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A Study on Development of Framework for Greenhouse Gas Reduction

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Abstract

Global warming and climate change have come to the fore as a key sustainable development issue. Many governments are taking steps to reduce Green House Gas (GHG) emissions through national policies that include the introduction of emissions trading programs, voluntary programs, carbon or energy taxes, and regulations and standards on energy efficiency and emissions. Korea industry is expected to get severe impacts due to its dependence on large volume of energy consumption. Systematic framework is developed for GHG reduction of enterprise operation processes. The framework is expected to serve firms with several benefits such as, systematic analysis of GHG reduction potential with respect to their internal and external processes, as well as selection of effective investments regarding GHG reduction projects. Furthermore, the framework can be expanded to diverse areas with modest extra efforts.

Keywords: Emission Trading, GHG reduction, Greenhouse Gas, Systematic Framework

1. Introduction

Extreme weather events due to global warming, natural disasters and other natural · ecological change and environmental crisis have been caused. According to IPCC 4th Assessment Report (AR4) released in February 2007, the last 100 years the average global temperature has already increased from 0.74 ℃, industrial structure that relies on fossil fuels to keep the worst case was expected 6.4 ℃ (average 4.0 ℃) to rise in the end of 21C[1]. It is known that GHG emissions caused by human activities affect global warming. Accordingly, the UN, international organizations, governments, academia and community organizations are for their efforts to reduce GHG emissions[12].

Korea's total GHG emissions by 2005, 591.1 million tons of CO_2 compared to '90 was approximately double, and by increase 2.2% per year is expected to reach 813 million tons in 2020. Korea ranked 9th in the world's GHG emissions, in terms of per unit of GDP and per capita emissions represent a relatively high emission levels. The government of the Republic of Korea to solve the severe climate change and energy issues at the same time, and as a national crisis in order to promote growth, adopt the green industry and green technologies to lead to economic growth through 'low-carbon green growth'. They set targets GHG emissions by 2030 compared to 4% reduction in 2005 (BAU 37% reduction) and are making various efforts.

Higher proportion of energy consuming industries in Korea domestic manufacturing companies of GHG emissions by 12 percent of the total emissions in the energy sector, and then showing more emissions, and '90–'03 year growth rate of emissions increase total emissions by 10% has shown growth of more than double. However, Korea's industrial sector energy efficiency of the process to a lower level than in developed countries vulnerable to climate change cooperation to reduce GHG emissions, if implemented in earnest promotion is concerned about a serious blow. Domestic activities of some companies to reduce GHG emissions are reported, but it is the level of piecemeal

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technology applied rather than systematic reduction activities in accordance with strategy and planning.

It is essential to the applicability of the GHG reduction methodology by systematic procedure, the analysis of external environment, analysis of the carbon footprint through the assessment of business processes, identification of alternative reduction / evaluation and prioritization of the selected alternative, to companies and organizations for effective action to reduce GHG emissions. In this paper, it is introduced a framework for industry to reduce GHG emissions. The expected effects of this framework, and future plans is described in conclusion.

2. Overview of Framework

In order to reduce GHG emissions, the exact current process should be identified. First, the process of collecting the necessary data, second the process of developing GHG inventories, and last the process of calculating the carbon footprint is required. If the current carbon emissions status is analyzed, the process of selection alternatives is necessary, which set reduction targets and select alternatives in accordance with the technical and economical optimization. Finally, execute the selected alternative carbon reduction, monitoring and reporting process is required.

In Figure 1 shows an overview of the framework. The framework consists of the 4 Phases, and more details for each step are described:

- Phase 1: External Environment Scan – GHG emissions reductions associated with the analysis of the external environment
- Phase 2: Internal Footprint Assessment – evaluation of current emission in business processes

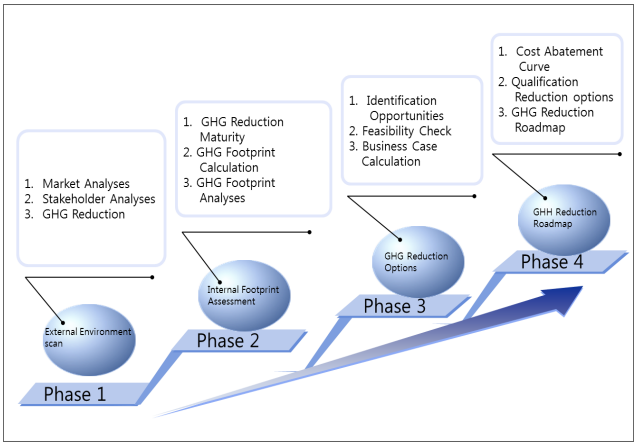

Figure 1. Phase of Framework

- Phase 3: GHG Reduction Options – Identifies and evaluation of optimal alternatives to achieve the goal of GHG reduction
- Phase 4: GHG Reduction Roadmap – Prioritize the execution of the final alternatives

3. Phase of GHG Reduction

3.1 Phase 1: External Environmental Scan

3.1.1 Market Analyses

Market Analyses step are analyzed to reduce GHG emissions associated with the various market factors. National, regional and industrial sector are identified to analysis of the current status and related political discussions, domestic and international regulation of GHG emissions. In addition, developments of new technologies associated with emission reductions, the profit potential related with the economic situation and changes in taxation, and changes in demand for the social trends is analyzed by extensive literature analysis, interviews or surveys, etc.

3.1.2 Stakeholder Analyses

In this Step, identify and analyze stakeholders to reduce GHG emissions as a basis the outcome through the market analyses. Corporate stakeholders associated with reducing GHG emissions can be governments, interest groups, NGO, suppliers, raw materials / parts suppliers, competitors, investors, customers and its employees. All companies should understand stakeholders exactly that company interacts with, in order to ensure the success of the business. By analyzing the wants and needs of stakeholders associate with GHG emission, risks and opportunities can be pinpointed. In addition, it can be utilized as important materials of future strategies that determine potential benefits and expected impacts of stakeholders caused by activities of reduction GHG emissions. A wide range of information required for the analysis of stakeholders also can be identified by internal and external literature analysis, interviews or surveys, etc.

3. 1.3 GHG Reduction Drivers

On the basis of the results in market analyses and stakeholder analyses can identify drivers to reduce GHG emissions. Drivers can be classified into 4 factors

as increasing sales, cost reduction, risk mitigation and the creation of intangible value Figure 2. The creation of new markets for growth by development of green technologies to reduce GHG emissions may be an example of increasing sales. Cost reduction factors include increasing productivity of the value chain (e.g., increasing resource productivity, waste reduction), and risk mitigation factors that include, for example, legal rules for GHG emissions reduction. Intangible value creations factors may be that enhance the corporate image, better partnerships with suppliers, and recruiting employees. GHG reduction drivers may vary by business strategies that company pursues. GHG reduction strategy should change depending on the main drivers of each company Figure 2. User interface terminals can control each electrical appliance itself such as refrigerators and air conditioners installed directly on the device, and also can control enclosed group scheduling unit such as home, commercial buildings, factories.

3.2 Phase 2: Internal Footprint Assessment

Phase 2 is consisting of three sub-step: GHG Reduction maturity assessment, GHG footprint calculation and analysis, which can analyze and evaluate current status of emission through the business processes.

3.2.1 GHG Reduction Maturity Assessment

Maturity assessment is performed by GHG Reduction Maturity Model (GRMM) which can evaluate the maturity of organization and operation processes. It is divided into 9 areas, business improvement, communication, governance, measurement, people, policy, strategy, supply chain and total cost management[5]. This model proposes the areas for improvement by comparing the current level of the organization against targets, and presents relative maturity compared with the benchmark results. Figure 3 shows GRMM key areas and example of maturity assessment.

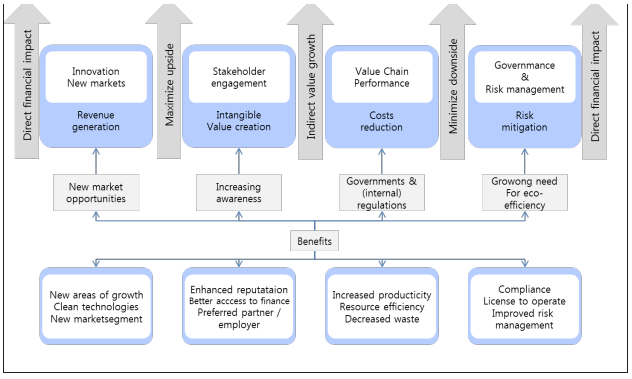

Figure 2. GHG Reduction Drivers

3.2.2 GHG Footprint Calculations

To calculate GHG footprint in business processes, the GHG Protocol (Corporate Accounting and Reporting Standard) 2008 published by the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) was the reference[7,8]. Coverage is defined as the range suggested by World Resource Institute (WRI)[9-12]:

- Scope 1: Direct emissions
- Scope 2: Indirect emissions (electricity)
- Scope 3: Other indirect emissions, such as logistics and business travel

In addition, the calculation of GHG frame is used the WRI GHG Protocol that one of the methodology of the most widely used in worldwide, and GHG emission factor in the form of database provided that target companies and public agencies[7]. After that, defining the boundaries of consideration and appropriate data are collected to calculate the carbon footprint.

3.2.3 GHG Footprint Analyses

This step is to identify sources of GHG emissions based on measured data from the corporate carbon footprint

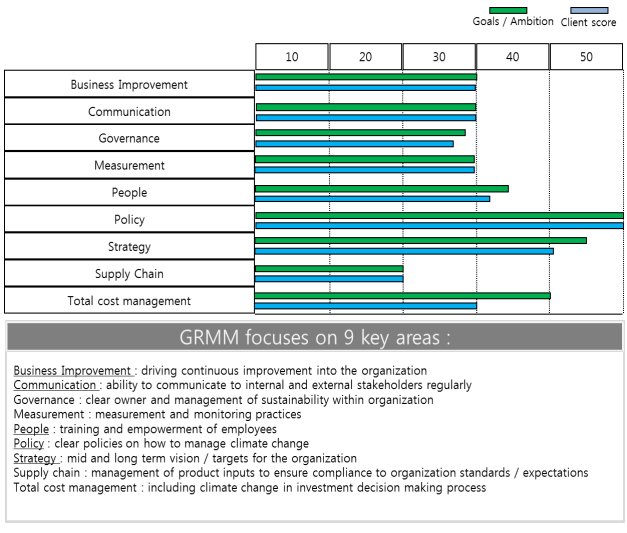

Figure 3. GRMM Key Areas and Example of Maturity Assessment.

and operational processes. Detailed measurements and analysis focused on the particular organization and processes that affect the whole lot of processes are also available through such micro management on GHG emissions.

3.3 Phase 3: GHG Reduction Options

In Phase 3, the most appropriate alternatives that can be applied to the industry based on feasibility and economic assessment are determined. Figure 4 shows stages of selecting alternatives to reduce GHG emissions by interviews with other expert groups, surveys and workshops.

3.3.1 Identification Opportunities

Step 3.1 is to identify an alternative that can reduce GHG emissions. This alternative is used as input data that is allowed in the previous market analysis step, benchmarking, or the outcome of the internal environment of companies. Industry's success stories are also intensively studied. Above all, GHG reduction policy and techniques are developed by considering GHG emissions, energy usage patterns and future business plans. Already planned or executed alternatives can be considered preferentially, other alternatives that are excluded from technology or economic feasibility by third parties also may be considered. In addition, an alternative can be developed through an expert workshop.

Identified alternatives can be classified energy efficiency (Efficiency), renewable energy (Renewable Energy), and carbon offset (Offset). Demand limiting that restrict the operation of process equipment in idle time, energy and GHG reductions in the process by process optimization or alternative technologies, energy savings of building facilities, and efficient use of fuel and materials and include waste reduction are in energy efficiency area. In the renewable energy area, it is to purchase various renewable energies purchasing such as wind, solar, bio-fuels etc. or to produce from itself. The project are included Carbon Capture and Ctorage (CCS), carbon trading with companies, and Clean Development Mechanism (CDM) / Voluntarily Carbon Standard (VCS) in the carbon off-set area.

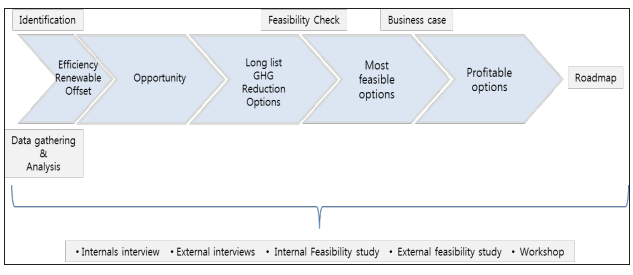

Figure 4. Stages of Selecting Alternatives to Reduce GHG Emissions.

3.3.2 Feasibility Check

Step 3.2 is to analyze technical feasibility of identified alternatives from step 3.1. First, interviews or workshops with group of experts, an internal feasibility studies that analyze the pros and cons of those alternatives at the level of complexity, and the potential technical feasibility studies in terms of potential technology development should be done. Also workshops should be done to share and validate the feasibility of derived alternatives. After that, a list of alternatives candidates to meet specific business needs. It is possible to draw a final alternative after analyzing business case calculations in step 3.3.

3.3.3 Business Case Calculations

Step 3.3 is to select economically feasible GHG reduction alternatives derived from the candidates in Step 3.2. A data to identify cash flows of a particular alternative is collected, and the investment value of alternative is evaluated by various analytical methods such as NPV (Net Present Value), PBT (Payback Time), and ROI (Return on Investment). In case of difficult to collect data, appropriate assumptions are applied. Also the intangible value of reduction alternative applied, for example, the value of stakeholders, brand equity, innovation value, etc. is evaluated qualitatively.

3.4 Phase 4: GHG Reduction Roadmap

In Phase 4, it is to determine investment priorities of the selected alternatives. First, the investment value is evaluated for each reduction alternative by the estimation of potential reductions through cost abatement curve, and then the difficulty of implementation is also evaluated in the next step. Finally, based on the results of these two analyzes to determine the priority of execution.

3.4.1 Cost Abatement Curve

In this Step, the cost abatement curve to be drawn to compare through Phase 3 alternatives aimed at reducing identified potential reductions of GHG. The curves were

drawn by refer to the McKinsey report released in 2007[5]. Input data for the baseline scenario and develop scenarios by selecting the most appropriate parameters and assumptions. When estimated annual cost reduction by reducing marginal abatement cost alternatives are analyzed and compared to alternative sources for each cut, and each alternative should be considered lifecycle cost and revenue. Also potential estimated at each plant by sources.

3.4.2 Qualification of GHG Reduction Options

Step 4. 2 run to evaluate the difficulty of each alternative in Step 4. Steps identified in one business value by comparing the analysis of data and to identify alternatives that are worth investment. Interview and decision-makers to the needs of the workforce and to develop alternatives for each interview, and financial evaluation criteria to assess the difficulty of the run. Difficulty on the basis of these interviews can develop the standards of evaluation. In particular, if each source by the number of reduction options, depending on the marginal abatement costs strategically selected. Figure 5 illustrates the qualification matrix for the selected alternative reduction. The horizontal axis represents the difficulty of running the vertical axis represents potential reductions expected effects, the size of each circle shows the GHG reductions, the color of the circle denotes the cost of the investment.

3.4.3 GHG Reduction Roadmap

Step 4.3 is final step to prioritize execution based on the results of the previous evaluation. Qualification matrix derived from Step 4.2 on the basis of the results go through the process received a final draft selection by type reduction alternative roadmap, drafted and stakeholder feedback through workshops.

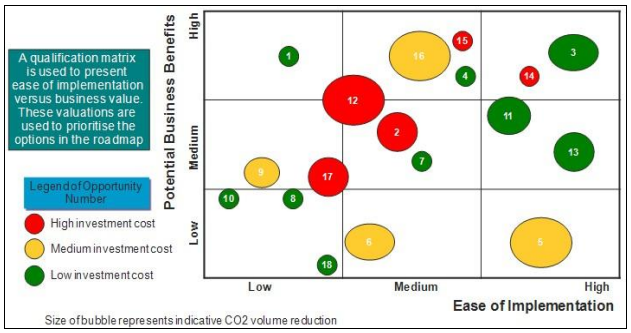

Figure 5. Considering the Difficulty and Potential Reductions Qualification Matrix.

4. Conclusions

The expected effects of enterprise processes, which reduce GHG emissions in the systematic development of the framework can be summarized by the following three points.

- The amount of GHG emission reduction potential of a systematic analysis: market analysis, stakeholder analysis, including competitor analysis, based on a systematic review by the framework as a guide to reduce the amount of potential alternatives and emissions reductions can be formally identified.
- GHG emissions reduction projects efficiently selecting and investment guide for the offer: investment reduction potential and execute the ease of evaluation, based on a roadmap by providing economical and efficient emission reduction projects selected at the same time in the long term to reduce GHG emissions can be undertaken consistently and continuously.
- Companies operating in the field of non-utilization to reduce GHG emissions framework: the framework targets the company's operating processes have been developed. The large flow of non-public institution or a company, such as local governments to reduce GHG emissions without major modifications to the project would be possible to apply.

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