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Human activity is the cause of the climate problem.

So human action must be the solution.

António Guterres

Abstract

Una delle questioni più urgenti e importanti per il nostro pianeta è come bilanciare la crescente domanda di energia con la necessità di ridurre le emissioni di gas a effetto serra e, di conseguenza, mitigare il cambiamento climatico. I governi di tutto il mondo stanno attuando politiche ambientali ed energetiche volte a ridurre tali emissioni e ad attuare, tra le altre politiche, l'efficienza energetica mondiale a zero emissioni. Con la firma dell'Accordo di Parigi nel 2015, tutti i paesi si sono impegnati a mantenere l'aumento della temperatura globale ben al di sotto dei 2 ºC rispetto ai livelli preindustriali. Da allora, altri paesi hanno ribadito questo impegno stabilendo strategie per ridurre a zero le emissioni entro la metà del secolo. Purtroppo però, vi sono ancora differenze tra le aspirazioni e le politiche implementate al raggiungimento di tal fine. Infatti, i Contributi Determinati a livello nazionale per il 2030 (NDCs), assunti dai paesi nell'ambito dell'Accordo di Parigi, riducono solo di uno o due terzi le emissioni rispetto a quanto è necessario per mantenere percorsi di emissione coerenti con gli aumenti di temperatura da 1,5 a 2 ºC. A questo proposito, il settore dell'energia risulta essere un fattore imprescindibile alla riduzione delle emissioni e al miglioramento del cambiamento climatico poiché, da solo, è responsabile per più del 60% di tutte le dispersioni di gas serra a livello globale, anche se, indubbiamente, sono molti i settori che concorrono in tal senso. Ne consegue che, la soluzione al rallentamento del cambiamento climatico non può essere univoca, né isolata, ma al contrario richiede un'azione combinata e collaborativa sotto ogni aspetto, da parte di tutti gli stati e degli attori non statali, attraverso l'adozione e l'implementazione di politiche e misure adeguate, efficienti e in linea con gli obiettivi posti dall'Agenda 2030 e dall'Accordo di Parigi.

Dato che l'energia e l'ambiente sono questioni strettamente correlate e sono rilevanti nella lotta contro il cambiamento climatico, l'obiettivo principale di questa tesi è proprio quello di indagare come le politiche e le misure attuate a livello ambientale ed energetico siano costruite insieme per massimizzare questo obiettivo. In particolare, questa tesi si concentra su uno dei settori in cui le politiche energetiche e ambientali collaborano, vale a dire l'efficienza energetica. L'elaborato, il cui corpo centrale è formato da tre capitoli, presenta una struttura ad imbuto, dal macro al micro, ossia dalla dimensione internazionale, passando per quella regionale rappresentata dall'Unione Europea, fino a quella nazionale investigata nell'ambito del caso studio. Per quanto riguarda l'analisi dei contenuti la struttura adottata segue quella della tesi, ogni capitolo è suddiviso in due sotto capitoli, nei quali viene esposto prima il contesto generale e internazionale, poi il focus si sposterà su quello dell'Unione Europea.

Il primo capitolo fornisce un quadro storico delle fasi e dei progressi più importanti e significativi rispetto al surriscaldamento globale e al cambiamento climatico. Nella prima parte viene illustrato il percorso che ha portato la comunità internazionale alla redazione del primo trattato legalmente vincolante in materia ambientale, ovvero l'Accordo di Parigi del 2015 e alle successive conferenze, fino ad arrivare all'ultima COP27 del 2022 a Sharm el-Sheikh. È bene sottolineare che, anche prima del decisivo Accordo di Parigi, sono stati molti gli sforzi fatti a livello internazionale a tutela dell'ambiente, del clima e dello sviluppo sostenibile. Proprio questo concetto, infatti, è stato definito nel 1987 dal Rapporto Brundland, *Our Common Future*, a seguito della prima Conferenza mondiale sull'Ambiente e lo Sviluppo, istituita dall'Assemblea Generale delle Nazioni Unite nel 1983 e presieduta dall'allora Primo Ministro della Norvegia, Gro Harlem Brundtland: "lo sviluppo sostenibile è uno sviluppo che risponde alle esigenze del presente senza compromettere la capacità delle generazioni future di soddisfare le proprie esigenze." (UNGA, 1987: 41).

La seconda parte del capitolo descrive le tappe europee in materia di tutela ambientale e cambiamento climatico e presenta un focus sui principi della politica ambientale dell'Unione e sui più recenti pacchetti di misure volti al raggiungimento della neutralità climatica entro il 2050, come il Green Deal. Le radici della politica ambientale della CEE possono essere ricondotte al Consiglio europeo tenutosi a Parigi nel 1972, a seguito della prima conferenza delle Nazioni Unite sull'Ambiente Umano di Stoccolma e poi ampliate nel 1987 attraverso l'Atto Singolo Europeo. Nel 1999 il Trattato di Amsterdam ha istituito la tutela ambientale come uno degli obiettivi primari dell'Unione Europea. Successivamente, nel 2009, il Trattato di Lisbona ha definito la lotta contro il cambiamento climatico un obiettivo specifico e ha riconosciuto il ruolo fondamentale che l'Unione europea deve svolgere negli sforzi internazionali per combattere il cambiamento climatico.

Il secondo capitolo, invece, si concentra sulle politiche attuabili per ridurre le emissioni di CO_2 e sulla loro efficacia. In particolare, la prima parte mostra che i paesi possono scegliere di utilizzare una serie di strumenti politici, come gli strumenti di politica climatica appositamente progettati per tagliare le emissioni di gas a effetto serra e la CO_2, ed altri strumenti di politica non climatica che sono stati sviluppati per scopi estranei all'ambiente, ma comunque essenziali per risolvere il problema. Nello specifico, appartengono alla prima categoria: i sistemi per lo scambio di quote di emissione, le tasse sui veicoli basate sulle emissioni, le tariffe di riacquisto,

le feebates,[1] gli standard di prestazione per le emissioni di gas serra negoziabili, gli incentivi fiscali per le imprese, gli standard di intensità delle emissioni di gas serra e i mandati o i divieti tecnologici. Al contrario, sono strumenti di politica non climatica: le imposte sul carbonio, le accise sui carburanti, i sussidi per i combustibili fossili, le accise sull'elettricità, i sussidi per l'elettricità, i sussidi per l'industria e l'agricoltura e per le famiglie, le norme sull'inquinamento atmosferico, i regolamenti sui fertilizzanti e le norme sul l'efficienza dei carburanti. Tutte queste politiche poi possono essere classificabili come strumenti basati sul mercato o strumenti di regolamentazione diretta. Le politiche globali (a monte), il sistema *Cap-and-Trade*, le politiche basate sul mercato con copertura parziale (a valle), ed altre imposte sull'energia figurano tra gli strumenti politici basati sul mercato, mentre gli incentivi per la generazione da fonti rinnovabili, le più ampie politiche per decarbonizzare la produzione di energia, le politiche di efficienza energetica e le combinazioni normative rientrano tra gli strumenti di regolamentazione diretta.

La seconda parte del capitolo offre una descrizione del sistema di scambio delle emissioni dell'Unione Europea e del suo sistema di tassazione dell'energia, fornendo i programmi legislativi in cui queste politiche sono inserite. Vengono poi brevemente introdotti anche altri pacchetti e misure per ridurre le emissioni di CO_2 e di gas a effetto serra. Uno degli strumenti più importanti nella lotta europea contro il cambiamento climatico è il sistema comunitario di scambio delle quote di emissione (ETS). Attraverso lo sviluppo di un mercato del carbonio, il sistema cerca di ridurre le emissioni nel modo più economico possibile. Rappresenta, inoltre, il primo, e il più significativo, mercato del carbonio al mondo ed è tutt'ora il più grande. L'UE ETS è un sistema *Cap-and-Trade,* ovvero pone un limite alle emissioni degli impianti che rientrano in questo sistema, ossia stabilisce un numero specifico di quote di emissione. Il tetto "Cap" si abbassa progressivamente per ridurre le emissioni nel tempo e grazie alla possibilità di scambiare crediti di emissione, gli impianti possono ridurre le emissioni laddove ciò sia meno costoso. L'UE ETS copre la maggior parte delle industrie manifatturiere, così come il settore energetico e l'aviazione intra-UE, sia in partenza che in atterraggio all'interno dei paesi partecipanti. La sua applicazione geografica copre i 27 Stati membri dell'UE (UE-27), dalla Norvegia, dall'Islanda, dal Liechtenstein e dal settore energetico dell'Irlanda del Nord.

[1] Una feebate è una politica di incentivazione che incoraggia il miglioramento continuo dell'economia dei carburanti e delle emissioni di gas a effetto serra fornendo incentivi ai costruttori per costruire veicoli più efficienti e premiando i consumatori che acquistano veicoli più efficienti. Il concetto di feebate è semplice: i veicoli inefficienti ricevono una sovrattassa (FEE-), e i veicoli efficienti ricevono uno sconto (-reBATE).

In particolare, il sistema di scambio delle emissioni viene descritto nelle sue quattro fasi, dalla prima che copre gli anni 2005 – 2008, fino all'ultima 2021 – 2030. Per quanto riguarda la tassazione energetica, risulta evidente che le tasse sull'energia possano aiutare l'UE a raggiungere i suoi obiettivi ambientali e climatici promuovendo il passaggio a fonti energetiche più pulite, e a pratiche commerciali rispettose dell'ambiente. Per collegare la tassazione dei prodotti energetici con gli attuali obiettivi energetici e climatici dell'UE, in modo tale che riflettano l'effettivo livello di inquinamento dei carburanti, l'UE intende modificare l'attuale regolamento sulla tassazione dell'energia nell'ambito del pacchetto *Fit for 55*. Al termine del capitolo vengono introdotti altri pacchetti di misure per ridurre le emissioni di CO_2 e di GHG come il REPowerEU. Il piano delinea una serie di azioni che aiuteranno la rete energetica dell'UE a diventare più resistente, riducendo la dipendenza dai combustibili fossili russi e facendo progredire la transizione verde.

Il terzo capitolo mira a individuare la migliore strategia per allineare le politiche energetiche agli obiettivi climatici fissati dall'Agenda 2030 e dall'Accordo di Parigi. Di conseguenza, la prima parte analizza gli Obiettivi di Sviluppo Sostenibile (OSS) 7 e 13, rispettivamente sull'energia e l'azione climatica, al fine di valutare le loro interazioni dirette e quindi il loro coinvolgimento nel raggiungimento degli obiettivi climatici. Ciò dimostra chiaramente la responsabilità primaria del settore energetico per le emissioni globali, dato che da solo è responsabile di due terzi di tutte le emissioni di gas a effetto serra e dell'80% delle emissioni di biossido di carbonio. Pertanto, il settore dell'energia rappresenta un attore chiave negli sforzi per ridurre le emissioni e mitigare il cambiamento climatico, contribuendo così, anche grazie all'efficienza energetica, al raggiungimento dell'OSS 13. Infatti, l'obiettivo giuridicamente vincolante dell'Accordo di Parigi di mantenere il riscaldamento globale ben al di sotto dei 2°C, rispetto ai livelli preindustriali, è strettamente legato all'immediato sviluppo delle energie rinnovabili e dell'efficienza energetica. Dunque, l'integrazione delle misure sul cambiamento climatico nella pianificazione nazionale, l'istruzione e la consapevolezza sul clima, l'aumento di finanziamenti per la mitigazione climatica, e l'accesso universale ai moderni servizi energetici entro il 2030 sono tutti fattori che contribuiranno a promuovere gli obiettivi delle energie rinnovabili e dell'efficienza energetica. Questo accade perché i due OSS, il 7 e il 13 si influenzano a vicenda, sia in positivo che in negativo, pertanto il loro rapporto viene definito "bidirezionale".

La seconda parte del capitolo è dedicata, invece, al caso studio su alcune politiche di efficienza energetica, attuate da alcuni Stati membri dell'UE, in particolare Germania, Italia, Polonia e Svezia. Dopo essere stata approvata dall' Unione Europea nel 2012, la Direttiva sull'Efficienza Energetica è stata sottoposta a revisione nel 2018 e inserita all'interno del pacchetto "Energia pulita per tutti gli europei", con lo scopo di aggiornare il quadro normativo fino al 2030 e oltre. Il focus principale riguarda il grande obiettivo di ridurre il consumo di energia di almeno il 32,5% entro il 2030. L'obiettivo, che richiede cooperazione in tutta l'UE, si basa su proiezioni di modelli dal 2007 al 2030. Di conseguenza, il consumo energetico dell'UE per il 2030 non dovrebbe essere superiore a 846 Mtoe[2] di energia finale o 1128 Mtoe di energia primaria. Inoltre, il regolamento sulla Governance 2018/1999 prevede che gli Stati membri creino Piani Nazionali Integrati decennali per l'Energia e il Clima (PNIEC) che specifichino le loro strategie per il raggiungimento degli obiettivi in materia di efficienza energetica entro il 2030. I PNIEC, che coprono gli anni 2021-2030, sono stati presentati nel 2020 insieme alle singole valutazioni, di ciascun piano, da parte della Commissione. L'effetto combinato dei vari PNIEC si traduce in un risparmio netto del 29,4%-29,7% (FEC e PEC[3] rispettivamente) per l'efficienza energetica. I vari PNIEC degli stati presi in esame sono valutati in relazione alle politiche e alle misure adottate per ridurre le emissioni e promuovere l'efficienza energetica.

Concludendo, essendo il settore energetico responsabile di oltre il 70% delle emissioni, risulta evidente che l'efficienza energetica sia, da un lato, un elemento chiave per ridurre le emissioni di gas a effetto serra, ma allo stesso tempo, non sufficiente per raggiungere gli obiettivi fissati dall'Agenda 2030 e dall'Accordo di Parigi. Nei loro Contributi Determinati a livello Nazionale (NDCs), la stragrande maggioranza dei paesi ha suggerito nuovi obiettivi di emissione per il 2030. Sebbene siano stati attuati tutti gli attuali NDCs, si prevede che le emissioni globali di gas a effetto serra saranno del 14% più elevate nel 2030 rispetto al 2010, dimostrando che è necessario fare molto di più per ridurre le emissioni al livello necessario per raggiungere l'obiettivo di 1,5 ºC. Inoltre, per quanto riguarda il caso studio, emerge che le interconnessioni tra le politiche di efficienza energetica e la riduzione delle emissioni di gas a effetto serra sono riconosciute dalla Commissione europea, ma spesso l'impatto quantitativo delle politiche adottate dai paesi esaminati è poco chiaro e difficile da identificare.

[2] Milioni di tonnellate equivalenti di energia.
[3] Final Energy Consumption (FEC) and Primary Energy Consumption (PEC).

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Introduction

One of the most urgent and cross-border current challenges is climate change. In order to prevent the worst effects of climate change, it is important to step up climate mitigation efforts. All nations agreed to keep the global temperature increase well below 2°C above preindustrial levels when they signed the Paris Agreement in 2015. Since then, many nations have reaffirmed this commitment by announcing plans to cut emissions to net zero by the middle of the century. Regrettably, there is still a disparity in both aspiration and policy. The Paris Agreement's existing national commitments for 2030 (NDCs) by countries only reduce emissions by one- to two-thirds of what is required for emission pathways consistent with 1.5–2°C temperature increases. Additionally, current policies are insufficient to meet the temperature objective, let alone stop the predicted growth in global emissions.[1]

Against this backdrop, the energy sector is a key component in efforts to cut emissions and enhance climate change because it produces two-thirds of all greenhouse gases worldwide. The energy industry is responsible for more than 60% of all greenhouse gas emissions. In 2017, energy-related CO_2 emissions increased by 1.4% after remaining steady for the previous three years. A historical net production of 32.5 Gt of CO_2 was produced as a result of this emissions rise. It is evident that multiple sectors and procedures contribute to world emissions. This means that there is not a single, straightforward answer to stop climate change. It is insufficient to tackle only one aspect, urgent combined action is required in each sector.[2]

As a consequence, it is clear that there is an urgent need to implement policies and measures aimed at reducing greenhouse gas emissions. Given that energy and the environment are closely linked issues and are relevant in the fight against climate change, the main objective of this thesis is precisely to investigate how the policies and measures implemented at the environmental and energy level are built together to maximize this objective. In particular, this thesis focuses on one of the areas in which energy and environmental policies collaborate, namely energy efficiency.

[1] Chateau, J., Jaumotte, F., and Schwerhoff G. (2022) Economic and Environmental Benefits from International Cooperation on Climate Policies. [pdf] IMF Departmental papers. Washington, DC: International Monetary Fund. Available at: https://www.imf.org/en/Publications/Departmental-Papers-Policy-Papers/Issues/2022/03/16/Economic-and-Environmental-Benefits-from-International-Cooperation-on-Climate-Policies-511562 [Accessed 02 May 2023] p. 1.

[2] ResearchWatch (2023) Energy Overview. Available at: https://resourcewatch.org/dashboards/energy?tab=global [Accessed 02 May 2023].

The structure of the elaborate is funnel-shaped. It starts from an international dimension, and then ends, with the case study, to a national dimension, without neglecting the regional one represented by the European Union. The same procedure applies to the content analyzed. With regard to methodology, particular emphasis has been placed on international and European institutional reports, as well as related databases, publications, and research. The accredited sites and documents of international organizations, environmental and energy agencies, and legislative and scientific acts have also been of great value.
The thesis presents a central body of three chapters, each of which is divided into two sub-chapters. One deals with the international dimension, while the other presents a regional focus on the European Union.

The first chapter delivers a historical overview of the most important steps and progress made in the field of climate change and global warming. The first part focuses on the international perspective, explaining what were the game-changer conferences and agreements to recognize the problem first and its management and possible solutions then, from the book *Silent Spring* by the marine biologist Rachel Carson, to the last Climate Conference in Sharm el-Sheikh, last November 2022 (COP27). The second part deals with the European case that has led to its commitment to the environment and climate since the 1970s, following the first United Nations Conference on the Environment. Also, in this part, it is outlined an overview of the main stages and environmental regulations in Europe, up to the Green Deal and the package Ready for 55% and the recent implementation of the project REPowerEU, last May 2022.

The second chapter focuses on feasible policies to reduce CO_2 emissions and their effectiveness. In particular, the first part shows that countries can choose to use a range of policy instruments, such as climate policy instruments specially designed to cut GHG and CO_2, and other non-climate policy tools that were developed for purposes unrelated to the environment but are nonetheless essential to solving the problem. Both of them can be market-based or not. The second part of the chapter articulates the description of the emissions trading system of the European Union and its system of taxation of energy, supplying the legislative programs in which these policies are inserted. At the end of this chapter, other packages of measures to reduce CO_2 and GHG emissions are introduced, like the REPowerEU plan.

The third chapter aims to identify the best strategy to align energy policies with the climate objectives set by the 2030 Agenda and the Paris Agreement. As a result, the first part analyzes SDGs 7 and 13, on energy and climate action respectively, in order to assess their direct interactions and therefore their involvement in achieving climate goals. This clearly demonstrates the primary responsibility of the energy sector for global CO_2 and GHG emissions and, consequently, energy efficiency as one of the best ways to reduce them. The second part is dedicated to the case study on energy efficiency policies implemented by some EU member states, specifically Germany, Italy, Poland, and Sweden. After having provided the framework for energy efficiency in the Union, the National Climate and Energy Plans of the countries concerned shall be assessed in relation to the policies and measures taken to cut emissions, and promoting energy efficiency.

Finally, the conclusions complete this research. Specifically, being the energy sector responsible for more than 70% of emissions, it is highlighted that energy efficiency is a key element for reducing GHG emissions, but not enough to achieve the goals set by the 2030 Agenda and the Paris Agreement. In their Nationally Determined Contributions (NDCs), the vast majority of countries suggested new emission targets for 2030. Although all of the most current NDCs have been implemented, it is anticipated that global GHG emissions would be 14% higher in 2030 than they were in 2010, showing that much more effort has to be done to reduce emissions to the level needed to attain the 1.5°C objective. Moreover, with respect to the case study, it emerges that the interlinkages between energy efficiency policies and GHG emissions reduction are recognized by the European Commission, but often the quantitative impact of the adopted policies is unclear and difficult to identify.

1. Historic overview of environmental and energy policies

During the first years of the 1960s, academics and activists of the Western world began to draw attention to the intolerable environmental conditions of unbridled industrialization. The book *Silent Spring*, written by Rachel Carson in 1962, an American marine biologist, represented the first step in this direction. This volume was a denunciation of the adverse environmental effects of the pesticide DDT, used for various purposes, including the elimination of mosquitoes affected by malaria. In this context, a considerable number of disclosures emerged, that is, to name a few, the mercury leakage at Minimata in Japan, the oil spill in Cornwall, and the Chornobyl radiation leak in URSS in 1986.

As a consequence, in the Western world grew an increasing collective concern for the environmental situation which led, among others, to the birth of several NGOs like "Friends of the Earth" in 1969 and "Greenpeace" in 1972. The momentum did not only symbolize a backlash to the pollution of the environment, but it also mirrored a widespread restlessness concerning the impetus of economic growth resulting in the demographic increase and the likelihood of running out of the world's resources.

In this regard, *The Limits of Growth*, a report realized by the international think-tank "Club of Rome", examined the repercussions of the exhaustible disposition of the planet's assets, particularly oil and fossil fuels. Additionally, against this backdrop a counter-culture movement struggling with unrestrained consumerism arose, demonstrating to the international community the level of social interest and pressing it in becoming aware of the problem.[3]

This resulted in the idea of sustainable development, described by the World Commission on Environment and Development (WCED) in 1987, as:

> 1. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed

[3] Best, A., Hanhimäki, M. J., Maiolo, A. J., and Schulze, E. K. (2015). International history of the twentieth century and beyond. 3rd edn. Abingdon: Routledge, pp. 354 – 355.

> by the state of technology and social organization on the environment's ability to meet present and future needs. [4]

The WCED is also dubbed the Brundtland Commission as it took its name from the Norwegian Prime Minister Go Harlem Brundtland, the then chairman of the Commission. In 1983, the United Nations General Assembly, concerned about issues regarding climate change, ozone depletion and other environmental questions, established the WCED, a global panel of environmental policymakers, state employees, and experts. The Brundtland Commission had the responsibility of presenting enduring strategies to achieve sustainable development and ensure its continuity in the 21st century. In addition, it was entrusted with the duty of discovering means of fostering international collaboration among nations regarding development and resource management, and establishing mechanisms for addressing the environmental challenges of all countries, as well as those of the global community, in the long run. The UN Programme of Action on Sustainable Development was urged to be established by the Brundtland Report, which within its coverage of sustainable development, incorporated chapters that addressed various topics, such as the function of the global economy, population and human resources, food security, species and ecosystems, energy, industry, and suggested legal principles to safeguard the environment. The report served also as a basis for the Rio Summit that took place in Rio de Janeiro in 1992, which resulted in the formation of the United Nations Commission on Sustainable Development (UN CSD) that very year.[5]

[4] United Nations (1987) Report of the World Commission on Environment and Development: *Our Common Future*, (United Nations General Assembly Doc A/42/427). Available at: https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf [Accessed 31 March 2023].

[5] Jarvie, M. E. (2016, May 20th). *Brundtland Report*. Encyclopedia Britannica. https://www.britannica.com/topic/Brundtland-Report [Accessed 30 March 2023].

1.1 The international stage

The United Nations has a long-standing commitment to sustainable development, which can be traced back to the United Nations Conference on the Human Environment that took place in Stockholm, Sweden in 1972. This conference represented a pivotal event as it marked the first time the UN had addressed environmental issues on a major scale. During the conference, participants established a set of principles aimed at effectively and properly managing the environment, which included the Stockholm Declaration and the Action Plan for the Human Environment, as well as many other resolutions. These assumptions were adopted for safeguarding and promoting the human environment together with providing guidelines for international collective actions towards the environment.

In particular, the Stockholm Declaration, which consisted of 26 principles, put environmental issues at the heart of international worries and pointed out the beginning of the debate between industrialized and developing countries regarding the correlation between air, water, and ocean pollution, the economic growth and the general wellness of individuals worldwide. Similarly, the Action Plan was divided into three main categories: the Global Environmental Assessment Programme (the action plan); the Environmental management activities; and the International measures to support assessment and management activities carried out at the national and international levels. Furthermore, these categories were divided into 109 recommendations. However, the most substantial outcome of the Stockholm conference was embodied by the establishment of the United Nations Environment Programme (UNEP), the first UN program to focus exclusively on environmental concerns.[6]

In 1992, on the occasion of the 20th anniversary of the first above-mentioned Human Environment Conference in Stockholm in 1972, the well-noted "Earth Summit", or United Nations Conference on Environment and Development (UNCED), was held in Rio de Janeiro, Brazil, in June 1992. The conference brought together politicians, diplomats, scientists, media representatives, and non-governmental organizations (NGOs) from 179 countries to address the impact of human socio-economic activities on the environment. At the same time, a "Global Forum" of NGOs was also held, with a record number of representatives presenting their own vision for the world's future concerning the environment and socio-economic development.

[6] United Nations. United Nations Conference on the Human Environment, 5th - 16th June 1972, Stockholm. Available at: https://www.un.org/en/conferences/environment/stockholm1972 [Accessed 31 March 2023].

During the Rio de Janeiro Conference, it became apparent the interdependence of social, economic, and environmental factors and the need for joint action in multiple sectors to sustain success over time, since they affect each other. The "Earth Summit" aimed to create a wide-ranging plan and a new program for international participation in environmental and development matters that would contribute to direct cooperation and development policy in the 21st century. The summit assumed sustainable development as a feasible objective for all. It acknowledged also that complementing and balancing economic, social, and environmental concerns to fulfill our needs is essential for supporting human life on the planet and such a combined method is attainable. This recognition opened a debate within and between governments on how to assure sustainability for development since the conference highlighted the necessity of new approaches of producing and consuming, living and working, for example. In fact, the aim of this summit was to encourage Governments to reconsider their approach to economic development and to find solutions to prevent the depletion of the planet's resources and reduce pollution. This two-week event was the culmination of years of planning, negotiation, and education among all member states of the United Nations started in December 1989. One of the outcomes of the Earth Summit was Agenda 21, the official international assent about development and environmental cooperation. At the heart of Agenda 21 was the recognition of the need for collaboration between countries to protect the environment. It was intended to be a reflection of the international agreement to sustain and complement national strategies and plans for sustainable development. Agenda 21 called on all States to work together to improve, protect and manage ecosystems, and to share responsibility for the future.[7]

The Earth Summit resulted also in the Rio Declaration, which consisted of 27 principles aimed at promoting new and fair partnerships and development through collaboration among States, social sectors, and individuals. Not only these principles reflected the responsibility of human beings towards sustainable development, but also the right and the duty of States to employ their own means and wealth for their environmental and developmental policies, and also the exigency of State cooperation in eradicating poverty and protecting the environment. Conserving, protecting, and restoring the integrity of the Earth's ecosystem was the primary objective behind the Rio Declaration. At this groundbreaking conference, 172 governments, of which 108 represented by heads of state or government, implemented three significant agreements to lead forthcoming ways to development: these were the above-cited Agenda 21

[7] United Nations. Conferences. *Environment and sustainable development*. Available at: https://www.un.org/en/conferences/environment [Accessed 29 March 2023].

and the Rio Declaration, and also the Statement of Forest Principles, which aimed to establish a series of principles for the sustainable management of forests globally. Furthermore, two legally binding documents were introduced at the summit: the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD). The negotiations of these legal documents were initiated during the Convention to Combat Desertification (UNCCD), which was later opened for signature in October 1994 and came into effect in December 1996. It also resulted in the establishment of the Commission on Sustainable Development, the world conference on the sustainable development of small island developing States in 1994, and negotiations for the establishment of the agreement on straddling stocks and highly migratory fish stocks. The Earth Summit in Rio was noteworthy because it differed from other UN conferences in terms of its size and the scope of problems analyzed. The United Nations convened in Rio de Janeiro to encourage governments to revise economic development and reach solutions to cease the destruction of invaluable natural resources and the world's pollution.[8]

Five years after the 1992 Earth Summit in Rio de Janeiro, in 1997 the UN General Assembly carried out a special session, as it was stated during the conference, in order to review the progress being made. So, in June 1997, the "Rio+5", as the Special Session of the General Assembly is known, took place in New York to check the advances made by countries, international organizations, and civil society in measuring up and reaching the goals of Agenda 21 in that amount of time, subsequent to the Rio Earth Summit.[9]

Later on, the Millennium Summit was held in September 2000 in New York by the United Nations that introduced a new development strategy to meet the necessities and the actuality of the third millennium. The realization of this summit was anticipated by an overseas information campaign started in 1998. The campaign's goals were reinforcing the effort of the international community and bolstering collaborations between governments and civil societies to set up an inclusive world where no one is left behind. At that point in time, the Millennium Summit represented the wider meeting of heads of state and government on earth. It culminated with the endorsement, by the 189 Member States, of the Millennium Declaration, in which the eight

[8] United Nations. *United Nations Conference on Environment and Development*, Rio de Janeiro, Brazil, 3rd -14th June 1992. Available at: https://www.un.org/en/conferences/environment/rio1992 [Accessed 31 March 2023].
[9] United Nations, 19th Special Session of the General Assembly to Review and Appraise the Implementation of Agenda 21, 23rd - 27th June 1997, New York. Available at: https://www.un.org/en/conferences/environment/newyork1997 [Accessed 27 March 2023].

Millennium Development Goals (MDGs) were laid down. These were: eradicating extreme poverty and hunger; achieving universal primary education; promoting gender equality and empowering women; reducing child mortality; improving maternal health; combating HIV/AIDS, malaria, and other diseases; ensuring environmental sustainability; developing a global partnership for development.[10]

At the 2002 World Summit on Sustainable Development in Johannesburg, South Africa, a Political Declaration and Implementation Plan were adopted to promote a number of provisions in order to attain a development that considers respect for the environment. The Summit, attended by over a hundred heads of state and government, as well as many government representatives and non-governmental organizations, culminating in decisions related to water, energy, health, agriculture, biological diversity, and other spheres of interest. Regarding water, the Implementation Plan fostered collaboration between the public and private sectors, anchored on legislative frameworks laid down by governments. In the area of energy, the Plan highlighted the need to broaden the energy supply and add renewable energy sources to the global energy supply. Concerning the health field, pledges made to combat HIV/AIDS were reasserted, and the right of states to intend the Agreement on Trade-Related Aspects of Intellectual Property Rights was underlined to further widespread accessibility to medicines. In agriculture, the Implementation Plan conceived exhaustive negotiations on the WTO Agreement on Agriculture, including market access and the decrease of export subsidies. In terms of biodiversity, an international regime was requested to guarantee a just and fair sharing of the advantages stemming from the use of genetic resources. The text also covered the Kyoto Protocol provisions on the reduction of greenhouse gases for the parties that had already endorsed it, while urging those who had not done it yet. Additionally, a global solidarity fund for the suppression of poverty was established, and ten-year programs were set in motion to uphold regional and national ventures aimed at speeding up the transition to sustainable production and consumption models.[11]

[10] United Nations. *Millennium Summit*, 6th - 8th September 2000, New York. Available at: https://www.un.org/en/conferences/environment/newyork2000 [Accessed 30 March 2023].
[11] United Nations. *World Summit on Sustainable Development*, 26th August – 4th September 2002, Johannesburg. https://www.un.org/en/conferences/environment/johannesburg2002

The Millennium Development Goals were adjusted at high-level reunions in New York in 2005, 2008, and 2010. At the 2005 UN World Summit, held in September at the United Nations Headquarters in New York, took part more than 170 heads of government. The then Secretary–General Kofi Annan presented a set of motions in his report *In larger Freedom*. During the Summit, global leaders reached a consensus to take action on several fronts to tackle significant international problems. Governments expressed their strong dedication to attaining the development objectives established in the Millennium Declaration by 2015, committing an extra $50 billion annually to combat poverty. They were determined also to explore creative sources of development financing and other measures to guarantee the durable sustainability of debt. Furthermore, they utterly affirmed their unwavering commitment to trade liberalization and they undertook to work hard in order to execute the development elements of the Doha work program.[12]

Subsequently, during the High-level meeting on Achieving the Millennium Development Goals that took place in New York in 2008, it emerged that substantial advancements were achieved, but the interested parties needed to intensify their efforts and adopt urgent measures to accomplish the MDGs in due time. The purpose of the High-Level Meeting was to provide a platform for global leaders to assess advancements, pinpoint inadequacies, and commit to implementing tangible measures and detecting the essential resources and mechanisms to address them. By requiring international leaders to declare their particular plans and propositions, the High-Level Meeting expedited the execution and supervision of the MDGs.[13] Afterwards, the Global Plan of Action, entitled "Keeping the Promise: United to Achieve the Millennium Development Goals" was adopted during the 2010 Millennium Development Goals Summit in New York. On that occasion, a series of proposals about activities to counteract hunger, disease, and poverty were submitted. Notably, several heads of state from industrialized and developing countries, backed by foundations, the private sector, the civil society, and international organizations, delivered more than $40 billion aid in to support women's and children's health. In fact, in the course of a special UN event at the Summit, the "Global Strategy for Women's and Children's Health" was started.[14]

[12] Op. Cit. UN, *World Summit on Sustainable Development*, 2002, Johannesburg [Accessed 27 March 2023].
[13] United Nations. *High-level meeting on the Millennium Development Goals*, 22nd – 25th September 2008, New York. Available at: https://www.un.org/en/conferences/environment/newyork2008 [Accessed 29 March 2023].
[14] United Nations. *Millennium Development Goals Summit*, September 20th – 22nd, 2010, New York. Available at: https://www.un.org/en/conferences/environment/newyork2010 [Accessed 30 March 2023].

The 2012 United Nations Conference on Sustainable Development in Rio, also called as "Rio +20" since it was held two decades after the 1992 "Earth Summit" in Rio de Janeiro, produced a document with accessible and feasible steps towards the enforcement of sustainable development. At the conference, member states embarked on a process to establish a series of Sustainable Development Goals (SDGs), based upon the Millennium Development Goals (MDGs) and intersecting the post-2015 development agenda. The Conference also established directives for green economy policies and carried out planning for funding sustainable development. In addition, the Conference approved 10-year framework programs on sustainable consumption and production models and made forward-looking choices on a set of thematic areas such as food security, oceans, cities, and energy. It also decided to hold a third international conference on small island developing States in 2014. The Rio+20 Conference garnered significant attention from both the UN and non-UN communities, resulting in over 700 voluntary pledges and the creation of new partnerships to push forward sustainable development. After this conference, the United Nations Environment Assembly was set up, turning into the world's leading decision-making body on environmental issues. The Assembly convenes to define priorities for global environmental policies and to formulate international environmental law.[15]

The Rio+20 UN Conference on Sustainable Development, by means of its output "The Future We Want", set up the United Nations High-level Political Forum on Sustainable Development (HLPF) in 2012. The High-level Political Forum on Sustainable Development is the primary stage for monitoring and taking note of the update and review of the 2030 Agenda on Sustainable Development and the Sustainable Development Goals at the international level. The Forum, which undertakes policy statements discussed at the intergovernmental level, took place for the first time on 24th September 2013 and it covered the Commission on Sustainable Development which had been operational every year since 1993.[16]

At the same time, the Global Sustainable Development Report (GSDR), a UN publication, was derived from "The Future We Want" in order to reinforce the science-policy correlation at the United Nations High-level Political Forum on Sustainable Development (HLPF). Member states acknowledged the authority of science to grasp and drive connections between

[15] United Nations. *United Nations Conference on Sustainable Development*, 20th – 22nd June 2012, Rio de Janeiro. Available at: https://www.un.org/en/conferences/environment/rio2012 [Accessed 31 March 2023].
[16] United Nations. *High-Level Political Forum*. Available at: https://hlpf.un.org/ [Accessed 29 March 2023].

environmental, economic, and social development goals, also in light of the complexity and ambition of 2030 Agenda and of the ineffectiveness of a compartmentalized approach. In 2016, Member States concluded that the report should be delivered once every four years, to inform the four-year Sustainable Development Goal review deliberations at the HLPF under the leadership of the General Assembly. It should be redacted by an Independent Group of Scientists commissioned by the Secretary-General: the Group would include 15 experts embodying a multiplicity of backgrounds, scientific disciplines, and institutions, providing geographical and gender balance. It would also be assisted by a task group of six UN bodies such as UN DESA, UNCTAD, UNDP, UNEP, UNESCO, and the World Bank.[17]

Next, a Special Event was held in New York in 2013, two years before the Millennium Development Goals deadline, during which Member States decided to meet at a High-level Summit in September 2015 to adopt a new series of purposes that would have been based on the assumptions of the MDGs. The United Nations Summit on Sustainable Development was held two years later in 2015, engendering 2030 Agenda and its seventeen sustainable development goals.

A special event was scheduled by the President of the United Nations General Assembly on 25th September 2013 in order to reach the Millennium Development Goals by 2015. In the course of the event, the states involved restated their pledge to attain the objectives and decided to hold a High-level Summit in September 2015 to embrace a fresh set of goals. These objectives would extend the groundwork laid by the Millennium Development Goals and take into account upcoming challenges. The new purposes were devised to maintain an equilibrium between the three components of sustainable development, which are to promote economic transformation and offer opportunities to uplift people from poverty; advance social justice; and safeguard the environment. [18] Over 150 global leaders convened at the United Nations Headquarters in New York for a three-day summit on sustainable development in 2015. The main goal of the summit was to officially endorse a far-reaching program for sustainable development. This plan, named Transforming Our World: The 2030 Agenda for Sustainable Development by 2030, contained a declaration, 17 sustainable development goals, and 169 targets. The plan aimed to discover innovative approaches to enhance the livelihoods of people

[17] United Nations. *Global Sustainable Development Report* (GSDR). Available at: https://sdgs.un.org/gsdr [Accessed 29 March 2023].

[18] United Nations. *President of the General Assembly's Special Event towards Achieving the Millennium Development Goals*, 25th September 2013, New York. Available at: https://www.un.org/en/conferences/environment/newyork2013 [Accessed 30 March 2023].

worldwide, eliminate poverty, encourage prosperity and well-being for everyone, safeguard the environment, and combat climate change.[19]

As a matter of fact, nowadays the crisis of climate change transcends national boundaries and demands collaborative, synchronized actions on an international scale. To counteract the adverse effects of climate change, global leaders at the UN Climate Change Conference, held in Paris and known as COP21, realized the major turning point producing the Paris Agreement, approved by 187 parties.[20]

However, before discussing the Paris Conference and the Paris Agreement, we need to take a step backward and reconnect with the 1992 UN Rio Conference on Environment and Development (UNCED). As mentioned above, the 1992 Rio Conference, known as the "Earth Summit", led, *inter alia*, to the creation of the United Nations Framework Convention on Climate Change (UNFCCC), which became effective on 21st March 1994. This convention is extremely and closely related to the other two that were defined during the "Earth Summit": the UN Convention on Biological Diversity and the Convention to Combat Desertification. Indeed, in this background, the Joint Liaison Group was established to foster collaboration between those conventions, with the scope of expanding activities on topics related to common interests.[21] This convention was a landmark for its time since there was not all scientific knowledge about climate change, global warming, pollution, and their effects and consequences on the earth. Actually, during the discussions, the General Assembly recognized that the atmosphere represents a worldwide problem of humankind and the Intergovernmental Panel on Climate Change (IPCC) highlights the needed scientific recommendations to manage greenhouse gas emissions on the international stage. So, the UNFCCC constituted a milestone as one of the most efficient international environmental treaties since it required member states to operate together towards a common objective: the interests of the environmental, climate, and individuals regardless of the scientific vagueness.[22]

[19] United Nations. *United Nations Summit on Sustainable Development*, 25th – 27th September 2015, New York. Available at: https://www.un.org/en/conferences/environment/newyork2015 [Accessed 28 March 2023].
[20] Op. Cit. UN, *Environment and sustainable development*. [Accessed 29 March 2023].
[21] United Nations Framework Convention on Climate Change. *What is the United Nations Framework Convention on Climate Change?* https://unfccc.int/process-and-meetings/what-is-the-united-nations-framework-convention-on-climate-change
[22] Redgwell, C. (2018). International Environmental Law. In M. D. Evans (Ed.), *International Law.* 5th edn. Oxford: Oxford University Press, p. 695.

In this regard, the first aim of the UN Framework Convention on Climate Change is the:

> […] stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.[23]

In addition, the Convention includes specific obligations for all 197 member state parties, in particular for industrialized countries. They have to realize registers of greenhouse gas sources and sinks, in order to develop national and/or regional plans to shorten global warming, encourage scientific studies, and boost cooperation in managing the effects of climate change. Industrialized countries are required to take charge of most emission cuts as they are responsible for most past and contemporary emissions.[24] They are named "Annex I countries" and they are part of the Organization for Economic Cooperation and Development (OECD). Industrialized countries have also the responsibility to sustain climate and environmental initiatives in developing nations by ensuring new and additional financial assistance to cover all prearranged costs undertaken by developing countries in fulfilling their convention commitments.[25]

The UN Framework Convention on Climate Change introduced a system of subsidies and loans managed by the Global Environment Facility (GEF), a financial mechanism controlled by the World Bank as trustee, the UN Development Programme, and UNEP. Besides the UNFCCC, the Convention on Biological Diversity (CBD), the UN Convention to Combat Desertification (UNCCD), the Minamata Convention on Mercury, and the Stockholm Convention on Persistent Organic Pollutants (POPs) rely on the GEF in achieving the goals of global environmental conventions.[26]

So, the Convention *per se* only requires those nations to implement and refer policies and actions on abatement from time to time. It was only with the adoption of the Kyoto Protocol, on December 1997, that the United Nations Framework Convention on Climate Change became

[23] United Nations (1992) United Nations Framework Convention on Climate Change. Available at: https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf Art. 2. [Accessed 31 March 2023].
[24] Op. Cit. Redgwell, C. p. 695.
[25] Op. Cit. UNFCCC, *What is the United Nations Framework Convention on Climate Change?* [Accessed 29 March 2023].
[26] Op. Cit. Redgwell, C. p. 695.

operational, through pledging industrialized nations to restrict and lower greenhouse gas (GHG) emissions in compliance with established individual goals. Due to its challenges in the process of ratification, it became effective in February 2005 and nowadays it has 192 state parties.[27]
The pivotal commitment of the Kyoto Protocol is laid down in Article 3:

> 1. The Parties included in Annex I shall, individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A do not exceed their assigned amounts, calculated pursuant to their quantified emission limitation and reduction commitments inscribed in Annex B and in accordance with the provisions of this Article, with a view to reducing their overall emissions of such gases by at least 5 percent below 1990 levels in the commitment period 2008 to 2012.[28]

It emerges that for the Protocol to be effective, it must be implemented by at least 55 states that are part of Annex I since they constitute 55% of that group's 1990 major GHG emissions. In addition to the adoption of national measures in the first place, the achievement of these targets and timetables for the decreasing of carbon dioxide emissions was subordinated to the elaboration of three flexible markets mechanisms that is to say: the International Emission Trading, the Clean Development Mechanism (CDM), and the Joint Implementation (JI).[29]
These instruments, in principle, foster greenhouse gas emissions reduction to begin where is more affordable like in developing countries. In substance, it is not relevant where emissions are diminished, on condition that they are effectively cut out from the atmosphere. This has two additional advantages: in promoting green investment in the developing world and in involving the private sector in an attempt to reduce and maintain constant GHG emissions to a harmless level. Another one is represented by the opportunity to pay less for the transition from the previous, pollutant technology to more recent, cleaner facilities and assets, with also durable advantages for humans and the environment.[30]
As stated before, the Kyoto Protocol, due to its complexity, entered into force on February 2005, leaving available less than eight years for Annex I parties to reach the abatement set for the period 2008 – 2012.

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[27] UNFCCC. What is the Kyoto Protocol? Available at: https://unfccc.int/kyoto_protocol [Accessed 28 March 2023].
[28] UNFCCC (1997) *Kyoto Protocol to the United Nations Framework Convention on Climate Change* (FCCC/CP/1997/L.7/Add.1). Available at: https://unfccc.int/sites/default/files/resource/docs/cop3/l07a01.pdf [Accessed 27 March 2023].
[29] Op. Cit. Redgwell, C. p. 696.
[30] Op. Cit. UNFCCC, *What is the Kyoto Protocol?* [Accessed 28 March 2023].

The Bali Plan of Action, adopted at COP13 in 2007, stated the intention of achieving agreement about the post-2012 legal framework with COP15 in 2009. Subsequently, consultations followed two paths, guided by two different Ad Hoc Working Groups: one was about long-lasting action of collaboration under the Convention, and the other developed additional obligations under the Protocol. The Copenhagen Accord was the result of COP15, which took place in Copenhagen in 2009. Contrary to Kyoto Protocol, the Accord was not binding, so it relied on a bottom-up method of expected decreases. The following year, at the COP16 in Cancun, decisions were taken on both paths, but there was no agreement on several fundamental issues, such as long-term worldwide emissions goals and whether to broaden the Kyoto Protocol after 2012.[31]

Even the subsequent COP17, held in Durban in 2011, did not bring results on which legal framework to undertake. Indeed, the possibility of a legally binding outcome remained open thanks to meticulous and in-depth drafting of the result of Durban, the "Durban Platform for Enhanced Action" that set-in motion: "a process to develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention"[32] until 2015.
The endorsement of the legally binding Paris Agreement in December 2015 made it possible to honor the purpose.

The Agreement established long-lasting objectives to lead all the parties, but the most known is undoubtedly Article 2 which stated:

> (1). This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:
>
> (a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;

[31] Op. Cit. Redgwell, C. pp. 696 – 697.
[32] UNFCCC. *Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action*. Available at: https://unfccc.int/files/meetings/durban_nov_2011/decisions/application/pdf/cop17_durbanplatform.pdf [Accessed 27 March 2023].

(b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and

(c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

(2). This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.[33]

The Paris Agreement is the first legally binding treaty that came into effect on 4th November 2016. At present, 196 Parties, comprising the European Union, have ratified the agreement. The pact entails obligations for all nations to curb their emissions and cooperate to tackle the effects of climate change. Additionally, it urges countries to enhance their commitments progressively. The treaty also establishes a framework for industrialized countries to aid developing countries in their efforts to mitigate and adapt to climate change while instituting a system for transparent monitoring and reporting of countries' climate objectives. The Paris Agreement sets a solid framework that will address the worldwide endeavor for many years to come. It symbolizes the initiation of a transition towards a world with net-zero emissions.[34] Moreover, the execution of the agreement is imperative to accomplish the Sustainable Development Goals.

The Paris Agreement operates on a cycle of five years, in which countries undertake more ambitious measures to combat climate change. Every five years, each nation must present an updated national climate action plan, commonly known as a Nationally Determined Contribution (NDC). Through their NDCs, countries outline the steps they will take to decrease their greenhouse gas emissions and accomplish the objectives of the Paris Agreement. Additionally, countries specify in their NDCs the measures they will take to bolster their capacity to adapt to the effects of increasing temperatures.

[33] UNFCCC (2015) *The Paris Agreement*. Available at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf [Accessed 28 March 2023].
[34] Ibidem.

Moreover, the first "Global Stocktake" is another measure adopted during the Agreement and it is scheduled for 2023 aiming to evaluate advancements toward the objectives of the Paris Agreement. This procedure will encourage nations to undertake ambitious climate measures that restrict global warming to below 1.5°C. To provide a better context for long-term objectives, the Paris Agreement urges countries to devise and present long-term low greenhouse gas emission development strategies (LT-LEDS), which are not compulsory, unlike NDCs, and provide long-term future of NDCs.[35]

The UN Climate Change Conference (COP24) held in Katowice, Poland in December 2018, saw the approval of the Paris Rulebook, which established the practical execution protocols for the Paris Agreement. In fact, after the approval of the Paris Agreement, it became necessary to understand how to implement it in a fair and transparent manner. Initially, the parties involved decided to establish the deadline for submission of the guidelines at the COP24 in 2018. Nevertheless, the increasing environmental disasters in the form of growing global emissions and the spreading of the consequences of climate change, namely landslides, fires, floods, and droughts forced the Member States to bring forward the beginning of negotiations in 2016.

This resulted in the adoption of the Katowice Climate Package at COP24. It represents a milestone in the context of the implementation of climate action worldwide because it reinforces and operationalizes the Paris Agreement. The Package establishes the fundamental steps and instruments to implement the Paris Agreement, pledging the consolidation of international collaboration in one of the largest concerns of the present day: the transformation to a low-emission and climate-resilient planet. In accordance with the Intergovernmental Panel on Climate Change (IPCC), to comply with the Paris Agreement, which is limiting global warming to 1.5°C, it is necessary to reduce carbon dioxide emissions by roughly 45% before 2030, from 2010 levels. This means that the passage to a carbon-neutral economy must be completed within just a few decades from now, even taking as a reference limiting global warming to 2°C. However, the Paris Agreement's guidelines take into consideration the differences in capacities and the socio-economic situations of the countries without neglecting the objective of achieving more and more ambitious goals in the field of climate action. The enhancement of national systems in each country for the fulfillment of the Agreement is sustained by these guidelines that are studied with the aim of pushing and marking the

[35] UNFCCC. *What is the Paris Agreement?* Available at: https://unfccc.int/process-and-meetings/the-paris-agreement [Accessed 28 March 2023].

advancements. In fact, the creation of fertile national systems fosters not only the implementation of projects and activities at the national level but also the sharing of climate action at the international level. Actually, a complete application of the Paris Agreement nationally enables states and non-state actors to exploit the resulting gains of climate action, as confirmed by the last 10 years examined.

So, basically, the Katowice Package outcome is elaborate and is reached through detailed technical analysis and political trade-off. It includes functional guidance on the information about domestic mitigation and other climate goals and activities that governments will provide in their Nationally Determined Contributions (NDCs); how to communicate about efforts to adapt to climate impacts; the rules for the functioning of the Transparency Framework, which will show to the world what countries are doing about climate change; establishment of a committee to facilitate implementation of the Paris Agreement and promote compliance with the obligations undertaken under the Agreement; how to conduct the "Global Stocktake" of overall progress towards the aims of the Paris Agreement; how to assess progress on the development and transfer of technology; how to provide advance information on financial support to developing countries and the process for establishing new targets on finance from 2025 onwards. However, the Paris Rulebook was ultimately ratified at COP26 in Glasgow, Scotland, in November 2021.[36]

Fifty years after the United Nations Conference on the Human Environment in 1972, Stockholm welcomes a new conference in June 2022, underlining the link between poverty and the environment. The "Stockholm+50: A Healthy Planet for The Prosperity of All – Our Responsibility, Our Opportunity" has drawn attention to the universal interaction of the environment and the urgency to jointly tackle the tripartite emergency of nature, namely biodiversity loss, pollution, and climate change. As a consequence, it emerges the exigency to adopt audacious and conscious actions, along with an efficient and transparent political commitment to speed up operations in this regard, to reinforce the international system, to expand ambitiousness and unanimity, creating a trustworthy way toward a healthy environment.

[36] UNFCCC. *The Katowice climate package: Making the Paris Agreement Work for All*. Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/katowice-climate-package [Accessed 28 March 2023].

The debate during "Stockholm+50" confirmed the relevance of regional realities and national enforcement, and the requirement for conjunction of finance, incentives, capacity assistance, and policies, to reach sustainable development.[37]

Finally, last November 2022, Sharm el-Sheikh hosted COP27 which achieved five highlights, but the most relevant is definitely to set up and enforce a loss and damage fund for those countries severely impacted by climate catastrophes like inundations and aridity. It represents a landmark because, for the very first time, the international community identified the necessity of financial support to address losses and damages caused by the devastating impacts of climate change, and negotiated the creation of a fund and its financing procedures. Although the details will be defined in the next year, such as who should contribute to the fund, from which funds will be withdrawn this money, and what nations will receive it, it represents substantial progress toward justice.[38]

[37] United Nations. Stockholm+50: a healthy planet for the prosperity of all – our responsibility, our opportunity (2022). Available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/37743/SAP.pdf?sequence=3&isAllowed=y [Accessed 30 March 2023].

[38] UNFCCC. *Five Key Takeaways from COP27*. Available at: https://unfccc.int/process-and-meetings/conferences/sharm-el-sheikh-climate-change-conference-november-2022/five-key-takeaways-from-cop27 [Accessed 27 March 2023].

1.2 The European perspective

In the early 1970s, the European Community started to worry about environmental issues. The roots of its environmental policy can be traced back to the European Council held in Paris in 1972, which followed the First United Nations Conference on the Environment. During this council, the Heads of State and Government recognized the need for a comprehensive environmental policy to guide the economic expansion and action program of the community. Subsequently, the Single European Act, signed in Brussels in 1987 to facilitate the Single Market Project, expanded the scope of the 1957 Treaty of Rome, which established the European Economic Community (EEC), by including a new section dedicated to the environment. This marked the first legal basis for a shared environmental policy aimed at safeguarding the environment, protecting human health, and promoting sustainable use of natural resources. The Community's commitment to environmental protection and the role of the European Parliament in developing environmental policy was reinforced through subsequent revisions of the Treaty.

Building on the momentum of the Rio Conference, the Maastricht Treaty of 1993 formally elevated the environment to a key area of European policies and introduced the notion of sustainable development into Community legislation. This commitment was further strengthened with the Treaty of Amsterdam, signed in 1999, which made environmental protection one of the primary objectives of the European Union. The Treaty also mandated the integration of environmental protection into all sector-specific policies of the EU in order to promote sustainable development, which continues to be a central concept in European policies today.

The Lisbon Treaty of 2009 established the fight against climate change as a specific objective, along with the promotion of sustainable development in relations with third countries. This Treaty further solidified and clarified the scope of the European environmental policy aimed at ensuring sustainable development. Notably, the Lisbon Treaty acknowledged the integral role that the European Union must play in international efforts to combat climate change. It also stipulated that qualified majority voting, rather than unanimous voting, would be used for environmental issues, including climate change. Moreover, the Treaty extended all environmental regulations to encompass climate change as well.[39]

[39] Kurrer, C. (2022). Fact Sheetson the European Union. *Environment policy: general principles and basic framework*. Available at: https://www.europarl.europa.eu/factsheets/en/sheet/71/environment-policy-general-principles-and-basic-framework [Accessed 31 March 2023].

The core objectives and principles of EU environmental policy are stated in the Treaty establishing the European Community (TEC), the Nice consolidated version, in particular in Article 174:

> 1. Community policy on the environment shall contribute to pursuit of the following objectives:
>
> - preserving, protecting and improving the quality of the environment,
>
> - protecting human health,
>
> - prudent and rational utilization of natural resources,
>
> - promoting measures at international level to deal with regional or worldwide environmental problems.
>
> 2. Community policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Community. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay. In this context, harmonization measures answering environmental protection requirements shall include, where appropriate, a safeguard clause allowing Member States to take provisional measures, for non-economic environmental reasons, subject to a Community inspection procedure.[40]

The EU environmental policy is based on the principles of precaution, prevention, and control of pollution at source, as well as the "polluter pays" principle. The precautionary principle is a risk management tool that can be employed in the event of scientific vagueness about an alleged risk to human health or the environment, arising from a given action or policy. The "polluter pays" principle is enforced by the Environmental Liability Directive, aimed to prevent or else repair environmental detriment to endangered species and natural habitats, water, and soil. Certain professional activities such as the shipping of hazardous substances, or activities involving the discharge into the water, are requested to adopt preventive measures in the event

[40] European Commission (2012) Treaty establishing the European Community (Nice consolidated version). *OJ* C 325, 24th December, pp. 33–184. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:12012E/TXT&from=EN

of an upcoming danger to the environment. On the other hand, if the damage has already taken place, they have to undertake adequate measures to repair it and assume the costs. The Directive's area of application has been broadened three times to comprehend respectively the management of mining waste, the operation of geological storage sites, and the safety of offshore oil and gas operations.

Incorporating environmental considerations into its Lisbon Strategy, the European Union implemented its first Sustainable Development Strategy (SDS) in 2001. Later in 2016, the Commission published a communication entitled "The Sustainable Future of Europe: Next Steps - European Action for Sustainability," which outlines how the Sustainable Development Goals (SDGs) can be integrated into the EU's policy objectives, following the UN General Assembly's adoption of the 2030 Agenda for Sustainable Development in September 2015. In alignment with its commitments to the UN Convention on Biological Diversity, the EU adopted its biodiversity strategy for 2020 in 2011. To participate in discussions at the UN Biodiversity Conference 2022 (COP15), which focused on a post-2020 global biodiversity framework, the Commission presented a comprehensive and long-term 2030 biodiversity strategy in May 2020 aimed at protecting nature and restoring ecosystem health. The European Parliament supported this strategy in June 2021 and provided additional recommendations to enhance its effectiveness. [41]

For many years, the EU has successfully established some of the world's toughest environmental regulations. The aim of EU environmental policy is to further promote eco-friendliness in the economy, conserve Europe's natural resources, and safeguard the health and well-being of its citizens. Through its environmental policies and regulations, the EU strives to safeguard natural habitats, ensure clean air and water, facilitate proper waste management, raise awareness about harmful chemicals, and encourage sustainable business practices. During its inter-institutional cycle from 2019 to 2024, the EU is expected to further enhance its role as a global leader in the fight against climate change.[42]

[41] Op. Cit. Kurrer, C., *Environment policy: general principles and basic framework*. [Accessed 31 March 2023].
[42] European Commission, Directorate-General for Environment (2022) *Environmental impact assessment of projects: rulings of the Court of Justice of the European union*. Publications Office of the European Union, Available at: https://data.europa.eu/doi/10.2779/21 p. 9.

The objectives of the Union's environmental policy, as outlined in Article 191(1) of the Treaty on the Functioning of the European Union (TFEU), realized on the former and aforementioned Article 174 TEC, are:

> 1. Union policy on the environment shall contribute to pursuit of the following objectives:
>
> - preserving, protecting and improving the quality of the environment,
>
> - protecting human health,
>
> - prudent and rational utilization of natural resources,
>
> - promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change.[43]

On December 11th 2019, the von der Leyen Commission introduced the European Green Deal an ambitious package of measures aimed at achieving EU carbon neutrality by 2050. It represented a new growth strategy for the EU with the primary goal of facilitating and streamlining the transition to an economy that is climate-conscious, competitive, and economy-inclusive. The measures, accompanied by a roadmap of key policies, range from ambitious cuts to emissions to investments in cutting-edge research and innovation to preserve Europe's natural environment. The EU's environmental policy approach is grounded in Articles 11 and 191-193 of the Treaty on the Functioning of the European Union (TFEU), while Article 3(3) of the Treaty on European Union (TEU) emphasizes the importance of sustainable development as a key objective for the EU, with a commitment to safeguarding and improving the environment.[44]

[43] European Commission (2012) Consolidated version of the Treaty on the Functioning of the European Union. OJ, C 326/132, 26th October. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:12012E/TXT&from=EN

[44] Op. Cit. European Commission, Directorate-General for Environment, *Environmental impact assessment of projects: rulings of the Court of Justice of the European union*. p. 9.

The European Green Deal (EGD) forms a crucial aspect of the European Commission's approach to fulfilling the United Nations' 2030 Agenda, sustainable development objectives, and other priorities outlined in President von der Leyen's political guidelines.[45] The Commission will reorient the European Semester's macroeconomic coordination process as part of the Green Deal to include the United Nations' sustainable development goals. This will prioritize sustainability and citizens' well-being in economic policy and ensure that the EU's policymaking and action align with the sustainable development goals (SDGs).[46]

The European Green Deal proposes, *inter alia*, various significant actions, one of which is the European Climate Law. This law's objective is to ensure that the Union achieves a zero-climate impact by 2050, and it includes increasing the greenhouse gas emission reduction target to at least 55% by 2030. The European Commission has suggested several other measures as well, such as the Communication on the sustainable Europe investment plan, the European climate pact, the Fair Transition Fund regulation, the proposition for the trans-European energy infrastructure guidelines regulation, for the EU energy system integration strategy, and also for the EU hydrogen strategy. Additionally, the Commission adopted a new EU climate change adaptation strategy on 24th February 2021. This strategy outlines how the EU can cope with the inevitable effects of climate change and become resilient to it by 2050.[47]

On April 5th 2022, the Commission put forth an upgraded proposal concerning fluorinated gases, which aims to achieve a reduction of 40 million tons of CO_2 emissions by 2030. In addition, on October 14th 2020, the Commission introduced an EU strategy focused on decreasing methane emissions. As the second biggest contributor to climate change after CO_2, decreasing methane emissions is essential to meeting both the 2030 climate targets and the 2050 climate neutrality objective.

[45] For more information, see European Commission, Directorate-General for Communication, Leyen, U. (2020) *Political guidelines for the next European Commission 2019-2024: Opening statement in the European Parliament plenary session 16 July 2019; Speech in the European Parliament plenary session 27 November 2019*. Publications Office of the European Union. Available at: https://data.europa.eu/doi/10.2775/101756 [Accessed 06 April 2023].

[46] European Committee of the Regions, Gløersen, E., Mäder Furtado, M., Gorny, H., et al. (2022) *Implementing the European Green Deal: handbook for local and regional governments*. European Committee of the Regions. Available at: https://data.europa.eu/doi/10.2863/359336 p. 10.

[47] Amanatidis, G. (2022). Fact Sheets on the European Union. *Combating climate change*. Available at: https://www.europarl.europa.eu/factsheets/en/sheet/72/combating-climate-change [Accessed 04 April 2023].

Furthermore, on December 15th 2021, the Commission presented an additional proposal that seeks to reduce methane emissions both in the energy sector throughout Europe and across the global supply chain.[48]

The European Green Deal (EGD) and its associated initiatives aim to inspire and facilitate significant changes in the way we approach and carry out green and digital transitions. The goal is to empower all actors, regardless of level or sector, to contribute to the preservation of ecosystems, as well as to ensure health, food and water security, and human safety and development. The EGD emphasizes that incremental changes are not enough and transformational changes are necessary. The EGD has two primary approaches for producing transformative change, which are the foundational principles of the EGD, and have significant implications for its execution at the regional and local levels.

Firstly, there are innovative methods of public action that promote the resolution of environmental transition challenges. The EGD promotes cross-sector collaboration among public authorities and encourages partnerships with private, public, and "third sector" organizations, involving the active participation of a diverse range of stakeholders who can contribute to or be impacted by the transition processes. The second pillar of the EGD involves ensuring fairness in distributing the economic and social responsibilities during the transition process. This requires improving communication, cooperation, and collaboration among various actors at different institutional levels, such as regional and local authorities who govern areas with varying levels of resilience in adapting to the green transition, social groups, as well as public and private actors.

The European Green Deal (EGD) was established as a growth strategy that prioritizes the adoption of environmentally and climate-friendly technologies, production methods, and consumption patterns. With the post-COVID recovery and the steep increase in fossil fuel prices following the Russian invasion of Ukraine, there is a consensus that transitioning towards a green economy is the most reliable pathway to long-term prosperity and growth across Europe. To this end, the EGD offers a stable framework for regional and local initiatives that aim to achieve digital and green transitions. The EGD's implementation requires the active involvement of governments at all levels, beginning with the national level, where each member

[48] Op. Cit. Amanatidis, G., *Combating climate change* [Accessed 04 April 2023].

state determines how European funds, instruments, and objectives are implemented through recovery plans, national energy and climate plans, and partnership agreements. However, achieving the goals of the EGD requires a comprehensive mobilization of public authorities at all levels, as well as significant investments in public financial resources. It also necessitates significant changes in national and regional governance frameworks and sectoral policies.

As *per* the 2021 European Green Deal Barometer,[49] one-third of sustainability experts surveyed identified the lack of commitment by EU Member States as the primary obstacle to implementing the Green Deal. Inadequate governance mechanisms were cited as the second most significant barrier, followed by unequal progress among EU Member States. This highlights the challenge faced by local and regional authorities in adapting to the varying and evolving national frameworks for EGD governance and implementation, which can sometimes be inadequate.[50]

The Zero – Pollution Action Plan: "Towards a Zero Pollution for Air, Water and Soil" is a significant component of EGD. The plan aims to achieve a zero-pollution objective by 2050 for air, water, and soil, where pollution levels no longer pose a threat to public health and natural ecosystems, and are within the planet's sustainable limits, thereby creating a toxic-free environment. To achieve this vision, it is necessary to implement cross-sectoral measures and bring about systemic changes. To tackle various types of pollution and their effects at different levels, it is essential to establish governance structures at the global, EU, national, regional, and local levels. The Zero Pollution plan encompasses a wide range of policy domains, including air, chemicals, circular economy, industrial emissions, marine and coastal environments, nature and biodiversity, noise, plastics, soil and land, and water. The impact of pollution on human health and natural ecosystems is not limited by borders, and it is imperative that collaborative efforts be made to reduce it to levels that are not detrimental to either. Local communities' wellness is affected by pollution, and concerted efforts are necessary to mitigate its harmful effects.[51]

[49] For more information, see Institute for European Environmental Policy. *European Green Deal Barometer*. Available at: https://ieep.eu/publications/european-green-deal-barometer/ [Accessed 06 April 2023].
[50] Op. Cit. European Committee of the Regions, *Implementing the European Green Deal: handbook for local and regional governments*, pp. 7 – 9.
[51] Ivi, pp. 69 – 79.

Another crucial part of the European Green Deal is the Clean Energy goal. By utilizing renewable energy sources and smart grids, the adoption of cleaner energy generation, consumption, and transmission can enhance regional resilience. It can also separate economic and social activities from imported fossil fuels, ultimately resulting in reducing greenhouse gas emissions, which is crucial for attaining EU climate objectives. A crucial aspect of this transformation is the transition to more sustainable energy consumption practices. This involves not only upgrading infrastructure and products to enhance energy efficiency but also modifying behavior and processes to decrease energy intensity. The European Green Deal places significant emphasis on the Clean Energy Transition as a crucial aspect. In the European Union 27 regions, around 75% of greenhouse gas emissions come from energy production and use, which the Green Deal aims to address by promoting energy security and affordability, modernizing energy markets, enhancing energy efficiency, and increasing renewable energy capacity. These efforts contribute to the broader transition towards a more sustainable economy and boost energy independence.

Presented below are ongoing Clean Energy initiatives:

- "The National Energy and Climate Plans"[52] describe how Member States plan to reach their clean energy transition objectives between 2021 and 2030. These plans detail particular actions and regulatory adjustments that could impact regional energy production systems.
- "The Long-term Renovation Strategies"[53] lay out the objectives of Member States to change and decarbonize their building stock by 2050.
- "The EU Energy Systems Integration Strategy"[54] aims to modernize the EU's energy system by enhancing integration between energy producers and consumers.
- "The EU Hydrogen Strategy"[55] establishes a backdrop for the production of renewable hydrogen within the EU's energy systems. Given the high storage capacity of hydrogen,

[52] For more information, see European Commission. *National energy and climate plans*. Available at: https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en [Accessed 06 April 2023].
[53] For more information, see European Commission. Energy. *Long-term renovation strategies*. Available at: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/long-term-renovation-strategies_en [Accessed 06 April 2023].
[54] For more information, see European Commission. *EU strategy on energy system integration*. Available at: https://energy.ec.europa.eu/topics/energy-systems-integration/eu-strategy-energy-system-integration_en [Accessed 06 April 2023].
[55] For more information, see European Commission. Energy. *Hydrogen*. Available at: https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen_en#eu-hydrogen-strategy [Accessed 06 April 2023].

the Hydrogen Strategy is closely linked to the Energy Systems Integration Strategy.

- "The EU Offshore Renewable Energy Strategy"[56] addresses challenges such as access to sea-space, industrial and employment aspects, collaboration, and technology transfer to accelerate the deployment of offshore renewables.
- "The EU Methane Strategy"[57] defines measures to decrease methane emissions, a potent greenhouse gas, by enhancing measurement and reporting standards, as well as implementing leak detection and prohibiting methane venting and flaring.
- "The revisions of the Trans-European Networks for Energy"[58] define nine energy corridors (electricity, gas, and oil infrastructure) and three thematic areas for action (smart grids, electricity highways, and cross-border carbon dioxide networks).[59]

With regard to European energy policy, Article 194 TFEU outlined its five main objectives:

> 1. In the context of the establishment and functioning of the internal market and with regard for the need to preserve and improve the environment, Union policy on energy shall aim, in a spirit of solidarity between Member States, to:
>
> (a) ensure the functioning of the energy market;
>
> (b) ensure security of energy supply in the Union;
>
> (c) promote energy efficiency and energy saving and the development of new and renewable forms of energy; and
>
> (d) promote the interconnection of energy networks.[60]

However, even if Article 194 TFEU makes certain areas of energy policy a matter of shared competence, marking a step towards a common energy policy, each Member State retains the right to "[…] determine the conditions of use of its energy sources, the choice between different

[56] For more information, see European Commission. Energy. *Offshore renewable energy*. Available at: https://energy.ec.europa.eu/topics/renewable-energy/offshore-renewable-energy_en [Accessed 06 April 2023].
[57] For more information, see European Commission. Energy. *Methane emissions*. Available at: https://energy.ec.europa.eu/topics/oil-gas-and-coal/methane-emissions_en [Accessed 06 April 2023].
[58] For more information, see European Commission. *Trans-European Networks for Energy*. Available at: https://energy.ec.europa.eu/topics/infrastructure/trans-european-networks-energy_en [Accessed 06 April 2023].
[59] Op. Cit. European Committee of the Regions, *Implementing the European Green Deal: handbook for local and regional governments*, pp. 108 – 109.
[60] Op. Cit. European Commission, *OJ*, C 326/134.

energy sources and the general structure of its energy supply […]" (Article 194, paragraph 2).[61] The European Council implemented a global integrated climate and energy policy on October 24th 2014, and updated it in December 2018. The policy aims to achieve several objectives by 2030, including a rise of up to 32% in the usage of renewable energy, a 32.5% boost in energy efficiency, and the interconnection of at least 15% of EU electricity systems. Currently, negotiations are underway for new EU energy targets for 2030, which propose an increase of up to 42-45% in the usage of renewable sources and a reduction of 40-42% in primary energy consumption, and 36-40% in final energy consumption.[62]

On 25th February 2015, the Commission released the Strategy for an Energy Union (COM/2015/0080) with the aim of achieving an Energy Union that provides a reliable, competing, cheap, and sustainable energy supply for households and businesses in the EU. In November 2016, the Commission presented a package of proposals "Clean energy for all Europeans" (COM/2016/0860). The package is made up of eight legislative propositions concerning governance (governance of the Energy Union - Regulation (EU) 2018/1999; the structure of the energy market (Directive (EU) 2019/944 on electricity; Regulation (EU) 2019/943 on electricity; and Regulation (EU) 2019/941 on risk preparation), energy efficiency (Directive (EU) 2018/2002 on energy efficiency; Directive (EU) 2018/844 on energy performance in buildings), renewable energy (Directive (EU) 2018/2001 on energy from renewable sources) and standards for regulators, namely the EU Agency for the Cooperation of Energy Regulators (Regulation (EU) 2019/942 establishing ACER).[63]

The Energy Union Governance Regulation, which was the final piece of the package, was finally endorsed on 4th December 2019. Under the Regulation, EU Member States are required to draw up 10-year integrated national energy and climate plans (NECPs) for the period 2021 – 2030, to present an advancement report every two years, and to formulate coherent long-term national strategies to achieve the objectives of the Paris Agreement.

[61] Ciucci, M. (2022). Fact Sheets on the European Union. *Energy policy: general principles*. Available at: https://www.europarl.europa.eu/factsheets/en/sheet/68/energy-policy-general-principles [Accessed 03 April 2023].
[62] Op. Cit. Ciucci, M., *Energy policy: general principles* [Accessed 03 April 2023].
[63] For more information, see: European Union Agency for the Cooperation of Energy Regulators. ACER. Available at: https://www.acer.europa.eu/ [Accessed 28 April 2023].

The Commission unveiled the "Ready for 55%" package on two dates – 14th July and 15th December 2021.

Its primary objective is to cut down greenhouse gas emissions by at least 55% by 2030, based on the 1990 levels, and attain carbon neutrality by 2050 in the European Union. This all-encompassing package involves an appraisal of all prevailing EU climate and energy legislations, with a specific emphasis on renewable energy, energy efficiency, energy taxation, air, and sea transport, and building sectors. It included the Renewable Energy Directive (COM/2021/0557), the Energy Efficiency Directive (COM/2021/0558), the Energy Taxation Directive (COM/2021/0563), the directive on the energy performance of buildings (COM/2021/802), the gas directive (COM/2021/803) and the gas regulation (COM/2021/804). It also includes new proposals, such as the regulation on the deployment of alternative fuels infrastructure (COM/2021/0559), the ReFuelEU initiative in the aviation sector (COM/2021/0561), and the FuelEU initiative in the maritime sector (COM/2021/0562).[64]

This set of proposals seeks to revise and renew existing EU legislation and introduce fresh initiatives that align with the climate objectives agreed upon by the Council and the European Parliament. Its primary goal is to establish a comprehensive and equitable framework that can help achieve the EU's climate targets while ensuring a socially just transition, reinforcing innovation and competitiveness of EU businesses, and creating a level playing field with third-country economic players. Additionally, the package intends to bolster the EU's dominant position in the global struggle against climate change.[65]

The Ready for 55% package also intends to revise the European Union Emission Trading System (EU ETS) by making it more daring. The EU Emissions Trading Scheme (EU ETS) functions as a carbon market that employs a system of trading and limiting emissions in the energy-intensive industries and energy production sector. It serves as the primary measure adopted by the EU to address emission reduction. The implementation of the EU ETS in 2005 has resulted in a significant decrease of 41% in EU emissions. The latest measures comprise several changes such as the enlargement of limitations on emissions in maritime transport; a more rapid decrease in emission allowances within the program, and the gradual elimination of free allowances for specific sectors. Additionally, the EU ETS will carry out the global

[64] Op. Cit. Ciucci, M., *Energy policy: general principles* [Accessed 03 April 2023].

[65] European Council and Council of the European Union. (2023). *Fit for 55*. Available at: https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/ [Accessed 03 April 2023].

international aviation carbon compensation and reduction scheme (the Carbon Offsetting and Reduction Scheme for International Aviation – CORSIA), while the Modernization Fund and the Innovation Fund will receive a boost in funding. The market buffer will also undergo revision. Moreover, a new self-governing emissions trading mechanism will be established for buildings, road transport, and fuels used in other sectors. The "Environment" Council approved a general guideline regarding the revision of the EU ETS in June 2022. Later, in December 2022, an interim agreement was reached between the Council and the European Parliament, which includes increasing the overall ambition to reduce emissions by 2030 in the EU ETS-covered areas to 62%. This target is slightly higher than the Commission's proposed goal of 61%.

Moreover, the Ready for 55% initiative encompasses a proposition to amend the directive regarding the advancement of renewable energy. The objective is to elevate the current EU objective of a minimum of 32% renewable energy sources in the overall energy mix to a minimum of 40% by 2030. Additionally, the proposal suggests implementing or enhancing sub-goals and targeted actions in all fields, with a special emphasis on those that have been lagging in the adoption of renewable energy sources, specifically in the transport, construction, and industry sectors.

On 27th June 2022, the EU Energy Ministers concurred on their shared position regarding the proposed modification to the EU Directive on the promotion of renewable energy. On the other hand, the aim of the proposed revision of the Council Directive on energy product and electricity taxation is to bring it in line with EU energy, environment, and climate policies. It also seeks to update the scope of energy products and the structure of tax rates, rationalize the use of tax exemptions and reductions by Member States, and maintain the revenue-generating capacity of Member States' budgets while preserving and enhancing the EU internal market. The Council is currently discussing the proposal, and in December 2022, EU finance ministers had a policy debate on the Energy Taxation Directive revision.[66]
Thus, the Ready for 55 % package is a comprehensive set of proposals aimed at achieving a fair, competitive, and green transition by 2030 and beyond. The package is designed to strengthen existing legislation and introduce new initiatives in several strategic sectors,

[66] Op. Cit. European Council and Council of the European Union, *Fit for 55* [Accessed 03 April 2023].

including climate, energy and fuels, transport, construction, land use, and forestry. One of the key features of the package is its focus on interconnections between the various proposals. This approach recognizes that achieving the desired outcome will require a coordinated effort across multiple sectors and areas of policy.

Another important aspect of the package is its emphasis on achieving the desired outcomes through a balanced mix of policy tools. The package recognizes that excessive reliance on regulatory policies could result in unnecessarily high economic burdens, while relying solely on carbon pricing may not be enough to overcome persistent market failures and non-market-related obstacles. Therefore, the chosen policy mix is characterized by a delicate balance between pricing, objectives, standards, and support measures. This approach recognizes that different tools will be needed in different sectors and contexts to achieve the desired outcomes. Overall, the Ready for 55 % package represents a significant step forward in the EU's efforts to transition to a more sustainable and competitive economy.
By focusing on interconnections between different sectors and adopting a balanced mix of policy tools, the package is well-positioned to achieve its goals while minimizing unnecessary economic burdens.[67]

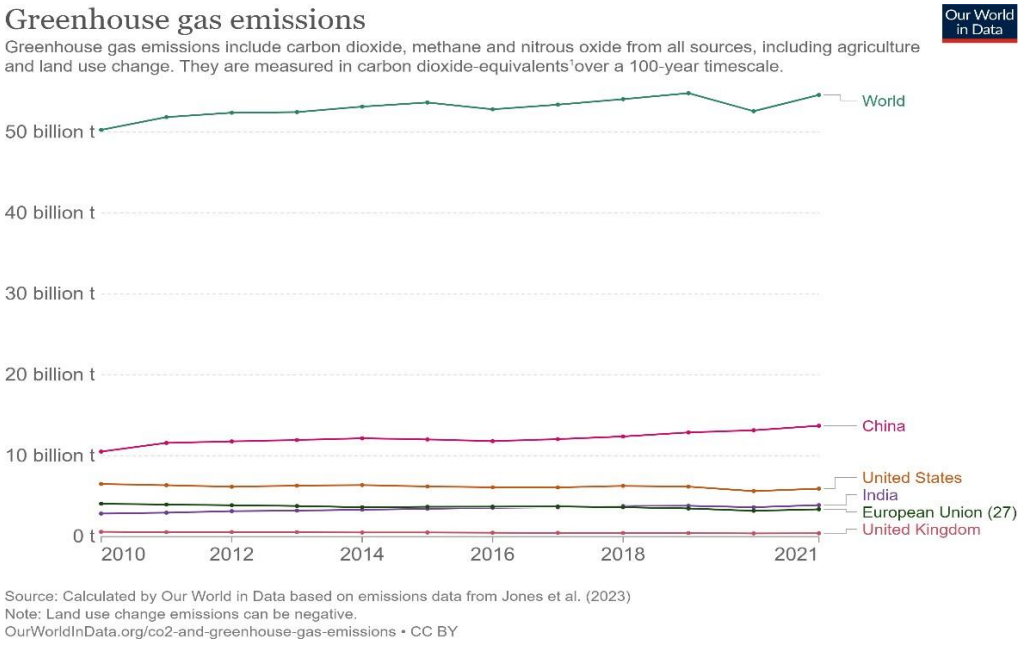
On 18th May 2022, the European Commission presented the REPowerEU plan (COM/2022/0230) in response to the difficulties and disruptions of the global energy market caused by the Russian invasion of Ukraine. The plan aims to end the EU's dependence on Russian fossil fuels and to make further progress in addressing the climate crisis. The Commission proposed a target of 10 million tons of renewable hydrogen produced internally and 10 million tons of renewable hydrogen imported by 2030 to replace natural gas, coal, and oil in industries and transport sectors difficult to decarbonize.
On 14th September 2022, the Commission proposed an emergency intervention in the European energy markets (COM/2022/473) to address the recent dramatic price increases. This consisted of exceptional measures to reduce electricity demand and measures to redistribute surplus revenues from the energy sector to final customers.[68]

[67] European Commission (2021) *Communication from The Commission to The European Parliament, The Council, The European Economic and Social Committee and The Committee of The Regions 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality* (COM/2021/550 final). Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0550 [Accessed 5 April 2023]
[68] Op. Cit. Ciucci, M., *Energy policy: general principles* [Accessed 03 April 2023].

2. Policies to reduce greenhouse gas emissions

Over the past years, there has been a surge in efforts to address the climate crisis as its consequences have become more severe and policymakers have prioritized tackling this issue. The Sixth Assessment Report from the Intergovernmental Panel on Climate Change highlighted the grim reality of the climate crisis, including loss of life, ecological damage, and humanitarian crises. The report emphasized the crucial difference between limiting global warming to 1.5°C versus 2°C and the need for a 43% reduction in global emissions by 2030 to achieve the former. However, global emissions continued to increase in the decade leading up to 2019, underscoring the urgent need for swift and comprehensive emissions reductions across all sectors of the economy. The International Energy Agency's (IEA) analysis reveals a noteworthy disparity between the commitments countries have made and what their current policies can actually deliver. The most recent report from the Intergovernmental Panel on Climate Change also affirms that numerous countries require supplementary policies to accomplish their self-imposed National Determined Contribution (NDC) targets. Despite a brief decrease in emissions during the COVID-19 pandemic, energy consumption has rebounded to pre-pandemic levels, and energy-related emissions reached an all-time high in 2021 on a global scale (Figure 1).[69]

Figure 1: Greenhouse gas emissions 2010 – 2021.



[69] The World Bank (2022) *State and Trends of Carbon Pricing 2022*, World Bank, Washington, DC. DOI: 10.1596/978-1-4648-1895-0. License: Creative Commons Attribution CC BY 3.0 IGO, p. 11.

The current status of carbon pricing highlights the disparity between policies and commitments. Despite the fact that carbon prices have reached record highs in some ETSs and carbon taxes in the past year, the majority of them are still significantly lower than what is required to attain net-zero emissions by 2050 and meet the Paris Agreement's targets. To bridge the policy gap, implementing more ambitious carbon pricing can be essential, but it should be part of a comprehensive climate policy package and supported by long-term strategies. As a result, there is a growing interest in cross-border carbon pricing policies, which aim to achieve this ambition while addressing concerns related to economic competitiveness and carbon leakage.

However, increasing carbon prices presents a significant political challenge, especially given the rising costs of energy commodities and the persistent economic pressure created by the COVID-19 pandemic.[70] Governments can adopt carbon pricing as a cost-efficient policy tool to support their overall climate change strategy. This involves imposing a fee on greenhouse gas emissions, which in turn creates a financial motivation to decrease emissions or increase their removal. By considering the costs of climate change in economic decision-making, carbon pricing can promote changes in production, consumption, and investment choices, ultimately supporting the growth of low-carbon economies. Carbon Pricing Instruments (CPIs) are designed to tackle price obstacles to promote low-carbon development, but they may not be sufficient to address all the challenges and market failures associated with climate policy. Therefore, CPIs usually require other types of policies to complement and strengthen their effectiveness. These additional policies could encompass research and development, specific regulations for various sectors, investment in technologies and infrastructure, elimination of regulatory hurdles, and market reforms to promote incentive-based approaches.

Moreover, there may be a requirement for further measures to minimize the adverse impacts of climate policies on specific sectors or demographics. There are various policy tools that governments can use to set a price on carbon, and they can customize these tools to fit their own domestic situations, priorities, and requirements. The effectiveness of carbon pricing in mitigating climate change is dependent on the breadth of the application of the price, the pricing level, and the availability of opportunities for reducing emissions.

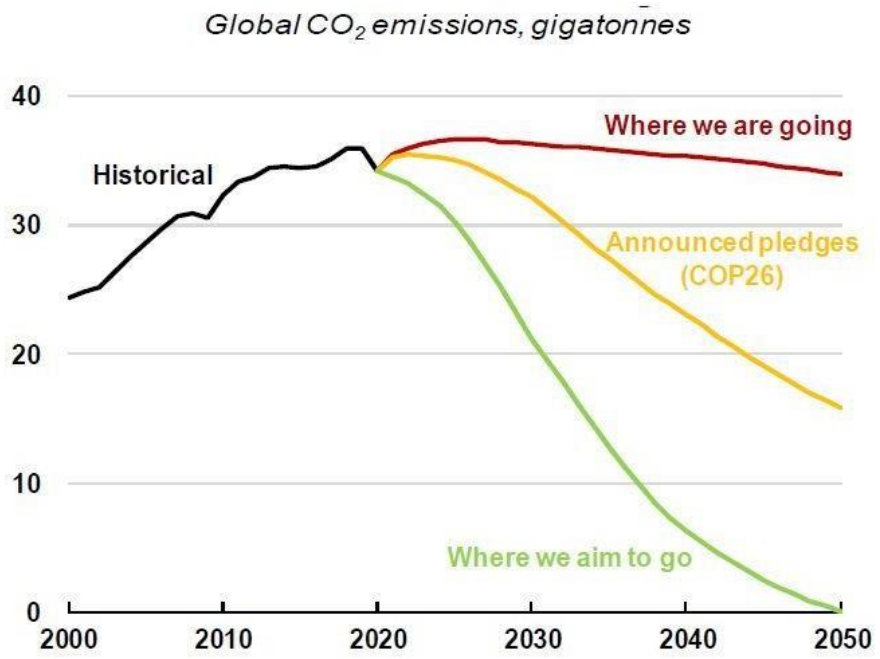
[70] Op. Cit. The World Bank, *State and Trends of Carbon Pricing 2022*, p. 12.

Policies that impose carbon prices across the entire economy are more successful than those that only target specific sectors or products, and higher carbon prices encourage more significant reductions in emissions.

To encourage long-term investments and promote the development of low-carbon economies, it is essential to establish a credible and more predictable price signal over the long term.[71]

It is imperative to mitigate the dangers posed by climate change by promptly expediting the shift towards achieving net-zero greenhouse gas (GHG) emissions (Figure 2). Advancing towards net zero will not only assist in diminishing reliance on fossil fuels but also mitigate the risk of energy price fluctuations in the future. In order to successfully achieve net-zero GHG emissions, policy packages must be implemented to ensure that households and businesses have affordable access to low and zero-carbon alternatives.[72]

Figure 2: The climate challenge.



Source: Adapted from (IEA, 2021), in OECD, Pricing Greenhouse Gas Emissions.

[71] Op. Cit. The World Bank, *State and Trends of Carbon Pricing 2022*, p. 12.

[72] OECD (2022), *Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action*, OECD Series on Carbon Pricing and Energy Taxation, Paris: OECD Publishing. https://doi.org/10.1787/e9778969-en p. 7 [Accessed 12 April 2023].

2.1 Types of policy instruments and their effectiveness

It is imperative that we speed up the transition to net zero greenhouse gas (GHG) emissions to mitigate the risks of climate change. Despite an increase in awareness of the urgency to address climate change, there remains a gap between ambition and action. The pledges made thus far, even if fully implemented, are inadequate to meet the objectives of the Paris Agreement. To prevent a discrepancy between commitments and implementation, countries must now transform their long-term climate pledges into concrete policy plans that prioritize the climate and economy in the short and medium term. A recent analysis by the United Nations Framework Convention on Climate Change (UNFCCC) of the nationally determined contributions (NDCs) undergone by Paris Agreement parties concluded that there is: [73]

> "[…] an urgent need for either a significant increase in the level of ambition of NDCs between now and 2030 or a significant overachievement of the latest NDCs, or a combination of both, in order to attain cost-optimal emission levels suggested in many of the scenarios considered by the IPCC for keeping warming well below 2 °C or limiting it to 1.5 °C. If emissions are not reduced by 2030, they will need to be substantially reduced thereafter to compensate for the slow start on the path to net zero emissions. […]" (Article 15, UNFCCC, 2021).[74]

To decrease greenhouse gas emissions, countries have the option to use various policy tools, such as climate policy instruments specifically designed for this purpose. Additionally, there are non-climate policy instruments that were not created for climate reasons but are still crucial to address the issue. Both types of instruments can be either price-based or not. Price-based instruments, such as carbon pricing, directly impact prices to incentivize market reactions. On the other hand, non-price-based instruments, like regulations for vehicle emissions and energy efficiency, impose restrictions on producers and consumers, limiting their options to reduce emissions.

[73] Op. Cit. OECD, *Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action*, p. 11.
[74] UNFCCC (2021), *Nationally determined contributions under the Paris Agreement: Synthesis report by the secretariat.* (FCCC/PA/CMA/2021/8). Available at: https://unfccc.int/sites/default/files/resource/cma2021_08_adv_1.pdf p. 6 [Accessed 28 March 2023].

Instruments that are not based on prices offer fewer options for market participants to decrease emissions, whereas climate policies based on pricing, such as explicit carbon prices, are among the available options.

Carbon taxes, which were initially introduced in the Nordic countries at the beginning of the 1990s, and tradeable GHG emission permits (or allowances), which were formulated by the European Union's (EU) emissions trading scheme (ETS), which has been in operation since 2005, are two examples of explicit carbon pricing. GHG emissions are effectively priced by carbon taxes and emissions trading systems since they are adjusted to a base that is proportionate to GHG emissions. Moreover, for instance, emissions-based vehicle taxes promote the adoption of more carbon-efficient automobiles but fail to account for the GHG emissions produced by their use. They have a significant impact on vehicle selection and can therefore promote the electrification of the fleet. Feed-in tariffs encourage the use of renewable energy sources, such as solar and wind power, for generating electricity, which can hasten the transition to a zero-carbon energy sector. They do not, however, expressly advocate against the consumption of fossil fuels for energy production. Similar to this, corporate income tax incentives can promote spending on carbon-neutral methods of production and consuming low-carbon or carbon-neutral products by providing selected activities with advantageous variations from a country's conventional tax treatment, even though they do not price GHG emissions.[75]

Climate-related factors are the driving force behind non-price-based climate policy tools (such as GHG emissions intensity regulations). Although they typically include expensive compliance procedures, they do not directly alter the costs of activities or assets. Not all policy initiatives that have an impact on reducing climate change are driven by environmental concerns.

Fuel excise taxes are one type of price-based device that is often used primarily for revenue-raising purposes while also discouraging the usage of fossil fuels. Subsidies for fossil fuel usage may be put in place to help needy households or energy-intensive enterprises, but they also make fossil fuel consumption less expensive, which raises GHG emissions. As a non-price-based device, air pollution regulations have the potential to reduce GHG emissions from the burning of fossil fuels, a major contributor to air pollution. In order to reduce climate change,

[75] Op. Cit. OECD, *Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action*, pp. 12 – 13.

it is economically and politically necessary to utilize a variety of policy tools, such as subsidies, legislation, and pricing.

This is due to at least two groups of factors. To achieve net zero, it is first necessary to get beyond the numerous market failures, inertia, and path dependencies that exist. Second, differing starting points, economic structures, and political, social, and legal restraints might influence a country's decision to pursue a particular course of action. Nevertheless, it is difficult to compare countries' climate change mitigation strategies in a systematic manner due to the diversity of approaches and overlap between instruments.[76]

Table 1: A provisional typology of some mitigations policies.

	Explicit carbon prices	Other price-based instruments	
Climate policy instruments (main policy motivation is to reduce GHG emissions)	Emissions trading systems	Emissions-based vehicle taxes Feed-in tariffs Feebates Tradable GHG emissions performance standards Corporate tax incentives	GHG emissions intensity standards Technology mandates or bans
Non-climate policy instruments (Other principal policy motivation but highly climate-relevant)	Carbon taxes	Fuel excise taxes Fossil fuel subsidies Electricity excise taxes Electricity subsidies Some industrial and agricultural and household subsidies	Air pollution standards Fertiliser regulations Fuel efficiency regulations

Source: OECD Pricing Greenhouse Gas Emissions.

In consideration of this premise, it appears evident that carbon pricing policies (carbon taxes and emissions trading systems) are the finest tools, on the grounds of efficiency, cost-effectiveness, and encouraging investments in clean technologies. However, design specifics are crucial. Comprehensive, revenue-generating, and socially beneficial policies are required. Additionally, transparent credit trading markets like a sizable number of market players and

[76] Op. Cit. OECD, *Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action*, p. 14.

institutions uphold property rights, and the price stability provisions are needed for emissions trading systems. Nevertheless, because of the costs to individuals and (trade-sensitive) companies, carbon pricing schemes can be difficult to implement. Compared to other tools, these burdens may be more severe. Packages of regulations can be a reasonable, but not ideal, intermediate solution in the absence of carbon pricing. But in order to keep costs in check, they need to be carefully planned to take advantage of all available chances for cost reduction across all sectors. It may be more effective to combine a number of "feebates", like tax, subsidy, and regimes, as this avoids the requirement for credit trading. Carbon pricing or comprehensive regulatory/feebate packages are typically preferable to other policies, such as renewable mandates, when used alone.[77]

But selecting the right instrument—or instruments—to cut CO_2 emissions is a difficult political choice. A variety of tools might be employed, from market-based tools like carbon taxes and cap-and-trade systems to regulations on vehicle emissions and fuel economy to incentives for renewable fuels.

Principal instruments for mitigating CO_2 emissions

As previously mentioned, *Carbon Taxes* and *Cap-and-Trade Systems* are the primary instruments to ease CO_2 emissions: carbon taxes should ideally be levied upstream in the fossil fuel supply chain in proportion to the amount of carbon in the fuels. They could also be imposed on CO_2 emissions from major factories; while cap-and-trade systems limit emissions by requiring covered businesses to possess permits for each ton of potential or actual emissions. The number of allowances is capped by the government, and a market price for allowances is established through trade among covered sources. Once more, these regulations could be implemented at the source of emissions releases or upstream to the carbon content of fuels.

Other instruments are the *Energy Efficiency Standards* and the *Emissions Standards*. The former, enacted for automobiles, establishes minimum standards for the typical fuel efficiency (kilometers per liter) of automobiles sold by various firms, or, nearly equivalently, a maximum rate for the typical CO_2 emissions per kilometer throughout automobile sales. Credit trading would ideally allow some producers (who specialize in huge vehicles) to fall below the norm by buying credits from others who go far beyond the standard. Additionally, standards can be

[77] Parry, I. W. (2012). Chapter 1. What Is the Best Policy Instrument for Reducing CO_2 Emissions? In *Fiscal Policy to Mitigate Climate Change*, USA: International Monetary Fund. Available at: https://doi.org/10.5089/9781616353933.071.ch001 [Accessed 13 April 2023] p. 1.

used to increase the energy efficiency of new structures, home appliances, and other durable products that use power. The latter establishes a cap on the maximum permitted CO_2 emissions per kilowatt hour (kWh), calculated as the average of all the generators' plants. Once more, flexibility can be achieved by allowing emissions-intensive generators to purchase credits from generators that exceed the criteria in order to fall short of the standard.
Renewable portfolio requirements, which set minimum percentages of renewables in a generator's fuel mix, feed-in tariffs, and subsidies for renewable production are all examples of policies to support the generation of electricity from renewable sources that characterize another tool for mitigating CO_2 emissions, the *Incentives for renewable fuels*.

Moreover, there are also the *Feebates* and the *Regulatory combinations.* Feebates, which apply fees to new cars based on how much their CO_2 emissions deviate from a "pivot point" level, apply rebates (or subsidies) to cars whose CO_2 emissions are lower than the pivot point. Similar feebates are used in the power industry, where generators are charged a fee per kWh in proportion to any difference between their average CO_2 per kWh and the pivot point, while generators with CO_2 per kWh below the pivot point receive a refund. Depending on whether the pivot point is below or at the industry average emission rate, feebates can be created to either increase revenue slightly or be revenue neutral.
Instead, the Regulatory combinations entail a collection of independent rules created to take advantage of many of the chances for emission reduction that would be taken advantage of under comprehensive emissions pricing. An emissions standard for the power industry and numerous criteria for the energy efficiency of automobiles and electrically powered appliances, for instance, might be included in the combination. Alternatively, a policy package containing the rules' feebate equivalents might be created. Finally, *Excise taxes on individual fuels, electricity,* or *vehicles* can be implemented.[78]

[78] Op. Cit. Parry, I. W., What Is the Best Policy Instrument for Reducing CO_2 Emissions? pp. 2 – 3.

Environmental effectiveness

Having said that, there are other relevant criteria to consider when selecting the best policy to reduce CO_2 emissions. *Inter alia*, policymakers may be concerned about:

- the *Effectiveness* (in regards to short-term CO_2 emissions reduction);
- the *Economic costs* (an economic approach is one that reduces the economic impact of a specific emissions reduction);
- the *Ability to deal with uncertainty* (regarding future fuel prices, the accessibility of technology that reduces emissions, and other factors);
- the *Distributional impacts* (how money is distributed across industries and income groups, which are important for fairness, competitiveness, and acceptability); and
- the *Promotion of clean technology development and deployment* (the development and use of clean technologies, which is important for long-term effectiveness).

Specifically, in this dissertation will be discussed only the first two criteria.[79]

In the first instance, the environmental effectiveness of a policy depends on its capacity to take advantage of opportunities for lowering (energy-related) CO_2 emissions throughout the economy. These possibilities regard mainly four groups:

1. the power sector fuel mix;
2. the power sector output;
3. the direct non-electricity fuel use in homes and industries; and
4. the transportation fuels.

The first group consider the possibility of lowering the average CO_2 emissions per kilowatt hour (kWh) of energy produced by transitioning from coal to fuels with lower carbon footprints (natural gas, fuel oil), or fuels with zero carbon footprints (nuclear, hydro, wind, solar, and geothermal). Moreover, technologies to increase plant efficiency, like lowering fuel requirements per kWh of generation, can also reduce emissions intensity, and carbon capture and storage (CCS) technology might someday show to be effective in limiting CO_2 emissions from fossil fuel plants. The power sector output instead aims to utilize electricity-savings

[79] For those interested in deepening all criteria, see Parry, I. W. (2012). Chapter 1. What Is the Best Policy Instrument for Reducing CO_2 Emissions? In *Fiscal Policy to Mitigate Climate Change*, USA: International Monetary Fund. Available at: https://doi.org/10.5089/9781616353933.071.ch001 pp. 14 – 20 [Accessed 13 April 2023].

innovations, like low-energy lamps, in order to reduce demand for residential, commercial, and industrial electricity need along with lessening the use of electrically powered appliances and machineries. The last two groups intend to reduce the direct use of fuels, like natural gas, in offices, companies, houses, and other buildings and to decrease the use of transportation fuels by lowering the number of miles that a vehicle travels and increasing the fuel efficiency of average vehicles, respectively. That being said, the level of effectiveness of market-based policies and direct regulations is considerably different. The first group of policies includes: comprehensive (upstream) policies, cap – and – trade systems, market-based policies with partial coverage (downstream), and other energy taxes. Instead, direct regulations comprehend: incentives for renewable generation, broader policies to decarbonize power generation, energy efficiency policies, and regulatory combinations (Table 2).

Table 2: Market-based policies and Direct regulations

Market-based policies	Comprehensive (upstream) policies	Cap-and-Trade system	Market-based policies with partial coverage (downstream)	Other energy taxes
Direct regulations	Incentives for renewable generation	Broader policies to decarbonize power generation	Energy efficiency policies	Regulatory combinations

Source: OECD Pricing Greenhouse Gas Emissions.

Market-based policies

Analyzing the market-based policies, it emerges that *Comprehensive (upstream) policies* represent a highly successful policy for lowering CO_2 emissions. It consists of a carbon tax, imposed upstream in the fossil fuel supply chain, which is proportional to the amount of carbon of each fuel. The potential emissions of CO_2 from subsequent fuel combustion are completely covered by this tax mechanism. If the carbon tax is carried forward, it raises the cost of electricity as well as fossil fuels, particularly coal but also natural gas and petroleum goods. All of the aforementioned alternatives for reducing emissions are encouraged by the rising energy prices.

Regarding the *Cap – and – Trade systems*, these are almost equally effective in the long run because they can be applied to the same base as the carbon price. In other words, the policy will take advantage of the same potential for emissions reduction under the carbon tax as the value of allowances (i.e., the emissions price) is reflected in fuel and power costs.
Another option is represented by those *Marked-based policies imposed on the release of CO_2 emissions*. Unless they are supplemented with actions concerning fuels for transportation, domestic heating fuels, and modest factories, these policies are less successful at lowering emissions than upstream systems. For instance, the EU Emissions Trading Scheme alone accounts for nearly half of the CO_2 emissions associated with the energy sector.[80]

Finally, there are other energy taxes that have less impact on CO_2 emissions. *Excise tariffs* on household and commercial power consumption only take advantage of one of the four primary potentials for emissions reduction. Even within the transportation industry, taxes on vehicle ownership are ineffective; they do not motivate people to use a particular vehicle less and may not even significantly increase demand for fuel-efficient vehicles. A coal tax also misses out on some opportunities that a carbon price takes advantage of, such as the switch from natural gas and fuel oil to nuclear power and renewable energy sources, as well as mitigation measures outside the power sector. This is true even though a coal tax is successful at cutting the most carbon-intensive fuel.

Direct regulations

Before exploring the level of effectiveness of direct regulations, it is relevant to note that with the same implied CO_2 pricing as the market-based instruments, direct regulations on their own are likely to have a very modest impact. To approach the efficacy of comprehensive market-based policies, these tools must be coupled in comprehensive policy packages.
Compared to comprehensive pricing plans, incentives for *Renewable generation policies* alone are not very effective. They make little effort to cut emissions beyond the power industry. Given that they do not entail the transfer of carbon tax income or allowance value in increased generating prices, they at best provide very minimal incentives for electricity saving. Additionally, they do not use the emissions savings from moving from coal to natural gas and fuel oil or from these fuels to nuclear inside the power industry.

[80] Op. Cit. Parry, I. W., What Is the Best Policy Instrument for Reducing CO_2 Emissions? pp. 4 – 6.

Among the *Broader policies to decarbonize energy production*, an industry-wide standard for CO_2 per kWh is a better strategy than a renewables incentive program since it promotes all potential changes to the generation mix to reduce CO_2 emissions, rather than just switching to renewables, as well as increases in plant efficiency. To keep their expenses down, these regulatory measures must be supplemented by comprehensive credit trading provisions. The emissions standard also has a pricing option known as a feebate. This strategy takes advantage of the same CO_2 per kWh reduction incentives as an emissions standard but with a few potential cost-effectiveness benefits. The feebate is roughly equal to a tax on carbon emissions from the power sector, with money going toward paying an electricity production per-unit subsidy. The feebate generally has a higher influence on power costs if the pivot point is lowered (i.e., the threshold CO_2 per kWh that determines whether businesses pay fees or receive rebates; this is because more generators are paying fees than are receiving subsidies).

Further, *Energy efficiency policies* can also lower the demand for power and direct fuel consumption, by imposing criteria for energy intensity. Efficiency standards are less successful than market-based carbon measures in reducing emissions in the power sector. The lack of incentives offered by efficiency standards for power generators to lower CO_2 emissions per kWh may be the most significant factor.
Another problem is that they do not promote a decrease in the consumption of products and durables that consume a lot of energy. Because the transportation industry uses a large amount of oil-based fuels, efficiency standards are nearly equal to CO_2 standards. These tools are less effective than market-based regulations. By increasing fuel costs per kilometer, higher fuel prices encourage consumers to drive less and to purchase more fuel-efficient cars: fuel economy standards (feebates or CO_2 standards) only make use of the latter margin of behavior, which, on average, could diminish their effectiveness in comparison to a fuel tax by roughly 50%.

On the other hand, to match the environmental effectiveness of comprehensive market-based policies, *Regulatory combinations* including a set of actions to lower the emissions intensity of power generation and improve the efficiency of major energy-using durables can be quite far-reaching.

However, even with these combined policies, not all opportunities for emission reductions, particularly reductions in the use of cars and other energy-consuming durable goods, will be realized.[81]

The cost-effectiveness of policy instruments

The economic cost, namely the cost-effectiveness, of policy instruments is another principle that policymakers have to evaluate in the process of selecting an efficient policy. Basically, a cost-effective action reduces emissions to a specific level at the least expensive overall to the economy. This is important not only for its own purpose but also to increase the likelihood that the policy will be maintained over time. The expenses of all the various, individual steps taken to reduce emissions are summed up in the economic costs of an emissions mitigation program (leaving the benefits to the environment out of consideration). These might comprise, for instance, direct costs associated with the production of energy using more expensive but cleaner fuels. Additionally, they take into account the less evident expenditures that households incur as a result of driving less or using less energy-intensive equipment than they would like.

Market-based and regulatory policies: a first glance.

Market-based regulations are economical in that they set a uniform price for all sources of emissions that fall under their purview. All businesses and households are therefore given the same incentives to change their behavior in order to reduce emissions, but only up to the point where the price of emissions is equal to the cost of the last ton reduced (for example, the cost of switching to additional fuel in the power sector or the cost to drivers of skipping trips). For carbon trading systems to be cost-effective, fluid markets are necessary, which may not be feasible in nations without institutions for upholding property rights or lacking a significant number of market participants.[82] It should be noted that, however, market-based policies, whether or not they include complete coverage of emissions such as, for example, taxes on electricity or certain fuels, are referred to herein as cost-effective since they reduce costs within the energy sector for the emission decreases that they accomplish.[83] In addition to their circumscribed effectiveness, regulatory measures like emissions regulations and energy efficiency standards may also work weakly from a cost-effectiveness perspective if they require

[81] Op. Cit. Parry, I. W., What Is the Best Policy Instrument for Reducing CO_2 Emissions? pp. 6 – 8.
[82] Op. Cit. Parry, I. W., What Is the Best Policy Instrument for Reducing CO_2 Emissions? pp. 8 – 9.
[83] Comparing policies' costs for the same efficacy in terms of emissions reduction is a different form of comparison. In this type of comparison, market-based solutions that only partially cover emissions are not thought to be cost-effective. Instead of reaching the cost-effective balance of decreases amongst all emissions sources, they lay an excessive amount of burden on covered sources and none at all on other sources in order to accomplish the same emissions reduction as under the policy with full coverage.

all companies to fulfill the same benchmark. For instance, a generator that depends significantly on coal will find it more expensive than a generator that relies less on coal to fulfill a standard for average CO_2 per kWh. Extensive credit trading provisions must be included with these requirements in order to promote cost- effectiveness. By acquiring credits granted to another producer whose CO_2 per kWh was lower than the standard, the coal-intensive generator would be able to exceed the standard and have CO_2 per kWh higher than it otherwise would. However, using pricing variations of these regulations is an easier way to enhance cost-effectiveness without the need for any credit trading. To give an example, in the case of the energy sector feebate, coal-intensive producers would choose to pay government fees (and produce more CO_2 per kWh above the pivot point), whereas comparatively clean generators will earn rebates (for producing less CO_2 per kWh under the hinge point).

However, it is crucial that the additional subsidy obtained by relatively clean/energy-efficient producers for lowering CO_2 by a ton is the same as the tax savings experienced by relatively dirty/energy-inefficient producers. If not, because they receive differing rewards for decreasing emissions, the two categories of producers will have an unnecessarily expensive pattern of emissions reductions. More generally, to put a unique price on CO_2 emissions throughout the economy, a regulatory combination must not only enable credit trading within sectors but also across sectors in order to be cost-effective. Without a single price, there is the possibility that one sector will be responsible for too much of the cost of emissions reductions while another may bear too little of the burden.

Comprehensive carbon taxes and cap-and-trade programs with allowance auctions offer a possible substantial source of yearly government income—possibly on the order of 1% of GDP for the US and over 2% for China. Beyond the prices in the energy markets, how this revenue is employed will have an immense effect on the overall costs of the market-based policy (Figure 3). Carbon taxes and cap-and-trade systems with allowance auctions are expected to have favorable overall costs even though, to a certain extent, environmental advantages will be far more than these costs. This is due to the fact that the benefits of revenue recycling are offset by a negative effect. As carbon taxes and cap-and-trade systems raise energy prices, they tend to decrease overall economic activity (although very poorly), and therefore it has a poorly waning effect on employment and investment.[84]

[84] Op. Cit. Parry, I. W., What Is the Best Policy Instrument for Reducing CO_2 Emissions? pp. 9 – 11.

A Closer Look at Cost-Effectiveness

The fundamental argument is that how revenues are used can significantly affect how much market-based instruments ultimately cost. The cost of implementing a policy is significantly reduced if the profits from carbon taxes are put to socially beneficial uses, such as funding socially desired spending or lowering other economies' tax distortions. In the same way, allowances must be auctioned and the earnings must be put into constructive employ for cap-and-trade systems to be profitable. If, instead, the allowances are distributed free of charge to the industry in the form of a single payment, the overall (net) costs of the policy are significantly higher, as a revenue recycling benefit is waived. Actually, since most of the allowance prices are usually paid by consumers in the form of higher energy costs rather than by industries in the form of lower producer prices, distributing all allowances free to the industries involved will actually vastly overcompensate them. Certain regulatory combinations might theoretically outperform market-based approaches in terms of total cost-effectiveness if income from taxes or cap-and-trade is not applied wisely.

An advantage of regulatory tools in this regard is that they often have a smaller impact on energy costs than market-based measures since they do not entail the shifting of tax revenues or allowance rents in price hikes. As a result, regulatory policies have a lower potential detrimental effect on the economy as a whole than market-based strategies that do not take advantage of the positive effects of revenue recycling. The most cost-effective strategy for the majority of nations is a carbon tax or auctioned cap-and-trade system with income used to reduce more expansive disproportionate taxes, both directly and indirectly through decreasing deficit (which prevents the need to raise other taxes).[85]

[85] Op. Cit. Parry, I. W., What Is the Best Policy Instrument for Reducing CO_2 Emissions? pp. 12 – 14.

2.2 A spotlight on the European Union Emission Trading System and its energy taxation

Emission taxes and command-and-control strategies have always characterized European environmental policy. However, the discussion regarding a European trading system was supported by the political atmosphere following the Kyoto Protocol debates, where emissions trading was mentioned as one of the potentials "flexible mechanisms", in conjunction with the Clean Development Mechanism (CDM) and Joint Implementation (JI).

As already mentioned in the previous paragraph 2.1, in an emissions trading scheme, the total amount of GHG emissions from one or more economic sectors is restricted or capped. Then, a government auctions or grants tradable emission allowances—each representing the right to emit a specific volume of emissions (usually a metric ton of carbon dioxide equivalent)—to entities covered by the emissions cap. The sum of the allowances equals the emissions cap. During a conformity phase, covered entities are compelled to give up their emission allowances. They have the option to sell extra allowances or purchase more if necessary. This form of policy is sometimes known as a "cap-and-trade" system.[86]

EU Emission Trading System

In March 2000, the European Commission released its Green Paper on GHG Emissions Trading, which marked the start of the first in-depth consideration of a system of tradable permits. To develop ideas about how the system may work and whether it might be attainable, many working groups were formed. The European Commission published a proposal in October 2001 suggesting the implementation of a GHG emissions trading system across the European Community to allow certain industries and companies to exchange their allocated amounts of CO_2 emissions. This plan of action was constructed on the outcomes and suggestions of all working groups. After being published, the proposal required two years of revisions before being enforced in October 2003. The European Union Emission Trading System (EU ETS), the largest emissions trading scheme in the world and the core component of EU efforts to decrease greenhouse gas emissions, ultimately went into effect in January 2005. Each country set an emission-reduction target for 2012 in conformity with the Kyoto Protocol's burden-sharing agreement.

[86] Op. Cit. The World Bank, *State and Trends of Carbon Pricing 2022*, p. 13.

The EU ETS developed a first warm-up period from 2005 to 2007 and an implementation phase from 2008 to 2012, which is linked with the Kyoto Protocol fulfillment term.

The EU has established the ETS as a legally binding requirement. That is, it must be adopted by all member states and, indeed, its participation is a prerequisite for new nations before they are eligible to join the EU. Approximately 12,000 installations in the heat and power production companies as well as in a few energy-intensive industrial sectors are a part of the EU ETS as it operates at the present time. These installations are responsible for 30% of all EU greenhouse gas emissions and roughly 45% of EU CO_2 emissions.

The fact that the EU ETS program is both centralized and decentralized is one of its most intriguing aspects. At one end, the European Commission, the primary authority, specifies who will be involved in the market and makes an effort to set the number of permits that will be issued, the way that allowances will be allocated throughout the many different emission sources, and the fulfillment and trading criteria. On the other hand, the distribution of permits inside each of the 25 member states' borders is their responsibility. A National Allocation Plan (NAP) specifies how many allowances will be allocated in each nation. Following that, the sum of all member state distribution plans determines the overall cap in the EU trade system.[87]

The overall number of allowances requested by each member must be less than predictions based on business-as-usual, and NAPs must not prevent the EU from meeting the target outlined in the Kyoto Protocol's burden-sharing agreement. These are just two of the requirements that must be met by NAPs to be compliant with the EU.

Phase I (2005-2008)

However, the creation of the NAPs proved to be a difficult and contentious process that was occasionally marked by lobbying and strategic exchanges between the EU Commission, member states, and the business community. Due to the fact that not all NAPs were submitted simultaneously, worries of a "race to the bottom" among member state allocations were intensified. For instance, the UK NAP was released early and is widely regarded as being fairly restrictive. The UK submitted a request to revise its NAP and boost its allocation quantities whenever other member nations' NAPs were released and revealed to be milder. The proposal was denied by the Commission, but the instance shows that member states' strategic behavior is present in the allocation process. The solution to this issue would be a centralized allocation at the European level, or at the very least a consensus on the overall volumes to be assigned.

[87] Sterner, T. and Coria, J. (2012) *Policy Instruments for Environmental and Natural Resource Management*. 2nd edn. New York: RFF Press. pp. 93-94.

Early evaluations suggested that the allocation was still too permissive, and the trading system was criticized as being insufficiently stringent even before it became operational, despite the European Commission's decision to lower the proposed amounts for Phase I in 14 of the 25 NAPs presented by the member states—representing about 5% of the total cap.

Phase II (2008-2012)

Nevertheless, prices for emission allowances (EUA) in the first year of trading were higher than several analysts were expecting, reaching a peak of almost 30 €/ton early in 2006. However, once the first statistics on confirmed emissions in 2005 indicated that the market was oversupplied with allowances, prices began to drop sharply in 2006. EUA prices did not immediately drop to zero, despite the fact that this is the most obvious explanation for the price break. Furthermore, it took another year for the prices to drop to near-zero levels because it became increasingly obvious that the initial trial period's demand would not be increased due to weather or other circumstances. As member states finalized their NAPs for Phase II, the European Commission frequently emphasized its desire to increase the cap for the second trading period since extremely low allowances prices in Phase II (2008–2012) might substantially undermine the credibility of the trading scheme. By the beginning of October 2007, the European Commission had finished reviewing the NAPs for the current 27 member states. The evaluated NAPs were reduced overall by 10.4% below the member state-proposed caps, resulting in an overall limit of 2.1 billion tons. This translates to a reduction of 6.0% below certified emissions for 2005.[88]

Phase III (2013-2020)

The EU has pledged to reduce its overall emissions by at least 20% below 1990 levels by 2020 on the path to Phase III, and it is willing to increase this reduction to as high as 30% under a new global climate change accord, providing that other industrialized nations make equal efforts. Additionally, it established a goal of boosting energy efficiency by 20% and the share of renewable energy in overall EU consumption to 20% by 2020, with a 10% objective for biofuels in car fuel. Additionally, the package aims to encourage the advancement and responsible application of carbon capture and storage (CCS). Crucial to the EU's agenda is enhancing and broadening the EU ETS. The European Commission released a package of legislative recommendations outlining its plans to attain climate neutrality in the EU by 2050

[88] Op. Cit. Sterner, T. and Coria, J., *Policy Instruments for Environmental and Natural Resource Management*, pp. 94 – 95.

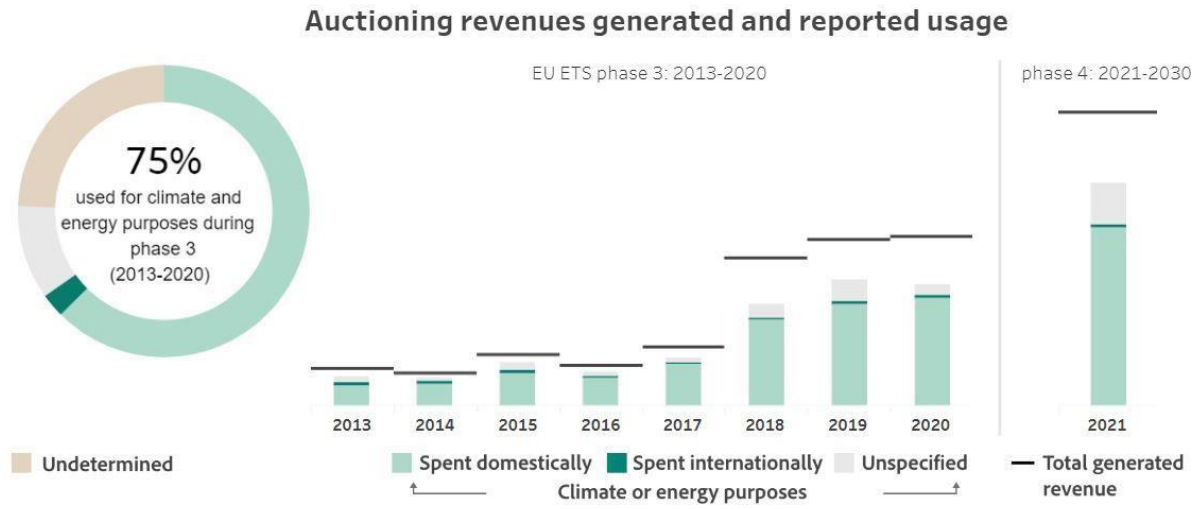
on July 14th, 2021. Among these ideas was the intermediate goal of at least a 55% net reduction in greenhouse gas emissions by 2030. Several pieces of EU climate legislation, notably the EU ETS, are proposed to be revised as part of the package, which outlines concrete methods the Commission aims to meet EU climate targets under the European Green Deal.[89]

Phase IV (2021-2030)

The EU ETS administered industries must lower their emissions by 43% from 2005 levels in order to meet the EU's total greenhouse gas emission reduction objective for 2030. This will be made possible through a variety of related measures that will be part of the updated EU ETS Directive, which will be in effect from 2021 to 2030. The updated EU ETS Directive offers clear, strong, and equitable regulations to reduce the danger of carbon leakage. The free allocation mechanism has been amended to concentrate on the industry's most at risk of moving their output outside of the EU and will be extended for another ten years. These industries will be given their entire quotas for free. Free allocation is expected to gradually disappear for less vulnerable sectors from 2026, going from a ceiling of 30% to 0 at the conclusion of Phase IV (2030). To better match the degree of free allocation with the real output levels, more accommodating rules have been established: each year, allocations to specific installations may be changed to reflect pertinent output gains and losses; every five years, the list of installations that are subject to the Directive and suitable for free allocation will be updated; and finally, Phase IV will include two revisions to the benchmark values that determine the amount of free allocation to each installation in order to prevent unexpected gains and account for advancements in technology since 2008. Over the course of 2021–2030, the industry is scheduled to get an overall of over 6 billion allowances for free.[90]

[89] European Commission. *Climate Action. Revision for Phase IV (2021-2030)*. Available at: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/revision-phase-4-2021-2030_en [Accessed 16 April 2023].
[90] Ibidem.

Figure 3: Auctioning generated and reported usage.



Source: Database Environmental and Energy Agency (EEA, 2023).

EU Energy taxation

On the other hand, in the European Union, taxes constitute a sizable portion of the final costs' customers pay for energy. Taxes can have a significant influence on both investment and consumption structures, as well as the types of energy used and how they are employed. This is reflected in the various energy taxation rates across the EU, which vary significantly depending on whether an energy source is used for residential or industrial purposes, the type of energy used (diesel or other fuels for transportation, for example), and the rate itself, which has little bearing on the energy content or externalities like CO_2 emissions or air pollution.[91] Actually, fuel taxes are not typically enforced for environmental purposes, and they are not the best tools for addressing the extensive range of environmental issues connected to road transportation. Even though the tax should only be applied to fossil fuels and not just the transportation industry, they are almost ideal for global climate challenges. Good empirical evidence demonstrates how effective gasoline taxes are because of how they have changed over time and across countries. For taxes to be effective on the environment, there need not be an environmental objective. So, although environmental considerations may have had some influence on the development of these taxes, the main driver is likely the simplicity of tax administration.[92]

[91] European Commission. *Energy taxation*. Available at: https://energy.ec.europa.eu/topics/markets-and-consumers/energy-taxation_en [Accessed 16 April 2023].
[92] Op. Cit. Sterner, T. and Coria, J., *Policy Instruments for Environmental and Natural Resource Management*, pp. 285 and 78.

Even within develop market economies, domestic fuel costs vary widely, primarily as a result of various tax rates. Sometimes, the cost of gasoline in the United States, for example, is only 25% of what it is in a number of European nations. Prices are cheaper than in Europe in both Canada and Australia. Taxes vary widely across nations, even those in the OECD. Even though the EU requires a minimum fuel tax level, fuel fiscal measures are established at the national level, leading to a variety of fuel regimes across EU members. The variances in tax rates are the main cause of the significant country-to-country variations in domestic fuel costs in Europe. In many nations, diesel is typically far less expensive than gasoline. There could be a number of causes for this. Diesel used to be favored over gasoline since it is typically more energy efficient and was thought to produce fewer hazardous exhaust emissions; however, more recent research has shown that diesel is dangerous for human health and that particulate matter (PM) plays a role in this. Diesel fuel was therefore preferred until catalytic converters lowered the pollutants from gasoline engines. When policies were being developed, energy efficiency weighed more heavily than health concerns, and diesel was more efficient (which was also a plus for global warming). Since there are now more worries about the health impacts of PM, diesel will likely receive more attention.

Fuel taxes are shown to be a successful policy. More than any other instrument, including the EU emissions trading system (ETS), fuel consumption has been reduced so sharply in the EU, Japan, and elsewhere that it has actually had a sizable and significant impact on the atmospheric carbon content. Even though each nation has unique characteristics, demand for gasoline is often responsive to price—and consequently to taxation. In the short term, the reaction is not very good, but it is in the long term.

Fuel taxation is a potent tool for reducing fuel use, but it cannot be used without taking into account the costs and accessibility of alternatives, such as public transportation, and it is not always simple to follow an independent tax policy without taking into account the policies of surrounding nations. Finally, the majority of transportation-related externalities are not best addressed by gasoline taxes. They would be an effective tool for combating global warming if they were based on the amount of fossil fuel in the fuel. [93] Energy taxes can aid the EU in achieving its environmental and climatic goals by promoting the switch to cleaner energy sources and environmentally friendly business practices.

[93] Op. Cit. Sterner, T. and Coria, J., *Policy Instruments for Environmental and Natural Resource Management*, pp. 286 – 290.

To connect the taxation of energy products with the EU's current energy and climate objectives, the EU intends to amend the present energy taxation regulation as part of the Fit for 55 package.[94]

Update the Energy taxation directive

A proposal to update the Energy Taxation Directive (ETD) was presented by the European Commission in July 2021. The proposal seeks to ensure greater consistency between various EU policies and to assist in reaching the EU's medium- and long-term energy and climate goals, including the Green Deal. The idea accomplishes this by more properly representing the environmental effect of different energy sources while also incentivizing customers and businesses to modify their behavior. The plan has three primary goals: harmonizing electricity and energy product taxes with EU energy and climate policy in order to facilitate the EU meet its 2030 goals and achieve carbon neutrality by 2050; safeguarding the ability of Member States to raise revenue by updating the range and structure of rates; as well as by rationalizing the use of voluntary tax exemptions and reductions. An Impact Assessment, which examined the effects of various policy alternatives and, based on its findings, chose the best option, was included with the proposal and its Annexes. The Impact Assessment was used to help the Commission choose the best policy option to forward. The plan was supported by an Open Public Consultation, which attracted over 200 responses from various stakeholders, including major manufacturers, airlines, and ordinary people. A specific ad-hoc Working Group of the Council is now debating the idea with the participation of Member States.[95]

The Energy Taxation Directive (ETD) establishes EU regulations for the taxation of energy goods as well as electricity used as fuel for vehicles or heating systems. The Directive has been in effect for nearly 20 years in its current version after being adopted in 2003. A change to the Directive was suggested by the Commission in 2011. Members of the European Council, though, were unable to reach a consensus on the amendment. The EU's foreign commitments, particularly the Paris Agreement in 2015, have changed significantly as the energy markets and technological developments have seen substantial advancements. The Commission began the process of rewriting the Directive in 2019. The Commission issued its assessment of the Energy Taxation directive as the first step in the legislative process in September 2019. Its conclusion

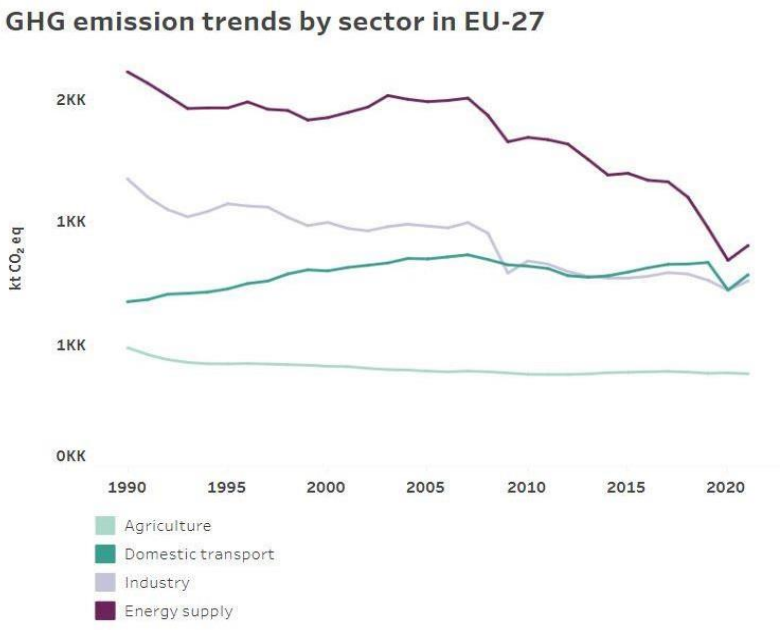
[94] European Council and Council of the European Union. *Infographic - Fit for 55: how the EU plans to revise energy taxation*. Available at: https://www.consilium.europa.eu/en/infographics/fit-for-55-energy-taxation/ [Accessed 16 April 2023].

[95] European Commission. Taxation and Customs Union. *Review of the Energy Taxation Directive (proposal)*. Available at: https://taxation-customs.ec.europa.eu/taxation-1/excise-duties/review-energy-taxation-directive-proposal_en [Accessed 16 April 2023].

is unmistakable: the EU Energy Taxation Directive is outdated and not consistent with the EU's goals for the internal market and the environment. As a result of the examination, it was determined that: the ETD does not support energy efficiency, alternative low-carbon/sustainable fuels, or emission reductions; the ETD does not offer enough incentives for investments in green technologies, and it is inconsistent with other EU policies on climate change (the EU Emission Trading System, the Renewables Directive, and the Energy Efficiency Directive); and, a broad spectrum of sectorial exceptions and diminutions carried out by Member States *de facto* promotes the consumption of fossil fuels.[96] The amendment of the energy taxation regulation, which the EU is now working on, is anticipated to play a significant part in the EU's attempts to move toward a greener future by guaranteeing that the most polluting fuels are taxed the most heavily. It tries to give producers, users, and consumers the proper incentives to adopt sustainable behaviors. By ensuring that the taxation of various energy products mirrors their environmental impact, the amended guideline can encourage companies to make more environmentally friendly decisions.

In the EU, energy is the cause of 77% of greenhouse gas (GHG) emissions (Figure 4).

Figure 4: Greenhouse gas emissions by sector 1990 – 2020.



Source: Database Environmental Energy Agency (EEA).

[96] Op. Cit., European Commission. *Review of the Energy Taxation Directive (proposal)* [Accessed 16 April 2023].

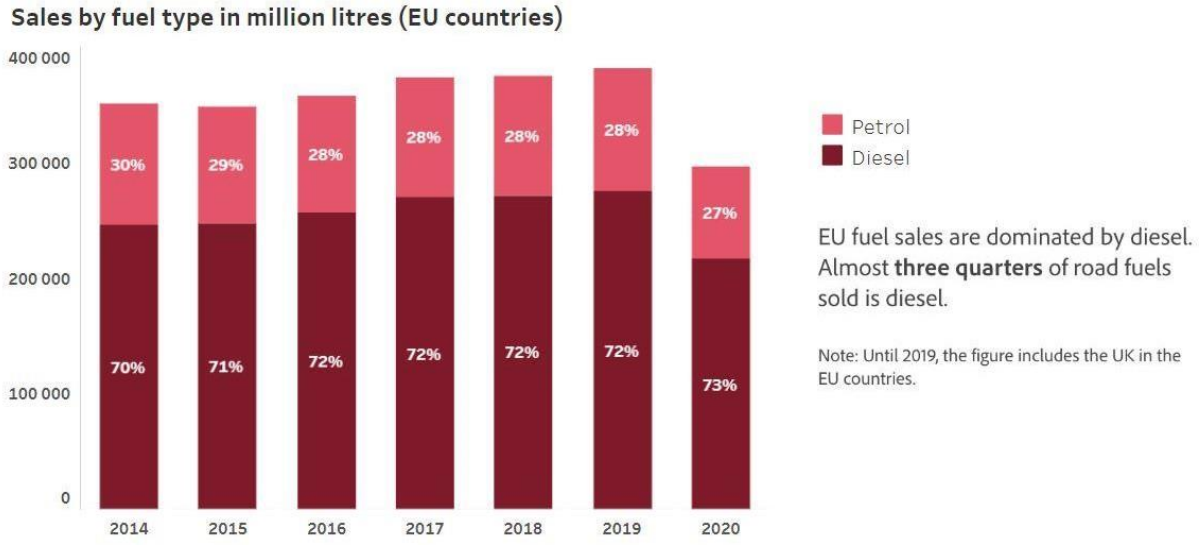
By assuring that the taxation of electricity, transportation fuels, and heating fuels in the EU reflects their effects on the environment and our health, revised regulations will assist the EU to achieve its climate goals. This will promote a shift to greener energy, more ecologically friendly solutions, and more sustainable industries. The proposed Energy Taxation Directive update concentrates, above all, on two key areas: tax rate structures and expanding the tax base. So, regarding the former, the minimum tax rates ought to be determined by the actual energy content and environmental impact of fuels and electricity, instead of relying solely on volume; the latter concerns the enlargement of taxable products as well as the elimination of some of the current exclusions and discounts.

On the contrary, currently, the final cost of energy products is heavily influenced by taxes, which vary across consumers, like businesses or families, energy types such as electricity or gas, and Member States. In 2017, they accounted for an average of 31% of the cost of heating oil, 25% of the cost of gas, and 40% of the cost of electricity for homes. The industrial sector, for competitiveness reasons, is normally taxed less than families: the average industrial client pays 13% of the gas price in taxes, while major users only 6%, and about 34-38% in taxes on electricity. The impact of taxes on pricing also varies greatly between Member States; for example, household taxes on electricity and gas can vary between 7% to 70% and 10% to over 60%, respectively. Fuel taxes constitute 60% of the cost of gasoline and 55% of the cost of diesel, with variations amongst Member States extending from 50% to 66% for gasoline and 45% to 60% for diesel. Due to significant tax exemptions or discounts that Member States apply to certain customers or purposes of these products, tax rates vary significantly between people and industries. Products like electricity, gas, and oil are taxed at wildly varying rates amongst Member States, which may not accurately reflect their energy content.[97] When analyzing the average rates per MWh, gas and diesel are taxed at 94 and 73 euros per MWh, respectively, while heating oil is taxed at 25 euros per MWh and gas is taxed anywhere from 2 to 15 euros per MWh (for families and large industrial consumers). In contrast, energy costs an average of 28 euros per megawatt- hour (MWh) for major industries and 80 euros per MWh for modest

[97] The actual Energy Taxation Directive (ETD) advises Member States to tax energy items in accordance with their energy content, but it does not impose that requirement. The taxes on energy estimated here pertain to "pure fuels," not the actual mixed fuels available at the petrol station (for example, gasoline and diesel contain some proportion of biofuels).

households in the EU.[98] Taxes frequently fail to properly account for the external costs connected to the production and utilization of fuel. For instance, even if the external costs of various heating generation technologies vary greatly, the average excise tax for heat from heating oil for homes is roughly 8 €/MWh and the average tax for heat from natural gas is around 5.5 €/MWh6. Excise rates for coal used for home heating are often less than or equal to the minimum rate (1€/MWh) and less than 5€/MWh in most nations. Additionally, the excises for the heat produced by industrial fuels are just 6 €/MWh. As a result of tax benefits that have persisted over the past 10 years in the EU and totaled over €40 billion in 2016, the existing taxation system encourages the use of fossil fuels. The Energy Taxation Directive, in particular, is responsible for a significant portion of these tax benefits, which include tax breaks for fossil fuels used as heating and transportation fuels (Figure 5).[99]

Figure 5: EU fuel sales 2014 – 2020.[100]



Source: Database Environmental Energy Agency (EEA, 2023).

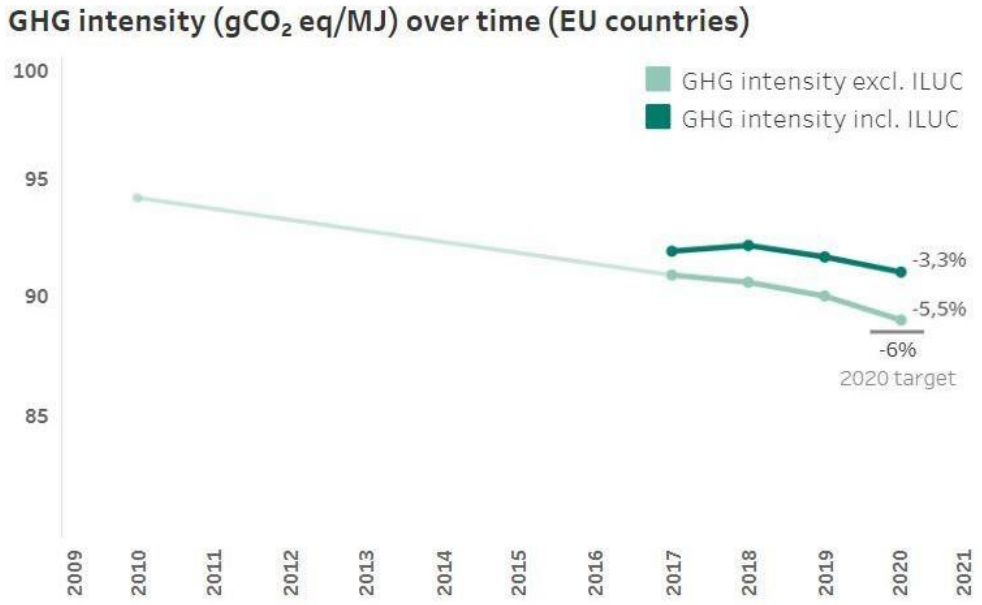
[98] European Commission. *Factsheet on energy taxation*. Available at: https://energy.ec.europa.eu/system/files/2019-07/qmv_factsheet_on_taxes_0.pdf [Accessed 16 April 2023] pp. 1-2.

[99] Op. Cit. European Commission, *Factsheet on energy taxation*, pp. 2 – 3.

[100] Monitoring the quality of gasoline and diesel used for road transportation in the EU is the goal of the EU Fuel Quality Directive (FQD). Additionally, it established the maximum and minimum sales quantities for the fuels that could be marketed in the EU. The directive also establishes a reduction goal for the greenhouse gases released throughout these fuels' lifecycle, from extraction to processing to distribution.
For more information about this Directive, see European Parliament and Council of the European Union (2009) Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC (Text with EEA relevance). *OJ*, L 140/88, 5 June, pp. 88 – 113.

In this regard, not only the implementation of the package Fit for 55, and consequently the Review of the Energy Taxation Directive, is extremely important to achieve the EU climate goals, but also the effort sharing between Member States is equally essential, due to the fact that energy products like gas, oil, and electricity are taxed differently and often without taking into account the level of pollution produced, as shown in Figure 6.

Figure 6: Greenhouse gas intensity of fuels.[101]



gCO_2eq/MJ means grams of CO2 equivalents per megajoule of energy produced

Source: Database Environmental Energy Agency (EEA, 2023).

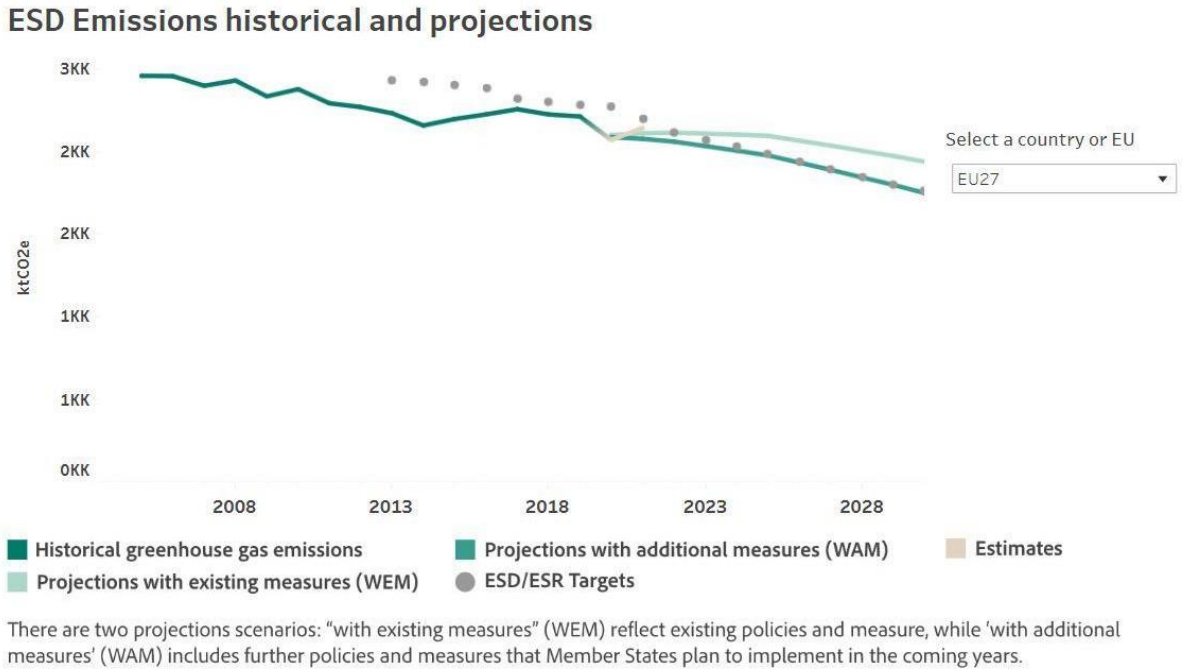
In accordance with the law, as it stands, EU Member States must adhere to binding yearly greenhouse gas emission targets for the period 2021–2030 for all economic sectors that are not included by the EU Emissions Trading System (EU ETS). These industries—which include trash, non-ETS industry, buildings, and transportation—account for over 60% of all domestic emissions in the EU. The European Commission released a package of legislative recommendations outlining its plans to attain climate neutrality in the EU by 2050 on July 14th, 2021. Among these ideas was the intermediate goal of at least a 55% net reduction in greenhouse gas emissions by 2030. The package calls for updating a number of EU climate laws, including the EU Emissions Trading System (ETS), the Effort Sharing Regulation,

[101] By 2020, the GHG intensity of transport fuel must be at least 6% lower than it was in 2010 (excluding indirect land use changes - ILUC), according to the FDQ, which sets a target for fuel suppliers. The EU is not on schedule to reach its goal in 2020.
*Data for GHG average intensity in 2017 relied on only 22 Member States, and until 2019 the graph includes also UK.

transportation, and land use laws, and lays out in concrete terms how the Commission plans to meet EU environmental goals under the European Green Deal. EU leaders announced a legally binding goal in October 2014 to reduce domestic emissions by at least 40% by 2030 compared to 1990. They stipulated that in order to contribute to the overall goal, areas of the economy that are not included by the EU ETS must decrease emissions by 30% by 2030 compared to 2005. Based on the guiding principles of equity, cost-effectiveness, and environmental integrity, the Effort Sharing Regulation transforms this promise into legally enforceable yearly greenhouse gas emission targets for each Member State for the years 2021–2030.[102]

The Effort Sharing Decision is a component of the EU's 2020 framework for energy and climate policy. In terms of percentage changes from 2005 levels, it establishes national emission objectives for 2020 (Figure 7).

Figure 7: Effort Sharing Decision - Historical emissions and projections.



Source: Database Environmental Energy Agency (EEA, 2023).

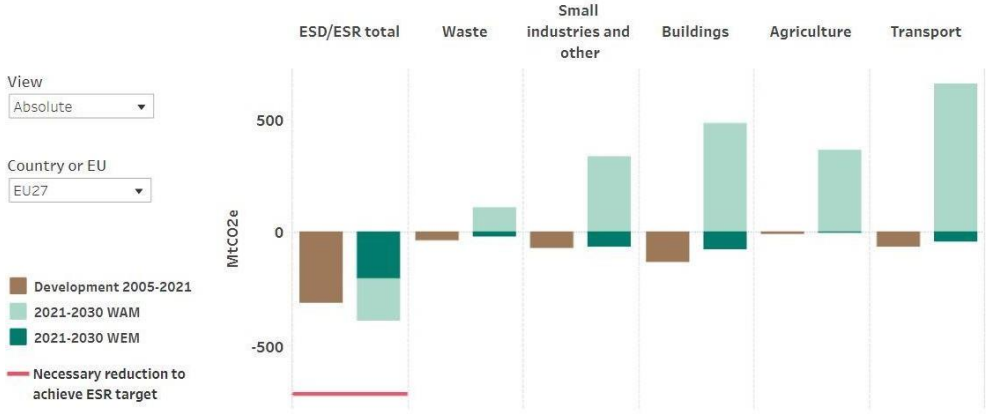
It also specifies flexibilities and how to calculate annual emission allocations (AEAs) in tons for each year from 2013 through 2020. The national objectives are based on the corresponding wealth of Member States as indicated by GDP per capita. Because their relative higher

[102] European Commission. Climate Action. *Effort sharing 2021-2030: targets and flexibilities*. Available at: https://climate.ec.europa.eu/eu-action/effort-sharing-member-states-emission-targets/effort-sharing-2021-2030-targets-and-flexibilities_en [Accessed 16 April 2023].

economic growth is anticipated to be a greater emission driver and because of their relative lower investment capacities, less developed nations have more modest targets. The national emission objectives for 2020 vary from a 20% decrease (based on 2005 levels) for the wealthiest Member States to an increase (from 2005 levels) of 20% for the least wealthy Member State. Member States are in charge of national policies and methods to control emissions from areas covered by Effort Sharing legislation (Figure 8), in contrast to sectors included by the EU ETS, which are governed at the EU level.

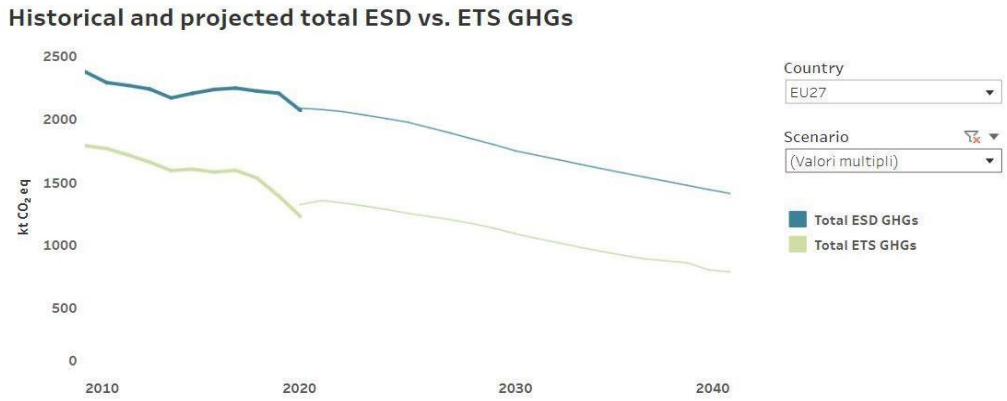
Possible policies and measures examples include: enhancing public transportation, a transition away from fossil fuel-based transportation, improved heating and cooling techniques, environmentally friendly farming techniques, and use of renewable energy for heating and cooling (Figure 9).[103]

Figure 8: Historical and projected developments in ESD.



Source: Database Environmental Energy Agency (EEA, 2023).

Figure 9: EU ETS and Effort Sharing emissions.



Source: Environmental Energy Agency (EEA, 2023).

[103] European Commission. Climate Action. *Effort sharing: Member States' emission targets*. Available at: https://climate.ec.europa.eu/eu-action/effort-sharing-member-states-emission-targets_en [Accessed 16 April 2023].

REPowerEU plan

Another prominent energy program, promoted within the European Green Deal action plans, is REPowerEU Plan. It was unveiled by the European Commission in response to the hardships and disruption of the global energy market brought on by Russia's invasion of Ukraine. REPowerEU is a strategy for energy efficiency, clean energy production, and supply diversification. Building the new energy system and infrastructure that Europe requires is supported by monetary and legal measures.

Substantially, it is necessary to speed up the transition to clean energy and strengthen Europe's energy independence from unreliable sources and volatile fossil fuels in order to adapt to the changing geopolitical and energy market realities. In wake of Russia's invasion of Ukraine, REPowerEU is the European Commission's strategy to wean Europe off Russian fossil fuels long before 2030. The REPowerEU plan outlines a number of actions that will help the EU's energy grid become more resilient while reducing reliance on Russian fossil fuels and advancing the green transition.

It relied on:

- *Diversifying*, in an effort to find alternative energy sources, the EU is collaborating with international partners. It is urgently required alternate sources of gas, oil, and coal in the immediate term, and also renewable hydrogen in the future;
- *Saving*, energy savings are possible for every individual, company, and organization. If everyone commits to them, even small behavioral adjustments can have a big impact. Also required will be backup plans in case of supply disruptions; and finally,
- *Accelerating the use of clean energy*, the least expensive and cleanest energy sources are renewables, which can also be produced domestically, minimizing the demand for energy imports.

The green transformation will move more quickly thanks to REPowerEU, which will also encourage significant investment in renewable energy. To reduce emissions and dependency, we also need to make it easier for industry and transportation to switch from fossil fuels.[104]

It will need a major expansion of renewable energy sources, as well as quicker electrification and substitution of fossil-based heat and fuel in industry, buildings, and the transportation

[104] European Commission. *REPowerEU: affordable, secure and sustainable energy for Europe*. Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en [Accessed 16 April 2023].

sector, to end the EU's dependence on Russian fossil fuels. Over time, the transition to clean energy will contribute to decreased energy costs and less reliance on imports. The cheapest and cleanest energy source is renewable, and since it can be produced domestically, it lessens the demand for energy imports. The EU tentatively agreed to tougher laws in March 2023 as part of the European Green Deal and the REPowerEU plan, raising the EU's binding renewable objective for 2030 to 42.5% with the ambition to attain 45%. Reaching the 45% mark as envisioned by REPowerEU will nearly double the current share of renewable energy in the EU, bringing the total renewable energy generation capacity to 1,236 GW by 2030 as opposed to the 1,067 GW by 2030 envisioned under the Fit for 55 package. The implementation of photovoltaic energy will be accelerated by the EU Solar Energy Strategy. This strategy, which is a part of the REPowerEU plan, intends to double the amount of solar photovoltaic capacity now installed by 2025 to over 320 GW and to reach over 600 GW by 2030. By 2027, this advanced extra capacity will replace the yearly use of 9 billion cubic meters (bcm) of natural gas.

By switching to cleaner energy sources, boosting industrial competitiveness, and fostering global technology leadership, replacing coal, oil, and gas in industrial procedures would help reduce Russia's reliance on fossil fuels. By 2030 and beyond, the industry might be able to save 35 billion cubic meters of natural gas thanks to electrification, energy efficiency, and the use of renewable energy, surpassing "Fit for 55" objectives. Nearly 22 billion cubic meters (bcm) of gas might be reduced most by non-metallic minerals, cement, glass, and ceramics manufacture, chemical manufacturing, and refineries. By 2030, it's anticipated that about 30% of primary steel produced in the EU will be decarbonized using renewable hydrogen. Industrial activity will be crucial in accelerating the manufacturing of the tools and parts required to swiftly alter our energy system.[105]

The simplest, safest, and cleanest method to lessen our dependency on Russian fossil fuel imports is to save energy. From consumers and enterprises to all industrial sectors, everyone can readily contribute to lowering energy consumption. The individual activities will have a good effect on costs when combined with energy efficiency measures, which will immediately lower energy bills, strengthen economy, and quicken the EU's transition to sustainable energy.

[105] Op. Cit. European Commission. *REPowerEU: affordable, secure and sustainable energy for Europe*, [Accessed 16 April 2023].

There are numerous strategies to decrease everyday energy use, including: increasing the effectiveness of home appliances, utilizing more public transportation and active transportation, lowering the heating or air conditioning settings, turning out the lights, and also driving more sustainably.

In order to phase out the imports of Russian fossil fuels, which are currently costing European taxpayers close to €100 billion annually, additional investments totaling €210 billion are required between now and 2027. With extra EU funding, the Recovery and Resilience Facility (RRF) is at the center of implementing the REPowerEU Plan. To direct funding of the Plan priorities and implement the required reforms, Member States should include a chapter about it in their Recovery and Resilience Plans.

The remaining RRF loans (now worth €225 billion) and fresh RRF grants (currently worth €20 billion), which were made possible by the auctioning of Emission Trading System allowances held in the Market Stability Reserve, may be used by Member States. Additional funding sources for REPowerEU include: European Agricultural Fund for Rural Development, National Financial Actions, Cohesion Policy Resources, Private Investment, the European Investment Bank, Funding from the national and EU levels to promote REPowerEU goals, Innovation Fund, and Connecting Europe Facility.[106]

It is possible to divide short-term and medium-term measures within the REPowerEU Plan. The first group is represented by several actions, like collaborations for new energy with trustworthy producers, including potential future collaboration on renewables and low-carbon gases; rapid development of solar and wind energy projects along with the use of renewable hydrogen might prevent the import of almost 50 billion cubic meters of gas; boosting biomethane output to reduce gas imports by 17 billion cubic meters; first EU-wide hydrogen initiatives by the summer; an EU Save Energy Communication providing suggestions on how individuals and businesses may prevent the import of over 13 billion cubic meters of gas; by November 1st, 2022, fill gas storage to 80% of its capacity; and, plans for reducing demand coordinated by the EU in the event of a gas supply disruption.

[106] Op. Cit. European Commission. *REPowerEU: affordable, secure and sustainable energy for Europe*, [Accessed 16 April 2023].

With respect to medium-term measures, other activities are planned: new national REPowerEU Plans are being created under the revised Recovery and Resilience Fund to support €300 billion in investments and reforms; increasing industrial decarbonization with anticipated initiatives totaling €3 billion under the Innovation Fund; especially in designated "go-to areas" with little environmental risk, new legislation and proposals call for quicker authorization of renewable energy sources; investments in an interconnected and adjusted gas and power infrastructure network; raising the EU-wide efficiency target for 2030 from 9% to 13% demonstrates increased ambition in terms of energy savings; increase the European Union's 2030 aim for renewable energy from 40% to 45%; EU plans are being updated to guarantee that industry has access to essential raw materials; regulations to boost energy efficiency in the transportation industry; powering EU industry with domestic production of 10 million tons of renewable hydrogen, a hydrogen accelerator will construct 17.5 GW of electrolyzes by 2025; and, a new framework for hydrogen regulation.[107]

[107] Op. Cit. European Commission. *REPowerEU: affordable, secure and sustainable energy for Europe*, [Accessed 16 April 2023].

3. How to align energy policies with climate objectives

By signing the 2015 Paris Agreement on Climate Change, 197 nations agreed to make ambitious measures to prevent climate change, prepare for its repercussions, and provide developing nations more help. Along with the pledges made by national governments, the Paris Agreement has received widespread global support from businesses, civic society, and regional governments. A comprehensive global action plan for "people, planet, and prosperity" consisting of 17 Sustainable Development Goals (SDGs) and 169 Targets to be accomplished by 2030 was also adopted by UN member nations in 2015, including Goal 7 on “Affordable and clean energy” and Goal 13 on “Climate action”. A new “post-2015” age of sustainable development has officially begun as a result of these bold international promises. In a society that faces significant social, economic, political, and environmental issues, they strive for transformational change. There is a growing body of research in particular fields that focuses on the connections between normative and empirical commitments made under the Paris Agreement and the 2030 Agenda.

This data shows how climate change effects will make it more difficult to accomplish some development goals, such as the impact of climate change on agricultural productivity, which could hamper efforts to end hunger and poverty. As well as having immediate implications with development goals, measures made to combat or adjust to climate change may additionally result in positive and negative synergies. Analyses of various social, economic, and national contexts have shown how climate action outcomes can have varying effects on socially vulnerable populations, including extreme situations where national climate adaptation programs have led to the violent eviction of underprivileged people. In particular, climate change will have an impact on the possibility of achieving objectives pertaining to material and physical wellness, such as prosperity and welfare, poverty eradication and employment, food, energy, and water availability, and health.[108]

On July 2022, the Third Global Conference on Strengthening Synergies Between the Paris Agreement and the 2030 Agenda for Sustainable Development was held in Tokyo, Japan. The United Nations Department of Economic and Social Affairs (UNDESA) and the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) jointly organized

[108] Fuso Nerini, F., Sovacool, B., Hughes, N. *et al.* (2019) Connecting climate action with other Sustainable Development Goals. *Nat Sustain*, 2, 674–680. Available at: https://doi.org/10.1038/s41893-019-0334-y

the conference, in collaboration with the United Nations University (UNU) and the Institute for Global Environmental Strategies (IGES). Thirty Ministers, the leaders of UN institutions, and other high-ranking participants from the corporate, youth, and academic worlds attended the conference's high-level segment. All of the participants highlighted in their remarks the necessity of urgently stepping up joint implementation as well as the need for increased SDG and climate ambition.

There is overwhelming evidence that the international community is not making progress in achieving these two important priorities. A growing body of research also indicates that achieving win-win results for both climate action and the SDGs is entirely feasible, but that the full potential of such synergistic results can only be realized by deliberate effort. For instance, the most recent IPCC assessment demonstrates that, if the world community acts decisively on climate change now, there is a chance to not only advance the SDGs quickly, but also to earn enormous long-term development co-benefits. The participants highlighted the numerous interconnections that exist and should be taken into account when creating and implementing policies and plans for the SDGs and the climate. When actions are taken to achieve one objective and also make the achievement of another goal simpler, such interlinkages can result in significant co-benefits.

Conversely, when progress on one target hinders progress on another goal, SDG and climate action programs must plan for potential trade-offs or unintended negative repercussions. Moreover, participants agreed that unanticipated crisis situations, such as the ongoing Covid-19 outbreak, were causing progress toward the SDGs and climate protection to lag behind expectations in a variety of ways. In order to find significant gaps in the implementation of the SDGs and the climate agreement, it was particularly stressed how crucial it is to maintain and enhance information exchange. Participants, in particular, thought about the numerous and intricate relationships that exist among security, sustainable development, and climate change. As a result of cascading impacts, climate change may pose a systemic security risk, having an impact on political stability as well as economic growth and prosperity, along with the security of food, water, energy, health, and other resources. Without tackling the climate crisis, it was noted that no country can experience long-term security. Along with several different indirect channels, climate change may translate into greater violence.

Conflict prevention and peacebuilding efforts can benefit from a better knowledge of these links. The majority of nations proposed new 2030 emissions targets in their Nationally Determined Contributions (NDCs).

However, despite all of the most recent NDCs being put into practice, the total GHG emission in 2030 is predicted to be roughly 14% higher than it was in 2010, indicating that a significant amount of work still has to be done to reduce emissions to the level required to meet the 1.5°C goal. To hasten the process, a comprehensive strategy emphasizing the intersection of these two global goals is essential. The pace of implementation might be greatly accelerated and ambition raised by concentrating on specific actions for coordinated execution at all levels.[109]

[109] UN DESA and UNFCCC (2022) Third Global Conference on Strengthening Synergies Between the Paris Agreement and the 2030 Agenda for Sustainable Development. In *Global Climate & SDG Synergy Conference*. Tokyo, 20th – 21st July 2022. Available at: https://sdgs.un.org/publications/third-global-conference-strengthening-synergies-between-paris-agreement-and-2030 [Accessed 25 April 2023] pp. 2 – 3, 13, 27.

3.1 The interaction between SDG 7 “Affordable and clean energy” and SDG 13 “Climate action”

Interdependencies between the Sustainable Development Goals (SDGs) included in the 2030 Agenda for Sustainable Development (United Nations, 2015) are referred to as SDG interactions, and they occur when actions taken to achieve one SDG have an effect on the achievement of one or more other SDGs. The SDGs were intended to be interconnected and indivisible from the beginning of their conceptualization, reflecting the inescapably linked challenges that humanity faces: reducing poverty and ensuring human prosperity while preserving the environment and its resources, thus coordinating the three (social, economic, and environmental) dimensions of sustainable development.[110]

Interactions may occur, at least, at three different levels:

1. interactions at the policy level that highlight divergent priorities and worldviews;
2. interactions at the level of resource allocation for SDG-specific actions; and
3. systemic interactions between social and ecological systems that have unintended effects on other SDGs.

The space available for achieving other SDGs may change if the pursuit of one SDG has an influence on a particular component of the Earth system. This can happen through direct and indirect interactions with other subsystems. For instance, if chemical fertilizers are used to boost agricultural productivity, the increased yields may also result in greater trade activity and local food security. However, excessive fertilizer use has the potential to impair downstream water quality and a community's health significantly. In "business as usual" circumstances, governments typically emphasize accomplishing their independently assessed goals, undertaking resource-level actions that have unexpected consequences in the social-ecological realm. Conversely, pursuing policy coherence to implement the SDGs entails an inverted approach: first, trying to understand dynamics and interactions in social-ecological systems; only then, considering their normative repercussions in terms of SDG governance, understanding how to distribute various capacities and financial resources.[111]

[110] Pham-Truffert, M, Metz, F, Fischer, M, Rueff, H, Messerli, P. Interactions among Sustainable Development Goals: Knowledge for identifying multipliers and virtuous cycles. *Sustainable Development*. 2020; 28: 1236– 1250. https://doi.org/10.1002/sd.2073 [Accessed 25 April 2023] p. 1236.
[111] Ivi, p. 1237.

How can the global community bridge the ambition gap and more effectively utilize the synergies and co-benefits between climate change and the SDGs? Are trade-offs between SDGs and the environment avoidable? How might Voluntary National Reports (VNRs) and Nationally Determined Contributions (NDCs) be made even better in the future? These were a few of the issues covered in the abovementioned Third Global Conference on Strengthening Synergies Between the Paris Agreement and the 2030 Agenda for Sustainable Development. Participants also discussed the modalities of implementation, such as capacity building and financing, which continue to be crucial prerequisites for more successful climate and SDG action. The relevance of tackling energy sources was stressed by the participants. Improved air quality and higher energy security are only two of the many advantages of reducing fossil fuel use and/or increasing the use of renewable energy. Rising carbon pricing will encourage the private sector to make more environmentally friendly business decisions in nations that impose carbon taxes and/or emission trading schemes.[112]

SDG 7

The world is moving closer to its sustainable energy goals. However, the current rate of development is not adequate to complete Goal 7 by 2030. To achieve the climate goal of lowering greenhouse gas emissions, advancements in energy efficiency, for instance, will need to increase. Massive gaps in access to contemporary sustainable energy still exist.

The COVID-19 epidemic has eroded or undone advancements in several nations.

A large mobilization of public and private money for clean and renewable energy, especially in developing nations, will be necessary to achieve energy and climate goals. Increasing energy efficiency is essential to achieving the world's climate goals. The 2030 target asks for an increase in energy intensity of 2.6% annually, which would be an increase of two times over the rate seen between 1990 and 2010. With an average annual improvement rate of 1.9%, the global primary energy intensity, which is measured as the ratio of the world's total energy supply to GDP, increased from 5.6 megajoules per US dollar (2017 purchasing power parity) in 2010 to 4.7 in 2019. Energy intensity improvements until 2030 will need to average 3.2% annually to reach the Goal 7 target and make up for lost time.

The aim is still attainable, but only with a large investment in methodical, cost-effective energy efficiency improvements. Due to variations in economic structure, energy availability and electrification, regional progress differs. Eastern and South-Eastern Asia is the only region to

[112] Op. Cit. UN DESA and UNFCCC, *Global Climate & SDG Synergy Conference*, pp. 31 – 33.

have achieved the goal thus far, with an average annual rate of 2.7% from 2010 to 2019 backed by robust economic growth.[113]

SDG 13

The window of opportunity to avert a global climate disaster is fast closing. Climate change-related increases in heatwaves, droughts, and floods are already having a significant impact on billions of people worldwide and may have the capacity to permanently alter ecosystems. Global greenhouse gas emissions must peak before 2025 if the Paris Agreement's goal of limiting warming to 1.5°C above pre-industrial levels is to be achieved. The Intergovernmental Panel on Climate Change (IPCC), an organization of the UN charged with evaluating climate change science, states that these emissions must then decrease by 43% by 2030 and reach net zero by 2050. In response, nations are formulating climate action plans to reduce emissions and prepare for the effects of the climate through locally specified contributions. The 1.5°C objective cannot be met with the nations' present commitments, nevertheless. Over the following ten years, greenhouse gas emissions are expected to rise by roughly 14% as a result of these pledges. To shift from a tipping point headed toward a climate tragedy to a turning point for a sustainable future, immediate and significant reductions in emissions are required across all sectors.

Global greenhouse gas concentrations reached new highs in 2020, and current data indicate that this trend will continue. The temperature of the Earth increases along with these concentrations. One of the seven warmest years on record (from 2015 to 2021) was 2021 when the average global temperature was 1.11 - 0.13°C above pre-industrial levels (between 1850 and 1900). While annual changes in global temperatures are to be expected, a warming trend is present over the long period. Extreme weather occurrences are becoming more frequent as global temperatures rise.

As a result, there will be melting ice caps and glaciers, extreme heat and rains, sea level rise, and other possibly catastrophic phenomena, all of which will have negative social and economic repercussions. The COVID-19-related societal and economic disturbances in 2020 reduced global energy demand. The outcome was a 5.2% decrease in worldwide carbon dioxide (CO_2) emissions in 2020, which is the highest decrease ever and about five times bigger than the dip that occurred in 2009 during the global financial crisis (see Table 3 and Figure 10). This

[113] UN DESA and UN Statistical System (2022) *The Sustainable Development Goals Report 2022*. United Nations, New York. Available at: https://unstats.un.org/sdgs/report/2022/ pp. 40-41 [Accessed 21 April 2023].

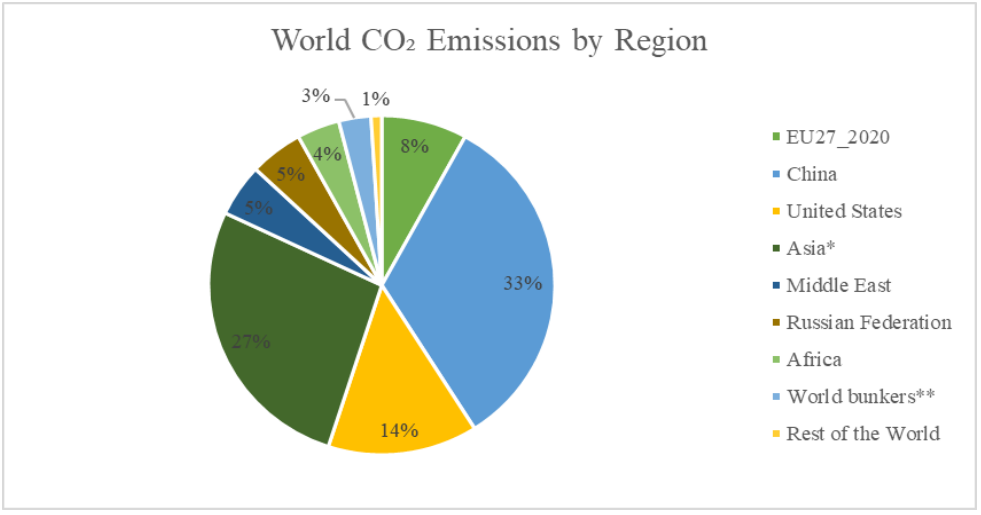
decrease amounted to over 2 billion metric tons. However, it was only a brief reprieve. The phasing down of COVID-related limitations led to a rise in demand for coal, oil, and gas. As a result, 2021 saw a 6% increase in energy-related CO_2 emissions, which was their highest level ever and entirely undid the pandemic-related drop witnessed in 2020. According to the IPCC, there is no doubt that human activity is to blame for climatic warming, which is occurring at a rate unheard of in the last 2,000 years.[114]

Table 3: World CO_2 Emissions by Region MT CO_2

Region	2000	2005	2010	2015	2019	2020
EU27_2020	3 267	3 391	3 137	2 827	2 656	2 394
China	3 138	5 449	7 872	9 177	9 975	10 116
United States	5 730	5 703	5 352	4 929	4 744	4 258
Asia*	5 025	5 882	7 095	8 090	8 744	8 320
Middle East	882	1 146	1 478	1 717	1 752	1 696
Russian Federation	1 474	1 482	1 529	1 533	1 640	1 552
Africa	661	865	1 021	1 162	1 241	1 144
World bunkers**	857	993	1 122	1 189	1 312	929
Rest of the World	2 211	2 172	1 973	1 726	1 601	327
World	23 245	27 083	30 579	32 349	32 265	30 736

Source: IEA, May 2022, estimates of world CO_2 emissions from fuel combustion.

Figure 10: World CO_2 Emissions by Region MT CO_2



*non-OECD and OECD Asia, excluding China; ** International aviation and international navigation.

Source: IEA, May 2022, estimates of world CO_2 emissions from fuel combustion.

[114] Op. Cit. UN DESA and UN Statistical System, *The Sustainable Development Goals Report 2022*, pp. 52 – 53.

In its Sixth Assessment Report,[115] the IPCC issues an urgent "code red" warning for humanity and describes the consequences that could result from an increase in global temperatures of 1.5°C or more. Extreme weather and climate are already present in every corner of the world. Scientists predict an increase in the frequency and severity of heatwaves, flooding, precipitation, droughts, and cyclones as the world warms. More quickly than in any previous century, sea levels have already increased. According to projections, even if greenhouse gas emissions are drastically cut and global warming is kept too far below 2°C, the sea level could increase by 30 to 60 centimeters by the year 2100. Greater frequency and severity of coastal floods and erosion would result from a rising sea level. Along with ocean warming, there will be an increase in the frequency and intensity of marine heatwaves, ocean acidification, and decreased oxygen levels. Biodiversity loss is quickening even before the full force of climate change has been revealed. With different severity depending on the temperature threshold attained, more losses in terrestrial, oceanic, and coastal systems are anticipated. Ecosystem decline and biodiversity loss will have an impact on nature-based services, putting human health and life in danger.

These circumstances also raise the likelihood of emerging zoonotic illnesses, like COVID-19, and potential pandemics in the future. In many parts of the world, the droughts, floods, and heatwaves brought on by climate change are increasing strain on food production. Due to floods and droughts, portions of Africa, as well as Central and South America, are already dealing with increased, and often acute, food insecurity and malnutrition. Everyone is being impacted by climate change, but the most vulnerable are being hammered the hardest. According to the IPCC study, between 3.3 billion and 3.6 billion people reside in environments that are extremely susceptible to climate change.

The inability to adapt to climate change is hampered by poverty, poor access to essential amenities, violence, and poor governance, which could lead to humanitarian catastrophes that force millions of people from their homes. 700 million people are projected to be in danger of being displaced by drought by 2030. Climate change is a hazard to both human well-being and the health of the planet, according to scientific data. A little window of opportunity to ensure a future worth living will be missed if there is any further delay in coordinated global action.[116]

Given that energy is responsible for two-thirds of all greenhouse gas emissions and 80% of

[115] Pörtner, H. O., Roberts, D. C., Tignor, M. M. B., Poloczanska, E., eds *et al*. and Intergovernmental Panel on Climate Change (IPCC) (2022) *IPPC 2022: Climate Change 2022: impacts, adaptation and vulnerability: working group II contribution to the sixth assessment report of the intergovernmental panel on climate change.* Cambridge University Press, Cambridge, UK. DOI: 10.1017/9781009325844.

[116] Op. Cit. UN DESA and UN Statistical System, *The Sustainable Development Goals Report 2022*, pp. 52 – 53.

carbon dioxide (CO_2) emissions, the energy sector must be a key player in any efforts to lower emissions and mitigate climate change, thereby reaching SDG 13. Universal access to electricity, clean fuels, and technologies need not be at odds with achieving climate goals, but greater demand for energy in favor of extra productive applications of electricity for economic growth in areas where services are lacking can result in equivalent hikes in emissions if that demand is not entirely satisfied by renewable energy.

Approximately 90% of the decrease in emissions in the energy sector required by 2050 may be achieved by the immediate adoption of renewable energy sources and energy efficiency, while still furthering economic growth and development. The world is currently far from meeting the aspirational goal of keeping warming to 1.5°C and is not close to meeting the far below 2°C climate aim. SDG 13 can only be achieved by consistently utilizing renewable energy sources and taking steps to save energy, including putting SDG 7 into practice.

Therefore, it should be established a framework to greatly increase the use of renewable energy sources and widely incorporate energy-saving technologies. Energy is necessary for all forms of social and economic growth. However, the main cause of climate change is the combustion of fossil fuels for energy. It is a significant factor in the rising atmospheric levels of greenhouse gases and the resulting harm to our ecosystems. Therefore, the environment must come first in a sustainable energy source. It is imperative to end the worldwide reliance on fossil fuels while simultaneously creating energy systems that supply people with energy that is climate-neutral and meets their requirements. Measures to execute the National Determined Contributions (NDCs) of the Paris Agreement are directly related to the SDG 7 goal of achieving universal access to affordable, dependable, sustainable, and modern energy. SDG 13 can only be achieved by consistently utilizing renewable energy sources and energy-saving techniques, such as implementing universal energy access in line with SDG 7, thereby waging a quick struggle against climate change and its repercussions. The SDG13 sustainability goal would remain unachievable without prompt and successful implementation of a worldwide energy transition.[117]

[117] UN DESA (2019) *Report – HLPF Accelerating SDG7 Achievement – SDG7 Tag Policy Brief.* United Nations, New York. Available at: https://sdgs.un.org/publications/report-hlpf-accelerating-sdg7-achievement-sdg7-tag-policy-brief-33180 pp. 19 – 21.

The Paris Agreement's legally enforceable goal of limiting global warming to far below 2°C over pre-industrial levels depends heavily on an immediate upscaling of renewable energy sources and energy efficiency. Although it would not be totally sufficient considering the size of the decarbonization challenge, achieving SDG 7 might place the world on pace to fulfill this task. Targets for renewable energy and energy efficiency will be advanced by better-integrating climate change strategies into national planning, raising awareness of climate issues, increasing education, and mobilizing funding for mitigation.

Providing everyone with access to modern energy services by 2030 is fully compliant with the Paris Agreement in some circumstances because it is only anticipated to have a negligible impact on global carbon emissions, on condition that they are sustainable.[118] To put it another way, even if the contemporary fuels provided are still fossil fuels (such natural gas, kerosene, or LPG), providing energy access will not make climate change worse because it is predicted to have only a minimal impact on world carbon emissions. Additional low-carbon options are provided by decentralized renewable energy sources including solar panels, small-scale wind, and micro-hydro. The scientific literature demonstrates that it is possible to decouple economic growth from carbon emissions, but if this is not done, emissions are anticipated to increase significantly as the wealth and standard of living of households in emerging countries increase.[119]

Although there has been significant movement toward sustainable energy transitions globally, particularly in the last several years, more has to be done to accomplish these targets, and in particular to reduce temperature growth to 1.5°C. Our efforts in the next years must be in line with this target since, in accordance with the International Renewable Energy Agency (IRENA), the range of opportunities to reach a 1.5°C route is getting increasingly small. Multiple socioeconomic advantages would result from a comprehensive strategy for the energy transition, one that is based on climate-safe energy production while also emphasizing immediate needs. This approach would also help pave the way for a transition that is fair, organized, and inclusive. The greenhouse gas emissions from energy production constitute a significant contributor to the warming of the atmosphere, demonstrating the close relationship between energy and climate change. Degradation of the land, destructive storms, and ecosystem

[118] McCollum, D., Gomez Echeverri, L., Riahi, K., & Parkinson, S. (2017) SDG7: Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All. In: *A guide to SDG interactions: from science to implementation.* Eds. Griggs, D.J., Nilsson, M., Stevance, A., & McCollum, D., pp. 127-173 International Council for Science, Paris. Available at: https://council.science/publications/a-guide-to-sdg-interactions-from-science-to-implementation/ p. 134.

[119] Ivi, pp. 162 – 163.

changes are all effects of climate change. The requirement for people to gather biomass for energy causes encroachment into natural ecosystems in some areas where there is an inadequate amount of modern energy sources.

More frequent and powerful extreme weather events caused by climate change constitute a serious threat to the electricity supply in nations that primarily rely on hydropower for electrical supply, which in turn impacts the ability to power vital institutions like hospitals and health centers. The world is on track to warm by no less than 3°C above pre-industrial levels by 2100, missing the Paris Agreement target. Global efforts to combat climate change to date have been insufficient.[120]

Interactiveness between SDG 7 and SDG 13

Considering that the primary cause of today's energy system's global GHG emissions is fossil fuels, SDG 7 and SDG 13 directly interact. The SDG 13 targets acknowledge that the United Nations Framework Convention on Climate Change (UNFCC) is the main international, intergovernmental platform for negotiating the global response to climate change, even though they do not include any specific goals for stabilizing the global climate. The Paris Agreement of December 2015, aims to keep "the increase in the global average temperature to well below 2°C above pre-industrial levels" is the obvious result of that forum's previous action. The IPCC came to the conclusion that in order to keep long-term global climate change below 2°C, a dramatic, practically immediate up-scaling of renewable energy and energy efficiency is required. To do so, the vast majority of nations have committed to making Nationally Determined Contributions (NDCs), which are tailored plans for how each country aims to cut its emissions over the following years.[121]

Given the mounting evidence of more frequent and intense weather events that put the well-being and livelihoods of millions of individuals all over the world in jeopardy, combating climate change must be a top priority for the entire world. Nations are searching for a mix of energy sources that simultaneously reduce greenhouse gas emissions due to the urgency of climate change and the expanding global desire for energy, ensures that nobody is left behind, fosters economic progress, provides jobs, fosters resilience, safeguards ecosystems and the

[120] UN DESA (2021) *Leveraging Energy Action for Advancing the Sustainable Development Goals – SDG7 Tag Policy Brief*. United Nations, New York. Available at: https://sdgs.un.org/publications/report-2021-sdg7-tag-policy-briefs-leveraging-energy-action-advancing-sustainable pp. 124 – 125.

[121] Op. Cit. McCollum, D., Gomez Echeverri, L., Riahi, K., & Parkinson, S., *A guide to SDG interactions: from science to implementation*, pp. 162 – 163.

planet, and promotes health. Addressing these combined climate and energy concerns has a new context thanks to the worldwide reaction to the COVID-19 pandemic. Since energy consumption is responsible for nearly two-thirds of all anthropogenic emissions worldwide, carbon reductions in the energy sector are a key component of the global climate action agenda. A major force behind energy transitions is the desire to lower CO_2 emissions associated with energy use. Therefore, quick action is required to match energy patterns to a similar approach as outlined in the Paris Agreement. Energy transitions can occur in a variety of ways based on the conditions, resources, and starting points in a given location. SDG 7 outlines some of the essential components of the necessary energy transition, such as universal access, a significant increase in the proportion of renewable energy sources in the global energy mix, and a doubling of energy efficiency.

These initiatives also present an opportunity to advance, *inter alia*, climate action (SDG 13). IRENA asserts that energy efficiency improvements and renewable energy strategies have the potential to meet 90% of the IPCC's recommended energy-related carbon reductions by 2050 while ensuring that everyone has access to clean energy.[122] To ensure that this transition is equitable and leaves no one behind, climate change mitigation of the energy sector, however, necessitates immediate global action as well as alignment with the 2030 Agenda's and the Paris Agreement's goals. The next ten years will see developments in demand and supply, policy changes, and ongoing technological breakthroughs impact every part of the existing energy-related systems. The current transformational shifts are already having a significant impact on the systems that have developed throughout the past century. For the millions of people who lack access to electricity, possibilities that were previously unthinkable are beginning to materialize, with the ability to eradicate poverty and inequality, foster resilience, and achieve the SDGs.[123]

SDG 7 and SDG 13 and the pandemic

The COVID-19 epidemic has posed a serious threat to the whole energy system and brought to light the price of anchoring economies to fuels that are subject to price fluctuations. It has made the very real problems caused by unstable energy access to healthcare systems worse. In conjunction with the rest of the economy, the energy system has been seriously rattled. After

[122] For more information, see IRENA (2021) *World Energy Transitions Outlook: 1.5°C Pathway (Preview)*. Available at: https://www.irena.org/publications/2021/Jun/World-Energy-Transitions-Outlook

[123] Op. Cit. UN DESA, *Leveraging Energy Action for Advancing the Sustainable Development Goals – SDG7 Tag Policy Brief*, p. 125.

the COVID-19 epidemic, nations must decide whether to carry on as usual or seize the chance to dedicate resources to an environmentally friendly future. The energy transition, when integrated with boost and recovery measures, can represent a long-term investment in the welfare of those impacted by this crisis, helping to end the economic downturn and create additional employment opportunities. Many nations gave measures focused on ensuring individuals and companies had access to affordable energy sources a high priority in the initial phases of the pandemic. In several situations, as the epidemic spread, priorities shifted in favor of longer-term objectives including planning for a sustainable response and achieving climate and development goals. The pandemic highlighted the significance of setting and attaining long-term climate and development priorities. Some nations realized this and concentrated their efforts on setting higher goals to combat climate change and improve infrastructure. However, some nations have made significant investments in the fossil fuel sector thanks to recovery programs. In their package deals, G20 nations spent more money on environmentally harmful measures than on climate-friendly ones, as reported by the Climate Transparency Report 2020.[124] According to information collected by the Energy Policy Tracker, at least $268 billion of the G20 bailout funds have been allocated to fossil fuels, rather than the $199 billion for green energy. Energy transformations are already being given priority in the effort to recover from the COVID-19 pandemic, as seen by the adoption of energy-related recovery measures by more than 100 nations. This proves the potential for these transitions to have a positive socioeconomic impact.[125]

Energy transition as a tool to coordinate short-term objectives with mid-term and long-term priorities for SDG 7 and SDG 13

The energy transition represents a strategy to balance short-term goals with long-term and mid-term priorities for SDGs 7 and 13. In fact, it can be a wise investment if it is incorporated into boost and recovery measures. The epidemic has exposed flaws in the existing system, including its reliance on fossil fuels and vast access gaps to energy, which have an impact on healthcare, access to water, information and communication technologies, and other essential services.

[124] Climate Transparency (2020) The Climate Transparency Report 2020. [pdf] Available at: https://www.climate-transparency.org/wp-content/uploads/2020/11/Climate-Transparency-Report-2020.pdf [Accessed 25 April 2023] p. 11.
[125] Op. Cit. UN DESA, *Leveraging Energy Action for Advancing the Sustainable Development Goals – SDG7 Tag Policy Brief*, pp. 126 – 127.

Recovery plans that emphasize the energy transition can aid in reversing the current economic downturn and generating additional employment opportunities in the near and long future.

A comprehensive policy strategy that is based on climate-safe energy production but also prioritizes immediate needs would have many advantages and help pave the way for an equitable energy transition. The initial three years of targeted recovery programs could result in socioeconomic gains while also quickening the energy transition. As estimated by IRENA, the transition would increase global GDP by 1% higher than existing plans, on average, throughout three years (IRENA, 2020),[126] assuming the necessary investment has been made and quick recovery measures were implemented. Depending on regional demographics, national economies, and relative phases of development, the energy transition will have different socioeconomic effects in different locations. Bold energy transition policies can have a variety of positive effects on developed countries as well as developing ones, so any short-term effort should take these broader aspirations for resilient, forward-thinking economies and communities into account. In addition to helping to phase out coal, achieve universal access, and ensure a fair and sustainable transformation, committing to the energy transition will also result in long-term effects, such as job creation, an increase in GDP, less air pollution, and improved health. The energy transition could have long-term effects, according to IRENA, if there is a significant increase in the production of electricity from renewable sources, electrification of end-use industries, and advancements in energy efficiency.[127]

SDG 7 partnerships for climate action and SDG 13

The multi-layered partnership between SDG 7 and SDG 13 is another important condition for governments to achieve energy efficiency objectives. Several projects have surfaced in the last few years to support the energy transition as a response to climate change. These programs include the Marrakech Partnership for Global Climate Action, the High-Level Dialogue on Energy sponsored by the UN Secretary-General, and the COP 26 Energy Transition Council. By fostering cooperation between governments, cities, regions, corporations, and investors, the Marrakech Partnership for Global Climate Action aids in the implementation of the Paris Agreement. In September 2021, during the 76th session of the UN General Assembly, the UN

[126] For more information, see IRENA (2020) *Global Renewables Outlook Energy Transformation 2050*. Available at: https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020

[127] Op. Cit. UN DESA, *Leveraging Energy Action for Advancing the Sustainable Development Goals – SDG7 Tag Policy Brief*, pp. 127 – 128.

Secretary-General will host a High-Level Dialogue on Energy to advance the implementation of the 2030 Agenda for Sustainable Development. The Council concentrates on enhancing the global assistance for clean energy provided to poor nations. Moreover, The Small Island Developing States (SIDS) Lighthouses Initiative is a plan of action to assist SIDS in switching from energy systems based on fossil fuels to resilient and renewable energy systems. A 3% global increase in energy efficiency is the goal of the Three Percent Club for Energy Efficiency, which is made up of nations, companies, and international organizations. In order to expedite investments in clean energy, the Economic Commission for Africa's SDG 7 Initiative for Africa seeks to connect the objectives of governments, the private sector, project developers, and development partners.[128]

Call for action towards 2025 NDC review, 2030 Agenda, and net zero by 2050

Additionally, the values of sustainability, resilience, and human solidarity must be fully upheld by government acts in order to succeed. Strategies and policies for economic stimulation should be in conformity with the 2030 Agenda, the Paris Agreement, and strategies for their implementation. Some of the steps that can be taken to better integrate energy and climate action are the green recovery and the coal phase-out, the green hydrogen economy, and energy storage innovation. The former regards, apart from renewables and climate change mitigation, the energy expenditures made in reaction to the pandemic's consequences, which can support ever more ambitious long-term goals for renewables and efficiency in every sector, as well as bolstering increased climate promises. The latter is about increasing transition-related investments in heating and cooling innovations, research, and demonstration projects, which could be also encouraged by post-COVID-19 stimulus packages and related policies. This would help less developed technologies like green hydrogen and the phase-out of coal should be prioritized, and the recovery should concentrate on clean and renewable technology, including flexibility options like energy storage.[129]

Another two steps to more effectively combine energy and climate action are holistic policy-making to create jobs and promote a just transition and channeling finance towards clean solutions. In the first one, recovery programs also present chances for comprehensive strategies to guarantee that supply chains, supporting infrastructure, and skills are set up when

[128] Op. Cit. UN DESA, *Leveraging Energy Action for Advancing the Sustainable Development Goals – SDG7 Tag Policy Brief*, pp. 129 – 130.
[129] Ivi, p. 130.

investments take place. An equitable and organized transition that does not leave anyone behind would be made possible by governments using such a comprehensive approach to customize investments to different domestic policy goals. While the second one underlines the necessity to take rapid and determined legislative actions in a number of sectors in order to mobilize the funding required to scale up investments in renewable energy and energy efficiency. Investments connected to the energy transition must be prioritized above investments in fossil fuels, and public financing must be mobilized to encourage the development of adequate facilities for renewable energy. Public international money must be greatly increased in order to support developing nations in adopting climate initiatives that promote renewable energy and energy efficiency solutions, as well as to fund conditional NDC targets.

Finally, the last two steps analyzed are international cooperation and global solidarity, and energy as a resilient system of the 21st century. The former stresses what the pandemic has revealed to be crucial that no nation is an island. Like the climate issue, the COVID-19 crisis needs to be resolved with strong international cooperation. To create a stronger multilateral framework that can restore and sustain prosperity, finance the global commons, and assure a reinforced global financial architecture, the entire world must now act in unison through a reset of global systems. As a means of combating climate change and as a chance to recover from the pandemic, the latter step emphasizes that clean and sustainable energy is currently a top priority on the international agenda. Not only is it important to stop carbon from reaching the atmosphere, but it's also important to improve its performance.[130]

SDGs uncertainties

Apart from the interlinkages between these two SDGs, it is also compelling to compare the uncertainties that bind them. The ambition of such activities after 2030 as well as the rate at which countries are willing to decarbonize their energy systems via a rapid expansion of renewables and energy-efficient technologies/consumption practices are unknown. The latter is what will guarantee that long-term environmental objectives are achieved. The precise numbers for what a suitable, respectable level of energy access actually involves in terms of the whole spectrum of services needed to escape the poverty trap are also unknown.

[130] Op. Cit. UN DESA, *Leveraging Energy Action for Advancing the Sustainable Development Goals – SDG7 Tag Policy Brief*, pp. 130 – 131.

The carbon emissions of the world's poorest countries will be determined by these threshold levels in conjunction with fuel and technological choices.[131]

SDGs dimensions

Moreover, time, geography, governance, technology, and directionality constitute the dimension of the SDGs, another appealing aspect to confront. With regards to time: given the limited cumulative budgets for GHG emissions needed to keep global warming far below the 2°C threshold, near-term and immediate initiatives encouraging renewable energy and increasing energy efficiency are crucial. However, changing the global energy system will take decades. Geographically speaking, as climate change is an international issue, efforts to advance renewable energy sources and increase energy efficiency are crucial in every region of the world. However, some nations have larger energy systems than others, some have more carbon-intensive energy systems, and some nations depend more on the transportation of commodities for their GDP; however, some nations have two or all three of these features. China, India, the United States, Europe, Brazil, Russia, Australia, and Canada are just a few examples of nations that can make a significant difference in the fight against climate change through their national initiatives. Between now and 2030, the energy system will continue to emit one unit of carbon into the atmosphere, where it will remain during the rest of the century. Regarding governance, market – and policy – based measures, as well as other types of policy initiatives, can be used to promote and incentivize the use of renewable energy sources and energy efficiency. Numerous policies have already undergone local, regional, and national testing. Policy in one jurisdiction can be influenced by experience obtained in another. Additionally, consideration must be given to energy and climate policies to phase out fossil fuels. States that produce fossil fuels must recognize and take action in accordance with their climate responsibilities throughout the whole lifecycle of their resources. To influence consumer preferences and guarantee that households choose the fuel and technology that is best for them and society as a whole, households need to implement well-designed policies in the area of energy access provision.

Concerning technology, innovations in this sector, particularly the use of renewable energy sources on the supply side (such as solar, wind, hydro, and geothermal electricity generation and biofuels), are essential to the decarbonization of the global energy system. In order to give

[131]Op. Cit. McCollum, D., Gomez Echeverri, L., Riahi, K., & Parkinson, S., *A guide to SDG interactions: from science to implementation*, p. 163.

the possibility for negative emissions capacity globally, carbon capture and storage technologies have to be implemented in both fossil fuel facilities and biomass-to-energy plants. The demand side is more complicated; while it is crucial to create more energy-efficient technology, consumer tastes, and human behavior also have a significant role in how widely technology is adopted. However, it is the industry where some of the most significant emissions reductions can be made. Similar to the supply of energy access, low-income households' willingness and likelihood to embrace contemporary fuels, cooking stoves, and lighting technologies are significantly influenced by their level of poverty.

Finally, the dimension of SDG 7 with SDG 13 is bidirectional, which means that they influence each other. The Paris Agreement's declared goal of keeping global climate change well under 2°C over the long term will need a substantial, essentially immediate upscaling of renewable energy sources and energy efficiency. If the SDG 7 targets are met by all nations, the world may be on the right track to overcoming this dilemma. In the opposite direction, working toward the SDG 13 targets for more effectively incorporating climate change measures into national planning, improving education, awareness, and capacity on climate issues, and mobilizing funds for mitigation will go a long way toward ensuring that the SDG 7 targets for renewable energy and energy efficiency are met.[132]

So, coherent policymaking is crucial given the limited amount of time left to implement the 2030 Agenda. Moving toward more integrated methods and away from business as usual, narrowly focused policies is necessary to achieve policy coherence. The research on the relationships between SDGs shows the dangers of depending on siloed knowledge, establishing policies based on territorial sovereignty, or pursuing development strategies decided only by a centralized authority. As it could be quite expensive to ignore these interactions. Instead, carefully and creatively managing SDG trade-offs and co-benefits, leveraging their universality, and creating new collaborations hold the greatest promise for new paths toward sustainable development.

[132] Op. Cit. McCollum, D., Gomez Echeverri, L., Riahi, K., & Parkinson, S., *A guide to SDG interactions: from science to implementation*, pp. 163 – 164.

Actions taken in support of the SDGs should use an integrated strategy intended to reduce discrepancies and disparities and maximize synergies for all 17 SDGs. Understanding the systemic interactions and the functions of each SDG helps gather the needed data to make better judgments about how to use the limited available resources. Policies that are consistent with systemic interactions may be one method to allocate those resources in the most efficiently. As a consequence, policy consistency would avoid the misallocation of resources, ineffective use of those resources, and unproductive initiatives.[133]

[133] Op. Cit. Pham-Truffert, M, Metz, F, Fischer, M, Rueff, H, Messerli, P., *Sustainable Development*, pp. 1247 – 1248.

3.2 Case Study: implementing energy efficiency policies in some European Union states

The global energy sector has seen significant changes in recent years as a result of the recovery from COVID-19 and heightened supply tensions following Russia's invasion of Ukraine.[134] Concerns over energy security and the inflationary effects of higher energy prices on the world's economy have significantly increased as a result of the unprecedented global energy crisis brought on by the Russian Federation's invasion of Ukraine. For almost all administrations, bringing down record-high consumer bills and ensuring dependable supply is a top political and economic priority. Although there are other approaches that nations can take to deal with the current situation, concentrating on energy efficiency action is the unquestionably first and best option to handle the issue while also achieving affordability, supply security, and climate goals. Energy efficiency is the only energy resource that comes close to meeting the problems of energy affordability, supply security, and climate change. For this reason, the International Energy Agency refers to energy efficiency as the "first fuel" of all energy transitions. [135]

The 7th Annual Global Conference on Energy Efficiency was conducted by the IEA in Sønderborg, Denmark, in June 2022. This was the biggest-ever meeting of ministers from different nations to particularly address the importance of taking more aggressive action on energy efficiency. 26 governments made a unified statement at the conference “welcoming the Sønderborg Action Plan on Energy Efficiency” and “calling on all governments, industry, enterprises, and stakeholders to strengthen their action on energy efficiency”.[136]

The “first fuel” status of energy efficiency has been highlighted by its capacity to concurrently achieve energy affordability, security, and climate goals. Efficiency measures lower overall energy demand, driving down energy costs and CO_2 emissions, creating jobs, and lowering consumer bills. 2022 has had the potential to mark a turning point in the development of energy efficiency. Through efforts to increase energy efficiency, governments all around the world were bolstering their economies, assisting populations in need, and fostering economic growth.

[134] International Energy Agency (2023) *The Evolution of Energy Efficiency Policy to Support Clean Energy Transitions*. IEA, Paris. Available at: https://www.iea.org/reports/the-evolution-of-energy-efficiency-policy-to-support-clean-energy-transitions p. 4.
[135] International Energy Agency (2022) *Energy Efficiency 2022*, IEA, Paris. Available at: https://www.iea.org/reports/energy-efficiency-2022 pp. 8 and 19.
[136] Ibidem.

However, it will be vital that governments continue to implement more focused, long-lasting, and comprehensive sets of policies if they are to take advantage of this opportunity and accelerate progress.[137]

Against this backdrop, European Union sought to look further into the future after the Paris Agreement in December 2015, realizing that the required adjustments would take time to take effect. The EU adopted the *Clean Energy for all Europeans* package[138] in 2019, completely revising EU energy law and defining binding energy and climate targets for 2030. A detailed plan explaining how each nation plans to achieve its climate targets in the following 10 years, starting in 2021, has been prepared by EU countries as part of this process, creating yet another ground-breaking framework. The National Energy and Climate Plan (NECP) is what the idea is known as. The NECPs were established as part of the *Clean Energy for all Europeans* agenda and are defined under the Regulation on the Governance of the Energy Union ((EU) 2018/1999).[139]

The goal of the Energy Union plan (COM/2015/080),[140] which was released on February 25th, 2015, is to create an energy union that provides homes and businesses in the EU with energy that is safe, sustainable, competitive, and reasonably priced. The three long-standing goals of EU energy policy—supply security, sustainability, and competitiveness—form the foundation of the Energy Union.

The Energy Union prioritizes five jointly advantageous characteristics to accomplish these goals:

1. energy security;
2. the internal energy market;
3. energy efficiency;

[137] Op. Cit. IEA, *Energy Efficiency 2022*, p. 21.

[138] For more information, see European Commission. Energy. *Clean energy for all Europeans package*. Available at: https://energy.ec.europa.eu/topics/energy-strategy/clean-energy-all-europeans-package_en [Accessed 01 May 2023].

[139] See, European Parliament and the Council of the European Union (2018) Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11th December 2018 on the Governance of the Energy Union and Climate Action. *OJ*, L 328/1, 21st December, p. 1 – 77. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018R1999&qid=1682873370460 [Accessed 30 April 2023].

[140] See, European Commission (2015) *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of The Regions and the European Investment Bank. A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy* (COM/2015/080 final). Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2015:80:FIN [Accessed 30 April 2023].

4. decarbonization of the economy; and
5. research, innovation, and competitiveness.[141]

Energy efficiency is one of the five dimensions, but only to a certain degree. For instance, it refers to the crucial function that energy efficiency plays in safeguarding vulnerable consumers and points out that energy poverty can be addressed by a combination of measures, primarily in the social sector and within the authority of authorities on the national, regional, or local levels. It emphasizes to the significance of reducing energy demand through increases in energy efficiency. It describes how this can be accomplished in the building and transportation industries.[142]

In fact, energy efficiency is one of the primary principles of the European Commission's plan to achieve the EU's climate goals, lessen reliance on imported fossil fuels, boost supply security, and promote the use of renewable energy sources. The goal of the "energy efficiency first principle" is to see energy efficiency as a source of energy in and of itself and to give demand-side solutions precedence whenever they are more economical than making investments in energy infrastructure. It also emphasizes how crucial it is to cut back on energy production because doing so can help limit the amount of money required for the switch to renewable energy sources. It helps to strengthen the EU's energy system's resilience and promotes more environmentally friendly approaches to the use of finite resources.

[141] European Commission. Energy. *Energy Union.* Available at: https://energy.ec.europa.eu/topics/energy-strategy/energy-union_en [Accessed 25 April 2023].
[142] European Council for Energy Efficient Economy (2023) Policy Pages. *Energy Union*. Available at: https://www.eceee.org/policy-areas/energy-union/ [Accessed 25 April 2023].

The "energy efficiency first principle" is a cornerstone of both the Energy Efficiency Directive, and the Regulation on Governance of the Energy Union and Climate Action, [143] in particular the latter defines it in Article 18:

> 'Energy efficiency first' means taking utmost account in energy planning, and in policy and investment decisions, of alternative cost-efficient energy efficiency measures to make energy demand and energy supply more efficient, in particular by means of cost-effective end-use energy savings, demand response initiatives and more efficient conversion, transmission and distribution of energy, whilst still achieving the objectives of those decisions;[144]

The Energy Efficiency Directive[145] was revised in 2018 after being initially enacted in 2012. The EED was created to bridge the gap between the EU's 2020 aim for energy savings and the current framework of Directives, national and international energy efficiency measures. It contains supply-side efficiency measures for the first time in an "energy efficiency" directive and covers all industries with the exception of transportation. A series of legally obligatory measures were introduced by Directive 2012/27/EU[146] to aid the EU in achieving its 2020 energy efficiency target of 20%. This indicates that the total energy consumption of the EU should not exceed 959 Mtoe of final energy (after the UK's withdrawal) or 1312 Mtoe of primary energy (Table 4).

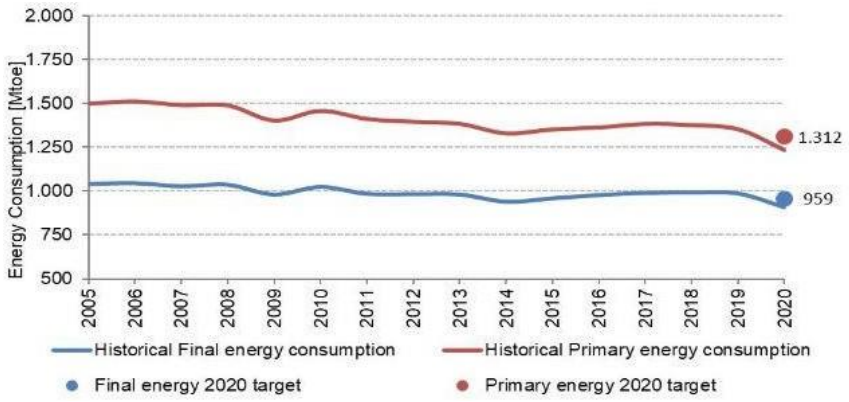
Table 4: EU Energy Efficiency Targets

EU27_2020	2005	2010	2015	2019	2020	Milestone & target 2020	2030 Target
Primary energy consumption	1 497.9	1 457.7	1 352.7	1 353.8	1 236.3	1 312*	1 128
Final energy consumption	1 040.9	1 024.1	958.4	986.4	907.0	959*	846

*Milestone for EU27_2020, based on the target for EU28. Source: Eurostat April 2022.

[143] European Council for Energy Efficient Economy (2023) Policy Pages. *Energy Efficiency First Principle*. Available at: https://www.eceee.org/policy-areas/energy-efficiency-first/ [Accessed 25 April 2023].
[144] See, Op. Cit. European Parliament and the Council of the European Union, *OJ*, L 328, p. 1 – 77.
[145] Articles 5 and 7 in particular will be taken into consideration in the case study. The former refers to "Exemplary role of public bodies' buildings", while the latter to "Energy efficiency Obligation schemes". For a more complete explanation, see European Parliament and the Council of the European Union (2012) Directive 2012/27/EU.
[146] See, European Parliament and the Council of the European Union (2012) Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency. *OJ*, L 315, 14th November, p. 1 – 56. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1399375464230&uri=CELEX:32012L0027

Figure 11: Final and primary energy consumption trends of the EU27 (the line represents the trajectory between 2005 consumption and the 2020 consumption and the dots represent the 2020 PEC and FEC targets)



Source: Joint Research Centre (JRC) based on Eurostat data, Dataset of April 2022.

According to the directive, all EU nations must use energy more wisely throughout the entire energy chain, including during production, transmission, distribution, and end-use consumption. With final energy consumption hitting 907 Mtoe and primary energy consumption reaching 1236.3 Mtoe, both goals were largely met in 2020 (Figure 11).

The Covid-19 epidemic had a significant impact on this. The updating Directive on Energy Efficiency (2018/2002) was approved in 2018 as a component of the *Clean Energy for all Europeans* package to update the regulatory framework through 2030 and beyond. A major energy efficiency target of at least 32.5% for 2030 is its primary component. The aim is based on modeling predictions from 2007 to 2030, which must be accomplished collaboratively throughout the EU. In absolute terms, this means that the EU's energy consumption for 2030 should not exceed 846 Mtoe (million tons of energy equivalent) of final energy or 1128 Mtoe (million tons of equivalent) of primary energy (after the UK leaves the EU). The amending directive also provides, *inter alia*, an extension to the 2012 directive's mandated energy savings in end-use. For the years 2021 to 2030, the EU member states must achieve new energy savings of 0.8% of final energy consumption annually.

The Governance Regulation 2018/1999 mandates that Member States create integrated 10-year national energy and climate plans (NECPs) that detail their strategies for achieving energy efficiency and other targets by 2030.[147]

[147] European Commission. Energy. *Energy efficiency directive*. Available at: https://energy.ec.europa.eu/topics/energy-strategy/energy-union_en [Accessed 25 April 2023].

They demand that each Member State lay out its 10-year plans for cutting emissions, boosting the use of renewable energy sources, enhancing energy efficiency (including in buildings), increasing cross-border infrastructure and interconnections, ensuring that markets are ready for new technologies, fostering research and innovation, as well as outlining key priorities for the future to guarantee coherence with the 2050 climate neutrality goals. The national plans had to be drafted in a way that was as wide-ranging as possible, and that meant that each nation had to participate in various forms of consultation. The notion that the national plans require close coordination between all government agencies in order for all aspects of government investment and policy to proceed in the same direction is a significant new component. This ought to eliminate the sporadic circumstance where one Ministry seems to be endorsing a policy course that is opposed by another Ministry's policy. Additionally, mandating the creation and publication of comparable plans by every EU member state increases the chance for collaboration and synergy between neighboring nations.

The most important thing is that each country can create a 10-year climate and energy outlook that also considers what its neighbors are doing. The Commission released a thorough analysis of the overall impact of all the draft plans in all the various areas targeted in June 2019, after Member States had submitted their draft NECPs in early 2019. This included country-specific recommendations from the Commission outlining ways in which these draft plans could be changed to potentially make advancements and efficiency gains with the objective to achieve our shared goals. In other words, it gave the draft NECPs a European component by transferring them from a solely national perspective to an EU-wide context. The NECPs are anticipated to stimulate investment on a genuinely continental scale by outlining the direction of travel at the EU level and offering frequent progress reports.

Overall, the NECPs are crucial to advancing the clean energy transition because they allow EU countries to consolidate all energy and climate-related targets, monitoring, and reporting under a single heading while adhering to a uniform design. They can secure Member State pledges and prevent slippage.[148] The EU countries' final integrated national energy and climate plans, which cover the years 2021 to 2030, are presented in 2020 along with the Commission's individual evaluations of each plan.

[148] Directorate-General for Energy (2020) In focus: National energy and climate plans. *European Commission News*, 16 June. Available at: https://commission.europa.eu/news/focus-national-energy-and-climate-plans-2020-06-16_en [Accessed 30 April 2023].

The combined effect of the various NECPs results in net savings of 29.4%–29.7% (FEC and PEC respectively) for energy efficiency. Even while the results were higher than those projected in the draft NECPs, they still fell short of the then-current 32.5% energy efficiency objective. The analysis also comes to the conclusion that the EU is on track to surpass its present 2030 objective of a 40% reduction in greenhouse gas emissions, with a combined impact of about 41%, if further efforts are made at all levels to maintain the momentum, fill up any gaps, and fully utilize the prospects for a green recovery.[149] The NECPs will also serve as an important foundation as the EU seeks to raise its ambition within the European Green Deal with the objective to attain carbon neutrality by 2050.[150]

To this end, in order to fulfill the emissions reduction objective of at least a net 55% by 2050, the European Commission amended the Energy Efficiency Directive as part of the *Fit for 55* package. In order to make the increased targets for primary energy consumption reduction (by 39%) and final energy consumption reduction (by 36%) by 2030 legally obligatory, the European Commission proposed a reform of the energy efficiency directive in 2021. The EU has come under fire for being excessively lax in its implementation of the present objective, which is a non-binding overall reduction of 32.5% by 2030.

In July 2021, the Commission originally proposed increasing the 2030 energy efficiency target from 9% to 13%, both for final and primary energy consumption, relative to the projections made with the PRIMES 2020 reference scenario.[151] In 2022, as part of its REPowerEU plan, the Commission modified its own EED proposal included in the Fit for 55 Package.[152] As already mentioned in paragraph 2.2, a significant development in energy efficiency, as well as in energy security, was the May 2022 publication of the RePowerEU plan by the European Union, which aims to minimize dependency on Russian fossil fuels and expedite the clean

[149] European Commission. Energy. *National energy and climate plans (NECPs)*. Available at: https://energy.ec.europa.eu/topics/energy-strategy/national-energy-and-climate-plans-necps_en#final-necps [Accessed 8 May 2023].
[150] Directorate-General for Energy (2020) In focus: National energy and climate plans. *European Commission News*, 16 June. Available at: https://commission.europa.eu/news/focus-national-energy-and-climate-plans-2020-06-16_en [Accessed 30 April 2023].
[151] One of the most important analysis tools used by the European Commission in the fields of energy, transportation, and climate change is the EU Reference Scenario. It enables decision-makers to examine the long-term forecast for the economy, energy, environment, and transportation systems using the 2020 policy framework. In particular, the primary models for the EU Reference Scenario 2020 and the basic components of the modeling framework for predictions of energy, transport, and CO_2 emissions are the PRIMES and PRIMES-TREMOVE.
[152] European Council for Energy Efficient Economy (2023) Policy Pages. *The recast Energy Efficiency Directive*. Available at: https://www.eceee.org/policy-areas/the-recast-energy-efficiency-directive/ [Accessed 25 April 2023].

energy transition by reducing its use by two-thirds by the end of 2022 and by 100% by 2030. One of the plan's three main cornerstones is energy conservation. It calls for raising the previous EU-wide energy savings target set forth in the Energy Efficiency Directive from 9% to 13% in order to double the deployment pace of heat pumps to roughly ten million aggregate units between 2023 and 2027 and speed up electrification, particularly in industry. The Commission has asked Member States to start public awareness efforts.

The EU Save Energy Communication,[153] published in August 2022, provides ways for consumers to make short-term savings. The European Gas Demand Reduction Plan,[154] which outlines immediate actions to cut gas use in Europe by 15% until spring 2023, is related to this.

The EU Recovery and Resilience Facility[155] (RRF) will be increased as part of a proposal made by the European Commission to finance the strategy. Energy efficiency components make up roughly 29% of the expected EUR 249 billion in total spending on the green transition pillar.[156]

In light of the above, it is interesting to evaluate what are the objectives and policies implemented by some states of the European Union, related to energy efficiency. To give a spectrum of political and economic settings as diversified as possible, in this particular scenario the NECPs of Germany, Italy, Poland, and Sweden are investigated.

[153] For more details, see European Commission and the Directorate-General for Energy (2022) *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions EU 'Save Energy'* (COM/2022/240 final). Available at: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2022:240:FIN [Accessed 30 April 2023].
[154] For more information, see European Commission (2022) *Save Gas for a Safe Winter: Commission proposes gas demand reduction plan to prepare EU for supply cuts*. [press release] 20 July. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4608 [Accessed 27 April 2023].
[155] For more information, see European Commission, *The Recovery and Resilience Facility*. Available at: https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility_en [Accessed 27 April 2023].
[156] International Energy Agency (2022) *Energy Efficiency 2022*, IEA, Paris. Available at: https://www.iea.org/reports/energy-efficiency-2022 pp. 45 - 46.

3.2.1 Germany

Section 1: EU target contributions

1.1 National contribution towards 2030 EU target

The NECP establishes a PEC reduction target of -30% compared to 2008 values. Savings of 240 Mtoe PEC, 216 Mtoe PEC-NEU, and 185 Mtoe FEC are implied by this. 9.10% PEC and 7.23% FEC are different in the WEM and WAM scenarios, respectively. This only results in a 28% reduction when using the 2030 and 2008 numbers from the NECP. The WAM and WEM situations are defined in a manner that is generally clear. In terms of other national goals, it is anticipated that final energy consumption in transportation will decrease by 10% by 2020 and 40% by 2050 as compared to 2005 (Table 5 and 6). The final NECP does not maintain the goal of a climate-neutral building stock by 2050, which was included in the draft NECP. However, it is mentioned as PAMs in the long-term climate and energy strategies.

1.2 Contribution of PAMs and sectors

Despite having 51 more PAMs than the draft NECP, the NECP does not disclose the anticipated PAM contribution to the 2030 target. By the end of 2019, the German Climate Plan has implemented many of them, making many of them new. A large portion of these new actions are revisions to already implemented plans. Except for PAM counting into Article 7 EED, the effects of the measures are not quantified.[157]

Section 2: Policies and measures

2.1 Building renovation strategy

The 2030 renovation milestone calls for a decrease of non-renewable PEC from its current level of 4400 PJ (2008) to 2000 PJ. Germany plans to only define additional goals for 2040 and 2050 in the unfinished LTRS in a qualitative way, according to the NECP. Regarding the absence of national and European framing, the language is not entirely clear. A complete list of actions concerning building renovation is included in the NECP.[158] These primarily consist of financial assistance (subventions, grants, and recently introduced tax incentives), information, and support from ESCOs. The effects of the measures are not measured.

[157] European Commission, Joint Research Centre, Economidou, M., Ringel, M., Valentova, M., et al., *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension*, Publications Office, 2020, https://data.europa.eu/doi/10.2760/678371 p. 78.

[158] Federal Ministry of Economic Affairs and Energy (2019) *Integrated National Energy and Climate Plan of German*. Available at: https://energy.ec.europa.eu/system/files/2022-08/de_final_necp_main_en.pdf pp. 85 – 90.

These actions include:

- A broad Energy Efficiency Strategy for Buildings (ESG);
- The new Buildings Energy Act (GEG), which raises building standards for existing structures;
- There are numerous financial assistance programs for both private and public sector building renovations, including grants for the substitution of oil boilers as well as overall refurbishment (KfW),[159] the use of renewable energy sources, and supporting heating optimization;
- Additional measures like national heating labeling for heating systems or energy consulting for non-residential buildings of local nonprofit organizations;
- Expansion of support programs for heat networks, heat storage, and cross-cutting building investments;
- Urban energy renovation;
- Urban development support (StBauF);
- Building Research Initiative Efficiency House Plus, and Energy transition constructions ("Energiewendebauen").

2.2 Energy Efficiency Obligation Schemes

The necessary savings for 2030 are 3 996.5 PJ or 95.46 Mtoe FEC. A number of different actions must be taken to fulfill the criteria (Table 8). Gross and net saves are the two types of savings impacts, with the latter taking into account overlaps, windfall savings, and rebounding. The net savings are totaled by the NECP as a contribution to the saving requirement (Table 7). The net savings only total 3371 PJ, which is insufficient to meet the demand. The NECP[160] offers a fairly thorough list of legislative initiatives that address every industry and will be expanded upon in a 2050 Energy Efficiency Strategy. Particularly, carbon pricing for the transportation and heating industries will be implemented. The new Building Energy Law (GEG) consolidates and strengthens regulatory measures in the built environment, and subsidy programs are either strengthened or created, i.e., to encourage the widespread implementation of renovations. The mobility sector is the subject of a second focus, and a large set of policies are introduced to address the various modes of transportation (e.g., environmental bonus promotion of electromobility, funding guidelines for the purchase of electric buses for public

[159] Kreditanstalt für Wiederaufbau. It is an Institute of Credit for Reconstruction, based in Frankfurt.
[160] Op. Cit. Federal Ministry of Economic Affairs and Energy, *Integrated National Energy and Climate Plan of German*, pp. 84 – 85.

transportation, support for electricity-based fuels, HGV toll, and lowering rail fares). A set of measures also focuses on expanding the marketplace for energy services. SMEs Initiative Energy Transition and Climate Action (MIE), energy consulting services for private families and SMEs, power-saving check-ups, or the promotion of energy management systems.

2.3 Central government renovations

The majority of the information in article 5 EED is absent. The following PAMs for central (and other) government restorations are included in the NECP:[161]

- Federal buildings: the role of public structures as examples;
- Contracting between the Federal Government and Länder; Contracting for Model Projects; Information on Standard Contracts and Guidelines;
- Networks for local government resource and energy efficiency;
- Public organizations should purchase energy-efficient products.

2.4 Energy poverty measures

Section 2.4.4 of the NECP[162] addresses energy poverty in great detail. The actions taken generally assist social help and regulate the energy market (by forbidding suppliers from cutting off customers for unpaid bills).

The energy evaluation for energy-inefficient households, which includes specialized guidance on how to preserve energy in daily life, is one of the targeted initiatives mentioned.

2.5 Funding of PAMs and required investments

The funding of PAMs and necessary investments are only mentioned very briefly, and no information regarding the necessary investments is provided. The federal government's budget will serve as the primary source of revenue.[163]

[161] Ivi, pp. 49, 90 – 91.
[162] Op. Cit. Federal Ministry of Economic Affairs and Energy, *Integrated National Energy and Climate Plan of German*, pp. 58 – 59.
[163] Op. Cit. Federal Ministry of Economic Affairs and Energy, *Integrated National Energy and Climate Plan of German*, pp. 90 – 95.

Section 3: Key updates and improvements

3.1 Main changes and improvements in relation to draft NECPs 2019

Although the percentages given do not equal the projected -30% PEC, the 2030 target is clearly stated. WEM and WAM scenarios are presented clearly. An amount of 89 national measures have been added to the list of PAMs, which has also been significantly enriched. But saving effects, implementation times, and possible overlaps are absent. It is frequently difficult to determine whether the measures are upgrades of previously existing ones.

3.2 Main updates in relation to 2020 timeline

The ambition in relation to the 2020 goal has definitely grown. Germany's 2030 PRIMES 2007 data would be reduced by 27% as a result of the goal (GIC - NEU). Comprehensive coverage of EED Article 7; a defined saving requirement; and recognized and quantified PAMs. The discrepancy between anticipated savings and necessary savings, however, is not addressed. In general, information on the restoration of the public sector (EED Article 5) is lacking, and information on EPBD Article 2a is scarce. Only a benchmark for 2030 has been established (Table 9). In the NECP, a broad range of measures are specifically mentioned. It should be observed that a variety of these actions (transport measures) appear to be revisions or tightening of already existing PAMs.[164]

[164] Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension*, pp. 78 – 79.

3.2.2 Italy

Section 1: EU target contributions

1.1 National contribution towards 2030 EU target

The ultimate energy contribution is determined by taking into account a reduction objective of 0.8% per year in the period 2021–2030 (estimated on the principles of the three years period 2016–2018) and assuming the attainment of the mandatory savings stipulated in Article 7 of the EED Directive. The following primary energy contribution results in a potential saving rate of 43% compared to the PRIMES 2007 reference scenario and a decrease in final energy consumption of 12.6 Ktoe compared to 2020 levels (Table 5 and 6). Although the WEM and WAM scenarios were presented, it is unclear how they differ in terms of the implemented policies. Other officially adopted national aims were not stated.

1.2 Contribution of PAMs and sectors

The projected effect of PAM is provided in terms of yearly savings (Table 7) in 2030 and total energy savings during the period 2021–2030 for the actions specified in EED Article 7. The Article 7 notification given as a separate document covers the computation methodology. The methods employed seem to be consistent overall. By 2030, the actions outlined in Article 7 should save 9.5 Mtoe in total energy, or 102% of the overall goal set forth in EED Article 3. Nearly all of the measures taken into account in the WAM scenario are updates or upgrades of the current ones. The EU-funded Cohesion Policies 2021–2027 program for Energy Efficiency Measures includes a few new initiatives (representing 3% of the overall savings).[165]

Section 2: Policies and measures

2.1 Building renovation strategy

Only a small amount of the long-term building renovation strategy is included in the final NECP[166] (relating to the existing building stock). According to information on the 2030 milestone, the yearly deep renovation rate will rise from its present low level (0.26%) to 0.7% for residential buildings and 2.9% for non-residential buildings.

There is a list of measures, but no estimate of the precise impacts and costs. By March 10th, 2020, the official LTRS will be released with additional information and analysis.

[165] Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension*, p. 89.

[166] Ministry of Economic Development, Ministry of the Environment and Protection of Natural Resources and the Sea, Ministry of Infrastructure and Transport (2019) *Integrated National Energy and Climate Plan of Italy*. Available at: https://energy.ec.europa.eu/system/files/2020-02/it_final_necp_main_en_0.pdf pp. 84 – 89.

2.2 Energy Efficiency Obligation Schemes

The overall aggregate reductions needed from 2021 to 2030 have been calculated to be 51.4 Mtoe. The EEOS (12 Mtoe) and the tax deduction method for building renovations are said to have the most effects (Table 8). Additionally, the policies affecting the transportation industry will be crucial: the modal change in the transportation of products is linked to savings of 13 Mtoe.[167]

2.3 Central government renovations

Italy chose the standard course of action and estimated the total floor space that would need to be updated each year at 400 000 m2. At the end of 2030, 6.4 million square meters will have undergone renovations at this annual rate.

2.4 Energy poverty measures

To fight energy poverty, Italy is modifying and coordinating several current strategies.[168] The tax deduction for building renovations, *Conto termico*, the National Fund for Energy Efficiency, and cohesion programs 2021–2027 should all play a key role. The "Credit transfer" system (to suppliers, building firms, and lenders in case of insolvency subjects and tenants of social houses) and ecological advantages for social housing as well as construction in earthquake-prone regions are envisaged in particular. This will lower the investment expenses for these vulnerable groups' energy efficiency measures.

2.5 Funding of PAMs and required investments

For practically all PAMs, planned budget estimates are included in the final Italian NECP. Over the years 2021-2030, the total budget amounts to almost 70 billion euros. The financing sources are public (from the national budget), but no additional information was given.[169]

[167] Ivi, pp. 172 – 191.
[168] Op. Cit. Ministry of Economic Development, Ministry of the Environment and Protection of Natural Resources and the Sea, Ministry of Infrastructure and Transport, *Integrated National Energy and Climate Plan of Italy*, pp. 222 – 225.
[169] Ivi, pp. 176 – 178.

Section 3: Key updates and improvements

3.1 Main changes and improvements in relation to draft NECPs 2019

The final version of the NECP does not significantly differ from the original NECP, however, the Article 7 declaration that is included with the plan provides more information. Due to a decrease in the main energy target for 2030 from 132 to 125.1 Mtoe, the overall ambition was marginally raised.

3.2 Main updates in relation to 2020 timeline

The method chosen to define the target appears to be consistent with the one previously employed for the 2020 targets. Although the annual (final) energy savings are expected to drop from 15.5 to 9.5 Mtoe, according to Italian estimates, the degree of ambition has remained unchanged (Table 9). With a few minor adjustments, the initiatives taken to implement EED Articles 5 and 7 in 2010 are confirmed. The primary components of the updated long-term renovation plan (EPBD Article 2a) were not covered.[170]

[170] Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension*, pp. 89 – 90.

3.2.3 Poland

Section 1: EU target contributions

1.1 National contribution towards 2030 EU target

According to the NECP, in comparison to the PRIMES 2007 prediction, primary energy use will be 23% more energy efficient by 2030. As a result, the primary energy consumption will be lower by approximately 27.3 Mtoe relative to the PRIMES 2007 prediction, resulting in a 2030 PEC level of 91.3 Mtoe. For PEC and FEC, the decrease in the form of WEM/WAM situations is 12% and 15%, respectively (Table 5 and 6). Both the general outline of WEM and WAM are quite thorough and understandable. However, it is not entirely clear how the measures are to be attributed to the WAM scenario. The effects of each measure are not stated. Beyond what is required by EU law, Poland has established two additional goals:

- Creation of effective and environmentally sustainable district heating systems;
- Improvements in cogeneration technologies' ability to produce heat. [171]

1.2 Contribution of PAMs and sectors

It is impossible to judge the ambition because the NECP[172] does not provide impact data for PAM contributions for the 2030 target. No information is given on the methods used to determine the impacts. One exception is the way (aggregate) savings are established within Article 7 EED, where starting points and measurable impacts are given (Table 7).[173]

Section 2: Policies and measures

2.1 Building renovation strategy

According to the NECP, the LTRS will be delivered separately. As a result, it offers very little information and no goals or milestones for the years following 2020. A renovation share (70% of all thermally insulated structures in the housing stock) is given for 2030, however, it is still unclear if this is meant to serve as a target or not. The NECP includes a number of measures to accomplish the renovation goal.

[171] Ministry of State Assets and working team (2019) *Integrated National Energy and Climate Plan of Poland*. Available at: https://energy.ec.europa.eu/system/files/2020-08/pl_final_necp_part_1_3_en_0.pdf pp. 29 – 31.
[172] Op. Cit. Ministry of State Assets and working team, *Integrated National Energy and Climate Plan of Poland*, pp. 83 – 85.
[173] Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension*, p. 103.

Their contribution is not, however, measured:

- Several financial assistance programs;
- Using energy services for renovations;
- Using the anti-smog tariff to convert to electric heating;
- Supporting low-energy buildings, particularly during the design, construction, and rehabilitation phases in a way that ensures their energy efficiency, and enhancing the accessibility of renewable energy in both new and existing buildings. [174]

2.2 Energy Efficiency Obligation Schemes

The required quantity of savings for 2030 is 30,635 Ktoe. This will be accomplished in significant part through an EEO program encompassing 24,500 Ktoe in aggregate savings and several alternative measures.

The following significant alternative measures (Table 8) are included (calculations in brackets are calculated differently; therefore, adding up with the EEO savings is not possible):

- Thermo-modernization and Renovation Fund: 700 Ktoe (70 Ktoe year);
- 2000 Ktoe (200 Ktoe each year) in tax reduction for investments made in thermos-modernizing single-family homes;
- 1350 Ktoe (135 Ktoe annually) has been added to city public transportation;
- Assistance for businesses in the RES and energy efficiency sectors, with emphasis on energy service providers (under the ESCO scheme): no impacts measured.[175]

2.3 Central government renovations

Poland has chosen a different course of action. An estimated 43 440.1 MWh in energy savings should be realized between 2021 and 2030 as a result of actions enhancing building energy performance. Information is generally lacking because central government renovations are handled in conjunction with the absence of the LTRS. There is no definitive list of actions that can be directly attributed to Article 5 EED, besides the 2016 Energy Efficiency Act, which establishes energy efficiency obligations for the public sector.

It is yet unknown whether the recruited PAMs additionally handle renovations for the federal government. Impacts are not measured.[176]

[174] Op. Cit. Ministry of State Assets and working team, *Integrated National Energy and Climate Plan of Poland*, pp. 30, 89 – 93.
[175] Op. Cit. Ministry of State Assets and working team, *Integrated National Energy and Climate Plan of Poland*, pp. 83 – 88.
[176] Ivi, pp. 30 – 31.

2.4 Energy poverty measures

In section 3.4.4,[177] the NECP places a particular emphasis on energy poverty initiatives. This includes the following actions:

- Gas and electricity consumers are the targets of awareness campaigns;
- The quantity of households experiencing energy poverty is being tracked;
- The persistence of publicly (including EU) sponsored programs and their potential adjustment to the requirements of energy-inefficient users, particularly loan programs meant to support modernization initiatives;
- Building, enhancing, and expanding district heating networks;
- Keeping an eye on the safety of electricity and gas consumers who are most vulnerable;
- Anti-smog tax for using electric heaters instead of gas ones.

2.5 Funding of PAMs and required investments

The PAMs have not received a clear budget or financing source. The WAM scenario establishes overall investment needs, but just generally, per sector (households, industry, transport, services, agriculture), not per measure. Sources of funding are generally not specifically mentioned.[178]

Section 3: Key updates and improvements

3.1 Main changes and improvements in relation to draft NECPs 2019

A distinct connection between the WEM/WAM scenario and the PRIMES 2007 scenario is not yet established, despite the fact that the Article 3 EED objective has been defined. Beyond the contributions to Article 7 EED, estimation of PAM impacts is still largely lacking. Although they are supposed to be included with the LTRS, the objectives and specifics for Articles 2a EPBD and 5 EED are still largely absent. In contrast to the draft NECPs, which had only referenced generic measures, the NECP offers a significantly more extensive range of PAMs (30 in total). The PAMs are described in great detail overall, however, there are no explicit impacts or associated budgets.

[177] Ivi, pp. 119 – 122.

[178] Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension*, pp. 103 – 104.

3.2 Main updates in relation to 2020 timeline

A separate methodology is used for the target contribution and related 2020–2030 objectives:

- For 2020, Poland chose an absolute main energy savings objective (a reduction of 13.6 Mtoe from 2010 to 2020). As a result, consumption levels of 71.6 Mtoe (FEC) and 96.4 Mtoe (PEC) are produced;
- According to PRIMES 2007, the 2030 aim is to reduce primary energy by 23% from the 2030 baseline (GIC-NEU). 91.3 Mtoe (PEC) or 67.0 Mtoe (FEC) would result from this.

The 2020 objective would need to be reduced by nearly 12% if it were reformed as savings from the 2020 PRIMES estimates (GIC: 117,108 Mtoe minus NEU: 7279 Mtoe, leading to 109,829 Mtoe). The 2030 aim is far more ambitious in this regard (Table 9). The NECP outlines an extensive collection of new PAMs that span all industries: these include promoting low-energy buildings, including during the design, construction, and redevelopment stages, in a way that ensures their energy efficiency, and improving the accessibility of renewable energy in both new and existing structures. They also act on the energy efficiency of buildings, improve housing conditions, improve housing stock technical conditions, and increase energy efficiency. The development of energy-efficient low-carbon transportation, an anti-smog tax, and financial support for initiatives to increase energy efficiency in gas transmission and distribution as well as in underground gas storage (UGS) facilities are further measures.[179]

[179] Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension*, p. 104.

3.2.4 Sweden

Section 1: EU target contributions

1.1 National contribution towards 2030 EU target

Sweden wants to reduce its energy intensity by 50% from 2005 levels by 2030. In 2030, primary and final energy will be 461 TWh and 339 TWh, respectively, assuming an annual economic growth rate of 2%. The Swedish Energy Agency's Reference EU scenario, comprising energy and climate policies up to July 1st, 2018, is known as the WEM scenario. This scenario predicts that without new policies and measures, Sweden's primary and final energy consumption (Table 5 and 6) in 2030 will be 516 TWh and 384 TWh, respectively. The final NECP does not define the WAM scenario. Instead, it is claimed that the Swedish Energy Agency and other pertinent agencies are in communication to develop cost-effective ways for achieving the 2030 Energy Efficiency Target. The following national targets are listed in the final NECP:[180]

- Sweden must reduce its net greenhouse gas emissions to zero by 2045 and eventually attain negative emissions. Additional actions should only account for up to 15% of emission reductions;
- By 2030, Sweden must reduce its transportation sector emissions by 70% from 1990 levels;
- By 2040, Sweden must reduce emissions from industries not covered by the EU Emission Trading System (EU ETS) by 75% from 1990 levels. Additional measures can only produce up to 2% of the total. By 2030, Sweden must reduce emissions from industries not covered by the EU ETS by 63% as compared to 1990.

Apart from these goals, the Swedish Energy Agency has pinpointed five industries and, in collaboration with the pertinent parties, defined the following strategic areas: fossil-free transportation, world-class production, a flexible and reliable energy system, future trade and consumption, and resource-efficient buildings.[181]

[180] Ministry of Infrastructure (2019) *Integrated National Energy and Climate Plan of Sweden*. Available at: https://energy.ec.europa.eu/system/files/2020-03/se_final_necp_main_en_0.pdf pp. 24 – 26.

[181] Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension*, p. 119.

1.2 Contribution of PAMs and sectors

Except for the primary measure listed under Article 7 (the Energy and Carbon Tax), the expected effect of PAMs with respect to energy savings is not detailed in the final NECP (Table 7). Additionally, the calculation process is only described for the energy and carbon tax. The aggregate final energy savings from this strategy are anticipated to be 172.2 TWh in 2021–2030, which is more than enough to reach the objective of 163 TWh. It is not stated how much the measures contribute to Article 3 aim. Which measures are new is not entirely clear. The Reference Scenario includes policies and measures in effect from July 1st, 2018. Following 2018 will be the following actions: "Information Center for Sustainable Building", "Development of Local and Regional Capacity, Including Sustainable Transport Solutions".[182]

Section 2: Policies and measures

2.1 Building renovation strategy

The final NECP does not refer to the renovation strategy milestones. By 10th March 2020, Sweden will report to the Commission its long-term renovation strategy, along with possible benchmark dates. There are documented measures for the current refurbishment approach, but no savings numbers. These consist of:

- Building Regulations (BBR) of the National Board of Housing, Building, and Planning;
- Assistance with remodeling and energy-saving measures in rental homes;
- The National Renovation Centre (NRC);
- The Sustainable Building Information Center;
- The renovation, conversion, and extension deduction;
- The informational website renoveringsinfo.se

A new initiative from them is "The Sustainable Building Information Centre" (to be put into effect after 2018).[183]

[182] Op. Cit. Ministry of Infrastructure, *Integrated National Energy and Climate Plan of Sweden*, pp. 26, 85, 87 – 89.
[183] Op. Cit. Ministry of Infrastructure, *Integrated National Energy and Climate Plan of Sweden*, pp. 26, 85 – 88.

2.2 Energy Efficiency Obligation Schemes

The overall aggregate savings needed from 2021 to 2030 have been calculated to be 163 TWh or 14015.5 Ktoe. To point out that this is an estimate of the overall savings obligation that is based on Eurostat data from 2015 to 2017. The 2018 energy figures will be taken into account for determining the ultimate energy savings commitment. The Energy and Carbon Tax is the primary measure presented under Article 7 (Table 8). It is regarded as an alternative course of action. In the years 2021–2030, it is anticipated that the Energy and Carbon Tax will result in cumulative energy savings of 172.2 TWh (14806.5 Ktoe). This appears to be adequate to meet the 2030 criterion.[184]

2.3 Central government renovations

Sweden selected a different course of action. In the final NECP, no Article 5 measures have been recorded. The required total savings from 2021 to 2030 is 28.6 GWh. According to Article 5, the Swedish National Property Board and the Fortifications Agency must split any savings.[185]

2.4 Energy poverty measures

The finished NECP does not include any energy poverty measures.[186] Energy poverty and general poverty are treated equally in Sweden. As a result, there are no specific measures to address it, and the term "energy poverty" is not utilized. The social policy addresses the problem.

2.5 Funding of PAMs and required investments

Only some measures have had their planned budget quantified. Various funding sources, including the state budget, the Energy Efficiency Finance Facility (EEFF), the EU, the county councils, and regional associations, are also mentioned.[187]

[184] Ivi, 76 – 82.
[185] Ivi, pp. 26 – 27.
[186] Ivi, pp. 38, 75, 109.
[187] Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension,* pp. 119 – 120.

Section 3: Key updates and improvements

3.1 Main changes and improvements in relation to draft NECPs 2019

A couple of the missing components found in the draft NECP have been remedied in the final document, including:

- Article 5: Some details regarding the Article 5 savings duty have been published. Sweden selected a different course of action;
- Article 7: Energy and carbon tax anticipated energy savings and a preliminary energy savings obligation for the years 2021 to 2030 have been presented;

The broad objective has not changed (Table 9). The proposed NECP still calls for a 50% reduction in energy intensity by 2030 from 2005 levels. The 2020 NECP also includes primary and final energy assets that can meet the 2030 target under the assumption that economic activity will increase by 2% annually. The final NECP includes the energy-saving requirements set forth in Articles 5 and 7, which were absent from the draft.

3.2 Main updates in relation to 2020 timeline

The country's energy intensity linearly increased from 2015 to 2020 (20% decrease from 2008) and 2030 (50% reduction from 2005), using an identical methodological approach for both 2020 and 2030 targets. Fuels used for non-energy purposes are included in the 2020 aim but are not in the 2030 target. The final NECP has 10 measures, 8 of which are from the Energy Efficiency Dimension, however, they are not listed in the NEEAP 2017. They are one for energy supply, two for SMEs and industries, three for cross-sectoral measures, and two for the renovation of buildings. More particularly:

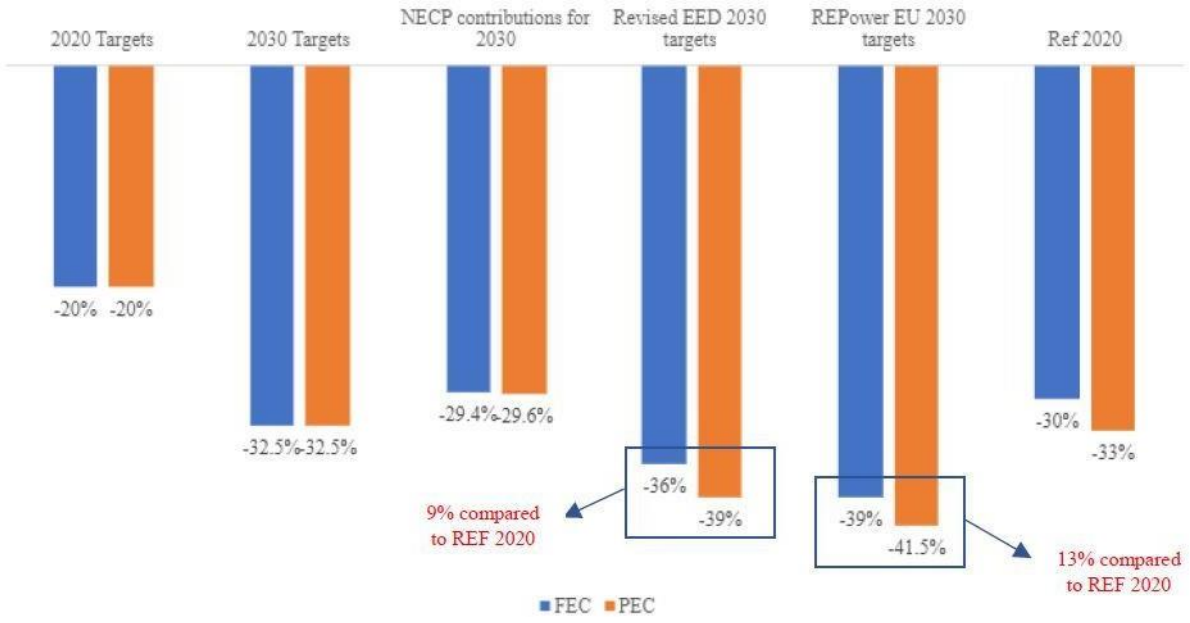
- Sectoral energy efficiency plans;
- Grid operator regulatory model;
- Energy Step program;
- Energy mapping support;
- Assistance with market entry, technology development, and innovation clusters;
- Creation of regional and local capacity, including environmentally friendly transportation options;
- The informational website renoveringsinfo.se;
- The National Renovation Centre (NRC).

NEEAP 2017 also contained the primary Article 7 legislation (the Energy and Carbon Tax). It is stated that efforts taken under this strategy in 2021 and beyond will result in energy savings even after 2030. There are also other activities for the Renovation Strategy developed after NEEAP or undertaken after 2018. These projects (Information Centre for Sustainable Building, NRC, renoveringsinfo.se) primarily focus on spreading information. In terms of Article 5, the final NECP does not contain any explicit implementation guidelines.[188]

Lastly, the Russian invasion of Ukraine has forced the EU to reckon with reality: energy efficiency and the adoption of renewable energy sources are important for energy independence and security as well as climate policy. As Figure 12 shows, in its July 2021 plan for a redesign of the EED, the Commission suggested an EU objective for 2030 of 9% reduction relative to the 2020 reference scenario. This translates to a decrease of 1 023 Mtoe for PEC and 787 Mtoe for FEC, respectively, which is 36% for FEC and 39% for PEC less than the 2007 reference scenario. By the REPowerEU package, which was adopted in May 2022 to swiftly decrease the EU's reliance on Russian fossil fuels, broaden energy supplies at the EU level, and expedite the green transition in response to the insecurity about the EU's energy supply created by the war in Ukraine, this target was raised even further to 13%, which would equate to an overall energy consumption in the EU of 980 Mtoe for PEC and 750 Mtoe for FEC.[189] Member States are required to submit draft modifications to their NECPs in 2023 and final updates in 2024 under the Regulation on the Governance of the Energy Union and Climate Action. In 2030, this will give Member States the chance to establish new national goals and determine new national contributions.[190]

[188] Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension,* p. 120.
[189] European Commission and Directorate-General for Energy (2022) *Report from The Commission to The European Parliament and The Council 2022 Report on The Achievement of the 2020 Energy Efficiency Targets* (COM/2022/641 final). Available at: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52022DC0641 [Accessed 02 May 2023] p. 7.
[190] European Environment Agency (2022) *Trends and projections in Europe 2022.* EEA Report No 10/2022 [pdf] Luxembourg: Publications Office of the European Union. Available at: https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2022 [Accessed 27 April 2023] p. 35.

Figure 12: Reduction of PEC and FEC compared to REF2007 scenario projections



*REF2007 refers to Referent 2007 scenario. Source: European Commission, Directorate-General for Energy, 2022.

Table 5: Achievement of 2020 PEC targets per Member States

Member state	PEC	PEC Target	% achieved PEC
Germany	262.3	276.6	105.4%
Italy	132.3	158.0	119.4%
Poland	96.9	96.4	99.5%
Sweden	41,7	43.4	104.1%

Source: JRC based on Member States' reporting, Eurostat, Dataset April 2022.

Table 6: Achievement of 2020 FEC targets per Member States

Member state	FEC	FEC Target	% achieved FEC
Germany	201.7%	194.3%	96.4%
Italy	102.7	124.0	120.7%
Poland	71.1	71.6	100.6%
Sweden	30.9	30.3	97.8%

Source: JRC based on Member States' reporting, Eurostat, Dataset April 2022.

Table 7: Cumulative energy savings over 2014 – 2020 reported by the Member States – compared to the amount of cumulative energy savings required in 2014 – 2020 under Article 7 of the EED (in Ktoe)

Member state	REPORTED cumulative energy savings over 2014-2020	REQUIRED cumulative energy savings over 2014-2020	% of achievement
Germany	36 812	41 989	88%
Italy	23 239	25 502	91%
Poland	10 473	14 818	71%
Sweden	9 940	9 114	109%

Source: information reported by Member States.

Table 8: Overview of the top three measures per Member State (based on the cumulative energy savings in 2014-2020 reported for each policy measure[191]

Member state	Top 3 policy measures per Member State (per decreasing order of cumulative savings)	Cumulative energy savings 2014-2020	% of the Member State's cumulative savings
Germany	Energy and electricity tax	12205	33%
	Energy Savings Ordinance (existing buildings)	7543	20%
	KfW support programmes for energy-efficient construction and renovation	4140	11%
Italy	Tax reductions	10394	45%
	White Certificates	8392	36%
	Enterprise 4.0 Plan	1830	8%
Poland	White certificates scheme	9159	87%
	Thermomodernisation Fund	662	6%
	Fuel tax	355	3%
Sweden	Energy and CO2 tax	9940	100%

Source: information reported by Member States.

[191] Not all the Member States have reported 3 policy measures.

Table 9: Renovation rates reported in national long-term renovation strategies

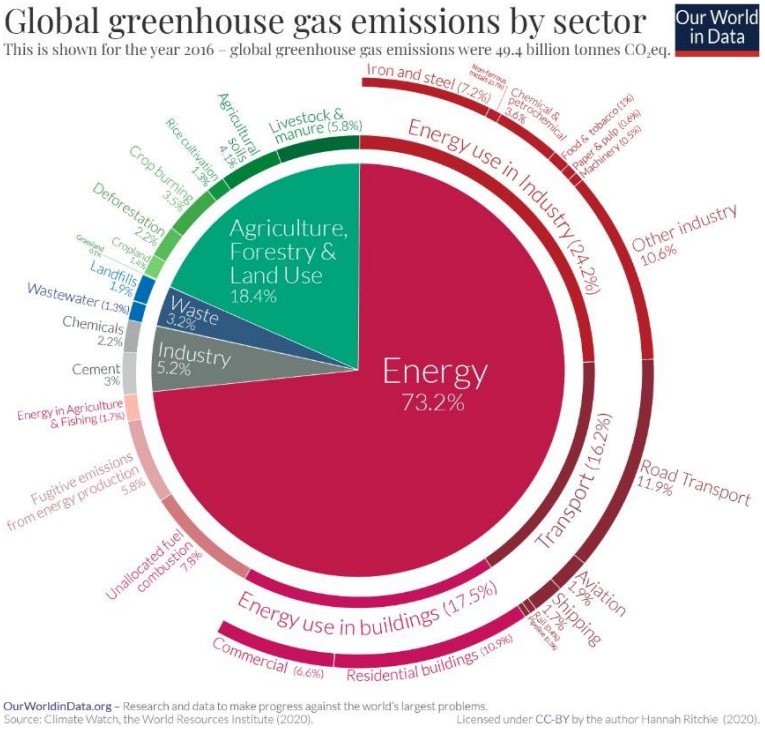
Member state	Completed renovation	Planned renovation		
	2020	2030	2040	2050
Germany		1.3% to 2% p.a. SFH and 1.5% to 2% p.a. MFH for the period 2020-2030		
Italy	0.86% p.a.	1.9% p.a. residential; 2.8% p.a. non-residential	2.7% p.a. residential; 2.6% p.a. non-residential	2.7% p.a. residential; 2.6% p.a. non-residential
Poland		3.6% p.a. 236 000 cumulative buildings	4.1% p.a. 507 000 cumulative buildings	3.7% p.a. 751 000 cumulative buildings
Sweden	2.5%- 5% p.a. 2016-2019 10% p.a. after 2019			

*p.a means *per annum*. Source: JRC 2022 based on information reported by Member States.

Conclusion

The primary goal of this thesis was to understand how environmental and energy policies coordinate with each other in reducing GHG and CO_2 emissions and so, accomplishing climate goals, stated by the 2030 Agenda and the Paris Agreement. It becomes clear that energy efficiency is the most suitable and desirable match in this regard. Promoting energy efficiency facilitates emission reduction, as the energy sector alone is responsible for more than 70% of global emissions. However, alone, it is not enough to achieve the climate goals.[192]

Figure 103: Global greenhouse gas emissions by sector.



Source: Database Climate Watch, the World Resources Institute (2020).

As Figure 13 shows, 73.2% of emissions come from the energy sector. Innovations are required across a variety of industries to achieve net-zero emissions.

It is not possible to reach it with one solution.

The GHG emissions by energy sector are divided into: Energy use in industry (24.2%), Energy use in buildings (17.5%), Transport (16.2%), Unallocated fuel combustion (7.8%), Fugitive

[192] As stated in paragraph 2.1, energy efficiency is one of the direct regulations. See, Op. Cit. Parry, I. W., *What Is the Best Policy Instrument for Reducing CO_2 Emissions?* pp. 7 – 8.

emissions from energy production (5.8%), and Energy use in agriculture and fishing (1.7%).[193] In particular, it has been found that this occurs both at the international and European levels. At the international level, it is recognized that energy efficiency is the best policy linking the environmental and energy-related issues, through the clear and crucial connection between SDGs 7 and 13. In their Nationally Determined Contributions (NDCs), the vast majority of countries suggested new emission targets for 2030. Although all of the most current NDCs have been implemented, it is anticipated that global GHG emissions would be 14% higher in 2030 than they were in 2010, showing that much more effort has to be done to reduce emissions to the level needed to attain the 1.5°C objective.

A thorough plan that emphasizes how these two global goals overlap is necessary to speed up the process. Concentrating on particular activities for coordinated execution at all levels could considerably expedite the pace of implementation and increase ambition. For this purpose, Nerini et al. (2019: 5) stated that "Climate action [SDG 13] will require efforts to better plan and manage resources in an integrated way. Many of the Targets on food- […] water- […] and energy [SDG 7]- […] systems are reinforcing or indivisible with climate action". Even McCollum et al. (2018: 14) claimed that "[…] ensuring universal energy access to the poor, deploying most types of renewables at scale and/or boosting energy efficiency efforts [SDG 7] will have positive impacts on—or, conversely, will be aided by—the targets for achieving […] reduced climate change (SDG13)".
Also, according to the HLPF on Sustainable Development (2019: 21):

> Only through the consistent use of renewable energy and energy efficiency measures, including the implementation of the energy access for all in accordance with SDG 7, and hence the immediate fight against climate change and its effects, can SDG 13 be met. Without timely and effective implementation of a global energy transition, the SDG 13 sustainability objective will remain unattainable.

[193] Ritchie, H., Roser, M., and Rosado P. (2020) *CO_2 and Greenhouse Gas Emissions*. Published online at OurWorldInData.org. Available at: https://ourworldindata.org/emissions-by-sector [Accessed 05 May 2023].

At the European level, the importance of energy efficiency in meeting climate goals is also clear. Indeed, an important component of the European Green Deal and the Union's plan to achieve a decarbonized economy by 2050 in a cost-effective manner is energy efficiency, as well as one of the five pillars of the Energy Union. Synergies and interactions between the different aspects are planned because the other aspects lie under the headings of decarbonization, energy security, internal energy market, research, and innovation. Apart from the obvious connection, in NECPs almost all of the submitted energy efficiency measures contained (685 measures or 49% of the total)[194] were linked to the decarbonization dimension, revealing the considerable connection that exists between these two dimensions. For instance, Italy, along with other European countries not analyzed in this thesis,[195] present the greatest interaction between decarbonization and energy efficiency. Specifically, measures submitted under the decarbonization dimension were also reported under the energy efficiency dimension. At the same time, according to European Commission, the Italian NECP acknowledges the linkages between GHG emissions and policies promoting renewable energy and energy efficiency.

However, a thorough analysis of these interconnections at the level of specific policies and programs is not included in the plan. Overall, it is uncertain how energy efficiency and renewable measures will affect GHG targets quantitatively. Italy has not given any details on how interactions can be maximized or minimized, either positively or negatively.[196] The German NECP does not contain any further steps to significantly raise environmental taxes and instead depends on carbon pricing under the new emissions trading system. Germany has one of the lowest environmental tax incomes to GDP ratios in the EU. Energy-related taxes, such as the energy tax (69.2%) and the electricity tax (11.8%), account for the majority of environmental tax revenue in Germany (82.8%). Compared to other EU nations, Germany has especially low tax collections from resource and transportation fuel taxes. Indirect taxes on

[194] Roughly, 1400 recognized policies and measures (PAMs) on energy efficiency in all NECPs. See, Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension,* p. 45.

[195] Namely Cyprus, Portugal, Estonia, Ireland, Croatia, Hungary, Denmark and Slovenia. See, Op. Cit. European Commission, Joint Research Centre, *National energy and climate plans for 2021-2030 under the EU energy union: assessment of the energy efficiency dimension,* p. 24.

[196] European Commission (2020) *Commission Staff Working Document Assessment of the final national energy and climate plan of Italy* (SWD (2020) 911 final). Available at: https://energy.ec.europa.eu/system/files/2021-01/staff_working_document_assessment_necp_italy_en_0.pdf [Accessed 04 May 2023] p. 12.

pollution are not collected in Germany.[197] On the other hand, the Swedish NECP contains the "Industrial Leap" program. It encourages low-carbon innovation, such as those aimed at lowering process-related GHG emissions, in sectors which consume a lot of energy. The "Climate Leap" program's local and regional GHG emission reduction initiatives are also supported by the government. Climate Leap assists local governments with funding projects like installing electrical vehicle charge stations, converting to biofuels for district heating, installing bike lanes and other cycling infrastructure.[198] With reference to the Polish NECP, the European Commission found that the interactions within and among the many elements of the Energy Union are outlined, but they are not thoroughly covered. Interactions between sectoral policies and measures that are already in place and those that are planned are not fully covered. As an example, several energy subsidies, including fossil fuel subsidies, are mentioned and measured under various support measures in the final plan, but it fails to appear like the plan completely complies with globally accepted criteria. The phase-out of subsidies for fossil fuel generation has no set timetable.[199]

However, the Energy Union valued very highly the significant role that energy efficiency plays and has transposed into law the "Energy Efficiency First" policy.[200] For example, Germany NECP specifically examines the connections between the Energy Union's other pillars and the energy-efficiency first principle. It is the country, among those analyzed, which better addressed this principle with the other dimensions. The principle's effects are specifically discussed and it covers all sectors.[201] Despite the fact that energy efficiency is crucial for achieving all targets, particularly the decrease in greenhouse gas emissions, the majority of final NECPs only include scant information on how this principle will be used. In accordance with the European Green Deal, the proposed European Climate Law, and the Communication on ramping up Europe's 2030 climate ambition, NECPs marks a significant effort by Member States and lays the groundwork for increasing the ambition to achieving climate neutrality.

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[197] European Commission (2020) *Commission Staff Working Document Assessment of the final national energy and climate plan of Germany* (SWD (2020) 904 final). Available at: https://energy.ec.europa.eu/system/files/2021-01/staff_working_document_assessment_necp_germany_en_0.pdf [Accessed 03 May 2023] p. 14.
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[200] Op. Cit. European Parliament and the Council of the European Union, *OJ*, L 328, p. 1 – 77.
[201] Op. Cit. European Commission, (SWD (2020) 904 final), p. 13.

The EU's existing energy efficiency goals make a major contribution to its climate goals. The 20-20-20 goals and the 2030 climate targets established by the Climate Law are eloquent cases of how energy efficiency measures have made it possible for growth and decreased energy consumption to coexist, and have been crucial to accomplishing the goal of reducing greenhouse gas emissions. In order to meet their previously established and ongoing energy efficiency goals, Member States have put in place the institutional frameworks and frameworks that are required. By means of the National Energy and Climate Plans (NECPs), a governance framework is in place to guarantee that these goals are in line with the overarching EU goals. For the EU to become more resilient, it is therefore urgent to expedite these energy efficiency measures.[202]

Furthermore, congruent policymaking is crucial given the limited amount of time left to implement the 2030 Agenda. Moving toward more integrated methods and away from business-as-usual, tightly focused policies is what it means to pursue consistency in policy. Indeed, in Pham-Truffert et al. (2020: 1247) view:

> […] the interactions between SDGs highlights the risks of relying on expertise that is organized in silos, designing policies based on territorial autonomy, or pursuing development strategies determined solely by centralized authorities. […] Instead, the greatest potential for innovative pathways toward sustainable development lies in […] harnessing their universality and forging new partnerships. Actions toward the SDGs should adopt an integrated approach designed to minimize incoherencies and contradictions and maximize synergies on behalf of all 17 SDGs.

The claims made by Pham-Truffet et al. are perfectly applicable in the European case, as the European Commission is to play the role of "central authority",[203] providing a common framework for all states, both acting as "auditor" of every NECP. Instead, the "decentralized role" is played by Member States that translate the regional objectives of the European Union, according to their specific case. As a result, in order to all the SDGs, not only the 7 and the 13 examined in this thesis, are fully implemented and the objectives set by the 2030 Agenda and

[202] Op. Cit. European Commission, Directorate-General for Energy, (COM/2022/240 final), p. 5.
[203] For example, not only through the Green Deal and related plans but also through the presentation of a single NDC for all Member States.

the Paris Agreement are achieved, there must be conjunction both in the implementation, both in worldwide cooperation between states and non-state actors. The holistic dimension of the international community does not require isolated action, but joint and cohesive action on the part of all governments in carrying out the SDGs.

The collective and interconnected action is a common feature of all the aspects analyzed in this thesis. This is reflected at the international level by conferences and agreements, at the regional level by Community policies and objectives, and at the national level by joint efforts nationwide and with neighboring States. In this particular situation, this corresponds to the crucial value of synergy, defined as both a collective effort in implementing the SDGs and a worldwide collaborative commitment as an international community of individual nations.
This is also underlined by Breuer et al. (2019: 12):

> More generally speaking, the achievement of some SDG targets at the national level may depend on policies implemented by other countries, as well as on action on intra- (ministries within one country), inter- and supra-national levels of governance. Therefore, while policy coherence and horizontal integration is usually strongly advocated in the context of the interlinkages between SDGs, it is also necessary to directly address multi-level coherence and vertical integration between policy levels.

The importance of multi-level integration, as well as regional cooperation, is also highlighted in the European Commission's evaluations of NECPs. As regards regional cooperation, the European Commission stated that Poland has been highly dynamic, especially in the Baltic Energy Market Interconnection Plan (BEMIP) High Level Group.[204] Besides, in order to advance the clean energy transition on its islands, Italy would also profit from intensifying regional cooperation with its neighbors, particularly by promoting renewable and sustainable projects throughout the Mediterranean.[205] In general, all four states analyzed[206] are involved in ongoing efforts to increase cross-border cooperation and activities that promote the implementation of its national energy and climate plan.

[204] Op. Cit. European Commission, (SWD (2020) 920 final), p. 18.
[205] Op. Cit. European Commission, (SWD (2020) 911 final), p. 16.
[206] See also, Op. Cit. European Commission, (SWD (2020) 904 final), p. 17; and Op. Cit. European Commission, (SWD (2020) 926 final), pp. 15 – 16.

In relation to multi-level integration, Germany, Italy, Poland, and Sweden are encouraged by the European Commission to maximize the potential of multilevel dialogues on climate and energy by actively engaging with regional and local authorities, social partners, civil society organizations, business community, investors, and other stakeholders to discuss the various futures for its energy and climate policies.

List of abbreviations

ACER	Agency for the Cooperation of Energy Regulators of European Union
AEAs	Annual Emission Allocations
BBR	Building Regulations
CBD	Convention on Conservation of Biological Diversity
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CO_2	Carbon Dioxide
COP	Conference of the Parties
CPI	Carbon Pricing Instruments
EEA	European Environment Agency
EEC	European Economic Community
EED	Energy Efficiency Directive
EEFF	Energy Efficiency Finance Facility
EEOS	Energy Efficiency Obligation Schemes
EGD	European Green Deal
EPBD	Energy Performance of Buildings Directive
ESCO	Energy Service Companies
ESD	Effort Sharing Decision
ESG	Energy Efficiency Strategy for Buildings
ETD	Energy Taxation Directive
EU	European Union
EUA	European Union Allowances
EU ETS	European Union Emission Trading System
FEC	Final Energy Consumption
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEG	Building Energy Act (Germany)
GHG	Greenhouse Gas
GIC – NEU	Gross Inland Consumption – Net Energy Use
GSDR	Global Sustainable Development Report
GW	Gigawatt
GWh	Gigawatt hours
HGV	Heavy Goods Vehicle
HLPF	High – Level Political Forum
IEA	International Energy Agency
IGES	Institute for Global Environmental Strategies
ILUC	Indirect Land Use Changes
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
JI	Joint Implementation
JRC	Joint Research Centre of European Commission
KfW	Kreditanstalt für Wiederaufbau
Ktoe	Kilotons of oil equivalent
kWh	Kilowatt hours
LTRS	Long – Term Renovation Strategies
MDG	Millennium Development Goals

MFH	Multi Family House
MT CO_2	Metric tons of carbon dioxide
Mtoe	Megatons of oil equivalent
MWh	Megawatt hours
NAP	National Allocation Plan
NDC	National Determined Contribution
NECP	National Energy and Climate Plan
NEEAP	National Energy Efficiency Action Plan
NGO	Non – Governmental Organization
NRC	National Renovation Centre
OECD	Organization for Economic Cooperation and Development
PAM	Policies and Measures
PEC	Primary Energy Consumption
PJ	Petajoule
PM	Particulate Matter
POPs	Persistent Organic Pollutants
RES	Renewable Energy Sources
RRF	Recovery and Resilience Facility
SDG	Sustainable Development Goals
SDS	Sustainable Development Strategy
SFH	Single Family House
SIDS	Small Island Developing States
SME	Small and medium-sized enterprises
TEC	Treaty establishing the European Community
TFEU	Treaty on the Functioning of the European Union
TWh	Terawatt hours
UGS	Underground Gas Storage
UK	United Kingdom
UN	United Nations
UNU	United Nations University
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UN CSD	United Nations Commission on Sustainable Development
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affair
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
US	United States
VNR	Voluntary National Reports
WAM	With Additional Measures
WCED	World Commission on Environment and Development
WEM	With Existing Measures
WTO	World Trade Organization

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Glossary

Co-generation, also known as combined heat and power (CHP), describes the simultaneous production of both useful heat (that can be used, for example, in industrial processes or city heating schemes) and electricity in a single process or unit. Co-generation enables much greater plant efficiencies to be obtained in terms of energy conversion with overall efficiencies as high as 80-90 %. The energy savings potential of co-generation is important with regard to reducing emissions and improving energy efficiency. [1]

Carbon dioxide (CO_2) is a colorless, odorless and non-poisonous gas formed by combustion of carbon and in the respiration of living organisms and is considered a greenhouse gas. Emissions means the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time. Carbon dioxide emissions or CO_2 emissions are emissions stemming from the burning of fossil fuels and the manufacture of cement; they include carbon dioxide produced during consumption of solid, liquid, and gas fuels as well as gas flaring.

Diesel oil price reflects average consumer prices at the pump of diesel; prices are usually recorded on the 15th day of each month. Transport diesel oil is used to power diesel engines in buses, trucks, trains, cars and other industrial machinery.

Energy intensity is one of the indicators to measure the energy needs of an economy. It is often used as an approximation of energy efficiency. Many factors influence energy intensity. It reflects on structure of economy and its cycle, general standards of living and weather conditions in the reference area. Energy intensity is calculated as units of energy per unit of GDP.

Final energy consumption is the total energy consumed by end users, such as households, industry and agriculture. It is the energy which reaches the final consumer's door and excludes that which is used by the energy sector itself.

Final energy consumption excludes energy used by the energy sector, including for

[1] All definitions provided in the glossary are taken from the website: Eurostat (2023) Statistic explained. *Thematic glossaries*. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Thematic_glossaries [Accessed 08 May 2023].

deliveries, and transformation. It also excludes fuel transformed in the electrical power stations of industrial auto-producers and coke transformed into blast-furnace gas where this is not part of overall industrial consumption but of the transformation sector.
Final energy consumption in "households, services, etc." covers quantities consumed by private households, commerce, public administration, services, agriculture and fisheries.

Fossil fuel is a generic term for non-renewable energy sources such as coal, coal products, natural gas, derived gas, crude oil, petroleum products and non-renewable wastes. These fuels originate from plants and animals that existed in the geological past (for example, millions of years ago). Fossil fuels can be also made by industrial processes from other fossil fuels (for example in the oil refinery, crude oil is transformed into motor gasoline).
For decades fossil fuels satisfy most of the human energy requirements. Fossil fuels are carbon-based and their combustion results in the release of carbon into the Earth's atmosphere (carbon that was stored hundreds of millions of years ago). It is estimated that roughly 80% of all manmade CO_2 and green-house gas emissions originate from fossil fuels combustion.

A **gigajoule**, abbreviated as **GJ**, is a unit of measurement of energy consumption: a gigajoule is equal to one thousand million joules.

Gigawatt hours, abbreviated as **GWh**, is a unit of energy representing one billion (1 000 000 000) watt hours and is equivalent to one million kilowatt hours. Gigawatt hours are often used as a measure of the output of large electricity power stations. A kilowatt hour is equivalent to a steady power of one kilowatt running for one hour and is equivalent to 3.6 million joules or 3.6 megajoules.

Greenhouse gases constitute a group of gases contributing to global warming and climate change. the non-fluorinated gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O); the fluorinated gases: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), nitrogen trifluoride (NF_3).

Gross domestic product, abbreviated as **GDP**, is a basic measure of the overall size of a country's economy. As an aggregate measure of production, GDP is equal to the sum of the gross value added of all resident institutional units engaged in production, plus any taxes on products and minus any subsidies on products. Gross value added is the difference between output and intermediate consumption. GDP is also equal to: the sum of the final uses of goods and services (all uses except intermediate consumption) measured in purchasers' prices, minus the value of imports of goods and services; and, the sum of primary incomes distributed by resident producer units.

Gross inland energy consumption, sometimes abbreviated as **gross inland consumption**, means the overall supply of energy for all activities on the territory of the country, but excluding international maritime bunkers. It includes energy needs for energy transformation (including generating electricity from combustible fuels), support operations of the energy sector itself, transmission and distribution losses, final energy consumption (industry, transport, households, services, agriculture, ...) and the use of fossil fuel products for non-energy purposes (e.g., in the chemical industry). It excludes international maritime bunkers, but it might include other fuels purchased within the country that are used elsewhere (e.g. international aviation and “fuel tourism” in the case of road transport).
This aggregate is calculated using the following formula:
Gross inland energy consumption = Primary production + Recovered & Recycled products + Imports – Export + Stock changes – International maritime bunkers

Kilowatt hours, abbreviated as **KWh**, is a unit of energy representing one-thousand-watt hours. Kilowatt hours are often used as a measure of domestic energy consumption. A kilowatt hour is equivalent to a steady power of one kilowatt running for one hour and is equivalent to 3.6 million joules or 3.6 megajoules.

Primary energy consumption measures the total energy demand of a country. It covers consumption of the energy sector itself, losses during transformation (for example, from oil or gas into electricity) and distribution of energy, and the final consumption by end users. It excludes energy carriers used for non-energy purposes (such as petroleum not used not for combustion but for producing plastics).

Solid fuels are fossil fuels covering various types of coals and solid products derived from coals. They consist of carbonized vegetable matter and usually have the physical appearance of a black or brown rock.

Ton(s) of oil equivalent, abbreviated as **toe**, is a normalized unit of energy. By convention it is equivalent to the approximate amount of energy that can be extracted from one tons of crude oil. It is a standardized unit, assigned a net calorific value of 41 868 kilojoules/kg and may be used to compare the energy from different sources.

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