



Global
Green Growth
Week 2016

Green City Planning & System

Experience in Korea

2016. 9. 7



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국토연구원

Research Fellow
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1. What is Green City ?

Green City Planning Strategies

Reorganization of urban spatial structure

- Analyzing problems of existing space structures such as the industry and features, land use distribution and energy demand
- Transportation systems and strengthening links
- Realize a minimal fossil fuel consumption
- Preservation of the existing green network
- Planning and analysis with transportation network
- To prevent urban microclimate composition and urban heat island effect

Land Use and

Construction (Buildings)

- Suggest land use planning to reduce energy consumption and Carbon emissions through location analysis
- Propose land use plan on type characteristics of new renewable energy
- Plan of the public open space based on the way the wind passages, such as the composition for the urban heat island relaxation phenomenon

New renewable energy

- Establish alternative energy supply facility plan
- Establish industrial energy demand management Plan in conjunction with Population, land use and industrial demand

Transportation

- Establish a transport-specific distribution plan to reduce energy consumption and carbon emissions from transport sector in the traffic estimation and review plans for the placement and size of the functional road
- Transit, biking, walking in the center of the green transportation system
- Transportation energy consumption derived (rail, parking and infrastructure are connection)
- Complex facilities Plan (user convenience, energy consumption reduction)

Urban Park · Green Space

- Establish Urban park & Green Space Planning in connection with wind path planning
- Establish management strategies of parks and green spaces by product

Waste Management · Resource

Recycle

- Establish reasonable waste disposal plan to predict emissions and types of municipal waste and industrial waste
- Consider Reduction, re-use and recycling plan for the Carbon Emissions Reduction

Green City model applied using energy technologies



- Convergence of renewable energy, energy efficiency and building energy technology
- Seek greener city through the House Energy and CO2 Zero

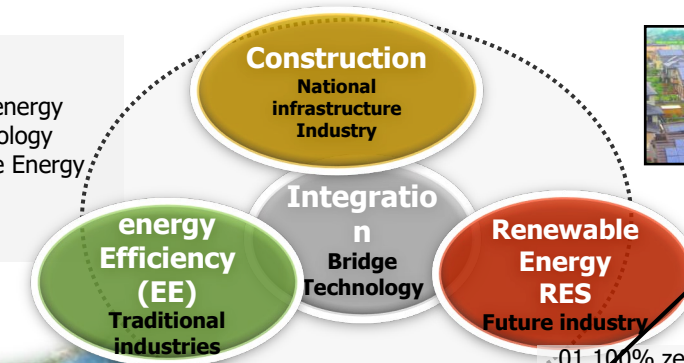
05. integration design technology:
Renewable energy technology integration technology of public buildings and commercial buildings
(BIPV Building Integrated Photovoltaic, BiWP small building integrated wind power, BiST building integrated solar thermal, etc.)



07. building energy-saving core technology development:
(Vacuum insulation panels, vacuum windows, LED lighting technology, Heat recovery, etc.)



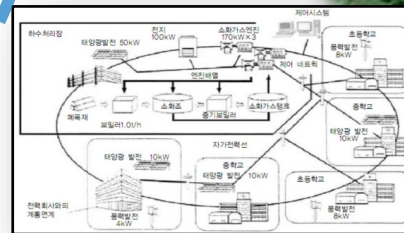
04. central supply system of renewable sources
(Solar, bio, cogeneration district heating, geothermal)



01. 100% zero-energy house:
Only the supply of natural energy without fossil fuels within the housing to cover all energy houses
(Renewable+System, various building energy-saving technology, heat recovery, passive solar, backup systems)



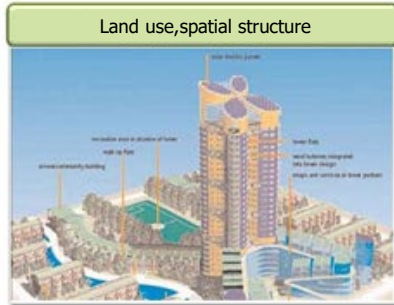
02. Zero Energy Community (Town) :
Configure the form of a certain size to set the zero-energy house
(Introducing renewable energy in the thermal and electricity supply system)



03. Micro CHP :
Renewable conjunction with small cogeneration systems technology

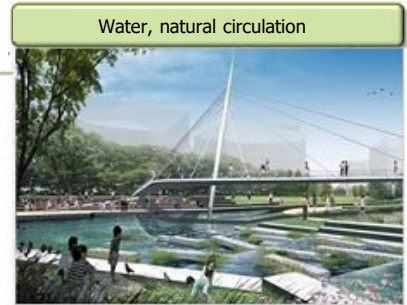
06. The integration of green building:
Solar collectors, photovoltaic modules should be used as building cladding can be applied effectively

The Conceptual diagram of Green City



Multiple land used for building low-carbon urban spatial structure

Carbon reduction through the composition of water and nature circulation a hydrophilic space



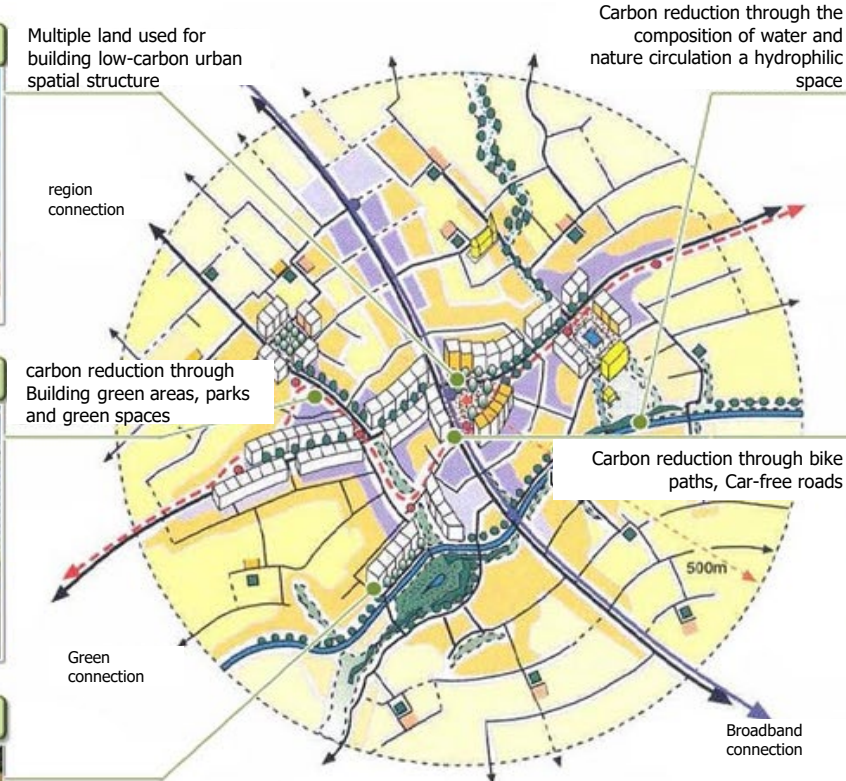
carbon reduction through Building green areas, parks and green spaces

Carbon reduction through bike paths, Car-free roads



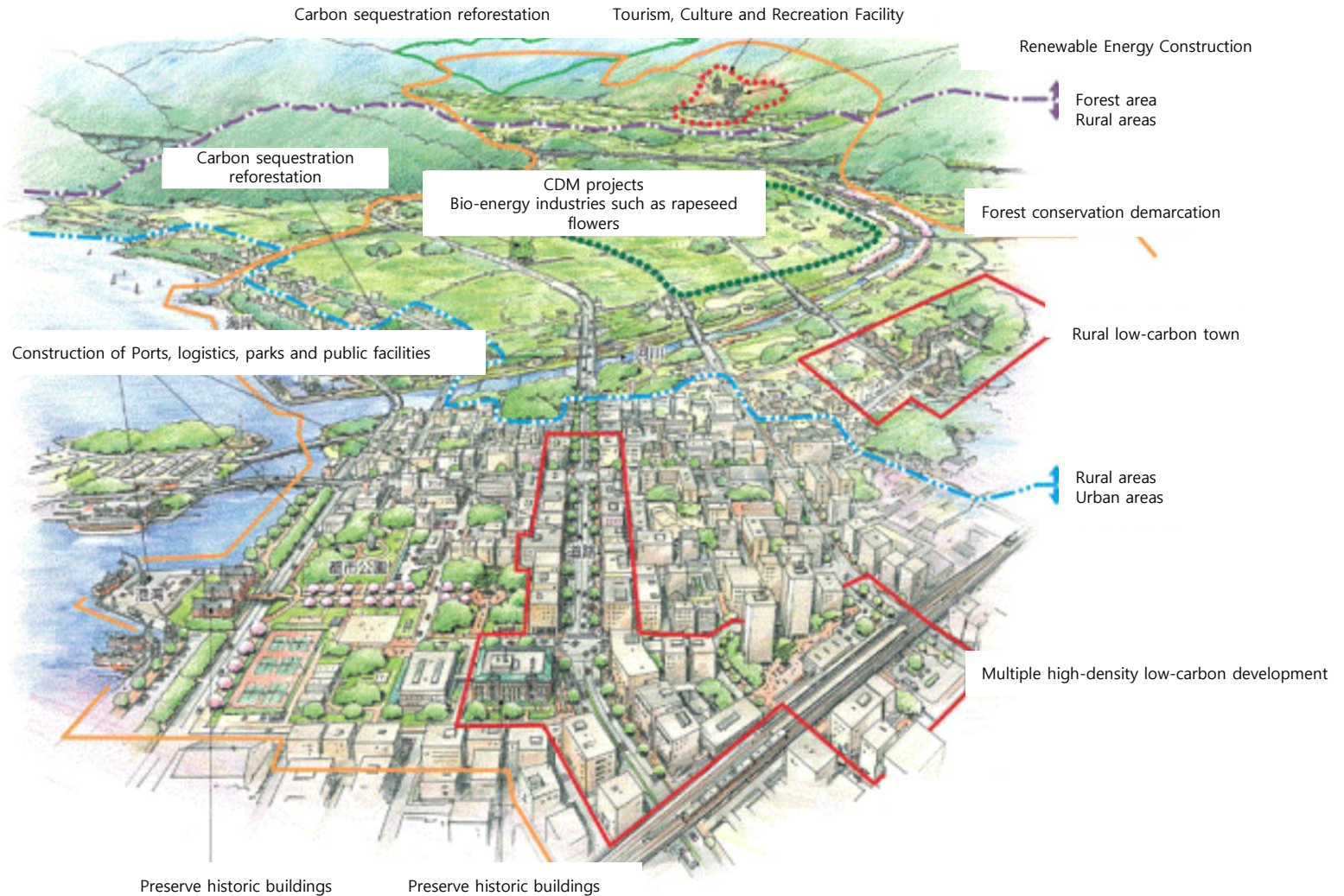
Carbon reduction through renewable energy, green home, etc.

Constructs carbon reduction system through green consumption and green start, public practicing sports



- 철도
- 복합용도
- 버스(대중교통)
- 고밀주거
- 자전거보행자로
- 저밀주거
- 접근로
- 근린센터광장
- 지구광장
- 친수공간

The Model of Green City



2. Korea's Low Carbon Green Growth Policy : National Level

Chronological List

- 2008. 08. 15: Suggest 'Low Carbon Green Growth' as a national vision
- 2009. 02. 16: Establishing Green Growth Committee as a presidential advisory body
- 2009. 07. 06: Establishing 1st Green Growth National Five-Year Strategies (2009~2013)
- 2009. 08. 24: Legislating Urban Planning Guideline to establish low carbon green city
- 2009. 11. 17: Establishing National Greenhouse Gas Reduction Target in 2020
(30% reduction compare to BAU)
- 2010. 01. 13: Legislating Low Carbon Green Growth Law
- 2010. 04. 14: Implementing Low Carbon Green Growth Law
- 2014. 06. 03: Establishing 2nd Green Growth National Five-Year Strategies (2014~2018)
- 2015. 06. 30: Establishing national greenhouse gas reduction target in 2030
(37% reduction compare to BAU)

Green Growth & Spatial Planning
related legislation

Low-carbon Green Growth Act

National Strategy for
Green Growth

Five year plan for
Green Growth

National Land Planning and
Utilization Act

Comprehensive National
Territorial Planning

Basic Urban Plannin

Policy Direction of
Green City

Korea's Legal and Institutional Systems

Low-carbon Green Growth Act

The Low-carbon Green Growth Act is a comprehensive definition on green concept including land, city, building, transformation and lifestyle.

This law aim to

- Introduce a climate change & energy management regulation and CO2 emission trading schemes for the green energy industry
- Generate green territory and create green economy

Transform the current fossil fuel-oriented economic system within environmental improvements

Establishment of a special presidential advisory group, Green Growth Board

Enforcement of plans on green economic growth, climate changes, energy and sustainable growth (20 year plans revised every 5 years)

Promotes green management of businesses, eco-friendly taxation, tax cut on green businesses, GHG reduction

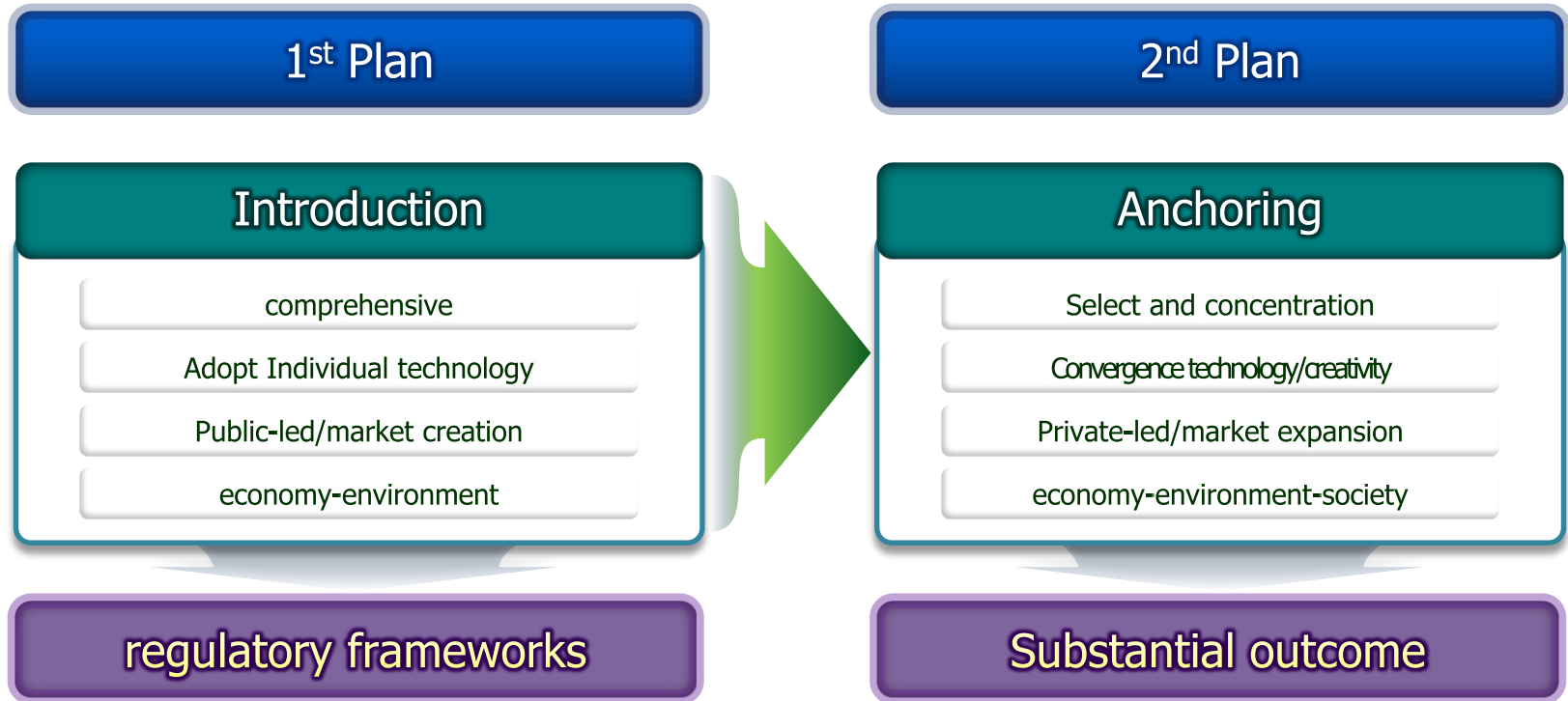
Cope with climate change & manage energy consumption for contribution to global GHG reduction efforts & setting long term yearly reduction goals

As the Korea's Low-carbon Green Growth Act, the government of developing countries are necessary to designate related regulations such as energy use laws, recycle energy promotion law, sustainable development act...etc.

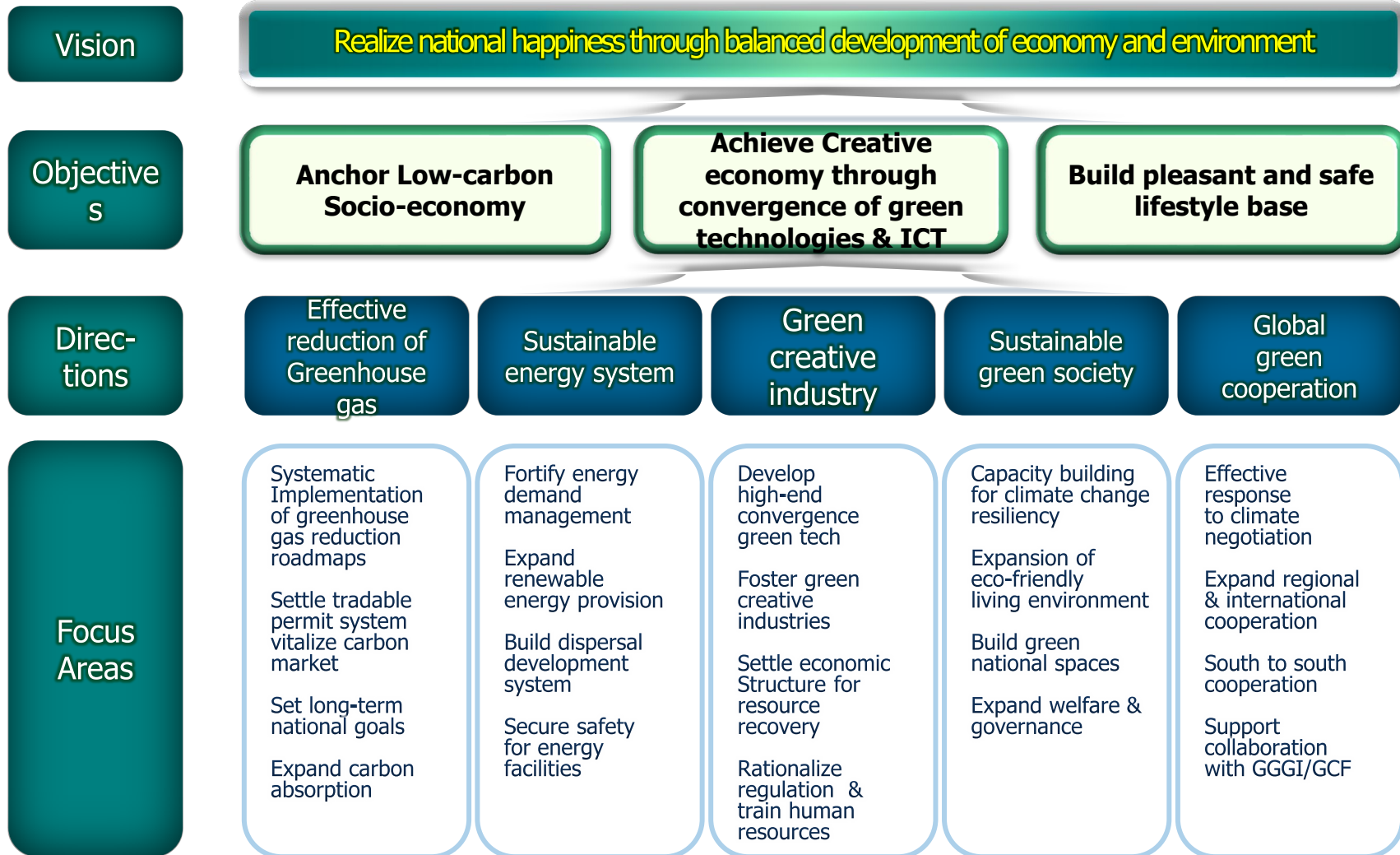
- green building
- green transportation
- low-carbon transportation system

Five Year Plan for Green Growth

- July 2009 : prepared 「National Strategy for Green Growth」 & 「1st 5 year Green Growth Plan('09~'13)」
- June 2014 : termination of 1st Plan & launching of 「2nd 5 year Green Growth Plan ('14~'18)」



Five Year Plan for Green Growth(2nd)



✓ **Urban Planning Guidelines for Low-Carbon Green Growth**

- Ministry of Land, Infrastructure and Transportation announced
"Urban Planning Guidelines for Low-Carbon Green Growth."(July, 2009)

To Deals with standards, evaluation, predictions and countermeasures concerning the application of low-carbon green growth concepts to urban planning factors

Overview of MOLIT's Urban Planning Guidelines for Low-Carbon Green Growth

▶ Institutional / regulatory foundation to deal with climate change influences on urban planning

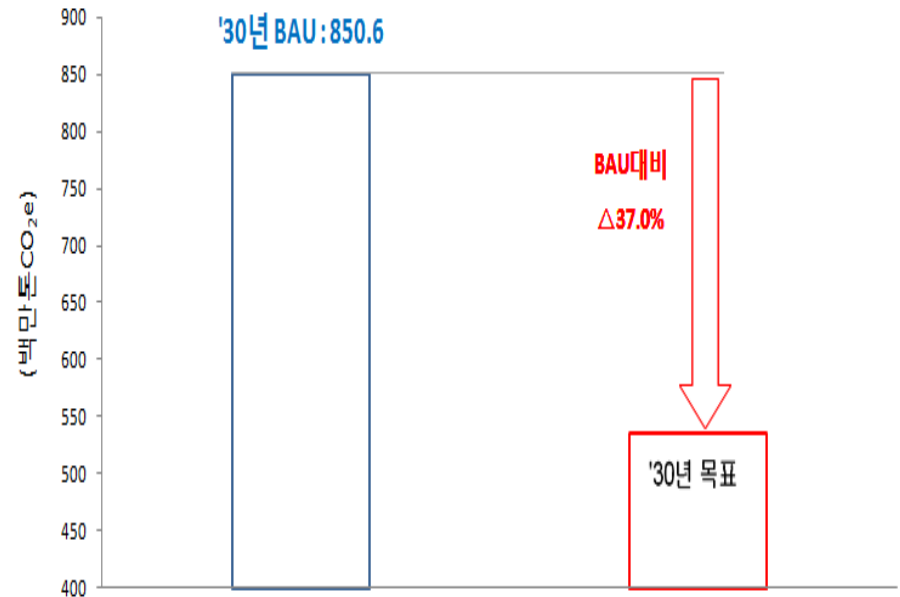
▶ Reducing greenhouse gas by figuring out the current emission volumes

▶ Evaluating energy efficiency of plans on the land use unit basis

※ **Features :** ① **Time-Frame** ② **Target** ③ **Measurability** ④ **Feasibility**

○ Targets for reduction greenhouse gas of Korea

- Targets to 2020: Suggesting the mid-term goal in 2009 to reduce 30% of greenhouse gas compared to the estimated emission, Business As Usual (BAU)
- Targets to 2030: Suggesting the regulation upward in June 2015, that reducing the 37% of greenhouse emission compared to the estimated BAU



3. Korea's Low Carbon Green Growth Policy : Local Government Level

Commitment of Seoul to respond the climate change

Vision

Realizing the resilient Low-carbon City

Objectives

Reducing the 4,500 thousand TOE energy consumption and 15 million ton of greenhouse gas by saving the energy

Supply the 10% of new renewable energy in total energy consumption

Maintaining the ultrafine dust(PM2.5) concentration to $15\mu\text{g}/\text{m}^3$

Establishing the safe and attractive public transportation infrastructures for comprehensive management

Increasing the living waste recycling rate to 75%

Increasing the recycling rainwater amount to 1 million ton

Expanding the green spaces more than 30% compared to 2015

Expanding the urban agricultural space 10 times compared to 2012

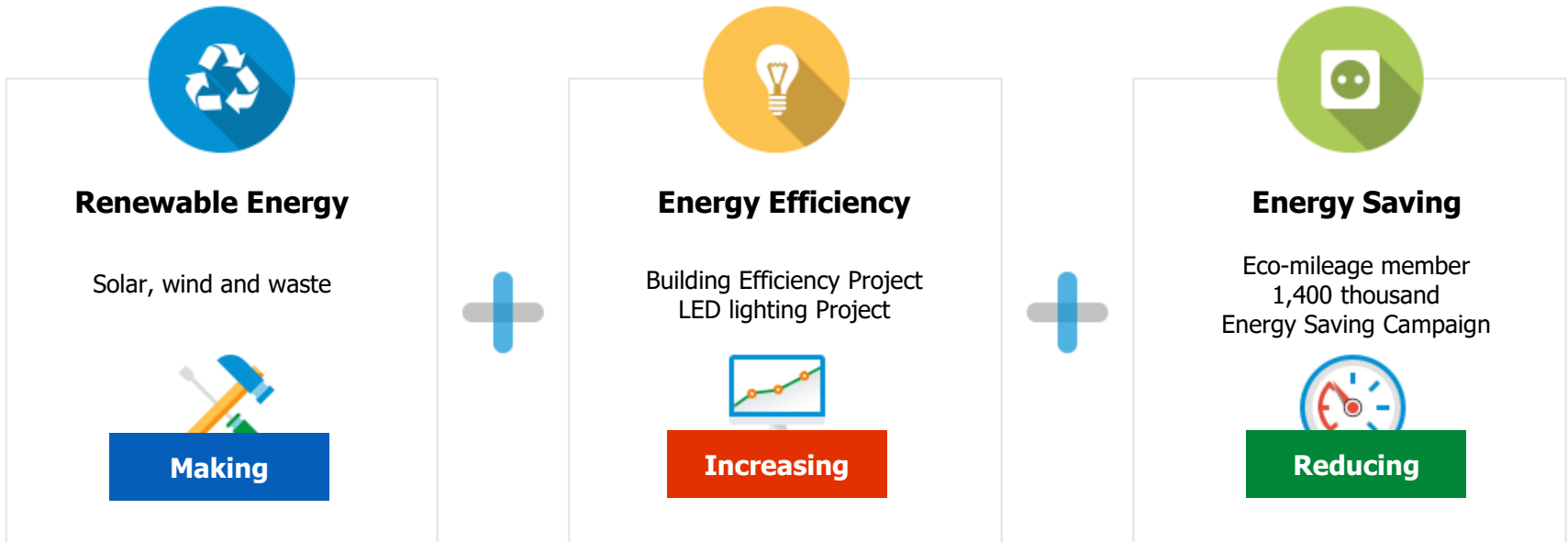
Reducing the premature death rate to 40% compared to 2013

Reducing the areas prone to floods .

One Less Nuclear Power Plant - Seoul Metropolitan Gov.

- Concept :

The flagship energy policy launched by Seoul to respond to climate change and energy crisis. The main target of this policy is to cut energy consumption by 2 million TOE, which is equivalent to the capacity of one nuclear power plant, mainly by directly engaging citizens in energy-saving and renewable energy generation.



Seoul Sustainable Energy Action Plan (One Less Nuclear Power Plant Phase 2)

- Concept :

The flagship energy policy put in place by the Seoul Metropolitan Gov. This action plan is to produce clean energy, saving energy and improve energy efficiency with citizen.



Energy Independence

- Preparing to be Energy self-sufficient city
- Producing safe and sustainable renewable energy
- Enhancing energy industry and job industry



Energy Share

- Sharing the energy resource with vulnerable social group and future generation
- Improving the energy production and consumption with other regions by cooperating together



Energy Engagement

- Establishing energy governance for energy policy and implementation
- Establishing systems for enhancing volunteer engagement and opening policy

Seoul Sustainable Energy Action Plan (One Less Nuclear Power Plant Phase 2)



Solar generation city
by citizen



Renewable Energy,
Distributed power
12% →20%



Opening Building
Energy Consumption
and Introducing Saving
Model



Changing Street
lighting to LED (100%)



Driving Mileage
(1,410 thousand cars by `18)



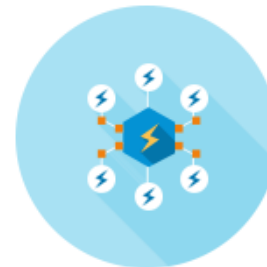
Establishing Energy
governance for
citizen engagement



Improving Energy Efficiency
Project for sharing



Reusing the energy in
village units and
creating job for seniors

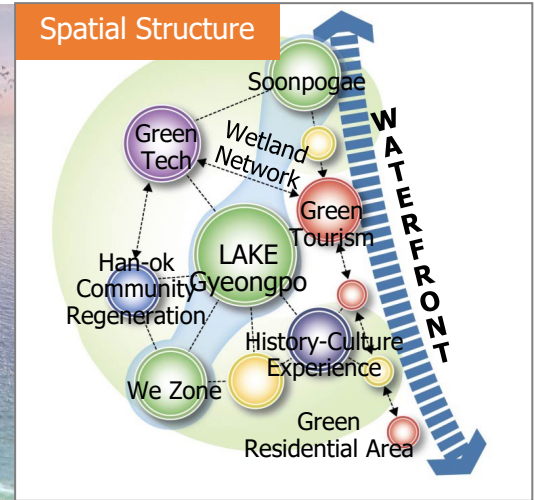
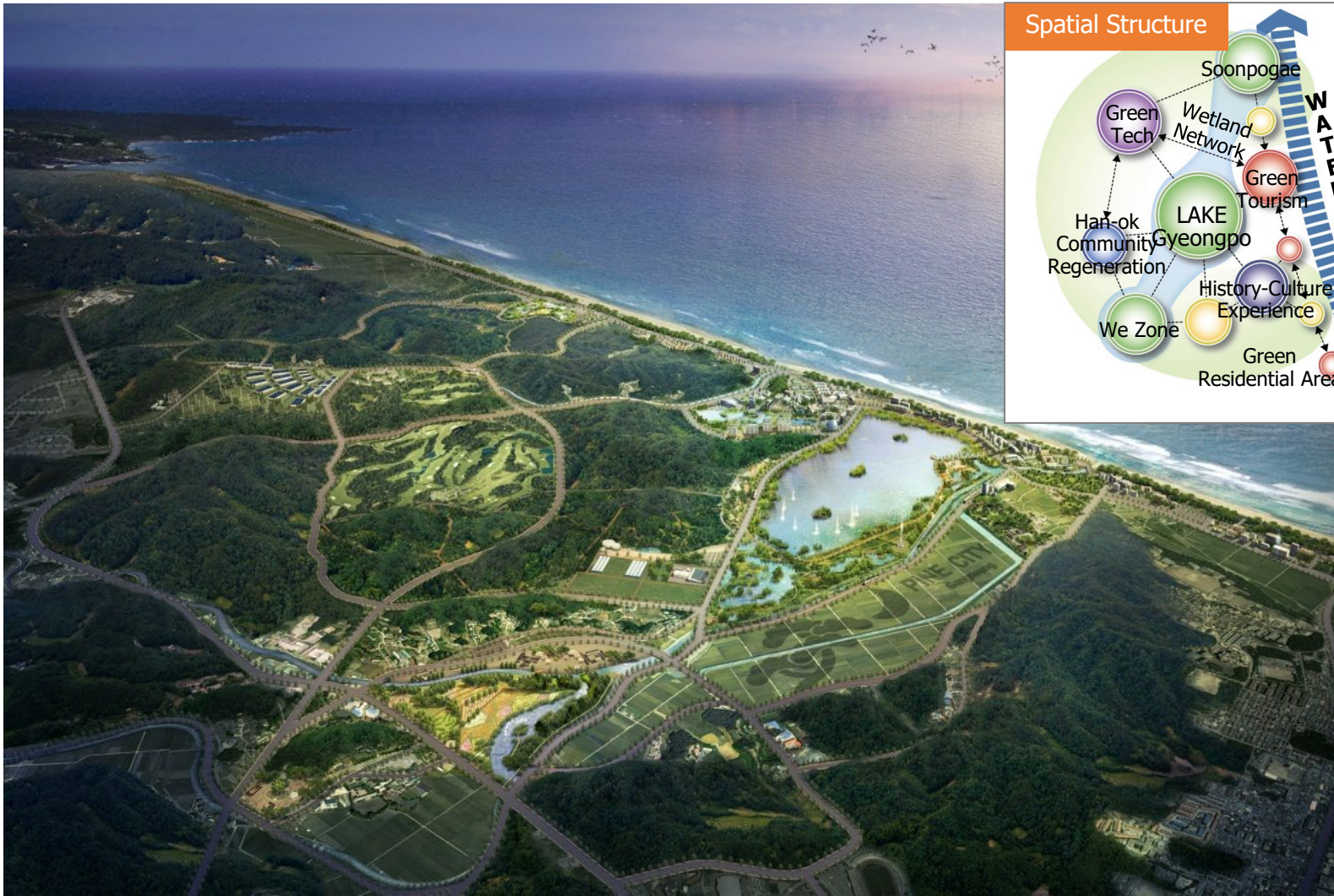


Energy New Industries

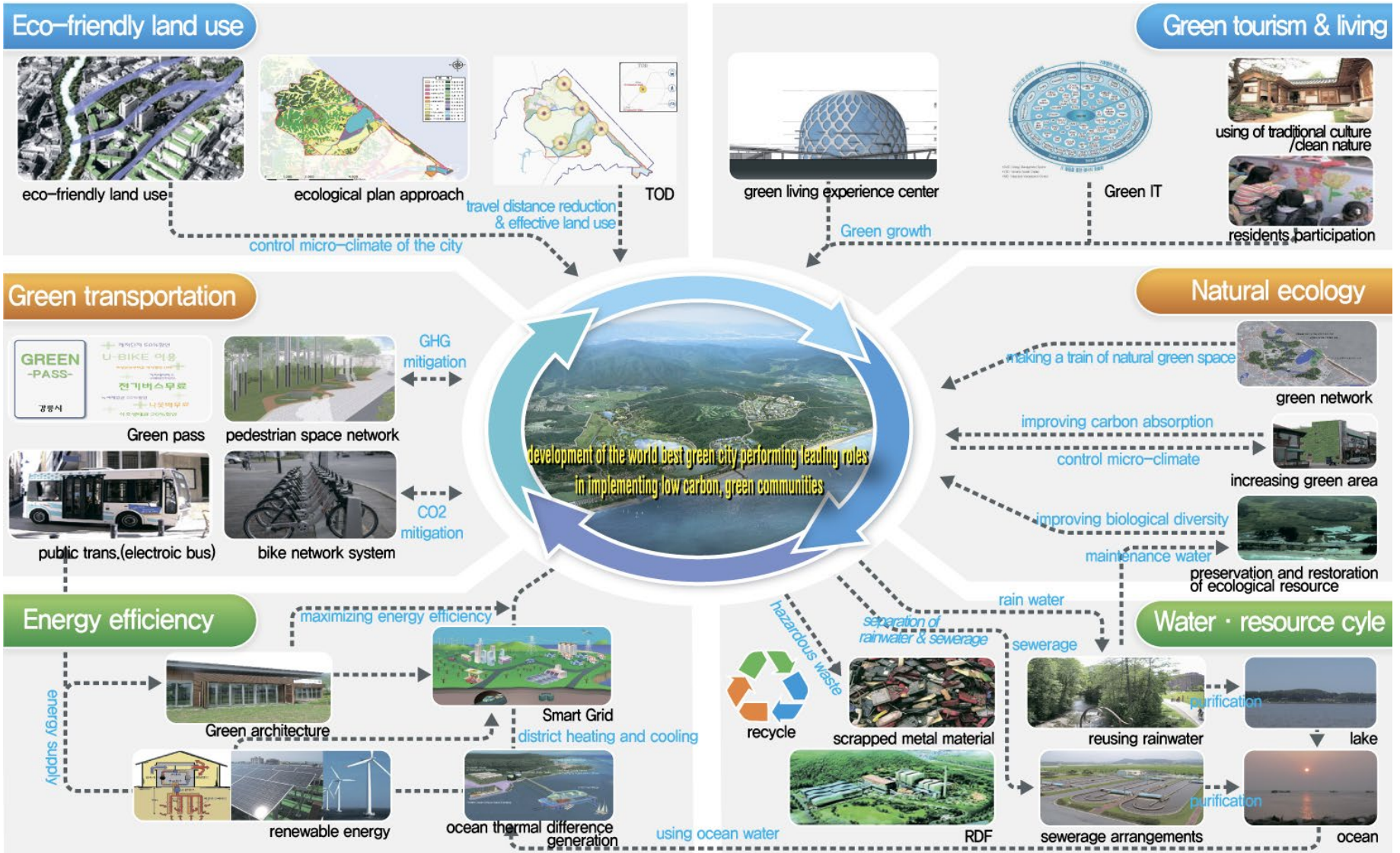


25 Energy Hub Centers
Creating new jobs in
service

❖ Gangneung City - Green City Development



❖ Gangneung Green City Development : Green City Model

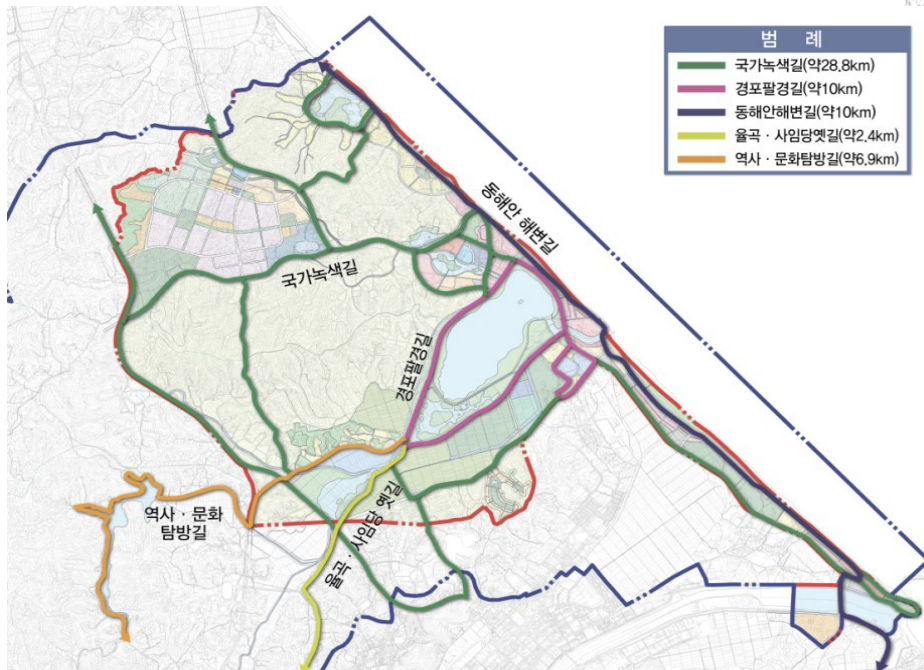


❖ Gangneung Green City Development : Sub Project

Phase 1 (2009 ~ 2013) : 9 Projects (\$ 90 million)

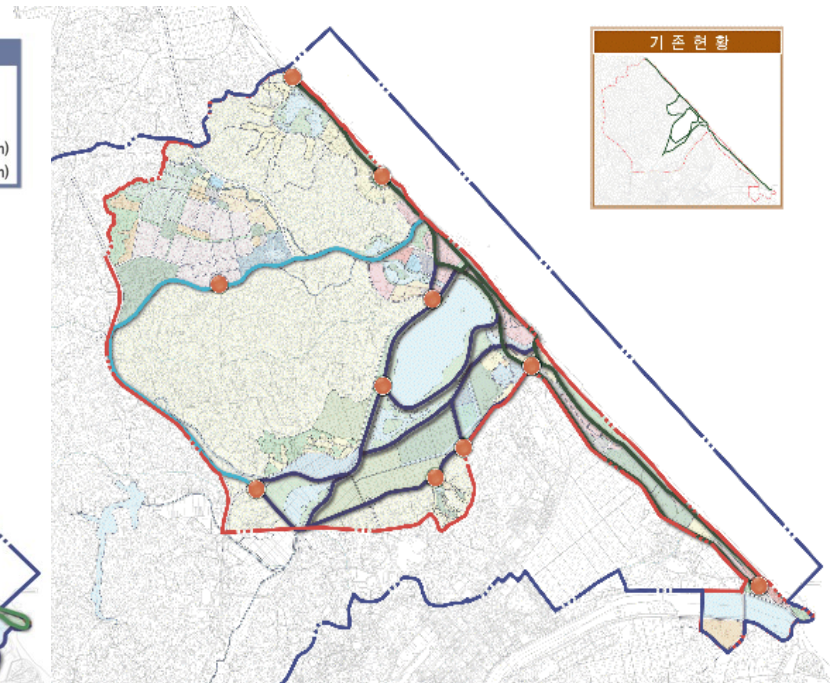
Green Road

● Walkable Historical Pedestrian Pathway : 28.8km



Bicycle City

● Transportation Mode Shift : 31.2km



❖ Gangneung Green City Development : Sub Project



Ecological Wetland Restoration

● Farmland → Ecological Wetland : 290,000m²



Ecological detention pond

● Prevent Flooding River : 267,000m²

❖ Gangneung Green City Development : Sub Project

Solar and Wind Power for terminal disposal plant of sewage

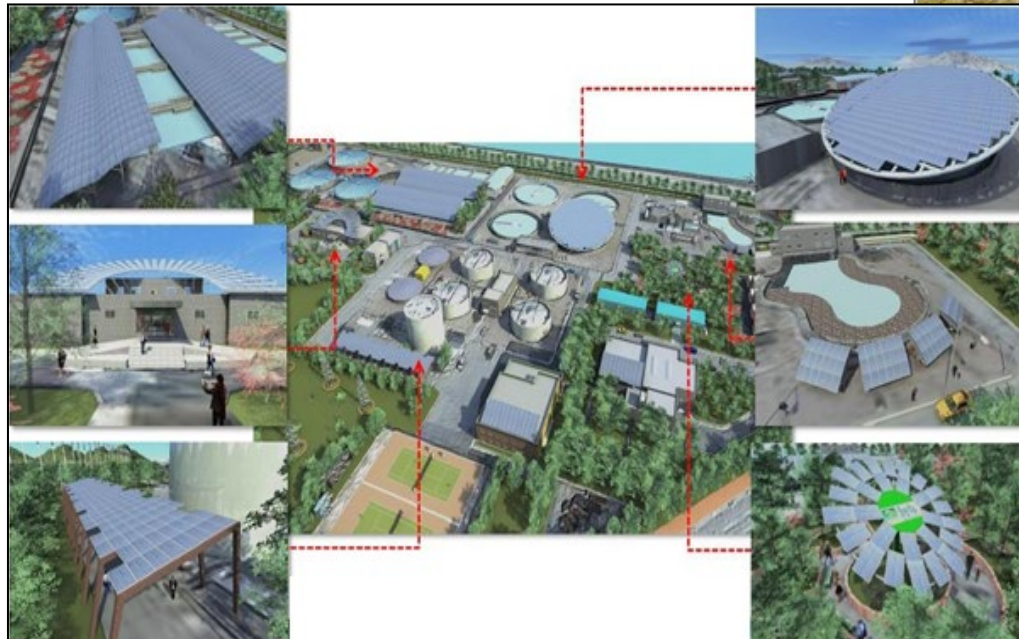


Solar Power

500kW / 8000m²

Wind Power

100kW / 500m²



Water Recycle System

Sewage

20m³/day

Fire Water

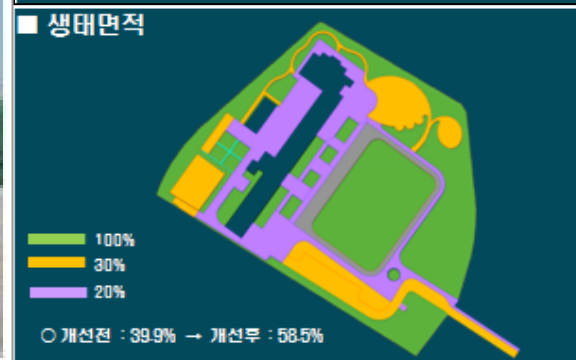
Rain

80m³/day

Restroom, Washing

❖ Gangneung Green City Development : Sub Project

Low Carbon Elementary School



❖ Gangneung Green City Development : Sub Project

Plans to Apply Green Technology (6 green technologies & 68 factors)

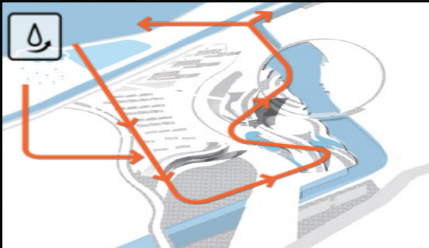
Green City Landmark Project



Eco Green/Wet Land (6)



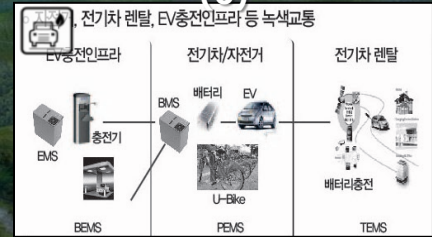
Water/Resource Circulation (8)



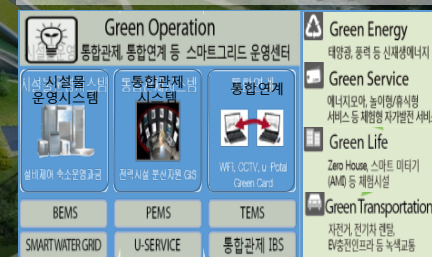
New/Recyclable Energy (6)



Green Transportation (6)



Smart Infra (5)

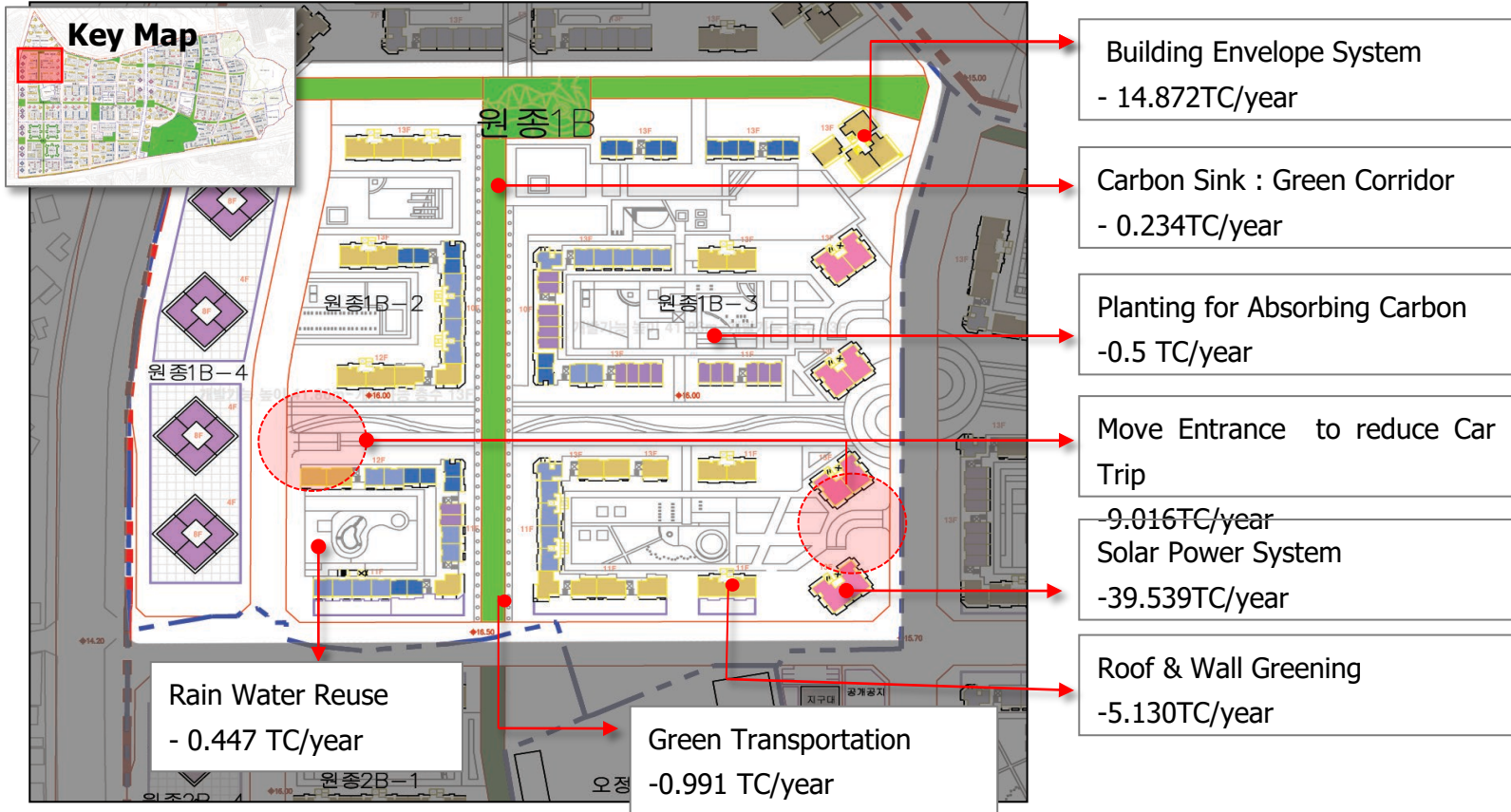


Green Construction (37)



❖ Bucheon City – Low Carbon City Redvelopment for Gogang District

CO2 reduction potentiality for 1B-2 & 3 Block : 70 TC(259 T CO2)/year



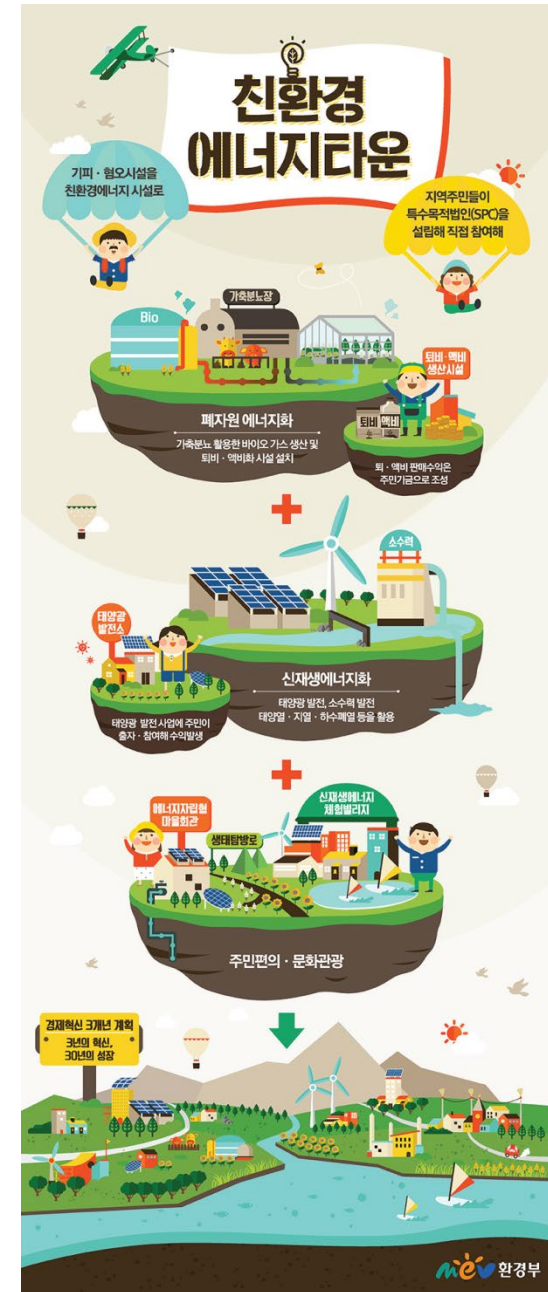
3. National Pilot Project: Eco-friendly Energy Town

The concept

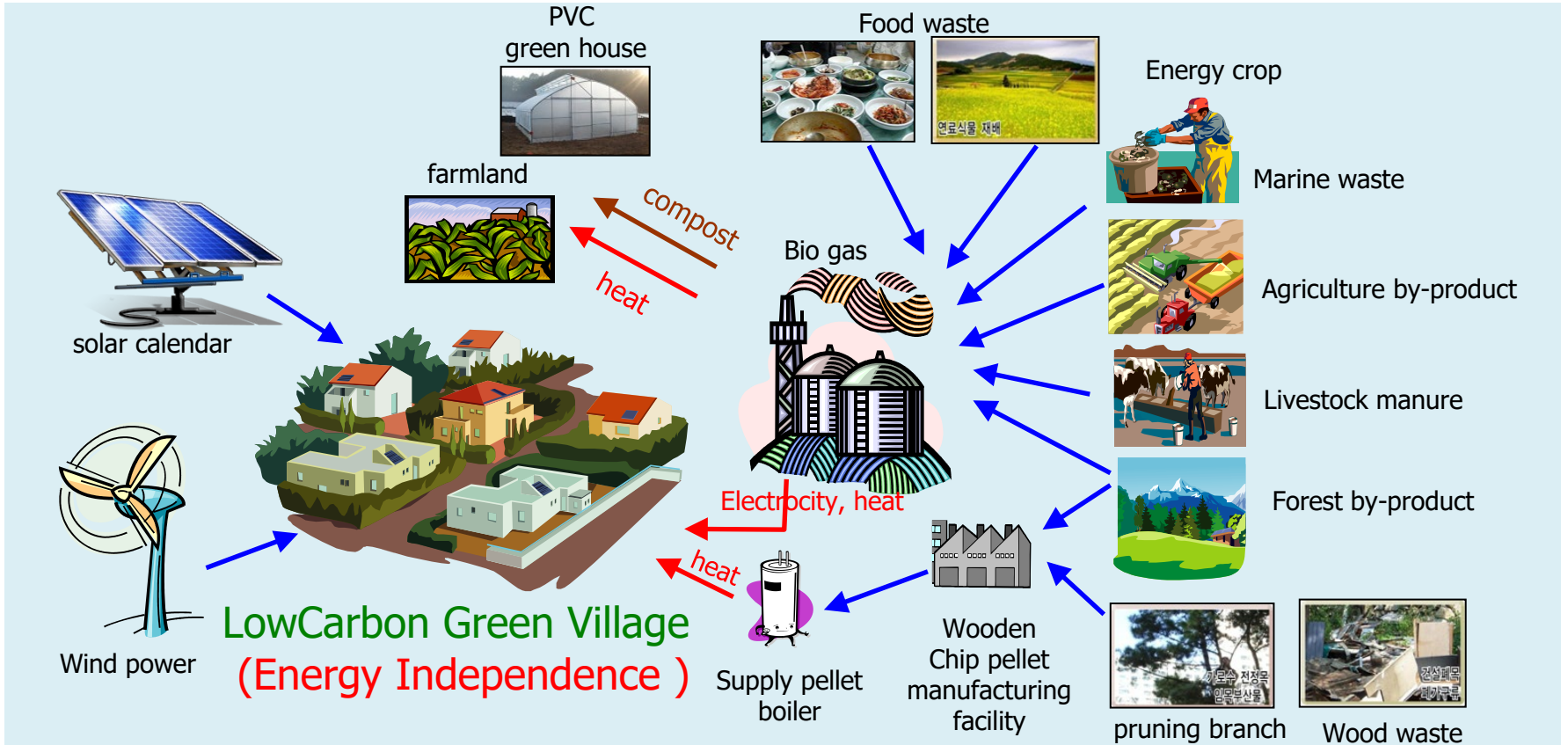
- Gov. project designed to return profits to the residents by combining the production of new and renewable energy such as waste energy and solar photovoltaic energy
- Improving the welfare and income of local residents by using waste resources such as food waste, and livestock manure and biomass to produce energy
- Energy self-sufficient: Securing independency generated from landfills or incineration facilities and new renewable energy facilities
 - Designing sustainable operating model for residents
- Culture tour connection: When installing unpleasant facilities, cultural tour connection need to be considered to provide residents incomes from tour sites, cultural heritage resources



Environmentally Friendly Energy Town



The concept



Biomass
Natural power



Integrated
recycling process

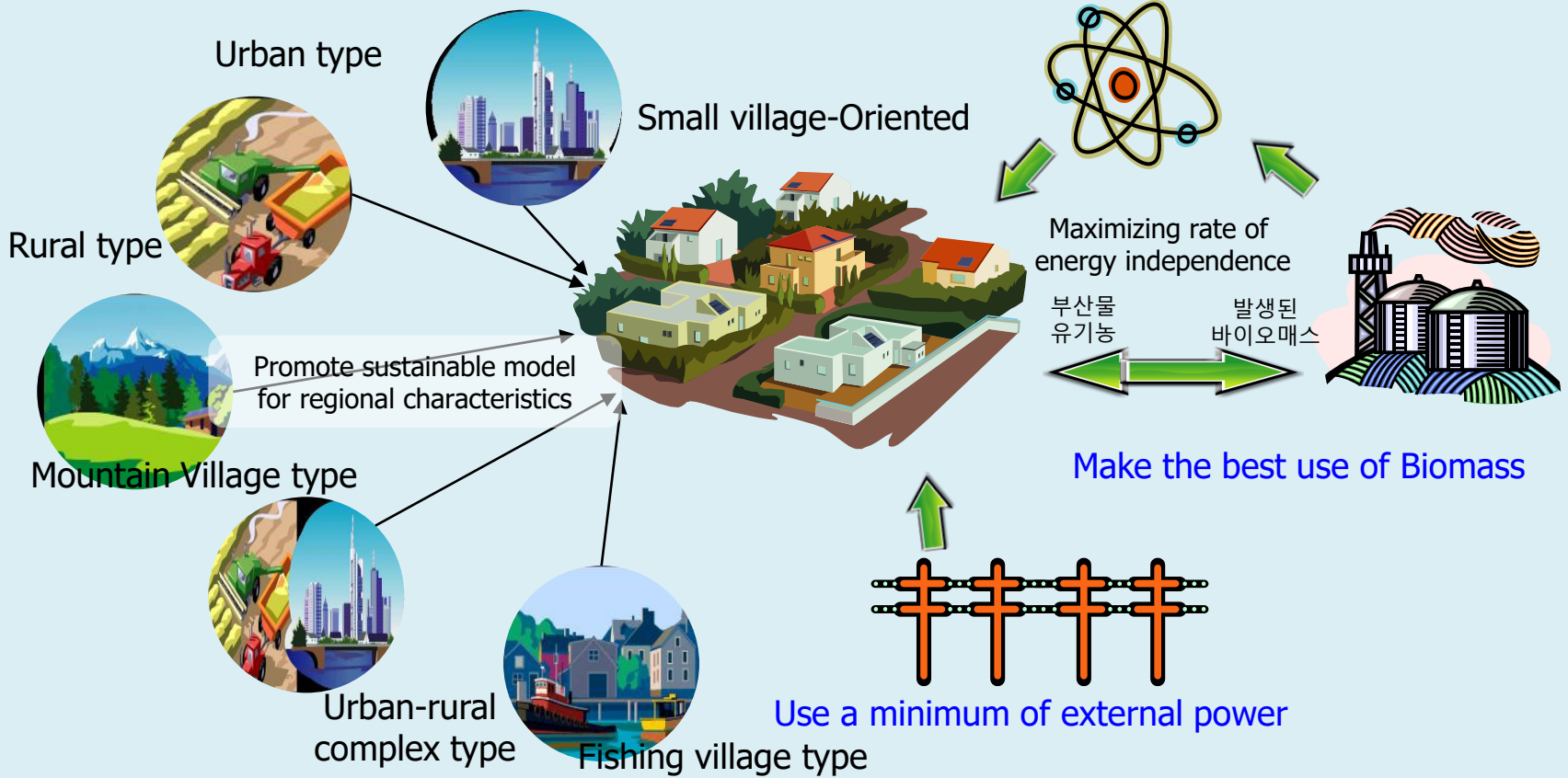


Energy, material
Use local circulation



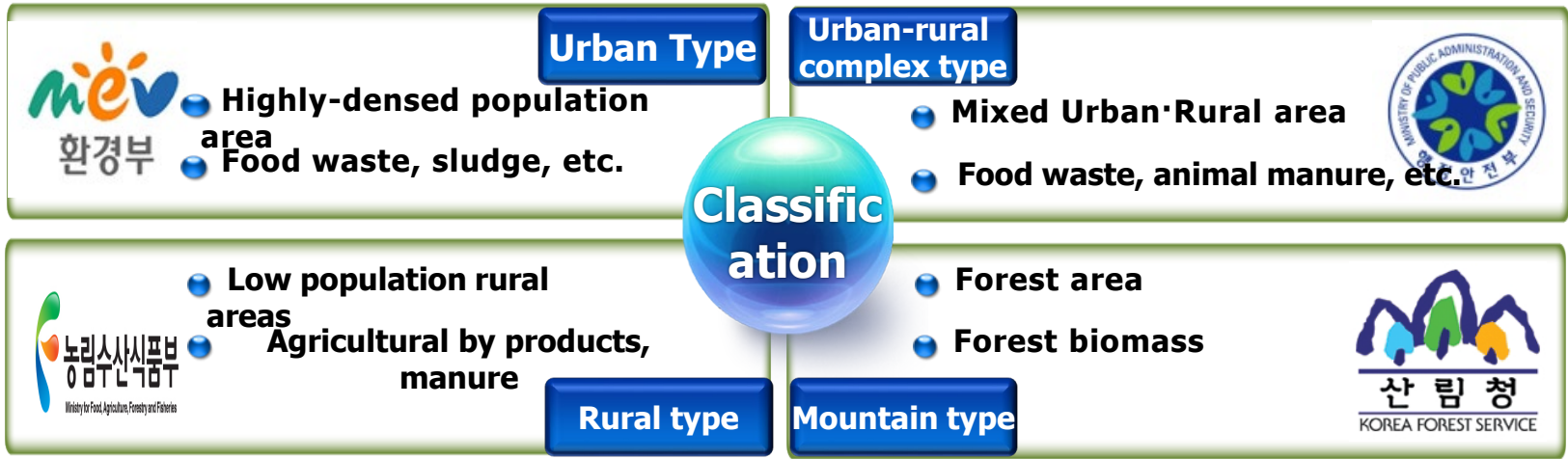
Carbon neutrality
Enhance energy
independence

Basic Direction



Summary of Pilot Project- 4 Types

Plan to develop **pilot town** for 2-3years by separating types from 2010



Pilot Project

Provide solution to problems derived from pilot project results, provided improvements by departments

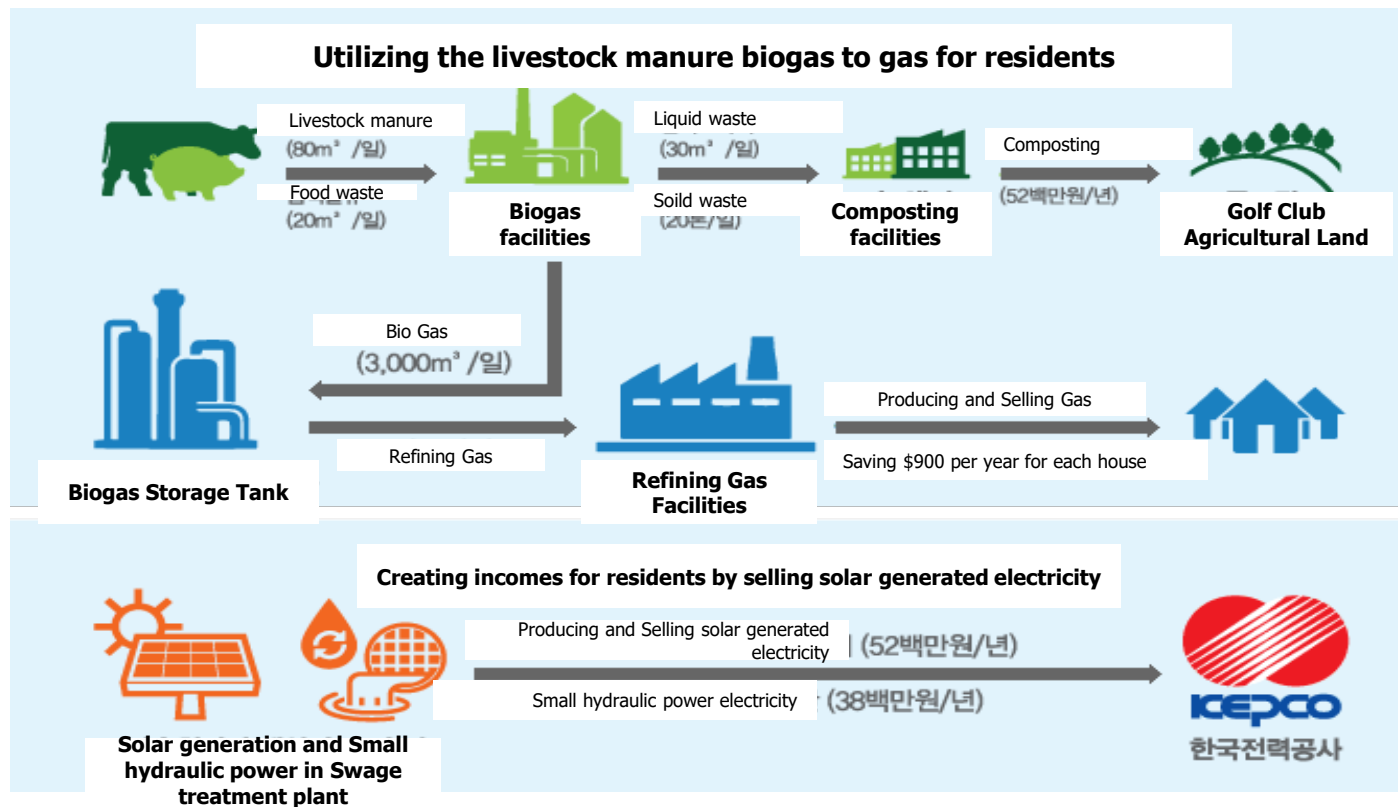


Project

Problems derived from the pilot project results, Spread Nationwide(2013~)

Project Site : Hongcheon, Gangwondo

- Location : Somaegokri, Bukbang-myeon, Hongcheon-gun, Gangwondo (57 houses, 127 residents)
- Facilities : Livestock manure and biomass facilities (100ton/day), Composting facilities (50ton/day), Solar generation (340kW), Small hydraulic power (25kW)



Project Site : Gwangju Metropolitan City

- Location : 104 Unjeongdong, Bukgu, Gwangju Metropolitan City (460 houses, 1,095 residents)
- Facilities : Solar power generation (20MW), New renewable energy experience village, Green Village, Solar power bath, Ecological park



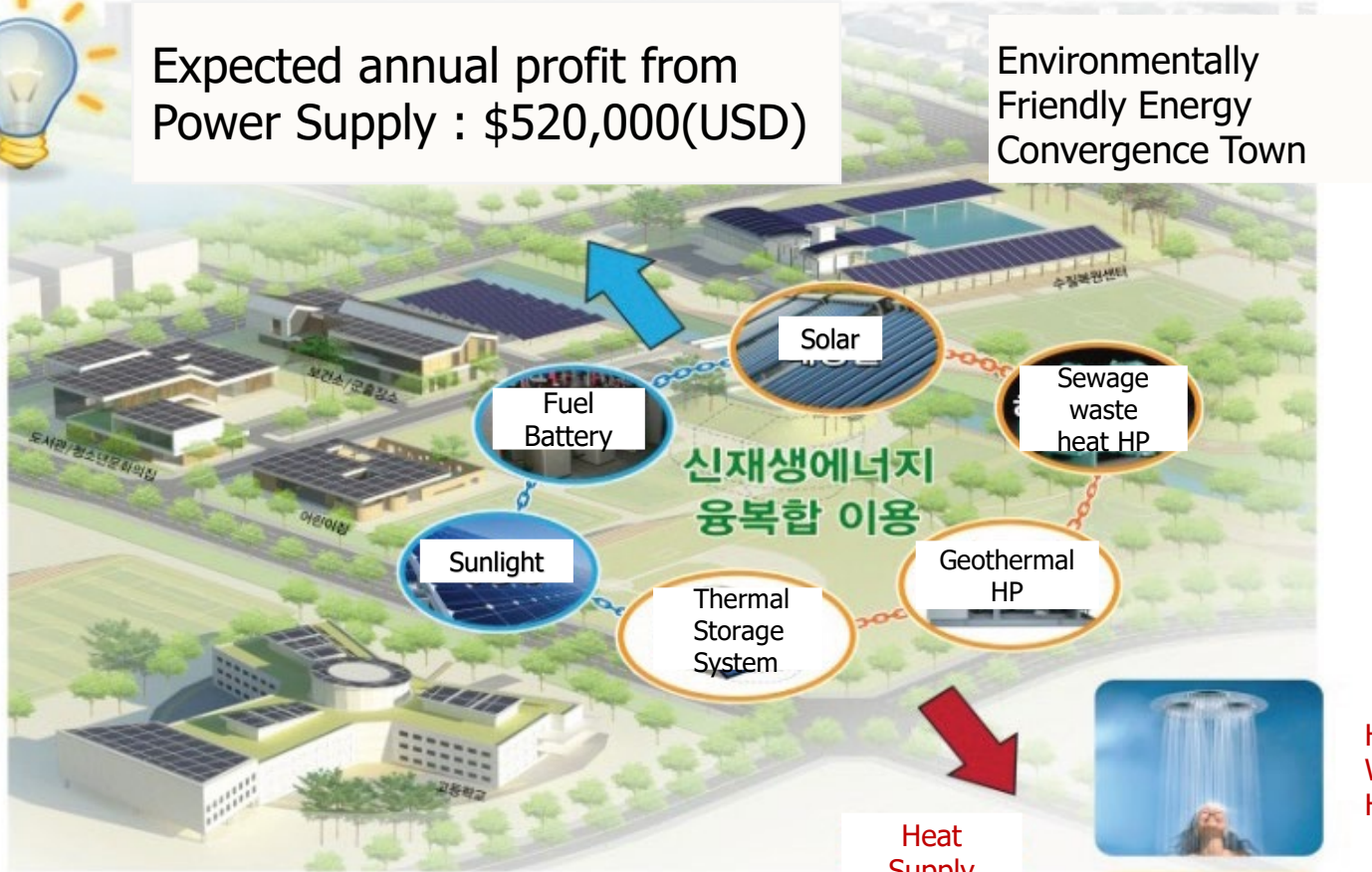
Project Site : Jincheon-gun, Chungcheongbukdo

- Location : Seockjangri, Ducksan-myeon, Jincheon-gun, Chungcheongbukdo (swage treatment plant and industrial complex facilities district)
- Facilities : Solar Energy (2,000m²), Solar Power Energy (950kW), Heat pump from swage and ground (100RT), Fuel cell (10kW), Seasonal thermal storage system(5,000m²)



Expected annual profit from Power Supply : \$520,000(USD)

Environmentally Friendly Energy Convergence Town



Achieve 100% Energy Independence Town by implementing Renewable Energy



Hot Water Heating



Central Heating

4. Ministry of Land, Infrastructure and Transportation

Developing Low Carbon Urban Planning Support System

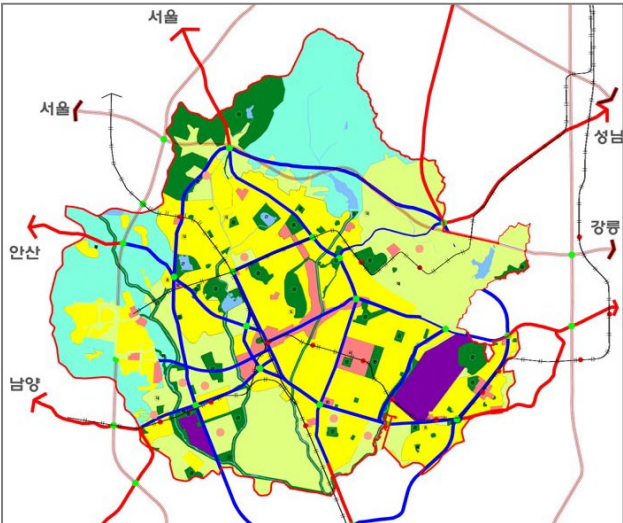
- Goal :
 - Establishing flexible and reasonable low carbon urban planning system
- Main Research Contents:
 - Developing technologies to establish low carbon urban planning and design
 - Developing technologies to manage low carbon urban planning project
 - Developing technologies to simulate low carbon urban spatial land use
 - Establishing comprehensive low carbon urban planning system
 - Establishing comprehensive system to support low carbon urban planning

PSS : Planning Support System Examples

Methods	Scope	Methodology	Scale	Policy Support
Athena Impact Estimator for Buildings	<ul style="list-style-type: none"> Applied to single fields Building energy evaluation based on life cycle 	<ul style="list-style-type: none"> Nonspatial methods Utilizing spread sheet 	<ul style="list-style-type: none"> Individual buildings 	<ul style="list-style-type: none"> Applying at collecting information stage
Community Energy and Emissions Inventory (CEEI)	<ul style="list-style-type: none"> Applied to numerous fields Evaluating land use, transportation, waste and buildings 	<ul style="list-style-type: none"> Nonspatial methods Based on investigation Inverse estimation 	<ul style="list-style-type: none"> Local self-government areas and metropolitan cities 	<ul style="list-style-type: none"> Applying at collecting information stage
CommunityViz	<ul style="list-style-type: none"> Applied to numerous fields Evaluating sustainability elements 	<ul style="list-style-type: none"> Spatial methods Based on investigation 	<ul style="list-style-type: none"> Residential areas and metropolitan areas 	<ul style="list-style-type: none"> Information Collection Applying at Interpretation and cooperative work stage
The Development Patter Approach (DPA)	<ul style="list-style-type: none"> Applied to numerous fields Evaluating sustainability elements including building, transportation and renewable energy 	<ul style="list-style-type: none"> Nonspatial methods Based on investigation Inverse estimation 	<ul style="list-style-type: none"> Pacel Residential areas District Local self-government areas and metropolitan cities 	<ul style="list-style-type: none"> Information collection and interpretation Applying at Cooperative work and implementation stage
Energy Demand Characterization (The Canadian Urban Archetypes Project)	<ul style="list-style-type: none"> Applied to numerous fields Evaluating buildings and transportation energy 	<ul style="list-style-type: none"> Nonspatial methods Based on investigation Case investigation based on questionnaire survey 	<ul style="list-style-type: none"> Residential areas (about 300houses) 	<ul style="list-style-type: none"> Information Collection Applying at interpretation stage
Envision Tomorrow	<ul style="list-style-type: none"> Applied to numerous fields Evaluating sustainability elements including building, transportation energy 	<ul style="list-style-type: none"> Spatial methods Based on investigation Inverse estimation 	<ul style="list-style-type: none"> Pacel Residential areas District Local self-government areas and metropolitan cities 	<ul style="list-style-type: none"> Information collection and interpretation Applying at Cooperative work and implementation stage

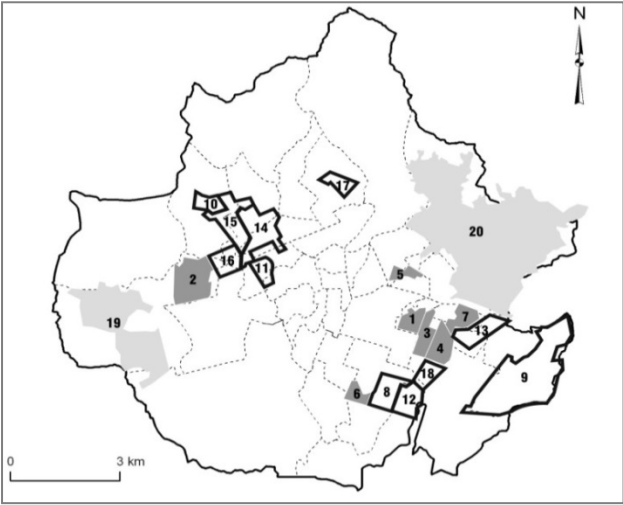
Study system and Content of Urban Level

Urban Planning Support
S/W
Development



[Urban Master Plan]
2030 Year Aim, Long-term CO₂ Emission Estimation

[Urban Master Plan Conception per Section]
Urban Master Plan Level, Proposal CO₂ Emission reductive Plan
(Land Use, Traffic, Energy, Waste, Green Space, etc)



[Conception of Urban Management Scenario]
Conception of Carbon-reductive City Management Scenario
(Low-Carbon Planning Factor – Urban Planning Factor – Urban Characteristic – Integration of Future Scenario)

[Administrative District/Dong Development Unit]
Estimation of CO₂ Emission and CO₂ Emission Aim Proposal according to reductive Plan per Administrative District/Dong,

Development Urban Section
CO₂ Emission Estimation Algorithm

Other Task Integrative support

Development Urban Model / Development Urban Management Scenario

Study system and Content of Urban Level

탄소저감 도시계획 지원 시스템

프로젝트명: 서울시 도시기본계획 | 생성 | 개요 | 현황선택

시나리오 목록

- 시나리오#1
 - 분야별 탄소 배출량
 - 에너지 시설 운영계획
 - 폐기물 시설 운영계획
 - 토지이용계획
 - 시기화 예정용지
 - 에너지 시설 입지
 - 폐기물 시설 입지
- 시나리오#2
 - 분야별 탄소 배출량
 - 에너지 시설 운영계획
 - 폐기물 시설 운영계획
 - 토지이용계획**
 - 시기화 예정용지
 - 에너지 시설 입지
 - 폐기물 시설 입지
- 시나리오#3
 - 분야별 탄소 배출량
 - 에너지 시설 운영계획
 - 폐기물 시설 운영계획
 - 토지이용계획
 - 시기화 예정용지
 - 에너지 시설 입지

추가 | 삭제 | 내보내기 | 시나리오 종합 분석

탄소저감 도시계획 지원 시스템

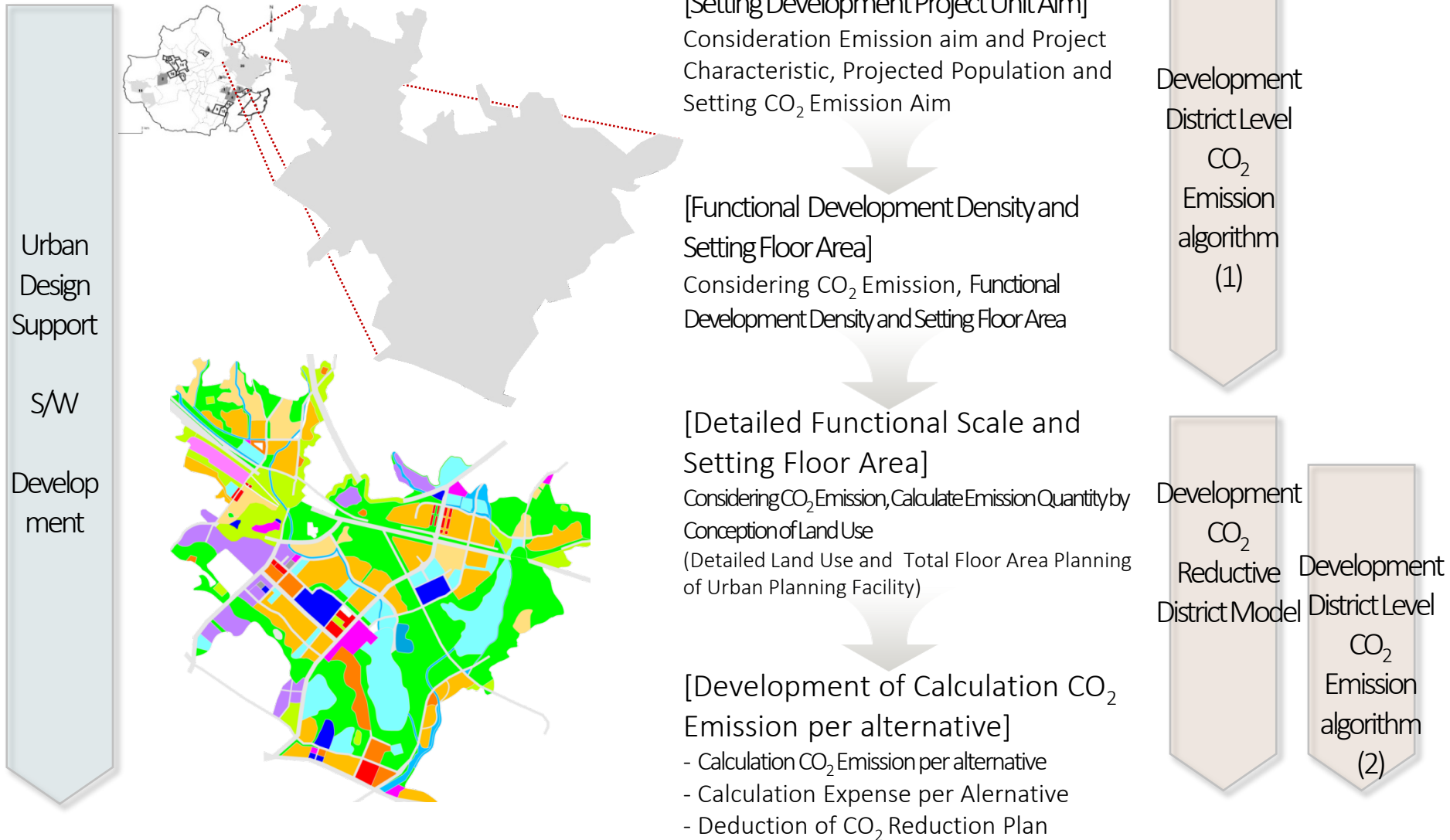
프로젝트명: 서울시 도시기본계획 | 생성 | 개요 | 현황선택

시나리오#2 개요 및 분야별 탄소배출량

의심지	의심번호	의심일	2013.04.20
토지부담	토지이용유형		
	다핵형	거점중심	단축형
	주지역의 용감	상업지역의 용감	주변도시 연계
	+10%	+5%	+2%
인구부담	주지역의 용감	건축용	용적률
	+20%	70%	180%
교통부담	인구 성장률		광역 성장률
	+15%		+4%
	성원관리 1순위	성원관리 2순위	성원관리 3순위
	중심용	상원용	원상용
중심상업 1순위	중심상업 2순위	중심상업 3순위	
3차산업	2차산업	1차산업	
교통부담	통행시간 용감	대중교통 용감	내트릭스 구성 (신규) 4%
	-10%	+10%	

추가 | 삭제 | 내보내기 | 시나리오 종합 분석

Study system and Contents of District Development Project Level



Study system and Contents of District Development Project Level

The image displays two screenshots of a web-based urban planning system. The top screenshot shows the main interface for a district development project, and the bottom screenshot shows a detailed analysis report for a specific plan.

Top Screenshot: Main Interface

The interface is titled "탄소저감 도시계획 지원 시스템" (Carbon Reduction Urban Planning Support System). It shows a project overview for "새만금 복합도시 택지개발사업-1" (Saemangeum Complex City Land Development Project-1). The main area displays a map of the development site with various colored zones. A sidebar on the right lists different land use categories with corresponding codes:

- 단독주택: LT_C_UQ111_UQA110
- 공동주택: LT_C_UQ111_UQA120
- 주상복합: LT_C_UQ111_UQA130
- 상업업무: LT_C_UQ111_UQA200
- 교육시설: LT_C_UQ164_UQV300
- 교육연구시설: LT_C_UQ164_UQV500
- 공공청사: LT_C_UQ164_UQV200, LT_C_UQ164_UQV700, LT_C_UQ166_UQX500, LT_C_UQ164_UQV999
- 사회복지시설

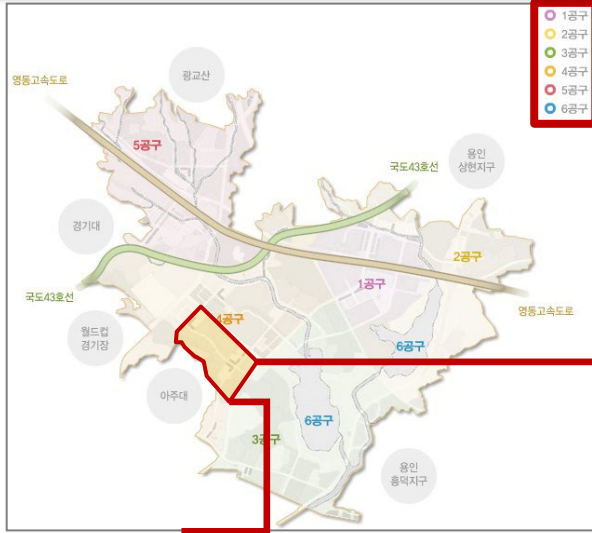
Bottom Screenshot: Detailed Analysis Report

The bottom screenshot shows a detailed analysis report titled "5-3. 대안 분석 결과물" (5-3. Analysis Results of Alternatives). It includes a table titled "대안 #1 개요 및 분야별 탄소배출량" (Overview and Carbon Emissions by Sector for Alternative #1) for the date 2013.04.20.

항목	Planner #1	항목	2013.04.20
탄소량 범위	주거지역	상업지역	공공(교육)
	공공(공공)	공공(의료)	공공(청사)
	공업지역	도로연장	에너지시설
분야	리무	항공시설	주차량
	고용유요	신에너지	에너지절약
탄소저감 요소	에너지절약	도시농업	폐기물배출
	물관리	재생에너지	저탄소연료
	녹지유지	자연에너지	공탄축하
		폐기물처리	-

Prospective Results and Practical Use of Study

5-3 Study system and Contents of District and Complex Level



[Setting of CO₂ Emission per District]
Setting of CO₂ Emission per District [District Unit Plan/Complex]

[CO₂ Reduction Design /Construction Guideline Development]
Consideration of CO₂ Emission plan per District [District Unit Plan/Complex),
Complex/Architecture Detailed Design

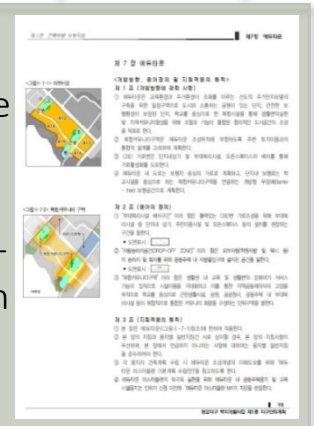
Development of Urban Design Guideline

Development of Complex Level CO₂ reductive Construction Guideline / CO₂ Reductive technical Factor Development



Urban Design Stage, Reflection of CO₂ reductive Guideline

((Tentatively Named) Carbon-reductive District Unit Plan Guideline)



Establishing Optimized Model for Zero Energy Residents and Test Site

- Goal :
 - Minimizing the energy requirement of residential district based on existing developed technologies
 - Developing optimized model for first zero energy consumption by producing new renewable energy
- Main Research Contents:
 - Establishing zero energy residential districts, combining design technologies and construction technologies
 - Research for 4 welfare IT monitoring technologies including test product installation, performance and zero energy technology
 - Research economic effects by securing clean residential environment
 - Research various considerations required from technologies, policies and markets to distribute zero energy residences

❖ Zero Energy Housing Complex in Nowon-gu, Seoul

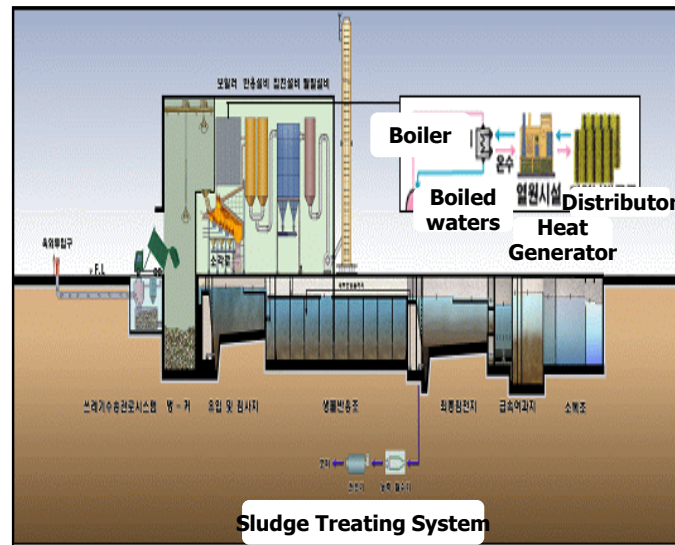
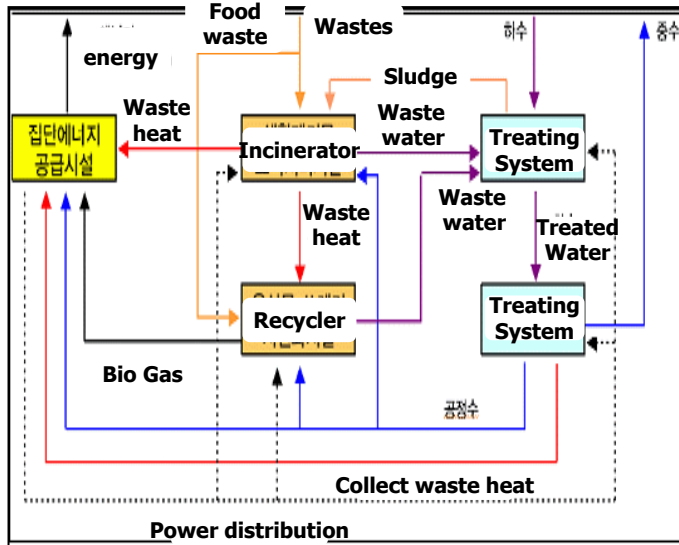


❖ Seosabeol New Town Development with CDM

- World first new town development with CDM registered project
- Spatial clustering of waste processing facilities for efficient energy consumption
- Expand use of ecologically green spaces and water circulation system

Buildings / Facilities		Numbers	Solar Light	Solar Heat	Geothermal	Fuel Cell
Housing	Single housing	3,796	1,790	2,006	-	-
	Multi housing	3,415	3,415	-	-	-
Public Facility	Schools	10,501	254	224	10,023	-
	Gov. Buildings	19,720	622	483	18,615	-
	Parks	175	175	-	-	-
	Information Centers	2,114	83	-	-	2,031
Total Sum		39,721	6,339	2,713	28,638	2,031

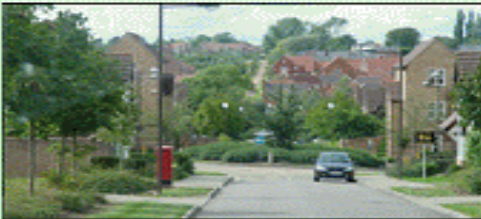
※ Unit: MWH / Year (per-year total generation up to 5.5% (4MWH) of total consumption)



❖ Seosabeol New Town Development : Green, Water & Eco System

Green Space & Eco System

- Expansion of green places
- Conservation, restoration, creation & enhancements



Water Circulation System

- Secures water sources
- Maintain swampy places



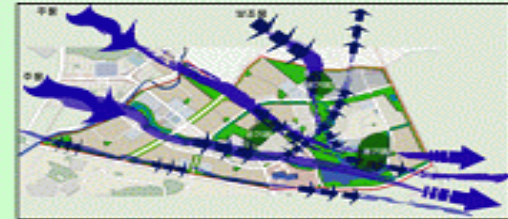
Wind System

- Wind paths through green places
- Planting considering wind paths

Wind paths through green places

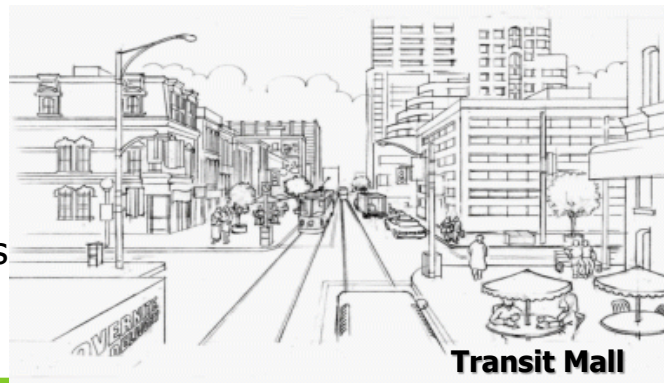


Planting considering wind paths

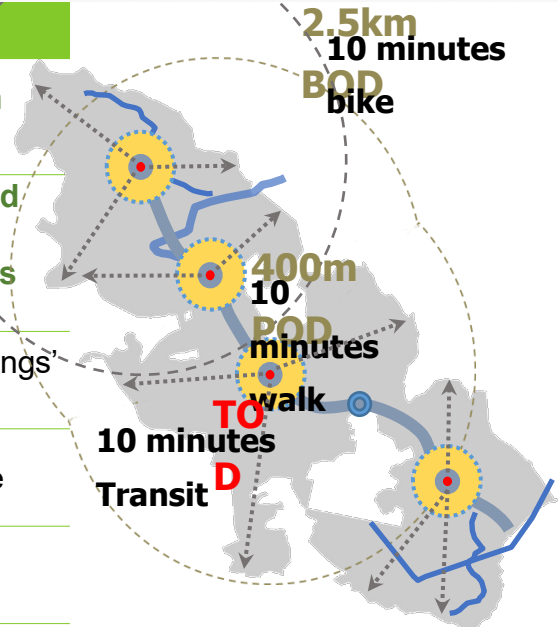


❖ Incheond Geomdan New Town Planning

- Low Carbon Green City Planning Method
- 10 minute distance from subway station to transportation centers
- Pedestrian network for reducing energy consumption



Categories	Methods	Techniques	Adopted Techniques
Urban Structure	Formation	Compact City Public Transportation	Station-centric allocation (TOD, BOD, POD)
Site Planning	Pedestrian-centric Environment	Pedestrian Network Spatially Separated Road Traffic Calming	In-site pedestrian/bike road network Parking lots on site fringes Traffic Calming
	Building Allocation	Planning facing directions & wind paths	Construction considering buildings' facing directions
	Microclimate	Green spaces & water places	Green space & water place
Buildings & Facilities	Renewable Energy Use	Buildings with renewable energy system	Zero-energy town Transit malls
	Water & Ventilation	Gray water & ventilation	Building system recycling gray water & ventilation



5. Green City for Climate Change Adaptation

Inundation and Landslide Caused by Localized Heavy Rain Seoul and Gyeonggi Province (July 26th to 28th, 2011)

- Accumulated precipitation from the 26th to 28th of July, 2011 was 664 mm for Dongducheon, and 546 mm for Seoul. Maximum precipitation per hour in Gwangju, Gyeonggi was 99.5 mm (06 am, 27th) and 94 mm (08 am 27th) in Gwanak, Seoul. 53 people died and 129,872 households were without power. 4 buildings were destroyed. 9,957 households were inundated.

< Inundation of Olympic Expressway >



< Landslide on Umyeonsan (Mt.) > < Damaged Houses Due to Landslide >



❖ Severe Rain Storm in Gunsan, Korea(2012.8.12)

- From the night of August 12th to 6am on 13th, 2012, **concentrated heavy rainfall in Gunsan, 444mm precipitation in naecho-dong, Gunsan**
- **Regional torrential rains over maximum hourly precipitation 130mm**
- Most damage was caused by **soil runoff and roads & houses inundation, Gunsan-ci and Taean-gun were most damaged**
- Gunsan's provisional heavy rainfall damage is **50 million dollars**(private damage, 44 million dollars)

< Roads inundation at old health center intersection >



< Land Slide at Soryong-dong >



< Soil runoff at Soryong-dong >



❖ **Damage Instances of Inundation and Landslide Caused by Localized Heavy Rain_ Pyeongchang, Inje (June, 2006)**

- Accumulated precipitation from July 14th to 18th, 2006 was 491.5 mm for Pyeongchang, and 453.0 mm for Inje-gun. Maximum precipitation per hour in Osaek, Yangyang was 109 mm. The number of dead in Inje-gun was 31 and, 10 people in Pyeongchang-gun. Property loss for Pyeongchang was KRW 510 billion, KRW 412 billion for Inje

**< Land Use without Consideration of Disaster Prevention :
Damage on Roads and Buildings Due to Landslide and River Overflow >**

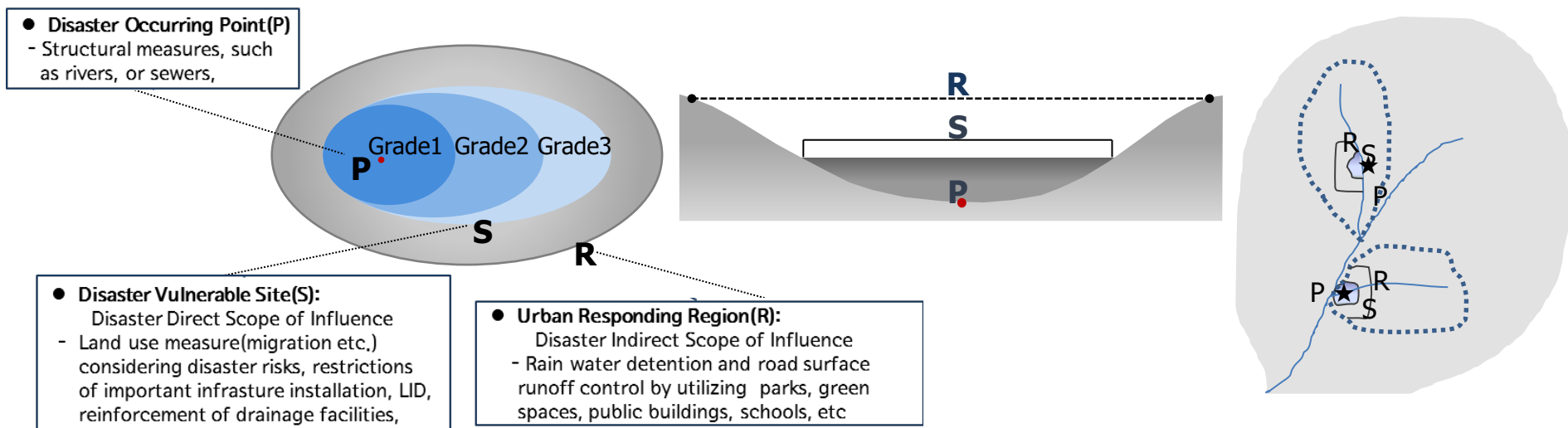


2. Disaster Prevention System Implementation Considering Regional Disaster Pattern and Characteristic : PSR Strategy

❖ What is PSR Strategy?

- PSR, a modern version of our ancestor's spatial drainage system (**valley - small pond - village(natural & man-made waterways) – large pond – river**), denotes a **multilayered urban disaster prevention strategy** that delays runoff of rainwater or stores it **"layer after layer"** taking characteristics of **the scope of direct and indirect disaster influences** into consideration

< PSR Strategy Concept >

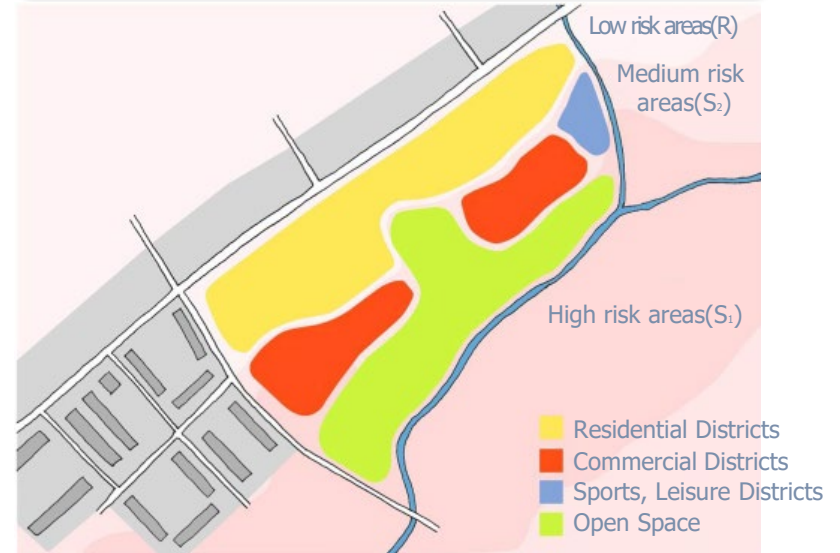


- Illustration of PSR-based disaster reducing urban design techniques

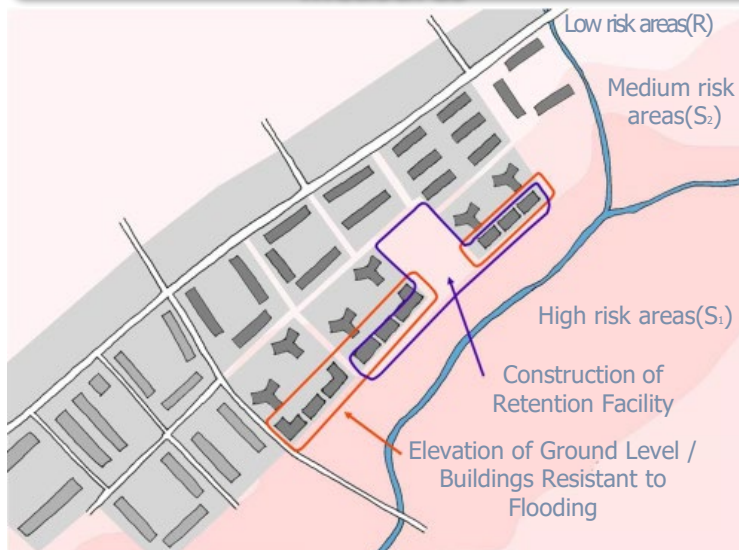
1. Flood damage influencing area division



2. Land use arrangement



3. Disaster vulnerable area(S) measures



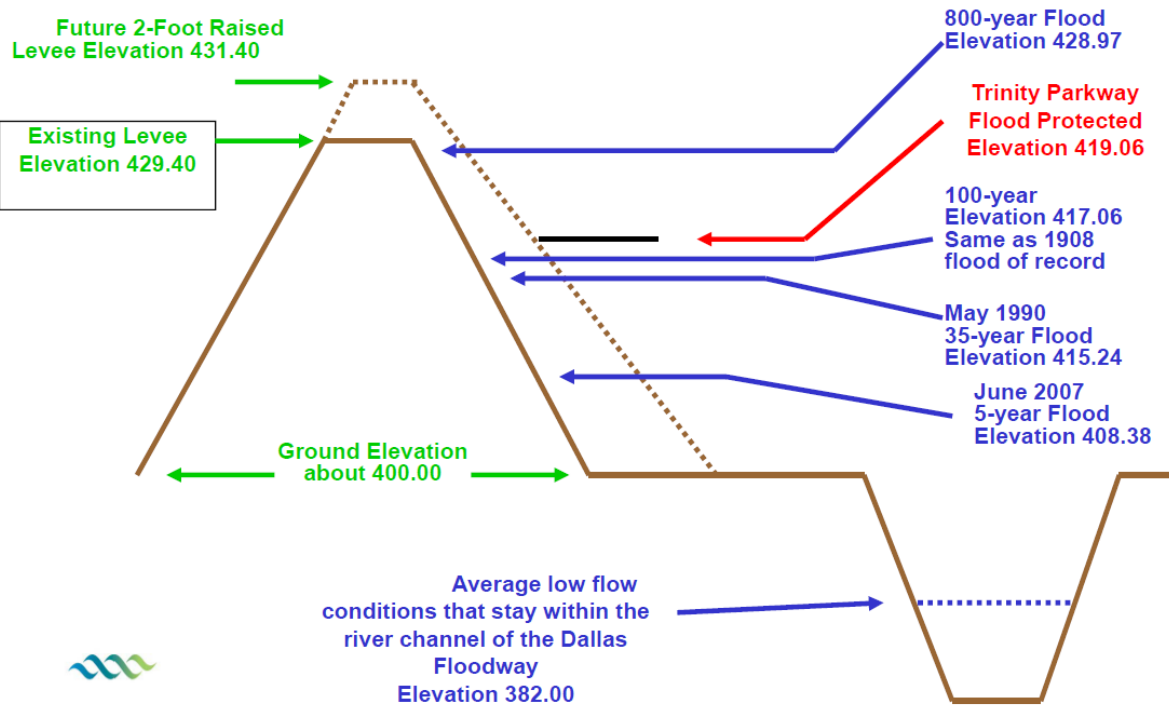
4. Urban responding area(R) measures



❖ Measures for Disaster Occurring Point (Point)

- Take structural measures mainly with disaster prevention facilities
 - Reinforce dykes, enlarge sewer or storage capacity, expand pump stations, install erosion control facilities, etc.

< Trinity River Project (Dallas, USA) >



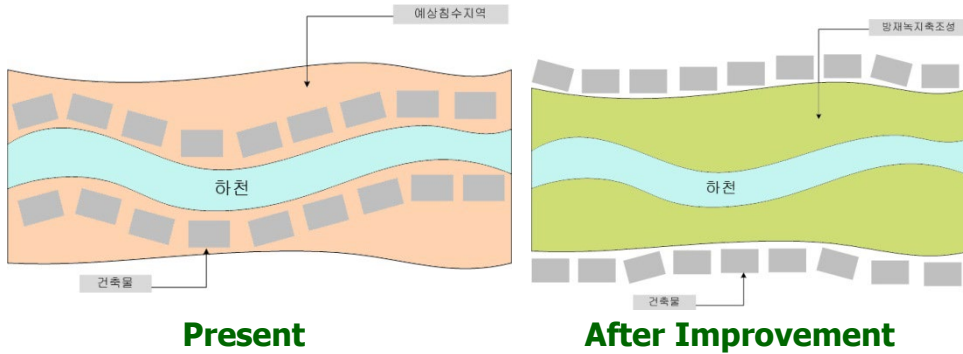
< Example of Erosion Control Facility >



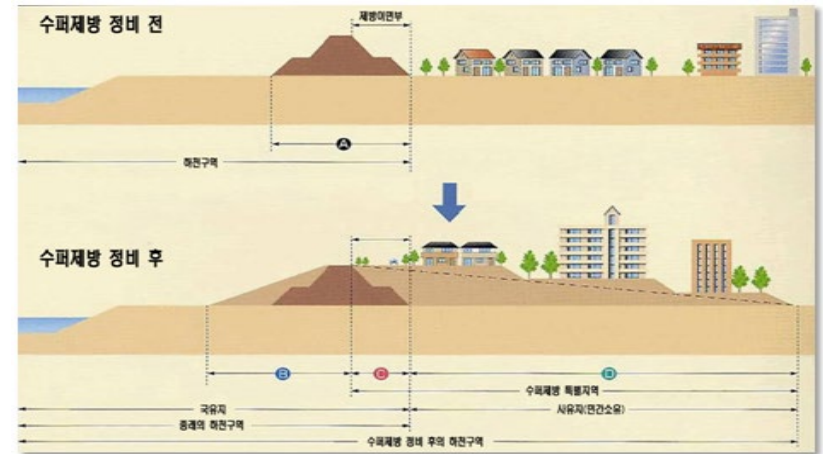
❖ Measures for Disaster Vulnerable Site (Site)

- To minimize human casualties, improve land use, restrict installation of important urban infrastructure, reinforce rainwater drainage, introduce low impact development techniques, employ adaptive measures for building, etc.

< River basin low land : Green corridor constructed for disaster prevention >



< Concept Drawing of Super Dyke >



< Ecological Waterways >



< Ecological retention area >



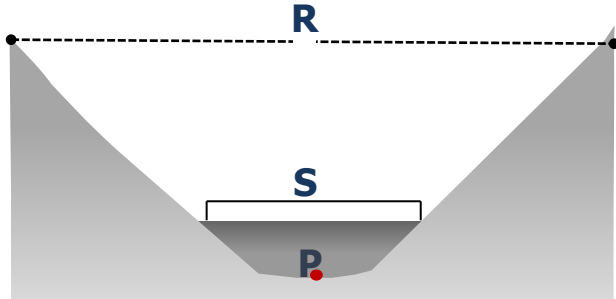
< Piloti Structure >



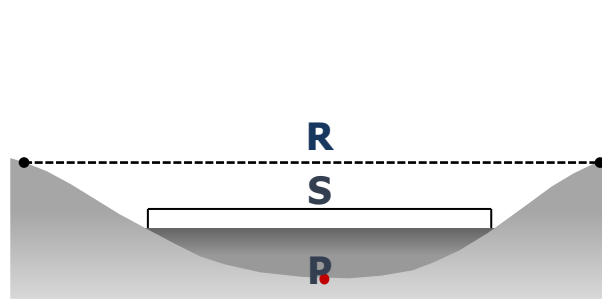
❖ Measures for Urban Responding Region (Region)

- Customized measures to fit topographical characteristics
 - Employ appropriate measures taking inclination and catchment area of the locality into consideration: **Steep-slope lowland type** is an area with steep slope and small catchment area, **Gentle-slope lowland type** is an area with gentle slope and large catchment area, whereas **Mixed topography** is an area that has characteristics of both the steep-slope lowland type and the gentle-slope lowland type

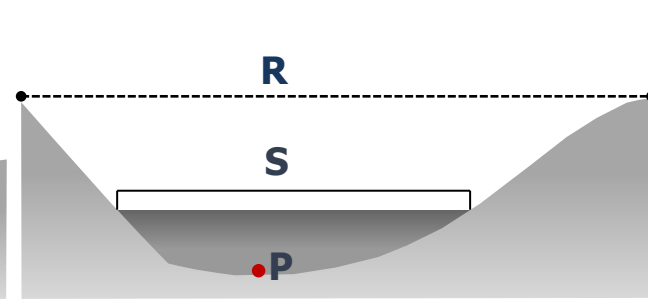
< Steep-slope Lowland Type >



< Gentle-slope Lowland Type >

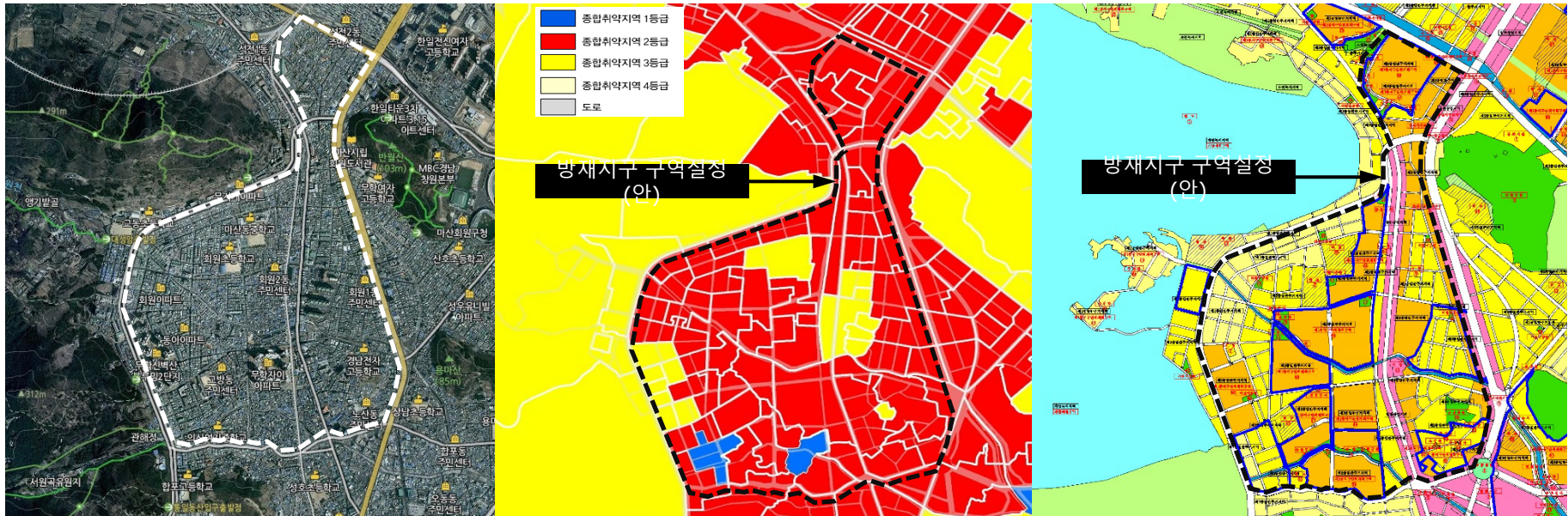


< Mixed Topography >



❖ Management and support of disaster preventing zone (guideline)

- Establishment of disaster reduction measures of disaster preventing zone
- (Act limit) prohibiting the construction deterrent to accident prevention
Restrictions upon housing use less than expected flooding level (Pilotti frame construction, low-lying ground rising, etc.)
- (Incentive) The floor space index is eased by 120% through the deliberation of the city planning commission considering the loss due to housing use restrictions less than the expected flooding level and the cost for the disaster reduction measures
- (City Improvement) Disaster risks are resolved through the urban development by preferentially designating the districts as the target region for "residential environment improvement projects", "housing redevelopment projects", and "housing reconstruction projects"



Comprehensive flood control planning for urban sheds

Problems of urban watersheds

- Limits in traditional river measures (river-wide expansion, bank increasing, etc.)
- Lack of cooperation between upper and downstream municipalities and in various disaster plans

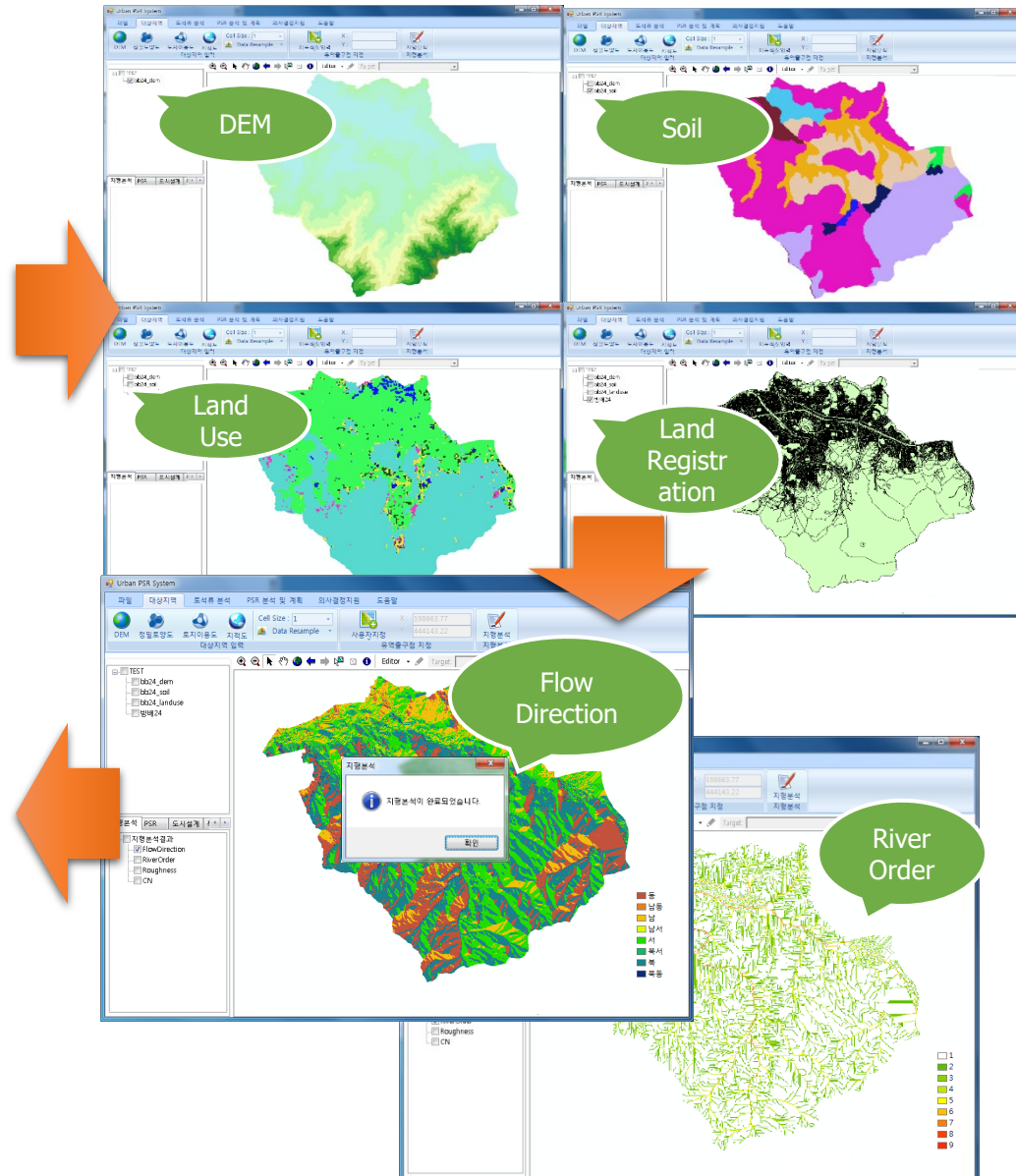
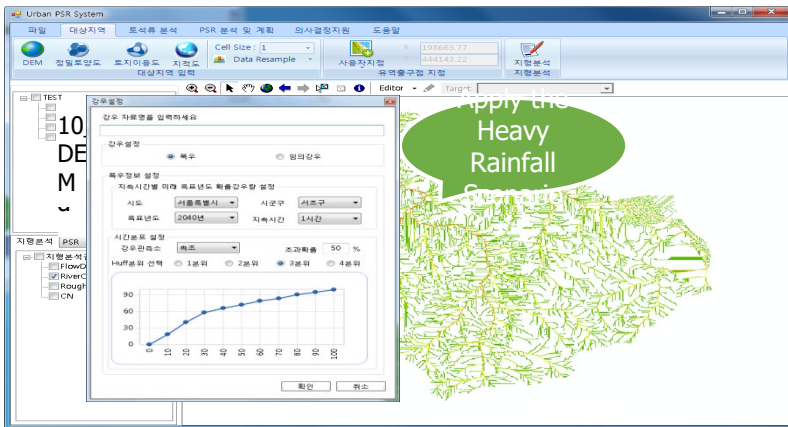
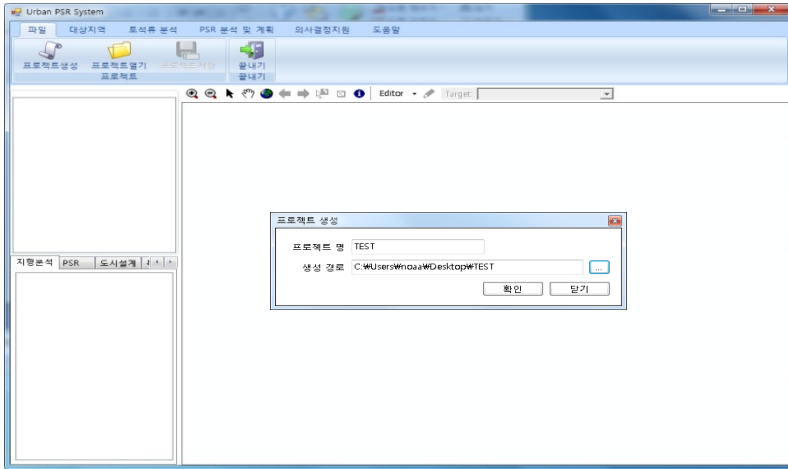
Current Status

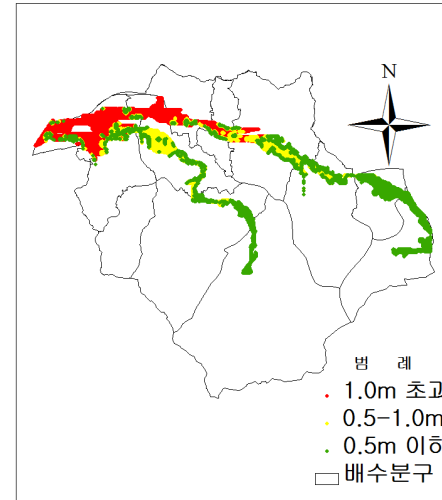
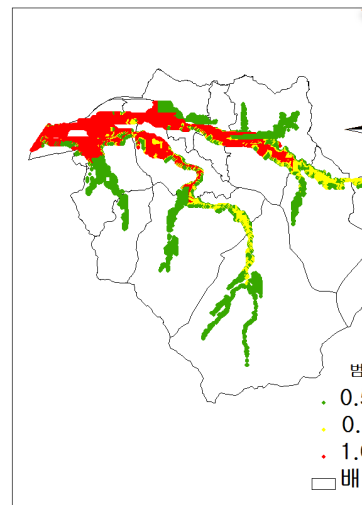
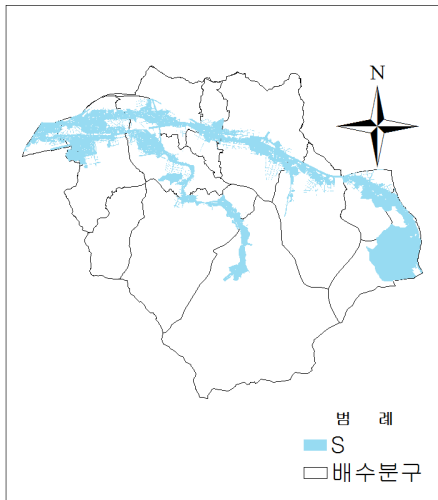
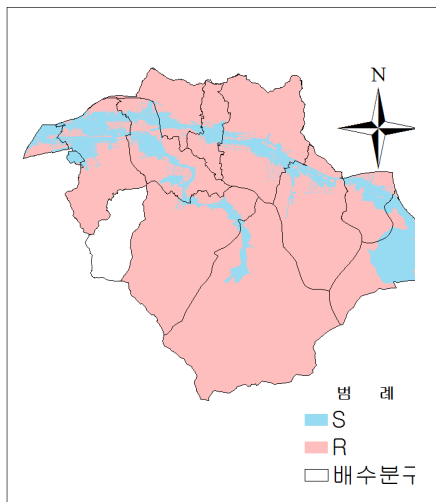
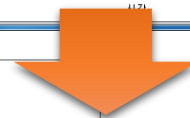
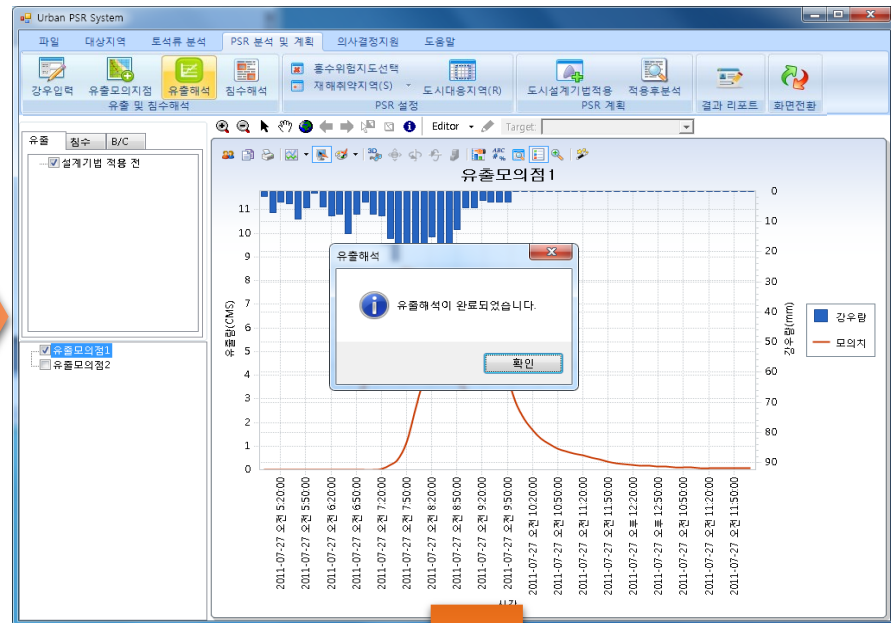
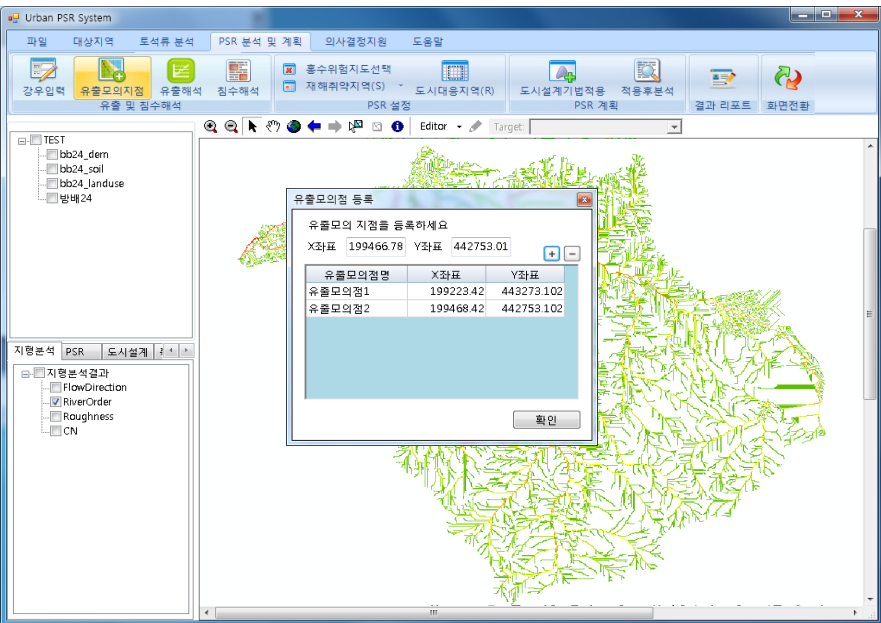
- Comprehensive watershed plan for connecting rivers-sewers-city infrastructures in cities watersheds where habitual flooding occurs (rivers flowing more than 2 municipalities)
- Demonstration projects for Gyeyang River - Urban Watersheds (Incheon, Gimpo) where flooding damages frequently occurred (pilot project location)
- Expanded to the whole country from 2014

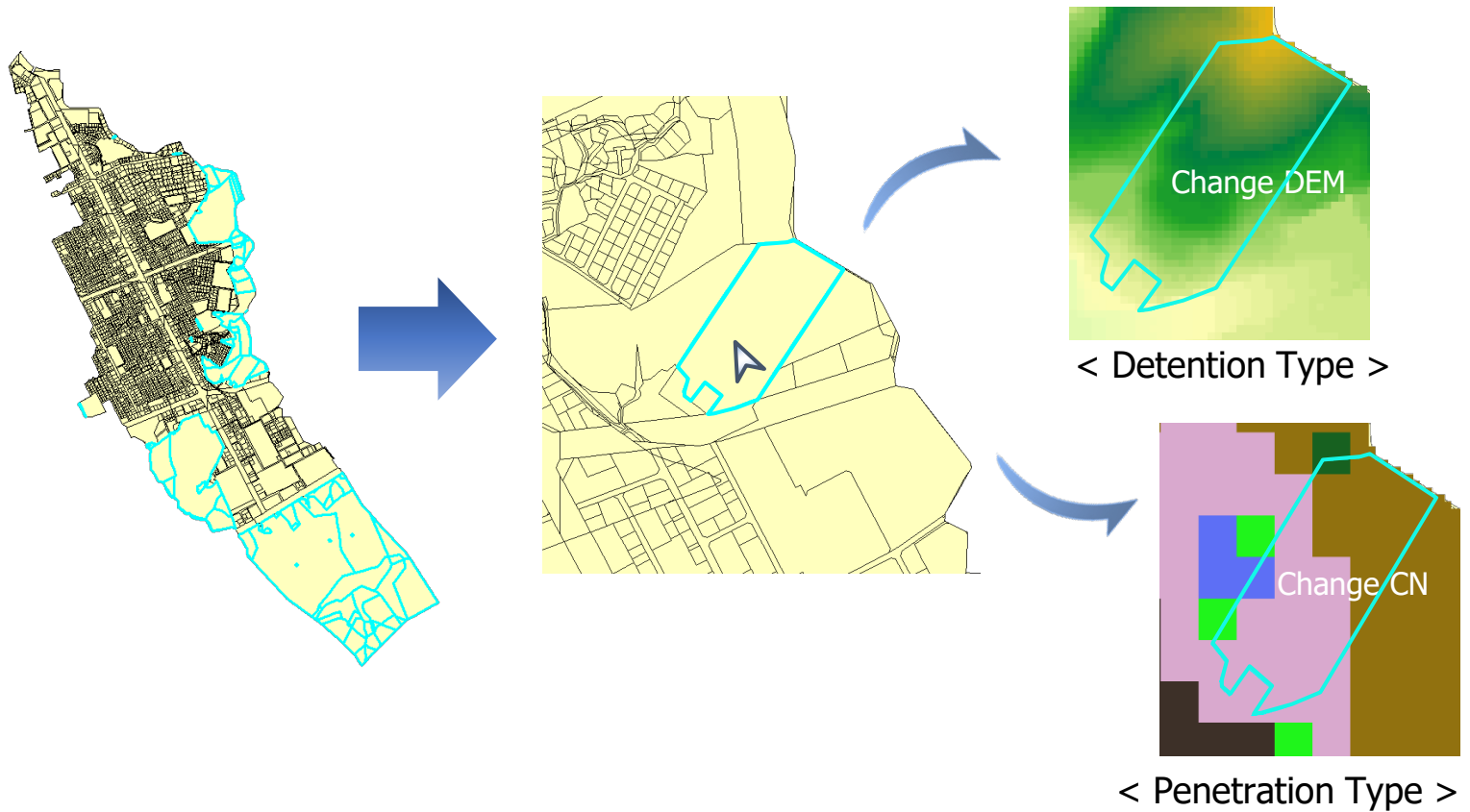
< Pilot project location >



Simulation System for Flood Preventive Urban Planning







Source : EPA SWMM verion 5.1 Manual, EPA SUSTAIN version 1.2 Manual

	Point BMP	Linear BMP	Area BMP
Detention Type	Rain Barrel		Green Roof
Penetration Type	Rain Garden Infiltration Basin	Infiltration Trench Grassed Swale Vegetated Filter Strip	Porous Pavement
Mixed Type	Bioretention Constructed Wetland Dry Pond Wet Pond		

THANK YOU

