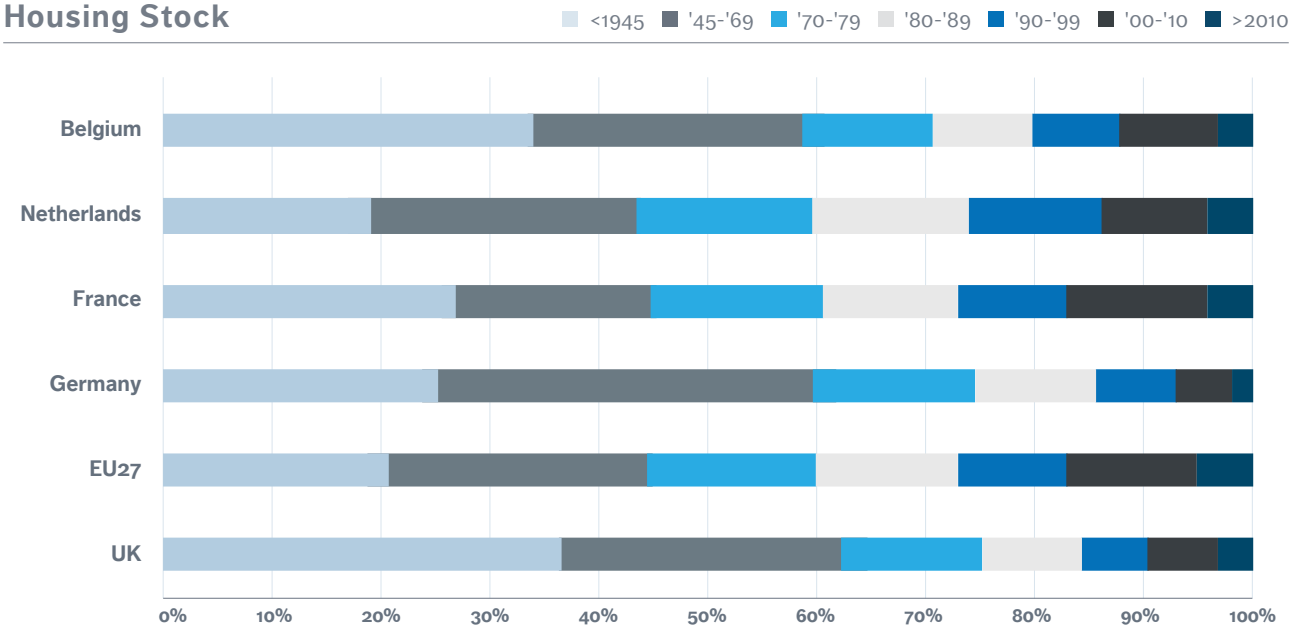
At the end of 2019, Belgium submitted its final 2021-2030 "National Energy Plan – Climate"[36] to the European Commission. Within Belgium, decisions are shared between the Federal authority and the three regions and the three communities. The Belgian Federal authority is still responsible for a great share of fiscal policy. Therefore, in 2021 it has decided that, from 2026 onwards[37] all new company cars should be carbon neutral. As of 2019, only 2.3 %[38] of company cars were fully electric. To achieve that goal, the Belgian government will adapt the fiscal deductibility, fiscal incentives and mobility budget.

The situation in France is more complex, and fraught with hurdles and political peril. The attempt to impose an "eco-tax" on fuel was met with months of violent protests by the "gilets jaunes", and the French government ultimately abandoned the proposed tax.[39] It will be interesting to see how successful future necessary measures will be.

Across the EU, rail travel is being encouraged for both passengers and cargo, as well as increased electrification of the sector. If we learn the lessons of remote work from our Covid lockdowns, commutes could see significant permanent reductions from hybrid work-from-home office workers. Autonomous and electric vehicles, vehicle sharing, and remote work present significant opportunities for the transport sector across Europe. The auto industry has noticed. As electric car sales grow across the continent,[40] new electric models are now the stars of auto shows.[41] The EU plans rely heavily on e-fuels, such as green hydrogen, but jump-starting the hydrogen market may require 'blue' natural gas-based production and a longer path to real savings in emissions. Automation, robotisation, and electrification of delivery of goods is likely to make big diesel lorries rare, as rail transport can take the long-haul goods transportation to hubs, and medium-, small-, and mini-size electric vehicles, many of them autonomous, could be able to fully electrify commercial transport within a state. For more on the potential path to hydrogen, see Candriam's October 2020 white paper, ***Enabling a Virtuous Decarbonisation Loop***.

Residential housing offers significant potential. It is projected that by 2050, across the EU 27 less than a quarter of residential housing stock will have been built after 2021.[42] Currently, about 75% of the existing housing stock suffers from poor energy performance.[43] EU 27 projections for 2030 assume that residential buildings could reduce energy use by around 30%, mostly coming from more energy-efficient heating and cooling, partially offset by *increased* total energy consumption by appliances.[44] As climate ambitions toughen, some model scenarios require close to 60% savings in total energy consumption.[45] How does this look at the country level, and what can we say about existing regulation?

Figure 13A: Existing Housing Stock



Source: Eurostat[46]

Figure 13B: Household electricity consumption

Country	MWh per capita	Efficiency rank
Belgium	1.61	5
Netherlands	1.35	1
France	2.38	6
Germany	1.52	2
EU	1.58	4
United Kingdom	1.56	3

Source: Eurostat

The Netherlands enjoys the lowest proportion of its energy needs going to households, using the least energy per capita in our sample group. They manage this with the least advanced regulation in the peer group. The housing stock built before 1980 is the smallest, however, as can be seen in Figure 18A.

The UK's housing energy efficiency regulation is the most advanced among our sample, while the buildings are the oldest, with more than 60% build before 1970. While France has younger housing stock, regulation for energy efficiency is less advanced and French households use the most electricity per capita in the peer group. One reason for this high domestic electricity usage in France is the low proportion of fossil fuels that are used for heating. France uses the lowest proportion of fossil fuels for heating, while the reliance exceeds 80% for all the others in the sample (Figure 6 / 5B).

Two elements must succeed for the residential sector to achieve the energy savings projected by the EU.

- **The speed of renovation of older buildings must increase dramatically** beyond the meagre 1.8% currently.[47] Unfortunately, such increase is not envisioned by the current modelling projections, and central government initiatives with European funds are needed for this to be sped up.

- **Decentralised and localised heating systems must be implemented,** as outlined in the EU study.[48] The transition to electric heating can be accomplished locally, for example by equipping residential buildings with solar panels. Renovations offer an opportunity transition to local storage systems to ease pressure on the main grid, as well as to improve insulation.

The EU plans outline possible options, but bottlenecks and mismatched incentives in the construction industry and potentially high upfront costs are impeding progress.[49] Using EU Cohesion Funds to improve the energy efficiency of housing could both directly benefit the population and aid in the transformation of the sector, while creating jobs.


LOCK
LOCK

Putting the 'Net' in 'Net Zero' – Carbon Capture and Deforestation

Under the European Green Deal, 'Net Zero' requires an element of carbon removal. Greenhouse Gases will be extremely hard, or impossible, to fully eliminate in sectors such as agriculture and transport.[50] Under the best of the EU scenarios, the EU will continue to emit some GHGs.

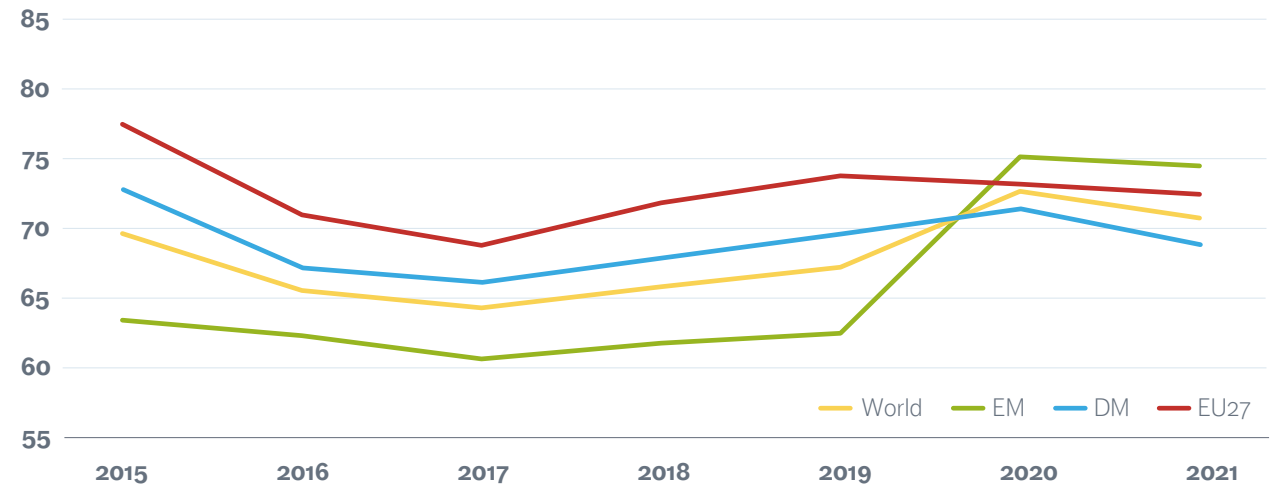
Based on the plan documents, the EU cannot achieve net carbon neutrality by 2050 without significant contributions from the forests in Europe. All discussions are about *net zero* emissions, *not zero* emissions, the difference being that we need solutions to absorb what is left in emissions by 2050. Even under the updated plans, any remaining emissions, however large, would need to be absorbed by technological innovations such as carbon capture and storage (CCS), or by or natural sinks such as Europe's forests. At present, we do not have the technological solutions to even consider eliminating emissions.

Even if GHG emissions decline to a modest level, the forests will still have plenty of remaining atmospheric CO2 to absorb from emissions in the past. To that end, we need to make sure that Europe's forests have the capacity to cope with any excess emissions. In order to ensure that in 10-30 years the forests have this capacity, we need to plan and act now, as growing new forests can be a slow process.

In 2018, over 40% of the continent's area was woodland, 6% was scrubland, 17 % grassland, and 24% cropland.[51] Forest dynamics involve natural forest growth, as well as changes resulting from human activity, such as deforestation, harvesting, and afforestation. Dynamics also include natural attrition due to mortality, droughts, forest fires and the like. The EU analysis lists the net absorption capacity of the continent's forest as a fraction above 400 mega tonnes of CO2, per year largely unchanged over the last several decades.[52] Indeed, under our Candriam Sovereign Sustainability model, the EU 27 has relatively stable deforestation scores over the last five years, while Emerging Markets have recently improved their scores (decreased deforestation activities) and contributed to the global decrease in deforestation.

Figure 14 shows the deforestation scores from our Sovereign Sustainability Model. We employ a variety of sources, including satellite imagery, to gauge forest cover loss, total biomass loss, and land use change. Our model also estimates of the emissions impact as a result of land use change.

Figure 14: Deforestation Score History for EU 27, DM, EM and World

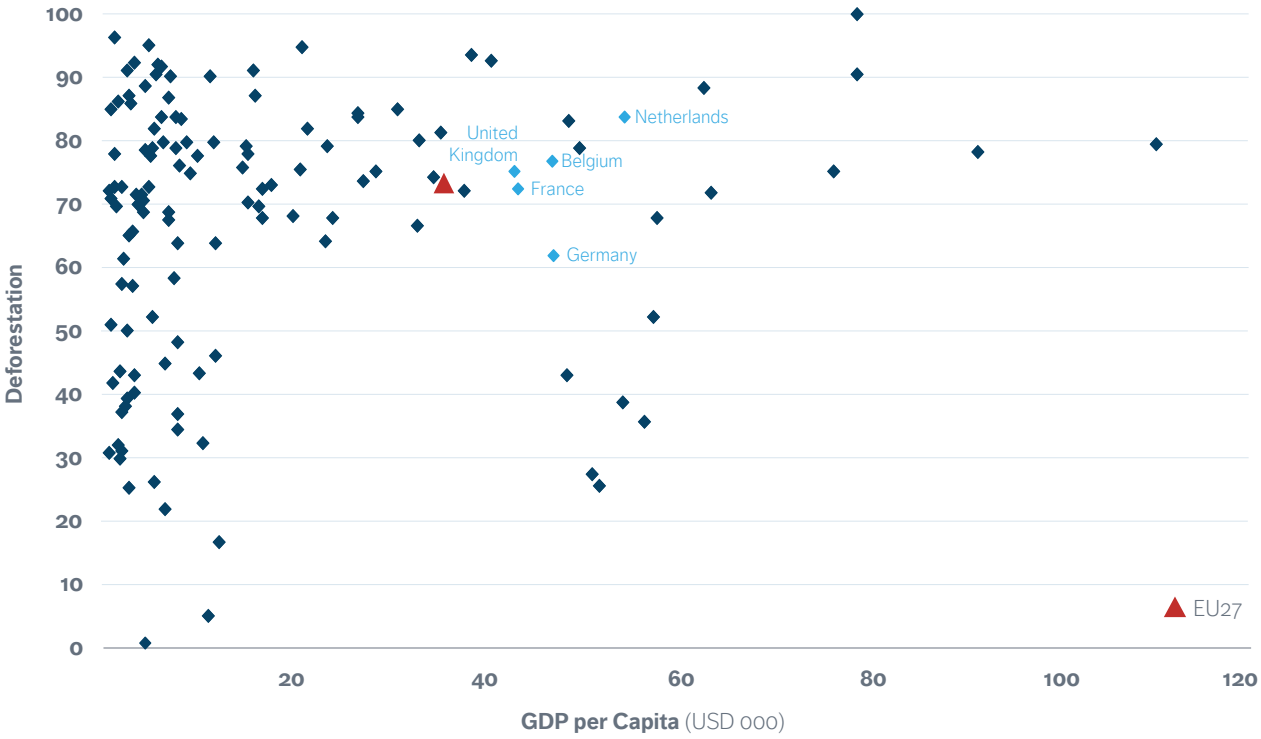


Not all attempts to restore forests or create new ones are successful, as we describe in ***Sovereign Sustainability – Deforestation****.*

Source: Candriam

The 2021 Candriam Deforestation scores for the sample EU countries we analysed in depth are shown in Figure 15. The Netherlands achieves the best score of the sample, followed by Belgium and France, with all above the EU 27 average. The UK also performs well on this metric, scoring just below Belgium. If the UK were still an EU member, it would have raised the average score for the region.

Figure 15: Deforestation Score 2021

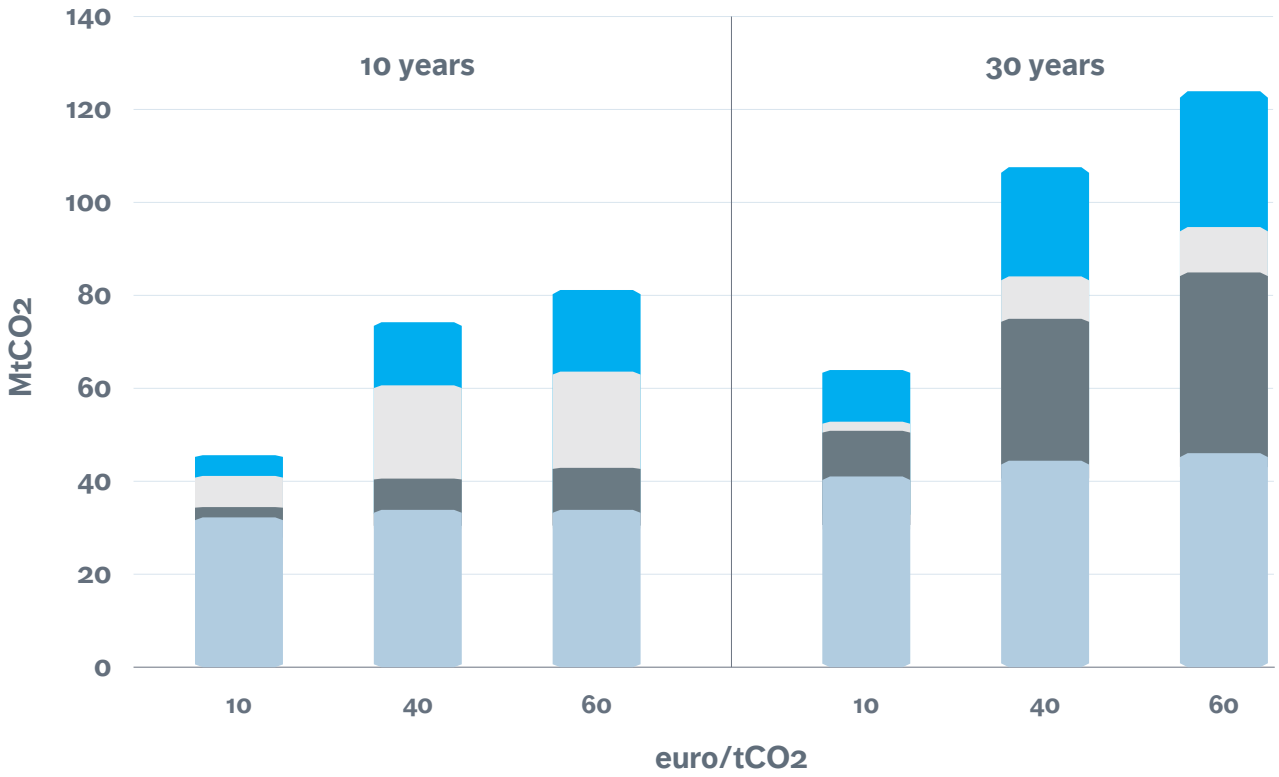


Source: Candriam

The score for Germany fell in 2021. While satellite data shows little change in direct human-driven activity, we track other measures which have helped quantify the recent damage from pests and drought. We can expect these grey swans to threaten the forest carbon sink with increasing intensity in the future.[53] This is acknowledged in the technical appendix to the EU impact study, along with "mega-fires" in Sweden,[54] whose frequency is also likely to increase.

The land Europe needs for forest carbon sinks must compete with other land use demands. Agriculture warrants a full analysis such as dietary preferences, methane emissions from livestock, and emissions from soils and grassland. Biofuels, requiring land, are increasingly part of the plans to decarbonise transport. Even without these complexities, the EU impact study acknowledges that a climate-neutral EU requires substantial carbon removal from the atmosphere to offset emissions that are hard to abate. The study concludes that this will not be possible without a substantial *enhancement* of the forest carbon sink.[55]

Figure 16: Carbon Capture Potential Scenarios by Carbon Price

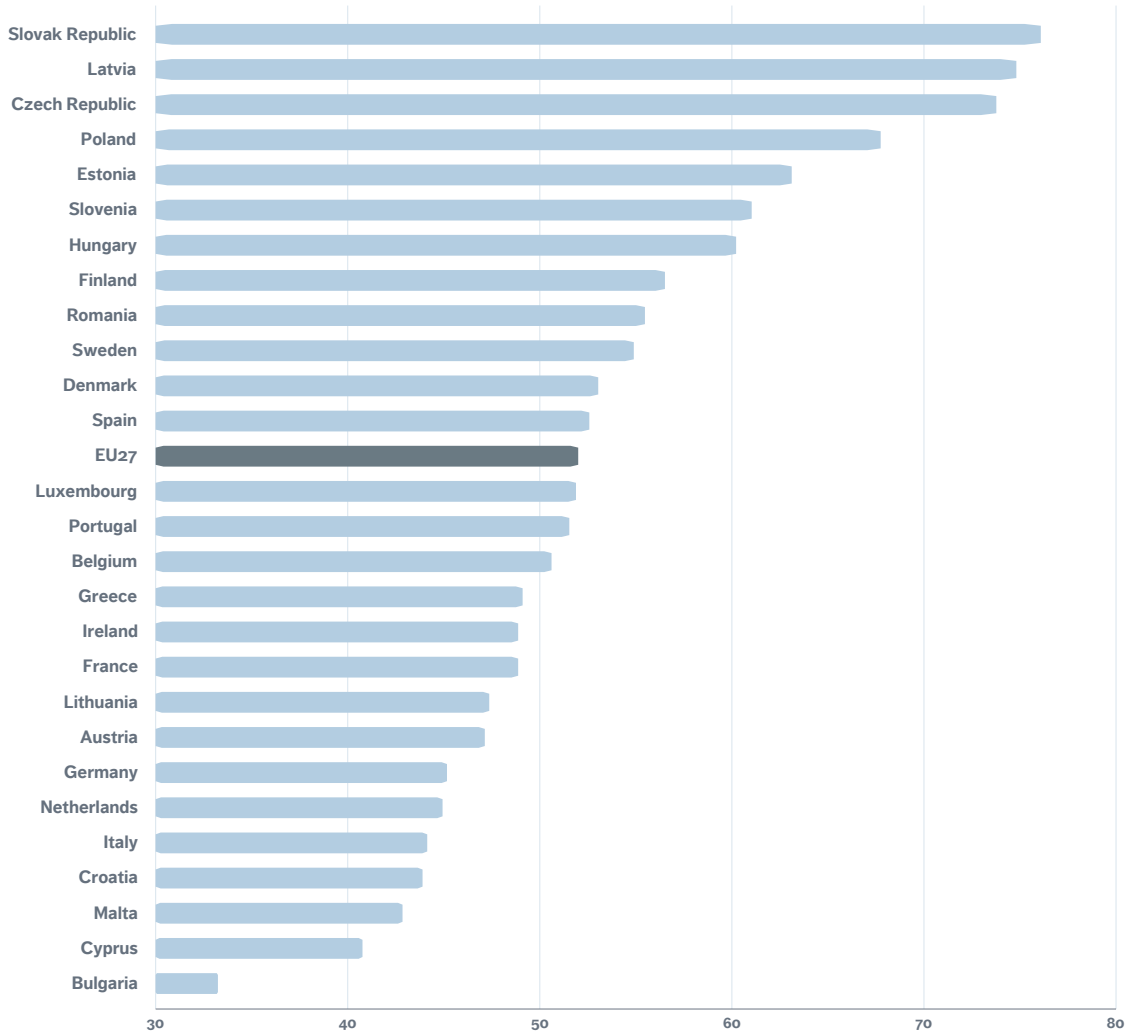


Source: European Commission Impact Assessment[56], page 98

A forest does not grow overnight. We must assume that the absorption capacity of forests in Europe will be quite insufficient in 2050, and we should prepare now for significant new forests. New economic incentives could enhance the capacity of the forest carbon sink.

Some land is better suited for crops, including biofuel crops, than for afforestation. Where there is direct competition for land, we think it prudent to prioritize forests for their carbon sink role. At present, there are no close substitutes for forests for carbon capture, either in terms of technological availability on a large scale or cost per ton of CO_2 sequestered. The first attempt to directly capture CO_2 from the air on a commercial scale has begun,[57] but we cannot yet rely on the timing of implementing this technology on a sufficient scale.

Figure 17: Waste Generation and Management Score



Source: Candriam

Improving waste management in the EU could aid in energy production. While management practices have been improving with new legislation (such as that concerning single-use plastics), the EU still generates a lot of waste, some of which is currently used for energy production. With controversy surrounding some projects in their infancy,[58] this is a developing issue that is worth close monitoring due to its significant potential and associated dangers of local air pollution. The EU has banned exporting plastic waste to non-OECD countries,[59] and some emerging markets have banned imports,[60] so waste management will have to be a focus going forward.

The competition for land usage involves the economic impact of land change. The expansion of the EU's carbon pricing system to include the forestry sector can play an important role in guiding the incentives. The EU outline proposes measures including carbon credits generated by the forests in the Effort Sharing Regulation /Emissions Trading System, or such as merging agricultural non-CO2 emissions with forest removals, to create a "bio-economy" sector with its own targets.[61]

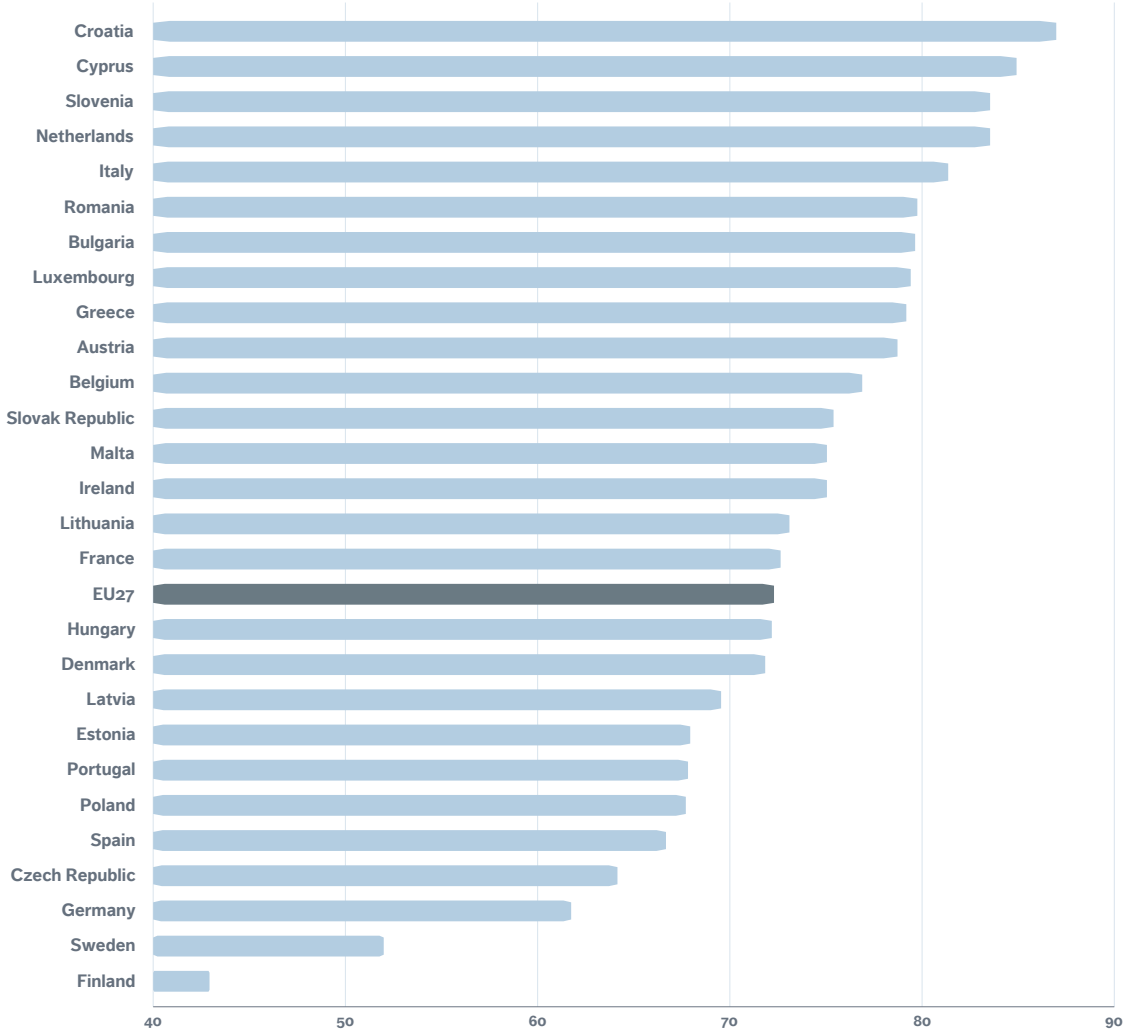
One must not forget that climate is a common good. The EU-China Summit in Beijing on 16 July 2021 is a good preamble to the COP26 in Scotland.

The private sector also has a role to play beyond simply complying with any new regulation.

In our previous analyses on afforestation and reforestation, we have concluded that forests are the cheapest available carbon capture technology. The EU's impact study adopts conclusions from Fuss, et al. (2018), along the same lines.[62]

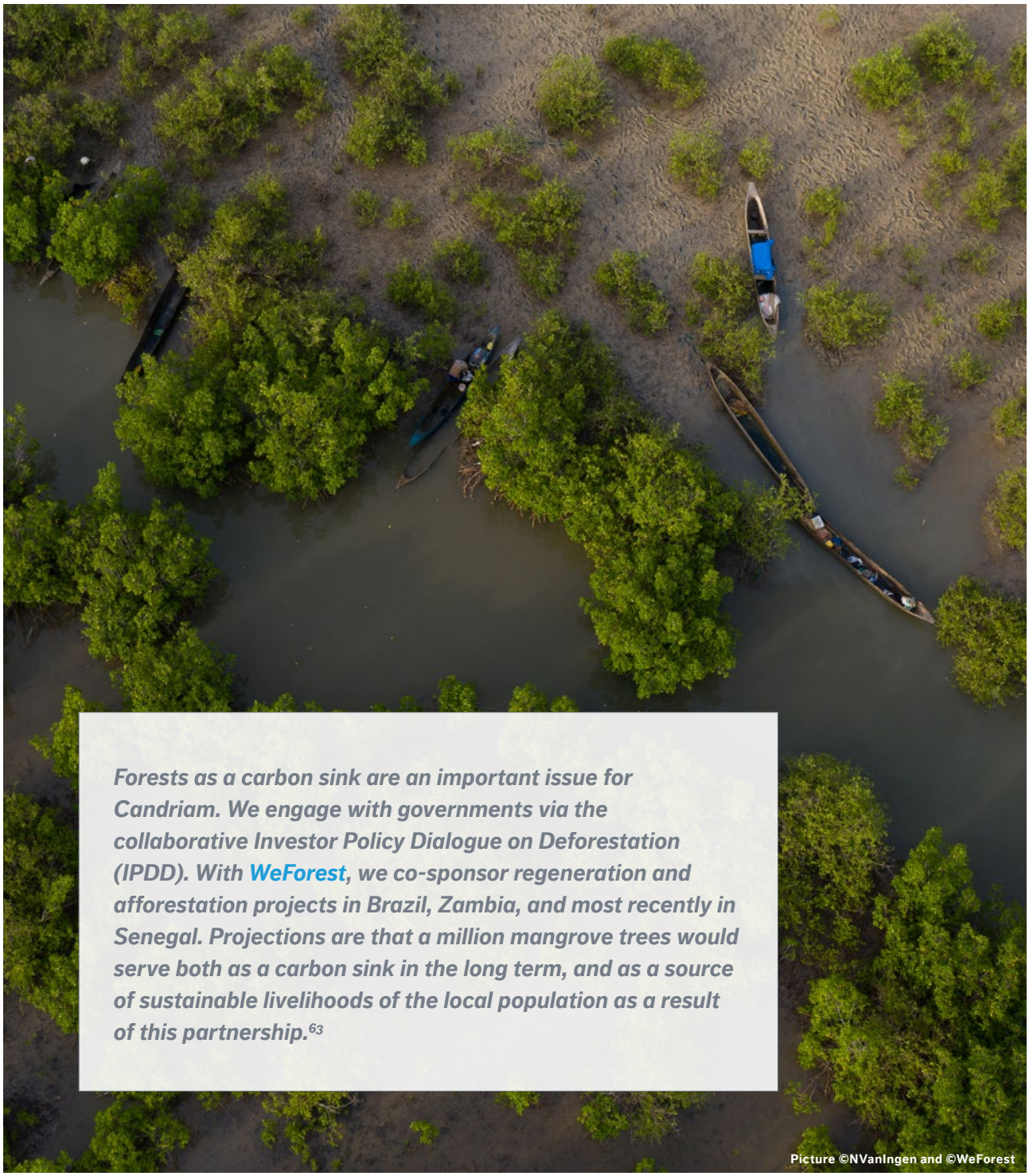
Deep decarbonisation of our economy should undoubtedly be the first priority for all.

Figure 18: EU 27 Deforestation Scores



Source: Candriam

Any economic incentives should be tailored to the specific potential of countries for afforestation, and structured in light of existing forest management practices. It is illustrative to see that EU countries which perform relatively poorly on deforestation are either exploiting substantial resources that they (such as Finland), or are exposed to the effects of climate change via forest fires (Sweden, Spain, and Portugal), or exposed to climate change via droughts and pests (Germany).



Forests as a carbon sink are an important issue for Candriam. We engage with governments via the collaborative Investor Policy Dialogue on Deforestation (IPDD). With WeForest, we co-sponsor regeneration and afforestation projects in Brazil, Zambia, and most recently in Senegal. Projections are that a million mangrove trees would serve both as a carbon sink in the long term, and as a source of sustainable livelihoods of the local population as a result of this partnership.[63]

Picture ©NVanIngen and ©WeForest

Social Implications and Policy

The second, or 'green' Industrial Revolution has the potential to both create and redistribute wealth, just as the original 'brown' energy Industrial Revolution did. Policymakers must take care that this essential energy transition leaves no one behind. Limiting global warming to 1.5°C seems almost out of reach unless we urgently make dramatic changes in how energy is generated and used. Even with immediate action, the severity and frequency of droughts, floods, hurricanes, forest fires, crop failures and other grey swans should be expected to increase for the foreseeable future. The population of the world will continue to be directly affected.

The outsourcing/offshoring era foreshadowed some of the potential undesirable social effects of decarbonising the economy. As the world globalised, advances in information and communication technologies enabled individual processes, factories, and even entire industries to move to select emerging markets in search of cheaper labour, and sometimes in pursuit of less stringent environmental and worker protection legislation. This hollowed out traditional industrial regions in the West, leaving their governments to ensure the well-being of, or at least jobs for, the affected population. Many governments failed in this responsibility, creating the conditions for the stark political polarisation that we are now experiencing.

The transition to a green economy may be even more disruptive, and even more dangerous, than the globalisation of industry. Opposition will be fierce, led by businesses who fear a decline in their power or prosperity. It is critical that the European Commission and sovereign states within the Union develop a consistent social policy, bolstered by solidarity funds. There will be significant need for wealth transfer, and the need for aid for populations in affected regions – whether affected by drought, wildfires, or stagnation of carbon-intensive industries. As the physical impact of climate change becomes ever more palpable across the globe, practical application is even more important than the modelling of decarbonisation scenarios.

To some extent the social effects of offshoring/outsourcing was managed with EU funds for impoverished areas to compensate for deficiencies or sometimes absence of engagement from the sovereign states with these regions. This cannot replace well-designed local policy. Over time the outsourcing/offshoring of industries created financial pressures in the offshored areas, increasing in inequality and political instability. The United States and the United Kingdom are recent examples of the results. We addressed both in our most recent ***Sovereign Sustainability Report***.

Climate change is likely to require sizeable government management in coming decades. The refugee wave of 2015, especially the German experience, as well as the Covid-19 NextGenerationEU (NGEU) program and the associated changes in EU's long-term budget were mere precursors. The social impacts of climate change might be foreshadowed by those of the coronavirus epidemic – some high-value-added services will be able to adapt more easily than others, some industries will need substantial help, essential workers and healthcare systems will need support, while some sectors are unlikely to make it to the other side of the transition. Their business models will not be viable in a decarbonised economy.

The EU plans anticipate job reductions in certain sectors, such as coal, oil and gas, ferrous metals, or road transport, and new opportunities in other sectors, such as renewable energy.[64] The plans acknowledge that inefficiencies in the labour market will exacerbate the impacts of the shift in sectoral composition of employment. New jobs may not be created in the same geographic area as jobs are lost. Furthermore, the disparity of countries within the EU means countries will be impacted to differing degrees.

The potential social impacts are not being ignored. To facilitate the social part of the transition, the EU Council established the Just Transition Fund with an initial funding of EUR 17.5 billion to support small- and medium-sized enterprises, start-ups and other newly-established firms to provide employment opportunities for the affected populations.[65] Additional funds could expand the fund to EUR 30 billion. A good start, but only a start -- as the impacts are hard to quantify at the very beginning of the transition, and it is unlikely that the funds earmarked so far would be sufficient in the long term. Our Candriam white paper, ***A Just Energy Transition – Impacts on European Power Producers***, examines efforts of some specific companies.

Politicians will face a dilemma when carbon taxes come up against the pockets of voters. While it is envisioned that carbon pricing revenues could be used for VAT reductions, reduction of tax rates for low-skilled workers, and even direct transfers to lower-income households,[66] implementation presents a political minefield.

The North-South divide witnessed during the 2008-2010 financial crisis could return to Europe, and consensus could be even harder to reach next time. On a positive note, the Covid relief emergency packages were agreed smoothly. Will European nations reach financial consensus on decarbonisation?

The EU plans note that macroeconomic models are imperfect forecasts of the effects on sectors. Everything from worker skillsets to end products differ in such diverse areas as, for example, market services and construction.[67] One could argue that given the long time horizon, modelling the impacts on the populace requires much deeper study and a constant focus and updates to ensure that the governments in member states act and plan in unison.

The new requirement that nations must adhere to the rule of law[68] as a condition to receive European funds was a necessary step to even start considering longer-term plans, such as 2050 decarbonisation. The newly-established European Public Prosecutor's Office was essential. The credentials of Chief Prosecutor Laura Codruța Kövesi are impeccable, as evidenced by the number of Romanian politicians and government officials in jail for corruption.

Global Action – *No Man is an Island*

Europe is not its own planet. However appealing or fair to think we are only responsible for our own actions, that is an oversimplification and a fallacy. Our actions extend beyond what we do inside our region -- our consumption imports the actions outside our region, as well.

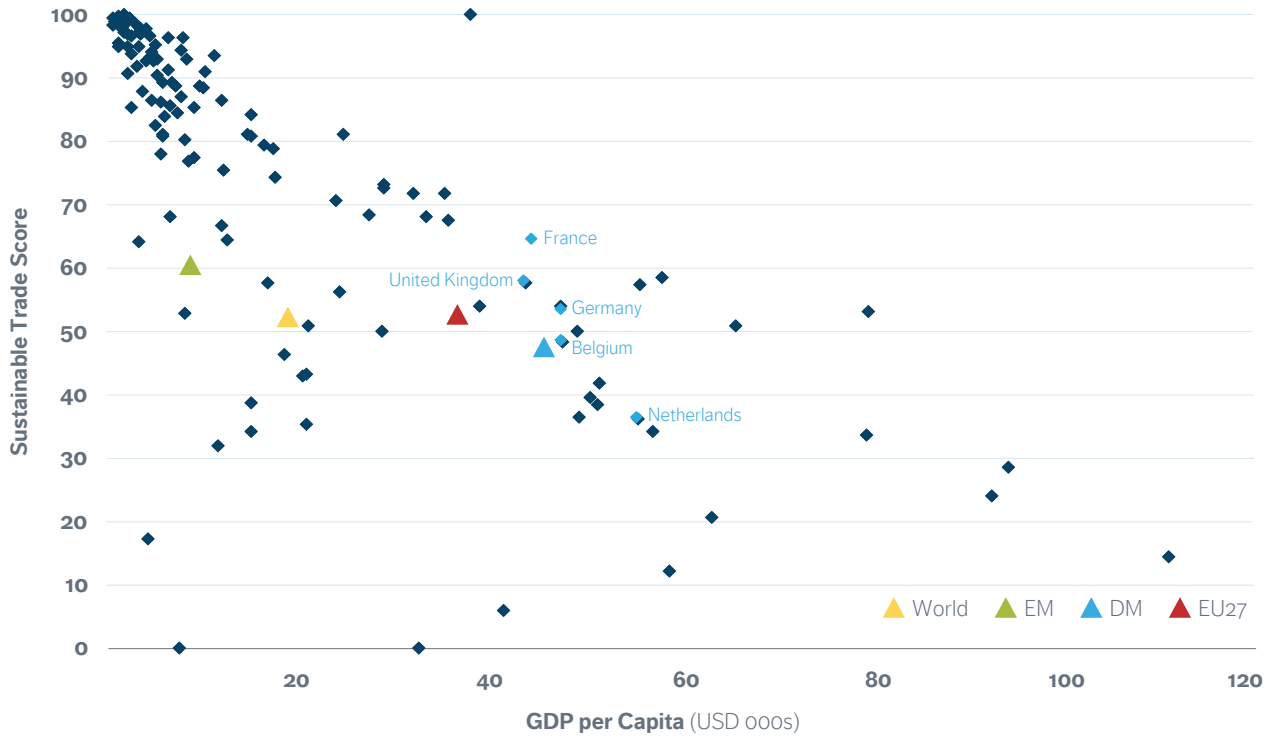
The EU has begun to address the implications. The proposal for the first phase of the Carbon Border Adjustment Mechanism (CBAM)[69] would require importers to purchase carbon certificates to offset the GHG footprint of certain products, as if they were produced within the EU's carbon pricing rules. Alternatively, a non-EU producer can provide certificates purchased in a third country. It is proposed that from 2026 this system would include cement, iron and steel, aluminium, fertiliser, and electricity.

Of course, some take a hands-off approach to carbon alignment in international trade, and to even to climate change in general, as demonstrated by the new UK Trade Secretary.

Source: Twitter[70]

The opposite approach – evidenced by the model results presented in our white paper, ***Sovereign Analysis – Natural Capital vs the Nature of Capital*** -- is that the CBAM does not go nearly far enough. Consumption patterns in developed countries are simply incompatible with the Paris Agreement. While the CBAM is a welcome sign, our analysis shows the need to expand CBAM to all EU trade flows.

Figure 19: Sustainable Trade Score 2021

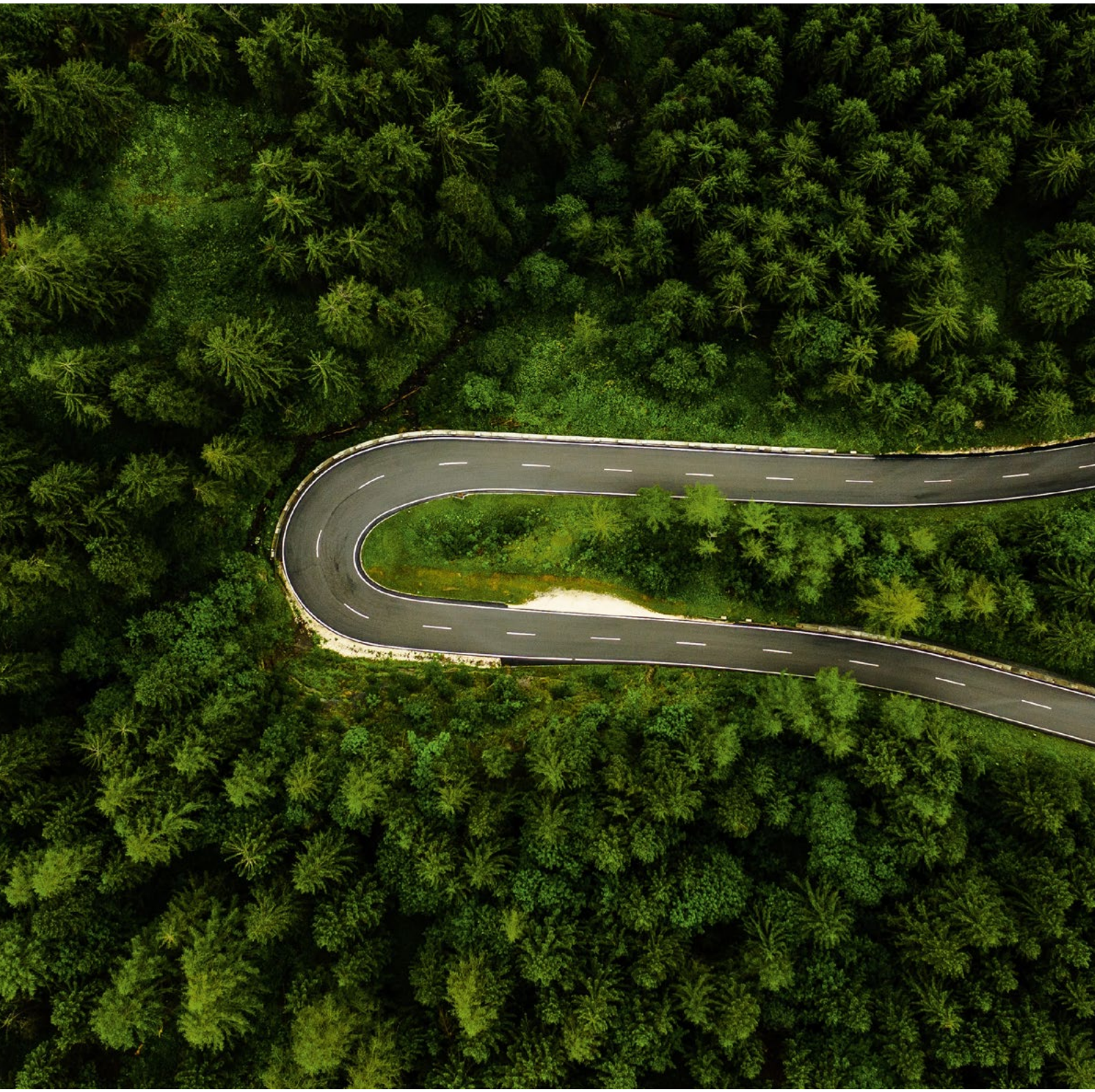


Source: Candriam

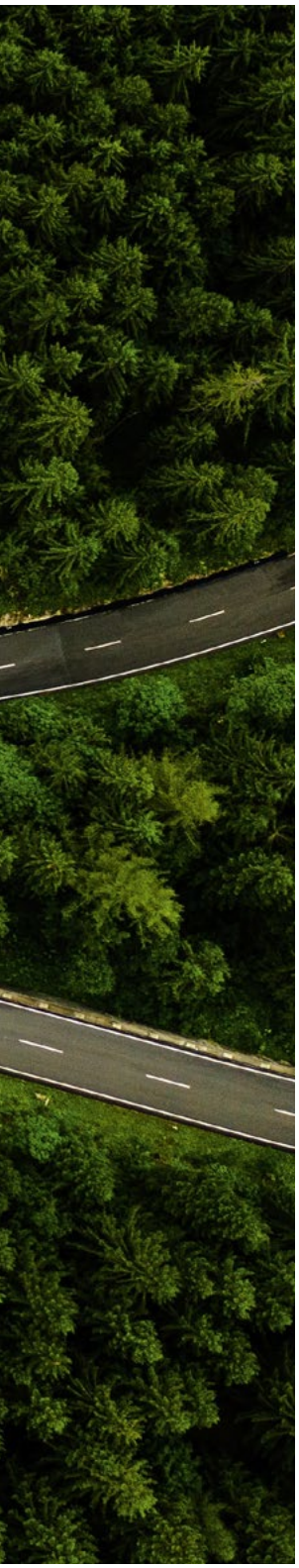
Small countries with little international trade would be the most sustainable from a trade perspective, as they do not have the option to shift polluting production elsewhere. We demonstrated this in our Sovereign Sustainability Report, using the measure we constructed to weigh the carbon footprint of the trade flow in each direction between any two states. Our measure includes the overall Greenhouse Gas emissions performance of the trading partners.

The Union can set an example to the rest of the developed world. As a whole, EU 27 is doing about average for the world, but is outperformed by the emerging markets average, as imports into these markets are not as carbon-intensive as imports into developed markets. Developed markets underperform emerging markets, underperform global averages, and developed markets in total also underperform the EU 27. The CBAM is a good start, but not radical enough.

International cooperation is a necessary prerequisite. Carbon border taxes must be adopted broadly if we are to decarbonise and keep global warming within manageable limits. One way for the EU to facilitate this would be to use some of the tax revenues to invest in reforestation in the developing countries, in cooperation with the local sovereign authorities. This could make more carbon credits would be available, and exporters to the EU would in effect be investing in forests in their own countries.



Conclusion – Ambitious but Possible



The European Union's ambitious 2050 plans for net zero emissions are backed by a wealth of data and solid modelling. Yet, with so many inputs and a long forecast horizon, even a slight change can create a major difference by the end of the forecast period. Models can only point to a general direction, they can not guarantee a result.

Climate is a dynamic, complex, and 'chaotic' system. It is impossible to predict how developments in the coming decades will affect certain sectors – forestry and agriculture in particular. It is possible that the forests of Europe will continue to be plagued by droughts, fires, and pests, and that in 2050 they will be vastly different from the projection. The plans do offer a glimpse of what opportunities could arise if the forest fund is further strengthened, and we consider it prudent to redouble these efforts. EU reforestation efforts should be expanded to third countries as well. Like Covid, GHG emissions do not respect national borders.

Decentralised energy generation, storage, and usage will offer many investment and employment opportunities, as will the circular and digitalised economy. Public-private partnerships should be further encouraged and strengthened. These would benefit from a coherent strategy to coordinate the broad social impacts that climate change and energy transition will entail.

Decarbonisation efforts will undoubtedly be resisted by affected parties, but opposing economic interests should be balanced to achieve the new targets while minimising the impact to society, rather than protecting individual sovereign interests.

We should expect to share the burden of decarbonisation. Once Europe has firmly embarked upon the path to net zero by 2050, it should lead by example. Sharing of technological and financial support to the less developed parts of the European continent should be followed by transfers to other nations through institutions for impact investment and technology-sharing forums within international institutions. International cooperation is essential if we are to halt climate change in any nation. To ensure that international efforts are not futile, the EU should continue to promote democratic norms and institutions, and protect human rights and the rule of law globally.

For common goods such as global health or the environment, climate chauvinism has even less chance of success than vaccine protectionism.

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