Development of CO2 Emission Model at The Site Level and Its Application

2010.02.20

Chan PARK, Dong-Kun LEE, Eun-young KIM
Seoul National University

Table of Contents

I . Introduction

Background

- Due to crisis of climate change and low carbon green growth policy, many local governments in Korea are making action plans to reduce CO_2 emission
- Low carbon development strategy is one of the ongoing issues to mitigate CO_2 emission that include the influence of land use change, influx of population, and any other influence factors in development site level
- However, many development plans have limitations in terms of estimating development impact on CO_2 emission and potential reduction of CO_2
- As a result, It causes difficulties in reinforcing possibilities of climate change policy, analyzing CO_2 emission reduction method, and finding the best counterparts to minimize the impact of climate change

The aim of this study

- To develop estimation model of CO_2 emission reflecting development impact and potential reduction that contain introduction of new technology, life style change, and land use scenario

- To verify model suitability at site level and review new plan’ s development impact on CO_2 emission

II. Methodology

Methodology

Overview

CO2 emission by energy consumption

Household, Commercial, Industrial

Potential CO2 reduction

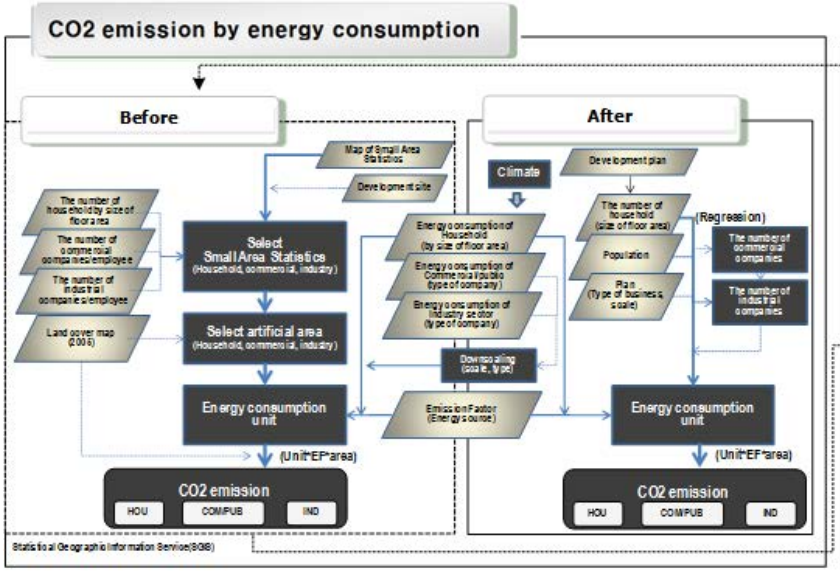
Land use change, technology, life style

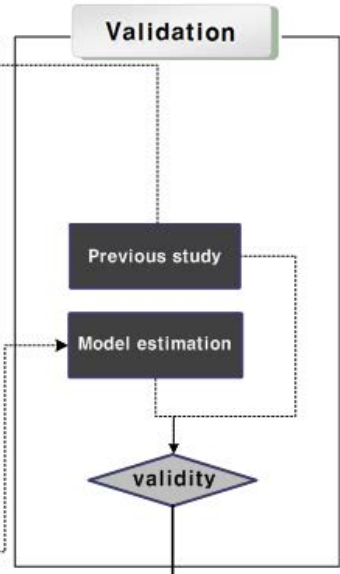
Validation

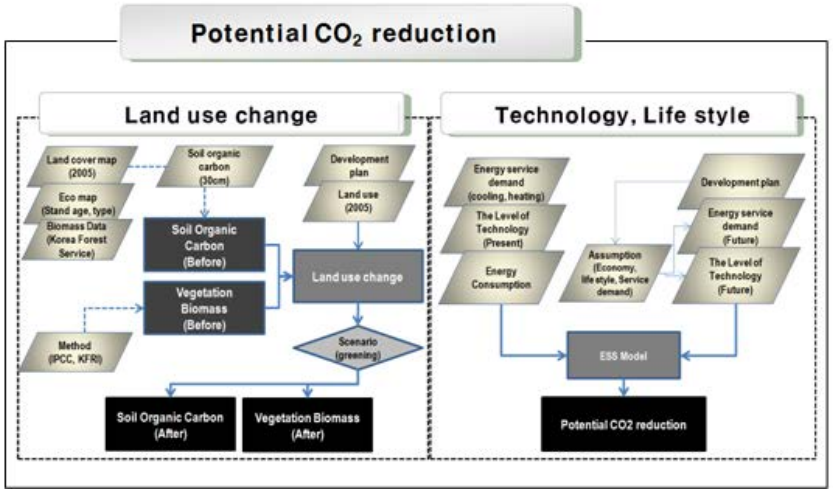
Previous study, model estimation

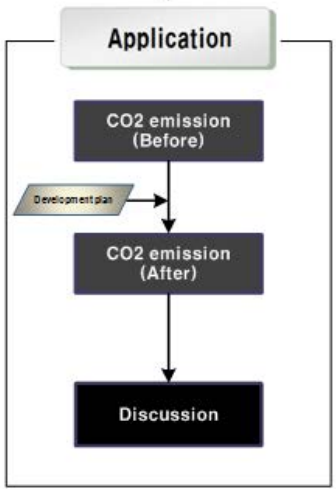
Application and Discussion

Gwachun city



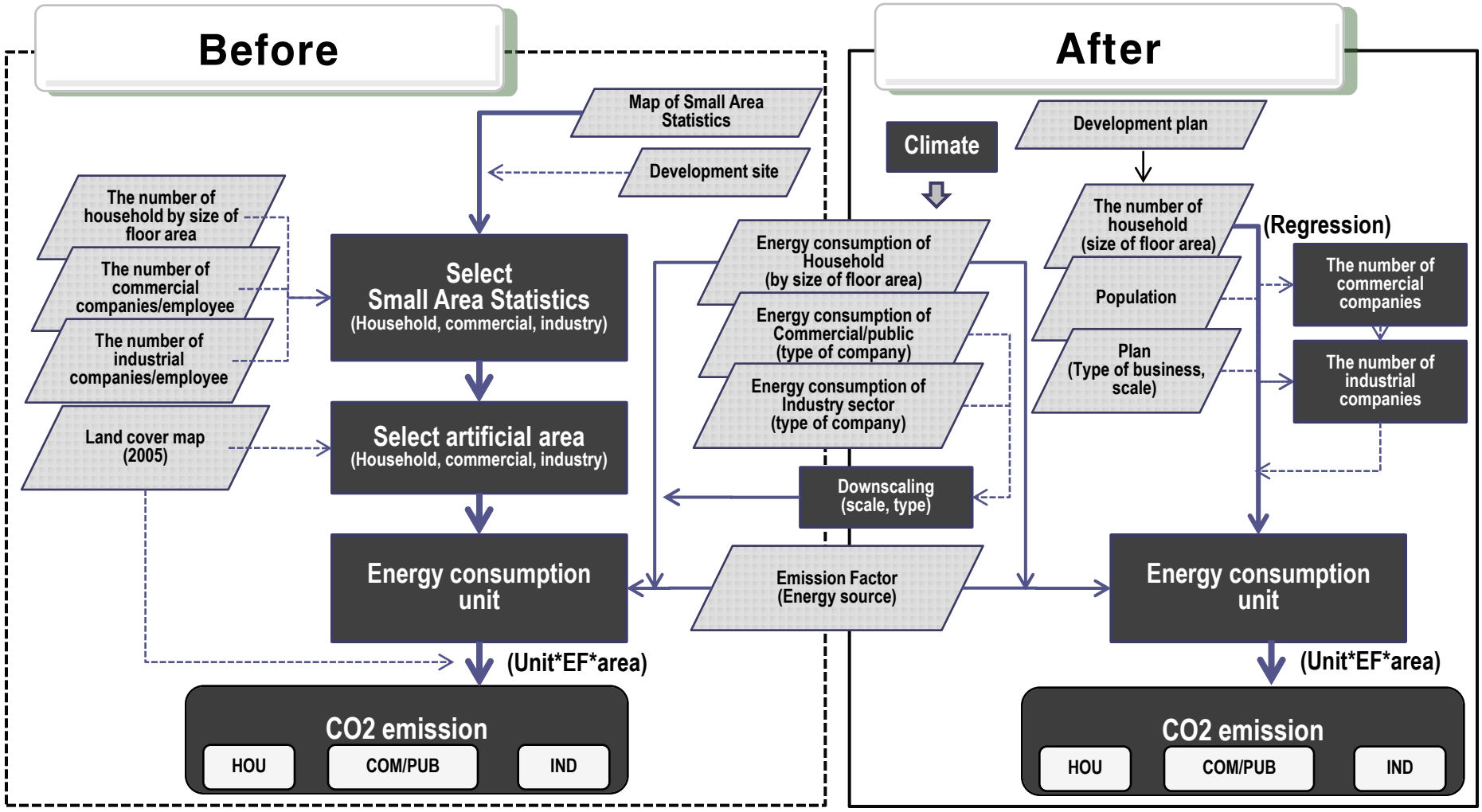






Methodology

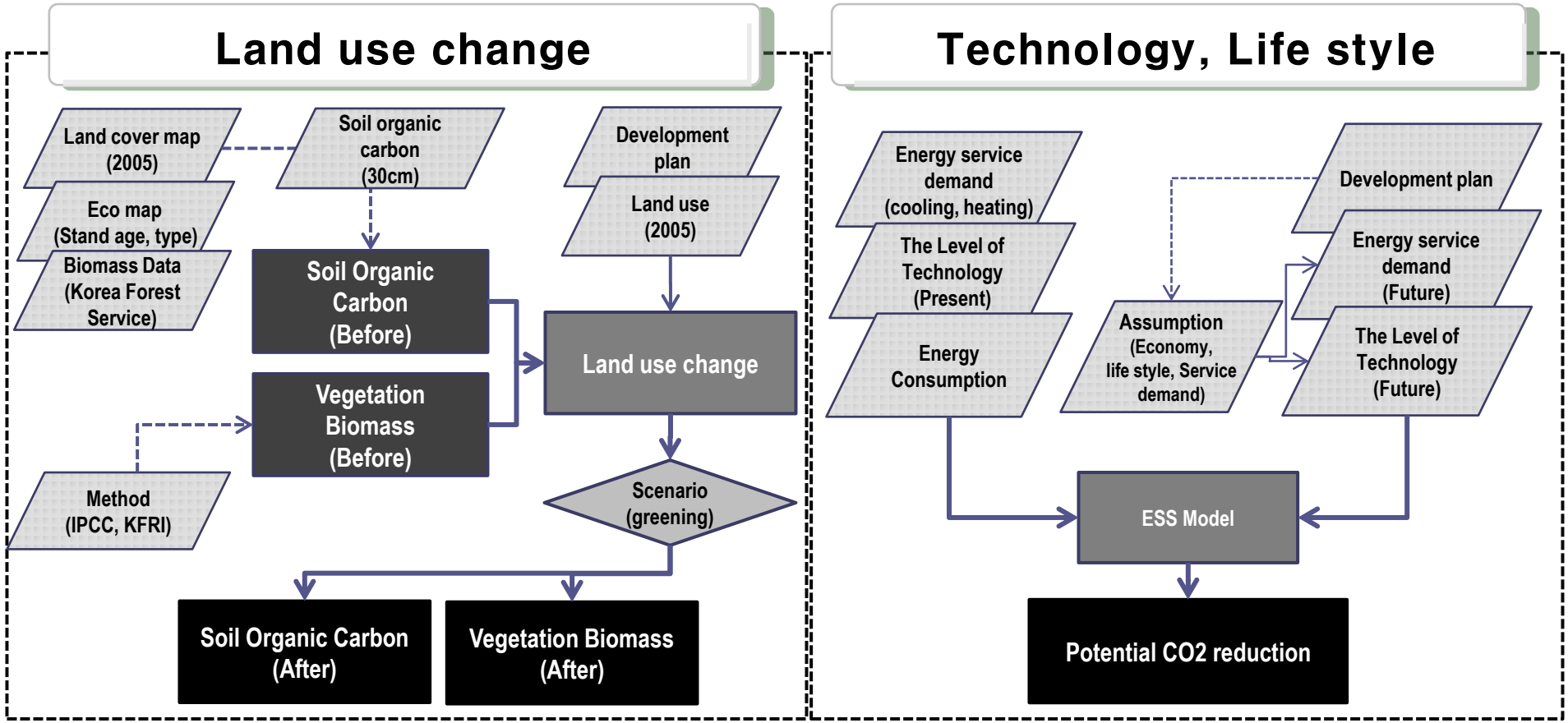
CO_2 emission by energy consumption



Statistical Geographic Information Service(SGIS)

Methodology

Potential CO_2 reduction

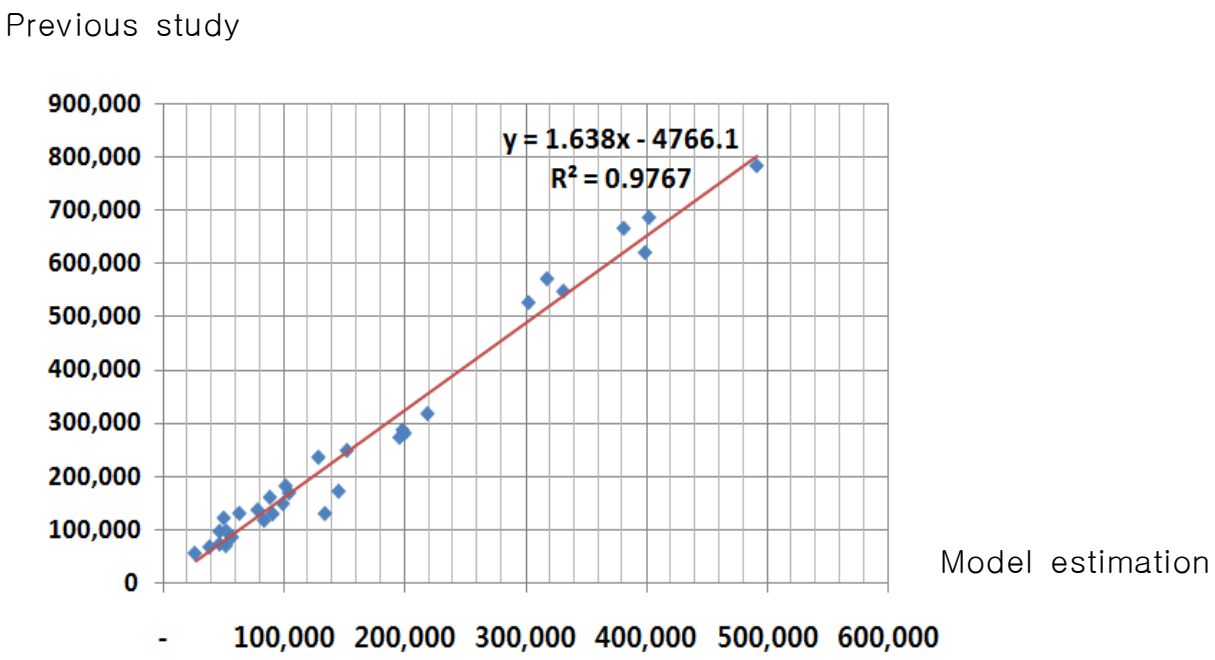


III. Model application and result

Model application and result

Validation

- There is a strong correlation between model estimation and previous study
- This model will be more precise if some data is available in national statistics database especially small business sector.

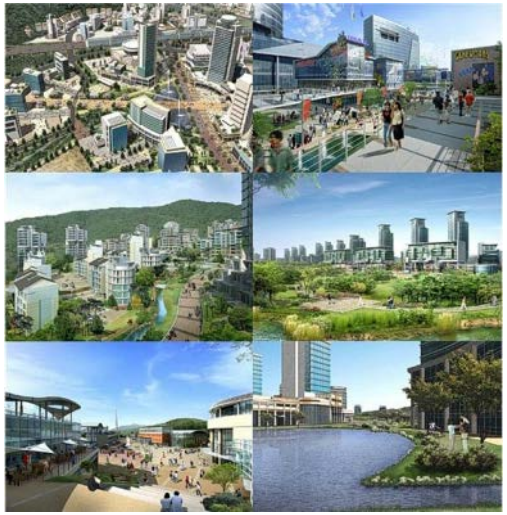


Model application and result

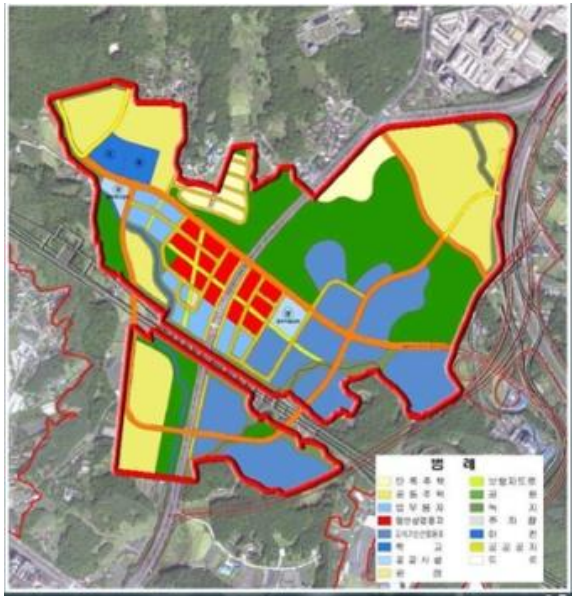
Gwachun Knowledge based Town

- Present :
  - Monwon Dong, Galhyun Dong area
  - Green belt area
- Development goal :
  - Research facilities and Household area
  - Over 25% of Park and Green Area

▲ Present Condition



▲ Images



▼ Development Plan

Type of Land use	Present (Ratio(%))		Development Plan	
	Area(㎡)	%	Area(㎡)	%
Household	82,121	6.4	294,380	23.0
Commercial/Public	5,316	0.4	84,858	6.7
Industrial		-	251,722	19.8
Road/Parking lot	124,393	9.8	195,412	15.3
Forest	160,368	12.6	-	-
Agricultural Area	842,887	66.1	-	-
Pasture	57,219	4.5	-	-
Park/Green area		-	378,437	29.7
School		--	25,000	1.9
Etc	2,136	0.2	44,631	3.6
Total	1,274,440	100.0	1,274,440	100.0

Model application and result

1) Household – Basic assumption

- We calculated CO_2 Emission of 342 houses in Study site
- We set the number of households by following development plan
- Currently, study area is rural area, but it will be changed as urban area. So in this study we used two standards for each period for calculating CO_2 emission

	Total(Housing)	Under 33㎡	33~66㎡	66~99㎡	99~132㎡	132~165㎡	Over 165㎡
Before (Small Area Statistics)	342	0	40	72	179	18	33
After (Study Area)	4,910	30	1,435	2,088	724	443	190

Model application and result

2) Commercial, Industrial – Basic assumption

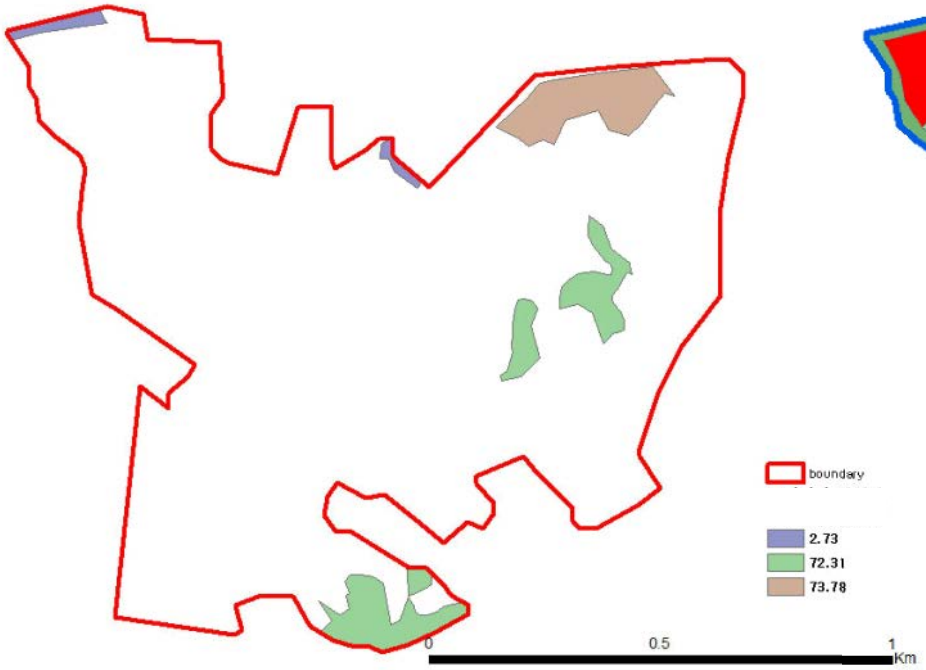
- There are 73 business facility in Gwachun City.
- Individual business facilities excluded in this study.
- Type and size of business after the development is the same as mentioned in city development plan(other part has followed average ratio of Gwachun)

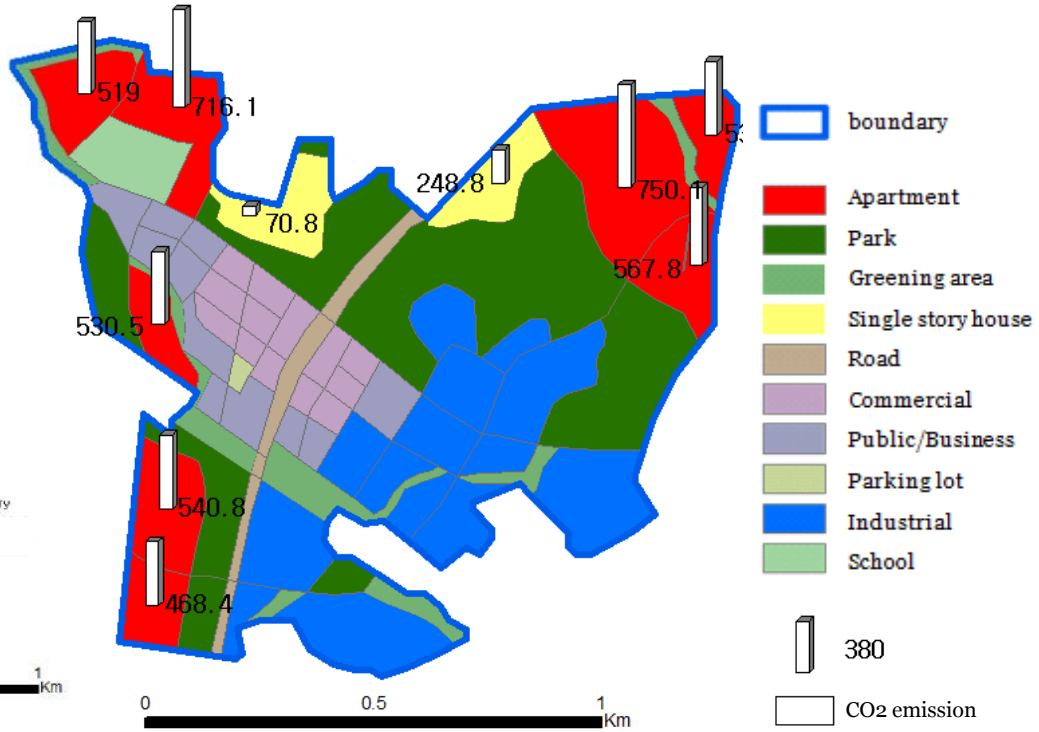
Commercial/Industrial Sectors	Before	After(Study Site)
Wholesale and retailing	18	140
Lodging and Restaurant	55	220
Communication		1
Financial and insurance		15
Real estate and leasing service		30
Business Service		100
Institutional		1
Education		48
Health and Social welfare		5
Recreation, Amusement		100
Individual Business		0
Electric, Water		0

Model application and result

1) Household Sector

- 134.7 tC of CO_2 is emitted per year before the development
- 4,946 tC of CO_2 is emitted per year by 4,910 houses after the development



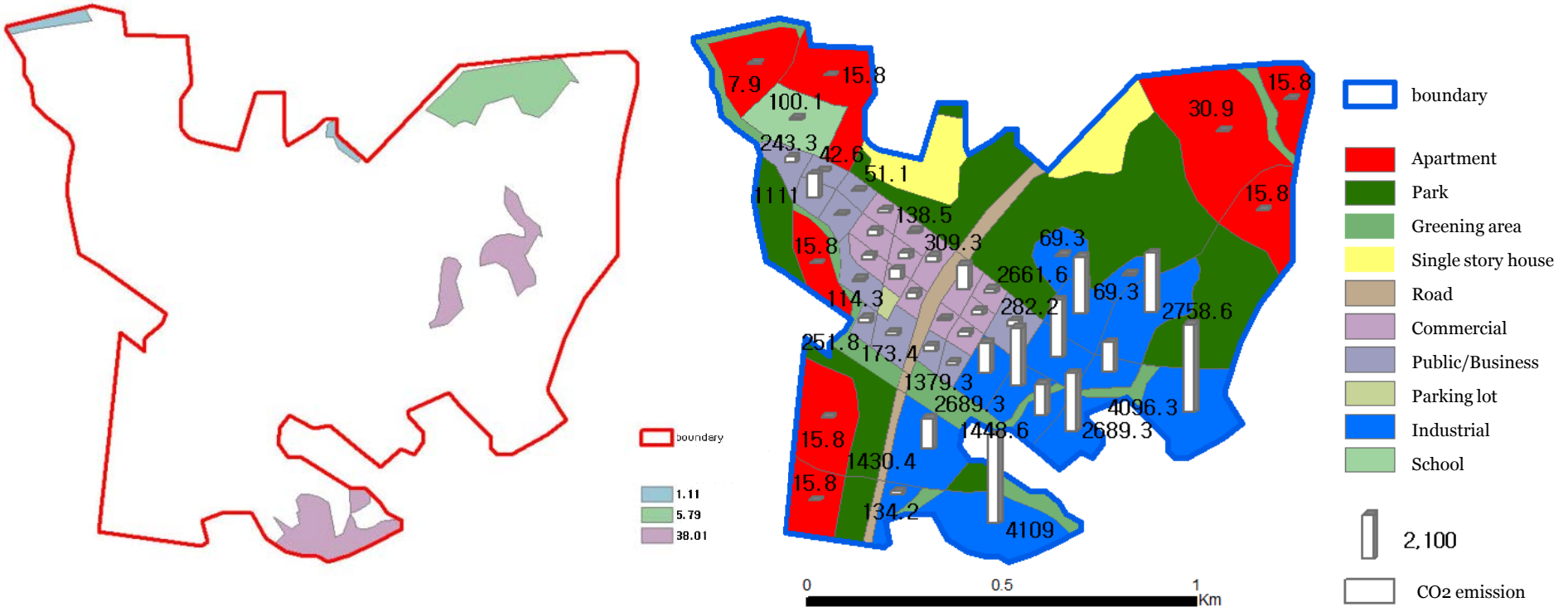


◀ Before After ▶

Model application and result

2) Commercial/Industrial Sector

- 27,576 tC of CO_2 emission will increase because of development of Knowledge based town
- According to city development plan, 6,721 tC of CO_2 will be increased per year in education, commercial, business block.



◀ Before After ▶

Model application and result

CO_2 Emission Change (Energy)

- 39,045 Cton of CO_2 Emission will increase if knowledge based town is Completed(41% of Increase based on 2005)
- It is more than 20 times of total reduction amount by forest and vegetation in Gwa-chun City
- The portion of CO_2 emission in household, commercial sector was 54.4%.
- Since development of knowledge based town, CO_2 emission in industrial sector will be increased.
- 10% of total CO_2 emission can be reduced by introducing high efficiency product

	Study Area		Gwachun city		Increase Ratio(%)	Reduction Potential (Study site)
	before	after	Before**	After		
Total Amount	179.6	39,244.0	92,387.7	131,451.1	41%	
Industrial	–	27,576.2	1,635.7	29,211.9	1,685%	551.5
Transportation*	–	–	20,573.7	20,573.7	–	
Housing/Commercial/Institutial	179.6	11,667.8	70,178.3	81,665 .5	16%	2,248.5

* Co2 emission in transportation sector has been excluded in this study

** previous study

(Unit:TC)

Model application and result

CO_2 Emission Change (land use change)

- CO_2 emission on soil is the least in scenario 1. And forest will reduce CO_2 emission 126 tC/year
- If forest areas are conserved, 208 tC will be reduced per year.
- Absolute amount of CO_2 reduction is less through carbon sink than technology advance or life style change
- But, carbon sink is useful for local governments to implement climate Policy because they can control land use change

	Carbon Emission (Total)		Reduction Potential (1 year)	Total Reduction Potential (30 Years)
	Soil	Forest	Forest	
Scenario 1	177.1	313.2 (105.4)	126.1	3,292.7 (3,500.5)
Scenario 2	1,457.1	313.2	74.0	449.7

(Unit: tC)

IV. Conclusion and remarks

Conclusion

- Gwachun city set a goal in 2009 to reduce 5% CO_2 emission until 2015
- CO_2 emission can be reduced by life style change and technology advance as well as carbon sink
- But, when development happens it is impossible to reach reduction goal by just using CO_2 emission reduction policies.
- To make low carbon city, there should be holistic approach in city level
- Policy should be shifted from the expansion of urban areas for the stimulation of economic growth to the increase of available land through the renewal of existing urban areas and increasing the efficiency of space to reduce CO_2 emission
- Taking into account social and economical constraints, afforestation program is becoming a more attractive mitigation option to decision makers

Conclusion and remarks

Remarks

- This method can be used for supporting decision making process for making development plan
- If development plan is not detail, there should be some assumption to estimating future emission. It may cause uncertainty in calculation of CO_2 emission
- This model is useful if it adds transportation sector, technology, life style change, natural carbon sink for further study

Suggestion

- The success of reduction target is only possible with strong and effective implementation at national and local level

Thank you for your attention!