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A Literature Review of the Vulnerabilities to Fraud in the EU ETS and the CDM

How does the environmental context affect fraud in the market?

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Executive Summary

The Kyoto Protocol uses financial incentives to reach the environmental goal of reducing greenhouse gas emissions. This environmental context facilitates certain frauds, namely scams, bribery and corruption and fraud through structural flaws.

This thesis investigates the vulnerabilities of fraud of the European Emission Trading System (EU ETS) and Clean Development Mechanism (CDM). In particular, the purpose is to examine current literature and cases to understand the effect of the environmental context on fraud. Fraud is the outcome of deceitful intentions (Collins Dictionary of Law, 2006).

Based on the fraud cases and literature I found that the main factors facilitating fraud are the complexity of measuring atmospheric gases, their intangibility and alienability, the flawed assumption of perfect interchangeability of credits, the conflicting incentives in a financial market with an environmental goal and the legal vagueness and information asymmetries caused by the structure's uncertainty.

Through the analysis of market players, I found that the incentives of numerous stakeholders make regulating the market difficult. The problem is that good incentives may lead to environmentally undesirable outcomes, while fraudulent incentives may not do so.

Through analysing the cases, the environment is found to be a central victim in scams, bribery and corruption and fraud through structural weaknesses. This means that distant, defenceless or unaware victims cannot sufficiently protect themselves against fraud due to the environment's non-excludability.

Through my findings, I found that most fraud cases that negatively affect the environmental objectives are associated with the CDM, while the other cases were largely associated with the EU ETS. This supports the idea of limiting the trade between the markets to limit fraud.

Instead of replacing the system, I recommend that the know-how should be used to improve the current system, for example by excluding projects with questionable environmental benefits like carbon sinks (Martin & Walters, 2013).

A limitation is that malicious fraudulent behaviour and good intentions with unexpected results were not always possible to distinguish.

List of abbreviations

AIE	Accredited Independent Entity
CDM	Clean Development Mechanism
CO_2	Carbon dioxide
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
EUA	Emission allowance
EU ETS	European Emission Trading System
GHG	Greenhouse gases
JI	Joint implementation
MSR	Market stability reserve
MTF	Missing trader fraud
PoA	Programmes of Activities
VAT	Value-added tax

List of figures

Contents

1. Introduction

The impact of humans on the environment has been researched for a long time. Since then, evidences for major, irreversible anthropogenic changes have emerged. As a result, climate change has become a widely discussed topic, and the effect of human behaviour on the environment has come under closer scrutiny. Climate change has, for example, led to rising temperatures, rising sea levels, extreme weather patterns, and species migration.

Consequently, legislative protection of public environmental assets is moving to the forefront of public's interest. Legislation generally intervenes when market mechanisms are unable to regulate the players' actions, such as due to undesirable effects on third parties or due to fraudulent behaviour. Therefore, officials around the world are facing the previously unprecedented task of regulating global anthropogenic effects on the environment. Facing new regulatory challenges like these require novel solutions, whose outcomes are uncertain and often include fraud opportunities within the new system.

This thesis will concentrate on the Kyoto Protocol's mechanisms used to control greenhouse gas emissions, particularly carbon dioxide (CO_2). For the arguments in this thesis, fraud is defined in accordance with criminal law as "the achievement of a practical result by false pretence" (Collins Dictionary of Law, 2006). The literature review will focus on the vulnerabilities to fraud created within interacting mechanisms like the Clean Development Mechanism (CDM) and EU Emissions Trading System (EU ETS). The CDM certifies projects in developing countries, whose credits can be used to offset emissions in the EU ETS, which is a compulsory cap and trade system with tradeable emission quotas. Specifically, the aim is to investigate if/how the environmental context affects fraud in the markets. This is linked to a number of questions, which will be discussed through the thesis, including:

- What factors facilitate the fraud in these markets (*See 5.1 Factors of fraud in the EU ETS and CDM*)
- How frequent and big is fraud in this field? (*See 5.4 Magnitude of fraud in the EU ETS and CDM*)
- Is fraud a sufficient reason to replace the system? (*See 5.5 Implications of fraud: Scrap it or Save it?*)

- To what extent does the interplay of environmental protection objectives and financial markets create stakeholder incentives, and how may those intentionally or unintentionally lead to undesirable outcomes with regards to environmental protection? (*See 5.1.4 Incentives of stakeholders*)

- Does the environmental context affect the victims' vulnerability to fraud? (*See 5.3 Victims of fraud in the EU ETS and CDM*)

- This flexibility also allows the interaction between mechanisms, does this trading further affect fraud opportunities? (*See 6.0 Conclusion*)

This thesis is not meant to be a discussion of whether or not the EU ETS should have been chosen over a carbon tax initially. However, there will be a discussion whether or not the current system should be replaced by alternative regulations. Overall, due to the size and influence of the mechanisms, the focus will lie on the EU ETS and the CDM. One could argue that the JI is not as central due to its smaller size and as it might yield similar, but moderated, results as the CDM as the JI works mainly in developed countries. The CDM will be important due to its size and trading agreements, which allow it to impact the efficiency of the EU ETS. Also, for simplicity any credit generated under the various mechanisms is simply called credit or EUA if it is transferred, since there is a one to one credit conversation between the mechanisms.

This thesis is separated into six parts. The first part provides an overview of the context and the approach to answer whether the environmental context affects fraud in the mechanisms. The second part will discuss the Kyoto Protocol mechanisms in detail. Furthermore, the stages that firms go through in each mechanism are linked to the relevant opportunities for fraud. This will set the scene for the discussion of the fraud types and factors in the fourth and fifth part. Also, the trading periods of the EU ETS will be discussed to understand the evolution of this complex regulatory mechanism and its effect on fraud. The third part will give a theoretical background of the main concepts, which will be used in the discussions in the following chapters. This part, for example, comments on how emissions as a public bad are commodified and made rivalrous under the cap and trade system.

The fourth part will present the fraud cases separated into the typologies of Martin and Walters (2013). Each type, its factors, reactions and link to the environmental context will be listed. The fifth part will then examine the previously mentioned questions. This starts with a

deeper analysis of the main factors of fraud in the EU ETS and CDM. Also, possible recommendations, which are suggested by scholars, are introduced and critically reflected. The focus then moves to the victims of each fraud type and how they are affected by the environmental context. Due to the non-excludability, there may be several, distant or defenceless groups of victims to one fraud. Finally, the magnitude of fraud in the CDM and EU ETS is discussed and the question of whether the system should be fundamentally changed or if it can be saved is answered.

The sixth and final part is the conclusion. This states that the environmental context does affect the system's vulnerability to scams, bribery and corruption and fraud allowed through structural issues. Moreover, these types can negatively impact the market's environmental objectives. The cases of computer, state or tax fraud are attributed to financial and structural factors and did not directly impact the environmental objectives. Interestingly, most cases that do affect the environmental objectives are associated with the CDM, while the other analysed cases were mainly associated with the EU ETS.

2. Environmental legislation

The first legally binding commitment for emission reductions of greenhouse gases (GHG) is the Kyoto Protocol, in which signatories agree to a 5% reduction within the first interval (2008-2012) compared to the 1990 levels (European Commission, n.d.-a). It includes carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride (European Commission, n.d.-a), each of which are converted into CO_2 equivalents for coherence. The second interval (2013-2020) targets a 20% reduction and adds nitrogen trifluoride to the GHG list (European Commission, n.d.-b). After that the 2020 climate and energy package will aim for a 20% reduction in GHG emissions compared to 1990 levels, a 20% target for energy from renewable sources, and a 20% advance in energy efficiency (European Commission, n.d.-c).

These legislations allow the joint enforcement of targets, acknowledging that an equalisation of the various marginal abatement costs across countries increases efficiency. Therefore, the actual percentage reduction per country varies. This market-based focus is also apparent in the mechanisms members can use to achieve reductions, namely the Clean Development Mechanism (CDM), International Emissions Trading, and Joint Implementation (JI). Fraud can hinder such efficiency and cost equalisation, thus efforts to prevent fraud are crucial.

2.1 EU Emissions Trading System (ETS)

The European, and largest, emission trading scheme is the EU ETS. With this compulsory GHG cap and trade system a pre-defined, maximum yearly emission quantity across all polluters allows for flexibility in the geographical origin of the actual emission reductions. It includes “31 countries (all 28 EU countries plus Iceland, Liechtenstein, and Norway), […] more than 11,000 heavy energy-using installations […] [and] around 45% of the EU’s GHG emissions” (European Commission, n.d.-d).

Within the EU ETS trading is allowed, thus installations can buy or sell emission allowances at a market price if they have insufficient or excess allowances in relation to their yearly emissions. This incentivises firms to reduce their emissions as long as the marginal abatement costs lie below the market price or buy allowances rather than reducing their

emissions if the costs lie above the market price. This allows cost-effective reductions. The allowances can also be banked meaning that instead of being used to cover emissions in this trading period, they are used in future trading periods. One allowance equals one ton of CO_2 or an equivalently harmful amount of nitrous oxide or perfluorocarbons (European Commission, n.d.-d).

Figure 1 describes the steps required to trade EUAs. These stages introduce how the mechanism may be vulnerable to fraud. This will be expanded upon later in the thesis.

Figure 1.

Process of trading in the EU ETS and the related opportunities to fraud

Stage	**Details**	**Link to fraud opportunity**
Opening a Union Registry Account	The firm has to apply for an account. This includes identifying a minimum of two authorised representatives.	These agents need training in security measurements to avert cybercrime. There is a chance that they make bad judgements or steal from the accounts.
Application	The firm has to apply for EUAs with an emissions monitoring plan, specifying the methodology for observing the emissions.	This stage determines the amount of emissions that have to be covered by buying or being allocated EUAs. This might incentivise misrepresentations.
Approval	Applications will be approved by a certified third party, which will in turn be monitored by an accreditation body. Free EUAs will be provided to some industries based on the data of the top 10% of firms in the industry (European Commission, n.d.-m).	To reduce EUA costs, a firm might be open to bribing this verifier. The less efficient the top 10% of firms are, the more free credits will be allocated to the other firms in the industry.

Trading	The firm buys or sells EUAs.	Profit-seeking firms may buy credits which are traded at lower prices, even if the integrity of the source is speculative.
Annual Compliance	The firm has to report the emissions for the last year.	A high EUA price increases the incentive to misreport.
Verification	An independent verifier has to approve the compliance data. The number of site visits is determined by the verifier. After the accreditation body surveyed the verification, the correct amount of EUAs has to be submitted to cover the past emissions.	This creates an opportunity for bribes and corruption. Furthermore, possible resource constraints may decrease the thoroughness of the accreditation body.
Account Confirmation	Within the last three months of very year, every firm has to confirm account details.	This provides opportunities to cyber criminals to gather data.

Note. Project stages and details from European Commission (n.d.-n), DEHSt (n.d.) and European Commission (2015)

The thesis will focus on the vulnerabilities of fraud, which are changing as new regulations are introduced. Therefore, it is important to understand the differences between the following trading periods, to understand the previous progress made in the market:

2.1.1 1st trading period (2005 to 2007):

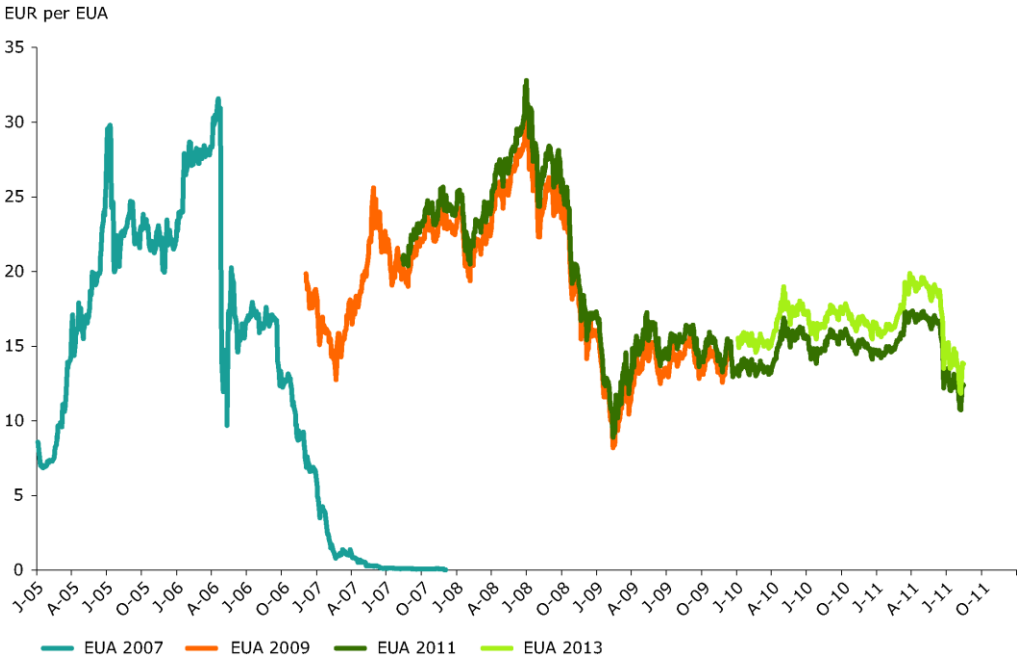
This first period allowed a transition into the system, an opportunity to learn about the new market and time to build the required infrastructure within legal bodies as well as private firms. Energy intensive industries, e.g. cement, oil, bricks or steel manufacturers, as well as power and combustion installations will have to comply with the EU ETS.

The signatories were allowed to determine how many and to what price emission allowances (EUAs) were distributed on the national level. Ultimately, nearly all EUAs were allocated without charge and installations with high previous emissions received a large portion,

thereby being grandfathered into the new system (Bagchi & Velten, n.d.). Ultimately estimations of emissions led to an oversupply of issued credits and a sharp price decline:

Figure 2.

EUA prices 2005 to 2014



Note. Retrieved from *EUA future prices*, by European Environment Agency, retrieved from https://www.eea.europa.eu/data-and-maps/figures/eua-future-prices-200520132011/eua-future-prices-200520132011-eps-file/image_original

2.1.2 2nd trading period (2008 to 2012):

In order to handle the surplus, the EUAs were reduced by 6.5% for period 2 (European Commission, 2016), however, the financial crisis curbed demand for the industries' outputs, therefore the oversupply continued.

The price for each insufficient EUA to cover the yearly emission was set to €100. Also, 1.058 billion tons of newly allowed CDM and JI credits were used in period 2 or banked for period 3 (European Commission, n.d.-f) , worsening the oversupply and furthering price volatility (see Figure 2).

In 2012, intra-European aviation was included under a separate, fixed cap of 5% below the 2004 to 2006 baseline for yearly aviation emissions (European Commission, n.d.-e). The inclusion of flights to airports outside of Europe was recently postponed to 2021 due to the

development of an international aviation carbon scheme, while the allocation of free aviation allowances was reduced from 85% to 50% (Radosavljevic, 2017).

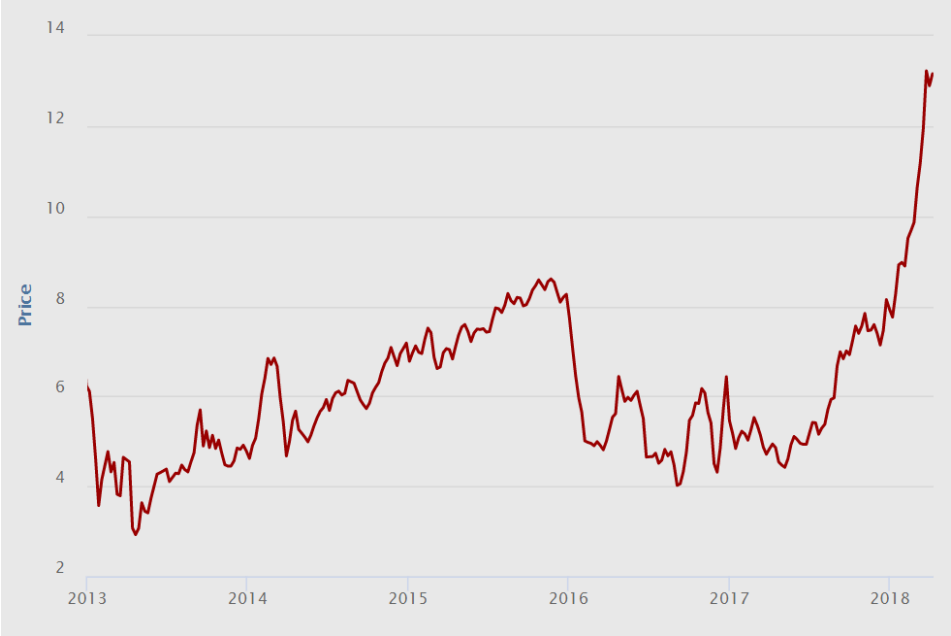
2.1.3 3rd trading period (2013 to 2020):

The surplus was around 2 billion EUAs, which equals approximately one year of EU ETS emissions (Healy, Graichen, Cludius, & Gores, 2017). Throughout the 3rd period, a yearly linear reduction rate of 1.74% will be applied to the cap. While auctioning previously only made up a minority (4%) of EUAs allocation, now stricter guidelines aim for auctioning of around 57% of all EUAs (European Commission, n.d.-g).

To counter the surplus, the European Commission started a short-term action called 'back-loading', in which the auction volume was reduced by 900 million EUAs between 2014 and 2016 (European Commission, n.d.-h). In 2019, these EUAs and circa 600 million unallocated EUAs will enter a market stability reserve (MSR) to reduce the oversupply and the price volatility caused by the impact of major global events (European Commission, n.d.-h). If the amount of EUAs in the market falls under 400 million EUAs or rises above 833 million EUAS, 100 million EUAs will be added or subtracted respectively (Glowacki, 2018). This control of supply could possibly lead to a pseudo price floor or price range.

Figure 3.

EUA prices 2013 to 2018



Note. Retrieved from *European Emission Allowances*, by European Energy Exchange, retrieved from https://www.eex.com/en/market-data/environmental-markets/spot-market/european-emission-allowances#!/2018/04/09 Copyright 2017 from European Energy Exchange AG

The EUA price has risen by nearly €6/ton of CO_2 during the last 6 months (to date: 20.04.2018) (see Figure 3) (European Energy Exchange, 2018). This may be due to expectations of rising prices once the MSR is established in 2019, news about China creating a carbon market or predictions of rising emissions in the near future. At €14.68/ton of CO_2 (European Energy Exchange, 2018), the price is currently higher than the industry experts' average forecast for the end of 2020 of €12.55/ton of CO_2 (Szabo, 2017). However, it is still far from the peaks of around €30/ton of CO_2 seen in earlier periods in Figure 1. Also, the price might change if the expectations turn out to have a different effect on the EU ETS.

2.1.4 4th trading period (2021 to 2030):

From 2021 onwards and with continuity after 2030, the yearly linear reduction will increase from 1.74% to 2.2%. The MSR will be doubled for the first three years of this period. Additionally, an innovation fund will increase support for cutting-edge or exceptional innovation and technologies to rejuvenate the industries and a modernisation fund aims to increase energy efficiency in ten poorer countries (European Commission, n.d.-i).

The aim is to continue auctioning as the main allocation method. Still, in the 4th period, roughly 6.3 billion EUAs will be free for new or expanding firms and sectors with elevated carbon leakage risks (European Commission, n.d.-i). The carbon leakage risk of an industry measures how likely firms, which are facing climate policies, are to leave Europe for countries with lower regulations or enforcement. The aim is to include fewer sectors into this grouping and to eventually end free allocation due to carbon leakage risk.

The aim is that emissions from covered industries have decreased by 40% in 2030 compared to 2005 (European Commission n.d.-d). The 2.2% linear reduction from 2021 onwards will lead to a 43% reduction of emissions by 2030 compared to 2005 levels (European Commission, n.d.-e). Due to these domestic goals, credits from CDM and JI projects are currently not included in the 4th period. Nevertheless, the Paris Agreement will create a replacement and therefore still offer some sort of certified international emission reductions accepted under national goals (European Commission, n.d.-f).

2.2 Clean Development Mechanism (CDM)

Firms in the EU ETS have two possibilities to cover their excess emissions, namely by buying allowances from other firms in the EU ETS or by supporting offset projects in developing countries. The credits from these CDM projects are then acceptable as emission allowances for firms in the EU ETS to allow for low-cost emission reductions.

From the viewpoint of the host developing country, the CDM allows the participation in global emission reductions and the chance of investments, knowledge transfer and economic development for the local community. It implies the Kyoto Protocol's political compromise to allow cheaper reductions by including developing countries without financially burdening them (MacKenzie, 2008).

Fundamental requirements for CDM certification include the demonstration of the financial and environmental additionality of the project. This means that the project would not be financially feasible without the credits and that the project provides greater reductions in emission than would be the case in an alternative future without the project. Without adherence to the environmental additionality rule, the CDM projects would not sufficiently reduce emissions in less developed countries. Thoroughness and the strict adherence to these objectives are important to avoid the flooding of the market with easily acquired credits. A resulting price drop could decrease the incentives for all firms in the EU ETS to reduce their emissions and invest in green alternatives. Hence, problems in the offset market influence the efficiency of the EU ETS.

Credits from nuclear, land-use or large hydropower plants are excluded from the EU ETS (ICAP, 2018). In the third trading period, further restrictions were imposed on the transfer of CDM credits into the EU ETS. Qualitative restrictions exclude credits generated through the highly disputed HFC-23 destruction and any credits that are not generated in Least Developed Countries (ICAP, 2018). Furthermore, while the amount of exchangeable credits from offset projects was previously determined on a national level, in 2013, it will be limited to max. 50% of the reductions between 2008 and 2020.

Figure 4 describes the steps to receive accreditation for a project. This outline is useful to understand the mechanisms' vulnerabilities to fraud for further discussions later in the thesis.

Figure 4.

The stages of the CDM project approval and their fraud possibilities

Stage	**Details**	**Link to fraud opportunity**
Project Design and Formation	The project developer creates a project design document including e.g. the baseline, methodology and additionality calculations.	The validity of these calculations and the methodology are important to fulfilling the environmental objectives of the CDM.
National Approval	The Designated National Authority (DNA) in the developing country has to accept the project.	The DNA employees need adequate training to accurately verify highly unique and complex projects. Possibility of exertion of political pressures and bribes.
Validation and Registration	The Designated Operational Entity (DOE) checks all information, data and whether the approval requirements of the Kyoto Protocol are fulfilled. It will also publicise the project for 30 days to allow comments. The DOE will request the acceptance of the project from the CDM Executive Board (EB).	The project developer and the DOE will agree on the fee. This system is likely to influence the thoroughness of the checks of the design document. Relationships between DOEs and the EB are possible.
Project Financing	This is handled by the project developer.	Once validated, developers can sell credits as future contracts.
Monitoring	The project developer has to regularly monitor and report result to the DOE. These are used to calculate the credits and in the	Remoteness makes checking of self-reported data highly resource intensive for the DOE. This makes thorough on-site checks that go

	verification step.	beyond the provided data unlikely.
Verification and Certification	The DOE publicly verifies and certifies the number of credits generated through the project. After this, any underperformance in emission reductions is the DOE's responsibility. A request for credits is send from the DOE to the CDM EB.	This can be done by the same or another DOE as in the validation step. Bribes but also differences in competence, interpretation or judgement can be reasons for differing outcomes (McAllister, 2011). The developer decides on the regularity of verification, and hence the credit transfers' timing.
Issuance of certified credits	The CDM EB approves or denies the issuance of credits. If approved, it will send out the credits.	Two percent of the credits are kept as an administration compensation, possibly incentivising the acceptance of larger projects.

Note. Project stages and details from Jacqueline M. Drew & Michael E. Drew (2010) and United National Development Programme (2003)

These possible fraud opportunities in the CDM can impact the EU ETS as the tradeability of credits between the two mechanisms allows credits of poor additionality or questionable circumstances to flow into the EU ETS.

2.3 Joint Implementation (JI)

This mechanism of the Kyoto protocol aims to decrease the costs of reducing emissions by allowing countries in the EU ETS to reach their national targets through investing into countries which are also covered by the EU ETS. Like the CDM, the JI facilitates the transfer of investments and knowledge. In contrast to the CDM, the JI takes place in developed countries with relatively strict, established environmental laws and enforcement.

The first credits were able to be used in 2008 (UNFCCC, n.d.-a) and the mechanism only provided a minority of the credits. However, by 2013 it provided one third of the offset

credits through 583 projects (Carbon Market Watch, 2013). Ukraine, Russia and the Czech Republic host the most JI projects (UNEP DTU Partnership, 2018-a).

If the host country has met requirements, such as e.g. having a national, up-to-date GHG inventory and a system to assess anthropogenic emissions, the project belongs to the simplified Track 1 (UNFCCC, n.d.-b). Then, the host country has more flexibility in setting rules, accepting projects and allocating credits. If the requirements are not met, the project belongs to Track 2 and an independent verifier, has to check whether additionality requirements are met. For the more complex Track 2, the certification stages and most fraud opportunities are similar to the ones in the CDM:

Figure 5.

The stages of the JI project approval and their fraud possibilities

Stage	**Details**	**Link to fraud opportunity**
Project Design Document	It includes e.g. the baseline, additionality calculations and findings about the project's effects on the environment.	The fulfilment of the environmental objectives depends on the legitimacy of these calculations and reliability of the methodology.
National Approval	The host country approves the project.	This provides an opportunity for fraud, if officials are corrupt or open to bribery. Even if there is no conscious fraud, missing knowledge of complex project specifics can lead to undesirable lapses in judgements.
Determination	The Accredited Independent Entity (AIE) checks the fulfilment of approval requirements and publicises the information for 30 days to allow for comments.	This process takes between two and twelve months (Closson, 2007), which implies that the AIE efforts may vary, which may be due to the project uniqueness and subjectivity in validation. The stakeholder discussion is dependent on national

		regulation, thereby allowing national differences in thoroughness.
Automatic Certification	The project is automatically certified by the JI Supervisory Committee after 45 days unless they demand an additional inspection.	This time constraint implies that projects with poor additionality are more likely to pass certification during times when many applications have to be checked by the JI Supervisory Committee.
Monitoring	The project is monitored as decided in the validated plan.	The monitoring is done by the developer and then periodically checked by the AIE in the next step.
Periodic verification	The data is verified by the AIE.	The monitoring and the emissions data will be checked during this one-week-long process (Closson, 2007).
Transfer of Certified Credits	If the JI Supervisory Committee doesn't voice any concerns, the host country will send the verified credits to the investing country.	If a project is allocated more than 15,000 tons of CO_2, the fee to the committee doubles from US$0.10/ton to US$0.20/ton (UNFCCC, 2011). This could incentivise the acceptance of larger projects.

Note. Project stages and details from Sophie Closson (2007) and World Bank (2007)

An example of a JI project (Bureau Veritas Certification, 2008):

> The reduction of emissions by replacing traditional fuel fired power plants with 33 hydropower plants in the Ukraine. The project was developed by E-Energy B.V. and verified by Bureau Veritas Certification. The total capacity of the hydropower plants is 25.8 MW and annual emission reductions are estimated to be 37,761 tons of CO_2 equivalent. The verifier received only positive comments from stakeholders and estimated generally positive environmental effects.

3. Theoretical context

This part is an introduction into the theories underlying the mechanisms and discussed in this thesis.

3.1 Marginal abatement costs and tradeability

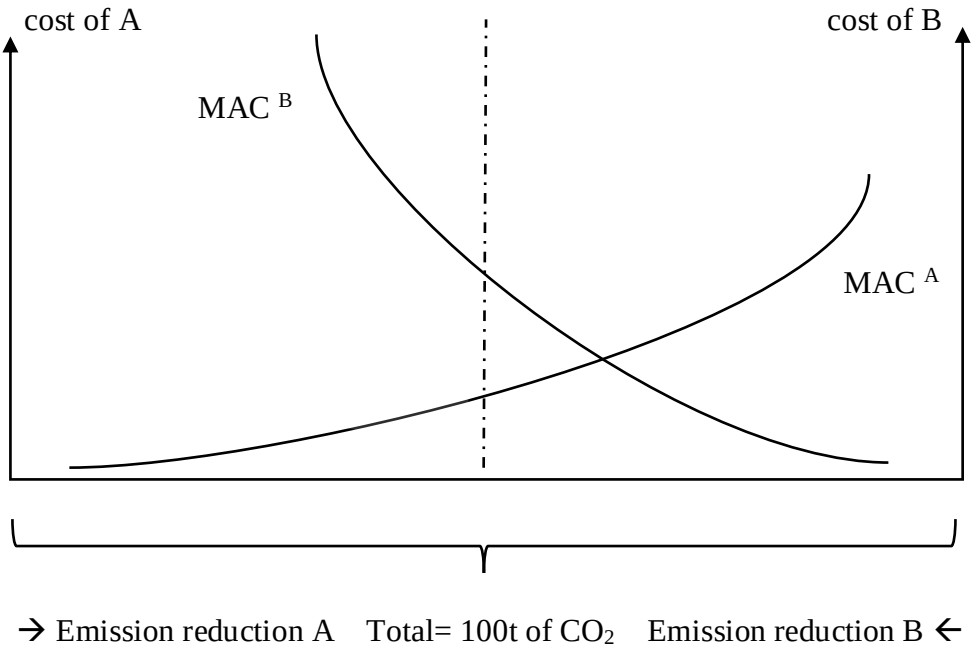
With numerous industries and heterogeneous firms included in the EU ETS, each firm will have unique characteristics that influence its costs of reducing emissions (see Figure 6). The goal is to make reductions inexpensive and stimulate a movement to cleaner, non-polluting alternatives (Kolstad, 2011), while incentivising firms and without greatly diminishing the firm's or industry's profitability. For cost-effective pollution reduction, abatement must be such that marginal cost of abatement are equal across the participants (Kolstad, 2011).

The EU ETS attempts to do so by allowing the trade of emission allowances, so firms with lower abatement costs will be incentivised to further reduce emissions as long as their costs lie below the price of the EUA. Firms with higher reduction costs will not reduce emissions as long as it is more cost-effective for them to buy allowances from other firms. So in Figure 6, firm B will buy EUAs from firm A to cover its emissions for as long as B's MAC are higher than A's MAC. For this market to be competitive and efficient, there must be many firms, which is the case in the EU ETS (Kolstad, 2011).

Furthermore, a firm's abatement, and thus the abatement costs can be decreased by linking one emission trading system with another. Prerequisites for this include several mandatory systems that are consistent in the use of units (a ton of CO_2) and can be combined under one total emission cap (European Commission, n.d.-l). Benefits include more inexpensive abatement, higher liquidity in the market, less price volatility and global consensus about the system (European Commission, n.d.-l).

Figure 6.

Trading of EUAs



Note. Retrieved from Eskeland, G.S. (2017) ENE 423 Environmental Economics Lecture 4, Sept 8, 2017 [PowerPoint slides]. Retrieved from https://nhh.instructure.com/

3.2 Commodification

An EUA, the right to release a ton of CO_2, has been classified as a commodity. Quantities of traditional commodities are principally perfectly interchangeable as long as the quality standard is the same. However, there is a scientific consensus that CO_2 sources are not perfectly exchangeable as "carbon stored above-ground (i.e. in trees) is not equivalent to the carbon stored below-ground (i.e. in fossil fuels)" (Bachram, 2004, p.6). So CO_2 is not "completely privatizable, alienable, separable" (Bridge (2000) as cited in Castree, 2003, p.285).

So one could argue that EUAs are a proxy commodity aimed at facilitating the trade and economic value of CO_2.

3.3 Externalities

Greenhouse gases are pure public bads, so they are non-rivalrous and non-excludable (Kolstad, 2011). Non-rivalrous means that the consumption by one individual does not reduce the quantity to consume by another individual and non-excludable means that it is not realistically possible to exclude someone's exposure (Kolstad, 2011) to the gas. Due to the non-excludability, transactions can have externalities which are positive or negative effects on external stakeholders. These spill-over effects can be widespread and may not be considered by the parties in the negotiations. Without consideration, the external stakeholders are unlikely to receive compensation for any negative effects.

Through the government issued quotas in this cap and trade mechanisms, the regulation attempts to transform a freeriding problem of a public bad by making the emission of greenhouse gases rivalrous. Thus, one firm can only legally emit a ton of CO_2 if another firm does not emit. Therefore, if more firms use the quotas to cover their emissions, it is likely that the price for the EUAs will rise.

3.4 Contract theory and adverse selection

Contract theory specifies how parties in a negotiation create a contract under private information (Arve, 2017). Adverse selection would mean that one party, here the polluter, has some private characteristic that he/she does not disclose to the regulator, but that would influence the optimality of the regulator's decision (Arve, 2017). In the EU ETS this characteristic could concern the firm's cost of emission reductions. Since the regulator has less knowledge about the firm's distinctive characteristics, he has to base his decision on uncertain assumptions. Allowing the tradeability of quotas means that cost differences can be revealed and are exploited by firms acting in self-interest.

4. Fraud analysis

New regulation often provide opportunities for fraudulent activities, e.g. due to uncertainty as well as absence of, or trial-and-error legislations. Fraud in the EU ETS and in the offset market is rising (Interpol, 2013) and common white collar crimes related to financial fraud have appeared as well (Interpol, 2013). Due to the value of the EU ETS, which traded €49 billion in 2015 (European Commission, 2016), it is important to understand how common and how harmful fraud opportunities are. There is little certainty about the number of undetected fraud cases in these mechanisms, however "hundreds of projects and millions of credits are accused of being fraudulent" (Lohmann, 2009, p.176).

There are several reasons why it is critical to specify the fraudulent activities and to find ways to prevent them instead of reacting post-fraud:

- the volume of the EU ETS provides substantial fraud motivation,
- the mechanism's efficient operations are diminished by fraudulent activity,
- the fraudulent activity can negatively affect global environment quality,
- the long-lasting effects of anthropogenic environmental damage through fraud make the next generations dependable on the environmental protection enforcement of the current generation,
- the cheating of underlying environmental goals victimises many third parties, and
- the linking of trading systems will increase complexities and fraud opportunities.

Cases of fraud often involve millions of euros in damages for the victim, e.g., surprise audits in California's ETS "RECLAIM" revealed violations of US$5 million (McAllister, 2011). This might be a reasons why the appearance of these fraudulent cases is widely reported in the media. Other probable reasons for elevated media coverage include the newness of environmental markets and the public's tendency to feel more strongly about pollution than about traditional financial fraud due to negative externalities. However, attention also increases the reputational costs of fraudulent firms and the regulatory structure as they will face stronger public criticism. Therefore, media coverage could somewhat help in increasing

the indirect cost of fraudulent credits and thereby impact the development of the EU ETS and the offset market.

Fraud generally requires some rewards, monetary or otherwise, for dishonest behaviour. Therefore, financial incentives, like the EUA price in the EU ETS, simultaneously provide incentives for correct behaviour as well as for fraudulent conduct. However, the EUA price might not be the only factor for fraud in the EU ETS and the offset market; and while the monetary incentive might not be excludable, there may be other ways to determine or reduce the risk of fraud in the EU ETS and in the offset market. To determine these, the types of fraud and their factors have to be identified and whether or not their occurrence is facilitated by the underlying environmental goal of the markets. For that reason, the fraud cases are separated into the typologies introduced by Martin and Walters (2013):

4.1 Computer crime

Computer crime or cyber-crime is extensive, is often un-reported, increases annually by 11.3% and has an annual global economic impact of US$600 billion (Ashford, 2018). This crime uses computers to, e.g., gain access to external computers through hacking, take control of websites through web jacking or steal personal information through fake internet sites through phishing. Examples include:

- Hacking examples:
    - In November 2010, the account of Holcim Ltd. was hacked, the log-in details stolen and then used to remove 1.6 million credits worth €23.5 million (Interpol, 2013). Through international collaboration 600,000 credits were retrieved but reclaiming the rest was difficult due to the cross-jurisdictional disagreement on whether the previous or the new owner should carry the loss (Interpol, 2013).
    - In January 2011, 475,000 credits from Blackstone Global Ventures' account in the Czech registry were stolen before new security could be installed (Krukowska & Carr, 2011). The company blamed the registry and demands

mandatory insurance for accounts as customary for other financial institutions (Krukowska & Carr, 2011).

- Phishing examples:
    - In January 2011, 2 million credits were stolen through the Austrian, Czech, Estonian, Greek, and Polish registries (Interpol, 2013). Emails were sent to companies that use the EU ETS's registries directing them to fake websites to phish their log-in details and later use those to transfer their credits via the real registries. As a reaction, trading was temporarily suspended and due to quick international collaboration, the credits were tracked and frozen (Interpol, 2013).
    - In February 2010, 250.000 credits worth €3.2 million were stolen through a fake website (Interpol, 2013). As a result, some registries suspended trading temporarily, meaning that permits could be bought or sold but not be moved between firms.

Factors making the system susceptible to fraud include lacking security in the registries, inadequate training of the company employees handling the identification data, different jurisdictions across the EU and the electronic aspect of the EU ETS. The electronic aspect is useful for low transaction costs and fast movement of credits, which in turn makes the market susceptible to computer crime.

Reactions to these cases include demands for binding security standards across registries and secondary authentication like short-time passwords for verifications of transactions. As a result of computer crime in the EU ETS, new legislation was passed that aimed to apply the financial sector's mechanisms to the EU ETS (Interpol, 2013). However, while tracking numbers allow the authorities to react post-fraud, it is predominantly oversight across jurisdictions and international cooperation which are necessary to track credits quickly. Otherwise, as the credits pass through multiple accounts and jurisdictions, it becomes increasingly complex to determine who carries the loss and the resulting long court battles prolong the negative impacts for the victims. This uncertainty allows the establishment of credit verification industries, which, however, could provide additional vulnerabilities to fraud due to the third party involvement.

The question is whether the system is vulnerable to these crimes due to the environmental objective of the market. For computer crime in the EU ETS, the reasons for fraud are mainly related to financial and security aspects, thus, this type of fraud is not affected by the market's environmental nature. Furthermore, the environmental objectives are not directly influenced by cybercrime as no new credits are produced. However, the price drops, due to the uncertainty resulting from these cases, could make emission reductions less attractive.

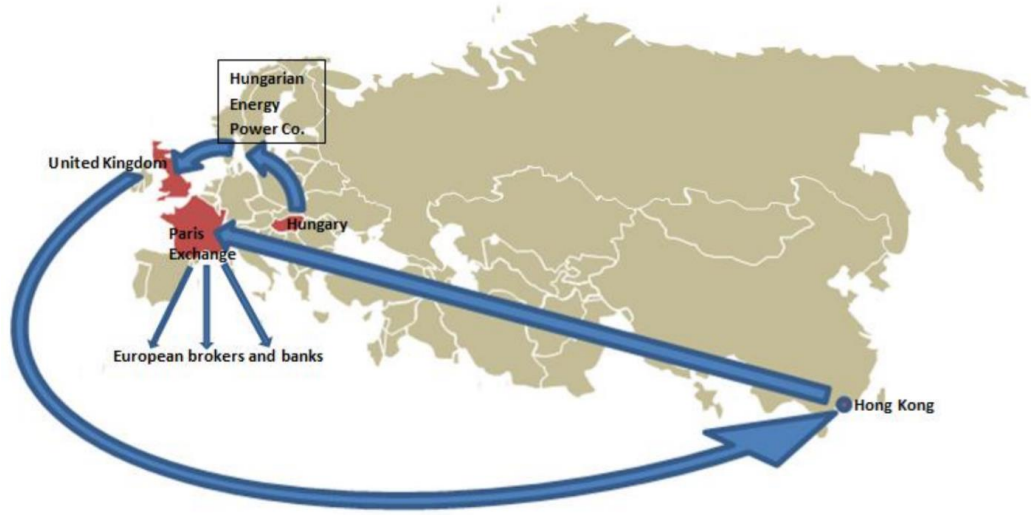
4.2 State crime: Double counting

This type of fraud includes the double counting or recycling of credits. Recycling previously used credits is legal for governments if they cancel the same number of unused credits and only sell them in other markets with the restriction of never entering the original market again. This restriction was not followed in the next example:

- Double counting example:
    - In 2010, 2 million credits were used in Hungary and then sold with the limitations that they may not be sold in the EU ETS again (Interpol, 2013). They were resold legally until a company from Hong Kong illegally put them back into the EU ETS via the Paris Exchange (see Figure 7) (Interpol, 2013). Numerous unsuspecting buyers bought the fraudulent credits (Interpol, 2013). It was not publicised whether the brokers and banks used these credits to offset emissions or stored them as financial investments. Yet, it is reasonable to assume that several buyers bought credits to continue production and cover these emissions.

Figure 7.

Illegal double counting of credits



Note. Retrieved from *Guide to Carbon Trading Crime*, by Interpol, retrieved from https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiw4Onb8a_aAhUEkywKHZA_AmoQFgguMAA&url=https%3A%2F%2Fwww.interpol.int%2FMedia%2FFiles%2FCrime-areas%2FEnvironmental-crime%2FGuide-to-Carbon-Trading-Crime-2013&usg=AOvVaw17tYgpVkx4mNeTxbZqcwH4 Copyright 2013 from International Criminal Police Orgnisation (INTERPOL)

The mechanisms that makes double counting legal for governments adds complexity to the system and the agreement that these credits can be used in foreign ETS facilitates this fraud. Therefore, the easier it is to transfer credits from one ETS to another, the easier double counting becomes. This also highlights the difficulty for national enforcement to cross-check the credits between the international ETSs. Therefore, the linking of ETSs, e.g. the linking of the EU ETS and the Swiss ETS, could facilitate oversight and tracking of double counted credits. This would reduce the risk for honest buyers to get involved in fraudulent transactions.

In 2010, at the time of this case, there was no centralised registry for all EU countries. This hindered detection of the fraud. However, the Union registry was established in 2012 and has since monitored all accounts, transfers and annual settlement of emissions and EUAs (European Commission, n.d.-j). If there is sufficient oversight, this registry could reduce the risk of double counting.

As a reaction to the discovery, the Paris Exchange stopped trading for a few days and initiated returns of the credits to restore market confidence which allowed the price to

recover to previous levels (Airlie (2010) as cited in Interpol, 2013). This case highlights the argument whether the buyer or the seller should be responsible for the validity of the credits.

Is this fraud influenced by the environmental objective of the market? No, it has more to do with the market's structure. However, one might argue that any market lacking a tangible product is vulnerable to double counting, which would include environmental markets as well as more traditional markets like insurance or warranty markets.

The environmental objectives would be influenced by double counting if the government failed to cancel the same number of unused credits. This is not the case in this example. Theoretically, it is also not the case that one credit is used to offset emissions several times, as a different, unused credit was destroyed to allow the trade of the first credit. However, if the government had failed to cancel new credits, this fraud would have negatively impacted the environmental objectives.

4.3 Taxation crime

The embezzlement of Value-added tax (VAT) amounts to around 12% of the yearly EU VAT revenue (European Commission, n.d.-k). Within Europe the transfer of EUAs across national borders involves various VAT rates, ranging from 0% to 27%. This type of fraud includes missing trader fraud (MTF), in which the different VAT rates are exploited through trading across jurisdictions; carousel fraud, which consists of multiple rounds of MTF between the fraudsters; money laundering, which hides illegal funds; and round trip tax scams, in which fraudsters charge themselves artificially high or low prices to send money to tax havens. Examples include the following:

- MTF fraud example:
    - As part of a larger international organisation, 36 people are accused of embezzling €1.6 billion in VAT from the French government (RFI, 2018). This is part of the 2009 MTF that resulted in a €5 billion loss in VAT across Europe (Europol, 2009). Due to the extensive MTF, the trading volume increased by 160% in June 2009 (Martin & Walters, 2013).

- Carousel fraud examples:
    - In 2010, several small companies across Italy collaborated to run a large VAT fraud of €500 million (Reuters Staff, 2010).
    - In 2012, an elaborate scheme in the UK led to €41 million in VAT being stolen (Interpol, 2013).
- Round trip tax fraud example:
    - At normal market conditions, the price is a result of market negotiations. However, two related traders can manipulate the prices or the transaction. An example would be if a company needs EUAs, but instead of directly buying them from their own offset project, they establish a trading company in a tax haven. The offset company will sell the credits with a very low margin, while the trading company will resell with a high margin and thereby store an unjust proportion of the profits in the tax haven.
- Tax fraud example:
    - Seven Deutsche Bank employees were found guilty of embezzling €220 million in VAT through the EU ETS (De la Motte & Votsmeier, 2016).
- Money laundering example:
    - A possible example would be to build an offset project in a developing country with (partially) illegal funds and then trade the credits by buying or selling credits in various ETSs and finally extract the money e.g. through foreign, cross-jurisdictional financial markets or luxury goods.

Factors allowing these MTF and carousel fraud cases include the free inter-jurisdictional trading in Europe (Frunza, Guegan & Thiebaut, 2010) and the electronic, intangible nature, which enables quick and low-cost transfers. The MTF possibility arises if the fraudster "has both the obligation to self-assess the VAT on its purchases and the right to collect VAT on onward sales" (Ainsworth, 2009, para.14). Furthermore, in the auctions, a small price decrease will enable a fast sale, so slim margins also aid this fraud. Moreover, the recentness and uncertainty of the market allowed the parties to avoid detection for two years due to its

dubious status as both a financial instrument and a basic commodity (Frunza et al., 2010), meaning the responsibility for oversight was not clearly defined. Also, overlapping timing with the financial crisis allowed them to avoid detection (Frunza et al., 2010).

Factors allowing round trip tax scams include the ability of firms to position themselves at several stages along the value chain and the uniqueness of each offset project, which in turn makes it difficult to examine whether prices are too high or low.

For money laundering, the more lax regulations in developing countries allowed an entry point to introduce illegal funds into financial markets in developed countries. So tradeability increases the complexity and thereby opportunities for fraud. Also, it is often unclear whether the buyers of credits are involved in the fraud, so the more steps are built into money laundering, the more difficult it is to find the illegal origin of the funds.

As a reaction to the MTF example in 2009, trades were temporarily suspended and the French and UK governments removed the VAT on EUAs, transforming them into securities (Martin & Walters, 2013). Afterwards the market volume decreased by 90% (Martin & Walters, 2013), but this was probably also due to the loss of confidence in the market. The implementation of a 0% VAT rate for imported credits by France and the UK does not reduce the risk for MTF as exporters are still allowed to reclaim VAT (Frunza et al., 2010).

Not all reactions are as swift. Criticism arose saying that six countries, including Bulgaria and Latvia, delayed the implementation of regulations that would then be identical across jurisdictions (Teffer, 2015).

Reactions also include new regulations from September 2012 onward to increase control. For example, a delay of at least 26 hours on non-trusted credit transfers, a limit on the number of transactions permitted, higher security checks for new accounts and equal security requirements for all national registries (European Commission, n.d.-j). Europol was granted authority to monitor accounts and block suspicious EUAs (Brown, Hanafi & Petsonk, 2012).

The question is whether the EU ETS is vulnerable to these crimes due to the environmental focus of the market. For taxation crime, the focus lies mainly on tax evasion, so while the intangible nature and the tradeability of credits may indirectly affect the fraud, it is mainly related to financial reasons and the structure of the VAT system: “While VAT fraud is serious, the threat is not confined to the carbon market; it has a long history in other EU

commodity markets" (Brown et al., 2012, p.26). So the environmental aspect of the market only indirectly influences the system's vulnerability to taxation crimes. The discovery of these fraud cases has increased uncertainty resulting in lower EUA prices and may thereby decrease incentives to fund renewable source. However, overall, tax fraud has not negatively impacted the environmental objectives, as no fake allowances were created as part of the tax fraud. Also, one might argue that the fraud opportunities helped the market to gain momentum and increase in volume. Depending on the fraud's spill-over effects, it may actually include a positive effect on the cost of polluting as EUA prices were high before its discovery due to greater demand and trading volume.

4.4 Scams

This type includes selling fake credits, investment scams, Ponzi schemes and security fraud. The following examples illustrate these variances of scamming:

- Fake credits examples:
    - Six partners, who embezzled a total of £107.9 million by convincing investors to buy credits from fake offset projects, were convicted in November 2017 after 10 years of investigations (HM Revenue & Customs, 2017).
    - Indian firms manipulated the grid emission factor by over-reporting fuel use and omitting projects that would reduce the assigned credits by 1.5% to 3% (Michaelowa, 2011). By multiplying the emissions factor by the activity rate, it determines the number of credits available for offset projects (McAllister, 2011). It is estimated that five projects in China and India received a surplus of 1.7 million credits over 10 years (Michaelowa, 2011; Fogarty, 2011). According to the current price of €13.34/credit (European Energy Exchange, 2018), this would mean €22.7 million were fraudulently acquired through manipulated data within 10 years.

- Investment scam example:
    - AU$3.5 million were embezzled by salespeople who targeted victims through environmental discussions and then called to sell credits, which were never accessible to the victims (Martin & Walters, 2013). While this case occurred outside the EU ETS, both markets provide comparable incentives and structures for investment scam, making the EU ETS is vulnerable to scams.
- Ponzi example:
    - In the Californian ETS "RECLAIM" in 2000, US$50-80 million were embezzled through a Ponzi scheme and the criminal received five years' probation (Interpol, 2013). In Ponzi schemes, old investors are paid off with the money from new investors, creating the illusion of profitability. While this case occurred outside the EU ETS, the EU ETS provides similar incentives and structures for investment scam as "RECLAIM", making the example suitable to the EU ETS.
- Security scam:
    - This fraud would entail the manipulation of EUA prices with false information, e.g. influential traders issuing recommendations to buy or sell EUAs while secretly doing the contrary. Another possibility would be to influence the commodity index to affect demand and EUA prices. Also, if firms are invested into several stages along the carbon market, there is an allure to increase the value of their (offset project) investments by bidding up the EUA prices. Often, investment firms hold stakes in offset project developing firms and market the generated credits. Examples include Goldman Sachs which owns a minority stake in BlueSource (Reuters Staff, 2008a), Morgan Stanley which owns 38% of MGM International (Reuters Staff, 2007) and Credit Suisse which owns 10% of EcoSecurities (Reuters Staff, 2008b). This might give them an advantage in selling offset credits, create information asymmetries or allow the exploitation of power. The manipulation of EUA prices also impacts the incentives of other firms to invest into renewables and may therefore impact the achievement of the environmental objectives.

Factors allowing fake credits include the complexity and geographic remoteness of the offset market, which hinders detection. The environmental context aids in the execution of investment scams and Ponzi schemes as the investors are enticed by the positive message and it might give them intangible benefits linked to ostentation, self-satisfaction and humanitarian effort. The system allows companies to invest at multiple stages along the value chain, which increases fraud opportunities in general as fewer transactions are happening through the efficient market and facilitates security fraud as incentives are not as clearly separated when investors also act as developers and brokers.

The question is whether the EU ETS is vulnerable to these crimes due to the environmental context of the market. Most scams targeting individuals depend on the gullibility of the victims, such as the (private) investors. While the investors' primary goal might be profit, there are likely to be some who were interested in the environmental benefits of their investments, so in those cases the environmental context allowed the fraud to be more successful. An underlying question would be whether these private investors would buy EUAs without the criminal offender's persuasion. If they were planning on buying EUAs anyway, the scam negatively impacts the environmental objectives as more participation by private investors could raise the EUA price and the incentives to invest into renewable sources. However, if they were not planning on investing in EUAs, the scam does not impact the environmental objectives. Another question would be whether the fake credits actually impact the environmental objective. After all, if they are not sold on the carbon market but only to private investors who invest for profit, these scams do not negatively impacted the environmental objectives in the market.

There are some scams that do not target individuals, but the environment, for example, the case of the manipulated grid emission factor. In this case, the environmental context affects the vulnerability of fraud in the market. Also, these cases clearly negatively impact the environmental objectives.

4.5 Bribery and corruption

This type includes false records and pressure on local communities and ecosystems.

- False records example:
    - In Mumbai, a large international consultancy firm simply copied parts of the documentation from other CDM projects (Böhm, 2013). This might be due to corruption or profit-seeking behaviour within the firm.
- Pressure on locals examples:
    - The nephew of the prime minister of Papua New Guinea had been pressuring natives into transferring their land rights to allow for possible future carbon offset projects (Gridneff, 2009).
    - A Norwegian project in Uganda resulted in the involuntary relocation of 8,000 residents from 13 communities (Bachram, 2004). There was no indication about the extent to which Norwegian parties knew about the relocation.
- Pressure on local ecosystem example:
    - In Brazil, a controversial reforestation program with eucalyptus monocultures, led by the World Bank, raised criticism regarding negative social and environmental impacts (Dubey et al., 2011). The offset project resulted in dried up streams due to the thirsty nature of the non-indigenous tree (Bachram, 2004) and cases of misuse of corporate power and intimidation (Dubey et al., 2011).

Even though projects require 3rd party verification, the results may be manipulated through bribes, corruption and extreme political pressure especially when there are strong political or business interests (Interpol, 2013). Due to the non-excludability of carbon, bribery and corruption resulting in negative environmental consequences may affect numerous indirect groups of victims. The factors facilitating the deceitful pressure on third parties or the incentives for fraudsters by decreasing the chance of punishment, can be categorised into two groups:

- Factors linked to the complexity of the CDM process, including
    - The geographic remoteness of projects, which moderates public scrutiny and control;
    - the lack of understanding of the highly specialised CDM processes, which hinders public comprehension;
    - the dilemma of environmental additionality, which is based on an imaginary future baseline that cannot be proven or disproven;
    - the complexity of nature, which makes each project unique and difficult to compare; and
    - the regulation that the DOEs are paid by the project developer, which creates conflicts of interests between accurate verification and financial rewards.
- Factors linked to the structures of the developing countries in which the offsets take place include:
    - the power or interests of corporations and politicians, which is likely positively linked to the project's size;
    - the country's history of corruption and bribery, which makes future bribes more likely;
    - the local people's lack of understanding of the land's market value or their lack of ability to defend against forceful eviction;
    - unclear or unenforced land tenure or ownership and
    - low GDP, which makes prioritisation of local ecosystems over financial rewards difficult.

The CDM system encourages projects in developing countries, which likely include remoteness and corruption as part of that location's mix. Geographic remoteness facilitates the pressure on local communities as it is far away from public scrutiny. Moreover, countries with high corruption are likely to suppress the interests of third parties. The people with the power to stand up for third parties, such as journalists and NGOs, might be less inclined to

do so in countries where they have less protection. The lack of protection has been linked to corrupt countries, where at least one reporter is murdered per week (Transparency International, 2018). So the CDM's desire to reduce reduction costs by sanctioning corrupt, least developed countries makes it more susceptible to fraud.

As a reaction to bribery and corruption cases, the UN is working on increasing oversight by increasing resources, training and control of project support staff (Schapiro, 2010). In 2005, 10% of DOE project applications were returned for more details while 65% were returned in 2010 (Schapiro, 2010). Also, NGOs try to monitor and protest projects, by e.g. establishing networks to exchange information and to empower the public to defend the climate objectives (Coiley, 2017). However, their resources and power are likely limited in relation to political or corporate influence.

The question is whether the offset market is vulnerable to corruption and bribery due to the environmental context of the market:

On the one side, the complex environmental context facilitates fraud and decreases the probability of being detected due to the previously mentioned uniqueness of CDM projects and the difficulty in accurately estimating baselines and additionality. The environmental objective of the projects might make it easier for fraudsters to exert pressure and justify the relocation of locals with utilitarian arguments. Also, as the negative externalities that arise in environmental markets are not experienced by the ones profiting but by the ones who are not included in the negotiations, the environmental context makes the fraud more profitable.

On the other side, one might argue that these corruption cases arise because of the financial incentive, which makes powerful individuals more interested in those areas in the first place and is therefore rather linked to the financial system. But what creates these financial incentives? One could reason that these incentives result from the misalignment of the costs of reducing emissions and the financial reward for doing so, which in turn arises due to the complexity of natural gases and their various sources. The cost of one ton of CO_2 reduction can vary greatly depending on the country, source and local situation. These differences in reduction costs between projects or countries is the reason why the CDM was implemented in the first place. Yet, different costs may lead to greater incentives for fraud as credits are sold for market prices which are not influenced by the costs of sourcing the credits.

Consequently, the complexity of the environment facilitates distorted financial incentives and thereby fraud cases linked to false reporting, corruption and bribery.

Does the fraud in turn impact the environmental objectives? Specifically in these cases, it is questionable whether financial and environmental additionality was achieved. Consequently, the achievement of environmental objectives is also questionable. To fully determine this, implications such as dried up rivers would have to be included. Thus, the complexity lies in comparing the reduction in CO_2 to highly source-specific environmental repercussions. In the previous cases, it seems plausible that fraud has negatively affected the environment and therefore the objectives of the CDM projects. However, this would have to be determined on a project-by-project basis.

The problem with bribery and corruption might be that there are many ways to "go easy" on developers without it being detectable as fraud. Measuring only certain variables during verifications (Interpol, 2013) or simply differences in competence, interpretation or judgement could be reasons for differing outcomes (McAllister, 2011). Therefore, it is likely that the dark figure of bribes and corruption cases in the carbon market is much larger and that many will escape accountability.

4.6 Structural fraud

This type of fraud is created by the poor alignment of the financial incentives used to reach the environmental objectives. This may be due to suboptimal regulations or the lack of oversight, for example, due to lacking spot checks. Examples include:

- Poor incentive structure example:
    - Due to the EU ETS's incentives, a main product, HCF-22, is less profitable than a side product, HCF-23. Therefore, companies are flooding the market with HCF-22 to profit from the inexpensive destruction of HCF-23 (Kaime, 2017). This creates wider negative externalities as the inexpensiveness of HCF-22 averts refrigerator firms from switching to greener products (Rosenthal and Lehren, 2012). While regulation could stop the financial advantage of destroying HCF-23, Chinese companies which do not qualify

for the CDM have gone back to simply releasing the HCF-23 (Siciliano (2012) as cited in Kaime, 2017). This shows how financial incentives allow room for exploitation and incentivise players to profit from a regulatory attempt to protect the environmental.

- The lack of regulation example:
    - The Indian company NFIL has openly stated that they aim to misuse unregulated chemicals, like HCF-23 previously, and aim for short run profits instead of investing into a transition to greener solutions (Rotz, 2011). The firm applied for 2,802,150 credits per year, which were used in the UK and verified by DNV (DNV, 2006).
- Inadequate verification examples:
    - In December 2008, DNV, the validator of 48% of all credits, was temporarily suspended due to flawed reviews and inadequate expertise of field auditor (Schapiro, 2010). A total of five irregularities were found through one spot check of an office in Oslo (Schapiro, 2010). By February 2009, DNV was reinstated (Schapiro, 2010).
    - In September 2009, a spot check at SGS was initiated after some verification reports of a single project were compared and did not correspond (Schapiro, 2010). This revealed six irregularities such as dissatisfying quality of analyses and staff knowledge (Schapiro, 2010). By December 2009, SGS was reappointed (Schapiro, 2010).
    - In 2009, the five largest DOEs were rated by the Öko-Institute and none received a rating better than D (Schapiro, 2010). However, this is not necessarily an indication of fraudulent behaviour.
- Inadequate consideration of local laws example:
    - In Nigeria, the World Bank's initiative to reduce gas flaring enables companies to earn offset credits for reduction programs (Dubey et al., 2011). However, gas flaring is illegal under Nigerian law, so the requirement of environmental additionality based on the current status is not fulfilled. Local

people claim that oil companies exploited the CDM to increase environmental degradation, as flaring was expanded as opposed to reduced (Okakwu, 2016).

Factors facilitating the fraud are linked to the incentive structure created in the CDM:

- In most other markets, the verifiers do not invest or the investors do not produce and use the product themselves -or do so without spill-over effects. Through this, fraudulent behaviour can create undesirable consequences for other players. Yet, in the offset market, firms are allowed to take on roles at several stages along the value chain, which conceals the reasons for specific actions. Examples would be when consulting firms also act as verifiers (Martin & Walters, 2013) or when investors like Goldman Sachs helped design the system and subsequently own 10% of the now retired voluntary Chicago Climate Exchange (Sharife, 2010). These firms could use the knowledge from several stages to exploit information asymmetries and potentially victimise the environment.

- In addition, there is a very small, specialised circle of people who can properly perform on-site measurements (Schapiro, 2010). Because the market of verification and validation is not as profitable as the market of developing projects, many experts are likely to move into the development industry and are later audited by former colleagues (Schapiro, 2010). Their strong understanding of the system and its limitations could aid them in developing projects. This high fluctuation of positions along the value chain fuels allegations of fraud (Böhm, 2013) and further enhances the conflicts of interest. Houghton, from the Intergovernmental Panel on Climate Change, stated that the exclusion of professionals with self-interests would be impossible (Lohmann, 2001). This even extends into the bodies charged with regulating the market as the CDM Executive Board is also heavily lobbied (Schapiro, 2010). This could possibly explain cases of very restricted oversight (Böhm, 2013). Therefore, it is likely that influential players have vested interests that may facilitate misrepresentation or even exploitation of the mechanism.

- Another incentive discrepancy is created by the interchangeability of credits. Currently, all the credits, no matter the source, are interchangeable. While this increases tradeability, it also disregards the varying social and environmental impact of projects. So the market creates incentives for the credibility of the allowances but

not for the additionality or overall environmental impact of the emission reduction resulting from the offset project. With the economic incentives of the companies and the environmental incentives of the public and governments, there is an inherent conflict in the market and a burden on the regulation to work with both sides.

As reactions to these cases, credits from the destruction of HCF-23 or N2O are no longer accepted (European Commission, n.d.-f). Also, the UN is trying to increase the oversight into the projects (*See 5.2 Reactions and recommendations*). Only one spot check was required to find the irregularities in each of the major players in the DOE market and even though they were only suspended for two months each, it send a signal for accountability. Yet, these cases showed the UN's restrictive ability to monitor firms as they only check validation reports and do not perform on site checks due to the remoteness and uniqueness of the projects (Schapiro, 2010).

Structural fraud is facilitated by the environmental focus on the market, as the negative externalities that arise are not (proportionally) carried by the involved parties but by external parties. This biases, e.g., the developers' decision to undertake the project.

These fraud cases affect the environmental objectives due to the tradeability of credits: if developers do not have to actually meet additionality requirements and can get credits for less ambitious projects, then the creation of abundant, easily acquired credits may decrease the EUAs value. In normal markets, as one pays less, conscientious firms still pay their part. However, if there is trading such as in the EU ETS, the cheap credits can lead to lower market prices, meaning that low enforcement of credit validity in some areas lead to poorer incentives for all to reduce their emissions. As banking is allowed, this impact can also be carried into and influence incentives to comply in future trading periods.

5. Behind the façade of fraud

This chapter will start with the factors of and improvements against fraud. Then, it will move to the victims of fraud and the fraud's magnitude. Finally, an answer to whether or not the system should be replaced to reduce the vulnerabilities to fraud will be reached.

5.1 Factors of fraud in the EU ETS and CDM

While the previous chapter identified various factors impacting the cases, the following part will answer the question of which factors facilitate fraud and therefore focus on a deeper analysis of the core factors that increase vulnerability to fraud.

5.1.1 Measurability of carbon

Additionality:

For credits to be certified for the CDM and therefore utilised in the EU ETS, developers have to prove financial and environmental additionality. This includes the comparison to an estimated future baseline, which specifically states what would happen without the project. This makes the additionality calculations highly source specific, unverifiable and controversial due to the questionable ability to estimate impacts for the whole lifetime of the project, e.g. 20 years. This uncertainty facilitates intentional misrepresentation: in order to get more credits, developers could increase the baseline of the current situation (no project) to increase the net reduction of the project or they could increase the reductions achievable through the project. By 2007, in "about 40% of the registered CDM projects additionality is unlikely or questionable" (Schneider, 2007, p.44), which can be a result of fraudulent manipulation, genuine errors or the previously mentioned unfeasibility to perform accurate estimations for 20 years into the future.

Financial additionality is often violated, e.g. International Rivers assessed "that almost three-quarters of CDM registered projects were already complete at the time of approval" (The Washington Times, 2009, para. 5). This could either mean that the approval process took a lengthy time but the developer was optimistic about getting the necessary credits or that financial additionality was not fulfilled as the credits were not necessary to incentivise the

developer to commit to the project. Moreover, the varying financial backgrounds of two individual developers might mean that one would require the credits to undertake a generally profitable project, while the other would find the project profitable without the incentivising credits (Schneider, 2007). Therefore, the less affluent developer might consider financial additionality to be satisfied, but actually it is not as the project is already viable on its own – just for another developer (Schneider, 2007). Subsequently, for proper financial additionality, the project has to be evaluated for its own viability and not based on the developer's context. If the legislation were to change and only include projects with certain additionality, imperfect estimations would likely exclude numerous projects with marginal or unanticipated additionality.

However, all local regulations need to be considered. If verifiers do not consider national climate legislation, developers can receive credits for changes that are already declared by law. For example, in 2006, the Chinese Renewable Energy Law offered vast financial support to firms that build wind farms; however, all new wind projects applied for credits (Wara & Victor, 2008). Therefore, financial additionality was, either intentionally or unintentionally, violated. As all new projects applied for credits, the fraud seems intentional.

Complexity of nature:

The complexity and unique context of projects also hinders the proper measurability and allocation of credits to each project, the DOE's ability to verify those numbers, and the detection or prosecution of fraudsters. So the complexity makes hiding fraudulent behaviour easier and the system vulnerable to fraud. The specialised knowledge required makes poor verification harder to identify and inspection very resource intensive. The high requirement for insights into the market mechanisms might exclude some fraud types but the ones who have most to gain will internalise this knowledge, either for legal or illegal activities. Therefore, the knowledge complexity can increase the system's vulnerability to large-scale crime, which is cleverly planned and difficult to detect or fully verify.

Geographic remoteness:

Many offset projects are located in rural locations in developing countries. This creates a distance to public scrutiny and CDM EB oversight. If this is paired with problems of determining additionality and the complexity of nature, it makes it highly unlikely to properly and consistently measure carbon or inspect the self-monitoring of reductions. This reduces the probability of detection and increases expected benefits of fraud.

5.1.2 Intangibility and alienability of carbon

Intangibility:

For traditional commodities, the actual transfer of the tangible product prevents manipulation and spill-over costs to some extent. But the intangibility of carbon and the other gases increases the difficulty of measuring and authenticating credit claims and therefore increases the markets' vulnerability to fraud. Furthermore, this allows "a separation between ownership of the investment project and the rights to trade the emissions that are offset" (Interpol, 2013, p.25). One person may own the project, but another may obtain the permission to trade the produced CDM credits (Interpol, 2013). This alienability, the separation of the gas and the emission reductions from the actual source (Martin & Walters, 2013), diminishes the power of those who own the source and allows opportunistic behaviour. Particularly sparse knowledge of and enforcement of legislation in rural areas allows foreign developers to get involved and negotiate attractive deals. Since the CDM is focussed on least developed countries, this provides ample opportunities for fraud.

Moreover, the intangibility also creates problems in the EU ETS. Paired with the numerous sources, intangibility makes the emission measurement in developing countries more difficult. However, in this sector, alienability in turn does not affect the firms beyond the fact that it might provide them with more or cheaper credits from offset projects.

Visibilty:

The agreement of the CO_2's status and visibility allowed an assignment of economic value. Political and social players as well as industries that profit from GHG reductions have supported the visibility of carbon, which has increased fraudulent behaviour (Martin & Walters, 2013). Yet, visibility could also be important to the market. Arguably, the economic value that was achieved through the marketization of carbon was crucial to incentivise the private sector in the reduction of emissions and the fulfilment of environmental goals. This implies that the visibility had overall positive effects on emission reductions without significantly supporting fraudulent behaviour.

5.1.3 Interchangeability of credits

Source neutrality:

The EU ETS is a far-reaching system that has facilitated trading and cost efficient emission reductions by allowing the conversion between several gases, thereby giving them a direct value. Fraud may be able to remain undiscovered due to the lack of incentive for firms in the EU ETS to check the credit's source. The flawed assumption of source neutrality, that CO_2 reductions from two different sources have the same environmental impact, simplifies the system while disregarding social and environmental impacts. Without being able to accurately estimate all socioecological consequences during a project's lifetime, the credits from different sources will not be fully exchangeable (MacKenzie, 2008). Yet, fully integrating the specifics that make each source unique would make the system very complex. This once more stresses the importance of verifiable additionality calculations, as the flawed exchangeability creates misaligned incentives, which may result in fraudulent behaviour. Also, vague regulations about source equalisation change the focus on the financial outlook and the acceptance of the credit rather than the fulfilment of the environmental requirements and proper source examination. So it is controversial to attach a value to sources without fully considering its uniqueness. Moreover, the wrong value would distort interests of CDM parties, increasing the vulnerability to fraud.

Transaction costs:

On the other hand, it is a valid argument that increased complexity in the system would greatly raise transaction costs and make tradeability very difficult. Black-boxing is crucial to maintaining liquidity in the market as one-on-one negotiations for credits would greatly harm the mechanism's efficiency (MacKenzie, 2008). However, this black-boxing may allow opportunistic actions. The source specific positive and negative externalities that often arise in environmental markets should be considered under the costs of an environmental product. After all, this lack of consideration for the negative impacts on external stakeholders allows exploitation and corruption in the CDM. The low transaction costs and high credit interchangeability therefore decrease the attention to sources' environmental consequences and increase opportunistic behaviour by players in developed countries.

It is interesting that the transactions costs vary greatly between firms, with the ones for small firms emitting around 10,000 tons of CO_2/year being approximately €0.76/ton and the ones for large firms emitting 1 million tons of CO_2/ year being around €0.03/ton (Heindl, 2012).

These costs result mainly through the involvement in the EU ETS and not due to the offset market interaction (Naegele, 2015). Therefore, increased transaction costs due to more source differentiation might not greatly disadvantage buyers or reduce their incentives to buy offset credits. Also, Naegele (2015) found that the participation in the offset market rises with firm size, that only large firms profit from using offset credits and that over 60% of the firms that do participate use the maximum number of the offset credits allowed. Therefore, as they are likely to buy credits on mass, making buyers responsible for the offset credit's environmental additionality may not greatly increase their transaction costs.

Commodities:

As previously stated, credits have been classified as commodities. However, traditional commodities with equal quality standards are essentially exchangeable, while CO_2 is not "completely privatizable, alienable, separable" (Bridge (2000) as cited in Castree, 2003, p.285) and therefore not perfectly exchangeable from an environmental perspective. One could then argue that EUAs are not a true commodity but a proxy designed to allow for carbon's tradeability, marketisation and economic value. As more and more firms switch to renewables and sell their quotas, which is beneficial from an environmental perspective, EUAs themselves will be less valuable to the firms. The new, lower EUA price would then provide less incentives to switch to renewables. So, the proxy commodity does not always truly represent the system's objectives, thereby distorting incentives and possibly working against the environmental goals. For the market as a whole, there is little financial incentive to have widespread reductions, just like players may try to avoid over-extraction in traditional commodity markets. So while individuals are incentivised to reduce their emissions below their targets to sell credits, the collective action to do so could reduce the overall market value of their credits. Consequently, without exchange or with higher price floors, the incentives to reduce emissions further than the target could be higher. Therefore, the classification as a commodity affects the vulnerability to fraud by allowing the exchange of differentiated products and the exchange allows an increase in credit supply due to fraudulent activity to decrease the markets' incentive for further emissions reductions.

5.1.4 Incentives of stakeholders

The market-based mechanisms combine environmental protection with financial incentives. This may prove to be problematic due to misalignments of incentives, since human investment is often a prerequisite for fraud.

The quotas incentivise polluters to abate effectively, but also incentivise fraudsters to manipulate the number of credits they receive. So, to what extent should these incentives be allowed to shape how the market functions to achieve efficient emission reductions? The difficulty lies in what actions to regulate and what actions are necessary for proper function. For example:

> A 100 developers with environmentally additional projects might misuse the strong price-competition between DOEs (Martin & Walters, 2013) through small fees, leading to low incentives to allocate resources to verification and validation. This would make financial sense to developers as long as their projects are accepted. So there is no incentive for high fees or good verification. If this process allows the certification of some projects that does not have environmental additionality, should the government intervene because some developer are fraudulent? (*See "4.5 Magnitude of fraud")*.

There are several groups, who might commit fraudulent actions intentionally or unintentionally due to incentive misalignments:

Developers:

The developer has the financial incentive to apply with the maximum number of credits and would never want to decline any certifiable credits. This makes regulation necessary. Oversight comes in the form of an independent third party, the DOEs. Once the credits are validated and accepted by the CDM EB, the developer can start selling the credits as futures (Schapiro, 2010). Therefore, they can be traded but are not yet used to offset emissions since the reductions have not truly happened yet (Schapiro, 2010). This might incentivise developers to misrepresent the reductions achievable through the project, e.g. by misreporting or by bribing the DOE, who is "the only entity apart from the investors to visit the project site and assess it in the real world" (Schapiro, 2010, p.33). A problem arises when the validated credits have never been created, but have already entered the market. For example, in Brazil, the German DOE TÜV SÜD verified a project which was later temporarily closed due to the global recession, but the future credits for that period were already for sale (Schapiro, 2010). This example demonstrates that numerous, unforeseeable factors might create opportunities, in which undesirable incentives and behaviour arise more or less intentionally. Therefore, the process structure might not only create corrupt incentives

but also undesirable outcomes from activities of truthful players. Subsequently, it is critical to understand how breaks for fraudulent incentives arise.

DOEs:

Another major group of players with strong influence and incentives in the market are DOEs. The DOEs operate in a very price competitive industry (Martin & Walters, 2013) and are hired by developers, which may reduce their impartiality. DOEs with low fees and quick verification are likely to get the most accounts as there has been no significant link between good verification and project approval since only a very small number of projects have been rejected historically, e.g. four percent between 2005 and 2008 (Schapiro, 2010). So this system may create conflicts of interests and incentive problems as the DOEs' fees are at their discretion, which can potentially result in intentional or unintentional fraudulent behaviour.

This competitiveness may not be a problem if the DOEs were strictly monitored by the CDM EB through frequent spot checks, as more oversight could increase the DOE's costs of poor verification. For example, in the case where DNV was suspended for 3 months due to flawed verification (Schapiro, 2010). However, the vague decision making rules set to allow for project uniqueness permits various possible inspection techniques (Drew & Drew, 2010). Additionally, the geographical remoteness of the projects and the possible inconsistency due to human know-how and interpretation make inspection challenging and costly. So rural areas in developing countries that attract little public scrutiny could be a desirable location for hubs of fraudulent offset projects. These areas might enjoy economic upturn through foreign investments, but it could be at the expense of the environment. Therefore, without inspection there is little incentive for DOEs to allocate enough resources to thoroughly verify projects and charge prices that allow them to do so. Also, since poor verifications may harm only local, rather powerless stakeholders or the global atmosphere, there are few stakeholders or third parties with the power to hold them responsible for flawed assessments (*See 5.3 Victims of fraud).* These aspects facilitate the DOEs' incentive for fraudulent behaviour in the CDM.

CDM EB:

This entity basically has the intended role of supervising the offset market by controlling the developers and DOEs, for example by overseeing the requirements for environmental and financial additionality. Their role is largely in accordance with the overall idea of the CDM: to facilitate a steady supply of verifiable credits in order to lessen abatement costs for firms

in the EU ETS and to incentivise developers to invest money and to introduce know-how into locations in developing countries.

However, in reality, these roles can be corrupted by the market due to the lack of resources and through influence of other powerful parties, as the EB has limited time and resources to assess the proposals due to the large number of applications awaiting decisions: Wara and Victor (2008) analysed, that in 2008 one project is approved for certification each day. Since then, the amount of certified projects increased substantially until 2013 (UNFCCC, 2018-b). Another problem is that the CDM EB is dependent on asymmetric information as they rely on data from the DOEs, who in turn incorporate self-reports of developers. Additionally, there is strong lobbying of the Executive Members: Schapiro (2010) interviewed José Miguer, a member of the CDM EB, who stated that the required 75% approval for a new reform was prevented by lobbying of the board members. This might also explain why the rejections by the board do not adhere to consistent standards (Schneider, 2007).

So the actual incentives might be to verify sufficient credits to cover the demand from the EU ETS, to assess applications as well as possible during a limited time frame, to facilitate a quick and straightforward project application to incentivise developers to create projects, and to support the continuance of the CDM, for example by reducing fraud, which may be in part due to personal reasons such as staying in the influential position of EB member. Such incentives may create biases, which may result in more or less intentional fraudulent actions.

So the fact that, by March 2018, 60% of all projects are classified as large projects (UNFCCC, 2018-a) might be a combination of the project's better efficiency, greater supply of credits and more powerful incentives for the developer, host country and CDM EB. The reason for this number decreasing by two percent in the last five years (UNFCCC, 2013) might be the Programmes of Activities (PoA), which possibly altered players' incentives. This would show the strong impact incentives have on this market-mechanism and therefore on its vulnerability to fraud.

Changes in incentives through changes in structure:

The relatively recent concept of PoA could help the CDM EB to pass certification better. With PoAs, the board grants certification for larger clusters of smaller, similar projects instead of on a project-to-project basis (Beaurain & Schmidt-Traub, 2010). So far 53 PoAs have been certified, issuing nearly thirteen million credits (UNFCCC, 2018-c). What

influence does this have on fraudulent behaviour created by distorted incentives? Developers under one PoA would be incentivised to join resources and influence. For host countries, PoAs could result in numerous new projects, creating incentives to support such arrangements. DOEs will have more business opportunities as PoA include the small projects that were previously unfeasible for CDM credits (Bayer, Pinkerton & Urpelainen, 2016). However, DOEs are also liable to deliver all credits from a project if the project is found to be fraudulent within its pre-defined timeframe (Beaurain & Schmidt-Traub, 2010). Yet, DOEs often pass on this liability to developers (Lokey, 2009), thereby negating the incentive for stricter control. Still, the ambiguity around this new concept makes PoAs difficult for DOEs and the vague regulations around this new liability do not clearly state what behaviour would lead to liability (Beaurain & Schmidt-Traub, 2010). For the CDM, the collection of projects might allow better resource utilisation during the checking of applications. However, if powerful actors want to influence their decision, they will have even more incentives to lobby board members. But, since it requires only one board member to start an inspection of a PoA (Beaurain & Schmidt-Traub, 2010), this might give them incentive to resist lobbying since no majority is required to stop the inspection. Also, PoA projects are more utilised in non-corrupt countries than CDM projects (Bayer et al., 2016), diminishing the systems susceptibility to fraud, bribes and corruption. The problem would remain that little or even less scrutiny is placed on the national differences or legislations as the objective is to make smaller programs comparable.

Firms in the EU ETS:

The main incentives of firms which are forced to comply with the EU ETS are to increase profits. This incentivises them to under-report emissions, over-report emission reductions or acquire inexpensive offset credits. The question would be to what lengths they would be willing to go to save money. This is related to the EUA price, as higher prices provide larger incentives for fraudulent behaviour such as under-reporting (McAllister, 2011). As stated under *4.6 Structural fraud*, in markets without trade, the fraudulent behaviour would not impact the behaviour of conscientious firms. However, under the cap and trade, firms become interrelated (McAllister, 2011) and one's distorted incentives can influence other's emission reduction enticements. Thus, the incentives of firms in the EU ETS and their fraudulent actions can create larger intentional or unintentional indirect impacts on the environmental goals in trading markets.

Investors and speculators:

Another group of parties with incentives includes investors, traders and speculators in the financial trading of credits. Their incentives are mostly profit creation and establishing a stance in this new market. This may make them vulnerable to fraudsters, who sell their credits slightly below the market price to achieve quick sales. Considering the immense resources they allocate to this evolving market, they clearly have robust incentives. Due to the interchangeability of credits, their interest is likely to be on the acceptability, tradability and value of the credits rather than on the social or environmental aspects. Clearly, with high potential profits, they would be biased and inclined to use their power to argue for the survival of the EU ETS over a carbon tax implementation, accepting fraud as a typical market circumstance. Also, higher demand from investors and subsequent trading activity aimed at profit creation may allow environmental goals to be reached, as increased demand for credits and higher prices make reducing emissions more attractive. While they could profit from fraud, the main mitigating factor may potentially be the reputational consequence of fraudulent behaviour and subsequent lost trust from their buyers or clients. This reputational consequence could be elevated by the status and presence they hold in the public's eye. Therefore, the system's vulnerability to fraud depends on the investors' expected costs and benefits of misconduct in the EU ETS, including the private benefit of profit as well as the larger potential cost of a collapsing system, which are in turn directly correlated to the EUA price.

Third parties:

There are many third parties in the process, most of which might have strong or powerful incentives. These include governments in the host countries. For example, China hosts 56.7% of the CDM projects in Asia and Brazil hosts 35% of the projects in Latin America (UNEP DTU Partnership, 2018-b). The incentives of host countries might be to grow their national energy efficiency, lower pollution and attract foreign investment into local development. This may lead to verifiable, environmentally additional projects and result in overall positive outcomes. However, it may also create a system in which host countries tolerate fraudulent activities including corruption, allowing forceful evictions of smaller villages, special conditions and lobbying of influential groups to attract foreign investment. So relatively direct incentives may lead to diverse outcomes, which makes it difficult to relate specific incentives to fraudulent results.

The third parties also include governments in the developed countries, which want to provide inexpensive emission reductions in order to ease the burden on industries, while realising emission reductions to make sure the goals of the general public are represented. Considering the autonomy they have in the EU ETS, they hold considerable power over the system's implementation.

Locals:

Probably the least powerful stakeholders are local individuals, for whom the projects have more direct and substantial implications such as changes in employment, land ownership and health. Their interests could focus on the direct financial and social effects of a project rather than on the emission reductions, as their remoteness and low financial ability likely reduce their investment in global environmental goals. On the other side, people in remote locations often value the natural surroundings so they may be inclined to prevent some projects. Yet, they are rarely included in negotiations, as only 40% of all projects asked all stakeholders to participate (Martin & Walters, 2013). Therefore, due to the lack of influence, the incentives or negative consequences of fraud carried by them are unlikely to lead to system changes. Their position shows the systems' vulnerability to fraud includes a basic problem of environmental crime as loosing parties cannot guard themselves from negative externalities.

Mixed incentives:

When players participate at several stages along the value chain, the incentives can be distorted and it is harder for inspectors to find fraudulent behaviour as the interactions happen less on efficient markets and more "behind closed doors". Being positioned at several stages gives the player more bargaining power on the players at the other stages and might therefore increase their incentive to behave fraudulently.

After considering some possible incentives, it is clear how complex the relationship between incentives or power of players and the success or failure of market mechanisms can be. Thus, fitting, corrective regulations are necessary. Yet, as stated at the start of this subsection, it may not be desirable to eliminate all distorted incentives as some may facilitate desirable outcomes.

5.1.5 Structure of the mechanisms

The structural aspects that facilitate fraud arise through uncertainty caused by information asymmetry, legal vagueness, and security standards.

Information asymmetry:

With the establishment of a new, immature market, uncertainty is bound to allow some fraud opportunities. This may be due to the legislators having less information about the abatement costs of the firms, which characterises a case of adverse selection (Arve, 2017). Particularly the newness and lack of experience in regulating environmental markets often leads to legislative hit and miss approaches and conflicting objectives (Interpol, 2013). On the other side, the financial segment of the EU ETS is more likely to be regulated and effectively enforced as the accountability and enforcement structures are already established. The types of fraud facilitated by the newness of the market include the exploitation of information asymmetry. For example, the investor's lack of understanding of the system or the EU ETS's compromise to allow various estimation methodologies to account for national differences such as missing certified research labs (McAllister, 2011). However, this learning period during the implementation of new markets does not have to determine their long-term efficiency. The fraud opportunities will likely decrease as the governing parties learn more about additionality or effects of offset projects or about private information concerning the actual costs of reducing emissions in developed countries.

This also highlights the importance of trading periods. With uncertain terrain, these periods allow adjusting the regulations to the development of the market. However, the regulations should not be reformed too frequently as this will hinder implementation, adoption and market stability (MacKenzie, 2008). For example, changes in regulations and therefore information asymmetry may allow fraudsters to scam developers or investors by offering to consult on compliance to new regulations. It would be interesting to examine how the advantages of adjusting regulations are related to altering fraud opportunities. Generally, one would assume that selective, major regulation adaptions paired with lengthier trading periods like in the EU ETS outweigh possible vulnerabilities to fraud caused by regulation changes.

Legal vagueness:

Big factors which limit liability for fraud are the trading across jurisdictions and the varying regulations about who should carry the loss. This lack of clarity about who belongs to the fraudulent party decreases the expected costs of fraud. For example, after the same credits were traded through Citibank multiple times, the government claimed that the company was or should have been aware that the credits were fraudulent (Hampson, 2015), and therefore alleged that the bank did not fulfil proper due diligence and embezzled £10 million in taxes

(Szabo & Hampson, 2015). The case is not yet closed, which demonstrates how difficult it is to prove fraud such as missing trader fraud. A possible outcome could be that Citibank is found guilty due to the lack of due diligence, in which case many banks, investors and firms may start to more consciously verify the EUAs' origins, to avoid the possibility of being held accountable for fraudulent credits. However, due to the large number of credits owned, "just the possibility of being denied millions of euro in VAT deductions is a significant increase in risk" (Ainsworth, 2009, para. 5). This would lead to price increases and distort the efficiency of trading EUAs. If risks increase too much, market-based mechanism fail (Ainsworth, 2009) and authorities might intervene to reduce the uncertainty created through the market's structure. For example, how the registry had to be closed temporarily and organise swap backs to restore assurance (Interpol, 2013) in the example under the recycling of credits fraud (*See 4.2 State crime*). Therefore, legal ambiguity decreases the fraudster's costs and increases the systems vulnerability to fraud.

Also, while regulators are learning how to best control the market, firms are specialising in exploiting unregulated areas. See *4.6 Structural fraud* for the case of NFIL which openly aims to do so. Anything that hinders effective and cross-jurisdictional regulations might therefore allow vulnerabilities to fraud to rise. This includes the autonomy of nations to set up standards for DNA approval and rules for DOE accreditation (McAllister, 2011). While this is beneficial for effective, tailored emission reductions, it could also increase ambiguity and vulnerability to fraud. Host governments, for example, might bend laws to attract foreign investment or due to the influence of industry leaders. Therefore, equal or well scrutinised cross-jurisdictional regulations for all developers, host countries and investors would reduce opportunistic incentives. Also, victims could avoid lengthy, cross-jurisdictional court battles.

Security standards:

With the electronic nature of the market, typical vulnerabilities to fraud in other, non-environmental online trading systems are also applicable here. Therefore, similar security standards could be used. However, their implementation has varied between countries, e.g. safe log-ins (Steinhauser, 2011). With phishing attempts attacking the firm's network, their lack of internet security and employee training provide vulnerabilities for the hackers to access the system. Safeguards, which were optional at the time, like the "four-eyes" approach, could prevent some phishing attempts as an additional person has to verify the credit transaction before it can go through (Kirk, 2010).

Yet, since the fraud from other electronic markets can be easily transferred to the carbon trading market, the hackers have substantial resources and experience. Funk (2015) interviewed a hacker about security standards:

> 'The Dragon' is a hacker who has previously infiltrated the EU ETS and sees it as equivalent to simple stock markets. In his opinion, more security standards will only increase vulnerabilities and reduce the operators' attentiveness. Additional barriers like one-time passwords to other devices increase time requirements but are not a barrier to hacking.

Since doing nothing is hardly an option, the market should implement the same security standards as other, non-environmental trading markets, as the cases that arise through the electronic security failures are often separate from the environmental context. For example, obtaining an email whenever the company's log-in details are used (Kirk, 2010). Together with employee vigilance, this could speed up the voicing of suspicion, prevent the movement of the credits across jurisdictions and help the firm avoid long court battles. Because, while credits have identification codes, the tracking of credits across different registries is challenging (Kirk, 2010). The longer the tracing takes, the higher the probability that several transactions were made, increasing the number of victims and legal consequences for the involved parties. Cross-jurisdiction tracking and enforcement is dependent on the cooperation between nations and made more complex with varying legislations. To decrease the vulnerability to fraud, it is thus crucial that enforcement is strict, swift and resource-rich.

Some vulnerabilities to fraud might be less disadvantageous to the environment than others. For example, one could argue that while some vulnerabilities to fraud may fail to allow the optimal allocation of resources, they may at least lead to a degree of emission reductions, e.g. projects with uncertain financial additionality created with distorted incentives. Yet, hacking is unlikely to benefit the environment unless it creates prolonged increases in EUA demand or if the stolen credits are destroyed without creating market turmoil, as this would otherwise distort prices and reduction incentives. One small, but potential scenario where vulnerabilities to hacking could be beneficial would be if a hacker steals fraudulent credits used in a carousel fraud, as the victims might be hesitant to alert the authorities.

5.2 Reactions and recommendations

The literature provides numerous recommendations to alleviate the vulnerabilities to fraud in the system. There are two main views. One side believes that the vulnerabilities to fraud can be more or less resolved through additional regulation thereby improving the existing system. The other sees the vulnerabilities as deeply imbedded in the system and does not therefore believe in additional regulation. This chapter will introduce and reflect on the recommendations and later critically reflect which view might be more feasible under *4.5 Implications of fraud: Scrap it or save it?*. These recommendations are contingent on a specific scenario, which includes that climate change is present, is tackled through regulation within the European Union, which is approached with quotas under a cap and trade system, which are designed to allow tradeability. Another situation, such as one with non-tradeable quotas would yield different recommendations.

5.2.1 Additional regulation

Some recommendations aim to address the rudimentary problem of the measurability of carbon and the additionality concerns. One possibility would be to exclude projects where the baseline is remarkably susceptible to fraud, such as carbon sinks and methodically new projects (Martin & Walter, 2013). Additionality calculations for sinks are very debateable and vulnerable to fraud, for example, due to the inclusion of unimplemented sink degradation in the future baseline (Martin & Walters, 2013) or the complexity in measuring the emission reductions which depend e.g. on tree age, type and local ecosystems. Therefore, it might be feasible to exclude those sources. However, it may be unwise to exclude all projects with questionable additionality as experimentation with revolutionary, novel projects could lead to projects with great additionality in the future.

The questionable independency of the DOEs that arose through the free market interaction has called for a change in the verification process. The problem with minimising the risks of varying incentives is that in order for market mechanisms to work, the players have to be sufficiently incentivised. For example, the verifiers have to be incentivised to do in-depth checks and better consider national policies (*See the Nigeria example under 4.6 Structural fraud*) to avoid missing the environmental additionality mark. However, the problem could be that under self-regulated markets the reason why there are few in-depth checks may be because it is not desirable or profitable for the participants. One plan to adjust this suggested

that the DOEs would be paid directly by the CDM EB and assigned randomly to developers, who pay the EB for their services (Schapiro, 2010). José Miguez, who took over as president of the CDM EB in 2006, said that the EB blocked the change as validators persistently lobbied board members (Schapiro, 2010). Their resistance was due to the fixed rates DOEs would receive for their work under this new plan. Under these proposed changes, their incentives would no longer lie in gaining clients by providing the fastest or cheapest service but to fulfil the requirements of their employer, the CDM EB. However, the EB would need substantial resources to manage the DOEs around the world. Currently, they are under-resourced to simply verify the DOE activities (Schneider, 2007). Schneider (2007) argues that the administrative fee per certified credit could cover the increased costs and moreover ease the implementation of smaller projects, which would in turn face lower certification costs. Additionally, central training could reduce the discrepancies resulting from different judgements and know-how to some extent. Yet, some corruption might prevail. After all, the fact that the DOEs are stationed in field offices around the world (Schapiro, 2010) increases the likelihood of the closest DOE being assigned to a project to save costs.

Another possibility is to increase the DOEs' liability. Specifically by implementing the PoA regulation, which states that DOEs have to cover credits that are later found to be excessive or fraudulent, on the CDM projects (Schneider, 2007). However, the DOEs simply pass on this liability to developers through contractual agreements (Lokey, 2009), therefore it is unlikely that this recommendation significantly improves the system.

Caps on the trading of offset credits into the EU ETS have been discussed as a potential approach to decrease the influence of fraud on these related mechanisms. The direct trading between the mechanisms has been reduced as part of the regulations in the third trading period: The amount of international credits (from CDM and JI) that can be used in the EU ETS went from 1,400 million credits for the second trading period to 1,700 million credits for the second and third trading period combined (Kossoy & Guigon, 2012). This is likely due to the beliefs that the CDM is the cause of much of the system's uncertainty (Martin & Walters 2013), is not as cost-effective as expected (Schapiro, 2010) and has made reductions more expensive as the HCF-23 structural fraud resulted in total costs of "approximately €4.7 billion while estimated costs of abatement are likely less than €100 million" (Wara & Victor, 2008, p.12). Conversely, others believe that capping offsets does not increase the quality of the offsets, as the cap will be filled with the least expensive and lowest quality credits first and additional credits will be traded into the EU ETS via other trading markets (Wara &

Victor, 2008). Hence, while the trading between the CDM and EU ETS has been limited, further research would be required to investigate to what extent the offset credits are redirected via other systems to enter the EU ETS.

With the uncovering of the €5 billion missing trader fraud across Europe, the immense, transcontinental network and criminal resources available to fraudsters in the EU ETS became apparent (Europol, 2010). Therefore, several large-scale collaborations of up to 2,500 officers were created (Europol, 2010). For this reason funding enforcement is crucial to reduce the vulnerabilities to fraud caused by low probabilities of prosecution. So far Europol was allowed to access and read-only the confidential records in the databases (European Commission, 2011). Other markets, specifically the Californian RECLAIM, allowed the removal of fraudulent credits in retrospect over the course of 8 years (Kossoy & Guigon, 2012). Others believe in swift reactions and call for a central announcement board, where fraudulent credits are publicised (Steinhauser, 2011). While increasing Europol's power can be seen as a proactive measure, the other two recommendations are rather reactive, thereby not directly decreasing the vulnerabilities to fraud but rather focusing on increasing the potential costs of fraud by facilitating prosecution of fraudsters.

For effective enforcement, it is important to create consensus on which victim is the legal owner of stolen credits. Do they belong to the party they were stolen from or to the party that bought them from the fraudster? Also, should this distinction change depending on the level of security standards that firms and national registries implemented? So far, while not clearing up the ownership debate, it was decided that buyers who received credits in good faith are entitled to equivalent amounts of EUAs (European Commission, 2011). One possibility would be to create insurance against theft, as in other financial institutions (Krukowska & Carr, 2011). The question is whether compulsory insurance would create more transaction costs for the system overall than the fraud cases themselves, thereby decreasing efficiency.

Reactions also came from third parties. These can take on several approaches:

- Some have focused on the environmental additionality of offsets and introduced tradeable credit standards that only certify sustainable sources. An example is the WWF's Gold Standard, which created 14 million credits in 2017 (Gold Standard Communications Team, 2018) compared to the 6.6 billion EUAs traded in the EU

ETS in 2015 (European Commission, 2016). While being petite in comparison, it shows that firms are willing to pay premiums for credits that do not pose reputational risks (MacKenzie, 2008) or negative implications for the environment. This implies that public scrutiny and media attention can increase buyer's examination of sources.

- Another example of NGO reactions was Carbon Market Watch's successful protest in 2016 against the hydro dam Barro Blanco: the project was de-registered from the CDM due to abuse of human rights, however, the dam itself will be build (Coiley, 2017). This example shows that NGOs can protect the interests of less powerful stakeholders, but their influence and resources may be limited. Therefore, they may be able to draw attention to and intervene in fraudulent projects as well.

- Subsequently, the involvement of independent and impartial third parties could to some extent protect the local environment and inhabitants. However, more and more NGOs are undergoing highly publicised partnerships with large corporations, which has led to the accusation that funding leads to NGOs "provid[ing] a moral stamp of approval" (Bachram, 2004, p.11) for corporations. Particularly larger NGOs are vehement about the importance of corporations and the EU ETS to fight global warming, while smaller NGOs are opposed to the EU ETS (Bachram, 2004). This, as well as the NGOs lacking comprehension of the complex market, creates disharmony in the NGO sector and reduces the opposition to corporate goals (Bachram, 2004). Therefore, these groups might not always be as successful or reliable in defending the rights of powerless parties as assumed.

- Essentially, the involvement of another stakeholder increases the probability of skewed or diluted incentives and does not move from reactive to proactive measures. In addition, private citizen groups might allow the advance of effective verification and control methods, but for successful enforcement they require transparent and reliable access to information (McAllister, 2011). Yet, the system's reliance on complex self-reported data might make it difficult for these groups to gain insight.

In general, standards for credit quality proposed by any party could decrease the focus on the acceptability and place more importance on the sourcing context of the credit. However, the problem with special standards is how strict or lax their acceptance requirements are. For example, the UK New Forest Company has established large plantations of non-indigenous

trees in Uganda (Carrere, 2009). While the process has led to loss of employment, brutal evictions and the destruction of local biodiversity, they received the Forest Stewardship Council certificate crediting the company's conduct as beneficial to local people and the environment (Carrere, 2009). So standards that are easy to acquire are unlikely to improve conditions and may in fact worsen local situations due to reduced public scrutiny.

Recommendations can also be specific to the type of problem, e.g. MTF. Ainsworth (2009) states that the fundamental flaw allowing MTF in the system is that a party is both responsible for the reverse charge and can claim VAT on the next sale. A reverse charge means that instead of collecting the tax from the next person, the charge is collected through self-assessment by the buyer. Therefore, Ainsworth (2009) proposes 0% VAT on EUAs in the short run and a certified tax software to be realised across the EU ETS in the long run:

> If credits are sold within a nation's borders or if neither of the players in an inter-jurisdictional trade have a certified system, normal VAT charges apply. If a party has the certified software, it would take responsibility for registering the VAT return for a cross-border transaction. If the buyer and/or the seller in an inter-jurisdictional trade is certified, the buyer will receive the credits with 0% VAT and file for a reverse charge. Because of the certification, the seller can be certain that the reverse charge will be filed. If the seller is certified, but not the buyer, the seller's national VAT will be applied and the buyer might have to reclaim expenditures due to VAT differences if applicable.

Then, the buyer will never have the ability to receive the credits with 0% VAT without completing the reverse charge, reducing the system's vulnerability to MTF .

5.2.2 No additional regulation

Some argue that no environmental markets can exclude fraud risk (Kaime, 2017) and that attempts to regulate the market hide or worsen the underlying problem (Lohmann, 2009).

Particularly Lohmann (2009) advocates that the desire to improve the system through regulation, oversight or methodologies is an illusion. A better implementation or more effective prosecution of individual fraudsters will not help as the system is fundamentally flawed (Lohmann, 2009). The system is based on an imaginary alternative world, which makes it "impossible to distinguish between fraudulent and non-fraudulent offset calculations" (Lohmann, 2009, p.180). Therefore, there are no ways to enforce the rules and

the only way to stop fraud is by abolishing the market (Lohmann, 2009). However, other scholars argue that Lohmann's reasoning is unfounded and mainly reliant on quotations of his own work (Michaelowa, 2011).

Others argue that the aim of the market is not to be properly regulated but to fulfil the interests of the most powerful stakeholders, thereby making successful regulation unlikely. Power is exploited to create a capitalistic market while disregarding the "unjust and harmful consequences for the environment and the world's most vulnerable peoples" (Martin & Walters, 2013, p.37). The question might not be whether legislators can eliminate vested interests but whether they are incentivised to do so, as the system's flexible regulations give way to powerful lobbying by companies (Martin & Walters, 2013). The flaw is in the incentives created by the market in that firms seek easy fixes that keep the basic business practices, polluting, unaffected (Bachram, 2004). Thereby, the collection of incentives in the market make it uncontrollable (Bachram, 2004; Lohmann, 2001) and regulations unsuccessful.

Another argument is that increased, complex regulation simply increase the fraud opportunities (Lohmann, 2009). The lack of history of regulating environmental markets and the learning by doing regulatory approach may only provide superficial solutions without improving the underlying issues. So regulation would not be successful in solving the underlying fraud, which may eventually lead to the elimination of a system that could potentially successfully internalise the costs of emission reductions (Kaime, 2017).

It might seem like a straightforward solution to call for the abolishment of the market based on the fraud cases and shortcomings of the current system. Arguments include positive implementation examples of taxation, subsidies for renewable sources or obligatory (technological) standards (Bachram, 2004). However, implementing a new system on a transnational scope poses a great risk, as reaching an agreement will take prolonged negotiations and compromises (MacKenzie, 2008). The decision would be based on the assumption that the new system is better at protecting the environment against fraud and exploitation. Moreover, while the loopholes in new regulations would first have to be found, the current regulations are now adopted, implemented and known (MacKenzie, 2008).

5.3 Victims of fraud in the EU ETS and CDM

Knowing the victims to fraud is important to understand how to regulate fraud. After all, common frauds may be due to unassuming reasons, such as individual gullibility, and could be more directly targeted by raising awareness than by imposing regulation. Furthermore, it is also crucial to understand which fraud types put defenceless stakeholders such as future generations at a disadvantage, as these pose the least opposition to fraud and therefore need the government to intervene and represent them.

There are several possible victims, for example, that the two interacting parties steal from one another, steal from the tax office, or steal from the atmosphere. Before determining the victim of each fraud type, it is crucial to remember that one does not have to steal from the environment for this fraud to be linked to or facilitated by the environmental objectives, e.g. the environmental complexity might also make deception of included or excluded parties easier. Due to the environmental context and the possibility of external implications, each fraud type can have more than one group of victims.

Computer crime is often carried out by external parties, which are not part of the daily interactions in the markets, e.g. hackers. It is not the environment which is victimised but mainly the firms who are obligated to use the market. The fact that these victims are numerous and dispersed means there are many possibilities for fraud to enter the market. Therefore, the victims' characteristics allow several small security liabilities in dispersed sources, through which the system's vulnerability to cybercrime arises. As stated before, computer crime is not affected by the environmental context and therefore the victims are also not more vulnerable to cybercrime because of the environmental context.

In the state crime example, the environment is not victimised as the same number of credits are cancelled out, however this might not always be the case. The main victim here is the registry, as the Paris Exchange had to organise swap backs to maintain market stability. The fraud and the victim's vulnerability to fraud is not increased by the environmental context specifically but by the intangibility of carbon.

Under tax fraud the main victim is the tax office. Because tax fraud benefits from large VAT rates, the nations with higher VAT rates and/or low enforcement might be particularly vulnerable. Victims of money laundering will also include stakeholders who were negatively impacted through the activities that created the illegal funds. But since these are case

specific, the bigger victim is also the tax office. The system's environmental context does not increase its vulnerability to tax fraud. Therefore, the victims are also not more vulnerable to tax fraud because of the environmental context.

In cases of scamming, the victim is often one of the parties included in the transaction. The examples were mostly concerned with individuals being scammed, but in one case the environment is scammed:

- For individuals, the information asymmetries and the increased gullibility due to the complex environmental background make the victim more susceptible to scams. Thus, the environmental context does increase the victims' vulnerability to fraud. However, it does not affect their ability to protect themselves against scams, as it was their own decision to trust the scammer. The victim's lack of understanding increases the system's vulnerability to fraud, e.g. since they are more dependable on other's opinions, it is easier to influence their actions through security scams. Therefore, one could argue that allowing the public to invest into the system increases its vulnerability to fraud. However, these cases do not generally steal from the environment if investors would not have invested in EUAs otherwise.

- In the emission factor case, the environment is victimised. The fraudsters benefit by exaggerating the amount of reductions, which negatively affects the system's environmental objectives. This affects unprotected future generations and distant citizens.

In the bribery and corruption cases, the fraudsters steal from the environment. They do so by manipulating the emission factors or excluding the negative effects of projects from the decision making, such as the eucalyptus drying up the streams. Therefore, as the environment and local stakeholders are exploited, several groups which are unable to raise opposition are also impacted, such as future generations or distant citizens. Here, external parties are more vulnerable to fraud, because the spill-over effects from environmental transactions allowed their exploitation as not all costs or benefits are included in the negotiations. The environmental context and defencelessness of victims also makes it easier for fraudsters to avoid prosecution. Fraudsters may hide behind complex additionality calculations or behind utilitarian arguments, arguing that the relocation of some villages is beneficial if it results in environmental improvements.

Firms who bought fraudulent credits in good faith might benefit from lower prices, but if the fraud is detected, they face reputational damage. The firm's interest in profit might increase the system's vulnerability to fraud as the fraud would not be as desirable if buyers would focus on credit quality instead of simply credit acceptability. Once a big firm is linked to the credits, it is tempting for the press to mention them in the case. The environmental context likely increases the public's disfavour, therefore the environmental context is expected to magnify the victims' costs of fraud.

Structural issues allow fraud that victimises the environment through inadequate verification or the lack of regulation. Since the environment is exploited, this impacts several groups of possibly defenceless victims, such as next generations or indirectly affected citizens. The protection of the environment depends on precise and powerful regulation and enforcement. Without that, fraud is incentivised as the negative externalities are excluded from the project negotiations. Therefore, the environmental context allows the fraudster to profit from the exclusion of some costs. Due to the complexity of the environment, it might be difficult to create regulations that successfully stop fraudsters from exploiting the environments' vulnerabilities to fraud.

The proposed question was whether the environmental context affects the victims' vulnerability to fraud. The environment is a central victim in the fraud cases related to bribery and corruption, structural issues and some scams. In these cases, there are numerous groups of victims which are affected by the wide effects of the exploitation of the environment, such as future generation and distant citizens. The problem is that these groups are often defenceless, for example, future generations do not have a powerful stakeholder who is solely concerned with defending their rights. Additionally, these victims may not be aware of the fraud and therefore unable to raise opposition, which possibly delays fraud discovery and increases their exposure to negative side effects. They largely depend on the government to regulate current behaviour in a way to avoid reduced quality of life in the future. Therefore, the victims are more vulnerable to fraud due to the environmental context. The inter-generational, non-excludable effects of the environmental quality have likely greatly complicated the design of the market.

5.4 Magnitude of fraud in the EU ETS and CDM

The question is how frequent and big fraud is in these markets: While the fraud cases had lasting impacts for the involved parties, the magnitude of fraudulent behaviour on the whole system might not be as long-lasting. So to evaluate the vulnerabilities to fraud, it is important to differentiate between the costs for the involved parties and for the whole system. To determine the importance of the system's vulnerabilities through the magnitude of fraud, it is important to consider the proportion of fraudulent volume compared to the total volume in the system and the resulting impact of this fraudulent activity:

5.4.1 Magnitude of volume of fraud:

Some argue that fraud volume only corresponds to a minor percentage of the system (Brown et al., 2012). For example, when 3 million tons of CO_2 were stolen in 2011, this represents over €50 million or 0.15% of the overall emissions allowances (De Perthuis, 2011). Chaffin (2011) also found that the "fraud and thefts occurred in the spot market for carbon allowances, which accounts for only 10% of EU ETS carbon trading" (as cited in Brown et al., 2012, p.27). However, since numerous smaller and some larger cases, like the €5 billion MTF case, have appeared, this percentage adds up. Also, "it is impossible to know how many other cases of [fraud] […] have yet to be discovered" (Kaime, 2017, p.73). Therefore, the dark figure for fraud cases is likely much larger, which means the magnitude of fraud volume is likely bigger, making vulnerabilities to fraud more significant. Furthermore, even if the actual percentage of fraudulent credits may be low at the moment, the value of the EU ETS provides ample opportunities for fraud and therefore, it is important to improve legislations before more fraud cases arise instead of reacting post-fraud.

Others have claimed that fraud is a typical aspect of any financial market (Interpol, 2013; Kaime, 2017), thus one could imply that fraud is not a reason for major changes or the abolishment of the market. Furthermore, CF Partners claims that "security problems in the national registries are normal growing pains of a new financial market and an administration problem, rather than a sign there is something fundamentally wrong" (Steinhauser, 2011, para.30). However, CF Partners works as a consultant that verifies trustworthy emission credits (Steinhauser, 2011), therefore they might be incentivised to downplay fraud volume to delay new regulation in order to profit from the system's ambiguity. Also, just because fraud is common (Interpol, 2013), it does not mean the system's vulnerabilities should be

overlooked. Rather, they should be managed to prevent the growth of vulnerabilities, for example, the growing willingness of fraudsters to accept bribes if they observe insufficient oversight.

5.4.2 Magnitude of impact of fraud:

One could argue that the impact of fraud is not very significant, as it doesn't change the incentives of parties. However, Rotz (2011) argues that this is due to the risk being associated with social and environmental aspects, which are not the main focus of profit-seeking investors, and not with financial uncertainty, leading to investors circumventing these risks. Therefore, the impact of fraud might be high, but not clearly visible in the financial market structure. Moreover, fraud might not impact the decisions of powerful players as the costs of fraud may be unevenly distributed. For example, in the EU ETS "polluting industries are disproportionately located in low-income areas" (Bachram, 2004, p.13), thereby creating environmental injustice. If offset fraud cases also display environmental injustice, meaning that the players with the least power cover disproportional costs, the fraud's impact may be significant but not represented at the decision making table.

The fraud cases were considered significant enough to impact market regulation, as they led to changes in regulation and thereby shaped the market and its future transactions, e.g. the 26 hour delay or higher security levels (European Commission, n.d.-j). This impact of fraud may be further magnified by the expected heightened media attention given to fraud in environmental contexts. Therefore, the system's vulnerabilities expose the participants to reputational risks that are difficult to quantify.

Additionally, there were some impacts that may be considered to be positive consequences of the fraudulent activities. One might argue that increased trading in the EU ETS due to fraudulent activities also increased momentum and prices in the market, thereby incentivising firms to reduce emissions. However, at the same time, the discovery of fraud increased uncertainty in the market (Interpol, 2013) and market instability, thereby increasing price volatility and decrease incentives to switch to renewables. Therefore, the vulnerabilities may have complex impacts, which might not always be entirely undesirable.

So should one conclude that the magnitude of fraud justifies government intervention? Some sources argued that fraud is inevitable (Interpol, 2013) or only makes up a small percentage of the market (Brown et al., 2012; De Perthuis, 2011). Would additional regulation therefore

bring with it more negative results such as the prevention of positive externalities or the collapse of (profit-seeking) incentives, which may actually benefit the environmental objectives? If that is the case, then changes in the system could result in larger undesirable effects than the fraudulent activities of a few players did previously. Therefore, more regulation has uncertain impacts on the system's complexity and vulnerabilities to fraud. Yet, the alternative of taking no action, is unlikely to be an option as fraud has had considerable impact on these market-based mechanisms. Due to the increasing volume of the market, inclusion of sectors and linking of trading systems, it is important to determine and fix the system's vulnerabilities to fraud before the opportunities for fraud expand.

5.5 Implications of fraud: Scrap it or save it?

Previously the discussion focussed on whether or not the regulators should intervene. Indeed, additional regulations caused by the fraudulent activities of a few players might decrease the incentives of a lot of players, possibly decreasing the efficiency of the market. Nevertheless, vulnerabilities to fraud should be decreased to reduce fraud opportunities proactively. Also, the linking of ETSs will lead to increased complexities, which might widen the system's vulnerabilities. Therefore, it is important to actively work on reducing the vulnerabilities.

So now, the focus lies on how the government can intervene to reduce the system's vulnerabilities to fraud, with the main options being to scrap the whole system and find an alternative or to implement additional regulation and save the system. The focus is not on specific examples (*See 5.2 Reactions and recommendations* for proposed tactics for each option), but rather on which way could reduce the system's vulnerabilities to fraud better.

5.5.1 Scrapping the current system

In the EU ETS, "reliable enforcement is even more important than it is in direct regulation" (McAllister, 2011, p.1227). As explained, the enforcement of verification and additionality requirements is difficult to carry out. Previous attempts were made to improve regulations, oversight and verification, however, some changes may lead to controversial outcomes:

- One is the EB's decision to merge two expert groups in 2017 (UNFCCC, 2017-a): Previously, one was tasked with simplifying the transaction costs and formalities for small projects, while the other focussed on the compliance of larger projects. Under the merger, the members were reduced from twenty-three to fifteen people and the annual meetings set to three instead of five. Arguments for this included streamlined processes, stable judgment and better resource allocation of experts as well as of administrative resources. Another stated argument was that smaller expert groups, such as five people for the small projects, led to missing human resources if only some members are able to attend.

  It seems somewhat contradictory to reduce the number of experts, if the aim was to ensure that enough experts are present at the meetings. This reduction may cause less scrutiny or project-specific judgements. Therefore, the incentives to simplify processes and improve resource utilisation may also result in less oversight and increased opportunities to fraud.

- Another change was to decrease the minimum commitment for DOE performance evaluation from five to three during five years, as this reduces expenses by US$1,800/year for each DOE (UNFCCC secretariat, 2017). However, the CDM Accreditation Panel opposed this decision, as the minimum number has not been enforced so far and a cut in evaluations decreases the CDM EB's insight into the DOE's execution of activities, thereby undesirably impacting the system's accurateness (UNFCCC secretariat, 2017). This compromise between accurate evaluation and resource allocation might adversely impact the system's ability to accurately incentivise individuals and reduce emissions.

Therefore, if the system is not able to continuously monitor and enforce or exclude profit-seeking incentives from the regulation design, it may not be the best option in this environmental context. Therefore, an alternative may provide emission reductions while encountering fewer monitoring and enforcement practicality problems.

So which system might reduce emissions without creating many complex vulnerabilities to fraud? The most prominent alternative is a carbon tax. It is praised for its superiority in cases where numerous players are included (Buchanan & Tullock, 1975), which could be the case in the EU ETS. Due to the previously discussed issues of monitoring and enforcement in

environmental markets, the tax may be more efficient in enforcing reductions. Furthermore, it provides more stable prices for emitting pollution and allows the government the collection of tax revenues, which can be used to fund innovative, renewable projects. However, this means that the firms' assets decrease in value at least temporarily as they have to pay the additional tax (Buchanan & Tullock, 1975). Therefore, the industry will prefer the cap and trade system with free initial allocation to the carbon tax (Buchanan & Tullock, 1975). So, if the most powerful stakeholders can in fact substantially influence this market, it is unlikely that any strictly regulations would be implemented as the opposition to such a change would be strong (Bachram, 2004). Hence, it may be unlikely that the new system would greatly increase efficiency or decrease opportunities for (dishonest) behaviour by the powerful players. Some degree of fraud would likely be present under the carbon tax as well.

The question is how the situation would be if an alternative system is implemented. How many lengthy negotiations and compromises would be required to achieve an agreement on a new, centralised alternative? Numerous compromises were necessary for the establishment of the EU ETS (MacKenzie, 2008). What if no new agreement can be reached? One of the aims of the current mechanism is to include less developed countries and transfer knowledge in energy efficiency. Would these countries still benefit from the tax through subsidies etc. or would they be excluded? An alternative system would likely involve a mechanism comparable to the CDM to include less developed countries (MacKenzie, 2008). The complexity of the CDM provides several vulnerabilities to fraud, so the alternative would likely include some vulnerabilities to fraud as well. Yet, the difference is that substantial resources have been invested into the current system and many CDM's vulnerabilities are now known and can be moderated. Therefore, there are many uncertainties related to the replacement of the current system and the vulnerabilities to fraud in any alternative.

5.5.2 Saving the current system

One major area of discussion has been the execution of the CDM. The complexity of the environmental context has made the CDM susceptible to fraud and, due to the link to the EU ETS, this fraud has affected the trading system. Yet, the knowledge gained during the first trading periods was vital for the development of the complex, international trading systems (World Bank, 2015) in the unique environmental context. Now, new offset instruments can be constructed based on the skill that was accumulated in the CDM (World Bank, 2015).

Therefore, one could argue that the system itself was not flawed but rather the uncertainty of the environmental context required a learning phase for exploration and adaptation of the system. Since the learning phase has been endured and firms have accepted the system, the regulators could potentially make better use of resources by working on improvements rather than starting over. For example, the International Carbon Action Partnership was created to share ETS know-how internationally and to assist the joining of ETSs (ICAP, 2017).

One possibility of saving the EU ETS could be not to exclude, but to limit the use of credits from CDM projects (Schneider, 2007). The argument being that the cost reduction through the CDM is important for the efficient running of the EU ETS (Drew & Drew, 2010). However, as stated previously, Wara & Victor (2008) claim that a caps may create new paths for fraud to enter the market. Strict control over the CDM market could be more effective than exclusion of categories in improving the offset credits' quality (Schneider, 2007), and thereby reducing the number of CDM credits simultaneously (Wara & Victor, 2008). So far, several improvements have been made, for example 39 standardised baselines are sanctioned, with another 21 being under consideration (UNFCCC, 2017-b). This makes additionality calculations more standardised and less subjective to misrepresentation.

In order to improve the system, Wara & Victor (2008) argue that a variety of mechanisms including direct financial help from developed countries might be better than only relying on the CDM, which they argue incentivises countries to wait for foreign investments before implementing emission reductions. Conversely, Buen (2013) argues that the CDM projects facilitate interests in and know-how of the workings of ETS, thereby enabling offset countries like Korea and China to build their own cap and trade systems. If additional mechanisms are introduced, they will likely create additional vulnerabilities to fraud as, for example, aid packages are subjective corruption and bribery (Buen, 2013).

The carbon market was created with the intention to oblige the polluters to carry the costs of emission reductions (Martin & Walters, 2013) and allow market forces to self-regulate. So it is influenced by changes in the industries, thereby responding quicker and with less legislative involvement to global fluctuations than taxes. With upcoming mechanisms like the MSR, the system allows flexibility while protecting the price against major shocks from global events. Therefore, the improvements in the system are likely to increase its success in the future, thereby making the scrapping of the whole system less desirable.

The complexity of the environmental context creates high data and knowledge requirements for regulators (Kolstad, 2011) prior to the establishment of a system. These are reduced in the cap and trade system due to the focus on self-reporting, which allows governments to collect more continuous records, thereby learning how reduction costs differ between firms and over time, and frees up resources for compliance enforcement (McAllister, 2011). However, a big problem in the verification and accuracy of emission reductions has been that the reliance on self-reported data requires strong oversight and enforcement. So a non-regulatory approach to improving the system could be to strengthen oversight, enforcement and prosecution. Without strong enforcement of the regulations, any system will allow fraudsters to circumvent regulations and exploit the complexity of the environmental context.

5.5.3 Recommendation

So overall, the impression is that fraud in the system does not justify the replacement of the whole system. The environmental context of the market required a new, complex system, which had to be created under a lot of uncertainties. Now, the market is established and largely understood by the players. The accumulated know-how can now be used to improve the system in order to reduce emissions more efficiently. It is likely that vulnerabilities to fraud will not be completely solved, because while the market-based mechanisms incentivise players to comply, the EUA price also provides a direct incentive for fraudulent behaviour (McAllister, 2011).

However, any alternative would introduce new fraud opportunities, which would have to be discovered first. Moreover, fraud is part of many established systems, so it is unlikely to be the main reason for the complete overhaul of a system. Nevertheless, the aim should be to reduce vulnerabilities to fraud proactively as the prolonged impact of fraud and the dangers of fraudulent credits increases the transaction costs and decreases the reduction incentives of honest firms, for example, costs increase as they have to increase scrutiny, educate staff or pay certification companies. Improved regulations and enforcement thereby are likely to be the more efficient government intervention option if the aim is to reduce the vulnerabilities to fraud in the cap and trade and offset markets.

6. Conclusion

The interaction between the EU ETS and the CDM is a novel way to tackle the important but complex task of abating climate change. Due to the uniqueness of a system that values and converts intangible atmospheric gases from various sources, regulators created the system based on numerous uncertainties and compromises. As part of the global context, the multinational, co-operative tactic allows for regional and source flexibility. On top of that, this system incentivises various private players to reduce emissions, while not imposing too high a cost on them, to avoid the weakening of industries or smaller firms. Thereby, the cap and trade system allows the equalisation of the various marginal abatement costs across countries and industries to increase efficiency and to decrease the overall costs of environmental improvements.

The system's complexity and flexibility led to several vulnerabilities through which fraud can enter the EU ETS and CDM. In order to examine these vulnerabilities, several questions are answered:

How frequent and big is fraud in this field? The magnitude of this fraud is difficult to determine. Some authors claim it is a minor percentage (Brown et al., 2012; De Perthuis, 2011) or an inevitable feature of any financial market (Interpol, 2013; Kaime, 2017; McAllister, 2011). Yet others found that 73% of the CDM credits are miscalculated or not additional (Cames et al., 2016), which could be due to fraud or subjective judgements. Therefore, fraud can be disguised as a discrepancy due to the regulations' openness to subjective measurements, and varying additionality calculations. So "it is impossible to know how many other cases of [fraud] […] have yet to be discovered" (Kaime, 2017, p.73), which means fraud is likely more significant than expected.

Which factors facilitate fraud in these markets? The biggest factors that facilitate fraud cases are: a) the complexity of measuring carbon through unverifiable additionality calculations, based on unique local contexts in remote locations, b) the intangibility and alienability of carbon, which makes verification difficult and allows opportunistic behaviour, c) the flawed assumption of perfect interchangeability of credits, which creates tradeability, thereby moving the focus to credit acceptance in the EU ETS rather than source examination, d) the conflicting incentives of numerous stakeholders that arise through the interplay of environmental and financial incentives and may more or less intentionally lead to fraudulent

behaviour, and e) the structural aspects that arise through the uncertainty of the novel system and thereby create information asymmetries around regional circumstances or reduction costs, legal vagueness about liability for fraudulent credits, and difficulties in enforcement.

Is fraud a sufficient reason to replace the system? Martin & Walters (2013) argue that if fraud is present in the EU ETS, the market will not function effectively and the actions of players will not be altered, therefore failing to provide the desired emission reductions. Yet, the finding is that the vulnerabilities to fraud do not justify the system's replacement. After all, alternatives are likely to include fraud too and the overall impression is that the resources already invested into the current system are likely to yield returns since the learning phase has been endured and reforms can now made based on the accumulated knowledge.

How has fraud affected the proposed reforms of the system? Fraud makes the market less efficient and increases the public's scrutiny of the systems and pressure on the regulators. Thus, many suggested reforms specifically target the fraud in the market. Proposals include: limiting the interaction between the EU ETS and the CDM, the exclusion of projects with highly dubious additionality calculations like carbon sinks (Martin & Walters, 2013) or the implemention of a certified tax software across the EU ETS, which would greatly reduce the system's vulnerability to missing trader fraud (Ainsworth, 2009). Yet, due to the complexity of fraud opportunities, each reform has many implications which can in turn increase fraud vulnerabilities. For instance, the offset cap could exclude high quality credits with certain additionalities from legally entering the EU ETS and could create an additional unrestrained channel for offset credits to enter the EU ETS via other trading systems (Wara & Victor, 2008).

Since the system's flexibility allows the interaction between the EU ETS and the CDM, does this trading affect fraud opportunities? This interaction increases the complexity, which opens up each system to further fraud opportunities, which means that oversight and enforcement is more difficult. However, due to the global tactic necessary to tackle climate change, the trading across industries, nations and mechanisms could be the best approach.

What effect does the interplay of environmental protection objectives and financial markets have on stakeholder incentives? The effect may include misaligned incentives and conflicts of interest. The outcome of incentives on fraudulent behaviour is difficult to determine due the player's discretion, biases and free choices. For example, for the offset host country, an

incentive to increase local energy efficiency may lead to simplified approval processes for developers. This does not necessary equal fraud. Yet, if a project eventually does not fulfil the environmental additionality, the host country's unintentional choice to fast-track it would lead to undesirable outcomes with regards to environmental protection. So similar incentives may or may not lead to fraudulent behaviour, making it difficult to regulate them.

Does the environmental context affect the victims' vulnerability to fraud? Even if the fraudster does not steal from the environment, the fraud can be linked to or facilitated by the environmental objectives. Some fraud types do not harm the environment directly, for example, computer crime victimised firms that are trading in the EU ETS, state fraud harms the registries and taxation fraud is focussed on the tax authorities. Yet other types, such as some scams, bribery and corruption and structural fraud, do exploit the environment and thereby negatively impact defenceless, distant groups of victims. So the victims of those fraud types are more vulnerable to fraud due to the environmental context. Due to the inter-generational, non-excludable effects of the environment, the victims may be very widely spread or not aware of the fraud, thereby possibly hindering fast and reliable enforcement.

Consequently, how does the environmental context affect the fraud in the market? The conclusion is that the environmental context does influence the system's vulnerability to some fraud types. Precisely, the fraud cases related to scams, bribery and corruption as well as structural weaknesses are increased through the environmental context. For example, scams are facilitated as the environmental aspect increases the victim's gullibility. The presence of these fraud types can also negatively impact the fulfilment of the environmental objectives in the market, for example, corruption can consent the certification of projects that harm the environment such as the eucalyptus plantation that dried up streams in Brazil (Bachram, 2004). The analysed cases of computer, state or tax fraud did not directly influence the environmental objectives of the market - beyond possible decreases in EUA prices after the discovery of the fraud due to loss of confidence in the market. The environmental context also did not make computer, state or tax fraud more likely, as these mainly arose through financial or structural factors such as interjurisdictional differences in VAT percentages. Interestingly, the majority of cases that do affect the environmental objectives, namely bribery and corruption, scams or structural fraud, are associated with the CDM, while the analysed cases that do not affect the environmental objectives like computer, state and tax fraud were mainly associated with the EU ETS.

Limitations and further research:

A limitation to this thesis might be that the distinction between fraudulent behaviour and good intentions with unanticipated outcomes was not always clear. For instance, it is straightforward that bribery cases constitute as fraud, while the cases linked to the lack of verification could be due to honest misjudgements. To understand the magnitude of fraud better, more research into the separation of fraudulent cases would be necessary.

For further research, it would be interesting to examine if fraud in environmental markets displays similar uneven distributions as localised pollution, which may create environmental injustice (Bachram, 2004). If players with the least power face disproportional negative externalities due to fraud, the impact of fraud might be significant but not as visible as these stakeholders are generally underrepresented during the decision making process.

Additionally, due to change of focus towards nationally-focussed emission reduction goals, the CDM credits are not planned to be used in the fourth trading period. However, some sort of replacement including certified international emission reductions will be introduced under the Paris Agreement (European Commission, n.d.-f). Therefore, it would be interesting to examine the vulnerabilities to fraud of those new regulations once they have been introduced. Specifically, to what extent they are based on tradeability or how they have implemented the accumulated knowledge gained through the CDM.

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