A Study on Carbon Neutral City Plan of Sejong City

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ABSTRACT

The purpose of this study is to set up a realizable goal of the amount of CO_2 reduction for the Sejong city and to formulate the plans to achieve the goal. For that purpose, the goals of CO_2 reduction were set up for each of the following sectors: ①urban planning, ②urban construction, ③building, ④ energy ⑤traffic and ⑥green areas, and then the measures to realize the goals were presented.
The amount of CO_2 emission in 2030, estimated by this study, was 950 thousand tons, which is a 72.3% reduction compared to 1990.

KEYWORDS: CO_2 Emission Reduction, Carbon Neutral City, Sejong City

1. INTRODUCTION

Cities have a central role to play in tackling climate change, particularly as cities bear a disproportional responsibility for causing it. In fact, cities and urban areas consume 75 per cent of the world's energy and produce up to 75 per cent of its greenhouse gas emissions (C40 Cities Homepage).

The situation shows us why the measures of cities to reduce greenhouse gasses are important and how much they are responsible for climate change.

The advanced countries in terms of environment, thus, have made efforts at the level of cities to reduce the amount of CO_2 emission, as a means to respond to climate change. In Korea, lots of environment-friendly policies have been drawn up at the level of the government to reduce the amount of CO_2 emission, and the local governments have put a special emphasis on construction of green cities, in order to improve local images and the life quality of citizen. Unfortunately, there are still no cities establish more concrete and proactive measures for green city development.

Currently, the concept of ‘carbon neutal city’ is being considered in construction the Sejong city, as a measure to correspond to the international trend, ‘sustainable development’.

The purpose of this study is to set up a realizable goal of the Sejong city on the amount of CO_2 reduction and to formulate the plans to achieve the goal.

For that purpose, research into the measures to reduce the amount of CO_2 emission was conducted in such a multi-faceted way that takes into account the creation of wind ways, protection of green areas, management of energy demand, use of renewable energies, and establishment of a sustainable traffic system.

2. RESEARCH FRAME

Sejong city started its development plan since 2005 and it is planned to develop as a city for five hundred thousand citizens by 2030 as the goal for the multi functional administrative city. Korean government has also propelled in development of carbon neutal city (hereupon Sejong city) with over 70% of CO_2 reduction contrast to standard of year 1990(MACCA 2009).

In order to achieve CO_2 emission reduction targets in the Sejong city, the research was divided into the two areas as shown Figure 1.

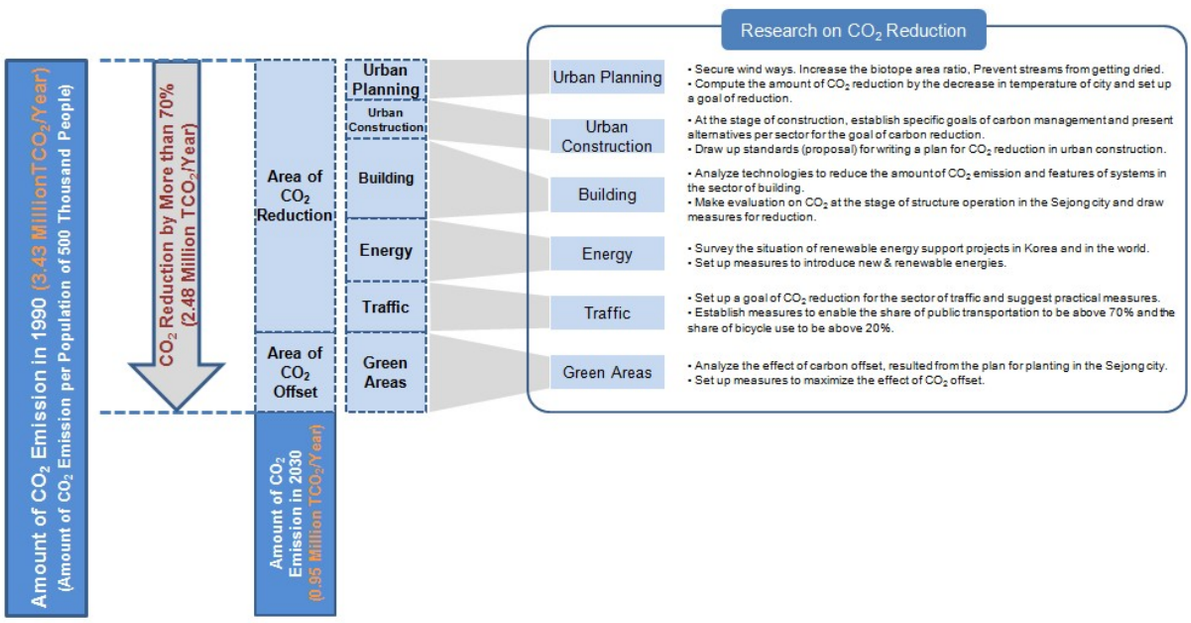

Figure 1. Research on Reduction of CO_2 Emission

That is to say, the research was divided into the two areas, (1) CO_2 reduction and (2) CO_2 offset; the area of CO_2 reduction was divided again into the sectors of ① urban planning, ② urban construction, ③ building, ④ energy, and ⑤ traffic, and the area of CO_2 offset was the sector of ⑥ green areas.

3. CO_2 REDUCTION TARGET AND MEASURES FOR REDUCTION

3.1 Sector of Urban Planning

EPA MIST(Sailor and Dietsch, 2007) was used in calculating the amount of CO_2 offset when the temperature of the Sejong city in 2030 is decreased by 3℃. The energy demand of a structure is applied a model using both gas and electricity. The mean temperatures are found in the data by Daejeon Regional Meteorological Administration, and the required number of days for air conditioning or heating was computed by the method provided in Sivak 2009(Sivak, 2009).

As a result of simulation, the CO_2 offset when the temperature of the city falls by 3℃, was calculated to be 89,466 tons in 2030.

The relevant literature was studied to find the measures to mitigate the urban heat island effect, and the methods to achieve the goal of CO_2 reduction were presented for the sector of urban planning of the Sejong city, such as wind ways, increase of biotope area ratios and prevention of dry streams. Figure 2 shows measures for CO_2 reduction in the sector of urban planning.

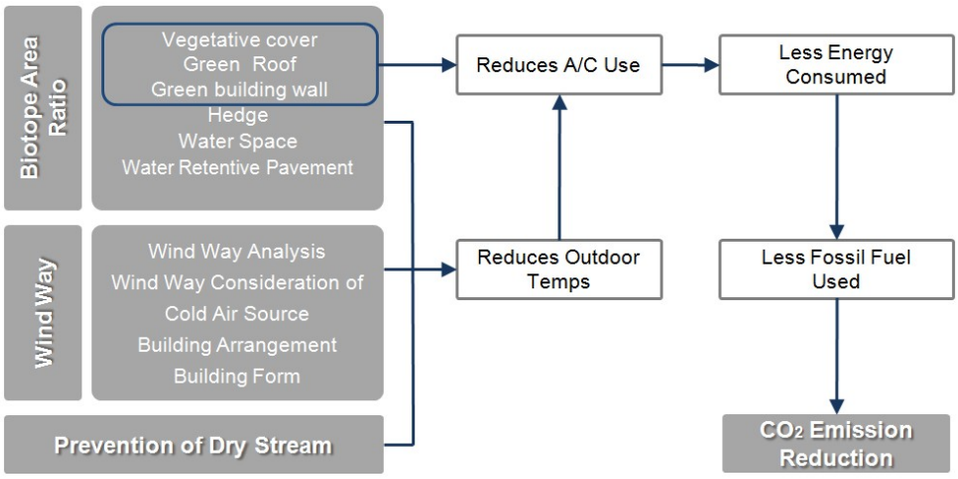

Figure 2. Measures for CO_2 Reduction in the Sector of Urban Planning

3.2 Sector of Urban Construction

The amount of CO_2 reduction in the sector urban construction was set up as 465,005TCO_2, which was calculated by applying the rate of reduction 72.6% of CO_2 emission in the sector of urban construction of standard city in1990, 640,900TCO_2. The applied rate of reduction corresponds to the rate of CO_2 reduction for realizing CO_2 reduction target in the Sejong city.

To achieve the goal of CO_2 reduction in the sector of urban construction, we recommended the making of "urban construction CO_2 reduction plan" and suggested an example plan and the measures to implement the plan.

In addition, we classified CO_2 reduction measures as to the technology to decrease CO_2 emission in urban construction and the technology for effective usage of construction waste, and proposed the measures for reduction by each of the technologies.

3.3 Sector of Building

Based on the plan for energy use (Korea land co., 2007), BAU(Business As Usual) CO_2 emission has been calculated in order to calculate CO_2 emission reduction rate for Sejong city contrasting to the emission of CO_2 by building sector of standard city in 1990. CO_2 emission BAU of 2030s Sejong city is 2,567,154 T CO_2/year.

Stages of CO_2 reduction plan has been established for above, CO_2 emission BAU of 2030s Sejong city and calculated CO_2 emission rate of 514,175 TCO_2/year in building sector of 2030 Sejong city planned(Reflected with reduction plan) as carbon neutal city. The CO_2 emission by building sector of 2030s Sejong city with 514,175 TCO_2/year contrasts to the CO_2 emission of 1,960,400 T CO_2 /year by building sector in standard 1990 city with equivalent reduction of 74% emission volume and it is equivalent to 80% of reduction in 2030 Sejong city's CO_2 emission BAU of 2,567,154 TCO_2 /year.

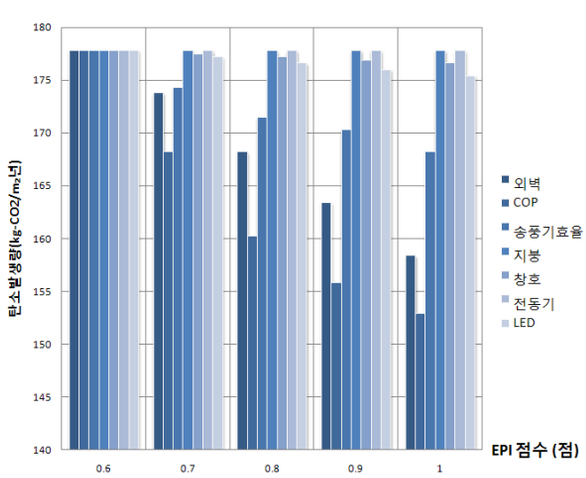

Figure 3. Amounts of CO_2 Emission per EPI Item

The building sectors in Sejong city has been organized as residential site, commercial site, and facility site, and developmental stages of CO_2 reduction rate for each service has been established into over 50% for 1st step, over 80% for 2nd step, and over 90% for 3rd step contrasting to 2030 Sejong city's building sector's stages of CO_2 reduction BAU (Business As Usual). Furthermore, in order to achieve over 50% reduction in 1st step, the buildings to be built in 1st step has been classified as 1st year(2010~2011), 2nd year(2012~2013), and lastly third year(2014~2015), and each year is set with CO_2 reduction rate of over 35%, over 50%, and over 65%.

Visual DOE was used in setting up the minimum points of EPI (Energy Performance Index) per purpose of structure, required for realizing the goal of CO_2 reduction (Figure 3).

Measure to Reduce CO_2 Emission per use of Building appears in Figure 4.

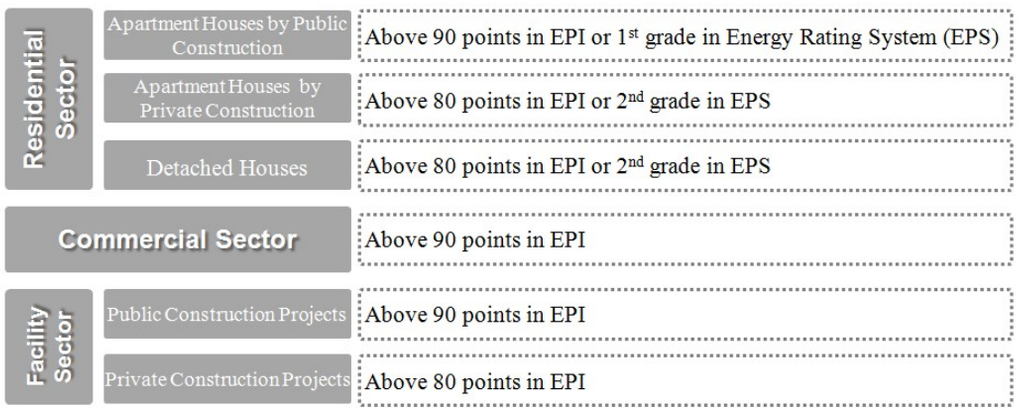

Figure 4. Measures to Reduce CO_2 Emission per use of Building

3.4 Sector of Energy

The rate of energy allotment was planned to be 15.18% for the renewable energy in the Sejong city.

The amount of CO_2 reduction by the renewable energy was calculated by subtracting the amount of CO_2 emission by the renewable energy, as much as the rate of allotment, from the amount of CO_2 emission by the existing energy sources. In case the renewable energy is contributed with 15.18% of the total energy demand, it was found to emit CO_2 of 214,231 TCO_2/year and to reduce 216,414 TCO_2/year. Figure 5 summarizes method to introduce renewable energy.

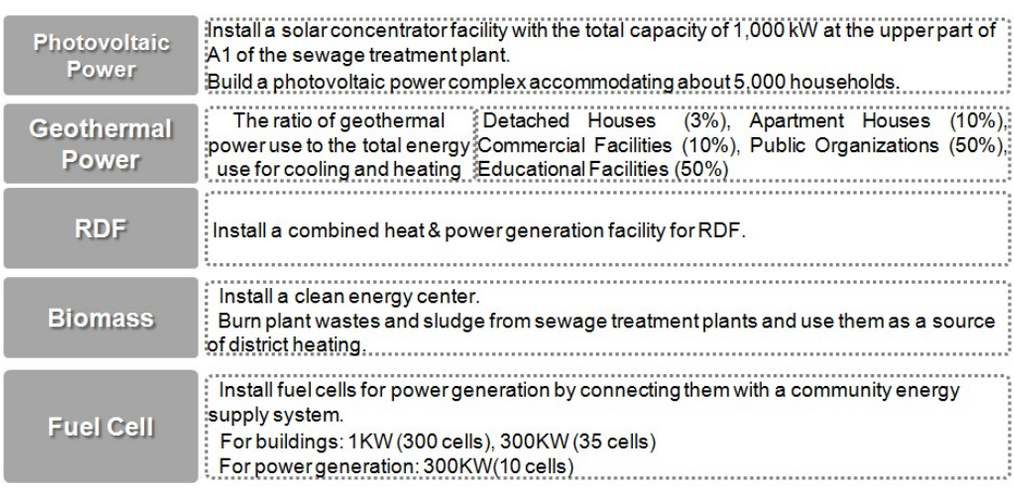

Figure 5. Measures to Introduce Renewable Energy

3.5Sector of Traffic

EMME/2 was used in deriving the future link traffic counts and link traffic velocities per vehicle, and they were applied to the formula to calculate the amount of CO_2 emission so that the yearly amount of CO_2 emission could be computed for the sector of traffic.

The amount of CO_2 emission, in case the Sejong city did not implement any measures to reduce CO_2 emission, was found to reach 1,098,345 TCO_2/year in 2030, but was 180,920 TCO_2/year in 2030 in case the city implemented all the measures for reduction. The measures were, thus, analyzed to be effective in reducing CO_2 emission by about 84%.

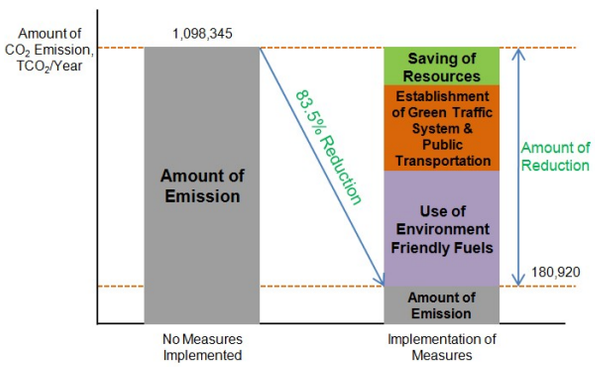

Figure 6. CO_2 Reduction in the Sector of Traffic

3.5 Sector of Green Areas

The amount of CO_2 offset by green areas was 24,287TCO_2 per year in the Sejong city (the year of 2030), and the amount of CO_2 offset by the surrounding areas was 54,062TCO2 pr year, so the total amount of CO_2 offset by the green areas in the city (the year of 2030) was calculated to be 78,349TCO2 per year.

To achieve the goal of carbon reduction at the sector of green areas, the plan for green areas in the Sejong city was described according to the following sub-divisions: 1. creation and conservation of green areas in the Sejong city; 2. a proper plan on species of trees for the city; 3. a plan for planting in the city; and 4. management of planting in the city.

4. CONCLUSION

The amount of CO_2 emission in Korea has dramatically increased. The emission by the population of 500 thousand people amounted to 3.43 million in 1990 and increased to 5.55 million in 2005.

This study estimated that the amount of CO_2 emission of the Sejong city is 950 thousand tons, which is reduced by 72% compared to 1990 and by 83% compared to 2005 (Figure 7).

If no measures were taken under the conditions of today to cope with climate change (BAU), the amount of CO_2 emission in a city with 500 thousand people was computed to reach 9.10 million tons in 2030, whereas the amount in the Sejong city was found to be reduced by 90% compared to BAU.

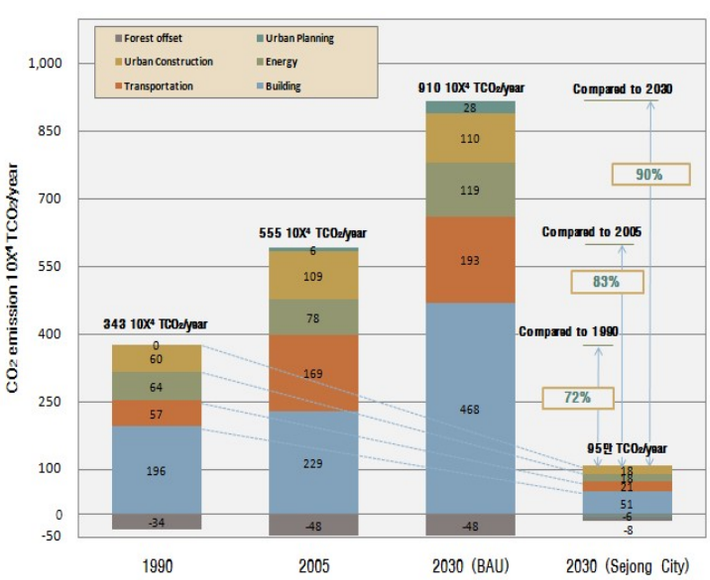

Figure 7. Comparison of CO_2 Reduction in Sejong City

This study can be regarded as the first attempt in Korea to calculate quantitatively the amount of CO_2 reduction and to suggest concrete measures to realize carbon neutal city. It is thought that the methodology of the study used in setting up the strategies for CO_2 reduction and in calculating the amount of CO_2 reduction will be helpful to further studies in the future.

The Sejong city as carbon neutral city is expected to improve the life quality of citizens by suggesting a novel residential environment as a new leading green city and to contribute to the invigoration of city by enhancing the urban brand value.

Acknowledgement

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