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# Company's Perspective to GHG Emissions Trading Scheme: A Survey in the Republic of Korea

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**[Abstract]** This research measured the Korean companies' perspective to GHG ETS, including their policy awareness and acceptability, the corresponding policy responses, and the difficulties and expectations for the real adoption of GHG ETS. The data was collected from 62 valid respondents by a questionnaire survey mainly targeting three energy-intensive sectors, iron & steel, cement and chemical industries. The surveyed companies strongly concern the market competitiveness loss due to the possible double burdens from GHG ETS and the extant regulations considering their limited potentials for further mitigations. The GHG ETS is therefore barely acceptable for them in comparison with other industrial energy-saving policies. A meaningful finding is that the companies prefer to make internal efforts to relieve the policy's negative impacts rather than to simply transfer the policy burden to their customers. Our survey suggests that Korean government shall clarify the operational components of GHG ETS for achieving better understanding from the companies. The evidences from this empirical survey may support the discussions and progress of GHG ETS in Korea, particularly from the industrial perspective.

***Key words**:* Emission trading scheme, survey, company, the Republic of Korea

## 1. Introduction

The Republic of Korea (Referred as 'Korea' hereinafter) has become the world's tenth largest energy consumer since 2005. As its economy heavily rely on energy consumption (Kim, 2011), the country's $CO_2$ emissions have been substantially increasing since 1990 and the upward trend remains far more significant than the other OECD countries (OECD, 2008). Recently, Korea approved the bill of the domestic Emissions Trading Scheme (ETS) as a policy effort to alleviate the growing greenhouse gas (GHG) emissions and to achieve its national GHG mitigation goal, 30% reduction of GHG emissions from the business as usual (BAU) scenario by 2020 compared with 2005 levels. As one of representative market-based instruments (MBIs) for climate change, GHG ETS allows the target entities to trade their permits of emissions or credits. This would maximize the cost-effectiveness for GHG reductions by letting the market determine the lowest-cost pollution abatement opportunities. In the past, the energy and climate policies were dominated by command-and-control measures, in which the companies are required to comply with certain efficiency standards or adopt specific technologies in mandatory. MBIs for GHG reductions are increasingly favored in preference to command-and-control approaches (Sonneborn, 2004). Morotomi (2003) pointed out that MBIs have a comparative advantage comparing with the mandatory regulations or voluntary programs in cost effectiveness for reducing the GHG emissions since the mitigation efforts would be adjusted by the market mechanism.

GHG ETS have been implemented or proposed in several countries and regions. The examples include United Kingdom Emissions Trading Scheme (UK ETS, 2002-06), New South Wales Green House Gas Reduction Scheme (NSW, since 2003) in Australia, European Union Emissions Trading System (EU-ETS, since 2005), Alberta's trading scheme (AER, 2007) in Canada, New Zealand's ETS (NZ-ETS, since 2008), Regional Greenhouse Gas Initiative (RGGI, 2009-) in United States, etc. (IEA, 2010). Among which, EU-ETS, the first and largest international scheme for the trading of GHG emission allowances, was launched in 2005 under the 'cap and trade' principle and participated by around 12,000 entities in 15 EU member counties, whose $CO_2$ emissions account for 40% of the total of EU. The first commitment period (2005-2007) is a preparation stage for the establishment of the MVR (Monitoring, Verification and Report) system. In the second phase (2008-2012), the market has been extended to 30 countries including the 27 EU members and Iceland, Liechtenstein and Norway. It covers $CO_2$ emissions from installations such as power stations, combustion plants, oil refineries and iron & steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and cardboard. The third phase (2012-2020) will target the 6 types

of GHGs and the total allowances will be reduced over time so that in 2020, the emissions will be 21% lower than the level of 2005. The changes to be introduced in 2013, notably a progressive move towards auctioning of allowances, will further enhance its effectiveness. EU-ETS has witnessed the cost effectiveness of this policy to reduce GHG by putting a price on carbon emissions and shown that it is possible for the trading of GHG emissions. This experience has inspired other countries and regions to launch the cap and trade schemes of their own.

In Korea, discussions on introducing a domestic GHG ETS were started under the Framework Act on Low Carbon Green Growth passed in 2010. A preliminary GHG ETS proposal was formulated in November 2010, which suggested the introduction of GHG ETS in Korea from 2013 in three phases. By that time, several studies analyzing the economic effect of GHG ETS and its impact on Korean industries were reported. Some researches indicated that the GHG ETS would be more cost effective than the mandatory regulation, such as the TMS (Target Management System), and save the cost by 44-68% in achieving the national GHG reduction target of 2020 (e.g., PCGG press, 2011; Kim, 2010b; Lee, 2009; Kim, 2009a) argued that Korea's industrial competitiveness in the world might be weakened due to this policy. The price increase of all sectors would be 1.38% in average. In particular, the price increase of metal products (including secondary metallic products), electricity, gas, tap water, non-metallic products would be higher at around 2.4%. Kim (2010a) suggests the adoption of differentiated methods for emissions allowance allocation (i.e., free allocation and auction) for different sectors in order to secure the industrial competitiveness for the country.

Although several studies confirmed the advantage of GHG ETS in economic efficiency, the preliminary proposal of ETS received strong opposition from the industry due to the concern of its negative impacts. The second version of GHG ETS proposal was amended by reflecting the opinions of industrial sector and submitted to the parliament in April 2011. It was finally approved by the lawmakers in May 2012. According to this bill, GHG ETS will formally start from January 1, 2015. The progress of GHG ETS in Korea will be described in details later in section 3.1.

Although the lobby from industries was once identified as the largest barrier blocking the introduction of GHG ETS in Korea, it is surprisingly that quite few studies have been conducted at the individual company's level for understanding their real viewpoints of this emerging policy progress. Aiming to close the existing gap, this research measured the awareness and acceptability of Korean companies to GHG ETS

in a qualitative way, and identified their corresponding responses to and expectations for this policy adoption. Three sectors, including iron & steel, cement and petro-chemical industries, were targeted considering their high energy intensities and great importance for realizing the country's target in GHG reductions. Three topics are discussed in this paper: a) Company's general information including energy usage status; b) Company's policy awareness and acceptability; and, c) Company's views of GHG ETS and corresponding behavioral responses and expectations to this policy.

The remainder of this paper is structured as follows. Section 2 outlines the questionnaire survey and the distribution of samples. Section 3 describes the detailed contents of GHG ETS in Korea and the background of the three target sectors. Section 4 discusses the results from the survey. Lastly, section 5 concludes the survey analysis and proposes topics for future studies.

## 2 Outline of the questionnaire survey and the distribution of samples

Based on the understanding of policy progress in Korea, a questionnaire was designed with the main objective to measure the company's perspective of GHG ETS, and to identify their corresponding responses and expectations. The questions are described concisely to avoid possible misunderstandings of the respondents.

The data were collected by a questionnaire survey during January 25 to February 10, 2012. Questionnaire was sent via fax and email to a total of 205 companies including 137 TMS targeted companies and 68 non-TMS ones. Environmental and energy managers were targeted in the survey. Among which, answers from 62 companies were collected and confirmed to be valid and used for the analysis. The distribution of the usable samples by company's characteristics is summarized in Table 1.

Table 1: Distribution of usable respondents by company's characteristics

| Company's characteristics | | Number of samples | | | | Number in total |
|---|---|---|---|---|---|---|
| | | Small | Medium | Large Medium | Large | (Percentage) |
| Sector | Cement | 2 | 6 | 2 | 1 | 11 (17.7) |
| | Steel | - | 8 | 5 | 3 | 16 (25.8) |
| | Petro-chemical | - | 13 | 13 | 9 | 35 (56.5) |
| Number in total (Percentage) | | 2 (3.2) | 27 (43.5) | 20 (32.2) | 13 (21.0) | 62 (100.0) |
| TMS target or not | TMS | 2 | 26 | 17 | 13 | 58 (93.5) |
| | Non-TMS | - | 1 | 3 | - | 4 (6.5) |
| Number in total (Percentage) | | 2 (3.2) | 27 (43.5) | 20 (32.2) | 13 (21.0) | 62 (100.0) |

The respondents from cement, iron & steel and petro-chemical sectors individually

account for 17.7%, 25.8% and 56.5 % of the total. According to the classification criteria of the Minor Enterprises Act of Korea (Taking into account only the number of employees), 27 are medium-sized companies, having more than 50 but less than 300 staffs. Small companies, with less than 50 staffs, are only 2. Thirteen are large ones with more than 1,000 employees. The remaining 20 are large medium-sized, which is the intermediate category between large and medium-sized companies. Among the total 62 samples, 58 are the TMS targeted companies.

## 3. The progress of GHG ETS in Korea and background of the three sectors

### 3.1 The progress of GHG ETS in Korea

Korea government has announced the national GHG mitigation target in November 2009, 30% reduction from the business as usual (BAU) scenario by 2020 compared with 2005 levels, to pursuit the low-carbon green growth. In January 2010, the Framework Act on Low Carbon Green Growth was enacted, which establishes the legal basis for the introduction of a national domestic GHG ETS as a measure to realize the mitigation goal by market mechanism. In 2011, Korea government announced the decomposed GHG reduction targets by sector and by year. The reduction targets of iron & steel, petro-chemical and cement industries are respectively 6.5%, 7.5%, and 8.5% compared with BAU cases by 2020.

A preliminary GHG ETS proposal was formulated in November 2010 which suggested GHG ETS introduced into Korea in three phases. The first phase would start in 2013 and end in 2015. Two subsequent phases, each running for five years, would follow after 2016. In the proposal, 10% of the allowances would be allocated by auction and the remaining 90% for free in the first phase, with the auction allowance proportion being increased thereafter. The penalty for any non-compliance emissions was less than five-times the average market price of the emissions. This preliminary proposal, however, received strong opposition from industry.

In view of Korea’s industry characteristic of the most export-dependent and the energy-intensive industry-oriented structure, concern has been voiced from industry over the possible loss of competitiveness due to increased production costs and product prices. Business voiced that it is too early for Korea to introduce a mandatory GHG ETS considering the major economies such as the U.S. and Japan have suspended their plans, and that industrial competitiveness would be weakened due to the cost increase.

In response, the second version of GHG ETS proposal was modified with fully reflecting the above opinions voiced by industry, and was submitted to parliament in

April, 2011. The start was postponed until January 1, 2015. Ninety-five percent allowances will be allocated for free in the primary period. The proposal called for an Allocation Committee, led by the Ministry of Strategy and Finance (MOSF), to be established to operate GHG ETS. This committee was tasked with defining the method of allowance allocation for each field and deliberating on a strategy to maintain a stable market. GHG emission reductions and trading are registered and managed in the GHG Inventory & Research Center (GIR), launched on June 15, 2010. The specific entities to be targeted for GHG ETS will be determined in Korea considering international trends, and one likely option is to target the largest energy consumers or GHG emitters, which are at the top of the TMS target list. By 2015, GHG ETS will have taken over TMS for these entities. Transfer of emission allowances is allowable between different implementation periods and any emissions exceeding the allowances are subject to a penalty of less than three times the average market price.

In May 2012, the GHG ETS bill was finally approved by the parliament after slight revisions. The same as the second version proposal, the Minister of Strategy and Finance will be in charge of the chairman for the allocation committee. The target entities are specified. The entities emitting over 125,000 t-$CO_2$ and business sites emitting over 25,000 t-$CO_2$ yearly shall participate obligatorily. Banking within and between planning period, and borrowing within planning period will be allowed. The emissions exceeding the allowance will be fined three-time of the average market price per ton but less than a hundred thousand won. After six years, domestic and foreign individuals or corporations can participate as parties for the transaction. The carbon leakage sector will be given 100% free allocation. Early action for GHG reductions and offset will be recognized.

### 3.2 Background of the three target sectors

Korea has developed its economy, for over a half century, heavily relying on energy-intensive manufacturing industries, such as iron & steel, petro-chemical and cement industries (Kim et al., 2011). The sensitivity coefficients, indicating the contribution degree of growing the posterior industries, for steel & metal and chemical sectors are 2.225 and 2.075, which are the highest among the industries (Averaged at 1.000). The total export of energy-intensive industries is 75.9 billion KRW, accounting for 20.2% of Korea's total exports (Park and Kim, 2009). Iron & steel industry has been expanded its output from 1 trillion KRW in 2000 to 29 trillion KRW in 2010, which accounted for 9.2% of the total of manufacturing industry and 2.8% of all the industries. Exports of this sector increased from $ 4.2 billion in 1990 to $ 25 billion in 2010,

accounted for 6.0% of all the industries (Sourced from: http://www.kosa.or.kr). For the petro-chemical industry, ethylene production capacity increased to 6.9 million tons by 2009 and ranked the fifth in the world, with a share of 5.5% of the world market (2007). This industry is the forth largest industry in the domestic manufacturing industry with a share of 5.8% in 2008. The export in 2009 amounted to 274 billion KRW, accounting for 6.5% of total exports in Korea (Sourced from: http://kpia.or.kr/index.html). Regarding the cement sector, currently, 10 companies in Korea produce about 6,200 tons per year and export to the U.S., Japan, and Africa (Sourced from: http://www.cement.or.kr).

The manufacturing subsectors accounted for over 94% of total energy demand of the industry in 2008 (Kim et al., 2011). As of 2006, the energy consumption of energy-intensive industries accounted for 38% of the total energy consumption of Korea and shared 80% of the manufacturing sector. It is higher comparing with the average level of the OECD members (22%) and showed an increase trend from 32% in 1997 to 38% in 2006, while the number was from 23% to 22% in the same period for the OECD in overall (Park and Kim, 2009). Park and Kim (2009) analyzed the energy efficiency of industry in Korea. During 1990-1997, the energy intensity of the three sectors, petro-chemical, iron & steel and cement, has been steadily improving although it has been ceased after the Asian financial crisis in 1997. Petro-chemical sector's energy intensity was improved from 2.967 in 1990 to 2.135 in 1997, with an annual improvement ratio of 3%. Steel achieved 1% improvement in energy intensity every year as similar as cement sector that improved its energy intensity 0.9% annually in the same period. These three industries are the major energy-consuming industries and GHG emitters in Korea. The total $CO_2$ emission by manufacturing sector in 2007 was about 233 million tons, among which petro-chemical sector accounted for 21%, about 50 million tons, iron & steel 36%, 86 million tons and cement 18%, 42.2million tons.

## 4. Results and discussions

### 4.1 Energy use status and annual $CO_2$ emission of the samples

#### 4.1.1 Energy use status of the samples

The companies were requested to show the range of their energy consumption amounts. The statistical result, as shown in Fig.1, indicates that 95% of the respondents consumed more than 2,000 TOE of energy in 2010. The samples using more than 100,000 TOE in 2010 account for 35.5% of the total. According to Kim (2009b), only the top 2.2% of SMEs consumed more than 2,000 TOE in 2009 and 85% of the rest SMEs even used less than 200 TOE in the same year. This implies that the respondents may represent the

largest energy-consuming SMEs in Korea.

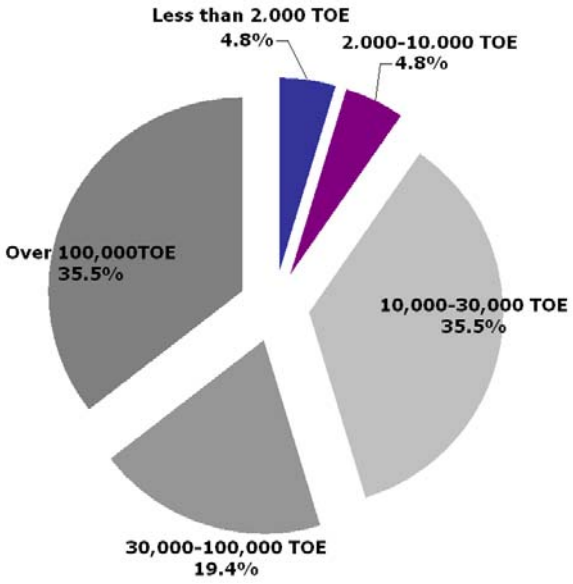


Fig.1: The distribution of samples by energy consumption amount in 2010.

The surveyed companies were also requested to elaborate the types of energies and their corresponding ratios in total energy use. The energy use structure of the samples in overall and by sector is summarized in Fig.2. The results confirm that electricity is the largest energy source for the surveyed companies as a whole, with an average share of 51% of total energy use. Natural gas is the second and accounts for 17% of the total. The third one is steam with a share of about 9 %. Oil and coal share around 7% each. Renewable energies account for less 1% as minor sources. The remaining 8% is others including LNG, Petro cokes and so on. There is some difference between energy use structures of the three target sectors. More than 50% of total energy used by iron & steel and petro-chemical industry is electricity, 64% and 51% respectively. The ratio of electricity is less than 30% for cement companies. Coal is a major energy source for cement companies, accounting for about 37% of total energy use, while this ratio is less 5% for petro-chemical and iron & steel sectors.

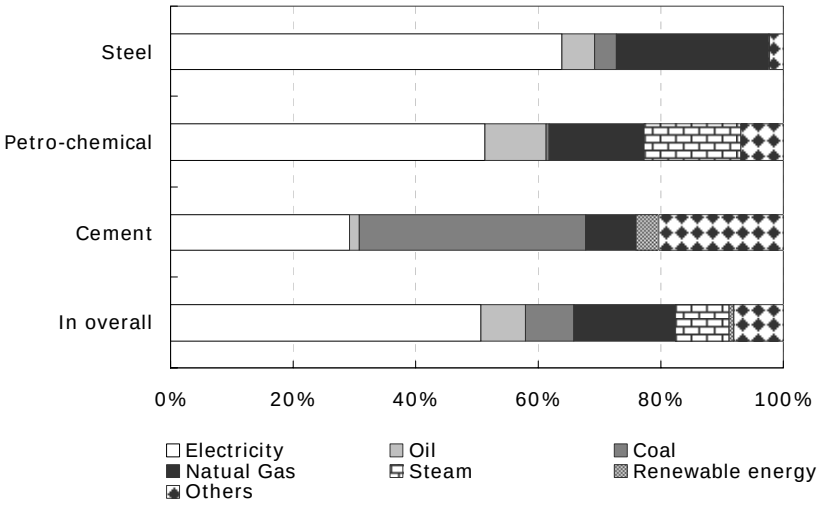


Fig.2: Energy use structure of the samples by sector.

Fig.3 shows the distribution of energy cost shares in total sales of the samples by sector. Rather than units in a physical quantity, this ratio represents energy intensity in the value of energies. Practically, it is difficult to request the companies to report their accurate energy uses by types due to resistance to disclose internally quantitative data. In overall, the samples have an evenly distribution of energy cost ratios between 5-20%. Nearly 30% of companies have an energy cost ratio of 5-10%. Similarly, the companies with energy cost ratios of less 5% and 10-20% individually have a share of around 25%. 16% have an energy cost ratio of 20-50%. The cement companies indicate high ratios of energy costs in sales. Around 55% of cement companies have an energy cost ratio of 20-50%. 9% of them cost more than 50% of sales for energy. Only 9% of cement companies have an energy cost ratio of 5-10%. In the petro-chemical sector, the companies with energy cost ratios of less 5% and 5-10% individually account 31% and 37% respectively. Nearly 23% have an energy cost ratio of 10-20%, and 6% of petro-chemical companies have energy cost ratios of over 20-50%. Steel companies have an evenly distribution of energy cost ratios. About 30% of steel companies have a ratio of below 5% and 10-20%, and 25% of steel companies have an energy cost ratio of 5-10%. 12.5% of steel companies have an energy cost ratio of 20-50%.

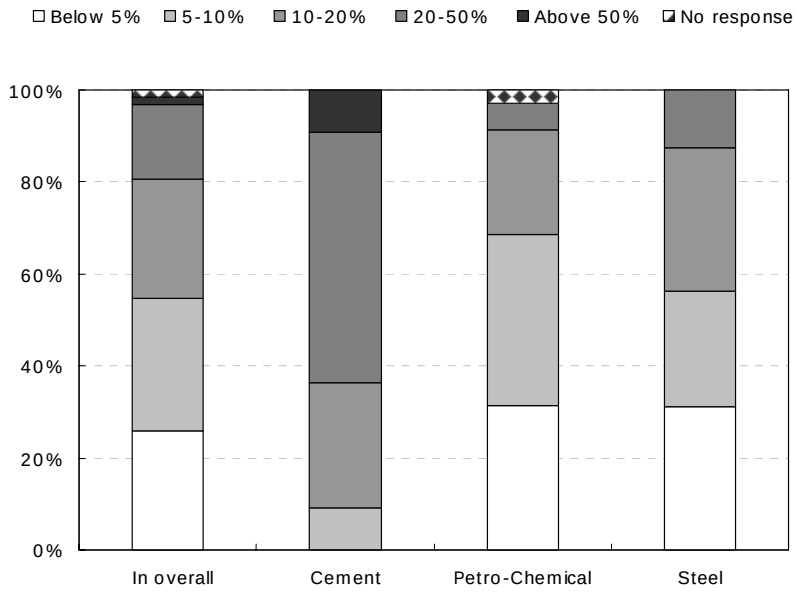


Fig.3: Distribution of energy cost shares in total sales by sector.

4.1.2 The annual $CO_2$ emission of sampled companies

The surveyed companies were asked to indicate the range of their annual $CO_2$ emissions. The results confirm that the samples are heavy $CO_2$ emitter, as depicted in Fig.4. Most of them, 91.9% of the total, emit over 25,000 t-$CO_2$ yearly. The companies with less than 5,000 t-$CO_2$ emissions share the second and accounts for 4.8% of the total. Remaining companies answered that their annual $CO_2$ emission are in the range of 5,000-15,000 t-$CO_2$.

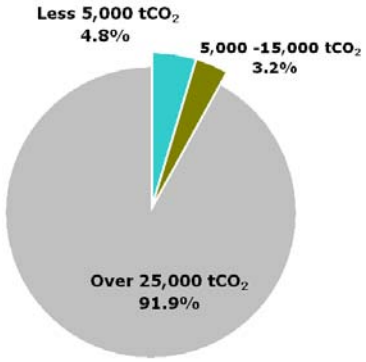


Fig.4: The annual $CO_2$ emissions of sampled companies.

4.2 Company's evaluation of numerical GHG reduction goals by sector

Korea government recently announced the decomposed national GHG reduction targets by sector. The reduction targets of iron & steel, petro-chemical and cement industries

are respectively 6.5%, 7.5%, and 8.5% compared with BAU cases by 2020. The sampled companies were asked to evaluate the stringency of mitigation target of their own industry. The results of the three sectors are depicted in Fig.5. The result indicates that the GHG reduction targets by sector are felt strict by most of the surveyed companies. Only 9% of the companies in cement sector answered that the decomposed national GHG reduction target for cement industry is low. 20% samples in petro-chemical sector selected answers of 'appropriate' but less than 10% of companies in cement and steel sectors circled this answer.

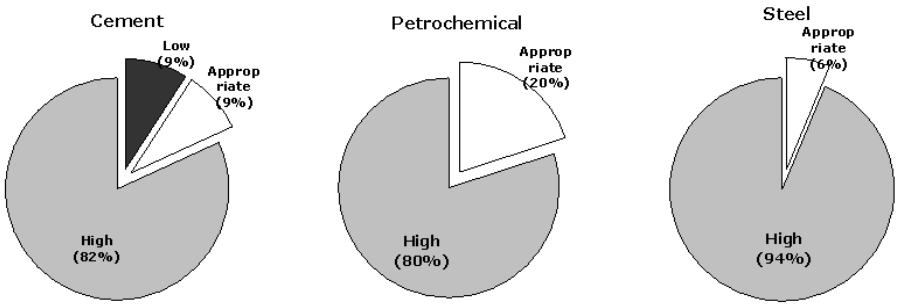


Fig.5: Company's evaluation of numerical GHG reduction goals by sector (N=62 in total).

The companies were requested to evaluate the impact of the nation GHG mitigation goal in medium-term and the decomposed sectoral GHG reduction target on their business. As indicated in Fig.6, 77.4% companies worried that this would bring the negative effect on their business. Only 3.2% samples expected that it could be possibly positive. These results clearly showed the energy-intensive sectors' attitude against the national GHG mitigation plan due to the concern of the negative impact on their business and weakened competitiveness in the market.

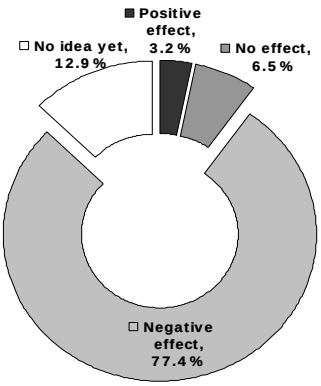


Fig.6: Company's evaluation of the effect of nation GHG mitigation goal on their business (N=62).

4.3 Statistics of company's awareness and acceptability of GHG ETS

In this survey, we asked the companies to show their subjective acceptability and awareness to the MBIs including GHG ETS, which are listed in Table 2. A five-point scale is applied for the evaluations. The points presented to the policy awareness mean: '5' = 'very clear'; '4' = 'clear'; '3' = 'moderate understanding'; '2' = 'don't know well'; and, '1' = 'completely unknown'. The statistics of company's policy awareness is summarized as in Fig.7.

Table 2: Descriptions and abbreviations of MBIs in this survey

| Descriptions | Abbreviations |
|---|---|
| Subsidies for GHGs & Energy Target Management Investment | MBI01 |
| Soft Loan for Energy Saving Facilities Installation | MBI02 |
| Soft Loan for High-Efficiency Products | MBI03 |
| Soft Loan for Demand Side Management Investment Programs | MBI04 |
| Grant for High Energy Efficiency Equipment (i.e., LED, transformer and freezer, etc.) | MBI05 |
| Soft Loan for Energy Saving Companies (ESCO) Projects | MBI06 |
| Tax Reduction for Investment in Energy-saving Facilities | MBI07 |
| Carbon Tax | MBI08 |
| GHG Emission Trading Scheme | MBI09 |

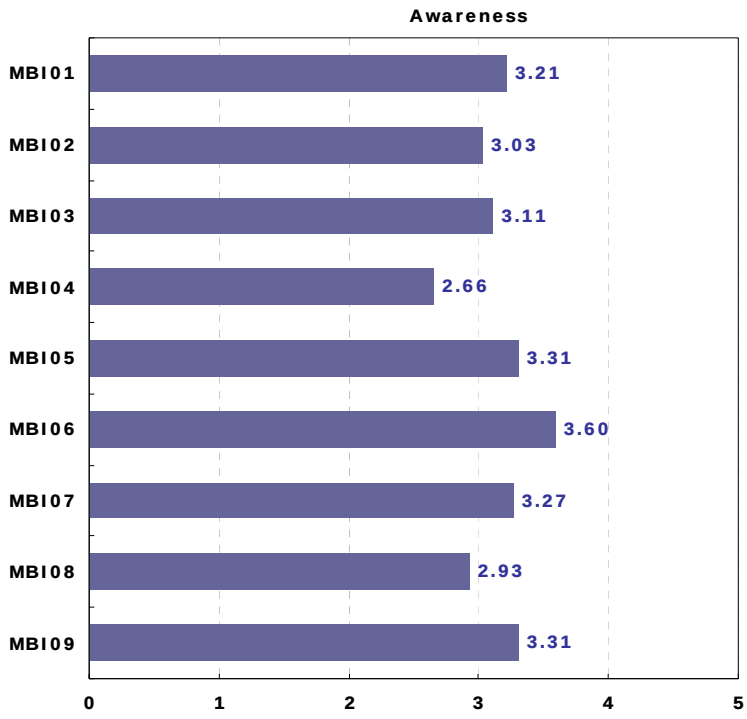


Fig.7: Company's awareness of MBIs.

The average score of awareness of MBIs is around 3.0 in general. The respondents know MBI06 (Soft Loan for Energy Saving Companies (ESCO) Projects) relatively well, with a mean of 3.60. The following policies with relatively higher awareness of the companies are MBI05 (Grant for High Energy Efficiency Equipment (i.e., LED, transformer and freezer, etc.) and MBI09 (GHG Emission Trading Scheme), with a score of 3.31 in average. In spite of the resistance from the industry, companies in this survey have become moderately aware of GHG ETS probably due to the large discussions of this policy in Korea recently.

Company's acceptability of GHG ETS was evaluated in comparison with that of command and control policies under implementation. The scales for the policy acceptability are: '5' = fully acceptable; '4' = relatively acceptable; '3' = moderate acceptance; '2' = hardly acceptable; and, '1' = completely unacceptable. The average scores are depicted in Fig.8. Tax reduction for investment in energy-saving facilities obtained the highest mean of 3.82. Soft Loan for Energy Saving Companies (ESCO) Projects achieved a similar and higher mean of 3.54. The samples indicate good acceptability to the regulative tools with means of 3.66. However, GHG ETS, similar with carbon tax, is obviously not welcome by the companies, with both averaged at around 2.0.

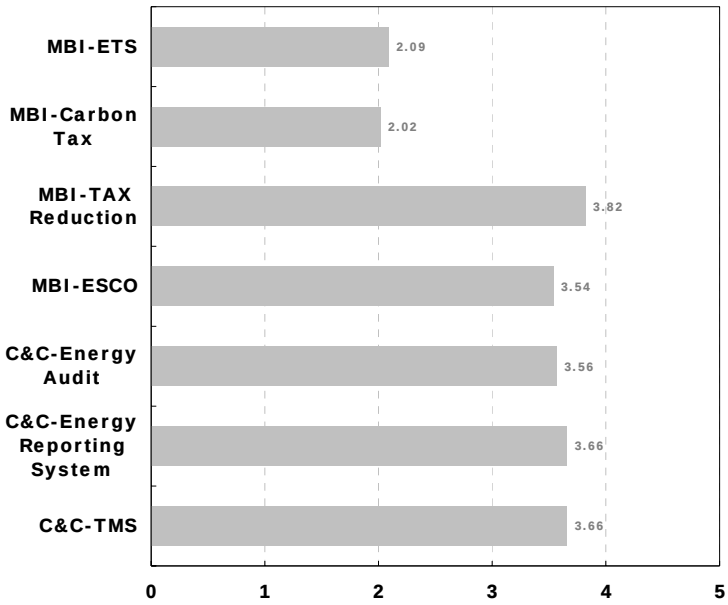


Fig.8: Company's acceptability of GHG mitigation policies.

## 4.4 Company's specific perspective of GHG ETS

### 4.4.1 Merit of GHG ETS for the companies

The surveyed companies were asked how they think about the positive aspects of GHG ETS to be implemented from 2015. A five-point scale is applied for the company's evaluations, with 5 = 'Very appropriate', 4 = 'appropriate', 3 = 'somewhat appropriate', 2 = 'inappropriate', 1 = 'inappropriate at all'. The average scores of the evaluations are depicted in Fig.9. The result indicates that Korean companies moderately recognize the GHG ETS as an effective measure for GHG mitigation. The other possible merits of GHG ETS listed are not favored with the low average scores below 3.0. Although the Korean government expects GHG ETS to work as a cost effective measure for energy saving and GHG reduction, businesses do not agree with this accordingly. A non-favorable attitude of Korean companies to the introduction of GHG ETS at current stage is reflected consistently by this survey.

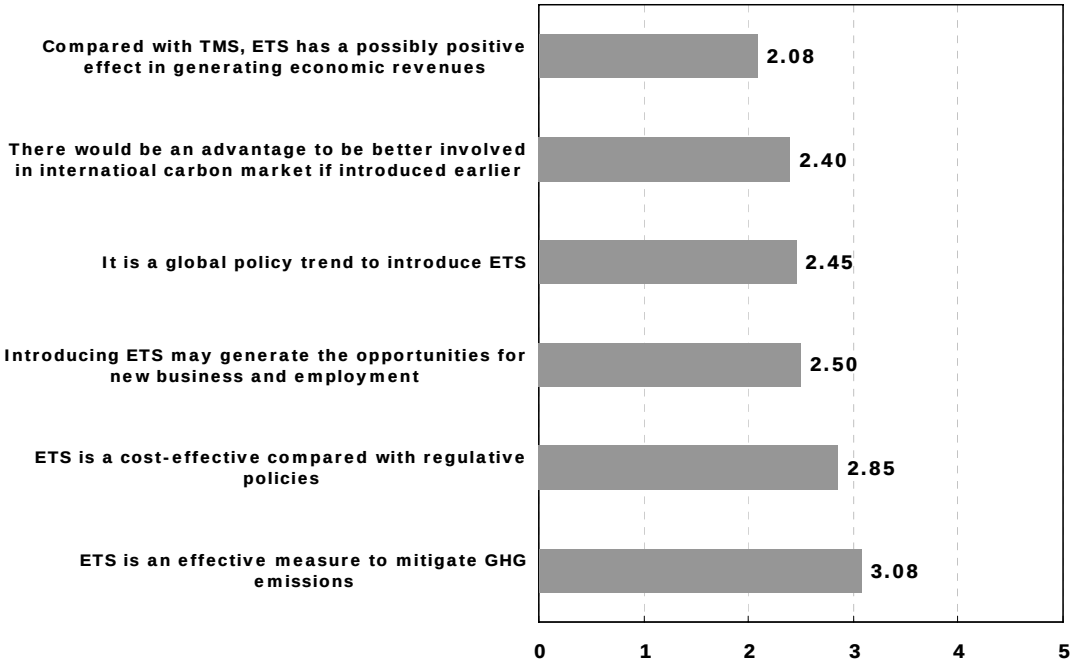


Fig.9: Company's evaluation of the merits of GHG ETS.

### 4.4.2 Negative effects of GHG ETS for the companies

With aims to find out to what extent the companies would concern about the negative issues of GHG ETS, the samples were requested to give a score to each of the listed aspects, with 5 being 'very important' and 1 meaning 'not important at all'. The statistical result is presented in Table 3. In overall, all aspects achieved remarkably high scores ranged from 3.97 to 4.52. This is obviously opposite to the evaluations of the merits of GHG ETS in section 4.4.1, indicating that companies in Korea strongly concern about the negative issues of GHG ETS. Among which, the companies most

worry about their loss of industrial competitiveness due to the production cost increase if the GHG ETS is phased in earlier than major competition countries (Average at 4.52). The uncleanness of the detailed operation scheme and ambiguity in coordination with existing regulations were also ranked with higher averages of 4.39 and 4.29, implying that in the early stage of GHG ETS, companies expect a clear policy frame for them to make necessary preparations. Since most of the sampled companies are also targeted by TMS, the concern of double burdens from TMS and GHG ETS are thought important. The companies also worry about their lack of capacity to cope with the implementation of GHG ETS (Averaged at 4.05). Whether a successful and stable carbon market could be formed was worried, with the related items achieved higher averages of 4.02 and 4.00.

Table 3: Company's evaluation results of negative aspects of GHG ETS

| No. | Negative aspects of GHG ETS | Average |
|---|---|---|
| 1 | Pre-matured implementation and loss of business competitiveness | 4.52 |
| 2 | Unclearness of the detailed operation scheme including emission allowance allocation method, etc. | 4.39 |
| 3 | Unclearness of the detailed measure to avoid possible double burdens with TMS | 4.29 |
| 4 | Ambiguity of the expected contribution of ETS to national GHG reductions | 4.16 |
| 5 | Company's lack of capacity to cope with the implementation of ETS | 4.05 |
| 6 | Insufficient liquidity of the carbon market due to the limited credit volume in total | 4.02 |
| 7 | The instability of carbon price and the speculative trading | 4.00 |
| 8 | Carbon leakage problem | 3.98 |
| 9 | Foreign companies hesitate to invest in Korea and the domestic deindustrialization | 3.98 |
| 10 | Ambiguity of competent authorities and their responsibilities in implementing ETS | 3.97 |

### 4.4.3 Company's behavioral preparations for GHG ETS

In the survey, we asked the companies to indicate the measures or actions for the preparation of the GHG ETS, which they would take or are currently under discussions. The result is shown in Fig.10. We found that most respondents established the internal inventory of GHG emissions verified by a third party, with a high percentage of 93.5%. This high percentage of participants for the inventory of GHG emissions is thought as the result of the inventory establishment project launched by implementing TMS in 2011 since most of sampled companies are targeted by TMS. The other measures with high participation ratios include to establish a specific division for TMS and GHG ETS

and to participate in the pilot project of GHG ETS or TMS. Their participation ratios are 38.7% and 29.0%, respectively.

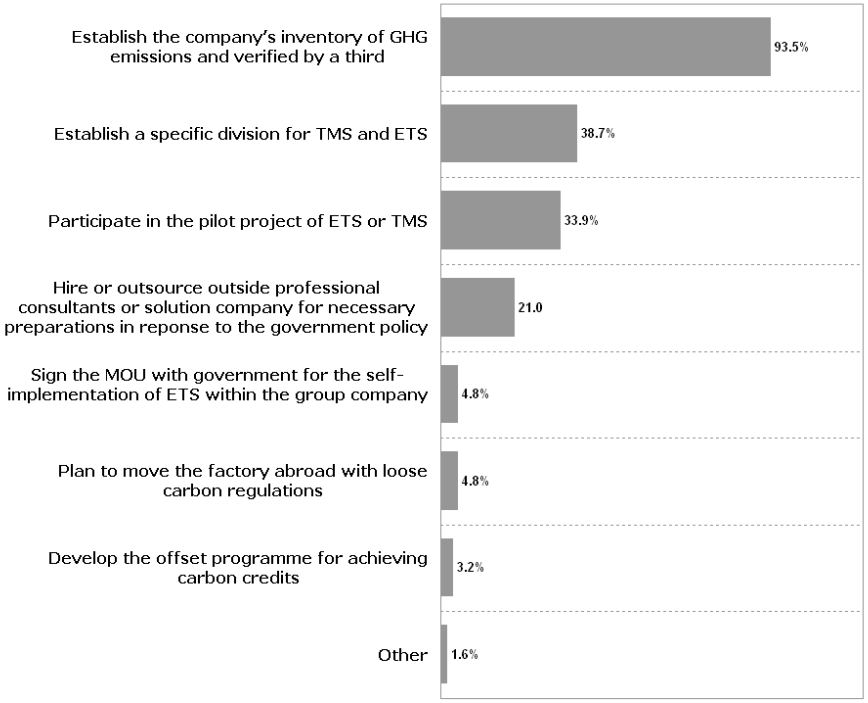


Fig.10: Corresponding actions of companies in response to GHG ETS.

4.4.4 The barriers of companies for GHG ETS

The sampled companies were also asked what barriers or difficulties they may encounter in preparing for GHG ETS. Fig.11 summarizes the result of responses.

It is clear for the companies to feel the burden of mitigation goal due to the limited reduction potential, with the highest agreement ratio of 82.3%. Petro-chemical and steel production processes are very energy intensive, and energy efficiency is closely related to production costs and profits. This is why energy-saving options have been the priorities in these industries for a long time and why many energy saving measures have been already implemented (Holmgren and Sternhufvud, 2008). The energy efficiency of Korean industries, particularly for the more energy-intensive petro-chemical and steel industry, has generally outpaced that of their counterparts in other countries (IEA, 2009). During 1990-1997, the energy intensity based on productions of the three sectors, petro-chemical, steel and cement, has been improved by 0.9-3% annually (Park and Kim, 2009).

The following barriers with slightly higher scores are 'lack of specialists on energy management and reduction potential identification' and 'Lack of technology', with each achieving a agreement percentage of 62.9% and 61.3%, respectively. This indicates that

the ambiguities with reduction potential tackle company's better carbon performance. The financial matters, such as budget shortage and lake of economic incentives, are recognized as not so important barriers at this stage.

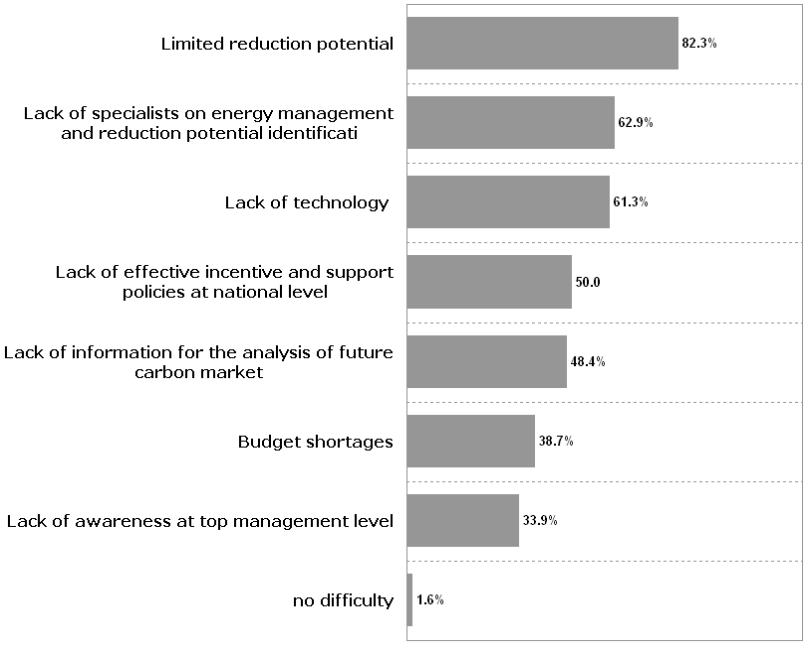


Fig.11: The difficulties and barriers for companies in preparation for GHG ETS.

### 4.4.5 Company's behavioral responses to the MBIs

The company's energy cost would increase if introducing carbon tax policy and/or GHG ETS. In order to monitor the possible responses of companies to these MBIs in discussions, we requested the companies to check the possibility to take alternative actions. A five-point scale was applied with the meanings as: '5' = very possible; '4' = relatively possible; '3' = moderate possibility; '2' = low possibility; and '1' = completely impossible. The statistics is shown in Fig.12.

The companies would avoid the reactive actions, including to reduce the production; move the productions to the areas with loose policy; close the production facilities; and, to take no reaction by accepting the loss. These four choices were presented average scores under 2.70. On the contrary, the companies prefer internal efforts in energy saving to relieve the policy's negative impacts. Practicing managerial energy-saving activities is the most possible choice, with the highest mean of 3.82. To invest in energy efficient technologies, self-investment in R&D, and use less carbon-intensive energies are preferable responses with higher possibilities. Another meaningful observation is that the companies would not like to simply transfer the policy burden to their clients.

The option of raising product prices for cost shifting achieved a moderate mean of 2.84. De Groot et al. (2001) suggested that Dutch companies would more possibly charge the customers with additional costs given an energy tax increase. The different finding of our survey may be attributed to the strict competition faced by Korean companies.

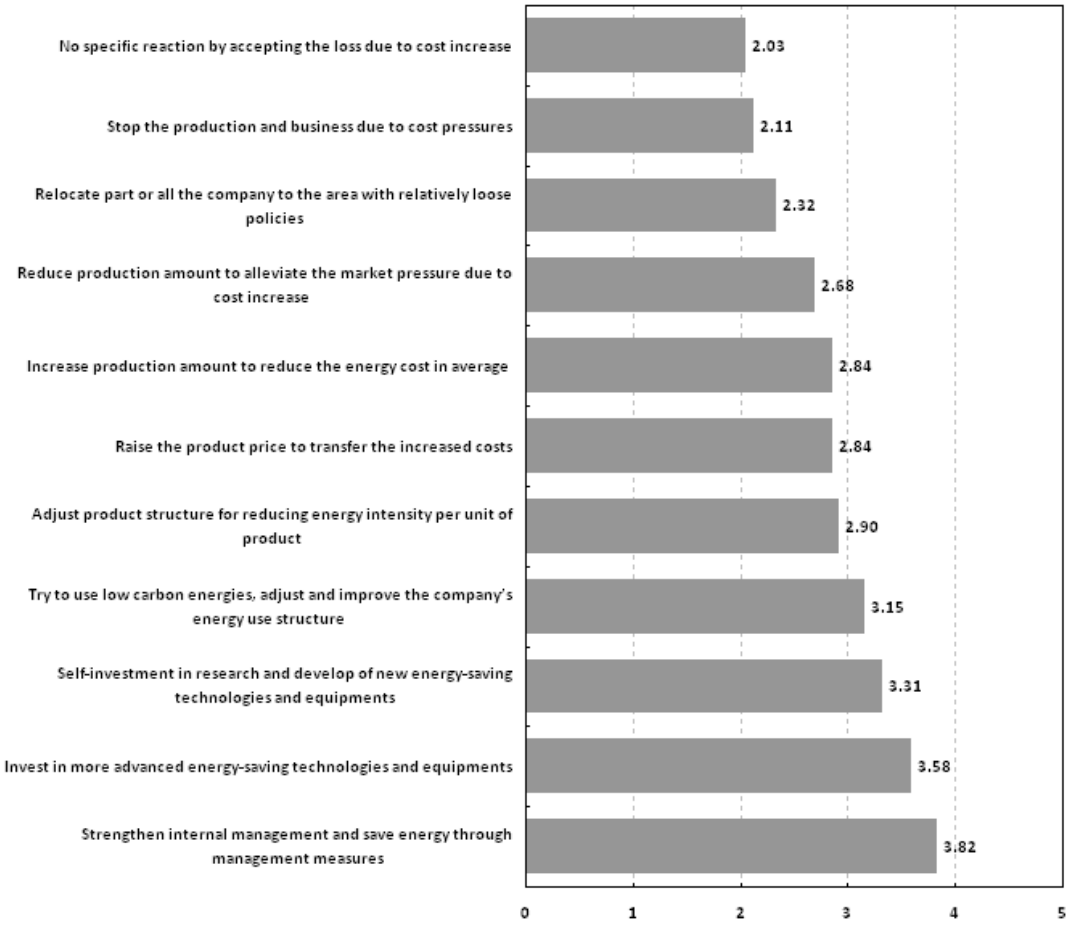


Fig.12: Company's behavioral responses to the MBIs (N=62).

4.4.6 Expectations of companies with respect to GHG ETS

In the survey, companies were requested to indicate their expectations to the government in implementing GHG ETS. The result is shown in Fig.13. Making clear the double burden of similar regulations is the highest expectation of companies. In the early stage of the implementation of GHG ETS, companies are requiring an overall clear frame for the policy institutional arrangement, such as allowance allocation method. Companies also highly expect compensation measures, such as providing incentives, and relief of the burdens by alleviated penalties under this new policy.

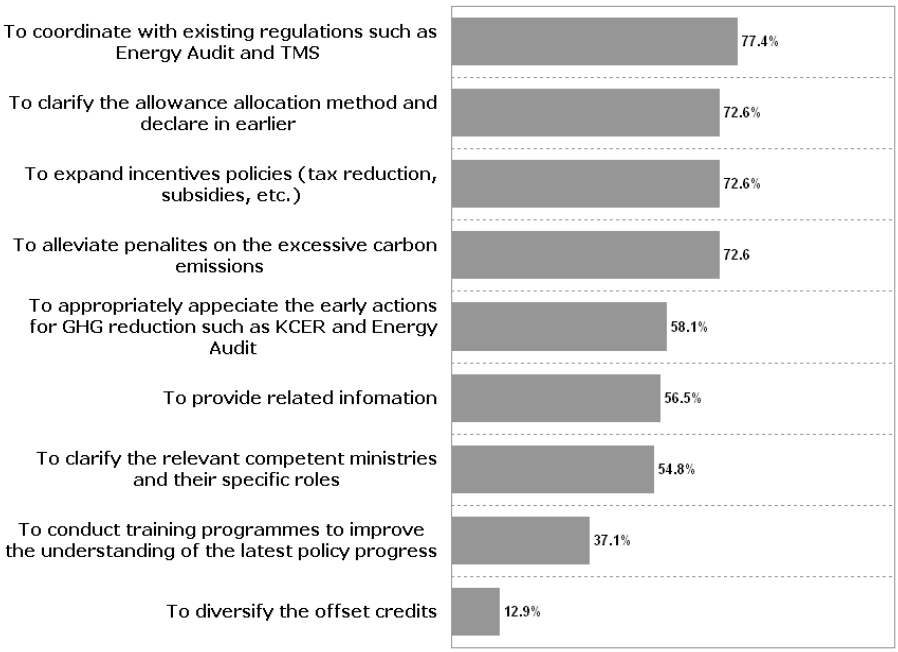


Fig.13: The expectations to government with respect to GHG ETS.

## 5. Conclusions

This paper measured the Korean company's perspective to GHG ETS, including their awareness and acceptability of GHG ETS in a qualitative way, and identified their corresponding responses to and expectations for this policy adoption by a survey targeting three energy-intensive sectors, petro-chemical, cement and steel industries. Our analysis confirmed that the companies strongly concern about the possible negative impact of GHG ETS on their businesses, particularly the market competitiveness loss due to the double burdens with existing regulations and the strict mitigation goal in comparison with limited mitigation potentials. The GHG ETS is therefore barely acceptable for the surveyed companies compared with other industrial energy saving policies. However, it was noteworthy that the companies in this survey would not like to simply transfer the policy burden to their clients but to make internal efforts in energy saving to relieve the policy's negative impacts by practicing managerial energy-saving activities, investing in energy efficient technologies, self-investment in R&D, and using less carbon-intensive energies. Company's expectation for the government is to clarify the specific procedures for the policy operation including the coordination with existing regulation and to have compensation measures to relief the burdens.

While there are ambitious government targets and measures on GHG mitigation, the policy must be considered the embracement of policy targets in advance (Kern, 2011).

Although Korean government finds a mean, the GHG ETS, and emphasizes its cost effectiveness under the strong-willed policy implementation of Green Growth as a new national vision, our survey result confirmed that the acceptance of Korean companies to this new policy is still a doubt. Policies can accelerate the progress made, but knowledge about the remaining efficiency potentials and their costs is a prerequisite for the success (Fleiter et al, 2012). The company's limited potential of GHG reduction and energy efficiency in Korea could hinder the actual policy implementation. The Korean government should devise a mean to overcome this problem. A more diverse range of technology options are needed for Korean companies to meet a more challenging GHG emission reduction target (Lee, 2011). Among the abatement options available, the replacement of old appliances is considered as a very cost-effective short term measure (IEA, 2009). Improving energy efficiency through technological progress, fuel switching and related policies, Korea can begin to make the necessary transition to a less carbon-intensive future (Lee and Ryu, 1991). Vigorous implementation of efficiency, fuel substitution, and renewable will be needed for the Korea to reach its goals (Kim, 2011). In addition, our survey suggests that Korean government shall make the operation component of GHG ETS to be more clearly recognized by companies. The GHG ETS should be presented in a correct way for achieving the company's support.

There are a few shortcomings of this study. The questionnaire survey relies on self-reporting of companies for data collection. Due to reluctance of the companies to cooperate, only a limited number of usable samples were gathered. The small sampling may cause certain bias for generalizing the results to a wider scope. Further surveys are necessary to extend to the other industries since the companies from different sectors may have different policy viewpoints. The following research efforts shall clarify the policy success conditions for promoting energy saving efforts of Korea companies under this new policy.

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