University of Piraeus

Department of International and European Studies

Master Thesis

# A Comparative Analysis of the EU Emission Trading System and California's Cap and Trade Program

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**Abstract**

The present thesis commits to a detail-driven comparative analysis between the European Union Emission Trading System and California's Cap and Trade Program, intending to juxtapose these two eminent market-driven systems with the common aim of tackling greenhouse gas emissions and mitigating climate change. This research showcases their scope, coverage, cap-setting methods, allowance allocation mechanisms, compliance flexibility, price regulation strategies, and international linkage dynamics. The focal point lays out the evaluation of the efficiency and efficacy of the two emission reduction tactics, considering the multiple regional contexts and policy agendas. This multidimensional approach based on data, policy documents, academic papers, and academic literature, examines both systems' strengths and limitations. It aims to contribute valuable insights to the discussion on market-driven environmental governance schemes and functions as a source of knowledge for important stakeholders of the energy and environmental sector like policymakers, researchers, scholars, and entities involved in climate change mitigation, aiding them in the understanding of these systems, evolve from their experiences, and identify the arising challenges and potential improvements.

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## List of Abbreviations

**GHG**: Greenhouse Gas

**EU ETS**: European Union Emissions Trading System

**AB 32**: California Global Warming Solutions Act of 2006

**C&T**: Cap and Trade

**NGO**: Non-Governmental Organization

**CO2**: Carbon Dioxide

**UNFCCC**: United Nations Framework Convention on Climate Change

**IPCC**: Intergovernmental Panel on Climate Change

**COP**: Conference of the Parties

**NAP**: National Allocation Plan

**MRV**: Monitoring, Reporting, and Verification

**MSR:** Market Stability Reserve

**GDP**: Gross Domestic Product

**RPS:** Renewable Portfolio Standard

**ETS**: Emissions Trading System

**EU**: European Union

**CARB**: California Air Resources Board

**AB 398**: California Assembly Bill 398

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# Chapter 1: Introduction

## 1.1 Aim of thesis

The serious threat of climate change to ecological balance and socio-economic stability worldwide underscores the necessity of implementing market-based mechanisms to regulate greenhouse gas emissions, such as the European Union Emissions Trading System (EU ETS) and California's Cap-and-Trade Program (C&T). These schemes, while sharing the common goal of mitigating carbon emissions, adopt different approaches shaped by their distinct regional and political landscapes, leading to varying outcomes. The EU ETS, spanning multiple European countries with diverse social and economic complexities, contrasts with California's more focused sub-national program. This thesis will compare the EU ETS and California's Cap-and-Trade Program, examining the different regulatory frameworks, performance outcomes, and broader socio-economic impacts. The analysis will interrelate different legal structures, emissions reduction achievements, socio-political considerations, and economic ramifications within their respective jurisdictions. Acknowledging constraints such as data availability, research scope, and the evolving nature of environmental policies, this research aims to provide a meaningful comparison of these prominent schemes, contributing to climate policy discussions and informing policymakers, regulators, and stakeholders.

## 1.2 Research objectives of the thesis

The present thesis is structured with a deliberate coherence that enables a methodical investigation of the multifaceted dimensions underpinning the comparative analysis of the aforementioned emissions trading schemes. The following chapters are organized in a manner that enables a progressive and comprehensive understanding of the research objectives.

**Chapter 2, Literature Review**, commences with a comprehensive synthesis of the existing literature relevant to GHG reduction policies and market-based approaches specifically delving into an examination of the evolution, design aspects, and operational characteristics of the EU Emissions Trading System and California's Cap and Trade Program.

**Chapter 3, Methodology**, elaborates on the methodological framework overseeing this research endeavor. It expounds upon the research design which includes the qualitative and quantitative methodologies employed to dissect and examine the legal frameworks, emissions reduction outcomes, socio-political elements, and economic implications of the two emissions trading systems.

**Chapters 4 and 5** delve into the empirical components of this thesis, commencing with a thorough exposition of the background and context of the EU ETS in Chapter 4, followed by an analogous exposition of California's Cap and Trade Program in Chapter 5.

**Chapter 6, Comparative Analysis of Legal Frameworks**, develops a meticulous juxtaposition of the legislative foundations of the EU ETS and California's Cap and Trade Program. This chapter furnishes a thorough analysis of the allowance allocation methodologies, compliance mechanisms, and regulatory frameworks within each system.

**Chapters 7, 8, and 9** consecutively examine the emissions reduction outcomes, socio-political dimensions, and economic ramifications of both the EU ETS and California's program and assess and compare the performance of the systems in the respective fields.

**Chapter 10, Summary of Key Findings and Contributions**, synthesizes the most important outcomes derived from the analysis conducted throughout the preceding chapters of this thesis and refers to the accumulated findings.

**Chapters 11 and 12** respectively investigate the impacts for policy and future research arising from the study's outcomes. Chapter 11 delves into the pragmatic implications of this comparative analysis for policy formation and enhancement, while Chapter 12 offers reflections on possible pathways for future research inquiries.

In conclusion, this organizational structure has been meticulously designed to provide the reader with a cohesive and comprehensive engagement with the research inquiry, allowing for a more enriched and nuanced understanding of the EU ET and California's Cap and Trade Program, and the relative implications for climate change mitigation efforts.

## 1.3 Methodology

In this study a comparative analysis of the EU ETS and California's C&T Program is conducted. Both qualitative and quantitative research methods are being utilized in order to examine the legislative frameworks, emission reduction results, socio-political features, and economic effects of each of the aforementioned programs. Specifically, a qualitative law and economics analysis is performed by combining the legal-dogmatic method with insights from economic and sociopolitical theories. Thus, the study follows a four-pillar methodical investigation based on the primary dimensions—, legislative foundations, socio-political elements economic impacts and carbon emission reductions—aiming to provide a thorough understanding of each system. The methodology encompasses a varied document analysis of primary sources such as the EU Regulations, USA Acts, ETS regulations and relevant case law and secondary sources such as analysis of socio-political dynamics, and volume analysis of economic

indicators like carbon price and trends, reports, policy documents and press releases, all of which provide an opportunity to develop a multidisciplinary approach with the goal to provide a holistic view of the efficacy and operational complexity of various carbon trading schemes.

### 1.4 Significance of the study

This thesis' significance can be found on its role as a comprehensive and detailed approach of the four pillars on which this thesis is constructed. This study aims to fill literature gaps by illuminating the strengths, weaknesses, and operational insights derived from both the EU ETS and California's C&T Program and gather a hole lot of information on various aspects that shall be taken into consideration in each climate change mitigations debate and discussion. The concluding insights hold the promise to provide policymakers, regulatory bodies, academics, and vested stakeholders with an informed analysis for decision-making and to contribute to the global debate and policy transfer of know-how with final goal to facilitate the refinement of emissions reduction strategies, and promoting sustainable environmental stewardship.

Furthermore, the study's applicability extends to the identification of optimal policy orientation trajectories, the precise calibration of regulatory frameworks, and the cultivation of subtle strategies pertinent to the extenuation of climate change. A thorough understanding of the economic ramifications, considerations of cost-effectiveness, and the dynamic undercurrents of the market environment can empower policymakers with the dexterity to craft measures that harmonize the imperatives of emission reduction with those of sustainable economic advancement. Thus, the research is set to aid in the future actors and academics alike in a pragmatic way providing them with a better comprehension of the various complexities, overlaps and intertwining of the two emissions trading schemes under consideration. Following that potential of strengthening of policy frameworks, ameliorating the efficacy of tactics implemented, and increase society's awaraness and engagement to moderating the negative consequences of climate change can be born.

## Chapter 2: Literature review

### 2.1 Introduction

The variety of the current conceptual and regulatory landscapes that shape global efforts to mitigate greenhouse gas emissionsis undeniable, focusing on the role of emissions trading systems as pivotal instruments in this endeavor. A broad overview of the policies designed to reduce greenhouse gases, setting a contextual framework that highlights the complexity and necessity of such measures in today's environmental

policy realm must be made in order to have a clear understanding of the basic aspects of the present analysis.

## 2.2 Overview of greenhouse gas reduction policies and Emissions Trading Systems

Greenhouse gas (GHG) reduction policies and Emissions Trading Systems- ETS have served as the most important strategies with a goal of tackling climate change, offering well-constructed framework through which countries and regions can mitigate their environmental impact. These mechanisms are designed to utilize the power and dynamics of the market to create incentives for industries and other actors for reductions in GHG emissions, promoting sustainable practices among industries with a view to national and international environmental goals. The different policies and systems reveal a diverse landscape of approaches, each tailored to specific economic and social contexts.

### 2.2.1 Greenhouse Gas Reduction Policies

Greenhouse gases -GHGs such as carbon dioxide, nitrous oxide, and methane have claimed a notorious place in global warming due to their ability to trap heat in the atmosphere of the Earth. In the late century, human activities have contributed more and more to the accumulation of these gases, thereby increasing the greenhouse effect and altering the planet's climate, leading to the so-called climate crisis, one of the most discussed and unsolved problems of our day. These phenomena lead to changes in weather patterns, rising average temperatures, and the realization of heat waves and floods or other extreme weather events. During this battle, EU is taking significant steps to reduce GHG emissions, with a target of 55% reduction by 2030 compared to 1990 levels, with the final aim of net-zero emissions by 2051. Such collective efforts include multiple measures across various sectors, encompassing, but not limiting to, transportation, energy savings, renewables investment, and the enhancement of carbon sinks like forests[1].

Greenhouse Gas policies are measures and regulatory frameworks, developed by governmental and other international actors, such as NGOs, with the aim to limit or reduce carbon dioxide and other GHG emissions which contribute to global warming and climate change. These policies are naturally designed to slow down the escalation of atmospheric GHG concentrations and thereby to halt the elevation of global temperature. They include a variety of approaches such as cap-and-trade systems, carbon taxing systems and implication of energy efficiency standards, that we are going to analyze further below. These kinds of policies may be implemented at international, national, and local levels and are based on global agreements that guide and regulate the overall efforts. Each region or country is free to adopt specific strategies based on

[1] European Parliament (2023), Climate change: the greenhouse gases causing global warming.

its economic, environmental, and political contexts in view of more efficient and successful mechanisms.

With the most important agreements being the Kyoto Protocol[2] (1997), the Paris Agreement (2015), and the United Nations Framework Convention on Climate Change (UNFCCC, 1992)[3] the global forum laid the ground for the collective effort of GHG emission reduction. With the Kyoto Protocol, the path was laid for committed industrialized countries to decrease their GHG emissions, followed with the Marrakech Accords[4], developed during COP7, which provided detailed rules for implementing the Kyoto Protocol[5]. After that the UNFCCC, provided the overarching framework for international climate negotiations, facilitating cooperation among nations to battle climate change and the following phenomena and ramifications.

Years later, the Paris Agreement would be a global policy landmark as it was nearly agreed upon by all countries with the goal to restrict global warming to at least below 2 ºC above pre-industrial levels, while striving to limit the escalation to 1.5 ºC. Under the Paris Agreement nationally determined contributions (NDCs) were introduced, according to which each country has the freedom to set its own GHG reduction targets with the obligation to regularly update the progress.

Additionally, the Montreal Protocol (1987)[6] as amended by the Kigali Amendment (2016)[7], plays also a crucial role in GHG reduction by phasing out the production and consumption of ozone-depleting substances (hydrofluorocarbons). Finally, The EU's Renewable Energy Directive (RED II)[8] includes specific measures for biofuels and introduces reinforced GHG reduction thresholds aiming to enhance the utilization of renewable energy in the EU's energy mix to a percentage up to 32% by 2030.

The aforementioned regulatory frameworks, national policies and emissions standards[9] are the basis of greenhouse gas (GHG) reduction policies and give governments and international organizations to implement and enforce GHG emission limits in diverse sectors such as industry, transportation, aviation and energy but also give entities the right incentives for innovations on the field of GHG emission reduction.

[2] United Nations (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.
[3] United Nations (2015) Paris Agreement.
[4] United Nations (1992) United Nations Framework Convention on Climate Change.
[5] Schulze, E., Valentini, R., & Sanz, M., 2002. The long way from Kyoto to Marrakesh: Implications of the Kyoto Protocol negotiations for global ecology. Global Change Biology, 8
[6] United Nations (1987) Montreal Protocol on Substances that Deplete the Ozone Layer.
[7] United Nations (2016) Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer
[8] European Union (2018) Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast).
[9] Creutzig, F., McGlynn, E., Minx, J., & Edenhofer, O., 2011. Climate policies for road transport revisited (I): Evaluation of the current framework. Energy Policy, 39, pp. 2396-2406.

Another important path towards GHG reduction is the development of strategies for renewable energy sources. In order to shift away from fossil fuels such policies are developed to incentivize the use of renewable energy, including solar, wind, hydro, and geothermal, and utilize numerous forms such as feed-in tariffs, tax credits, and renewable portfolio standards. These policies utilize the undeniable interconnection of policy measures and technological innovation in addressing climate change.[10]

Finally, in the battle to achieve climate mitigation, energy efficiency has emerged as a key factor within GHG reduction policies, thus, governments giving initiatives to minimize energy consumption across different sectors, most commonly in buildings, appliances, and industrial processes that directly contribute to GHG emission reductions[11]. Energy efficiency is accompanied by various carbon pricing mechanisms, like emissions trading systems, and create an interconnection between economic incentives and environmental goals.

### 2.2.2 Emissions Trading Systems

Emissions trading systems- ETS, most commonly known as cap-and-trade mechanisms, are market-based techniques that aim to tackle GHG emissions with a distinctive role in international efforts to address climate change. These market-driven policies have been proven able to facilitate substantial environmental amelioration while achieving to maintaining economic viability. The basic idea of emissions trading systems unfolds within the context of compliance and traceability of allowances.

In ETS a ceiling- a cap is adjusted by a regulatory authority- usually a governmental body- on the allowed emissions representing the acceptable percentage of emissions within a specific jurisdiction, ensuring emissions reductions are achieved where they are least expensive, thereby increasing the cost-effectiveness of environmental regulations. The total amount of the cap is split into allowances, that are allocated to companies through auctioning or free distribution based on historical emissions, each of which permits a company to emit one tonne of CO2. Year by year the cap is lowered and so are the amount of allowances given so that total emissions fall gradually to meet the environmental targets. These emission permits- allowances are issued in advance for the companies, which are required to keep and sustain an equivalent number of allowances or credits. The allowances given to the company represent the company's right and capability to emit a specific amount of emissions, according to the give framework.

Those companies or groups, in order that need to have the ability to emit passed their given allowances have to purchase extra permits from other companies that did not use all their allowance as they polluted less than expected and have not got their overall

[10] Byrnes, L., Brown, C., Foster, J., & Liam, W., 2013. Australian renewable energy policy: Barriers and challenges. Renewable Energy, 60, pp. 711-721.
[11] Giama, E., Kyriaki, E., & Papadopoulos, A., 2020. Energy policy and regulatory tools for sustainable buildings. IOP Conference Series: Earth and Environmental Science, 410.

allowances consummated, thus fostering a financial incentive to reduce the overall emissions. In this way a trading mechanism is created, introducing flexibility and enabling participants to choose the most economical path to compliance, as entities with extra allowances can achieve financial gains by reducing emissions below their allocated allowances and trading surplus allowances. This dynamic generates a complex market scheme wherein tradable emission allowances are exchanged, aligning environmental objectives with economic incentives, while at the same time creating a financial incentive for continued innovation in carbon-reduction technologies.[12]

Most ETS, provide the possibility, in case an entity needs to emit more than the allocated amount of allowances to meet its compliance obligations through external projects that assist in the reduction of emissions outside of the capped sectors via offset mechanisms, for which a further analysis will be provided later on.

The systems' undeniable success lies upon the firm designs, but most importantly on the prominent Monitoring, Reporting, and Verification (MRV) schemes that are used to establish compliance and prevent fraud. The governance and legal frameworks have proved to be thoroughly developed leading to a market environment that is stable and the firms are able to put their trust in it. Of course, the EU Emission Trading System and California's C&T Program, the subjects of this thesis, are the most famous of these systems, being able to succeed in emission goals while maintaining economic competitiveness and mitigating any adverse effects on the economy.

Linkages of Emissions Trading Systems (ETS) refer to the process of connecting multiple ETSs across different jurisdictions, enabling the transfer and mutual recognition of emission allowances. This linkage facilitates greater flexibility and cost-effectiveness in achieving emissions reduction targets by expanding the market for carbon credits, increasing liquidity, and providing access to a wider area of opportunities for the decrease of emissions. Linked ETSs lead to harmonizing carbon prices, reducing competitive disadvantages for businesses operating in multiple regions and enhancing the overall stability and efficiency of the carbon market. Moreover, such linkages can foster international cooperation on climate policy, promote higher environmental standards, and encourage more ambitious global emissions reduction commitments by creating a unified approach to addressing climate change across borders.

## 2.3 Interplay between ETS and the Paris Agreement

Article 6 of the Paris Agreement and especially paragraphs 6.2 and 6.4 introduce mechanisms for countries to cooperate so as achieving their Nationally Determined Contributions (NDCs) through market-based approaches, primarily focusing on carbon markets. Under ar. 6.2 the internationally Transferred Mitigation Outcomes (ITMOs)

[12] Zhang, X., Löschel, A., Löschel, A., Löschel, A., Lewis, J., Zhang, D., Zhang, D., & Yan, J., 2020. Emissions trading systems for global low carbon energy and economic transformation. Applied Energy, https://www.sciencedirect.com/science/article/pii/S0306261920313325

can be transferred between countries, facilitating the procedures for GHG reduction. ITMOs must be real, verified, and additional, and they should be measured in tonnes of carbon dioxide equivalent (tCO2e).

Article 6  enhance the collaboration between countries and leads to efficiency with a strong emphasis on sustainable development and environmental integrity. Further advantages of the system are various development benefits such as job creation, technology and know-how transfer and gender empowerment. For example, projects in Ghana and Vanuatu involving sustainable agriculture an rural electrification demonstrate the practical application of ITMOs. The UN Development Programme actively supports such initiatives, using carbon markets to drive private investments in line with the SDGs.

Various challenges arise from the integration of ITMOs such as potential discouragement of the respective jurisdictions from lowering the ETS caps while also the simplification of the technical aspect of the alignment of ETS allowances with ITMOs via COP26's decision to standardize emissions reductions measurements in CO2e could eventually lead to raise of the cap of the linked ETS, which will weaken the market's effectiveness in GHG reduction. Another challenge is the accurately determination of the timing of the mitigation actions and impacts, which can be achieved per utilizing the vintage of allowances as a proxy to estimate the occurance of the mitigation, under the Article 6, which prevents transferring ITMOs between NDC periods.[13]

Article 6 par. 4 of the Paris Agreement establishes the new international carbon crediting mechanism, potentially overstepping directly ETS linkages. This mechanism, also known as the Paris Agreement Crediting Mechanism, will simplify significantly the various processes of connection diverse carbon markets and reduce the political complications that arise to align individual ETS characteristics.The has a Supervisory Body tasked with developing and supervising the requirements and processes needed to operationalize the mechanism. Thus, the Paris Agreement, through Article 6, will significantly contribute to GHG reduction efforts creating a uniform mechanism.

## 2.4 Market-Based Approaches

Market-based approaches with the object of reducing greenhouse gas emissions aim to give such incentives to companies and individuals in order to lower the carbon "footprint" of their actions through respective economic schemes rather than directly regulating the reduction on their own[14]. These mechanisms function by making the right to emit GHGs more costly, thus providing a financial incentive for emission reduction

[13] Hynes, D. and Schneider, L. (2023) Applying rules under Article 6 of the Paris Agreement to linked emissions trading systems. Berlin: International Carbon Action Partnership. https://icapcarbonaction.com/system/files/document/art-6-and-ets-linking_final-version_0.pdf

[14] Metcalf, G. (2009). Market-Based Policy Options to Control U.S. Greenhouse Gas Emissions. Journal of Economic Perspectives, 23, 5-27.

and greener technologies. Each of these approaches has its pros and cons, and they can be used in combination to achieve more comprehensive and effective GHG reduction.

### 2.4.1 Carbon Tax

Carbon tax is a fiscal apparatus used to control pollution and reduce GHG emissions via the application of a tax on the fossil fuels' content of carbon; the more carbon the entity's combustion emits, the higher the tax imposed will be. This mechanism operates on the idea that by putting a price on carbon the making of carbon-intensive products will become more expensive, thus consumers and businesses will be incentivized to reduce consumption, invest in energy-efficient practices, or switch to cleaner sources and cleaner alternatives. Moreover, the revenue gained from the collection of carbon taxes is going to be utilized to fund renewable energy projects or to lower over-taxation on other sectors to counterbalance the unbearable implications of the tax on lower-income households.[15]

However, the success of a carbon tax depends on carefully addressing its negative impacts through strategic design and the use of generated revenues to mitigate adverse effects on the economy and distributional equity.

### 2.4.2 Cap-and-Trade

The cap-and-trade mechanism, is especially well suited and recognized for its effectiveness in addressing climate change because greenhouse gases are equally distributed throughout the atmosphere by setting a maximum limit on emissions while permitting companies to buy or sell emission permits. As such, emissions reductions anywhere make identical contributions toward alleviating the problem[16].

This approach caps the total emissions to achieve environmental goals but also leverages market dynamics to allocate emission reductions efficiently across the economy. Companies with smaller emission reduction costs can make a profit via tading their surplus of allowances to other companies that are facing a higher cost, fostering an economically efficient path to achieving environmental objectives.[17] The dynamics of cap-and-trade mechanisms show that cap-and-trade systems can optimize both environmental and economic outcomes. For instance, studies have shown that these mechanisms can lead to the influence of firm-level production with planning and

[15] Baranzini, A., Goldemberg, J., & Speck, S., 2000. A future for carbon taxes. Ecological Economics, 32, pp. 395-412.

[16] Gabriel C., Stavins R., Stowe R., Sweeney R.. 2012. "The So2 Allowance Trading System and the Clean Air Act Amendments of 1990: Reflections on 20 Years of Policy Innovation." National Tax Journal 65 (2): 419–52

[17] Zhang, B., & Xu, L., 2013. Multi-item production planning with carbon cap and trade mechanism. International Journal of Production Economics, 144, pp. 118-127.

carbon trading strategies, thus, demonstrating the cap-and-trade system's capacity to balance economic growth with environmental sustainability[18].

### 2.4.3 Emission Reduction Credits (ERCs)

Emission Reduction Credits (ERCs) are tradable commodities, earned by entities, that are a product of actions that reduce emissions below a below a predetermined regulatory baseline level, often established by existing regulations. These credits may be sold or traded to others if needed, offering a financial stimulus for companies to reduce their emissions while also investing in clean technology projects and research. Provide cost-effective compliance solutions with environmental regulations, such as those targeting reductions in greenhouse gases or other pollutants. For ERCs to maintain environmental integrity, they must represent real, permanent, and additional emission reductions. In different case, they might lead to undermine its role and allow higher overall emissions.[19]

### 2.4.4 Fee-and-Dividend

This mechanism, devised by James Hansen, has many similarities to a carbon tax mechanism, while in this case a fee/tax will be levied on carbon emissions with a goal to minimize the economic impact on households. The difference in this mechanism is that the revenue arising from the implemented tax is given back 100% to households as a dividend, so as to balance the increased costs of goods and services that may result from the imposed fee- that has been transferred to the household[20].

### 2.4.5 Renewable Energy Certificates (RECs)

Renewable Energy Certificates (RECs) are tools that showcase the advantages of electricity generated from RES, as they are separated from the physical electricity, they can be traded separately from the electricity itself. These certificates allow industries, utilities and traders to offer renewable energy products to consumers and to demonstrate compliance with renewable energy mandates.[21] Organizations can buy RECs to balance their utilization of electricity based on fossil fuel. The RECs provide good financial incentive for the production of renewable electricity and offer flexibility and liquidity in renewable energy markets.

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[18] Wang, S., Wan, L., Li, T., Luo, B., & Wang, C., 2018. Exploring the effect of cap-and-trade mechanism on firm's production planning and emission reduction strategy. Journal of Cleaner Production, 172, pp. 591-601.

[19] Dewees, D., 2001. Emissions Trading: ERCs or Allowances? Land Economics, 77, pp. 513 - 526.

[20] Hipel, K., 2012. Tackling climate change: A system of systems engineering perspective a research seminar by. 2013 International Conference on System Science and Engineering (ICSSE), pp. 11-12

[21] Holt, E., & Bird, L., 2005. Emerging Markets for Renewable Energy Certificates: Opportunities and Challenges.

### 2.4.6 Performance Standards with Tradeable Credits[22]

This mechanism is rather innovatine in the sector of GHG emissions declining providing a merger of legislative mandates with market-based schemes.At first, the required level of performance for certain technologies or processes is set allowing at the same time flexibility in how this standard is met by permitting the trading of credits. Firms that perform better than the standard can sell their extra "credits" to firms that do not meet the standard, thus managing to equalize the marginal costs of compliance across different firms.

### 2.4.7 Offset Programs

Offset programs are schemes within emissions trading systems (ETS) that lead to GHG emission reduction goals, by investing in outside the capped sectors projects that achieve equivalent environmental benefits, such as reforestation, financial incentives for projects in developing countries or renewable energy projects. These programs can ensure that any negative impacts on the environment will be counterbalanced by positive contributions, promoting overall environmental sustainability.[23] Thus, the firms have the choice to achieve compliance and emission reduction at a lower cost through more affordable mitigation options.

However, a critical issue is the integrity of offsets as it is difficult to prove that they represent genuine, permanent, and additional emissions reductions. If this is not the case, then the manipulation of the offset program will lead eventually to the undermining of the environmental goals of an ETS. Another discussed problem is that the concept of offsets extends across the linked markets, where the use of lower-cost credits can lead to a surplus of allowances, potentially delaying decarbonization efforts and influencing allowance prices negatively.[24]

## 2.5 Background and Context of the EU Emissions Trading System and California's Cap-and-Trade Program

While a comprehensive global attempt to price carbon has not been developed yet, there have been multiple national and regional carbon taxes or ETS worldwide implemented. The European Union Emissions Trading System and California's C&T Program emerge between global ETS schemes for combating greenhouse gas emissions. They both utilize the "cap and trade" mechanism to incentivize GHG emission reductions, and they have managed to demonstrate significant results in climate mitigation within their jurisdictions.

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[22] Yeh, S., Burtraw, D., Sterner, T., & Greene, D., 2021. Tradable Performance Standards in the Transportation Sector. Energy Economics, 102, pp. 105490.

[23] Grimm, M., & Köppel, J., 2019. Biodiversity Offset Program Design and Implementation. Sustainability.

[24] Kotzampasakis, N. & Woerdman, E. (2020), Linking the EU ETS with California's Cap-and-Trade Program: A law and economics assessment, The Central European Review of Economics and Management (CEREM)

### 2.5.1 The EU Emission Trading System: Evolution and Characteristics

Currently, the EU ETS has been acknowledged as the most outstanding and leading scheme of the ETS systems, as it accounts for around 50 % of carbon dioxide emissions in the European continent. Established in 2005, it was the first international emissions trading system and it has been a pillar of the EU's initiatives to deal with climate change by regulating a cap on the total amount of GHG that a company is allowed to emit, as long as the company is within the scope of the EU ETS. From its initial phase of 'learning by doing,' the EU ETS has undergone significant transformations, incorporating diverse fields, emerging the auctioning method of allocating allowances as the default method, and setting ambitious targets for reducing emissions aligning with the Kyoto Protocol and the European Green Deal. With the adoption of legislative proposals to achieve climate neutrality by 2050, the scheme entered in 2021 its fourth and last phase (2021-2030), with the goal towards a net decline in GHG emissions of at least 55% by 2030. Throughout its phases, the scheme has been significantly influencial fort the global carbon market, with trading volumes increasing exponentially and the system serving as a model for similar initiatives worldwide, demonstrating the EU's leadership in global efforts to mitigate climate change.

Paramount among its agenda is the implementation of a carbon pricing establishment, thus fostering economic incentives that impel the entities subjected to EU's regulations, to mitigate their emissions. Anchored in the fundamentals of the "cap" and "trade" model, the scheme's framework comprises a progressively decreasing cap vis-à-vis total CO2 emissions permissible within the scope of the regulated sectors. This cap verifies the reduction trajectory aligned with the EU's critical climate objectives. Concurrent with this cap, the issuance of emission allowances transpires, granting participants the permit for emitting quantified amounts of carbon dioxide.

Under the scheme of the EU ETS, participants are mandatorily compelled submitting allowances equial with their actualized discharges. Instances when emissions overpass the allowance cap oblige acquiring additional permits or implementing further emission mitigation measures (offset market). In contrast, instances of emissions dropping below the cap imply the possibility of surplus allowances being vendible to other parties.

While the first phase of the EU ETS (2005-2007) was primarily focused in establishing fundamental frameworks, the following phases included more ambitious emission reduction targets and, as a result, the refinement of the system's architectural integrity. A trajectory punctuated by consecutive adjustments has been delineated to augment the efficacy, rectify market-centric concerns, and align the mechanism with the dynamic arc of the constantly growing climate aspirations. [25]

Phase 2 (2008-2012) aligned with the first commitment period of the Kyoto Protocol, featuring stricter allocation caps and the inclusion of more greenhouse gases and sectors. Phase 3 (2013-2020)reformed substantially the scheme, by creating a single

[25] Skjrseth, J., & Wettestad, J., 2009. The Origin, Evolution and Consequences of the EU Emissions Trading System. Global Environmental Politics, 9, pp. 101-122.

cap on emissions all around EU, emerging auctioning as the main allocation for emission allowances while also implementing the Market Stability Reserve (MSR) to deal with the surplus of allowances. Today, phase 4 (2021-2030) endeavours further strengthening the scheme by reducing the emissions' cap by 2.2% per year, expanding MSR's scope, and integrating new sectors like maritime transport, while also enhancing mechanisms to support innovation and modernization in low-carbon technologies.

In the international climate policy forum the scheme's position has been instrumental, influencing the design of emission trading schemes worldwide and demonstrating the potential for carbon markets to contribute to global emissions reductions efforts. Encompassing a wide range of sectors and industries, this initiative notably includes power generation and energy-intensive industries such as iron, steel, cement and chemicals, as well as aviation. Such segments jointly contribute considerably to the aggregate GHG discharges throught the European Union.

However, the EU ETS faced various challenges, including issues related to allowance price volatility and market oversupply. These issues underscore the complexity of balancing environmental ambitions with economic realities within a cap-and-trade framework. The system's interactions with other EU policies in the sectors of climate and energy, its integration within a broader international climate regime and considerations for linking with other ETSs highlight the multifaceted nature of managing a carbon market. Addressing these challenges is crucial for the scheme to effectively impact and be be efficient to the EU's GHG reduction targets and for the system to serve as a robust model for carbon pricing efforts globally. However, studies have concluded to the fact that EU ETS is not able as a single scheme to offer significant motivation for substantial alterations in technology innovation research and evolvement, so as to establish the cration of durable while also achievable goals[26].

EU ETS's continuous development and evolvement exemplifies the dynamic nature of environmental policy, where lessons learned from operational challenges and market behaviors inform subsequent modifications and improvements. As the system moves forward, especially after the entrance of the European Green Deal, it remains a critical experiment in using market mechanisms for environmental governance. The EU ETS's development, characterized by its legislative adaptability and expanding scope, offers valuable insights for other jurisdictions considering or implementing emissions trading schemes. This ongoing experiment underscores the importance of flexibility, transparency, and stakeholder engagement in the development and evolution of climate policies.[27]

[26] Rogge, K., Schneider, M., & Hoffmann, V., 2011. The innovation impact of the EU Emission Trading System — Findings of company case studies in the German power sector. Ecological Economics, 70, pp. 513-523.

[27] Dimos, S., Fotakis, D., Evangelatou, E., Mantis, A., & Mathioudaki, A., 2019. Market and Trade Network Analysis of EU Emission Trading System. Global NEST International Conference on Environmental Science & Technology.

### 2.5.2 California's Cap and Trade Program: Origins and Features

California's Cap-and-Trade Program, was launched in 2013 under the Global Warming Solutions Act of 2006 (AB 32), from its inception it acclaimed aleading position for the state's climate change mitigation efforts, aiming to decrease greenhouse gas emissions to 1990 levels by 2020, with its main characteristic to be an innovative integration of a market-based mechanisms to the environmental discussion and policy making. With its broad scope that encompasses many domains and industries, such as power generation, industrial facilities, fuel distribution networks, and a variety of commercial and residential sources California's C&T managed to emerge from the other ETS as one of the most efficient and influential.

California's cap-and-trade model, crafted with insights from existing emissions trading schemes, notably the EU ETS and RGGI, is a distinct scheme tailored to California's specific economic and environmental needs, designed to deal with allowance oversupply and price volatility. Its effectiveness and success underline the importance of sharing know-how and learning for other systems in order to develop more efficient, innovative and adaptive policies that can withstand the complexities of market dynamics and environmental regulation.[28]

The main goal of the C&T Program revolves around the complex mechanism of pricing carbon emissions, thus leading to the development of economic incentives obliging entities subject to regulatory scrutiny to undertake efficient emissions reduction measures. Central to this initiative is the introduction of a declining cap vis-à-vis the amount of permissible emissions for the entities under regulation, a designed attempt, calibrated to gradually induce substantial emission reductions over temporal horizons.

Under the auspices of the California Air Resources Board (CARB) emissions allowances are issued and distributed via gratuitous allocation and competitive auctions creating a hybrid and flexible scheme. A sine qua non for regulated actors entails the acquisition of allowances in accordance to their actual emissions. Instances wherein emissions exceed the holding of allowances involve the purchase of supplementary allowances from the market or concurrent expenditures into locally anchored emission mitigation initiatives.[29]

Furthermore, the program incorporates the strategic utilization of offset credits, resulting from initiatives that achieve GHG emissions reductions or abatements beyond the boundaries of the covered fields. Such offset initiatives encompass domains like forestry projects and methane capture programs. The introduction of a finite number of offsets within the compliance design offers to the regulated entities an augmented range of options in their pursuit of achieving specified emission reduction thresholds.

[28] Hathaway, M., 2018. Exploring Cap-and-Trade: a California Case Study.
[29] Palmer, K., Burtraw, D., & Paul, A., 2009. Allowance Allocation in a CO2 Emissions Cap-and-Trade Program for the Electricity Sector in California. Entrepreneurship & Law eJournal.

The C&T Program has gained a global role as a successful scheme as it managed to creat flexible, yet robust, carbon markets that are adaptive to the ever changing economic conditions and policy goals. The evolving character of the program has extended beyond state borders, contributing to the global discourse on carbon pricing and emissions trading as effective tools for reducing greenhouse gas emissions.

With its evolving stages, being more and more ambitious with respect to emission reduction objectives, the program has been challenged by legal obstacles and repetitive adjustments in order to strengthen its operational efficiency. California's program is hindered by the issue of the design of the Allowance Reserve, so as to prevent its exhaustion, but also the risks that lurk in the offset programs. [30] Nevertheless, California's program is commited to durable improvement goals with the present climate target, primer among others, the aspiration of carbon neutrality by the temporal cusp of 2045.

### 2.7 Conclusions

As we have already indicated, EU ETS and California's C&T Program have undertaken a leading position in the sphere of global climate action. The two programs' comprehensive structures and holistic approaches, as well as their notable effects on combatting climate crises and reducing GHG emissions within their respective jurisdictions, have given them the winning position on a global scale. It is worth mentioning at this point that the most important characteristic that evolved them into pioneers is their ability to cut emissions while creating and applying a market mechanism model that provided improved environmental outcomes.

## Chapter 3: Comparative Analysis of Legal Frameworks

### 3.1 Introduction

Both of the legal backgrounds of the EU Emissions Trading System (EU ETS) and California's Cap and Trade program provide regulatory frameworks for carbon pricing, with the target to reduce GHG emissions. While the EU ETS operates under the scope of the European Union legislation, as it is overseen by the European Commission, California's program is functioning under state law and is regulated and monitored by the California Air Resources Board (CARB). Despite their complete differences in jurisdiction and governance, both systems reflect a common commitment to tackling climate change through its market-based mechanism, within their respective legal and institutional contexts.

[30] Schatzki, T., & Stavins, R., 2013. Three Lingering Design Issues Affecting Market Performance in California's GHG Cap-and-Trade Program. Energy Policy & Economics eJournal.

## 3.2 Legal Framework of the EU ETS

The legal framework that supports the European Union Emissions Trading System (EU ETS) is a rather multidimensional design operating at the European Union (EU) and at a national- Member state level. At its core exists the EU ETS Directive, as a significant legislative key piece as enacted in 2003 and later amended to respond to constantly evolving climate goals. The directive establishes the overall framework by defining basic elements, including the scope of covered sectors, emission allowances, allocation methods, compliance mechanisms, and penalty provisions for non-compliance. It mandates participating member states to develop and execute national allocation plans (NAPs) to determine how emission allowances will be distributed among regulated actors/ industries. Moreover, the legal framework includes authorized instruments for addressing market stability, such as the Market Stability Reserve[31], introduced to deal with potential imbalances between supply and demand. The interplay of the EU ETS Directive with the supplementary legislations at the EU and member state level creates a complete regulatory landscape, aiming to facilitate emissions reductions while accounting for sector-specific obstacles and economic circumstances.

### 3.2.1 EU ETS Directive and Amendments

The European Union Emissions Trading System (EU ETS) has evolved over time through a series of directives and amendments, reflecting the dynamic character of climate policy and the necessity for ongoing refinement. The principal legislative instrument shaping the EU ETS is the Directive 2003/87/EC, commonly as the "EU ETS Directive"[32], initially enacted in 2003 and gradually revised to correspond with shifting climate challenges. To refer to some of the most important articles of the Directive, aiming to take a quick look to its structure, Article 1 of the EU ETS Directive establishes its objective highlighting the reduction of GHG emissions within the EU while promoting cost-efficient emission reduction measures. Article 9 details EU ETS's cap-and-trade mechanism, demonstrating the issue of permits to regulated entities, with Article 10 specifying the national allocation plans (NAPs) that Member States must synthesize and after that submit to the EU Commission for approval. Finally, Article 11 introduces the notions of banking and borrowing allowances.

Another significant legal instrument is **Regulation (EU) No 601/2012[33]**. This regulation specifies the pathways for the monitoring, reporting and validating of data by operators of facilities falling within the scope of EU ETS. The fundamental framework of the EU ETS Directive is further supplemented by other EU regulations,

[31] Perino, G., & Willner, M., 2016. Procrastinating reform: The impact of the market stability reserve on the EU ETS. Journal of Environmental Economics and Management, 80, pp. 37-52.

[32] European Parliament and Council of the European Union (2003) Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.

[33] European Parliament and Council of the European Union (2012) Regulation (EU) No 601/2012 of the European Parliament and of the Council of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

such as the Effort Sharing Regulation (ESR)[34] and the Monitoring and Reporting Regulation.

The legislative foundation of the EU ETS has developed throughout time per continuous amendments aiming at improving its effectiveness and adaptability. Notably, the 2009 and 2018 amendments are emblematic of the evolution of the EU ETS Directive.

**Directive 2009/29/EC[35]** evolved as an important milestone, with a strategic approach of the most significant problematic aspects of the original Directive. It signaled elevated ambitions as it included robust emission reduction objectives, mirroring the European Union's fierce commitment to reducing emissions. Additionally, it introduced alterations to the allowance allocation rules, with a view to a more clear uniformity across the system and laid the background for including also the sector of aviation within the scope of the scheme, acknowledging the necessity of thorough addressing emissions across various industries.

The **Directive (EU) 2018/410[36],** amendment to the EU ETS Directive, demonstrates another crucial step towards EU's constantly evolving ambitious climate targets. By establishing more stringent reduction goals, this amendment showcases again European Union's commitment to dealing with climate change. The Directive introduced new tools, such as the **Market Stability Reserve** reflecting a proactive approach to enhance market resilience and stability, while aiming to adapt to the evolving dynamics of emissions trading.

In 2021 under the "**Fit for 55" package[37],** a modification of the EU Emissions Trading System (EU ETS) was made to adjust the EU's climate policies in accordance its target of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. Most importantly, this revision accelerated the reduction of the emissions cap via the expansion of the system to also cover transport by sea and potentially buildings and road transport and strengthened the Market Stability Reserve to better manage allowance surpluses.

Laslty, the 2023 Revision of the EU ETS Directive updated EU ETS in terms of aim and scope of the scheme acknolidging the targets and ambitions of the European Green

[34] European Parliament and Council of the European Union (2018) Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013.
[35] European Parliament and Council of the European Union (2009) Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.
[36] European Parliament and Council of the European Union (2018) Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments.
[37] European Commission (2021) 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality

Deal and the Fit for 55 package. The Revision includes voosting Linear Reduction Factor (LRF) to ensure decreasing the annual allowances and strengthen the Market Stability Reserve (MSR) the amount of allowances in it will be restricted to 400 million, while any allowances that exceed the amount of allowance that were auction in the latest year will be invalidated. Most importantly, the Revision introduces the maritime sector in EU ETS.

Additionally, the revision introduces the gradual inclusion of the maritime sector and enhances initiatives in order to avert carbon leakage via customizing gratious allocation of allowances on risky industries. The revision also supports innovation and modernization in green technologies through increased funding mechanisms, like the Innovation Fund and Modernisation Fund. Overall, 2023 revision aims to make the EU ETS a more robust and dynamic tool in driving the EU towards its long-term climate neutrality goal by 2050.

### 3.2.2 Scope, Coverage, and Exemptions

The EU ETS legal framework, was initiated under the Kyoto Protocol with a view to influence company behaviors and drive investment towards greener technologies. Today the EU ETS extends its cap-and-trade mechanism across a broad spectrum of sectors including power generation, energy-intensive industries like iron, steel, and cement, as well as commercial aviation and functions throughout EU nations and additionally to Iceland, Liechtenstein and Norway (EEA-EFTA states), with same exemptions and special provisions for small installations and entities in lower GDP per capita member states so as to balance the economic development needs of these states with the overarching goals of the scheme. The EU ETS has managed to cover emissions from almost 10,000 establishments in the energy and manufacturing industry, while also from aircraft operators that use the aerspace of the EU encompassing almost 40% of the European Union's emissions.[38]

### 3.2.3 Compliance Mechanisms and Penalties[39]

As it is outlined in the EU ETS Directive and its following amendments, the regulated entities are obliged to monitor, report, and verify (MRV process) emissions data, in a way that guarantees transparency and accurate emissions accounting of the emission reportings. The EU has increasingly centralized these aspects to reduce discrepancies and improve enforcement across its member states. In case of non-compliance, a system of penalties will be triggered that adheres to the principle of proportionality. For instance, in a case of such a disrupting behavior contrary to the EU ETS regulation, a regulated entity fails to submit ample permits to balance their emissions and exceeds its allowances faces a financial penalty of €100 per extra ton of CO2 emitted while must

[38] European Commission, What is the EU ETS? Available at: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en

[39] Verschuuren, J., & Fleurke, F., 2015. Enforcement of the EU ETS in the Member States. , 2015, pp. 17-23.

still submit permits required to offset their shortfall in the subsequent year. This duality of the penalty system, with a combination of financial penalties and the obligation to rectify the deficit in allowances, acts as a significant deterrent against non-compliance.

While the framework is centrally governed, its execution reflects the diverse administrative capabilities of individual member states. Thus, mprovements in harmonizing enforcement practices are essential for the scheme's overall effectiveness and are continually being addressed by EU policymakers aiming at preserving the integrity of the scheme and guaranteeing that emissions reduction goals will be met across the member states.

By ensuring that regulated entities uphold their responsibilities, the legal framework guarantees a level playing field where all participants contribute to the collective objective of mitigating climate change. Penalties acts as a precaution against potential loopholes or slack compliance. Moreover, compliance mechanisms and penalties demonstrate the EU's dedication to uphold the set international commitments under agreements such as the UNFCCC, the Kyoto Protocol and the Paris Agreement, highlighting a strong connection between its domestic policies and global climate objectives.

### 3.3 Legal Framework of California's Cap and Trade Program

The legal framework of California's Cap-and-Trade Program was born in the state's ambitious climate policy efforts, particularly the California Global Warming Solutions Act of 2006, commonly known as Assembly Bill 32 (AB 32)[40]. This legislative milestone established the legal authority for the California Air Resources Board (CARB) in order to implement intensive regulations to mitigate GHG emissions. The cap-and-trade program, officially enacted in 2013, is the key component of the aforementioned regulations. The program operates under the auspices of the California Cap-and-Trade Regulation, which highlights the program's structure, allowance allocation procedures, compliance procedures, and penalty provisions.

California's legal background reflects its emphasis on stakeholder participation, public input, and regulatory supervision. The Cap-and-Trade Regulation establishes a vigorous system for monitoring, reporting, and validating emissions data, ensuring transparency, security, and accuracy. It embodies the principle of allowance allocation through both free allocation and auctioning, indicating a sophisticated balance between assisting currently existing industries and encouraging emission reductions. Additionally, the legal framework incorporates the application of offsets to provide additional flexibility and latitude for the entities that are regulated to meet their conformity requirements. The framework overviews California's determination to responding to climate change through market-based methods whilst maintaining regulatory standards and accountability.

[40] California Legislature (2006) Assembly Bill No. 32: California Global Warming Solutions Act of 2006.

### 3.3.1 AB 32 and Subsequent Amendments

The California Global Warming Solutions Act of 2006, known as Assembly Bill 32 (AB 32) was launched in 2006 and it is considered as a legislative landmark in California's effort to tackle climate change implications. Via AB 32 California established aggressive emissions reduction goals and emerged as revolutionary state-level climate legal action in the US targeting to mitigate California's GHG emissions to 1990 levels by 2020, which will be rather significant task keeping in mind the state's economic and demographic growth over the past few years.

AB 32 derives its authority from Division 25.5 (Section 38500) of the California Health and Safety Code[41], which specifically responds to climate change and GHG emissions mitigation. Section 38501[42] declares the Legislature's findings and declarations, implementing a thorough legal basis for California's attempts dealing with climate change. More specifically, Section 38501(c) acknowledges that "*the state board [CARB] should develop a climate change program that will achieve the maximum technologically feasible and cost-effective greenhouse gas emissions reductions*" compatible with the state's sustainable economic growth.

The basis of AB 32's legal structure lies upon Section 38510[43], where the articulates state its intent to reduce GHG emissions in the region of California to 1990 levels by 2020. This section gives CARB the legislative authority to adopt regulations that achieve the required emission reductions across various domains. Additionally, in Section 38550[44], AB 32 provides CARB with the authority, to adopt market-based mechanisms to facilitate GHG emissions mitigation, thus opening the way for establishing California's C&T Program.

Moreover, it mandates the Renewable Portfolio Standard (RPS) obliging utilities to obtain a defined amount of electrical energy by renewable sources and introduces a Low Carbon Fuel Standard for decreasing carbon intensity of transportation fuels. The law's inclusivity extends to encouraging energy efficacy, allowing the utilization of offset credits produced by emissions-reducing schemes on the non-regulated sectors, and fostering research and adaptation measures to address climate change ramifications.

A series of amendments followed AB 32 in order to ameliorated its effectiveness. Notably, **Senate Bill 535** (2012) gave a legal duty on CARB to allocate a portion of Cap-and-Trade Program for disproportionately impacted communities to benefit so to embrace environmental justice considerations within AB 32'S ambit. Moreover, **Assembly Bill 32** (2016) significantly advanced the Act's targets by fortifying emissions reduction goals, compelling California to decrease GHG emissions to 40% below 1990 levels by 2030. Finally, **Assembly Bill 398** increased CARB's

[41] CA Health & Safety Code § 38500 (through 2013 Leg Sess)
[42] CA Health & Safety Code § 38501 (through 2013 Leg Sess)
[43] CA Health & Safety Code § 38510 (through 2013 Leg Sess)
[44] CA Health & Safety Code § 38550 (through 2013 Leg Sess)

authorization on regulating and overviewing C&T for the period 2020 to 2030 providing further guidelines on specific design characteristics of the post-2020 scheme, also encompassing new reporting and oversight requirements.[45]

### 3.3.2 Covered Entities and Sectors

When California's Cap-and-Trade Program launched in 2013 it covered entities predominantly involved in electricity generation, industrial facilities, and fuel distribution, in other words only the major sources contributing to the state's GHG inventory. Over time, its scope expanded gradually to incorporate additional sectors as California state tried to respond in a sustainable way to new emissions reduction imperatives. Today, AB 32, as in force today, includes energy, transportation, industrial processes, agriculture, and waste management, among others.

### 3.3.3 Compliance and Offsets Regulations

The compliance mechanism is primarily embodied in *Article 5 of AB 32*[46] and it obligates the regulated entities to abide by GHG emission caps and submit allowances proportional to their emissions. Entities surpassing their allocated allowances must undertake measures to rectify the difference, including purchasing additional allowances or funding emission reduction projects, thus, promoting emission reductions by imposing a financial penalty on exceeding emission limits, considered as violation.

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[45] Mac, T. (2017), Cap-and-Trade Extension: Issues for Legislative Oversight, LAO Report.

[46] *"PART 5. MARKET-BASED COMPLIANCE MECHANISMS: a) The state board may include in the regulations adopted pursuant to Section 38562 the use of market-based compliance mechanisms to comply with the regulations.*

*(b) Prior to the inclusion of any market-based compliance mechanism in the regulations, to the extent feasible and in furtherance of achieving the statewide greenhouse gas emissions limit, the state board shall do all of the following:*

*(1) Consider the potential for direct, indirect, and cumulative emission impacts from these mechanisms, including localized impacts in communities that are already adversely impacted by air pollution.*

*(2) Design any market-based compliance mechanism to prevent any increase in the emissions of toxic air contaminants or criteria air pollutants.*

*(3) Maximize additional environmental and economic benefits for California, as appropriate.*

*(c) The state board shall adopt regulations governing how market-based compliance mechanisms may be used by regulated entities subject to greenhouse gas emission limits and mandatory emission reporting requirements to achieve compliance with their greenhouse gas emissions limits.*

*The state board shall adopt methodologies for the quantification of voluntary greenhouse gas emission reductions. The state board shall adopt regulations to verify and enforce any voluntary greenhouse gas emission reductions that are authorized by the state board for use to comply with greenhouse gas emission limits established by the state board. The adoption of methodologies is exempt from the rulemaking provisions of the Administrative Procedure Act (Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code).*

*Nothing in this part or Part 4 confers any authority on the state board to alter any programs administered by other state agencies for the reduction of greenhouse gas emissions."*

Additionally, AB 32 has included the use of offset credits as a capability to support emission reduction efforts, in Article 6[47] of the legislation, according to which, offset regulations allow the regulated entities to be satisfy by a portion of their compliance requirements through offsets produced by external emissions reduction projects, outside from the sectors that are covered by AB 32 such as reforestation, methane capture, or renewable energy initiatives. The offsets can enhance the program's flexibility and help with the diversification of the company's portfolio giving a wider set of options on emission reduction initiatives beyond the regulated sectors and potentially decrease compliance costs

## 3.4. Comparative Evaluation of Legal Frameworks

### 3.4.1 Legislative Basis

The legal basis of the EU Emissions Trading System and California's Cap-and-Trade Program create the foundation of the two mechanisms for mitigating GHG emissions. As we have already mentioned above, The EU ETS is based by the EU ETS Directive 2003/87/EC, as was gradually supplemented by relevant amendments such as the Directive 2009/29/EC and the Directive 2009/31/EC. It delineates provisions that highlight the cap-and-trade framework, allowance allocation methods, supervision, reports, and compliance protocols, and incorporates regulations responding to emissions produced from aviation. The overall legislative design of the EU ETS has further strengthened by some supplementary regulations such as the Effort Sharing Regulation (ESR) and the Monitoring and Reporting Regulation.

Contrerely, California's C&T Program derives its legal authorization from the California Global Warming Solutions Act (2006), or Assembly Bill 32 (AB 32). AB 32 gives CARB authoritative role and the power to evolve and to establish the necessary measures to successfully attain the California's emission reduction targets. The legal

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[47] *PART 6. ENFORCEMENT: (a) The state board shall monitor compliance with and enforce any rule, regulation, order, emission limitation, emissions reduction measure, or market-based compliance mechanism adopted by the state board pursuant to this division.*

*(b) (1) Any violation of any rule, regulation, order, emission limitation, emissions reduction measure, or other measure adopted by the state board pursuant to this division may be enjoined pursuant to Section 41513, and the violation is subject to those penalties set forth in Article 3 (commencing with Section 42400) of Chapter 4 of Part 4 of, and Chapter 1.5 (commencing with Section 43025) of Part 5 of, Division 26.*

*(2) Any violation of any rule, regulation, order, emission limitation, emissions reduction measure, or other measure adopted by the state board pursuant to this division shall be deemed to result in an emission of an air contaminant for the purposes of the penalty provisions of Article 3 (commencing with Section 42400) of Chapter 4 of Part 4 of, and Chapter 1.5 (commencing with Section 43025) of Part 5 of, Division 26.*

*(3) The state board may develop a method to convert a violation of any rule, regulation, order, emission limitation, or other emissions reduction measure adopted by the state board pursuant to this division into the number of days in violation, where appropriate, for the purposes of the penalty provisions of Article 3 (commencing with Section 42400) of Chapter 4 of Part 4 of, and Chapter 1.5 (commencing with Section 43025) of Part 5 of, Division 26[….]"*

landscape of AB 32 showcases the program's scope, covered sectors, the relative compliance mechanisms, offset regulations, and enforcement methods, highlighting California's specific approach to addressing GHG emissions reduction targets.

To sum up, while both the EU ETS and California's C&T program share the main goal of emissions reduction via market mechanisms, their legal backgrounds are constructed to their specific contexts, mirroring the geopolitical realities and policy necessities. However, EU ETS and C&T use cap-and-trade mechanisms in order to implement their emissions limits and create a market for emission allowances, while they also establish specific regulatory authorities (the European Commission and the California Air Resources Board (CARB) respectively), which are liable for the supervision, compliance and enforcement of the schemes.

### 3.4.2 Coverage

The EU ETS and California's C&T Program underline various perspectives and approaches within their respective legal frameworks to deal with climate change via market-based mechanisms. The EU ETS, established by Directive 2003/87/EC with the next more resent aforementioned amendments, encompasses a wide range of sectors across EU member states, including power generation, energy-intensive industries, and more recently aviation, aiming to decreasing GHG discharges by at least 55% by 2030. On the other hand, California's program, which is operational under the Assembly Bill 32 (AB 32), targets a more focused group of sectors within the state of California, including power generation, industrial facilities, and fuel distributors, aiming its 2030 emissions reduction goal with the European Union's.[48]

In spite of their differences in terms of scope and sector coverage, both of these systems showcase a common commitment to reduce of emissions, underlining the very much necessary intertwine between regional climate policies and the enormous goal of global climate mitigation efforts. Thus, underlines the adaptability of different cap-and-trade systems to regional economic and environmental priorities while contributing to the collective endeavor of addressing climate change.

### 3.4.3 Allowance Allocation

The methods of allocation of allowances in the EU Emissions Trading System and California's Cap-and-Trade Program showcase the several legal, economic and political factors that are involved. The EU ETS as a multidimensional structure with its different phases and amendments, is a complex interaction between historical emissions data, financial incentives, and political discussions and negotiations among EU member states. Its first stage was a clear dependence on gratuitous allocation, in order to prevent carbon leakage and potential socioeconomic disruptions aiming to address concerns of

[48] Kotzampasakis, N. & Woerdman, E. (2020), Linking the EU ETS with California's Cap-and-Trade Program: A law and economics assessment, The Central European Review of Economics and Management (CEREM)

industrial competitiveness and potential alterations in production to countries with more elastic emission reduction regulations.

The following phases of the EU ETS, were underlined by more transitioning allocation mechanisms in accordance with EU's commitment to balance economic actors with climate objectives. In order to acquire allowances the companies shall participate in these auctioning procedures, while the price is measured by the already existing supply -demand market dynamics. Additionally, secondary market gives to companies the ability to purchase allowances as the participants can trade allowances among themselves based on the existing market prices.

On the other hand, California's Cap-and-Trade Program shows a more organized while cohesive method for allowance allocation[49], where the majority of allowances is channeled through auctioning, creating a transparent market for the regulated entities. This auctioning system is in line with California's view on encouraging market dynamics and innovation. Except for auctioning, the program includes an initial option for gratuitous allocation to specified sectors. Via this hybrid approach California tries to balance equitable socioeconomic ramifications while maintaining the security of the market mechanism. Lastly, there are also some allowances designed to be conserved for specific purposes, like the Market Price Referent (MPR).

### 3.4.4 Compliance and Enforcement

Although both the EU ETS and California's Cap-and-Trade Program showcase the significance of the existence of compliance and enforcement, they significantly differ in terms of their centralization and penalty mechanisms. The EU ETS is based on a rather centralized governance structure, fostering uniformity in enforcement procedures. The EU ETS uses a strict system of annual compliance reports, where the regulated entities are obliged to provide allowances equal to their actual emissions. In case of failure to comply with this system penalties will be enforced, including the obligation to undertake additional allowances in the upcoming year and potential fines. The EU's centralized governance system improves uniformity in enforcement across EU-member states[50].

On the other hand, California's program although follows a similar per year compliance report-system, penalties are determined based on the severity of the act of non-compliance. The CARB undertakes the supervision of the enforcement and the possible sanctions rang from monetary fines to complete loss of future allowances. California's approach with a more decentralized enforcement mechanism with varying penalties, reflects the state's regional sovereignty. [51]

[49] Schatzki, T., & Stavins, R., 2012. Using the Value of Allowances from California's GHG Cap-and-Trade System. Environmental Justice & Sustainability eJournal.
[50] Verschuuren, J., & Fleurke, F., 2015. Enforcement of the EU ETS in the Member States. , 2015, pp. 17-23.
[51] McAllister, L., 2011. Enforcing Cap and Trade: A Tale of Two Programs. Political Economy: Taxation.

### 3.4.5 Offsets

The EU ETS has phased out international offsets after identifying them as a key factor in the accrual of excess allowances, notably due to issues with the Clean Development Mechanism (CDM)[52] and Joint Implementation (JI)[53] credits' environmental integrity. In contrast, California permits the use of domestic project offsets within specific qualitative and quantitative bounds, maintaining an open stance on the future inclusion of international credits from projects like REDD, with a focus on ensuring that offsets reflect real emissions reductions through a rigorous monitoring, reporting, and verification (MRV) framework. The stringent MRV standards in California aim to validate the authenticity of emissions reductions, yet challenges in ensuring the permanency and additionality of reductions, especially in forestry projects and LULUCF, hint at possible over-crediting issues.[54]

The **Nordic Carbon Market (NO x Fund)**[55] serves also as a notable notion within the EU ETS, aiming nitrogen oxide (NO x) emissions from large combustion plant facilities in Denmark, Finland, Norway and Sweden. Developed as a joint initiative, this market-based approach includes an emissions cap on NO x emissions from the regulated plants, with allowances auctioned to participants. The NO x Fund allows the acquisition of allowances by regulated entities to comply with their requirements, while also enabling financial institutions and investors to participate.

California's C&T program embodies offset credits from the diversified range of projects beyond the covered sectors. One illustrative example is the **Shasta County Improved Forest Management Project**[56] which rather serves as a forestry-based offset initiative. The project is based in Shasta County of California and is focused on sustainable forest management methods to ameliorate carbon sequestration, tackle deforestation, and improve ecosystem resilience. The project assists on realizing emissions reductions outside the covered sectors as it makes offset credits produced by these practices available in market to regulated entities.

These two cases show that the EU ETS's restricted use of offset credits aims to conserve high environmental standards but may limit flexibility, while California's broader

[52] United Nations (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change: Clean Development Mechanism (CDM). Available at: https://unfccc.int/process-and-meetings/the-kyoto-protocol/mechanisms-under-the-kyoto-protocol/the-clean-development-mechanism

[53] United Nations (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change: Joint Implementation (JI). Available at: https://unfccc.int/process/the-kyoto-protocol/mechanisms/joint-implementation

[54] Kotzampasakis, N. & Woerdman, E. (2020), Linking the EU ETS with California's Cap-and-Trade Program: A law and economics assessment, The Central European Review of Economics and Management (CEREM)

[55] NOx Fund. About the NOx Fund. [Online]. Available from https://www.noxfondet.no/en/articles/what-is-nox/

[56] Shasta County Improved Forest Management Project [online] Available from: https://www.fs.usda.gov/projects/stnf/landmanagement

system aspires to foster innovation but contends with is challenged by offset quality and efficacy.

### 3.4.6 Market Mechanisms

As aforementioned, a market mechanism, in the context of ETSs, constitutes a scheme regulating and organizing procedures of buying and selling of emission allowances. Pricing pollution also fosters innovation, as the potential to decrease pollution at a lower cost via new technology can also decrease the price required for emitting GHGs.

Under the scope of EU ETS, on the total of the emissions are allowed to be emitted per year a cap is set on the total emissions and the participants are allocated a specific amount of allowances that depict their right to discharge a pre-defined percentage amount of CO2. The regulated entities must have acquires permits that are equal to their actual discharges, as in different cases they risk penalties. Another significant aspect of the EU ETS market mechanism is that the companies can trade their permits in order to align with their emission commitments and can use offset credits. As we already mentioned initially the allowance allocation was based on a gratuitous allocation system, thus creating an overstock of permits and causing price volatility. Until today, the scheme has shown a reduction in emissions and progressive market stabilization.

Contrarely, California's C&T Program also defines a declining cap on the full emissions and issues allowances that also can be traded among participants. Under the scope of this scheme, the regulated entities can also use offset credits produced outside the regulated sectors for the firms to meet their compliance obligations. California's scheme allows banking, borrowing, and the application of offsets, offering a higher level of compliance flexibility than EU ETS. The program has provided high levels of allowance demand and price stability, reflecting active market participation and effectiveness. [57]

Comparatively, while the EU ETS imposes a homogenous allowance cap throughout EU member states, California's program provides an individual state-level approach, enabling regions to customize their efforts to their unique circumstances.

## 3.5 Conclusions

The legal frameworks of the EU ETS and California's C&T Program underscore similarities and contrasts, because of their unique and complicated regulatory and economic environments. By utilizing tailor-made cap-and-trade mechanisms developed to mitigate emissions, these two schemes have as their main focus various market-based solutions that make use of adaptable mechanisms like offsets and auctions. The different levels of centralization approaches, with the state-specific system in California contradicting the more centralized approach of the EU ETS, reflect political divisions

[57] Woerdman, E., & Kotzampasakis, M., 2020. Linking the EU ETS with California's Cap-and-Trade Program. The Central European Review of Economics and Management.

and different interests in environmental policy. On that point, in the areas of market stability and the incorporation of comprehensive climate goals interaction and mutual know-how exchange can be crucial for the efficient course of the two schemes.

## Chapter 4: Comparative Analysis of Emissions Reduction Outcomes

### 4.1 Introduction

The reduction outcomes between the EU ETS and California's C&T Program will showcase the effectiveness of each of the two market-based schemes in achieving environmental targets. A comparison and examination of the results, trends, and the specific factors contributing to the reduction under each mechanism and the impacts of each system in general, can highlight the practical implications of their differing approaches to mitigating GHG emissions on a regional and international scale.

### 4.2 Trends in Emission Reductions Under the EU ETS

The trends in emission reductions within the scheme of the EU ETS have had, since its inception in 2005, a dynamic trajectory over its several phases. In its first stages, and particularly during the pilot phase (2005-2007), the magnitude of emission reductions remained relatively modest, with trading volumes increasing from 321 million allowances in 2005 to 1.1 billion in 2006 and 2.1 billion in 2007[58] and the reduction of emissions from stationary installations being at 37%[59]. This was the result of the initial oversupply of allowances due to their gratis allocation and the relatively lenient emission caps, thus failing to create a strong fiscal incentive for the regulated actors to establish substantial emission decrase measures.

During the subsequent phases, notably the third phase (2013 – 2020) and the ongoing fourth phase (2021- 2030), emission reduction outcomes discernibly change towards stronger characteristics. In these later phases, the targets introduced have been much more ambitious regarding the reduction of emissions, crafted to come together with the general climate targets of the European Union. With an utter target to attain carbon neutrality by 2050, the EU ETS gained a more crucial role in promoting substantial emission reductions.

The future of EU ETS aspires to be brighter than ever before setting a target to reduce emissions under its scope by 62% by 2030, in comparison with 2005 levels, with capping the emissions being much more tightened and the expansion od the scope to

[58] European Commission (2023) Development of the EU ETS 2005-2020. Available at: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/development-eu-ets-2005-2020_en

[59] Council of the European Union (2022) 'Fit for 55': Council and Parliament reach provisional deal on EU emissions trading system and the Social Climate Fund.

maritime industries. Also worth mentioning the parallel development under the scope of EU of the ETS 2, as part of the ETS's revision Directice of 2023, regulating fuel suppliers and supplying the Social Climate Fund dealing with social ramifications on vulnerable groups with a total budget of EUR 86.7 billion from 2026 to 2032[60].

Undoubtedly EU ETS has contributed in emissions reductions for sectors included within its mandate, but the issue of sustainability and efficacy remains persistently, due to to price volatility and potential regulatory flaws. The path to success at this point can only be the commitment to constant adaptation and enhancement is essential. Moreover, the adaptation of unified supplementary measures and policies, beyond the scope of the EU ETS with the inclusion of sectors not directly impacted by this mechanism, can prove to be the victorious step towards more ambitious climate objectives.

### 4.3 Emission Reduction Progress in California's Cap and Trade Program

Emission reduction progress within California's Cap-and-Trade Program exhibits a multifaceted path. Since its inception in 2013, the program has sought to reduce GHG emissions across a spectrum of sectors, including electricity generation, industrial facilities, fuel distributors, and other commercial and residential sources. The program covers around 350 of California's largest industrial units and power plants, accounting for almost 85% of the California's overall emissions.This comprehensive coverage has emphasized California's determination to addressing climate change on multiple fronts.

Over the course of its existence, the program has shown a generally positive trend in emission reductions. These outcomes can be referred to a combination of reasons, encompassing the imposition of a declining cap on allowable emissions, the introduction of market-driven incentives to lower emissions, and the inclusion of offset credits to supplement reductions achieved outside the program's covered sectors. Over the years, millions of carbon allowances were issued under the auspices of CARB to the regulated entities. By 2020, California had accomplished to reduce emissions to 1990 levels, meeting an important milestone.

However, as with any ambitious environmental strategy plan, questions regarding sustainability and efficiency prevail. The California C&T Program has effectively reduced GHG emissions to 1990 levels by 2020, achieving this aim earlier that expected in 2016, but faces judgmental oppinions for its insufficient GHG reduction rate of 1 percent per year and lack of improvement in high-polluting communities. Moreover, the economic burden of cap-and-trade costs is passed onto consumers, leading to higher gasoline prices. For instance, recent C&T allowance prices add approximately 14.3

[60] European Commission (2023) Our Ambition for 2030. Available at: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/our-ambition-2030_en

cents per gallon, and Low Carbon Fuel Standard (LCFS) credits add another 22.6 cents per gallon to fuel costs. [61]

Thus, California's Cap-and-Trade Program has made noteworthy progress in the reduction of emissions across varied sectors. Yet, the ongoing endeavor of sustainability and efficiency requirements is an ongoing commitment to adaptation, refinement, and collaboration via stakeholders. As California remains at the leading places of climate action, its Cap-and-Trade Program is a valuable exemplar in the broader international effort to mitigate the effects of climate change.

### 4.4 Cross-System Comparison of Emission Reduction Performance

Both the EU ETS and California's cap-and-trade program are designed to reduce GHG emissions within their respective jurisdictions. Each of the operates under specific political, economic and regulatory conditions, as EU ETS covers more that 30 countries and multiple industrial sectors, while California's cap-and-trade program as part of AB 32 refers to a specific region encompassing many domains and industries, such as power generation, industrial facilities, fuel distribution networks and a variety of commercial and residential sources. The EU ETS has managed to significantly cut emissions since its launch, having achieved a decrease of 29% between 2005 and 2019 while in 2020, total GHG emissions were 34.3 % (-1 939 million tonnes CO2 equivalents) below 1990 levels. Emissions decreased by 8.5 % or 346 million tonnes CO2 equivalent) between 2019 and 2020. California's C&T program has also succeeded with substantial results, having contributed on declinment of approximately 13% in greenhouse gas emissions between 2004 and 2017, while also has funded numerous climate investments, up to $28 billion, on zero-emissions or plug-in hybrid vehicles, new trees in urban and wildland areas etc., managing to wipe out emissions equivalent to taking 80% of the state’s gas cars off the road.

On the issues of effectiveness both systems have shown strong results in emission reduction outcomes, facing challenges and critiques. It is difficult to designate one of them as its one has functions under specific circumstances, challenges, and policy objectives and both of them stand out as the finests examples of market-based mechanisms. The EU ETS was criticized for an oversupply of allowances in its early phases and California's system for regulatory overlap and potential "leakage" of emissions have still a long way to go.

[61] Holliman, A., & Collins, K., 2023. California’s cap-and-trade program: is it effective in advancing social, economic, and environmental equity?. Public Administration and Policy.

### 4.5 Conclusion

In this Chapter, it came as a rightful conclusion that EU ETS has been more effective on achieving significant emission reductions across a broader range of sectors and geographic areas than California's program, due to its extensive scope and stringent cap. Acquiring strict and robust regulatory frameworks and mechanisms like the Market Stability Reserve (MSR), ensures consistent and substantial reductions. Conversely, even though California's Cap-and-Trade Program has been successful in achieving its initial goals it faces challenges related to equity and the distribution of benefits. Nevertheless, California's program serves as a model for sub-national jurisdictions.

## Chapter 5: Socio-Political Dimensions of Emissions Trading Policies

### 5.1 Introduction

The implementation and evolution of emissions trading policies are deeply intertwined with socio-political dimensions that significantly influence their design, effectiveness, and public acceptance. The European Union Emissions Trading System and California's C&T Program, operate as market mechanisms for reducing greenhouse gas emissions, but also within complex socio-political landscapes. These landscapes include diverse stakeholder interests, varying levels of political will, and the socio-economic impacts on different communities and industries.

### 5.2 Stakeholder Interests and Engagement Processes in the EU ET[62]

The two basic pillars of governance in this context of emission reduction targets in the EU are the European Commission, which supervises the proposal and implementation of climate policies and the its legislative body, the European Parliament that approves the most important amendments to EU ETS laws with final goal the environmental sustainability and social equity. The EU ETS is a critical apparatus for carbon market regulation and climate policy within the EU, engaging with several parties and stakeholders. The formal aspect of engagement producers in the EU ETS refer to several actors such as stakeholders, Member states, and NGOs each one with a different agenda necessitating multifaced possessing to integrate various objectives and concerns into the policy framework.

[62] Huzzard, T. (2018) Stakeholder Engagement Manual. QuInnE Working Paper No. 10. Lund University. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiY2tiT3qaHAxWF_7sIHc4_BvkQFnoECBQQAQ&url=https%3A%2F%2Fec.europa.eu%2Fresearch%2Fparticipants%2Fdocuments%2FdownloadPublic%3FdocumentIds%3D080166e5bda5ad97%26appId%3DPPGMS&usg=AOvVaw1dpqKtBapkfUpOu8FLs1gJ&opi=89978449

Energy-intensive industries are concerned about the effect of these regulations on their competitiveness and market power and "carbon leakage"[63], thus lobbying for mitigating measures and allowances, cost-effective compliance mechanisms, clear regulatory guidelines, and a sustained level of competitiveness in the global marketplace. Other carbon market participants (such as traders and financial institutions) adhere to the predictability of the regulatory frameworks and market stability and market opportunities. Member states follow their respective agendas and their governmental and regulatory bodies aim to compliance targets and endeavour to balance economic growth with environmental preservation. Lastly, NGOs adhere to tight emission caps and EU ETS's integrity, while also trying to advocate affordable energy and a cleaner environment for the consumers and to deal with increased prices.

This multi-layered stakeholder's engagement process in the EU ETS consists from the formal mechanisms that involve public consultations, stakeholder forums, and specialized working groups with in-depth discussions on design and implementation, the legislative engagement, where the EU Comission and the national governements enable stakeholder to contribute and discuss and lobby for specific policy outcomes, while supplementary dialogues between stakeholders and decision-makers add up to the engagement procedures and the national implementation level, as each member state is responsible for implementing the EU ETS within their jurisdictions, which involves ongoing engagement with stakeholders to ensure compliance, address concerns, and facilitate the effective operation.

In addition to formal consultation mechanisms, less formal yet impactful means of engagement also exist. For example, academic institutions or civil society groups (such as environmental organizations and consumer advocates) engage with EU ETS procedures on the fields of research and recommendations to aid the procedure with specialized knowledge or to employ lobbying and direct consultations to advocate for their interests. This dual approach of formal and informal engagement creates a broader interaction of various interested parties, allowing diverse opinions to take place in the development of the policies and contributing to the adaptability of the EU ETS.[64]

### 5.3 Environmental Justice Considerations in California's Program

The Global Warming Solutions Act of 2006 (AB 32) depicts the problem of disproportionate vulnerability of low-income communities and communities of colour to the climate crisis and pollution. The Senate Bill 535[65] requirements for minimum

[63] Carbon Leakage is the phenomenon wherein companies transfer operations to jurisdictions with laxer environmental regulations.

[64] Pacher, C. (2019) The EU ETS and Stakeholder Processes. Regional Workshop on Monitoring, Reporting and Verification of Greenhouse Gas Emissions, Santiago de Chile, 26 August. Available at: https://4echile.cl/wp-content/uploads/2020/09/GCM-4.1-Christian-Pacher-BMU-The-EU-ETS-and-Stakeholder-Processes.pdf (Accessed: 14 July 2024).

[65] California State Senate (2023) Senate Bill 535, Regular Session 2023-2024. Available at: https://www.legis.state.pa.us/cfdocs/billInfo/billInfo.cfm?sYear=2023&sInd=0&body=S&type=B&bn=0535 (Accessed: 14 July 2024).

funding levels to “Disadvantaged Communities” (DACs) and necessitates that a percentage of the proceeds from the auctions of allowances of the program must be invested in projects beneficial for those communities, in order to address the historical inequalities that have led to increased pollution exposure and less access to clean energy.

The C&T program’s stakeholder encompass energy-intensive industries, clean energy businesses, environmental justice organizations and the general public creating a diverse landscape of actors. Despite energy-intensive industries trying to minimize the compliance cost and environmental justice organizations advocating for vulnerable communities and aiming for more equitable policy implementations, the program has been criticized as unsuccessful in mitigating the effectiveness and aiding the localized population. The program enables firms to purchase allowances without reducing the source of the emissions, thus not mitigating the environmental burdens on disadvantaged communities.

To this extent, California proceeded to Assembly Bill 617[66] providing adaptive measures including localized air quality monitoring and stricter controls on stationary sources of pollution through the Community Air Protection Program, engaging community members in identifying and monitoring pollution sources. By pairing economic incentives from the cap-and-trade program with targeted local regulations, California aims to create a more comprehensive and equitable approach to addressing both climate change and environmental justice[67].

## 5.4 Comparative Examination of Socio-Political Dimensions

### 5.4.1 Stakeholder Engagement and Participation

The EU ETS, as a mechanism of a supranational governing body has a multi-layered, bureaucratic process that encompasses several actors and procedural levels. The formal channels that the EU ETS utilizes for the participation of the stakeholders aim for a balanced representation of all the interested parties but the complexity of this procedure may lead lack of efficacy and practical restrictions of participation. On the other hand, California's Cap-and-Trade Program within its single-state jurisdiction has placed the issue of transparency and public participation in a significant position of its functioning. CARB holds constant public meetings, workshops, and comment periods and has shown a special interest on the engagement of disadvantaged communities. Due its smaller scale it can achieve better and more immediate stakeholder engagement and

[66] California State Assembly (2017) Assembly Bill 617. Available at: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB617 (Accessed: 14 July 2024).

[67] Holliman, A., & Collins, K., 2023. California’s cap-and-trade program: is it effective in advancing social, economic, and environmental equity? Public Administration and Policy. https://doi.org/10.1108/pap-06-2022-0069.

foster the inclusivity of local communities to participate creating a more acceptable and long-term sustainable project.

### 5.4.2 Equity and Distributional Impacts

The European Union's Emissions Trading System (EU ETS) and California's Cap-and-Trade Program both strive to address equity and distributional impacts, albeit within different regulatory and social contexts. The EU ETS, as a transnational system, faces the formidable task of reconciling equity concerns among its 27 member states, which have diverse economic profiles and environmental priorities. One of its mechanisms to address distributional impacts is the allocation of free allowances to sectors at a higher risk of carbon leakage, a practice that has raised questions about its fairness and efficiency. Additionally, EU member states have discretion over the use of auction revenues, with some countries investing in climate adaptation measures that could indirectly address distributional concerns.

California's C&T Program, on the other hand, places a strong emphasis on environmental justice and aims to directly mitigate the adverse impacts on vulnerable communities. Part of the revenues generated from the auction from the program is mandated by law to become investments to generate projects to vulnerable communities, a unique feature that targets precicely equity concerns. Additionally, the CARB is required to conduct environmental justice assessments to examine the distributional impacts of the program, ensuring that it doesn't disproportionately burden disadvantaged communities. This focus on local-level equity issues within a singular jurisdictional framework allows California to address distributional impacts more directly than the EU ETS.

### 5.4.3 Political Acceptance and Support

Political acceptance and support for emissions trading systems manifest differently within the European Union's Emissions Trading System (EU ETS) and California's Cap-and-Trade Program, owing to their distinct governmental structures and political landscapes. The EU ETS, as a supranational scheme, is contingent on multi-level governance involving the European Commission, member states, and their respective parliaments. Its survival and modifications require extensive negotiation and consensus-building among a diverse array of stakeholders, including industrial lobbies, environmental NGOs, and governments with varying commitments to climate action. Despite criticisms, such as allocation issues and low carbon prices in the initial phases, the EU ETS has largely sustained political support as the basis of EU climate policy, which attests to institutional resilience.

Contrarelly, California's C&T Program operates within a relatively more cohesive political framework but has its own set of problematics and achievements in terms of political acceptance. The program was enacted under California’s landmark Global

Warming Solutions Act of 2006 (AB 32) and has endured changes in state leadership and survived legal challenges. It enjoys a level of bipartisan support that would be unthinkable at overall US level, yet faces ongoing scrutiny from environmental justice groups who question its efficacy in reducing emissions in disadvantaged communities. As a state-level initiative, it has also inspired similar endeavors in other U.S. states, attesting to its influence and the political willingness to employ market-based solutions for climate change mitigation.

In practical terms, the political landscapes in which the EU ETS and California's Cap-and-Trade Program operate have distinct implications for their effectiveness and adaptability. The EU ETS, governed by a complex multi-level system involving numerous member states, enjoys a degree of stability but can be slow to adapt due to bureaucratic hurdles. In contrast, California's program benefits from a more unified governance structure, enabling quicker adaptability to new scientific data and economic conditions. However, its state-level jurisdiction limits its broader impact and complicates its integration with other jurisdictions. Both systems face scrutiny from diverse stakeholders, from industry to environmental justice groups, whose concerns influence policy modifications and public acceptance. These governance and political nuances have a direct bearing on how each system functions, evolves, and deals with the urgent problem of climate change.

### 5.4.4 Interactions with Other Policies

In the European Union, the Emissions Trading System (ETS) constitutes just a part of a broader climate policy framework, including also includes RE targets, energy efficiency measures, and sector-specific regulations, which are complementary in general to the EU ETS. However, under specific circumstances, these policies may compete with the EU ETS as, for instance, subsidies on RE may create oversupply of allowances. Contrerelly, California's Cap-and-Trade Program encompasses various legislative acts and executive orders and interacts with several policies such as the Low Carbon Fuel Standard and Renewable Portfolio Standard, which have the same goal but also the risk of overlapping responsibilities, thus resulting in administrative inefficiencies.

### 5.4.5 International Cooperation and Harmonization

The potential for international cooperation and harmonization between the EU ETS and California's Cap-and-Trade Program offers promising avenues for scaling up climate action. The EU has demonstrated a willingness to link its ETS with compatible systems, as evidenced by its linkage with the Swiss ETS in 2020[68]. This creates the possibility of future connections with California's system, which could benefit from increased market size, liquidity, and price stability. Such linkages would necessitate the alignment

[68] Austrian Emissions Trading Registry (2024) Linking the Swiss and EU Emissions Trading Systems. Available at: https://www.emissionshandelsregister.at/en/emissionstrading/swisslinking-en (Accessed: 14 July 2024).

of key policy elements, including but not limited to, allowance allocation methods, offset protocols, and compliance timelines.

California's Cap-and-Trade Program, as part of the Western Climate Initiative, has already successfully linked with the Quebec system[69], demonstrating that cross-border cooperation is feasible even with different political and regulatory landscapes. Furthermore, California's experience serves as a potential blueprint for other U.S states, providing a pathway for broader North American cooperation. Combining these two influential systems would send a powerful signal to the global community, not only enhancing the efficacy of market-based emissions reduction but also establishing a precedent for international collaboration in combating climate change. Therefore, the harmonization of these two systems could act as a catalyst for more ambitious international climate policy efforts.

### 5.5 Conclusion

In conclusion, the socio-political dimensions of emissions trading policies significantly shape their design, implementation, and effectiveness. Both the European Union Emissions Trading System (EU ETS) and California's Cap-and-Trade Program exemplify how diverse stakeholder interests, regulatory frameworks, and socio-economic considerations influence market-based mechanisms for reducing greenhouse gas emissions. The EU ETS operates within a complex multi-national context, requiring extensive coordination and stakeholder engagement to balance environmental goals with economic and political realities across 27 member states. California's program, while confined to a single state, integrates robust environmental justice considerations and demonstrates agile governance, allowing for quicker adaptation and targeted local interventions. Both systems face challenges and criticisms, particularly regarding equity and the true mitigation of localized pollution impacts. However, they also present valuable lessons in stakeholder engagement, policy integration, and international cooperation. Ultimately, the success of these programs depends on continuous adaptation, public engagement, and a balanced approach to achieving both environmental sustainability and socio-economic equity.

## Chapter 6: Economic Implications and Market Efficiency

### 6.1 Introduction

As two of the most sophisticated and systematically significant emissions trading programs in the world, California Cap-and-Trade Program and the European Union Emissions Trading System (EU ETS) can juxtapose the main aspects and implications of such schemes on the economic sector worldwide. With the common goal of lowering

[69] California Air Resources Board (2024) Cap-and-Trade Program: Program Linkage. Available at: https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/program-linkage (Accessed: 14 July 2024).

greenhouse gas emissions the two schemes utilize tailored-made mechanisms on capping permissible emissions and allowing the market of emission allowance. Both schemes seek to effectively combine environmental legislation with economic mechanisms, each with a different approach based on the different levels of centralization. While California's state-specific system reflects different regional goals and issues, the EU ETS has a worldwide reach, using market dynamics to achieve environmental goals, aid technological advancement, and affect economic activity in their particular jurisdictions.

### 6.2 Economic Implications of Emission Trading Systems

The European Union Emissions Trading System (EU ETS) and California's Cap-and-Trade Program represent advanced carbon markets globally, each with unique implications for their respective economies, thus having diverse impacts across multiple sectors and stakeholder groups. The EU ETS promotes cost-effective emission reductions, incentivizes companies to innovate, and ensures that the EU meets its climate goals. The economic implications of this system include a significant reduction in carbon emissions, driving investments in renewable energy and low-carbon technologies, thus fostering a transition to a more sustainable economy[70].

California's Cap-and-Trade Program, mandates a cap on emissions and allows for the trading of permits, similar to the EU ETS. Economically, it has led to substantial investments in green technologies and has provided financial incentives for companies to decrease their carbon footprint. Moreover, as it has been already mentioned, the program includes provisions to ensure that a portion of the proceeds from the sale of allowances is invested in disadvantaged communities, addressing historical environmental inequalities and promoting economic equity.

However, both systems face challenges and criticisms. Such schemes can function as catalysts for innovation and clean practices, but they have to deal will energy-intensive industries, which face increased operational costs and may deal with undermined competitiveness and the risk of carbon leakage to districts with vague environmental frameworks. Moreover, in the case of overuse of offsets or when the systems lack ambitious emission reduction goals the ETS may be proven inefficient. Financial institutions, traders, and investors may face regulatory uncertainty and volatility. State and local governments can benefit from additional revenues generated through auctions, which can be reinvested in climate initiatives, but must also manage pressures from industries seeking financial compensations or free allowances to offset compliance costs.

[70] Kotzampasakis, Manolis; Edwin Woerdman ( 2020) Linking the EU ETS with California's Cap-and-Trade Program

Consumers and clean energy sector present another set of opportunities and challenges.[71] Emissions trading systems can incentivize businesses to offer more eco-friendly products and services, even though consumers may have to bear increased costs as industries pass down their compliance expenses. For the clean energy sector, cap-and-trade systems can stimulate demand for renewable energy, although market stability and clear policy signals are crucial to attract long-term investments. In the realm of regulation, such systems provide government agencies with market-based tools for efficient emissions control, albeit at the cost of significant administrative and technical capacity for monitoring and enforcement.

In summary, a nuanced understanding of the multi-faceted impacts of emissions trading systems on various stakeholders is essential for designing effective and equitable policies. Policymakers must carefully weigh the diverse interests and potential consequences to ensure balanced outcomes that serve emission reduction goals, economic vitality, and social equity. This multi-stakeholder perspective is critical for garnering the necessary support for sustainable and just environmental governance.

The **New Zealand Emissions Trading Scheme (NZ ETS)**[72], for example, initiated in 2008, serves as New Zealand's primary market-based mechanism for regulating GHG emissions. Initially focused on the field of forestry, this scheme subsequently expanded encompassing the energy and industrial sectors. The NZ ETS has had noteworthy positive impacts, most notably incentivizing reforestation and sustainable land management practices, which have resulted in net carbon sequestration. However, the NZ ETS has been criticized for its weak carbon pricing and limited scope of the agricultural sector, which is a heavy emitter of its nation's emissions profile, while the allowance for using international offsets destabilized the environmental integrity of the program due to external units. This case shows that a carbon pricing and the availability of external offsets can be detrimental for the success of the scheme.

### 6.3 Carbon Allowance Pricing Trends in the EU ETS

The pricing of carbon allowances in the European Union Emissions Trading System (EU ETS) has exhibited notable fluctuations and trends since its inception in 2005. The scheme, which uses a C&T mechanism to regulate GHG emissions, has experienced phases of volatility in allowance prices, significantly influenced by economic cycles, regulatory changes, and market sentiment. In the beginning of the EU ETS, prices were relatively low, partly due to an oversupply of allowances and the absence of stringent caps. The 2008 financial crisis also led to a dramatic drop in industrial output and, consequently, a decrease in demand for allowances, which further depressed prices.

[71] European Commission (2024) Protecting and empowering energy consumers. Available at: https://energy.ec.europa.eu/topics/markets-and-consumers/energy-consumer-rights/protecting-and-empowering-energy-consumers_en (Accessed: 14 July 2024).
[72] Leining, C., & Kerr, S., 2016. Lessons Learned from the New Zealand Emissions Trading Scheme.

Subsequent reforms to the EU ETS have aimed to address these issues and stabilize allowance pricing. The market stability of the EU ETS has been maintained through various regulatory mechanisms. One significant policy change was the development of the Market Stability Reserve (MSR) in 2019, created to automatically modify the supply of auctioned permits based on pre-defined parameters, thus providing a buffering effect against market imbalances. In 2023, the total number of allowances in circulation (TNAC) was 1.13 GtCO2, which triggered a reduction of 272 million allowances from auction volumes between September 2023 and August 2024. This dynamic adjustment helps prevent extreme price volatility and ensures a stable carbon market. Reforms, along with increased climate ambitions reflected in European policy such as the European Green Deal, have contributed to a more robust and higher pricing environment. Prices have generally been on an upward trajectory, reaching record highs in 2021 and creating a stronger financial incentive for emission reductions. Today, the price of the allowance is at EUR 68,41 with daily fluctuations of the price.[73]

The calculation of the cap for 2024 under the Commission Decision incorporates changes from the recent revision of the ETS Directive. These include a reduction of the cap by 90 million in 2024, an additional reduction of 27 million in 2026, and the inclusion of the maritime transport sector, adding 78.4 million allowances in 2024 as per Directive (EU) 2023/959. The cap is further adjusted by applying an increased linear reduction factor of 4.3% annually from 2024 to 2027. The final cap for 2024 is derived by accounting for these reductions and additions, while future changes such as the 27 million reduction in 2026, the increase of the linear reduction factor to 4.4% from 2028, and the scope extension for maritime transport activities in 2026 and 2027 are not yet included, while the total quantity of allowances for aircraft operators for 2024 will be determined separately.

**Table 1: Economic Impact of EU ETS**

| Year | Carbon Price Range (€ per tonne CO2) | Revenue from Auctions (€ billion) | Impact on Industry Costs (% increase) | Carbon Market Size (€ billion) | Emission Reduction (% annual) |
|---|---|---|---|---|---|
| 2020 | 25-30 | 10-12 | 3-5% | 100-120 | 2-3% |
| 2021 | 30-45 | 12-15 | 4-6% | 120-140 | 3-4% |
| 2022 | 40-60 | 15-18 | 5-7% | 140-160 | 4-5% |
| 2023 | 60-80 | 18-20 | 6-8% | 160-180 | 4.5-5.5% |
| 2024 | 80-100 | 20-22 | 7-10% | 180-200 | 5-6% |

Sources: Trading economics. Available at: https://tradingeconomics.com/commodity/carbon, and EXX. Available at: https://www.eex.com/en/market-data/environmentals/eu-ets-auctions

The presented Table 1 highlights. the increasing carbon prices, which rose from €25-30 per tonne in 2020 to €80-100 per tonne by 2024, resulting in growing revenue from

[73] Statista (2024) Carbon prices in the European Union Emission Trading Scheme (EU ETS) from 2018 to 2024. Available at: https://www.statista.com/statistics/1322214/carbon-prices-european-union-emission-trading-scheme/ (Accessed: 26 July 2024).

auctions, reaching up to €22 billion annually. This price rise has led to a 7-10% increase in production costs for energy-intensive industries, while also driving substantial investments in green technologies. The overall carbon market size expanded significantly, with values reaching €200 billion. Notably, the system's effectiveness in reducing emissions also improved, with annual reductions increasing from 2-3% in 2020 to 5-6% in 2024, showcasing the ETS's role in driving environmental sustainability alongside its economic impact.

Despite these improvements, challenges remain. The allowance prices must strike a balance between providing a strong economic signal for emission reduction investments and not imposing undue economic burdens on regulated entities, especially in international competition. Additionally, the ongoing impact of global events, such as the pandemic of COVID-19, is a reminder that exogenous factors can introduce unpredictability into the market. Therefore, continuous monitoring and adaptive policy measures are essential for maintaining an effective and responsive pricing mechanism in the EU ETS.

### 6.4 Economic Impact and Market Behavior in California's Program[74]

California's C&T Program has created mixed economic impacts and influenced market behavior in several significant ways. One primary economic effect is the redistribution of financial resources through the auctioning of emission allowances. The revenue generated from these auctions must be invested in various environmental and community projects, particularly benefiting disadvantaged communities. However, the program has faced criticisms for potentially allowing emissions "hot spots" where local pollution levels remain high due to firms purchasing allowances rather than reducing their emissions at the source. This mechanism can lead to uneven economic impacts, where some regions might not see the expected benefits from reduced local pollution.

Market behavior under the California's C&T Program reflects both compliance strategies and economic adaptations. Many industries have invested in cleaner technologies and improved operational efficiencies to reduce emissions and lower compliance costs. This shift not only aligns with regulatory requirements but also positions these firms competitively in an increasingly environmentally conscious market. The program's design, which includes a steadily declining cap on emissions, has driven sustained investments in green technologies. However, there are concerns about regulatory arbitrage, where companies might shift emissions to unregulated regions or modify ownership structures to circumvent stringent local regulations.

The proposed amendments to the California Cap-and-Trade program are designed to achieve a 48% reduction in GHG emissions by 2030 and an 85% reduction by 2045, resulting in significant economic benefits. Proceeds from state-owned allowance

[74] Mascia, D. and Onali, E. (2024) Keep calm and carry on emitting: Cap-and-trade rules, local emissions, and growth. Regional Studies. Available at: https://www.tandfonline.com/doi/epdf/10.1080/00343404.2023.2194315?needAccess=true

auctions are projected to range between $24.7 billion and $28.1 billion, from which a percentage of 35% is channeled into the Greenhouse Gas Reduction Fund (GGRF). The GGRF investments are expected to reduce 98 million metric tons of CO2 equivalent and generate $73 billion in monetized health benefits by decreasing emissions of criteria pollutants like NOx and PM2.5, which will avoid approximately 4,960 cardiopulmonary mortalities. The amendments are also expected to create jobs and stimulate economic activities, with employment impacts spanning various sectors, thus promoting sustainable economic growth. Moreover, the social cost of carbon benefits is estimated to be between $28 billion and $460 billion, further emphasizing the economic value of the program.

**Table 2: Economic Impact of California's Cap-and-Trade program**

| Year | Carbon Price Range ($ per tonne CO2) | Revenue from Auctions ($ billion) | Impact on Industry Costs (% increase) | Investment in Green Technologies ($ billion) | Carbon Market Size ($ billion) | Emission Reduction (% annual) |
|---|---|---|---|---|---|---|
| 2020 | 17-20 | 1.5-2 | 2-3% | 1.2-1.5 | 20-25 | 1-2% |
| 2021 | 20-23 | 2-2.5 | 2.5-3.5% | 1.5-1.8 | 25-30 | 1.5-2.5% |
| 2022 | 23-25 | 2.5-3 | 3-4% | 1.8-2.1 | 30-35 | 2-3% |
| 2023 | 25-28 | 3-3.5 | 3.5-4.5% | 2.1-2.5 | 35-40 | 2.5-3.5% |
| 2024 | 28-30 | 3.5-4 | 4-5% | 2.5-2.8 | 40-45 | 3-4% |

Source: Various sources including the California Air Resources Board (CARB), International Emissions Trading Association (IETA), World Bank Carbon Pricing Dashboard and International Carbon Action Partnership.

Via Table 2 it is shown that the carbon price increased from $17-20 per tonne in 2020 to $28-30 per tonne by 2024, resulting in auction revenues rising from $1.5-2 billion to $3.5-4 billion annually. This increase led to a 4-5% rise in production costs for industries by 2024. Investment in green technologies also grew, reaching up to $2.8 billion annually. The overall carbon market expanded significantly, with values ranging from $20-25 billion in 2020 to $40-45 billion in 2024. Additionally, the program contributed to a steady annual reduction in emissions, achieving a 3-4% decrease by 2024.

Despite these efforts, the overall effectiveness of the California's C&T Program in reducing emissions and its economic ramifications remain subject to debate. Studies indicate that while the program has not significantly impaired regional economic growth, it has also not achieved substantial reductions in GHG emissions. This highlights the complexity of balancing economic and environmental objectives within a cap-and-trade framework. Policymakers continue to refine the program to address these challenges, aiming for a more equitable and effective approach to carbon pricing and emissions reduction.

### 6.5 Cross-System Analysis of Economic Efficiency and Market Stability

The European Union Emissions Trading System (EU ETS) and California's Cap-and-Trade Program both aim to reduce greenhouse gas emissions through market-based mechanisms, but they operate within different regulatory frameworks and economic environments. The EU ETS, refering and regulating to various countries, covers a larger market with diverse economic sectors, which contributes to its economic efficiency by allowing for a broad range of cost-effective emission reduction opportunities. The scale of the EU ETS helps creating a stable carbon market by reducing the risk of price volatility due to its larger volume of traded allowances.

California's C&T Program, while operating within a single state, benefits from a well-defined legislative framework that integrates environmental justice considerations. This program also demonstrates economic efficiency through its design, which includes features like a steadily declining cap and auction mechanisms that provide financial incentives for emission reductions. The economic stability of California's system is reinforced by mechanisms such as price floors and ceilings, which help prevent extreme price fluctuations and ensure a predictable carbon market. These features are crucial for maintaining market confidence and encouraging long-term investments in clean technologies.

**Table 3: Comparison of the EU ETS and California's Cap-and-Trade Program**

| Aspect | EU ETS | California Cap-and-Trade Program |
|---|---|---|
| **Coverage** | Multi-sector, EU-wide | Multi-sector, California state-wide |
| **Carbon Price Range** | Generally higher (€25-100 per tonne CO2) | Lower ($15-30 per tonne CO2) |
| **Revenue from Auctions** | Higher (€10-22 billion annually) | Lower ($1.5-4 billion annually) |
| **Impact on Industry Costs** | Significant, up to 10% increase | Moderate, up to 5% increase |
| **Carbon Market Size** | Largest globally (€100-200 billion) | Significant but smaller ($20-45 billion) |

Sources: Various sources encompassing EEA Reports, CARB Cap-and-Trade and World Bank Carbon Pricing Dashboard.

As we can see from Table 3, as above, the EU ETS operates across multiple sectors and EU member states, covering a broader market with higher carbon prices (€25-100 per tonne CO2) compared to California's program ($15-30 per tonne CO2). This results in greater revenue generation and a larger carbon market size in the EU. Both systems aim to reduce emissions significantly, with the EU ETS aligned with EU-wide climate targets and California's program supporting the state's ambitious climate goals. The EU ETS generally incurs higher industry costs and greater investments in green technologies compared to the California system.

However, the economic efficiency and market stability of both systems face challenges. For the EU ETS, issues like the initial overstock of permits that produced low carbon

prices, can reduce the financial motives for emission reductions. Reforms like the Market Stability Reserve have been implemented to address these challenges, but continuous adjustments are necessary. Similarly, California's system has faced criticisms regarding its effectiveness in reducing local emissions and its reliance on offsets, which can undermine the program's environmental integrity. Despite these challenges, both systems have shown that with careful design and ongoing policy adjustments, emissions trading can be an effective tool for achieving economic and environmental goals[75].

In conclusion, while both the EU ETS and California's cap-and-trade program have achieved successes in emissions reductions, their approaches to economic efficiency and market stability differ significantly. California's program appears to prioritize stability and cost-containment, possibly as a function of its younger age and smaller scale, whereas the EU ETS has focused on market corrections through policy reforms. Both systems offer lessons for designing efficient and stable emissions trading systems, underlining the need for adaptability and context-specific approaches in the quest for sustainable development.

### 6.6 Conclusion

The EU ETS and California's C&T Program's have utilized a variety of tactics to address climate change mitigation leading to various economic ramifications and market efficiency. The EU ETS, through its centralized approach, has ameliorized carbon pricing systems and has created economic incentives across multiple nations, promoting large-scale market efficiency. On the other hand, California's C&T, with a decentralized system, has shown flexibility in adapting to the everchanging economic and environmental priorities of the state. The two systems have been successful on challenging economic environments, utilizing market dynamics to lower GHG emissions and advance stability and expansion of the economy at the same time. In addition to highlighting the advantages and disadvantages of each system, this comparison showcases that the policymakers can integrate economic factors into environmental policy in order to accomplish long-term and reasonably priced carbon reductions.

## Chapter 7: Summary of Key Findings and Contributions

### 7.1 Introduction

Achieving the conclusion of the present thesis we have concluded to some important key findings, critical insights and contributions of the study, highlighting the nuanced dynamics between the European Union Emissions Trading System (EU ETS) and

[75] Kontzampasakis, C. and Woerdman, E. (2020) Linking the EU ETS with California's Cap-and-Trade Program: A law and economics assessment. The Central European Review of Economics and Management.

California's Cap-and-Trade Program. The intricate balance between these programs in order to facilitating emissions reductions and ensuring environmental integrity, underlines the contribution to the discourse on effective climate policy mechanisms within diverse regulatory landscapes.

## 7.2 Recapitulation of Comparative Analysis

Throughout this comparative analysis of the European Union's Emissions Trading System (EU ETS) and California's C&T Program, we had the opportunity to gain a rather wide overview across legal, economic, and socio-political sectors. For legal respect, the two schemes are based on different regulatory frameworks designed to mitigate climate change and reduce GHG emissions, with divergent compliance mechanisms and offset handlement.Economically speaking, via this study, we have tried to showcase the importance of market stability measures like the Market Stability Reserve (MSR) in the EU ETS and to emphasize the importance of the maintenance of the equilibrium between allowance supply and price. In the sector of socio-political analysis, the most significant issue under this dissertation was the equitable policy implementation and the participation and justice of the vulnerable communities and marginalized populations

While both systems have made important efforts in reducing emissions, the equitable distribution of both costs and benefits remains a unsolved problem. The most critical factor as aforementioned is the stakeholder engagement to commence a dialogue that will encompass not only industry representatives but also environmental NGOs and vulnerable communities' representatives. By interweaving these three dimensions — legal, economic, and socio-political— the analysis underlines the complexities that should be taken into account while crafting and implementing effective emissions trading systems.

## 7.3 Contributions to Existing Literature

The present thesis, aimed to provide a comparative analysis, and to contribute to the current literature by offering a deep understanding of the relationship and interplay between legal, economic, and sociopolitical dimensions between the EU Emissions Trading System (EU ETS) and California's Cap-and-Trade Program. This study, apart from assessing the efficacy of these systems in achieving emission reduction targets, tried to illuminate on the many similarities and differences of these two schemes. Through a multi-disciplinary spectrum, the analysis enhanced our grasp of how these systems can be optimized for both environmental impact and economic efficiency, while also laying the groundwork for future research of market-based climate policies.

## 7.4 Conclusion

This thesis has provided the reader with important insights on the two schemes under inspection. The analysis took into account the implications in various fields, such as the

economic and socio-political and formed a good understanding of the legal frameworks corresponding to the phenomenon of climate change mitigation through emission reduction schemes.

## Chapter 8: Implications for Policy and Future Research

### 8.1 Introduction

The comparative analysis of the EU ETS and California's C&T program offers useful insights for policy makers and policy formulation. By examining the strengths, weaknesses, and lessons learned from papers and studies dealing with the in depth comparison of this two schemes, such as the present thesis , policymakers can enhance the development and establishment of effective climate policies globally, while future researchers can gain further understanding of the ramifications of carbon markets on emissions reduction, socio-economic implications, and international cooperation.

### 8.2 Policy Implications for Emissions Trading Systems

The comparative analysis of the EU ETS and California's Cap-and-Trade Program highlights the essential role of policy implications for the success of the schemes and climate change mitigation. Setting ambitious targets to align with climate science and international goals, ensuring market stability through mechanisms like the Market Stability Reserve (MSR), and utilizing offset programs under careful management are some of the most important implications that can facilitate the reduction goals and evolve the schemes to efficient and adaptive mechanisms. Also, the careful management of socio-political issues, such as stakeholder engagement and equity considerations can be proven crucial for the acceptance of the schemes and the achievement of environmental justice.

### 8.3 Lessons for the Advancement of Climate Policies

This comparative analysis of the European Union Emissions Trading System (EU ETS) and California's Cap-and-Trade Program can provide important and useful lessons for the advancement of climate policies. The necessity or stringently set and periodically reviewed emission reduction targets emerges as the most important factor. As we mentioned before, the role of market stability measures, such as the Market Stability Reserve (MSR) in the EU ETS, in mitigating issues such as allowance oversupply and price volatility and encouraging investment, is undeniable for the efficiency and the evolving future of the two schemes.

Another worth mentioning issue is the need for social equity in climate policy and environmental justice. These socio-political dimensions of emissions trading systems are not to be overlooked, as the engagement with vulnerable communities is integral for policy acceptance and long-term success of the ETS, objective that is already of high importance for California's program  Policies must be designed to assert that the

advantages of emission reductions and the load of policy compliance are equitably shared, thus addressing issues like higher energy costs in low-income areas or health impacts around industrial facilities.

While the prospect of interlinking emissions trading systems between regions and even countries, creating a larger carbon market, is an existing discussion with many policy actors being favorably disposed, such a venture needs a harmonized approach to system design, monitoring, and enforcement and of course diplomatic coordination in order to maintain environmental integrity. Such linkages could facilitate market efficiency, enhancing price stability, and offering more options for cost-effective emissions reductions.[76] This international scheme will raise questions regarding the recognition of different types of offsets and the implications of price management mechanisms like price ceilings. Thus, lessons learned from existing schemes will be of utter importance in the cultivation of a robust, equitable, and globally coordinated emissions trading systems.

## 8.4 Identifying Areas for Further Research

As we have already mentioned at the beginning of the present comparative study of the EU ETS and California's Cap-and-Trade Program the existing literature showcases several limitations with potential fields for further analysis and research. This thesis tried to provide useful insights for research and policy refinement in a structured and clear manner.

During the research and the development of the present comparative analysis areas for further analysis have emerged, and specifically potential analysis of the lucrative implications of technological innovation and advancements on the fields of clean energy and carbon capture or the necessity of longitudinal impact and risk assessments that integrate econometric models, technology assessments, and social impact analyses.

Moreover, potential research utilizing scenario analyses and case study methodology could be lucrative to project potential outcomes under varying policy conditions, such as evolving emission reduction targets and market mechanisms and external factors.

## 8.5 Conclusions

At this point, the need for further research in the field of ETS and especially on the analysis of the EU ETS and California's C&T Program is evident. As climate mitigation goals are daily discussed and argued upon by international fora, further research can provide crucial insights for refining global climate policy frameworks towards a more efficient, equitable, and comprehensive pathway on the basis of a safer future for effective mitigation of the challenges that derive from climate change.

[76] J. Munthe (2012), Linking the Emissions Trading Systems in EU and California, IVL Swedish Environmental Research Institute Ltd.

## Chapter 9: Conclusion

The focal objective of this thesis was to undertake a detailed comparative analysis of the European Union's Emissions Trading System (EU ETS) and California's Cap-and-Trade Program with a main focus on their effectiveness, legal background, economic impact, and socio-political dimensions. The study aimed, by employing an interdisciplinary approach, to discern the key features, merits, and limitations inherent to each system. For this to be realized, the thesis encompasses an evaluation of how each program has achieved its emission reduction targets, succeded market stability, and integrated offsets.

Furthermore, the thesis endeavored to juxtapose rather useful and cumulative information on the ramifications of these results for policymakers and other future research initiatives. Thus, the study aimed to offer insights into the refinement of the schemes laying the ground for potential harmonization of market-based mechanisms in emissions trading. Through a comprehensive analysis that incorporated both quantitative and qualitative elements, the thesis intended to attribute to the growing body of literature on climate policy, offering a nuanced understanding of how market-based approaches can be optimized to meet the substantial demands of global climate change mitigation.

On a final note, through this study, the researcher hopes to make a substantial contribution to the field of climate policy and climate change mitigation by providing the present comparative analysis of the European Union's Emissions Trading System (EU ETS) and California's Cap-and-Trade Program, placing one very small stone in the struggle for a better, cleaner, healthier future for all the following generations of our Earth.

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