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The European Emission Trading System and Its Followers

Comparative Analysis and Linking Perspectives

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ISSN 2191-5547 ISSN 2191-5555 (electronic)
SpringerBriefs in Environmental Science
ISBN 978-3-319-31185-2 ISBN 978-3-319-31186-9 (eBook)
DOI 10.1007/978-3-319-31186-9

Library of Congress Control Number: 2016934194

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG Switzerland

Preface

During the past decades there has been a wide debate on which economic instruments are more suitable to fight climate change in a way that is both economically efficient and legally rigorous. Among the various instruments, Emission Trading has gained increasing importance worldwide. Following the example of the European Emission Trading System (henceforth EU ETS), which set up in 2005 the first international carbon market, many other countries have decided to set up their own ETS at the national or regional level, generating a sort of rapid sprawling of the ETSs around the world. Given the difficulties encountered in the post-Kyoto phase (and actually during the Kyoto phase too) to pursue a multilateral solution to climate change problems, many scholars and policy-makers started looking at linking ETSs as a possible way to progressively achieve a common instrument to reduce polluting emissions. Linking ETSs implies deep economic and legal difficulties: it requires a rigorous legal framework for its proper economic functioning. Still, it might become one of the main routes to fight climate change in the near future.

To get a deeper understanding on this issue, this book provides a detailed analysis of the main ETSs from both the legal and economic perspectives with the intent to compare their features and examine whether and how to link them in the future.

It is the effort of a joint legal and economic team based at the University of Siena where we collaborate within the research group R4S—Regulation for Sustainability.

The book is divided into four parts. Chapter 1 is devoted to the analysis of the EU ETS, which has played a pioneering role in establishing a large international carbon market. Chapter 2 examines what we call the followers, namely, the main ETSs that have been set up in various regions after the EU ETS. In particular, we selected three ETSs (California, RGGI and Quebec) that we regard as crucially important not only for their dimensions but also for their actual or potential capacity to set up bilateral or multilateral ETS agreements. We originally examined also other ETSs that could play an important role in the future carbon markets, such as Australia and China. But we decided to exclude them from the final version because the Australian government eventually abandoned its ETS project, while the Chinese pilot ETSs are still at their early stages with no sufficient data available for a proper analysis. The first two chapters provide the foundations for the following two. In particular, Chap. 3 performs a comparative analysis of the ETSs examined above providing some critical insights on the lessons learnt from the leader (i.e. the EU ETS) and its followers. Finally, Chap. 4 investigates the pros and cons of linking various ETSs, discussing the requirements for a successful linking and the alternative ways in which this can be realised.

The book originates from a research project entitled "The future of carbon trading regulation in the post-2012 international climate change negotiations" supported by Enel Foundation. We are indebted to Enel Foundation for its financial support which gave us the opportunity to conduct a deep analysis of the subject. We are also thankful to many scholars and seminar participants who provided numerous insights and suggestions as our research evolved over time beyond the original project along with the continuous changes in the ETS legislation and in the international scenarios. In particular, preliminary drafts of single parts of this book were presented at the Tsinghua University in Beijing, the School of Oriental and African Studies in London and the University of Siena. We would like to thank seminar participants for stimulating discussions that helped us improve the analysis. We take this opportunity to thank also Sebastiano Cupertino, Michele Marini and Francesca Volpe for providing valuable research assistance in searching for relevant data and legislative sources, and two anonymous referees for their helpful and constructive indications.

Finally, Simone Borghesi and Massimiliano Montini would like to thank the Department of Land Economy at the University of Cambridge where they were hosted as Visiting Professors during the Spring semester 2015. Moreover, they gratefully acknowledge the receipt of the financial support from MIUR (Italian Ministry of the University and Research) for the PRIN 2010-11 National Research Project (Grant No. 2010S2LHSE) and from the project FESSUD (*Financialisation, Economy, Society and Sustainable Development*) (Grant Agreement No. 266800), funded under the European Union VII Research Framework Programme.

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Contents

Abbreviations and Acronyms

AAR	Authorised Account Representative (RGGI)
AB32	(Californian) Assembly Bill 32
CAD $	Canadian Dollars
CARB	California Air Resource Board
CCA	California Carbon Allowance
CCAP	(Quebec) Climate Change Action Plan
CCFE	Chicago Climate Futures Exchange
CCR	Cost Containment Reserve
CER	Certified Emission Reduction
CFR	Code of Federal Regulations (USA)
CH_4	Methane
CO_2	Carbon Dioxide
CO_2-e	Carbon Dioxide Equivalent
CP1, CP2, CP3	Commitment Period 1, 2, 3
CPM	(Australian) Carbon Pricing Mechanism
EC	European Community
EEA	European Environment Agency
EEX	European Energy Exchange
EFTA	European Free Trade Agreement
ETS	Emission Trading System
EU	European Union
EUA	European Union Allowance
EU ETS	European Union Emission Trading System
GHG	Greenhouse Gas
HFCs	Hydrofluorocarbons
ICAO	International Civil Aviation Organisation
ICE	Intercontinental Exchange
KP	Kyoto Protocol on Climate Change
MRR	Mandatory Reporting Regulation
$MtCO_2$	Mega Tonnes of Carbon Dioxide
MW	Megawatt

N_2O	Nitrous Oxide
NF_3	Nitrogen Trifluoride
OTC	Over-the-Counter
PFCs	Perfluorocarbons
QEA	Quebec Emission Allowances
RGGI	Regional Greenhouse Gas Initiative
RGGI COATS	RGGI CO_2 Allowance Tracking System
SF_6	Sulfur Hexafluoride
tCO_2	Tonnes of Carbon Dioxide
UNFCCC	United Nations Framework Convention on Climate Change

Chapter 1
The EU ETS: The Pioneer—Main Purpose, Structure and Features

1.1 Introduction

Since its introduction, the European Emission Trading System (EU ETS) immediately gained attention from scholars and policy-makers as it was the first transboundary cap and trade scheme and the largest air ETS in the world. For these reasons, it was commonly regarded as a "prototype" for the other ETSs established at national level around the world (Ellerman 2010).

Through the years, the EU ETS has progressively gained a paramount position within the EU climate change legislation and currently represents the most striking flagship in this sector, with more than 11.000 installations covered by the scheme. In parallel, the EU ETS has paved the way for the establishment of many other ETSs in several jurisdictions. Such schemes are now recognised worldwide as the "cornerstones" of the climate change policy, especially in the view of the lengthy and difficult process of the international climate change multilateral negotiations.

This chapter presents and analyses the EU ETS in a legal and economic perspective, with the view to assess whether it has truly represented a prototype for the other ETSs established around the world. To this end, the analysis firstly focuses on the most relevant legislative framework and technical aspects of the EU cap and trade scheme, in order to better understand its purpose, structure and features (see Sects. 1.2–1.9). Secondly, the evolution of carbon price and the economic and environmental effectiveness of the EU ETS are examined, so as to assess the real performance of the EU ETS and evaluate its suitability to act as a model for other national or regional ETSs (see Sects. 1.10 and 1.11). Finally, attention is devoted to the structural reform proposals that have been advanced to improve the functioning of the EU ETS in response to the difficulties encountered by the system in the last few years (see Sect. 1.12).

S. Borghesi et al., *The European Emission Trading System and Its Followers*,
SpringerBriefs in Environmental Science, DOI 10.1007/978-3-319-31186-9_1

1.2 The Current EU ETS Legislative Framework

The EU ETS was firstly established by EC Directive 2003/87. The scheme was initially based on a free allocation of the emission allowances (*grandfathering* method), whereby European Union Allowances (EUAs) were assigned for free, taking into account the historical emissions of the sectors and the installations covered by the scheme. The EUAs were distributed to the incumbent operators according to the specific National Allocation Plans (NAPs) developed by the EU Member States. Moreover, the scope of the scheme was quite narrow since it covered a few installations and CO_2 emissions only. The EU ETS format described above covered the first two periods, 2005–2007 and 2008–2012, and was mainly intended as a *learning by doing* experience, which, in fact, revealed some shortcomings, such as, for instance, a remarkable overallocation of EUAs seriously endangering its effectiveness (see below).

EC Directive 2008/101 firstly amended the original EU ETS, by including aviation activities in the trading scheme (as of 2012). This means that, in principle, the EU ETS legislation should now apply to EU and non-EU airlines alike, whose flights depart from an aerodrome situated within the EU territory and arrive in such an aerodrome from a third country. In practice, however, the system has been applied so far to EU internal flights only, due to the so-called stop-the-clock decision.

Beside the limited aviation amendment, the original EU ETS received a decisive new vigour only thanks to the amendments brought by EC Directive 2009/29. Notably, such a Directive was adopted in the framework of the broad *Climate and Energy Package*, which contained a set of new legislative measures to effectively tackle climate change and energy issues in a more integrated and cost-effective manner.[1] Moreover, the ambitious aims of the *Climate and Energy Package*, and its related *20/20/2020* targets, became the basis for the establishment of the long-term EU approach towards climate change and energy policy, strongly committed by the ambitious goal of becoming a *Low Carbon Economy* by 2050 characterised by dramatic greenhouse gases (GHG) emission reductions and green economy principles.[2] Within such a framework, in 2013 the EU moved even beyond the 20/20/2020 targets, by endorsing a −40 % GHG emission reduction target (going up to −43 % for EU ETS covered sectors) to be reached by 2030, compared to 1990 emission levels, in the broader context of the 2030 *Framework for Climate and Energy Policies*.[3]

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[1]The EU *Climate and Energy Package*: EC Decision 406/2009 (Effort Sharing); EC Directive 2009/28 (Renewable Energies); EC Directive 2009/29 (New EU ETS Scheme); EC Directive 2009/31 (CCS Scheme).

[2]COM (2011) 112 final, Communication from the Commission *A Roadmap for moving to a competitive low carbon economy in 2050*.

[3]On the EU 2030 Framework for Climate and Energy Policies see, inter alia, Commission Green Paper COM (2013) 169 final, *A 2030 framework for climate and energy policies*; Commission Communication COM (2014) 15 final *A policy framework for climate and energy in the period from 2020 to 2030* and the Conclusions of the European Council of 22–23 October 2014.

For the sake of the current analysis, it is important to focus specifically on EC Directive 2009/29 and on its main novelties that modified the EC Directive 2003/87.[4] In brief, it may be said that the amendments introduced by EC Directive 2009/29 strengthened and improved the EU ETS, while expanding its duration time by foreseeing a third commitment period, covering the period 2013–2020, and a fourth one, running from 2021 to 2028. More in detail, although the basic structure of the EU cap and trade scheme remained unchanged, as did the main duties of the incumbent operators, new sectors and additional GHG (N_2O and PFCs) were added to the EU ETS scope. The *grandfathering* method for the allocation of EUAs was set aside for a new default allocation system, based on auctioning. As a consequence of this new method of allocation, NAPs disappeared and a yearly EU-wide Cap to be set by the EU Commission was introduced.

1.3 EU ETS Purpose and Scope

As stated in article 1 of the EU ETS Directive, the EU ETS is a trading scheme of EU GHG emission allowances, which is designed to cover around 45 % of total GHG emissions in the participating countries. Its purpose is to promote GHG emission reductions in a cost-effective and economically efficient manner. It currently operates in 31 countries: the 28 EU countries plus Iceland, Norway and Liechtenstein.[5] The EU ETS entitles the EU Commission to set a yearly EU-wide Cap of EUAs to be allocated within the EU. At the same time, it requires the installations subject to its application to hold a GHG permit and to monitor and report their GHG annual emissions with the obligation to surrender every year a quantity of allowances equal to their GHG emissions occurred in the previous year, as monitored, reported and verified by an independent verifier. Installations subject to the EU ETS may comply with this obligation by improving their environmental performance and cutting their GHG emissions or by buying the EUAs on the related auctioning and trading market.

Within the EU-wide Cap, EUAs are allocated to installations covered by the scheme. The main method of allocation is auctioning, although, for the time being, many sectors receive permits for free to avoid the possible delocalisation of their production activities towards countries not covered by the EU ETS (see Sect. 1.5.4). In general terms, the scarcity of available EUAs should push the incumbent operators to curb their GHG emissions in order to comply with the GHG permit requirements. This should create an incentive for operators to invest in low-carbon technologies, at the same time giving them the possibility to sell their

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[4]From now onwards, when referring to the EU ETS Directive we will refer to EC Directive 2003/87 as amended by EC Directive 2009/29 even when not citing both Directives.

[5]Iceland, Norway and Liechtenstein are the only remaining members of the European Economic Area, which links the European Free Trade Agreement (EFTA) States with the EU.

(potential) surplus EUAs or to buy the extra EUAs they need to match their reported GHG emissions.

The allocation mechanism and the specific duties of the operators will be further addressed in the following paragraphs. As to the sectors and GHG currently covered by the EU ETS scheme, these are listed in Annex I to the EU ETS Directive and may be grouped as follows:

- Power and heat generation → CO_2;
- Energy-intensive industry sectors including oil refineries, steel works and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals → CO_2;
- Commercial aviation → CO_2;
- Production of nitric, adipic, glyoxal and glyoxylic acids, ammonia → N_2O;
- Production of aluminium → PFCs.

1.4 The Actors of the EU ETS: The Duties of the Operators and of the Participating States and the Sanctions Against Non-compliant Operators

Articles 4–6 of the EU ETS Directive spell out the main obligations of the operators of stationary installations subject to the EU ETS. Firstly, they must apply for a GHG emission permit and, once obtained such a permit from the competent national authority, they must comply with its conditions.

The requirements of the GHG emission permit application and the permit contents are specified in articles 4–5–6. In brief, the application must specify the measures planned to monitor and report the GHG emissions and the permit must specify the GHG emission monitoring and reporting plans as well as the obligation to surrender an amount of EUAs equal to the total verified emissions of the installation in each calendar year, within four months following the end of that year (i.e. within 30 April of each year the operator shall surrender a number of EUAs equal to its verified emissions of the preceding year).[6] With regard to aviation, article 3(c) requires operators of aircrafts covered by the EU ETS to apply for allocation of EUAs free of charge by submitting to the national competent authority their verified tonne-km data for the monitoring year. Article 3(g) requires operators of aviation activities to submit to the competent authority a monitoring plan setting out measures to monitor and report emissions and tonne/km data; that such plans are to be approved by the competent authority. Alike the regime applicable to stationary installations operators, article 12.2(a) requires aircraft operators to surrender by 30 April a number of allowances equal to their total emissions during the

[6]See also article 12.3 EU ETS Directive.

preceding calendar year, as verified. Once surrendered, EUAs are cancelled for avoiding double use or double counting.

The monitoring and reporting duties shall be implemented according to the binding rules provided by EU Regulation 601/2012 on the monitoring and reporting of GHG emissions, which foresees, for instance, that the GHG emission data reported must be verified by an independent verifier. The annual procedure of monitoring, reporting and verification, regulated by articles 12–15 of the EU ETS Directive as further implemented by EU Regulations 600/2012 and 601/2012, is known as *"the compliance cycle of the EU ETS"*.

As to the penalties applicable to installations not in compliance with their duties, article 16.2–5 of the EU ETS Directive states that any operator or aircraft operator who does not surrender sufficient allowances by 30 April of each year to cover its emissions during the preceding year shall be held liable for the payment of an *"excess emissions penalty"* of 100 € for each tonne of CO_2 equivalent emitted for which the operator or aircraft operator has not surrendered allowances.[7] Notably, the payment of the pecuniary sanction shall not release the operator or aircraft operator from the obligation to surrender an amount of allowances equal to those excess emissions when surrendering allowances in relation to the following calendar year. In addition to the pecuniary sanction, the so-called *name and shame* procedure applies. Indeed, Member States shall ensure the publication of the names of operators and aircraft operators who are in breach of requirements to surrender sufficient allowances. Moreover, a specific additional sanction is envisaged for an aircraft operator who fails to comply with the requirements of the EU ETS Directive and where other enforcement measures have failed to ensure compliance: in this event its administering Member State may request the EU Commission to decide on the imposition of an operating ban on the aircraft operator concerned.

Shifting to the duties of EU Member States and other countries participating to the EU ETS, they shall first of all set up the administrative, legislative and institutional arrangements to implement the EU ETS rules, first and foremost by appointing their national competent authorities. Furthermore, they shall adopt national rules on the national penalties for non-compliance with the national law on EU ETS and they shall comply with the rules on the contents of the GHG permit spelled out in article 6 of the EU ETS Directive. Articles 3(e)(5) and 11.2 provide that by 28 February of each year the competent authorities shall issue, respectively, the quantity of allowances allocated to aircraft operators and the quantity of allowances allocated to stationary installations operators for that year. Further duties are imposed on the participating States with regard to the allocation and auctioning of the allowances. These will be analysed in the following paragraph.

[7]The excess emissions penalty relating to allowances issued from January 1 2013 onwards shall increase in accordance with the European index of consumer prices.

1.5 Allocation Regime and Validity of the European Union Allowances

1.5.1 General Rules for Allocation of EUAs

As already mentioned above, one of the main novelties brought by EC Directive 2009/29 concerns the EU allowance allocation method which, starting from 2013, is normally no longer issued for free by means of the *grandfathering* method, but rather through auctioning. Indeed, the previous allocation regime adopted in the first trading periods foresaw by EC Directive 2003/87 proved to be not suitable to reach the ETS objective of reducing GHG emissions in a cost-efficient manner, mainly due to overallocation to incumbent operators and surplus of EUAs in the related market. The new allocation regime established by EC Directive 2009/29 seeks to overcome these shortcomings and create a more dynamic and efficient market, at the same time trying to promote eco-innovation in the sectors under the EU ETS coverage. The detailed rules on allocation are analysed hereinafter.

1.5.2 The EU-Wide Cap for Stationary Installations and for Aircraft Operators

The total quantity of EUAs to be allocated every year in the period 2013–2020 and 2021–2028 are set at EU level by a decision (i.e. a mandatory legislative EU act) adopted by the European Commission: therefore, an EU-wide Cap is set at central level. The available allowances within this Cap are allocated to Member States according to detailed rules set by EC Directive 2009/29 and then allocated to operators subject to the EU ETS by means of auctioning (although some exceptions apply, as it will be described below).

As far as stationary installations are concerned, article 9 of the revised EU ETS Directive states that for each year after 2013,[8] the EU-wide Cap will decrease by a linear factor of 1,74 % of the average quantity of EUAs issued annually in 2008–2012. This annual linear reduction will lead in 2020 to a number of GHG emissions from stationary installations 21 % lower than 2005. The linear factor shall be reviewed if appropriate by the Commission as from 2020 with the aim to adopt an "adjustment" decision by 2025. Moreover, the 2030 *Framework for Climate And Energy Policy* requires to lower the Cap by 2.2 % per year from 2021 to reduce emissions from fixed installations to around 43 % below 2005 levels by 2030.

[8]The 2013 Cap is set by EU Decision 2010/634 (*Commission Decision of 22 October 2010 adjusting the Union-wide quantity of allowances to be issued under the Union Scheme for 2013 and repealing Decision 2010/384/EU*). The Caps for the following years are calculated decreasing the 2013 amount of allowances by a given linear factor.

By 28 February of each year, each Member State shall issue the allowances to be allocated to its stationary installations. As already explained above, the operators are subject to the GHG permit application and conditions (art. 3–6 EU ETS Directive) and to the so-called *EU ETS compliance cycle*, whereby their GHG annual emissions shall be monitored, reported and verified and, finally, they shall surrender a number of EUAs equal to their verified GHG emissions of the preceding year by 30 April.

As far as aircraft operators are concerned, article 3(c)(2) provides the Cap to remain unchanged for the entire 2013–2020 period, corresponding to 95 % of the historical aviation emissions (i.e. average of the aviation annual emissions for years 2004, 2005 and 2006) multiplied by the number of the years in the period. According to article 3(d), 15 % out of these total aviation emissions will be allocated to aircraft operators through the auctioning system, under the auctioning rules that will be analysed later in this chapter. The 85 % of aviation allowances will be distributed for free according to the rules spelled out in article 3(e), according to which the aircraft operator shall submit the national competent authority an application including the monitoring plan and the verified tonne/km data for the monitoring year. Moreover, the number of free allowances to be issued to aircraft operators in each year from 2013 to 2016 will be reduced in proportion to the reduced EU ETS scope, due to the application of Regulation 421/2014/EU (as a consequence of the extension of the so-called stop-the-clock decision). The competent national authority will submit the applications received to the Commission that will establish the EU-wide total quantity of aviation allowances to be issued, distinguishing the amount of allowances to be auctioned (15 %) from that to be allocated for free (85 %). The latter is determined by the Commission on the basis of a benchmark calculated by dividing the total amount of free allowances by the sum of tonne/km data included in the applications submitted by the aircraft operators. On the basis of the Commission's decision, each administering Member States shall calculate and publish the total aviation allowances to be allocated for free to the aircraft operators, by multiplying the benchmark by the 2010 tonne-km data of each aircraft operator. Finally, by 28 February of each year, the competent administering Member State shall issue to the aircraft operators the aviation allowances.

1.5.3 The Allocation Rules for EUAs to Stationary Installations

As a general rule, the default method of allocation of EUAs to stationary installation is auctioning (article 10 EU ETS Directive). In fact, auctioning is considered the most transparent, non-discriminatory allocation method as well as the most suitable tool to implement the "*polluter-pays*" principle.

Article 10 of the EU ETS Directive identifies the Member States' shares of allowances in the auctioning volume. According to article 13 of the EU ETS Directive, the allowances issued from 2013 onwards shall be valid for the entire 2013–2020 period (3rd commitment period). Every year, four months after the beginning of each period referred to above, allowances, which are no longer valid and have not been surrendered and cancelled in accordance with article 12 of the EU ETS Directive, shall be cancelled by the competent authority. Then, Member States shall issue allowances for the current period to replace any allowance which have been cancelled.

According to article 11 of the EU ETS, each Member State shall develop the so-called *National Implementation Measures*, i.e., the list of installations covered by the EU ETS Directive in its territory and any free allocation to each installation in its territory calculated in accordance with the rules referred to in article 10a(1) and article 10c of the Directive. These measures shall be published and submitted to the EU Commission for approval.

1.5.4 The Benchmarks and the Special Regime for Manufacturing and Risk of Carbon Leakage

The general regime of default auctioning allocation described so far is subject to some exceptions foreseen in articles 10(a)–(b) and (c) of the EU ETS Directive, providing for free allocation of EUAs to certain sectors and under certain conditions. Such provisions have been implemented by EU Commission Decision 2001/278 determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to article 10a of EC Directive 2003/87 and EU Decision 2014/764 on the list of sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage, for the period 2015 to 2019.

Before going through these exceptions, it is important to underpin that no derogation from the monitoring, reporting and verification (*EU ETS compliance cycle*) is foreseen for the installations benefitting from free allocation, since all the operators subject to the EU ETS face the same monitoring, reporting and verification duties. In fact, the exceptions only cover the allocation method of the EUAs.

As a rule, no free allocation is foreseen for the electricity production and free allocation will progressively decrease up to 30 % in 2020, with the view to be totally phased out by 2027 (article 10(a).11). Free allocation is based on the benchmarks established ex ante by the Commission. Benchmarks are established per product and not per sector or output and are values used to calculate free allocation per installation. They reflect the average of GHG emission performance of the 10 % best performing installations (for a given product) in 2007–2008 in the EU. Moreover, the benchmarks do not differ according to the technology or fuel used or the size or location of the installation. Such an approach shall ensure transparency and no distortion of competition, at the same time providing incentives to GHG emission reductions and efficiency in the production activity.

The installations that reach performances closer to the benchmark will receive more EUAs, while the ones far from meeting the benchmark will receive a lower amount of EUAs for free, thus being forced to improve their performance or buy the extra EUAs in the market, or a combination of the two options (flexible approach). More in detail, manufacturing industry shall receive 80 % of EUAs for free, distributed on the basis of the ex-ante benchmarks, but this percentage shall annually decrease to 30 % in 2020 and 0 % in 2027.

Sectors and subsectors exposed to a significant risk of carbon leakage will receive 100 % of EUAs free of charge. The term "*carbon leakage*" is used to refer to the practice of operators who transfer their production in countries with laxer GHG constraints. In this respect, article 10(a).12–18 defines the detailed norms related to carbon leakage.

First of all, a sector or subsector is deemed to be exposed to a significant risk of carbon leakage if both of the two following requirements are fulfilled (article 10a.15):

(a) the sum of direct and indirect additional costs induced by the implementation of the EU ETS Directive would lead to a substantial increase of production costs, calculated as a proportion of the gross value added, of at least 5 %; and
(b) the intensity of trade with third countries, defined as the ratio between the total value of exports to third countries plus the value of imports from third countries and the total market size for the Community/Union (annual turnover plus total imports from third countries), is above 10 %.

Besides these two circumstances, a sector or subsector is also deemed to be exposed to a significant risk of carbon leakage if one of the two following conditions applies (article 10a.16):

(a) the sum of direct and indirect additional costs induced by the implementation of the EU ETS Directive would lead to a particularly high increase of production costs, calculated as a proportion of the gross value added, of at least 30 %; or
(b) the intensity of trade with third countries, defined as the ratio between the total value of exports to third countries plus the value of imports from third countries and the total market size for the Community/Union (annual turnover plus total imports from third countries), is above 30 %.

Similarly to the manufacturing industry, and despite the softer regime applicable to the carbon leakage sectors and subsectors, the ex-ante benchmarks approach applies here alike. Thus, sectors and subsectors under carbon leakage risk which reach the benchmark level will receive a higher share of free EUAs while the other ones falling short on the benchmark level will receive a proportional lower amount of free EUAs. As a result, only the most efficient and best performing sectors and subsectors under carbon leakage will receive an amount of EUAs enough to cover their GHG emission needs, as monitored, reported and verified.

The list of sectors and subsectors facing the risk of carbon leakage is adopted by Commission decision; it covers 5 years and is regularly updated. In 2009, the EU Commission adopted the first list of sectors and subsectors under risk of carbon leakage, to be applied for the allocation period until 2014,[9] now superseded by EU Decision 2014/764 covering the period 2015–2019.

1.6 The New Entrants Reserve (NER) and the NER300 Programme

Article 10a.7 states that 5 % of the EU-wide allowances for the period 2013–2020 shall be set aside for the *new entrants*. As the name NER300 suggests, the programme is funded from the sale of 300 million emission allowances from the new entrants' reserve (NER) set up for the third phase of the EU ETS. In particular, article 10a.8 provides that up to 300 million allowances within the new entrants' reserve have been available until 31 December 2015 to help stimulate the construction and operation of up to 12 commercial demonstration projects that aim at the environmentally safe capture and geological storage (CCS) of CO_2 as well as demonstration projects of innovative renewable energy technologies, in the territory of the Union. Such allowances are made available to support pilot projects that provide for the development, in geographically balanced locations, of a wide range of CCS and innovative renewable energy technologies that are not yet commercially viable. Their award is dependent upon the verified avoidance of CO_2 emissions and the related projects have been selected on the basis of objective and transparent criteria that include requirements for knowledge-sharing.

The total supply of EUAs NER300 has been divided in two tranches: (1) 200 millions allowances were allocated between 5 December 2011 and 28 September 2012 and (2) 100 millions allowances were auctioned in 5 months, starting from 14 November 2013. The first Call for proposals launched by the EU Commission was closed in December 2012. Therefore, the first projects awarded funding reached

[9]The original list adopted in 2009 with EU Decision 2010/2 was amended by two subsequent Commission Decisions. These are as follows: EU Commission Decision 2011/745 of 11 November 2011 amending EU Decisions 2010/2 and 2011/278 as regards the sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage (document C (2011) 8017) and EU Commission Decision amending EU Decisions 2010/2 and 2011/278 as regards the sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage (document C (2012) 5715).

their final investment decisions by December 2014 and must enter into operation by December 2016.[10] The Commission launched the second Call for project proposals on 3 April 2013. This was awarded in July 2014 with €1 billion for 18 renewable energy projects and one carbon capture and storage project. The projects awarded funding must reach their final investment decisions by July 2016 and enter into operation by July 2018 at the latest.

Unfortunately, the total amount of revenues coming from tranche I of NER300 has been significantly lower than expected due to a depressed carbon price. Table 1.1 reports the monthly sales of EUAs NER300 and the corresponding revenues for the first tranche of 200 millions EUAs NER300, while Fig. 1.1 shows the average unit price observed monthly during the first phase of implementation. In the second phase of implementation, the price was even lower so that the revenues arising from tranche II of NER300 are likely to be unable to trigger CCS and RES technologies in the near future. Table 1.2 below provides the monthly and total volume of EUAs NER300 sold between November 2013 and April 2014.

The NER300 programme is expected to be followed by a new programme (NER 400) that will allocate 400 million permits between 2020 and 2030 to support the use of CCS and innovative renewable energy technologies. Differently from the NER300, the scope of the new programme should be extended to cover also small-scale projects and low-carbon innovation in industrial sectors. Recent studies (Thomson Reuters 2014)[11] estimate that NER 400 could raise over 9 billions euros as compared to 2.1 billions previously raised by the NER300 programme. This forecast, however, is based on the assumption of a carbon price of 23 EUR/tonne in the period 2021–2030, which should be taken with much caution given the recent trend of the EUA price and the remarkable difference with respect to previous price expectations.

1.7 Article 27 of the EU ETS Directive: The Exclusion of Small Installations

Besides the special regime, of transitional nature and subject to different conditions, observed for carbon leakage and the modernisation of power sector, the EU ETS Directive foresees the exclusion of certain types of activities from the EU ETS due

[10] The EU Commission took the first award decision in December 2012, see C (2012) 9432 final Commission implementing Decision of 18.12.2012 *Award Decision under the first call for proposals of the NER300 funding programme*.

[11] Thomson Reuters (2014) "EU carbon price to average €23/t between 2021 and 2030: Thomson Reuters assess the future", August 28, 2014. http://blog.financial.thomsonreuters.com/eu-carbon-price-average-e23t-2021-2030-thomson-reuters-assess-future/.

Table 1.1 Detailed breakdown of monthly sales of EUAs NER300 during first phase of plan implementation (Dec 2011–Sep 2012)

Month	Sales channels	Volume sold (EUA)	Executed average price[c] (EUR)	Deviation from emissions index (excluding auctions) (%)	Value of sold allowances (EUR)
December 2011	OTC	12,000,000	8.15	0.000	97,849,000
January 2012	OTC	21,500,000	7.87	+0.051	169,201,000
February 2012	OTC	23,500,000	9.42	+0.003	221,476,500
March 2012	OTC OTC exchange-cleared Direct screen trades	21,400,000 25,000 175,000	8.43	+0.001	182,114,710
April 2012	OTC OTC exchange-cleared Direct screen trades	10,950,000 1,750,000 7,800,000	7.51	+0.002	153,869,020
May 2012	OTC OTC exchange-cleared Direct screen trades	3,200,000 8.200,000 9,600,000	7.19	0.000	151,028,600
June 2012	OTC OTC exchange-cleared Direct screen trades auctions	800,000 6,854,000 5,096,000 8,750,000	7.54[a] 7.76[b]	+0.003	164,079,320
July 2012	OTC exchange-cleared Direct screen trades auctions	5,125,000 4,125,000 11,250,000	7.99[a] 7.90[b]	+0.003	162,829,760
August 2012	OTC exchange-cleared Direct screen trades auctions	4,300,000 3,250,000 11,500,000	8.06[a] 7.97[b]	+0.004	152,545,510
September 2012	OTC exchange-cleared Direct screen trades auctions	2,550,000 6,300,000 10,000,000	8.25[a] 8.12[b]	+0.007	154,132,040
Total		200,000,000	8.05		1,609,125,460

Source European Investment Bank (2012)

[a]Average price executed via OTC, OTC exchange-cleared and direct screen transactions

[b]Average price executed via auctions

[c]The executed average price is calculated before deduction of expenses and market and EIB fees. Market fees and expenses include margins on volume weighted average price transactions, trading fees, exchange and clearinghouse fees and collateral funding costs

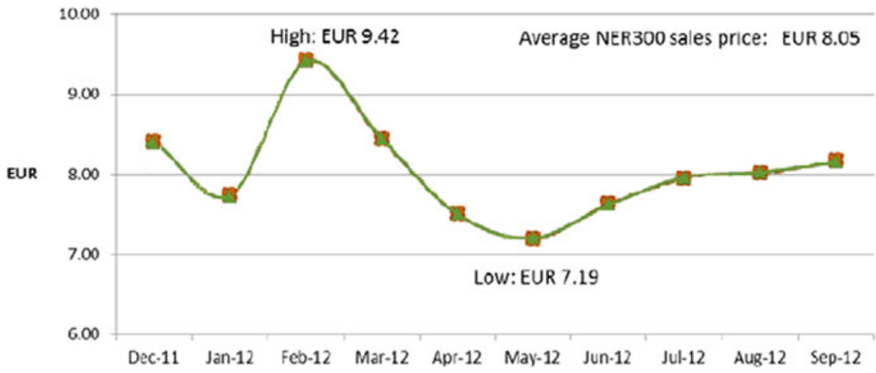

Fig. 1.1 Average NER300 sales EUA price and the average ICE Emissions Index trend during the period December 2011–September 2012. *Source* European Investment Bank (2012)

to their small size, provided that some *equivalent GHG emission reduction measures* will take place.

More in detail, its article 27 states that following consultation with the operator concerned, Member States may exclude from the EU ETS scheme installations which have reported to the competent authority emissions of less than 25,000 tonnes of carbon dioxide equivalent and, where they carry out combustion activities, have a rated thermal input below 35 Mega Watt (MW), excluding emissions from biomass, in each of the three years preceding the notification under point (a), and which are subject to measures that will achieve an equivalent contribution to emission reductions.

1.8 The Auctioning Regime

1.8.1 The Rules on Timing, Administration and Other Aspects of the Auctioning of GHG Emission Allowances According to EC Directive 2003/87 and EC Regulation 1031/2010

As we have already mentioned above in this chapter, one of the main novelties brought by EC Directive 2009/29 is the establishment of the auctioning system as the default method to allocate EUAs to stationary installations and aircraft operators. Auctioning is in fact regarded as the simplest and most economically efficient means of allocation at the same time ensuring stability to the carbon market, reinforcing the carbon price signal and abating GHG emissions at the least possible cost.

Article 10.4 of the EU ETS Directive empowers the Commission to adopt a Regulation on timing, administration and other aspects of auctioning in order to

Table 1.2 Breakdown of monthly sales of EUAs NER300 over the period November 2013–April 2014

Month	Sales channel	Volume sold (EUA)	EU allowance contract	Executed average price (EUR)	Deviation from emissions index (%)	Value of sold allowances (EUR)
Nov-2013	Screen trades OTC cleared	10,250,000 300,000	Dec–13	4.45	0.035	46,947,320
Dec-2013	Screen trades OTC cleared	16,300,000 500,000	Dec–14	4.86	0.014	81,695,800
Jan-2014	Screen trades OTC cleared	22,255,000 100,000	Dec–14	5.06	0.058	113,163,030
Feb-2014	Screen trades OTC cleared	20,195,000 100,000	Dec–14	6.55	0.117	132,850,480
Mar-2014	Screen trades OTC cleared	19,750,000 0	Dec–14	6.18	0.297	122,100,510
Apr-2014	Screen trades OTC cleared	10,250,000 0	Dec–14	4.97	0.116	50,948,200
Total 2nd Tranche		100,000,000		5.48		547,705,340

Source European Investment Bank (2014)

ensure that it is conducted in an open, transparent, harmonised and non-discriminatory manner. Such provision has been implemented by EU Commission Regulation 1031/2010. The preamble of the cited Regulation underlines the several advantages of a single auctioning platform. In fact, it provides that *"a common auctioning infrastructure, where a common auction platform conducts the auctions, best achieves the overarching objectives of the review of Directive 2003/87/EC"*. In the Commission's view, a single auctioning platform represents the most suitable way to achieve article 10.4 objectives, being the most cost-effective means of auctioning allowances without an undue administrative burden that would necessarily ensue from using multiple auctioning infrastructures. Moreover, it best provides for an open, transparent and non-discriminatory access to the auctions and ensures the predictability of the auction calendar, thus improving the clarity of the carbon price signal. In addition to that, a common auctioning infrastructure is important to provide equitable access to small- and medium-sized enterprises covered by the ETS and to ensure access to small emitters, at the same time lowering the risk of money laundering, terrorist financing, criminal activity or market abuse.

However, despite the clear preference of the EU Commission for a *"single, joint, common auctioning platform"*, the regulatory framework currently in place allows the Member States to decide on whether to opt in or opt out such a common platform. Currently, there are two auctioning platforms in place for the EU ETS: (1) the European Energy Exchange (EEX) based in Leipzig, representing the common platform for the vast majority of the EU ETS States. It also acts as the German platform, since Germany opted out the common platform and appointed its own single auctioning platform. Poland also opted out the common platform and notified the Commission its intention to use this common platform until it appoints its own single one; and (2) the ICE Futures Europe (Intercontinental Exchange, ICE) in London, appointed by the United Kingdom as its own auctioning platform.

It should be noted, to this respect, that even in case a Member State opted out the joint platform by appointing its own auctioning platform, the rules spelled out in EU Regulation 1031/2010 and the related conditions and functioning requirements will still need to be fulfilled and satisfied by all the relevant auctioning platform and the Member States, in order to ensure a certain degree of harmonisation in the auctioning of EUAs throughout the EU territory.

1.8.2 The Auction Revenues

With regard to the revenues generated from auctioning, it should be noted that article 10.3 of EC Directive 2003/87 states that Member States shall determine the use of revenues generated from the auctioning of allowances. However, in doing so, they have to abide by a series of rules specified in the Directive itself, which de facto introduce a sort of *"tied use"* on the destination of such revenues.

In practice, according to such rules, at least 50 % of the revenues generated from the auctioning of allowances or the equivalent in financial value of these revenues should be used for one or more of the following:

(a) to reduce GHG emissions, including by contributing to the Global Energy Efficiency and Renewable Energy Fund and to the Adaptation Fund as made operational by the Poznan Conference on Climate Change (COP 14 and COP/MOP 4), to adapt to the impacts of climate change and to fund research and development as well as demonstration projects for reducing emissions and for adaptation to climate change, including participation in initiatives within the framework of the European Strategic Energy Technology Plan and the European Technology Platforms;
(b) to develop renewable energies to meet the commitment of the Community to using 20 % renewable energies by 2020, as well as to develop other technologies contributing to the transition to a safe and sustainable low-carbon economy and to help meet the commitment of the Community to increase energy efficiency by 20 % by 2020;
(c) to promote forestry sequestration in the Community;
(d) to develop the environmentally safe capture and geological storage of CO_2, in particular from solid fossil fuel power stations and a range of industrial sectors and subsectors, including in third countries;
(e) to encourage a shift to low-emission and public forms of transport;
(f) to finance research and development in energy efficiency and clean technologies in the sectors covered by the EU ETS Directive;

(g) to promote measures intended to increase energy efficiency and insulation or to provide financial support in order to address social aspects in lower- and middle-income households;
(h) to cover administrative expenses of the management of the Community scheme.

The increasing role of auctioning as the normal allocation method of EUAs in the years to come could contribute to raise money that governments might use to finance environment-related projects and support environmentally friendly technologies, as well as to help mitigate the sovereign debt crisis that is adversely affecting their economies. As a consequence, a proper use of the auction revenues could potentially generate a double dividend (improved environmental quality and lower budget deficits). This possibility, however, obviously depends on the actual capacity to raise enough revenues through auctioning, a possibility that should not be given for granted, as the recent trend seems to show.

1.9 The Union Registry

Prior to the entry into force of the EC Directive 2009/29 amendments, the EUAs issuance, release and related market transactions were tracked by means of single national registries of the participating States connected with the EU Registry, which was named Community Independent Transaction Log (CITL). As an effect of the aforementioned amendments, the single registries were discontinued and the CITL left the floor to the EU Transaction Log (EUTL).

The legislative framework for the registry system is currently provided by EU Regulation 389/2013, which established the so-called Union Registry. Such a Regulation lays down the general, operational and maintenance requirements concerning the Union Registry for the trading period commencing on 1 January 2013 and for the subsequent periods. It repeals the former regime envisaged by EU Regulations 920/2010 and 1193/2011 which established the rules for the national and the Community registries. EU Regulation 389/2013 implements article 19 of the revised EU ETS Directive 2003/87/EC, which foresees the Commission's competence to adopt a Regulation for a standardised and secured system of registries in the form of standardised electronic databases containing common data elements to track the issue, holding, transfer and cancellation of allowances, to provide for public access and confidentiality and to ensure that there are no transfers which are incompatible with the obligations resulting from the Kyoto Protocol. The same provision specifies that the registry shall be accessible to the public and shall contain separate accounts to record the allowances held by each person to whom and from whom allowances are issued or transferred.

According to article 20 of the EU ETS Directive and articles 4–7 of EU Regulation 389/2013, a Central Administrator designated by the EU Commission shall operate and maintain the EUTL and conduct an automated check on each transaction to ensure that there are no irregularities in the issue, transfer and cancellation of allowances. The EUTL is also connected to the International Transaction Log established under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (KP), for the purpose of transactions with Kyoto units. Article 8 of EU Regulation 389/2013 requires each EU Member State to appoint a National Administrator and notify its contact details to the Commission. Such a National Administrator shall access and administer its Member States account, with regard to both the EU ETS allowances and the Kyoto units.

1.10 Carbon Pricing

During Phase I (2005–2007), the average annual price of EUA followed a trend characterised by a strong volatility on spot market, ranging between €7 and €31/ton, until 2007, when it basically collapsed to zero. This situation can be ascribed to the confluence of several factors. First, the goals for emission reduction in the pilot programme were constructed under time pressure with a shortage of reliable data and turned out to be relatively modest and not stringent enough (Ellerman et al. 2010). Second, aggregate emission data were unavailable until almost halfway through the pilot programme, and when the first tranche of actual emissions data was released in 2006 by the EU Commission, market participants realised aggregate emission levels were low vis-à-vis allowance supply. Third, emissions allowances in this pilot first phase of the programme could only be used between 2005 and 2007 and could not be further banked.[12] Fourth, the increase in energy efficiency and renewable energy sources promoted by the 20-20-20 Climate Energy package significantly contributed to further lowering the demand for permits, thus exacerbating market unbalance.[13] The too-late realisation of an existing oversupply coupled with an inability to use excess allowances sparked a dramatic fall in prices. The rationale for not allowing banking was the desire to separate Phase II (which coincided with the first Kyoto compliance period starting in 2008) from the pilot programme period, but the consequences of this decision were self-evident: by the final quarter of 2007, spot prices were essentially equal to zero, at €0.06/ton, even while contract futures prices for Phase II allowances hovered above €20/ton.

Contrary to what happened in 2005–2007, during Phase II the average annual EUA price trend was relatively more stable. As shown in Fig. 1.2, annual prices have been oscillating between €8.12 and €22.48/ton CO_2, depending on the levels of allowances demand.

[12]See Schleich et al. (2006) for an analysis of the implications of the EU decision to ban banking in Phase I and of the related efficiency losses based on simulation results.

[13]On the optimal policy mix between carbon pricing and energy policies (such as energy efficiency and support to renewables) see the interesting contributions published by Lecuyer and Quirion (2013) and Hood (2013) who provide further theoretical insights and guidance for policymakers on this issue.

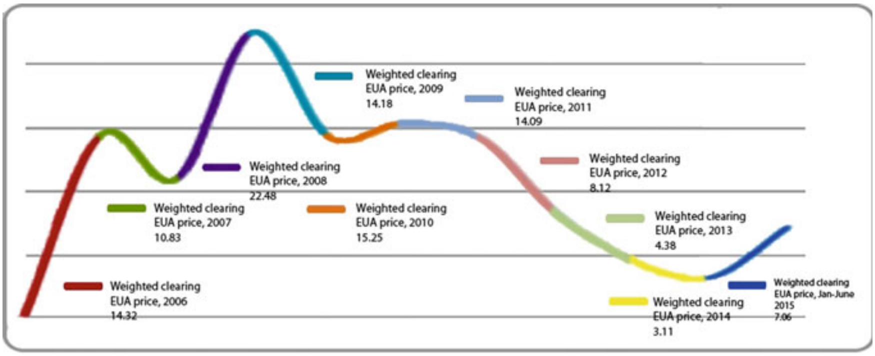

Fig. 1.2 Average EUA price trend during the period 2006–2015. *Source* Authors' own elaboration on the basis of EEA (2013) and ICE Global Markets in Clear View (2015)

As Chevallier (2010, pp. 15–16) pointed out, in Phase II the supply and demand of allowances on spot market were "[…] *adjusted through exchanges and over-the-counter transactions based on price levels, institutional characteristics of the market (compliance requirements, banking provisions,* etc.*), fundamentals identified during Phase I (linked to other energy markets prices, weather events, economic growth,* etc.*), and anticipations of the reduced allocation which will be linearly enforced through time* […]".

Between 2008 and 2012, the inter-temporal evolution of the EUA spot market was affected by several factors, which contributed to determine an overall downward trend, such as the ongoing financial crisis and the delays in post-Kyoto negotiations after the unsatisfactory outcome of the Copenhagen summit. These different and contextual events can explain the descending trend of the EUA unit market spot price, which decreased the value of a CO_2 equivalent ton by about 63.88 % from 2008 to 2012.

As Table 1.3 shows, the observed reduction in the average annual price in Phase II has been accompanied by an increase in the overall EUAs auctioned or sold in the secondary market.[14] While in Phase I (2005–2007) the market volume did not exceed 6,800,000 ton CO_2 equivalent, in Phase II the EUAs sold on the spot market have increased annually—both in absolute terms and as a percentage of the permits given for free—until reaching in 2012 the total amount of 125,034,099 ton CO_2 equivalent of permits. This increasing trend continued in 2013, when the EU ETS third phase started. In fact, in 2013 the market volume actually experienced a boom, since the EAU auctioned or sold on the spot market exceeded 808

[14]Please note that we are not claiming here the existence of a direction of causality between the two phenomena. Their correlation, however, is relevant to assess the evolution of the overall market volume, as described below.

Table 1.3 EU ETS market volume and average annual price during the period 2005–2014

	Freely allocated EUAs	Auctioned or sold EUAs (total amount)	Auctioned or sold EUAs (as percentage of freely allocated)	EUA average clearing price	Estimated revenues
2005	2096237465	0	0	0	0
2006	2071557066	6781750	0.33 %	14.32	97114660
2007	2152943931	1729500	0.08 %	10.83	18730485
2008	1958526978	53130000	2.71 %	22.48	1194362400
2009	1974536150	79315050	4.02 %	14.18	1124687409
2010	1998167092	91861500	4.60 %	15.25	1400887875
2011	2016870610	92942565	4.61 %	14.09	1309560741
2012	2049960954	125034099	6.10 %	8.12	1015276884
2013	886540000	808146500	66.41 %	4.46	2528259590
2014	791390000[a]	528399500	66.77 %	5.95	4137643960

Source Authors' own elaboration on the basis of EEA (2013), ICE Global Markets in Clear View (2015), European Commission (http://ec.europa.eu/clima/policies/ets/documentation_en.htm) and European Energy Exchange (https://www.eex.com/en/market-data/emission-allowances/spot-market/european-emission-allowances#!) databases

[a]See the *Status table on free allocation to industry and heat production* (updated on March 2015) (http://ec.europa.eu/clima/policies/ets/cap/allocation/docs/process_overview_nat_2015_en.pdf)

billion of CO_2 tons equivalent permits.[15] This amount decreased in 2014 to about 528 billion of permits, partially because of the implementation of the back-loading measures (see Sect. 1.12 below). Despite this reduction, however, the amount of permits auctioned or sold in 2014 was still more than four times higher than the highest level reached at the end of Phase II, which confirms the existence of a much larger market volume in Phase III.

It should be noted that the drastic reduction of the average annual price in 2012 (column 5) has more than compensated the progressive increase in the number of transactions (column 3), so that the estimated value of the ETS market (column 6) has decreased in 2012 with respect to the previous year. On the contrary, the market volume has been so high in the first years of Phase III (2013–2014) that the estimated value of the ETS market has increased dramatically with respect to the past and reached a peak despite the extremely low average price observed over that period. The increase of the auction volume observed in Phase II and in this first tranche of Phase III is likely to suggest a higher maturity of the carbon market, with

[15]The updated values reported in the last row of Table 1.3 have been computed by the authors based on the periodic reports of the EUAs auctioned on the primary market in the three EU validated markets: the *Transitional Common Auction Platform*; *Auction Platform Germany*; *Auction Platform UK* (see http://ec.europa.eu/clima/policies/ets/cap/auctioning/documentation_en.htm). These data are consistent with the estimations reported in the document recently published by the Italian Manager of Energy Services.

Fig. 1.3 Auction clearing price, maximum bid and minimum prices bid (euro/ton CO_2-e) during the period November 2012–December 2014. *Source* European Commission (2014). Auctions by the transitional common auction platform

professional traders having a better knowledge of its functioning and several big operators beginning to participate to the market.

The EUA price kept on decreasing from 2010 to 2013, loosing more than two-thirds of its initial value. The price reduction was particularly remarkable at the beginning of Phase III. In fact, as Fig. 1.3 shows, the auction clearing price for the EUAs fell from €8.49 to €2.7 per allowance between November 2012 and April 2013.[16] In particular, price fell drastically between March 2013 and April 2013 when the auction clearing price for the EUAs decreased from €4.98 to €2.65 per allowance (Fig. 1.4).[17]

As Fig. 1.5 shows, if we consider the overall period between January 2013 and June 2015, the EUA average spot market price was equal to €5.53, while the average market price was only €0.27 for the Certified Emission Reductions (CER) deriving from the implementation of Clean Development Mechanism (CDM) projects. As emerges from the figure, the EUA spot price has shown again an ample variance around these averages even in Phase III, but such variations have been less pronounced than in Phase II (the price range being €5.84 in Phase III versus €14.36 in Phase II). However, in Phase III the price has been stabilising around a much lower average than in the previous phase. From the comparison of the last two phases, in fact, it emerges that in Phase III the average annual price in the primary market over the period 2013–2015 (€6.03) has been much lower than the lowest average annual price in Phase II (€8.12).

The high volatility in the EUAs price characterising the implementation of the EU ETS so far, as well as the recent declining trend described above, raises the question on the opportunity to set upper and/or lower bounds to limit the price variations within a given range of values. In this regard, it should be emphasised that the EU ETS penalty system described above implicitly sets an upper bound to the EUA carbon price (i.e. the price of the allowance to produce 1 ton/y of CO_2). As a matter of fact, if the current carbon price gets particularly high (well above the penalty), firms may prefer not to cover their excess emissions and run the risk of having to pay the penalty as long as the expected cost of being non-compliant is

[16] *Source* European Commission (http://ec.europa.eu/clima/policies/ets/documentation_en.htm).

[17] It should be noted that the auction on 12 March 2013 had to be cancelled because it would have otherwise cleared below the reserve price.

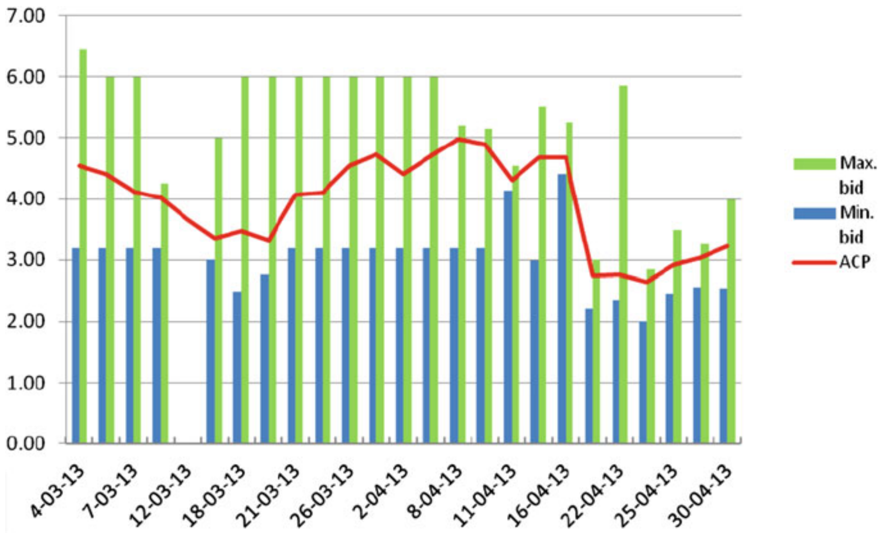

Fig. 1.4 Auction clearing price, maximum bid and minimum prices bid (euro/ton CO_2-e) during March 2013–April 2013 period. *Source* European Commission (http://ec.europa.eu/clima/policies/ets/documentation_en.htm), Auctions by the transitional common auction platform 2nd Report

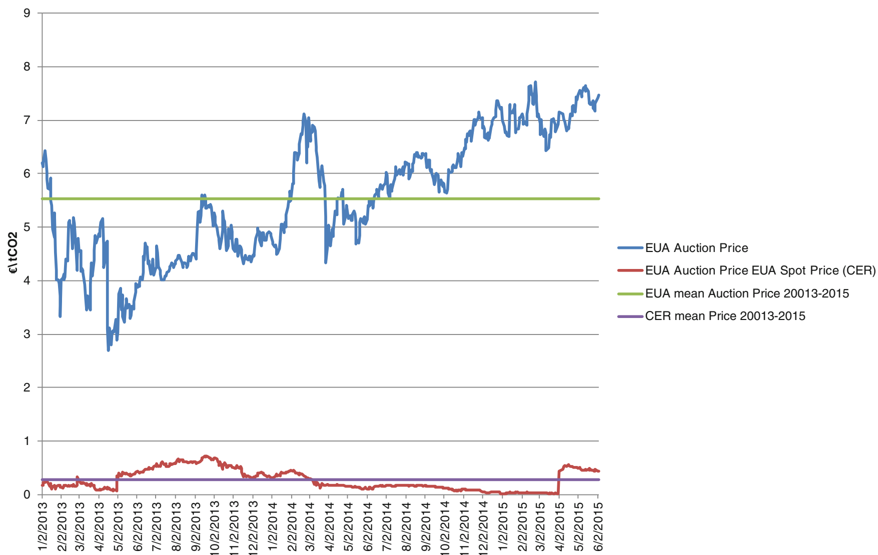

Fig. 1.5 EUA average spot market price (January 2013–June 2015). *Source* Authors' own elaboration on base of SENDECO2 data (http://www.sendeco2.com/it/prezzi-co2)

below the current cost of purchasing the allowances.[18] More precisely, as pointed out above, art. 16 of the Emission Trading Directive establishes that if an operator emits more than allowed by the permits at disposal, it will be liable not only to pay the penalty, but also to purchase the excess emissions *"when surrendering allowances in relation to the following calendar year"*. This suggests that the price that the non-compliant firm has to pay for its excess emissions is given by the market price when the purchase is made. Therefore, if firms expect that the future carbon price will be much lower than the present one, they may have an incentive to cheat (i.e. not cover all their emissions). It follows that the large fluctuations of the market price, together with possible limitations in the monitoring system observed so far, might possibly generate moral hazard behaviours among the operators.

However, given the extremely low value of the carbon price at present and the high value of the penalty (€100/ton), this theoretical problem is currently far from occurring in practice.

On the contrary, a price ceiling might provide a useful "safety net" against possible mistakes by policy-makers (Jacoby and Ellerman 2004; Stavins 2008). The latter, in fact, often lack sufficient information on the firms' abatement costs when establishing the emission cap. A price ceiling, therefore, may prevent abatement costs from rising above what is socially optimal and in this sense a penalty system might be a useful instrument against upward price fluctuations. If so, however, it would be reasonable to introduce in the market also a lower bound for the carbon price to prevent that possible flaws in the policy design (such as a too high emissions cap) may reduce the carbon price below what is socially optimal. In this regard, several contributions (Burtraw et al. 2010; Fell et al. 2012) have shown the cost-effectiveness of combining price ceilings and floors. Moreover, it is worth mentioning that Moreno-Bromberg and Taschini (2011) have proposed a new policy instrument (named *European-Cash-4-Permits*). Using a non-cooperative game theoretical model, the authors show that such instrument could generate a floating price floor. At the moment, however, no instrument has been set up for this purpose and the EU ETS has no price floor for the unit value of the EUA.

1.11 Incentives to Eco-Innovation and Technological Effectiveness

The EUA unit price level obviously plays a crucial role in affecting firms' investment decisions in more environmental-friendly technologies. When the EUA market value increases to a high amount, companies could consider convenient investing in eco-innovations, namely in new or more environmental-friendly technologies, rather than keep on buying further EUAs. Several studies have

[18] This point has been illustrated in heuristic terms by Borghesi (2011) using a simple analytical framework.

recently examined whether and to what extent the EU ETS has actually promoted the adoption of new or better technologies up to now. However, no unanimous consensus seems to emerge on this issue in the literature so far. As Kemp (2010) and Kemp and Pontoglio (2011) pointed out, this is mainly due to lack of firm-level data on both innovation and policy sides.

Most of the studies that have investigated the impact of the EU ETS on eco-innovations (EI) have focused on the first phase of application of the EU ETS and relied on small sample sizes or case studies based on interviews to managers and firms. In particular, Tomas et al. (2010) find that the EU ETS had a limited impact on the Portuguese chemical sector, in terms of costs increases and competitiveness costs. The EI effects of the EU ETS turn out to be negligible also in the paper and cardboard sector in Italy (Pontoglio 2010). The same applies to some German sectors examined by Rogge et al. (2011, p. 513) who conclude that *"the innovation impact of the EU-ETS has remained limited so far because of the scheme's initial lack of stringency and predictability"*. Using business surveys to investigate the EU power sector, Schmidt et al. (2010, p. 1) achieve similar results, concluding that *"the EU-ETS has limited effect on the innovation activities (adoption and R&D) of both users and producers of power generation technologies"*.

Martin et al. (2013) also rely on qualified interviews to firm managers. Focusing attention on six European countries, they find no evidence of early moving behaviour and emphasise that almost one-third of all firms showed a passive behaviour on the market in the first phases.

Other studies show a more optimistic view on the low-carbon innovation effects of the EU ETS in the first phases. Investigating a few early case studies, Petsonk and Cozijnsen (2007) conclude that the EU ETS had a substantial impact on innovation even in the first phase. Similar results emerge from the analysis of Irish ETS firms by Anderson et al. (2011) who find that the EU ETS stimulated a moderate technological change. While their study is based on a limited number of firms (27 returned completed questionnaire out of 68 potential respondents), Calel and Dechezlepretre (2016) extended the scope of the analysis, constructing a new data set that encompasses 743 EU ETS firms located in different countries. The empirical analysis performed by the authors shows that firms regulated by EU ETS were more innovative than unregulated firms, both in general terms and in low-carbon technologies. However, when using more refined estimates that combine matching methods with difference-in-differences, the authors find that the EU ETS did not influence the direction of technological change.

Finally, in order to provide a more robust empirical estimation of the process at stake, a few studies have tested the EI effects of the EU ETS using the 5th wave of the CIS (Community Innovation Survey) data set that for the first time covers environmental innovation adoptions.[19] In particular, Aghion et al. (2009) find that

[19]The CIS data set is the main data source for measuring innovation (including environment-related innovation) in Europe. The aggregated data, disseminated on the Eurostat

"improving energy efficiency" and *"reducing environmental impact or improved health and safety"* turn out to be the lowest ranking motives for innovation. Focusing on a large set of Italian firms (6,843 firms) during the initial phase of the EU ETS, Borghesi et al. (2012) find that the role of the EU ETS in affecting EI has been weak (though statistically significant) for energy efficiency innovations and for consumption-level/good-related reductions of atmospheric and water emissions. External forces and complementarity with other management practices seem to have had a larger influence than the EU ETS on the adoption of EI in the Italian industrial firms. Given the large fluctuations of the EU ETS price level, more effort has probably been placed on lobbying actions to be included in the "free auction" share of firms in the new ETS phase rather than on EI activities.[20]

These results seem consistent with the conclusions of the study by Gronwald and Ketterer (2011), who point out that uncertainty on future EU ETS scenarios and price volatility may have generated a postponement of abatement decisions that have hampered EI, at least in the first phases of the EU ETS.

1.12 Back-Loading and Proposals for Other Structural Reforms of the EU ETS

The amendments to the EU ETS brought into force by the EC Directive 2009/29 were aimed at strengthening its application and effectiveness, in particular with regard to the problem of overallocation and surplus of EUAs in the market. However, the State of the EU ETS carbon market reveals that the system is still affected by a surplus of EUAs, which undermines its effectiveness.

According to article 29 of the EU ETS Directive, if the Commission has an evidence that the carbon market is not working properly, it shall submit a Report to the EU Parliament and Council with the view to propose the measures to increase the transparency of the market and to improve its functioning. To this effect, the EU Commission released the *Report on the European carbon market 2012*,[21] showing that despite the regulatory changes introduced by the EC Directive 2009/29, there was still a persistent problem of surplus of allowances available in the market with

(Footnote 19 continued)

Webpage, covers several dimensions of the innovations performed by enterprises such as product and process innovation, innovation activity and expenditure, effects of innovation, innovation cooperation, public finding of innovation, source of information for innovation patents.

[20]See Borghesi et al. (2016) for an empirical analysis of the differential impact of the EU ETS on FDI in the Italian context which distinguishes firms that receive permits for free in the new ETS phase (since they are subject to the risk of carbon leakage) from the rest of the Italian ETS firms. See also Martin et al. (2014a, b) for in-depth analyses of the decision to exempt some sectors from auctioning.

[21]Report from the Commission to the European Parliament and the Council, *The State of the European carbon market 2012*, COM (2012) 652 final.

consequent low price of EUAs and scarce incentive to participation to the auctions. As pointed out before, such an extra offer of EUAs, not matching the real demand of the incumbent operators, was partly due to the economic crisis that lowered the GHG emissions in recent years. However, it was worsened by the forward supply and selling of phase three allowances for NER300 and by the selling of the left-overallowances in national phase two new entrant reserve.

In the aforementioned *Report*, the Commission noted that in the third commitment period of the EU ETS (2013–2020) a surplus of almost 2 billion EUAs was expected, possibly endangering the entire purpose and functioning of the EU ETS. The Commission therefore deemed appropriate to propose some specific measures to overcome this exceptional and risky situation of continued increase of supply of EUAs. To this effect, the *Report* called for a review of the timetable for the supply of EUAs in phase three of the EU ETS and proposed to postpone auctions for 900 million of allowances ("back-loading" proposal). On the basis of the Commission's proposal, in December 2013, the EU Council and the European Parliament adopted Decision No. 1359/2013/EU on back-loading,[22] which was followed by the issuance of the implementing Regulation No. 176/2014 of the European Commission.[23]

In any case, the back-loading resulting from the amendments of both article 10.4 EU ETS Directive and the Auctioning Regulation should be considered as an *interim relief* measure, acting only as a sort of temporary *buffer* solution. Indeed, the postponement of the auctioning of 900 million EUAs would not affect the structural surplus of around 2 billion allowances over the 2013–2020 period. In fact, such allowances, mainly allocated during the economic crisis, could be used long after the crisis is (hopefully) over, with the result that the effects of the surplus will be in place up to 2020 and beyond, and so the imbalance between supply and demand. Therefore, in addition to the back-loading initiative, a structural measure was needed to correct this oversupply and to limit its long-term negative impacts on the EU carbon market. In such a context, the mentioned Commission's *Report*, while proposing the back-loading initiative, also launched a debate on 6 alternative options for structural reform measures to be possibly adopted in the future.

Later on, the European Commission, building on the results of such a debate and partially departing from the original 6 options, presented in January 2014 a *Proposal concerning the establishment and operation of a market stability reserve*,[24] arguing that in order to restore the EU ETS as a more robust instrument a "market stability reserve" should be established for the 4th phase (starting in 2021).

[22]Decision No 1359/2013/EU of the European Parliament and of the Council of 17 December 2013 amending Directive 2003/87/EC clarifying provisions on the timing of auctions of greenhouse gas. See OJ L 343 19.12.2013, p. 0001.

[23]Commission Regulation (EU) No. 176/2014 of 25 February 2014 amending Regulation (EU) No 1031/2010 in particular to determine the volumes of greenhouse gas emission allowances to be auctioned in 2013–20.

[24]See COM (2014) 20, *Proposal concerning the establishment and operation of a market stability reserve for the Union greenhouse gas Emission Trading scheme and amending Directive 2003/87/EC.*

The Proposal on the market stability reserve was presented alongside the EU Communication on *A policy framework for climate and energy in the period from 2020 to 2030*,[25] which described the EU 2030 scenario and the proposed main objectives. It has a twofold aim. On the one side, it should try to address the surplus of emission allowances and, on the other side, it should improve the system's resilience to major shocks by adjusting the supply of allowances to be auctioned. Moreover, the mechanism envisaged would operate according to predefined conditions, in an "automatic manner" which would leave no discretion to the Commission in its implementation, thus ensuring more transparency and effectiveness to the system. The Proposal on the market stability reserve was approved by the European Parliament on 7 July 2015 and by the Council on 6 October 2015.[26] As a consequence, the market stability reserve shall be established in 2018 and the placing of allowances in the reserve shall operate from 1 January 2019.[27]

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[25]See COM (2014) 15, *A policy framework for climate and energy in the period from 2020 to 2030*.

[26]It should be noted that, at the moment of writing, the Decision of the European Parliament and of the Council concerning the establishment and operation of a market stability reserve is still awaiting publication on the Official Journal of the European Union.

[27]*Source* European Commission, (http://ec.europa.eu/clima/policies/ets/reform/index_en.htm).

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Chapter 2
California, RGGI, Quebec: The Followers

2.1 The California Cap and Trade Scheme

2.1.1 Introduction

The California cap and trade system has been introduced by the Global Warming Solution Act of 2006 (also known as Assembly Bill 32—hereinafter AB32) that addresses climate change and energy in a coordinated way; to this effect, AB32 sets the target of cutting Californian GHG emissions to 1990 levels by 2020[1] and requires the California Air Resource Board (CARB) to develop and adopt the implementing regulations necessary to achieve this objective.[2] The two main regulations implementing the GHG abatement target envisaged by AB32 are the following ones: (1) subchapter 10, article 5, Title XXVII of the California Code of Regulations, *California Cap on GHG Emissions and Market-Based Compliance Mechanisms*, as amended in 2012, providing the rules for the establishment, functioning and administration of the ETS (the California ETS Regulation hereinafter); and (2) Regulation on the *Mandatory Reporting of GHG* (MRR), laying down the rules for monitoring and reporting the GHG emissions.

Indeed, the two Regulations adopted by CARB have concretely established the California cap and trade scheme, which has started to operate in 2013. The CARB Executive Officer is the main authority involved in the management of the

[1]Such a target corresponds to 427 million tonnes of CO_2 equivalent by 2020 instead of the business as usual that would be 507 million tonnes of CO_2 equivalent.

[2]As it is well known, the Californian initiative is placed in a US Federal context, which is characterised by the absence of international commitments, since the USA has never ratified the KP, and therefore, it is not bound by its Annex B compulsory GHG emission reduction targets. However, this situation might change in the near future, if the US–China Joint Announcement on Climate Change delivered in Beijing in November 2014 will result in concrete legislative measures and actions at US Federal level. According to such an announcement: *"The United States intends to achieve an economy-wide target of reducing its emissions by 26–28 % below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28 %"*.

S. Borghesi et al., *The European Emission Trading System and Its Followers*,
SpringerBriefs in Environmental Science, DOI 10.1007/978-3-319-31186-9_2

California ETS. Such a scheme is structured upon three compliance periods running until 2020. Overall, the California ETS is expected to cover 85 % of the country's GHG emissions and almost 600 facilities are subjected to it.

2.1.2 The California ETS: Main Scope, Purpose, Structure and Features

The scope of application of the California ETS is determined by subarticle 3 of the California ETS Regulation. Similarly to what happens in the other ETSs operating in other countries, this provision identifies the scope of the scheme with regard to both the GHG and the emitting activities covered. As far as the GHGs covered are concerned, these are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), hydro fluorocarbons (HFCs), per fluorocarbons (PFCs), nitrogen trifluoride (NF_3) and other fluorinated greenhouse gases.

With regard to the types of activities covered, these vary according to the compliance period concerned. In fact, while the 1st compliance period was characterised by a narrower scope of application and encompassed only large industrial facilities and first deliverers of electricity,[3] since the beginning of the 2nd compliance period in 2015, the scheme extended its scope including suppliers of gas and liquid fuels as well.[4]

In addition to the two criteria mentioned above (types of GHGs and types of activities covered), the ETS Regulation also sets a threshold requirement for any entity to be covered by the scheme. In fact, it is established that only entities with reported and verified annual emissions in any "data year",[5] which equal or exceed the threshold of 25,000 metric tons of CO_2 equivalent, are subject to the application of the cap and trade scheme.

[3]Please note that according to subarticle 2 of the ETS Regulation: *"First Deliverer of Electricity or "First Deliverer" means the owner or operator of an electricity generating facility in California or an electricity importer".*

[4]In detail, the following sectors are covered since the starting of the California ETS (i.e. from the 1st compliance period): cement production; cogeneration; glass production; hydrogen production; iron and steel production; lime manufacturing; nitric acid production; petroleum and natural gas systems and petroleum refining; pulp and paper manufacturing; self-generation of electricity; or stationary combustion; first deliverers of electricity, namely electricity generating facilities located in California or electricity importers; carbon dioxide suppliers.

From 2015 onwards (since the starting of the 2nd compliance period), the following sectors will be added to the scope of the ETS: suppliers of Natural Gas: an entity that distributes or uses natural gas in California being a public utility gas corporation operating in California or a publicly owned natural gas utility operating in California; suppliers of distillate fuel oil; suppliers of LPG: the operator of a refinery that produces LPG in California or that fractionates natural gas liquids to produce LPG or a consignee of LPG into California.

[5]Please note that according to the ETS Regulation subarticle 2 the following definition applies to the term *"data year"*: *"data year means the calendar year in which emissions occurred"*.

The main purpose of the California ETS is to support the State in delivering its climate change policy and measures, particularly by achieving the target of reducing the GHG emissions to 1990 levels by 2020. In more concrete terms, this means lowering the GHG emissions by approximately 13 % by 2020 compared to 2013 levels (the starting date of the ETS) and by approximately 16 % compared to the *business as usual scenario*.

The California ETS is structured upon three progressive compliance periods: (1) 2013–2014, (2) 2015–2017 and (3) 2018–2020. Each year of any compliance period runs from 1 January to 31 December. For each year of the covered periods, a country-wide cap is set, representing the *GHG allowance budget*, i.e. the annual amount of GHG allowances available. In order to achieve the 2020 target, the initial cap will decrease in a linear manner by 2 % every year through 2015 and 3 % every year through 2020.[6]

The eligible emission units that may be used for complying with the surrendering obligation are called *compliance instruments*, while the *compliance obligation* represents the quantity of verified reported emissions or assigned emissions for which an entity must submit compliance instruments to CARB. With regard to the method of allocation of the allowances, it can be anticipated here that it is a mixed one, since some allowances are allocated for free upon determined benchmarks, while a remaining portion is allocated via auction or traded in the market (see below Sect. 2.1.5).

2.1.3 Duties of the Covered Entities and Competences of the California Air Resource Board (CARB) Executive Officer

Each covered entities shall register with CARB by submitting all the identification information and data required. The CARB Executive Officer will then open an account for the covered entity. Once such registration duty has been satisfied, the covered entity is first of all subject to the monitoring and reporting duty with regard to its annual GHG emissions. Secondly, and as a corollary to this duty, it must fulfil its compliance obligation, i.e. surrender an amount of compliance instruments corresponding to its reported and verified GHG emissions for each data/year of the compliance period in force.

[6]According to subarticle 6 of the California cap and trade regulation, the following caps apply: 1st Compliance period: 2013: 162.8; 2014: 159.7; 2nd Compliance period: 2015: 394.5; 2016: 382.4; 2017: 370.4; 3rd Compliance period: 2018: 358.3; 2019: 346.3; 2020: 334.2. Please note that while the initial cap only includes electricity and large industry (1st compliance period covered entities), the caps set for years 2015 onwards will encompass all the sectors covered by the California ETS.

As far as the reporting duty is concerned, each covered entity is subject to MRR and has a compliance obligation based on its total emissions. Entities covered by the cap and trade scheme are subject to a compliance obligation for every metric ton of CO_2, for which a positive emissions data verification statement is issued, rounded to the nearest whole ton. The emission reports are verified by third-party accredited entities (verifiers).[7] Such reports are due on an annual basis according to the following timetable: stationary entities shall submit their GHG report to CARB by 10 April each year, while electric power entities shall do so by 1 June.

The fulfilment of the reporting obligation and the related issuance of the Positive Emissions Data Verification Statement from the verifiers is of utmost importance also with respect to the second main duty of the covered entity, i.e. the compliance obligation. In fact, the compliance obligation is exactly the quantity of verified reported emissions that the covered entity shall surrender to CARB by using the eligible compliance instruments (allowances).

With regard to these surrendering obligations, the following regime applies: there is an annual and a triennial compliance obligation and an annual and triennial-related surrender deadline. The annual compliance obligation for a covered entity equals 30 % of emissions with a compliance obligation reported from the previous data year that received a positive or qualified positive emissions data verification statement. The surrendering deadline for the annual compliance obligation is on 1 November of the year following that of reported emissions. The triennial compliance obligation for a covered entity is the sum of the reported GHG emissions during a compliance period minus the compliance instruments (allowances) already surrendered under the annual compliance obligation. The deadline to surrender these remaining compliance instruments is set at 1 November of the calendar year following the final year of the compliance period. As a consequence, in years 2015, 2018 and 2021, final years of the California ETS compliance periods, there is no annual compliance obligation for the preceding compliance period but only a triennial compliance obligation.[8]

Borrowing of compliance instruments is not allowed; therefore, in order to fulfil a compliance obligation, a compliance instrument must be issued from an

[7]In such a context, subarticle 2 of the cap and trade regulation, providing all the relevant definitions, specifies that: *"Positive Emissions Data Verification Statement"* means *"a verification statement issued by an impartial verification body attesting that the verification body can say with reasonable assurance that the covered emissions data in the submitted emissions data report is free of material misstatement and that the emissions data conforms to the requirements of MRR"*.

[8]Since the compliance periods are 2013–2014, 2015–2017 and 2018–2020, the triennial surrender will occur 1 November 2015, 2018 and 2021, respectively. More in detail, the following schedule applies with regard to the percentage of compliance obligations due: First compliance period: 1 November 2014 30 % of 2013 covered emissions and 1 November 2015 70 % of 2013 and 100 % of 2014 covered emissions. Second compliance period: 1 November 2016 30 % of 2015 covered emissions; 1 November 2017 30 % of 2016 covered emissions; 1 November 2018 70 % of 2015 and 2016 and 100 % of 2017 covered emissions. Third compliance period: 1 November 2019 30 % of 2018 covered emissions; 1 November 2020 30 % of 2019 covered emissions; 1 November 2021 70 % of 2018 and 2019 and 100 % of 2020 covered emissions.

allowance budget year within or before the year for which an annual compliance obligation is calculated or the last year of a compliance period for which a triennial compliance obligation is calculated. Each covered entity fulfils its compliance obligation by transferring the due amount of eligible compliance instruments from its holding account to its compliance account.

Finally, as it has already been pointed out above, it should be recalled that the CARB Executive Officer is the California ETS competent authority. As a consequence, it receives the covered entities applications for registration in the scheme, administers the ETS registry (CITSS), issues the compliance instruments and receives the compliance instruments surrendered by the covered entities under the compliance obligation.

2.1.4 Sanctions Against Non-compliant Entities

In case, the covered entity or the opt-in entity does not satisfy its compliance obligation and does not surrender the applicable amount of eligible compliance instruments in due time, a case of *untimely surrender* occurs and a sanction is associated to this violation. The sanction is calculated according to the *excess emissions*, i.e. the difference between the compliance obligation and the compliance instruments timely surrendered by the entity concerned (if any), and is equal to four times the entity's excess emissions (i.e. four allowances must be surrendered for each metric tonne not covered in due time). The untimely surrender obligation is due within five days of the first auction conducted by CARB following the applicable surrender date. In case the covered entity or opt-in entity fails to comply with the untimely surrender obligation, separate penalties apply according to the California's Health and Safety Code and other relevant laws.

2.1.5 The Allocation Regime of the California Allowances

2.1.5.1 Nature and Validity of the Compliance Instruments

Each compliance instrument can be used to fulfil a compliance obligation equivalent to one metric ton of CO_2 equivalent; therefore, it represents the right to emit up to one metric ton of CO_2 equivalent. Compliance instruments are issued by the Executive Officer of CARB. They are tradable and transferable.

More in detail, according to subarticle 4 of the ETS Regulation, the following ones are eligible to satisfy the covered or opt-in entity's compliance obligation: (1) California GHG Emission Allowances, issued by the CARB Executive Officer. The Executive Officer shall assign each California GHG allowance a unique serial number that indicates the annual allowance budget from which the allowance originates. In addition, the Executive Officer shall place these allowances into a holding account under its control; (2) offset credits issued by CARB Executive Officer, who shall issue and register such CARB offset credits pursuant to the requirements of subarticles 13 and 14 of the ETS Regulation which will be analysed further on. The possibility to surrender CARB offset credits is subject to quantitative limitations.

2.1.5.2 The Regime for Offset Credits Under the California ETS

An offset credit is equivalent to a GHG reduction or GHG removal enhancement of one metric ton of CO_2 equivalent. As explained in the paragraph above, these credits are considered eligible compliance instruments and they shall be issued by the Executive Officer as a consequence of an offset generating project duly registered and listed within CARB.

Subarticle 13 of the ETS Regulation provides the regime applicable to offset projects and credits, as it is analysed more in detail below. Firstly, offset credits shall be issued only if generated by offset projects implemented according to an Approved Compliance Offset Protocol. Such Protocols shall be approved by CARB and shall satisfy the following requirements: determine the extent to which GHG emission reductions and GHG removal enhancements are achieved by the offset project type; establish data collection and monitoring procedures; establish a project baseline; ensure GHG emission reductions and GHG removal enhancements are permanent; establish the length of the crediting period; and establish the eligibility and additionality of projects using standard criteria, and quantify GHG reductions and GHG removal enhancements using standardised baseline assumptions, emission factors, and monitoring methods. So far, CARB has approved 5 Protocols on the following sectors: forestry; livestock; ozone depleting substances; urban forests and mine methane capture.

Secondly, offset projects generating offset credits must create GHG reductions or removals that are additional to business as usual, real, quantifiable, permanent, verifiable and enforceable. Therefore, the project proponent must monitor and report the GHG emission removals/reductions of its offset project. Such report will be verified by an independent accredited verifier.

Thirdly, a geographical requirement applies since the offset project must have a geographical boundary within the USA or its territories, Canada or Mexico.

Finally, once the conditions set above are fulfilled, the offset project has received a Positive Offset Verification Statement from the verifiers, the offset project operator has been registered with CARB and its related offset project has been listed by CARB, the Executive Officer will issue the offset credits generated by the project concerned. The CARB offset credit will have a unique serial number and may be transferred, traded or immediately surrendered for compliance with the California ETS. As a rule, offset credits can be used to fulfil the compliance obligation under the California ETS within a limited amount, namely to meet up to 8 % of the covered or opt-in entity total compliance obligation.

2.1.5.3 The Special Regime of Direct Allocation of the Allowances for Industry Assistance (Carbon Leakage), for Electrical Distribution Utilities and Natural Gas Distributors

In principle, the California allowances will be distributed to the covered or opt-in entities by means of auctioning. Notably, such allocation method is the most transparent and economic efficient one. Furthermore, it creates a certain shortage of allowances availability in the market, thus acting as a driver for the incumbent operators to improve their environmental performance through the adoption of green technology.

However, the auctioning method of allocation is subject to a few exceptions, providing a direct allocation free of charge for some sectors covered by the ETS. In fact, similarly to the other ETSs in force in other countries, the California ETS foresees a direct allocation for industrial sectors subject to risk of carbon leakage, electrical distribution utilities and natural gas distributors.

The direct allocation regime applicable to these sectors and the requirements and criteria to be fulfilled are spelled out in subarticle 9 of the California ETS Regulation. For industrial sectors subject to a carbon leakage risk, i.e. industries facing higher compliance costs (*emission intensive*) and suffering from higher competition from out-state production (*trade exposed*), which are therefore prone to a de-localisation of their production in foreign countries adopting laxer climate change policies and standards, free allocation is provided for purposes of industry assistance.

The sectors that are eligible for industrial assistance are listed in Table 8-1 of the ETS Regulation, while the relevant activities and products are listed in Table 9-1. Each eligible sector is further classified according to the level of carbon leakage risk faced, ranging from *"high"* to *"medium"* to *"low"* and consequently associated with an *industry assistance* factor, declining over the three compliance periods.[9] For instance, while for sectors under a high risk of carbon leakage the industry assistance factor remains at 100 % throughout the three compliance periods, for the ones facing medium risk it lowers to 75 % in the second and 50 % in the third compliance period. On the contrary, for sectors facing a low risk of carbon leakage, the industry assistance factor immediately declines to 50 % in the second compliance period and reaches only 30 % in the third one.

The precise amount of allowances allocated free of charge to these sectors is calculated for each year of the compliance periods by the Executive Officer by means of two alternative methodologies, according to the type of sector and activity concerned. In particular, if an entity belongs to a sector eligible for free allocation under Table 8-1 and carries out an activity listed in Table 9-1, the amount of allowances is

[9]The following sectors are subject to a high risk of carbon leakage: oil and gas extraction, paper mills, chemical, glass and cement manufacturing, iron and steel mills. Sectors under medium risk include petroleum refineries and food, gypsum product, mineral wool and steel shape manufacturing. Finally, sectors with low risk are pharmaceutical, medicine, aircraft manufacturing and support activities for all transportation.

calculated by means of a product-output-based allocation calculation methodology. Conversely, if an entity belongs to a sector eligible for free allocation under Table 8-1 and carries out an activity not listed in Table 9-1, the amount of allowances is calculated upon an energy-based allocation calculation methodology. Section 95891 (b) and (c) provide a detailed formula for each of the two calculation methodologies. In brief, it may be said that both formulas are based on benchmarks. Notably, the benchmarks are based on the most efficient performance of the sectors concerned and reward the operators who come closer to the benchmark performance.

The second special regime, foreseeing direct allocation, is reserved to *"Electrical Distribution Utilities"*. These are entities that own and/or operate an electrical distribution system but do not generate electricity. The amount of allowances the Executive Officer shall allocate to this sector is 97.7 million metric ton multiplied by the cap adjustment factors specified in Table 9-2 multiplied by the allocation factors, expressed in percentage, set for each utility until 2020 in Table 9-3 of the ETS Regulation. Such amount is determined for each year of the compliance periods. These utilities may satisfy their remaining compliance obligation by buying the compliance instruments they need. However, a purchase limit for electrical distribution utilities is set at 40 % of the allowances offered for auction. The *ratio* of making these utilities benefiting from direct allocation is protecting retail ratepayers that would otherwise have to face the price of compliance costs. In fact, the allowances directly allocated are issued in a *limited use* account of their holder and a *monetisation requirement* is set by section 95892 (c)–(d) of the ETS Regulation.

2.1.5.4 The Regime for Auctioning of the Allowances

The regime for auction and sale of the allowances is set in subarticle 10 of the ETS Regulation that prescribes the timing, requirements, format and price minimum.

Firstly, with regard to the actors of the auctions, the Executive Officer may act as the Administrator of the auctions or appoint an entity serving as Administrator. At least 60 days prior to each auction, the Auction Administrator shall publish all the relevant information on the auction. Entities wishing to participate to the auction shall be registered within CARB with the status of covered entity. In addition, they shall fill in and submit the auction participant application providing all their information and relevant data. Moreover, they need to provide a bid guarantee at least 12 days prior to the auction.[10]

Secondly, with regard to the timing, a first auction was held on 14 November 2012, but from 2013 onwards auctions shall be conducted on the twelfth business day of the second month of each calendar quarter (quarterly auctions). Prior the

[10]The bid guarantee must be cash or in the form of an irrevocable letter of credit issued by a financial institution with a US banking license or a bond issued by a financial institution with a US banking license. The amount of the bid guarantee must be greater than or equal to the maximum value of the bids to be submitted.

auction, allowances due to be auctioned will be placed in the Auction Holding Account of the CITSS. An auction may include allowances from the current and previous budget years that remained unsold at previous auctions. Auctioning of allowances from future budget years is allowed as well, but allowances from future vintages will be auctioned separately from the current and previous ones.

Thirdly, with regard to the auction Bidding Format, the provision states the auction will consist of a single round, sealed bids submitted in whole US dollars and whole cents. A reserve price schedule is also set for each auction with the result that no allowances will be sold at bids lower than the auction reserve price. The auction reserve price for vintage 2013 allowances auctioned in 2012 was $10 per allowance. For Advance Auctions conducted in 2012, the Reserve Price was $10 per allowance for vintage 2015 allowances. From 2012, and each year thereafter, the Auction Administrator will announce the auction reserve price for auctions to be conducted the following calendar year on the first day in December that is a business day in California, calculated on the basis of the auction reserve price for the previous calendar year increased annually by 5 % plus the rate of inflation as measured by the most recently available twelve months of the Consumer Price Index for All Urban Consumers. Prior to the opening of the auction window on the day of the auction, the Auction Administrator shall announce the auction reserve price.

An auction purchase limit representing the maximum number of allowances offered at each quarterly auction that can be purchased by any entity or group of entities will apply to auctions conducted from 1 January 2012 through 31 December 2014. For the Advance Auction of future vintage allowances the purchase limit is 25 % of the allowances offered for auction, while for the auction of current vintage allowances it will be 15 % of the allowances offered for auction. Bearing in mind the special regime of direct allocation analysed above, it shall be recalled that the purchase limit for electrical distribution utilities will be 40 % of the allowances offered for auction. The purchase limit for all other auction participants is 4 % of the allowances offered for auction.

Finally, with regard to the conclusion of the auction and the notification of its results, the Executive Officer will review the conduct of the auction by the Auction Administrator and then certify whether the auction met the requirements described above. Afterwards, she will direct the Financial Services Administrator to notify each winning bidder of the auction settlement price, the number of allowances purchased, the total purchase cost, and the deadline and method for submitting payment. As previously clarified, borrowing of allowances is not allowed, while banking is allowed with some limitations in the California cap and trade system. In fact, a holding limit quantity, restricting the maximum number of allowances that an entity may bank at any time, is set and is based on a multiple of the entity's annual allowance budget.

Finally, it shall be reported that according to section 95870 of the ETS Regulation an *Allowance Price Containment Reserve* is created. Such reserve is established as a strategic means to contain costs and protect the ETS from excess price fluctuation. As a result, the Executive Officer shall transfer allowances to the

Allowance Price Containment Reserve, as follows: (1) 1 % of the allowances from budget years 2013–2014, (2) 4 % of the allowances from budget years 2015–2017 and (3) 7 % of the allowances from budget years 2018–2020.

2.1.6 The California Instruments Tracking System (CITSS)

Alike the other existing ETSs, the Californian one relies on a registry to track all the issuances and subsequent transactions of the allowances. Indeed, the Compliance Instrument Tracking System Service (CITSS) is the country's tracking system devised to provide accounts for market participants for holding and retiring compliance instruments and to conduct transactions of compliance instruments with other registered account holders, ensuring transparency and reliability.

In brief, the CITSS is used to register entities participating in the California cap and trade programme, issue allowances and compliance offsets, track the ownership of compliance instruments, enable and record compliance instrument transfers, facilitate emissions compliance and support market oversight. According to sub-article 5 of the California ETS Regulation, the Executive Officer shall serve as CITSS Administrator at national level: each entity participating in the California ETS, fulfilling the requirements to be qualified as *covered entity* must register with CARB. The registration process has two steps: (1) application for a CITSS user ID and (2) once the applicant has been granted the CITSS user ID, application for an account. Moreover, any entity must designate a primary account representative and at least one and up to four alternate account representatives.

2.1.7 Carbon Pricing

Exchange-based trading of CCAs started in September 2011 with the introduction of derivatives contracts on the ICE and the Green Exchange. An overall amount of 3.927 million CCAs were exchanged, mostly through ICE's OTC platform. The total value of the CCA market in 2011 was estimated to be around US$63 million. In the same year, the estimated amount of offset credits issued by CARB was even higher: 7.375 million tons of US domestic offsets, corresponding to US$67.7 million value. A series of contracts have emerged on the market, according to the different expiration dates of the allowances and/or the different kind of assets and emissions curbing projects they refer to.

Figure 2.1 below shows the inter-temporal evolution of the price of these different allowances. As the figure shows, while the 2013–14 vintage[11] prices were

[11]The term "vintage year" refers to the first calendar year for which the allowance may be used for compliance.

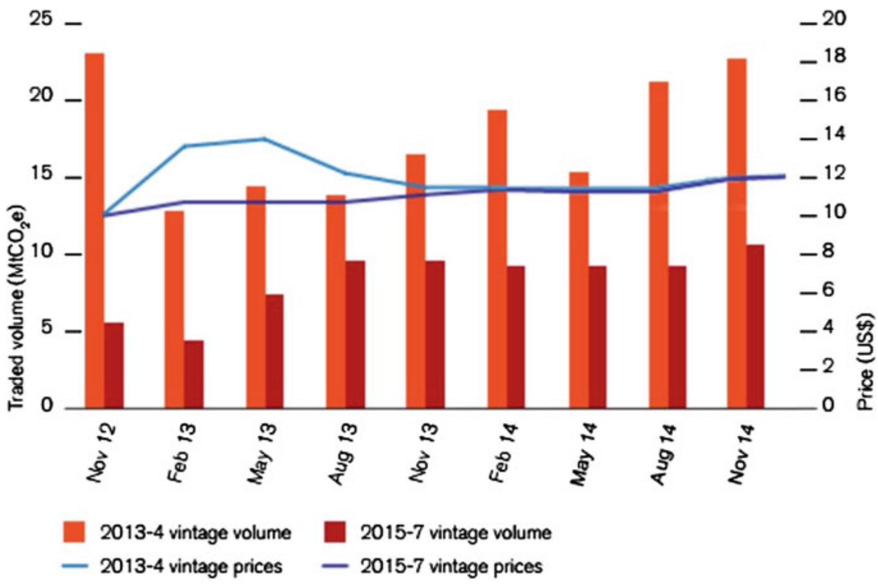

Fig. 2.1 Price of allowances auctioned and traded volumes in the primary market in California cap-and-trade programme. *Source* Author's own elaboration from World Bank (2014), updated on the basis of California Environmental Protection Agency data (http://www.ecofys.com/files/files/world-bank-ecofys-2014-state-trends-carbon-pricing.pdf)

initially rather volatile, from November 2013 onwards the prices of all kinds of allowances stabilised around US$12.

As already stressed above, differently from the EU ETS, the Californian ETS has set a minimum price level for its allowances. In fact, the reserve emissions allowance unit price has been set at US$10/unit in 2012, increasing 5 % per year plus inflation rate to be specified. As a consequence, the price floor has been set to US$10.71 in 2012, US$11.34 in 2014 and US$12.10 in 2015 (CARB 2015). As it emerges from Fig. 2.1 and column 5 of Table 2.1 below, the prices of Californian allowances basically moved along the price floor over these years.

2.1.8 Auction Revenues and Incentives to Environment-Friendly Technologies

Differently from the EU ETS, which has spurred a vast and growing literature on its impact on environment-friendly innovations and technological improvements, such data are so far generally unavailable for other ETSs outside the European Union. Therefore, it is impossible to perform a similar study for those systems. This applies to both US systems analysed in the present Report (namely, California cap and trade and RGGI).

Table 2.1 Compliance cost assessment

Auctions	CCAs 2013 sold	Future CCAs sold	CCAs 2013 selling price	Future CCAs selling price	Purchasing CCAs costs
Auction 1	23126110	5576000	10.09	10	289102449.9
Auction 2	12924822	4440000	13.62	10.71	223588475.6
Auction 3	14522048	7515000	14	10.71	283794322
Auction 4	13865422	9560000	12.22	11.1	275551456.8
Auction 5	16614526	9560000	11.48	11.1	296850758.5
	CCAs 2014 sold	Future CCAs sold	CCAs 2014 selling price	Future CCAs selling price	Purchasing CCAs costs
Auction 6	19538695	9260000	11.48	11.38	329683018.6
Auction 7	16947080	4036000	11.5	11.34	240659660
Auction 8	22473043	6470000	11.5	11.34	331809794.5
Joint Auction 1	23070987	10787000	12.1	11.86	407092762.7
	CCAs 2015 sold	Future CCAs sold	CCAs 2015 selling price	Future CCAs selling price	Purchasing CCAs costs
Joint Auction 2	73610528	10431500	12.21	12.1	1025005697
Joint Auction 3	76931627	9812000	12.29	12.1	1064214896
Joint Auction 4	73429360	10431500	12.52	12.3	1047643037

Source Authors' own elaboration based on California Environmental Protection Agency data (http://www.arb.ca.gov/cc/capandtrade/auction/auction_archive.htm)

While this lack of data prevents a robust econometric analysis on this issue for non-EU countries, it is still possible to make some considerations on the incentives to adopting new technologies and production systems deriving from the non-EU ETS through the use of the auction revenues.

In fact, the expected auction revenues reported by the California's Department of Finance in its 2012–2013 budget were approximately equal to US$1 billion. Half of this amount was used to cover the State's costs related to GHG mitigation activities, while the other half were invested in clean and efficient energy, low-carbon transportation, natural resource protection and sustainable infrastructure development. Differently from other ETS schemes that have experienced high volatility in the auction revenues (cf. the case of the RGGI described in the next section), the Californian ETS raised a rather stable amount of revenues during the first eight auctions (those concerning California alone). More precisely, revenues were always above US$200 millions, ranging between US$223.5 billions and US$331.8 billions (see Fig. 2.2). Results turned out to be remarkably different once California linked with Quebec. During the first four joint (California and Quebec) auctions, revenues increased significantly rising above US$400 millions in the first joint auction held in November 2014 and stabilising at more than US$1,000 millions in the following three joint auctions (see Fig. 2.2). The observed increase in the auction revenues is

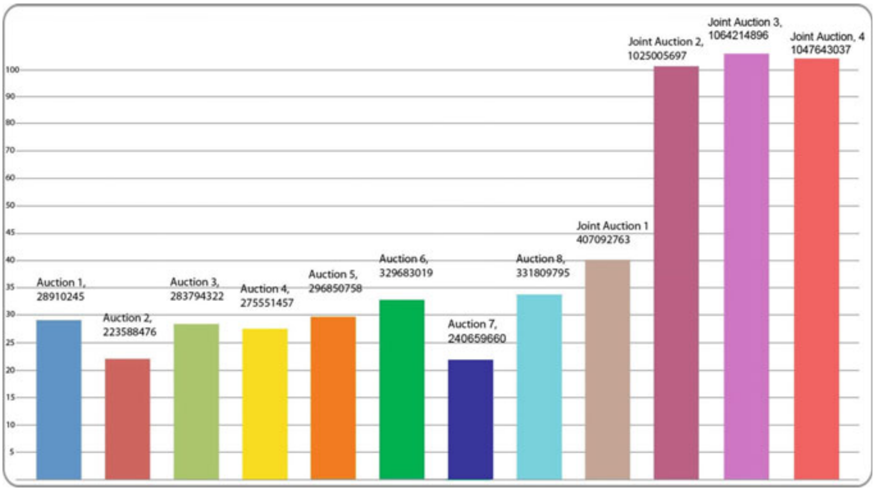

Fig. 2.2 Auctions revenues deriving from past auctions. *Source* Authors' own elaboration based on California Environmental Protection Agency data (http://www.arb.ca.gov/cc/capandtrade/auction/auction_archive.htm)

likely to reflect the initial enthusiasm of the operators for the larger market size deriving from the linking of the Californian and Quebec ETSs. Since auction revenues are destined to alternative sources and energy efficiency projects, their stabilisation around such high levels may play a crucial role in spurring investments in alternative technologies and it can reduce the uncertainty that often prevents firms from investing in new and less polluting (but initially more costly) technologies that need a few years to become profitable.

2.1.9 Compliance Cost Assessment

During the first three auctions, Californian compliant entities have incurred a total cost of around 800 millions $. This result has been computed considering the amount of CCAs bought in 2013–2014–2015 and the different average clearing price for each kind of allowance (see Table 2.1). In such a context, it shall be noted that the CCAs 2013 auction price has been growing steadily and significantly (about 40 %) over the rather limited time span of the first three auctions. From Auction 4 (in August 2013), however, the current CCAs selling prices declined stabilising around 11.5$ (see column 4 of Table 2.1), with a slight increase (up to the Auction 4 levels) in the two joint California–Quebec auctions. On the contrary, the future CCAs selling price has increased slowly but steadily (see column 5 of

Table 2.2 Facilities' emissions during the period 2008–2013 (data in CO_2-e metric tons/year)

Source category[a]	2008	2009	2010	2011	2012	2013
California facilities						
Cement plants	8,745,004	5,930,929	5,625,902	6,221,403	7,054,289	7,382,978
In-state electricity generation[b]	64,329,165	60,788,291	56,139,488	45,203,967	56,008,282	54,208,347
Other combustion sources[c]	10,522,295	9,226,370	9,077,145	9,819,263	11,257,856	11,276,608
Refinery and hydrogen plants	36,724,823	34,393,790	34,754,066	34,212,970	33,755,850	33,860,983
Oil and gas production	11,349,054	11,237,758	10,972,797	14,591,066	15,214,740	16,498,686
Total facilities	131,670,341	121,577,137	116,569,398	110,048,669	123,291,017	123,227,603

2011 data includes additional process emissions not required to be reported in 2008–2010. Process emissions are produced by chemical/physical reactions rather than combustion

[a] Facilities are categorised in identical source categories across all years, which may cause shifts in emissions between categories compared for previously posted 2008–2010 data

[b] Category includes cogeneration power plants. Out-of-state electricity generation sources were excluded from the 2008–2010 historic data to maintain consistency with the current version of MRR, which does not require reporting by out-of-state electricity generators

[c] Other combustion sources represent facilities with primarily combustion emissions, although they may also include relatively small amounts of "process" emissions, which are typically GHG emissions resulting from chemical reactions (versus fuel combustion or fugitive emissions)

Source California Air Resources Board (2015)

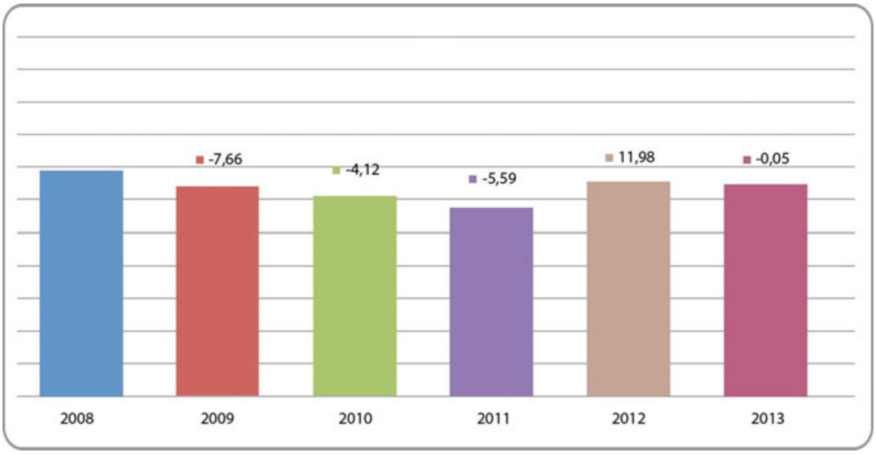

Fig. 2.3 Californian CO_2 equivalent annual emissions trend during the period 2008–2013. *Source* Authors' own elaboration on the basis of California Air Resource Board (2015). *Legend* Numbers reported in the figure refer to annual rate changes as compared to previous year

Table 2.1), basically eliminating the increasing gap between the current and future prices that had emerged in the first three auctions.

2.1.10 Environmental Performance: Preliminary Evaluation

CARB (2015) has recently updated its environmental performance report extending the observation period up to 2013. The report allows to better evaluate the potential environmental effectiveness of the Californian ETS, although it is important to bear in mind that a possible correlation between ETS application and CO_2 reduction obviously gives no indication on the direction of causality. On the basis of data currently at disposal, it seems reasonable to argue that the Californian climate change mitigating policy has produced a positive effect during the 2008–2011 period, in terms of a continuous reduction of the yearly total CO_2 equivalent emissions (cf. Table 2.2 and Fig. 2.3 below). CARB underlines that the observed decrease in the electricity generation emissions during the 2008–2011 period reflects lower Californian electricity emissions due to increased nuclear energy and renewable energies (hydro, solar, wind) production, as well as a decrease in energy consumption and a slight increase in electricity imports.

In 2012, emissions started increasing again (by about 12 % as compared to the previous year) going back to the 2009 levels, and in 2013 they levelled-off around 123 millions tons. The emissions recovery in 2012–2013 is likely to reflect the economic recovery experienced in those years, so that the scale effect deriving from the Californian economic growth[12] more than counterbalanced the technological effect induced by increasing allowance prices.

2.2 The Regional Greenhouse Gas Initiative (RGGI)

2.2.1 Introduction

The RGGI is a *CO_2 Budget Trading Program*[13] established as a result of a Memorandum of Understanding signed in 2005 by a group of 10 US States wishing to establish a cap and trade programme covering the power sector. It started in 2009 and, although quite limited in scope, represents the first cap and trade experience in the USA. After the withdrawal of New Jersey in 2011, it currently applies to 9 US States (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont). The RGGI is regulated by a framework legislation represented by the Model Rule adopted by all the participating States. Such legislation provides the basic principles, procedures and rules for the establishment, functioning and implementation of the RGGI. The Model Rules provide guidance to participating States for the ETS implementation. In fact, each of them is required to implement the Model Rule's prescriptions within its jurisdictions by means of own statutory and/or regulatory tools. The original Model Rule, released in 2006 as a result of the 2005 Memorandum of Understanding between the Parties involved in the RGGI, was amended in February 2013, in order to review and strengthen the ETS.

The RGGI sets an overall multi-state-wide cap on the CO_2 allowances to be apportioned among the participating States, which then allocate them to the covered installations. Currently, it covers 163 facilities distributed in the territory of the participating States. The peculiarity of the RGGI is that it is composed of 9 individual *budget trading programmes* implemented by the participating States in the framework of the Model Rules adopted by all of them. Therefore, consistency with the Model Rules ensures uniformity of the ETSs' rules, targets, procedures, standards and applicability throughout the entire RGGI territory. This section focuses on the Model Rules contents as amended in February 2013, by analysing the framework rules and mechanisms for the functioning of the RGGI that provide the compulsory basis for the regional budget programmes.[14]

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[12]In 2012 and 2013, the Californian GDP grew by 3.5 and 3.6 %, respectively (JP Morgan Chase & Co. 2014).

[13]The definition of "*CO_2 Budget Trading Program*" is provided in section XX-1.2 of the Model Rule, stating that it is: "*A multi-state CO_2 air pollution control and emissions reduction program established pursuant to this Part and corresponding regulations in other states as a means of reducing emissions of CO_2 from CO_2 budget sources*".

[14]As already mentioned above with regard to the California cap and trade programme, the RGGI cap and trade scheme could be affected, in the medium–long term, by the (announced) new US

2.2.2 The RGGI: Main Scope, Purpose, Structure and Features

Compared to other existing ETSs, the RGGI is characterised by a narrower scope of applicability, with regard to both sectors and GHG coverage. In fact, RGGI is very sector-specific since it only applies to fossil fuel-fired power plants with a name-plate capacity equal or greater than 25 MW burning more than 50 % fossil fuels located in the USA. These facilities represent the regulated sources and are named *CO_2 budget units* or *CO_2 budget sources* (if comprising one or more units, like fossil fuel-fired stationary boilers, combustion turbines or combined cycle systems). The only GHG covered by RGGI is CO_2.

As to the RGGI's purpose, this is initially to stabilise (in the period 2009–2014) and then reduce CO_2 emissions from the CO_2 budget sources (i.e. the power plants falling under its scope) in an economic efficient manner. More in detail, it sets the target of progressively reducing the CO_2 emissions of a linear factor of 2.5 % each year, starting from 2015, with the aim to achieve a 10 % CO_2 emission reductions compared to 2009 levels by 2018. To this end, it imposes to the covered facilities the duty to apply for a CO_2 budget permit, perform monitoring and reporting of their CO_2 emissions and, at the end of each compliance period (named *control period*), surrender an amount of allowances corresponding to their emission as duly monitored, reported and verified by an independent auditor.

The scheme is structured in three years of control periods, commencing on 1 January and ending on 31 December each, divided as follows: 1st control period: 2009–2011, 2nd control period: 2012–2014 and 3rd control period: 2015–2017. The surrendering duty shall be fulfilled at the end of each of the control periods and offset allowances may be used for compliance purposes, albeit with some restrictions.

2.2.3 Duties of the Covered Operators and Competences of the Regulatory Agency

The duties of the operators subject to the RGGI are spelled out in XX-2, 3, 4 and 8 of the Model Rule. These may be summarised by reference to the following requirements which shall be fulfilled in chronological order: (1) authorisation requirements with regard to the account representative; (2) permit requirements; (3) monitoring, reporting and compliance certification requirements; (4) record-keeping requirements; and (5) CO_2 surrendering requirements.

(Footnote 14 continued)

approach towards climate change policies and measures, as contained in the November 2014 US–China Joint Declaration.

The first requirement regards the authorisation requirements concerning the account representatives. In general terms, it should be noted that the *condicio sine qua non* for a covered entity to perform its activity is to apply for a CO_2 budget permit. However, in order to be eligible for such permit, a CO_2 budget source authorised account representative (AAR) shall be appointed for each of the budget sources covered by the RGGI. The AAR shall be selected upon agreement between the operator and the owner/s of the CO_2 budget source and shall be legally responsible for representing, binding and acting on behalf of the CO_2 budget source. An alternate account representative may be also appointed. The formal appointment of the AAR is made by submitting to the Regulatory Agency, i.e. the Environmental Protection Agency (EPA), an *account certificate of representation* providing all the details to identify the CO_2 budget source, its operator/s and the AAR. No CO_2 permit can be issued and no allowance trading can be made until an account certificate of representation is received by EPA.

Once the AAR has been designated, the second requirement to be fulfilled pertains to the CO_2 budget permit, since none of the covered activities may be operated without such permit. The AAR is responsible for filing the permit application to EPA, 12 months before the CO_2 budget source commences its activities. The permit shall include a CO_2 emissions monitoring plan.

The third (and core) requirement of the covered installations pertains to the monitoring, reporting and compliance certification duties. Indeed, the monitoring and reporting activities are of utmost importance since they shall be used by EPA to determine the budget source's compliance with the CO_2 surrendering requirements. Monitoring of the CO_2 emissions must be performed according to section XX-8 of the Model Rule, as well as according to sections 40–part 75 of the Code of Federal Regulations (CFR). The AAR shall submit to EPA quarterly monitoring reports covering each calendar quarter, supported by a compliance certification ensuring that all emissions have been correctly and fully monitored.[15] Furthermore, Model Rule section XX-4.1 prescribes that for each control period (i.e. every three years), by 1 March following the control period concerned, the AAR shall submit to EPA a compliance certification report.[16] The implementation of the duties described so far are integrated by a record-keeping requirement, which provides that the owners and

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[15]The Model Rule, section XX-8-5(3) with regard to the compliance certification states: *"The CO_2 authorized account representative shall submit to the REGULATORY AGENCY or its agent a compliance certification in support of each quarterly report based on reasonable inquiry of those persons with primary responsibility for ensuring that all of the unit's emissions are correctly and fully monitored. The certification shall state that: (i) The monitoring data submitted were recorded in accordance with the applicable requirements of this Subpart and 40 CFR part 75, including the quality assurance procedures and specifications (....)".*

[16]The compliance certification report must have the following content: identification of the source and each CO_2 budget unit at the source; the serial numbers of the CO_2 allowances that are to be deducted from the source's compliance account for the control period, including the ones of any offset allowance used to this end; a compliance certification where the AAR shall certify, *"whether the source and each CO_2 budget unit at the source for which the compliance certification is submitted was operated during the calendar years covered by the report in compliance with the*

operators of the CO_2 budget source and each CO_2 budget unit must keep on site at the source a series of specific documents for a period of 10 years from the date the document is created.[17]

Finally, the CO_2 surrendering requirements must be fulfilled: to this end, the owners/operators of a CO_2 budget source must hold in the source's compliance account CO_2 allowances available for compliance deductions under Model Rule section XX-6.5 in an amount not less than the total CO_2 emissions for the control period. In other terms, at the end of each control period the covered entities' operators shall surrender to EPA a number of CO_2 allowances corresponding to the CO_2 emissions generated by their facilities throughout the control period concerned.

The general compliance procedure is spelled out by section XX-6.5 of the Model Rule and is described hereinafter. Preliminarily, with regard to the CO_2 allowance deadline, it should be mentioned that the allowances due for compliance purposes shall be subject to *recordation*,[18] i.e. transfer within the facility's compliance account, on 1 March occurring after the end of the control period. This duty is implemented by the AAR in the broader context of the submission of the compliance certification report.

The CO_2 allowances are held in the CO_2 budget source's compliance account or are transferred into the compliance account by a CO_2 allowance transfer correctly submitted for recordation under section XX-7.1 of the Model Rule by the CO_2 allowance transfer deadline for that control period. In brief, it may be said here that the deduction is made by the Regulatory Agency that will deduct the amount of allowances available in the CO_2 budget source compliance account to cover its related control period emissions until such amount equals the number of tons of total CO_2 emissions for the control period.

The AAR may request in the compliance certification report that specific CO_2 allowances, identified by their serial number, shall be deducted first. In the absence of any such request the Regulatory Agency will conduct a default compliance deduction taking CO_2 offset allowances first and CO_2 allowances other than offset ones secondly.[19] In both cases, for offset and non-offset allowances, a chronological order will apply, i.e. CO_2 offset/non-offset allowances from earlier allocation years

(Footnote 16 continued)

requirements of the CO_2 Budget Trading Program"*;* whether all CO_2 emissions from the units at the source were monitored or accounted and reported in the quarterly monitoring reports.

[17]The documents subject to the record-keeping requirement are the following: the account certificate of representation for the AAR; all emissions monitoring information; copies of all reports, compliance certifications and other submissions and all records made or required under the CO_2 Budget Trading Program; copies of all documents used to complete a CO_2 budget permit application and any other submission to demonstrate compliance with the requirements of the CO_2 Budget Trading Program.

[18]According to Model Rule section XX-1.2, *"recordation"* is the movement of CO_2 allowances by the Regulatory Agency or its agent from one COATS account to another for purposes of allocation, transfer or deduction for compliance.

[19]"Non-offset" allowances are RGGI allowances not generated by offset project, differently from "offset" allowances, which are project-based.

shall be deducted before those from later allocation years. Moreover, in the event that some, but not all, CO_2 offset/non-offset allowances from a particular allocation year are to be deducted, these shall be deducted by serial number, with lower serial number allowances deducted before higher serial number allowances. In case there are insufficient allowances to complete the deductions, a deduction for excess emissions will apply, as it is analysed in the following paragraph dealing with the sanctions.

As it emerges from all the above, the duties to be implemented by the AAR/operator described so far are mirrored by a series of competences belonging to EPA. In fact, EPA is competent for issuing the CO_2 permits, receiving the monitoring reports, making possible inspections and conduct audits as well as reviewing the reporting certifications, and, finally, issuing the sanctions envisaged by the Model Rule in case of excess emissions.

2.2.4 Sanctions Against Non-compliant Operators

In case the CO_2 budget source operator contravenes the obligation to hold, at the end of each control period, a number of allowances equal to the facility's CO_2 emissions monitored and reported in the period concerned, a violation of the Model Rule and of the implementing regulatory and statutory rules of the participating RGGI State occurs. Each ton of CO_2 emission not covered by any eligible allowance (offset and non-offset) represents an excess emission and makes the operator liable to a penalty issued by the competent State.

However, the Model Rule determines a general sanction in section XX-6.5, by stating that the Regulatory Agency or its agent will deduct from the CO_2 budget source's compliance account a number of CO_2 allowances, from allocation years that occur after the control period in which the source has excess emissions, which equal three times the number of the source's excess emissions. In the event that a source has insufficient CO_2 allowances to cover three times the number of the source's excess emissions, the source shall be required to immediately transfer sufficient allowances into its compliance account. No CO_2 offset allowances may be deducted to account for the source's excess emissions. Such a sanction shall not affect the liability of the owners and operators found in breach for any other fine, penalty, or assessment, nor their obligation to comply with any other remedy, for the same violation, as ordered under the applicable State law.

2.2.5 The Allocation Regime of the RGGI Allowances

2.2.5.1 Nature and Validity of the Allowances

Each allowance represents the limited authorisation issued by the Regulatory Agency to emit one ton of CO_2. Allowances may be transferred and traded according to the rules on recordation that will be analysed in greater detail in the COATS paragraph. The types of allowances eligible for compliance purposes are RGGI allowances and offset allowances. Each allowance has a unique serial number useful to identify it, its year of allocation and to track its movements occurred by means of the recordation activities.

2.2.5.2 The Regime for Offset Allowances Under the RGGI

As it has been already mentioned, the CO_2 budget sources may fulfil their compliance duty deducting both allowances and, with some constraints, offset allowances. Offset allowances are awarded[20] by the Regulatory Agency to sponsors of CO_2 emissions offset projects reducing or avoiding such emissions or generating carbon sequestration. CO_2 offset allowances represent CO_2 equivalent emission reductions.

The regime applicable to offset projects and to offset allowances is spelled out in Model Rule section XX-10, which sets a series of eligibility requirements and other conditions to be fulfilled.

Firstly, only certain project types may be eligible to generate offset allowances that may be used within the RGGI.[21]

Secondly, a geographical limitation applies, since the offset project must be located in one of the 9 participating States or, alternatively, in any State or United States jurisdiction with which a cooperating Regulatory Agency has entered into a Memorandum of Understanding.

Thirdly, a *project sponsor*, responsible for all the activities and duties related to the offset project, must be appointed.

Fourthly, the CO_2 emission reductions generated by the offset project must be real, additional, verifiable, enforceable and permanent. To this end, the offset project must not have been required pursuant to any local, State or federal law, regulation or legal order, and it must generate CO_2 emission reductions that would not occur in the absence of the offset project. Moreover, an offset project audit must be provided, in order to verify the project-based CO_2 emission reductions. In such a context, the project sponsors must provide, in writing, an access agreement to the Regulatory Agency granting its access to the physical location of the offset project to inspect it for compliance purposes. Additionally, as it is further explained below,

[20]*Award* is the determination by the Regulatory Agency of the number of CO_2 offset allowances to be recorded in the general account of a project sponsor pursuant to Model Rule section XX-10.7. Award is a type of allocation.

[21]The project types eligible to generate offset allowances are the following ones: landfill methane capture and destruction; reduction in emissions of sulphur hexafluoride (SF_6); sequestration of carbon due to reforestation, improved forest management or avoided conversion; reduction or avoidance of CO_2 emissions from natural gas, oil or propane end-use combustion due to end-use energy efficiency; and avoided methane emissions from agricultural manure management operations.

a verification of the CO_2 emissions avoided or sequestrated by the project must be performed by third-party independent verifiers.

Finally, projects including an electricity generation component or receiving funds or incentives through the *consumer benefit or strategic energy purpose allocation* regulated by Model Rule subdivision XX-5.3(b) are not eligible as offset projects under the RGGI.

Offset projects have a crediting period of 10 years that may be renewed by the Regulatory Agency upon application of the project sponsor. A detailed procedure is envisaged by Model Rule XX-10-4 for the offset project application.

As already pointed out above, offset allowances may be used for compliance purposes with some limitations. In fact, the number of CO_2 offset allowances that are available to be deducted in order to comply with the CO_2 requirements for a control period may not exceed 3.3 % of the CO_2 budget sources CO_2 emissions for that control period. In principle, the possibility given to operators to comply with their targets also by means of offset allowances aims at giving them a certain degree of flexibility in meeting their obligations, providing a higher range of choices with regard to the means of compliance, while at the same time ensuring the achievement of CO_2 emission reductions through project-based activities.

2.2.5.3 The Regime for Auctioning of the Allowances

CO_2 allowances are issued by each RGGI participating State's Regulatory Agency in an amount determined by each of their applicable statute/regulation, within the total RGGI cap. Each of the participating State's legislation also prescribes the modalities for taking part to the regional auctions of the allowances that are held quarterly. Allocation rules may vary from State to State, but a general non-negotiable rule is set by Model Rule section XX-5.3, requiring that a minimum of 25 % of each participating State's CO_2 allowance budget shall be allocated to the *consumer benefit or strategic energy purpose set-aside account*. This is a general account established by the Consumer Benefit or Strategic Energy Purpose Fund Administrator from which allowances will be sold or distributed in order to provide funds to encourage and foster the following fields: promotion of energy efficiency measures, direct mitigation of electricity ratepayer impacts attributable to the implementation of the RGGI, promotion of renewable or non-carbon-emitting energy technologies, stimulation or reward of investment in the development of innovative carbon emissions abatement technologies with significant carbon reduction potential, and/or the administration of the participating States' CO_2 Budget Trading Program.

Beside this general allocation rule, another general allocation mandatory provision is set by Model Rule with regard to Cost Containment Reserve (CCR) allocation. CO_2 CCR allowances are offered for sale at an auction by the Regulatory Agency for the purpose of containing the cost of CO_2 allowances. They are separate from (and additional to) CO_2 allowances allocated from the participating States' "base" budget. A CCR trigger price, representing the minimum price at which CO_2 CCR allowances are offered for sale by the Regulatory Agency or its agent at an auction, is set at US$4.00 per CO_2 allowance in calendar year 2014, US$6.00 in calendar year 2015, US$8.00 in calendar year 2016, and US$10.00 in calendar year 2017. In each calendar year thereafter, the CCR trigger price shall be 1.025 multiplied by the CCR trigger price from the previous calendar year, rounded to the nearest whole cent.

The general rules applicable to the auctioning of allowances are laid down in Model Rule subpart XX-9. Additional elements, regarding for instance the time and location of the auction or the registration deadlines, may be specified by the Regulatory Agency in the auction notice of each auction, following the general requirements that represent the minimum standards to be included in the auction notice.

Banking of allowances is envisaged, since Model Rule section XX-6.6 provides that: *"Each CO_2 allowance that is held in a compliance account or a general account will remain in such account unless and until the CO_2 allowance is deducted or transferred".*

2.2.6 The RGGI CO_2 Allowance Tracking System (COATS)

The establishment of an electronic system to register the allowances issued and to track their transfers is a necessary feature common to all existing ETSs around the world. Indeed, it enables the authority in charge to administer the ETS, to keep record and trace all the issuance and movements (*recordations*) of the allowances in a reliable and accountable manner.

The RGGI CO_2 Allowance Tracking System is called COATS and is managed by the Regulatory Agency. As already pointed out above, a prerequisite for any operator to be eligible for a RGGI permit is to be registered with an account within COATS. Compliance accounts and general accounts, the former ones used for CO_2 requirements compliance purposes, the latter ones used for holding and transferring allowances, may be opened following the procedure of application to the Regulatory Agency already analysed above.

2.2.7 Carbon Pricing

As explained above, participating States receive their share of allowances from the overall cap. Each State sells 75 % of emission allowances through auctions. The remaining 25 % of allowances will be used for a public benefit purpose, such as promoting renewable energy and energy efficiency, or mitigating possible increases in consumer energy prices.

Tables 2.3 and 2.4 below describe the allowances allocation by States after the first and the second control periods, respectively.

As the last row of Table 2.3 shows, during the first control period the unsold allowances retired were almost one-fifth of the CO_2 allowances offered at auctions. The overall performance of the auctions, however, changed remarkably over time. More precisely, as described in Fig. 2.4, the first eight auctions of the RGGI ETS were characterised by a substantial equilibrium between current allowances offered and sold. On the contrary, from the 9th to the 18th auction (except the 11th) the RGGI system has experienced an oversupply of current allowances compared to the real demand. In the period 2012–2013, the supply of allowances was estimated to be about 140 millions above the cap established for the period 2009–2013 (cf. RGGI 2014). This situation adversely affected the auction revenues, which tended to decrease and, in any case, turned out to be lower on average in the period September 2010–March 2013 than those deriving from the first 8 auctions (see Fig. 2.5). To manage the overallocation problem, in February 2013 the regulation authority adjusted the cap by adopting the so-called new model rule.[22] As a result, the following auctions (from the 19th onwards) showed again an equilibrium and a rise in the corresponding revenues. The alternation of equilibrium and disequilibrium periods, together with the high volatility of the auction revenues over the observed period, is likely to reflect rapid changes in the facilities' activity production as well as in their expectations on their future need of this instrument for production and/or speculative reasons. This seems to confirm the volatility of the ETS markets already observed in other geographical areas (i.e. the EU ETS examined in Chapter 1 above) and for other kinds of pollutants (e.g. in the US SO_2 ETS market).[23]

The oversupply observed in many auctions adversely affected the allowance unit average price, which followed a decreasing trend during these years. Differently from the EU ETS, but in line with the Californian ETS, RGGI sets a floor price in the allowance auctions, which is currently around US$2/t CO_2 indexed to inflation.

In general, it can be claimed that the existence of a price floor in the auctions turned out to be effective because it prevented allowance prices from collapsing despite the overall surplus of allowances, so that the latter were generally traded at roughly the price floor during the overallocation period.

From September 2010 onwards, in fact, prices tracked the US$1.86 floor price (US$1.86 in 2010 and US$1.89 in 2011). The share of secondary market exchange-based transactions collapsed from 85 % in 2009 to 6 % in 2011 (see Fig. 2.6), most of which were on a bilateral spot basis (World Bank 2012).

[22]The current surplus of allowances is expected to be depleted over the remainder of the decade as a consequence of the proposed interim adjustments for banked CO_2 allowances (see http://www.rggi.org/docs/PressReleases/PR011314_AuctionNotice for further details on the proposed intervention).

[23]With regard to the US SO_2 ETS market see Ellerman and Joskov (2008).

Table 2.3 Allowance allocation by States after first RGGI control period

State	CO_2 allowance budget	Offered at auction	Sold at auction	Sold at fixed price	Transferred from State set-aside accounts	Early reduction allowances (ERAs)	Offered but unsold at auction	Remaining set-aside allowances	Set-aside allowances retired[c]	Unsold allowances retired[d]
Connecticut	32,085,108	29,549,635	22,953,057	221,278	601,834	198,231	–	1,390,355	322,006	6,596,578
Delaware[a]	22,679,361	12,958,576	9,952,619	–	6,098,153	3,128	–	–	3,622,632	3,005,957
Maine	17,846,706	14,971,146	11,797,376	–	2,518,615	–	3,173,770	353,773	3,172	–
Maryland	112,511,949	95,225,672	74,943,417	–	–	217,703	487,284	6,381,500	10,904,777	19,794,971
Massachusetts	79,980,612	78,855,612	62,024,346	–	–	18,276	–	1,125,000	–	16,831,266
New HAMPSHIRE	25,861,380	18,360,928	14,479,101	–	7,500,000	1,064,718	3,881,827	–	452	–
New Jersey	68,678,190	61,375,032	46,266,477	5,655,178	982,173	113,469	–	–	665,807	15,108,555
New York	192,932,415	182,338,053	143,536,651	–	4,499,999	806,883	–	769,253	5,325,110	38,801,402
Rhode Island	7,977,717	7,974,349	6,270,050	–	–	–	–	–	3,368	1,704,299
Vermont	3,677,490	3,665,232	2,877,123	–	–	–	–	6,265	5,993	788,109
Total	564,230,928	505,274,235	395,100,217	5,876,456	22,200,774	2,422,408	7,542,881	10,026,146	20,853,317	102,631,137

[a]In Delaware, the percentage of CO_2 allowances allocated to auction shall increase by 8 % per year from 2009–2014, such that 100 % of CO_2 allowances shall be auctioned in 2014
[b]2,422,408 early reduction allowances (ERAs) were awarded for the first control period
[c]For New York, the set-aside allowances retired column also includes New York's Behind-the-Meter Adjustments for 2009, 2010 and 2011
[d]For Connecticut, the unsold allowances retired column also includes CO_2 allowances that are intended to be retired
Source RGGI (2013) (http://www.rggi.org)

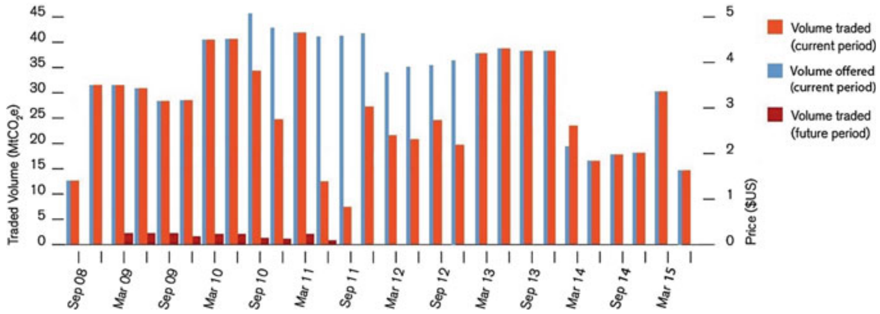

Fig. 2.4 Allowances offered and sold in auctions run during the period September 2008–June 2015. *Source* Authors' own elaboration from World Bank (2014) updated on the basis of Regional Greenhouse Gas Initiative data (http://www.ecofys.com/files/files/world-bank-ecofys-2014-state-trends-carbon-pricing.pdf)

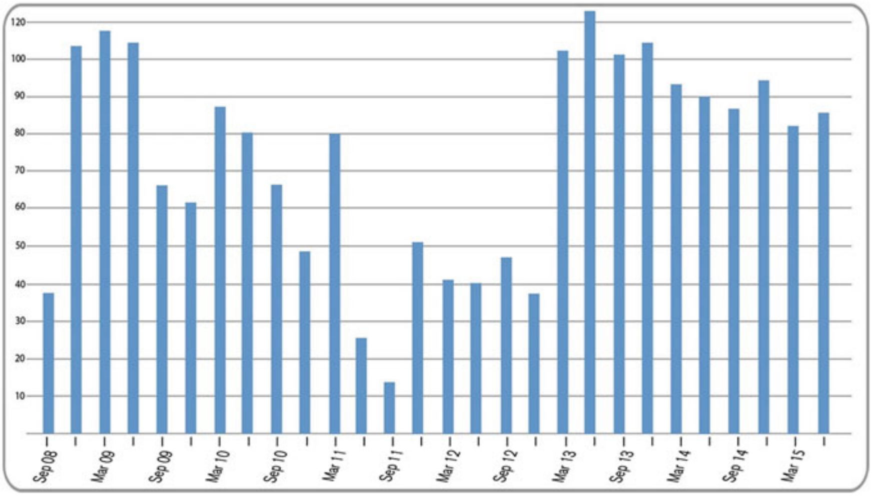

Fig. 2.5 Auction revenues in the period September 2008–June 2015. *Source* Authors' own elaboration based on Regional Greenhouse Gas Initiative data

The average daily volume of RGGI futures contracts listed on the Chicago Futures Exchange (CCFE) declined by a factor of 100 over the same period, from an average daily volume of 2.7 Mt CO_2 equivalent in 2009 to 0.28 Mt CO_2 equivalent in 2011.

After the regulatory intervention in 2013, however, average yearly prices recovered and kept growing reaching the peak level of 4.72 in 2014 (see Fig. 2.6). Market volumes also increased again after reaching their lowest level in 2012, although they remained far from the boom levels initially experienced in 2009.

Table 2.4 Allowance allocation by States after second RGGI control period

State	CO_2 allowance budget	First control period Interim adjustment[i]	CO_2 allowance adjusted budget	Offered at auction	Sold at auction[f,g]	Sold cost containment reserve (CCR) allowances[j]
Connecticut	27,281,967	531,969	26,749,998	26,181,640	22,091,336	323,731
Delaware[a]	19,184,261	375,603	18,808,658	14,869,032	12,720,378	228,829
Maine	15,175,054	295,567	14,879,487	12,448,488	10,410,958	180,069
Maryland[b,e]	95,368,910	1,863,361	93,505,549	87,951,051	74,104,427	1,135,217
Massachusetts	67,807,514	1,324,595	66,482,919	66,085,825	55,524,192	806,984
New Hampshire[c]	21,989,931	428,302	21,561,629	17,060,240	14,269,514	260,935
New York[d]	163,850,432	3,195,240	160,655,192	151,138,024	126,818,004	1,946,639
Rhode Island	7,603,453	132,122	7,471,331	7,421,068	6,363,649	80,491
Vermont	3,106,970	60,905	3,046,065	3,015,605	2,528,167	37,105
Total[f,g]	421,368,492	8,207,664	413,160,828	386,170,973	324,830,625	5,000,000
State	Sold at fixed price	Offered but unsold at auction[h]	Transferred from State set-aside accounts	Remaining set-aside allowances[f]	Set-aside allowances retired[b,d]	Unsold allowances retired[c]
Connecticut	0	4,090,304	211,545	0	356,813	0
Delaware[a]	N/A	2,148,654	1,524,538	0	2,415,088	0
Maine	N/A	2,037,530	2,094,433	336,566	0	0
Maryland[b,e]	1,600,000	13,846,624	0	1,600,000	2,354,498	0
Massachusetts	N/A	10,561,633	0	0	397,094	0
New Hampshire[c]	N/A	2,007,922	4,500,000	0	1,389	782,804

(continued)

Table 2.4 (continued)

State	Sold at fixed price	Offered but unsold at auction[h]	Transferred from State set-aside accounts	Remaining set-aside allowances[f]	Set-aside allowances retired[b,d]	Unsold allowances retired[c]
New York[d]	N/A	24,320,020	4,500,000	1,082,934	3,934,234	0
Rhode Island	N/A	0	0	22,850	27,413	1,057,419
Vermont	N/A	0	0	24,913	20	487,438
Total[f,g]	1,600,000	59,012,687	12,830,516	3,067,263	9,486,549	2,327,661

[a]In Delaware, the percentage of CO_2 allowances allocated to auction shall increase by 8 % per year from 2009–2014, such that 100 % of CO_2 allowances shall be auctioned in 2014

[b]For Maryland, the set-aside allowances retired column also includes CO_2 allowances that will be retired in accordance with deadlines in Maryland regulations

[c]For New Hampshire, the unsold allowances retired column includes 260,935 CO_2 allowances that were converted into 2014 Cost Containment Reserve (CCR) allowances plus 521,869 CO_2 allowances that were converted into 2015 CCR allowances

[d]For New York, the set-aside allowances Retired column also includes New York's Behind-the-Meter Adjustment for 2012 and 2013

[e]Maryland distributed 154,302 allowance allocation year 2013 CO_2 allowances after 17 March 2014. These CO_2 allowances were not included in the Second Control Period Interim Budget Adjustment. Additional information available at http://www.rggi.org/design

[f]In addition to the figures above, New Jersey sold 1,058.403 allowance allocation year 2012 CO_2 allowances, 879,132 allowance allocation year 2013 CO_2 allowances, and 279,758 allowance allocation year 2014 CO_2 allowances. There are no other New Jersey allowance allocation year 2012, 2013, or 2014 CO_2 allowances in circulation

[g]In 2011, the nine States, Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont, sold 2,807,952 allowance allocation year 2014 CO_2 allowances. 17,980,017 allowance allocation year 2014 CO_2 allowances were sold in Auction 23 and 18,062,384 allowance allocation year 2014 CO_2 allowances were sold in Auction 24 and 17,998,687 allowance allocation year 2014 CO_2 allowances were sold in Auction 25 and 18,198,685 allowance allocation year 2014 CO_2 allowances were sold in Auction 26

[h]States do not intend to reoffer CO_2 allowances in the offered but unsold at auction column. New Hampshire may convert some of these CO_2 allowances to Cost Containment Reserve allowances

[i]On 13 January 2014, the States announced the First Control Period Interim Adjustment for Banked Allowances (FCPIABA). The adjustment was applied to the 2014 CO_2 allowance budget. Additional information available at http://www.rggi.org/design/overview/cap

[j]A total of 5 million 2014 Cost Containment Reserve (CCR) allowances were distributed in Auction 23. More information available at http://www.rqqi.org/market/co2_auctions/results and at http://www.rqai.org/design

Source RGGI (2015)
http://www.rggi.org/docs/CO2AuctionsTrackingOffsets/Allocation/SCP_Allowance-Allocation.pdf

Fig. 2.6 Market volumes and prices on the RGGI during the 2008–2011 period. *Source* Authors' own elaboration from World Bank (2014) updated on the basis of Regional Greenhouse Gas Initiative data

2.2.8 Auction Revenues and Incentives to Environment-Friendly Technologies

In the case of RGGI, revenues from allowances, almost all of which are auctioned, go to State governments. Since their beginning in September 2008, RGGI auctions have raised about US$2.1 billion revenues (see https://www.rggi.org/market/co2_auctions/results).

Most auction revenues have been invested by State governments in local renewable energy or energy efficiency projects, while roughly 1/5 of the revenues have been used for State deficit reduction, in accordance with the double-dividend purpose often underlying the adoption of ETS and other market-based environmental policy instruments (e.g. carbon tax).

More precisely, auction revenues have been allocated across all RGGI States as follows (see World Bank 2012):

- 48 % to energy efficiency programmes promoting new installations and retrofits in residential and commercial facilities (e.g. insulation)[24];
- 14 % to direct electricity bill assistance;
- 7 % to support renewable power generation;
- 11 % to various other environment-related programmes and outreach activities; and
- 20 % to States' general budgets.

It is important to emphasise that RGGI-funded energy efficiency investments have led to remarkable consumer gains, with an estimated net economic impact of about US$1.6 billion and the creation of 16,000 new jobs (Hibbard et al. 2011). Such energy efficiency investments together with those in renewable energy sources, however, have also reduced the demand for RGGI allowances. This denotes the possible existence of a conflict between the use of ETS and that of energy efficiency/renewable energy policies that have been raised also within the context of the EU 20/20/2020 legislative package and is the object of current debate in the literature. In other words, improvements in energy efficiency/renewable energy policies may have a partial "crowding-out" effect on the ETS, reducing the demand (and thus also the price) of the allowances and thus weakening the role of the instrument itself.

Moreover, given the high volatility observed in the RGGI auction revenues and pointed out above, the actual money volume destined by State governments to renewable energy and energy efficiency projects might remarkably fluctuate over time if they are to rely on ETS revenues alone, thus possibly generating uncertainty on the support provided through the ETS to such alternative and innovative projects. For this reason, it seems advisable that additional and/or alternative government interventions take place to support renewables and energy efficiency beyond the ETS.

2.2.9 Compliance Cost Assessment

Entities who operate in RGGI system paid a total amount cost of about US $1,133,521,353 billions to purchase allowances in the auctions during the 2008–2013 period. The average unit allowance price observed in this period has generally shown high volatility. In the first 4 auctions the average clearing price was around US$3.30. In auctions 5 to 7, the average clearing price was about US$2.10. From the 8th to the 18th auction, allowances were sold at an average price of about US $1.90 before increasing to US$3 in the following two auctions (see Fig. 2.7). Afterwards, prices kept growing rapidly, reaching the record evaluation of US$5.5

[24]This measure is estimated to have generated electricity bill savings of US$1.3 billion for residential, commercial and industrial consumers across the participating States. Savings in non-electric energy supply (natural gas, heating oil) amount to an additional US$174 million.

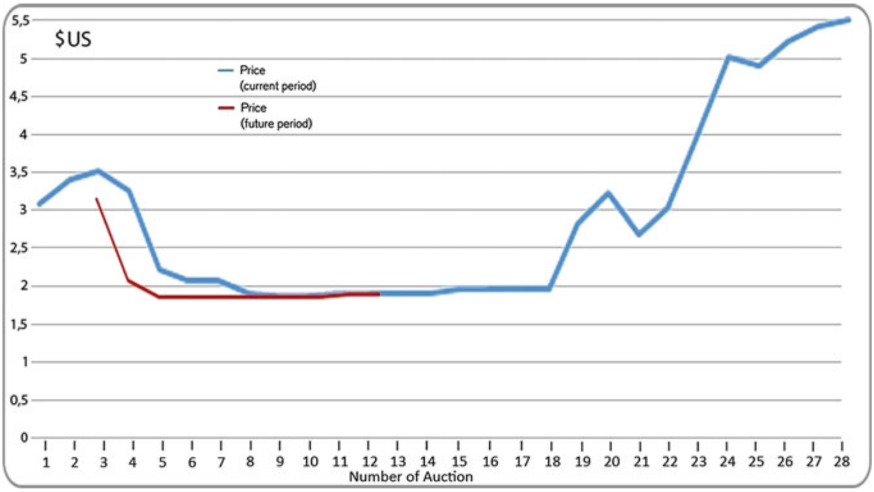

Fig. 2.7 Auction prices fixed during the September 2008–June 2015 period. *Source* Authors' own elaboration based on Regional Greenhouse Gas Initiative data

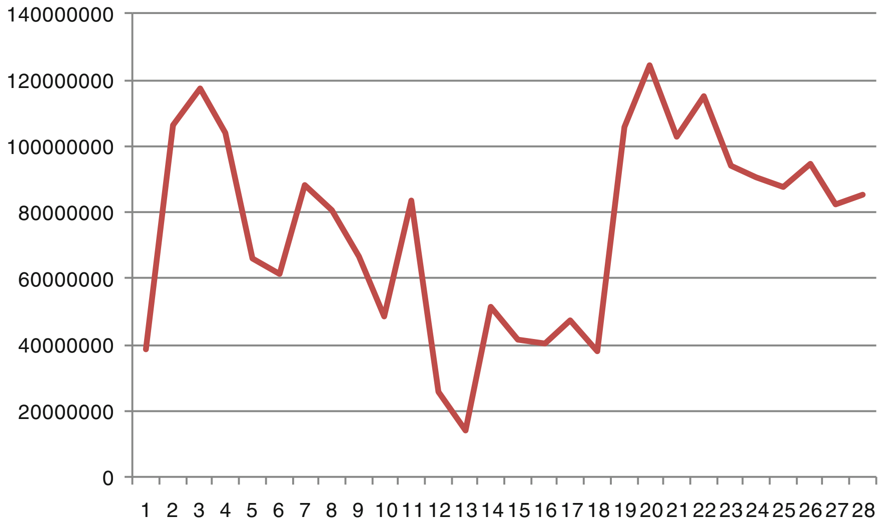

Fig. 2.8 Purchasing costs paid by compliant entities in auctions run in the period September 2008–June 2015. *Source* Authors' own elaboration based on Regional Greenhouse Gas Initiative data. *Legend* Horizontal axis = progressive auction number, vertical axis = purchasing costs

at the last auction. This trend, which is strictly linked to the oversupply of allowances from the 9th to the 18th auction, implied also a volatility in the overall entities costs sustained by the entities to purchase the needed allowances and thus comply with the ETS requirements (see Fig. 2.8).

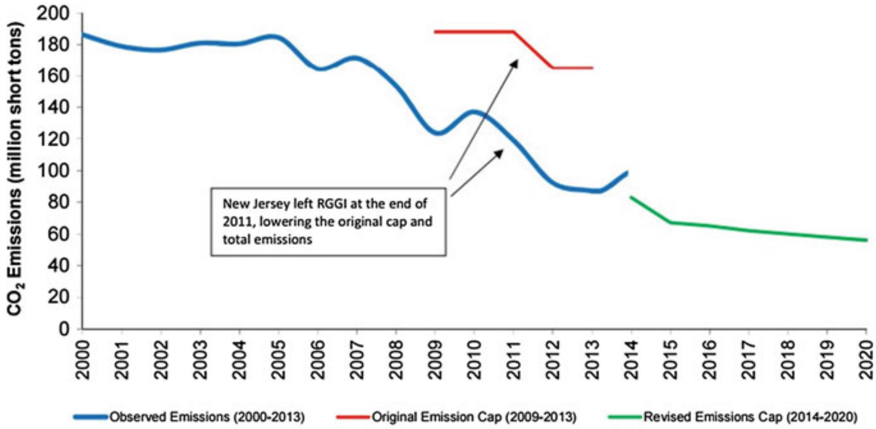

Fig. 2.9 Emissions trend in the RGGI States during the period 2000–2015. *Source* Authors' own elaboration from Congressional Research Service (2015), updated on the basis of Regional Greenhouse Initiative data

2.2.10 Environmental Performance: Preliminary Evaluation

During the first compliance period (2009–2011), emissions across the 10 participating States remained relatively stable, declining by only 2.7 million stCO_2 equivalents, from 123.7 million to 121 million stCO_2 equivalent.[25] This level is 36 % below the annual cap of 188 million stCO_2 equivalent. As Fig. 2.9 suggests, most emission reductions occurred before the RGGI actually entered into action. The World Bank estimates that the main reasons underlying the observed emission reduction were as follows: (i) lower electricity demand due to the development of energy efficiency measures and weather conditions; (ii) fuel switching from coal and petroleum to gas triggered by lower relative natural gas prices; and (iii) increasing power generation from non-emitting sources such as nuclear and renewable energy.

In the absence of sufficiently large data set at disposal, it is hard to disentangle the role played by the RGGI scheme among the many factors influencing the emissions trend. However, one cannot exclude that emissions started falling before the RGGI was implemented partly because some firms might have shifted to new technologies and alternative energy sources in advance, when the RGGI was announced, to gain an early mover advantage on the allowance market.

While the system was safely below the original emission cap in the period 2009–13, more emission reduction efforts will be needed to satisfy the revised emissions cap set for the period 2014–2020. The latter, however, seems in line with the overall

[25]In 2011, overall emissions were 33 % below the programme cap (RGGI 2012).

downward trend followed by RGGI emissions from 2007 onwards; therefore, it represents a feasible target for the future.

2.3 The Quebec Cap and Trade System

2.3.1 Introduction

The Quebec cap and trade system was formally established in 2011, when the Government of Quebec adopted the *Regulation Respecting a Cap and Trade System for GHG Emission Allowances* (the GHG Regulation hereinafter). However, this legal act represents the final step of a legislative process started in 2009, when the Province of Quebec adopted the first amendment of the *Environment Quality Act* granting the Government the power to establish a cap and trade system and officially endorsed by Decree its GHG emission reduction target of 20 % compared to 1990 levels, to be reached by 2020.[26]

The cap and trade system started operating in 2013 and is structured upon three compliance periods: 1st: 2013–2014, 2nd: 2015–2017 and 3rd: 2018–2020. Each year of the compliance periods runs from 1 January to 31 December. The scheme initially covered almost 80 % of Quebec's GHG emissions; from 2015 onwards, such percentage was increased up to 85 %. The GHG reductions target remaining unchanged, the GHG Regulation has been amended more than once to allow a harmonised linking with the California cap and trade programme from 2014, thus achieving an outstanding example of fully fledged linking.

This section analyses the Quebec cap and trade system main features and functioning from a legal and economic point of view, with the aim to provide the background information for the analysis of the Quebec–California linking performed below in this book.

2.3.2 The Quebec Cap and Trade: Main Scope, Purpose, Structure and Features

The scope of application of the Quebec ETS is determined by the Environment Quality Act (section 46.1), listing the GHG covered, and the GHG Regulation (sections 2, 3, and Appendix A), providing the definitions of "emitter/s" and GHG and identifying the targeted sectors of activity.

[26]See Decree 1187–2009 in Quebec Official Gazette Part 2, number 49 of 9 December 2009.

More in detail, the GHG covered are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), per fluorocarbons (PFCs), sulphur hexafluoride (SF6) or any other gas determined by regulation of the Government.

The types of activities covered by the scheme have changed over time, according to the applicable compliance period. In fact, while during the 1st compliance period (2013–2014) only industrial installations and electricity operators were covered, from the 2nd period (2015 onwards) fossil fuels distributors are also included.[27]

Similarly to what happens in all the other ETSs analysed above, a threshold requirement also applies to the emitters' subject to the Quebec cap and trade system. In fact, according to section 2 of the GHG Regulation, installations must have reported an annual amount of GHG emissions equal to or greater than 25.000 metric tonnes CO_2 eq in order to be covered by the scheme.

The Government, by means of an Order, sets a Cap on the emission units that may be granted by the Ministry for each year of the compliance periods. The Cap shall progressively decrease, from 2015 onwards, according to the 2020 GHG reduction target.[28] With regard to the obligations and main functioning rules, the Quebec system is very similar to the other ones previously analysed, since it requires operators subject to the scheme to carry out an annual mandatory monitoring and reporting of GHG emissions, and, for each compliance period, to surrender eligible allowances corresponding to their verified emissions.

The main authority responsible for managing the ETS is the Ministry for Sustainable Development, Environment and Climate Change of Quebec (the Ministry hereinafter), supported by the Auction Administrator and the Financial Services Administrator in the auctioning phase.

2.3.3 *Duties of the Covered Operators and Competences of the Ministry for the Environment of Quebec*

The entities subject to the Quebec cap and trade system shall firstly register in the Quebec cap and trade system. To do so, they shall register in the Compliance Instrument Tracking System Service (CITSS) in due time. The registration application must be submitted to the Quebec Ministry of the Environment (the Ministry),

[27]Appendix A of the GHG Regulation lists the sectors included in the cap and trade scheme: mining, quarrying and oil and natural gas extraction; electric power generation, transmission and distribution; natural gas distribution; steam and air-conditioning production for industrial purposes; manufacturing; and pipeline transportation of natural gas.

[28]The following Caps are spelled out in Order 1185–2012: for the year 2013, 23.20 million emission units; for the year 2014, 23.20 million emission units; for the year 2015, 65.30 million emission units; for the year 2016, 63.19 million emission units; for the year 2017, 61.08 million emission units; for the year 2018, 58.96 million emission units; for the year 2019, 56.85 million emission units; and for the year 2020, 54.74 million emission units.

according to the format and providing the information spelled out in section 7 of the Regulation. If the application is correct and fulfils all the information required, the Ministry opens an entry into the CITSS and provides the emitter with a dedicated account to hold, trade and record the allowances.[29]

Once this registration duty has been complied with, the emitter shall ensure an annual monitoring and reporting of its GHG emissions, according to the rules spelled out in the GHG Regulation. In fact, a common feature of all the existing ETSs worldwide requires transparency and reliability of reported data; therefore, emission reports are subject to third-party impartial verification. In the case of Quebec, this activity is performed by verifiers accredited under the ISO 14065 certification,[30] who provide an objective assessment of the report according to ISO 14064-3 standards.

The MRV activities are "preliminary" mandatory activities necessary to fulfil the compliance obligation.[31] As specified below, specific sanctions may be applied to non-compliant operators.

The authority empowered to manage and implement the system is the Quebec Ministry for the Environment which is competent to receive and assess the emitters' applications to CITSS, open the account, release the allowances and apply the sanctions for non-compliance with the duty to surrender the due amount of allowances.

2.3.4 Sanctions Against Non-compliant Operators

The enforceability of the system is ensured, *inter alia*, by the Ministry's power to issue sanctions, which should act as deterrents against non-compliant operators.

To this respect, section 22 of the Regulation states that the failure by an emitter to surrender the due amount of GHG emissions on the expiry of the compliance deadline leads to two different, cumulative sanctions: (a) the suspension of its general account; and (b) the application of an administrative sanction equal to 3 emission units for each missing emission allowance needed to complete the coverage. When the emitter's accounts do not contain enough emission allowances required for the application of the administrative sanction, the Ministry notifies the emitter, who must surrender them within 30 days from the failure to provide

[29]For further details, see sections 8–18 of the GHG Regulation.

[30]The Standard Council of Canada and the American National Standard Institute are accrediting bodies.

[31]section 21 of the GHG Regulation states that: *"On 1st November following expiry of a compliance period or, if that day is not a business day, on the first following business day, every emitter must have at least as many emission allowances in its compliance account as its verified emissions for every covered establishment during the compliance period or, where applicable, during the years following the last compliance period for which emissions coverage was required".*

coverage. If the failure to comply comes from an emitter eligible for the allocation free of charge of emission units, the Ministry removes a quantity equivalent to the emission allowances from the quantity that would normally have been allocated to the emitter without charge for the following compliance period.

Besides these sanctions, sections 71-ss of the Regulation provide specific pecuniary sanctions in case of violation of the compliance obligation and in case, among others, of violation of the rules related to the process of opening the account within CITSS, the trading process and the participation to the auctions.[32]

2.3.5 The Allocation Regime of the Quebec Allowances

2.3.5.1 Nature and Validity of the Allowances

Each unit issued by Ministry under the Quebec ETS represents a ton of CO_2 eq and allows its holder to emit a corresponding amount of GHG. Emission allowances are issued in electronic form and are identified in a way that allows them to be differentiated, in particular by type and by vintage. section 20 and 37 of the GHG Regulation specify that the eligible emission allowances are the following ones: emission units, offset credits, early reduction credits and any other emission allowance determined by a Regulation of the Government. Moreover, the GHG Regulation also determines that no borrowing of allowances is allowed.

2.3.5.2 The Regime for Offset Allowances Under the Quebec Cap and Trade

The Quebec cap and trade system, pursuant to section 20 of the Regulation, allows incumbent operators to use offset credits to fulfil their compliance obligation. Offset credits, expressed in tons of CO_2 eq, are issued by the Ministry in electronic format. They represent a quantity of GHG emissions never emitted or permanently and irreversibly removed from the atmosphere by an offset project voluntarily implemented by an individual, organisation or business, above and beyond usual practices (i.e. additional to business as usual). Eligibility requirements and strict rules apply to offset projects, regulated by the 3 applicable Protocols currently in force, covering the following areas: CH_4 destruction at covered manure storage facilities, CH_4 destruction at landfill sites, destruction of ozone depleting substances contained in insulating foams that have been removed from refrigerators and freezers.[33]

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[32]For the amount of the monetary sanctions, see sections 71–73 of the Cap and Trade Regulation.

[33]More details on the Protocols sector coverage, participation requirements and procedural rules can be found at http://www.mddelcc.gouv.qc.ca/changements/carbone/documentation-en.htm#regulations.

Section 20 of the GHG Regulation allows just a limited borrowing of offset credits, which may be used only if issued in the first year following the year of expiry of the compliance period. At the same time, the same provision determines a quantitative limitation of offset credits that the emitter may use to cover its obligations. In fact, they cannot exceed 8 % of its total GHG emissions to be covered for the compliance period. Further rules are provided in sections 70.1–70.21 of the Regulation, in particular with regard to MRV of offset credits and registration requirements for the participants.

2.3.5.3 The Special Regime for Carbon Leakage

The Quebec cap and trade shares several similarities with all the other ETSs analysed so far. Among these, it should be mentioned the provision of a special regime to protect "trade exposed" industry sectors in order to avoid the carbon leakage phenomenon.

We already defined above the concept of "carbon leakage" and specified the ratio behind the beneficial regime applicable to sectors that would, otherwise, be particularly vulnerable to foreign competition and face high production costs to comply with their national ETS. In fact, lacking a "more favourable" treatment, these sectors would be likely to offshore their production in countries with laxer climate change/environmental rules. In order to avoid such a risk, following the choice already made by most of the other ETSs, also the Quebec's regime foresees the free allocation of a certain amount GHG units to these sectors. The activities under a "carbon leakage" risk, i.e. eligible to free emission allowances, are listed in Appendix C, Part I—Table A of the GHG Regulation,[34] while Appendix C, Part II (A–D), determines the methods for calculation of the GHG allowances that may be allocated free of charge.

The total number of allowances that may be distributed free of charge during one year is determined by a Ministerial Notice and, obviously, may not exceed the annual Caps determined by Law. Starting from 2015 (2nd compliance period), the number of units allocated for free will drop by about 1 to 2 % a year, in order to meet the 2020 target, while at the same time progressively encouraging installations belonging to carbon leakage sectors to enhance their efforts to curb their GHG emissions. Finally, it should be underlined that despite the favourable conditions granted to these sectors, they are not exempted neither from MRV of their allowances, nor from holding a sufficient amount of units in their account (corresponding to their verified emissions) at the end of each compliance year.

[34]Provided they meet the requirements spelled out in Appendix C, Parts I and II of the Regulation these are: aluminium; lime; cement; chemical and petrochemical industry; metallurgy; mining and pelletising; pulp and paper; petroleum refining; glass containers, electrodes, gypsum products; and some agro-food establishments.

2.3.5.4 The Regime for Auctioning of the Allowances

Except the carbon leakage sectors described above, as a rule emission allowances are distributed via auctioning in the Quebec cap and trade. The auctioning rules are set in section 45-ss of the GHG Regulation. Here, it is specified, *inter alia*, that the Ministry is responsible to auction emission units in a specific place or online, at most 4 times per year.

Every emitter or participant registered in the CITSS, except an emitter or a participant whose accounts have been suspended or revoked for a reason other than a failure to surrender the GHG emissions of a covered establishment, may take part in an auction. For this purpose, the emitter or participant must, at least 30 days before the date of the auction, register with the Ministry as a bidder, by submitting the information and documents required in section 46 of the Regulation, and, most importantly, submit a financial guarantee to the Ministry, at least 12 days before the date of the auction.[35]

2.3.6 The Quebec Compliance Instrument Tracking System Service (CITSS)

According to section 7 of the GHG Regulation, every emitter subject to the Quebec cap and trade system must register by providing the Ministry with the information and documents listed therein. When an application for registration meets the requirements of sections 7-13 of the GHG Regulation, the Ministry opens, in the electronic system: (1) for each emitter or participant, a general account in which the emission allowances that may be traded are recorded; and (2) for each emitter, a compliance account in which the emission allowances used to cover the GHG emissions of its covered establishments at the end of a compliance period must be recorded.

The CITSS is a computerised GHG emission allowance tracking system that serves as the official register of the Ministry in support of the implementation of the cap and trade system. Issuance, trading, use and cancellation of GHG allowances are all tracked in a transparent and secure way within the CITSS. Finally, recalling what has been already explained above with regard to the registration procedure regulated by sections 7-ss of the GHG Regulation, it should be further pointed out that, since the Quebec and California CITSSs are linked under the central administration of WCI Inc., registration of covered entities is mutually recognised in both countries. However, emitters owning installations covered by the respective cap and trade schemes in both jurisdictions will have to open a CITSS account in both of them.

[35]The financial guarantee requirements to be met are spelled out in section 48 of the Regulation.

Table 2.5 Volumes and prices of Quebec emission allowances at auctions

Auctions	QEA 2013 sold	Future QEA sold	QEA 2013 selling price	Future QEA selling price	Purchasing QEA costs
Auction 1	1,025,000	1,708,000	10.75	10.75	29379750
	QEA 2014 sold	Future QEA sold	QEA 2014 selling price	Future QEA selling price	Purchasing QEA costs
Auction 2	1,035,000	285,000	11.39	11.39	26424800
Auction 3	1,049,111	1,302,000	11.39	11.39	26779154.3
Auction 4	694,000	1,455,000	11.39	11.39	24477110
Joint Auction 1	23,070,987	10,787,000	13.68	13.41	460264772.2
	QEA 2015 sold	Future QEA sold	QEA 2015 selling price	Future QEA selling price	Purchasing QEA costs
Joint Auction 2	73,610,528	10,431,500	15.14	15.01	1271040209
Joint Auction 3	76,931,627	9,812,000	15.01	14.78	1299765081
Joint Auction 4	73,429,360	10,431,500	16.39	16.1	1371454360
Joint Auction 5	75,113,008	10,431,500	17.00	16.89	1453109171

2.3.7 Carbon Pricing

A price floor of 10.75 CAD $ (Canadian Dollars) has been applied from 2013 (beginning of the Quebec ETS) and is scheduled to increase at a rate of 5 % plus inflation every year until 2020. Since the linkage with the Californian ETS and the first joint auction in November 2014, the annual price floor was set at CAD $12.08 for Quebec and US$12.10 for California (CDC Climate et al. 2015). In the joint auctions, the price floor is equal to the highest of the two based on the exchange rate at the time of the auction. For example, during the joint auction held in February 2015, the highest price floor turned out to be that of California so that the price for Quebec was set at CAD $15.01. Therefore, price floors may vary according to the fluctuations in the exchange rate between US$ and CAD $ and depending on whose price floor is the highest between Quebec and California (CDC Climate et al. 2015).

Table 2.5 reports volumes and prices of the Quebec emission allowances (QEA) sold at the auctions (first separately and then jointly with California), as well as the overall corresponding purchasing costs sustained by the operators (equal to the product of current and future allowances sold times their corresponding price).

As Table 2.5 shows, the selling price of Quebec emission allowances (expressed in Canadian Dollars) experienced a substantial rise ever since the beginning of joint auctions. As to the volume of the emission allowances, the amount sold at the joint auctions turned out to be much higher than that sold from California and Quebec separately before their linking. This can be easily verified by comparing the amount sold at the 2015 joint auctions (always above 70 million allowances, see Joint Auctions 2–5 in Table 2.5) with the overall allowances sold at the last separate auctions (which sum up at around 23 million allowances).[36]

2.3.7.1 Auction Revenues and Incentives to Environment-Friendly Technologies

Auction proceeds go to the Quebec Green Fund, in order to finance the 2013–2020 Climate Change Action Plan (CCAP) initiatives. Environmental measures and initiatives supported by the Green Fund in order to create a greener economy include innovation and the development of knowledge and technology, awareness-raising, land-use planning and development of and participation to related national/international GHG reduction initiatives.

An estimated budget of CAD $3.3 billion is expected to be used for such measures in the period 2013–2020 (Gouvernment du Quebec 2012).[37] The largest share of this budget should derive from auction revenues raised by the ETS. In mid-December 2015, the overall amount of proceeds paid to the Green Fund from the joint auctions held so far was equal to CAD $864,881,669.79 (Gouvernment du Quebec 2015).[38]

Box 2.1 The (former) Australian ETS: a quick glance

As mentioned above, in the Preface, beside the three selected ETSs (California, RGGI and Quebec) that have been analysed in a detailed way in this chapter, there are also other relevant ETSs experiences around the world. A special mention is deserved by the (former) Australian regime, which, despite having been now repealed, represents nonetheless an interesting example of an ETS, from which some lessons can be learned.

The Australian ETS, namely the Carbon Pricing Mechanism (CPM), was operative from 2012 to 2014. More precisely, it was established in November 2011 by virtue of the Clean Energy Act and started to operate in July 2012; quite soon, however, following a change in the political majority after the Australian 2013 general elections, the scheme was firstly suspended and then repealed in July 2014 by the Clean Energy Legislation (Carbon Tax Repeal) Act 2014.

At a closer look, the Australian scheme, on the one side, similarly to the other ETSs examined above, was conceived as a market-based tool to be

[36]The overall amount sold before linking can be computed summing up allowances separately sold at Auction 8 in California (see Table 2.1) with those sold at Auction 4 in Quebec (see Table 2.5).

[37]http://www.mddelcc.gouv.qc.ca/changements/plan_action/pacc2020-en.pdf.

[38]http://www.mddelcc.gouv.qc.ca/changements/carbone/revenus-en.htm.

integrated by other national mitigation actions and measures with the view to curb Australian GHG emissions by 5 % compared to the 2000 levels by 2020. However, on the other side, when compared to the other existing ETSs, the CPM was a quite peculiar case, specifically with regard to its structure. In fact, it foresaw a two-stage structure, consisting of a first phase (2012–2015), in which a carbon pricing mechanism (a carbon tax) was introduced, and a second phase (2015–2018), in which the real ETS should have come into play. Unfortunately, as already anticipated above, the Australian ETS was suspended and then repealed, before the beginning of phase two. Therefore, in reality, the proper cap and trade regime never really started to operate in Australia.

Despite its short duration and substantially unsuccessful outcome, the experience of the Australian ETS is particularly relevant, insofar as it is a good example of the difficulties that some countries may encounter in establishing their national Emission Trading Schemes. A major difficulty in this sense can be represented by the widespread opposition that may sometimes emerge against a carbon tax or a cap and trade scheme, due to the fears of a decrease in international competitiveness for the firms subject to such regime, as compared to other competitors operating at international level on the same product market, which are not subject to similar obligations and related costs. This was, in fact, the main reason that influenced the decision of the new Australian Government to suspend and repeal the CPM, following the 2013 general elections.

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Chapter 3
Comparing the EU ETS with Its Followers

3.1 Introduction

Emission Trading, and in particular, the European Union Emission Trading System (EU ETS), has received increasing attention in the last few years among both scholars and policy-makers. Many contributions have examined the legal, institutional and economic features underlying the functioning of the system (see Grubb and Neuhoff 2006; Grubb 2009; Tietenberg 2006; Ellerman et al. 2007; Kruger et al. 2007; Freestone and Streck 2009; Tuerk et al. 2009; Convery et al. 2010; Ellerman 2010; OECD 2011; Olmstead and Stavins 2012; Burtraw et al. 2013; Delbeke and Vis 2015), as well as the environmental effectiveness of its implementation (cf., for example, Anderson and Di Maria 2011; Rogge et al. 2011; Calel and Dechezleprêtre 2016; Germà and Stephan 2015). The importance of these analyses goes beyond the EU ETS itself, since cap and trade regimes can be considered one of the most prominent examples of the application of market-based instruments to environmental issues. In fact, the EU ETS represents the tip of the iceberg with regard to the existing cap and trade regimes within the climate change sector, while the Emission Trading regimes can be considered the most relevant application of market-based instruments to environmental problems.

This chapter aims at emphasising the main lessons learnt and the emerging trends of the EU ETS as well as of other relevant ETS regimes, comparing the different systems in order to identify the best practices and the desirable features that future ETS should have.

For this purpose, the structure of the rest of the chapter is the following. Section 3.2 briefly reviews the origin of the Emission Trading Schemes, starting from the early experiences in the United States (US) and focusing on the developments within the EU from a historical perspective. Section 3.3 describes the main features of the EU ETS as it currently stands, emphasising the lessons learnt from its implementation. Section 3.4 presents a focus on the environmental and technological effectiveness of the EU ETS, based on the early experience provided by

S. Borghesi et al., *The European Emission Trading System and Its Followers*, SpringerBriefs in Environmental Science, DOI 10.1007/978-3-319-31186-9_3

the first two application periods. Section 3.5 describes the worldwide sprawling of the ETS, looking in particular at some selected "followers" of the EU ETS, which seems to be quite comparable with the European prototype, namely the Regional Greenhouse Gas Initiative (RGGI), the Californian cap and trade system and the Quebec cap and trade system. Section 3.6 discusses a few emerging trends that are common to the various ETSs taken into account and the current prospects for ETS cooperation and coordination in the future. The final section contains some concluding remarks on the main findings that emerge from the comparative analysis performed in this chapter.

3.2 Evolution of the Emission Trading Schemes

The introduction of the ETS dates back to the 1970s, when the first cap and trade instrument was applied in the USA to implement the Clean Air Act. The success achieved by such a system in reducing air emissions in several US States subsequently led many other countries to adopt a similar policy tool in their own jurisdictions. In particular, those types of instruments initially proliferated mainly in the USA and other Anglo-Saxon countries, traditionally characterised by a liberal approach and, therefore, generally more prone to the use of market-based instruments. For example, Emission Trading systems have been implemented in Australia to reduce water pollution and consumption (Borghesi 2014), as well as in the United Kingdom (UK), where in 2002 the first broad application of a GHG trading scheme was conceived (Smith and Swierzbinski 2007).

On the contrary, for a long time, the European Union (EU) was much more focused on "command and control" environmental regulation and its environmental policies only gradually envisaged the introduction of market-based economic instruments. In fact, the European Commission firstly promoted the adoption of an EU-wide carbon tax in the nineties (Grubb et al. 2014). This proposal, however, was eventually abandoned, since it failed to obtain broad support from EU Member States, mainly due to the negative reaction of the European industrial sector.

Subsequently, the EU, spurred on by the US experience in this field, shifted its attention to the application of the ETS to GHG emissions from the industrial sector. As mentioned in the previous chapters, the EU ETS was first introduced by Directive 2003/87/EC and initially applied to CO_2 and a few sectors only (energy activities—such as oil refineries—production and processing of ferrous metals, mineral industry, pulp and paper industry). Later, its scope was extended to include the aviation sector with Directive 2008/101/EC.[1] Subsequently, the whole EU ETS

[1]According to Directive 2008/101/EC, emissions produced by all flights from, to and within the European Economic Area—that is, the 28 EU Member States, plus Iceland, Liechtenstein and Norway—should have be covered by the EU ETS, as of 2012. However, in order to allow time for International Civil Aviation Organization (ICAO) negotiations on a possible global market-based measure applying to aviation emissions, the EU ETS requirements were provisionally suspended

scheme was revised and updated, with the extension to new sectors (petrochemicals, ammonia, aluminium) and new gases (N_2O and PFCs), through the adoption of Directive 2009/29/EC (EC 2008, 2009).

Surprisingly enough, the EU and the US seem to have inverted their positions, the EU becoming a forerunner while the US being the follower. The attempt to keep up with the USA has led the EU to overtake the USA while making use of its own preferred policy tool. While the EU implemented and further upgraded the EU ETS, the USA did not manage to establish an overall federal ETS, despite the positive experiences of California and of the RGGI scheme established in some of the northeast and mid-Atlantic States of the USA.

As Ellerman correctly pointed out, this denotes a change in leadership in terms of environmental policies at a global level. In fact, nowadays, most countries, including the USA itself, look at the EU ETS as a prototype to be followed in the ETS field (Ellerman 2010). However, some criticalities that emerged in the functioning of the EU ETS, together with the rapid evolution of ETSs around the world, cast some doubts on the capacity of the EU to maintain its role in the years to come. To get a deeper understanding on this issue, in the next paragraphs, we try to emphasise the main lessons learnt from the application of the EU ETS and compare it with the trends emerging in the other ETSs around the world.

3.3 The EU ETS: Lessons Learnt

The experience of the application of the EU ETS Directive in the first two phases[2] (2005–2007 and 2008–2012) shows some remarkable achievements, but also a few important shortcomings.

The main achievement of the EU ETS is given by the records it established, as it is so far the largest carbon market in the world and the first transboundary cap and trade system. In fact, the giant European market includes 31 countries (the 28 EU Member States plus Iceland, Liechtenstein, Norway) and covers more than 11,000 installations. The unexpected capacity of the EU to establish such a broad system in a relatively short time is by far the most important feature that distinguishes the

(Footnote 1 continued)

in 2012 for flights to and from non-European countries, by means of the so-called stop-the-clock decision. Then, such suspension measures were renewed also for the period 2013–2016, so that, practically, so far only emissions produced by (internal) flights occurring within the European Economic Area fall under the EU ETS.

[2]We will focus here mainly on the first two phases of the EU ETS since few data are currently available on the initial part of the third phase (2013–2020). Indeed, if we exclude the carbon price (which is available on a daily basis), most EU ETS-related indicators are released with a significant lag by the European Commission. For instance, information on transactions in the EU ETS is yet to be released for the year 2013 in the EU Transaction Log, the official EU Registry of all transactions taking place in the EU carbon market.

EU ETS from previous experiences in this field. The advantage of such a large market size goes far beyond all the other well-known theoretical advantages of an ETS system, such as the induced technological innovation, the concrete application of the "polluter pays" principle and the greater flexibility of an ETS regime with respect to more traditional command and control instruments. Not only does the scope of the European market boost competition among the economic agents, but it also increases the possibilities of finding buyers for participating installations, thus rewarding innovative firms that manage to reduce emissions. This has the potential to reinforce the incentive to invest in new low-carbon technologies. Moreover, the EU ETS has also a symbolic value, which goes beyond purely economic considerations and demonstrates the will of the EU to stand as a leader in the international environmental policy context. This leading attitude, that the EU showed in the past with regard to command and control tools, now extends to the use of market-based instruments that were once a prerogative of the USA.

On the other hand, some shortcomings, that tend to weaken its effectiveness, have emerged in the implementation of the EU ETS. More specifically, it is possible to identify three main problems that have hindered the functioning of the system in the first two phases: (i) price volatility, (ii) governance problems and (iii) monitoring problems.

First, as pointed out in Chap. 1, the market price proved to be too volatile during the first two phases (2005–2012, see Fig. 3.1).[3] In the initial phase (2005–2007), this was mainly due to an overallocation of permits, while in the second phase (2008–2012), it can be ascribed to a drastic decrease in demand for permits caused by the severe economic crisis.[4] The oversupply observed in the first phases partly reflected an excessively decentralised system with too generic rules for the national caps (see the governance problem described below). On top of that, the difficulty of achieving an international agreement for the post-2012 period lowered the sense of urgency about the necessity of staying on track for the enforcement of the environmental policy goals set by the EU, most notably the reduction of emissions by 20 % (compared to 1990 levels) by 2020. The observed price volatility increases uncertainty for the firms operating on the EU ETS, which may lead to a tendency to postpone costly investments in low-carbon technologies and to keep on using old

[3]The spot price has shown an ample variance even in Phase III, but such variations have been less pronounced than in Phase II (the price range being €5.84 in Phase III versus €14.36 in Phase II). However, in Phase III, the price has been stabilising around a much lower average than in the previous phase, the average annual price in the primary market in Phase III during the years 2013–2015 (€6.03) being about 25 % below the lowest average annual price in Phase II (€8.12). As mentioned above, however, we will focus here on the first two phases since, unlike Phase III, they are already concluded and provide complete information on all transactions details.

[4]Koch et al. (2014) investigate the drivers of the EUA price drop in Phase II and find that economic recession is a robust explanatory variable for the observed price fall, while renewable policies and the use of international credits (that are also often invoked as carbon price drivers) have had a moderate impact on the EU ETS carbon price.

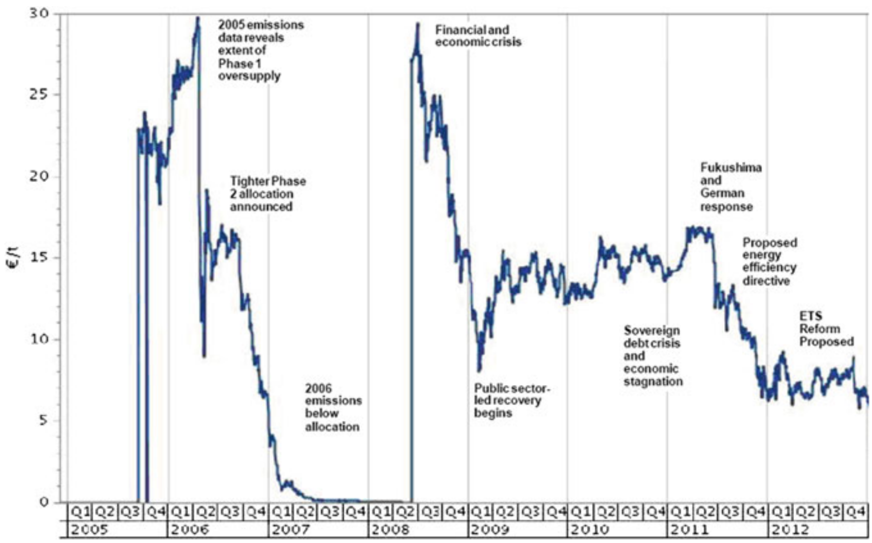

Fig. 3.1 Intertemporal evolution of EUA prices and major events in Phases I and II. *Source* Authors' own elaboration based on Point Carbon (2013) data

polluting technologies with detrimental effects on the environment (Gronwald and Ketterer 2012; Gronwald and Hintermann 2015).[5]

Secondly, the EU ETS showed a "governance" problem, particularly in phases I and II. In fact, the system was characterised by a too decentralised architecture whereby, for example, Member States retained too much leeway in defining the National Allocation Plans for allowances. During the first trading phase, in fact, most National Allocation Plans (NAPs) allocated an excessive number of emission permits, mainly because of the political pressure on the governments from interest groups who wanted to receive more permits (Gilbert et al. 2004; Sijm 2005). A similar overallocation occurred also in the second phase, when the European Commission had to intervene on 11 of the 12 original NAP proposals (with the only exception of the UK), reducing the total number of emission permits that were originally allowed by each State. Moreover, the existence of too generic rules for the national caps caused a lack of adequate tightness of the system. As a consequence, relevant issues, such as the management of the carbon leakage risk, were not properly addressed, leading to EU firms' competitiveness being questioned.[6] The governance

[5]See Clò et al. (2013) for a discussion of the impact of the EUA price drop on the effectiveness of the trading scheme and on the risk of carbon lock-in that the carbon price fall can generate.

[6]The existence and the entity of a carbon leakage effect induced by the implementation of environmental policies are the subject of a heated debate and of an extensive theoretical and empirical literature. See, among the others, Taylor (2005), Dean et al. (2009), Chung (2014) for analyses of the possible delocalisation effect of environmental regulation in general Martin et al. (2014a, b), Borghesi et al. (2016) for a discussion of the effect of the EU ETS regulation in particular.

issues were finally addressed with Directive 2009/29, which abolished the national competence to draft allocation plans and centralised all the relevant EU ETS decision-making power in the hands of the European Commission.

Thirdly, the EU ETS evidenced some management problems, particularly in phases I and II. These were related, in particular, to relevant shortcomings in the functioning of the national registries in some Member States, which highly undermined the effectiveness of the overall EU ETS. In particular, the repeated frauds which occurred in the EU ETS market during the first two phases showed a certain difficulty in monitoring the functioning of the scheme and paved the way for the call for more transparency. For instance, as Frunza et al. (2011) have shown, the volume of permits being traded in the Paris stock exchange fell dramatically once the so-called value added tax (VAT) fraud was discovered.[7] This suggests that the permit exchanges in that market were probably spurred more by the illegal activity that took place in the absence of proper regulation, rather than by the actual need to cover emissions. Beyond the VAT fraud, other scandals have occurred in the second phase, which generated severe criticisms to the effective functioning of the system. In particular, in November 2010, 1.6 million carbon permits went missing from the Romanian registry account of the cement-maker Holcim. On 10 January 2011, a hacking attack occurred on the Austrian registry, and nine days later, a market participant, Blackstone Global Ventures, declared that 475,000 carbon permits (about 7 million euros) had vanished from its account in the Czech Republic. Following the suspected theft from the Czech Republic's carbon registry, the European Commission decided to suspend spot trades (75 % of the ETS market) until 26 January 2011 and several countries (the Czech Republic, Greece, Estonia, Poland and Austria) temporarily closed their carbon trading registries.

These management problems led the European Council's climate change committee to approve new anti-fraud measures on 17 February 2011. Moreover, the EU reacted to these problems by adopting a new Regulation on registry, namely EU Regulation 389/2013, establishing a Union Registry administered at central level by the European Commission, which replaced the more vulnerable national registries, with the aim to prevent the frauds and stop the proliferation of the illegal cyber attacks described above.

On the basis of the pros and cons just shown above, it may be argued, therefore, that Ellerman is right to argue that the EU ETS system is a prototype, but not necessarily a model as it originally stood. In fact, the shortcomings highlighted

[7]By VAT fraud, we refer to the practice of some agents of importing permits VAT-free (due to the zero rate of taxation on intra-community cross-border trade) and sell them in the importing country with VAT charged and afterwards disappear instead of paying the VAT to the government. To make an example, the fraudster may buy permits from firm A located in another EU country and then sell them in its own country to firm B charging the VAT. If the fraudster disappears without paying the VAT, when firm B reclaims the VAT from the government, the Member State will suffer a loss since it has to reimburse an amount of money that it did not receive from the fraudster. This kind of fraud, that exploits the way VAT is treated within multijurisdictional trading, has applied to several other items in the past (e.g. microchips, mobile phones, health products, jewellery, etc.) causing relevant losses to the EU budget (cf. Frunza et al. 2011).

above had to be properly addressed and resolved in order to increase the effectiveness of the European system.

Some relevant shortcomings were addressed by EU Directive 2009/29, which aimed at strengthening the effectiveness of the EU ETS, in particular with regard to the overallocation and surplus of EUAs. However, the amendments introduced did not solve all the problems related to the surplus of EUAs in the European carbon market, which continued to negatively affect the system and undermine its effectiveness.

In order to address such persistent problems, the European Commission proposed the back-loading initiative, which was adopted by the Council and the Parliament in 2013, with the aim of postponing auctions for 900 million allowances planned for the period 2014–2016, so as to rebalance supply and demand in the EU ETS market and reduce price volatility.[8] See also Commission Regulation (EU) No. 176/2014 of 25 February 2014 amending Regulation (EU) No. 1031/2010 in particular to determine the volumes of greenhouse gas emission allowances to be auctioned in 2013–20.

However, the back-loading initiative was meant to represent just a temporary solution to be used during the EU ETS third phase (up to 2020), and the European Commission made clear from the very beginning that a more structural EU ETS reform was needed to correct the surplus of EUAs and to limit its long-term negative impacts on the EU carbon market.[9] To this effect, the European Commission presented a proposal for the establishment of a market stability reserve in the EU ETS,[10] which was approved by the Council and the Parliament in 2015 (see Sect. 1.12 above).

It is still too early to assess whether the approved back-loading initiative (in the EU ETS third phase) or the proposed market stability reserve (in the EU ETS 4th phase) will prove suitable tools to solve the shortcomings experienced so far by the European carbon market. It should be noted, however, that the market stability reserve may prove a controversial solution, in particular if compared with another option, the introduction of a price floor, which might have been chosen instead, to reach more or less the same goals. This alternative solution, in fact, which is a common feature of some of the most relevant ETSs currently existing around the world (e.g. the US-based California and RGGI ones), might have proven in the long term a more effective solution also for the EU ETS (see Sect. 3.5 below).

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[8]Decision No. 1359/2013/EU of the European Parliament and of the Council of 17 December 2013 amending Directive 2003/87/EC clarifying provisions on the timing of auctions of greenhouse gas. OJ L 343 19.12.2013, p. 0001.

[9]For a critical discussion of the back-loading and of the structural measures proposed by the European Commission to reform the EU ETS, see de Perthuis and Trotignon (2014). See also Caton et al. (2015) for an analysis of the implications of back-loading on carbon prices that compares the CO_2 equilibrium price with and without this policy measure.

[10]COM (2014) 20, proposal for the establishment and operation of a market stability reserve for the EU ETS.

3.4 The EU ETS, Eco-Innovation and Environmental Effectiveness: Early Experiences

One of the most important and controversial aspects of ETS regimes concerns their environmental effectiveness. While there seems to be a large consensus in the literature on the efficiency (that is, cost-effectiveness) of the ETS instrument, its capacity to actually reduce emissions is still the object of debate. This seems to apply also to the recent implementation of the EU ETS. During the first two phases, European emissions were substantially reduced. However, one may wonder whether this can be ascribed to the ETS, suggesting a causal relationship, or whether there is simply a spurious correlation between the two events.

According to the data released by the European Environment Agency (EEA 2012b, 2013), EU emissions have steadily declined in the last few years due to warmer weather conditions and more expensive fuels. This has led the EU to achieve and actually "overshoot" the 8 % emission reduction target required by the Kyoto Protocol. As a matter of fact, the overall EU27 GHG emissions were estimated to be 7.7 % below the 1990 levels in 2006, 11.3 % below that benchmark year in 2008, 18.4 % below in 2011, 19.2 % in 2012 and 20.7 % in 2013 (EEA 2012a, 2013, 2014a, b, c, d). This suggests that the Kyoto targets have not only been met, but largely surpassed and that basically the emission reduction target for 2020 (−20 %) has already been achieved by the EU, well in advance with respect to the original time schedule.

Within the EU, however, there exist large differences in terms of emission reductions between the original EU-15 countries and the new Member States that entered the EU after 2004. The overall EU emission reductions have mainly been driven by the EU enlargement into Central and Eastern European countries that have experienced a dramatic decline in their production with respect to 1990 levels. From closer scrutiny of the data, in fact, it emerges that in the new Member States, GHG emissions had decreased by 38.5 % between 1990 and 2013, whereas the EU-15 emissions have fallen by 16.4 % in the same period (EEA 2014e).

The estimated emission reductions, moreover, are likely to depend on the worldwide economic recession that has significantly reduced industrial production (and consequently the resulting GHG emissions). In fact, a look at EU-15 emission trends before the ongoing crisis (see Borghesi 2011; EEA 2010) shows that, when the crisis began to loom large in 2007, emissions were well above the intermediate target, so that the EU-15 was not on track to achieve the final Kyoto target, and that in 2008 they were still only 6.5 % below the 1990 level. Therefore, without the economic crisis and enlargement to Central and Eastern European countries, the EU emission reduction would have been much lower and the EU might have experienced serious difficulties in achieving the Kyoto Protocol target.[11]

[11]This consideration does not deny the possible role that the EU ETS can play in reducing European emissions. Using aggregate data, Ellerman and Buchner (2008) calculate that CO_2 emission abatement was between 2.4 and 4.7 % in Phase I of the EU ETS as compared to a

Another particularly relevant aspect for the assessment of the EU ETS performance concerns its impact on eco-innovation as defined by the "measuring environmental innovation (MEI)" project funded under the EU 6th Framework Programme (Kemp 2010). According to such definition, eco-innovation refers to "any product, process or organisational innovation that is more environment-friendly than relevant alternatives". While the specific effect of the EU ETS on GHG emissions can be hard to disentangle, its impact on eco-innovation (EI) and thus on the firms' capacity to abate pollution can be the object of a more direct investigation, both on the theoretical and on the empirical side. Carbon pricing can persuade the most virtuous firms to invest in new technologies, with a twofold aim: firstly, to avoid purchasing costly tradable permits; secondly, to sell, and thus monetise, the available permits in excess. Furthermore, innovative firms can gain early mover advantages from being at the forefront in the cap and trade market. This can allow them to acquire a dominant position, derived from the capacity to anticipate competitors in the implementation of environmentally friendly innovations (eco-innovations). The incentive to invest in low-carbon technologies, however, is diminished if the carbon price is low or extremely volatile.[12] In the former case, this is because a low-carbon price leads firms to keep using the old, polluting technologies and buy pollution permits rather than shift to new environmentally friendly technologies. In the latter case, it is because high price volatility generates uncertainty about the actual profitability of investing in the new technologies and about the expected advantages of eco-innovations.

As pointed out before (see Sect. 1.11), in the last few years, many contributions have tried to empirically evaluate the impact of the EU ETS on EI and the related literature is rapidly increasing along with the evidence on the ETS application experience.[13] Two main approaches can be distinguished within the empirical literature on this issue. On the one hand, several studies have performed analyses based on surveys of managerial interviews (e.g. Hoffmann 2007; Aghion et al. 2009; Rogge et al. 2011; Anderson et al. 2011; Martin et al. 2011; Schmidt et al. 2012); on the other hand, recent contributions have performed estimations of econometric models that account for the EU ETS among their covariates to test for the weak version of the Porter hypothesis (see Abrell et al. 2011; Borghesi et al. 2015;

(Footnote 11 continued)

counterfactual business-as-usual scenario (without the EU ETS). Similar findings emerge in the study by Anderson and Di Maria (2011) who estimate an emission reduction around 2.8 % in Phase I. What we intend to emphasise, here, is that the EU ETS alone (i.e. without the EU enlargement and the unexpected "contribution" of the crisis) might have been insufficient to achieve the KP target.

[12]See, for instance, Popp (2002) for an empirical analysis of the innovation effects induced by energy prices in general.

[13]See Martin et al. (2015) for a review of the literature on this issue.

Calel and Dechezleprêtre 2016).[14] Mixed evidence and no unanimous consensus emerge from the literature, that is still in its early stages of development, as it generally focuses on the early phases of the EU ETS due to a time lag in the data availability. In the near future, it will certainly be possible to derive more precise and robust indications from the empirical analysis as the EU ETS experience goes on and longer time series of data become available for more refined analyses. In general, however, the main conclusion that can be drawn so far is that the EU ETS had at most a very weak impact on EI. This can be mainly ascribed to the uncertainty surrounding the functioning of a totally new market mechanism, as well as to the high price volatility observed in the first phase. The low propensity to perform EI is particularly remarkable in specific sectors and countries, such as the cement and ceramic industries in Italy (Borghesi et al. 2012). A similarly weak effect of the EU ETs on EI emerges also from sector analyses focusing on other countries, such as the German electricity sector (Hoffmann 2007), or on the EU as a whole (cf. Schmidt et al. 2012, for the power sector). These dynamics, which are to be verified for subsequent EU ETS phases, reinforce the necessity of deepening and expanding empirical research, particularly in those energy-consuming sectors (e.g. cement and steel) in which EI is below the European average.

3.5 The Other ETSs: Differences and Similarities

While the European Union was revising and fine-tuning its own ETS, on the basis of the lessons learnt in phases one and two, a wide array of other ETSs emerged around the world.

Among them, we will focus in particular on the three ETS regimes examined in Chap. 2 as they seem to be quite comparable with the EU ETS: the Regional Greenhouse Gas Initiative (RGGI), the Californian cap and trade system and the Quebec cap and trade system.

All the ETS regimes described above closely resemble the EU approach to ETS. Table 3.1 below provides a comparison of the selected ETSs, highlighting the most relevant aspects underlying their design and features. For the purpose of the comparative analysis, the EU ETS will be considered as a benchmark against which the other relevant ETSs will be described and assessed.

Table 3.1 shows that, as far as their scope is concerned, all ETSs examined—with the exception of RGGI—present several relevant similarities and common features.

[14]As it is well known, the so-called Porter hypothesis (Porter 1991) argues that environmental regulation can have positive effects on firms' competitiveness. Such a hypothesis has been the object of two interpretations: (i) environmental regulation may trigger innovation ("weak" version of the Porter hypothesis) and (ii) induced innovation may enhance firms' productivity ("strong" version). The aforementioned studies, therefore, focus on the weak version of the Porter assumption taking the EU ETS as specific example of environmental regulation.

Table 3.1 The EU ETS and the other ETSs: a comparison

	Starting date	Compliance periods (CP)	Target	Benchmark year	GHG	Sectors	Threshold
EU	2005	1st CP: 2005–07 2nd CP: 2008-12 3rd CP: 2012–20	20 % by 2020	1990	CO_2, N_2O, PFC	Power, heat, energy-intensive industry, aviation	≥25 ktCO2e/y ≥35 MW
California	2013	1st CP: 2013–14 2nd CP: 2015-17 3rd CP: 2018–20	BAU by 2020	1990	CO_2, CH_4, N_2O, SF_6, HFC, PFC, NF_3	Until 2015: first delivery of electricity. After 2015: gas and liquid fuels delivery	≥25 ktCO2e/y
RGGI	2009	1st CP: 2009–11 2nd CP: 2012–14 3rd CP: 2015–18	2009–2014: BAU 10 % by 2020	2009	CO_2	Fossil fuels only	≥25 MW
Québec	2011	1st CP: 2013–14 2nd CP: 2015–17 3rd CP: 2018–20	20 % by 2020	1990	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	Until 2015: industrial and electricity sectors After 2015: also fossil fuel distribution	≥25 ktCO2e/y

(continued)

Table 3.1 (continued)

	Deadlines (month-day)	Price ceilings and floor	Allocation method	Exemptions for carbon leakage	Offset programmes	Banking/borrowing	Sanctions
EU	04/30	Neither ceiling nor floor	Shift from grandfathering to auctioning	Yes	Yes (CDM/JI)	Banking not borrowing	100€
California	04/10 (non power) 06/01 (power)	Floor not ceiling	Auctioning	Yes	Yes (national)	Banking not borrowing	4 * excess emissions
RGGI	03/01	Floor not ceiling	Auctioning	Yo	Yes (national)	Banking not borrowing	3 * excess emissions
Québec	01/11	Floor not ceiling	Auctioning	Yes	Yes (national)	Banking not borrowing	3 * excess emissions

Source Authors' own elaboration

For instance, they all cover a wide range of GHG emissions beyond CO_2. In addition to that, following the European model, all the regimes analysed establish exemptions for installations below certain similar thresholds. Furthermore, all ETSs have been divided into three compliance periods, although these obviously differ across the various regimes because of their different starting dates (with the exception of California and Quebec that started together and adopted the same compliance periods).

Moreover, all the ETSs analysed foresee the possibilities for linking with other project-based GHG emission offset programmes. For instance, the EU ETS allows the use of CO_2 reduction units generated through the implementation of the project-based mechanisms foreseen under the Kyoto Protocol (Clean Development Mechanism and Joint Implementation). Following a similar approach, the RGGI, the Californian and the Quebec cap and trade systems allow the use of credits produced from national offset projects carried out in specific sectors.

An additional common feature to most of the ETS analysed refers to the possibility of applying banking and/or borrowing. In this respect, in line with the EU approach, all the three ETSs analysed (California, RGGI and Quebec) allow banking, but not borrowing of the allowances.[15] Finally, with regard to the preferred allocation method, a common feature shared by all the regimes taken into account is the progressive shift from grandfathering to auctioning, originally envisaged in the EU ETS. Such a shift generated widespread worries within the industrial community of all countries, which led everywhere to the adoption of specific provisions against the risk of delocalisation of productive activities towards "ETS-free countries". In fact, in order to protect the sectors potentially exposed to carbon leakage, all the various ETSs, apart from RGGI, include similar exemptions.

Beside the common features and similarities shown above, a closer look at the ETS regimes taken into account reveals that the followers took a different path on some relevant issues with respect to the pattern set by the EU. As to the sanctioning rules, for instance, while all ETSs examined foresee the obligation for non-compliant firms to surrender the missing allowances in a subsequent period, some remarkable differences apply. In fact, the EU ETS provides for the application of a fixed monetary sanction of 100 euros for each missing ton, whereas the RGGI, Quebec and Californian ETSs opted for a different sanctioning regime, establishing that non-compliant firm installations have to return, respectively, 3 times (for RGGI and Quebec) and 4 times (for California) as many allowances as those not surrendered in each given period. The existence of different sanctioning regimes may imply large differences in the complying costs for the operators being sanctioned.

[15] As pointed out by Newell et al. (2014), banking is widely recognised as "an important tool to avoid short-term supply–demand imbalances and associated price movements". See Chevallier (2012) for a survey of the banking literature.

Just to provide an example, consider the current prices[16] of EU ETS, RGGI and Californian allowances. Given the corresponding sanction systems, a firm that emitted 50 tons in excess of the permits at disposal would have to pay 5304.5€ in the EU ETS, 2434.32€ in the Californian system while only 1163.34€ in the RGGI.

As far as the target setting is concerned, while Quebec has chosen the same target of the EU, corresponding to a −20 % emission reduction by 2020 (as compared to 1990 levels), the US-based regimes have chosen different paths (see Table 3.1). In fact, California merely aims at returning its emissions to the 1990 levels by 2020, while RGGI has chosen a stabilisation target for 2014 and a 10 % reduction target for 2020 (as compared to 2009 levels). In this regard, the Californian target does not appear to be so stringent in absolute terms, while the RGGI choice of taking a different benchmark year for its emission reductions (2009 instead of 1990) makes the systems not fully comparable to the others.

Another remarkable difference that sets the followers apart from the EU ETS concerns the adoption of price floors and ceilings. While the EU ETS has neither a price floor, nor a price ceiling,[17] a different choice has been made by the three other ETSs analysed, which have all chosen an intermediate path, whereby a price floor, but not a price ceiling is provided. Having a price floor has proved to be crucially important in particular for the US-based regimes, as both the RGGI and the Californian ETS allowance prices have basically hit the floor in their early stages of application. As emerges from Fig. 3.2—that compares the price trends of the EUAs, Californian and RGGI carbon allowances for the period 2008–2015—the Californian ETS has shown a price volatility that resembles the one characterising the EU ETS, with the Californian price that has fallen down to $12.22 in August 2013 moving on a declining trend towards its floor that was set at US$10/unit in 2012 and increasing 5 % plus inflation rate every year. Even in the case of the flatter price trend of the RGGI, it is possible to identify a tendency of the emission price to decline towards the price floor, falling from 2.97 in 2009 to 1.96 in 2010 and tracking the floor price (US$1.86 in 2010 and US$1.89 in 2011) from September 2010 onwards. During that period, the share of secondary market exchange-based transactions collapsed from 85 % in 2009 to 6 % in 2011; therefore, the existence of a price floor prevented RGGI price from declining even further. In this regard, it may be argued that the followers of the EU ETS might

[16]To perform the numerical calculation, we used the €/US$ exchange rate as of 28 January 2016 and the following allowance prices taken by the data sources indicated among brackets on the same day: (i) EU ETS = 6.09€ per allowance (https://www.eex.com/en/market-data/emission-allowances/spot-market/european-emission-allowances#!/2016/01/28); (ii) CARB: $13.23 per allowance (http://calcarbondash.org); (iii) RGGI: $8.43 per allowance (https://rggi-coats.org/eats/rggi/index.cfm?fuseaction=reportsv2.price_rpt&clearfuseattribs=true).

[17]The only exception among the countries taking part to the EU ETS is represented by the UK that in August 2013 has unilaterally introduced a price floor equal to £16 per tonne of CO_2, which is expected to rise over time. The government decision has been criticised by many commentators, for the risk that companies pass the cost on to consumer energy bills and for the competition loss that UK firms may suffer as compared to their competitors in the rest of Europe where the price floor does not apply.

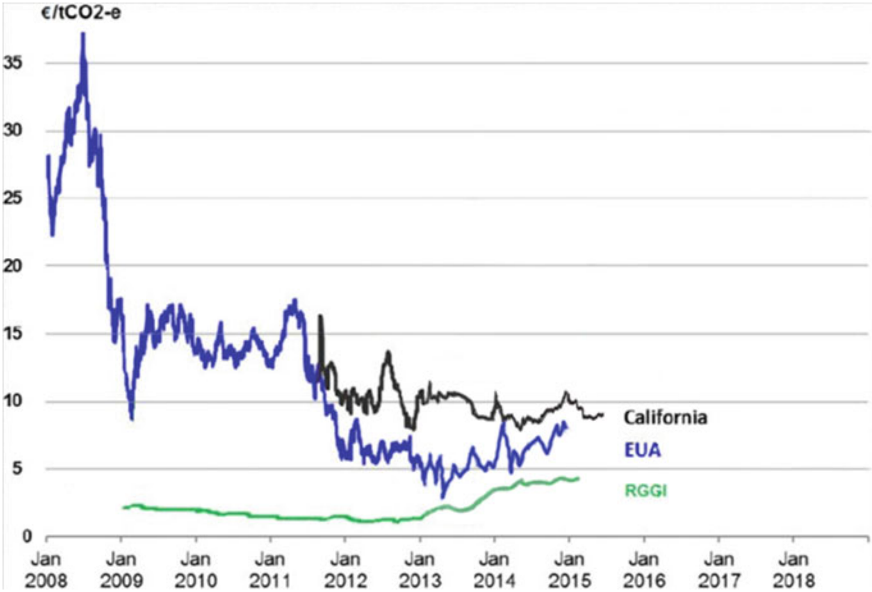

Fig. 3.2 Intertemporal evolution of emission allowance prices on different ETS markets. *Source* Authors' own elaboration based on Point Carbon (2013) extended using EEX data (https://www.eex.com/en#/en), CARB data (http://calcarbondash.org) and RGGI data (https://rggi-coats.org/eats/rggi/index.cfm?fuseaction=reportsv2.price_rpt&clearfuseattribs=true)

have actually improved the functioning of their ETS with respect to the original EU model and that the introduction of a similar price floor in the EU ETS would have probably prevented the European price from collapsing.[18]

3.6 A Few Emerging Trends from the Comparative Analysis

The analysis performed above has shown many common features in the different ETSs, especially with regard to their scope, allocation method and overall climate change goals to be achieved. As a consequence, a first trend that can be identified is that all the ETSs tend to converge to a common structure. Moreover, the ETS is recognised in all the countries analysed as a key tool to tackle climate change (Grubb et al. 2014). This notwithstanding, ETS is normally conceived as an "additional measure", that is an instrument to be used in parallel with others, so as to achieve GHG emission reductions objectives. In this respect, in fact, all the

[18]For a discussion and comparison of the possible mechanisms to implement a price floor and the related implementation pitfalls, see Wood and Jotzo (2011).

countries analysed tend to implement their respective cap and trade schemes along with other renewable energy and energy efficiency instruments, within the broader context of their national climate change policy.

Furthermore, another emerging trend is the provision of special, softer regimes, protecting the national industrial sector from the major risks related to the loss of competitiveness as a consequence of the ETS obligations. All the ETSs analysed (RGGI excluded) endorse this choice, envisaging a direct, free allocation of allowances rather than auctioning, for some exposed sectors, while requiring a rigorous identification of the sectors benefiting from these special regimes (to be determined by the law) and usually providing for these exemption regimes to be temporary.

Finally, all the ETSs analysed foresee some possibilities of “linking” with other project-based GHG emission offset programmes. For instance, the EU ETS allows installations to use Clean Development Mechanisms and Joint Implementation credits for compliance purposes. Similarly, the RGGI, the Californian and the Quebec cap and trade systems allow the use of credits produced from national offset projects carried out in specific sectors, although the sectors involved differ across the ETSs (see Chap. 2). Moreover, all the ETSs allowing for such types of linking solutions, i.e. allowing the use of “external” credits for compliance purposes within the ETS, always set specific limitations in the amount or percentage of credits which can be used for that purpose and prescribe specific conditions for the eligibility of the projects generating the offset credits.

Beyond this “unilateral” kind of linking, with each ETS recognising credits produced from various offset projects, another common feature that is emerging among most ETSs is their effort to establish “bilateral” linking. By this, we mean that one ETS can link to another ETS, so that both ETSs involved mutually recognise their allowances as eligible for compliance under either of the two programmes, thus enabling a two-way flow of allowances. So far, the only existing example of bilateral linking in operation is the one between California and Quebec, which has been established by means of an international agreement signed by the Parties in 2013. However, several other jurisdictions are currently considering the conclusion of similar linking agreements. For instance, the European Union had reached a preliminary agreement with Australia for a bilateral linking, to be started in 2018, but this was eventually abandoned due to Australian government’s decision to repeal its ETS legislation after the 2013 elections (see Box 2.1 above). As a consequence, the European Union is now looking for other partners for the development of bilateral linking agreements that would allow to extend the carbon market and fully exploit the increasing returns to scale that larger markets can generate. The possible emergence of some bilateral linking agreements in the near future has the potential to modify the economic equilibria among the existing ETSs in the years to come and might jeopardise the leadership role played by the EU ETS so far, possibly transforming it from forerunner into follower again.

Given the importance of this topic for the future evolution and success of the ETSs, Chap. 4 will focus specifically on linking, discussing in detail its features, advantages/disadvantages and future prospects.

3.7 Conclusions

The ETS is going through a crucial moment in the history of the climate change policy tools. It has become a milestone instrument for tackling climate change and is rapidly spreading in different jurisdictions, as the preferred tool for pricing carbon.

In such a context, the EU ETS represents the prototype regime with respect to all other similar experiences. The analysis conducted above has described the evolution of the EU ETS, from its origins to the present state, as well as its future prospects. As noted above, quite surprisingly, in recent years, the EU has changed its role from follower (of the US) to forerunner in the ETS race. However, in this attempt to stand as a model for other countries, the EU ETS shows just a partial success, characterised by some remarkable achievements and a few important shortcomings.

The capacity of the EU to build a broad and encompassing carbon market in a short time is, in our opinion, the most astonishing feature that distinguishes this experience from all other ETS in the world. However, such rapid achievement has had its own drawbacks—i.e. high price volatility, governance issues and administration problems—as highlighted above.

Even the reported success of the EU ETS in reducing carbon emissions and inducing technological innovation is not a clear-cut result. In fact, the bright success of the sharp CO_2 reduction is obscured by the dark shadow of the ongoing crisis. Once the clouds of crisis begin to lift, one might wonder whether the success will stay bright, or CO_2 emissions will start rising again.

Moreover, the expected technological improvement driven by the EU ETS is itself an object of debate. Further evidence will be needed in the future to disentangle this aspect and fully evaluate the real technological reactivity to the EU ETS.

Keeping these shortcomings in mind, as both lessons and warnings for the future, we have compared the EU ETS with three other relevant ETS regimes, namely the Regional Greenhouse Gas Initiative (RGGI), the Californian cap and trade system and the Quebec cap and trade system. These regimes have recently emerged as followers of the EU ETS. As argued in this chapter, these followers share with the EU ETS some common flaws, especially in terms of price volatility, but they have also shown the capacity to innovate and possibly devise alternative ways to manage their own ETS regimes, which may in the long term jeopardise the EU leadership in the ETS context.

In particular, as far as price volatility is concerned, the decision by all followers to introduce a price floor turned out to be very useful to prevent their prices from decreasing even further during the recent deep recession. In this regard, the European Union should probably learn from the followers and introduce a price floor in the near future. If not, the price of the European allowances may keep falling and end up becoming an application of what could be provocatively defined "the polluter does not pay principle". In other words, without any price floor, the price can become so low that polluters have no incentive to abate their pollution levels. If this is the case, the ETS would become nothing but one additional financial instrument, loosing the environmental motivation underlying its origin. A risk that, in our view, all ETSs should try to avoid, in order to preserve their credibility as suitable instruments to fight climate change in the future.

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Chapter 4
Linking Emission Trading Schemes

4.1 Introduction

Several Emission Trading Schemes (ETSs) have been developed in the last few years and are now in operation in many countries around the world. In recent times, a growing interest has arisen on the possibility of linking existing ETSs among them, as a viable opportunity for participating countries to increase the effectiveness of their own domestic or regional regimes. In such a context, this chapter provides an analysis of the main contents, features, drivers, pros and cons of linking, as well as the different types of possible linking. Then, assuming that only compatible and comparable ETSs may be linked, the "necessary and optional features" for linking different ETSs are identified and critically assessed. On such a basis, this chapter identifies three concrete options for linking cap and trade schemes, providing a critical analysis of their feasibility, as well as of the main challenges and opportunities raised by them. Finally, a very recent proposal to establish a system of "globally networked carbon markets", that is, connecting existing carbon markets through independent rating agencies and systems, is analysed as an additional opportunity, beyond the three linking options already proposed.

To this effect, the rest of the chapter is structured as follows. Sections 4.2–4.5 focus on linking ETSs around the world. In such a context, more in detail, firstly, the concept of linking is clarified and the different types of linking and their characteristics are introduced. Secondly, the legal requirements for the establishment of a linking between different ETSs are identified. Thirdly, the drivers, as well as the pros and cons of linking, are analysed, together with the necessary and optional features that shall ensure the compatibility and comparability of the ETSs to be linked. Building on such an analysis, Sect. 4.6 proposes three selected options for the linking of ETSs, aiming at enlarging the scope of the existing domestic/regional regimes and ranging from multilateralism to bilateralism. Finally, in Sect. 4.7, a recent proposal for the establishment of a system of "globally

S. Borghesi et al., *The European Emission Trading System and Its Followers*,
SpringerBriefs in Environmental Science, DOI 10.1007/978-3-319-31186-9_4

networked carbon markets" is critically assessed. Section 4.8 concludes with some final remarks on the main findings of the analysis and on the prospective directions for ETS cooperation and coordination in the future.

4.2 Exploring Different Types of Linking

In general terms, linking an ETS with another one aims at enabling operators subject to the first system to acquire allowances from the linked cap and trade scheme and to use them for compliance purposes within their domestic ETS. On the basis of its specific features, three main types of linking may be identified:

(i) Unilateral direct linking;
(ii) Bilateral or multilateral direct linking;
(iii) Indirect linking.

The three types of linking are described below, together with their main features and consequences for the ETSs involved, as well as with some relevant examples.

In the *unilateral direct linking*, the legislation in the "importing" ETS explicitly recognises allowances from the "exporting" ETS as eligible for compliance. However, since the link is unilateral it does not operate in both directions (i.e. if ETS A is unilaterally linked with ETS B, then ETS B allowances may be used within ETS A, but not vice versa).

The main consequence of the unilateral link is firstly an increased demand for allowances from the exporting scheme, making their price increase. As a result of the alternative range of choice for the importing operators, the price for allowances in the importing ETS is expected to decline. Moreover, the respective ETS authorities may adopt rules to control, limit or otherwise manage the flow of allowances from the exporting ETS to the importing one, for example imposing a quota restriction or a charge on the allowances purchased from the linked ETS.

Finally, the exporting ETS authorities must authorise operators in the importing ETS to hold the exporting ETS' allowances and can decide to withdraw and reissue them if they are not used for compliance within a specified period (Burtraw et al. 2013).

One of the most common practices of unilateral linking occurs between ETSs and offset programmes. This is the case, for instance, of the EU ETS and its unilateral linking with the credits originating from Joint Implementation (JI) and Clean Development Mechanism (CDM) projects. Similarly, other relevant cap and trade schemes, such as the RGGI, the California cap and trade and the Quebec cap and trade, allow the use of credits produced from national offset projects carried out in specific sectors, thus establishing a unilateral link with the offset projects generating these allowances.

In the *bilateral or multilateral direct linking*, the legislations of both ETSs involved mutually recognise their allowances as eligible for compliance under either of the two programmes, thus enabling a two-way flow of allowances (i.e. if ETS A and ETS B are directly mutually linked, then allowances from ETS A can be used within ETS B and vice versa). In case the mutual link is directly established between more than two different ETSs, the linking will become a direct multilateral one, whereby allowances from all the different ETS linked are reciprocally recognised as eligible for compliance. Bilateral (or multilateral) linking may be established by means of a bilateral/multilateral agreement between the countries involved or through reciprocal unilateral linking based on individual national legislation in each jurisdiction recognising allowances from the linked programme/s (Mehling and Haites 2009). As a consequence of the bilateral/multilateral linking, the price of allowances within each scheme should tend to convergence. However, in case one of the linked ETS had a heavier "political" weight, its own technical features (e.g. with regard to price collars) might tend to prevail on the others. Similarly, the determination of which of the linked ETSs will be a net buyer or seller will be a matter of both political decisions and economic circumstances (Burtraw et al. 2013).

So far, the only existing example of bilateral linking in operation is represented by the one between California and Quebec, which has been established by means of an international agreement signed by the Parties in 2013. Conversely, the RGGI is the only existing example of multilateral linking established by virtue of a Memorandum of Understanding (MoU) between the participating States, although it refers to a linking applying to a group of States belonging to the same Federal State (namely the USA), rather than to an international multilateral linking among fully sovereign and independent States.

Finally, in the *indirect linking*, whenever an ETS is (unilaterally or bilaterally/multilaterally) linked with another cap and trade scheme, the link indirectly propagates to all the ETSs or offset programmes with which the latter is linked (if any) (i.e. if ETS A is directly linked with ETS B and ETS B is directly linked with ETS C, then ETS A is indirectly linked with ETS C; or if ETS A is directly linked with ETS B and ETS B is directly linked with the Kyoto Protocol CDM and JI—or other type of offset projects—then ETS A will also be indirectly linked with the Kyoto Protocol CDM and JI—or other type of offset programmes).

An example of indirect linking may be envisaged in case that two or more ETSs are already linked between them. As mentioned above, the only existing linking agreement in operation so far is the one between California and Quebec. In this case, therefore, an indirect linking may arise with regard to credits generated from offset projects carried out in one jurisdiction which are then transferred to the other jurisdiction in the framework of the direct bilateral linking.

4.3 The Proper Legal Framework for Linking

In order to establish a linking between existing ETSs, it is necessary to follow a proper legal framework. In brief, a linking may be established in two ways, either by means of a formal international agreement between the Parties involved or via a more informal Memorandum of Understanding (MoU).

The international agreement on the one hand seems to offer more advantages in terms of transparency, accountability, reliability and continuity over time, but on the other hand, it is subject to stricter and more formal rules on interpretation, validity and negotiation process.[1] Thus, an international agreement, on the one side, is characterised by a higher relevance and a more formal standing, but, on the other side, it may involve more burdensome and time-consuming negotiations, as well as a more complex application and interpretation.

Conversely, the MoU seems to be more flexible and characterised by a simpler structure and decision-making process, but lacks the formality and evocative power of an international treaty, and may show laxer features, for example with regard to the risks of unilateral termination by one of the Parties.

In any case, both instruments seem to represent valid and effective international law tools for linking ETSs and both of them are suitable, in general terms, to create legally binding obligations upon the signatory Parties. Therefore, whether to choose the former or the latter instrument will largely depend on the existing political and economic situation and ultimately on the will of the Parties involved in establishing the linking.

The international agreement or the MoU which establishes the linking enables the importation of allowances from one ETS to another. Moreover, it may also provide rules or guidelines on specific issues of common interest to the linked ETSs, such as on monitoring, verification and reporting (MVR) procedures, on applicable time frames (i.e. possible different stages to enact the linking or to make it unilateral or fully fledged), on pricing and possible collars, (i.e. price ceilings and floors), on quantitative, qualitative or temporal restrictions in the use of linked allowances, and on competent authorities involved in managing the linking. It may also be the case that the international agreement or the MoU simply determines framework provisions, leaving to the adoption of subsequent more detailed regulations, in the form of technical annexes or domestic laws of the Parties involved, the duty to determine the remaining relevant technical aspects. Anyway, once the international agreement or the MoU has been concluded, the signatory Parties shall implement it into their national legal system according to their applicable domestic legislation.

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[1]See Vienna Convention on the Law of Treaties (1969), which regulates in general terms the conclusion, application, interpretation and termination of the treaties under International Law.

4.4 Linking ETSs: Main Drivers, Pros and Cons

There are at least three main reasons that may drive countries to link their own ETSs.

The first reason may consist in the political commitment towards a common effort to fight against climate change. Linking various existing ETSs may represent an effective tool to reduce GHG emissions beyond domestic borders. In this respect, the "ordinary expected" mitigation achievements under a certain national ETS may be potentially increased by widening and strengthening the system through linking with other ETSs. In such a context, a country wishing to promote linking may be driven by the will to take the leadership in scaling up the development of market-based tools to reduce GHG emissions and in acting as a facilitator/guide to adopt these policies at international level.

The second reason may consist in pursuing a higher cost-effectiveness in fighting climate change. Notably, ETSs are cost-effective market-based tools designed to contribute to halt climate change, conceived as additional measures to be accompanied by domestic mitigation policies. Linking ETSs offers the incumbent operators a wider range of compliance opportunities, opening up a broader reference market. Indeed, linking provides more flexibility and a variety of compliance choices to the operators subject to their national ETS, by giving them access to a linked market, where allowances may be offered at a lower price or at better conditions. Thus, linking may offer more cost-effective compliance opportunities to operators.

The third reason may consist in strengthening international cooperation with other countries. In this sense, linking a certain ETS with other cap and trade schemes of other countries may also be part of a broader cooperation policy, expanding also into other policies, between the countries involved in the linking agreement. In such a scenario, the main driver for the countries wishing to link their respective ETSs is related to establishing tighter relationships among them in several sectors, among which climate change, due to geographic proximity, cultural affinity and other common interests, such as for instance commercial and trade policy interests. Therefore, the establishment of an ETS linkage may serve as a tool to promote or consolidate a broader cooperation policy between the given countries.

As it can be inferred from above, the main reasons for linking also help in identifying the main advantages offered by linking which, unsurprisingly, fall by and large into the same three main categories identified above. The main advantages for linking, therefore, may be said to refer to the political, economic as well as regulatory and administrative spheres.

With regard to the political pros, considering the difficulties experienced by the climate change international negotiations in recent years, linking ETSs may provide a viable option, which is "alternative" or "additional" to the conclusion and implementation of a troublesome international agreement on climate change. In such a case, a bottom-up approach (i.e. linking domestic ETSs) might prove a more feasible and realistic option to reduce GHG emissions globally as compared to an international agreement on climate change concluded and implemented under the umbrella of the UNFCCC.

As to the economic pros, there might be several economic benefits provided by linking. Firstly, as already pointed out above, linking may provide a range of compliance options to the incumbent operators, which may choose the means to comply with their reduction commitments at the lowest possible cost available on the (enlarged) market. As a consequence, the first and most important economic benefit of linking ETSs is its potential reduction of the overall abatement costs (cf. Kruger et al. 2007; Jaffe et al. 2009; Metcalf and Weisbach 2012; Stranlund 2016). Secondly, by ensuring a certain degree of harmonisation in regulating GHG emission reductions in the jurisdictions involved, it consequently reduces the risks of leakage of economic activities towards countries with laxer standards and rules. Finally, linking ETSs may increase liquidity in the carbon market.

Finally, with reference to the regulatory and administrative pros, it seems that linking may spread positive effects over the climate change regulatory frameworks of the countries involved, since it offers to the regulators the opportunity to exchange lessons learnt and best practices in the cap and trade sector.

Despite the valuable advantages underlined so far, linking of ETSs may also pose some disadvantages for the participating countries, if not properly regulated.

First of all, an ETS linked to another one may be subject to the latter's influence, with regard to modifications in prices, rules and market behaviour of the incumbent entities. This may also involve some loss of sovereignty and control by each one of the involved ETS regulators.

Secondly, if not properly regulated, through clear rules and conditions, linking may lead to a more difficult management of the connected regimes, as well as to an increased lack of accountability and transparency in the connected systems.

Thirdly, despite its valuable benefits in terms of broader flexibility offered to the incumbent operators, linking may also lead to the so-called *race to the bottom* phenomenon, in case operators in the participating regimes were allowed to choose compliance options from the linked ETSs with lower environmental standards or to adopt laxer rules on sensitive aspects such as monitoring, reporting and verification procedures.[2]

In other words, it exists the risk that in some cases, a linking agreement may endanger the integrity of the market and, above all, may lead to achieving lower GHG emission reductions than it would have occurred in a single, non-linked ETS.

Therefore, for a linking between existing ETSs to be effective and achieve adequate mitigation goals, it is of utmost importance to design and implement adequate enforcement and procedural rules for managing the linked schemes.

[2]See Stranlund (2016) for a review of the literature on compliance and enforcement in ETSs and an in-depth discussion of how linking can mitigate or exacerbate compliance and enforcement problems.

4.5 Linking ETSs: Necessary and Optional Features

The existence of a political will to link their respective cap and trade schemes is the first and foremost condition needed for linking different ETSs. However, some other additional features appear to be necessary, while others should preferably occur but are not strictly needed, for the linking to be effective and successful. In this regard, a fundamental requirement for linking different ETSs is the existence of similar or equivalent rules and arrangements with regard to the most relevant technical aspects of the linked ETSs. This requirement may be identified as the "compatibility and comparability" of the ETSs involved and relates to the necessary degree of "harmonisation" between the existing regimes, which has been recognised as a fundamental condition for linking in the relevant literature (Ranson and Stavins 2015; Burtraw et al. 2013; Freestone and Streck 2009; Mehling and Haites 2009; Mace et al. 2008). More in detail, in order to assess the "compatibility and comparability" of the ETSs to be linked, it is useful to identify the ETSs' features that shall be compatible and comparable and to distinguish, among those, the ones that must be similar (*"necessary features"*) from the ones that should be preferably similar (*"optional features"*). To this effect, the following two paragraphs provide respectively a list and a brief analysis of the most relevant necessary and optional features for the establishment of proper linking between different ETSs.

4.5.1 Necessary Features

In our view, the following features must be necessarily similar in order to enable linking between different ETSs:

1. GHG emission cap;
2. Measurement, reporting and verification (MRV);
3. Enforcement procedures;
4. Allowance tracking system;
5. Price collars (floors and ceilings);
6. Banking and borrowing.

(1) *GHG emission cap*: The existence of a determined cap in both/all the ETSs to be linked is a necessary feature. The caps should be clearly identified, compulsory and stringent. Moreover, caps should be preferably of the same nature (i.e. both/all dynamic adjustable or fixed over time) in order to avoid excessively large impacts on the behaviour of incumbent operators in the market (Burtraw et al. 2013). The lack of a clear and concrete cap as well as the existence of different cap stringencies would represent a major obstacle for the establishment of a linking agreement between different ETSs. Linking systems with different stringencies of caps, for instance, will probably induce a flow of capital towards the lower price system, which may be politically unacceptable, especially for the more ambitious system.

Moreover, it could induce the latter system to lower its target, thus possibly determining a race to the bottom.

In theory, as Burtraw et al. (2013) have suggested, it would be possible to establish a linking that accounts for different cap stringencies by adopting an "allowance exchange ratio" between the linked systems (see also Sect. 4.7 below). In practice, however, differences in the stringency of the emission caps (and consequently also in allowance prices) may hinder a linking agreement between two ETSs. In fact, as noted in the literature, the existence of different stringencies is likely to have influenced the Californian decision not to link either with the EU ETS or with RGGI (Ranson and Stavins 2015). Notice, however, that linking might not necessarily require the presence of equal quantitative targets, but it can be based on the mutual recognition that the other ETS is sufficiently stringent, so as to ensure the necessary credibility to the overall linked systems.[3]

(2) *Measurement, reporting and verification (MRV)*: The existence of a strong, compulsory MRV system in both/all the ETSs to be linked is a "must" feature. According to Burtraw et al. (2013), the existence of consistent methodologies for measuring emissions is probably the most important requirement to align and link different cap and trade systems. MRV are essential features of a well-designed, effective and reliable ETS; therefore, their lack would undermine the effectiveness and integrity of the ETS, similar to the lack of a stringent cap.

(3) *Enforcement procedures*: The existence of a robust set of enforcement rules to be implemented and penalties to be issued against non-compliant operators constitutes an essential element of an ETS. Indeed, it ensures legal certainty and enforceability of the ETS. Therefore, its presence in both/all the ETSs to be linked is a basic requirement of foremost importance for the concrete effectiveness of the linked ETSs. Relevant differences in the enforcement rules would question the credibility of the linked systems and could seriously undermine the confidence in the systems. In our view, this applies also to different sanction systems that—as pointed out in Chap. 3—can have very different implications in terms of compliance costs for the operators being sanctioned.

(4) *Allowance tracking system*: The existence of a registry system to track the issuance of the allowances, as well as their property and cancellation, is an essential feature of the ETSs; therefore, in our opinion, it represents also a *sine qua non* precondition for linking. In fact, it is necessary to ensure transparency and accountability in the entire life cycle of the allowances. Furthermore, a well-designed registry system prevents the risks of frauds in the issuance and purchase of the allowances, at the same time avoiding the risks of their double use and double counting. Finally, a particularly important aspect of the tracking system concerns public access to data, which can play a crucial role for proper linking. If systems have different rules on public access to data, firms in more restrictive jurisdictions may end up not exchanging allowances with counterparts in less

[3]In this sense, it should be highlighted that California decided to link with Quebec although they have different emission reduction targets (see Table 3.1 before).

restrictive jurisdictions to preserve their strategic information (Burtraw et al. 2013), thus hindering the functioning of the linked systems.

(5) *Price collars (price floor and ceilings)*: The introduction of price collars is widely debated in the literature (e.g. Burtraw et al. 2013; Stavins 2007; Sterk and Kruger 2009; Tuerk et al. 2009) for the implications that such measures may have both within single ETS and on the prospects of linking different ETSs. Decisions on price collars are difficult to be harmonised due to the political acceptability, domestic priorities and different views concerning regulatory interventions on market mechanisms. However, the unilateral presence of a price floor or ceiling in one ETS would obviously affect the market dynamics in a linked one, thus leading to the propagation of such measures to the other markets. As argued by Burtraw et al. (2013, p. 29), "*there is a strong potential for differing floors to erode the environmentally integrity of the linked programs. If they are not aligned, linking could undermine the value of previous investments and thereby the confidence of investors going forward*".

(6) *Banking and borrowing*: Banking and borrowing are often invoked as a suitable instrument to reduce the compliance costs faced by the market operators. As Aldy and Stavins (2012, p. 158) claim, "*the flexibility to save an allowance for future use (banking) or to bring a future period allowance forward for current use (borrowing) can promote cost-effective abatement*", since it allows operators to perform trading across time. As for price collars, these cost containment measures are also difficult to align. However, the lack of harmonisation between linked ETSs on this issue may severely undermine the efficiency of a linking arrangement. For instance, if an ETS where no banking is allowed is linked to another ETS that allows banking, then compliance entities might change their permits portfolio and shift their allowances demand from the former to the latter ETS (Burtraw et al. 2013). Moreover, in an ETS that allows banking and borrowing the cap is defined de facto on cumulative emissions over a time period rather than on annual emissions. This can create an important disparity between the two ETSs (with and without banking and borrowing) that may prevent the proper functioning of the linking or its existence altogether. Therefore, in our opinion, the alignment of the linked ETSs on common rules for banking and borrowing plays a pivotal role for linking.

4.5.2 Optional Features

Beside the necessary features just described, there are also some "optional" features, which should not necessarily, but preferably, be similar in the various ETSs involved, in order to enable a successful linking between them:

1. Scope;
2. Compliance periods;
3. Allocation method;

4. Linking with offset programmes;
5. Carbon leakage rules.

(1) *Scope (covered sectors)*: The clear identification of the sectors covered by the ETS is a fundamental element for its correct functioning and for ensuring legal certainty. Correspondence in the scope of both/all the ETSs to be linked would be desirable in order to ensure a high degree of coordination and harmonisation and avoid unequal treatment between companies belonging to the same sector, but subject to different regimes, because they are located in different regions. However, such a feature is not a strictly necessary feature for establishing a linking. Differences in the sectors subject to each ETS may reflect their different roles in the linked systems; therefore, in our view, a certain degree of freedom in the selection of the sectors to be covered by each ETS seems to be acceptable.

(2) *Compliance periods*: Setting clear and reliable compliance periods is an important design feature for any ETS, but having the same compliance periods in both/all the ETSs to be linked is not a "must". Two countries, for instance, could decide to organise their own ETS in compliance periods of different lengths due to internal administrative reasons and still find it profitable to link one another, given the fact that compliance is normally assessed on a yearly basis. The presence of the same compliance periods may represent, however, an important comparative advantage for a successful linking, as suggested by the fact that in the case of California and Quebec, the compliance periods were coincident.

(3) *Allocation method*: The existence of an equivalent system to allocate the allowances in both/all the ETSs to be linked represents a highly desirable feature since different allocation methods can generate inequalities between companies that buy permits at auctions and those that receive them for free, although the adoption of exactly the same allocation method is in principle not strictly necessary for linking (Climate Strategies 2009; Freestone and Streck 2009; Burtraw et al. 2013). However, the current trend in the existing ETSs shows that auctioning is the most common allocation method, albeit normally tempered with some exceptions for carbon leakage, since a well-designed auction can ensure cost-effectiveness, transparency and non-discrimination among the operators involved, while avoiding the larger number of permits allocated to big emitters and the possible windfall profits that can arise when permits are given for free on the basis of historical emissions.

(4) *Linking with offset programmes*: Some ETSs establish a direct link with offset programmes generating credits that can be used within those ETS for compliance purposes. The existence of the same rules on offset credits in both/all the ETSs is not a necessary element for linking, but it would represent a desirable optional feature. However, as already pointed out above, it should be recalled here that in case of linking between two or more different ETSs, whereas only one of them is directly linked with offset programmes, the other(s) will also become indirectly linked with them, as a result of the ETS linking agreement. The harmonisation of the rules on offset credits, therefore, is not strictly necessary a priori, but might occur as a consequence of the linking agreement.

(5) *Carbon leakage rules*: Addressing carbon leakage exposed sectors under an ETS may ensure against the risk of the so-called *race to the bottom* and may prevent market distortion and loss of competitiveness. Most of the ETSs currently in force adopt carbon leakage rules as a common practice. In our opinion, the existence of carbon leakage rules in all linked systems is highly desirable, but not strictly necessary, since different rules in terms of carbon leakage exemptions are unlikely to determine significant delocalisation of production across countries. In fact, empirical studies generally find that environmental regulation is not a main driver of delocalisation (see Erdogan 2014 for a survey of the literature). The same seems to apply to ETS as a specific example of environmental regulation (Martin et al. 2014a, b; Borghesi et al. 2016), in particular given the relatively low market prices for carbon permits experienced in most ETSs so far.

As shown in Table 4.1, a certain degree of "compatibility and comparability" of the relevant ETSs is essential for a successful linking. In such a view, a few necessary and some optional features for a well-designed linking of different ETSs seem to emerge from the analysis performed above. Firstly, a stringent, determined cap is essential, together with a strong MRV system, relying on a reliable registry system, that helps preventing frauds. Secondly, setting price floors and ceilings in order to reduce the price volatility frequently observed in the carbon market is also a necessary requirement, as well as adopting same rules on banking and borrowing to enable firms to adjust to unforeseen changes of the economic circumstances. Thirdly, the progressive shift towards auctioning, as the standard allocation system, without extending too much the sectors exempted, but at the same time addressing carbon leakage concerns, is a desirable optional feature which should be preferably, though not necessarily, harmonised. Finally, similarity or harmonisation between the respective scopes and compliance periods is not a necessary requirement, but rather represents a desirable optional feature.

Table 4.1 Necessary and optional features for ETSs linking

GHG emission cap	Necessary
Measurement, reporting and verification (MRV)	Necessary
Enforcement procedures	Necessary
Allowance tracking system	Necessary
Price collars (floors and ceilings)	Necessary
Banking and borrowing	Necessary
Allocation method	Optional
Scope	Optional
Compliance periods	Optional
Linking with offset programmes	Optional
Carbon leakage rules	Optional

4.6 Options for Linking: A Critical Assessment

The lessons learned from the analysis conducted above may provide a useful benchmark for a critical assessment of the possible options for linking between ETSs at a maximum scale (global level) or at a minimum scale (multilateral or bilateral level). In this regard, the following three main alternative options for linking will be presented, which are meant to be read as a continuum from the more advanced one (option 1) to the less advanced one (option 3):

1. A global single ETS;
2. A multilateral agreement among regional/domestic ETSs;
3. One or more bilateral agreements between regional/domestic ETSs.

4.6.1 Option 1: A Global Single ETS

The first option consists in the establishment of a global single ETS, which could build on the existing domestic and regional ETS regimes, by upgrading them into a worldwide single ETS scheme. The creation of a global single ETS could be the evolution of the initial International Emissions Trading instrument, which was originally conceived under article 17 of the Kyoto Protocol as one of the key mechanisms for the fulfilment by the Parties of their commitments. While the original idea was to enable Emission Trading among Annex I Parties only, option 1 proposes its extension to all countries, so that a firm could exchange tradable permits with any other firm around the world.

The essential prerequisite for setting up such a system is that a global ETS agreement is signed at international level with the following three main features: (i) setting up a global ETS regulator, (ii) determining a worldwide cap and (iii) adopting a set of worldwide shared rules. The advantage of a global regulator would consist of ensuring uniformity of treatment for all operators on the carbon market, in particular in the enforcement of the same monitoring, verification and sanctioning rules. Moreover, the global regulator would adopt and implement a common set of rules for managing and operating the global ETS market, which would reduce the transaction costs that operators have to face due to the different norms and regulations applicable in the various jurisdictions.

This option, though theoretically very intriguing, presents, however, serious regulation and implementation problems. As far as regulation is concerned, it is hard to imagine the possibility of reaching an international binding agreement on the establishment of a global single ETS, given the difficulties experienced in the international climate change negotiations in the last few years (Montini 2011; Bodansky 2010). In fact, in recent years we have witnessed a substantial failure of the international climate negotiations to reach a binding agreement on a renewed Kyoto Protocol or another binding legal instrument for the post-2012 period. For a long time, the only tangible result obtained was the approval at Durban in 2011 of a negotiating mandate to adopt a "*protocol, legal instrument or agreed outcome with legal force*" by 2015. While awaiting the results of the negotiations, the Parties agreed at Doha in 2012 to launch a very limited second commitment period of the Kyoto Protocol, confined to the participation of EU and a few other countries,[4] which covers the period 2013–2020. Only recently, at COP-21 in Paris, the UNFCCC Parties managed to reach an agreement on the new climate change institutional and legal framework that will become operational from 2021 onwards. The agreement concluded in Paris is certainly an important and promising step forward towards an enhanced international cooperation and the definition of more ambitious goals, but it still does not contain legally binding targets for the Parties.

Therefore, on the basis of the experience gained in the international climate change negotiations, there seems to be no "political" room for the establishment of a global single ETS through the conclusion of an ad hoc international agreement. Anyway, even in the remote case that a global single ETS might be established sometimes in the future, a global ETS regulator would face severe concrete problems for its implementation. In the first place, it is unclear how a global cap could be set up, given the large political disagreement on carbon reduction targets and means that still affects the international community. In the second place, it would be difficult to reach an agreement on how to allocate emission allowances among the Parties. In fact, alternative allocation criteria would lead to totally different outcomes. To provide an example, if allowances were allocated according to the population level of each country, this would create large disparities between large and small countries and could implicitly promote demographic growth, with its well-known negative side effects on the environment. A similar problem would occur if allowances were attributed on the basis of each country GDP level. This criterion would generate remarkable disparities between rich and poor countries, preventing the latter from growing due to the initial lack of permits that are needed to enhance their economic activities, as well as to the lack of financial resources to purchase the necessary permits. In this case, therefore, poor countries might end up in a poverty trap and would certainly reject the adoption of a similar criterion, as it would be perceived extremely unequal. Another possible approach would be to allocate allowances according to the pollution intensity reduction pursued by each country. Even this criterion, however, could have distortionary effects. In fact, a reduction in pollution intensity is perfectly consistent with a further increase in the polluting emissions as long as the latter grow more slowly than GDP. It follows that this criterion might induce countries to give absolute priority to their income growth (with the consequent negative environmental effects that this may generate) rather than to the reduction of their pollution levels. These problems that were already identified by Pearce et al. (1991) in their seminal contribution in the early nineties are still unresolved. Therefore, more than twenty years later, the world seems to be still immature to embrace a global ETS.

[4]Belarus, Kazakhstan, Liechtenstein, Monaco, New Zealand, Norway, Switzerland, Ukraine.

4.6.2 Option 2: A Multilateral Agreement Among Regional/Domestic ETS Regimes

Considering that the conclusion of an international agreement on a top-down global ETS seems very unlikely, the second option to be explored consists in establishing a bottom-up multilateral agreement among regional/domestic ETS regimes, based largely on the existing systems. This possibility would essentially consist in a multilateral linking of various regional or domestic ETSs. It is evident that option 2, compared to option 1, looks much more feasible, since in this case sovereign countries would not need to delegate all their competences to a global regulator. However, the interested countries would still need to sign an agreement for coordinating their existing domestic/regional ETS, in order to identify minimum common standards for the network to operate. In such a context, for instance, the necessary and optional features identified above would need to become a set of common rules to be agreed by the Parties of the multilateral linking agreement.

Nevertheless, one cannot disregard the difficulties that might arise, even in this case, in negotiating such an agreement. In the first place, although countries would not need to give up all their competences, they would still need to partially limit their sovereignty and revise their own regimes in accordance with the agreed common standards in order to establish the network. This would be likely to encounter some opposition in many countries, particularly at a time characterised by a crisis of the environmental multilateralism (Montini 2011). Hence, although this second option would require a significantly more limited agreement than the one envisaged under the first option, the observed negative trend of multilateralism would also most probably affect the possibility of reaching such an international agreement on the establishment of a network connecting the existing domestic/regional regimes.

In the second place, the existence of numerous and remarkable differences among the existing ETSs might hinder the realisation of this option. In fact, the main ETSs currently operating in several jurisdictions around the world present remarkable differences in terms of price floors and ceilings, targets and length of compliance periods, sanctioning systems, and so on. These differences, especially the ones related to the necessary requirements, appear difficult to overcome in the short run, as the urgency of the climate change issue would instead demand. For instance, setting a minimum common standard on the price floor would require beforehand its introduction in the EU ETS, where it is currently missing. Moreover, it would require a shared view among the regimes examined above on what is the minimum acceptable allowance price. Such a shared view may be difficult to reach due to the large differences in the energy systems on which each regime relies and in the related energy prices. Similar considerations would most likely apply to the identification of a common emission target, which would require a rapid convergence towards a single objective and baseline that currently seems quite hard to reach.

4.6.3 Option 3: One or More Bilateral Agreements Between Regional/Domestic ETSs

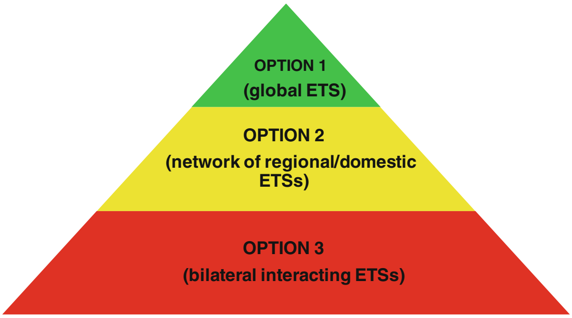
The difficulties highlighted above, with regard to the establishment of a global single ETS as well as a multilateral agreement among regional/domestic ETSs, seem to pave the way for a third option to be considered in the present context, namely the establishment of one or more bilateral agreements between interacting regional/domestic ETSs. In such a case, the interested Parties might try to develop partnerships and transitional arrangements, with a view to promote the adoption of bilateral linking agreements with other countries that have similar ETSs in place.

In this sense, as pointed out above, so far, the only existing example of bilateral linking in operation is represented by the agreement between California and Quebec, which has been established in 2013. Other attempts to reach similar agreements between other ETSs turned out to be unsuccessful so far. In particular, it ought to be recalled here that the preliminary attempt of linking the EU ETS with the Californian ETS started in 2011 encountered significant obstacles, mainly due to the concern raised by each jurisdiction of losing control over the allowance price as well as over the regulation of the system. For instance, while the EU allows the use of CDM credits, but not forest credits, the opposite applies to California (Zetterberg 2012).

These political and regulatory barriers may explain why the EU and California moved apart, looking for alternative partners. In particular, the EU boosted its search for a bilateral agreement with Australia, aiming at connecting and enabling trading between their respective schemes. A shared understanding on linking the EU ETS and the Australian Emissions Trading Scheme was concluded in 2012 (European Commission 2012). According to the preliminary agreement, a unilateral direct linking between EU and Australia should have been in force from mid-2015, whereby European units could be used for compliance with obligations under the Australian Scheme. This should have paved the way for the full two-way bilateral linking to be started in July 2018. However, the developments in the Australian political scenario following the 2013 elections marked a turning point in the negotiations and blocked the implementation of the planned agreement, as the Australian Government decided to repeal its own ETS legislation altogether (see Box 2.1 above).

It should be noted that despite the unsuccessful attempts described above, the EU is still quite open to the possibility of signing some linking agreements with other partners. Moreover, there might be other countries around the world that have an ETS already in operation or are currently aiming at establishing such a regime that might be willing to explore some linking possibilities for their national ETSs in the near future. This could be a feasible way to lay the foundations for the development of a series of bilateral agreements between regional/domestic ETSs. If two or more bilateral agreements were then linked together or if a country concluded several bilateral agreements playing a pivotal role in connecting its own partners, this could then possibly evolve in the long term into a multilateral

Fig. 4.1 The options pyramid



agreement between regional/domestic ETS regimes (option 2) or into a global single ETS (option 1). Thus, if one imagines that California—that is already linked to Quebec—reached a bilateral agreement with another country which has its own national ETS (say, China, that is expected to set a country-wide ETS in the near future), this would automatically create a multilateral agreement among the three countries or regions. This could then potentially evolve into a global ETS if the number of countries entering such a multilateral agreement was subsequently extended, thus progressively moving from option 3 to option 2 up to option 1 (see Fig. 4.1). Given the rapid spread of the ETSs worldwide, this possibility cannot be excluded a priori. In fact, if China—following the pilot projects currently in place—will introduce its own national ETS in the next few years, the country-wide Chinese ETS will certainly become a very attractive partner for bilateral linking agreements, due to its foreseeably giant dimension and growth perspectives. In such a case, the country that will lie at the intersection of several bilateral agreements will play a pivotal role and most probably take the lead in the creation of a hypothetical global market.

In any case, the potential benefits deriving from a bilateral linking or from a series of bilateral agreements between regional/domestic ETSs, such as the one envisaged above, deserve a careful evaluation, for the purpose of our analysis. In fact, one cannot completely disregard the risk that the benefits arising from the enlargement of the market could be counterbalanced by the higher administrative costs deriving from the need to coordinate different jurisdictions. Moreover, the allocation criteria should be harmonised if market competition is to be preserved. Otherwise, less stringent allocation criteria in one jurisdiction would end up favouring installations based in that jurisdiction at the expense of those located in another. In the absence of a basic core of common standards and appropriate coordination, this might lead to a race to the bottom in environmental terms, since each jurisdiction would be prone to protect the interests of their domestic players, by promoting or tolerating overallocation. In such a scenario, one cannot disregard the possibility that multinational firms might be tempted to relocate their installations to less stringent jurisdictions, thus giving rise to unexpected carbon leakage between developed countries. Finally, although the enlargement of the ETS market may improve competition and reduce abatement costs, it may also increase price volatility due to imitative behaviour in the financial market. In fact, the well-known phenomenon of herd behaviour (namely the observed tendency of individuals in a group to mimic the choices of others rather than decide on their own) that characterises many financial markets and has played a major role in triggering the recent global crisis may occur also in this field, since the ETS is itself a financial market.

Despite the existing shortcomings highlighted above, in our opinion reaching a series of "imperfect" bilateral agreements between various ETSs in the near future, and extending the experience beyond the only one between Quebec and California, would be probably better than waiting for a "perfect" bilateral agreement in the long run. This would generate mutual learning from different regulatory experiences in the ETSs context and would create the necessary know-how to improve bilateral agreements and avoid the potential problems described above.

4.7 Beyond Linking? Risks and Opportunities of the ETS Financialisation

In order to realize the potential benefits of a global carbon market (i.e. larger market size, improved price predictability and cost efficiency), the World Bank has recently proposed a new possible option that goes beyond linking as described above (Fuessler and Herren 2015). This proposal consists in "networking carbon markets", namely connecting carbon markets through independent rating agencies and systems. According to the World Bank proposal, the latter would rate environmental integrity and climate change mitigation value of carbon assets in the international markets and then convert ratings into carbon exchange rates. All international trading would then be registered in an International Settlement Platform that would possibly act as clearing house for the whole system.

According to the World Bank (2015), such a proposal could present some advantages with respect to the recently proposed one-way or two-way ETS linking systems. In particular, while linking with ETSs that have inappropriate verification may harm the environmental integrity and credibility of one's own ETS, the rating of carbon assets by independent agencies would preserve environmental integrity, providing a transparent approach that is able to address risk and uncertainty. Moreover, while linking ETSs might reduce national control over domestic climate change policies, connecting carbon markets through exchange rates would respect countries' sovereignty (allowing each jurisdiction to choose the appropriate level of trading in which to engage) and would encourage participation, possibly triggering a race to the top through modifications in the exchange rates.

Although the World Bank proposed system is certainly very interesting, one should not undervalue the risks associated with involving rating agencies in a carbon market, assigning them a pivotal role in the fight against climate change. The recent financial crisis, in fact, suggests that a misevaluation by rating agencies may have serious consequences, possibly causing a "domino effect" that may end up damaging the stability of the whole system.

The possible existence of fluctuations in the carbon exchange rates, moreover, might hamper the stability of carbon markets, increasing the role of expectations and speculative attacks which could lead to enhanced price volatility. In our opinion, therefore, this proposal—though certainly very appealing, particularly for the active and constructive role assigned to the private sector—should be taken with much caution, as it could lead to a larger financialisation of carbon markets that might set them apart from the environmental targets they should pursue.

4.8 Conclusions

This chapter has focused on linking Emission Trading Schemes (ETSs) as a possible option to overcome the difficulties encountered by international climate change negotiations over the last few years and increase the effectiveness of the existing domestic or regional regimes. In such a context, the main contents, features, drivers, pros and cons of linking, as well as the different types of possible linking arrangements have been analysed. Then, assuming that only compatible and comparable ETSs may be linked, the "necessary and optional features" for any successful linking have been identified and critically assessed.

Building on these premises, the attention has mainly focused on three possible options for linking among ETS at a global or at an international level, namely (i) a global single ETS, (ii) a multilateral agreement between regional/domestic ETS regimes and (iii) one or more bilateral agreements between regional/domestic ETS regimes. In the context of such an analysis, it has emerged an observable trend towards a decrease in environmental multilateralism. Multilateralism seems to have lost momentum, and this has obvious implications concerning the feasibility of the different options for connecting ETS schemes via a global agreement, a network of multilateral existing regimes and/or a series of bilateral agreements. Despite the promising results emerged from the COP-21 in Paris, the difficulties experienced in recent years in the international climate change negotiations make the establishment of a worldwide ETS very unlikely at the moment. A similar, though less severe, problem may arise in the attempt to build a global network of regional/domestic ETS regimes. For this reason, the development of a series of bilateral agreements aimed at creating interacting ETS blocks seems the most viable option (if not the only option which is really feasible) towards scaling up the existing ETS regimes as an intermediate step towards a worldwide application. In fact, the development of a series of bilateral agreements between regional/domestic ETS regimes (option 3) may represent a highly desirable solution for the near future, as it could provide the foundations for the establishment of a network of multilateral ETS agreements (option 2) in the medium term that might hopefully evolve into a global ETS (option 1) in the longer run.

Finally, beyond the three linking options listed above, a recent World Bank proposal aimed to establish a system of "globally networked carbon markets", that is connecting existing carbon markets through independent rating agencies and systems, has been presented and critically analysed as an additional opportunity. In this regard, despite the possible advantages that may derive from networking carbon markets, it has been noted that there might be some risks associated with involving rating agencies in a carbon market, assigning them a pivotal role in combating climate change. The recent financial crisis, in fact, suggests that a misevaluation by rating agencies may have serious consequences, possibly causing a "domino effect" that may end up damaging the stability of the whole system. Therefore, in our opinion, while the World Bank proposal deserves particular attention for its innovative character, it still needs a more careful evaluation and an appropriate design in order to avoid the risk that a larger financialisation of carbon markets may hamper the achievement of the environmental targets that is needed to fight climate change.

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