UN-ESCAP Gwangju Workshop

Gwangju's GHG Reduction Initiatives and Urban Climate and Environmental Assessment Model

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Need and Objective for GHG Reduction

Need and Objective for GHG Reduction

❑ Need

- **The South Korean government has set a goal under the Paris Agreement to reduce emissions by 815 mil tons by 2030**
- **Local governments need to develop an emissions reduction roadmap to meet the reduction targets in the non-industrial sectors* (96 mil tons), which are to be managed under the authority of local governments**

  ***Non-industrial sectors: e.g. residential, commercial, public, transport, agro-livestock, waste**

  - To be managed under the authority of local governments (hence the use of reduction inventory - TBD)
  - 72% of local governments' reduction plans focus on non-industrial sectors
  - More likely to reduce emissions than the industrial sector → Resistance to change in the industrial sector
  - GHG reduction initiatives tend to see immediate results (direct reduction projects)
  - Limitation: Accurate monitoring and management can be challenging, given that reduction projects entail multiple sectors and areas
- **Gwangju has drafted a 2030 GHG emissions reduction roadmap to contribute to national reduction goals and streamline the city's existing climate change plans**

Need and Objective for GHG Reduction

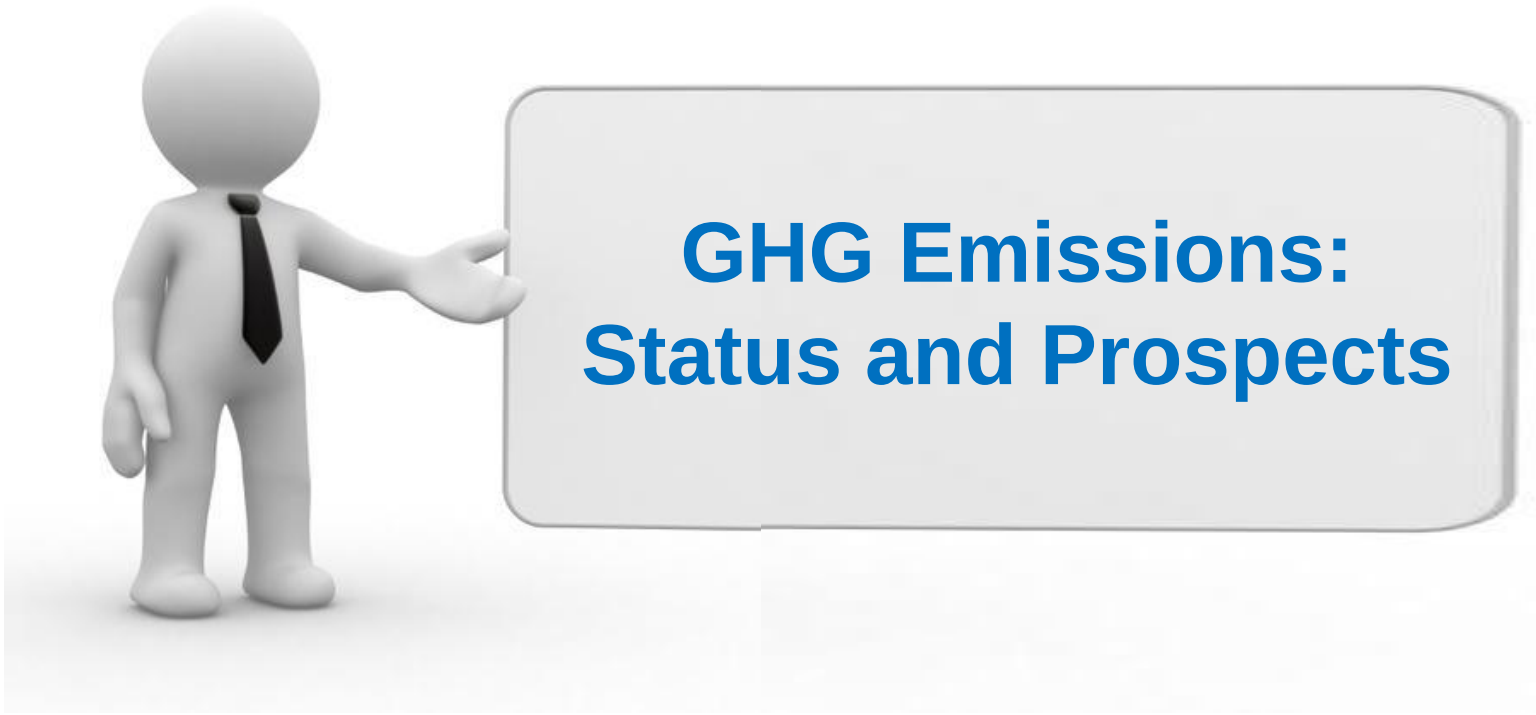
❑ Objective and scope

2030 Gwangju GHG emissions reduction roadmap

1. Status and prospects of Gwangju's GHG emissions → Set out directions for climate energy policy
2. Estimated emissions and reduction targets in 2030
3. Action plans to meet 2030 GHG reduction goals

→ Contribute to national reduction goals

- Spatial scope: City-wide
- Temporal scope: Base year 2005, target year 2030
- Emissions: Down 30.3% from Gwangju's BAU levels in 2030 ※ Allocated by Ministry of Environment
- Emission sources: Scope1 (direct sources), Scope2 (indirect sources)

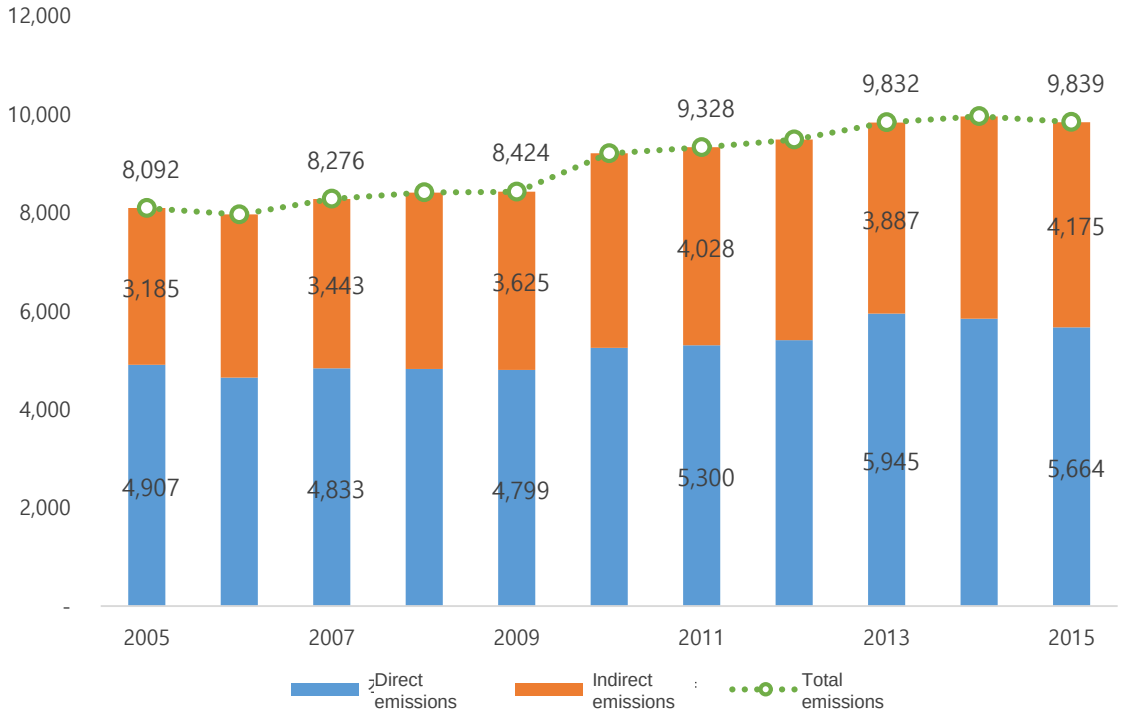


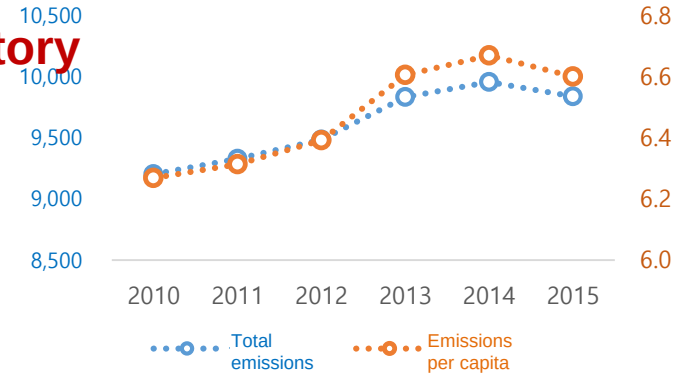
GHG Emissions: Status and Prospects

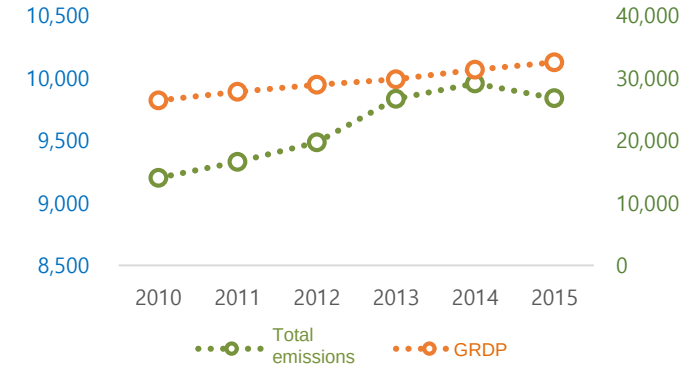
GHG Emissions: Status

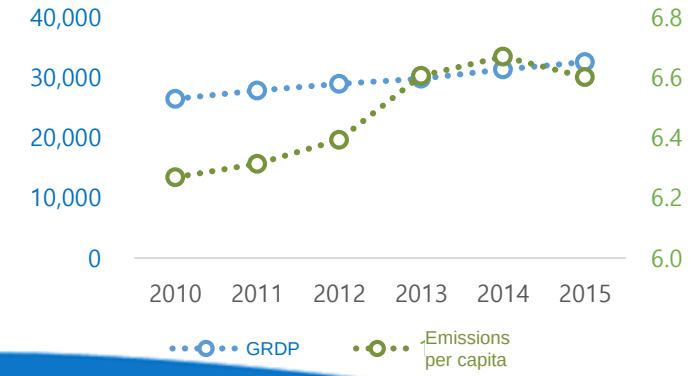
❑ Total GHG emissions in Gwangju: Total inventory

- **Emissions in 2015 (direct and indirect combined)**
  : 5,665,000 tons (direct) + 4,175,000 tons (indirect) = 9,840,000 tons
  : 8,092,000 tons in 2005 → 9,840,000 tons in 2015 (up 22%)









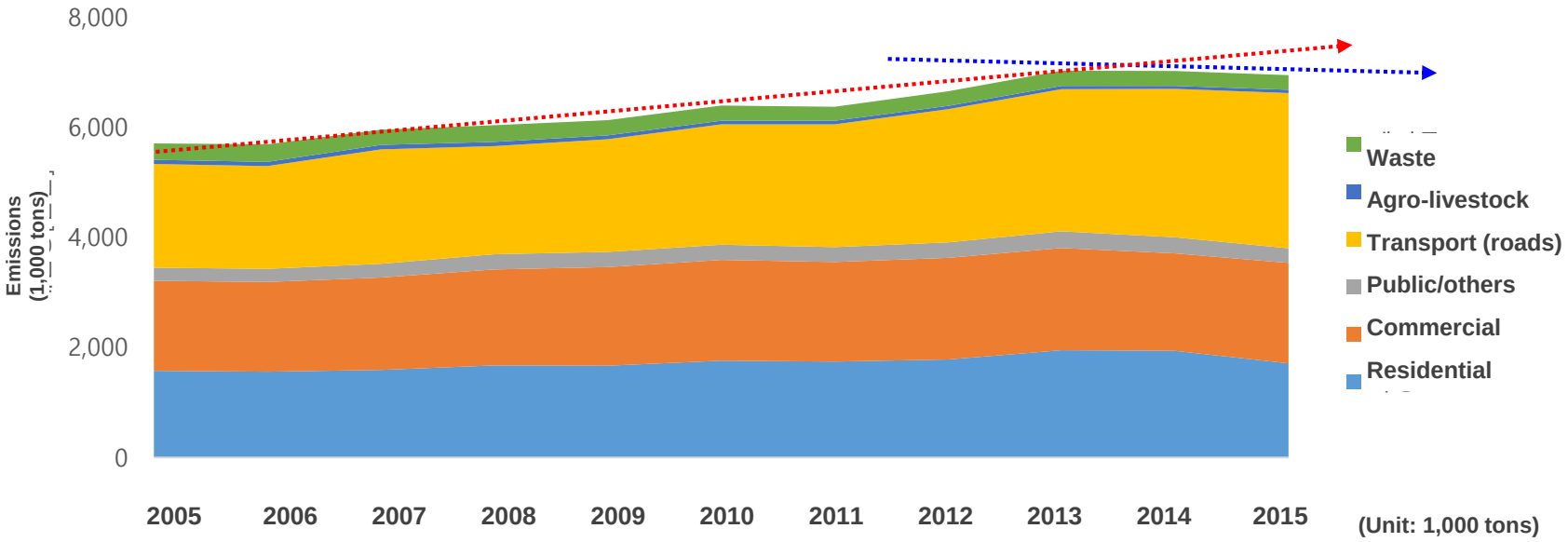
※ Direct emissions: Emissions directly resulting from fuel combustion or product manufacturing within the boundaries of a local government area
※ Indirect emissions: Emissions from consumption of electricity or heat

GHG Emissions: Status

❑ Gwangju's GHG emissions: Reduction inventory

※ System that enables the management of reduction projects in the managed areas

- **Total emissions: 5,710,000 tons in 2005 → 6,949,000 tons in 2015 (up 22%)**



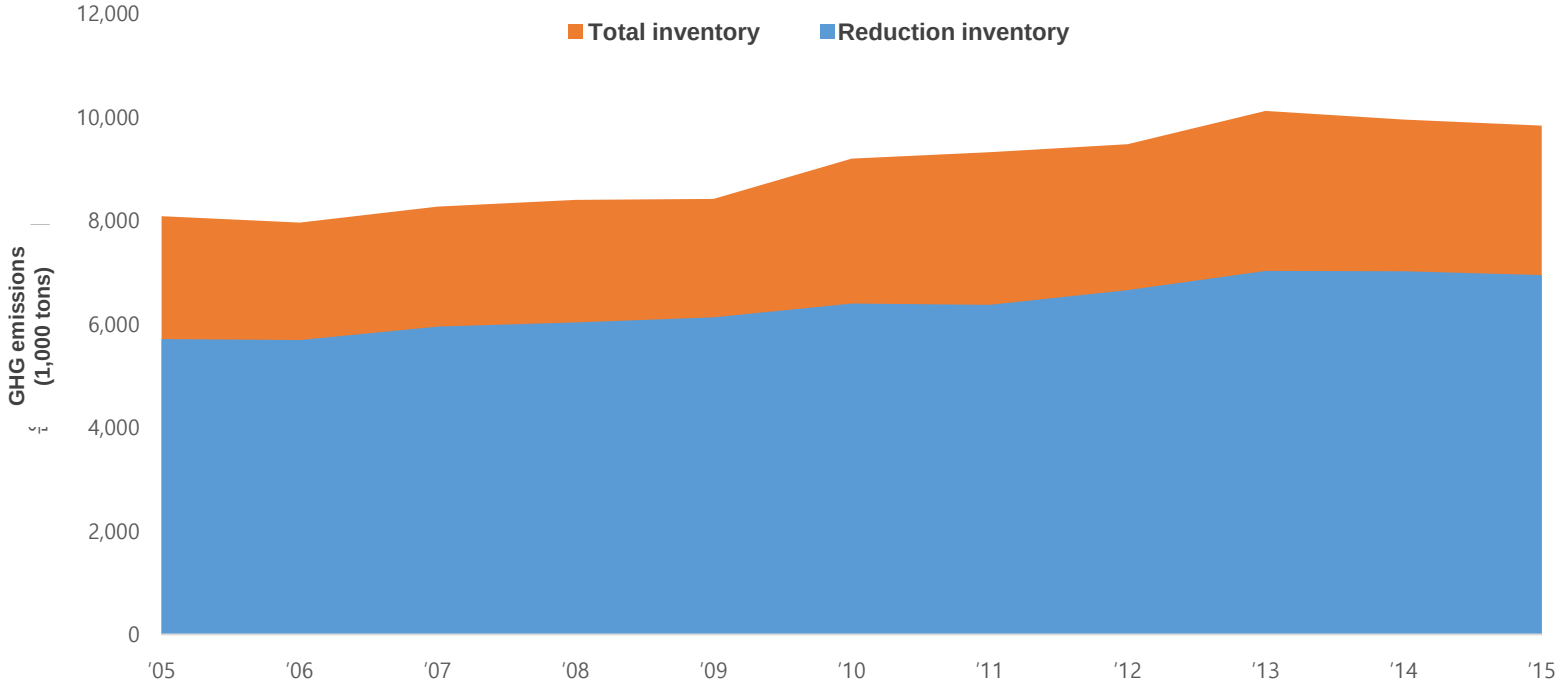
(Unit: 1,000 tons)

Criteria		2005	2010	2011	2012	2013	2014	2015	Share (2015)
Buildings	Residential	1,573	1,759	1,745	1,779	1,947	1,940	1,708	25%
	Commercial	1,640	1,831	1,808	1,852	1,862	1,772	1,827	26%
	Subtotal	3,213	3,590	3,552	3,631	3,809	3,711	3,535	51%
Public/others		236	279	271	280	301	290	266	4%
Transport (roads)		1,884	2,189	2,229	2,422	2,583	2,696	2,824	41%
Agro-livestock		80	64	65	59	59	59	60	1%
Waste		297	276	259	267	278	267	263	4%
Total		5,710	6,399	6,376	6,660	7,030	7,024	6,949	100%

GHG Emissions: Status

❑ Total inventory vs. Reduction inventory

- On average, reduction inventory is 71% of total inventory; **remaining 29% are emissions outside the authority of Gwangju**

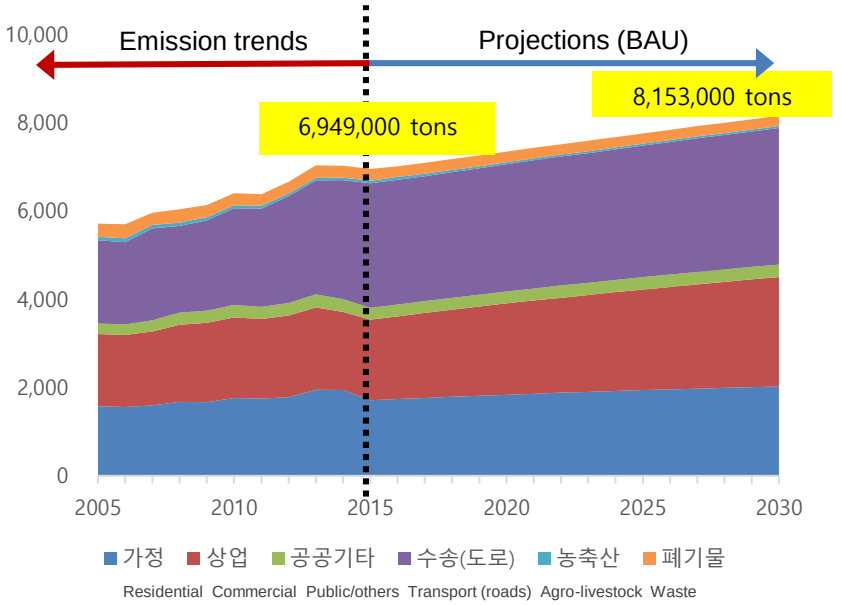


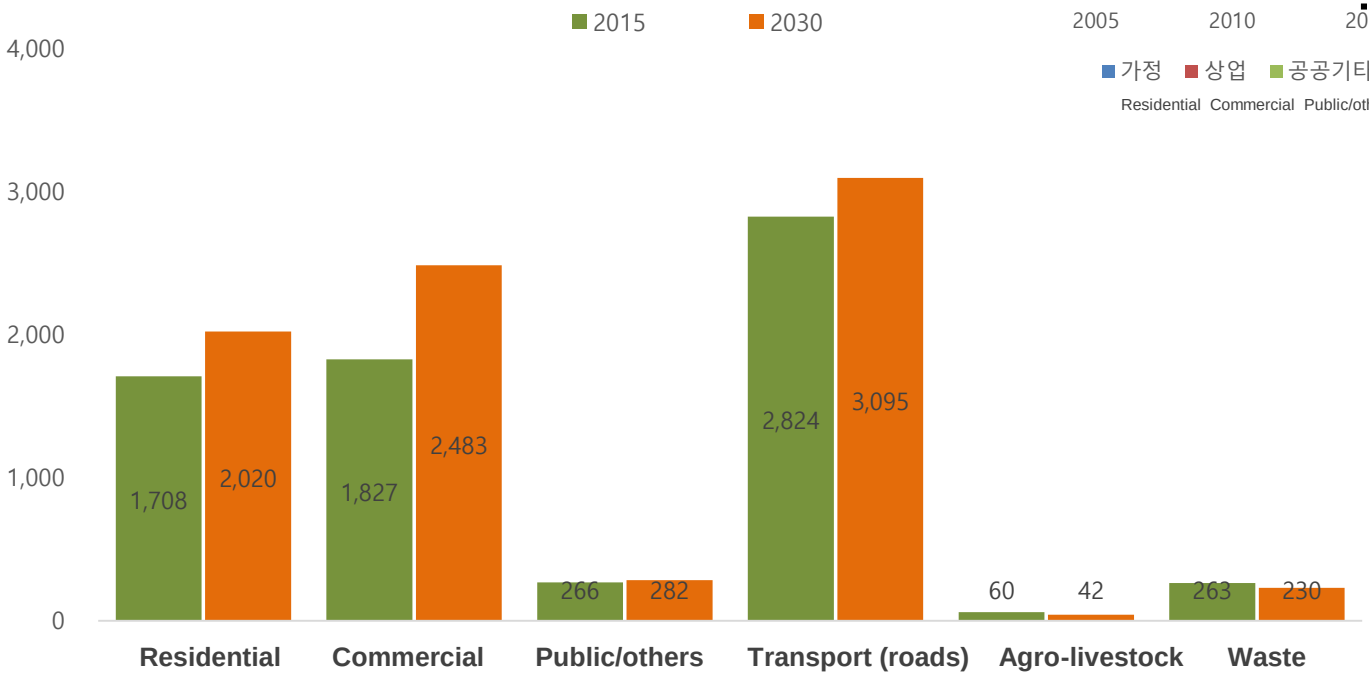
Criteria	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total inventory	8,091	7,962	8,277	8,406	8,424	9,202	9,327	9,483	10,123	9,956	9,840
Reduction inventory	5,710	5,694	5,957	6,037	6,132	6,398	6,376	6,660	7,030	7,024	6,948
Ratio	71%	72%	72%	72%	73%	70%	68%	70%	69%	71%	71%

GHG Emissions: Status and Prospects

❑ Gwangju's estimated total emissions in 2030 (BAU)

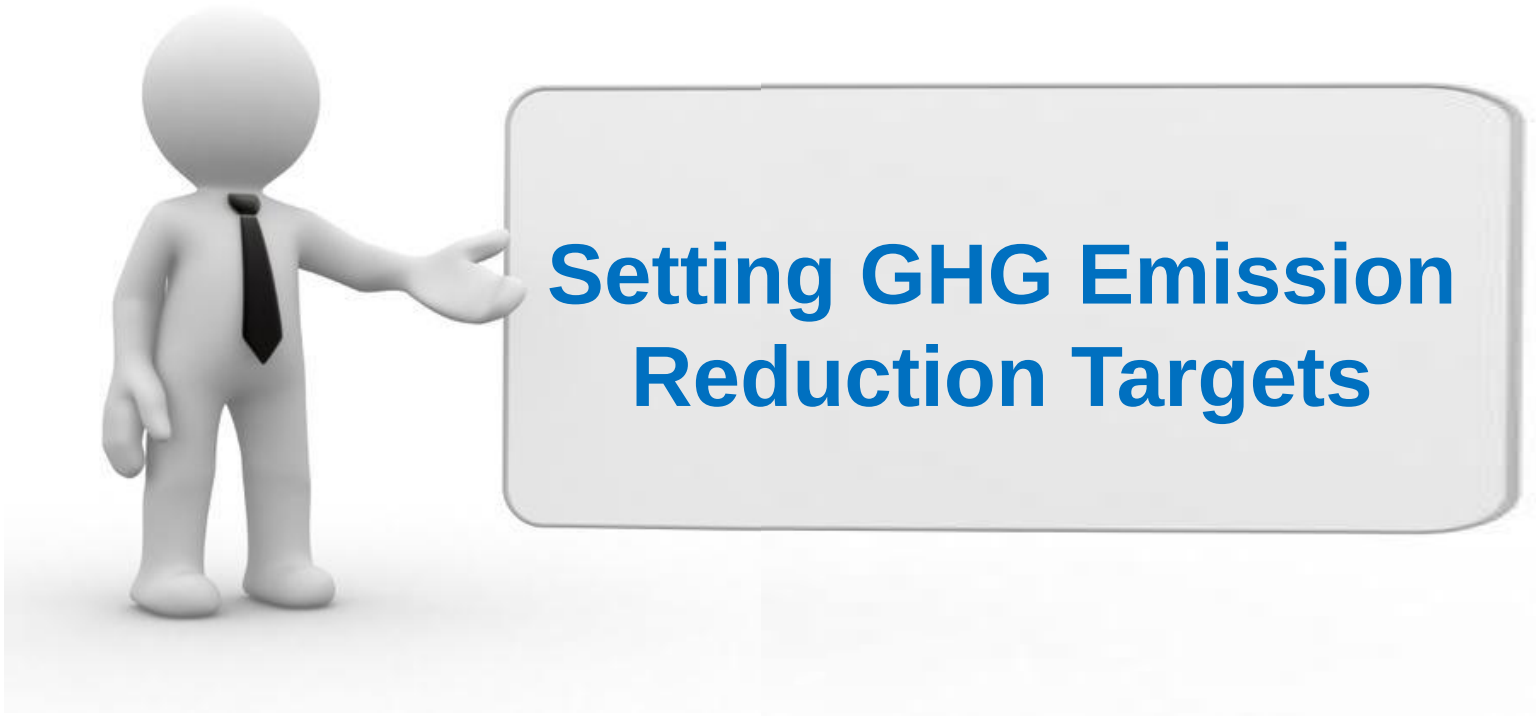
- Overall CAGR between 2015 to 3000: 0.32%
- Up 0.03% in 2025 and 0.05% in 2030 from 2015 levels
- Continued increase in transport and buildings
- Gradual decrease in waste and agro-livestock





※ CAGR by sector (2015-2030)

Residential	1.12%
Commercial	2.07%
Public/others	0.38%
Transport (roads)	0.61%
Agro-livestock	- 2.34%
Waste	-4.94%


Setting GHG Emission
Reduction Targets

Setting GHG Emission Reduction Targets

❑ Types of emission cuts

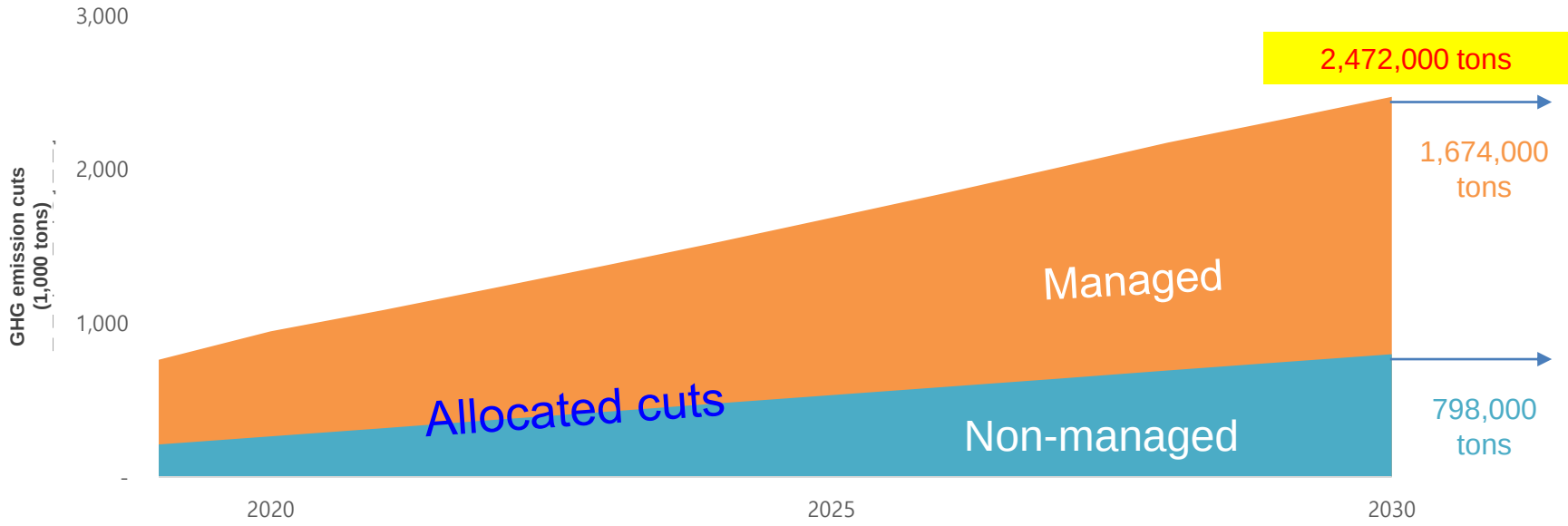
- **Managed cuts:** Emission cuts that can be managed/controlled by a local government's GHG reduction projects
  - → e.g. Solar PV generation, wider adoption of EVs, energy saving in buildings, urban forests
  - → Emissions can be monitored, which allows for planned reduction
- **Non-managed cuts:** Emission cuts that cannot be managed/controlled by GHG reduction projects
  - → e.g. Population decline, recession, uptake of new technology, strengthened efficiency, eco-friendly buildings, improvement of existing facilities
  - → Emissions cannot be monitored as they occur from random and multiple sources/projects; planned reduction is impossible

Total emissions to be reduced (1,000 tons)	Managed cuts (1,000 tons)	Non-managed cuts (1,000 tons)
2,472	1,674	798

Gwangju needs to cut down 1,674,000 tons CO_2eq. by 2030

Setting GHG Emission Reduction Targets

❑ Gwangju's target emission cuts by 2030 based on reduction potentials

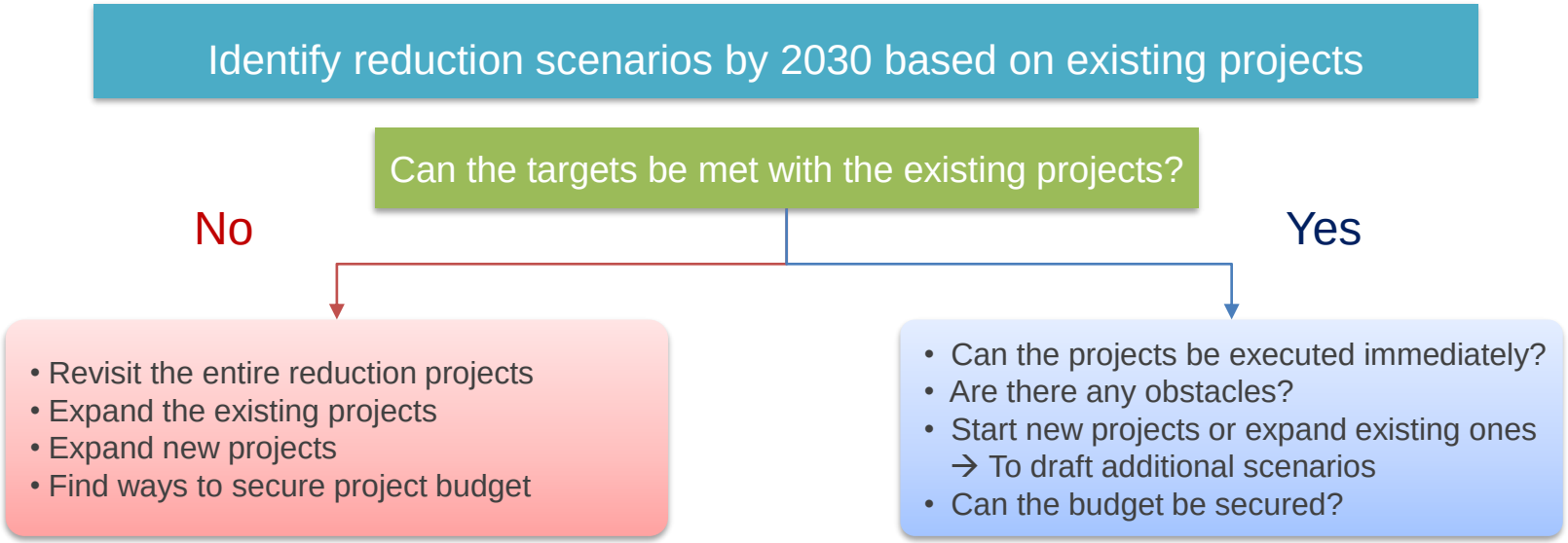


Criteria		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2030 BAU		7,253	7,344	7,427	7,512	7,587	7,672	7,756	7,839	7,921	7,993	8,073	8,153
Reduction potentials	Residential	222	281	317	354	390	425	460	494	528	562	596	629
	Commercial	302	373	418	465	513	562	612	660	709	759	810	861
	Public/others	30	39	42	46	49	53	57	60	63	66	70	73
	Transport (roads)	183	224	274	327	382	443	507	576	649	724	779	839
	Agro-livestock	1	2	2	2	2	2	2	3	3	3	3	3
	Waste	25	29	32	36	40	44	48	52	55	59	63	66
	Subtotal	763	947	1,085	1,230	1,377	1,529	1,685	1,844	2,008	2,174	2,320	2,472
Managed	Project-based cuts	249	682	767	858	952	1,050	1,153	1,259	1,369	1,482	1,575	1,674
Non-managed	Cuts	211	425	479	532	586	639	692	745	798	692	745	798
Total emission cuts		763	947	1,085	1,230	1,377	1,529	1,685	1,844	2,008	2,174	2,320	2,472

Setting GHG Emission Reduction Targets

❑ Ways to set reduction targets and possible reduction scenarios

- **Ensure the targets are based on Gwangju's current emission trends and are achievable**
- **Reduce administrative and budget burdens by building on existing projects, where possible**
  → **Target proposal to be based on proposed reduction measures and actionable means**
- **"Managed, project-based reduction potentials + Non-managed reduction potentials = total cuts"**
  ※ This doesn't involve management of non-managed cuts
  → **Consider non-managed cuts**
  e.g. Encourage participation through education, promotion and awareness-raising campaigns in managed indirect emissions projects
  → **This is because the authority to control non-managed cuts is undefined, even if the cuts are from within Gwangju**
  → **Unlike managed cuts, it is impossible to monitor non-managed cuts; a local government can only adjust emissions through GHG reduction projects**



Setting GHG Emission Reduction Targets

❑ 2 suggested scenarios for emissions reduction

Scenario 1(S_1)

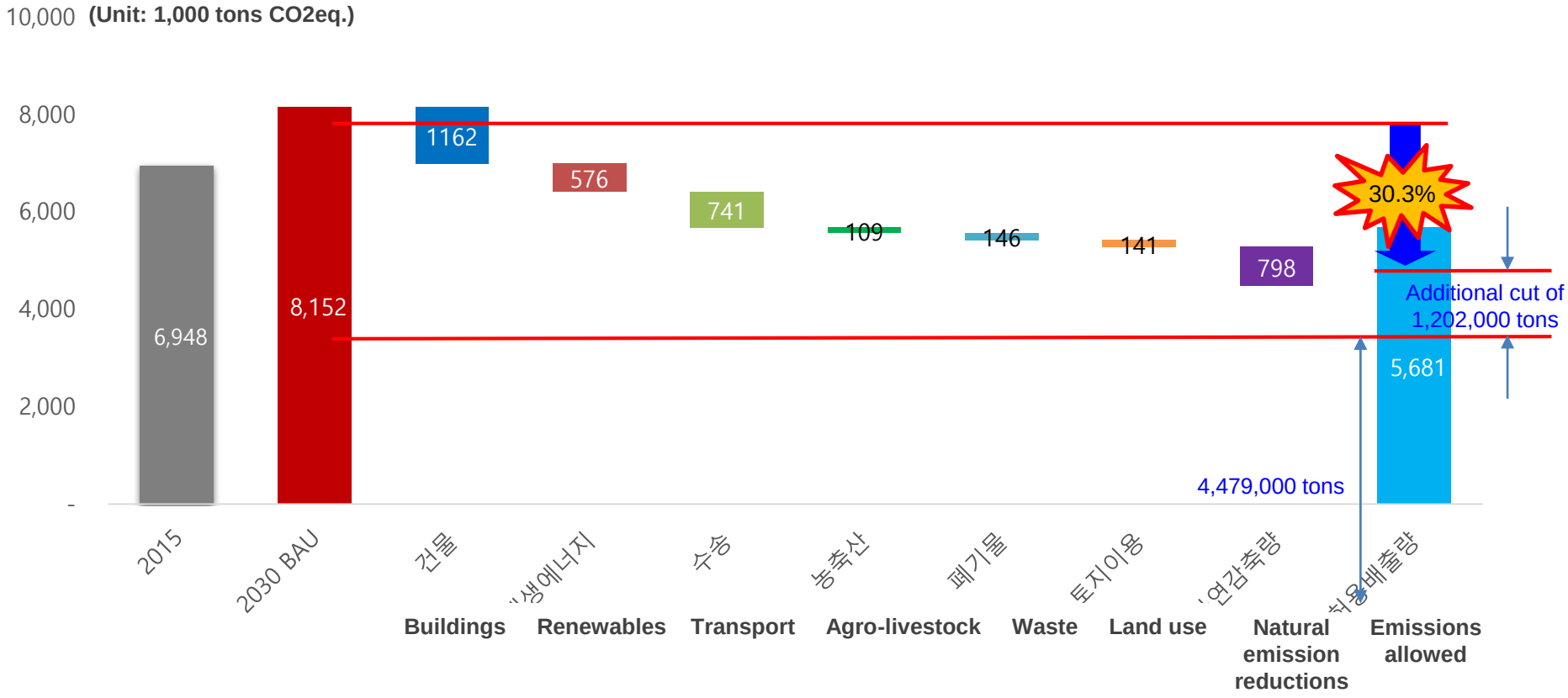
- Review Gwangju's existing climate projects
- Make conservative estimates of the projects' growth rates from 2011 to 2016
- Minimize administrative burden
- Note the improvement required to meet the reduction targets
- Ensure that the selected reduction projects are effective

Scenario 2(S_2)

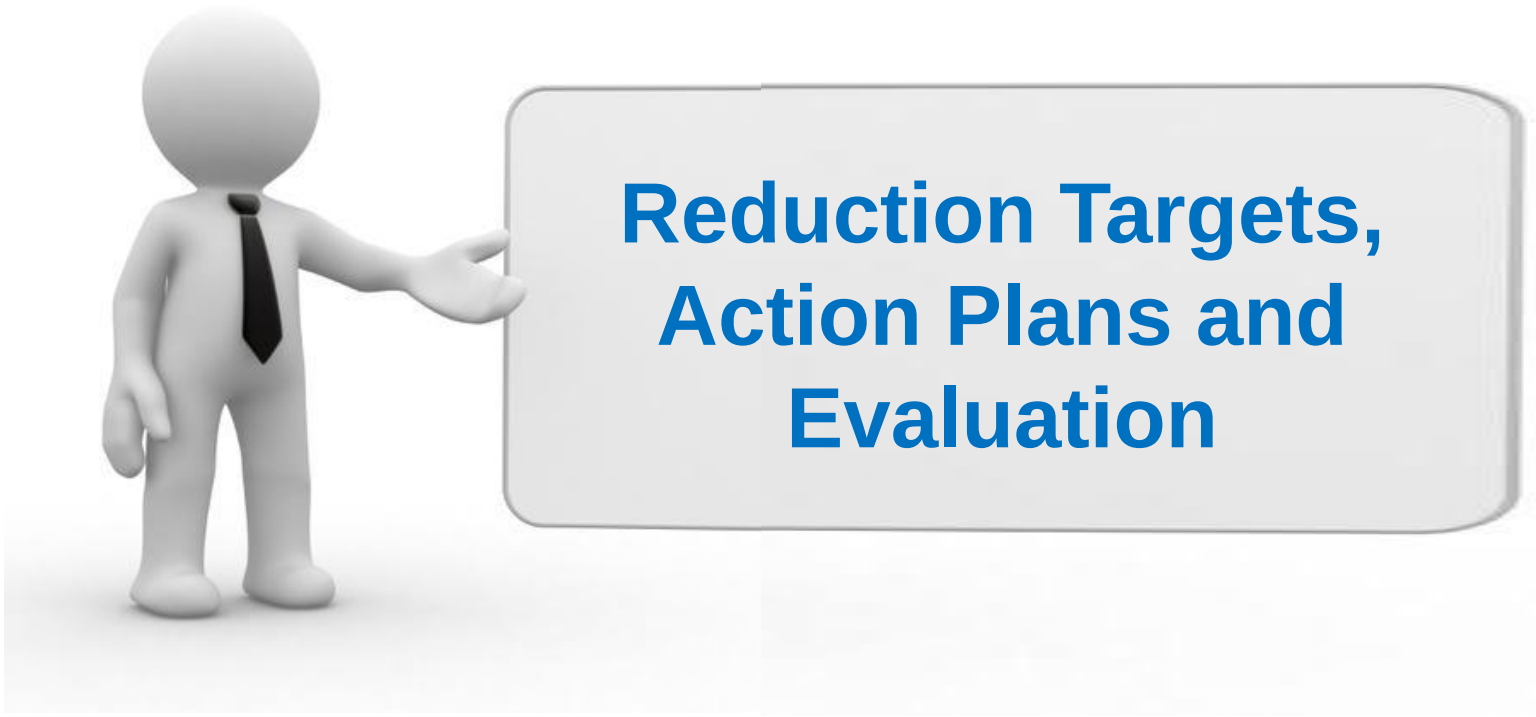
- Expand the selected existing projects in Scenario 1 and add new projects to increase reductions
- If Scenario 1 fails to meet the reduction targets, propose guidelines on additional projects
- A mix of expanded existing projects and new projects
  - Expanded existing projects: Effectiveness, feasibility
  - New projects: Effectiveness, feasibility

Setting GHG Emission Reduction Targets

❑ Overall reduction targets



- If reduction targets are met, GHG emissions in 2030 will be 82% of 2005 levels
- If Scenario 2 reduction targets are met, GHG emissions in 2030 will be 53% of 2005 levels


Reduction Targets,
Action Plans and
Evaluation

Vision, Goal and Strategies

❑ 2030 Gwangju GHG emissions reduction roadmap

Vision

Gwangju, a green city and a leader in low-carbon urban growth

Goal

To cut down GHG emissions by 30.3% from BAU levels in 2030

Guiding principles

- Public sector-led GHG reduction efforts involving citizen participation
- Toward a low-carbon city where the economy thrives and jobs are created
- Inclusive reduction initiatives that first cater for the vulnerable
- Groundwork for a transition to low-carbon urban living

Core strategies

Environment Green space	Economy New energy industries	Society Low-carbon culture
Expand green space that lowers temperatures in the city and protects from fine dust to increase carbon absorption	Foster and develop new energy industries to create jobs and reduce GHG emissions	Lay the groundwork for a low-carbon, green-living culture based on citizen and community involvement

Implementation strategies

- Leading and effective GHG reduction policy in the public sector
- Initiatives linked to the city's sectoral plans and policy that deliver tangible results
- New initiatives based on Fourth Industrial Revolution technologies and new energy industries
- Everyday GHG reduction campaigns that ensure citizen and community involvement

Action Plans by Sector

❑ Sectoral action plans: 61 projects in total (under Scenario 2)

Sector	Scenario 1		Scenario 2 (Strengthened reductions)		Action plans
	Target cuts (1,000 tons)	Share (%)	Target cuts (1,000 tons)	Share (%)	
Buildings	349	39	1,162	25	**Energy efficiency and performance improvements in buildings based on citizen participation** • Energy-saving and improved efficiency in public facilities • Energy-saving and improved performance in existing buildings • Performance improvements in new buildings to enhance energy efficiency • GHG emissions reduction in buildings facilitated based on citizen participation
Renewables	71	8	576	19	**GHG emissions reduction by generating 20% of electricity from renewables** • Wider deployment and expanded support for renewables • Production of renewables using idle land and resources • Energy self-sufficiency in public facilities
Transport	265	30	741	22	**Shift to green mobility to reduce fine dust and GHG emissions** • Wider use of eco-friendly modes of transport • Green transport solutions to cut down fine dust and GHG emissions • Energy-saving in transport infrastructure
Waste	138	15	146	3	**Laying the groundwork for a resource circulation city through a virtuous cycle of waste management** • Waste reduction and green product purchases • Energy-saving and turning waste into energy in wastewater treatment facilities
Agro-livestock	0.55	0	109	26	**Expanded urban farming and energy efficiency to reduce GHG emissions** • Green diet and eco-friendly local food • GHG emissions reduction using agricultural facilities and by-products
Land use	66	7	141	4	**Less reduction burden with urban forests contributing to GHG emissions reduction** • Expanded green space that lowers temperatures in the city • Create accessible carbon sinks in the city
Total	890	100	2,876	100	

Action Plans by Sector

❑ Buildings

Carbon points program

- Project description
  - Voluntary, citizen-led energy-saving efforts rewarded with incentives
- Project scope and budget (for 2030)
  - Combined (electricity, city gas, water) / 80 bil won (state funding 39 bil, city funding 41 bil)
- Estimated emissions cuts: 97,000 tons

NOx reduction equipment

- Project description
  - NOx reduction equipment installed at SMEs to reduce GHG emissions and fine dust
- Project scope and budget (emissions cuts for 2030/budget for 2018)
  - 878 units/ 526 mil won (state funding 376 mil, city funding 150 mil)
- Estimated emissions cuts: 232,000 tons

Action Plans by Sector

❑ Buildings

Building energy management system (BEMS)

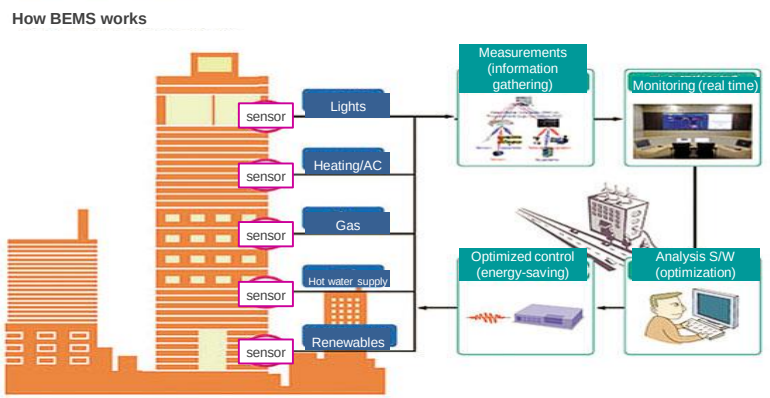
- Project description

  - Energy management system introduced to new buildings to cut down GHG emissions (required by law)

- Project scope and budget (for 2030)

  - 2,427,194m^2 / Existing policy measure; no budget needed

- Estimated emissions cuts: 316,000 tons (accumulated)



Performance improvements in new public buildings

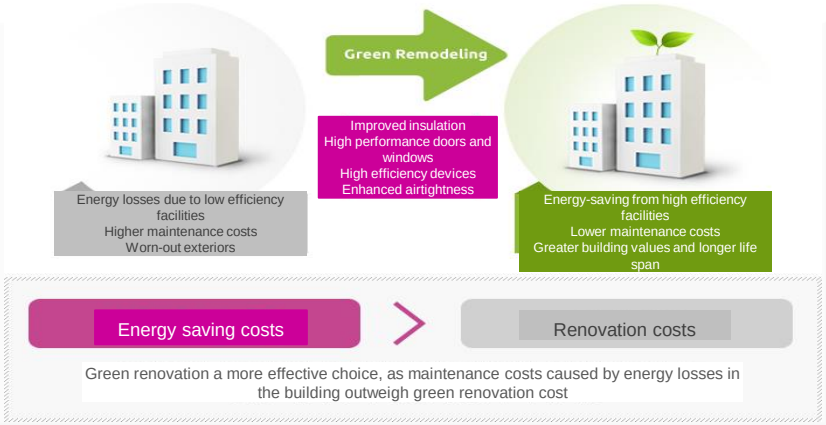
- Project description

  - Mandatory building energy efficiency standards from 2030 for public buildings

Project scope and budget (emissions cuts for 2030/budget for 2018)

  - 2,917,230m^2 / Existing policy measure; no budget needed

- Estimated emissions cuts: 269,000 tons (accumulated)



Action Plans by Sector

❑ Renewables

Community energy supply

- Project description
  - Electricity generated from combined heat and power plants is supplied to a local community to save energy and reduce GHG emissions
- Project scope and budget (for 2030)
  - 21,587,500m^2 / Facilities already installed; maintenance project
- Estimated emissions cuts: 48,000 tons

Subsidies for homes with renewable technology

- Project description
  - Solar PV, solar heat, geothermal or fuel cell installations in homes are entitled to subsidies.
- Project scope and budget (emissions cuts for 2030)
  - 674kW (solar PV) / 320 mil won (for 2018)
- Estimated emissions cuts: 286,000 tons (accumulated)

Action Plans by Sector

❑ Renewables

Rooftop solar PV panels at elementary/middle/high school

- Project description
  - Solar PV panels installed on the roofs of 20 elementary /middle/high schools per year
- Project scope and budget (for 2030)
  - 2,000kW per year / 3 bil won (private funding)
- Estimated emissions cuts: 82,000 tons (accumulated)

Agricultural solar sharing

- Project description
  - Solar PV panels installed on farmland to contribute to reducing GHG emissions and help farmers earn additional income
- Project scope and budget (emissions cuts for 2030)
  - 674kW (solar PV) / 4 bil won (private funding)
- Estimated emissions cuts: 69,000 tons (accumulated)

Action Plans by Sector

❑ Transport

A leader in EV uptake

- Project description
  - Deployment of EVs in the city to reduce GHG emissions and fine dust
- Project scope and budget (for 2030)
  - 248,000 units (accumulated) / 28.5 bil won (for 2019)
- Estimated emissions cuts: 248,000 tons (accumulated)

LCV and ZEV uptake

- Project description
  - Deployment of low emission FCEVs to reduce GHG emissions and fine dust
- Project scope and budget (emissions cuts for 2030)
  - 674kW (solar PV) / 23.9 bil won (state funding 11.6 bil, city funding 12.4 bil)
- Estimated emissions cuts: 107,000 tons (accumulated)

Action Plans by Sector

❑ Transport

Increased public transport share of travel

- Project description
  - City's transport network centering on public transport to reduce GHG emissions and fine dust
- Project scope and budget (for 2030)
  - 45,000 out of 459,000 units / 6 bil won (total budget)
- Estimated emissions cuts: 115,000 tons

Once a week no driving day campaign

- Project description
  - A weekly no driving day program to boost public transport use and reduce GHG emissions and fine dust
- Project scope and budget (emissions cuts for 2030)
  - 68,000 out of 459,000 units / no budget needed
- Estimated emissions cuts: 18,000 tons

Action Plans by Sector

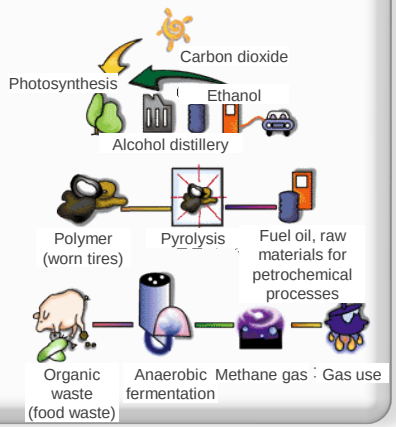
❑ Waste

Waste reduction at source

- Project description
  - RFID-based volume-based waste fee system; GHG emissions reduced across all stages from waste collection to treatment
- Project scope and budget (for 2030)
  - 340,000 households / 5 bil won (accumulated budget)
- Estimated emissions cuts: 7,000 tons

Biogas production using food waste leachate

- Project description
  - Food waste leachate treated to produce biogas energy, contributing to GHG emissions reduction
- Project scope and budget (emissions cuts for 2030)
  - 2,477 tons / Facilities already installed; only maintenance costs will incur
- Estimated emissions cuts: 52,000 tons

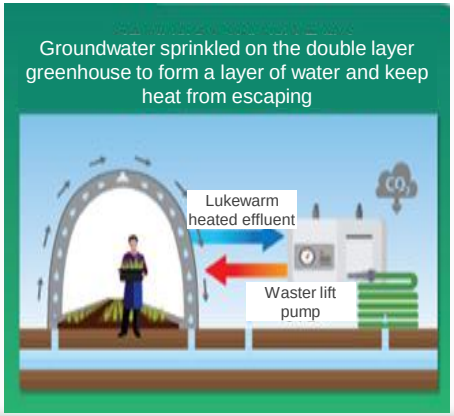


Action Plans by Sector

❑ Agro-livestock

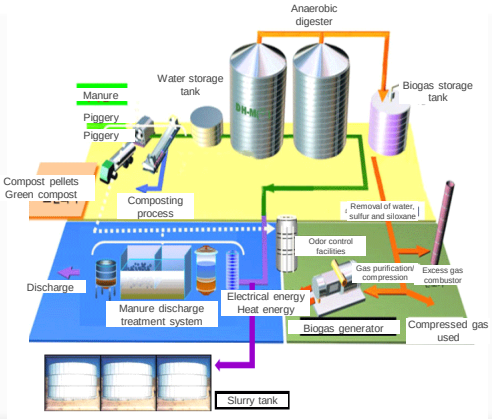
Support for GHG reduction facilities in farming

- Project description
  - Support for energy-saving and efficiency farming facilities to reduce GHG emissions
- Project scope and budget (for 2030)
  - 6ha / 600 mill won (per year)
- Estimated emissions cuts: 500 tons



Biogas plant trial project

- Project description
  - Trial project to create a zero-waste village by turning agricultural waste to energy
- Project scope and budget (emissions cuts for 2030)
  - 20 tons / 10 bil won (state funding)
- Estimated emissions cuts: 93,000 tons



Action Plans by Sector

❑ Land use

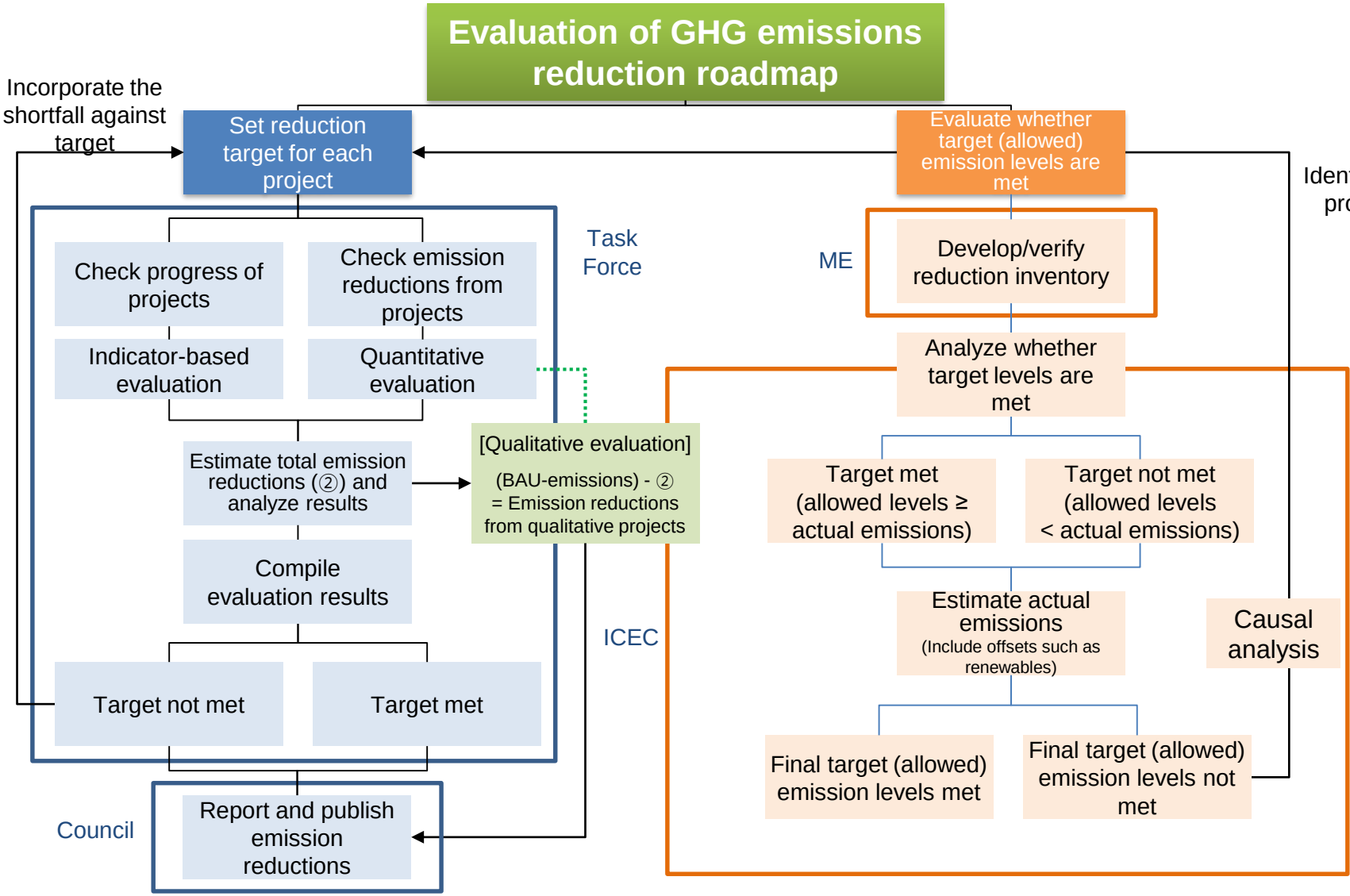
Urban forests: creation and maintenance

- Project description
  - Create urban forests and expand forest resources for climate change adaptation and fine dust mitigation
- Project scope and budget (for 2030)
  - 6,239 ha / 12.5 bil won (for 2018)
- Estimated emissions cuts: 65,000 tons

3D greenery in Gwangju

- Project description
  - Mitigate heat waves and fine dust and create a pleasant urban environment
- Project scope and budget (emissions cuts for 2030)
  - 2.25 mil m^2 / 30 bil won (until 2027)
- Estimated emissions cuts: 3,700 tons

Monitoring and Evaluation




Urban Climate and
Environmental
Assessment Model

Urban Climate and Environmental Assessment Model

❑ Background for model development

New urban environment issue arises

Heat waves/ urban heat island

- Summer heat waves caused by global warming
- Health concerns for the vulnerable
- **Growing use of AC**
- **Environmental issues and global warming**

Fine dust

- Use of fossil fuels creates fine dust
- **Fine dust blown from outside increases concentration**
- **Fine dust stays longer in the area**
- Health concerns for the vulnerable

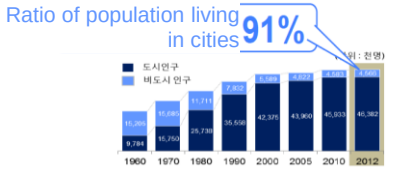
Frequent extreme weather conditions due to climate change

- **Heightened climate variability** caused by global warming
  → Increase in frequency and intensity of abnormal weather events
- **Extreme weather events** have become **routine**
  → e.g. **heat waves**, cold spells, heavy rain, droughts
- Rise in tropical nights, heat-related illnesses and deaths
- Repeated incidents of urban flooding
- **Fine dust** pollution from use of fossil fuels
  → Fine dust stays longer in the city

Need for objective and scientific information about heat waves/fine dust

Changes caused by urbanization

- Over 90% of total population **lives in cities due to urbanization**



90% of world population projected to live in urban areas by 2050

- Population density rises and the **city's structure becomes more complex**
- Increase in population density and industrial/economic infrastructure density
  → More **massive, irregular and complicated** damage
- Man-made structures cause environmental issues
- Management of **sustainable energy** supply and demand necessary

Urban Climate and Environmental Assessment Model

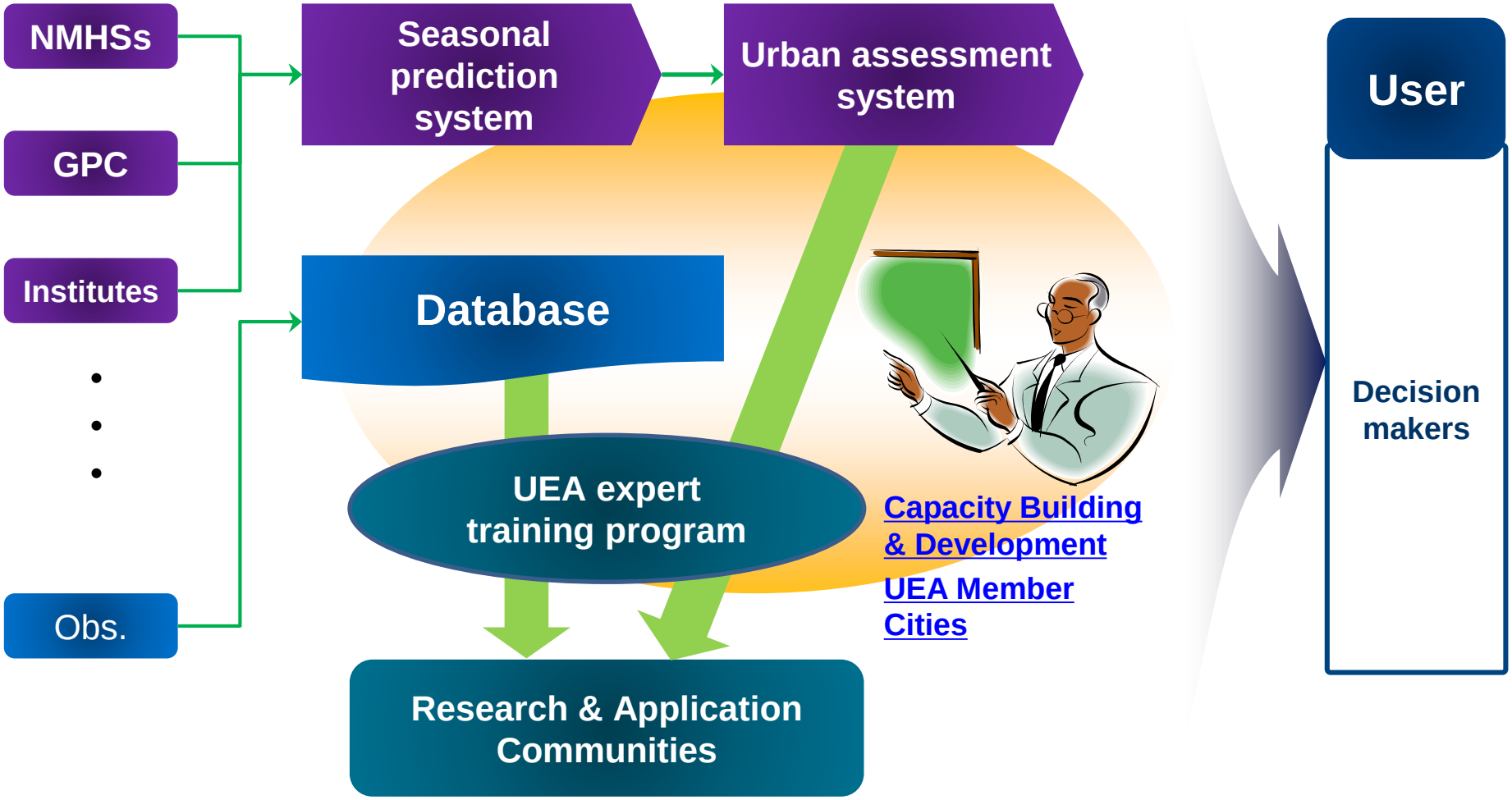
❑ Objectives of model development

Improve the quality of living for citizens and enhance the city's standing by addressing local climate events such as heat waves and fine dust

1. Build an integrated database on heat waves and fine dust and use it as a decision making tool to assist administrative action
2. Develop policies based on research and promote the growth of relevant industries
3. Provide a wealth of information to improve the health of citizens and strengthen their climate response
4. Strengthen the climate response of cities worldwide through the UEA's Knowledge Sharing Programs

Urban Climate and Environmental Assessment Model

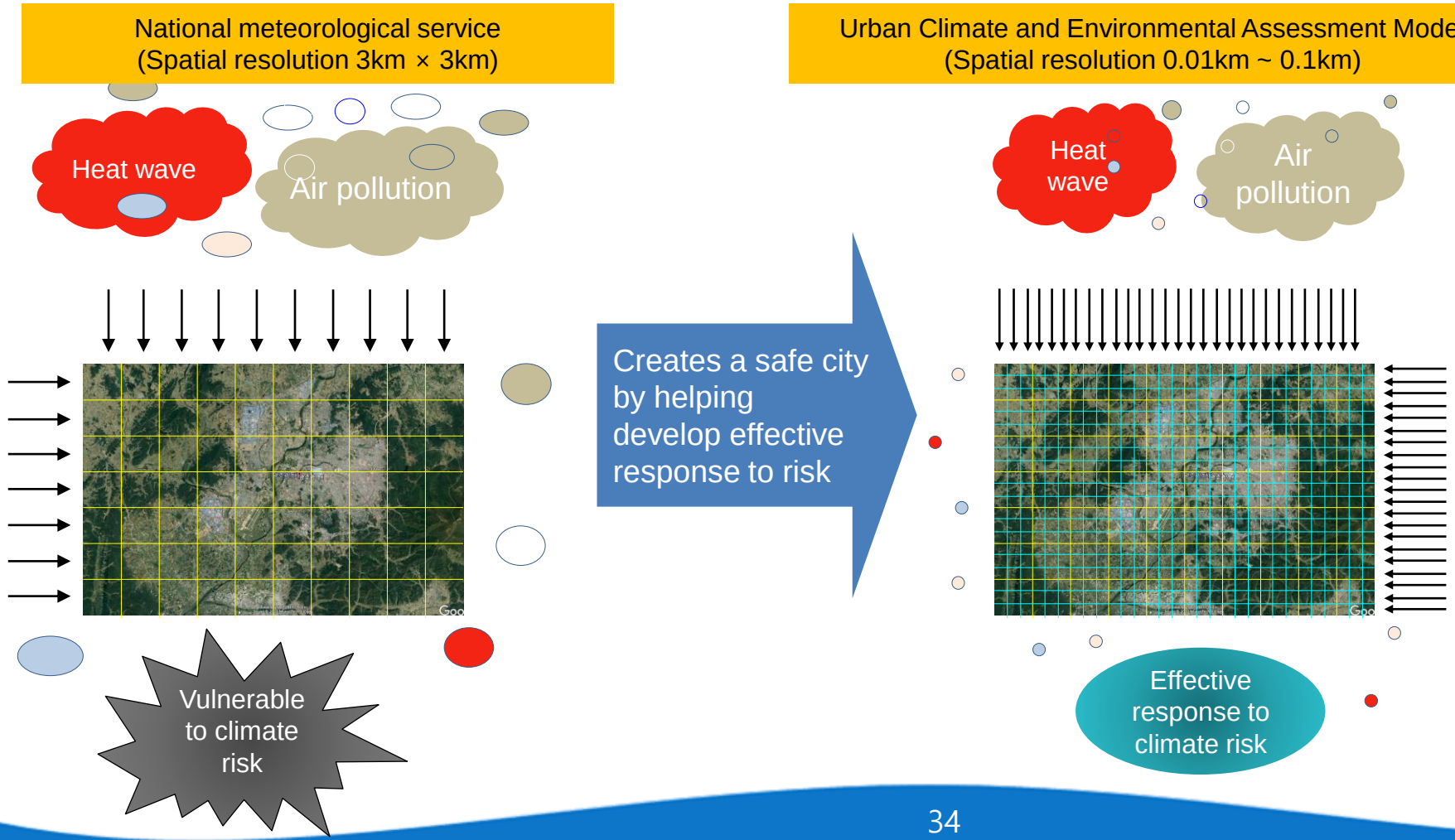
❑ Model structure and how it works



Urban Climate and Environmental Assessment Model

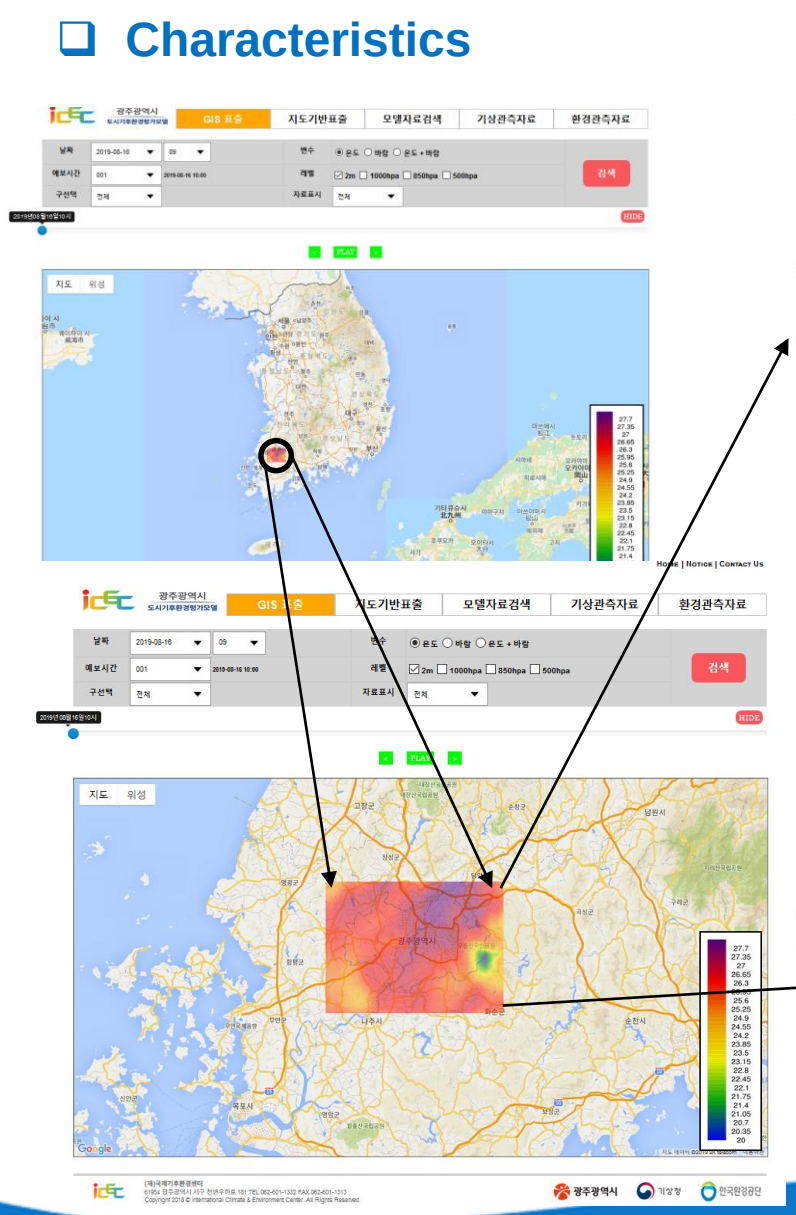
❑ Characteristics

- **Model builds on the existing meteorological service to enable city-specific service based on the city's microclimate**



Urban Climate and Environmental Assessment Model

❑ Characteristics

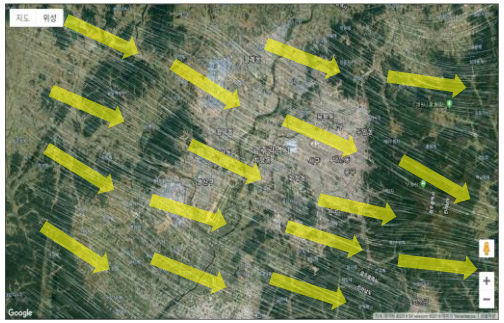


Urban Climate and Environmental Assessment Model

❑ Characteristics

Analysis of wind trajectories in the city to analyze, evaluate and predict the wind path

2019. 08. 16. 10hour



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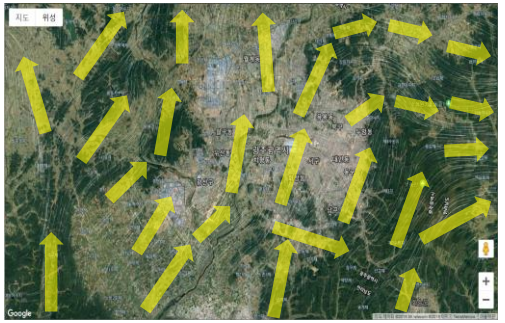
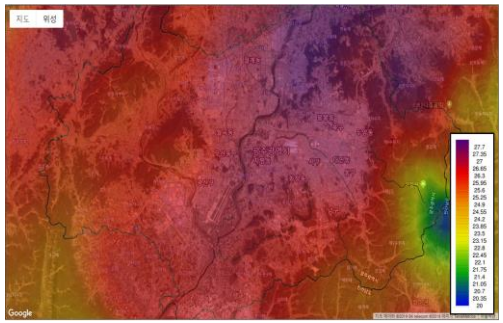


2019. 08. 16. 23hour

Analysis of the city's overall heat environment; spatial analysis, evaluation and prediction of areas vulnerable to heat



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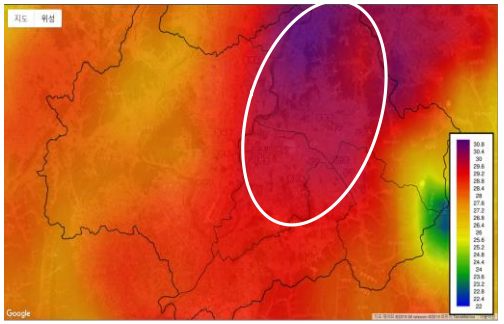

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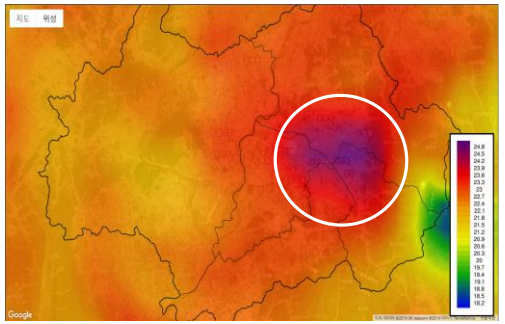
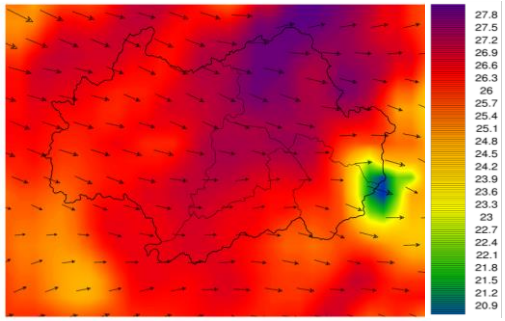


2019. 08. 16. 23hour

Analysis and evaluation of heat and wind environments



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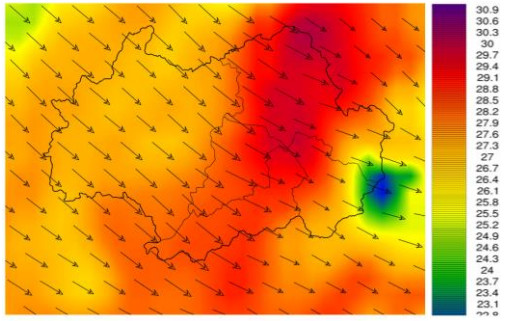

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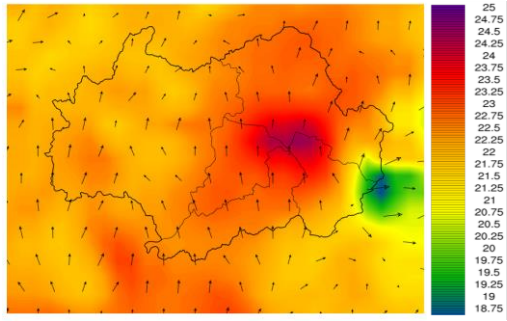

2019. 08. 16. 23hour

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