



UNCRD workshop (13/5/30)

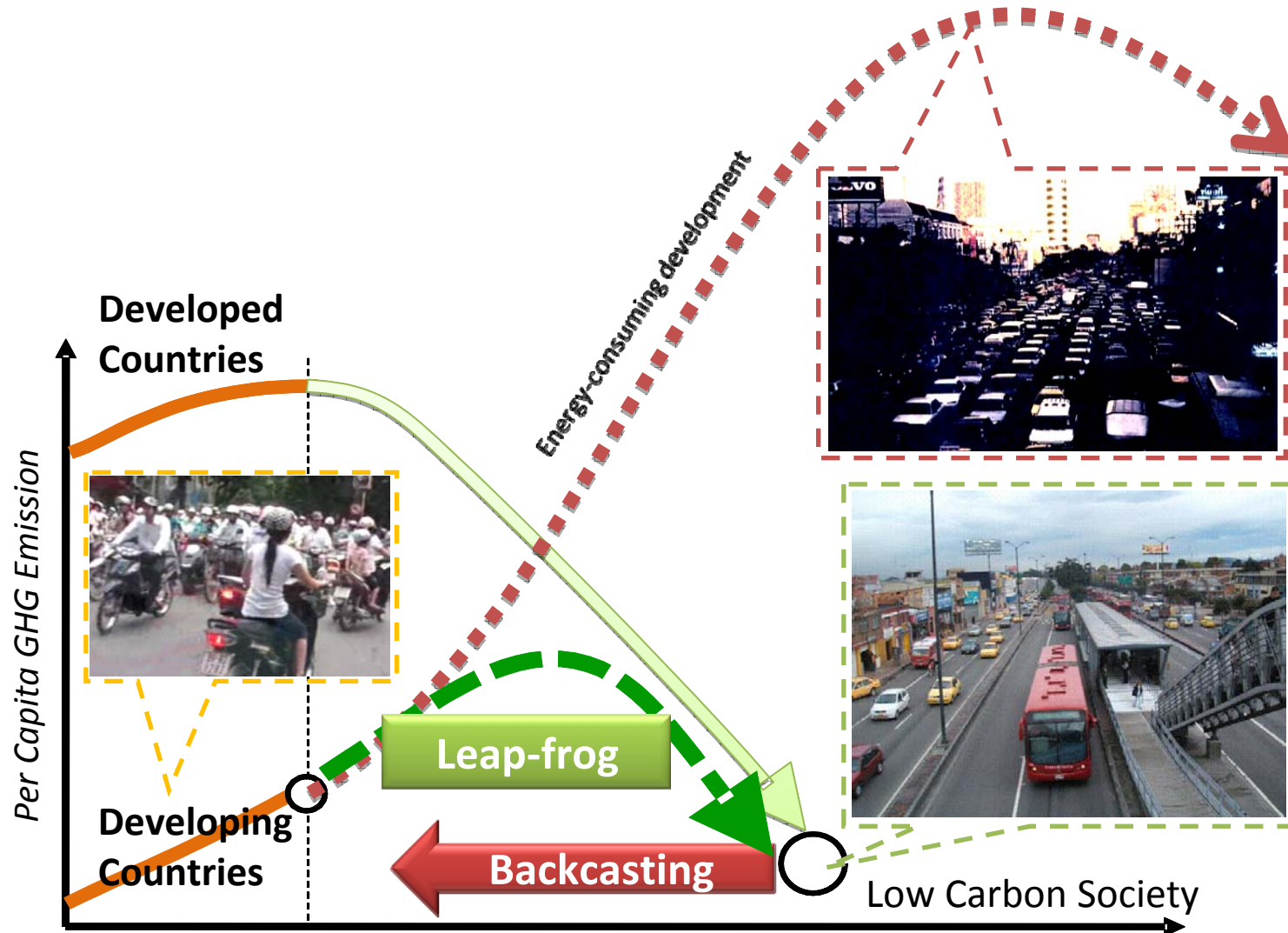
***Designing Sustainable Low-Carbon Transport
Systems integrated with Regional
Development in Asia***

Prof. Yoshitsugu Hayashi

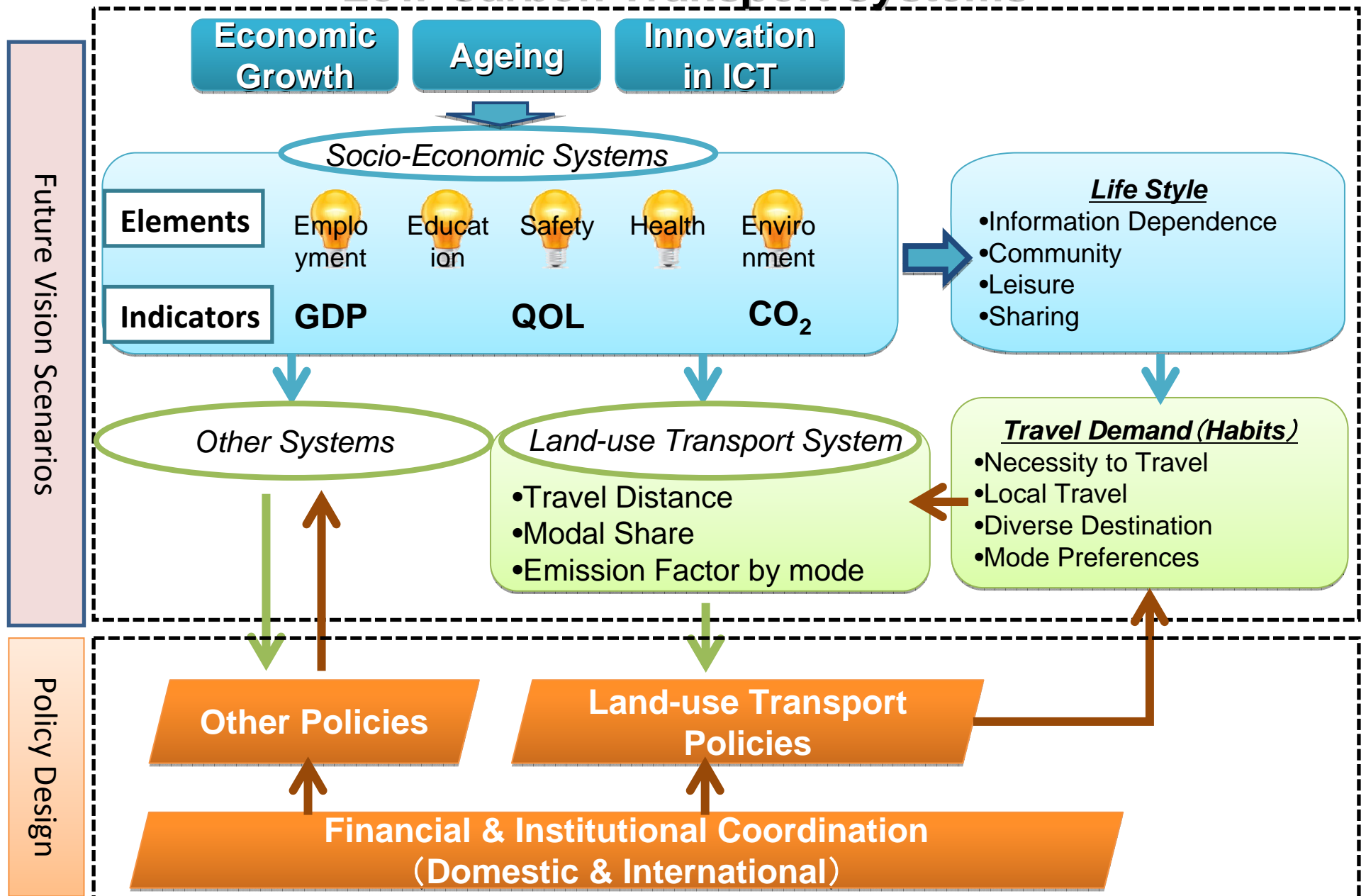
Dr. Kazuki Nakamura

Graduate School of Environmental Studies, Nagoya University
Int'l Center for Sustainable Transport and Cities

Risk of rapid growth in CO₂ emissions in developing countries in Asia

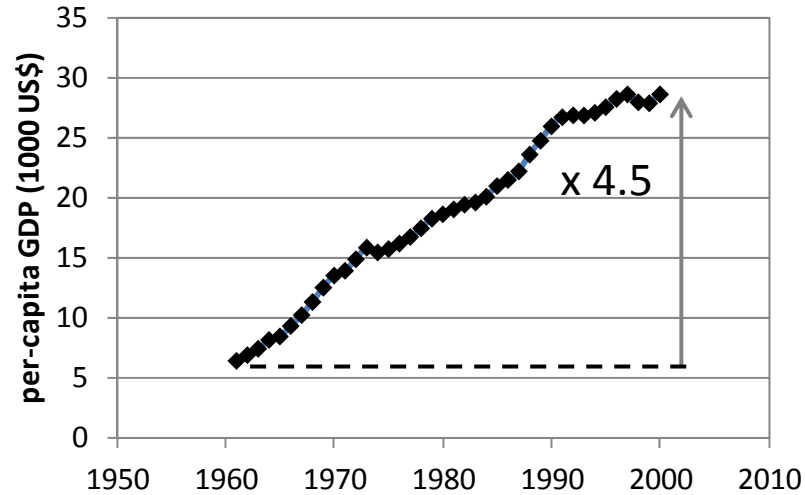


Framework of Backcasting Approach to Developing Low-Carbon Transport Systems

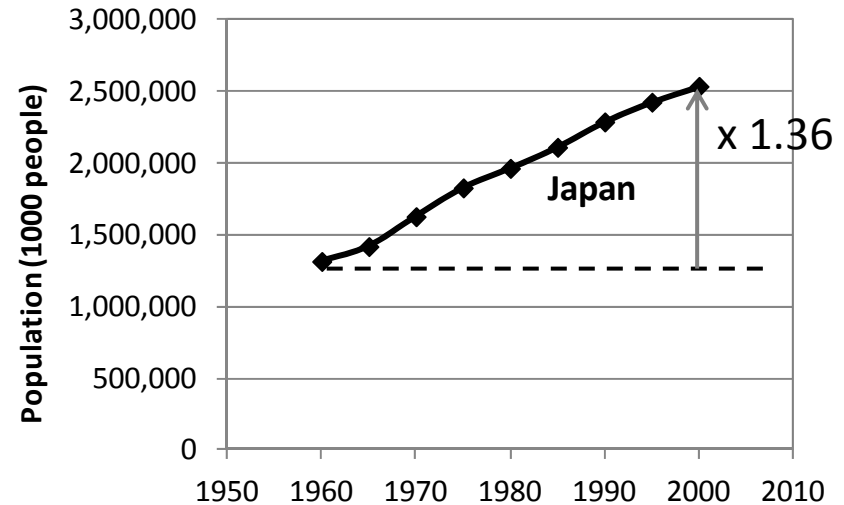


Socio-Economic Trends in Asia

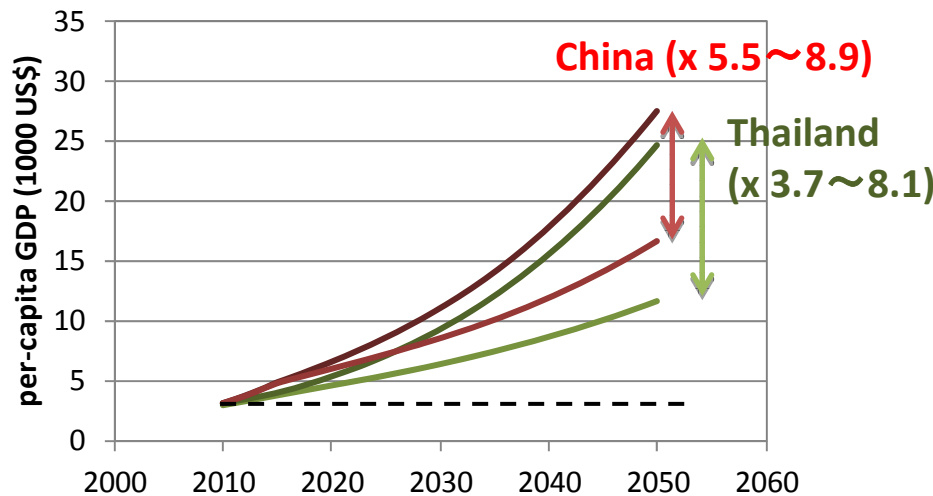
Economic Growth in Japan



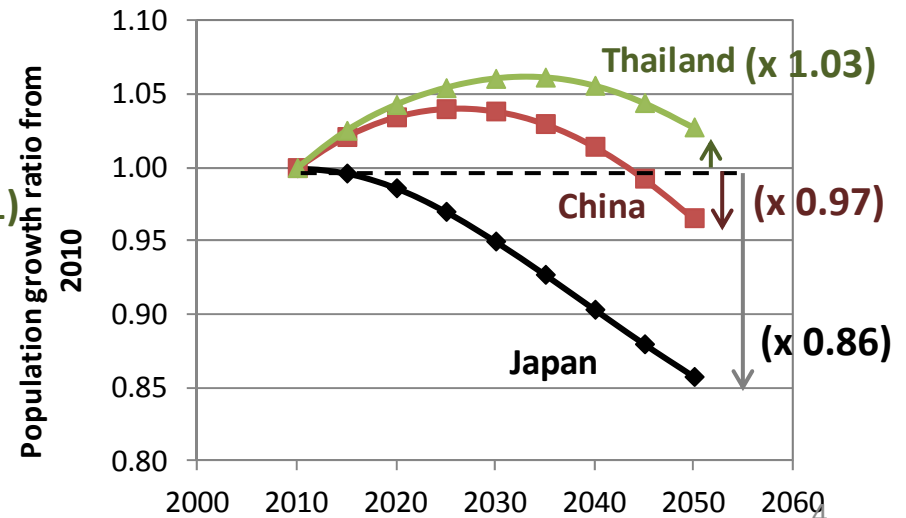
Population Growth in Japan



Economic Growth in Asia (Forecast)

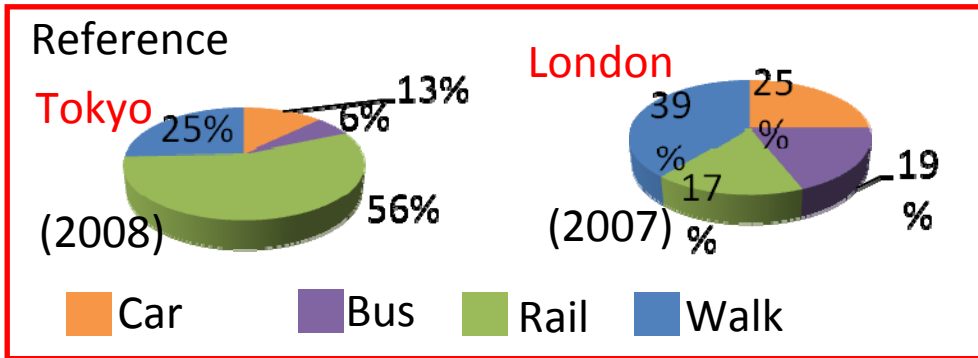
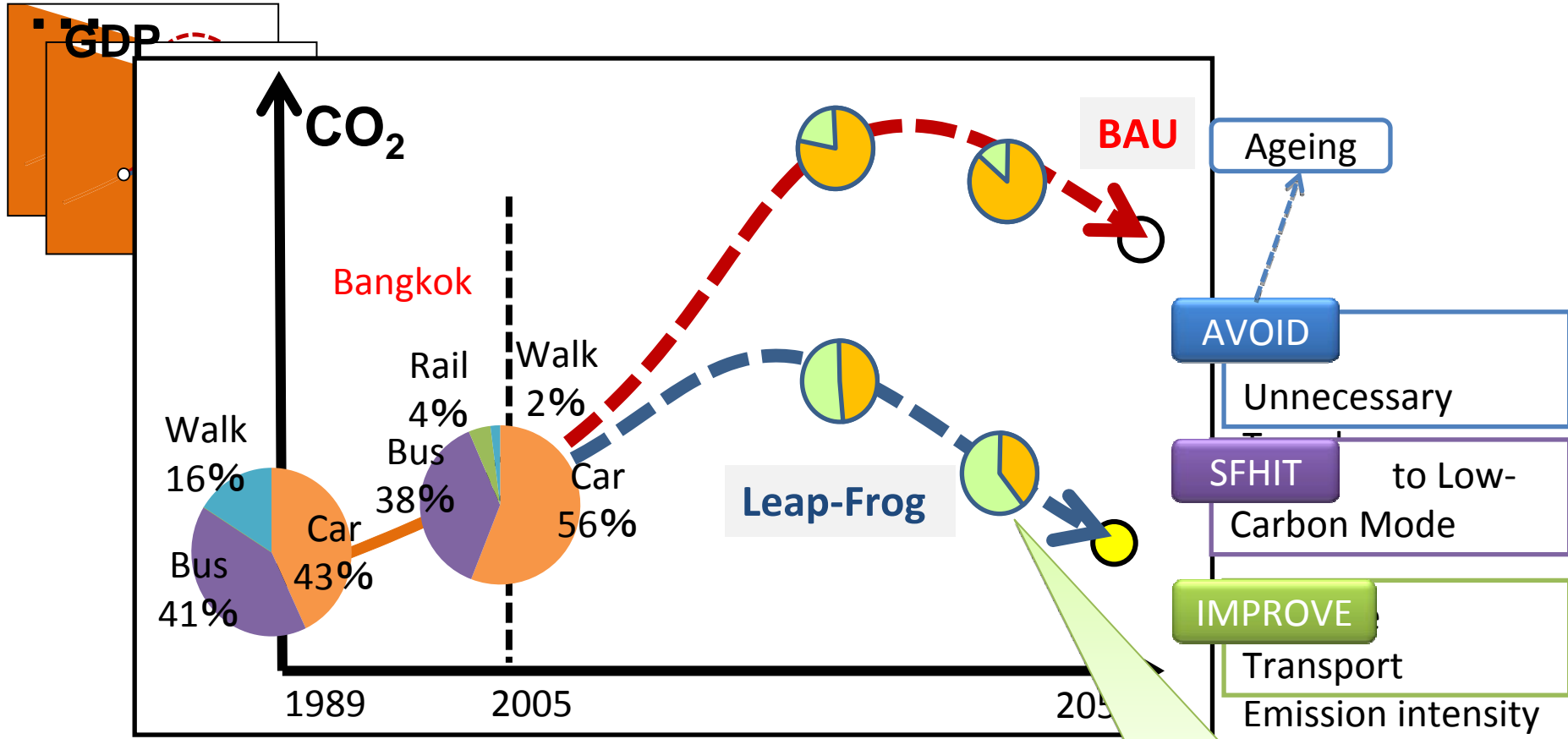


Population Growth in Asia (Forecast)



Source: UN World Population Prospects: The 2010 Revision

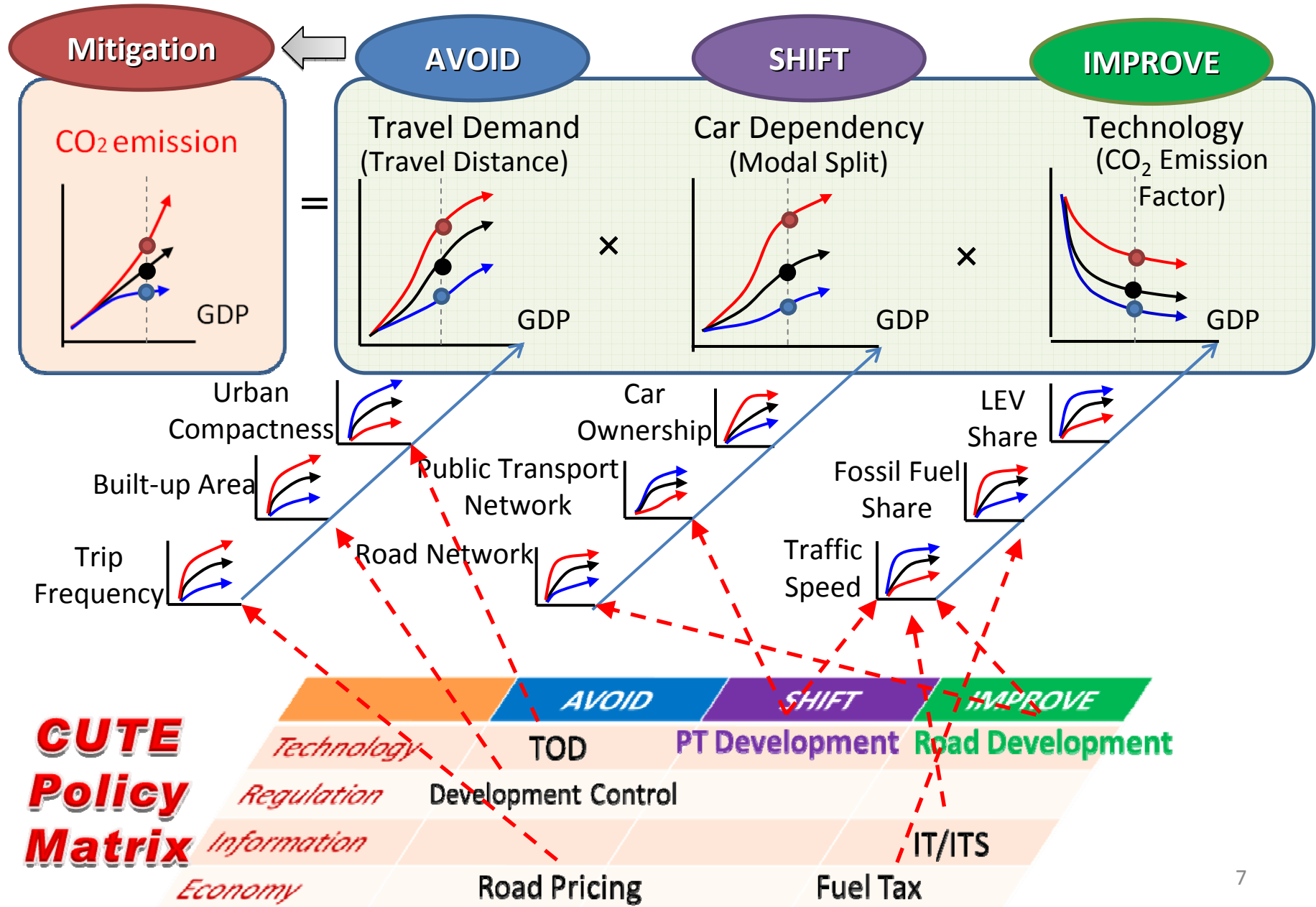
Visioning Future Transport Systems with Key Indicators



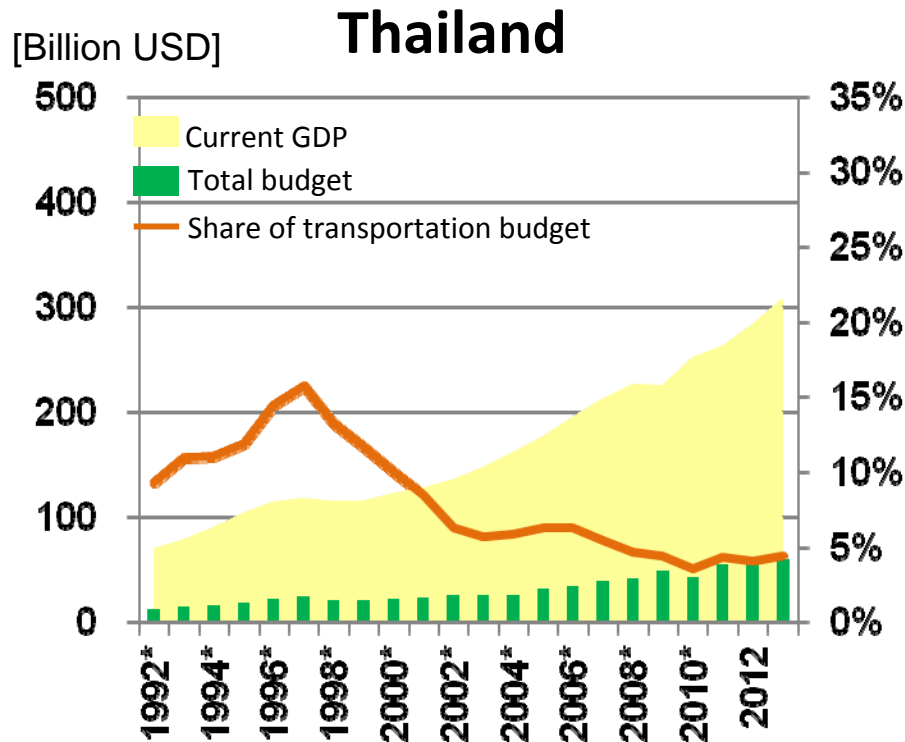
Policy/technology options (CUTE Matrix)

Strategies Means	AVOID	SHIFT	IMPROVE
Technologies	<ul style="list-style-type: none"> • Transport oriented development (TOD) • Poly-centric development • Efficient freight distribution 	<ul style="list-style-type: none"> • Railways and BRT development • Interchange improvement among railway, BRT, bus and para-transit modes • Facilities for personal mobility and pedestrians 	<ul style="list-style-type: none"> • Development of electric vehicles • Development of biomass fuel • "Smart grid" development
Regulations	<ul style="list-style-type: none"> • Land-use control 	<ul style="list-style-type: none"> • Separation of bus/para-transit trunk and feeder routes • Local circulating service • Control on driving and parking 	<ul style="list-style-type: none"> • Emissions standards • "Top-runner" approach
Information	<ul style="list-style-type: none"> • Telecommuting • Online shopping • Lifestyle change 	<ul style="list-style-type: none"> • ITS public transport operation 	<ul style="list-style-type: none"> • "Eco-driving" • ITS traffic-flow management • Vehicle performance labeling
Economy	<ul style="list-style-type: none"> • Subsidies and taxation to location 	<ul style="list-style-type: none"> • Park & ride • Cooperative fare systems among modes 	<ul style="list-style-type: none"> • Fuel tax/carbon tax • Subsidies and taxation to low-emissions vehicles

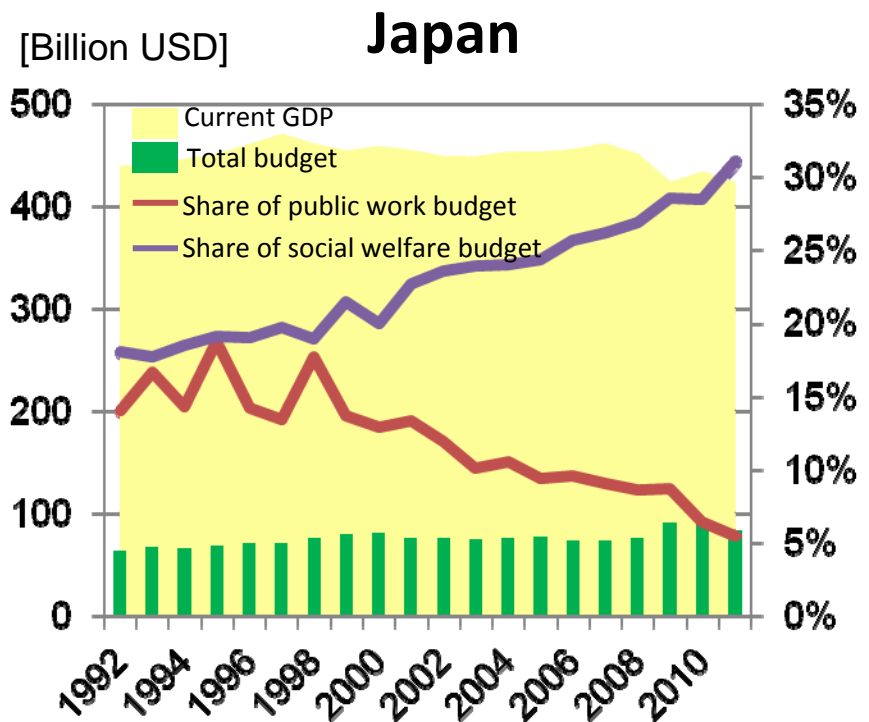
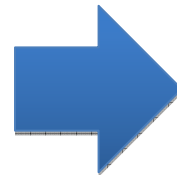
Dynamic Tracking of Transport Related Emission Mechanism



Feasibility of Policy Implementation



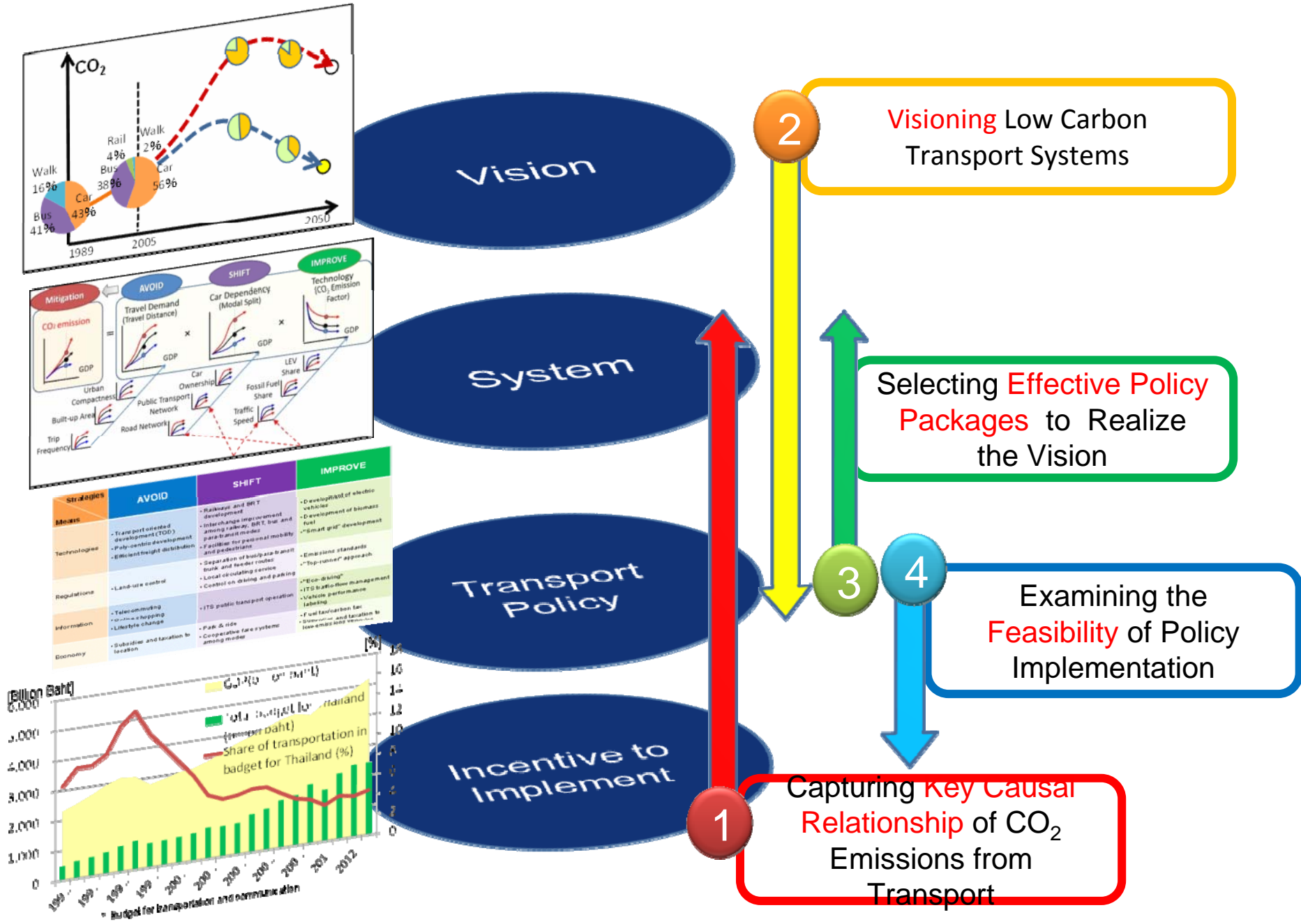
Increasing public investment in economic growth



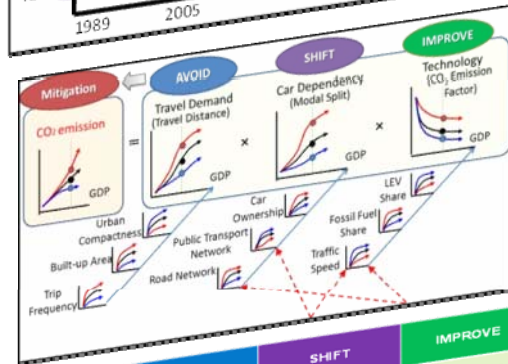
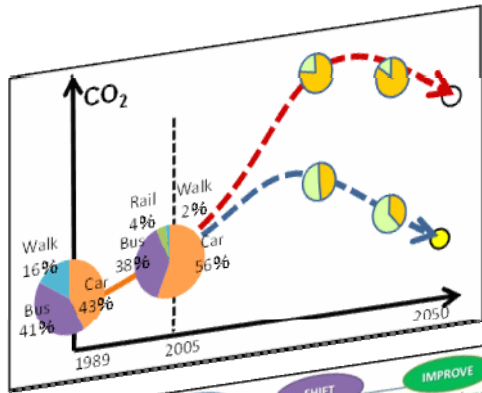
Increasing limitation to transport investment due to ageing and population decline

What are necessary frameworks to implement policies to realize the future vision?

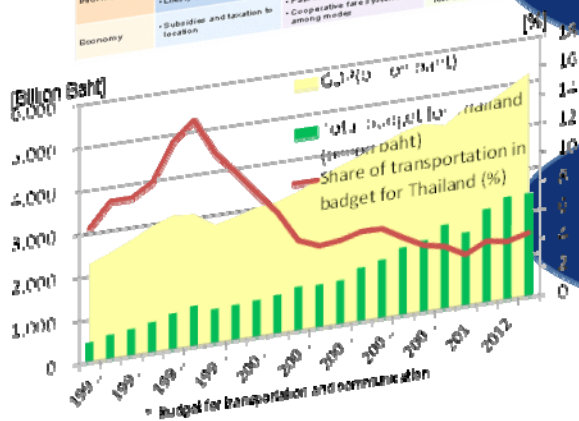
Steps of the Backcasting Approach



Steps of the Backcasting Approach



Strategies	AVOID	SHIFT	IMPROVE
Measures	<ul style="list-style-type: none"> Transport oriented development (TOD) Poly-centric development Efficient freight distribution 	<ul style="list-style-type: none"> Railways and BRT development Interchange improvement among railway, BRT, bus and para transit modes Facilities for personal mobility and restrictions Separation of bus/patrol, truck and feeder routes Local circulating service Control on driving and parking 	<ul style="list-style-type: none"> Development of electric vehicles Development of biomass fuel "Smart grid" development Emission standards "Top-runner" approach
Technologies	<ul style="list-style-type: none"> Land-use control 	<ul style="list-style-type: none"> ITS public transport operation Park & ride Cooperable fare systems among modes 	<ul style="list-style-type: none"> "Eco-driving" ITS traffic flow management Vehicle performance labeling Fuel efficiency label Subsidies and taxation to low-emission vehicles
Regulations	<ul style="list-style-type: none"> Taxation Online shopping Lifestyle change 	<ul style="list-style-type: none"> Subsidies and taxation to location 	
Information			
Economy			



Vision

System

Transport Policy

Incentive to Implement

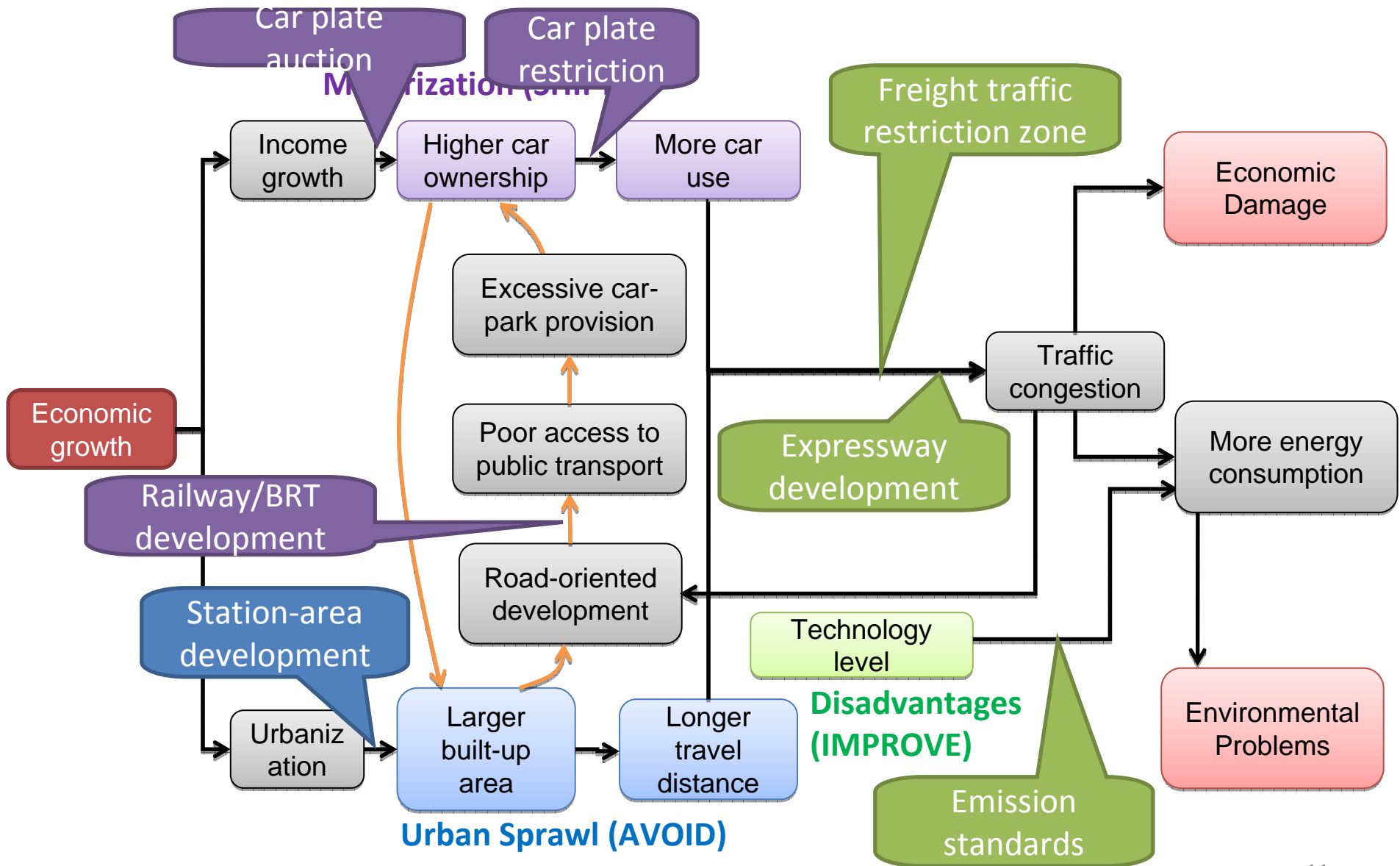


1

Capturing Key Causal Relationship of CO₂ Emissions from Transport

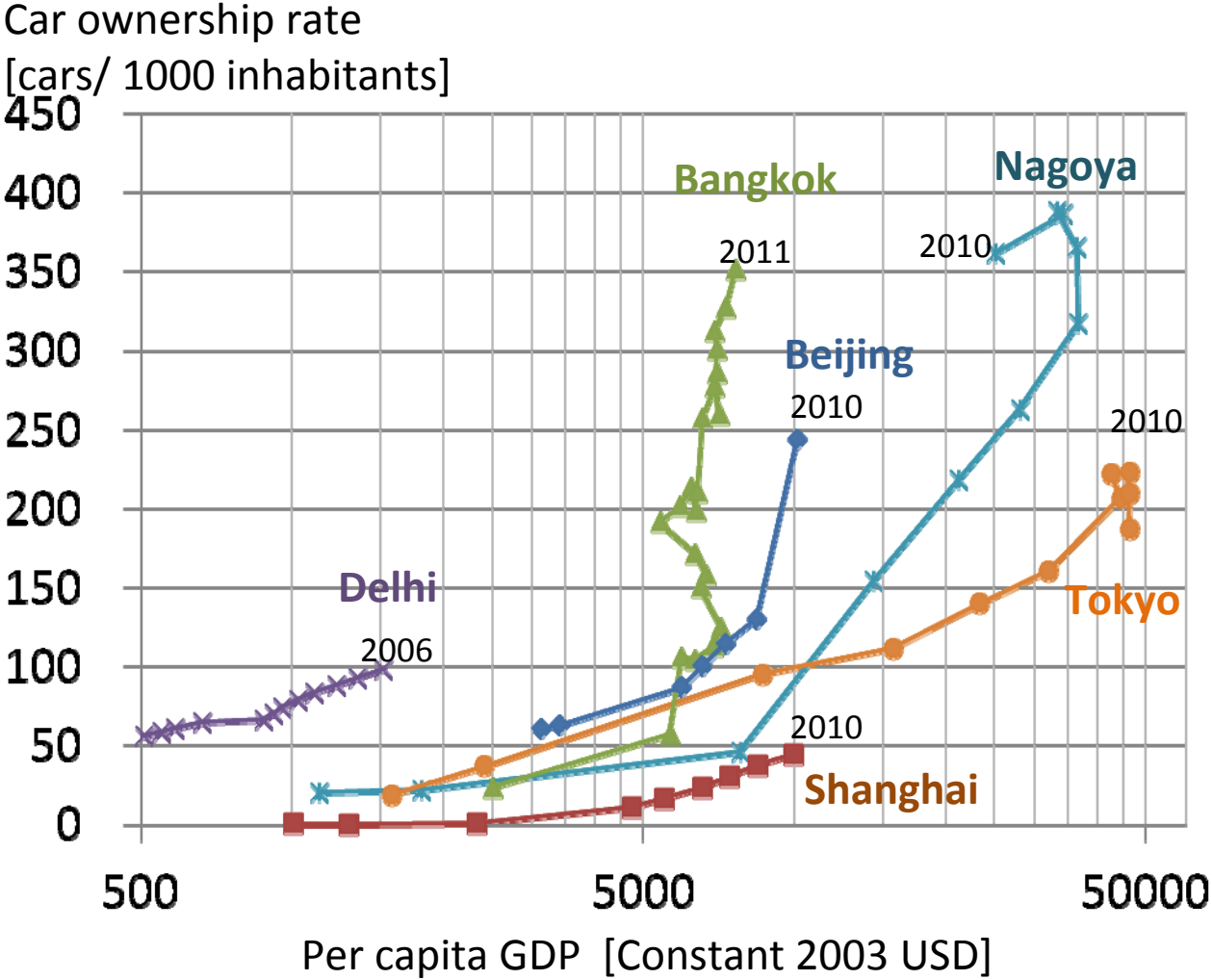
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Causal Relationship of Transport-related CO₂ Emissions in Asia: Vicious Circles between Motorization and Urban Sprawl



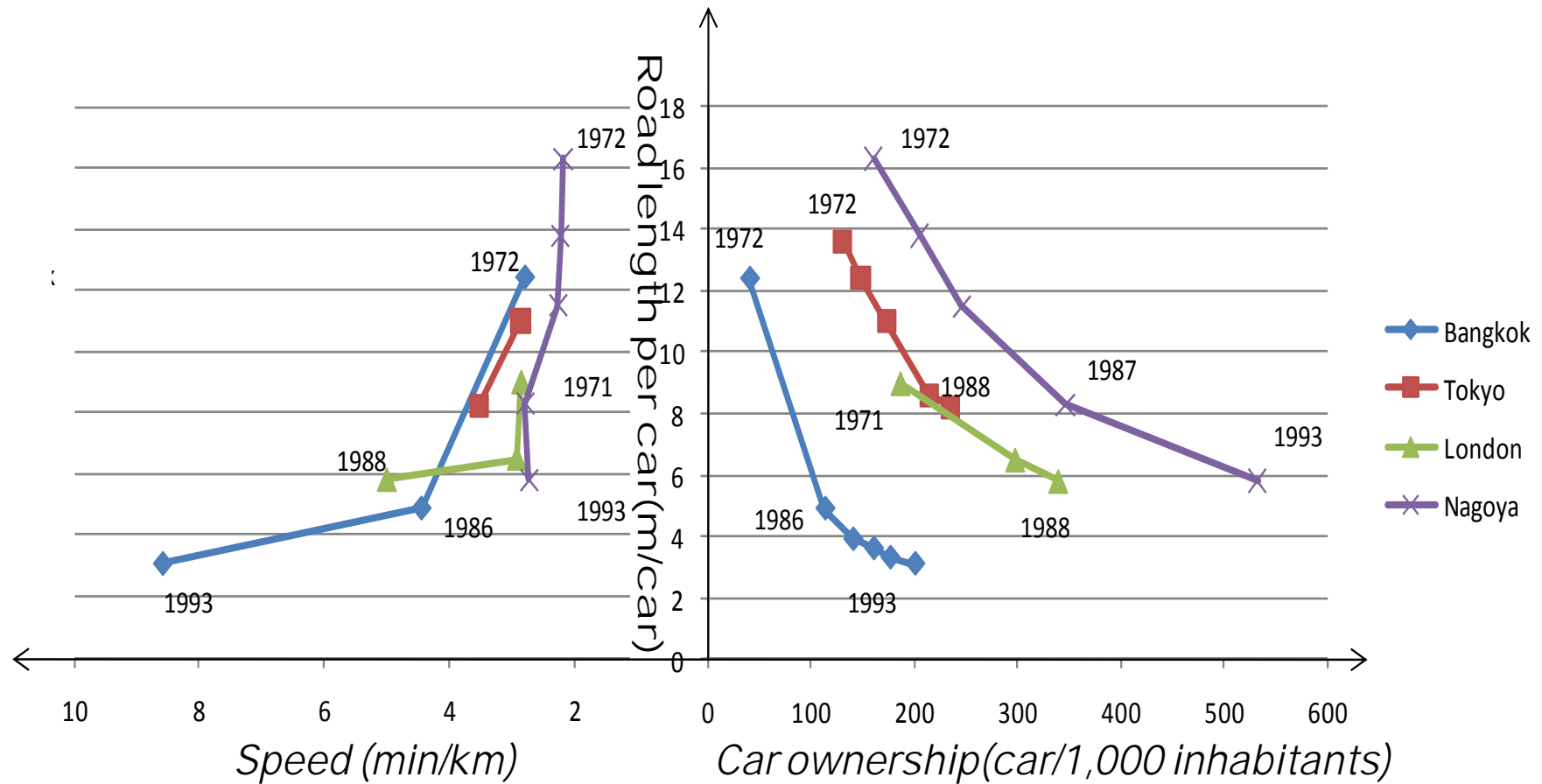
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The Trend of Car Ownership Growth



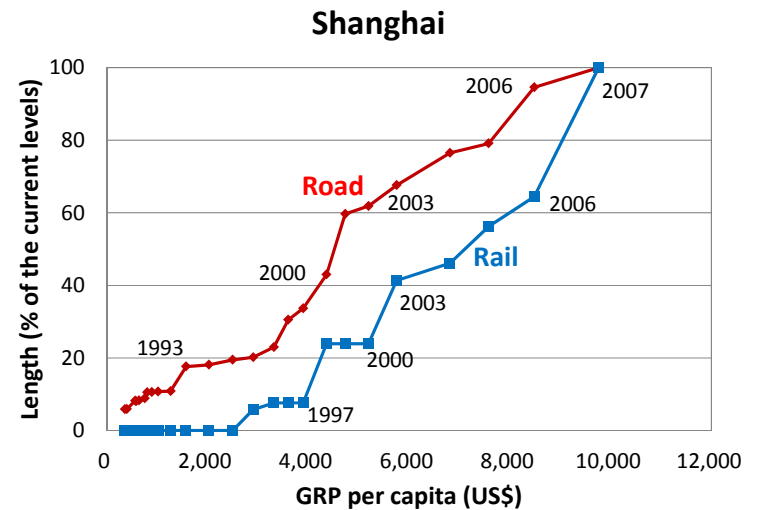
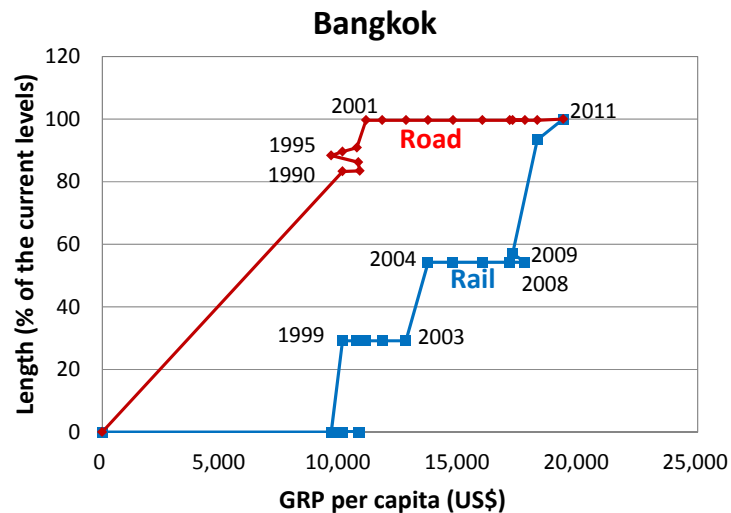
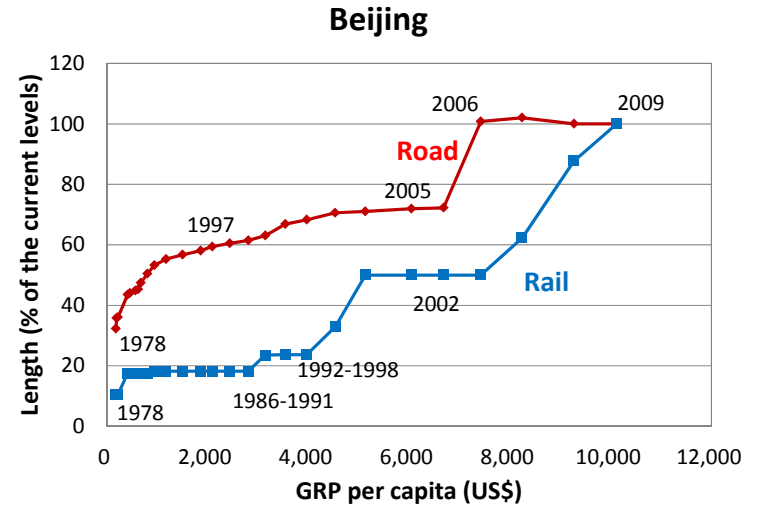
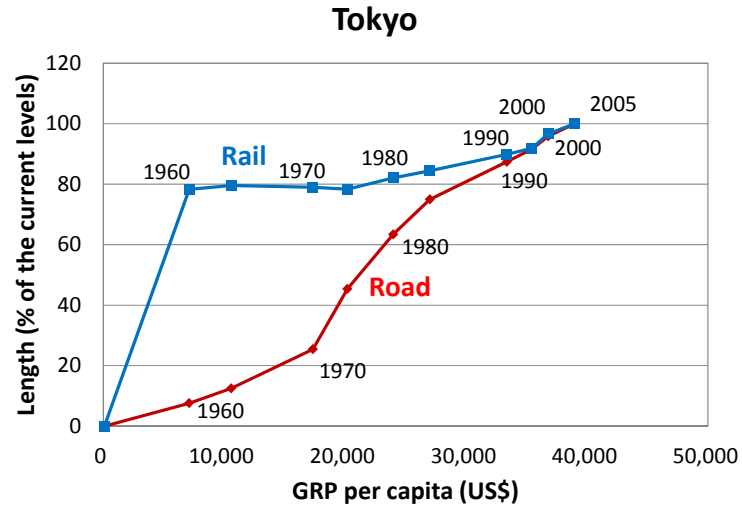
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The Trend of Traffic Congestion



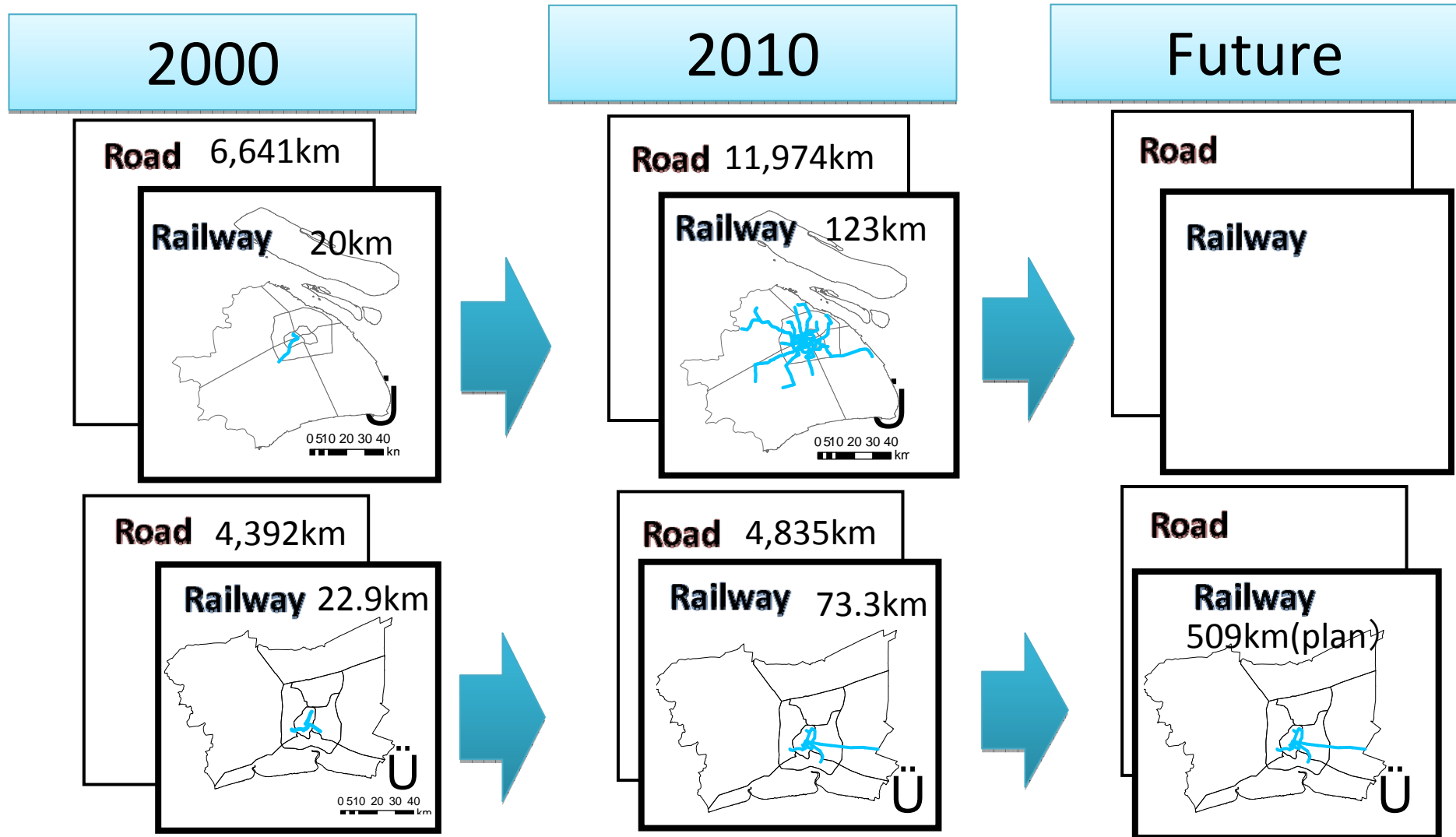
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The Trend of Road Development



1

Development of Mass Rapid Transit (MRT)

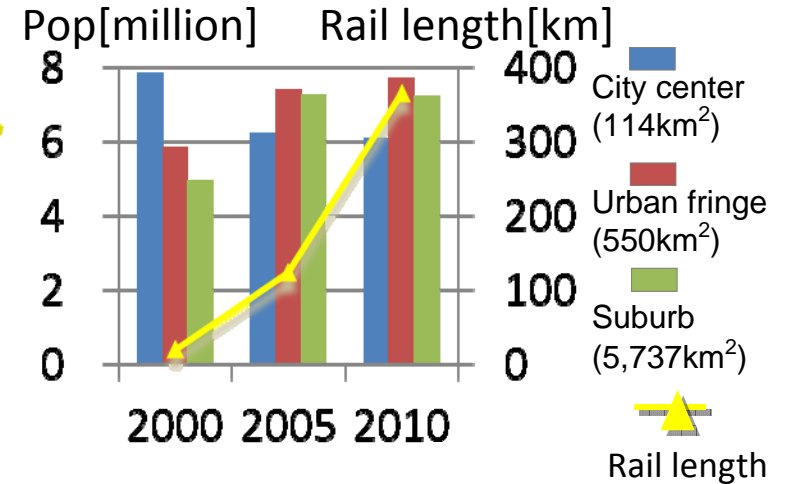
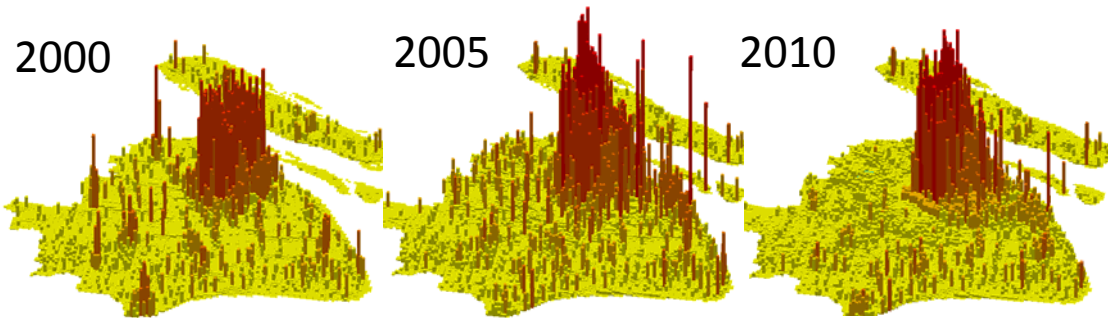


Megacities in Asian developing countries have started MRT development since the early 2000s

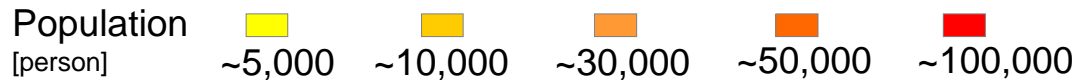
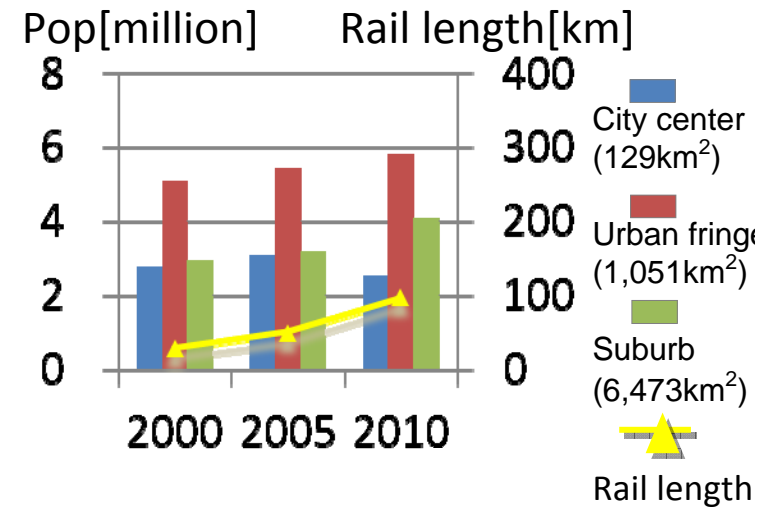
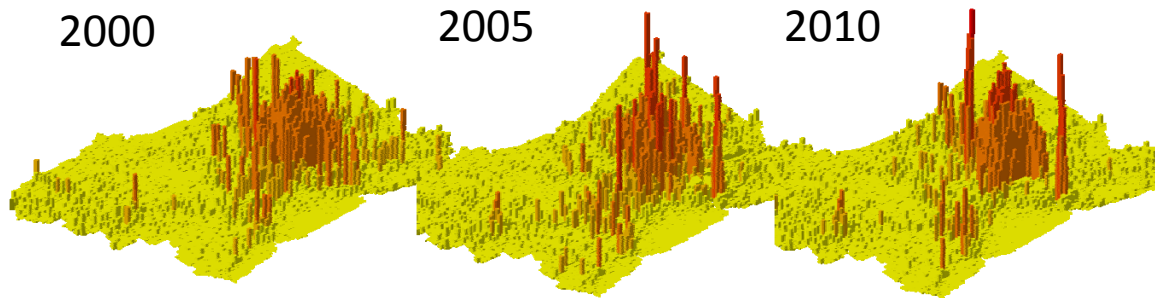
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Changes in Urban Forms

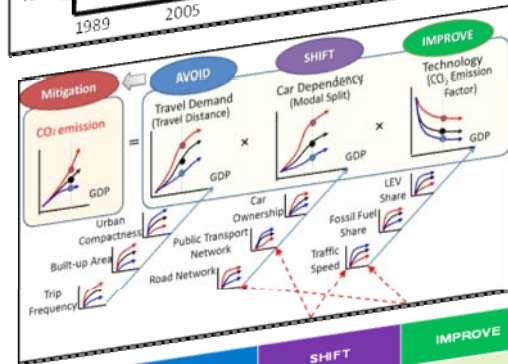
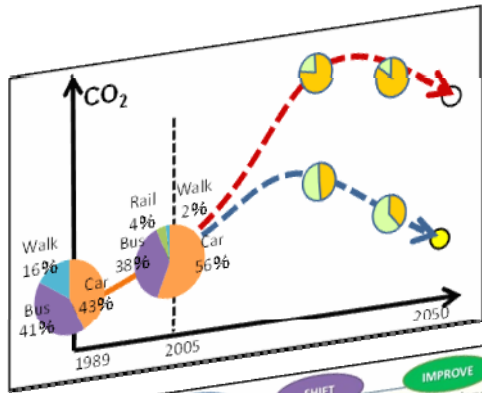
Shanghai (6,400km²)



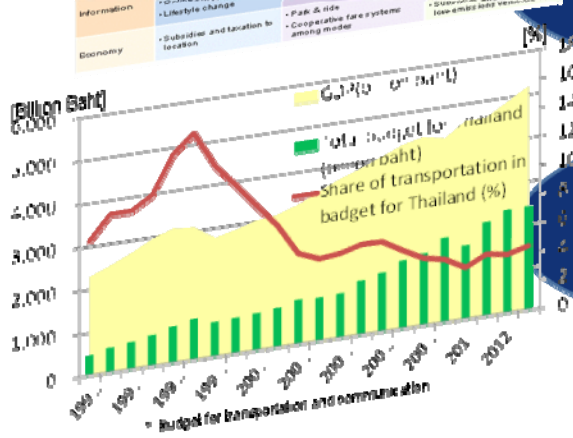
Bangkok (7,650km²)



Steps of the Backcasting Approach



Strategies	AVOID	SHIFT	IMPROVE
Measures	<ul style="list-style-type: none"> Transport oriented development (TOD) Poly-centric development Efficient freight distribution 	<ul style="list-style-type: none"> Railways and BRT development Interchange improvement among railway, BRT, bus and para transit modes Facilities for personal mobility and restrictions Separation of budget to transit, trunk and feeder routes Local circulating service Control on driving and parking 	<ul style="list-style-type: none"> Development of electric vehicles Development of biomass fuel "Smart grid" development Emission standards "Top-runner" approach
Technologies	<ul style="list-style-type: none"> Urban Compactness Built-up Area Trip Frequency 	<ul style="list-style-type: none"> Public Transport Network Road Network Car Ownership Fossil Fuel Share Traffic Speed 	<ul style="list-style-type: none"> "Eco-driving" ITS traffic flow management Vehicle performance labeling
Regulations	<ul style="list-style-type: none"> Land-use control 	<ul style="list-style-type: none"> ITS public transport operation 	<ul style="list-style-type: none"> ITS traffic flow management Vehicle performance labeling
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Economy	<ul style="list-style-type: none"> Subsidies and taxation to location 		



Vision

System

Transport Policy

Incentive to Implement

2 Visioning Low Carbon Transport Systems



2

Vision 2050: Urban Transport

Hierarchically Connected Compact City

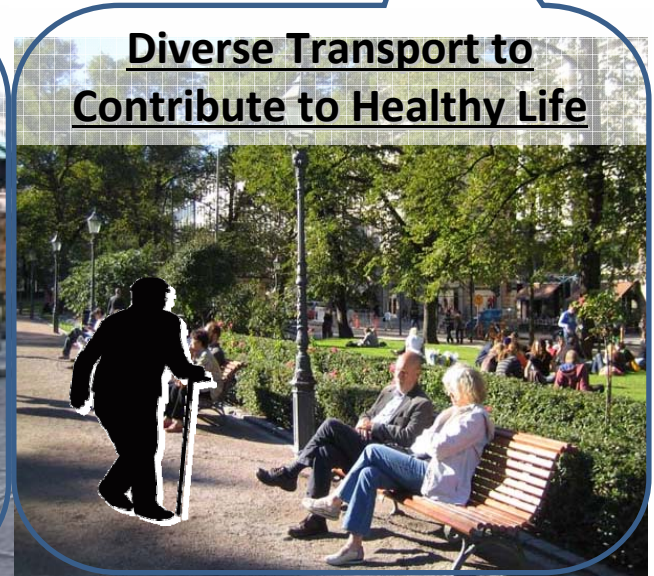
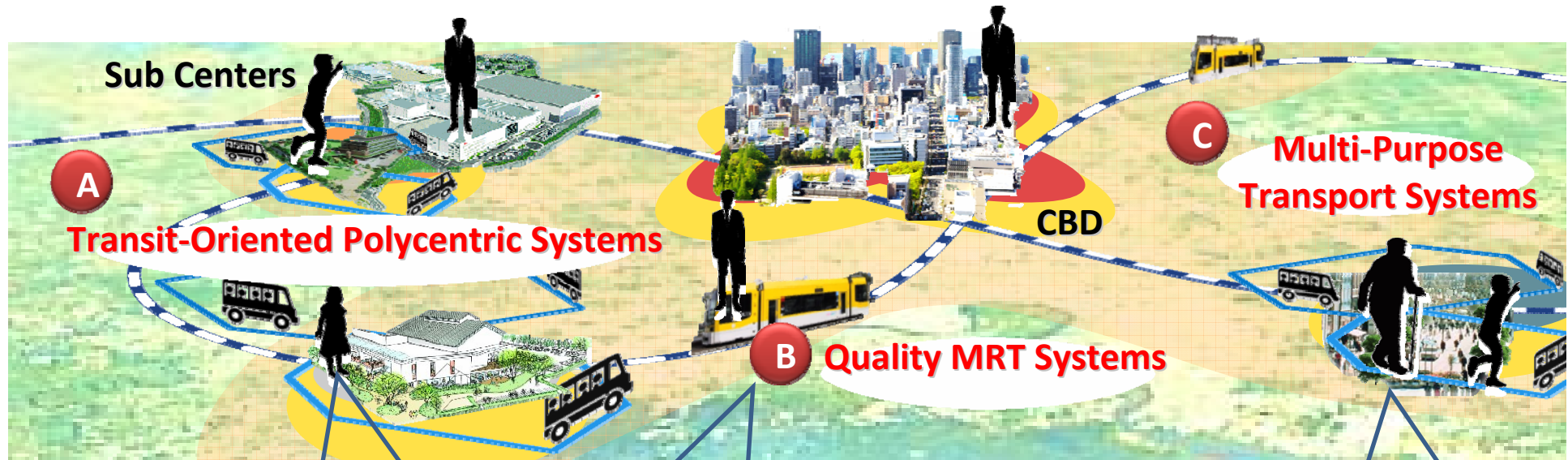
small vehicle,
renewable energy
+ biomass fuel



railway, bus rapid transit, conventional bus, para-transit, personal mobility

2

Key Options of the Vision (Urban Transport)



To form habits not to use cars

2

A

Policy Package of Transit-Oriented Polycentric Development for Early-stage Developing Cities with Land-use Control

Transit-Oriented Sub Center Development

Provision of local employment & education

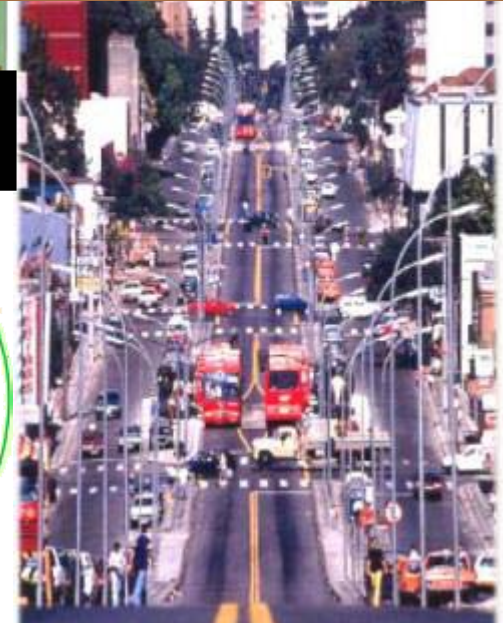
Value Capture

MRT development

Integrated fare system among modes

Comfortable bus stops

Curitiba BRT



2

B

Policy Package of Quality MRT Development for Early-stage Developing Cities without Land-use Control

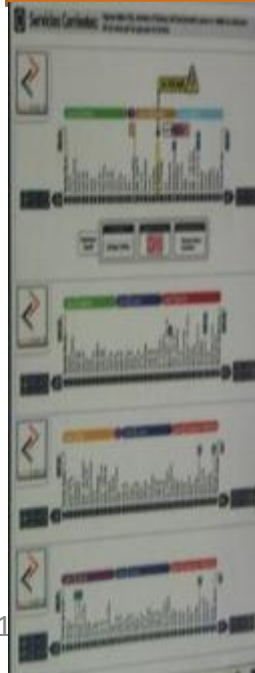
MRT Infrastructure/ Management Improvement

Express lines, Large capacity carriers

ICT-based operation

Traffic control

Bogota BRT



2

c Policy Package of Multi-Purpose Transport Development for Developing Mega-cities

Suburban Urban-Village Development

Neighborhood design connected to transit services

Multi-socioeconomic neighborhood development

Feeder Transport Improvement

Provision of feeder circular routes

Street improvement for personal mobility & pedestrians

Singapore LRT

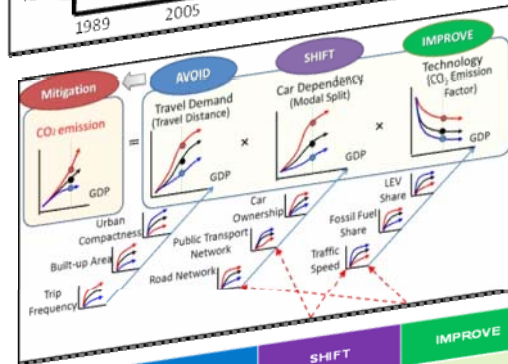
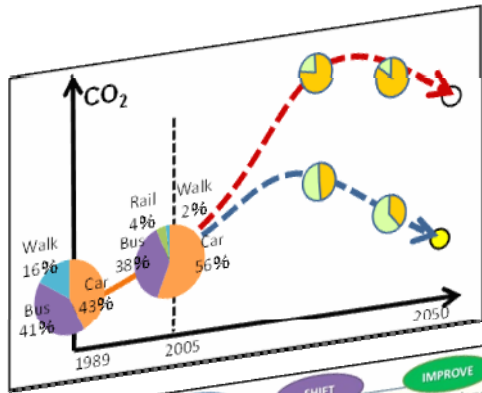
Punggol LRT

- Orbital local network
- 10km, 15 stations
- Connection to MRT
- Automatic operation

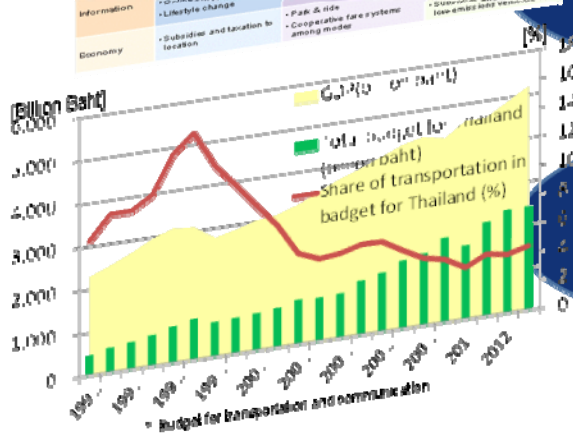


(Sun, G., LTA)

Steps of the Backcasting Approach



Strategies	AVOID	SHIFT	IMPROVE
Measures	Transport oriented development (TOD) Poly-centric development Efficient freight distribution	Railways and BRT development Interchange improvement among subway, BRT, bus and para transit modes Facilities for personal mobility and restrictions	Development of electric vehicles Development of biomass fuel "Smart grid" development
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Regulations	Taxation Online shopping Lifestyle change	ITS public transport operation Park & ride Cooperable fare system among modes	"Eco-driving" ITS traffic flow management Vehicle performance labeling
Information	Subsidies and taxation to location		Fuel taxation for Subsidies and taxation to low-emission vehicles
Economy			



Vision

System

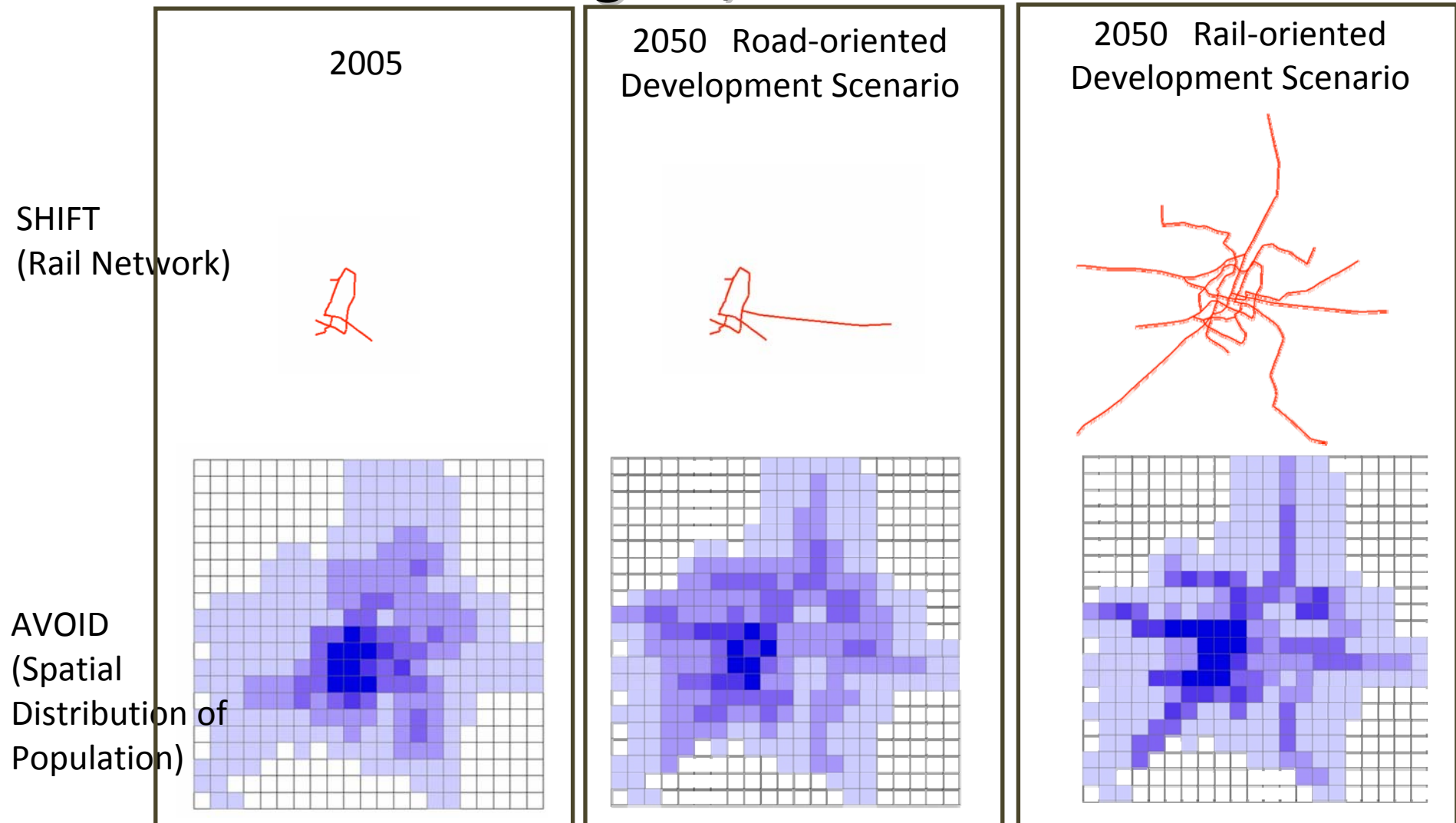
Transport Policy

Incentive to Implement



Selecting **Effective Policy Packages** to Realize the Vision

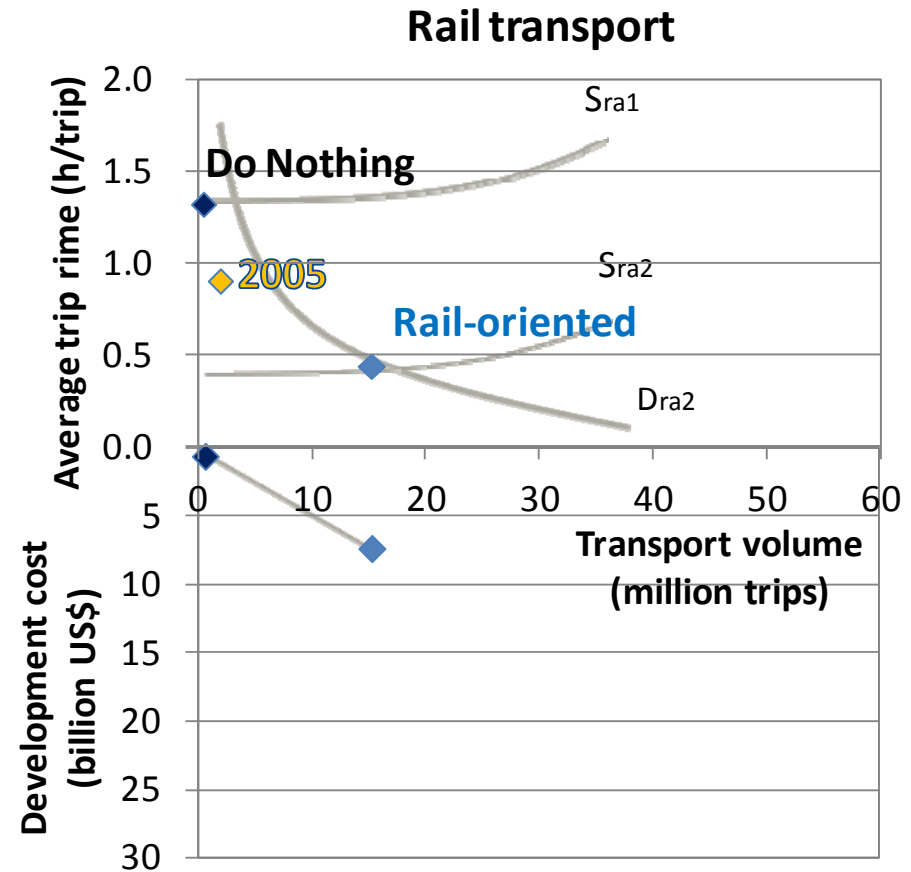
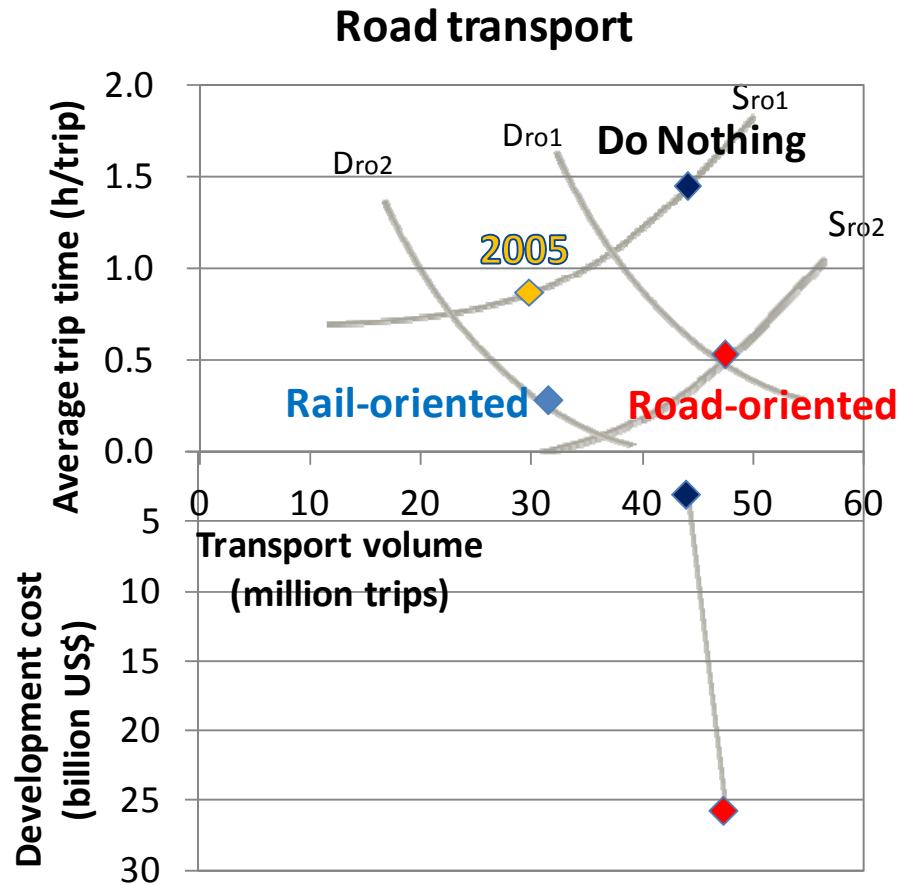
3 Testing Development Scenarios of Megacities; Bangkok, Thailand



Is Rail development more effective than Road development?

3

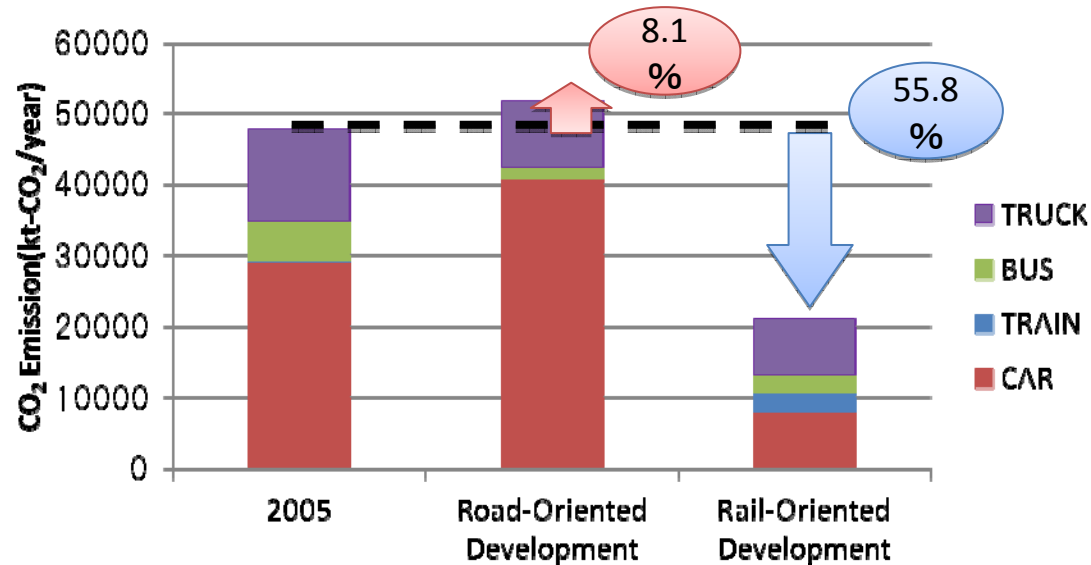
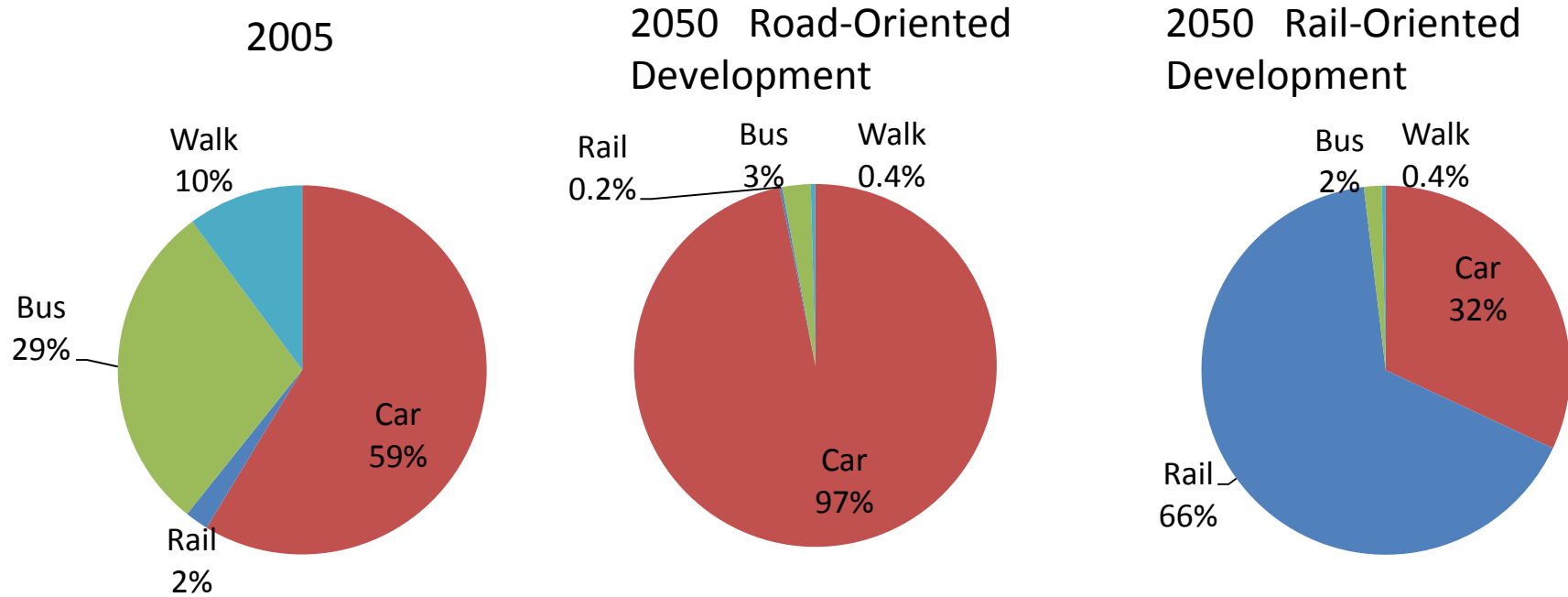
Estimated Time Saving from Road and Rail Development (Bangkok)



*1 In the Do-Nothing case, no investment in transport development would be made from 2005 to 2010.

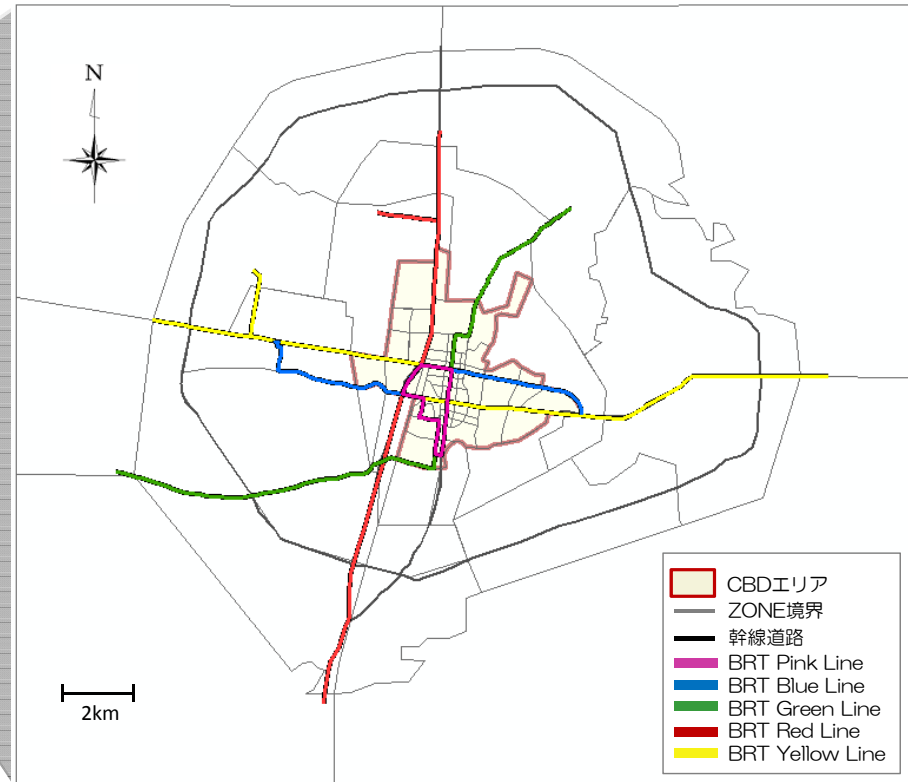
3

Estimated CO₂ Mitigation in Bangkok



3

Testing Development Scenarios of Middle-sized Cities; Khon Kean, Thailand



➤ 5 Routes of BRT Planned to operate from 2022

- 450km from Bangkok
- Pop 240,000
- Area 230 km²

3

The Future Vision of Khon Kean

With TOD case in 2022



Leverage Advanced Technologies

Hierarchical Compact City

Avoid Shift Improve



Seamless & Hierarchical Transportation System

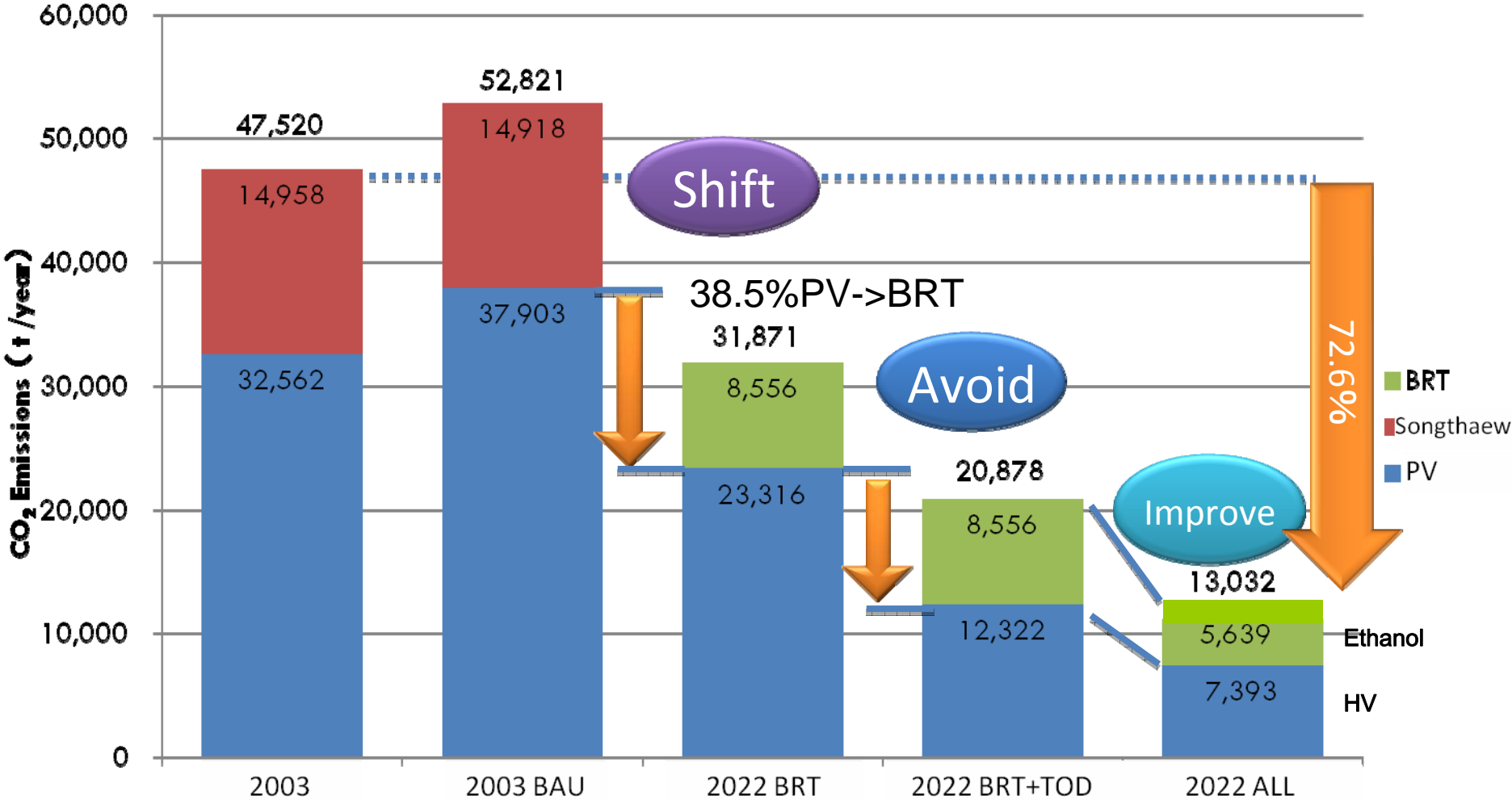


Bio Ethanol Production and Ethanol Bus Introduction



3

Estimated CO₂ Mitigation in Khon Kean



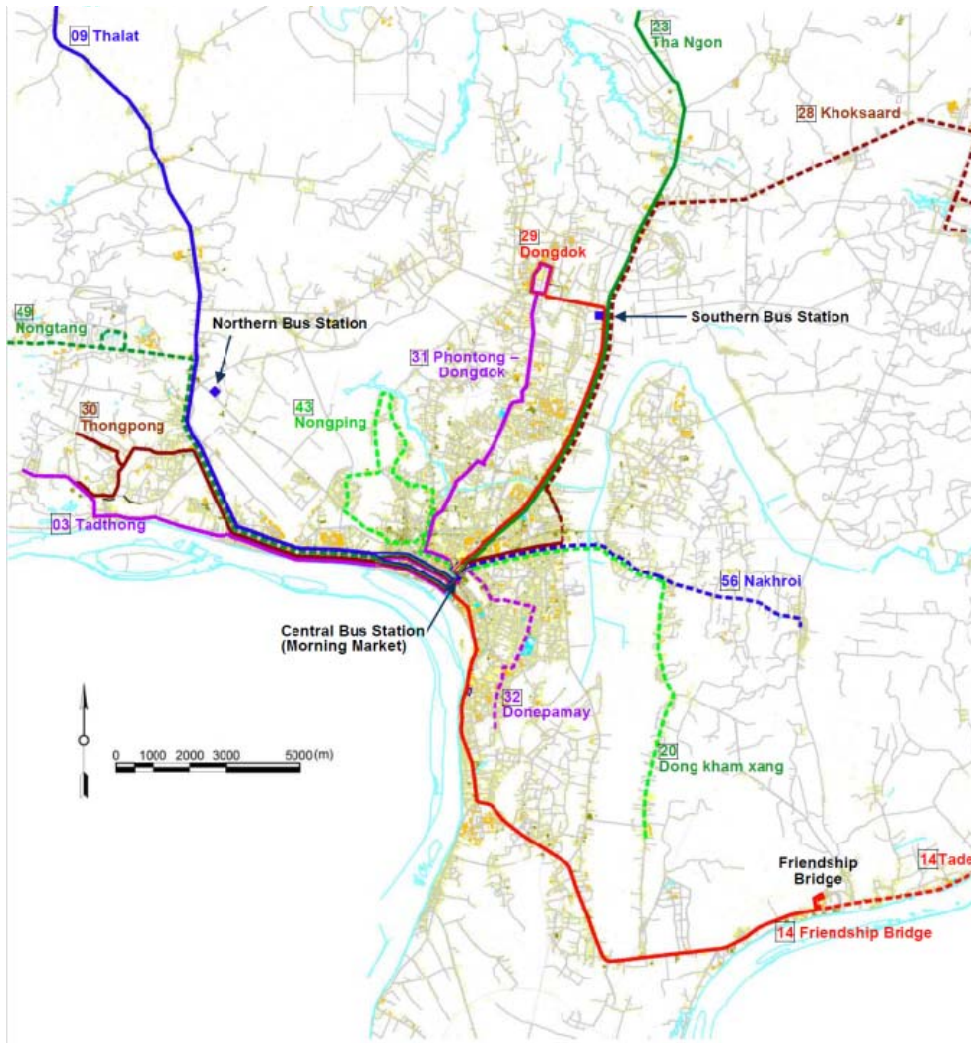
3

Policies in previous studies on Vientiane

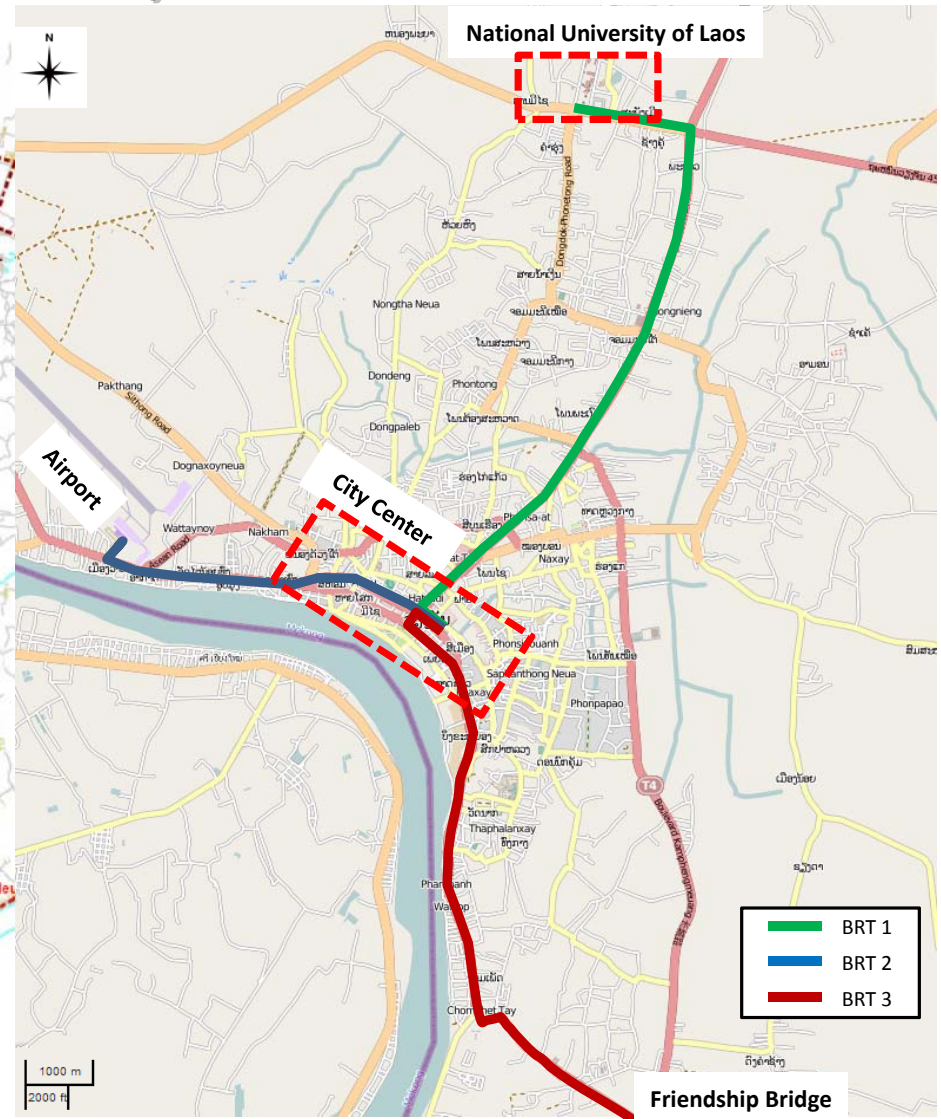
Strategy	Policy	Outline	Comparison		
			EST	ADB	JICA
A v o i d	Compact City	Sprowing area put together.	○		
	Transit Oriented Development (TOD)	Land use designed to maximize access to public transport	○		
	Information Communications Technolgies (ICT)	Cut down commute time by using the Internet.	○		
S h i f t	Non-Motorized Transport (NMT)	Accelerate the use of NMT.	○		
	Bus Improvement	Introduce of Loop bus or Articulating bus. etc		○	○
	Bus Rapid Transit (BRT)	Public transportation systems using buses to provide faster, more efficient service than an ordinary bus line.	○		
	Light Rail Transit (LRT)	Higher capacity and higher speed than traditional street-running tram systems.			○
	Road Pricing	An economic concept regarding the various direct charges applied for the use of roads.	○		
	Provision with Parking Space Parking Management	Maintenance appropriate parking. Introduce of Park and Ride. etc	○	○	○
I m p r o v e	Road Improvement	Improvement of the intersection and development bypass.			○
	Cleaner Fuels and Technogies	Eco-car to recommend.	○		
	Road Taffic Law	Implement the Road Taffic Law.	○	○	
	Intelligent Transportation Systems (ITS)	Improvement of the signal control.	○		
	Freight Transport	Efficiency of freight vehicles.	○		

3

Development Scenarios of Middle-sized Cities; Vientiane, Laos



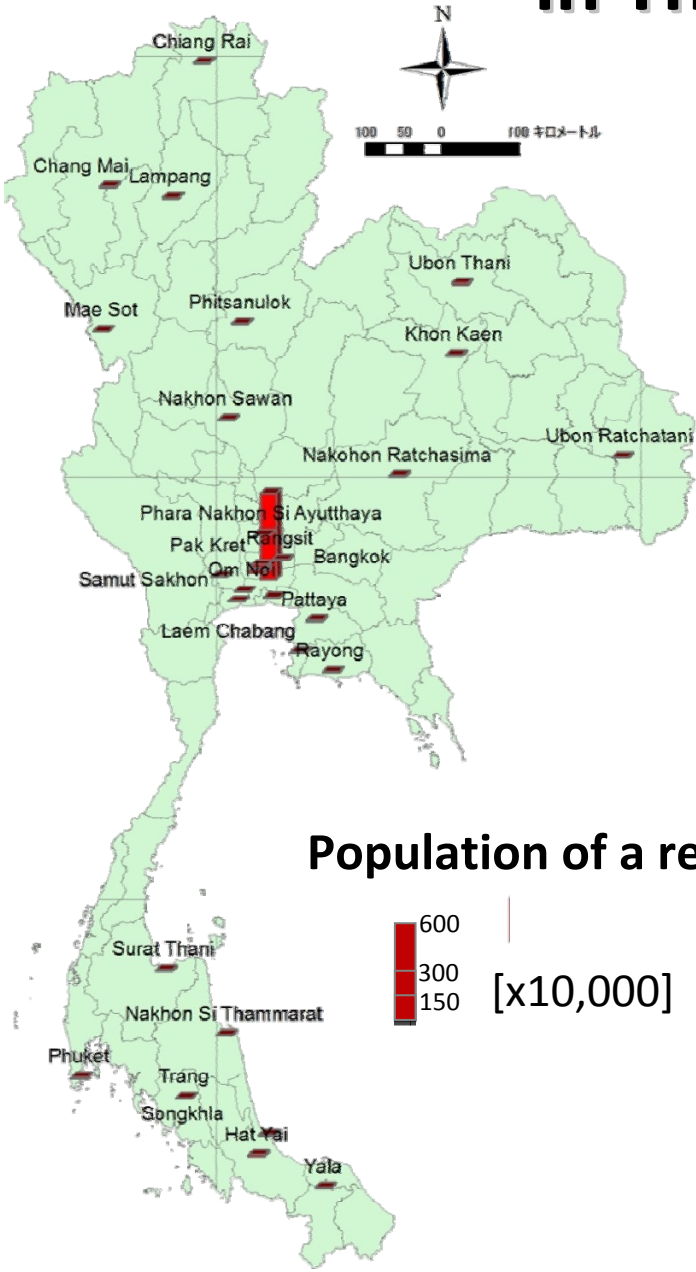
Map of Bus lines



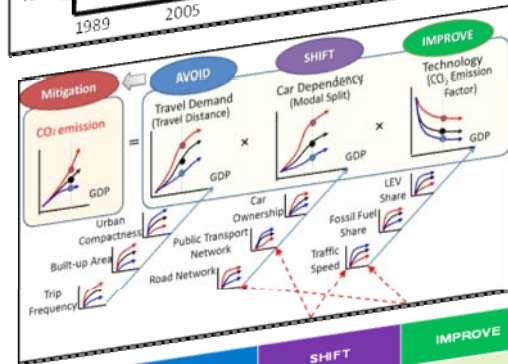
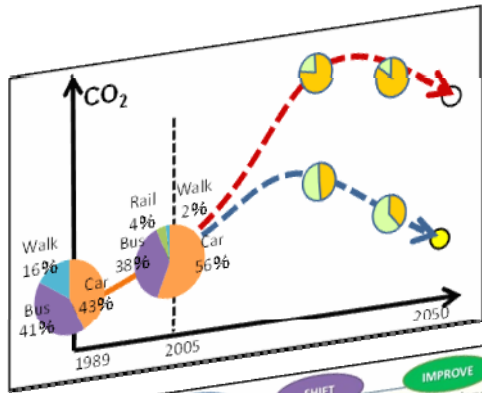
Map of proposed BRT lines
(Nihon Univ.)

3

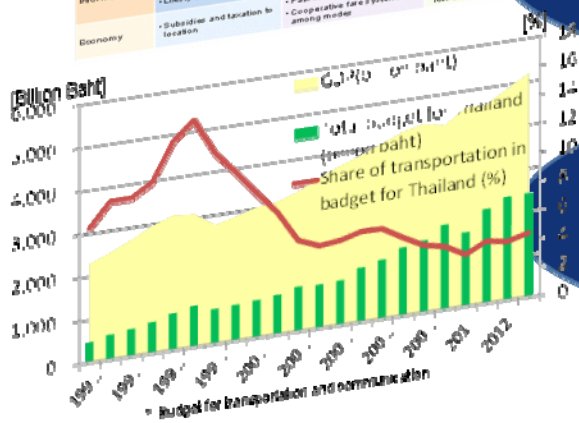
Low-Carbon Urban Transport Mode by Region in Thailand



Steps of the Backcasting Approach



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Regulations	<ul style="list-style-type: none"> Land-use control 	<ul style="list-style-type: none"> ITS public transport operation 	<ul style="list-style-type: none"> "Eco-driving" ITS traffic flow management Vehicle performance labeling
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Economy	<ul style="list-style-type: none"> Subsidies and taxation to location 		



Vision

System

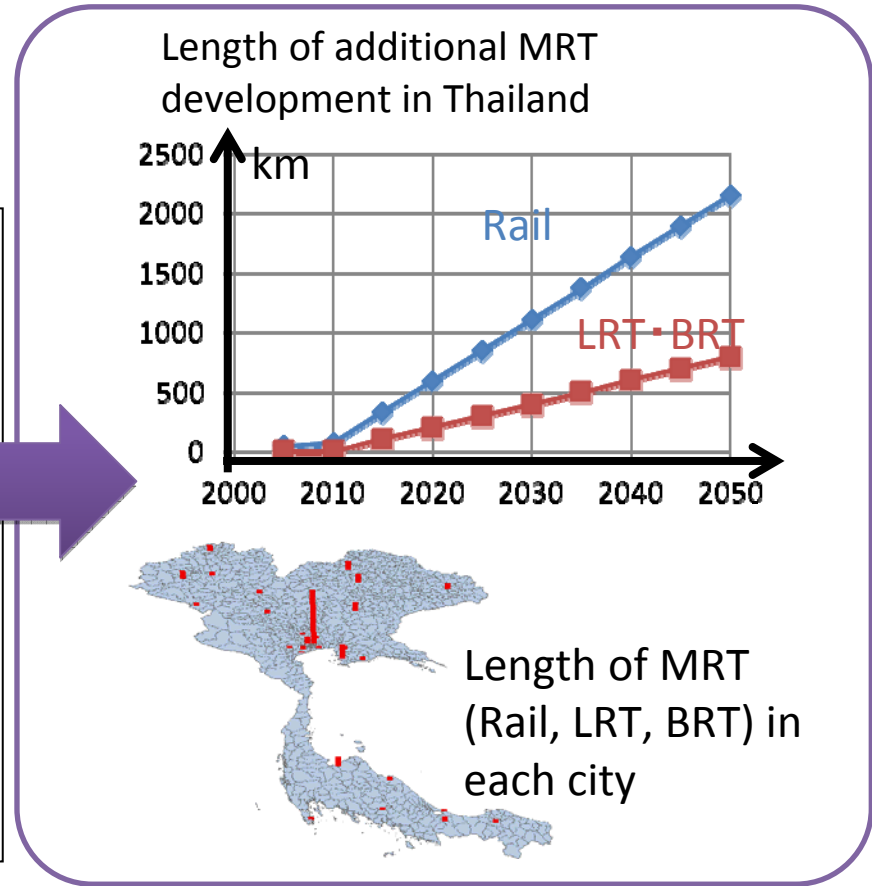
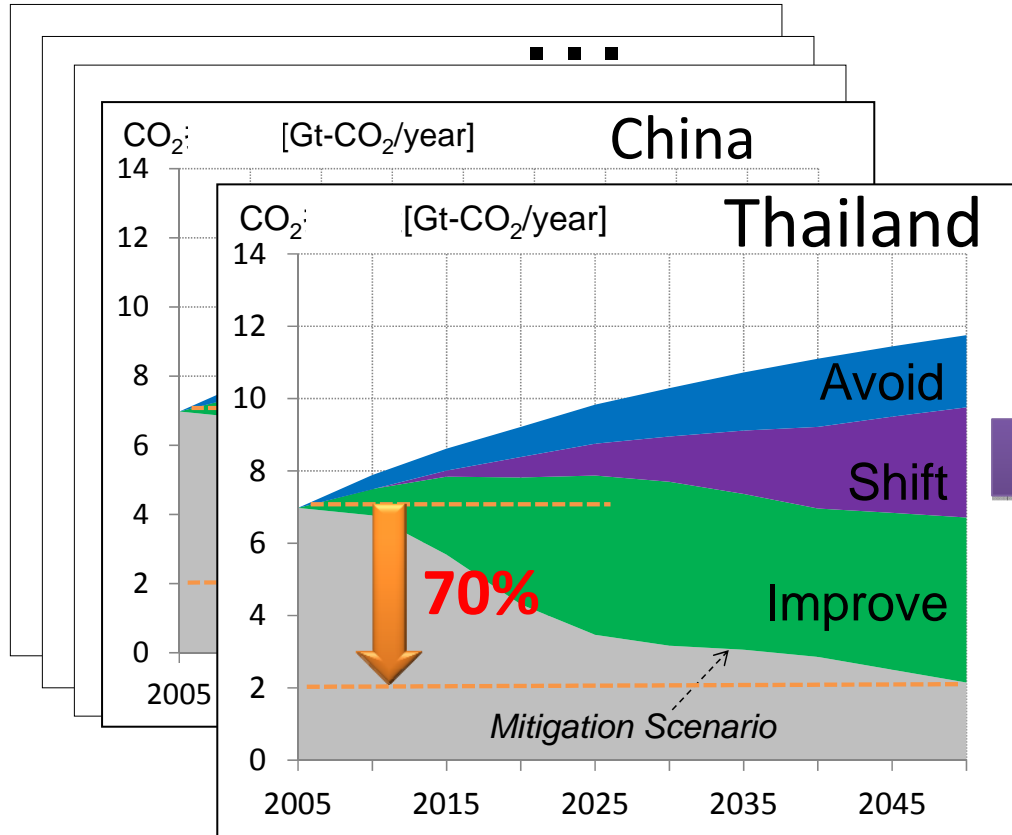
Transport Policy

Incentive to Implement

4 Examining the Feasibility of Policy Implementation

4

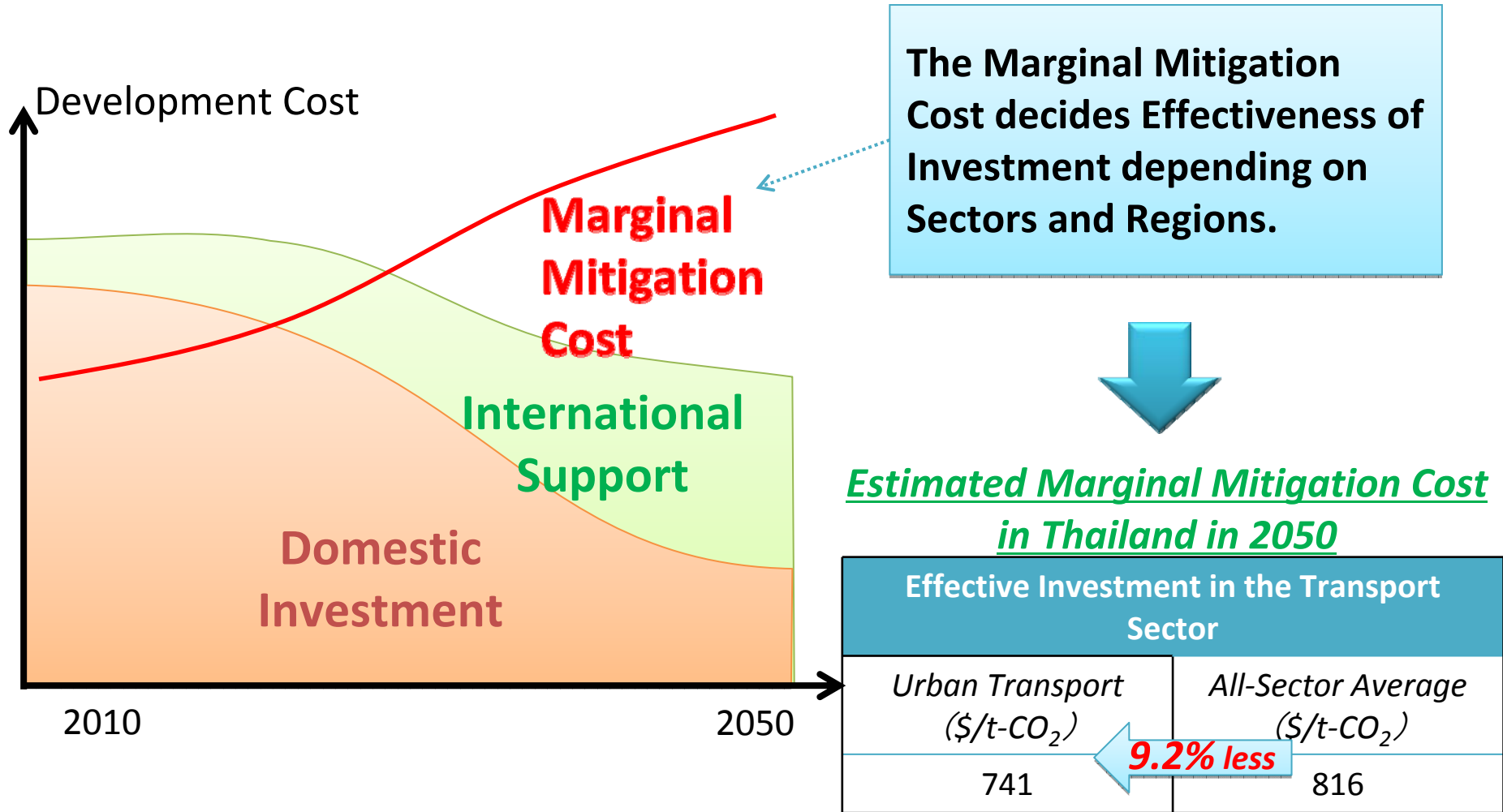
Identifying Necessary Levels of MRT Development to achieve 70% CO₂ mitigation target in Urban Transport



- AVOID** : land-use control (5%/year less expansion of built-up area)
- IMPROVE**: Increasing LEV share (EV76%, HV23%),
Improving Energy Efficiencies (by 28%)
Improving power generation efficiencies (17.6 times)

4

Examining Financial Feasibility of the MRT Development



Discussion

- What is the **challenges** of developing low-carbon transport systems integrated with regional development in Asian developing countries?
- What is the **visions** of the desirable system?
- How can we realize the vision with **measures** in a leapfrog manner?
- Is it **feasible** to implement such measures?