Synthesis Report on the Ex-Post Assessment of the EU Climate Policies

Deliverable 2.7

Andrzej Kassenberg, WiseEuropa

Krzysztof Krawiec, WiseEuropa

Joukje de Vries, CE Delft

Ward van Santen, CE Delft

Pol Fontanet Pérez, University of Vigo

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Abstract

This document synthesises an ex-post assessment of the climate policy of the European Union in the period of 2005-2020. It presents key insights into the heterogeneity of European climate policy in this period and identifies the main drivers, trade-offs, and conflicts that affect the establishment and implementation of policy.

In the introduction, we provide a list of the documents and legal acts included in the analysis and provide a summary of the methodology employed. We also describe the most important assumptions underpinning our quantitative and qualitative assessment of climate policy of the European Union for the period 2005-2020, as well as national case studies (NCS) and other WP2 activities, including four web-based stakeholder workshops.

The main part of this report is the conclusions drawn from the assessment of the establishment and implementation of EU climate policy in the period 2005-2020. We examined the conclusions from the perspectives of headline targets (the so-called '20-20-20 targets') of 20% reduction of greenhouse gas emissions by 2020 compared to 1990, 20% share of renewable energy in total final energy consumption, 10% renewable energy in transport by 2020, and 20% improvement in energy efficiency by 2020 compared to the reference scenario. As a consequence, this report is broken down into sections on greenhouse gas emissions, renewable energy sources, and energy efficiency. Next, we focus on the four "I" dimensions of climate policy. We argue that innovation and investment are crucial in a transformative climate policy because they tackle larger challenges and opportunities that go beyond achieving the 20-20-20 headline targets. We also synthesise our findings within the scope of infrastructure and integration.

Finally, we present recommendations from our ex-post review of EU climate policy at both EU level and in the Member States. Key recommendations include developing a comprehensive evaluation programme for EU climate policy and embedding the right conditions for a well-functioning monitoring framework in the design of EU climate policy area.

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Abbreviations

Abbreviation	Description
ACER	European Union Agency for the Cooperation of Energy Regulators
AFID	Alternative Fuels Infrastructure Directive
CAP	Common Agricultural Policy
CCS	Carbon Capture and Storage
EAFRD	European Agricultural Fund for Rural Development
EC	European Commission
EED	Energy Efficiency Directive
ENTSO-E	European Network of Transmission System Operators for Electricity
EPBD	Energy Performance of Buildings Directive
ESD	Effort-Sharing Decision
EU	European Union
EU ETS	EU Emissions Trading System
F4E	Fusion for Energy
FP7	Seventh Framework Programme of the European Union
FQD	Fuel Quality Directive
GDP	Gross Domestic Product
GHG	Greenhouse gases
GW	Gigawatt
NCS	National Case Study
NER 300	New Entrants' Reserve 300
NGO	Non-Governmental Organization
NIP	National Investment Plan
PPA	Power Purchase Agreement
RED	Renewable Energy Directive
RES	Renewable Energy Sources
SMART	Specific, Measurable, Achievable, Relevant and Timebound

Abbreviation	Description
SMEs	Small and Medium-sized Enterprises
TEN-E	Trans-European Networks for Energy
TEN-T	Trans-European Networks for Transport
WP	Work Package

1. Introduction

The European Union has established and implemented climate policies to reduce greenhouse gas emissions with the aim of decoupling economic growth from emissions. This was the first time that the EU's climate policy had been implemented on this scale. Earlier was relatively limited experience to draw on. The period 2005-2020 has seen the European Union's climate policy continue to evolve and mature. At the end of the assessed period successive climate targets became increasingly ambitious to the point of defining and moving towards climate neutrality. We are particularly interested in the insights that this period can provide us about transformative change in climate policy.

We have assessed the establishment and implementation of the EU climate policy at the EU and national levels. The purpose of the study was to assess the overall effectiveness of the EU policy framework by following the main climate indicators at the EU and Member State levels. The studies are structured around the '4Is'. According to Deliverable 1.1: Transformative climate policies: a conceptual framing of the 4i's (D. 1.1), this refers to four core cross-cutting challenges:

- Fostering breakthrough **Innovation**;
- Shifting **Investment** and finance;
- Rolling out the **Infrastructure** for a climate-neutral and resilient economy;
- **Integration** of solutions across sectors and policy instruments.

The measures and regulations established by European regulations and directives were reviewed from qualitative and quantitative points of view and they were selected to refer as fully as possible to the "4Is" and to key areas of climate policy. Table 1 illustrates their classification into the "4Is."

Table 1. List of documents and legal acts covered by the assessments

Policy theme	Specific regulation	Regulation	Infrastructure	Investment	Innovation	Integration
Carbon price policies	Greenhouse gas emission allowance trading system	Directive 2003/87/EC	X	X	X	X
	EU rules for the taxation of energy products and electricity	Directive 2003/96/EC	X	X	X	X
Energy efficiency requirements	Energy efficiency	Directive 2012/27/EU on energy efficiency	X	X	X	X
	Energy performance of buildings	Directive 2010/31/EU on the energy performance of buildings	X	X	X	X
	Clean and energy-efficient road transport vehicles	Directive 2009/33/EC on promoting clean and energy-efficient road transport vehicles	X	X	X	X
Renewable energy quotas	Renewable energy	Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources	X	X	X	X
	Cleaner fuels for road transport	Directive 2009/30/EC	X	X	X	X
Energy infrastructure	Trans-European Networks for Energy (TEN-E)	Regulation EU 347/2013	X			X
	Agency for the Cooperation of National Energy Regulators (ACER)	Regulation (EC) No 713/2009	X			X
	ENTSO-E	Regulation (EC) No 714/2009	X			X
Mobility Infrastructure	Trans-European Networks for Transport (TEN-T)	Regulation (EU) No 1315/2013	X			
	Alternative Fuels Infrastructure Directive (AFID)	Directive 2014/94/EU	X			

Policy theme	Specific regulation	Regulation	Infrastructure	Investment	Innovation	Integration
Various programs that provide financing for innovation in low carbon technologies	NER 300 programme	Commission Decision 2010/670/EU			X	
	Innovation Fund (part of ETS)	Article 10a(8) of Directive 2003/87/EC			X	
	The EU's joint undertaking fusion for energy (F4E)	Council Decision 2007/198/Euratom			X	
FP7/Horizon 2020 projects	Public-private partnerships in Energy	-		X	X	
	Intelligent Energy Europe Programme (IEE) and Horizon 2020 Energy Efficiency (2014-2020)	-		X	X	
Various programs supporting low carbon infrastructure	Modernisation Fund	-	X	X	X	
	Connecting Europe Facility	-	X	X	X	

This report synthesises qualitative and quantitative assessments, as well as national case studies, to find similarities and contradictions in EU climate policies from 2005 to 2020. The report includes an overview of key goals and results, discusses the transformative character through "4I's" and case studies, and concludes with lessons learnt on assessment methodology.

2. Methodology

Within WP2 of the 4i-TRACTION project, we have conducted quantitative and qualitative EU-wide assessments, as well as national case studies (NCS). The details may be found in the following deliverables available online on the 4i-TRACTION website:

- Deliverable 2.4: Report on Quantitative Assessment of Climate Policies (D. 2.4);
- Deliverable 2.5: Report on Qualitative Assessment of Climate Policies (D. 2.5);
- Deliverable 2.6: Report on National Case Studies (D. 2.6).

Using headline climate indicators and associated characteristics of the EU and Member States' energy systems, we quantified the effectiveness of the EU policy framework.

In the Report on Quantitative Assessment of Climate Policies (D. 2.4), an ex-post evaluation of the EU climate policy framework for the period 2005-2020 was conducted, both for the EU27 and selected Member States. A combination of top-down and bottom-up analyses was used to assess the effectiveness of EU climate policy; see Fig. 1.

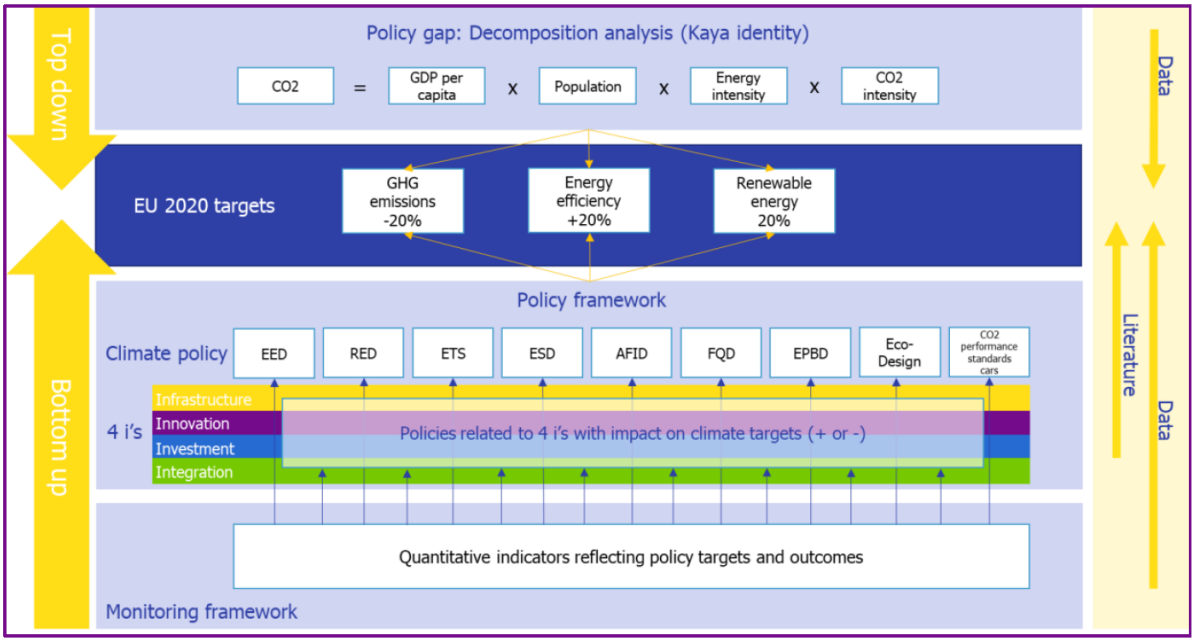

Figure 1. Illustration of top-down and bottom-up method used to assess EU climate policy.

As described in detail in Deliverable 2.4., within a top-down approach, a decomposition analysis was performed to analyse changes in GHG emissions in the period 2009-2018. As a result of the use of this method, the observed changes in GHG emissions are quantified in terms of changes in GDP, population growth, industry, service and transportation sector composition (structural change), energy efficiency, contribution of renewable energy to electricity generation, and other carbon savings. The bottom-up approach included a literature review (including evaluations and impact assessments) and the monitoring framework designed to measure progress towards headline targets. This framework is based on pre-2020 policies but is intended to contribute to monitoring the 2030 and 2050 climate objectives. It contains indicators on headline targets, climate policies, non-climate policies, and socio-economic outcomes. More information on the methodology of the quantitative ex-post assessment of climate policies is presented in the Deliverable 2.4.

In parallel to the quantitative analysis, the qualitative assessment addressed issues that cannot be fully captured by standard quantitative indicators. The study focused on answering the question of which key transformative challenges have been addressed by policy documents at the EU level in the areas of innovation, investment, infrastructure, and integration. The methodology included reviewing and evaluating existing planning documents and regulations, reviewing scientific literature, and conducting in-depth interviews with climate policy experts from the different Member States and representing various points of view. In order to get some comparability between them, there are several themes that we tackled in the interviews:

- Have all potential instruments, in relation to headline targets, been used during the process of policy formulating? If not, why, and was it possible to formulate a policy to be more effective?
- Whether some gaps or barriers have appeared during the implementation of discussed policies. What challenges were observed during their implementation?
- What implication can be drawn from the period of 2005-2020 (in terms of ambitions, complementarity, and implementation) for a better formulation of climate policies in the future?
- How can what has been identified in the assessments of EU climate policies during 2005-2020 be understood in terms of the multi-crisis that Europe is currently facing (pandemic, war, energy, and economic crisis). How can the multi-crisis contribute to the transformative change of EU climate policies?

More information on the methodology of the qualitative ex-post assessment of climate policies is presented in Report on the Qualitative Assessment of Climate Policies (Deliverable 2.5). The latter, together with the quantitative assessment report, constitutes an integrated assessment of EU climate policy for the period of 2005-2020 on the EU level.

Furthermore, based on a common methodology, national case studies (NCS) were developed. The focus of NCSs was on the implementation of EU climate policy and its interaction with initiatives at the national level. These analysed seven Member States' approaches to the achievement of common climate policy objectives and provided an assessment of the impact of national policies on the 4i's:

- Case #1 Belgian offshore wind: innovation and investment;
- Case #2 Voluntary Energy Efficiency Agreements in Finland;
- Case #3 Climate stress tests in France: what co-benefits can we expect for transition financing?
- Case #4 Germany's delayed electricity smart meter rollout;
- Case #5 The rollout of public charging infrastructure for electric vehicles in the Netherlands;
- Case #6 The impact of the EU ETS revenues and derogation 10c on investment and infrastructure in Poland;
- Case #7 The role of energy and environmental taxes in Spain.

Synthesis information about the national case studies can be found in the Report on National Case Studies (Deliverable 2.6).

The first results of the ex-post evaluations of EU climate policies were presented in a series of web-based stakeholder workshops, each devoted to one of the four "I's". The workshops focused on deliberations on the main transformative challenges addressed by EU climate policy in these particular areas. The workshops offered a forum for stakeholders to exchange their insights and perspectives, fostering a thorough understanding of the advancements achieved, flaws exposed, and potential chances for further development in the EU's climate policy. The workshops were a verification of the assessments contained in the two reports, i.e., quantitative and qualitative. An overview of the workshops provides additional information on this topic (see Annex). In addition, during the 3rd Annual Project Meeting in Delft 5-6 June 2023, an interactive session was organised to derive consistent messages from the NCS, the results of which are included in this report.

3. Conclusions from the assessment of the implementation of climate policy in the EU in the period 2005-2020

3.1. Headline targets

General

In order to meet the requirements of the Kyoto Protocol and beyond, the EU made the following commitments in 2009, the so-called '20-20-20 targets' (headline targets):

- **Reduction of greenhouse gas emissions** – 20% reduction of greenhouse gas emissions by 2020 compared to 1990;
- **Renewable energy sources** – 20% share of renewable energy in total final energy consumption, and 10% renewable energy in transport by 2020;
- **Energy efficiency** – 20% improvement in energy efficiency by 2020 compared to the reference scenario.

These targets were adjusted by the EU after the Paris Climate Summit in 2015, where an agreement was reached to stop global warming at less than 2.0°C and preferably at 1.5°C compared to preindustrial levels, which consequently means achieving climate neutrality in 2050. From then on, climate policy became a tool for building a decarbonised and climate-neutral EU.

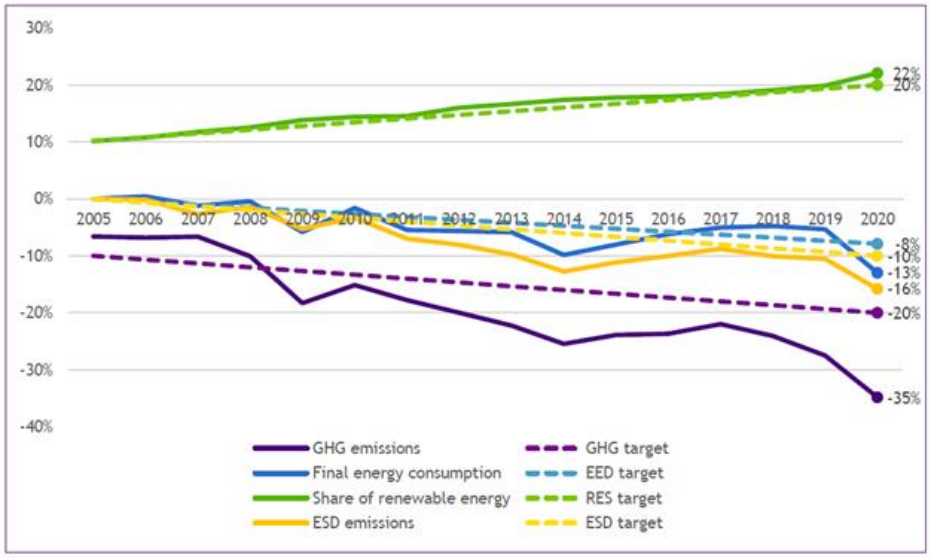

Figure 2. Progress on the EU headline climate targets in the period 2005-2020 reported by EU to the UNFCCC.

As shown in Figure 2, the 2020 headline targets were met. Following a top-down and bottom-up analysis, we have concluded that, generally, **EU climate policy has contributed positively towards achieving these targets**. The decomposition analysis performed at the EU level for the 2009-2018 period [more details in the Deliverable 2.4] reveals that without energy savings or improvements in carbon efficiency, emissions would have increased due to factors that generally fall outside the domain of climate policy, such as population growth, GDP growth and structural changes in the economy. However, increased reductions in net emissions have been achieved at EU level as a result of increased efficiency and, to a lesser extent, a general shift away from carbon-intensive fuels, such as coal, to fewer polluting ones ('fuel switching').

The EU has implemented various policy directives to tackle climate targets. According to our quantitative assessment, directives directly related to the three headline targets (EU ETS, ESD, RED and EED) generally scored highly in terms of effectiveness. EU policy instruments that are less directly related to the headline targets (such as the FQD, EPBD, CO_2 emission performance standards for vehicles, and the Ecodesign Directive) made a fair contribution to the reduction of GHG emissions, the increase of renewable energy, and the improvement of energy efficiency [more details in the Deliverable 2.5].

It is questionable whether climate policy was ambitious enough, as the EU easily exceeded the 20-20-20 targets. This could be attributed to the fact that it was the first implementation of such a policy and the 'learning by doing' approach. Furthermore, the economic downturn around 2008 and restrictions during the COVID-19 pandemic in 2020 may have contributed to a decrease in emissions, independent of climate policy. Nevertheless, **the question is from political, economic, and social perspectives whether it would have been viable to set more ambitious targets**. In the context of policy design and its ambition, there are different opinions among academics and experts interviewed about whether or not policies should have been more ambitious. Those who believe that the progressive approach implemented was the right one, argue that it made possible securing the approval of various public and private stakeholders and that this has allowed them to agree to more ambitious instruments which came into force at a later time. Moreover, much has been learnt from the deficiencies and faults of the original instruments, which has enabled the creation of improved, revised, or new policy instruments. The Spanish national case study (Fontanet-Perez et al., 2023) illustrates how this process of improving policies with shortcomings could work in practice: some academics believe that some of the reviewed instruments fall short of the needed ambition for the new targets (see, for example, the Energy Taxation Directive).

Against this background, the following question arises: While setting the targets at a low level in the beginning, would it not be conceivable to raise the ambition and more precisely adapt them to the circumstances, given the effectiveness of climate policy? The EU ETS, for instance, is more effective now than it was in the 2010s, as there were still investments in new coal capacity, not aligned with long-term mitigation requirements. The prices of CO_2 emission allowances were low and hardly encouraged changes in technology or energy carriers. At the same time, the enlargement of the EU to the countries of Central and Eastern Europe in particular required that

their specificities had to be taken into account, including their less advanced position and experience in terms of climate change mitigation. Based on conducted interviews, it seems that **a more profound transformative climate policy from the political, economic, and social circumstances at that time would have required more courage, which, with the need for compromise at the level of 28 countries, proved impossible.**

Regarding the effectiveness of EU climate policy, we have to note that even before the introduction of RED and EED, in some countries there were already national policies in place that contributed to the achievement of improvements in renewable energy and energy efficiency. Therefore, the progress towards these targets cannot be fully attributed to RED and EED. The Dutch national case study (Rienks, 2023), for instance, shows the innovative aspect of the introduction of electric vehicle charging networks in 2009-2020. As a result, European regulations arrived in a preprepared regulatory environment in some countries with advanced national climate policies. However, European regulations were often the new solutions in the remaining Member States and set the tone, requiring significant efforts to be implemented. Non-climate policies also contributed, albeit indirectly, to the achievement of the targets for greenhouse gas emissions and renewable energy sources (such as TEN-E and part of the TEN-T). From the perspective of today, not all effects were climate positive. Although, for example, replacing coal by natural gas might have been seen as a positive contribution to climate outcomes, they are still negative in terms of fossil lock-in. Meanwhile, besides contributing to climate-friendly transport infrastructure, such as rails and cycling lanes, TEN-T also supported the development of high-capacity motorway networks that led to increased GHG emissions through their users. The essence of their development was more focused on building EU integration in an economic sense, rather than solely focussing on climate targets.

It is challenging to quantitatively estimate the impact of EU policies at the European level. This is due to the differences between Member States and the different types of policies that (both directly and indirectly) affect the reduction of GHG emissions in the EU. On the contrary, policies implemented at national level directly affect GHG mitigation and are less complex to evaluate individually. This is shown through selected national case studies, referred to in more detail in this report.

GHG emissions

As shown in Figure 2, the 2020 target on GHG emissions was met. **EU-wide GHG emissions** reported to the UNFCCC **were 35% lower in 2020 than in 1990, a substantial overachievement of the 20% reduction target.** Although the 20% target in reducing greenhouse gas was achieved and was largely exceeded, this cannot be exclusively attributed to the effect of the EU climate policy. The reduction in GHG emissions has also been influenced by the economic downturn in 2008, but also through other (autonomous) developments such as an increase in energy efficiency. Based on a review of the literature, we note that the impact of the

economic downturn resulting from the COVID-19 pandemic on 2020 GHG emissions was likely significant (in 2019, there was a 28% decrease in GHG emission compared to 1990).

Analysis of literature and interviews with experts clearly indicated that the EU ETS has made an important contribution to reducing emissions. However, seeing the low prices of carbon allowances during most of the assessed period, a more robust price signal in EU ETS would have allowed achieving higher levels of reduction. **This suggests that the EU ETS did not manage to meet its full potential to achieve further GHG reductions.** An explanation for this is that it was in 2005 when was established a new instrument, and, at the same time, it was feared that the strengthening of the price signal would cause so-called 'carbon leakage' and weaken the EU economy. The pressure from the industrial lobby was also strong on this issue, according to in-depth interviews with climate policy experts.

The ESD also played an important role in reducing CO_2 emissions, but to a lesser extent. Based on literature review and interviews we have found that, from an EU policy perspective, there was added value in coordinating and agreeing emission targets for each Member State at the EU level, and it would be unlikely that emission reductions would reach the same level without this instrument. The fact that the mechanisms to achieve the ESD target are determined by each Member State ensures that the measures can be adapted to the specificities of each country. Of the four main sectors covered by the ESD (transport, buildings, waste, and agriculture) the most cost-effective reductions were implemented in the buildings sector. However, the implementation of measures in other sectors, particularly agriculture and transport, was hindered by their high costs and political complexities. With regard to ESD, there were insufficient EU and national funding opportunities to reduce emissions.

Energy efficiency

Figure 2 shows that the 2020 target on energy efficiency was met. Total final energy consumption was 1.041 Mtoe in 2005, with the target to be reduced to 959 Mtoe in 2020, a reduction of 8%. In 2020, total final energy consumption dropped to 906 Mtoe, a reduction of 13%, surpassing the 2020 target. Decomposition analysis at the EU level (performed for the 2009-2018 period) suggests that energy efficiency was an important contributing factor to emission reductions; the impact was stronger than that of renewable energy.

Based on the Finnish national case study, it can be concluded that the integration of energy efficiency targets and measures into local decision making (integration of climate policy) was a practical way to achieve energy efficiency standards established in EU legislation (Varis, 2023). This flexible policy instrument enables a broader approach to integrating policies with climate neutrality goals, making their implementation more coherent. The concept developed in Finland involves different actors from different levels and sectors and encourages others to implement further energy efficiency measures. It is important that the individual actors responsible for energy efficiency activities receive help and guidance from authorities and other actors. Low hierarchy and openness in the exchange of information made it possible to create a network that

strengthens trust between entities. This creates a unique environment for energy efficiency activities in Europe.

The challenge of implementing transport policies for improving energy efficiency (such as: reduction of transport intensity, better organisation of transport services, development of transport infrastructure, improvement of technical solutions in vehicles, and appropriate patterns of transport behaviour) arises due to the high costs associated with them, which also includes the necessity of significant infrastructure investments. Most Member States, following the implementation of the EED, have introduced measures into their programmes such as improving vehicle efficiency (labelling, scrapping old cars, annual car taxes). The vast majority of Member States have refrained from the idea of including obligations on transport fuel suppliers or carbon reduction programmes for industrial and commercial organizations, such as logistics and transport companies, in their plan. Such conclusions were drawn from a literature review as part of a qualitative assessment of climate policy [see more the report D2.5] .

Renewable energy

As shown in Figure 2, the 2020 target on renewable energy was also met. The decomposition analysis performed at the EU level for the 2009-2018 period suggests that **the deployment of renewable resources contributed positively to emission reductions.** However, the effect was smaller than that of energy efficiency.

The EU policy on renewable energy has developed gradually. In the first approach formulated in the Renewable Energy Directive (RED I Directive of 2009), national targets were differentiated among Member States, according to their commitments to achieve certain levels of RES development. Next, at the EU level, a further articulation of ambitions was formulated and translated into country-specific targets. Under the RES II Directive (2018), a binding overall target was established of 32% of the final gross energy consumption of the EU to come from renewable sources by 2030 and to establish a common framework for the promotion of energy from renewable sources. **This demonstrates a willingness to gradually increase ambition and seeks to balance the desire to achieve the most ambitious RES targets while considering political, economic, and social constraints.** It is worth noting that the costs of RES development were high in the initial period, but then began to fall rapidly. On the one hand, this was the result of technological development. On the other hand, it was influenced by the development of a market for RES installations supported by rising allowance costs under the EU ETS. This effect of the learning curve was highlighted in the qualitative policy assessment in both the literature and interviews.

The importance of decentralising energy production, producing energy directly at the point of use and allowing full public participation in energy market structures has been stressed by renewable energy organisations. Over the years, bottom-up initiatives by individuals and small companies have emerged in Europe, investing their own capital in the energy sector, both in the areas of energy production, distribution, and energy efficiency. **The general objectives of the**

development of RES have not been linked to the potential opportunities to use the decentralisation process of energy production from renewable sources.

3.2. The role of the 4i-dimensions in climate policy

In this part, we discuss the role of the 4I's (Innovation, Investment, Infrastructure, and Integration) in EU climate policy. **We argue that innovation and investment are crucial in a transformative climate policy because they tackle larger challenges and opportunities that go beyond achieving the 20-20-20 headline targets.** Infrastructure is also essential in this regard, although to a lesser extent (according to the quantitative assessment). Integration is a vital aspect of transformative climate policies that link the other I's among themselves as well as with non-climate policies. [see more in the Deliverable 2.4].

Innovation

According to the quantitative assessment, the role of innovation was crucial in reducing CO2 emissions, improving energy efficiency and increasing the use of renewable energy, and thus in achieving all three main objectives. This results from the assessment carried out as part of the D2.4 report. Although the links between innovation and climate policy were not always made, the different instruments clearly addressed different innovation issues. Some policies stimulated innovation, while others did so only partially (without a focus on diffusion) or did not fully recognise the role and importance of innovation.

As was emphasised in Belgium, national case study **innovation policy requires supporting technology, stimulating demand, and skilful dissemination. Its successful implementation requires both a holistic approach and the building of confidence among entrepreneurs (regulation) and the consideration of the behavioural aspect.** It is important to undertake pilots in order to learn from them in terms of introducing the innovation in question. The role of government is important through flexible coordination, creating standards, and identifying and removing bottlenecks. Governments can financially support the development of innovation until businesses are able to profit from their diffusion. The implementation of innovation can contribute to the development of exports. In the 2005-2020 period, the EU climate policy mix combined policies with a generic (indirect) approach to innovation (EU ETS, ESD) with policies considering a more targeted approach to innovation, because they mandated certain standards (AFID, FQD, CO_2 emission standards for cars and light commercial vehicles). As identified in the qualitative assessment in the case of the EU ETS, the low carbon price throughout the period led to only a modest impact on innovation. In the case of the ESD, it is hard to isolate its impact on innovation. Only emissions reduction targets were set with no specification on how to achieve them, leading to a diversity of instruments and the absence of a coordinated approach between Member States.

The more targeted instruments (AFID, FQD, CO_2 emission standards for cars and light commercial vehicles) had a much more direct link to specific aspects of technological innovation. The qualitative assessment generally indicates their positive impact on it. This was identified through both a literature review, in-depth expert interviews, and a stakeholder workshop on innovation. **The vehicle emission measures that were adopted provided incentives for manufacturers to develop and market low-emission vehicles. In the context of innovation, AFID has contributed to the diffusion of cleaner technologies.** FQD has had a more indirect impact on innovation, resulting from the development of different sectors of the fuel market and related technologies to meet emission reduction targets. According to an ex-post impact assessment commissioned by the European Commission, it has enabled accelerated research and development of fuel-efficient technologies, as well as increased market adoption of fuel-efficient technologies in both passenger cars and light commercial vehicles. However, concerns have also been raised about the lack of ambitious targets and inadequate design of instruments. Due to advancements in innovation, the cost of alternative fuel infrastructure and vehicles is likely to decrease further, increasing the appeal of this mode of transport and its contribution to climate action.

The EED and the Ecodesign Directive have had a significant impact on improving energy efficiency and also indirectly on reducing GHG emissions, but less on the development of innovation than the previously mentioned instruments. The EED focused on introducing new technologies rather than replacing and updating existing ones. The Ecodesign Directive was more focused on the dissemination of existing technologies. As a result, policy implementation was slower than energy efficiency improvements. Furthermore, the requirements did not keep up with technological change.

The NER300, an innovation-specific funding programme for low-carbon technologies, provides the following insight: top-down approaches to technology selection (e.g., CCS) have limits, and the pursuit of balance in fund distribution (in terms of geography, technology, and project variety) leads to increased complexity. Careful due diligence plays a critical role in matching grant funds, but it also adds complexity and has a limited impact on risk reduction and innovation enhancement. It is noteworthy that the decision as to which technologies to include was not based only on the technical or feasibility criteria of the call, but also had a significant political element.

In the qualitative assessment, a lack of consistency was noticed between, on the one hand, to support RES development, such as through the NER300 or Horizon 2020, and on the other hand, that European industry was not protected from competition from non-EU countries, for example, the ones of Asia-Pacific region. Some conservatism in the approach to RES from the point of view of innovation policy was also expressed by expert interviews. It was suggested that a more ambitious approach to this issue could have been taken.

Besides EU policy, the implementation of innovation is also linked to the design of innovation instruments at the Member States level, some of which have been studied through case studies with the following conclusions:

i. The German national case study on the country's smart meter rollout addresses technological innovation and the interplay between technological innovation, infrastructure, and regulation. Referring to the need to digitalise energy systems in the EU and increase energy efficiency, the EU mandated its Member States to introduce smart metering systems in 2009. Germany only took on the task of introducing smart meters between 2013 and 2019. The delay in implementing this solution can be drawn back to the government not designing a transformational rollout. The assessment shows how overregulation can hinder the upscaling of innovative technologies. As such, German authorities introduced strict technological requirements that developers must meet before these innovative technologies could be sold on the market. Instead of eliminating uncertainty among market participants, legally prescribed technological complexities made it difficult for developers. As a result, it took years for smart metering systems to become market ready. The German case provides valuable lessons on the challenges of scaling innovation as they continue to evolve. It also shows the trade-offs that decision-makers have to go through, above all to monitor the implementation of transformational innovations and to react quickly to signals of anomalies (Faber et al., 2023).

ii. Belgium was one of the first countries to develop offshore wind energy. The specialisation of Belgian offshore wind energy services focused on innovative software, artificial intelligence, data monitoring, and remote sensing. Offshore engineering companies have a large market share due to the early development of offshore wind energy and their investments in innovative vessels for the construction and maintenance of offshore wind farms. The majority of offshore wind farm capacity is owned by Belgian companies or public sector entities, and Belgian municipalities also play an important role. Two elements have helped provide long-term certainty for investments: green energy certificates (17-20 years) and power purchase agreements (PPAs). Between 2009 and 2020, 2.6 GW of power was installed. As a result, an innovation ecosystem consisting of private and public sector players and research organisations was created. Belgian know-how in this field has become exportable (Wyns, 2023).

iii. The example of the Netherlands relates to the interdependence between innovation and infrastructure, showing the innovative aspect of the introduction of an electric vehicle charging network between 2009 and 2020. This included the necessary changes to the electricity grid and the development of information systems to inform users where to find charging stations. Government policy played an important role as it gave direction, built networks and stimulated the deployment of electric vehicles. However, it is unlikely that it alone could have contributed to the rapid introduction of high-quality public charging infrastructure. The private sector and other public sector organisations and large municipalities have played a more direct role in this deployment. In urban areas, the

market has matured, while public charging infrastructure was almost non-existent in rural areas. To stimulate the development of public charging infrastructure, the central government co-funded it through municipalities (Rienks, 2023).

iv. The Spanish case study concerns an analysis of the implementation of energy and environmental taxes in Spain and their role in mitigating climate change between 2005 and 2020. Different levels of taxation were found to have different effects on spending on technological innovation, with low tax pressure having almost no effect on innovation, while pressure increases spending on eco-innovation. The link with innovation is that environmental taxes promote the uptake of lower carbon alternatives by increasing the price of polluting products/services. There is also a link with policy and governance innovation, as better instrument design can lead to better outcomes. Technological innovation can be divided into investments in clean technologies or end-of-pipe solutions. Current environmental taxes in Spain stimulate both types of innovation in a similar way. Although end-of-pipe innovations tended to be cheaper and more effective short-term solutions, they are less desirable than switching to new technologies that do not focus on mitigation, but on prevention (Fontanet-Pérez et al., 2023).

In addition, the innovation perspective could have been broadened, not only to focus on technological innovations and business models as sources of solutions for climate neutrality but also on policy and governance innovations for new concepts such as the virtual power plant.

Two issues should be noted in relation to the innovation-related findings from the case studies that emerged from the interviews with experts. First, with ten new Member States joining the EU in 2004, followed by three other countries, all with different characteristics, resources, and mindsets from those in western and norther Europe, a coherent innovation policy that fits all could not be expected. Second, several advantages could also be achieved by reinforcing business and social innovation activities in the coal and lignite mining regions of the European Union through investment activities that promote the quality of life in these areas post the cessation of mining.

Investing in research and development should be a priority for EU Member States, preferably as a part of a long-term strategy in sustainable energy sources to promote cost-effective energy and advance the economy.

In the development of innovation, not only for the purposes of implementing climate policy, it is also crucial to build ties between public administration, business, and research institutions. Building mutual trust is especially important as it was found in several national case studies. Such cooperation creates a synergy effect, limits incorrect decisions, and allows for the creation of compromise solutions. It is important that the government's policy sets the direction, stimulates the right solutions, and at the same time is flexible enough not to create barriers. The inclusion of financial institutions as well as local governments is an important complement. As a result, a market is created for innovative solutions that may lead to the development of an export speciality.

Investment

Based on the decomposition analysis and the design of the monitoring framework, we assessed that investment, among innovation, is – out of the 4I's – the most important enabler for transformative change and effective climate policy.

With reference to the quantitative assessment, it can be stated that the **starting point for making effective investments is to formulate a long-term policy, minimise risks, take advantage of economies of scale, and limit funding to 'clean' projects for the energy-climate transition.**

It is rather debatable whether the EU ETS was an important tool to drive investments during the time period studied. We have seen massive investments in renewables and infrastructure, but not driven by the relatively low carbon price. One could also argue that the function of the carbon price is rather to prevent fossil investments, more than stimulating non-fossil ones. On that note, one could look at the investments in fossils that occurred still in the 2010s and ask why the EU ETS did not prevent that funding. The example of a Polish national case study regarding the impact of two forms of EU ETS funding on the development of infrastructure and the level of investment can be cited here. Activities reported to the European Commission in Poland showed that investments in infrastructure did not constitute a significant part of the reported activities. The profits from the auction were to be allocated to initiatives related to the energy transition, but Poland's actions call into question compliance with the directive. The derogation mechanism was not of a forward-looking nature, as the generation market was consolidated, and the investments reported under the National Investment Plan (NIP) focused on the modernisation of conventional generation capacity. The report of the Supreme Audit Office revealed irregularities in the implementation of the NIP. These include: 1) the lack of transparent rules for qualifying reports on investment activities under NIP and 2) the lack of clearly defined goals that can be achieved thanks to NIP. The implementers did not verify the feasibility of individual investment projects, creating a risk that not all reported measures would be implemented. In the survey done for the Polish case study conducted on this issue, experts pointed out:

- A slowdown in the pace of decarbonisation through the consolidation of coal units (run by state-owned companies) and the lack of support for the RES sector,
- Acceleration due to the allocation of funds for the development of transmission infrastructure and improvement energy efficiency, support for energy entities and support for the development of decentralised energy,
- There is no significant impact on the pace of decarbonisation.

Still related to carbon prices, **research shows that lower prices may induce smaller investments, which are typically associated with increasing the efficiency of current technologies (instead of stimulating larger-scale investments with a more significant impact on decarbonisation).**

Regarding the regulation on CO_2 emission standards for cars and light commercial vehicles and the directive on alternative fuels, which set medium- and long-term targets, give stakeholders a clear picture of the requirements to be met. The ex-post evaluation covers the car and light commercial vehicles (LCV) CO_2 regulations (respectively Regulation 433/2009 and 510/2011) as a result of quantitative counterfactual analysis and regression analysis shows that the regulations have been effective at reducing CO_2 emissions from new cars by 138 $MtCO_2$ and from new LCVs by5 $MtCO_2$. (Gibson et al., 2016). This has also had a positive impact on further encouraging investment in research and development.

Various factors reduced the effectiveness of the FQD, including inconsistencies in the regulatory framework mainly due to its inconsistency with the RED, low anticipated return on investment for fuel suppliers and producers to decrease GHG intensity, absence of supportive national schemes, insufficient availability of renewable feedstocks, and a lack of harmony in national transpositions and blending mandates in Member States that choose to include these mandates in their legislations.

During the period under review, private investment in RES increased, although on an insufficient scale. At the same time, the failure to prevent fossil fuel investments should be considered, which may have contributed to delays in investment in grid infrastructure.

It is essential to emphasise the competitive advantage of wind and solar energy when considering the opening of the generation market to new investors. Renewable energy sources have become more accessible to a wider range of actors due to their modular nature, simplicity, and popularity. This allows investments to be adaptable based on their capital and needs. Other low-carbon sources did not make such progress because of technological, social, environmental, and regulatory factors.

Regarding investment and financial challenges, specific instruments with high transformative potential for climate mainstreaming in the financial sector (regulators and financial institutions) were identified. In particular, this was related to the links between investment and integration with regard to the strong focus on the integration of EU energy and transport infrastructure. In addition to policies supporting climate and energy targets, these efforts were also supported by funding programmes in the EU. An example of this were funds for connecting energy networks between EU countries and the structural fund related to the accession of new countries to the EU in the period in question.

Having a public investment implementation strategy is a key element in ensuring profitability, as well as trying to avoid disparities and distributional effects of accessing services in sparsely populated areas. It is necessary to introduce complementary instruments that support long-term infrastructure planning and financial support for its implementation, e.g., planning and development of trans-European transport and energy networks. **Creating an integrated infrastructure development policy covering planning, supply and demand,** as exemplified by the development of the infrastructure of electric car charging points in the Netherlands (see above in the innovation part of this report).

An example of how to do this is in France, where it became clear how climate stress testing by financial supervisors can affect banks. The French national case suggests steps to better address climate issues and suggests ways to improve internal procedures, incentives, and governance structures study. The more bank teams are trained and coordinated on climate issues, from the bank's executive committee to operational teams, the more they can potentially be in a position to make decisions on financing the transition. However, this will depend on the banks' ability to identify financial opportunities or regulatory requirements to provide incentives. Bank transformation plans can be an effective solution, as they should build on the transformation plans of the banks' counterparties and enable banks to better understand how they can accompany their counterparties in the transformation study (Calibel and Fidel, 2023).

According to the qualitative assessment and interviews, there was not enough impact of climate policy on preventing investment in the wrong sectors (such as fossil fuels). Taxation could be one way to address it. During the period in question, no solutions were consolidated at EU level in this respect, as each country had its own solutions or none at all.

Looking together at the actions taken to reduce GHG emissions, develop RES and improve energy efficiency, one can conclude, following the experts interviewed within the project, that the role of the financial sector has been largely overlooked. This has affected the scale of investments made in the renewable energy sector, for example. As the scale of investment expenditure in the context of EU climate policy is beyond the capacity of the public sector, there was a need to redirect private capital toward more sustainable investments. This required a profound change in the way the financial system operates, as banks and financial institutions have made decisions so far based solely on their own economic interests, without taking into account the interests of sustainability and climate policy. There was a perception among the interviewees that the EU could do much more to regulate the financial sector, not even through the lens of risk, but through direct investment in certain sectors. The measures taken were often more cosmetic than effective. It would have been much more effective and necessary to properly channel financial flows.

Infrastructure

As found in the quantitative assessment of climate policy, infrastructure was acknowledged as an essential facilitator for transformative changes and effective climate policies. However, infrastructure support in achieving headline targets was less significant than innovation and investment. Additionally, as part of the qualitative assessment and interviews, the existing energy infrastructure was not always sufficient to interconnect the entire EU, as well as local renewable energy sources. The latter was exacerbated by some operators who refused to connect more photovoltaic farm installations to the grid.

Infrastructure development requires differentiated policies as well as a pragmatic approach to formulating standards – see the Dutch national case study (Rienks, 2023). If the process is market-driven, it should be flexible and not over-regulated – see the German national case study

(Faber et al., 2023). In addition, it is important for the government to be involved in the whole process and to coordinate the whole undertaking – see Dutch and Belgian national case studies (Rienks, 2023; Wyns, 2023).

The following key conditions that should be met for RES and their infrastructure are: the introduction of smart grid solutions in combination with trans-European high-voltage network (TEN-E) solutions, differentiation between mature (electricity) and less mature (district heating) renewable energy technologies in order to use them more efficiently and effectively increased investment in regional RES potential (wind, solar, biomass).

The difficult conditions in the energy supply created an opportunity for the development of renewable energy and the improvement of energy efficiency. For this to happen it required overcoming barriers and creating a friendly climate for the development of RES and energy efficiency, which is discussed below.

Infrastructure plays a key role in the development of RES. However, the development observed during the period analysed was uneven in terms of geographical location, financing methods and sources and regulation. **This raises the question of whether the deployment of a cleaner electricity generation infrastructure that is dispatchable, resilient, cost-effective, and socially acceptable could have been better managed**. Above all, according to the literature review and interviews, it would have been necessary to target support more precisely in relation to local (national and regional) conditions, to make more use of local (administration, SMEs, NGOs) interest in RES development, to link infrastructure development more strongly to access to investment and to start earlier a process of a just transition in traditional energy-mining regions (social acceptance and political consent), which would have created 'pressure' for RES development.

During the interviews, some experts emphasised that the markets for alternative fuels and infrastructure would have been underdeveloped without the AFID. A unilateral approach by Member States would fail to achieve coordinated market development and the subsequent harmonised adoption of technical specifications for infrastructure and vehicles.

District heating has been identified as a key type of infrastructure in densely populated areas to reduce energy dependency, lower costs for households and businesses, and provide significant reductions in greenhouse gas emissions. District heating infrastructure assets are capital intensive and can generate long-term lock-in effects. Moreover, like any infrastructure, they can have serious adverse environmental and social impacts, such as landscape degradation. **It could therefore be argued that deployment and governance of heating systems should take a societal perspective and explicitly consider non-monetary impacts.** This applies to the entire EU, however, and some countries have succeeded, and others have not (or have not even tried). As a result, some of them are now in a much better position to complete the decarbonisation of their heating systems (in particular Denmark, Finland and Sweden). The reasons for this fact may be:

- A strong and clear policy containing incentives for the implementation of renewable energy or energy efficiency standards resulting from political support;
- A significant share of renewable energy sources enabling the generation of low-emission electricity for electric heating and heat pumps;
- Access to more financial resources to support the development of RES, offering of financial incentives or financing of research and development;
- A high level of environmental awareness in society supported by pro-climate information and education campaigns.

The regions most vulnerable to energy shortages and fossil fuel dependency did not receive enough support from the EU and the Member States to address this vulnerability, which is evident from the literature review and interviews.

The development of infrastructure was highly dependent on both available resources and mechanisms that encouraged investment in it. This was also influenced by the risk of undertaking larger projects in the context of future uncertainty. It was also important to integrate the goals set with the support and development of infrastructure to serve their implementation, for example, in the field of promotion of electric transport**.** It is also worth noting that, **on the one hand, the development of infrastructure supported the climate and energy transformation, and on the other hand, infrastructure projects were developed to increase GHG emissions, such as gas pipelines or highways.** As part of the development of RES and the improvement of energy efficiency, the development of infrastructure progressed, but its scale was insufficient in relation to the needs.

Integration

We recognised that integration is an important enabler for (transformative) change and effective climate policy, but the support for this (originating from our quantitative methodologies) is less strong than for innovation, investment, and infrastructure. The amount of (recent) ex-post evaluations on the selected climate and non-climate policies is limited and a large share of the available studies lack a quantitative assessment.

With reference to the National Case Studies, various aspects of integration can be distinguished:

- Cooperation, e.g., smart meters, see German national case study (Faber et al., 2023);
- Connections between different levels of governance, i.e., the EU and member states or national governments and the regional level, e.g., interdependence between different environmental taxes, see Spanish national case study (Fontanet-Pérez et al., 2023);
- Financial supervision with the activities of banking institutions, e.g., climate change, French national case study (Falipel and Fidel, 2023);

- Implementation of solutions to improve energy efficiency, e.g., interaction between different actors, Finnish national case study (Varis, 2023);
- Large-scale introduction of electric vehicle charging stations, e.g., trust-building between different actors, Dutch national case study (Rienks, 2023).

Integration issues are crucial when designing and implementing a coordinated environmental taxation policy. An example of this comes from the Spanish national case study, where there was a need to integrate new environmental taxation instruments into the current regulatory framework to minimise negative interactions and enable synergies with other public policy instruments.

As the literature and interviews show, **the most important aspects of the integration of climate policy were the integration of different types of instruments that serve the implementation of three main targets.** An example of such a link was the integration as well as complementarity between the EU ETS and the ESD, as the EU ETS concerned large GHG emission sources and the ESD smaller ones. The link between different directives and policies was important for the transformational nature of the policy in the period analysed. Integration between the solutions introduced at the EU level and those used in the Member States did not always occur. For example, in the power generation sector that is covered by the EU ETS, we find numerous instances of other instruments at Member States level like environmental taxes that are targeted to the same sector. There were gaps, incomplete implementation of solutions, or even overlaps. This was also applied to links with non-climate policies. In particular, there was no support for climate policy from the Common Agricultural Policy (CAP) and partially also from transport policy. Despite the introduction of a circular economy policy in 2015, it was not significantly reflected in the changes taking place in the energy or transport sectors, which could serve the purpose of climate policy. The potential of local integration of energy and climate transformation was not fully exploited, which depended on regulations and support both at the level of the EU and Member States.

The Clean Energy for All Europeans package supported policies for the deployment of renewable energy and energy efficiency measures, as well as measures to promote smarter energy use and the integration of the electricity system with renewable energy, thereby also reducing greenhouse gas emissions. This package, which was adopted in 2019, played an important role in integrating the various aspects of energy efficiency. It aimed to consolidate fragmented national obligations and reporting and allows for better harmonisation.

The mainstreaming of energy efficiency is fundamental in terms of the integration of electricity and gas systems or the electrification of heating and transport. The revised versions of the EED and EPBD (2018) were part of the Clean Energy for All Europeans package. The combination of these two acts allows them to complement each other and generate a symbiosis in terms of creating requirements for district heating systems, particularly in the building sector.

The European Union's rural development policy on renewable energy requires further clarification of the conditions necessary for an effective link between renewable energy and rural

development. The European Agricultural Fund for Rural Development (EAFRD) has not been used significantly to support efforts of the EU to meet renewable energy targets.

Interaction with international law and non-EU countries poses a challenge for the external integration of EU climate policy. Participants of workshops and experts during the interviews pointed out the importance of using multilateral avenues in the EU's external relations to reconcile its own agenda of **promoting climate policy integration with the objectives of other states and entities.**

4. Recommendations

Develop a comprehensive evaluation programme for EU climate policy

The track record of ex-post evaluations in climate policy are much less developed than Europe's longstanding experience on ex-ante studies and impacts assessments in other fields. While evaluations are generally carried out in line with legal requirements, it is difficult to make causal attributions in a quantitative manner of EU policy instruments based on those assessments. It seems necessary to assess to what extent the policies implemented are transformative or complementary. An approach from the 4Is (Innovation, Investment, Infrastructure, and Integration) may be useful in this regard. To gain a better understanding of the costs and effects of climate policy in the EU, it is recommended to establish a comprehensive evaluation programme that includes both directly related and indirectly related instruments. This could consist of the following:

- Establishing a clear methodology for determining costs and effects of EU climate policy in the coming years;
- conducting ex-post evaluations of the key climate instruments and policies in sectors, and an overarching review of costs and effects from EU policies.

Embed the right conditions for a well-functioning monitoring framework in the design of EU climate policy

Based on our design of a monitoring framework, we recommend selecting relevant indicators and imposing this type of monitoring framework at an early stage, ideally when transformative policies are designed. In this way, data collection can be targeted towards illustrating progress on the targets by means of the selected indicators. Secondly, we suggest obligating – or strongly advising – Member States to monitor and collect (complementary to what is already obligated) data on these indicators. Third, standards should be developed on how these data should be collected, stored and presented. Finally, in case it is not possible to define targets or objectives that are

SMART, we advise defining a set of indicators that together resembles key developments on targets and objectives and is able to monitor in a reliable way.

At present, climate policy is enshrined in the European Green Deal and concretised in specific related strategies and, above all, in a set of 14 pieces of legislation aimed at achieving a 55% reduction in GHG emissions by 2030 compared to 1990. At the same time, the other two new targets, improving energy efficiency and the share of RES in final energy consumption, have been adopted or are in the process of being adopted. Building on the experience of the –4I-TRACTION project, a set of integrated indicators is necessary to build, relating both to the policies themselves, including those indirectly linked to climate policy, and to individual instruments both on the EU level and in the Member States. The essence of future monitoring should be, first and foremost, to assess the interdependence of individual solutions relating to the three headline targets and to represent a transformative approach.

Strengthening climate policy making and implementation by taking a transformative approach (innovation, investment, infrastructure, integration)

The experience of the 2005-2020 period makes it possible to recommend the need for integrated solutions to achieve climate and energy targets. Important steps have already been taken in this regard, such as the European Green Deal and the Fit for 55-package. However, it is worth noting that the starting point for profound changes to climate policy is innovation, which serves to transform the material base of the EU economy. Hence, there is a need to further strengthen the links between innovation policy to support research and development and climate policy throughout the innovation creation and implementation chain. The EU institutions in particular should build trust between all participants in the innovation process. A broader approach to innovation is necessary, including social and governance aspects.

Just as important as innovation is the redirection of investment and finance towards the implementation of a long-term climate policy, placing the emphasis on green technologies and moving away from funding anti-climate solutions and, in particular, those that lock us in years in a carbon economy. This redirection is also about more precise support in relation to local conditions. A stronger inclusion of the financial sector is needed to support the implementation of adopted headline targets, for which both legal solutions for ESG and the introduction of taxonomies are important steps. The key to rolling out infrastructure for a climate neutral and resilient economy is further strengthening the development of renewable energy, along with storage, and improving energy efficiency and flexible energy management. In particular, the national case studies recommend an integrated approach, in terms of the tools used and the inclusion of all relevant actors, in the implementation of climate protection solutions. It is recommended that non-climate policy to a much greater extent needs to be integrated with climate policy, especially the common agricultural policy as well as the transport one.

Coherence in terms of content and communication of climate policymaking

Consultation on policies and instruments within the EU is important, but it is mostly people, stakeholders, and interested parties who take part. A significant proportion of recipients of policies and instruments learn about them too late. Therefore, according to expert interviews, there is a need to extend targeted communication to relevant user groups on what the policy or instruments mean for them and what risks they may face, and what safeguards are proposed. This is not only the role of the EU institutions, but above all of the Member States, which the EU should encourage.

Climate test as a tool for compliance of solutions with climate policy

There is a need for a comprehensive approach and the integration of climate into activities that at first glance do not come into contact with it, such as finance, trade, health, or education. To this end, it is important to set up a mechanism to determine the impact on greenhouse gas emissions (or the need for adaptation measures) for an increasing set of decisions. To this end, it is proposed that a climate change test be introduced for decisions to be taken both at the EU level and at the Member State level. This is to involve assessing each decision as to its impact on reducing or increasing GHG emissions, directly and indirectly (carbon footprint), as well as increasing or decreasing the ability to absorb CO_2, and its positive or negative impact on adaptation to the effects of climate change. The instrument currently used for selected policy documents, i.e., Strategic Environmental Assessment, is insufficient and needs to be strengthened. The legal basis for this is currently contained in Article 6 par 4 in the European Climate Law, which reads as follows.

"The Commission shall assess the consistency of any draft measure or legislative proposal, including budgetary proposals, with the climate-neutrality objective set out in Article 2(1) and the Union 2030 and 2040 climate targets before adoption, and include that assessment in any impact assessment accompanying these measures or proposals, and make the result of that assessment publicly available at the time of adoption. The Commission shall also assess whether those draft measures or legislative proposals, including budgetary proposals, are consistent with ensuring progress on adaptation as referred to in Article 5. When making its draft measures and legislative proposals, the Commission shall endeavour to align them with the objectives of this Regulation. In any case of non-alignment, the Commission shall provide the reasons as part of the consistency assessment referred to in this paragraph."

The introduction of the Green Deal as well as the strategies resulting from it and the FIT for 55-package are a step in the right direction, but there is still much to be done to achieve climate neutrality by 2050.

Without sacrificing ambition of climate policy, embrace the diversity of Member States and their populations

The climate agenda should be seen as a programme that takes into account the diversity and the specifics of the individual economic sector of each EU member. In particular, with regard to Member States from Central and Eastern Europe. That is why it is so important, taking into account their specificity, to support them on the road to joint achievement of climate neutrality by the EU in the required time.

EU climate policy cannot disregard the international dimension

The economies of the EU and other large economies are responsible for significant greenhouse gas emissions, not even necessarily from their territory, but simply through the consumption of products and services produced outside their borders. Embedding solidarity into climate policy requires an equal international approach, including historical responsibility. Some of the experts consulted made references to the importance of the international dimension of the EU climate policy. This climate policy should take into account the impact on third countries and how it can contribute to help them better prepare to pursue and achieve the necessary climate commitments.

Take advantage of the experience of the Member States and learn from the mistakes made at the national level

Each Member State implements EU policy into its national policies in its own way. As we have seen in the national case studies, this leads to both successful and less successful implementations. A few examples are given below:

- Transformative climate policy to achieve climate neutrality requires the involvement and coordination of many actors in all sectors. From a management point of view, active support and stakeholder participation should be facilitated (see Finnish NCS for details). This support should ensure long-term income security and access to capital. In addition, it is important to create a favourable research and development environment and to use the strengths of the industry, i.e., know-how (see Belgian NCS for details).
- The most significant co-benefit of climate stress testing: a process that mobilises banks' internal teams and supervisors around climate-related issues. (see French NCS for details).
- To foster technological diffusion, governments should provide clear guidance to relevant stakeholders. Policymakers should monitor the rollout of transformative innovations more closely and react in a fast and flexible way to signals from the ground (see German NCS for details). Consider involving the public sector in private sector activities in the early

stages of a transformative innovation. Use tenders in combination with sub-national governments as an effective innovation strategy. Avoid resistance by rolling out transformative innovations in areas that have few incumbent industries (see Dutch NCS for details).

- Ineffectively utilised financial tools in EU climate policy should be abandoned (see Polish NCS for details).

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Annex: An overview of the workshops

In order to present preliminary findings from the ex-post assessments of EU climate policies conducted within WP2, a series of stakeholder workshops were organised between April and May 2023. Each workshop was dedicated to one of the four "I's" (innovation, investment, infrastructure, and integration) and centred around discussions on the key transformative challenges addressed by EU climate policy in these respective domains. The workshops provided a platform for stakeholders to share their insights and perspectives, facilitating a comprehensive understanding of the progress made, identified gaps, and potential opportunities for further advancement in EU climate policy.

The objectives of the workshops were to:

- Present the early results of each ex-post assessment;
- Facilitate dialogue between the authors and expert stakeholders;
- Equip 4i-TRACTION partners with complementary insights on the four policy areas.

All workshops took place in Zoom. Each workshop was scheduled to last up to 90 minutes and was organised according to the following structure:

- 15-20-minute presentation by the author on early results from the ex-post assessment of the given policy area;
- 40-60 minutes of discussion with participating experts.

Overview of the workshop findings – Investment

Investment
Lack of clarity in national decarbonisation strategies: Participants highlighted the need for more clarity regarding technology choices and phase-out dates for specific technologies. Lack of clarity constitutes an investment risk – especially in long-term planning. **Role of the financial sector:** the role of the financial sector beyond financial institutions' own financial risk management needs to be clarified. To facilitate the financing of projects with longer maturities and lower profitability profiles, there is a need to adjust risk management analysis to better fit the objectives of the energy transition. This issue pertains to investments in low-carbon technologies but also concerns the phase-out of fossil fuel-based ones. **Transparency and ambition of public funding** Better adjustment of public funding regarding technology readiness levels and the scale of investment projects is needed as well as more clarity in public support schemes for household investments. There is a need to lower the administrative burden for small project holders and to raise awareness about the availability of small-scale public funding. **Participants also mentioned the following issues:** The cost-effectiveness approach as insufficient in tackling energy transition objectives; A need for better integration of energy efficiency objectives in industrial investments; A need for more attention to policies that affect the Global South.

Source: Sobkiewicz, Marianna; Miłobędzka, Aleksandra; 2.9. Report on online thematic workshops covering the early results from ex-post assessment; WiseEuropa; Warsaw

Overview of the workshop findings – Infrastructure

Infrastructure
Lack of EU-level guidance on climate-neutral infrastructure Participants highlighted that there has been a lack of EU-level guidance and regulation pertaining to climate-neutral infrastructure. The 2014 Alternative Fuels Infrastructure Directive was highlighted as the only example of such guidance. **Need for an infrastructure strategy** Infrastructure policy tends to be overlooked in EU climate policy. Experts agreed that there is need for an integrated strategy. Moreover, it was noted that infrastructure emerged as a key aspect of climate policy at a later point than many other policy issues. It was only in the mid-2010s that stakeholders began to acknowledge that infrastructure would need to change substantially to achieve the objectives of climate neutrality **Green public procurement** Green public procurement emerged as a key aspect of infrastructure policy yet one that has not received adequate attention in EU legislation. Despite there being a Public Procurement Directive, according to the participants EU policy remains insufficient in this realm. Although guidelines exist, green public procurement remains a voluntary tool and is not utilised sufficiently.

Source: Sobkiewicz, Marianna; Miłobędzka, Aleksandra; 2.9. Report on online thematic workshops covering the early results from ex-post assessment; WiseEuropa; Warsaw

Overview of the workshop findings – Integration

Integration
Distinctive character of transport policy Experts highlighted the importance of distinguishing between internal and external integration regarding certain transport policies. It was noted that applying the EU ETS in the aviation sector and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) constitute two particularly sensitive issues. Their interaction with international law and non-EU countries represents a challenge for the external integration of EU climate policy, in which the EU has, for instance, been accused of violating international law by extending its jurisdiction too far. Participants highlighted the importance of utilizing multilateral avenues in the EU's external relations to reconcile its own agenda of promoting climate policy integration with the objectives of other states and entities. Simultaneously, EU transport policies constitute internal issues that are deeply embedded within the EU community, e.g., emissions standards or regulation on infrastructure for electric vehicles (sectoral integration). **Need for addressing integration more profoundly in long-term policy** Participants emphasized the need for addressing integration to a greater extent in long-term climate policies. There is a need for more clarity on how integration is linked to specific policy issues, sectors, and objectives.

Source: Sobkiewicz, Marianna; Miłobędzka, Aleksandra; 2.9. Report on online thematic workshops covering the early results from ex-post assessment; WiseEuropa; Warsaw

Overview of the workshop findings – Innovation

Innovation
Disparities between Member States Participants emphasised the existing differences between Member States regarding a range of issues. Firstly, the complexity of energy efficiency-related regulation necessitates that MS improve their implementation at national and regional level. Further, experts noted the importance of pre-determinants of RES deployment in Member States based on each country's access to fossil fuels. **Business model and policy innovation** Expert stakeholders emphasized the importance of the analysed period for policy innovation in the realm of energy and climate, partly but not only due to the implementation of the EU ETS. At the same time, it was noted that there was a lack of adequate action in relation to business model innovation, in particular due to evolving market conditions, e.g., the progressive decentralisation of energy markets. **The prominence of the EU ETS in EU climate policy-related studies**

Participants highlighted the fact that EU climate policy-related literature tends to be dominated by studies on the EU ETS, while other policies do not always receive adequate attention. While the EU ETS is a cornerstone of EU climate policy, there is a need to devote more attention to other policies to gain sufficient insights about other aspects of the EU's energy transition

Source: Sobkiewicz, Marianna; Miłobędzka, Aleksandra; 2.9. Report on online thematic workshops covering the early results from ex-post assessment; WiseEuropa; Warsaw.

The series of four workshops summarised the findings of each ex-post study and supported the dissemination of the results to relevant stakeholders. In addition, it facilitated the dialogue between the authors and experts in each policy field. The discussions provided valuable insights about the developments made in EU climate policy between 2005 and 2020, but also allowed the participants to reflect on future policy avenues.

For each "I", key policy aspects emerged during discussion and most urgent risks and issues were identified that can support future EU policy developments and contribute to the broader discussion and consultation processes concerning each policy realm.

About the project

4i-TRACTION – innovation, investment, infrastructure and sector integration:
TRAnsformative policies for a ClimaTe-neutral European UnION

To achieve climate neutrality by 2050, EU policy will have to be reoriented – from incremental towards structural change. As expressed in the European Green Deal, the challenge is to initiate the necessary transformation to climate neutrality in the coming years, while enhancing competitiveness, productivity, employment.

To mobilise the creative, financial and political resources, the EU also needs a governance framework that facilitates cross-sectoral policy integration and that allows citizens, public and private stakeholders to participate in the process and to own the results. The 4i-TRACTION project analyses how this can be done.

Project partners

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