MSc Program
Environmental Technology & International Affairs

Study on the Market Stabilization Measures in the Korea Emissions Trading Scheme (Its comparison with the EU ETS and recommendations)

A Master's Thesis submitted for the degree of
"Master of Science"

supervised by
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Vienna, 22. 06. 2015

Affidavit

I, **SUK-YONG HA**, hereby declare

1. that I am the sole author of the present Master's Thesis, "STUDY ON THE MARKET STABILIZATION MEASURES IN THE KOREA EMISSIONS TRADING SCHME", 65 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

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Abstract

This research is a study on the design features and policy measures for market stabilization in the KETS, including the potential issues and available recommendations at the present. It aims to contribute to the successful settlement and development of the KETS as a pillar strategy of environment policy in Korea. Furthermore, the study on the uniquness of the market stabilzation measures in the KETS could provide a another exemplar for the developing countries to prepare the launch of the ETS in near future.

In the Chapter 2, the development process of the KETS (Charter 2-1) is chronologically described as background knowledge. Together with the national emission reduction target, the cap in the KETS is reviewed. Especially, the characteristic of cap coverage is discussed on the perspective of the market liquidity. (Chapter 2-2). The next is to look through the main characteristics of the KETS for market stabilization, which will help understand the policy measures for the market flexibility in the KETS.(Chapter 2-3)

For this study, it is necessary to benchmark strategically the volatility of price spike and crash of the EU ETS and to learn the lessons from the experiences which the EU ETS has gone through over the almost past 10 years. The *strategic benchmarking* includes the performance evaluation (Chapter 3- 1) and the review on the current reform proposal for revitalization of the driving efficiency in the EU ETS (Chapter 3-2). Next the lessons learned through *strategic benchmarking* on the EU ETS (Chapter 3-3) is summarized for the contribution to the KETS.

Finally, in chapter 4, the comparison of market stabilization between KETS and EU ETS (Chapter 4-2) is followed by the previous reform options of the EU ETS (Chapter 4-1) which is very useful to gain the comprehensive perspective for market stabilization measures. The current status of the KETS and the MSM actions took recently by the Government are handled in Chapter 4-3. In conclusion, the available policy recommendations for the KETS at the present stage are presented.

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Lists of abbreviations

BAU : Business As Usual

CDM : Clean Development Mechanism

CER(s) : Certified Emission Reduction unit(s)

EEA : European Environment Agency

EITE : Emissions-Intensive, Trade-Exposed industries

EPRS : European Parliamentary Research Service

ERU(s) : Emission Reduction Unit(s)

ETS : Emission Trading Scheme

EUA(s) : European Union Allowance(s)

FKI : Federation of Korean Industries

GHG(s) : Greenhouse Gas(es)

GIR : the GHG Inventory & Research Center of Korea

JI : Joint Implementation

KAU(s) : Korean Allowance Unit(s)

KCU(s) : Korean Credit Unit(s)

KETS : Korea Emission Trading Scheme

KRW : Korea Won

KRX : Korea Exchange

LDCs : Least Developed Countries

LRF : Linear Reduction Factor

LULUCF : Land Use, Land Use Change and Forestry

MAC : Marginal Abetment Cost

MRV: Monitoring, Repotting and Verification

MSM : Market Stabilization Measures

MSR : Market Stability Reserve

NPAs : National Allocation Plans

The Commission : The European Commission

The Framework Act : The Framework Act on Low Carbon Green Growth

The Decree of the ETS Act : The Enforcement Decree of the Act on the Allocation and Trading of Greenhouse Gas Emissions Allowances

The Decree on the Framework Act : The Enforcement Decree of the Framework Act on Low Carbon Green Growth

The ETS Act : The Act on the Allocation and Trading of Greenhouse Gas Emission Allowances

TMS: Target Management Scheme

The NAP : The National Emissions Permit Allocation Plan

The Roadmap : The National Greenhouse Gas Emissions Reduction Roadmap 2020

1. Introduction

GHG emission in Korea has doubled from 1990 to 2012 and now slightly exceed 690 Mt CO_2. (MoE, 2014 (a)) According to the IEA data (IEA, 2014 (a)), Korea become the world's 7th largest GHGs emitter. Thanks to fast economic growth of the country during last few decades, GHG emission is fast growing among the OECD 34 countries. Especially, its ratio per both capita and GDP is higher than OECD countries' average. (IEA, 2014 (b)) Without the appropriate GHG abatement efforts, the trend appears to be continuing for a while.

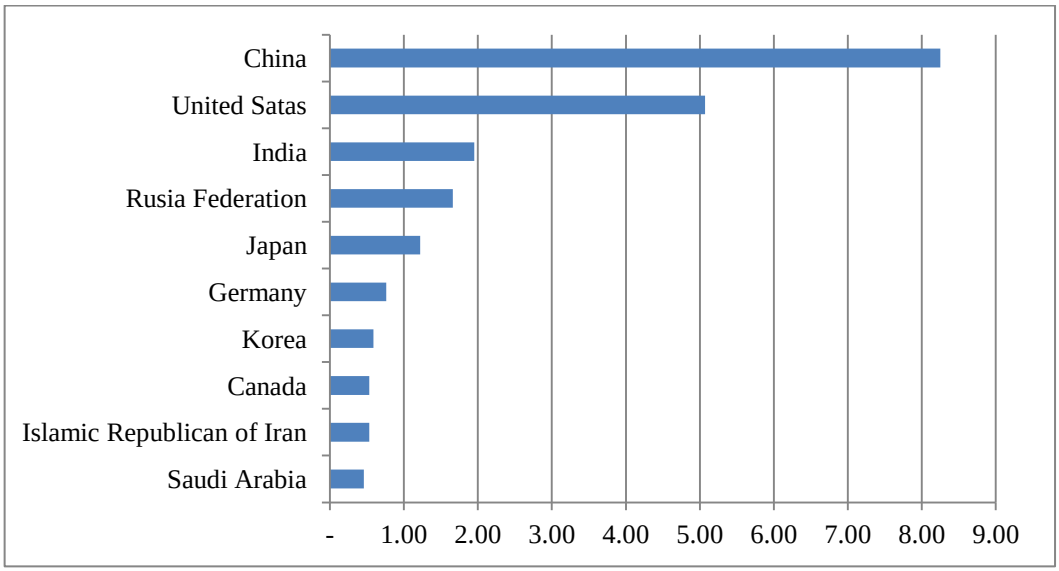

Figure1: Top 10 emitting countries in 2012 (Unit : $GtCO_2$)

Table 1: CO_2 Emissions Selected Indicators for 2012

Region/ Country	Population (Million)	GDP (Billion 2005 USD)	Energy Production (Mt)	CO_2 Emission (Mt CO2)	CO_2/ Pop. (t CO2 / capita)	CO_2/GDP (kg CO2 / 2005 USD)
World	7,037	54,588	13,461	31,734	4.51	0.58
OECD	1,254	39,490	3,869	12,146	9.68	0.31
Korea	50	1,078	46	592	11.86	0.55

Korea is one of the few OECD countries which have no binding obligations to reduce emissions under the Kyoto Protocol. (Yale, 2012) But as part of the Copenhagen Accord, Korea pledged to reduce GHG emissions by 30% in relation to BAU level by 2020. This goal equals to a 4% reduction below 2005 BAU levels. As a major step towards this goal, the government introduced the KETS to answer the emission reduction on Jan. 2015.

The ETS is a treading market scheme where the emission allowances, which are intentionally designed as an artificially assets by the policy objective, are transacted. Economically the idea of emission trading has emerged as the approach of integrating the negative externality into market scheme. The objective of ETS is to reduce emissions in the most cost-effective way and to provide incentives for investment in new and innovative technology to abate emissions through the market mechanism.

The efficiency of ETS has theoretically been explained through MAC theory. MAC is 'the cost of abating an additional unit of GHGs emission'. (Brunner et al., 2009) As long as MACs of polluters differ, incentives for trade exist. Polluters with high MAC buy allowances from polluters with low MAC until the market equilibrium meets. This equilibrium generally called as a Coase theorem. (Coase, 1960) The demand for allowances is equalized with the supply of allowances. Prices would be determined based on the market equilibrium, if there are no market failures like as asymmetry of information. (Brunner et al., 2009)

Egenhofer et. el (2010) point out the importance of the price formation mechanism especially in ETS. The allowances price is a key criteria on which the business depends for the efficient investment in abatement technology. The incentive for efficient abatement comes from the opportunity costs of using allowances. (Egenhofer et al., 2010) Therefore the function of establishing a long-term and predictable price signal in the ETS plays the most important role for driving the efficiency of the ETS.

For this reason, the ETS has more advantages than the other environmental control mechanism such as the corrective tax and government regulation. According to the World Bank's data (2014), about 40 countries including the EU and over 20 sub-national

entities have already implemented the ETS, covering almost 6 Gt CO_2, about 12 % of the annual GHG emissions.

In spite of the advantages of the ETS, there has been a variety of controversies on the efficiency of the ETS. As well known, EU ETS as the main pillar of EU climate policy and as exemplar for other newly emerging cap-and-trade systems all over the world is in great turmoil at the moment. It was caused externally due to the serious economic recession in many countries after the financial crisis and internally due to the weakness of intrinsic design of the scheme. The efficiency of the EU ETS has currently been under threat. A study even strongly argues that without speedy reform, the EU ETS could be dead as a instrument of European climate policy. (Graichen et al., 2015)

What has been actually the problems in the EU ETS ? And where have these serious problems come from ? The answers to those questions are very critical for the KETS which has just been launched, mainly modeled by the EU ETS, in order to be settled down as a pillar strategy of the country's environment policy .

As already explained, the ETS is to solve the GHG emissions problems under the market mechanism. The ETS market functions under the market price formation through the supply and demand of allowances. If the ETS market is under the low efficiency, it means that the current market price is not properly formed enough for business to invest in emission abatement technology and that the future market price signal is too weak to provide business with the incentive for efficient emissions abatement. The key factor of driving the efficiency of ETS is the *market stabilization* to provide the proper and predictable price signal of allowances through the market mechanism to market participants.

It is noteworthy to mention the regulatory characteristic of the ETS market, different from the general market. Egenhofer (2010) emphasizes the importance of policy measures and rules in setting and allocating allowances. For a start, the policy goal is defined in the ETS. After the rules on allowances transaction in the market are established in advance, an ETS market starts to work like other market according to the market mechanism. Therefore, the study on the pre-defined *market stabilization*

measures is important to understand the uniqueness in the KETS.

The research is a study on the design features and policy measures for market stabilization in the KETS, including the potential issues and available recommendations at the present. Its aim is to contribute to the successful settlement and development of the KETS as a pillar strategy of environment policy. Furthermore, the study on uniqueness of the market stabilization measures in the KETS could provide a potential exemplar for the launch of the ETS in the developing countries.

In the Chapter 2, the development process of the KETS (Charter 2-1) is chronologically described as background knowledge. Together with the national emission reduction target, the cap in the KETS is reviewed. Especially, the characteristic of cap coverage is discussed on the perspective of the market liquidity. (Chapter 2-2). The next is to look through the main characteristics of the KETS for market stabilization, which will help understand the policy measures for the market flexibility in the KETS.(Chapter 2-3)

Because the main problems of current EU ETS could be compressed as the volatility of price spike and crash, it is necessary to benchmark the cases of the EU ETS strategically and to learn the lessons from the experiences which the EU ETS has gone through over the almost past 10 years. The *strategic benchmarking* includes the performance evaluation (Chapter 3- 1) and the review on the current reform proposal for revitalization of the driving efficiency in the EU ETS (Chapter 3-2). Next the lessons learned through *strategic benchmarking* on the EU ETS (Chapter 3-3) is summarized for the contribution to the KETS.

Finally, in chapter 4 the comparison of market stabilization between KETS and EU ETS (Chapter 4-2) is followed by the previous reform options of the EU ETS (Chapter 4-1) which is very useful to gain the comprehensive perspective for market stabilization measures. The current status of the KETS including the early MSM actions by the Government is presented in Chapter 4-3. In conclusion, the recommendations are made on environmental effectiveness and dynamic efficiency of the KETS.

2. Main characteristics of the market stabilization in the KETS

2-1. Development process of the KETS

The Korean government announced a national emission reduction target of 30 % by 2020 under the BAU level at Nov. 2009. (MoE, 2011) This government's pledge was submitted to the Copenhagen Accord at the COP 15 meeting of UNFCCC in Dec. 2009. Although Korea had no binding reduction commitments as a Non-Annex I country under the Kyoto Protocol, the country set the very challenging target to tackle emissions.

Regarding this challenging commitment, a study (Hyun and Oh, 2015) points out both its external and internal backgrounds. Externally, Korea faced international pressure to participate in global efforts to address climate change agenda by reducing national GHG emissions. The main background of introduction of KETS was to answer actively the GHGs emissions reduction issues.

Internally, in order to overcome a stagnant economy at that time, the newly elected Korean government proposed 'low carbon, green growth' as a growth strategy to drive the economic revitalization. It tried to encourage industries toward green investment in low carbon technology as new growth engines.

As the foundation of the green growth agenda, The Framework Act was enacted in April 2010. Related with GHG abatement, the Framework Act required that large emitters and energy consumers report the quantities of GHG emitted and energy consumed to the government every year. (MoGL, 2010)

In order to manage this requirements, GIR was set up in June 2010. The Framework Act also required that 'the government operate a system for trading for trading emissions of greenhouse gases by utilizing market functions in order to accomplish the State's target of reduction of greenhouse gases'. (MoGL, 2010) Accordingly the proposal for an Korea ETS was published in December 2010.

At first, the Framework Act put into place temporary mechanisms that was useful for the future ETS. It was the GHG and Energy TMS which was implemented in March 2011. In practice, under TMS, the covered business entities must submit data on GHG emissions and energy consumption to the Government on a yearly basis. Subsequently the government assigns an emissions and energy reduction target for the following year. A kind of GHG emissions limitation was allocated to the GHG emitters that exceeded legally-determined thresholds. TMS was administrated by GIR which was founded on the basis of the Framework Act. This scheme was expected to cover about 90% of the industrial GHG emissions, and 70% of the total national GHG emissions. (MoE, 2011)

TMS is a command-and-control measurement to address the emission reduction, not offering the flexibility in meeting the target. (Yoo, 2012) Actually TMS was a bridge scheme to transfer to the ETS. The TMS was an important precursor to the ETS, covering almost the same controlled business entities as the KETS. (Bloomberg, 2013) By operating this scheme, the government and the covered business entities were able to collect 'the verified emissions data for several years prior to the start of the KETS'. (Hawkins and Jegou, 2014)

Table 2: Comparison among the environment policy measures. Simplified from the text in order to compare the pros and cons among policy measures. (Mankiw, 2012)

Item	Market Friendly Policy (Indirect)		Command and Control (Direct)
	Carbon (Corrective) Tax	ETS	Regulation (TMS)
Policy Target	-Price of emission	-Total amount of emission at the lowest cost	- The specification of emissions quantity ceiling -The location of pollution
Pros	-Simple design -Wide application	-Efficiency on reaching goal	-The fixed and predictable policy
Cons	-The uncertainty of goals -Inefficiency in tax revenue distribution	-The difficulty in setting goal. -The price volatility	- The inefficient government involvement in the market

Meanwhile, the legislation of the ETS Act was approved by the National Assembly in May 2012. The Decree of the ETS Act was enforced in November of the same year, being passed by the Cabinet. Korea became the first Asian country to pass a nation-wide ETS into law. This outlined the rules and governance structure for the ETS.

When the ETS Act was approved by the National Assembly, there had been significant opposition to this policy from industries. The main oppositions were that the covered business entities would have incurred higher production costs and lost international competitiveness in the countries without the ETS. (Bloomberg, 2013) Hyun and Oh (2015) also mentions that the Korean Chamber of Commerce claimed that Korea's target of 30% emissions cut is too ambitious and that adopting the ETS will most likely slow down economic growth. The KETS faced a strong opposition from the business and industry bodies. Actually the resistance was so strong that the timeline to its introduce was rescheduled for 2015, instead of the initial implementation plan in 2013.

After the establishment of the institutional framework of KETS, the government designated KRX as an allowances exchange in January 2014. At the same time, the Master Plan for KETS implementation was released. Five months later on June 2014, the NAP was followed up. It was the detail elaboration on the operation of the KETS especially for the period of 2015 to 2017, including cap in circulation and allocation methods.

After the release of the NAP, 'the Korea Chamber of Commerce and the Federation of Korean Industries once again requested for a full-scale reconsideration of the KETS and re-postponement of the launch date to 2020'. (Hyun and Oh, 2015) Through the negotiation with industries, the revised NAP was finally approved in September 2014. According to the revised plan, the cap was slightly adjusted upward without the change of the national cumulated emission reduction targets. After the severe negotiation with the business and industry bodies, the KETS started officially from 1st January 2015.

As stated, the time has long past for the introduction of the KETS. Mainly due to the strong opposition from the stakeholders and the concern about the EU ETS's severe experience caused by market volatility, the final design of the KETS was amended with

complemented measures, especially related with the market stability tools. In next chapter, the design features is reviewed especially on the market stability perspectives.

It would be helpful to mention the main suggestions from industry lobbies to understand the contents of the NPA. Some of the suggestions from industry was amended on the Decree of the ETS Act. by the Government ; provisions for free allocation, banking and borrowing and usages of offsets. But the others were rejected. The Government presented the will to secure the environmental effectiveness in the KETS without destroying its integrity.

Table3: Main suggestions for industry lobbies. Revised from the original. (Bloomberg, 2013)

The suggestions from industry	The Propose by the Government
-100% free allocation for industrial sectors until 2021	-100% free allocation relative to the cap till 2017 and 97% free allocation relative to the cap till the 2nd Phase
-Coverage of the direct emission only	-TMS covers indirect emissions from grid-power consumption, as may the ETS
-Exclude industries such as aluminum and chemicals (exposed to int'l competition)	-
-Allow unlimited banking and borrowing between Phases	-Banking but not borrowing between Phases are permitted.
-No limits on the offsets	-Offset usage to 10% of emission in each year, With no int'l credits permitted till 2021
-Reduce the maximum penalty charge Won 100,000 /t (77.7 Euro / t)	-
-Delay implementation of the KETS	-

2-2. Cap and coverage

The KETS is 'designed as a cap-and-trade system with an absolute quantity limit on emissions, which will be lowered over time'. (Hawkins and Jegou, 2014) The cap is the maximum level amount of GHG emissions. It is the target which the participating business entities have to meet during a committed period of time.

As stated, in KETS, setting a cap has been an very difficult task, due to the strong arguments on the international competitiveness from the business and industry bodies. The arguments focused on the level of the national reduction target and its allocation. Because Korea is a very CO_2 intensive economy, the covered business entities should adjust their output levels downward in case of high emission reduction target. It could make the growth rate of the covered business entities slow down during the committed periods.

The NAP contains the specified rules for the operation of the KETS , related with the total emissions cap per commitment period. The KETS cap for the first commitment period was derived through a process of the following: 1) finalizing a national emission reduction target for 2020, 2) designing a road map for 2020 to reduce emissions and 3) setting the KETS cap for the first commitment period during the period 2015-2017. (Hyun and Oh, 2015)

National emission reduction target

National emission reduction target for 2020 had been determined in Article 25(1) of the Decree on the Framework Act; the reduction of 30 % of the projected 2020 emissions. According to The Roadmap (MoE, 2014 (b)), the government's BAU emissions forecast will reach 776.1 Mt CO_2 in 2020. Therefore the GHG emissions in 2020 will amount to 543.27 Mt CO_2 after the abatement. It is actually equivalent to a reduction of above 4 % of 2005 emissions (569.0 Mt CO_2) by 2020. (Hyun and Oh, 2015)

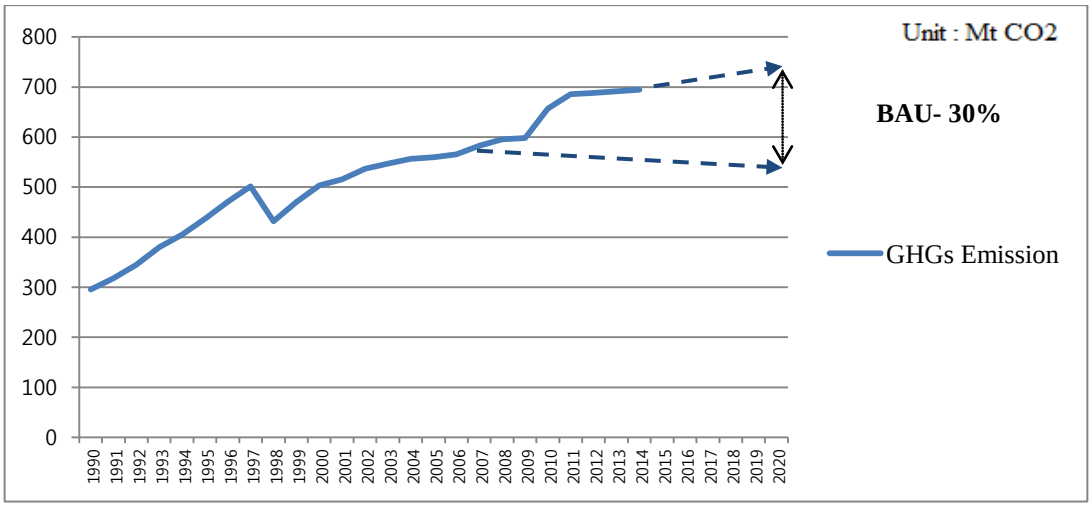

Figure 2: National Emission Reduction Target for 2020

The reduction target level of KETS is the highest level among the IPCC recommendations for Non-Annex I Parties (IPCC, 2007); a decrease of 10~30 percent GHG emissions.

Cap

According to the NPA (MoE, 2014 (a)), BAU estimates and national emissions targets for the first commitment period (2015-2017) of KETS were determined as follows,

Table 4: National BAU level, emissions targets and Cap for the first Commitment Period. (MoE, 2014 (a)) Revised from the original table. (See Appendix 1 for BAU emissions of all the detailed business sectors)

Category (unit) / year	2014	2015	2016	2017	2020
BAU (Mt CO2e)	694.5	709.0	720.8	733.4	776.1
National emissions target (Mt CO2e)	659.1	637.8	621.2	614.3	543.0
(% to BAU)	5.1%	10.0%	13.8%	16.2%	30.0%
(reduction rate %)	-	3.2%	2.6%	1.1%	-
Cap (Mt CO2e)	-	573.5	562.2	550.9	-

Regarding the cap setting process for the first commitment period, Hyun and Oh (2015) point out the difficulties in finalizing the annual target. Although the Framework Act fixed the 30% reduction to the BAU level with estimation of 776 Mt CO_2 as the country's pledge at the COP 15 meeting of UNFCCC, the industrial sector requested to re-estimate the BAU level as of 2013 with the latest data. After the request was accepted, the government planned to release a revised 2020 emissions forecast under a BAU scenario in 2013. The inter-ministerial experts working group compared the BAU estimates in 2009 with the BAU level of 2013. They found out that the amount of anticipated emissions from the industrial sector has decreased due to the anticipating economic downturn, while a large increase was seen from electricity generation on the basis of the continuing increase of the emery consumption inside the country. But in spite of these sartorial changes in emissions, the gap in the aggregate between the old and new estimates was as minute as approximately 3%. Therefore Hyun and Oh (2015) explain the background of the government's final conclusion that the updating of the 2020 BAU would not be significant enough to compensate for the burden of altering the 2020 BAU estimate which was already pledged to the international community. In the result, the government fixed the national emission target as at the same level of 776.1 Mt CO_2 as announced at the Framework Act.

Instead, the annual target was arranged in accord with the economic situation without the change of 2020 abatement target. As shown in the table 4, the rate of national emission target to the BAU increases gradually. The reduction rate during the 1st Committed Period slightly decrease. The current economic stagnation is expected to recover slowly during the coming years. In spite of the decrease of the reduction rate, because the rate of the national emission target to the BAU will increase, the balance could be kept to meet the 2020 target.

Base on the total cap, emission allowances are allocated to participants of KETS. The unit of allowances is KAU, equivalent to ton of CO_2 (t CO_2). The amount of emission reduction target is transferred to the emission allowances, being allocated to the participants. According to the NAP (MoE, 2014 (a)), the emissions allowances by sectors and industries are as follows.

Table 5: Emissions allowances allocated to sectors and industries for the 1st Commitment Period (Unit : M KAU)

Industry	Business sector	1st Commitment Period				%
		2015	2016	2017	Total	
Total Cap		573.46	562.19	550.90	1686.55	100.0%
Pre-allocated	emission permits	543.23	532.58	521.92	1597.73	94.7%
Emission permits	in reserve	30.23	29.61	28.98	88.82	5.3%
Converted to	Power sector energy	250.19	245.28	240.38	735.85	43.6%
Industry		274.95	269.56	264.18	808.69	47.9%
Transportation		1.29	1.26	1.24	3.79	0.2%
Buildings		7.11	6.97	6.83	20.91	1.2%
Public sector/	Waste materials	9.69	9.49	9.31	28.49	1.7%

As shown in the table, the government maintains a reserve of allowance with a certain ratio of total allowances during the 1st commitment period. Allowances in the reserve would be given to new entrants, in case of new facilities opening or changes or expansion of existing facilities. (MoGL, 2012 (b)) Business entities or facilities that are designated as new entrants can participate in the ETS from the year following their designation. In addition, the reserve could be released to the KETS trading market under the purpose of market stabilization in case of the request of the industry and the need of policy implementation.

The total reserve amounts to 88.82 Mt CO_2, among which only 16.12 % (14.32 Mt CO_2) can be transferred for the use of MSM. (MoE, 2014 (a)).

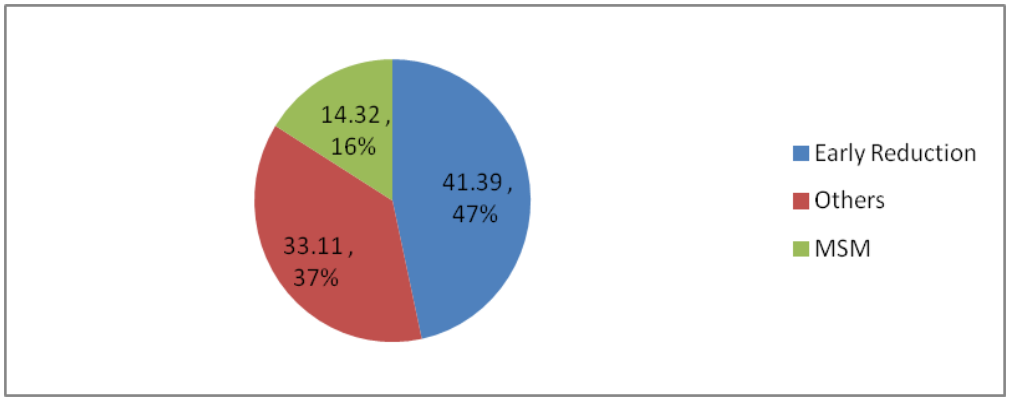

Figure 3: Portion of usage among total reserve

Table 6: Annual reserve during the 1st Commitment period. (Unit : 1M KAU)

	1st Commitment Period				%
	2015	2016	2017	Total	
Total Cap	573.46	562.19	550.90	1686.55	100.0%
Emission permits in reserve	30.23	29.61	28.98	88.82	5.3%

Coverage

The cap in the KETS consists of a wide range of emission sources. The ETS Act (MoGL, 2012 (a)) define as its' coverage, a business entity or a firm which emits no less than 125,000 tons of CO_2 annually based on the average of GHG emissions for the preceding three years or a facility produces 25,000 tons of CO2e annually for the same period. In addition, 'a controlled entity that does not fall under Subparagraph 1, but files an application for designation' could be also covered as a business entity eligible for allocation (voluntarily participating entities) in the KETS. (MoGL, 2012 (a))

'Under the KETS, 525 business entities consisting of 243 companies and 283 facilities in 23 sub-sectors have been given a fixed amount of emission allowances'. (Hyun and Oh, 2015) Covering almost two-thirds (65%) of the country's total emissions, the KETS becomes the world's second largest ETS market next the EU ETS. (Hyun and Oh, Jan. 2015: 1-2)

Hyun and Oh (2015) point out that the KETS is applicable to all sectors based on the entirely threshold. It means that both the business entities and individual installations whose annual emission go over certain levels, are covered in the KETS, irrespective of their sectors. In the result, the KETS contains approximately tow third (65%) of the country's GHG emissions, which is relatively higher than the other ETS. If the growth of the participating sectors by 2020 is taken into consideration, the KETS is expected to cover almost 75% of the country's GHG emissions. (Hawkins and Jegou, 2014)

Regarding cap coverage, it is more noticeable that the KETS is applicable to both direct and indirect emissions. Because in general either direct or indirect emissions can be a subject of the ETS, but not both are not likely to be covered simultaneously within the ETS, Hyun and Oh (2015) point out the KETS is unique, because it include both

emissions sources in the power sector.

Under the general ETS regime, the power sector shifts the burden of cost spent for buying emissions allowances towards the electricity rate. In the result, both large electricity-consuming businesses and consumers would be double-burdened. Besides this reason, when the cap of the power sector is calculated, the inclusion of indirect emissions could be double-charged in spite of the only once occurred action. It will make the system very complicated when the quantity of emissions is calculated. (Hyun and Oh, 2015) Because the proportion of indirect emissions in Korea reaches above 20% (Bloomberg, 2013: 10), it is relatively high in comparison with other countries. He explains that due to the cheap electricity price in Korea, consumers would not reduce their electricity consumption if the ETS covers direct emissions only. For this reason, the KETS includes also indirect emissions in its scheme. TMS, which is the precursor of KETS, also included indirect emissions.

Hawkins and Jegou (2014) emphasize that the coverage of indirect emissions could incentivize companies to improve their energy efficiency. But they also present the risk of 'causing a misallocation of allowances in addition to complicating reporting and compliance procedures'. Therefore in order to avoid double-counting or misallocating allowances, if any, the evidence of forceful accounting methods has to be provided for the environmental integrity of the KETS.

Regarding GHG emission sources, The KETS includes all six Kyoto Protocol GHG. In addition to CO_2, N_2O, and PFCs, the KETS also covers methane (CH_4), hydro fluorocarbon (HFC), and sulfur hexafluoride (SF_6). According to Hawkins, the GHG sources which emissions cannot easily be quantified and monitored with accuracy, especially such as N_2O and CH_4 emissions from agriculture, have be to managed with alternative sound methodologies of measurement and monitoring measures. If the unverifiable emissions is included, the credibility of the KETS will be deteriorated.

In summary, the KETS has a wider coverage for emission sources in many aspects than the other ETS. It has pros and cons. As advantages, the broad coverage provides wide potentialities for market liquidity and efficiency. (Brunner et al., 2009) Thanks to

the inclusion of a wide range of sources and participating sectors in the KETS, it could disperse the impact of economic shocks in any one sector to the other sectors. But it could distort the KETS market through partly transferring external shocks into other sectors.

Nevertheless, the extensive emission sources coverage of the KETS enhances its ability to cope with the external impacts, increasing the market liquidity. Establishment of infrastructures for accurate MRV and advancement of various criteria on reporting and verifying the amount of GHG emissions would be developed throughout the implementation periods. (Hyun and Oh, Jan. 2015)

2-3. Policy measures for market stabilization

Market stabilization measures is one of the unique characteristics in KETS. In case of the market abnormalities, it is critical to keep the ETS market mechanism stable, protecting from the external unexpected shocks. MSM is taken into action extensively in case of significant changes in prices or trading volumes. The objective is 'to facilitate the stable setting of a price for trading emission allowances' (MoGL, 2012 (a)). The Decree of the ETS Act (MoGL, 2012 (a)) prescribe that MSM should be taken through deliberation by the Allocation Committee.

The Decree of the ETS Act (MoGL, 2012 (b)) designates the cases which could be applied to MSM. First, the price of allowances for 6 consecutive months exceeds the average price during the preceding 2 years by 3 times. Second, trading volume within a month increases by more than twice the volume of the same month in the last 2 years. Third, the price of allowances within a month either more than doubles or decreases by 60% compared to the price of the same month in the last 2 years.

As stated on the Decree of the ETS Act, all these measures could be taken on the basis of the allowances price changes just prior to 2 years and average monthly trading volume in the last 2 year. Therefore, the MSM for 1st and 2nd year (2015~2016) of the Commitment period has to be prepared. The Government provides the criteria for the MSM application as the price threshold. In case that the 3 month average price of KAU

exceeds KRW 10,000 (EUR 7.7), the Allocation Committee could decide the application of MSM. (MoE, 2014 (a))

The NAP (MoE, 2014 (a)) states also that the following measures to stabilize the market could be taken by the Government. First, to auction up to 25% of allowances from the reserve (MoGL, 2012 (a)); Second to adjust the number of emission allowances to be allocated to a business entity for each compliance year (MoGL, 2012 (a)); Third to set a maximum (less than 150% of allowances allocated in the corresponding Commitment year) or minimum (more than 70% of allowances allocated in the corresponding Commitment year) limit for the holding of allowances by each business entities (MoGL, 2012 (a)); Forth to increase or reduce the borrowing limit (MoGL, 2012 (b)); Fifth to increase or reduce the offset limit (MoGL, 2012 (b));; or Sixth to adjust the to set the highest or lowest price. (MoGL, 2012 (b))

Table 7: Specified MSM provisions of KETS.

Provisions	Measurers	Management
Market Stabilization Measures	1)**Additional allocation from the reserve** (up to 25%)	Volume (Liquidity)
	2)An **adjustment of the number of emission allowances** to be allocated to a business entity for each compliance year **from the reserve**	
	3)An increase or decrease of **the borrowing limit** (up to 10%)	
	4) An increase or decrease of **the offsets limit** (up to 10%)	
	5)Establishment of **an allowance retention limit**: minimum (70%) or maximum (150%) of the allowance of the compliance year	
	6) Temporary set-up of **a price ceiling or price floor**	Price

Usage of the reserve : additional allocation and adjustment of the number of emission allowances

According to the provisions especially for the additional allocations, it is allowed in the following cases. (MoE, 2014 (a)) First, the government is able to allocate additional allowances in case of the increase of the total cap due to the change of plan. Second, The participating business entities may request readjustments from the reserve pool in certain conditions. The NPA put a limitation on cases under which the additional allowances could be accepted. The additional allowances in the KETS is accepted under the following circumstances.

Table 8: Cases for the readjustment of allowances allocation

Subject	Cases
Government	When the total cap increase , due to the change of plan
The participating business entities	When emissions increase, due to the changes an unexpected expansion of a firm's facilities or the transfer/merger of a factory
	When a firm's emissions have increased by more than 30% over its allocated allowances, due to an unexpected economic situation

Hawkins and Jegou (2014: 24) mentions that the most striking aspect of the KETS regarding the allowances allocation is the possibility of its readjustment, by using the allowances in reserve. The readjustment by the additional allocations or cancelation of allowances could be accepted in the KETS under the pre-described conditions. But in general, during an Commitment Period the allocation of allowances should not be changed.

The readjustment provision will help the KETS increase the market flexibility, coping with the unexpected external shocks. The KETS seems easier to keep the market stability through controlling the volume of the allowances in circulation. The readjustment ability in the KETS contribute to the market flexibility.

Banking and Borrowing

Beside the readjustment ability in the KETS, there are the various provision for increasing the market flexibility for market stabilization. The most general tools are the banking and borrowing of allowances. According to the NAP (MoE, 2014 (a)), in order to ensure the market flexibility to cope with the unexpected situation, 'an business entity could carry over allowances to the following compliance year in the same commitment period or to the first compliance year in the following commitment period with approval from the competent authority, implying no limits'.

In addition, the NAP (MoE, 2014 (a)) defines that the borrowing limits of allowances shall not exceed 10% of allowances permits to be surrendered. But, unlike banking, only the borrowing of allowances of the following compliance year within the same commitment period is allowed. It will prevent the participating business entities from the repeat of borrowing from the following commitment period. This is because the unlimited borrowing could result in the weakening of incentives to reduce GHG emissions and making it impossible to check whether emissions reduction targets are achieved.

Hyun and Oh (2015) points out the potentiality of undermining KETS's liquidity in case of the high limitation on banking and borrowing of allowances. But on the contrary, if the limitation is low, it could weaken the incentives to continue reduction efforts in order to avoid 'penalty for failure to comply with the obligation to surrender emission allowances'. Therefore it is critical to keep the moderate certain scale of limitation.

But the NAP (MoE, 2014 (a)) does not put the limitation on the size and period of banking. In a case of a limit on banking, the excess number of unused allowances would become useless due to the restriction of vintage year because might result. Hereby the banking to the following period makes the participating business entities to utilize efficiently the incentives for their reduction investment efforts.

Offset credits

The another consideration on the market flexibility is the approval of offset credits. Offset credits are a kind of additional coverage. It works as counterbalance. (Garnaut Climate Change Review, 2008) Emissions reduction from activities in a sector can generate the tradable offset credits. Those are used to offset emissions in other sector. Therefore the import of offset credits can extend the coverage in ETS. Any increase in emissions by one sector will need to be compensated through the purchase of other sector's emission reductions. (McLennan Magasanik, 2009)

In the KETS, the credits obtained through a CDM project in the Kyoto Protocol is 'accepted for the duty of allowances surrender'. (MoE, 2014 (b)) And reduction performance certified by the government through projects outside the boundary of business type of the covered business entities is also allowed as offset credits. (MoE, 2014 (b))

Through acknowledgment of the offset credits, the KETS is designed to include the total GHG emissions reduction, being obtained outside the boundary of its own business type. According to the Bloomberg data (Bloomberg, 2013), there are 100 active projects in the CDM pipeline located in Korea, able to generate over 20 Mt CO_2 credits per year.

But when the offset credits are accepted without limits, the participating business entities tends to select the external projects with cheap cost. It could lead to decrease the abatement incentive of the KETS. In order to prevent the probability of the import of cheap certificates from external projects, the ETS Act (MoGL, 2012 (a)) allows only GHG reductions projects generated with international standards, defined in the UNFCCC and relevant protocols, including CDM projects. Also the Decree of the ETS Act (MoGL, 2012 (b)) restricts the ratio of offset within 10% of the allowances to be surrendered by a business entity.

Furthermore, because KETS makes an effort to reduce GHG emissions mainly through the implementation of the domestic ETS rather than to achieve emissions reduction through overseas projects (Hyun and Oh, 2015), the acceptable amount of GHG

emissions reduction achieved by external projects performed in any foreign nation is limited to maximum 50% of the surrender limits of offset allowances.

The KETS is equipped with extensive measures for mark stabilization. Almost all available options to cope with instability of market could be applied in the KETS. Those range widely from the additional allocation of reserved allowances, the flexibilities of the temporal allocation (banking and borrowing), the use of offset credits to the market price collar mechanism.

A very wide actions can be taken to control both prices and volumes under the objective of market stabilization. It means that the Government is actively allowed to intervene with KETS market. Not only the significant spikes in allowance prices but also the price crashes could be managed through market interventions of the government. Hawkins and Jegou (2014) point out that 'the flexibility to control the market through cost containment measures is a unique feature of the KETS'.

The measure on the retention of allowance and the price collar is not yet defined in details in the NAP of KETS. It would be better to look through the basic ideas of those measures after the review of the EU ETS reform options. The EU Commission had purposed the similar measures to the price collar in the KETS.

3. Challenges facing the EU ETS : Restoration of dynamic efficiency

After around 10 years' experience of EU ETS, there has been a variety of published ex-post analyses and ex-ante studies. They evaluate the different phases of the EU ETS and assess the current and future challenges. The evaluation of the results of EU ETS in past phases is based on its objectives which are stated on EU ETS directives (EC, 2003); it “promote GHGs reductions in a cost-effective and economically efficient manner”

The EU ETS has two aspects of both a short- and long- term objectives. (Egenhofer et al., 2010: i) In a short-term perspective, it aims to reach *effectively* the emission reduction targets till year 2020 at lowest possible costs. On the other hand, as a long-term vision till 2050 and beyond, it has to help *efficiently* the transformation into low carbon technologies as an climate change policy in EU. In other word, it aims to achieve its cumulative cap through its dynamic efficiency. This aim can be reached by providing the industry the incentive for mitigation efforts, investments, and research and development (R&D) toward low carbon technologies over time. (Edenhofer et al., 2014: 12). Therefore the long term objective would be a imperative task to EU ETS as much as the short term target to abate emissions quantitatively at macro level. The EU ETS as a main pillar of EU environment policy has to drive sufficiently low carbon new economy without EU industry's competitiveness loss.

In this chapter, on the perspective of whether it provided real incentives both *to reduce emissions* in short-term (*environmental effectiveness*) and *to drive innovation* in long-term (*dynamic efficiency*) or not, the evaluation on EU ETS has been involved through the literature review of analysis and studies. Main focus is to trace the causes and events of the current challenges facing the EU ETS in details. In addition, the discussion about reform options for revitalizing the EU ETS is followed up. These discussion and lessons learned from EU ETS will lead to the contribution to avoid the potential problems of the Korea-ETS.

3-1. Performance evaluation

Evaluation of environment effectiveness

Regarding the evaluation of the environmental effectiveness of the EU ETS, main point is to review and compare the driving factors of emission abatement during phases. It focuses on analyzing whether the reductions can be attributed to the EU ETS or whether other external factors such as the economic recession, or renewable and energy efficiency policies are more relevant. (Edenhofer et al., 2014) Therefore at first it will be helpful to review what kind of driving factors and events were during each phase of EU ETS.

According to the data (Brown et al., 2012) based on the overview of studies, during the phase I (2005–2007), the EU-ETS reduced carbon emissions by 120 million to 300 million tons (Mt CO_2), or roughly 2~5% below the BAU scenario. The additional reductions of approximately 340 Mt CO_2 in its first two years (2008–2009) of Phase II (2008–2012) were achieved. It amounted for roughly 8% below projected BAU emissions. Therefore during Phase I and during the first two years of Phase II in total, emissions within the EU ETS reduced by around 3% of estimated BAU emissions.

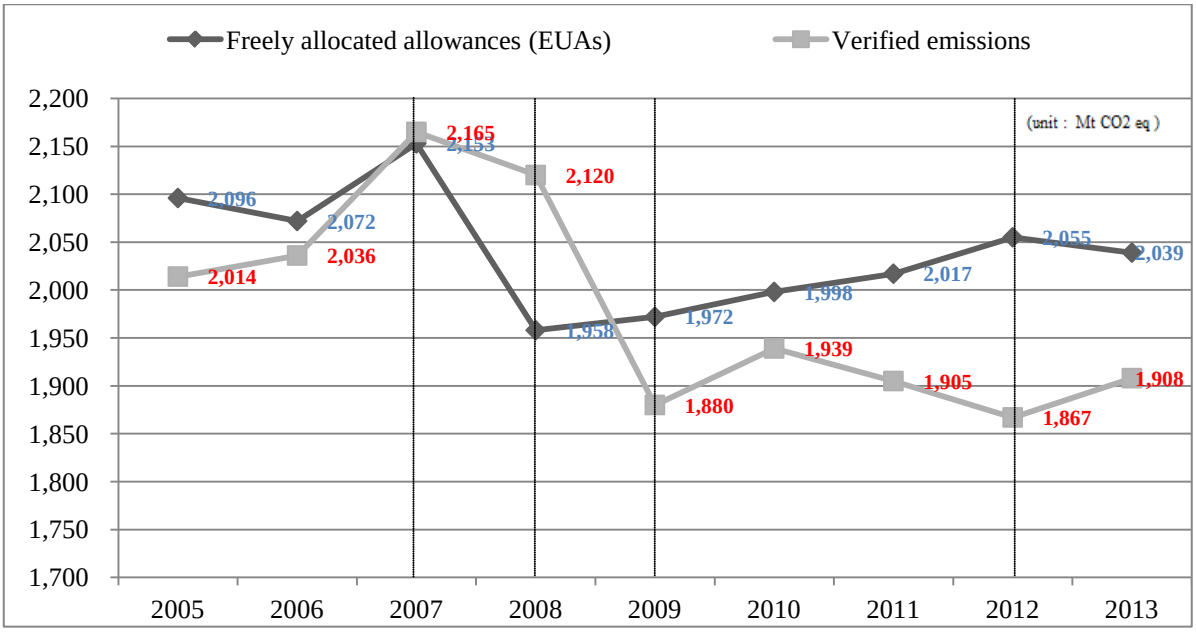

Figure 4: Freely allocated EUAs & emission by EU all countries (from 2005 to 2013) Revised form original. (EEA, n.d.)

Although many studies show the different figures of reduction amount by different methodology (Martin et al., 2014), they conclude that there has been quantitatively effective abatement across in both the phase 1 and phase 2 since the introduction of the EU ETS, helping the EU reach its Kyoto reduction target. (Egenhofer et al., 2010)

Table 9 : Summary of ex-post analyses on EU ETS's abatement results at macro levels.

Studies	Main Conclusion
Ellerman (Ellerman and Buchner, 2008)	For 2005 and 2006, there has been abatement of 'probably between *50 and 100 million tons* in each of these years'. This would amount to between *2 to 5%* of total covered emissions.
Ellerman (Ellerman et al., 2010)	For the overall phase 1, emissions' reductions of between *2% and 5%*, translating *into 120 to 300 million tones* of CO2. (Note: reduction against an estimated BAU baseline projection) Methodology : To multiply from 2005 the previous year's ETS sector CO2 emissions by the observed rate of GDP change and the annual rate of CO2 intensity improvements over 2000-2004.
Anderson (Anderson and Di Maria, 2011)	Overall abatement at *2.8%* during Phase 1. Methodology : The calculation of the BAU emissions scenario for each country by applying dynamic panel data techniques and including industrial production data, energy production and energy prices as well as information on temperature and precipitation.
Cooper (Cooper, 2010)	compares the *3%* decline in total emissions between 2007 and 2008 to the 2% decline in industrial production over the same period, due to the recession, concluding that, in 2008, emissions were not much reduced by the EU ETS.

In line with the general macro level studies, many scholars looked into the abatement at business sector levels.

The energy sector plays a special role for abatement under the EU ETS. First, Ellerman (2010) points out the energy sector reduced emissions in 2005 and 2006. They present that emissions by this sector exceeded the allocated allowances in 2005 and 2006, in spite of receiving more than 40% of the annual permits allocation. For this reason, their

abatement efforts were driven by fuel switching; the conversion of oil or coal fired powers stations to gas fired power stations. The study presented evidence that there would have been incentive for the switch, derived by EU ETS. (Ellerman et al., 2010) The EU ETS influenced the fuel switching from coal to gas power stations, mostly through EUAs price signals, either in terms of actual prices or future price expectations.

Against this argument, using 'a complex model of energy use and price interactions between fuels (e.g. coal and gas)', Delarue (2008) points out that fuel switching occurred partly due to exogenous factors without relation with the fuel prices reflected in the EUA prices. But in spite of the impact from external reasons, he finds out that the magnitude of the fuel switching is likely to be attributed to a potential influence from EU ETS rules and future expectations as its regulatory effect. He mentions that the speed of the switching was actually decreased through the combination of high gas prices and a low carbon price in 2007.

At any way, Martin (2014) shows that as long as the annual cap is observed as a legally binding target and non-compliance faces severe penalties, it is certain that environmental effectiveness of the EU ETS is delivered during Phase I and during the first two years of Phase II. According to the remark of Martin, while the cap was set tightly enough and regulated emitters did not violate the scheme, the achievement of reduction was made during the first periods. (Martin et al., 2014)

Regarding the abatement of industry sector, Ellerman (Ellerman et al., 2010) adds that its abatement occurred largely through the trade of allowances with the energy sector. He concludes that the EUAs price, in particular the expected future EUAs price, was driving companies to invest in energy efficiency. The high rise of output prices in the electricity sector caused by the EU ETS was likely to affect the industrial sector as a whole. In fact while the power sector on the one hand has the highest incentives to reduce emissions because of their more stringent allocation of EUAs, the industrial sector on the other hand tried to abate effectively through the EU ETS market.

But the different situation was developed during the rest part of phase 2 and recent years. Edenhofer (2014) highlights that between 2009 and 2013, actual emissions stayed

below the annual cap. (See figure 4.) He insists that because 'temporarily the annual cap was not binding, thus the emission target has actually been overachieved'.

In order to find out the main reasons of this situation, Gloaguen and Alberola (2013) evaluates the drivers behind the cumulative emission reductions in EU ETS sectors between 2005 and 2011, comparing to BAU scenario. He finds the cumulative emission reductions are within range between 1,152 and **1,324 Mt** CO_2. The study attributes relative shares of the different factors that contributed to these reductions through 'the application of econometric methods'. (Edenhofer et al., 2014) The following is the main findings from the studies.

Table 10 : Summary of emission reduction drivers in EU ETS sectors between 2005 and 2011

Emissions reduction drivers	Mt CO_2	%	Remarks
Policies from EU climate and energy package for 2020	766-805	60%-80%	GHG reduction, renewables, energy efficiency
Energy efficiency		20%-30%	
Impact of the EUAs price signal		0-10%	Relatively small
Economic crisis	296-346		
Fuel price variations	262		
Total	**1,324**-1,413		

Gloaguen and Alberola (2013) summarize that while the annual cap of the EU ETS has been achieved for each year of its operation, the main reasons for these emissions reductions come from factors other than the EUAs price. Nevertheless he points out that this figures does not lead to the conclusion that the EUAs price does not contribute to emission reductions. Instead, it implies that due to the combination of the economic downturn and the development of renewables, market participants don't need to undertake additional abatement. Interestingly, they note that as long as the EUAs price is positive, other factors and measures such as renewables or energy efficiency than the EUAs price will contribute to abating emissions in different ways.

According to his analysis, there were overlapping policies with EU ETS. EEA also highlights the importance of co-benefits between air pollution measurements (EU ETS) and climate policies such as 'EU Climate and Energy Package' and 'EU Large Combustion Plant Directive'. Emissions are expected to decline as a result of improvements in energy efficiency and fuel switch motivated by the restricted supply of EUAs with relatively high price. They give an evidence that the implementation of the EU Climate and Energy Package lead to a emission reduction from sectors outside the EU ETS, such as transport and residential and commercial buildings. The EU Large Combustion Plant Directive has also led to a emissions abatement through a fuel switching from coal to gas.

Brunner (2009) also points out that complementary measures such as insulation and fuel efficiency standards should be employed in order to exploit the abatement potential of non-covered sectors. He argues that both an absolute cap on emissions and complementary instruments are required to reduce emissions in a cost efficient manner. Both are not the conflicting factors for abatement, but the complementary ones.

In conclusion, on the environmental effectiveness point of view, the evaluation on the EU ETS seems to be positive. At macro levels, there was an contribution of the EU ETS to a emission reduction. But it has to be remarked that emission abatement by individual companies and sectors was influenced by other factors than EU ETS. As discussed, these include fuel prices (i.e. the difference between coal and gas prices), complimentary overlapping policies and macroeconomic fluctuations such as the recent recession.

Macroeconomic fluctuations such as the recent recession affect drastically emissions, sometimes. A recession might result in the increased EUAs supply. This would be responsible for cause a surplus of EUAs as a deference between the pre-allocated EAUs and the verified emission. In addition, it is useful to keep in mind that the initial results mainly come from the tight cap with the strict regulation on potential violation of the scheme. (Martin et al., 2014) The tight cap contributed to the incentives for investment and the trading of EUAs among business in the expectation of the higher future EUAs price.

Evaluation on dynamic efficiency

Currently the key question regarding EU ETS performance is the low EUAs price. The reason for this concerns is why it could lead to the deterioration of its dynamic efficiency, decreasing the incentives of investment in low carbon technology of the business. According to the current study on EUAs (Edenhofer et al., 2014), 'futures contracts for prompt EUAs delivery trade at around 5€ / tCO_2, and futures contracts for delivery in the year 2020 are only slightly higher at around 7-8€ / tCO_2'. In fact, it shows that the 2020 price is not at least zero due to the anticipation of future scarcity, in sharp contrast to Phase I, when zero prices did indeed occur. It is a little bit positive, but in general, many studies remark that the actual EUAs price, specifically the future 2020 price, is too low to drive the dynamic efficiency of ETS.

It is very difficult to judge what a adequate level of EUAs price looks like over time, because there are several driving factors for pricing. Therefore it will be useful to review the price variation in EUAs trade market over the past phases in order to trace the dynamic efficiency.

At the beginning, the EUAs prices were in the range of EUR 20–25/tCO_2, reaching a high of approximately EUR 30/tCO_2 in early 2006, and hovering around EUR 15/tCO_2 for most of 2006. After a steady decline, it reached almost zero at the end of Phase I. (Anderson and Maria, 2010)

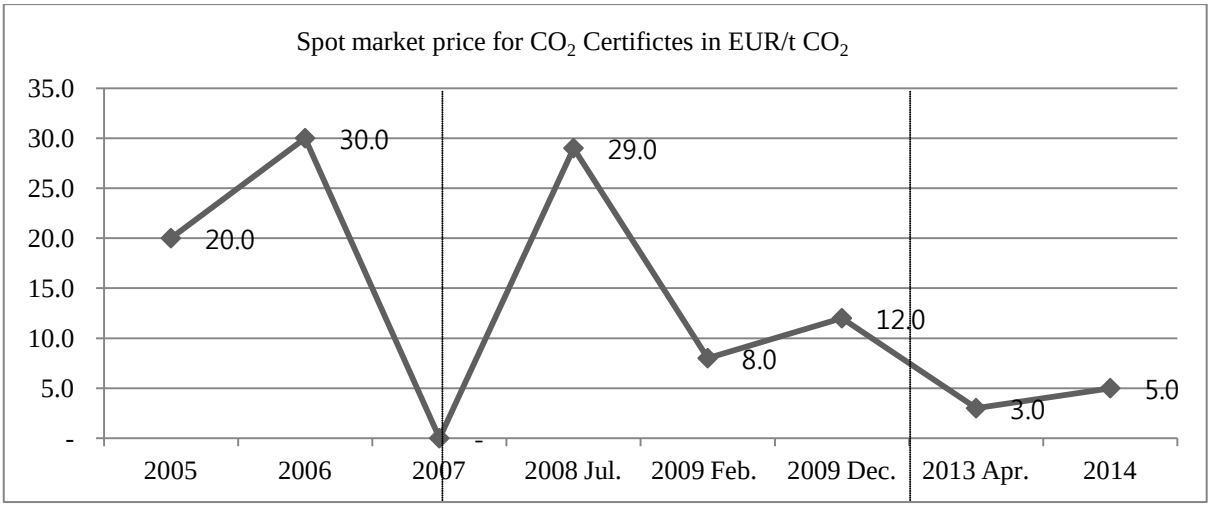

Figure 5 : Spot market price variation of EUAs. Show the key event of price crash.

There was lack of liquidity of EUAs as the same phenomenon as in new trading schemes. (Egenhofer et al., 2010) As already discussed, only the power plants in energy sector participated actively in trading. Due to the high rising gas prices and falling coal prices, power plants had high demand for EUAs with more emissions. Therefore the power sector run short of the supply of EUAs. Furthermore even through the false impression of an supply shortage in the market, the EUAs prices rise up to almost €30 per ton. But ironically in fact the market were in oversupply state. The fact was brought into light.

At early 2006, the verified emissions data of year 2005 was published. According to the report, there was a big discrepancy between the actual emission and the allocated amount of the EUAs. (Hawkins and Jegou, 2014) The verified data shows that the actual emissions in 2005 was 4~5% percent below the allocated EUAs. (See figure 4.) The studies say that this over-allocation was responsible for a initial allocation plan largely based on business entities' own estimation of their emissions rather than on actual historical emissions data of regulated entities. (Hawkins and Jegou, 2014)

Egenhofer et el. (2010) explain that the EU ETS was very quickly adopted without sufficient preparation, as the main reason of its oversupply. The member states registries and NAPs were delayed in some cases by more than a year, following the start in 2005, because many national laws need to be to adapted. In the result, due to the lack of the verified data, allowances was allocated through an intensive government-industry negotiation. The data collection was a voluntary effort by all stakeholders, taking time to verify its accuracy. The study points out that only three member states could rely on verified data.

Actually it was resulted from the unavailability of the verified data in many cases at the beginning. But once the extent of the over-supply came out to be known, the EUAs price on the market continued to decline after the price crash. What makes the matter worse, it was even more aggravated, because the carrying over banking into the next phase of the allocated allowances was not allowed at that time. At last the carbon price reached to a negligible level.

In line with this price crash, there was a windfall profits during Phase I. Hwakins and Jegou (Hawkins and Jegou, 2014) show that some companies covered by the EU ETS during this phase, especially in electricity field of energy sectors, earned windfall profits by passing the EUAs price through to consumers although they had received allowances free of charge. They passed this price increase of the opportunity cost of producing power through to consumers, although they received in fact the EUAs for free. Therefore they increased its revenue without increased costs. (Brown et al., 2012) A comprehensive analysis (Ellerman et al., 2010) estimated that windfall profits for the coal, gas, and oil power sectors in Europe totaled Euro 11.4 billion for Phase I. In case of comparison with the total 730 billion market size of the European utilities by 2009, this amount of windfall profits can be estimated as huge. (Insights, 2009)

At the launch of Phase II the European Commission (The Commission) rejected most NAPs on the basis of the lessons from learned from phase I. The reason for this was that the unverified plan would have again resulted in an over-allocation of EUAs. Being compared with the submitted draft NAPs, EUAs were cut by 10% percent on the whole. Thanks to the supply cut, phase II prices rose initially to over EUR 20/tCO_2, reaching EUR 29 in July 2008.

But during the course of Phase II (2008–2012), the EUAs price has greatly fluctuated once again. Its prices dropped with the arrival of the financial crisis in autumn 2008. It went down to as little as EUR 8/tCO_2 in February 2009. (Hawkins and Jegou, 2014) Fortunately because in this time carrying over allowances into Phase III was allowed, the low demand for EUAs during the recession did not made EUAs price went down to zero completely. Towards the end of 2009, prices recovered barely at around EUR 12~14/tCO_2.

However, since 2011 summer, EUAs prices have once again declined steadily. In April 2013 it finally fell to less than EUR 3/tCO_2. Because the allocations for 2008 to 2012 had planned on the assumption of the expected higher rates of economic growth, therefore the declining economic activity automatically resulted in an over-supply of EUAs. When the Commission presented its plans for emissions trading reform for Phase II in early 2008, they predicted average grow 2.2 % of GDP per year. But In reality,

GDP in 2012 was lower than in 2008, the economy having shrunk on average 0.1 % per year in that period. (Graichen et al., 2015) Less economic activity led to lower emissions, especially on the part of energy-intensive industries. This over-allocation was in large driven by this wrong projection about demand for EUAs.

The other aspect related to over-supply of EUAs was an problems of CERs in the EU ETS trade market. When drawing up NAPs of the Phase II in 2006, a number of EU member states worried that EAUs prices could be very high in that period. Based on this projection, very generous national regulations were applied on the acceptance of JI/CDM credits. In the result, a large volumes of offset credits was added to national quotas. The western member states assumed that emissions reduction in emerging countries and the successor states of the Soviet Union would be slightly, but not significantly, cheaper than in EU member states. (Graichen et al., 2015)

According Graichen (2015), Eastern European countries and the successor states of the Soviet Union had been granted a lot of so-called 'hot air' in the Kyoto Protocol for the period 2008-2012. Russia and Ukraine in 2011 and 2012 turned parts of this 'hot air' into JI credits and sold these in the EU ETS trading market. He points out nearly 450 million JI credits had flowed into the EU ETS by 2013. (Graichen et al., 2015)

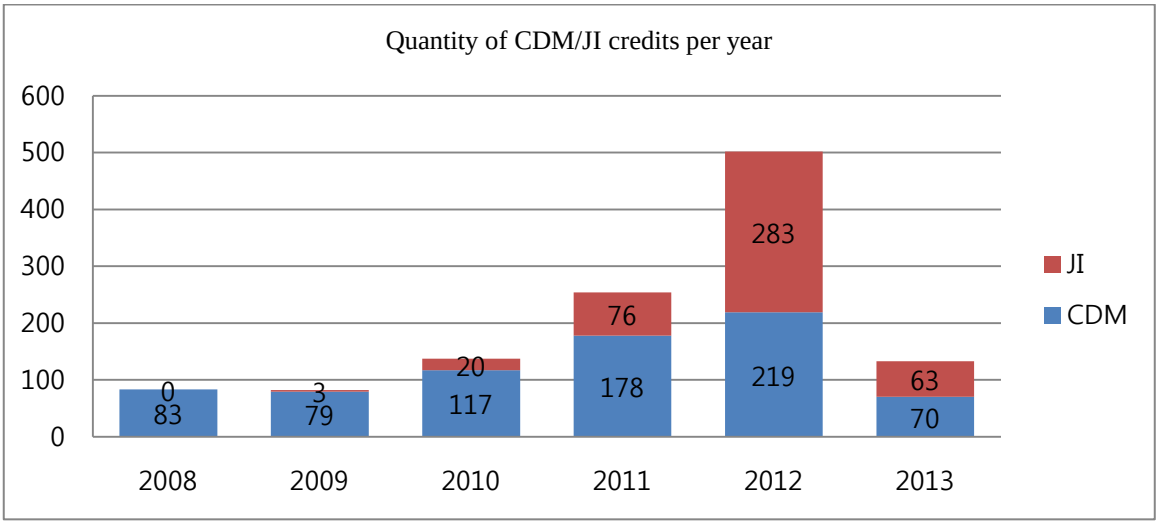

Figure 6 : Historical offset use in the ETS. Plotted from original table (Morris et al., 2014) .

In consequence, the volume of redeemed JI/CDM credits must be added to the EU's over-allocation when the surplus of EUAs is calculated. The Commission states that at the start of the third trading period (2013-2020), the EU ETS was characterised by a surplus of over 2 billion EUAs. (EC(b), 2014)

Table 11: EUAs, emissions and offsets surrendered (stationary installations, 2008-2013) (Unit M EUAs) : 2012 EUAs includes 120M early Phase 3 auctions, 2013 includes 30 M late Phase 2 auctions. Revised from original table. (Morris et al., 2014)

	Total allowances issued A	Verified emission B	Spare EUAs C(A-B)	Offsets surrendered D	Surplus E(C+D)
2008	2,011	2,120	-109	84	-25
2009	2,049	1,880	169	81	250
2010	2,081	1,939	142	137	279
2011	2,101	1,905	196	254	450
2012	2,260	1,867	393	504	896
2013	2,057	1,904	153	133	286
Total	12,559	11,615	944	1,193	2,136

Furthermore, there were some political uncertainty. The study (Neslen, 2013) points out the coincidence of the sharp price drop with the failure of the European Parliament's vote on the back-loading of EUAs. Back-loading was temporarily to postpone 900 million EUAs from auctions until demand is expected to increase. It was proposed to control their falling price. These measures were intended to help the EU deal with its EUAs surplus. This initial back-loading plan was fail to be passed. In a second attempt, this proposal was narrowly supported by the European Parliament. After this measurement, the prices have increased slightly to about EUR 5/tCO_2. At this time, policy-events such as the back-loading votes affected price fluctuations. The policy uncertainty on post 2020 targets as well as the lack of credibility of long-term commitment might have decreased the demand of EUAs. (Grosjean et al., 2014)

To summarize, the evidences clearly presents that the significant over-supply of EUAs caused the low level of the current price. It results from the wrong projection in demand due to the lack of verified data and the difficulty to adjust to the macroeconomic

downturn. The influx of additional offset credits was also added to the surplus of EUAs. Moreover it was deteriorated in case of some delay of policy measurements like the initial restriction on inter-phase banking or auctioning.

Table 12: Summary of main causes for allowances price crash.

Price Crash (Effects)		Events	Causes	Drivers
Dec. 2007	almost zero	Publication of 2005 emission data (Mid of 2016)	Significant discrepancy between allocated allowance and actual emission	System failure (Misfit with plan)
Feb. 2009	8 Euro	Global financial crisis	Economic depression	External shock
Apr. 2013	Less than 3 Euro	Failure of the European Parliament's vote on the back-loading of allowances	Delayed reform for over -supply of allowances	Political delay and uncertainty

The above mentioned problems have been partially addressed through an increasing tightening of the cap, the banking of EUAs to future trading periods, the increased auctioning, and the use of verified emissions data as a basis for free allocation under the grandfathering method more recently followed by its replacement. But despite those amendments, the EU ETS trade market is still struggling with low allowance prices. It works obviously as risks against the fulfillment of the EU carbon market and the ability of the EU ETS toward dynamic efficiency.

3-2. Current reform

In order to address the problems of the initial pilot Phase and Phases II, the partial amendments has been adopted during next phases. It was mainly focused on the internal design features of the EU ETS.

Phase II Amendments

Specifically, for the purpose of answering the over allocation of EUAs, 'the EU has moved to a more centralized cap and allocation process based on actual historical emissions data, which it began collecting in Phase I'. (Brown et al., 2012) The more centralized EU-wide cap aimed to prevent the inflation of cap, as occurred in Phase I. In addition, the banking of allowances for use in future was allowed. Banking helps to smooth volatility in carbon markets by enabling companies to choose whether to sell surplus EUAs or save them for future use, when emissions caps tighten. (Brown et al., 2012) Its objective is 'to promote early investments in emission reductions by offering the flexibility to reduce their emissions now and hold allowances for future use'. (Brown et al., 2012) In Phase II, the explicit limits on the amount of offset credits from CDM and JI were not given to EU member states at 13.4% of EU cap. Therefore they could use them to meet their emissions targets under the cap.

Phase III Evolution

When Phase III started in 2008, the radical amendments on the supply side was made. First, the most obvious change in Phase III was to the aggressive limitation on the cap. The level of cap was set through the top down primary legislation of the Commission. A declining trajectory starts from a baseline 5.22% below the Phase 2 cap in 2013. It declines by a further 1.74% off that baseline each year thereafter. This cap target amounts to 21% below 2005 levels by 2020. It delivers roughly 2/3 of the effort towards Europe’s GHGs target: a 20% cut in emissions relative to 1990 levels. (Morris et al., 2014)

A second apparent change was related to the way how to allocate EUAs. Instead of grandfathering, it was issued to each sector based on emitters' carbon efficiency as benchmarked against the 10% best performers in their business category. (Morris et al., 2014) In addition, the share of free allowances was sharply reduced to be sold at auction. A ceiling on the maximum volume of free allowances for each year of Phase III was imposed, amounting to 43% of the annual cap in 2013. Furthermore, the power sector has to purchase all allowances through auction. A declining share was applied to other

sectors, starting at 80% in 2013 and dropping to 30% in 2020.

Another new feature was introduced in Phase III. Regarding Kyoto credits, a range of restrictions on the type of offsets was introduced. A ban on the use of credits from industrial gas destruction projects (HFC-23, and N_2O that is emitted in the production of adipic acid.). (Morris et al., 2014) 'The ETS in Phase III accepted CERs from new CDM projects only if the projects are located in nations defined as least-developed countries (LDCs)'. (Brown et al., 2012) Because LDCs have issued only 0.003% of the CERs in the global market, this decision makes a dramatic restriction of the CDM market.

For the main amendments of the EU ETS over Phases in relation to the design aspect of EU ETS to answer the problems, see Appendix 2.

Backloading

Morris (2014) points out that in spite of all significant advances in the design and ambition of the scheme during Phase III, these amendments were inadequate to respond to the impact of the recession and the spike in offsets at the end of Phase II, in 2012. (See Figure 7) He mentions that the new trajectory of the cap did not create any scarcity in the near term, in substantially increasing the surpluses of Phase II. Furthermore he presents that the new method of free EUAs to industry is not properly targeted and continues to reward drops in production rather than investment in increased carbon efficiency. Regarding the new ETS offsetting restrictions, it arrived too late to prevent the massive inflow of unwanted credits.

In order to answer this continuing over supply, the Commission made a supplementary decision. They proposed so-called 'backloading' as a short-term measure. By this measurement, the auctioning of 900 million allowances was temporarily postpones from 2014-2016 until 2019-2020 the last two years of Phase III. During 2014 the auction volume would be reduced by 400 million allowances, in 2015 by 300 million, and in 2016 by 200 million. However, this temporary measure does not change the overall cap during Phase 3. This was designed to create a temporary scarcity of allowances.

(Edenhofer et al., 2014)

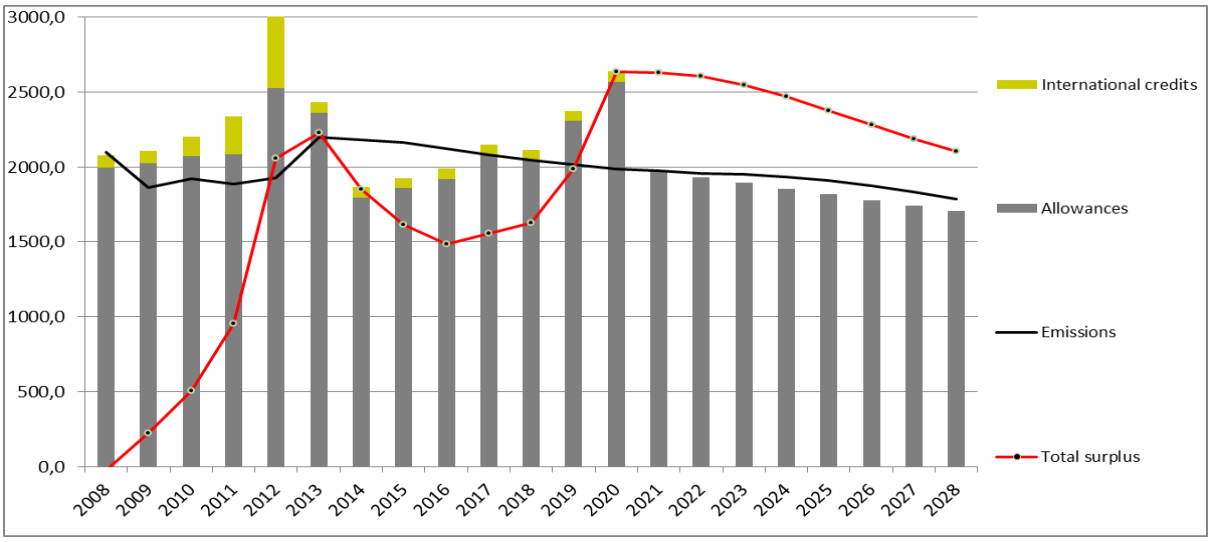

Figure 7: Historical and projected future profile of supply and demand up to 2028 With back-loading (Unit : Mt CO_2) (EC(b), 2014: 3)

Main arguments are related to the estimation on the amount of the surpluses. The Commission assumed in its report at the beginning of 2014 (EC(b), 2014) that, the surplus would amount to around peaking 2.6 billion certificates in 2020, shrinking slightly to around 2.3 billion certificates by 2028.

A study (Graichen et al., 2015) points out this is a relatively conservative assumption, considering the actual emissions developments in recent years. According to its argument, the Commission's prediction is based on the assumption that emissions will sink by around 1% per year, with a result of renewable energy and energy efficiency measures implementation. But Graichen (Graichen et al., 2015) presents there would be a surplus of 3.8 billion EUAs by 2020 and 3.4 billion by 2030, updating the Commission data in 2014 to include already published 2013 ETS emissions and an initial estimate for 2014. It's data show EU ETS emissions estimated down at least 3 % in 2013 with a result of renewable energy and energy efficiency measures implementation. Other study (Morris et al., 2014) presents the different projection. If existing legislation is expected to drive significant growth in renewable generation, the closure of coal plants, and increases in energy efficiency for appliances industrial processes, they that surpluses might reach as high as 4.5 billion by 2020.

In fact, many studies points out that the backloading decision is still inadequate for addressing the structural and continuing over-supply. Without a comprehensive reform of the emissions trading system, the surplus would remain until 2030. Whatever the projection scenarios of surplus EUAs are, the fundamental reforming of the ETS becomes imperative.

Linear Reduction Factor

The rigorous disturbance of the supply-demand balance results in the huge surplus of allowances. The significant and continuing drop of the EUAs price decrease the dynamic efficiency of EU ETS. At last the debate mainly triggered the low EUAs price leads to a structural reform of the EU ETS. It aims at achieving scarcity in the market as the core of the subject in order to revitalize investment incentives for low-carbon technologies through a stable EUAs price level. It also requires increasing the resilience and credibility of the EU ETS.

At last, in October 2014, the Commission has proposed a structural reform of the EU ETS for the period beyond 2020, with its new proposal for a climate and energy framework for 2030. (Edenhofer et al., 2014) Actually this proposal consists of two folds. One is a decrease in the number of allowances from 2021 by 2.2 percent annually. The other is the introduction of a market stability reserve (MSR).

At first, in the framework for climate and energy policies up to 2030 (EC(a), Last update: 30/04/2015) the Commission suggested to tighten the LRF. The current annual reduction rate is 1.7% up to 2020 and beyond. (See Figure 7) It is consistent with an overall reduction of about 73% by 2050. But by the tightening of LRF, the Commission has proposed an LRF of 2.2% from 2020 onwards, directing to a reduction of 87% by 2050 (baseline year 2005). Edenhofer et al (2014) point out that the LRF is neither part of the legal proposal nor a structural reform instrument, because it mainly addresses the question of environmental ambition. This is consistent with an 40% overall reduction in GHG emissions by 2030 or 80% by 2050, according to their own calculations. (Edenhofer et al., 2014)

Market Stability Reserve

The Commission presented a legislative proposal for the creation of a MSR as an automatic stabilizer. Its aim is to adjust the supply of EUAs in the EU ETS trade market to be auctioned by 2021. MSR reserve would operate 'independently under pre-defined rules'. (Hawkins and Jegou, 2014)

The Commission defines that a MSR, 'as a rule-based mechanism, would only change the timing of auction volumes'. It would be introduced in 2021. It does not affect the level or timing of free allocation. Furthermore 'it would be "cap-neutral" and not lead to a change of the environmental ambition level'. (EC(b), 2014) Moriis (2014) summarizes that the goals of the MSR defined by the Commission are to reduce large structural surpluses in the short term, and to stabilize EUAs in phases of fluctuating demand over the medium- to long-term.

According to the Commission's original proposal (EC(a), 2014), it functions by controlling the volume of allowances in circulation. This circulation volume as the surpluses is the difference between all allowances issued and emissions verified since 2008. Through MSR mechanism, the circulation volume as the surpluses is regulated. If the surplus at any point exceeds an upper threshold (Commission proposal: 833 million tons of CO_2), then the volume of emissions allowances auctioned will shrink by 12 percent of the volume in circulation in the previous year (at least 100 million tons of CO_2). (EC(a), 2014) The EUAs not emitted would be placed in the MSR. In the reverse case, if the surplus falls below a certain lower threshold (the Commission proposal: 400 million tons of CO_2), the volume auctioned in the next year would be increased by 100 million certificates. (EC(a), 2014) The following figure demonstrates how the MSR works.

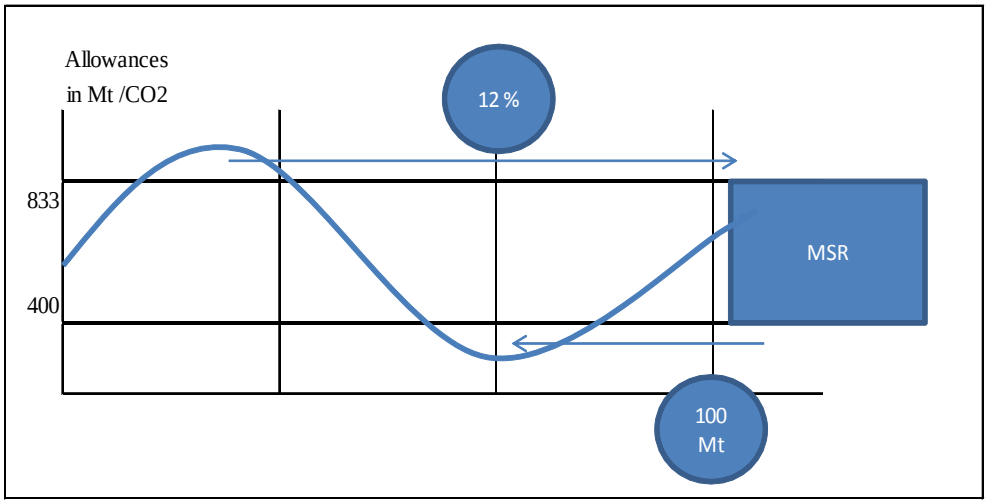

Figure 8: Schematic presentation of the market stability reserve. Revised from original. Graichen et al. (Graichen et al., 2015)

Graichen (2015) points out that the MSR changes the current fixed-volume mechanism of EU ETS into the flexible price-(quantity)volume mechanism. This flexible-volume mechanism would control EUAs surpluses through a reserve. It would finally stabilize the price.

In fact, MSR is implicitly based on the assumption that a surplus size in the range of 400 - 833 million allows market prices to remain undisturbed. (Edenhofer et al., 2014) There is justification problem of such a surplus level. The Commission states that 'the upper and lower boundaries of the range were determined following consultations with stakeholders and reflect a range where experience shows that the market was able to operate in an orderly manner'. (EC(a), 2014) It is not clear how to define the level of the MSR range.

In addition to the problem of surplus rage, it is fundamental questions whether a temporary reduction of the surplus will cure the price decline. Edenhofer (2014) points out that the MSR does not provide a clear price signal, because it only changes the timing of auctioning. In this sense, MSR would be a kind of long-term backloading proposal. A cap neutral adjustment of the auction timing should is likely to has a little impact on the EUAs price due to inter-temporal price smoothing.

In spite of the questions on MSR'S dynamic efficiency to provide the incentives for lock-in into the low carbon technologies through the price stabilization, negotiations through long debates and controversies has been going toward agreement of a final text in March and April 2015. According EPRS (2015), the vote on the final text of the proposal in the Parliament is expected in July 2015.

3. Key lessons learned from the EU ETS

As for the performance evaluation on the EU ETS, it is generally accepted that the environmental effectiveness of the EU ETS is reached, but that the EU ETS lacks dynamic efficiency. In fact, the emission target has been overachieved in quantities figures. The main discussion on the current performance and challenges of the EU ETS is the persistent and continuing low price of EUAs.

Its low price is the main issues. This is reason why EUAs price is the key driver for emission abatement. Its low price and fluctuation has disadvantages on addressing the relevant emission reduction especially on long term perspectives. In case of the absence of a stable price signal, business entities is not willing to undertake investments into relevant technologies. (Cooper, 2010) When a relatively stable and proper (high) price is indeed guaranteed, business entities have incentives to invest into climate-friendly low carbon technologies. (Hawkins and Jegou, 2014) Under the expectation of high price, they plan to launch long-term projects for abatement technology to meet long-term targets cost-effectively. According to the experts' rough calculation, carbon capture and storage (CCS) technology, for example, would need EUAs price of at least €40 per ton to be profitable. It is interesting if considering that companies that pollute more than their allowance have to pay a penalty or buy EUAs on the market, where they trade now for close to €15 a metric ton. (E&E, 2010)

In order to answer the price problem properly, it is critical to review the process of price formation. Theoretically the actual and future level of the EUAs price is determined by the scarcity of EUAs. When the allocated amounts are higher than actual emissions, scarcity will diminish. In the result, the carbon price is decreasing. As reviewed, the over-supply problems were caused both by *intrinsic* system design factors

such as free allocation including unverified data issues, and by the *exogenous* factors like the influx of CDM offset credit and recession during the economic crisis.

In addition, there are additional another factors in the process of prices formation in the EU ETS. Political objectives, for such example as adapting the cap, have also an impact on the price. Especially in case of a current regime with temporarily non-binding annual caps, the political decisions in the supply side have more influence on the price formation in the EU ETS. If market participants does not believe in the long-term cap announced by policymakers, the lack of credibility thus results in further downward pressure on the EUAs price. Therefore the policy uncertainties and regulatory changes have great impacts on the EU ETS. Only the political timely decisions and sufficient measurements would help to reduce uncertainty over supply and demand now and in the future. In the result, those measurements stabilize market expectations.

The current survey to the a low EUAs price driver shows interestingly the importance of political credibility. (Grosjean et al., 2014) He questions a structural problem of the EU ETS related to the low price to 23 EU ETS experts. Most experts agreed that political uncertainty and a lack of credibility were key concerns, followed by inconsistency with long term-goals, overlap of climate policies, lack of flexibility, and over-allocation.

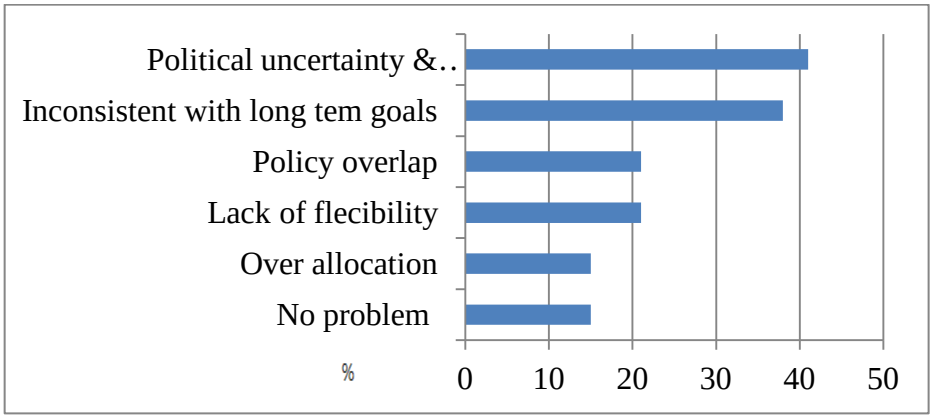

Figure 9 : Results from 32 experts interview. 'Can you identify failures in the current design that require government intervention ?'

Very significant lessons could be learned from the experience of EU ETS on the environmental effectiveness and the dynamic efficient perspectives. The current difficulties of the EU ETS were resulted from the oversupply through imbalance between demand and supply. It leaded to the persistent low EUAs price, deteriorating the dynamic efficiency of EU ETS. The surplus of EUAs came from both supply and demand side.

Table 13: Demand and supply fundamentals which effect the current low prices.

Demand side fundamentals	Supply side fundamentals
<Exogenous Drivers> -Financial Crisis -Excessive influx of CDM / JI Credits -Future GDP growth forecast discrepancy <Intrinsic Drivers> - Policy overlap (unilateral policies at member states) -Impact of complimentary Policy (ex, renewables)	< Exogenous Drivers > -Future changes in the cap (adapting the mid- and long-term climate objectives) -Time inconsistency < Intrinsic Drivers > -Intrinsic designs misfit (fee allowances, banking, auction etc.)

In order to secure the stable market with predictability and credibility, the market liquidity of allowances in circulation is well managed through the polity measures to cope with the external impacts with high flexibility. Therefore the intrinsic designs based on regulatory rules of ETS are decisive for supplying the market liquidity and improving the market flexibility.

On one hand, the market liquidity is mainly determined by the abatement target setting, ranging from cap size to it coverage. Currently EU try to solve the surplus problem through the policy measures of Linear Reduction Factor (LRF) which defines a tighter target in the EU ETS. The more tighter target management will contribute to cut off the surplus of EAUs.

On the other hand, the market flexibly is largely improved by the market stabilization measures. EU now wait for the vote of MSR from the EU Parliament. In spite of the controversies about its ability to combat the current problems, it will help the increase of market flexibility of the EU ETS.

At early stage of the EU ETS, the instrumental mechanism to keep the market stable is not fully equipped. The external impacts makes the market more unstable than expected. For the KETS development at the very early stage, the market stabilization measure is obviously one of the key success factors. In next chapter, the comparison on the market stabilization measures between the KETS and the EU EST is continued.

4. Comparison of market stabilization measures between the KETS and EU ETS

4-1. Previous reform options for market stabilization of EU ETS

Currently the EU ETS tries to address the allowances surplus problem through the policy measures of LRF and MSR for its revitalization in the environmental effectiveness and the dynamic efficient. Because many studies states the proposed MSR could not adequately solve the current problems, it would be useful to review comprehensive reform options which was discussed previously prior to the currently proposed reform of the EU ETS. Before the comparison of MSM between EU and KETS, the review of these options would give some insight to gain the benefit for the available recommendation for the KETS.

In November 2012, the Commission released a report outlining a number of options for reform based on the public and academic debate. (EC, 2012). They presented 6 options for structural reform measures of EU ETA. Grosjean categorizes these options as three sets. (Grosjean et al., 2014). The table is as follow,

Table 14: Reform options proposed by the Commission

EU Set 1: Reduce EUAs surplus	**EU Set 2: Adjust scope**	**EU Set 3: Reduce Price Uncertainty**
1) Increase the EU reduction target to 30 per cent by 2020	4) Expand the EU ETS to other sectors	6) Price floor -Soft price collar (EUAs reserve) -Hard price collar
2) Retire a number of allowances in phase three	5) Restrict the number of usable offsets	
3) Early revision of the LRF		

The options of set 1 and set 2 are related with the market liquidity. The options of set 1 among them would help for market stabilization through the reduction of the EAUs surplus, decreasing the market liquidity. On the other hand, The measures of the set 3 would contribute to manage the market flexibility through price control. Especially, the price volatility could be controlled effectively by setting the price collar.

Setting a price collar

To set a price collar addresses *directly* price certainty. On the contrary 'the MSR is a purely quantity-based instrument that *indirectly* aims to stabilize the allowance price'. (Edenhofer et al., 2014)

A price ceiling, also called 'price cap' or 'safety valve', can help to limit cost uncertainty by defining a fixed price at which additional allowances are made available in excess of the cap. (Brunner et al., 2009) 'A price collar is a two-sided price instrument that combines a price floor (minimum price) with a price ceiling (maximum price)'. (Edenhofer et al., 2014) In case of price floor, only when the auction price is beyond a pre-defined minimum price, the EUAs are released in the auction. 'A price ceiling could also be implemented by releasing additional EUAs for auctions from a reserve if the auction price hits a specified maximum price'.(Edenhofer et al., 2014) In addition, a price collar has two different forms. A soft price collar normally includes a minimum price at auction but is limited in its ability to control price hikes by the allocation reserve, whereas a hard price collar allows for unlimited quantity adjustments to achieve fixed price levels. (Grosjean et al., 2014)

Edenhofer (2014) summarizes out three different potential outcomes of a price collar as follow.

Table 15 : Different potential outcomes of a price collar

EUAs	Price	Emission
Low demand	Set close to the floor level	below the cap
moderate demand	Somewhere between the floor and ceiling	determined by the cap
high demand	Set at the ceiling	above the cap

Thus, a price collar as the price-(quantity) volume mechanism would reduce the price uncertainty caused by the demand side, for example, due to uncertain future GDP growth or future technological development. It could minimize the exogenous schocks such as global financial crisis which the EU ETS has experienced

Edenhofer et al (2014) mention also that 'this mechanism represents a compromise between concerns about environmental outcomes (cap on emissions) and concerns about cost uncertainty (EUAs price volatility)'. They present various advantages of price collar. First, it can facilitate the environmental effectiveness of complimentary 'but unilateral climate policy measures (e.g. renewable supporting schemes) in the EU Member States with heterogeneous costs and preferences, as long as the price operates at the floor level'. Second, 'in contrast to the MSR, it directly addresses dynamic efficiency', especially because it could 'deliver a stable and sufficiently high allowances price' while managing expectations of long-term prices. As another advantages, they state that 'it would address the industry's concern of prices that are so high that they might threaten EU competitiveness'.

Regarding a general common criticism of a price collar, it could deteriorate a cap's long-term environmental effectiveness, especially where they are combined with banking. (Brunner et al., 2009) If market participants expect the emissions cap to be tightened in the near future, they also expect a higher price ceiling under the new cap. Therefore market participants would like to buy as many EUAs as possible at the present price, in order to bank them for later use. In the result, it could hinder to reach long term emission reduction targets.

An other concerns is the determination of the 'right' price collar. (Edenhofer et al., 2014) Same problem is mentioned about the MSR as well. Edenhofer et al. points out the differences between MSR and price collar. They support the advantage of price collar because its price corridor or band could be sufficiently large thus allowing for enough flexibility in price formation, on the contrast of very narrow upper and lower limits of MSR. But in spite of their argument, the method of the specification definition is still unclear.

Furthermore, 'a price floor, even if implemented as an auction reserve price, might be interpreted as a tax'. (Edenhofer et al., 2014) The introduction of a price band in addition to a cap looks like a tax. Price collar scheme would be difficult to get through the political process, because it could be perceived to be similar to a tax.

At any way, Edenhofer et. al. (Edenhofer et al., 2014) conclude that instead of a narrow reform focusing on the EUAs surplus by MSV, a comprehensive reform including setting a price collar is required. He insists that only the focusing on addressing the problem of the cumulative surplus of EUAs is not adequate to solve the dynamic efficiency of EU ETS. This is the reason why the MSR is not likely to address the stabilization of price expectations as the main problem. The MSR as a quantity-based and cap-neutral set only helps to change the timing of auctioning. Therefore the MSR could only temporarily solve the problem of oversupply of EUAs. It does not provide a clear price signal. (Edenhofer et al., 2014)

Edenhofer et. al. (Edenhofer et al., 2014) compare the comprehensive reform options as follows.

Table 16. Evaluation of considered reform options. Legend: "+" means high, "-" means low and "o" means indifferent. MSR is the reform proposal by the Commission. * The price collar is only discussed here because the others is out of discussion boundary of this thesis' theme. Revised from original. (Edenhofer et al., 2014)

Reform options, instruments and measures	Environmental effectiveness	Dynamic efficiency	Political feasibility
MSR	0	0	+
Price collar	At max price: -, At min price: +	+	-
Expanding sectoral coverage	0	+	-
Additional instruments for inducing innovation	0 (+ in case of more ambitious cap in the future)	+	+

In summary, Edenhofer et. al. (2014) prefer the option of 'setting a price collar within the EU ETS, expanding the EU ETS to other sectors (e.g. transport, buildings) and addressing additional market failures through policy instruments in addition to EU ETS to MSR'. As seen on the above table, he presents that the approach to address directly price control has advantages on environment effectiveness and dynamic efficiency, improving the market flexibility of the EU ETS.

But as stared, the Commission is now trying to focus on the MSR for reform of the EU ETS. Many studies raise the questions on its effectiveness to solve the current the supply surplus of EAUs. Only the approach focusing on the quantity-volume base reform seems to be less active to respond the unexpected situation of economy than the tools to manage the proper price range of EAUs through action volume control. At any way, the Commission seemed to feel burdens from the characteristics of price collar as a kind of tax. There would be a risk on passing through the vote of the EU Parliament, as the case of 'backloading'.

4-2. Comparison of MSM between the KETS and the EU ETS

As shown in the chapter 2, the KETS has been equipped with a wide range of converge to improve the market liquidity and a variety of policy measures to manage both volume and price of allowances. The KETS is designed to cope with the external shocks and the unexpected demand effectively. The Government can actively intervene the market, managing the liquidity of market through the flexible instruments of the KETS. Through the comparison on the market stability measures between the KETS and the EU ETS, the capability of the KETS for the risk management could be reviewed as follows.

Coverage

As for coverage, the difference is that the KETS contains approximately tow third (65%) of the country’s GHG emissions, comparing with the ET ETS of 45%. approximately 525 business entities and 283 facilities. (MoE, 2014 (b)) While the KETS is entirely threshold-based and applicable to all sectors, the EU ETS applies the sector-based approach. (Hawkins and Jegou, 2014)

As seen in the Commission's reform proposal (table 14 : set 2, 4) and the evaluation of reform proposal of Edenhofer (table 14), the expanding of sector coverage is one of the key reform options. The extensive coverage of the KETS has more advantages than the EU ETS, due to the leverage effect of marginal abatement costs across the entire economy. It would contribute the increase of the market liquidity in the KETS.

In addition, the KETS is applicable to both direct and indirect emissions. And the KETS includes all six Kyoto Protocol GHGs unlike the EU ETS. All these differences with the EU ETS provide the high market liquidity to the KETS.

Market stabilization measures

As shown in the table 5, the KETS has the extensive provisions for the market stabilization to exercise the market flexibility in case of emergency.

First, additional allocation from the reserve up to 25% is allowed in the KETS (MoGL, 2010). As already explained, any additional allocation in the EU ETS is not possible.

Second, comparing with the EU ETS, the KETS includes the provisions for the readjustment of allocations. (MoGL, 2013) At any case, this is not possible under the EU ETS. It means that the volume of allowance could be easier managed in KETS than in EU ETS.

Hawkins and Jegou (2014) present several reasons for this difference First, because the EU has binding emissions reduction commitments under the Kyoto Protocol, changes to the allocation through an increase in the total volume of emissions allowances could undermine efforts to achieve the binding reduction target. Therefore, the readjustment would affect environmental effectiveness of the EU ETS. Second, allocation readjustments at the request of individual businesses would likely lead to tensions between member states. This is related to the fairness issue among the member states. Third, as a legislation problem, it would be difficult to obtain the approval of readjusting cap from the EU Parliament, Council, and Commission in the EU system. He mentioned the case of the EU decision on the back-loading measurement. 'The European Parliament initially rejected the measure in April 2013 and only backed it during a second attempt in July 2013'. (Hawkins and Jegou, 2014) Although this back loading measure does not change the any amount of allowances, it takes one and half year to gain approval.

It is noticeable that the readjustment provisions is only applied under the condition of 'a domestic or international economics situation, technological advancement etc.' (MoGL, 2013). As seen on the process of setting the national emission reduction target, the Korean Government has tried to keep the pledge to international community with the 2020 national emission target as already stated. Against the requests on readjustment from the industries, the government derived to meet the already pledge target in spite of unbinding to the Kyoto Protocol. This would increase predictability and credibility of policy increase in KETS.

At any way, the KETS is more likely to keep the market stability than the EU ETS. This would be obviously advantage for the stable market operation of KETS from the supply side, unlike the EU ETS.

Third, an increase or decrease of the borrowing limit (up to 10%) is allowed in the KETS. (MoGL, 2012 (b)) The EU ETS has no quantitative restrictions on borrowing regulation. Hawkins and Jegon (2014) mention that although borrowing of allowances is also available to participants in both ETS, but under the EU ETS, borrowing is implicitly possible as allowances for the next trading year are distributed two months before installations have to surrender allowances for the previous year. But in case of banking, under both the EU ETS and the KETS the banking of allowances to the following year is possible.

Fourth, in the KETS, through an increase or decrease of the offsets limit (up to 10%) offset credits are used for the market stabilization. (MoGL, 2012 (b)) But as regulated, the use of international offset credits in the KETS is very limited. The use of offset credits is subject to a quantitative limit. In this reason, the potentiality of the allowances surplus through the influx of CDM will not occurs in the KETS unlike the case of EU ETS.

The KETS imposes its tighter quantitative offset limits the EU ETS. According to Hawkins and Jegou (2014), 'the EU-wide limit for the use of international offset credits for the years from 2008 to 2020 amounts to 50% of the required emissions reductions compared to 2005'. Especially during Phase II of the EU ETS, companies were allowed

to use offsets credits for up to 13.4% of the total EU cap. But they point out that 'it is interesting that recently the EU announces that emissions reductions from 2020 will have to be achieved through domestic actions alone, effectively banning international offsets from its ETS'. (Hawkins and Jegou, 2014) Considering the severe experience of the EU ETS from the influx of CDM credits, explicit restriction on the use of offset credits in the KETS will help market stability in supply side.

Fifth, in the KETS, an allowance retention limit (minimum 70% or maximum 150%) of the allowance of the compliance year is established. (MoGL, 2012 (b)) In the KETS, the trading of the speculative purpose can be restricted through the retention limit of allowances which the covered business entities could hold.

Sixth, the temporary set-up of a price ceiling or price floor is possible in the KETS unlike the EU ETS. (MoGL, 2012 (b)) Although the specific rules is not yet provided, it is very unique characteristic of KETS in supply side, unlike the EU ETS. Hawkins and Jegou (Hawkins and Jegou, 2014) points out that the flexibility to control the market through cost containment measures is a unique feature of the KETS.

According to their opinion, the EU ETS does not provide for any active market interventions. (Hawkins and Jegou, 2014) Although the EU ETS has experienced price crashes throughout the last 9 years and in spite of the additional concerns about the impact on the driving efficiency from high price fluctuation, the EU could not intervene to stabilize prices directly. The legislations on the policy measures for market boost or stabilization put through a long process which requires all the approval of the EU Parliament, Council, and Commission.

From the lessons learned from the price variability in the EU ETS, the KETS was prepared with the pre-defined provisions to implement stabilizing measures through the government intervention. Surely, it is available in case of significant changes in prices or trading volumes.

As already, almost all of the market stabilization options could be applied in KETS. The available measures for market stabilization range widely from the allocation of

reserved allowances, which is similar to MSR in the EU ETS, the flexibilities of the banking and borrowing, the volume control of offset credits to the market price collar mechanism. Really wide actions can be taken to control both prices and volumes under the objective of market stabilization.

Although several aspects of the KETS were modeled on the EU ETS, many different design features was equipped in the KETS, thanks to the lesson learned from the EU ETS's experience. It will promote the environmental effectiveness of the KETS with the driving efficiency. As reviewed, the KETS has the unique design features to keep the market stable, in order to achieve the environmental effectiveness with driving efficiency. The below table provide the overview of main difference between the KETS and the EU ETS on the market stabilization measures perspectives.

Table 17: Comparison between the KETS and the EU ETS on the market stabilization measures perspectives. (* no actual use only for MSM, but the market flexibility.)

<table>
<tr><th colspan="2">Comparison</th><th>KETS</th><th>EU ETS</th></tr>
<tr><td>Coverage</td><td>Coverage</td><td>60%, threshold basis, 6 GHG, direct and indirect emission</td><td>45%, sector base,
3 GHGs, indirect only</td></tr>
<tr><td rowspan="6">MSM</td><td>Additional allocation of allowances</td><td rowspan="2">Possible under the regulated condition from reserve</td><td rowspan="6">Backloading & MSR

(Borrowing: implicitly possible without restrictions) *
(Offset : limited to13.4% of cap)*</td></tr>
<tr><td>Readjustment of allowance allocation</td></tr>
<tr><td>Allowances retention</td><td>Min.70%,Max.150% of the compliance year</td></tr>
<tr><td>Borrowing</td><td rowspan="2">An increase or decrease of the limit (up to 10%)</td></tr>
<tr><td>Offset credits</td></tr>
<tr><td>Price collar</td><td>Temporary set-up</td></tr>
</table>

In conclusion, the KETS has very extensive measures for market stabilization, comparing with the EU ETS. In the result, it looks like that there will not be the same price hike or crash in the KETS as the EU ETS has experienced. In the KETS, the operational instruments has the high flexibilities, copying with the external shocks. The KETS are equipped with extensive and effective tools to cope with the market fluctuations.

4-3. Current market status and MSM actions in the KETS

Current market status

The trading of KAUs started on January 12, 2015. After the first 4 days, the trading almost stopped.. KAU price, the unit price of one ton of CO_2, increased from 8,640 won (approx. Euro 6.6) currently to 10,300 KRW (approx. Euro 7.9).

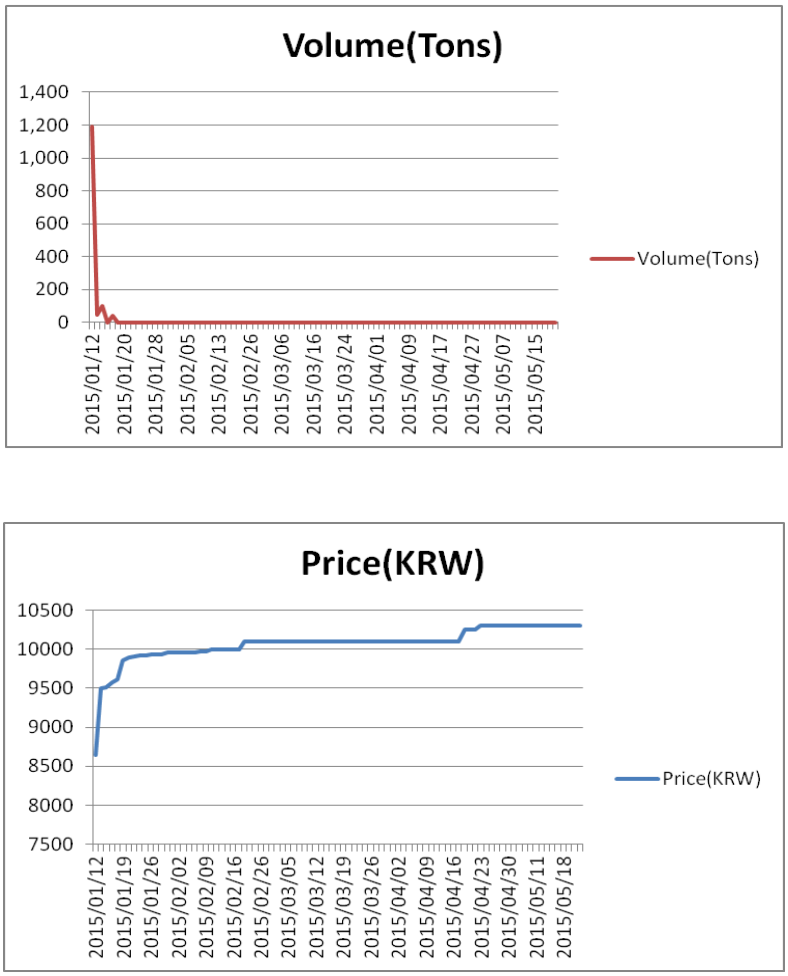

Figure 10: Trend of volume currently traded in the KETS market and the change price of allowances. Created on the basis of the KRX data. (https://ets.krx.co.kr/contents/05/0502/JHPETS0502M01.jsp)

According to the press of KRX (KRK, 2015), the trading has been minimal so far, because the covered business entities are uncertain about the volume of GHGs

emissions that they will emit in the future.

As already stated in the development process of the KETS, there has been a constant conflict between the government and the industry to set the cap level of allowances. According to the report (Kwon, 2015), in late 2014, just before the KETS was launched, a coalition of 525 the covered business entities was still requesting a total cap of 2.2 Bt of emissions allowances during the 1st Commitment period. Actually the pre defined total number of allowances was 1.6 Bt, about 73% of the requested amount from the industry.

In this situation, the participating business entities try to hold the allocated allowances and to secure the allowances in low price as many as possible for the future use. But, because the future economic situation is under the great uncertainty, the participating business entities seems in no hurry to transition.

Meanwhile, in consideration of the reference price of about 10,000 KRW (EUR 7.7), above which the government could intervene the market through MSM, the price will be expected to form around this level. In the result, the allowance price is likely to be maintained under the 10,000 KRW (EUR 7.7) with rare transaction in spite of a little upward pressure.

In some extreme case that the allowances shortage happens with the economic expansion, the business entities which holds the allowances in advance, would try to preoccupy the market dominant power. While the seller's market would be formed, the allowances price could rise up to the maximum price. It could be the level of maximum 3 times of reference price (30,000 won, approx. 23.1 Euro). This is because it would be the same price as the maximum penalty surcharges. The Decree ETS Act defines that the imposition standard of penalty surcharges shall be 3 times the average price of allowances in the compliance year in which the obligation to surrender emission permits is imposed. (MoGL, 2012 (b)) There could be always possibility of the price hick at the early stage of the KETS. But actually, it seems to be a extreme scenario which is unrealistic.

At any way, as many cases at the beginning, the market participants and the stakeholders wait and see the market. The KETS trading market is stagnated with almost zero transaction.

Early implemented measures for market stabilization

After the launch of the KETS, the Government took some actions for market stabilization, in order to answer the strong requests from the industry and respond the inactive ETS trading market.

Onset of the KETS, the steel, petrochemical and semiconductor sectors asked the government for the increase of cap. They shows the strong concern about their international competitiveness, saying that the scheme is seemingly unfair allocation. But interestingly, the oil-refining sector is less complaining due to their early plan for emissions reduction measures. (Kwon, 2015) (See Appendix 3 for details : The emissions reduction targets by business sub sectors and industries for the 1st Commitment Period)

Beside the competiveness issue, the industry complained of the heavy burden, caused by the relatively stiff penalties. The FKI, a major business lobby group, published the study of arguing that penalties will cost their stakeholders 27.5 trillion won (approx Euro 21.2 billion) by 2017. (Eun-jung, 2015) Against its estimation, the government argued that the industry has over emphasized the cost burden, presenting their projection of around 1 trillion won (Euro 769 million).

In order to answer the request from the 243 covered business entities, almost half of total covered entities and to calm down the negative sentiment on the KETS, the government granted 40 companies a total of 6.7 million additional allowances in February. (MoE, 2015 (a)) The allowances were taken from the allowance reserve, not affecting the total emissions cap. But several companies which did not be awarded the additional allowances, are still trying to file a lawsuit against the government’s allocation plan.

Under this circumstance, the government announced that the offset credit (KCU) were listed on KRX from April 6, 2015. (MoE, 2015 (b)) As planned, the project-based emission abatement outside the covered business entity, such as funding renewable energy, energy efficiency or forestation projects, was certified as the KCU for trading.

The government studied the possibility of early introduction of offset credits trade in the KETS market. After reviewing 4 global companies that have CDM projects approved by the UNFCCC, the government approved to turn their emissions reductions into tradable credits on the domestic KETS market. The 19.1 Mt CO_2 are able to be converted into KCU and traded on the KETS market. The government and the KRX expect that the listing of KCUs would stimulate more brisk trading in the KETS.

The government expected that the additional allocation and the approval of CDM offset credits will help boost market transactions. The price formantion was made around the current reference level of 10,000 won (approx. 7.7 Euro) At this moment, the Government are keep an eye on the market, after the intervention through the market stabilization actions at the early stage.

5. Conclusion

Under the current situation, studies point out the problem of a 'thin market' in the KETS. According to their opinion, the current KETS created an entry barrier that is higher than the other ETS. The covered business entities have complained of the allocated cap. Due to the excessive concerns on the negative experiences from the EU ETS, the government could have placed more weigh on the risk management than the market activation. The market participants also have the high possibilities to take wait and see strategy till the latter part of the Commitment period under the market uncertaintity.

Therefore they suggest that there is a need to prompt efforts to provide explore market-invigorating measures or even market making measures. They seems to ask for the active market boosting strategies. One of these ideas, the investment bank intermidiate the supply of allowances from reserves through varioues derivatives for the market makng. But the deliberate activation could destort the market mechanism. Furthermore the excessive intervention of the Government will decrease the consistency and the credibility of the policy. More importantly, the environmental integrity will be demaged.

Currently the consideration on the KETS is very contrast with the EU ETS. While the KETS faces the inactive transaction, the EU ETS confronts of the surplus of it. The price in the KETS takes a little bit the upward pressure. In the EU ETS, it is going through the downward deadlock. The EU ETS have to decrease the surplus through the readjustment of the cumulated cap limitation and the temporal 'backloading' measures in line with the long term MSM. The KETS currently tried to increase the supply of allowance through the additional allowances form the reserve and the influx of the offset credits.

The KETS has a advantage to be equipped with the more extensive MSM than the EU ETS. The KETS could have more market flexibility than the EU ETS, coping with the unexpected external shocks effectively.

At this moment, there could be available recommendations. Considering the market

stabilization as the key success factors in the KETS, the balance between the environment effectiveness and dynamic efficiency has to be well maintained.

First, setting the cap is first and foremost step in the ETS. In case of the EU ETS, the discrepancy between the first planed emission and the verified emission has continued, resulting in the surplus of allowance. What makes it worse, the unexpected economic crisis deteriorated the oversupply even in spite of the reset of the cap in 2nd Phase. The accumulated surplus has resulted in the low price of the EUAs. The ability of the dynamic efficiency of the EU ETS has been continuously damaged. For the settle down of the KETS in early stage of implementation, the government has to keep an eye on the market stability. The quick and sound scheme management of the government is the key successor factors.

Second, because now is the early implementation stage of the KETS, the details of institutional flexibility, such as MSM, should be prepared through the accumulation of experiences. As discussed in the EU case, the pre-study on the comprehensive and various MSM is important copying with the unexpected external impacts. For a example, some experts insists that price collar, addressing the price fluctuation directly, has more effectiveness among the other measures for driving the efficiency in the EU ETS. The specified study of the pros and cons on the price collar could be helpful for the future implementation of the KETS.

It is noteworthy to remind the direction on the long and medium-term objectives and system operation of the KETS's each Period in the KETS. The Master plan (MoSF, Jan. 2014) states that the 1st Commitment Period is the stage of settlement of the system. The institutional measures have to be established through the trial and error experience. The KETS seems to be the up-date version of the EU ETS with the extensive market stabilization measures. It is designed with the lessons learned from the severe problems of the EU ETS. For the successful settlement for the KETS and moreover for the contribution to the future emerging ETS, the deep study on the MSM has to be followed.

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Appendix

1. Projected BAU Emissions by Sectors and Sub-Sectors and reduction target of 2020. (Unit : Mt CO_2)

Industry	Business	BAU							Target	Reduction
		2014	2015	2016	2017	2018	2019	2020	2020	Rate
Industry	Oil refining	16.1	16.2	16.3	16.4	16.4	16.5	16.6	15.3	7.8%
	Mining	0.8	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.0%
	Steel	110.3	115.0	115.4	115.8	116.2	116.5	116.9	109.3	6.5%
	Cement	40.5	40.7	40.7	40.7	40.7	40.7	40.8	37.3	8.6%
	Petrochemical	54.5	55.5	56.3	57.1	58.0	58.8	59.6	55.1	7.6%
	Paper, Wood	7.9	7.8	7.7	7.6	7.5	7.4	7.3	6.8	6.8%
	Textile	10.3	10.0	9.9	9.7	9.6	9.4	9.3	8.7	6.5%
	Ceramics	5.1	5.1	5.1	5.1	5.1	5.2	5.2	5.0	3.8%
	Non-ferrous metals	4.6	4.7	4.7	4.7	4.7	4.8	4.8	4.6	4.2%
	Machinery	11.6	11.8	11.9	12.0	12.2	12.3	12.4	11.5	7.3%
	Electricity/ Electronics	38.5	39.1	39.5	39.8	40.1	40.4	40.8	15.3	62.5%
	Display	23.1	28.5	35.0	42.5	51.0	60.4	70.2	42.2	39.9%
	Semiconductor	11.2	11.8	12.3	12.7	13.2	13.7	14.2	10.3	27.5%
	Motor vehicles	11.1	11.3	11.4	11.5	11.6	11.8	11.8	8.0	32.2%
	Ship building	2.8	2.9	3.0	3.2	3.3	3.4	3.6	3.4	5.6%
	Other manufacturing	16.5	16.5	16.4	16.3	16.2	16.2	16.1	15.8	1.9%
	Food & beverages	6.3	6.2	6.1	6.1	6.0	5.9	5.8	5.5	5.2%
	Construction	2.6	2.6	2.7	2.8	2.9	3.9	3.0	2.8	6.7%
	Subtotal	373.8	386.4	395.1	404.7	415.4	428.0	439.0	357.5	18.6%
Transportation	Transportation/Passenger car	95.0	96.0	96.7	97.4	98.2	98.9	99.5	65.4	34.3%
Buildings	Home	78.2	78.6	79.1	79.7	80.2	80.7	81.2	59.2	27.1%
	Commercial	76.3	77.0	78.9	80.8	82.7	84.6	86.3	63.4	26.5%
	Subtotal	154.5	155.6	158.0	160.5	162.9	165.3	167.5	122.6	26.8%
Public sector/Others	Public sector/Others	17.4	17.2	17.3	17.5	17.6	17.7	17.8	13.4	24.7%
Agriculture, forestry and fishing	Agriculture, forestry and fishing	30.2	29.9	29.6	29.3	29.1	28.8	28.5	27.0	5.3%
Waste materials	Waste materials	14.9	14.8	14.7	14.7	14.6	14.2	13.8	12.1	12.3%
Total		**685.8**	**699.9**	**711.4**	**724.1**	**737.8**	**752.9**	**766.1**	**598.0**	21.9%

2. Development of the EU ETS.

Years	Phase I	Phase II	Phase III
	2005-07	2008-12	2013-20
Cap-setting	Sum of the caps of member states	Sum of the caps of member states.	Single community-wide cap set by the Commission
Cap-level	2,181 MtCO2e	2,083 MtCO2e (12% below Phase I)	2,039 MtCO2e, declining by 1.74% annually (11% below Phase II)
Free allocation (ratio) (method)	Minimum 95%	Minimum 90%	Power generation: no free EUAs, Industrial sectors: 80% to decrease to 30% by 2020; EITE industries: 100% based on benchmark
	Grandfathering	Grandfathering	Benchmarking
Banking	Within trading period	Within and across trading periods	Within and across trading periods
Offsets Credits	CERs, excluding nuclear facilities and LULUCF; limited at 50% of a country's reductions compared to BAU, but none were used	CERs and ERUs, excluding nuclear facilities and LULUCF; limited at 13.4% of EU cap	CERs and ERUs, excluding nuclear facilities, LULUCF, and the destruction of industrial gases; CERs only from LDCs

Source : Revised from original (Hawkins and Jegou, 2014)

3. Emission allowance for 1st Commitment period by Sectors and Sub-Sectors (Unit : 1M KAU)

Industry	Business sector	1st Commitment			Period	%
		2015	2016	2017	Total	
Total Cap		573.46	562.19	550.90	1686.55	100.0%
Emission permits	in reserve	30.23	29.61	28.98	88.82	5.3%
Converted to	Power sector energy	250.19	245.28	240.38	735.85	43.6%
Industry	Oil refining	19.15	18.78	18.40	56.33	3.3%
	Mining	0.25	0.24	0.24	0.73	0.0%
	Steel	103.96	101.92	99.88	305.76	18.1%
	Cement	43.52	42.67	41.81	128.00	7.6%
	Petrochemical	48.86	47.90	46.94	143.70	8.5%
	Wood	0.38	0.38	0.37	1.13	0.1%
	Textile	4.70	4.61	4.52	13.83	0.8%
	Ceramics	6.26	6.14	6.02	18.42	1.1%
	Paper	7.63	7.48	7.33	22.44	1.3%
	Non-ferrous metals	6.89	6.75	6.62	20.26	1.2%
	Machinery	1.42	1.39	1.36	4.17	0.2%
	Electricity/ Electronics	2.88	2.82	2.76	8.46	0.5%
	Display	9.15	8.96	8.78	26.89	1.6%
	Semiconductor	10.45	10.25	10.05	30.75	1.8%
	Motor vehicles	4.24	4.16	4.08	12.48	0.7%
	Ship building	2.68	2.63	2.58	7.89	0.5%
	Food & beverages	2.53	2.48	2.44	7.45	0.4%
	Subtotal	274.95	269.56	264.18	808.69	47.9%
Transportation	Aviation	1.29	1.26	1.24	3.79	0.2%
Buildings	Building	4.02	3.94	3.86	11.82	0.7%
	Communications	3.09	3.03	2.97	9.09	0.5%
	Subtotal	7.11	6.97	6.83	20.91	1.2%
Public sector/	Water Service	0.77	0.75	0.74	2.26	0.1%
Waste materials	Waste materials	8.92	8.74	8.57	26.23	1.6%
	Subtotal	9.69	9.49	9.31	28.49	1.7%

4. The summary of the differences between the KETS and the EU ETS

	EU ETS	KETS
Type of ETS	Mandatory absolute cap-and-trade system	Mandatory absolute cap-and-trade system
Cap	2020: 1,777 $MtCO_2e$/year	2020: 543 $MtCO_2e$/year (estimate)
Trading periods	2005-07; 2008-12; 2013-20	2015-17; 2018-20; 2021-26
Coverage	CO_2, N_2O, PFCs (direct)	CO_2, N_2O, PFCs, CH_4, HFCs, SF_6 (direct and indirect)
	45%	65%
Free allocation (in %)	Phase I: 99%; Phase II: >90%; Phase III: no free allocations to power sector (some exceptions), manufacturing to be reduced from 80% to 30% by 2020, exemptions for EITE industries based on best-practice benchmark (100% free allocation to those reaching the benchmark)	Phase I: 100%; Phase II: < 97%; Phase III: < 90%; 100% free allocation for EITE industries during all three periods
Readjustment of allocations	Not possible	Possible in case of (a) important changes in the overall economic situation; (b) individual company requests
Penalty	Fine of EUR 100 (EUR 40 during Phase I) and requirement to surrender missing allowances	Fine at three times the market price capped at eq. EUR 69; unknown whether firms will be required to surrender missing allowances
Market stabilization measures	Very limited: back-loading decision was difficult to obtain and proposed market stability reserve would be an automatic stabilizer	Provisions to intervene with specified stabilization measures under pre-defined scenarios

Source : Revised from original on the perspective of driving efficiency. (Hawkins and Jegou, 2014)

5. Direction of the KETS proposed by the 1st Master Plan

Direction	1st Commitment Period (2015~2017)	2nd Commitment Period (2018~2020)	3rd Commitment Period (2021~2025)
Main objectives	Accumulation of experiences and settlement of the system	Reduction of considerable amount of GHG emissions	Aggressive reduction of GHG emissions
System operation	-Improvement of institutional flexibility -Establishment of infrastructures for accurate MRV	-Expanding the scope of the system, upward revision of the targets -Advancement of various criteria on reporting and verifying the amount of GHG emissions	-Inducement of voluntary reduction in preparation for post-2020 climate change regime