Low-Carbon Green City for Sustainable Development

- Future Trend and Advanced 3D Compact-City Strategies-

2011. 10.

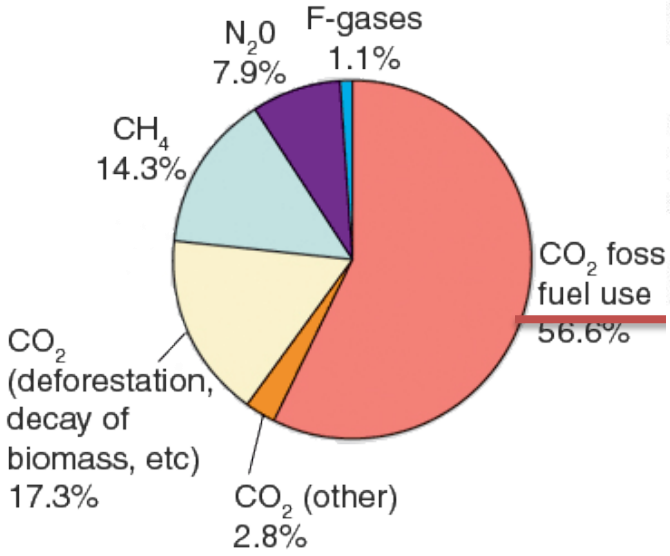
Hyungun SUNG
Ph.D in Urban Planning
Research Fellow
Director of the center for future city and TOD research

KOTI THE KOREA TRANSPORT INSTITUTE

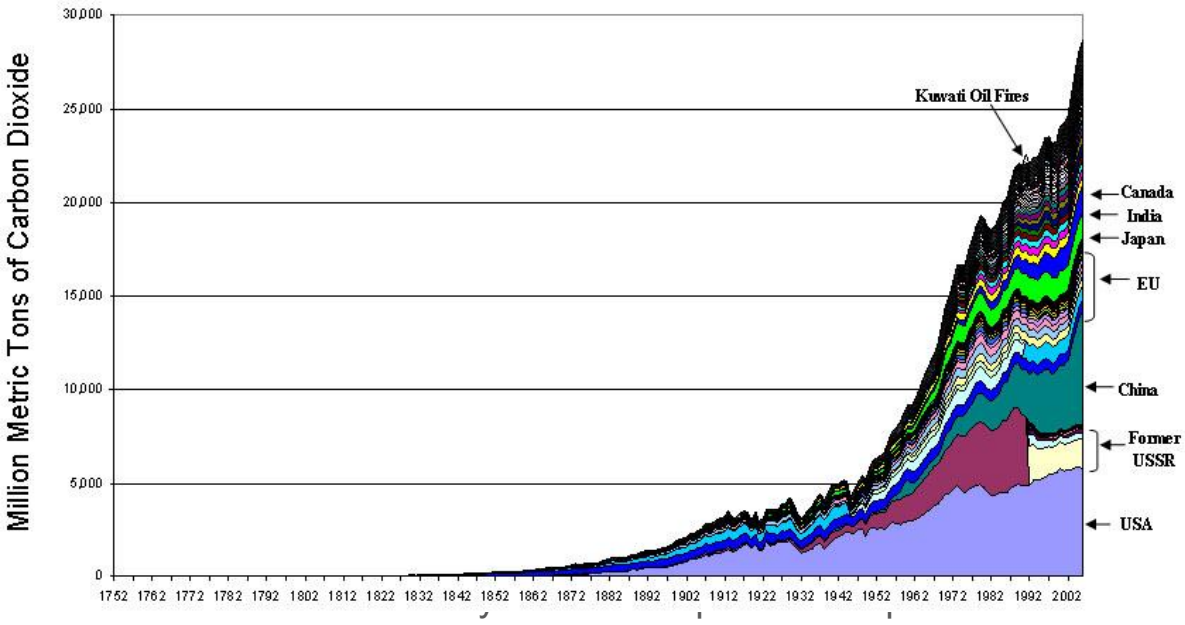
Note: Most of this presentation is also addressed in the joint conference of KOTI-OECD in Paris, 2010

1. Climate Change and Greenhouse Gas Emission

Global Anthropogenic Greenhouse Gas Emissions in 2004



Reference: IPCC 4th Assessment Report:Climate Change 2007: Synthesis Report
Source: http://www.epa.gov/climatechange/emissions/globalghg.html



Global CO2 Emissions: 1752-2006

Reference: IPCC 4th Assessment Report:Climate Change 2007: Synthesis Report
Source: http://www.epa.gov/climatechange/emissions/globalghg.html

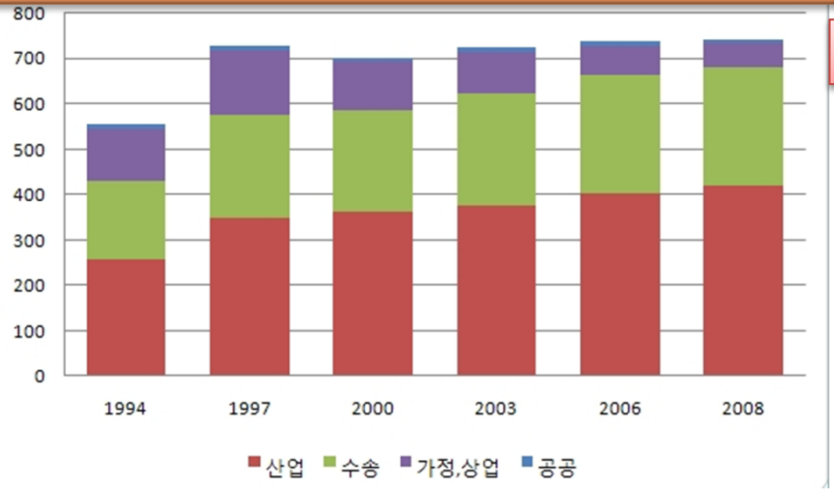
2. GHG and Transport in Korea

Greenhouse Gas Emissions in Korea

- 16th rank in the world(594.4Mt·CO2, Yr. 2005)
- 4th rank among OECD countries in increasing rate during past 5 years
- 25% for Buildings and 17% for Transportation

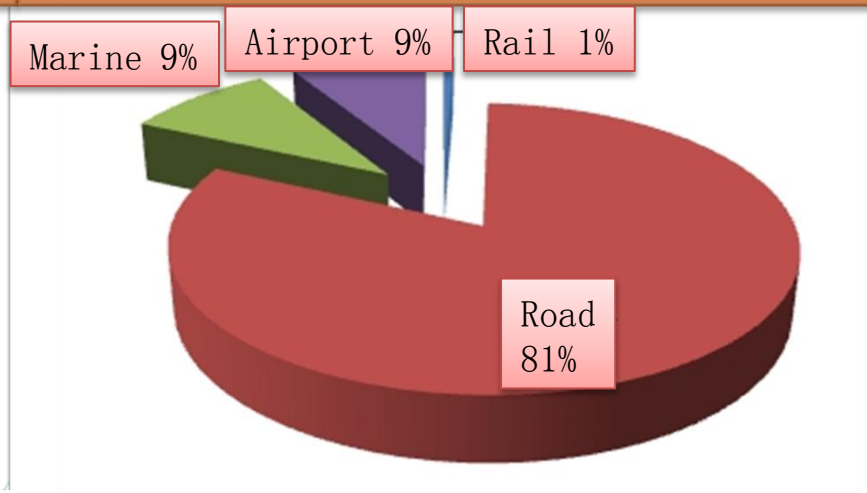
Trend on Energy

35% for transport among total domestic GHS emissions



Split in Transport

81% for road part among transport energy consumption



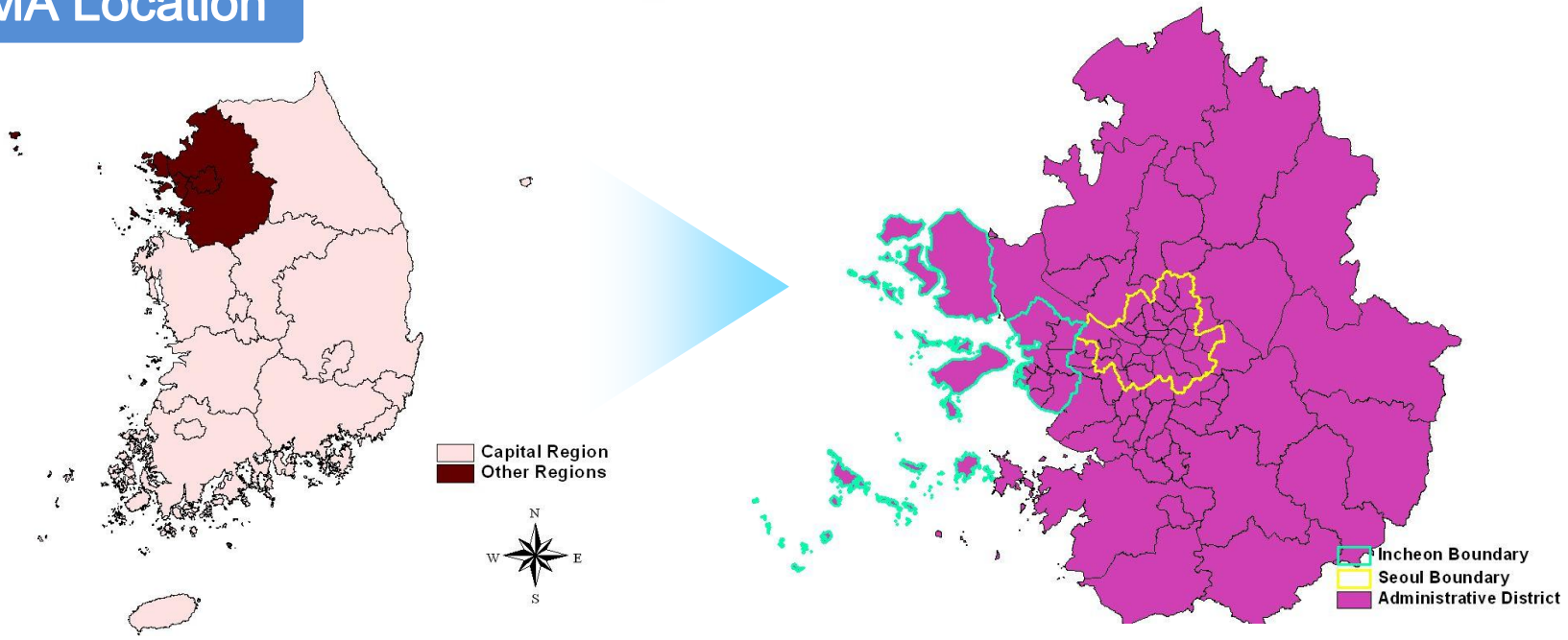
Source: KEEI

Ⅱ Future Trend & Seoul, Korea

1. Seoul and Korea at Present
2. Future Trend on Seoul, Korea and the World
3. Future Trend Summary and Development Prospect

1. Seoul Metropolitan Area(SMA) at Present

SMA Location



SMA's Administrative Government Structure

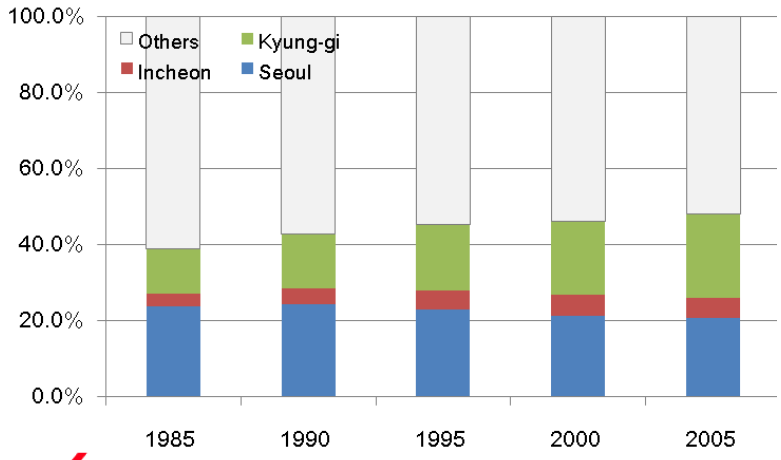
Seoul MA City	Incheon MA City	Kyung-gi Province
25 Districts(Gu)	8 Districts+2 Counties(Gun)	27 Cities (Si)+4 Counties

1. Seoul and Korea at Present

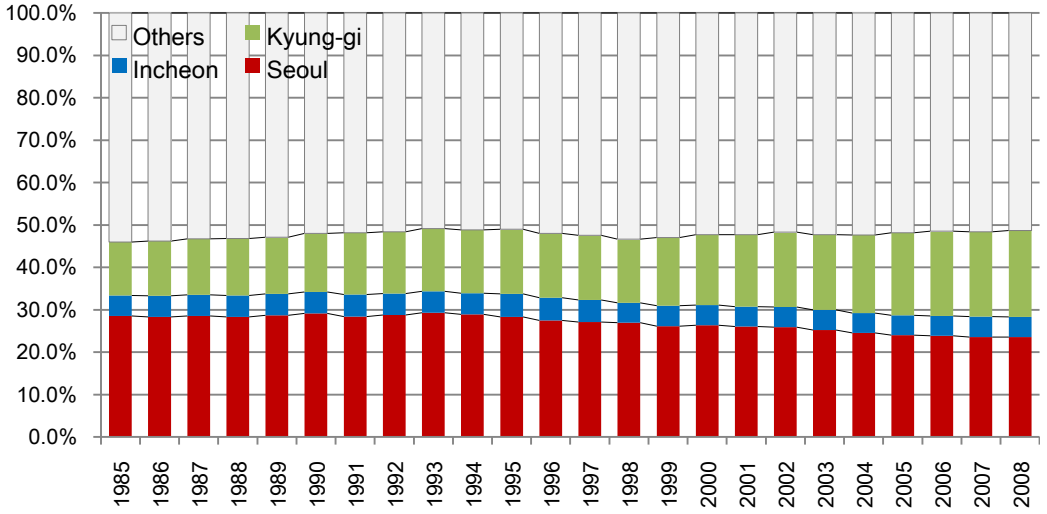
Population and Economy

		Population (Yr 2005)	% Pop. To Entire Korea	No. of Employees in 2008	No. Firms (Yr 2008)	% No. of Employees to Entire Korea	% GRDP to Entire Korea
Seoul MA	Seoul	9,820,171	20.77%	8,158,554	1,439,374	25.0%	23.6%
	Incheon	2,531,280	5.35%	1,487,299	310,145	4.5%	4.7%
	Kyung-gi	10,415,399	22.03%	6,403,782	1,153,201	19.6%	20.3%
	Total	22,766,850	48.15%	16,049,635	2,902,720	49.3%	48.6%
Entire Korea		**47,278,951**	**100.0%**	**32,576,560**	**6,529,564**	**100.0%**	**100.0%**

Population(%)



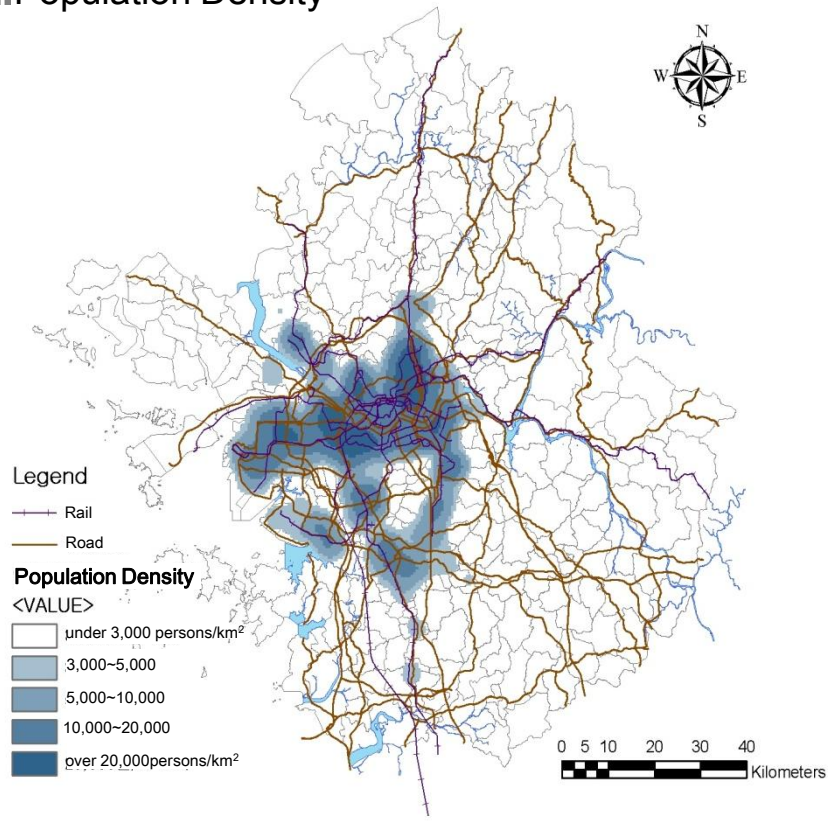
GRDP to Entire Korea(%)



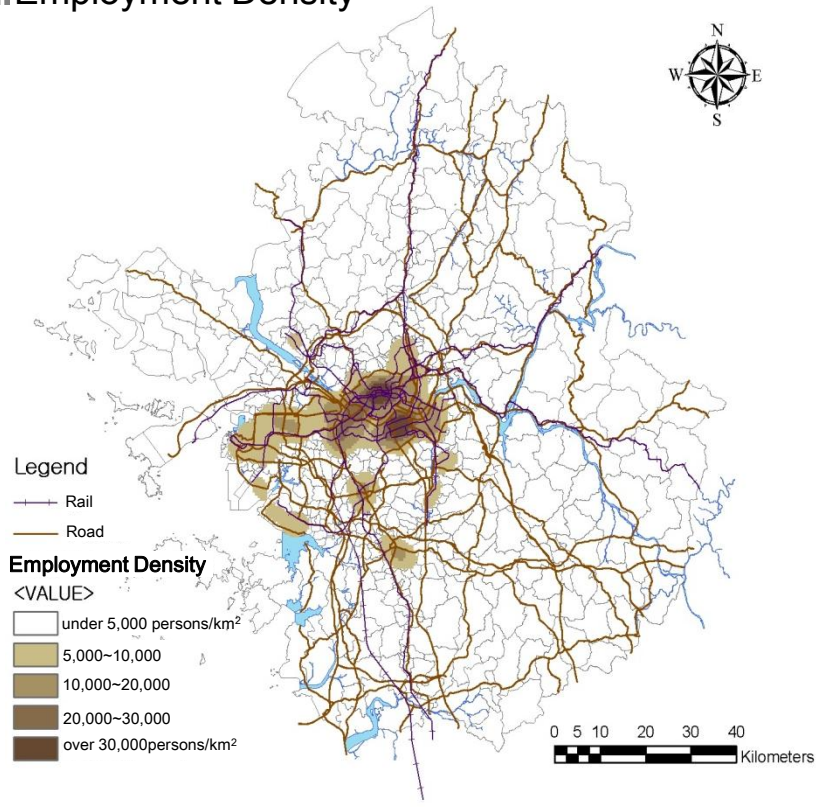
1. Seoul and Korea at Present

Population and Economy

Population Density



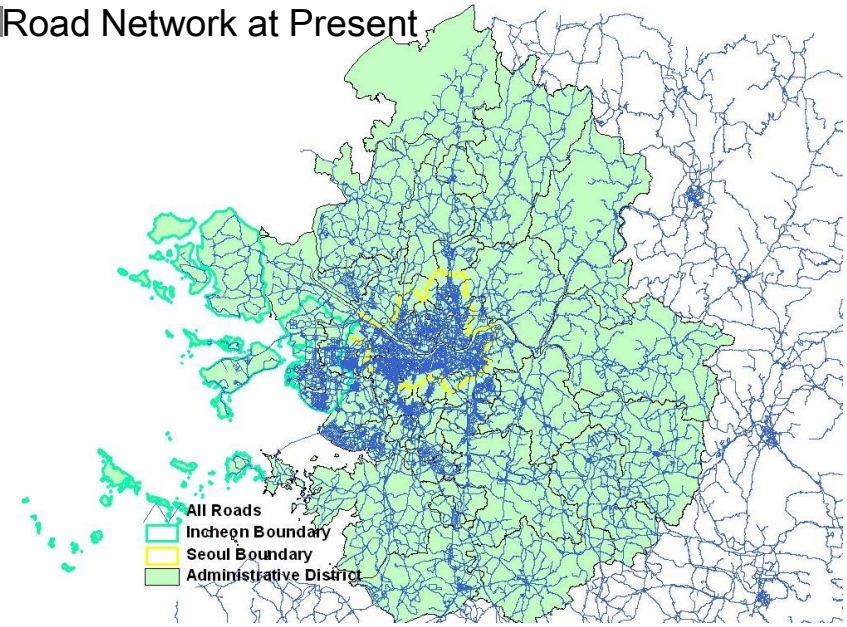
Employment Density



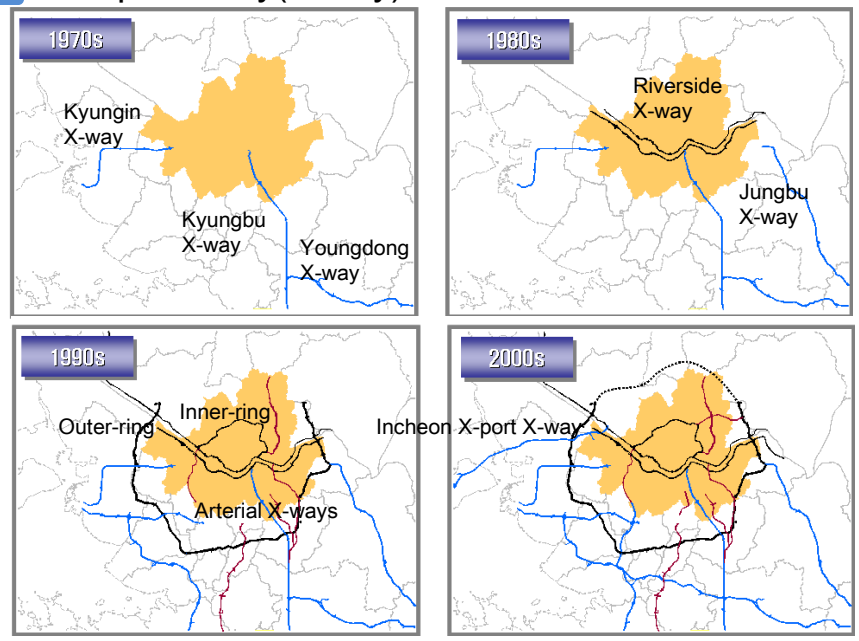
1. Seoul Metropolitan Area(SMA) at Present

Road-Oriented Suburbanization

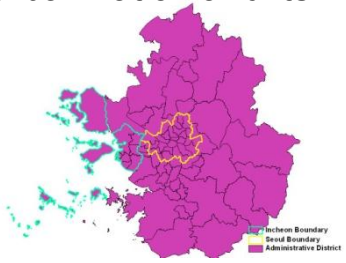
Road Network at Present



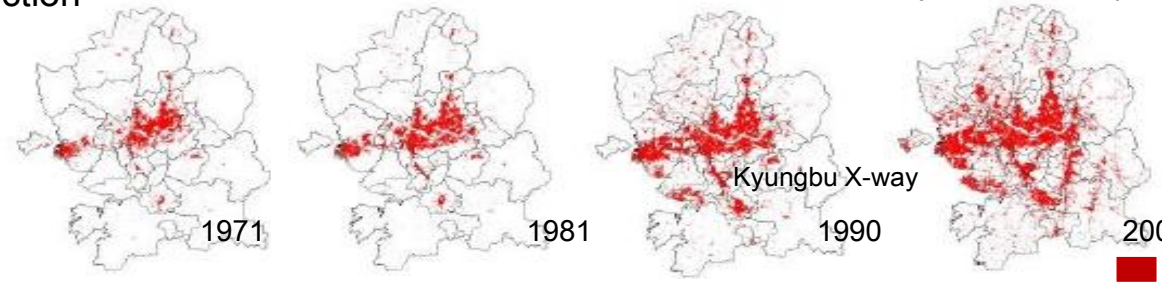
Expressway(X-way) Investment



Suburbanization and its Direction

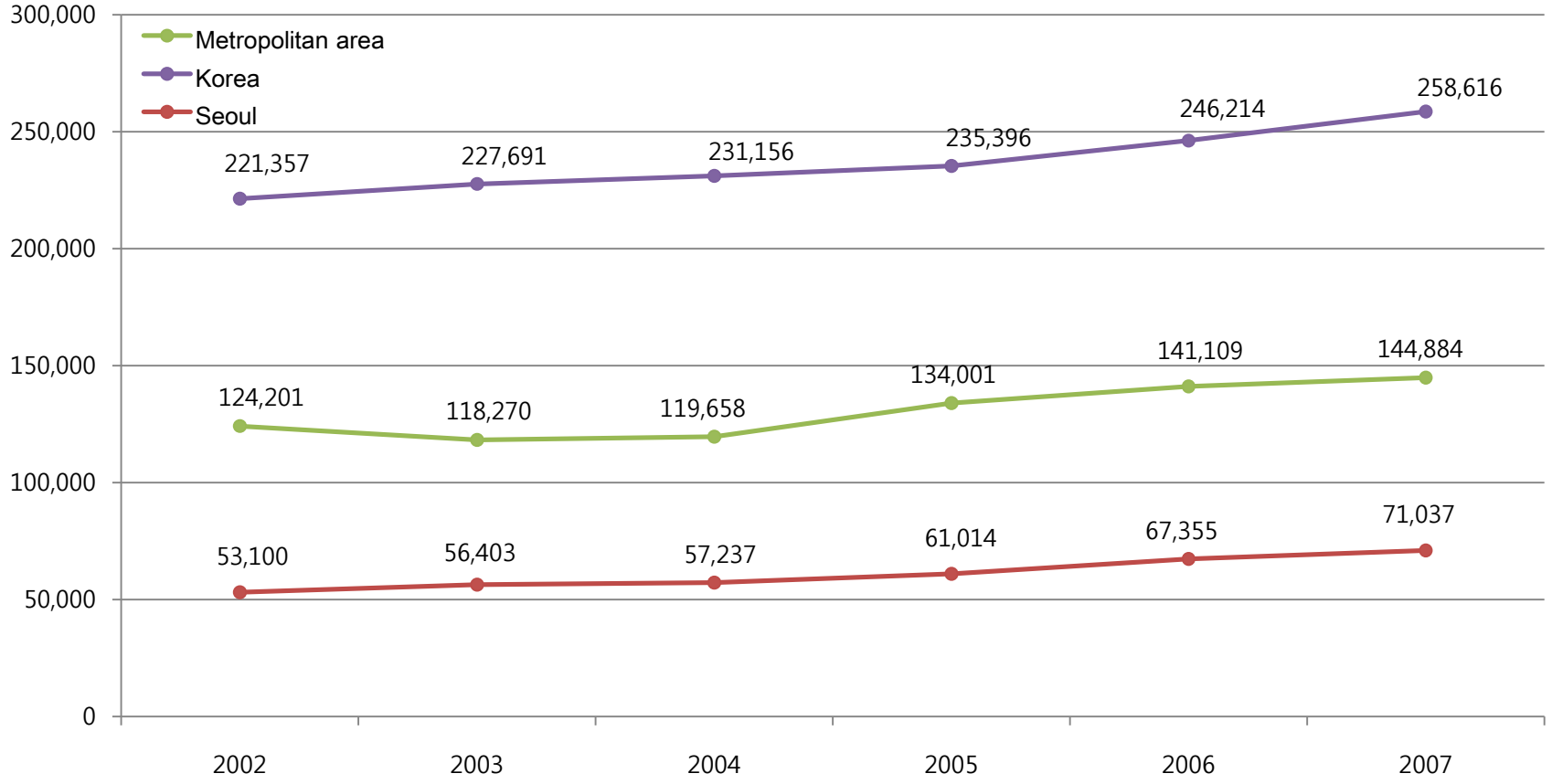


New Town Dev. Projects Without-City



1. Seoul Metropolitan Area(SMA) at Present

Traffic Congestion and Costs

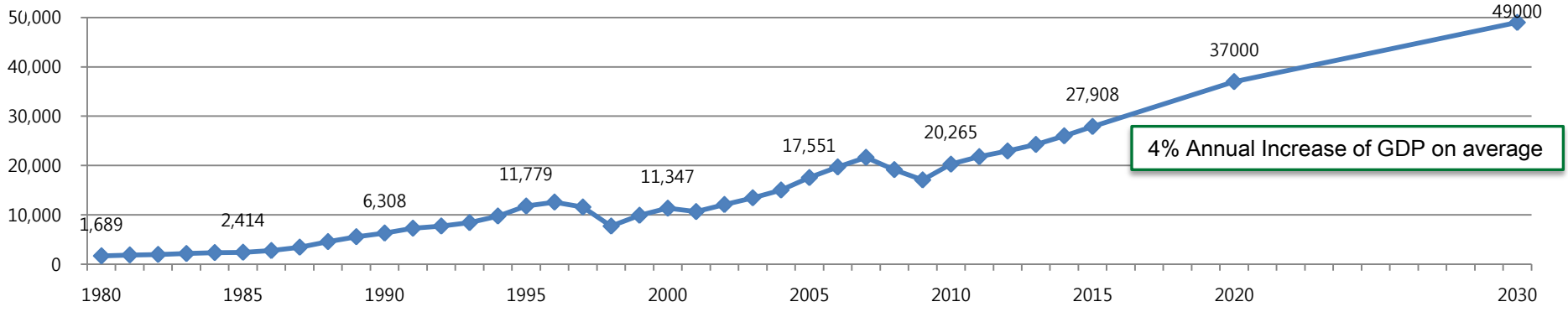


* Traffic Congestion Costs(Unit 100M Won) 1Us $= 1,110Won

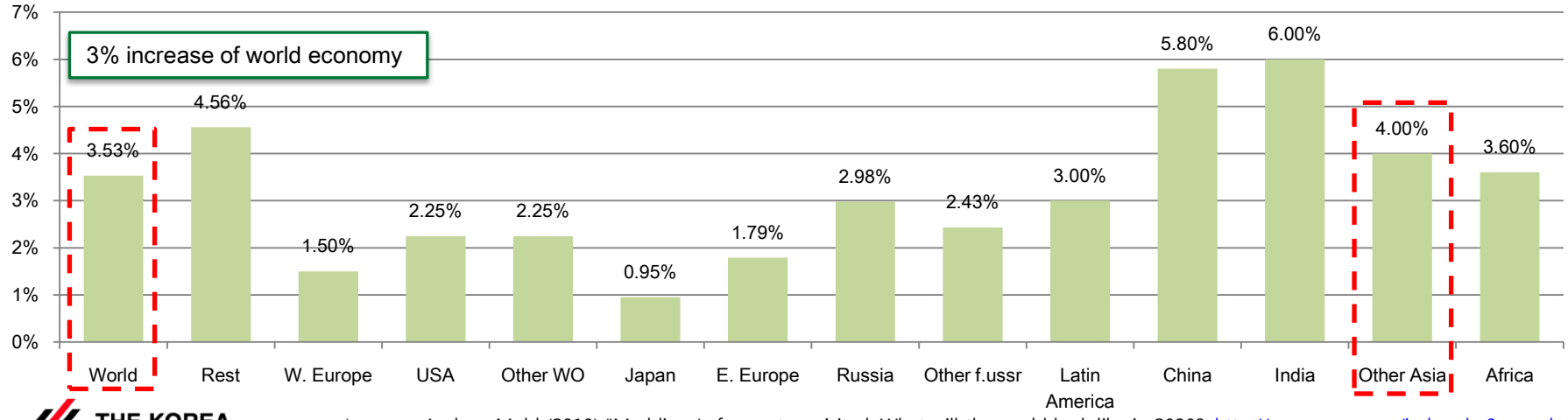
2. Future Trend in Seoul, Korea and the World

Economic Growth

GDP Estimates in Future (Korea) : Development Demand and Suburbanization ↑



Unit : us$ *source : 1980~2015 : IMF(International Monetary Fund Home Page)
*source : 2020, 2030 : vision 2030 (Korea)-함께가는 희망한국-한세대 앞을 내다보는 미래전략보고서

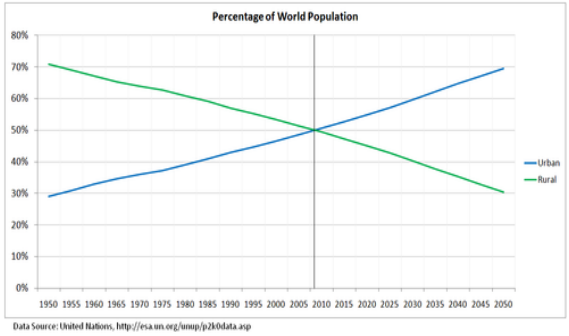


*source : Andrew Mold (2010) "Maddison's forecasts revisited: What will the world look like in 2030?, http://www.voxeu.org/index.php?q=node/5708)

2. Future Trend in Seoul, Korea and the World

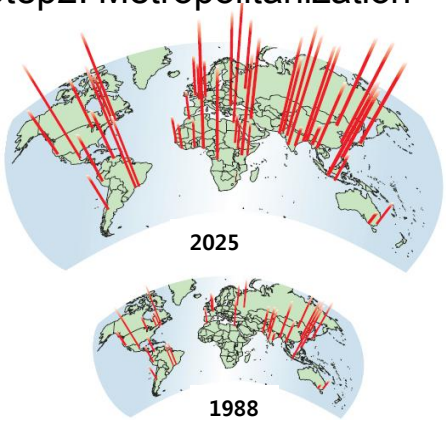
Urbanization, Suburbanization and Mega-city Region

Step1. Urbanization



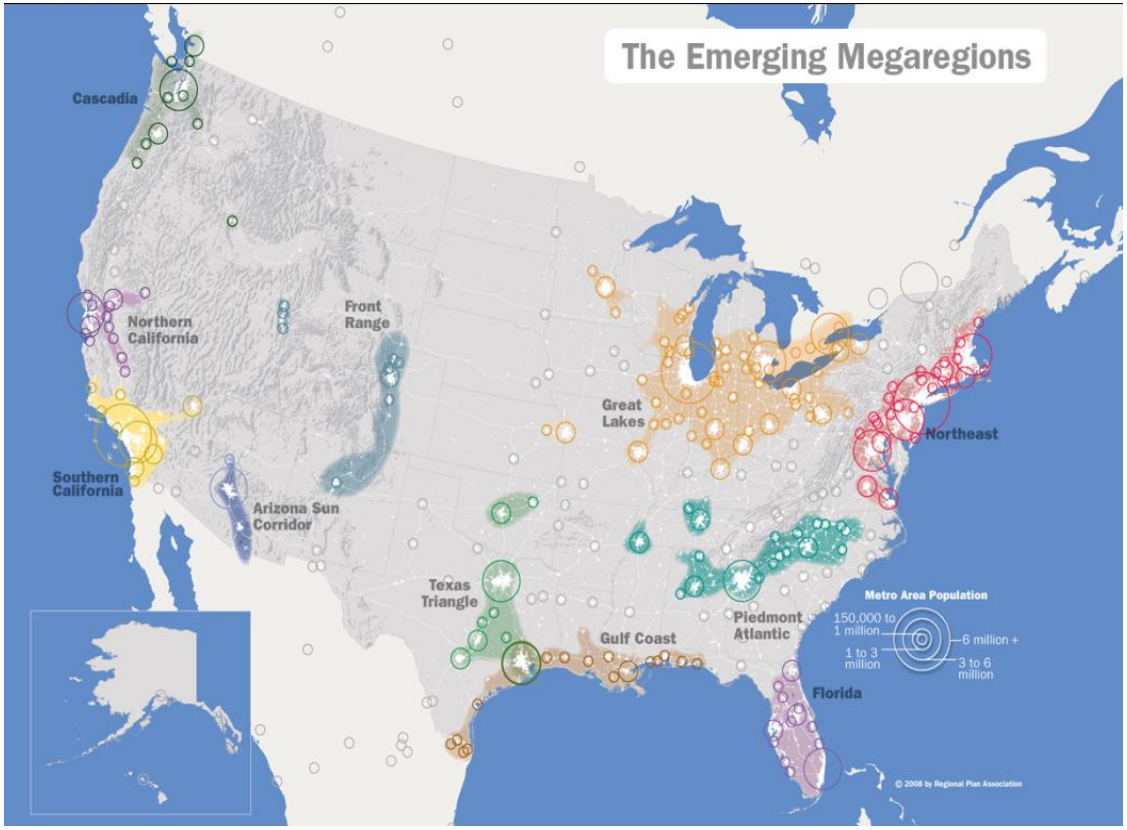
* Source: http://en.wikipedia.org/wiki/Urbanization

Step2. Metropolitanization



* Source: Plannetearth(2005) "Megacities: Our Global Urban Future, p.9

Step3. Mega-regionalization

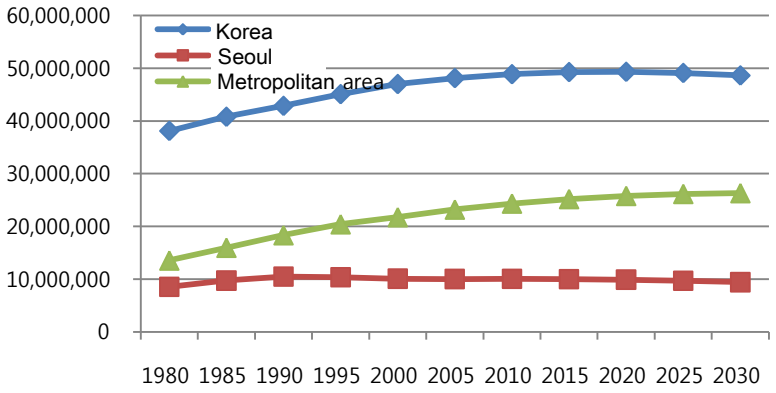


* Source: http://www.america2050.org/maps/

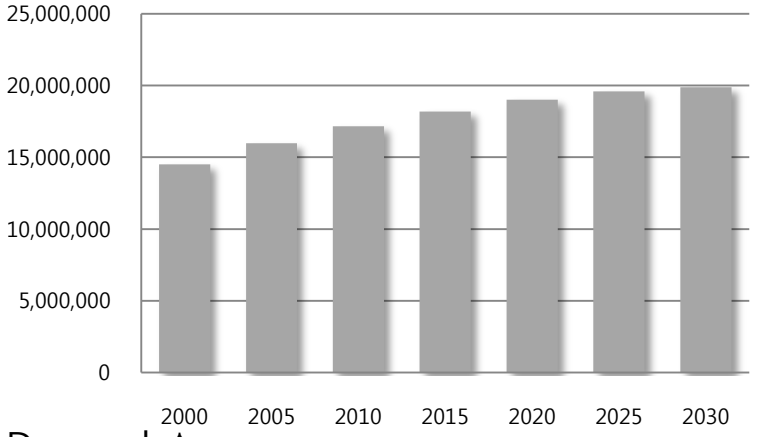
2. Future Trend in Seoul, Korea and the World

Population Structure and Housing Demand in Korea

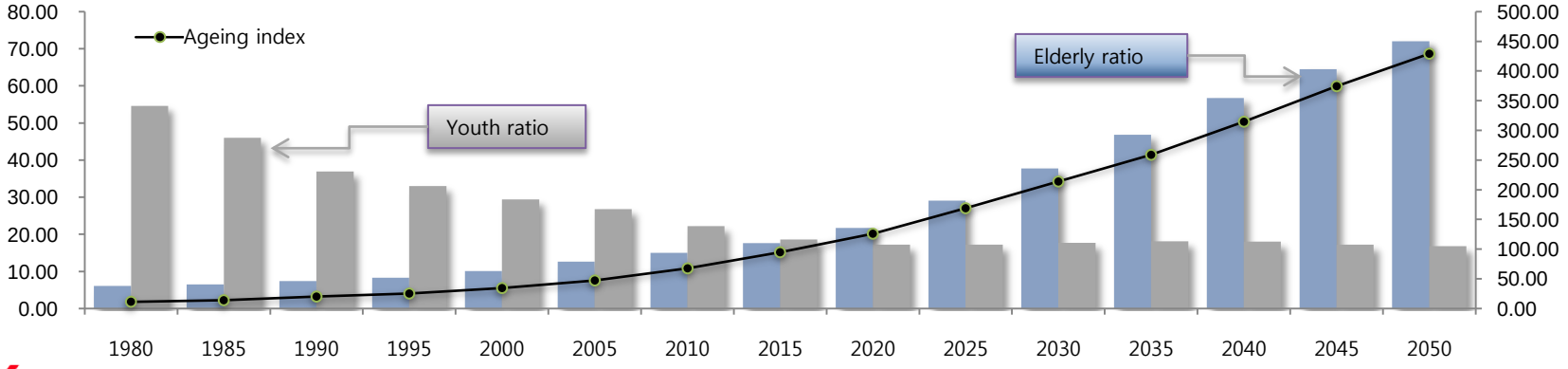
Population estimates in future



Estimated Households: Family Nuclearization



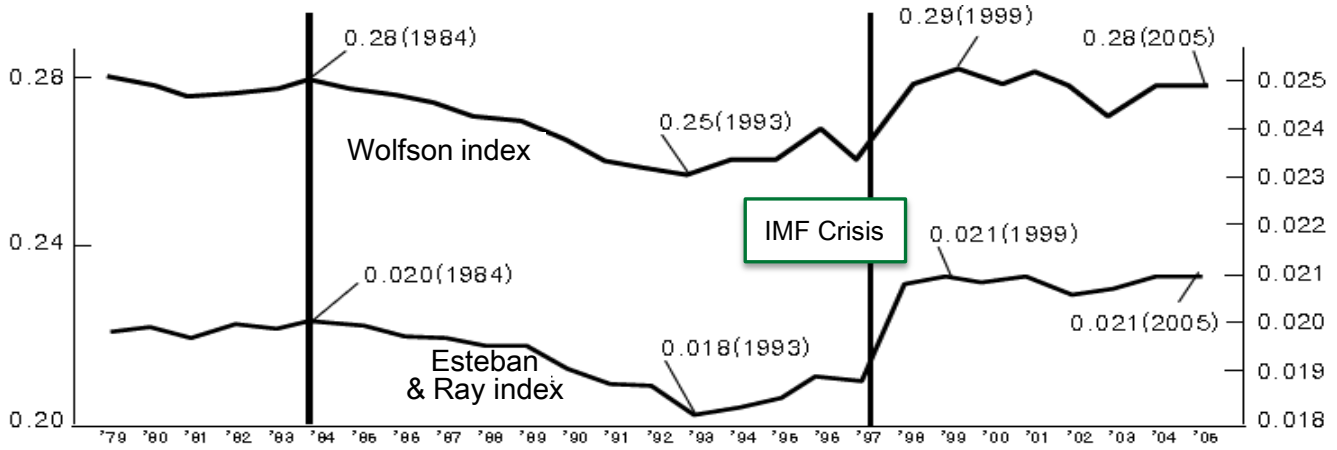
Super-Aging Society : Recentralization and Transit Demand ↑



2. Future Trend in Seoul, Korea and the World

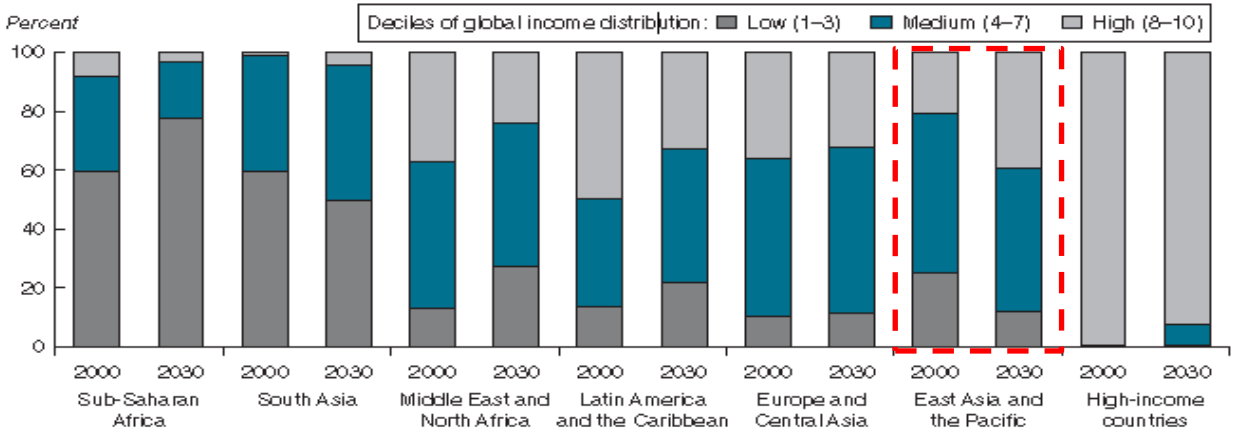
Income Distribution and Travel Budget

Korea



* Source: CEO Information (2006), SERI

World: Income Distribution → Polarization and Transit Demand ↑



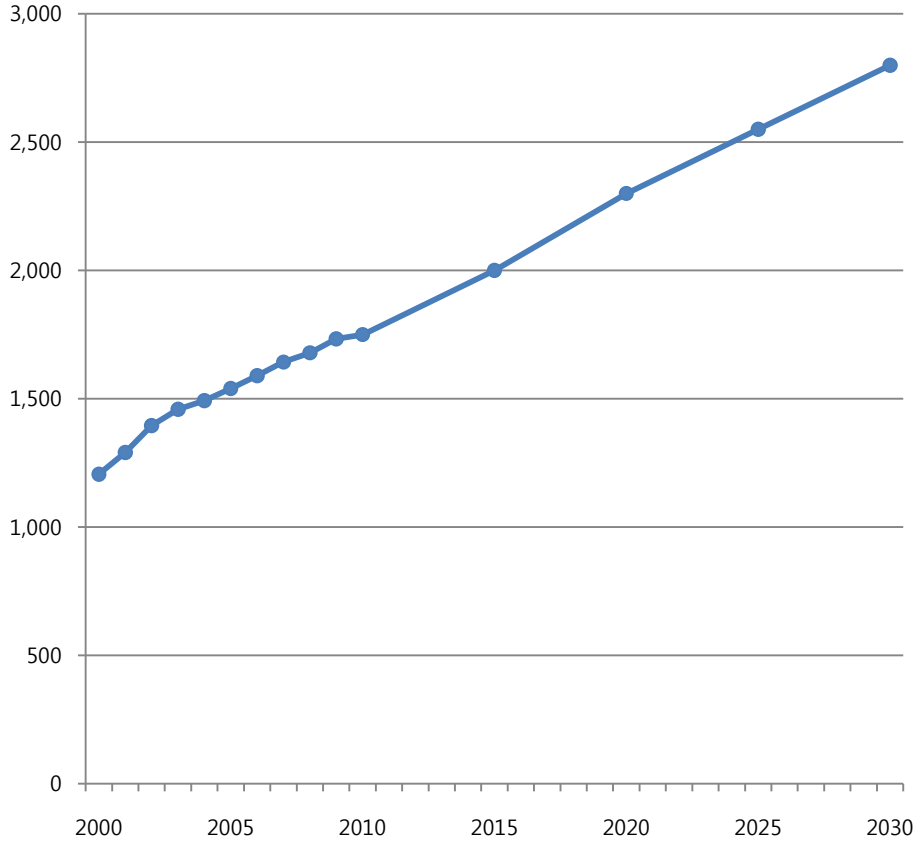
* Source: : World Bank (2006)

2. Future Trend in Seoul, Korea and the World

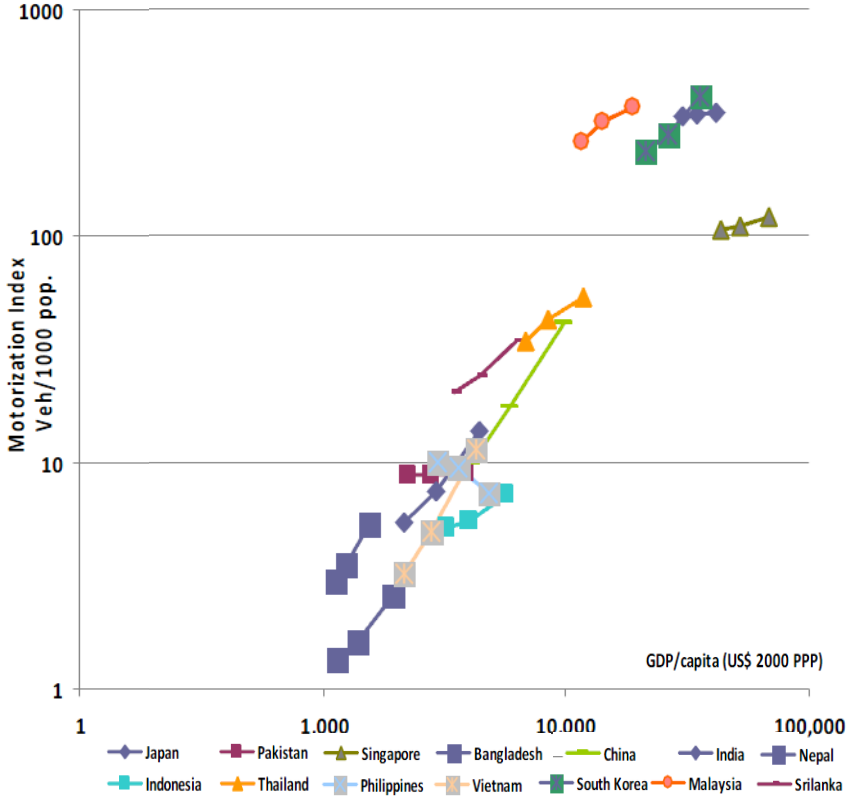
Car Ownership and Travel Demand

Car-Oriented Mega-city Region?

No. of Cars registered



Motorization trend in Asia



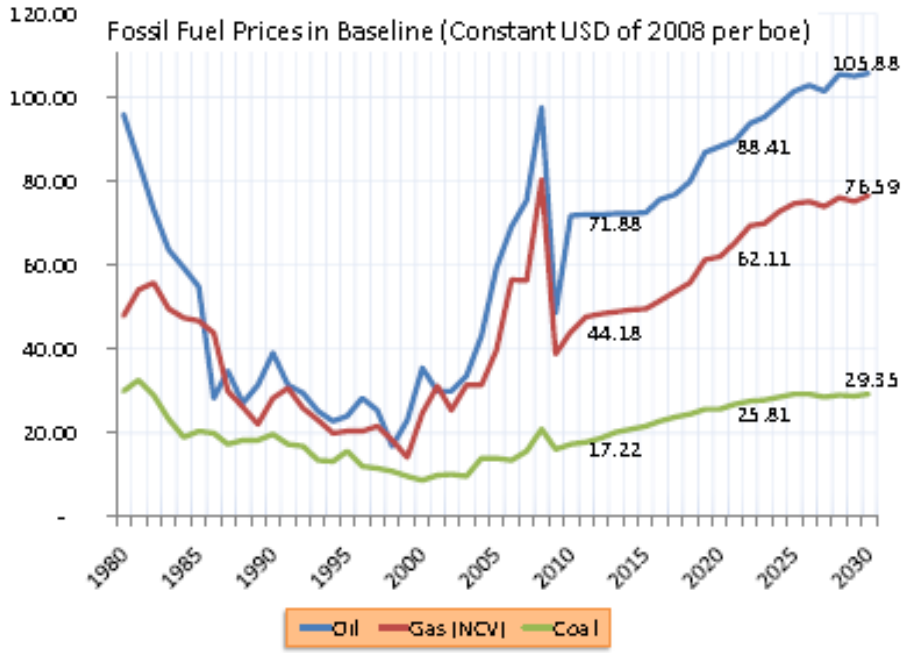
분석년도: 2005년, 2008년, 2015년 * Source: Jamie Leather (2009), p.4

2. Future Trend in Seoul, Korea and the World

Fuel Price and Vehicle Technology

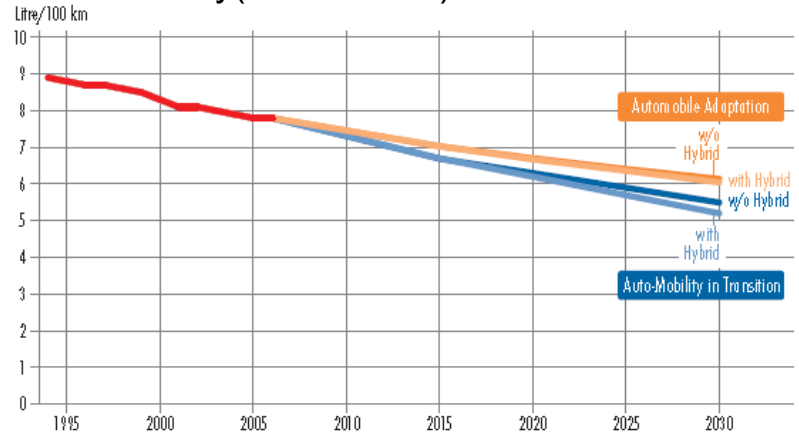
Car-Oriented Mega-city Region?

Trend of World Fossil Fuel Prices

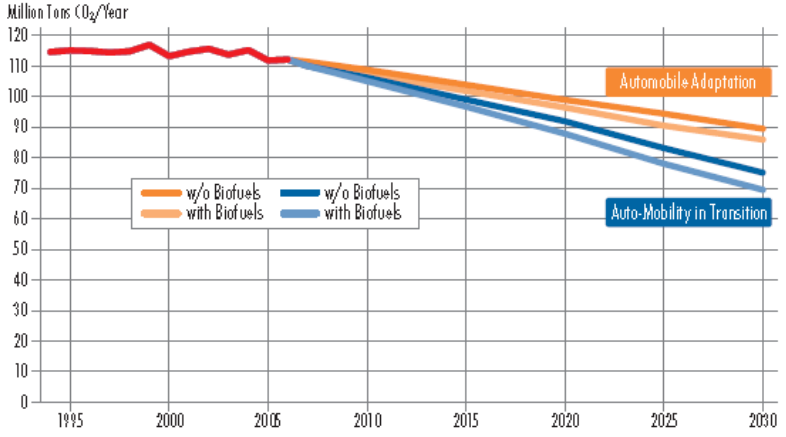


* Source : European Commission (2009) “EU Energy Trend to 2030, p.16

Fuel efficiency(Liter/100km)



CO^2 M. Tons per Year



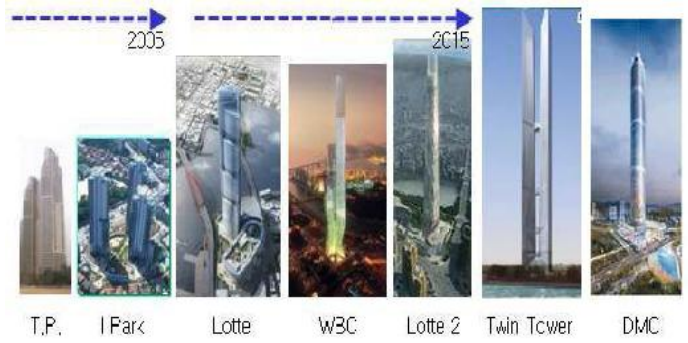
* Source : Shell (2010)

2. Future Trend in Seoul, Korea and the World

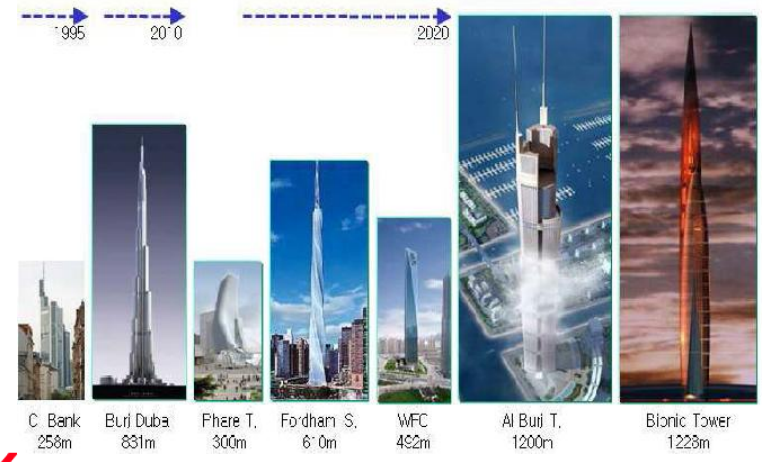
Architecture and Civil Engineering Technology

Super-skyscraper city demand ↑

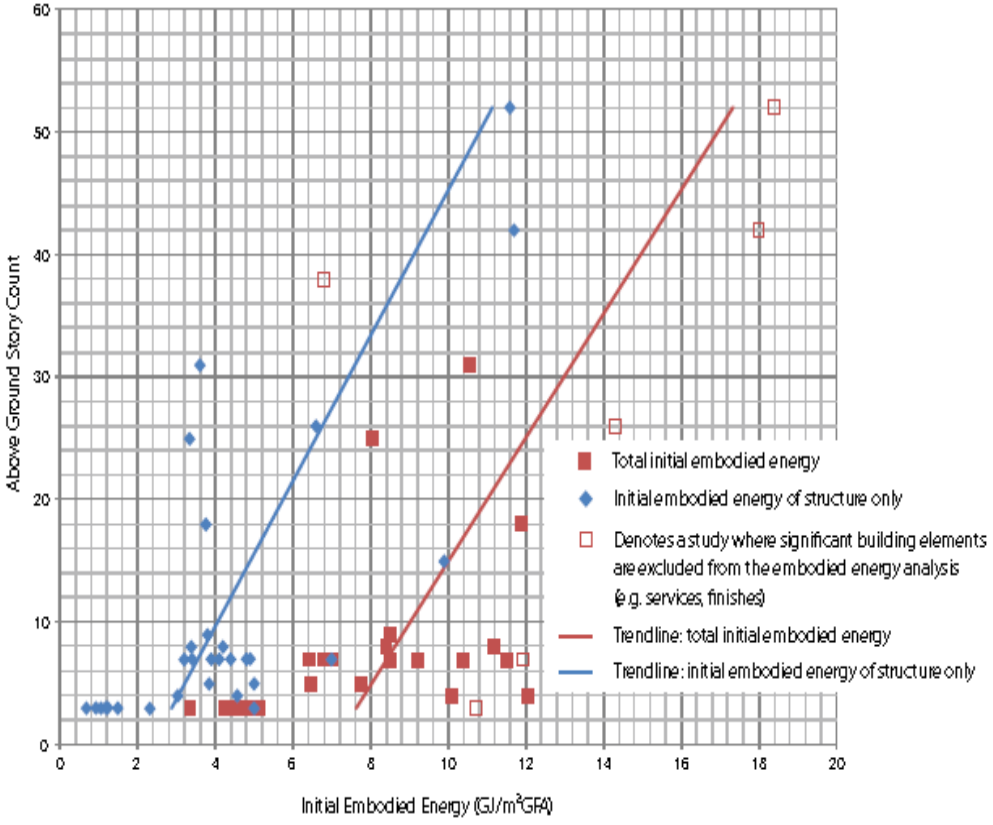
Skyscraper in Korea



Skyscraper in the World



No. Floors & Energy consumption



*sources: CTBUH Journal(2009), left; Hammond &Jones (2008), right

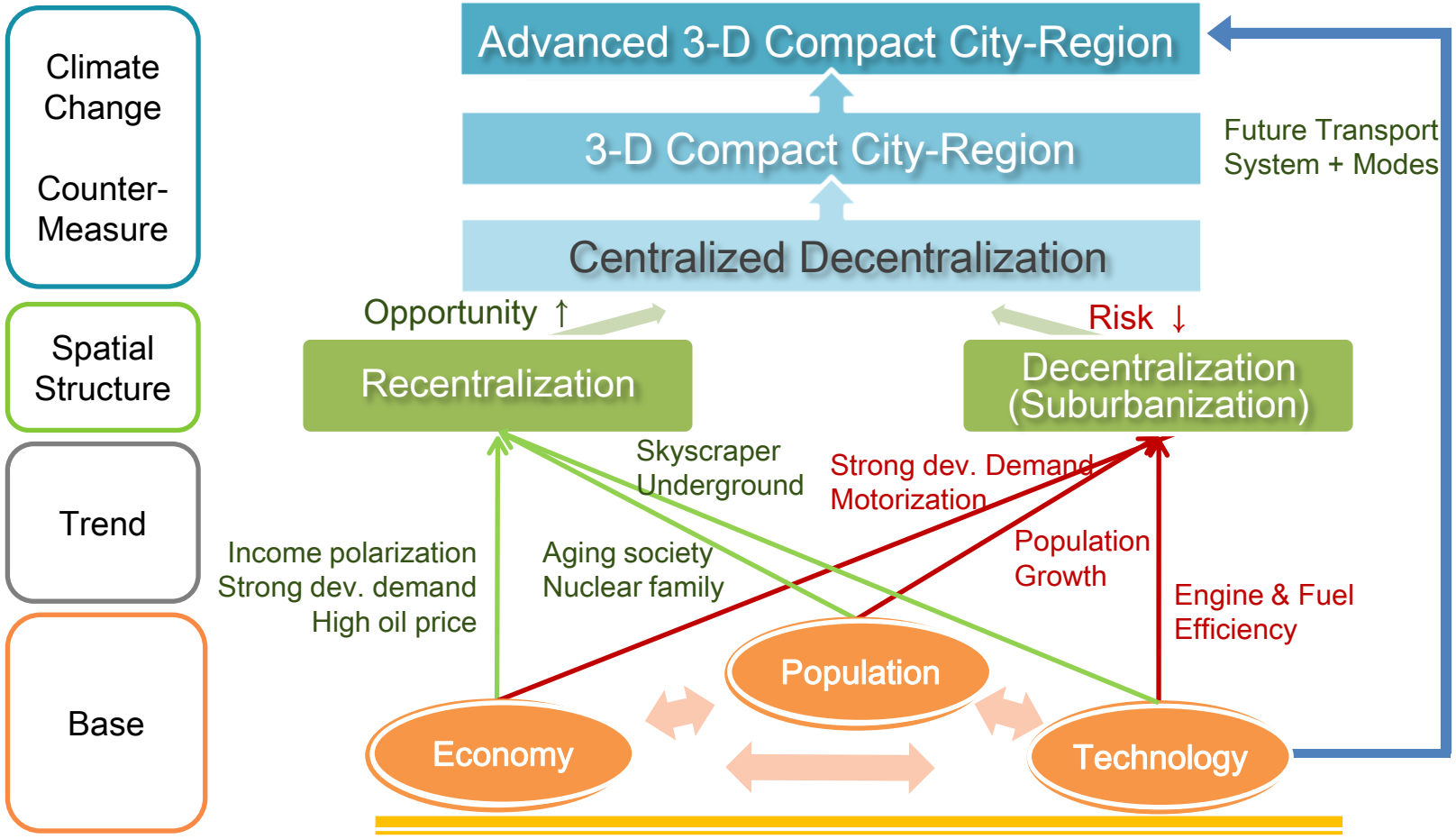
3. Future Trend Summary and Development Prospect

Summary of Future Trend in Seoul

		Future Trend in 2030	Space and Transport Prospect
Economy		- World Economy : Annual growth 3.53% - Domestic Economy : Annual growth 4%	- Employment Demand ↟ - Development needs ↟ - Travel Demand ↟ - Transportation Infrastructure ↟
Urbanization		- 60% of the world's population living in cities - Growth of metropolitan areas - megalopolis	- Seoul(GDP ranking: 20→17) - Urban sprawl - Travel Demand(between regions) ↟
Population	Number	- Metropolitan area ↟ - Seoul ↓	- Suburbanization ↟ - travel distance ↟
	Structure	- post-aged society (24.3%) - Increasing 1~2person households (51.8%)	- Housing demand(in urban area) ↟ - Medium/small-sized housing demand ↟
Commute	Car	No. of car ↟	Dependence on personal Vehicles ↟
	Oil price	Oil Price ↟	Personal Vehicle demand ↓
Technology	Transportation	Fuel/Engine Technology ↟	Travel costs ↓ Personal Vehicles demand ↑
	Architecture	High rise / Energy saving Technology ↟	Skyscraper ↟
	civil engineering	Underground Space Technology ↟	Underground Space Development needs ↟

3. Future Trend Summary and Development Prospect

Prospect Scenarios and Climate Change

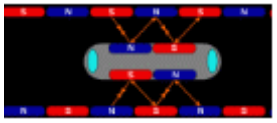


Development and Application Analysis of Transport Technology in Future

1. Future Prospects of Transport System and Modes
2. Application Analyses for Future

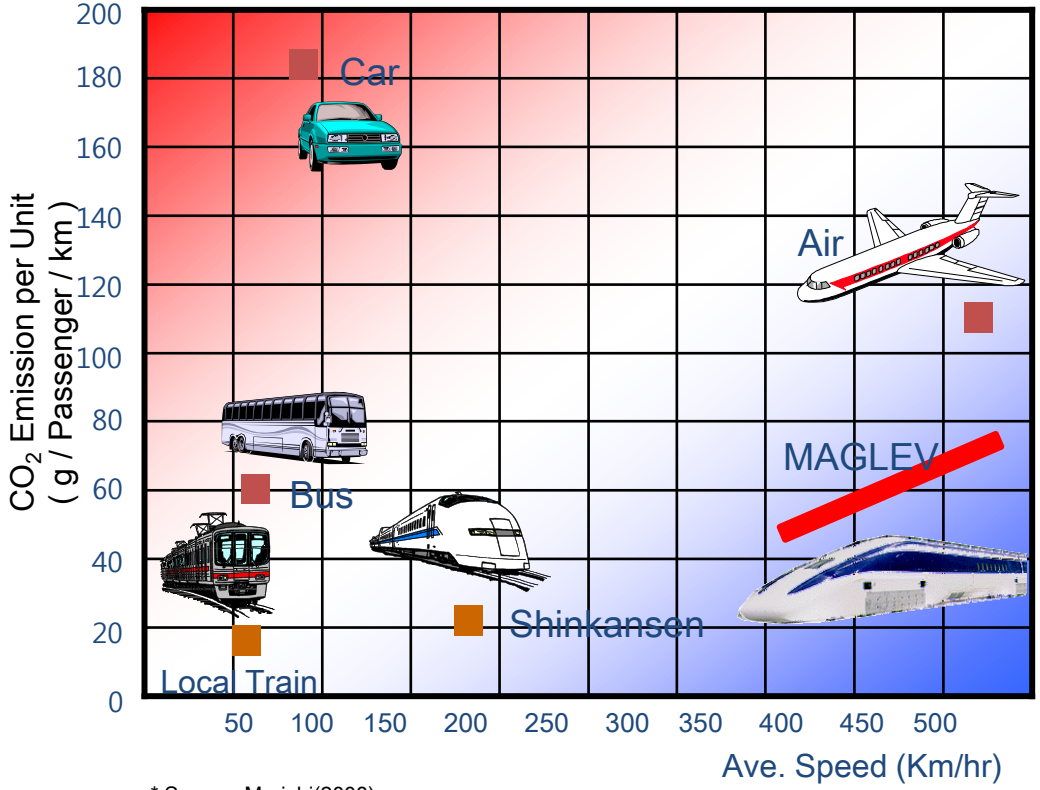
1. Future Prospects of Transport System and Modes

Long-Distance Transport System and Modes

	Automated Highway System, AH	MAGLEV, magnetic levitation	Transition Flying Car
Image		 	
Concept	.using existing roads, underground . 9-25 Platoons . Manless driving	.high speed magnetic levitation train .Maximum speed 6437km/h .(now 581km/h)	. roadable aircraft . 185km/hr, 105km/hr(on road)
case	. PATH Project(I-15 San Diego 1991)	. MAGLEV(Tokyo-Osaka) trial run(2003)	.Terrafugia Transition Flying Car
Benefits	. safety and mobility, capacity ↑ .energy and time save .Efficiency of road space↑ .Just-In-Time	.High speed / Large capacity .minimized vibration .. air Pollutant free	.20 hours training .roadable . Commercialization possibility↑
Dis-advantages	.Traffic congestion (slip road) .Uncertain environmental and land-use benefits .Possibility of major accidents .social equality↓	.high construction costs(US$34.6M per kilometer)and operating costs .noise	.high price .Land consumption↑ .social equality↓

1. Future Prospects of Transport System and Modes

Sustainability and Speed: Maglev



* Source: Morichi(2008)
주) MAGLEV Test Line: Tokyo – Osaka

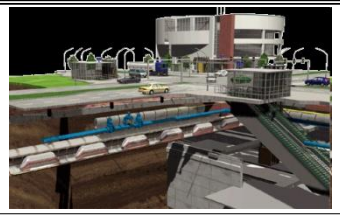
1. Future Prospects of Transport System and Modes

Short-Distance Transport System and Modes

	Automated Public Transit System, APTS	Bike Rapid Transit	Neighborhood Electronic Car
Image			
Concept	.2~6person , point-to-point, on-demand operating .Minimize interval .Max. 40km/h 3200~4800persons/hour .Using electric and hydrogen	.overpass/underpass . Interchange .Speed ↑ Impact of Climate↓	.Battery Electric Vehicles .low-speed .for two people .Low Pollutant short distance . under 40km/hr
case	.Morgatown PRT, ULTra, CVS, PRT200 etc.	.none . US Transglide 2000, Canada Velo-city, Germany Velovent ect.	.California, US .Zero Emissions Vehicle(rebate $1,500
Benefits	.Total Automation System .Occupy less space .Traffic congestion↓ .Pollutant free	.long-distance drive .Transportation Safety ↑ . energy saving /Pollutant free .promotion of health .Door-to-Door/ minimize land use	.Low Pollutant short distance vehicle .minimize parking space
Disadvantages	.Not applicable in CBDs .initial investment↑	.energy consumption↑(high-tech systems) .Construction/ operating cost ↑ .Safety .Potential greenhouse effect	Land consupmtion

1. Future Prospects of Transport System and Modes

Logistics System

	CARGOCAP	Advanced Multi-modal Freight System
Image	 	None
Concept	.Underground Capsule(48"×32") Logistics System .using Electricity(500V) .Intelligent Logistics System .Better is high demand for small size of freight .Just-in-Time pickup and Delivery	.Rail-road freight transport system .Minimize the time transshipment
case	.none (Applicable in Yr. 2015)	.none
Benefits	.Traffic congestion↓ .Environment &energy efficiency↑ .Transportation Safety ↑ .land-use efficiency↑ .Freight transport reliability ↑	.Addition costs is small (Present system use) .24hours/365days none stop system .Traffic congestion↓ .Drivers' stress↓ .Reducing Traffic Accidents .Environment &energy efficiency↑
Disadvantages	.none	.Not applicable in short-term

2. Application Analyses for Future Transport

Evaluation Criteria

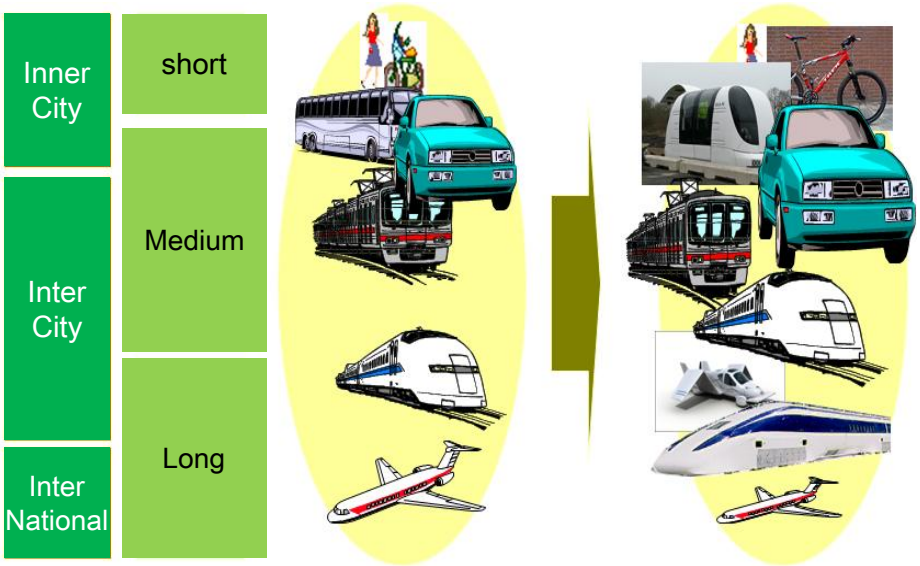
- Criteria 1 : Practicality and Competitiveness
  - Technology development, Compatibility
  - Spatial hierarchy, Competitiveness
    - · Substitutes vs. Complements
    - · Innercity vs. Intercity vs. International

- Criteria 2 : Cost and time budget limits
  - Compared to income levels,
    Constant travel budget (8~12%)
  - Travel time invariability(per day) (time vs. distance)
    - · time and space Convergence

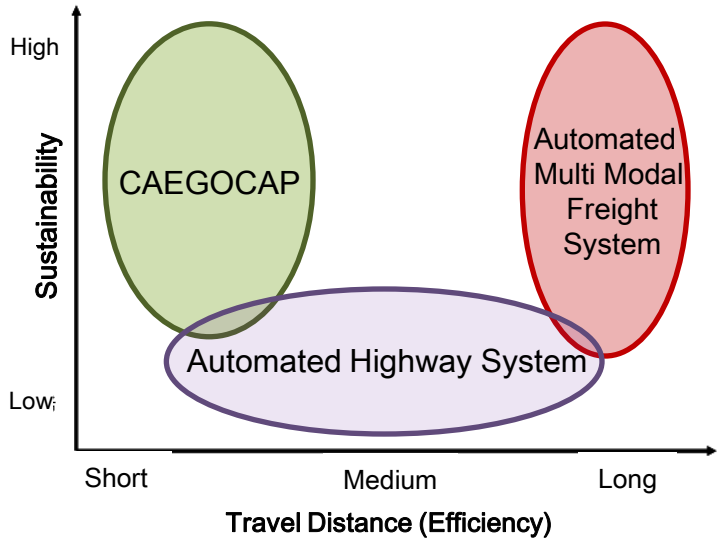
2. Application Analyses for Future Transport

Evaluation Criteria 1: Application

Passenger Transport



Freight Transport

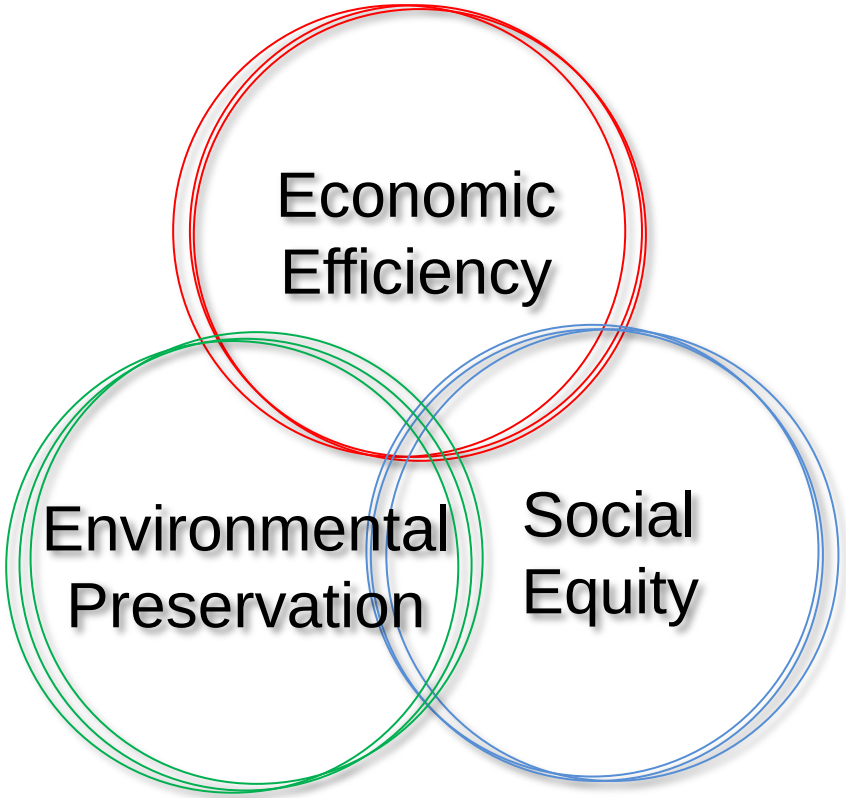


- New system and modes are complementary, not competitive, goods
- But, the role of old transport system and modes is becoming shrinking

2. Application Analyses for Future Transport

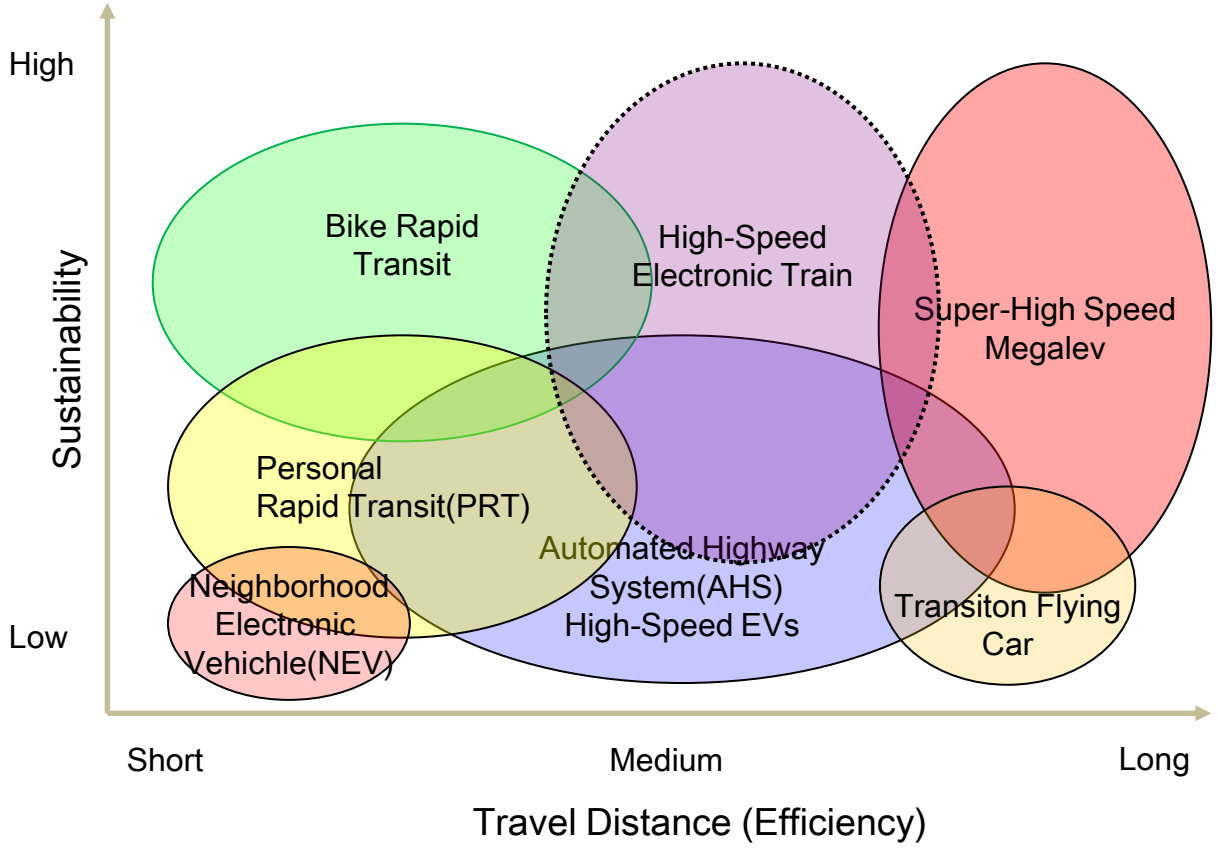
Evaluation Criteria

- Criteria 3 : Sustainability
  - Economic Efficiency
    (time, construction costs, operating costs)
  - Social Equity
    (quality of life, the mobility Handicapped)
  - Environmental Preservation
    (Pollution, Land consumption)



2. Application Analyses for Future Transport

Evaluation Criteria 2

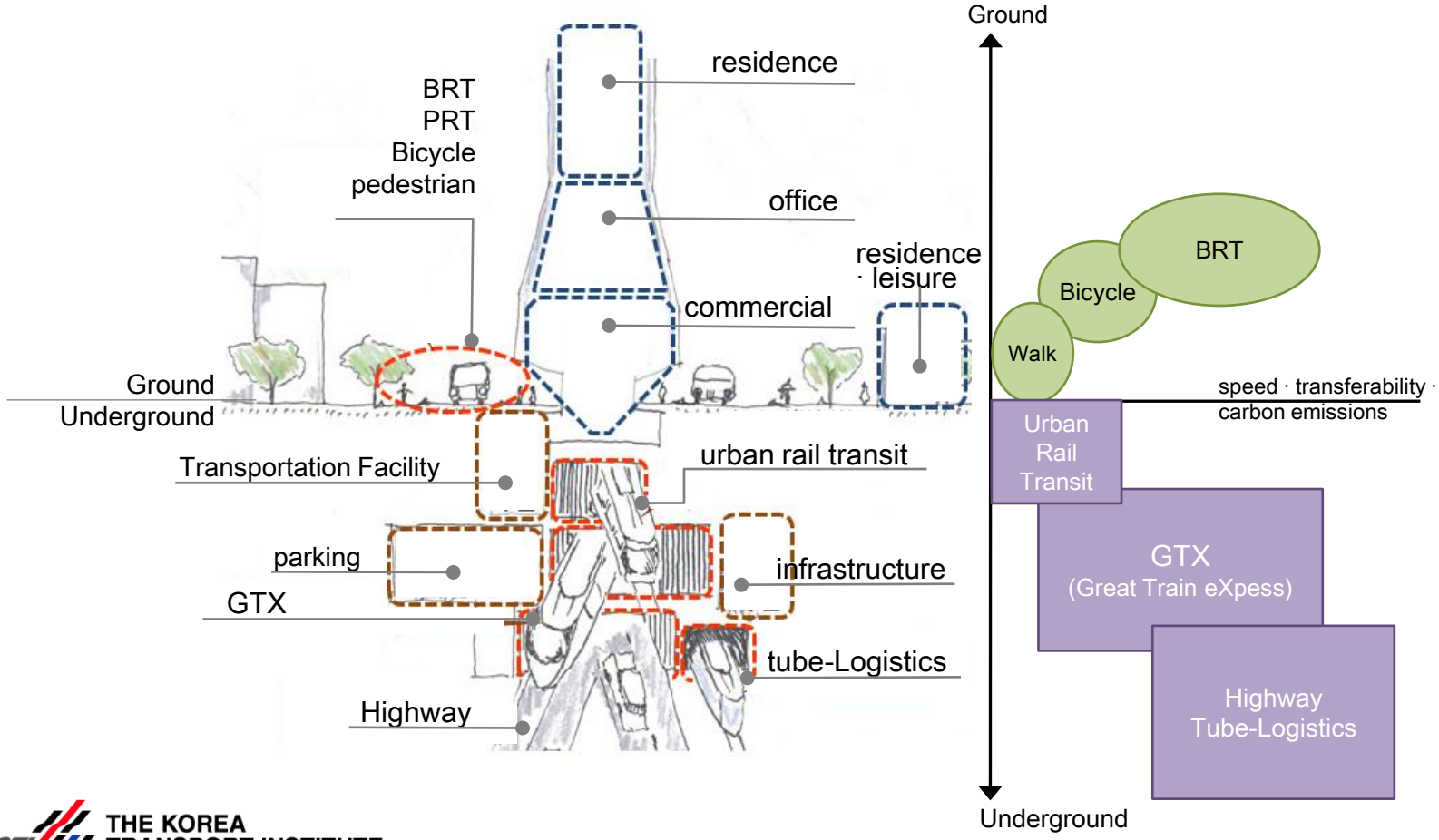


Ⅳ Concept and Characteristics of Advanced 3-Dimensional Compact City

1. The Concept and Vision of Advanced 3-D Compact City
2. Advanced 3-D Compact City Development Panning

1. The Concept and Vision of Advanced 3-D Compact City

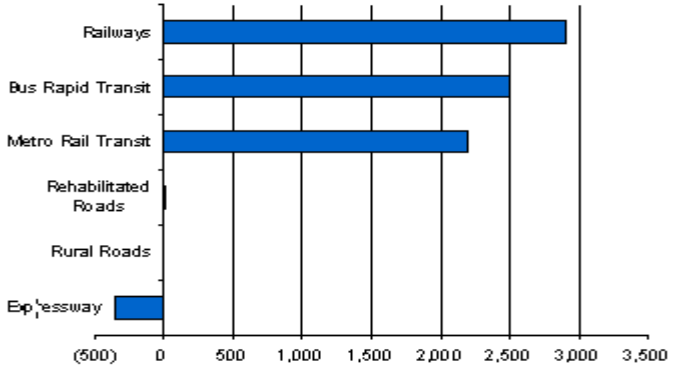
Concept and Planning Elements of Advanced 3-D Compact City

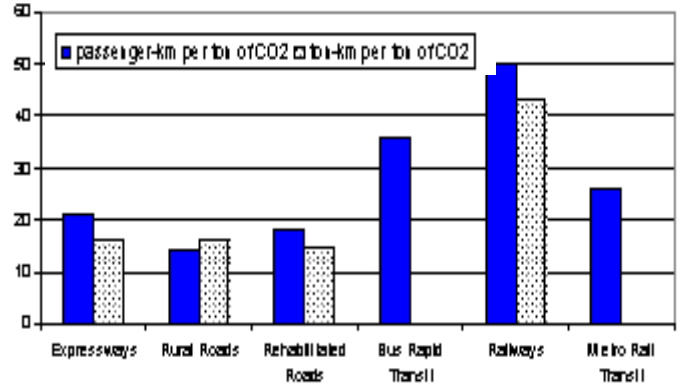


1. The Concept and Vision of Advanced 3-D Compact City

Need of Advanced 3-D Compact City

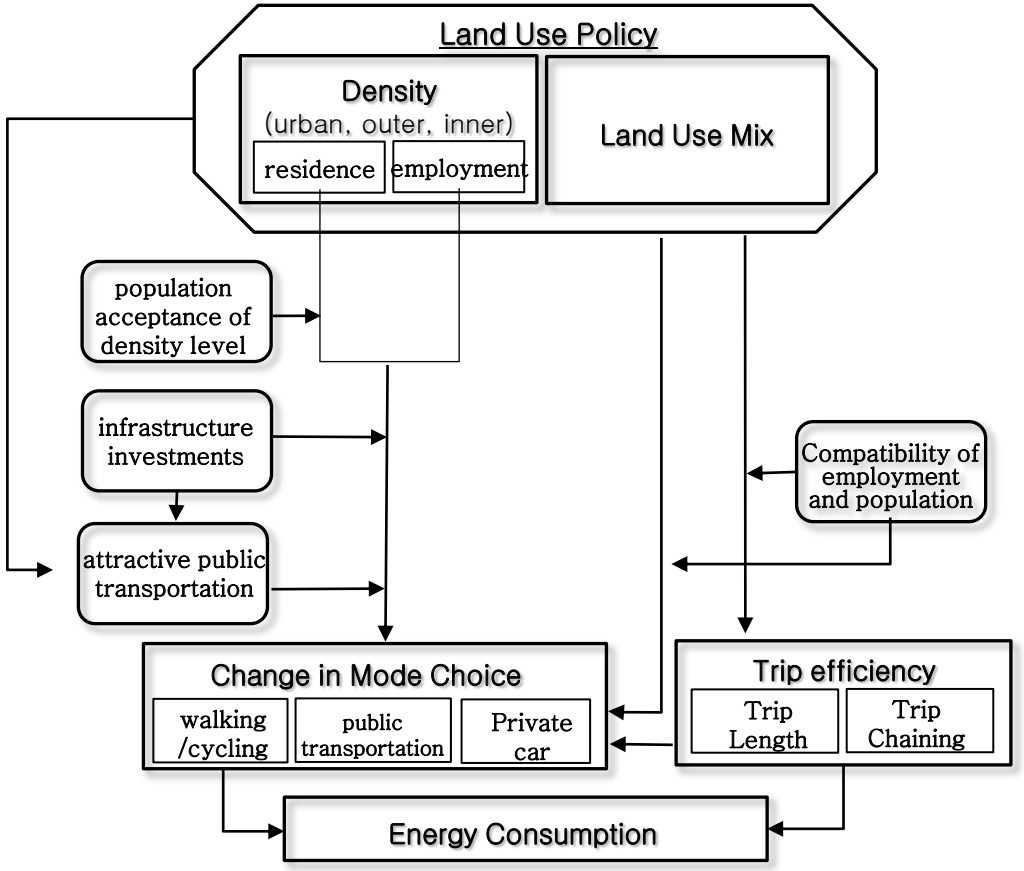
Reduction of CO^2 emissions





unit: CO^2 tons per passenger or freight ton
* Source : Asian Development Bank(2010), p.14, 15

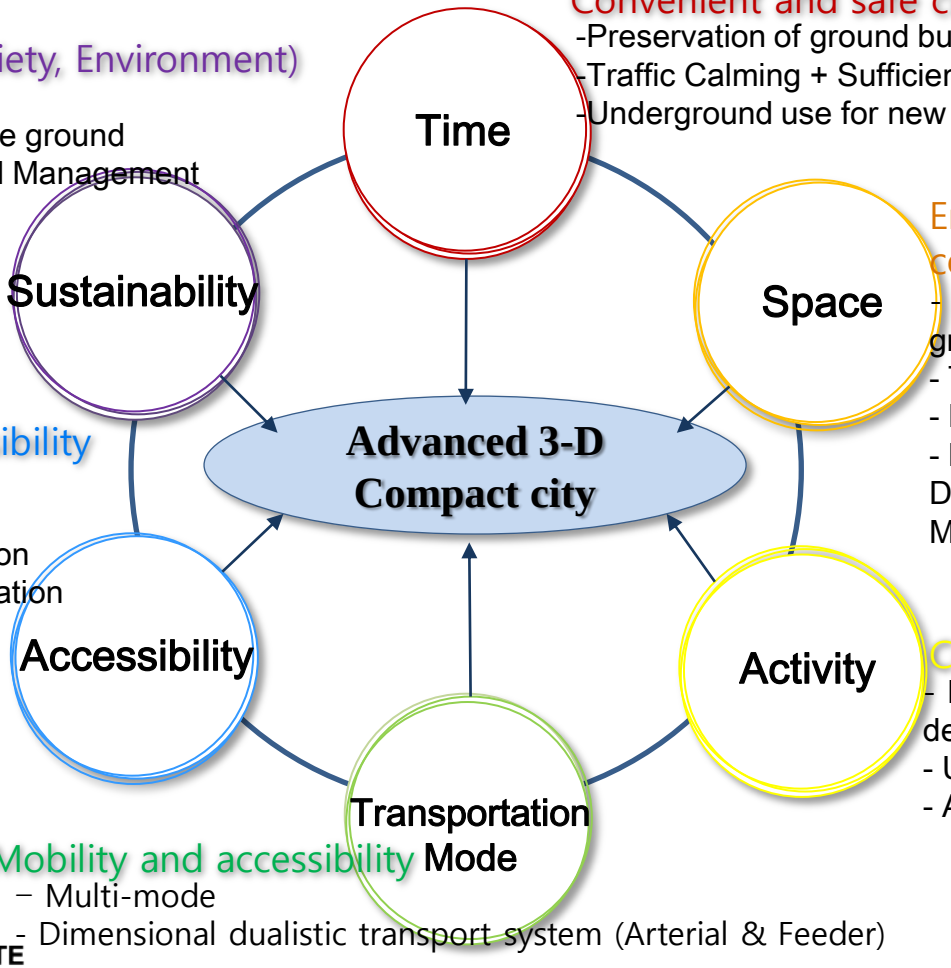
The Correlation between Land-use and Energy consumption



* Source: Mindali, et al.(2004), p.151.

1. The Concept and Vision of Advanced 3-D Compact City

Concept and Vision of Advanced 3-D Compact City



Convenient and safe city
-Preservation of ground built environment in past and present
-Traffic Calming + Sufficient open space on ground
-Underground use for new transport and transfer system

All-win(Economy, Society, Environment)
- Public Transportation
- Low speed transit on the ground
- Transportation Demand Management

Enhancement of land use and conservation of land resources
- Global and domestic economic growth
- Transport Hub
- Hierarchy network
- Multi-Dimensional Complex Developments Urban Growth Management

Improvement of Accessibility
- Multi-mode transit system
- Diversity
- Smart work center based on Information and Communication Facilities

Compact and 24hours activity
- High-density, high-rise, compact development
- Underground Arterial traffic system
- Automatic Logistics System

Mobility and accessibility
- Multi-mode
- Dimensional dualistic transport system (Arterial & Feeder)

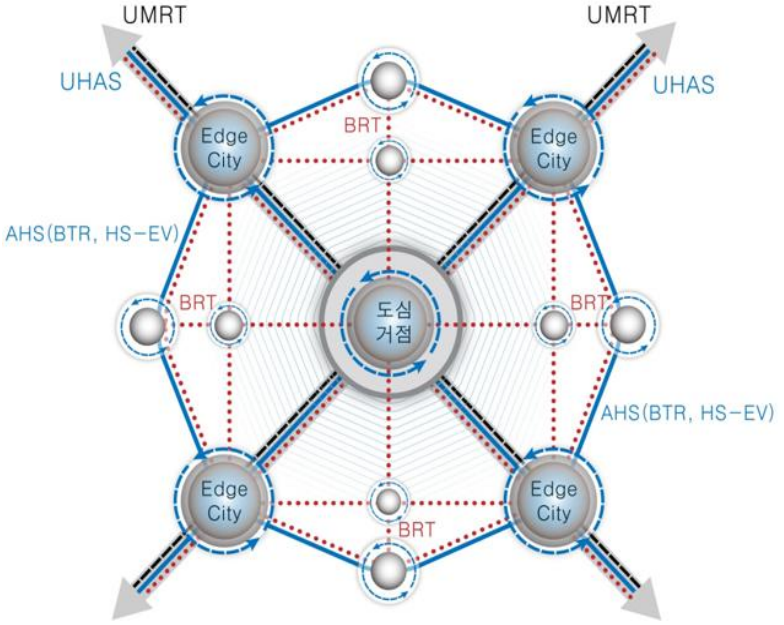
2. Advanced 3-D Compact City Development Planning

Transport Planning

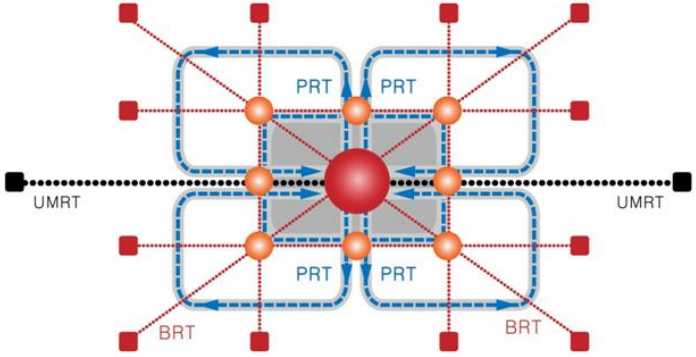
· UAHS : Underground AHS
· UMRT : Underground Metro Rapid Transit
· BRT : Bus Rapid Transit
· HS-EV : High Speed-Electronic Vehicle
· PRT : Personal Rapid Transit
· NEV : Neighborhood Electric Vehjcle

Logistics System

Regional transportation system



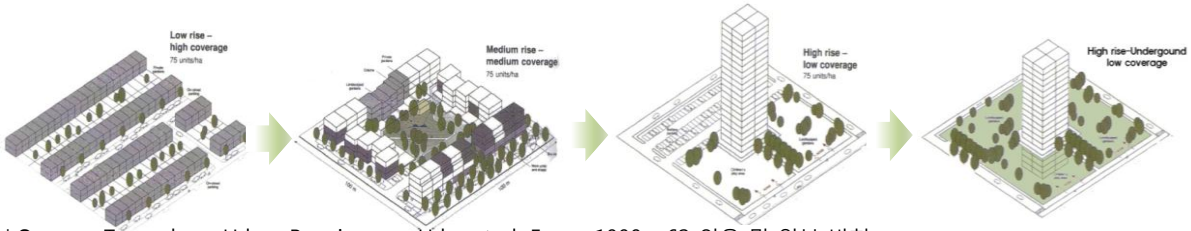
District transportation system



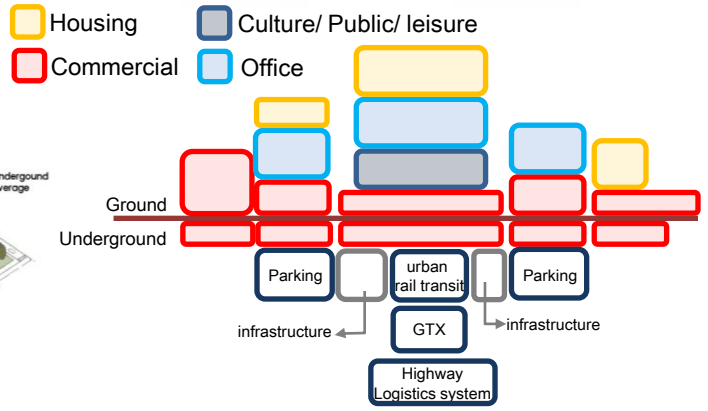
2. Advanced 3-D Compact City Development Planning

Land-Use Planning

Vertical Land Use



* Source : Towards an Urban Renaissance, Urban task Force, 1999, p62 인용 및 일부 변형



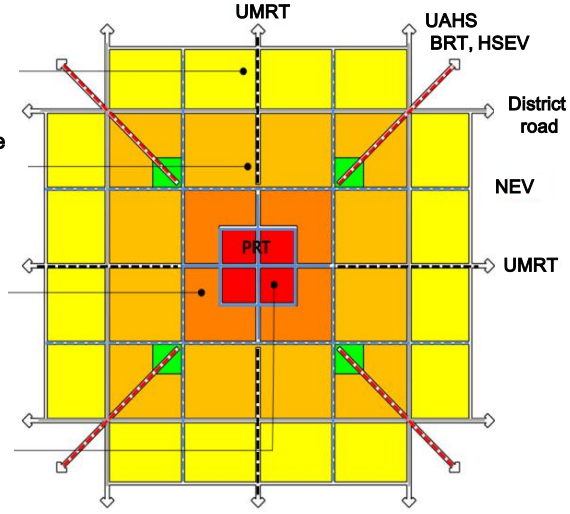
Horizontal Land use Model _ Urban Center

Medium-Low density land use
Housing, Neighborhood Facilities
Floor area ratio : 100~250%

Medium-High density land use
Housing, Education
Neighborhood Facilities
Floor area ratio : 250~400%

High density mixed housing
Housing, Office, Commercial
Floor area ratio : 500~600%
500m radius

High density mixed land use
High density housing, Office, Commercial, Transportation Hub
Floor area ratio : over 600%
250m radius



Horizontal Land use Model _Edge city

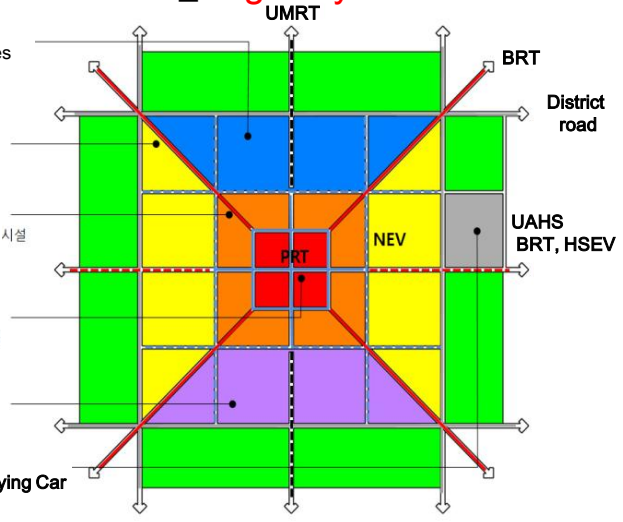
Educational Cultural Complex
Education, Cultural, Leisure Facilities

Medium-Low density land use
Housing, Neighborhood Facilities
Floor area ratio : 100~250%

Medium-High density land use
Housing, Education,
Neighborhood Facilities
Floor area ratio : 250~400%
500m radius

High density mixed housing
Housing, Office, Commercial
Transportation Hub
Floor area ratio : 500~600%
250m radius

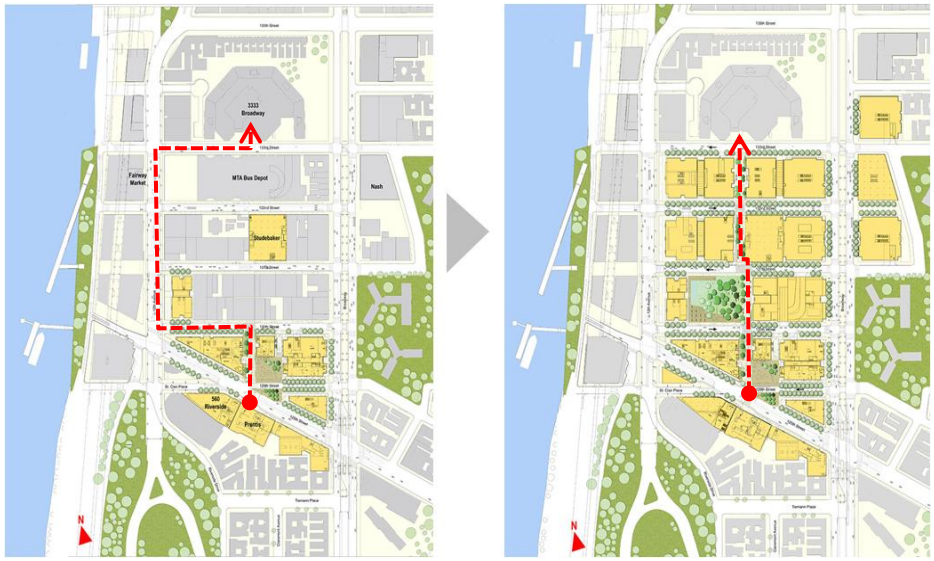
High-tech industrial complex
Industrial complex, R&D,
Freight facilities

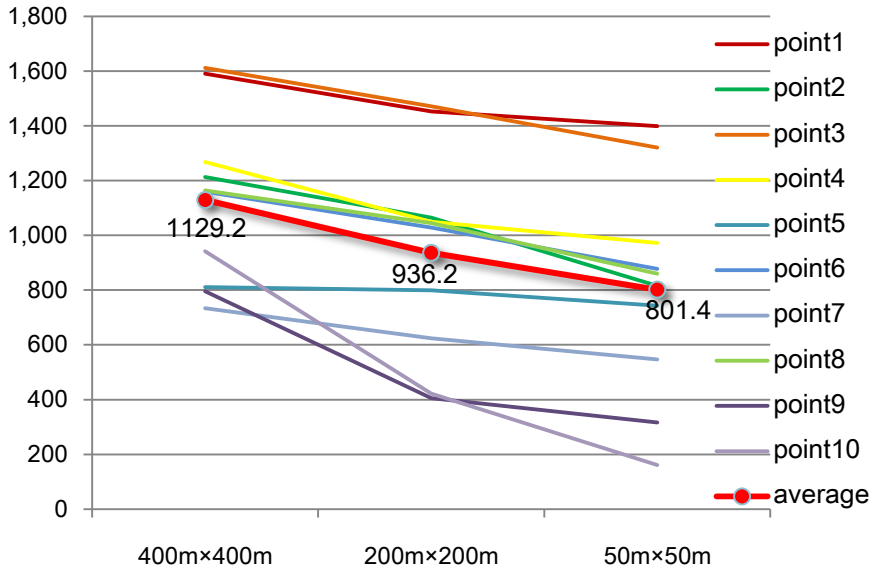


2. Advanced 3-D Compact City Development Planning

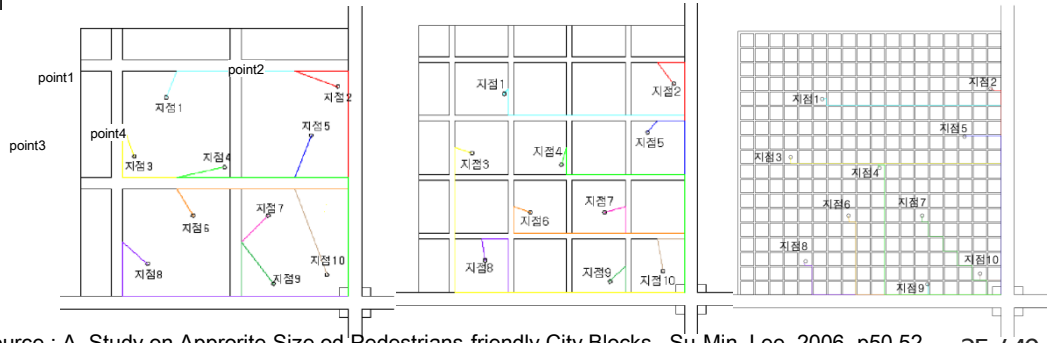
Urban Design Planning

Minimizing the block size → Walking accessibility ↑





* Source : http://neighbors.columbia.edu/pages/manplanning/proposed_plan/gallery.html

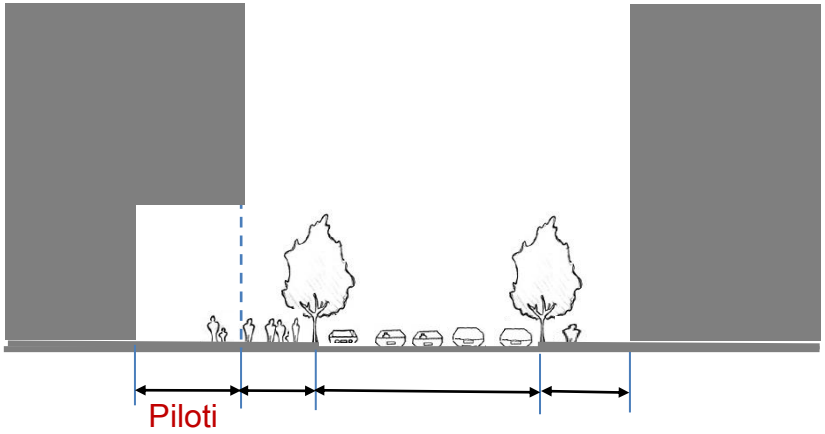


* Source : A Study on Approrite Size od Pedestrians-friendly City Blocks, Su-Min Lee, 2006, p50,52

2. Advanced 3-D Compact City Development Planning

Architecture Design Planning

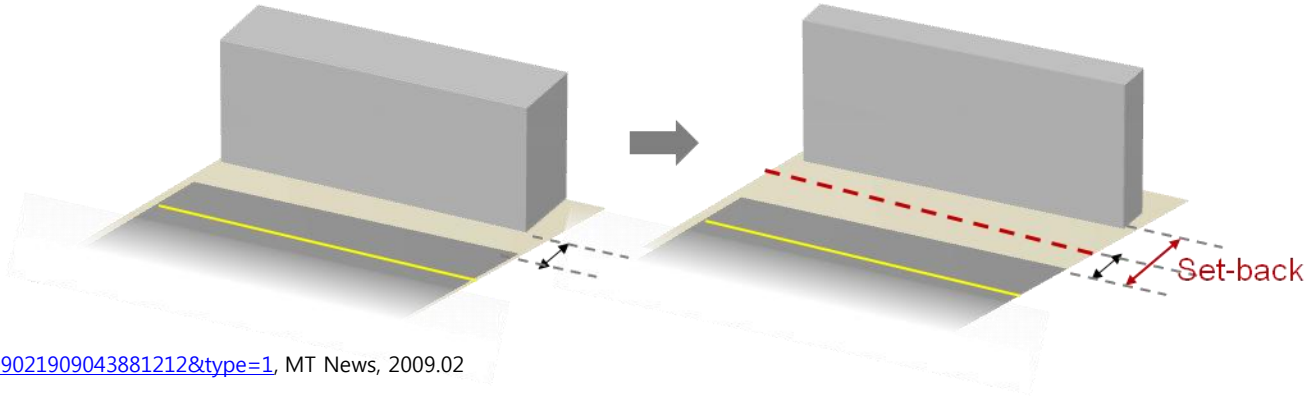
Improve pedestrian environment _ Piloti Structure



Greening building and sky passageway

Skyterrace@Dawson
*source : http://lalaland2613.wordpress.com/2009/12/15/skyterrace-dawson/

Improve pedestrian environment _ Set-back : Pedestrian-way width ↑



*source : http://stock.mt.co.kr/view/mtview.php?no=2009021909043881212&type=1, MT News, 2009.02

V Conclusion and Policy Strategies

1. Needs of Advanced 3-D Compact city Development
2. Policy Strategies for its Realization

1. Needs of Advanced 3-D Compact city Development

Not demand, needs of Advanced 3-D Compact City

- Needs 1: Encouraging opportunities and discouraging risks

→ Climate change countermeasure

- Strong economy growth
- Income polarization
- Aging society + nuclear family
- High oil price
- Architecture & civil engineering technology development

- Strong economy growth
- Population growth
- Income growth
- Motorization
- Engine and fuel efficiency

- Needs 2: People, utilitarian & advanced technology-oriented approach strategies

- 3-Dimensioal Compact City
  - Underground: Transport + SOC Facilities
  - Ground: People- & Environment –friendly Open Space and Transport
  - Sky: Skyscraper + Walking passageway + Flying car
- Advanced City
  - Underground automated highway system / Megalev transit system
  - High and low speed EVs, PRT, BRT, E-bike, etc.
  - Advanced congestion pricing system for UAHS

2. Policy Strategies for its Realization

- Strong Support from Governments & Continuous Economic Growth
  - Change of spatial structure in a region can attained from strong support of gov.
  - A big-money investment and long-term construction project
- A Model City Development in Reality (Ex. Daegok Rail Station Area)
  - Realizing the expected impacts and encouraging the support
- Comprehensive & Integrated Planning and Policies
  - 3-D development ← integrated planning is necessary
  - Safety and disaster prevention planning is prerequisite
- Institutional Support for It
  - A new and advanced development project is achievable through institutional improvement
  - Integrating many related laws makes it easily achieve for future sustainability

Thank you