UNCRD Expert Group Meeting
on Integrated Regional Development Planning
29 May 2013, Nagoya

Consideration of Climate Dynamics in Integrated Development Planning

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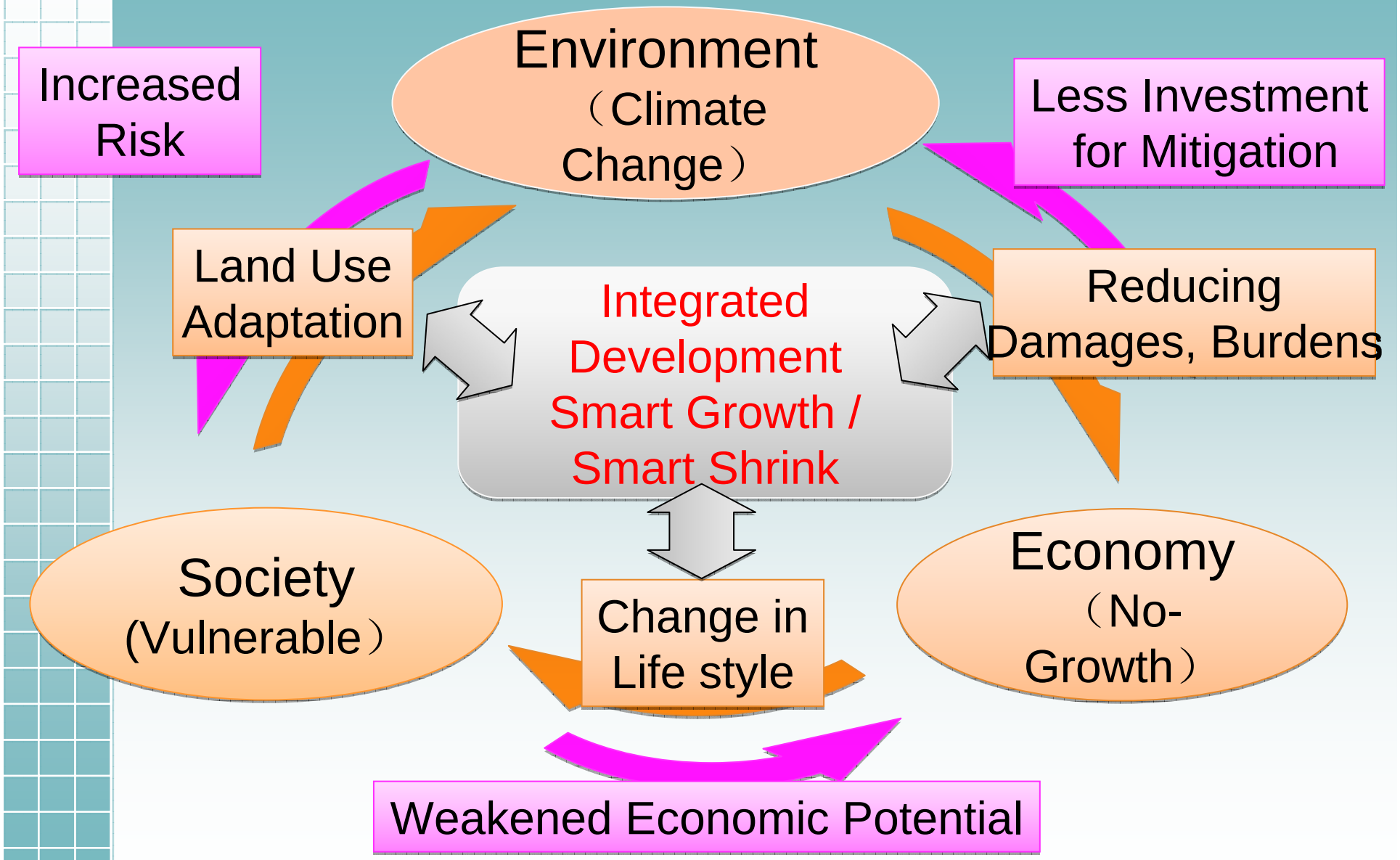
for Sustainable Transport and Cities, **Nagoya University**

Chair, Scientific Committee of **WCTRS**

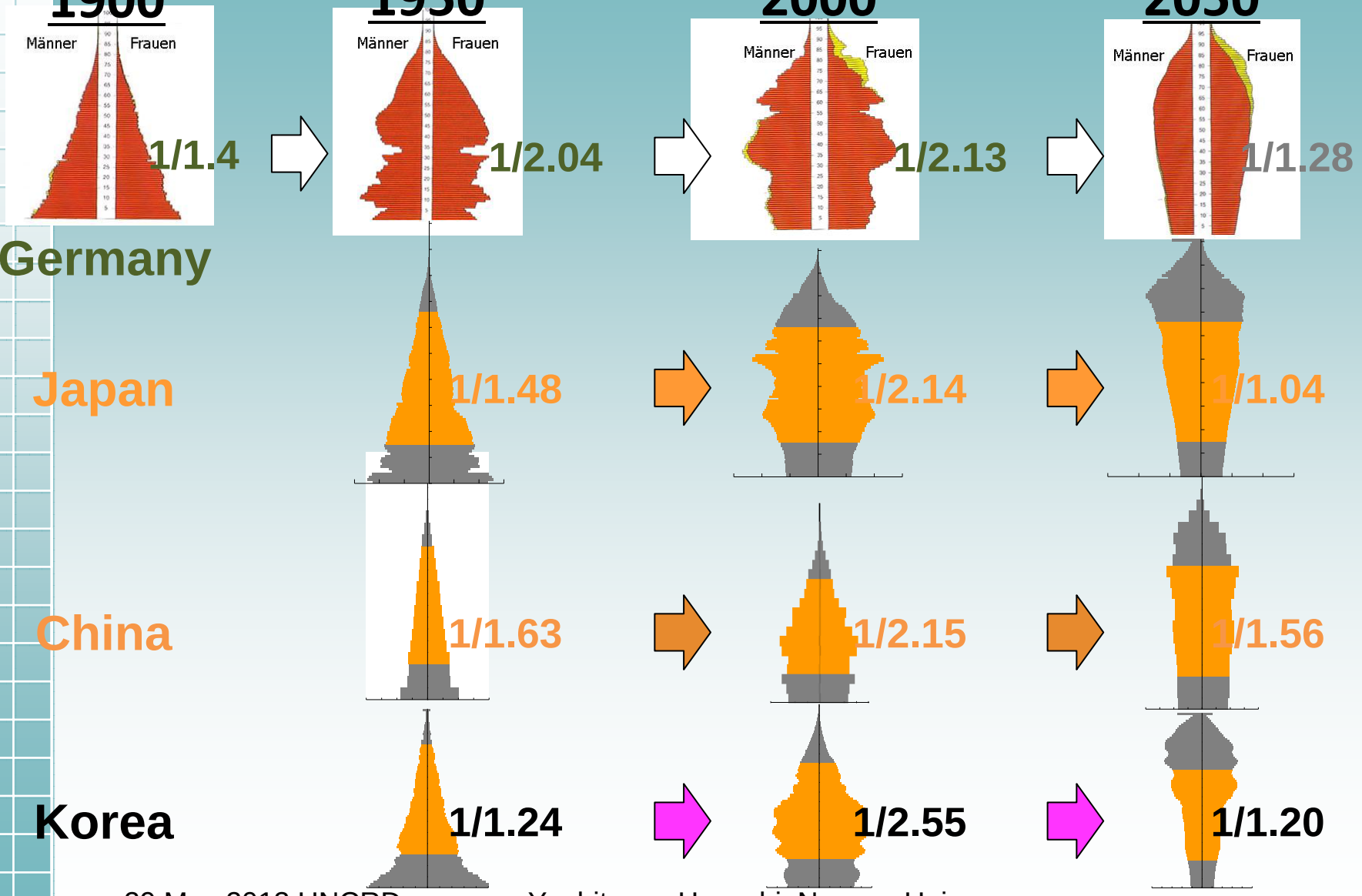
(World Conference on Transport Research Society)

1. Climate Dynamics and Integrated Development

Climate Dynamics and Counter-Strategies



Aging （Growth →Maturity →Shrink）



Challenges for Low-carbon Transport Sector

Drastic Drops in Birth Rate in Asia

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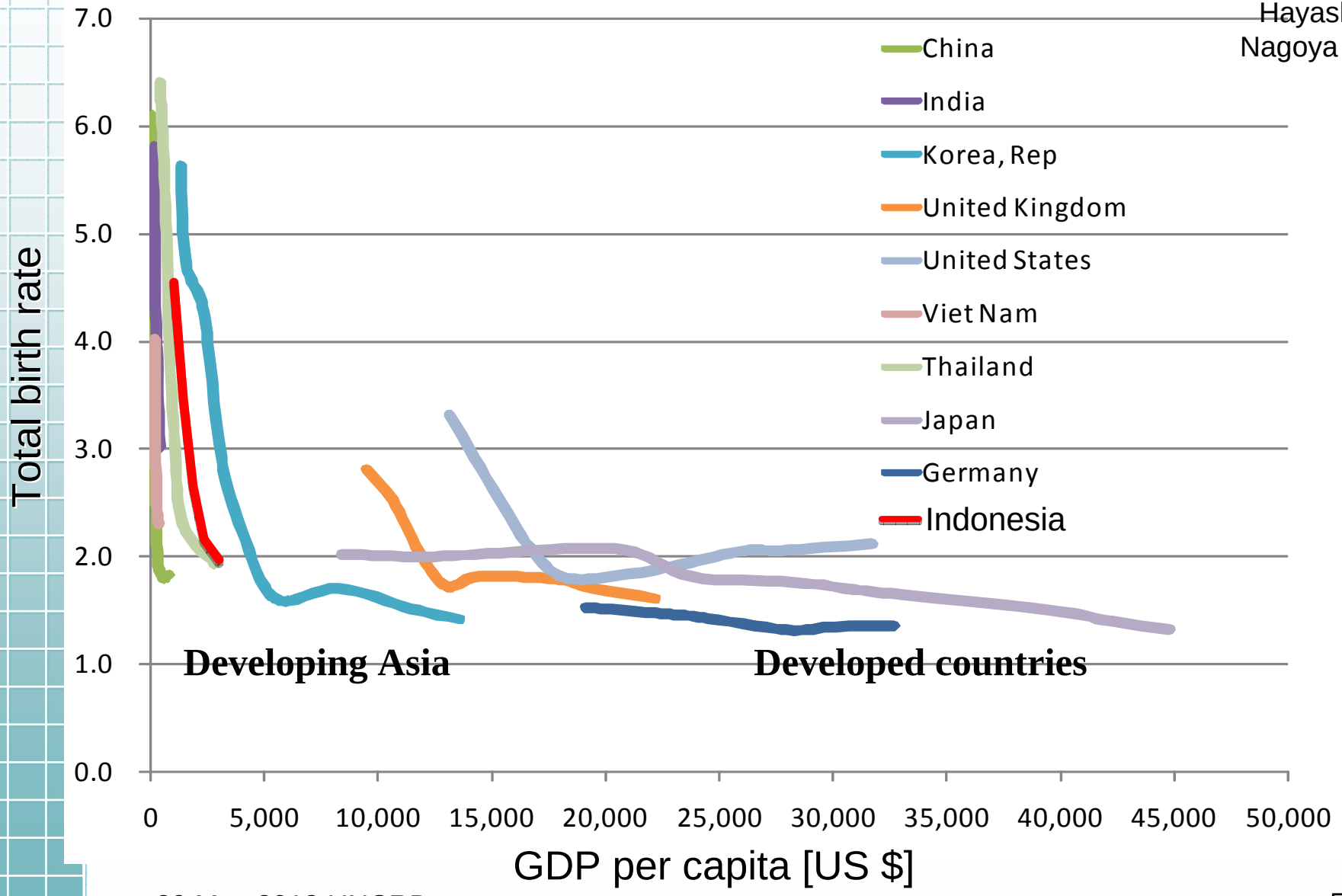
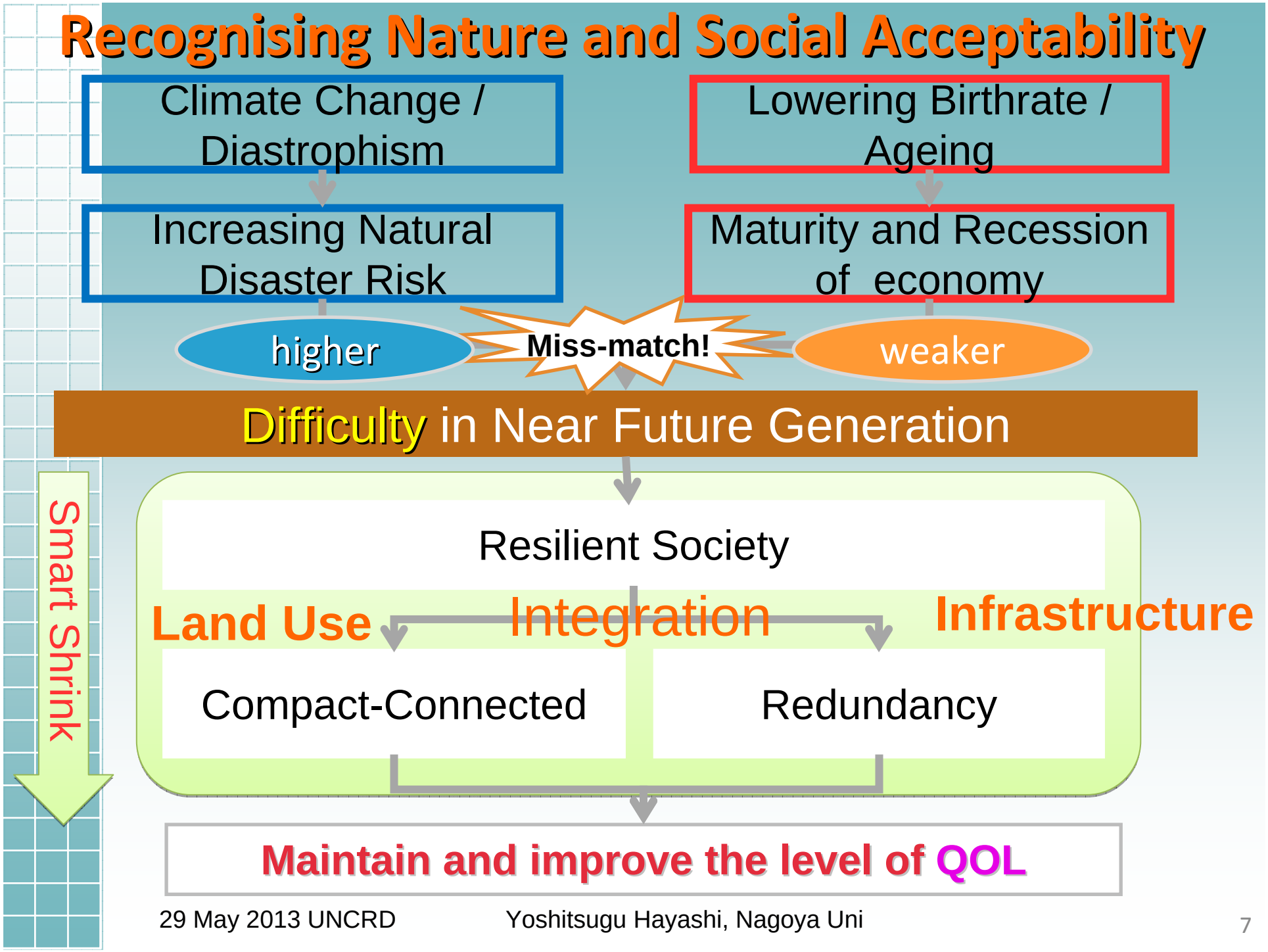


Growth outside, Shrink inside

- Rapid Growth in Asian Developing Countries
  - Rich people with poor infrastructure
- Westernization of Society in Asian Developing Countries
  - Nuclear Family, Urban Sprawl with Motorisation
  - Aging, Recession & Unemployment
- Vulnerability of Society → Difficulty in Adaptation
  - Poverty
  - Aging → Less Potential Economic Power

Recognising Nature and Social Acceptability



Various Aspects of Integration (1)

- Land use ←→ Transport
  - Catastrophic Congestion in 90's Bangkok due to excess dependence on road transport
  - Rail transit Revolution since 1999
  - Rail share shift from almost zero to 4% in 2011 (c.f. 50% in Tokyo Met., 10% in Greater London)
- Infrastructure ←→ Land Use
  - 1954 Flood in the Netherlands
  - 2011 East Japan Great Earthquake
- Integration of Strategies:

  Avoid←→ Shift←→ Improve

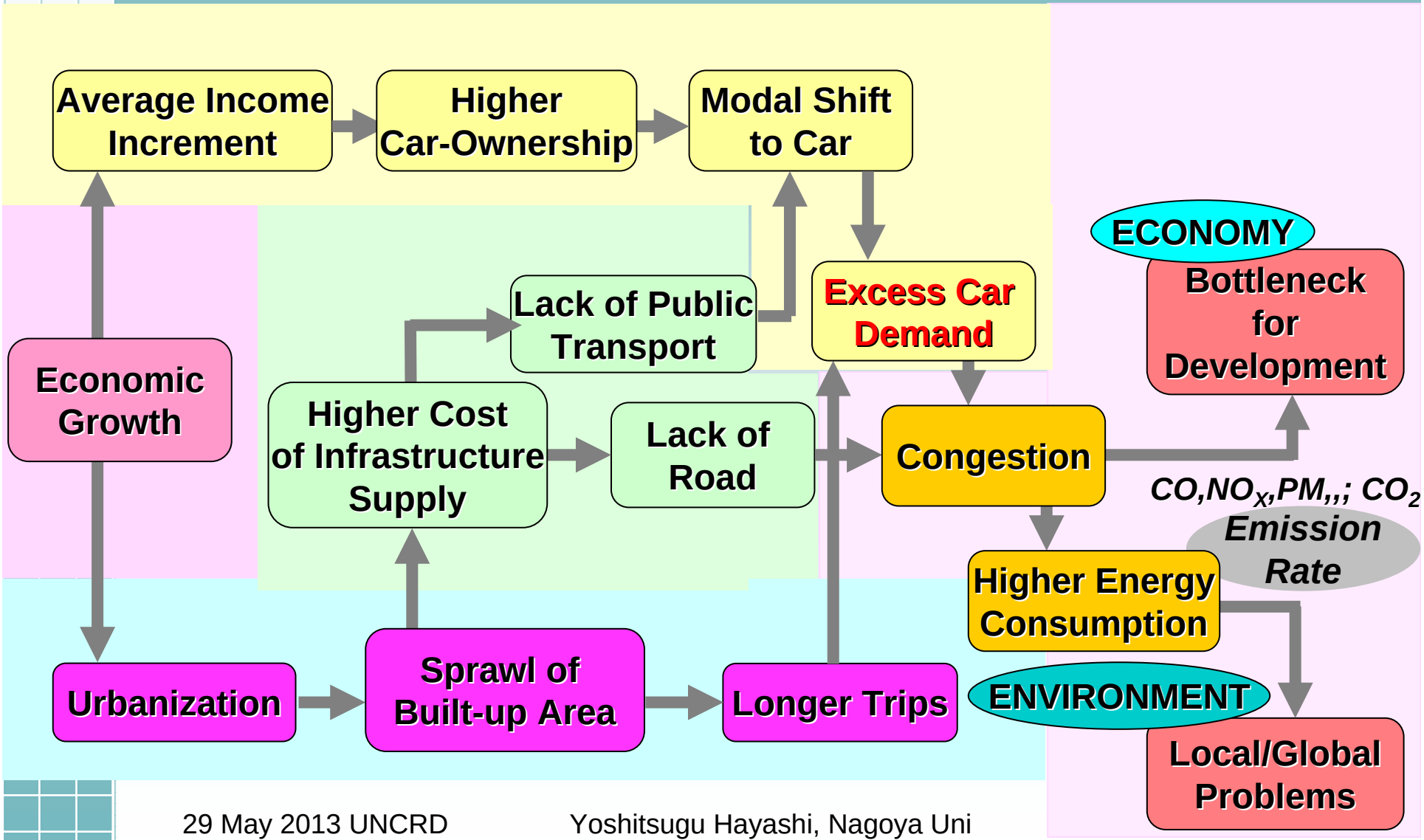
Various Aspects of Integration (2)

- Watershed
  - Before urbanisation: Grandparents taught grandchildren about local climate and culture
  - After urbanisation: Nuclear family+Motorisation have dispersed the family and the community

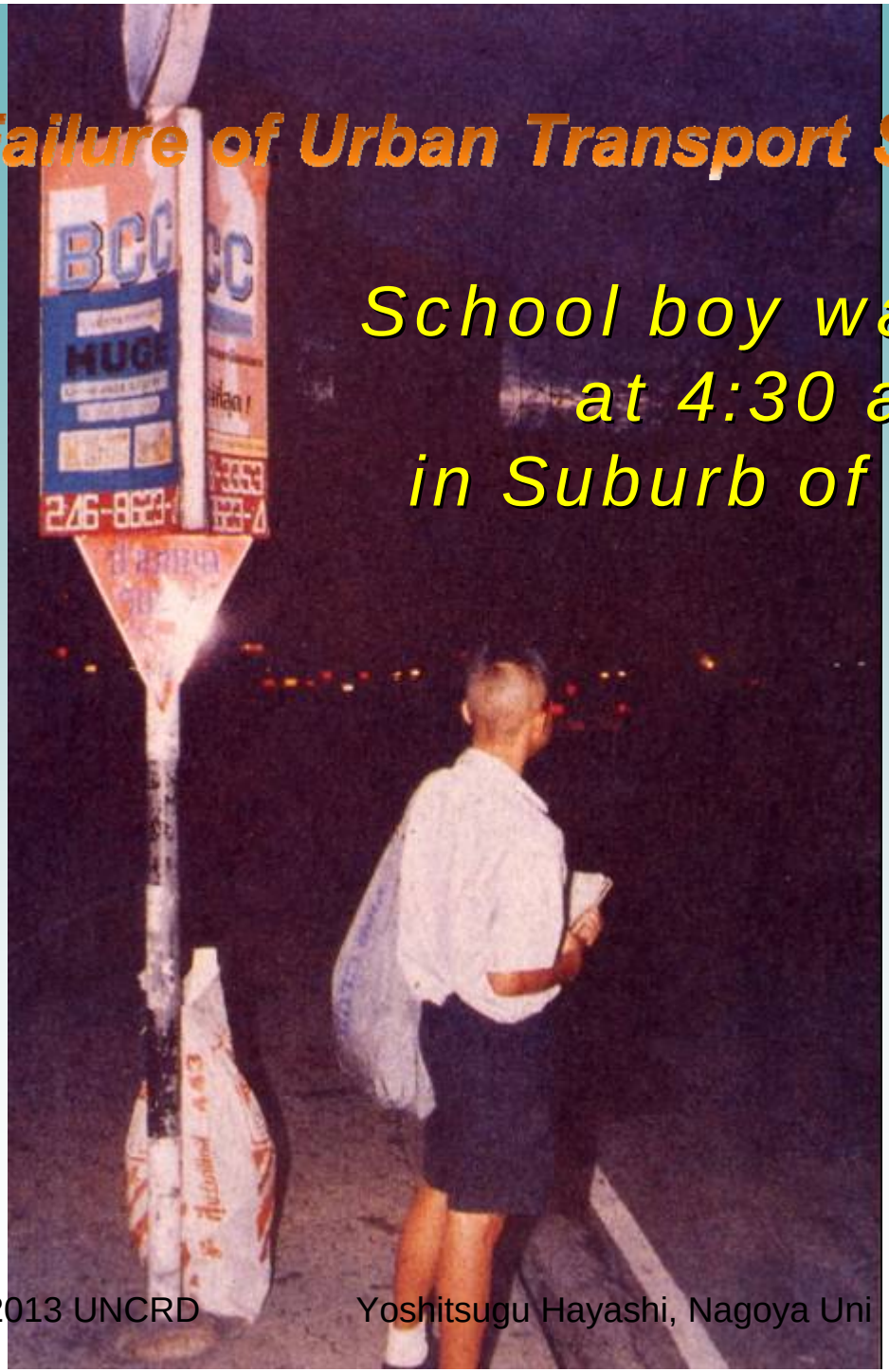
- Population Decline
  - Low birth rate in most of East and Southeast Asia
  - “Growing Small” Cities and Regions to foresee the future decline in population

2. Understanding Urbanization - Motorization nexus

Motorization and urbanization may threaten economy and environment



Failure of Urban Transport System



School boy waiting for bus
at 4:30 am
in Suburb of Bangkok

Bangkok Post
4 Sept 1993

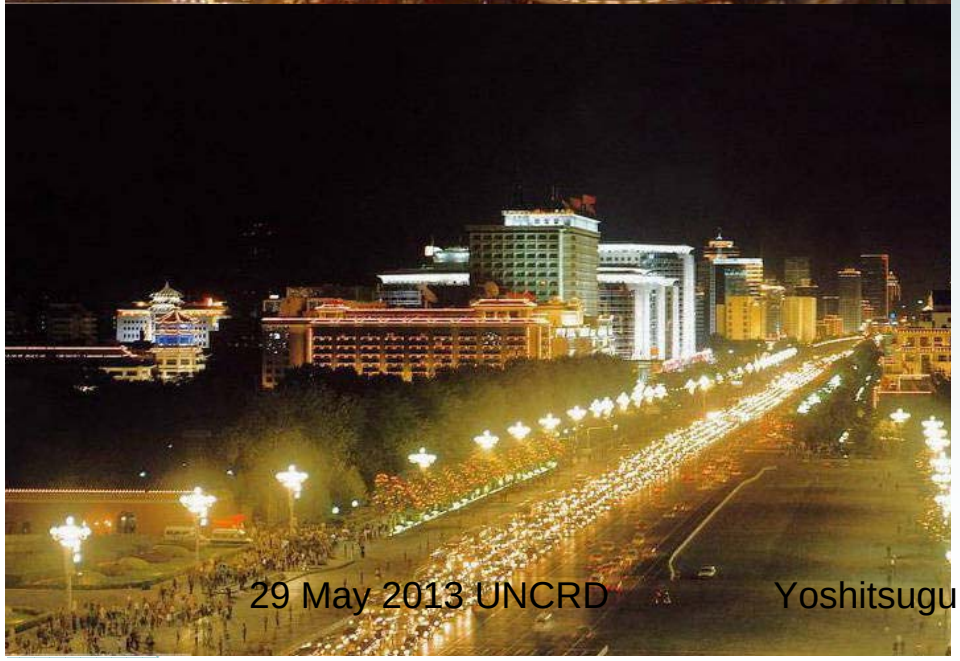
Failure of Urban Transport System

Slower than walkers in Sukunvit Rd, Bangkok

Photo by Hayashi(1993)

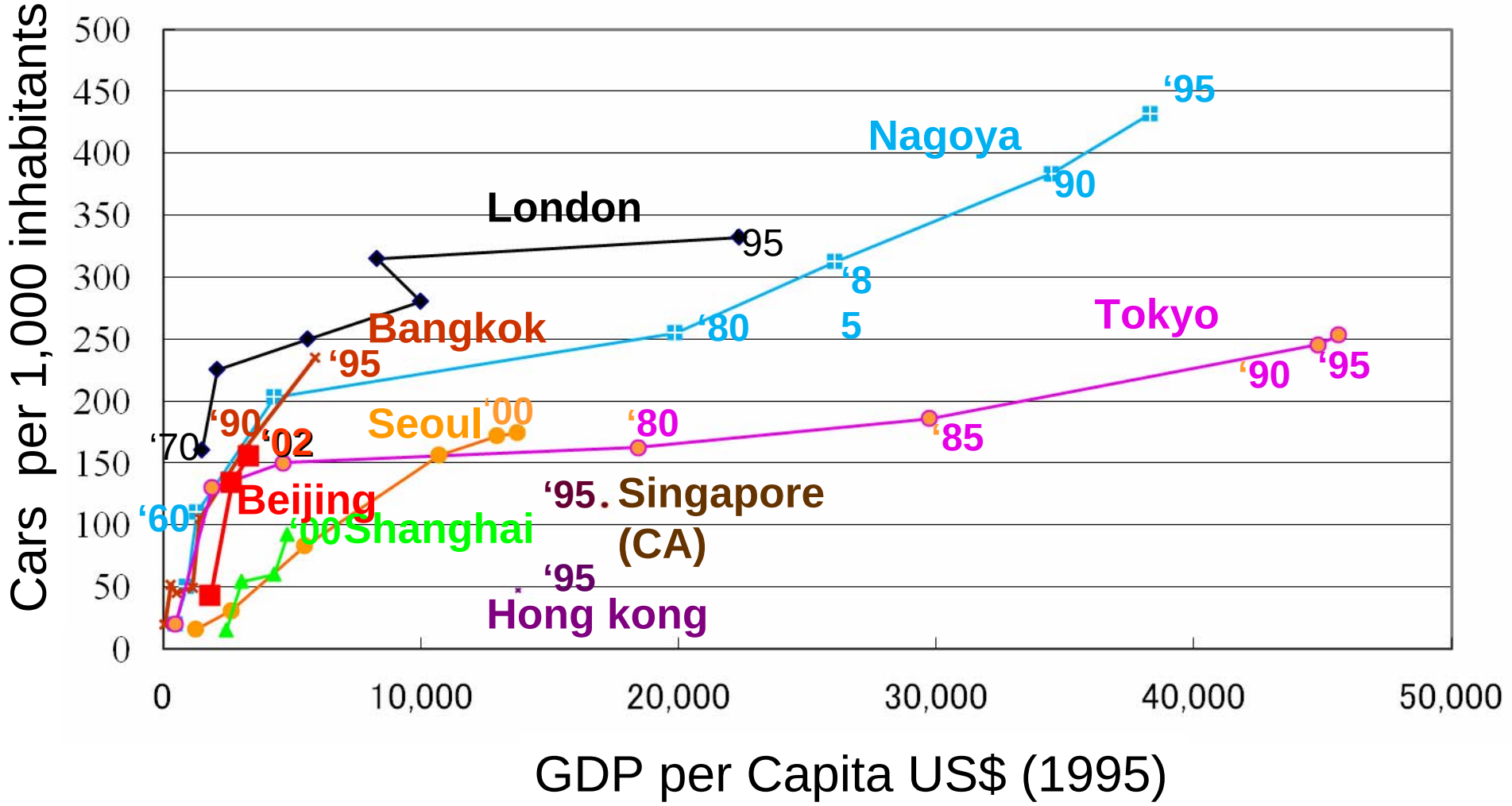
Failure of Urban Transport System

Traffic Jam in Beijing (Chang`an Jie)



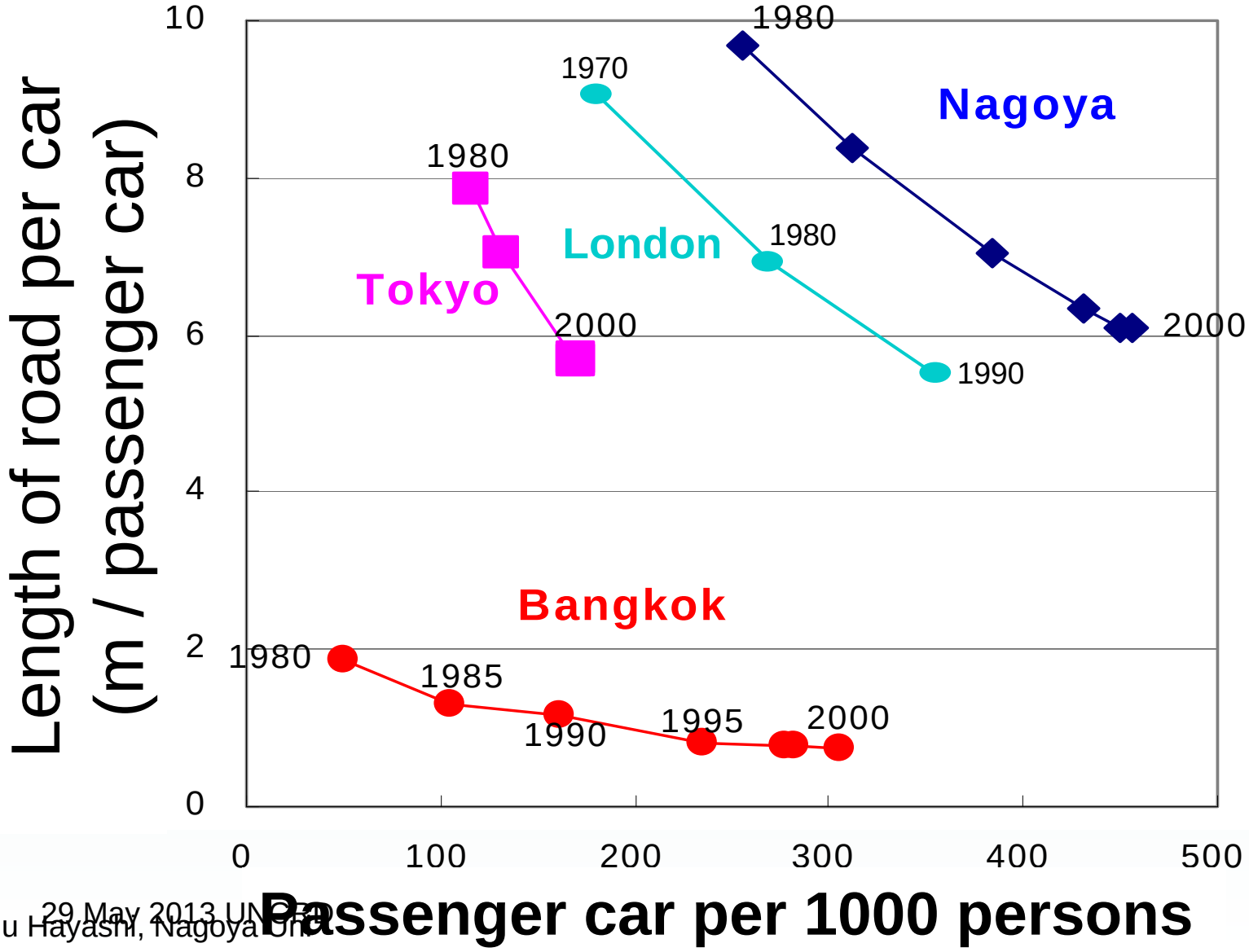
Failure of Urban Transport System

Car Ownership



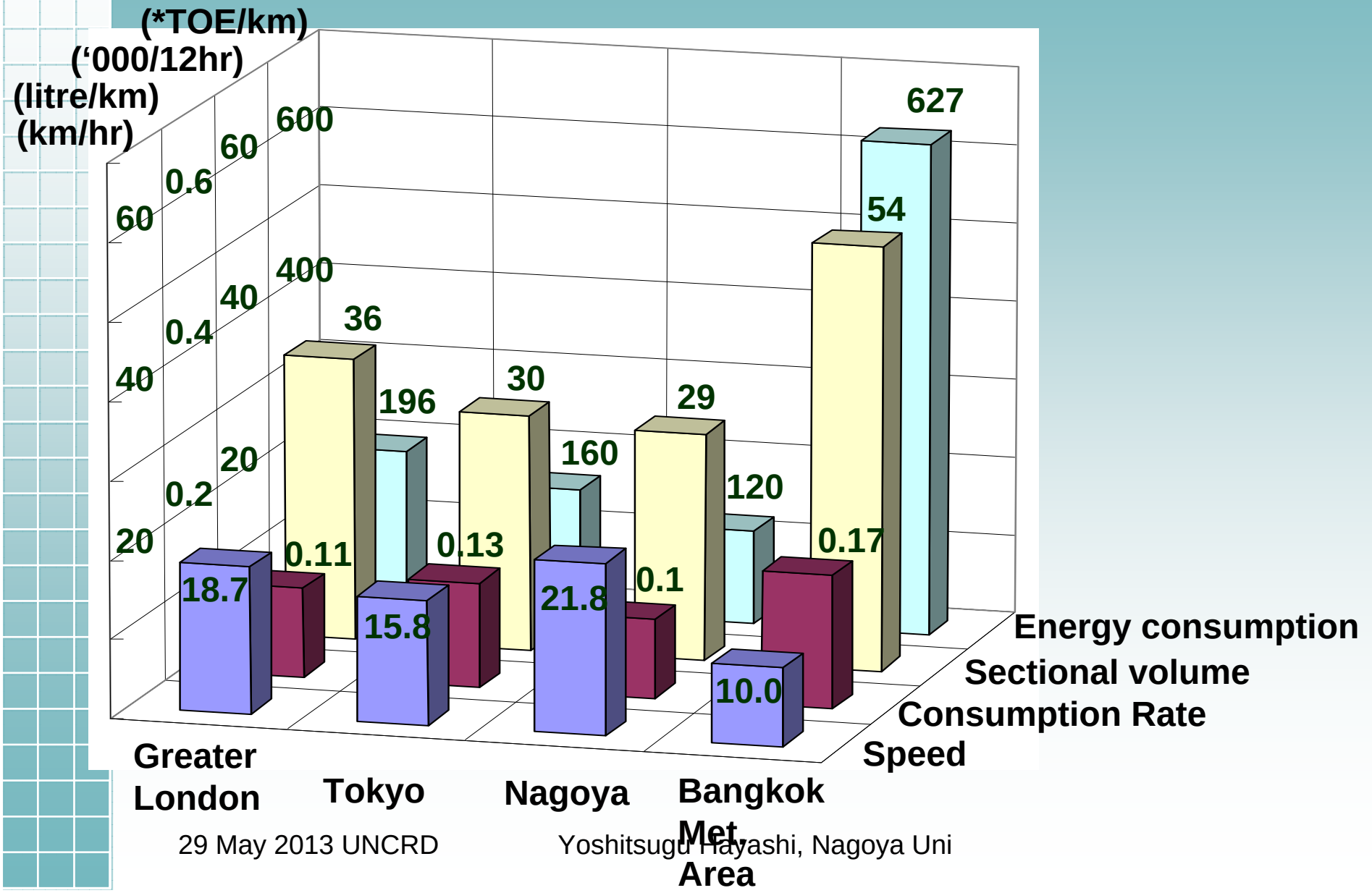
Failure of Urban Transport System

Car Ownership & Road Supply



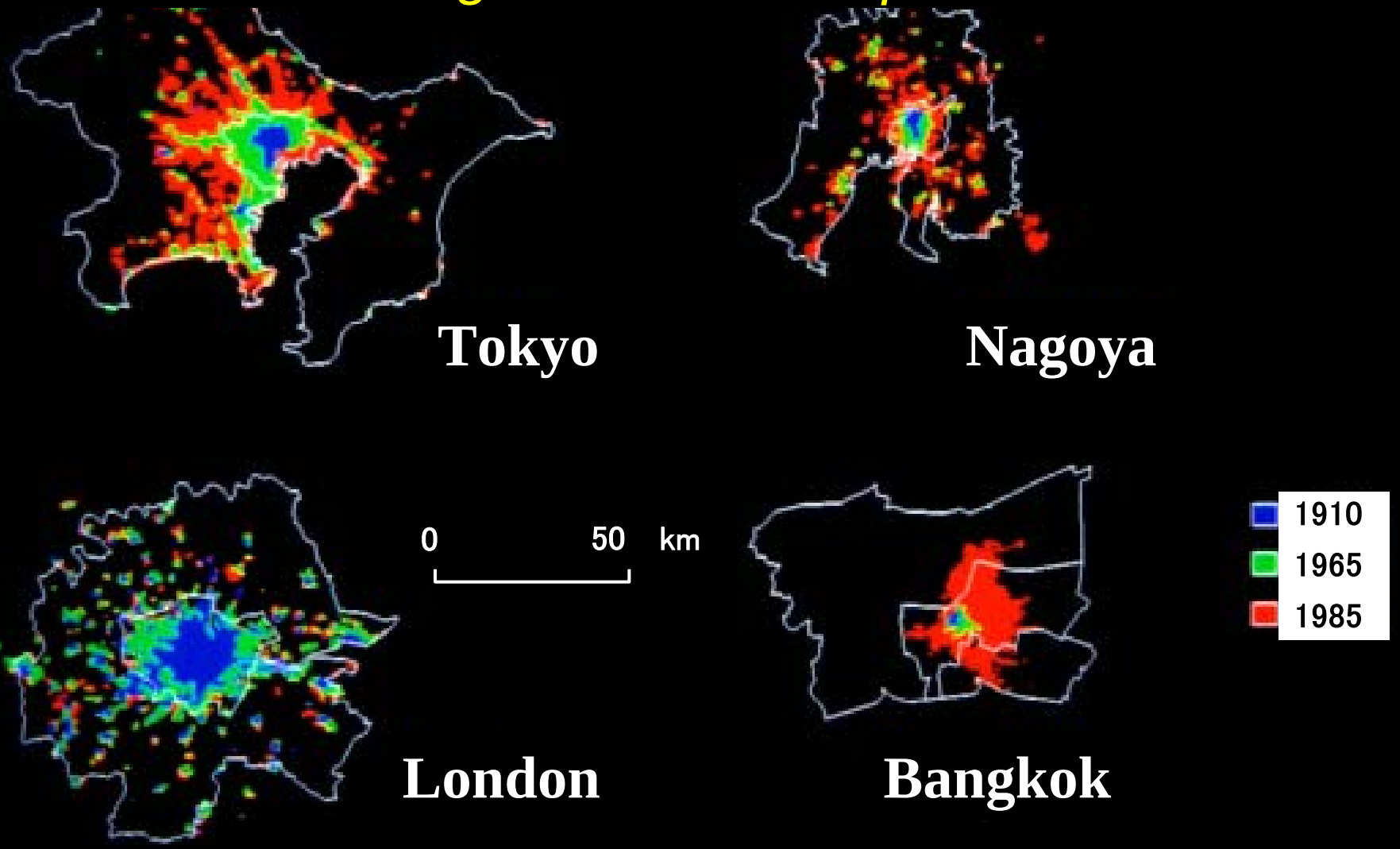
Failure of Urban Transport System

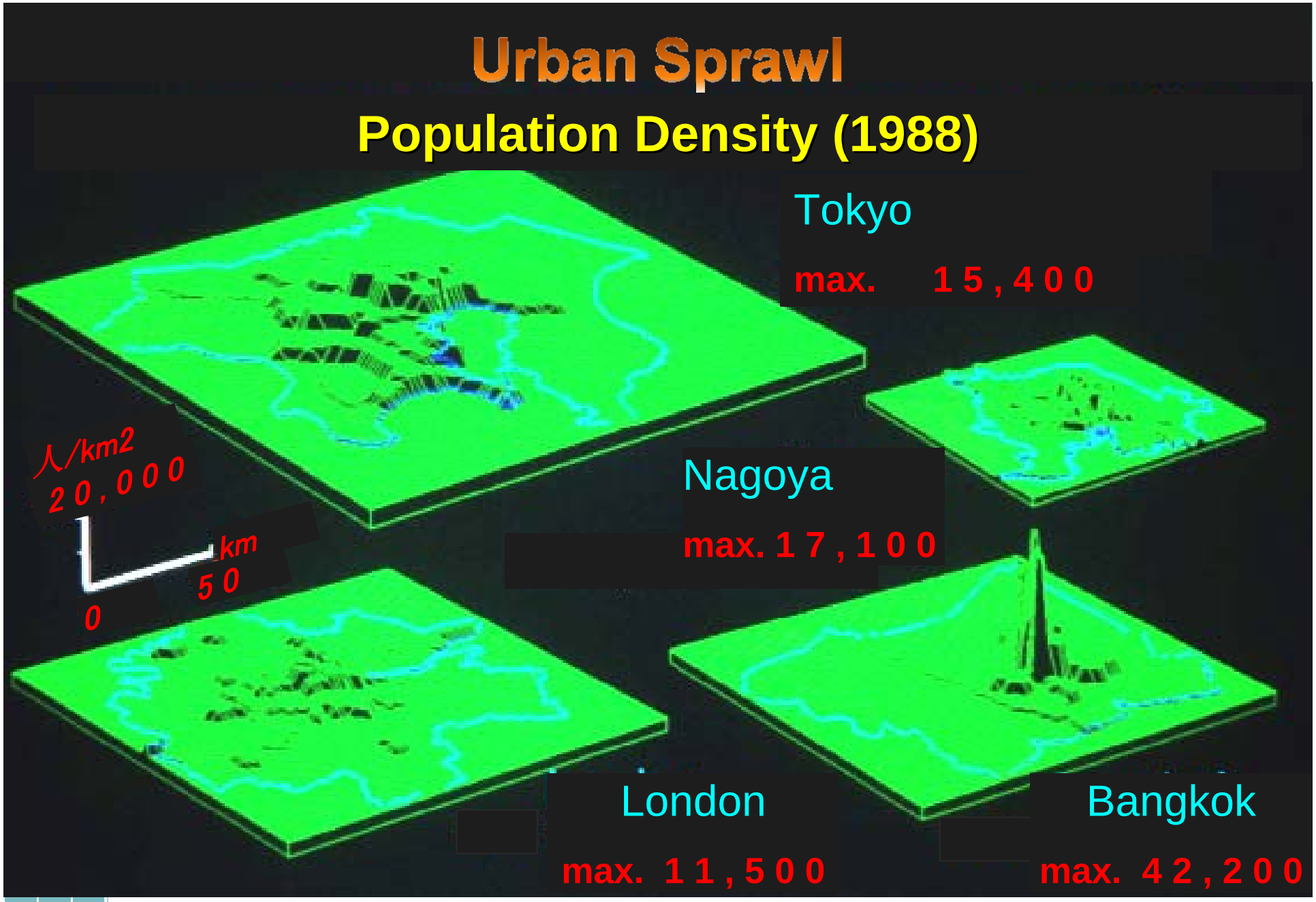
Motorization & Road Supply



Urban Sprawl

Changes in Built-up Areas

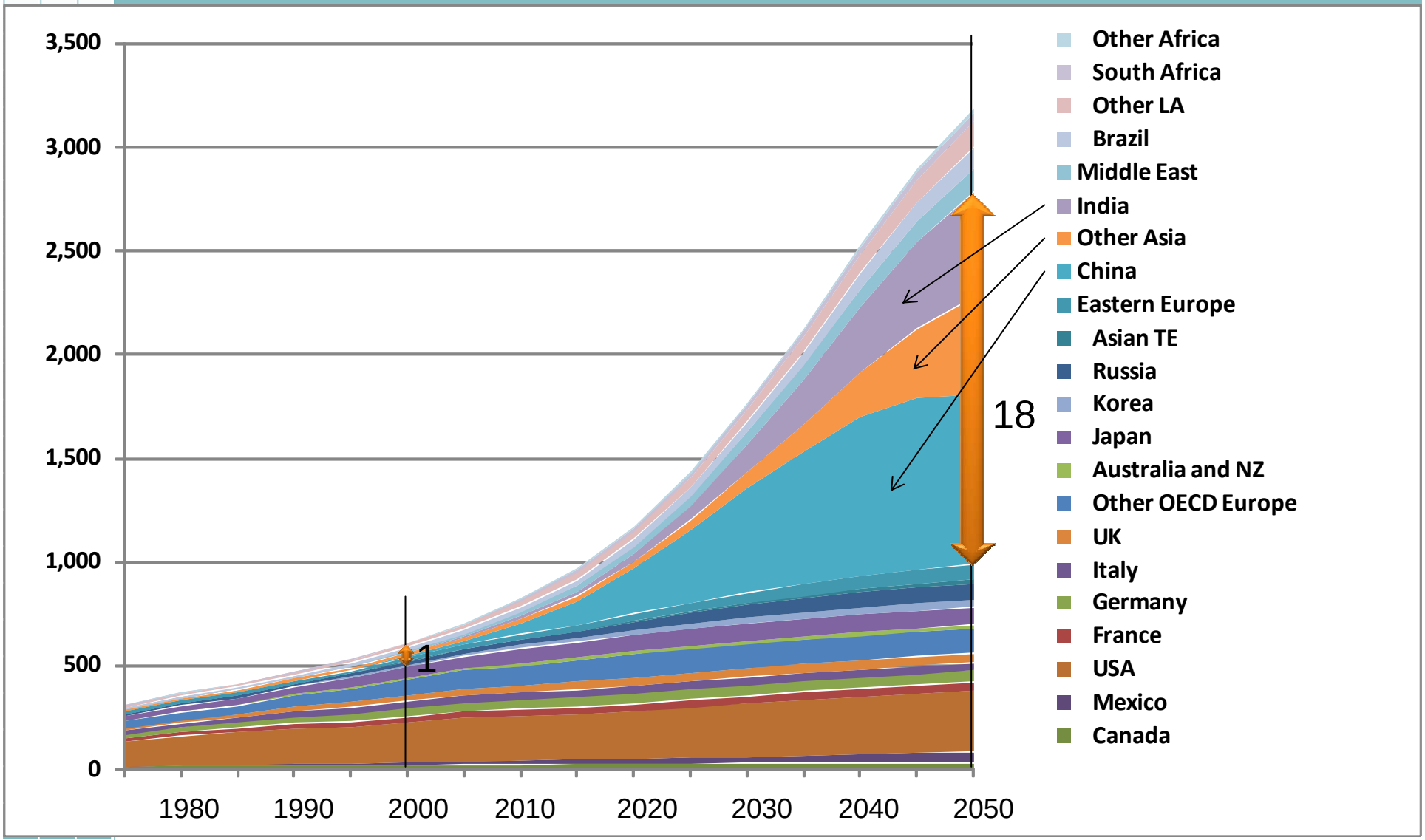



Urban Sprawl
Population Density (1988)
Tokyo
max. 15,400
人/km2
20,000
km
50
0
Nagoya
max. 17,100
London
max. 11,500
Bangkok
max. 42,200

3. What will happen the next?

Increasing Use of Automobile

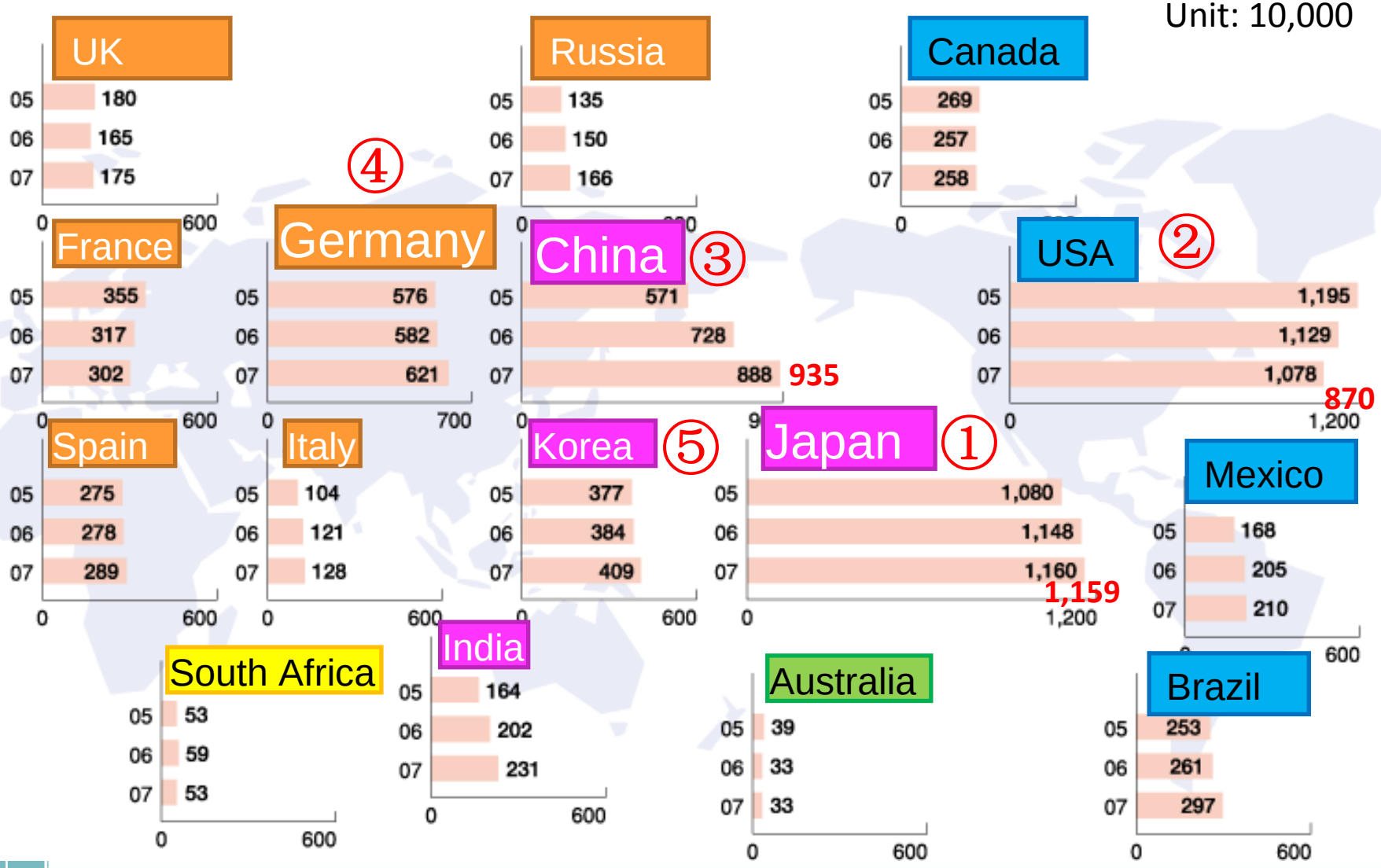
IEA Vehicle Ownership Projections -Where Will These Cars Fit?-



Increasing Use of Automobile

Automobile Production in the world (2005, 2006, 2007)

Unit: 10,000



Source: http://www.jama.or.jp/index.html

Increasing Use of Automobile

Automobile Production in the world (2009, 2010, 2011)

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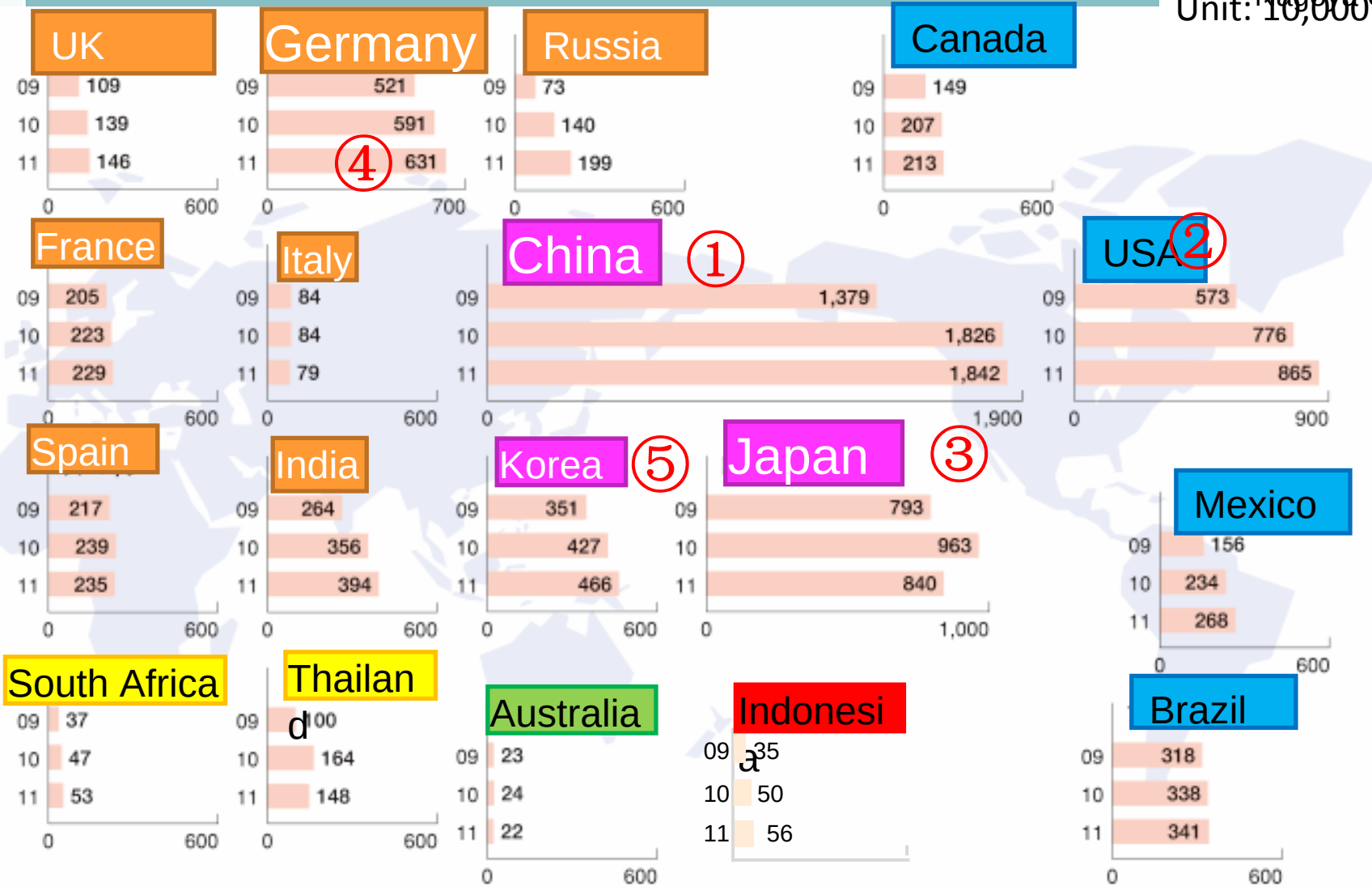
Unit: 10,000



Source: http://www.jama.or.jp/index.html

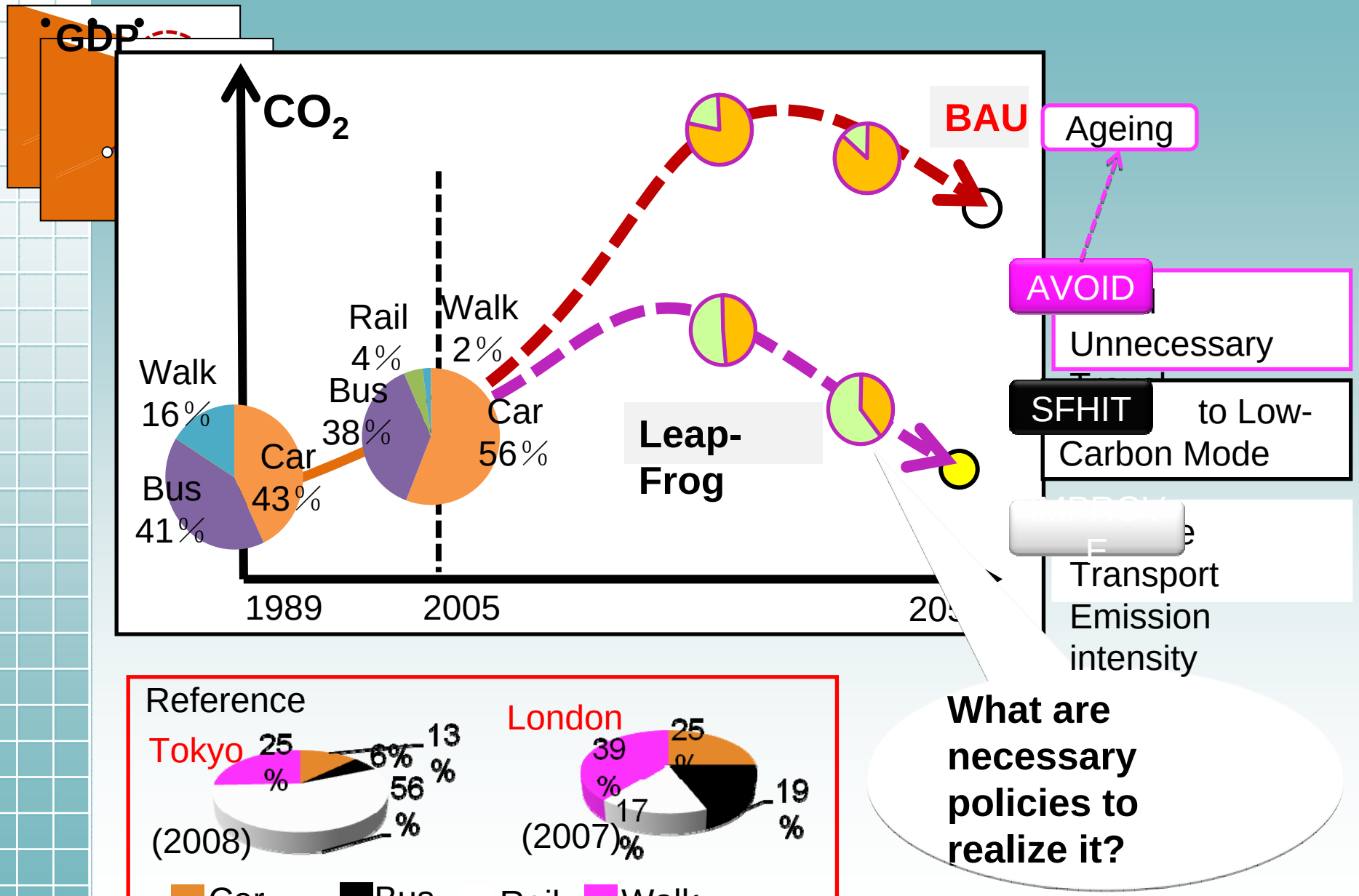
Increasing Cars with Poor Infrastructure in Asian Developing Countries

- Skyrocketing Increase in Car Ownership (20 times in 2050)
- Less Power to Self-finance Railways in Mega-cities
- Increasing Mega-cities (50 or more in 2050) without Railway Systems
  - Catastrophic Congestion like 90's Bangkok

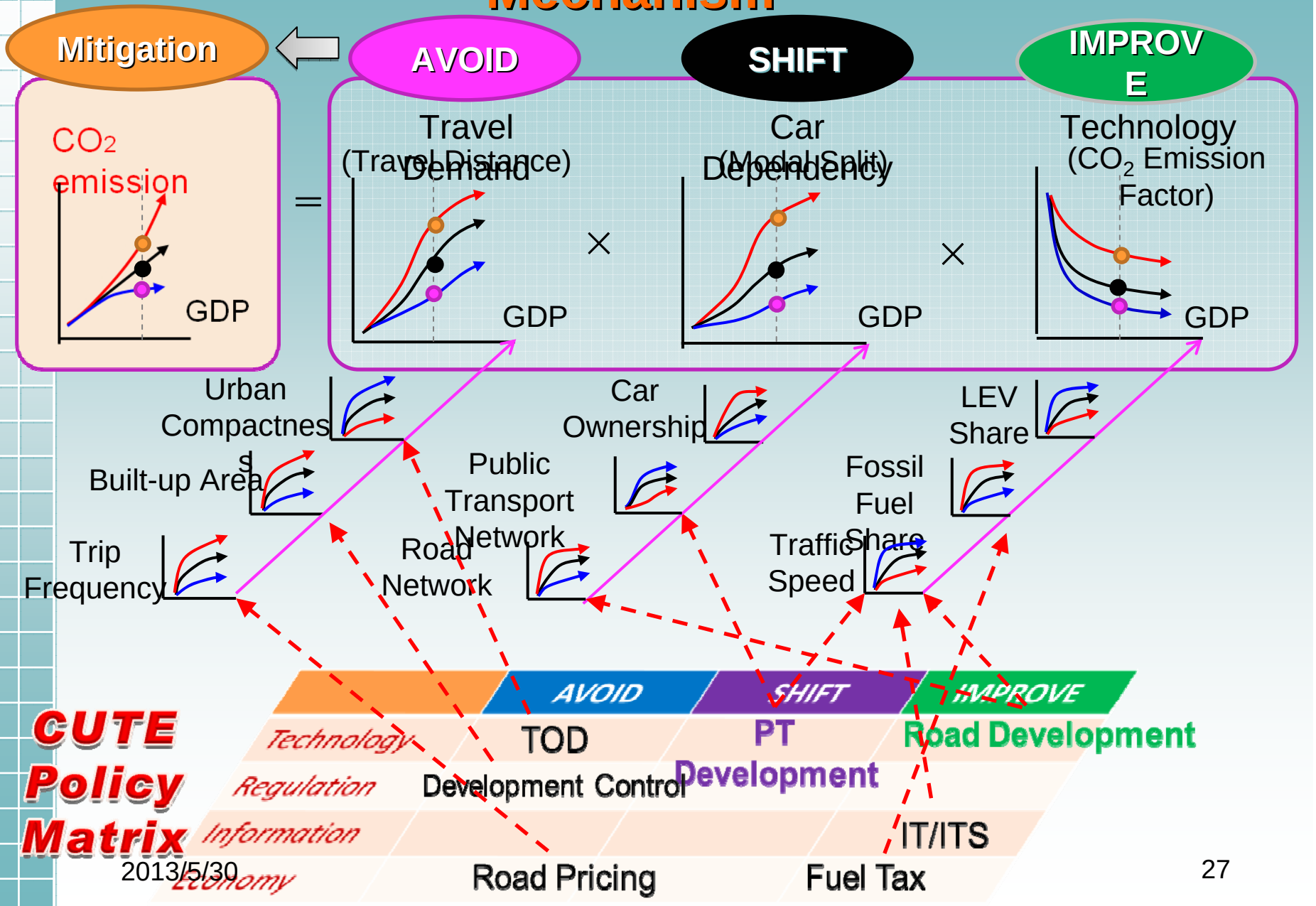
→ Unacceptable Increase in CO2 from Urban Transport

4. Strategies for Solution and Finding Integrated Policy/ Technological Instruments for Less Damages on Climate

Visioning Future Transport Systems with Key Indicators

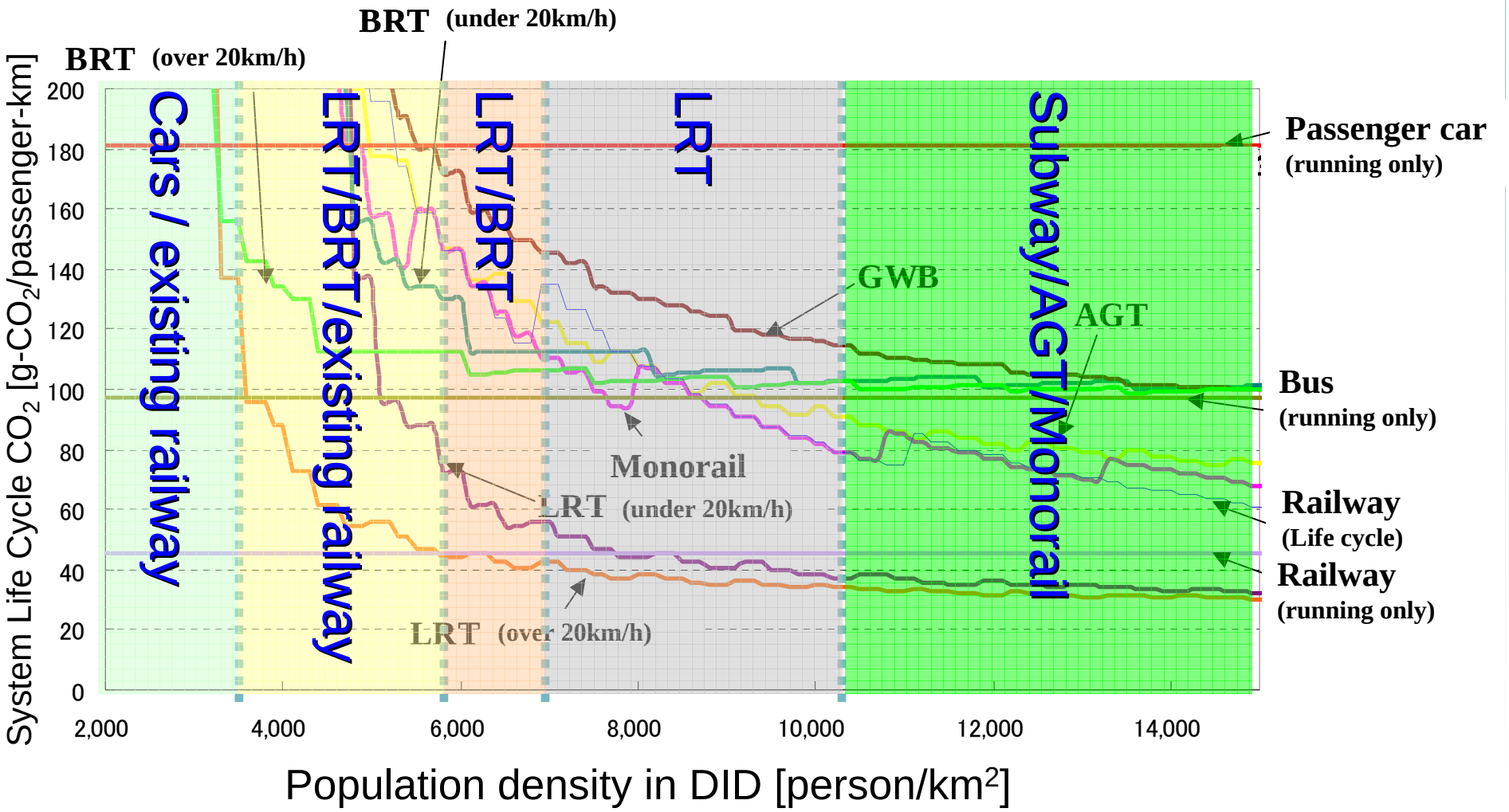


Dynamic Tracking of Transport Related Emission Mechanism



Innovation of Transport System

Which Mode is Optimal ?
- Life Cycle CO2 /Trip Density -



Transport Strategy - Techno/Policy Instruments

CUTE Matrix		Strategy		
		Avoid	**Shift**	**Improve**
		Reduce traffic demand	**Reduce emissions per unit transported**	**Reduce emissions per kilometer**
Instruments	**Technology**	▪ Pedestrian Ort Dev't ▪ Bicycle Ort Dev't ▪ Transit Ort Dev't	▪ Integrated Public Transport System ▪ Highly Competitive Railway	▪ LEV, EV ▪ Alternative Energy ▪ Advanced Infra- Tech ▪ Logistic Efficiency
	Regulation	▪ TDM ▪ Parking Regulation ▪ Compact/Mix Land Use	▪ Bus/Tram Priorities ▪ Non-MT ▪ Smarter Modal Evolution	▪ Emission Standard ▪ Top Runner Program ▪ Eco-Drive
	Information	▪ ICT ▪ Telework ▪ Smart Choices for Workplace and Schools	▪ Awareness Campaign	▪ Knowledgebase ▪ ITS ▪ Labeling of Vehicle Performance
	Economic	▪ Fuel Tax ▪ Road Pricing ▪ Car Charge / Fee ▪ Location Subsidy	▪ Fuel Tax ▪ Road Pricing ▪ Car Charge / Fee	▪ Fuel Tax ▪ LEV Preferential Tax

Innovation of Transport System
CUTE Matrix

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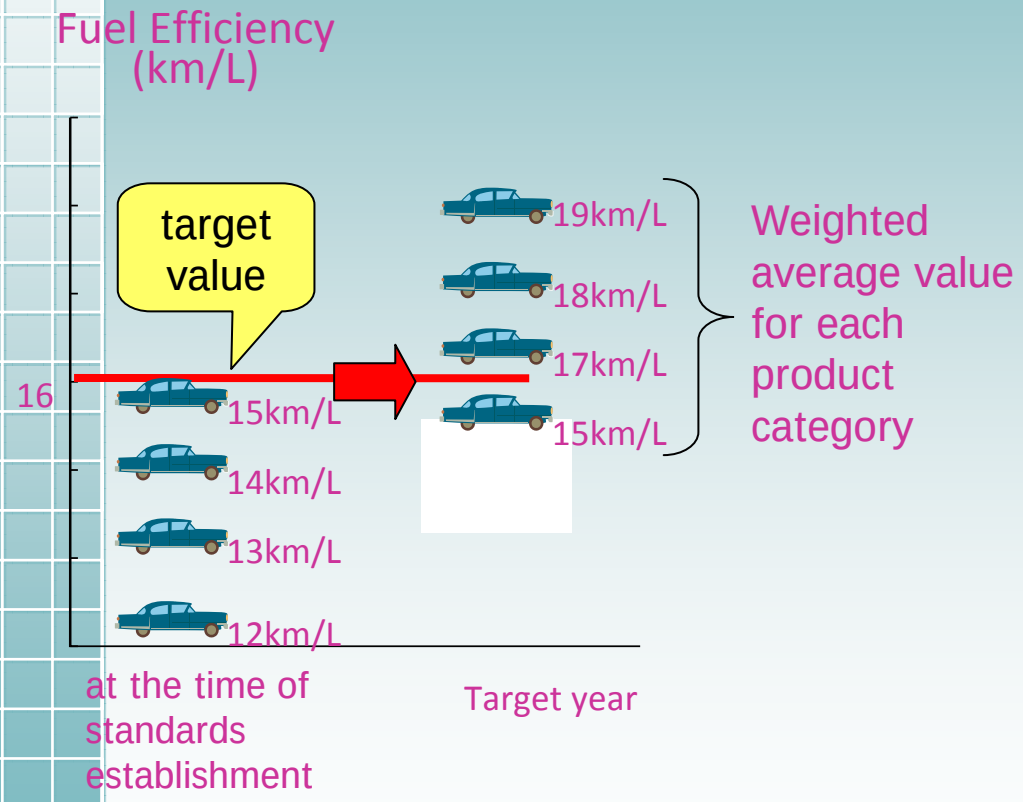
Strategy / Instrument	Avoid	Shift		Improve	
	Reduce need to travel	***Reduce car use***	***Improve alternative modes***	***Improve road network***	***Improve vehicles and fuels***
Technology	TOD	Pedestrian friendly urban design	Rail/bus infrastructure	IMTS	LEV Alternative fuel
Regulation	Compact city Mix land use	Access permits	Bus/tram priorities	TDM	Emission standard Top runner program
Information				Eco-drive IT/ITS	IT / ITS
Economy				Road pricin	

Innovation: Japan
Greening Taxation

LEV subsidy
LEV preferential tax

Innovation of Transport System
The "Top Runner" program: Efficiency improvement
(Ministry of Economy, Trade and Industry)

Top Runner Program with vehicles



List of the Specified 21 Appliances

Passenger Vehicles
Freight Vehicles
Air Conditioners
Electric Refrigerators
Electric Freezers
Electric Rice Cookers
Microwave Ovens
Fluorescent Lights
Electric Toilet Seats
TV Sets (CRT, LCD, Plasma)
Video Cassette Recorders
DVD Recorders
Computers
Magnetic Disk Units
Copying Machines
Space Heaters
Gas Cooking Appliances
Gas Water Heaters
Oil Water Heaters
Vending Machines
Transformers

Innovation of Transport System
CUTE Matrix

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Strategy / Instrument	Avoid	Shift		Improve	
	Reduce need to travel	***Reduce car use***	***Improve alternative modes***	***Improve road network***	***Improve vehicles and fuels***
Technology	TOD	Pedestrian friendly urban design	Rail/bus infrastructure	IMTS	LEV Alternative fuel
Regulation				T	**Emission Standard** **Top Runner Program**
Information	Telework ing	Awareness campaign	Bus location system	Eco-drive IT/ITS	IT / ITS
Economy	Location al Subsidy	Fuel tax Road pricing	Rail/bus fare	Road pricing	LEV subsidy LEV preferential tax

Innovation: Japan Top Runner Program

Innovation of Transport System
Effects of Tax and Subsidy Policies

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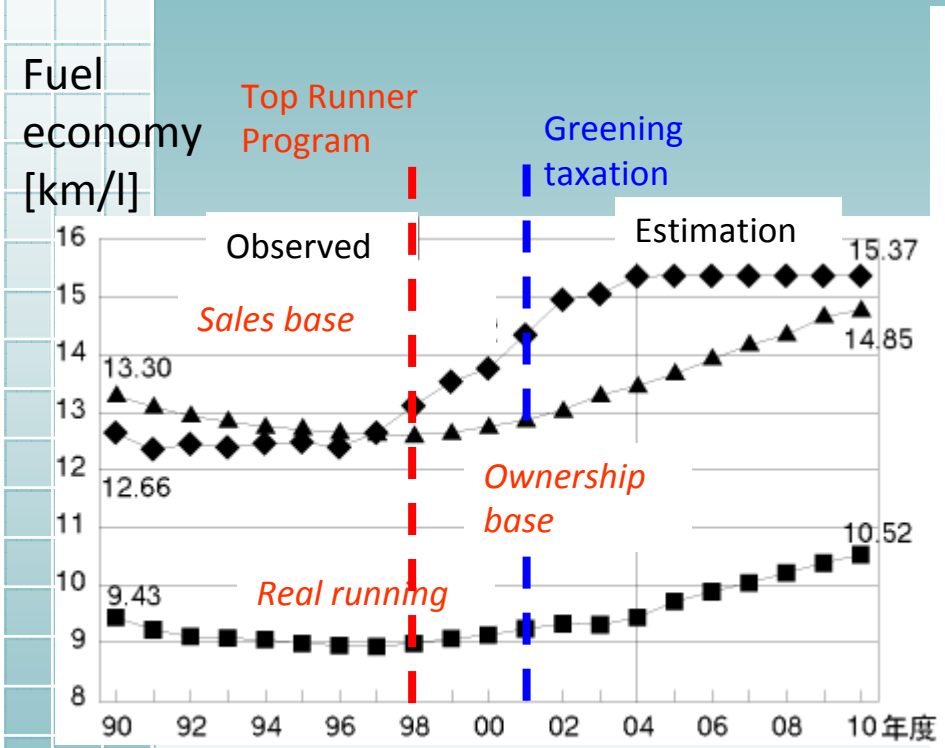
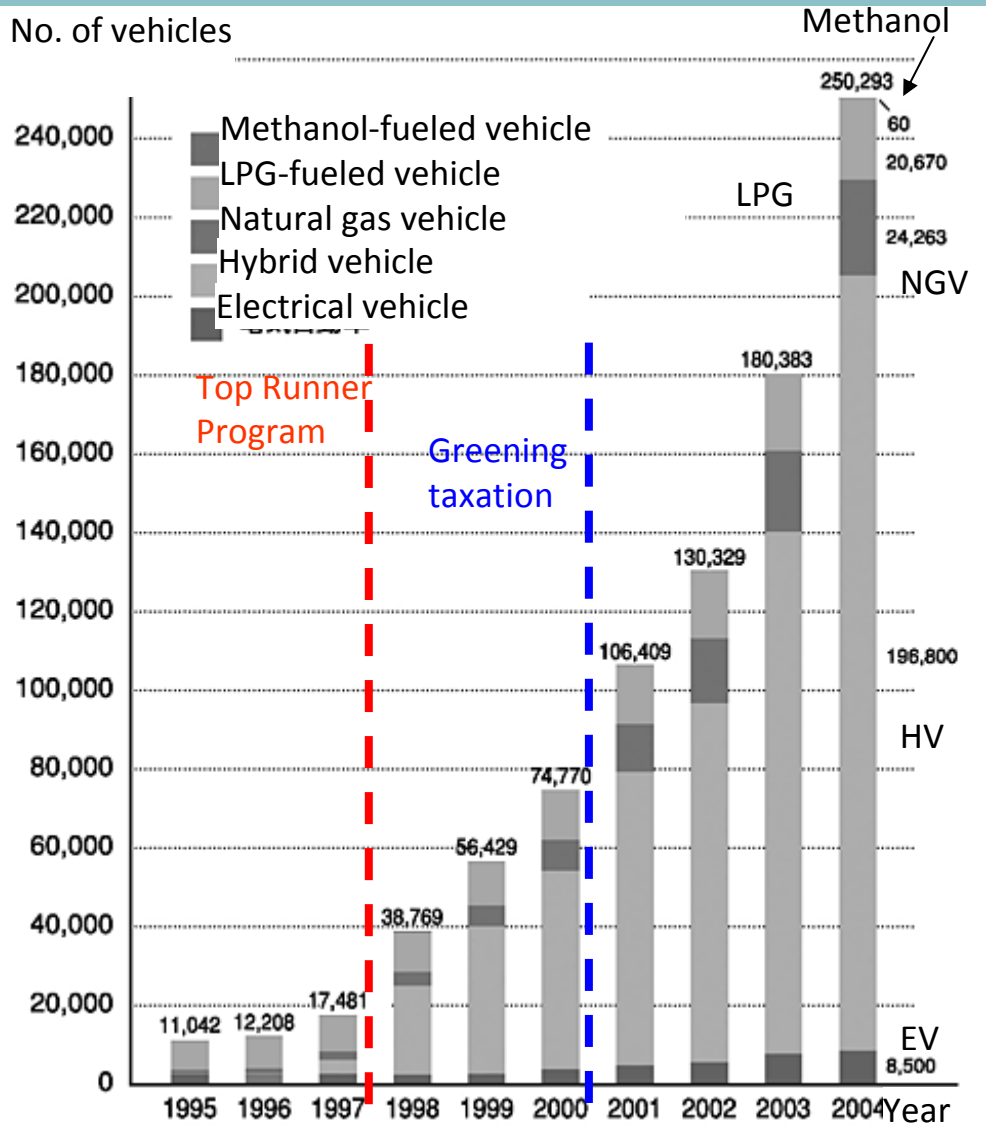
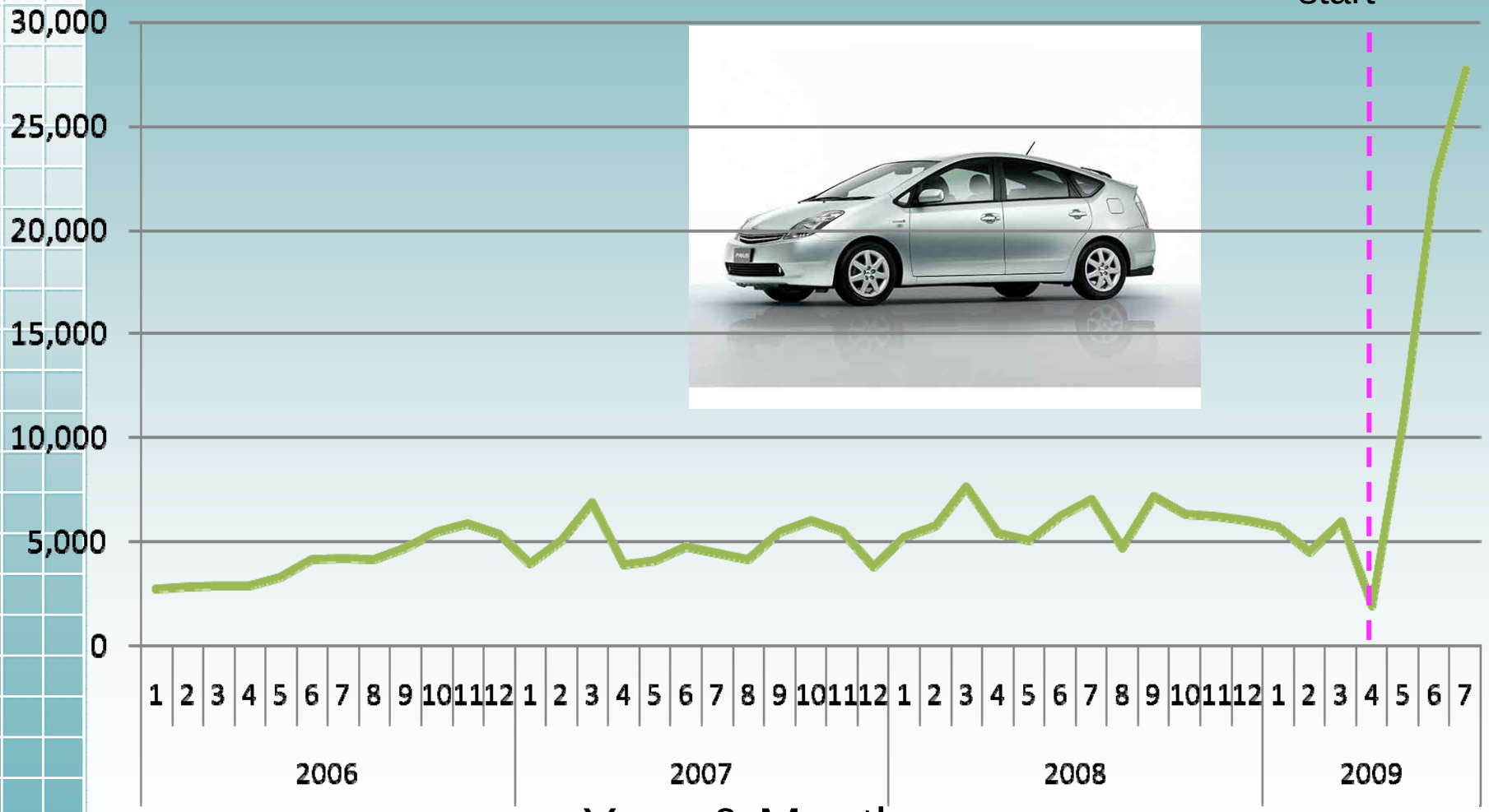




Innovation of Transport System

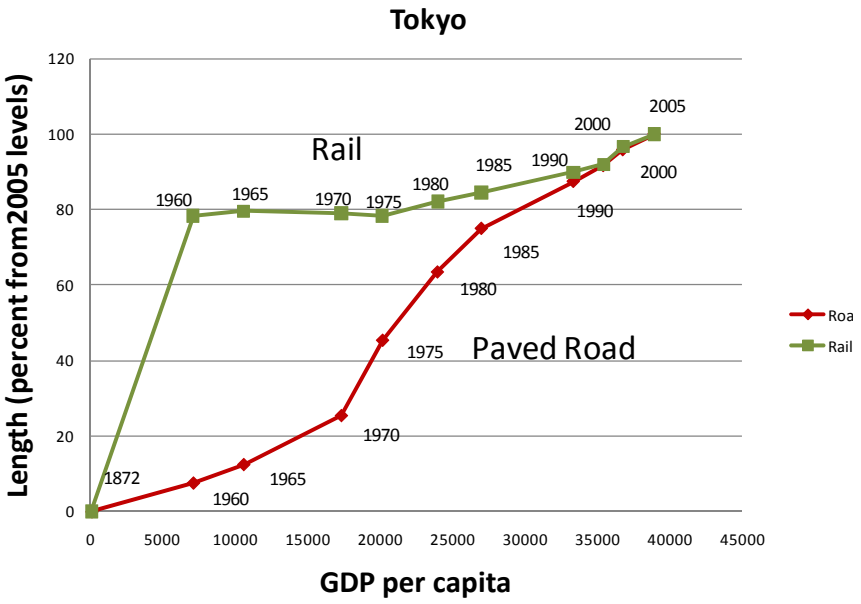
Effect of Subsidy for Low Emission Cars

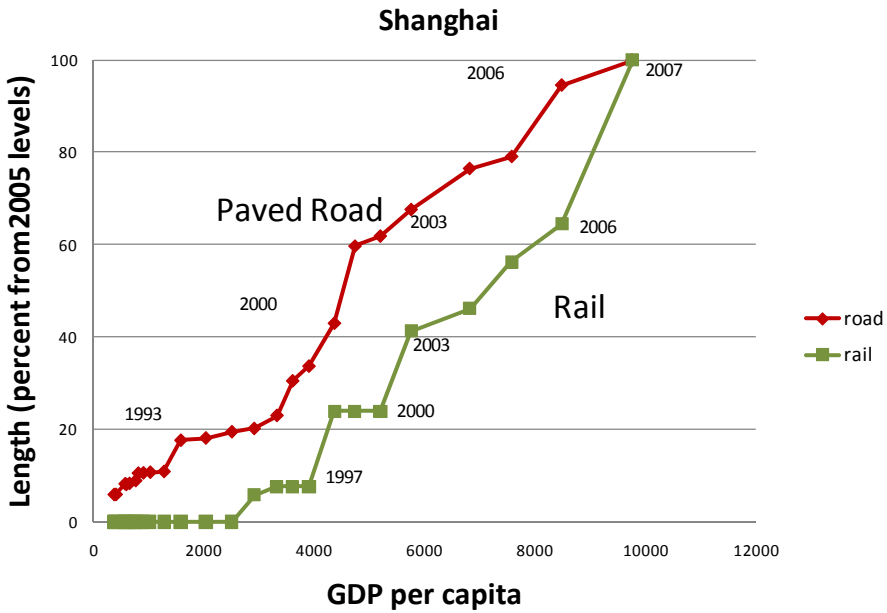
Domestic sales of new cars
(Toyota, prius)

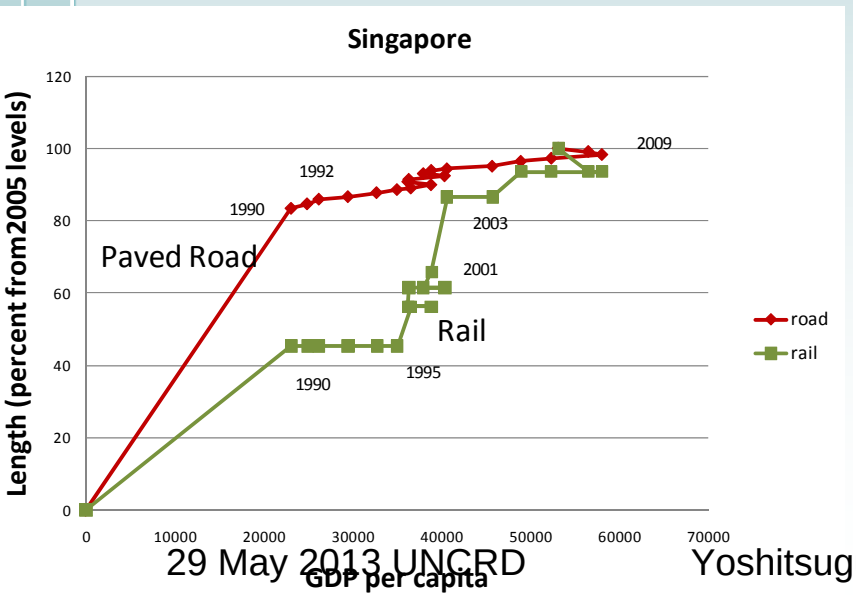


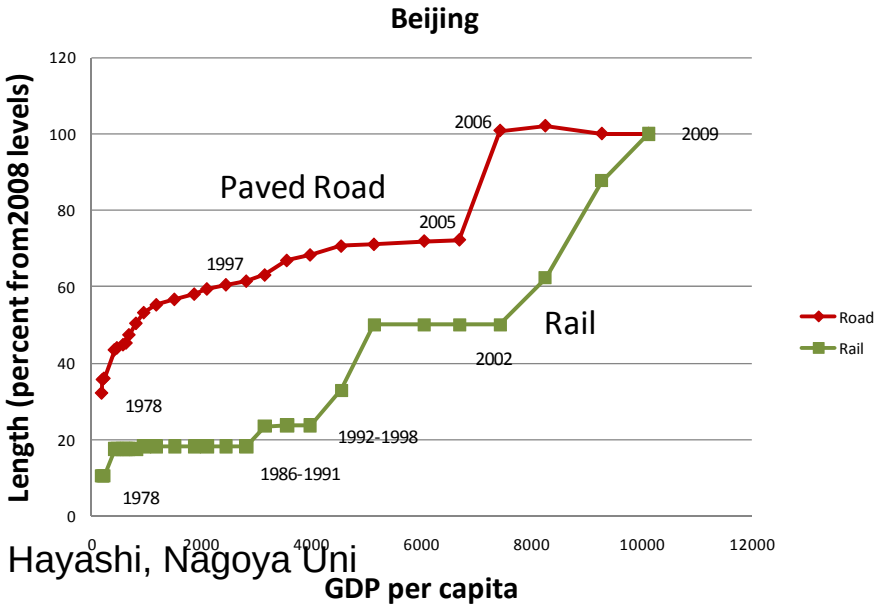
4. Levels of Railway Development

Which is more priority, Rail or Road ?

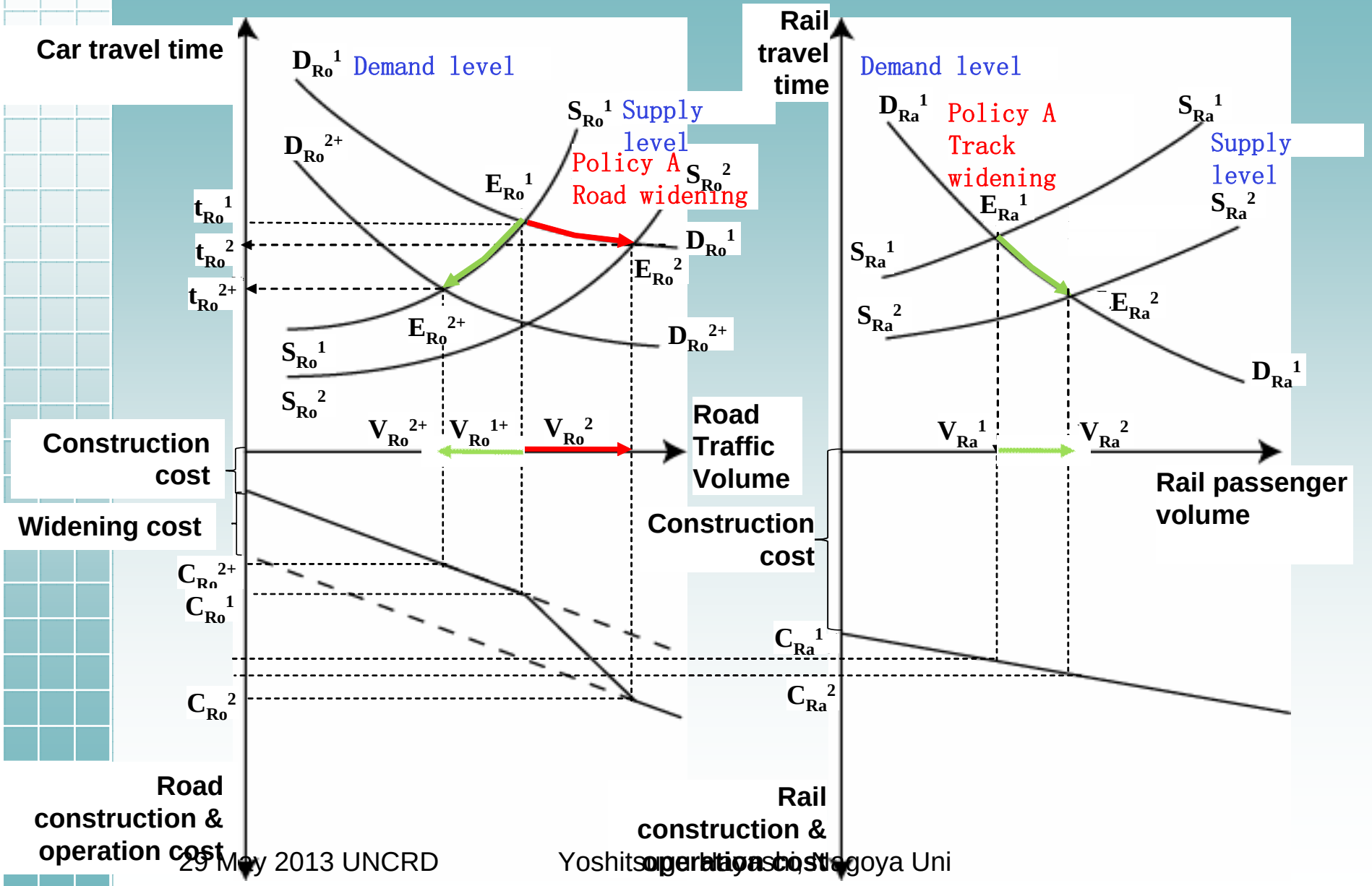








Hayashi's Chart for Optimal Rail-Road Balance



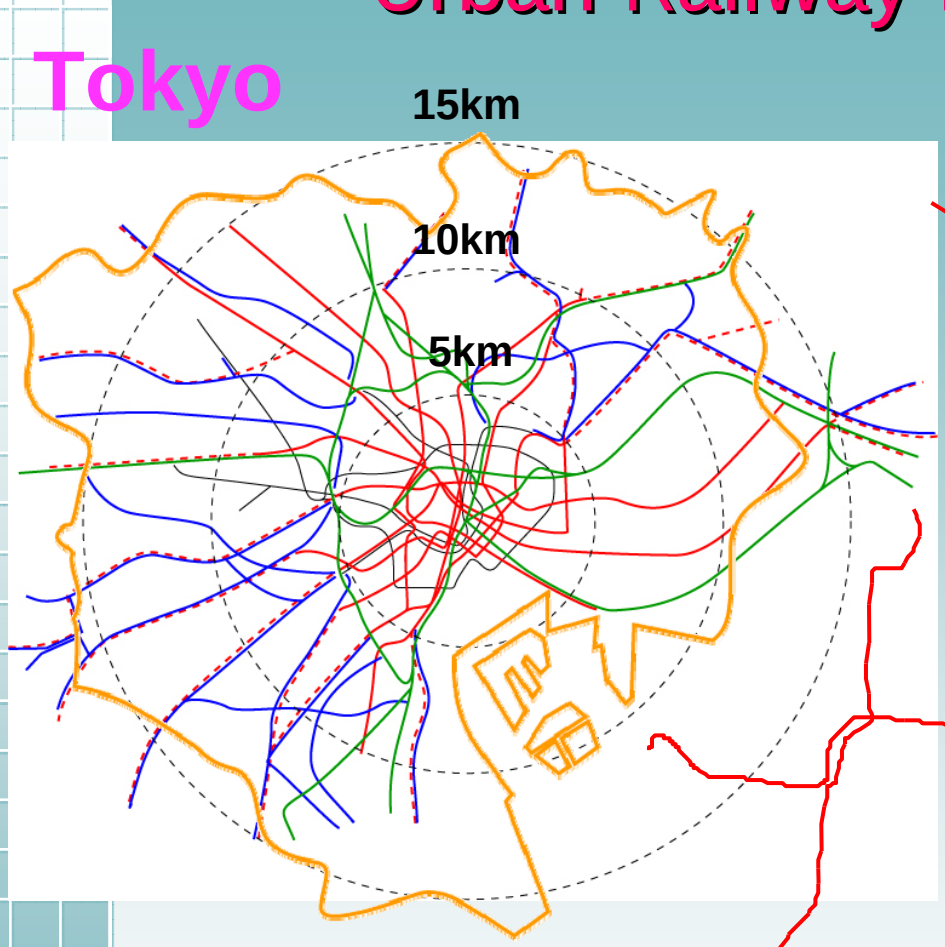
Extent of inner-city road congestion due to unseamless rail transport

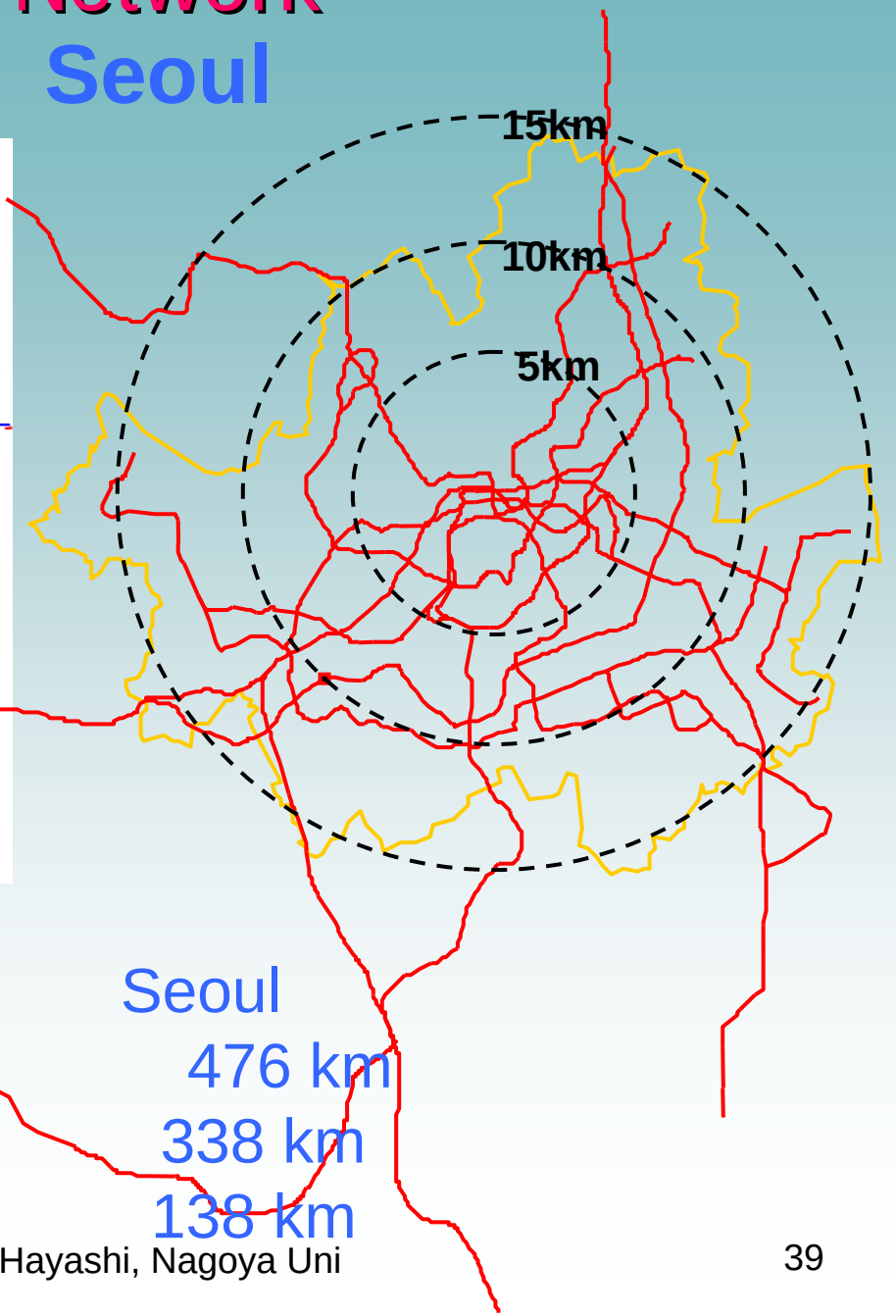
	(Tokyo)	(Seoul)	(Shanghai)
Territory:	621	vs. 606	vs. 600 km^2
Population:	8.3	vs. 9.9	vs. 1.0 million
Subway:	286	vs. 280	vs. 420 km

Road Congestion in inner areas:

Tokyo << Seoul → Why ??

Urban Railway Network

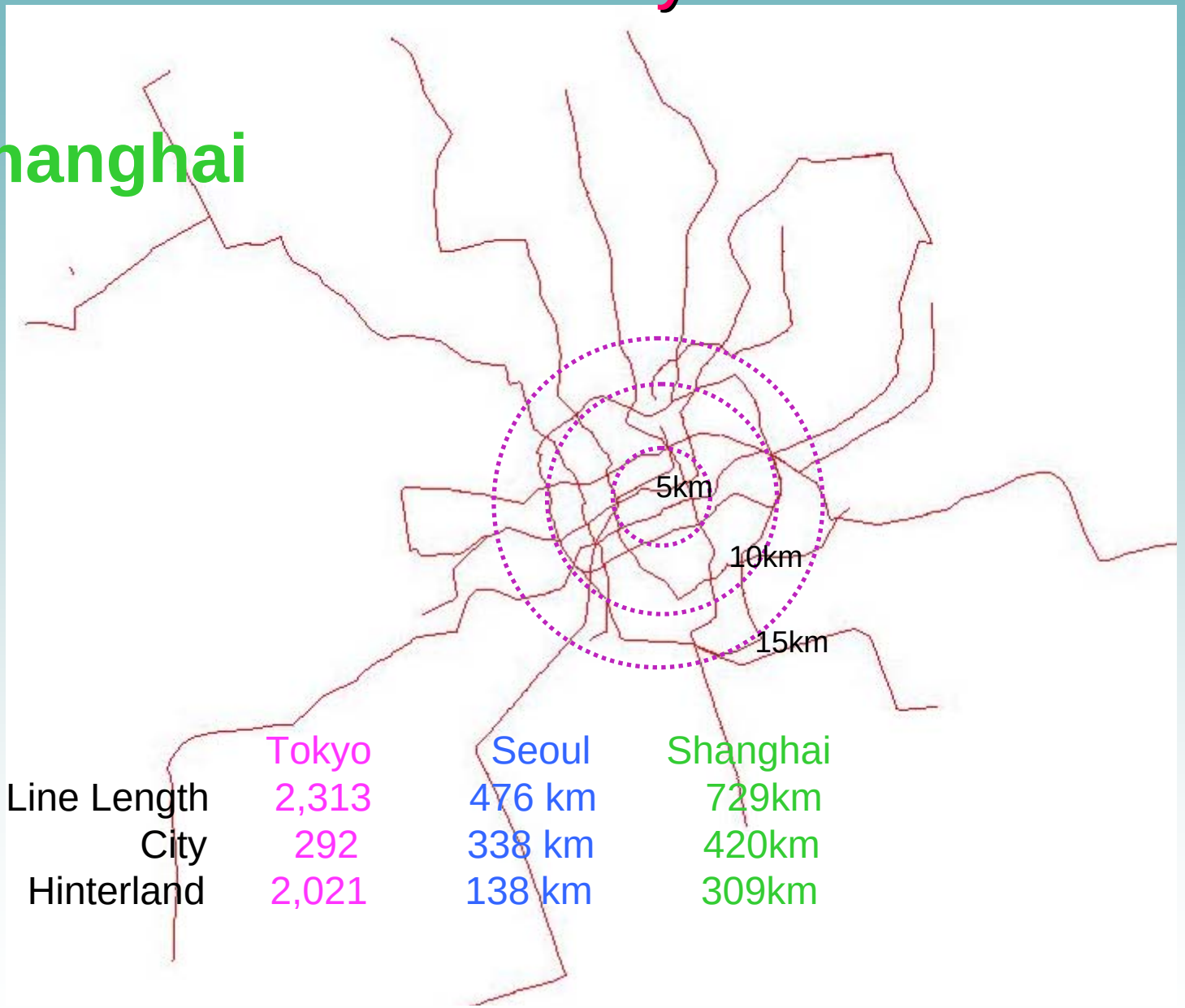




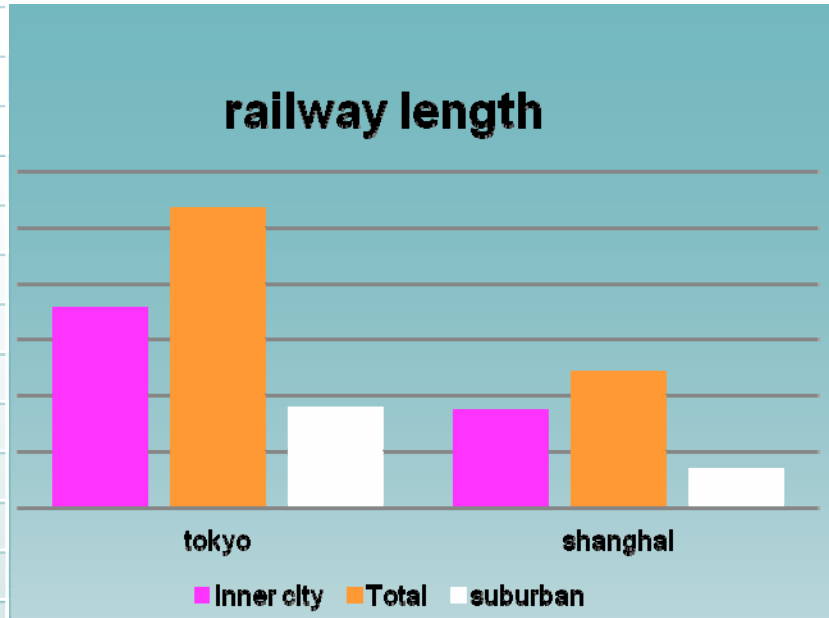
	Tokyo	Seoul
Total Line Length	2,313	476 km
City	292	338 km
Hinterland	2,021	138 km

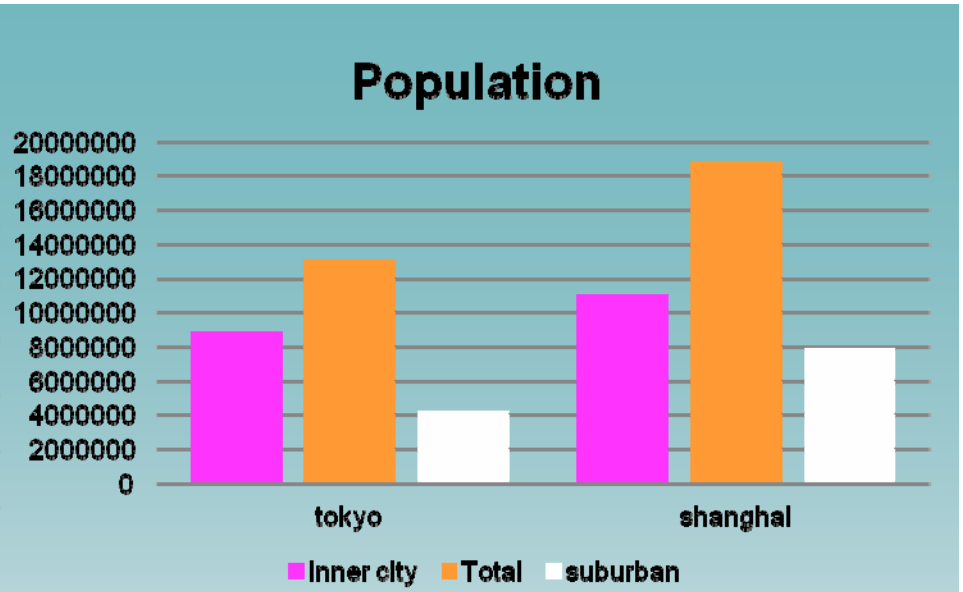
Urban Railway Network

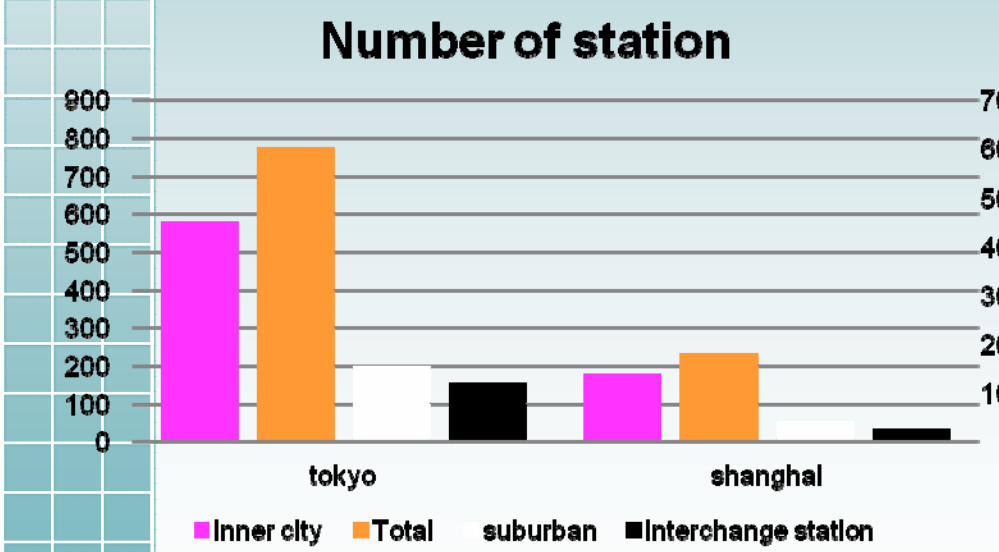
Shanghai

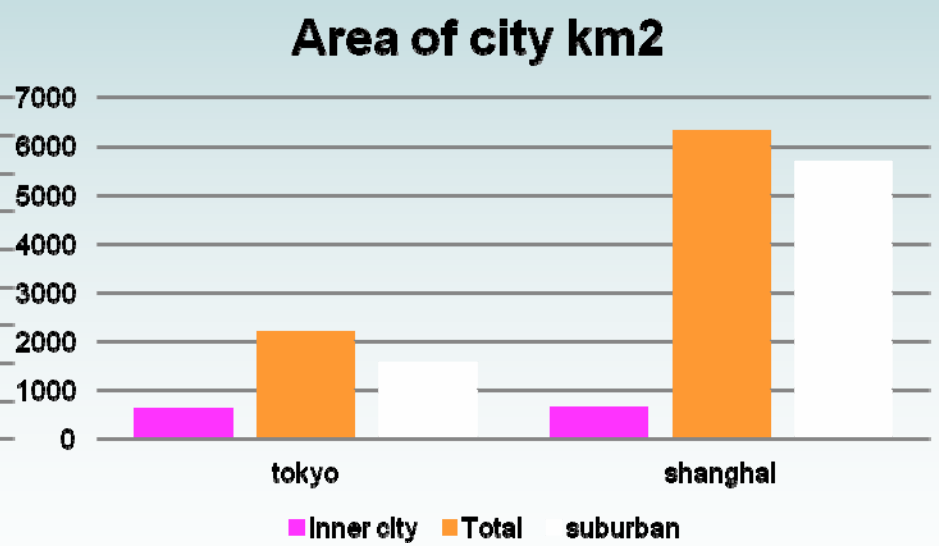


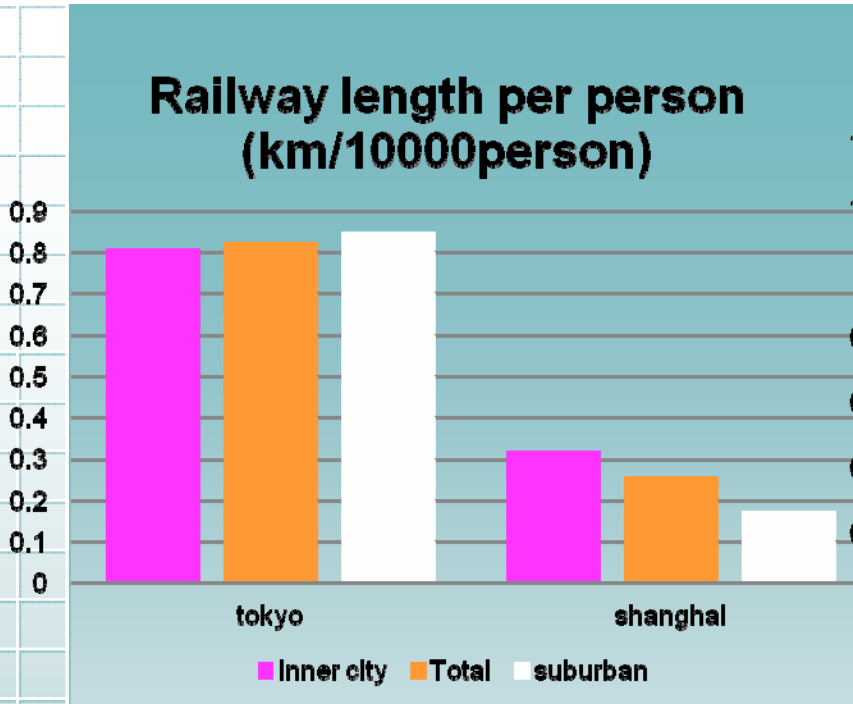
	Tokyo	Seoul	Shanghai
Total Line Length	2,313	476 km	729km
City	292	338 km	420km
Hinterland	2,021	138 km	309km

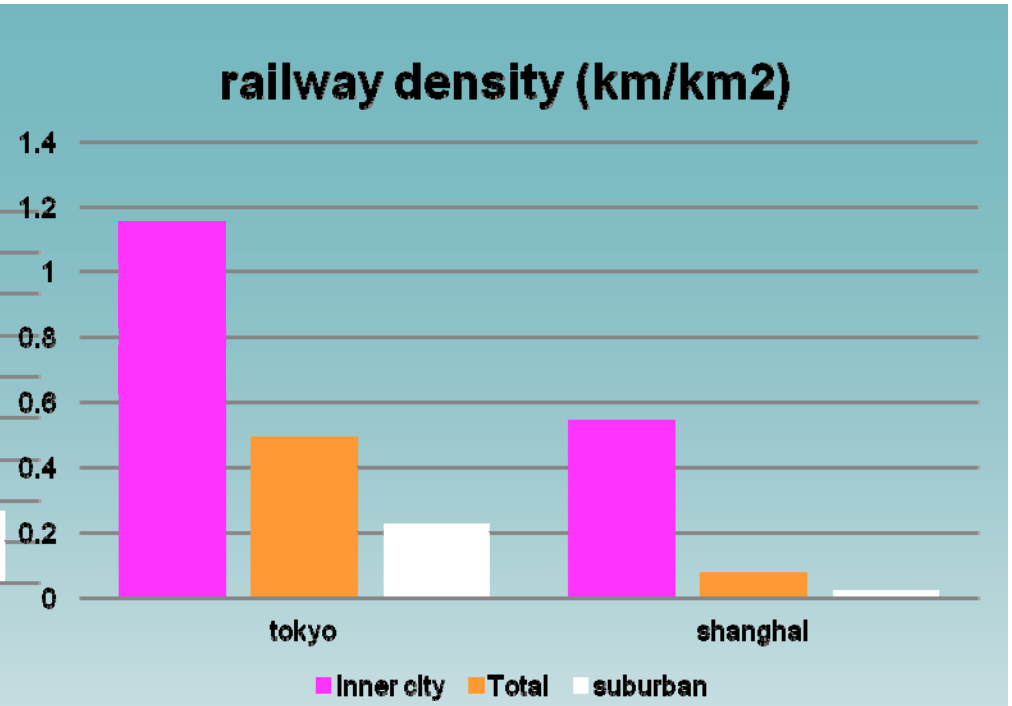

railway length
1200
1000
800
600
400
200
0
tokyo
shanghai
Inner city
Total
suburban

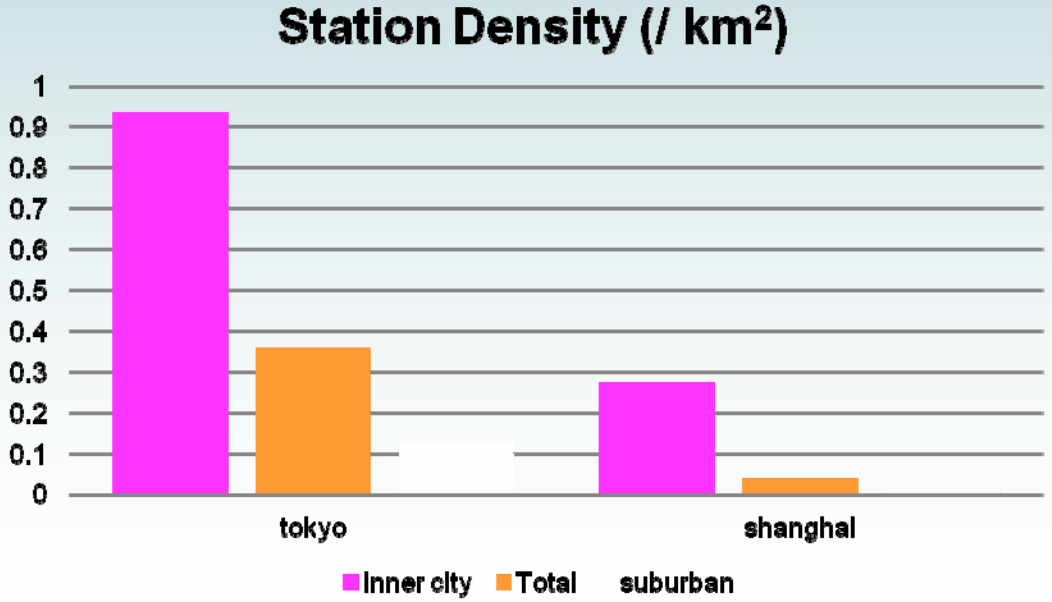

Population
20000000
18000000
16000000
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
tokyo
shanghai
Inner city
Total
suburban


Number of station
900
800
700
600
500
400
300
200
100
0
tokyo
shanghai
Inner city
Total
suburban
Interchange station


Area of city km2
7000
6000
5000
4000
3000
2000
1000
0
tokyo
shanghai
Inner city
Total
suburban


Railway length per person (km/10000person)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
tokyo
shanghai
Inner city
Total
suburban


railway density (km/km2)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
tokyo
shanghai
Inner city
Total
suburban


Station Density (/ km²)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
tokyo
shanghai
Inner city
Total
suburban

Bangkok Airport Link: Rolling Stock

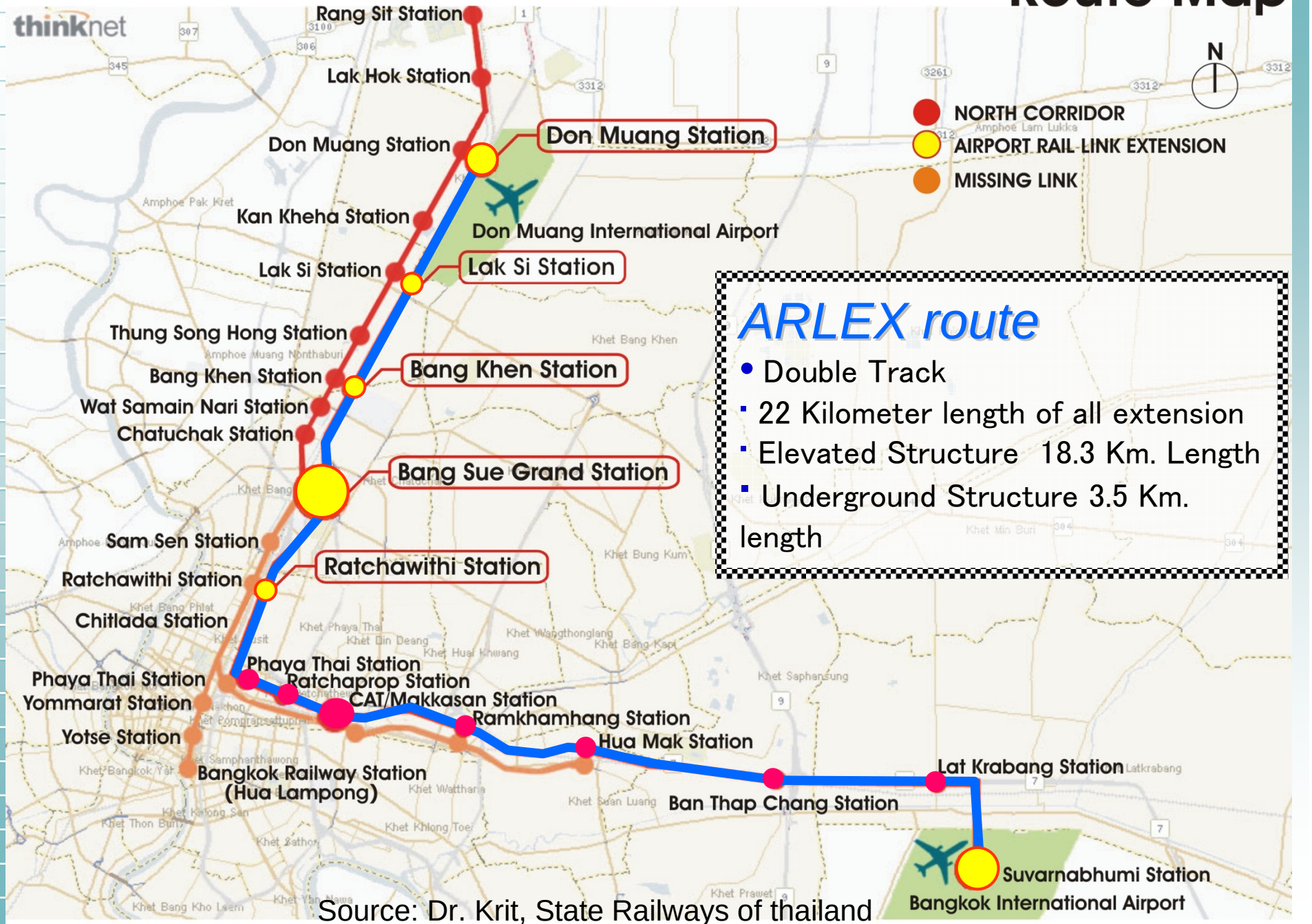
SA Express (4-car train)

SA City Line (3-car train)

The trains fleets made by Siemens in Krefeld, Germany

Source: Dr. Krit, State Railways of thailand

Route Map



ARLEX route

- Double Track
- 22 Kilometer length of all extension
- Elevated Structure 18.3 Km. Length
- Underground Structure 3.5 Km. length

Source: Dr. Krit, State Railways of thailand

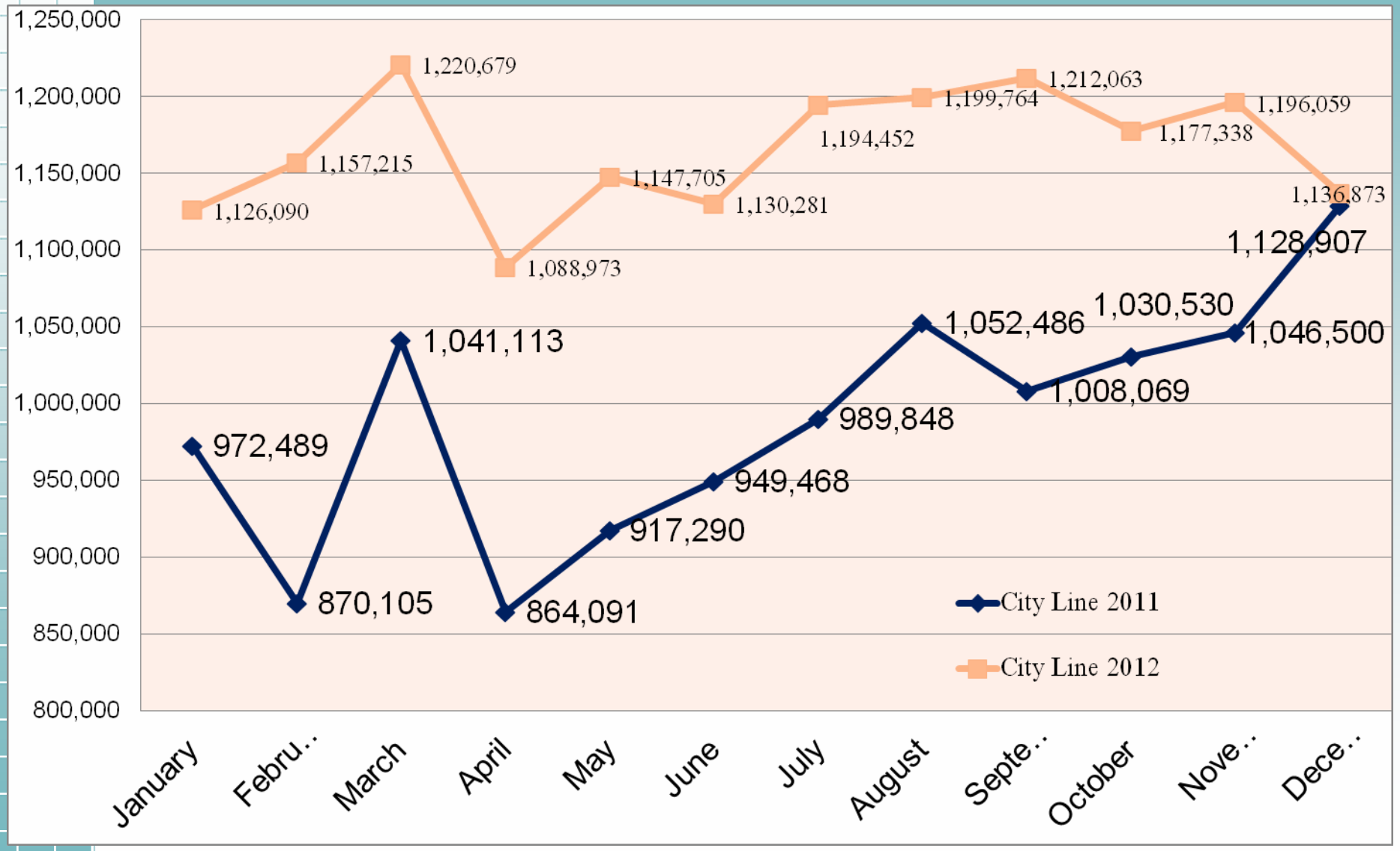
Overview ARL system – Key Operating Data

System Overview

Total Track length (double Track)	approx. 28.8 km. (thereof ~ 27 km. elevated)
Track Gauge	Standard Gauge (1.435)
Number of Stations	3 Express Stations 8 City Line Stations
Maximum Speed	Main Line: 160 km/h
Trip Time	For MAS - Express (06:00 - 24:00 hours) running time 15 min. For PTH - Express (06:00 - 24:00 hours) running time 17 min. For City Line (06:00 - 24:00 hours) running time 30 min.
Traction Power Supply	25 kV AC, Overhead **Catenary** System

Source: Dr. Krit, State Railways of thailand

City Line Passenger

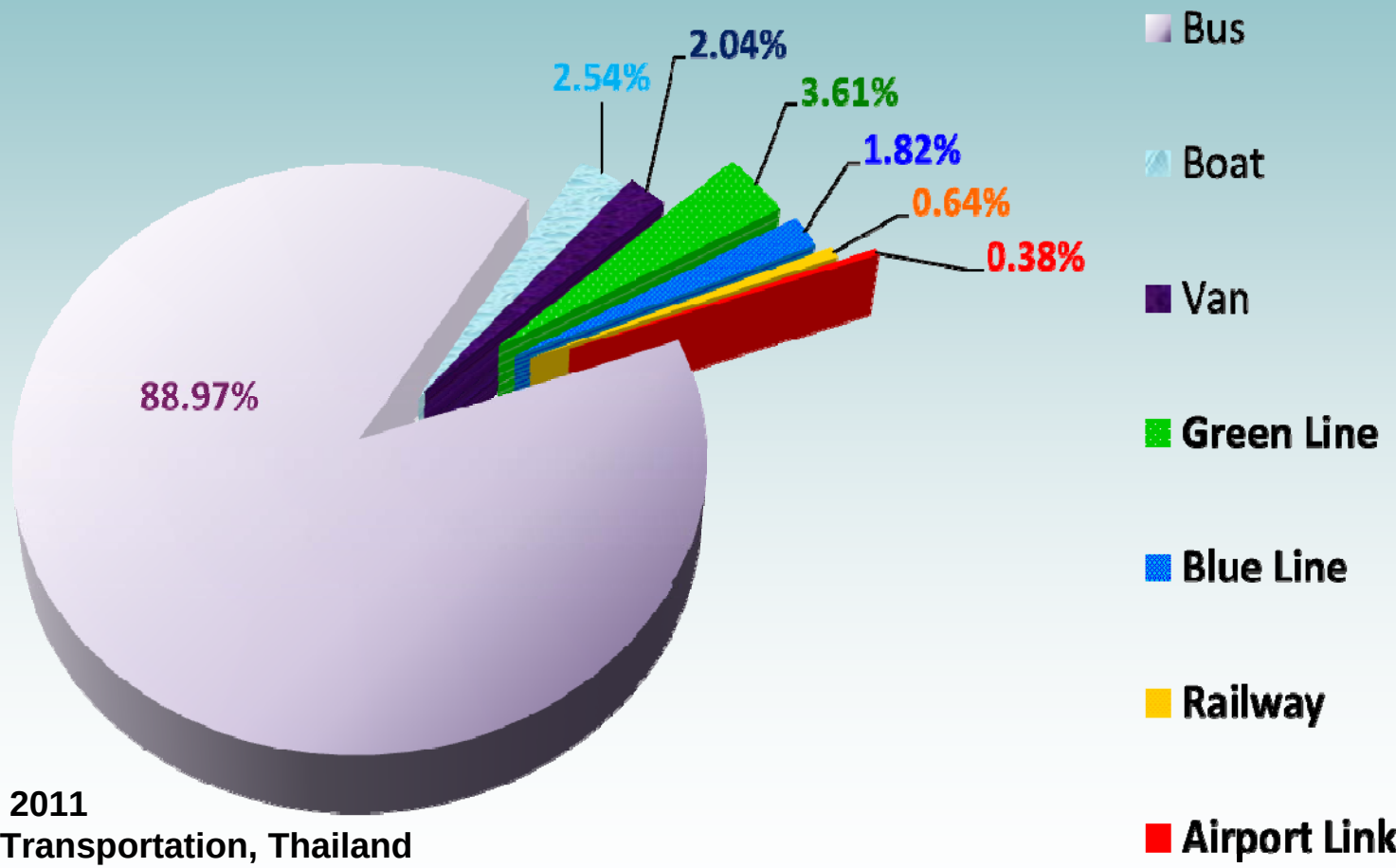


Source: Dr. Krit, State Railways of thailand

Suvarnabhumi Airport Rail Link

Bangkok Thailand

Passengers Share of Domestic Punblic Transport

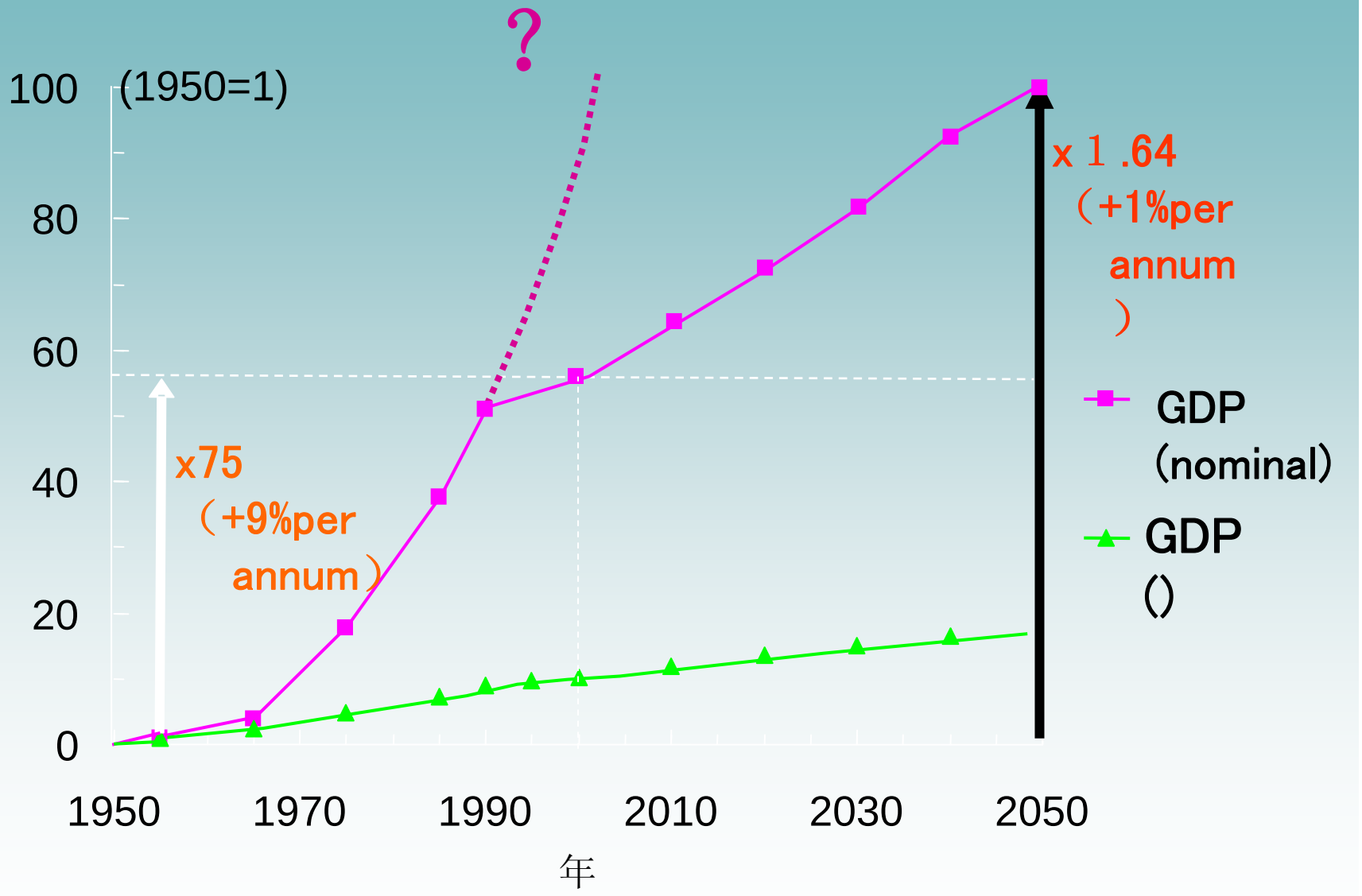


Yearly data 2011
Ministry of Transportation, Thailand

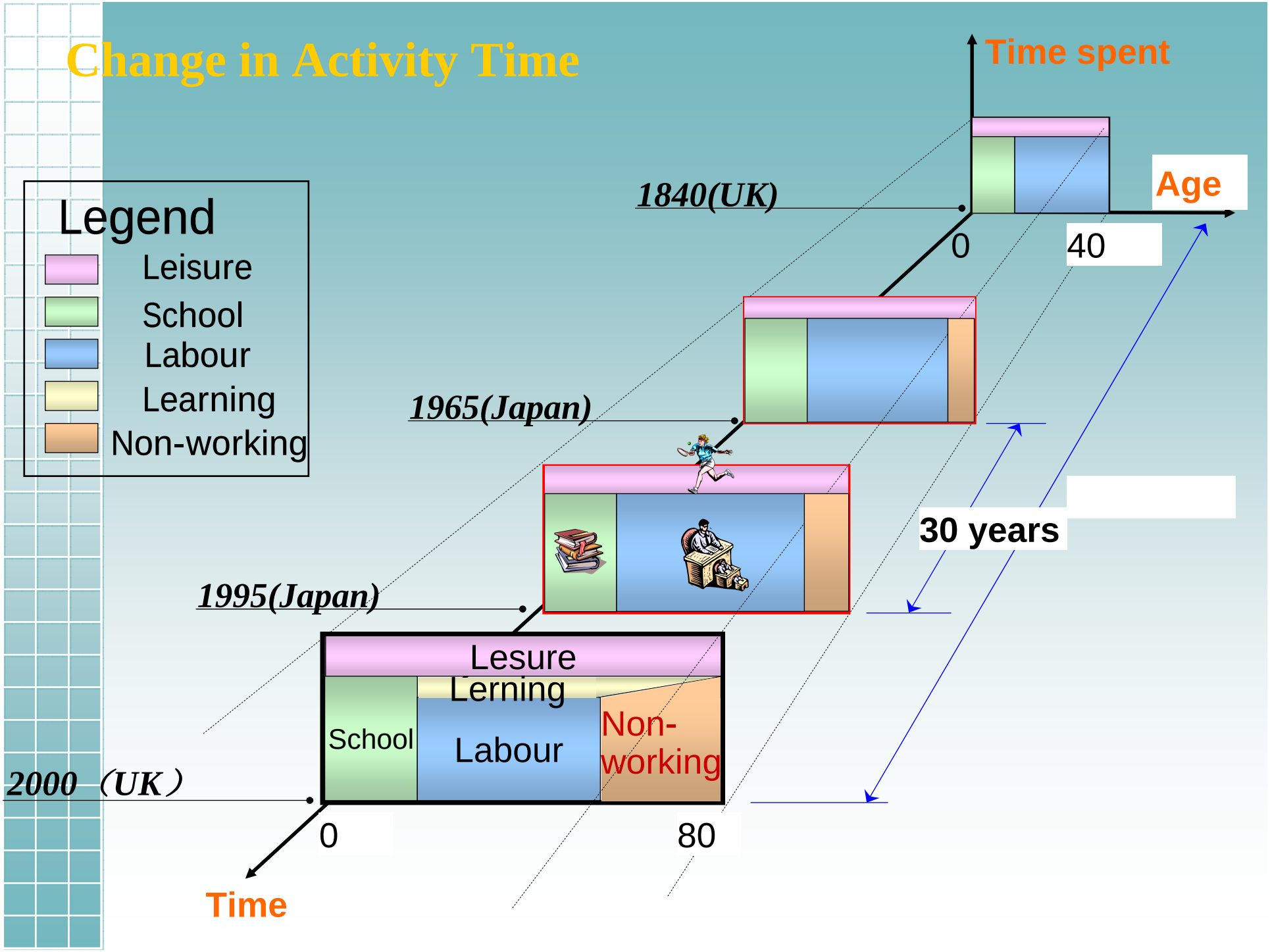
Source: Dr. Krit, State Railways of thailand

5. Economic Development Stage and Demographic Change

Change in Economic Growth



Change in Activity Time



【Goal】 **Higher QOL**

【Endogenous Condition】

＜Domestic＞	＜Int'l＞
Low birth rate	Growth of Asia
Aging	Globalization
IT	IT

Economy ⟷ Ecology

A. Economic Opportunity	B. Living & Cultural Opportunity	C. Amenity	D. Safety & Security・	E. Burden on Environment
●Opportunity for Income ●Accessibility to Agglomeration of Industries/Population	●Service ●Education/Culture ●Health/Medical Care ●Shopping/Service ●Amusement/Travel	●Housing ●District Landscape ●Nature of Region ●Identity of Region ●Comfortability / Punctuality of travel ●Time for leisure/cultural life	●Risk of Natural disaster ●Risk of Building / Facility disaster ●Risk of Chemical Pollution ●Risk of Traffic Accident ●Resource Preservation ●Criminal Rate	●Burden from Industry ●Burden from Domestic ●Burden from Transport ●Heat Island ●Noise

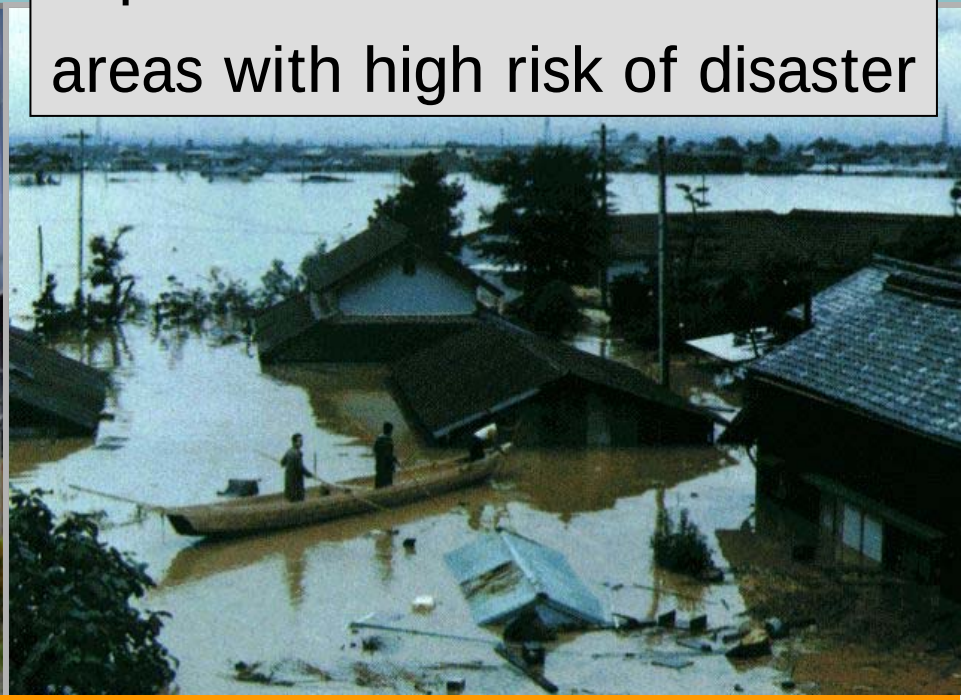
6. Integrated Development Planning for Adaptation with Lower Risk Living and Higher QOL

Urban Space at Risk

As a result of interaction between motorization and sprawl

Decline in inner-city

Expansion of residences into areas with high risk of disaster



Lowering QOL

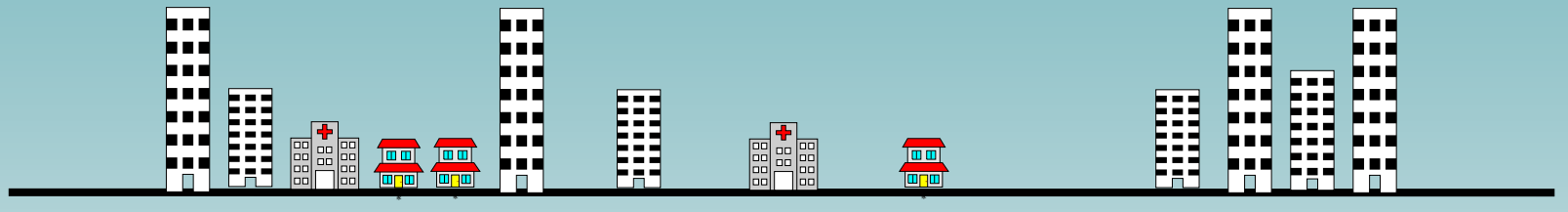
Increasing maintenance cost of unnecessary infrastructure

Deteriorating landscape and losing identity

Smart Shrink

Retreat from hazardous areas

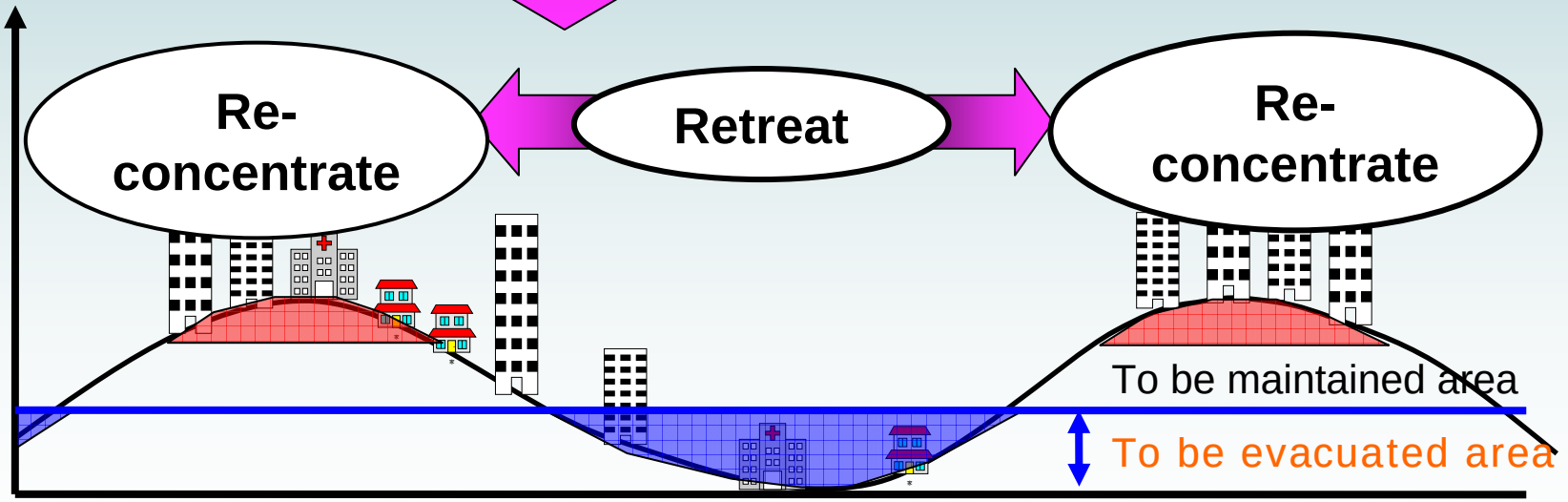
>> Re-concentration into areas with higher QOL



(Social Value) - (Social Hazard)

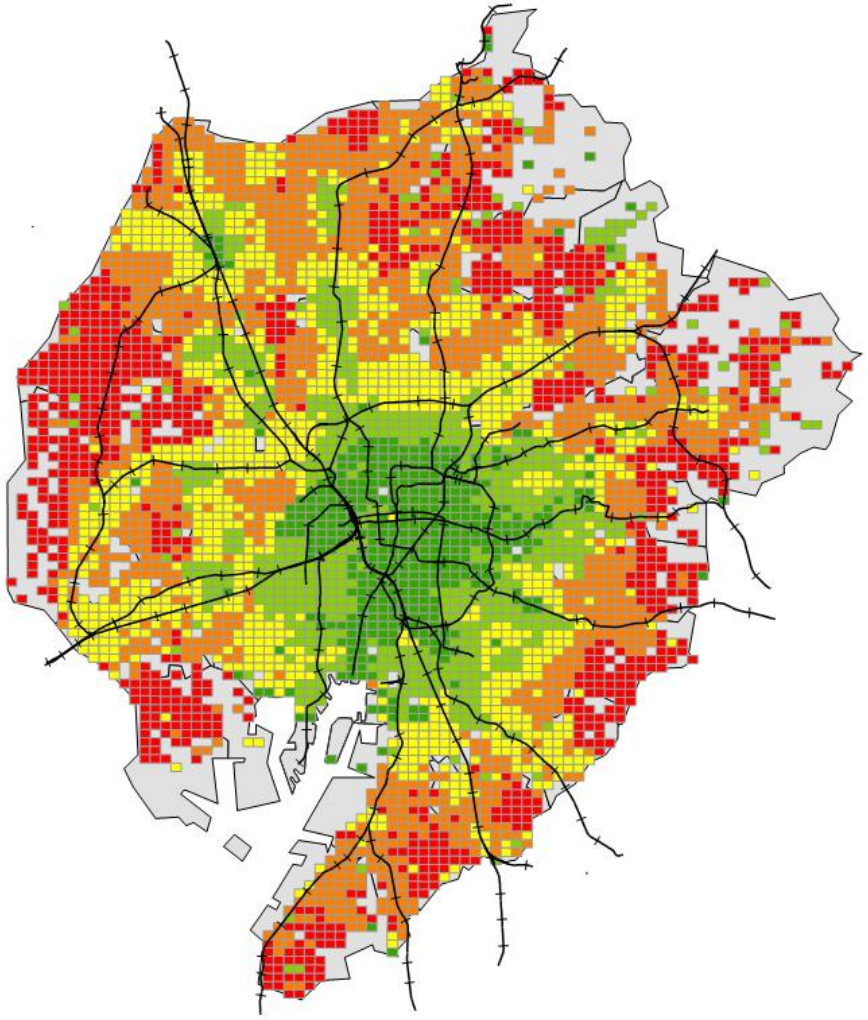
= *"Equivalent level of water"*

Social Value –
Hazard Level

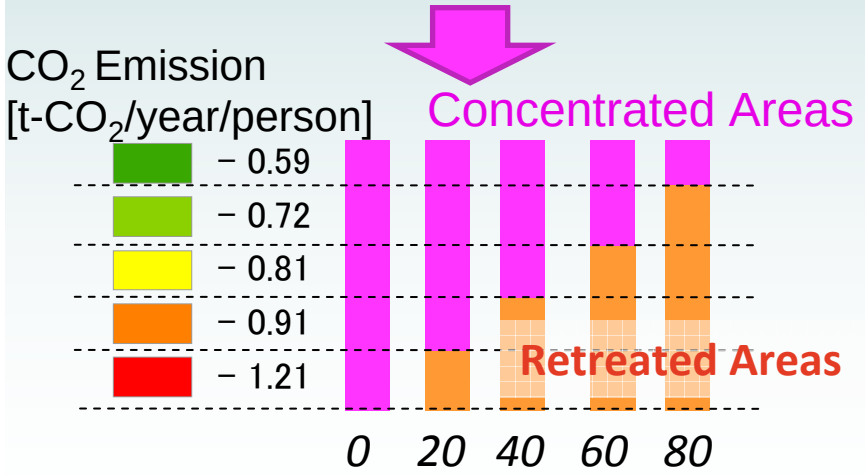


「Social-Hazard」＝To be evacuated＝High equivalent level of water

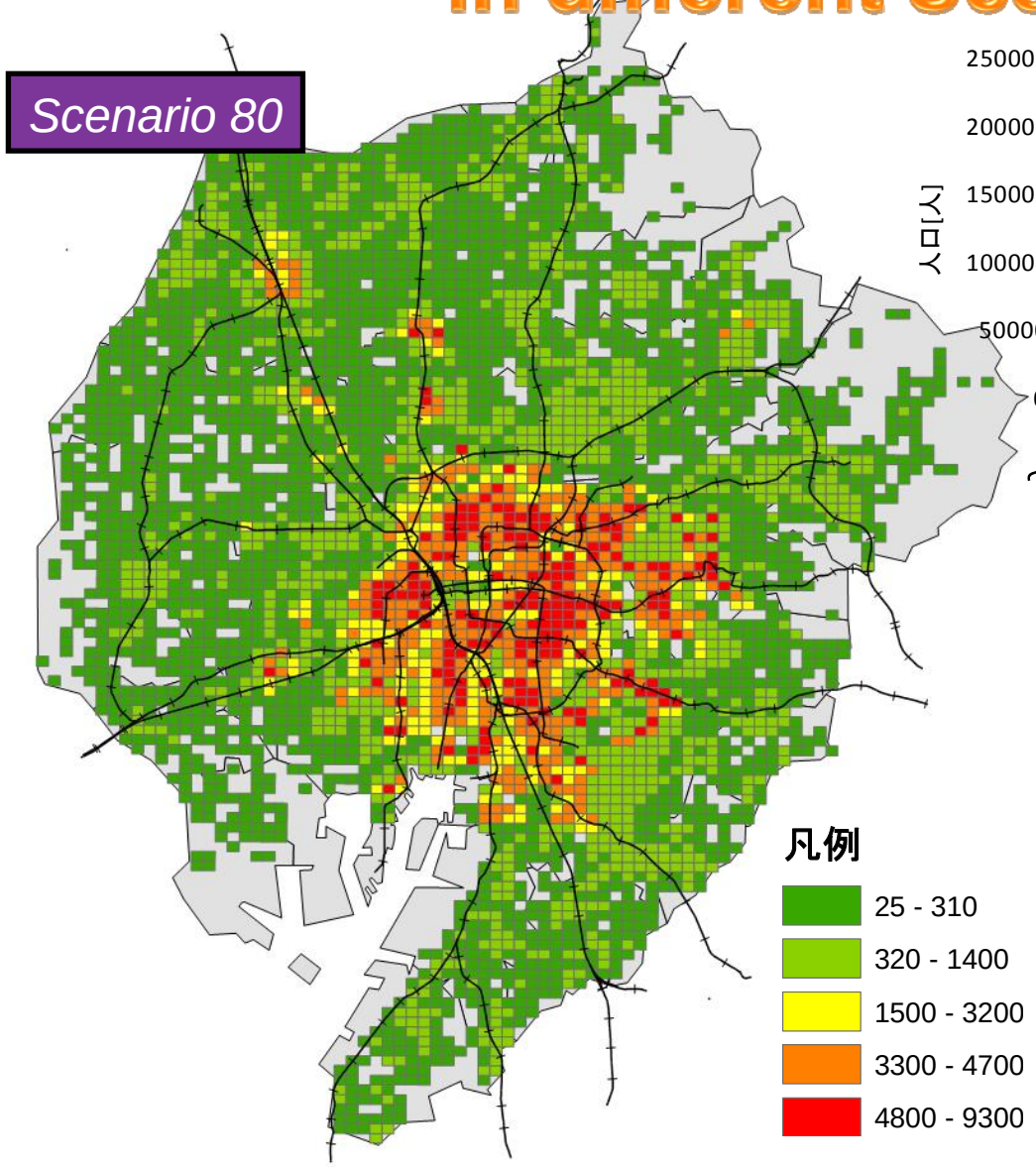
Retreat according to QOL/CO2

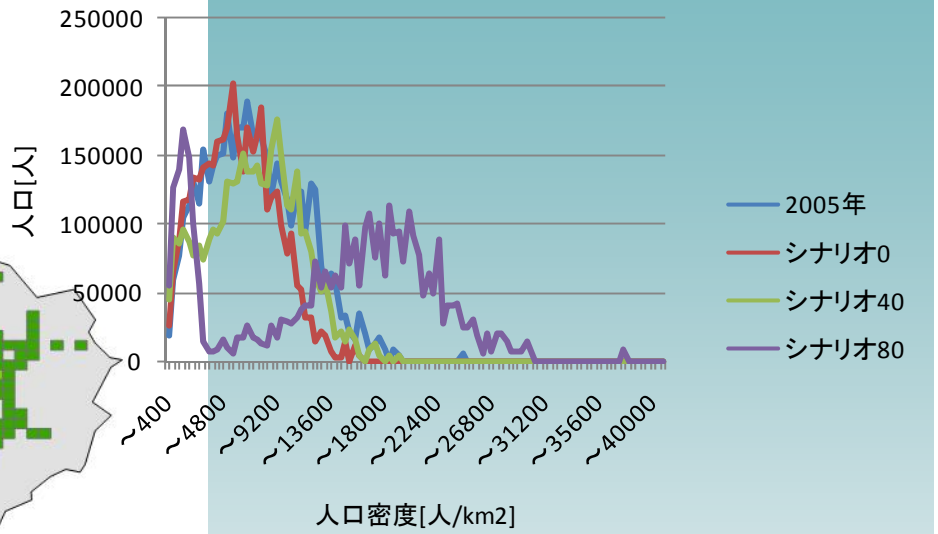


Scenario 0	Night time POP density will be same as now
Scenario 20	Retreat from **Top 20**%
Scenario 40	Retreat from **Top 40**%
Scenario 60	Retreat from **Top 60**%
Scenario 80	Retreat from **Top 80**%



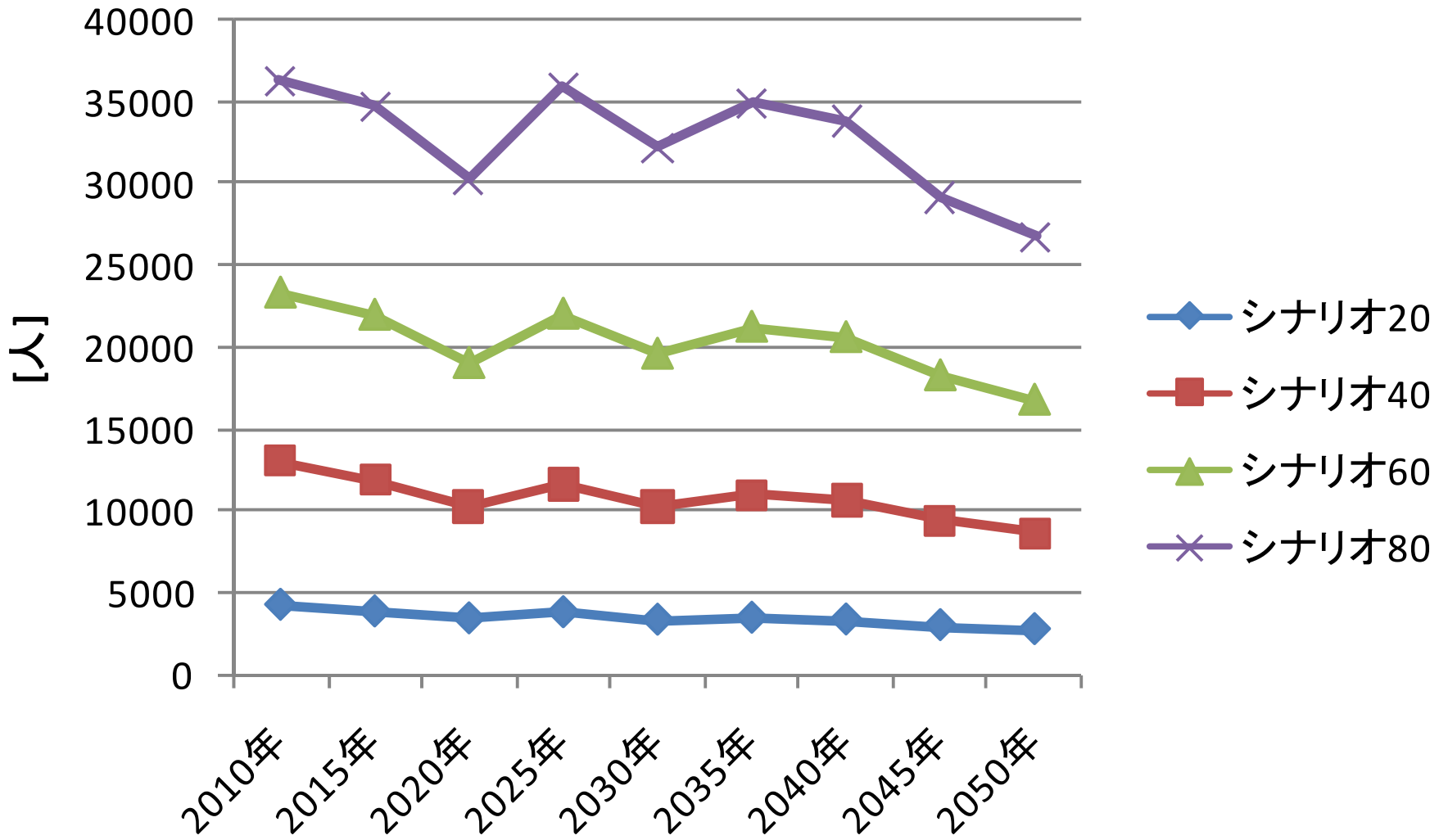
Population Density in 2050 in different Scenarios





- Disappearing of high density areas in scenarios
- Extremely high density in scenario 80
- Retreat from suburb will not be completed.

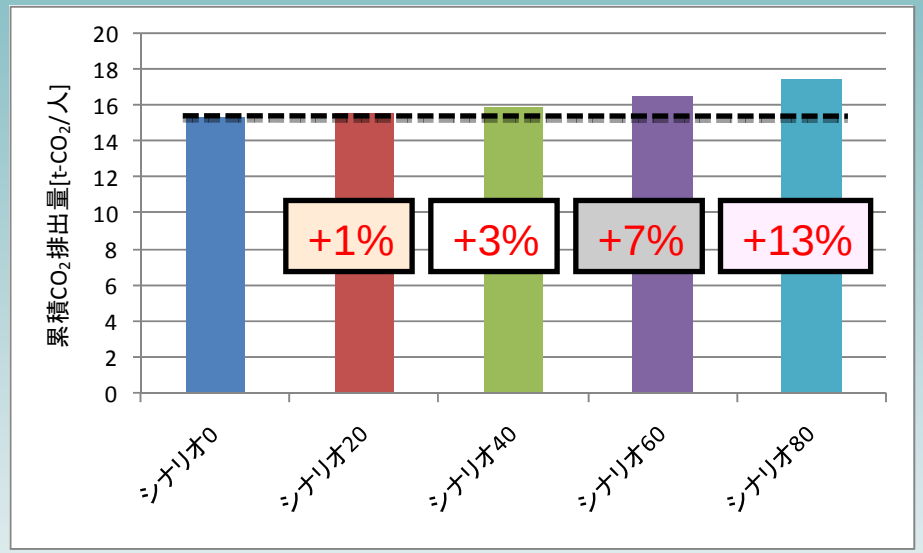
Immigration Population into Nagoya City



Effects on CO2 Reduction from House Construction

Per Capita Annual Co2 Emission

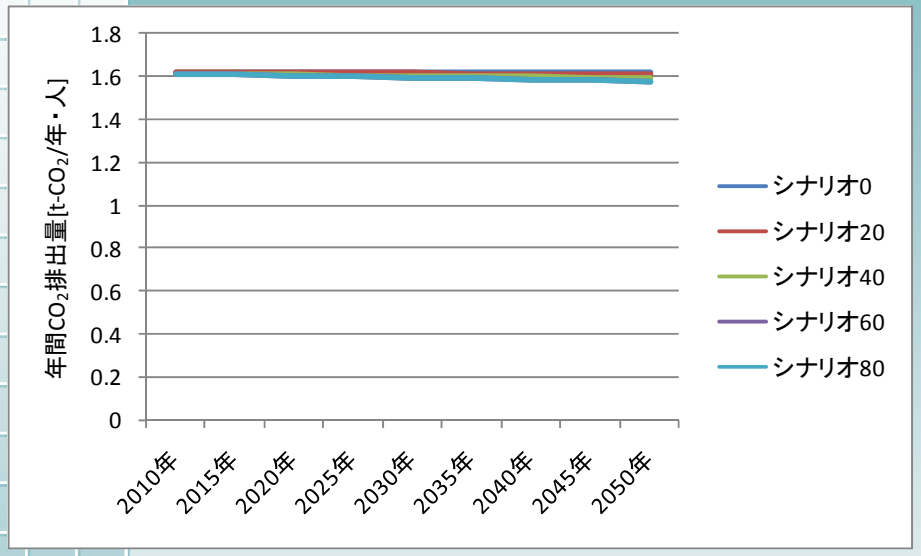
Accumulated CO2（2010～2050）



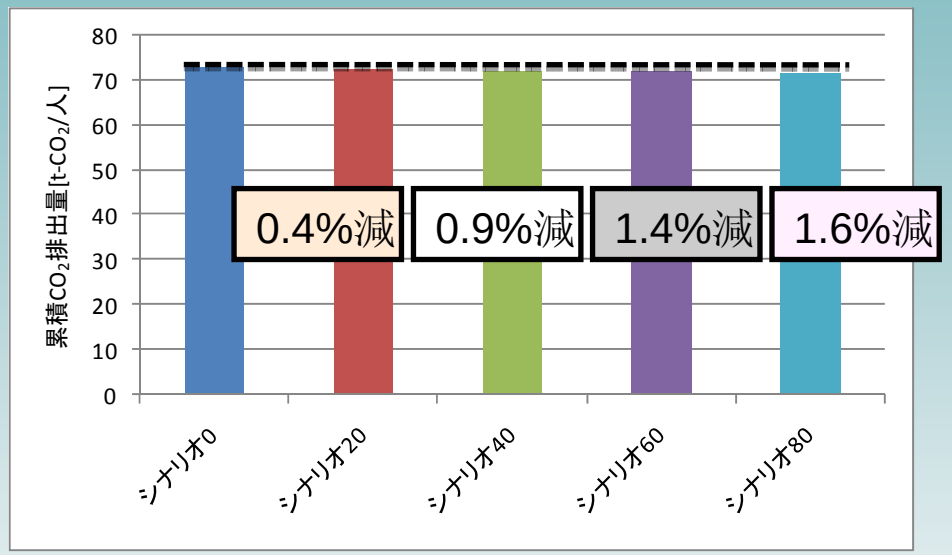
- Small differences between scenarios
- More high rise concrete buildings will increase CO2 emissions.

Effects on CO2 Reduction from Domestic Activities

Per Capita Annual Co2 Emission



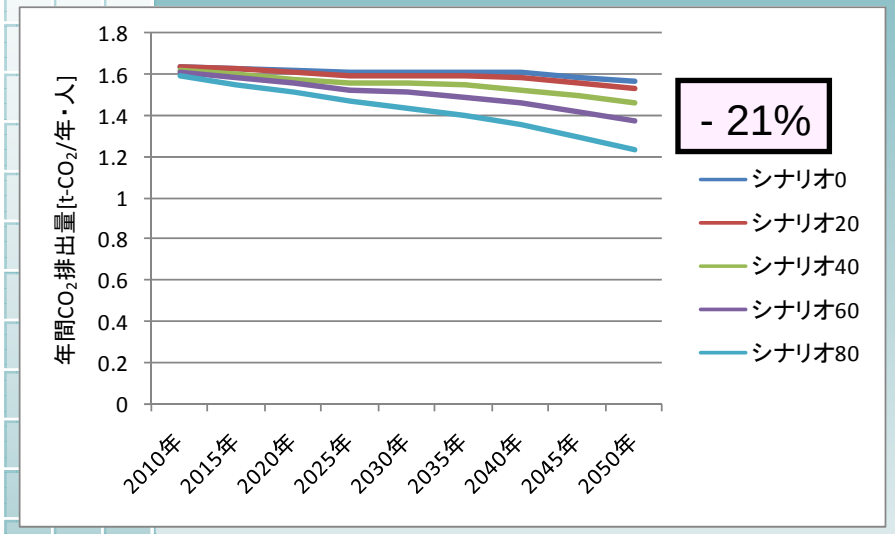
Accumulated CO2（2010～2050）



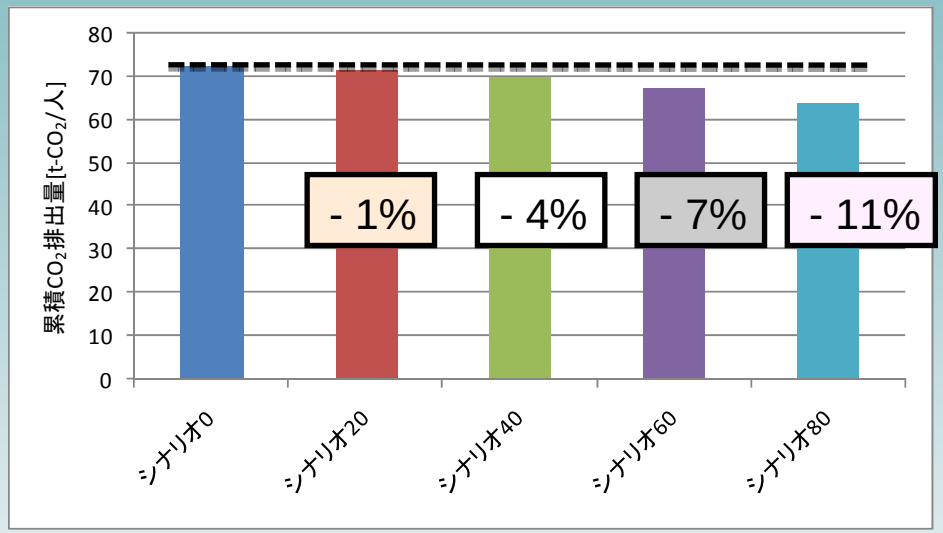
- Reduction effects by land use shrink is small.
- CO2 from human activities increase according to floor space increase. But floor space will not change much due to smart shrink.

Effects on CO2 Reduction from Transport

Per Capita Annual Co2 Emission



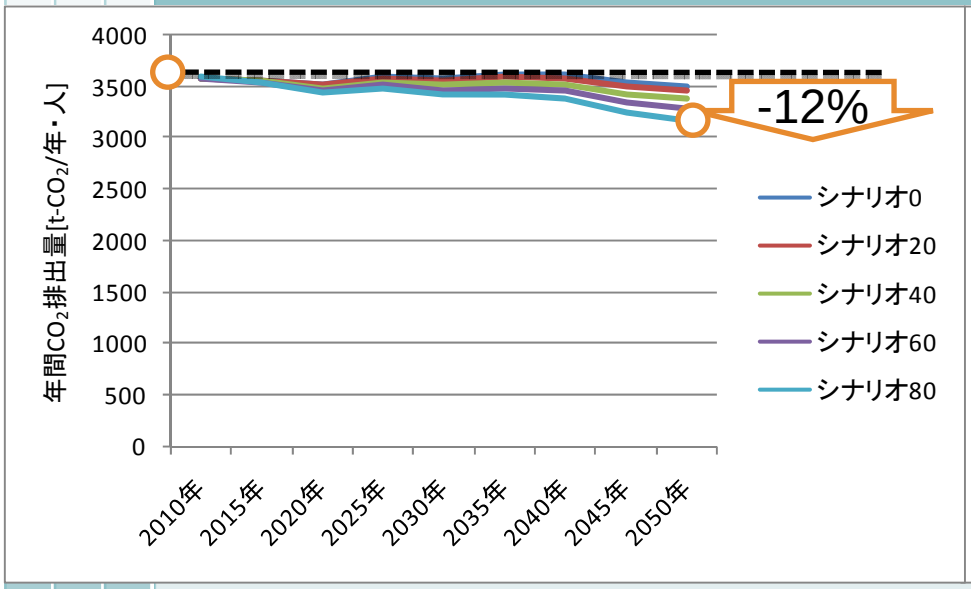
Accumulated CO2（2010～2050）



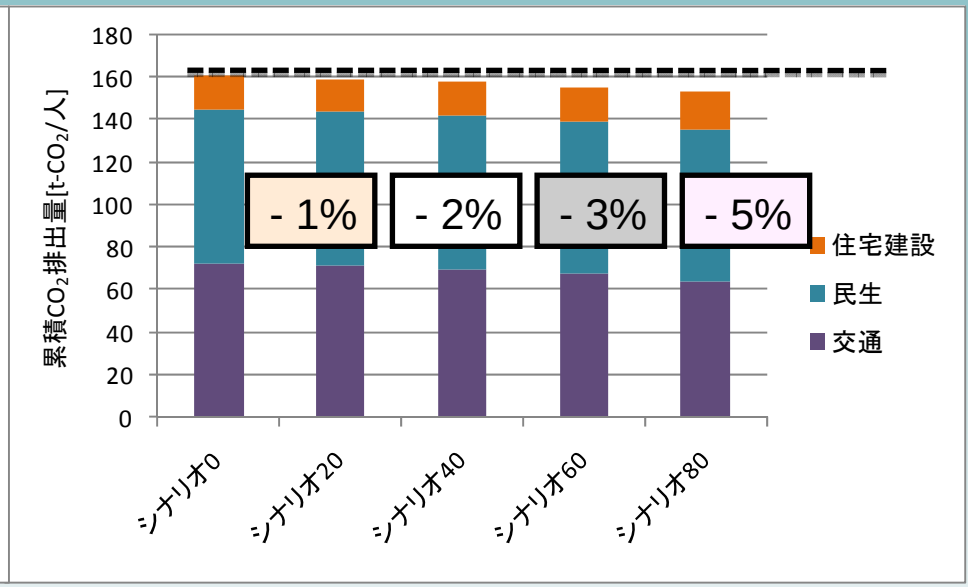
- CO2 reduction due to decrease in car share du to smart shrink is 11%.

Effects on Total CO2 Reduction

Per Capita Annual Co2 Emission

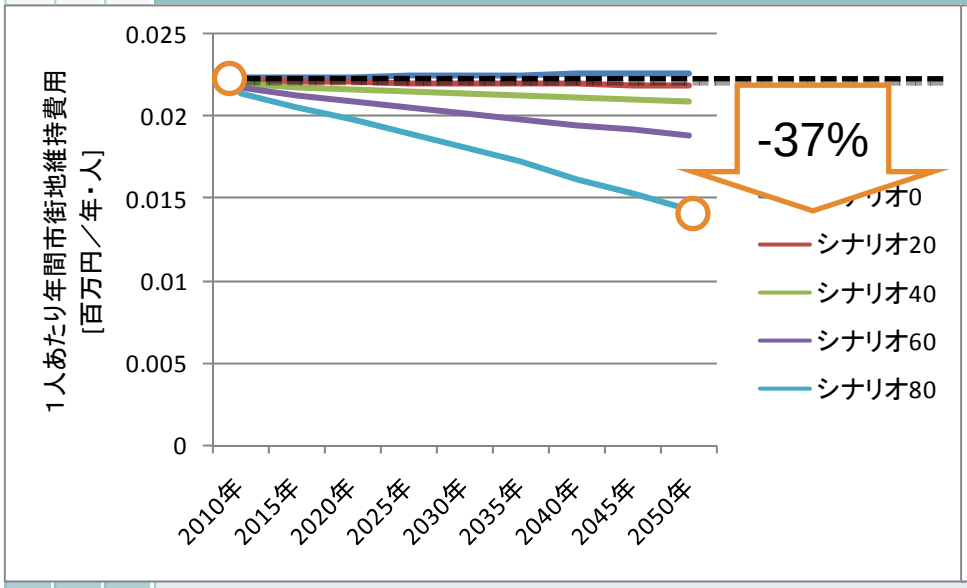


Accumulated CO2（2010～2050）

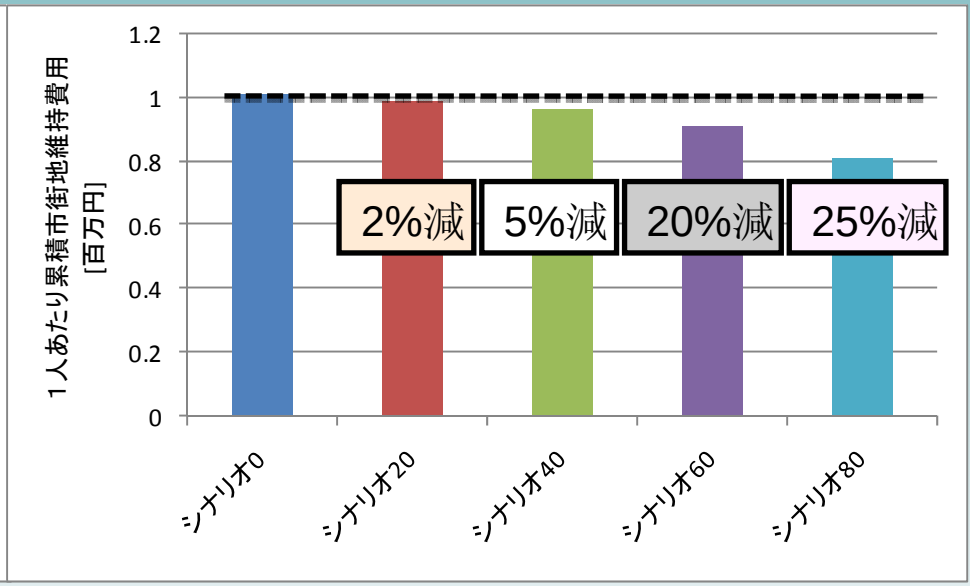


Effects on Reduction in Maintenance Cost of Built-up Areas

Per Capita Annual Co2 Emission

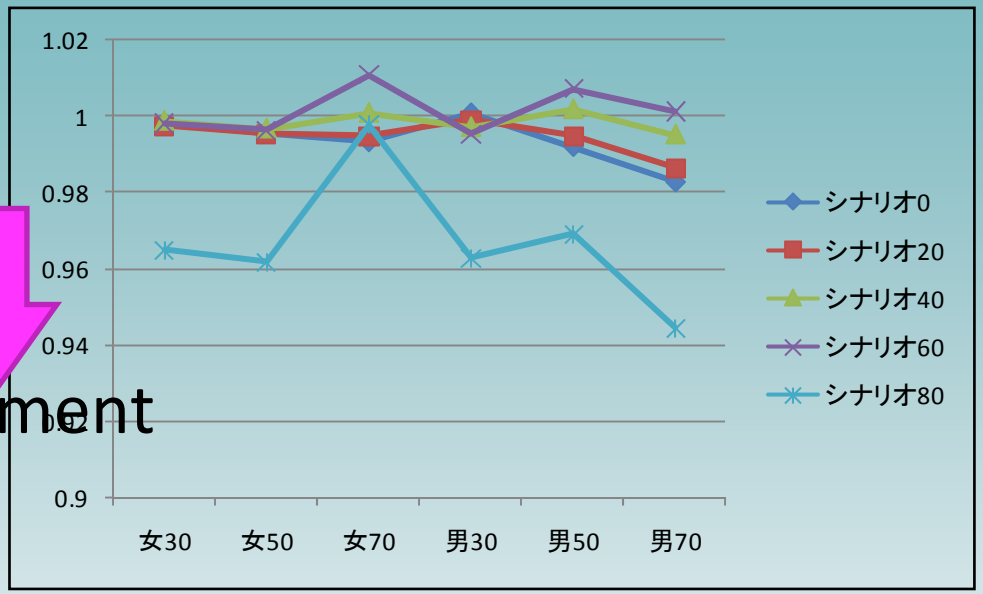


Accumulated CO2（2010～2050）



- Effect on reduction due to smart shrink is big

Effects on QOL



Improvement

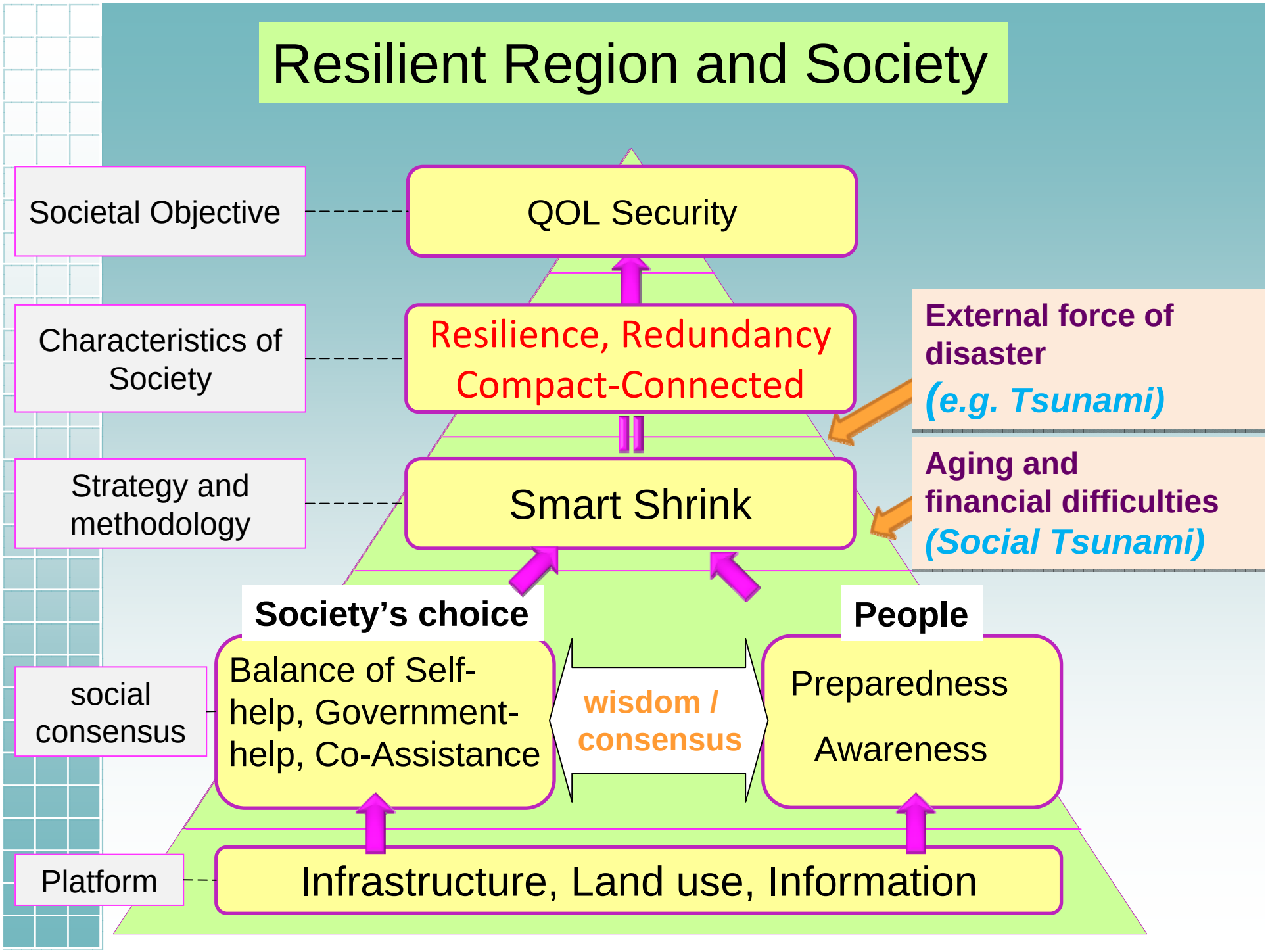
- Scenario 80: +5% improvement in QOL
  - No remarkable improvement in aged women
    - City centre has high score of QOL
    - Large improvement for aged men
    - Weight on flood risk is large in QOL function
    - Retreat is conducted from those areas with higher risks


Beautiful Country


Next to them…,
水沢 江刺 種山高原
Mizusawa Esashi Taneyama Heights
一関 343 陸前高田
Ichinoseki Rikuzentakata
19 343

Natural disaster risk

Non Resilient Infrastructure


Resilient Region and Society
Societal Objective
QOL Security
Characteristics of Society
Resilience, Redundancy
Compact-Connected
External force of disaster
(e.g. Tsunami)
Strategy and methodology
Smart Shrink
Aging and financial difficulties
(Social Tsunami)
Society's choice
People
social consensus
Balance of Self-help, Government-help, Co-Assistance
wisdom / consensus
Preparedness
Awareness
Platform
Infrastructure, Land use, Information

Resilient Region and Society


①Resilience
Was levee in Taro, Miyako resilient?
Old levee (avoid)
国道45号
至宮古市
防護区域 A=100.4ha
防潮堤（水産庁所管）
S48-53年に
至岩泉町
田代川水門および
河川堤防
S47～53年
New levee
(directly opposing)→broken
Tsunami
田老漁港
After
Before
Source：MLIT, JAPAN

①Resilience

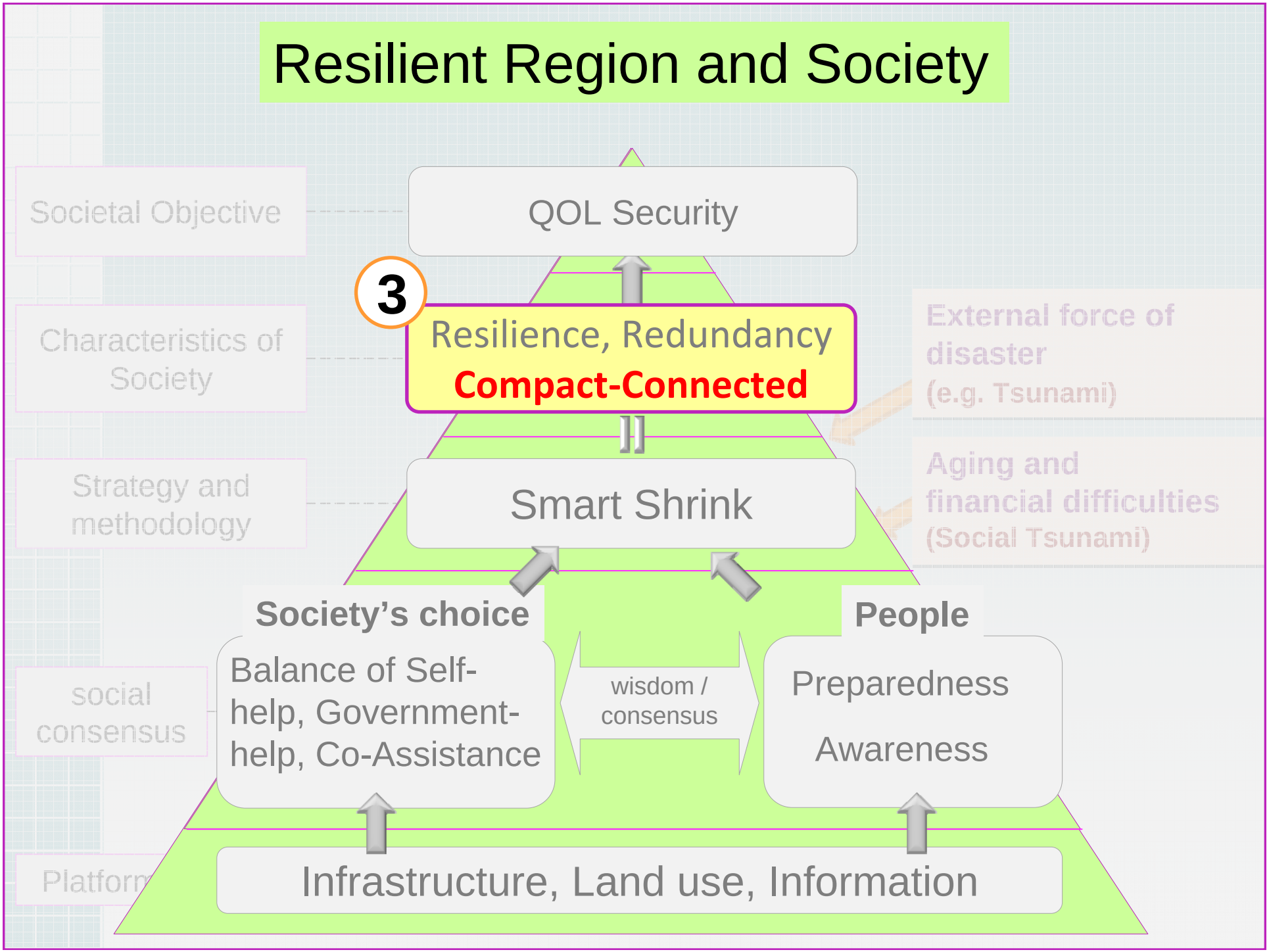
Eastern Sendai Motorway played a second levee

Eastern Sendai Motorway

Importance of infrastructure Alignment

Source : Google Earth

Resilient Region and Society



Long term evacuation
(case of move to higher ground)

Yoshihama, Minamisanriku

No victims

Moved to a Hill

Tsunami flood area

（参照）内閣府　中央防災会議　東北地方太平洋地震を教訓とした地震・津波対策に関する専門調査会第3回会合資料（2011.6.19）

Regeneration of social bonds(Shanghai)