Urban Transport Energy Use in the APEC Region – Phase II

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Asia-Pacific
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Study Background

- **Rising Oil Import Dependence in APEC**
  - APEC's net oil import dependence will jump from the current 36 percent to 52 percent by 2030.
- **Continued Dependence on Oil Products**
  - The transport sector will continue to drive up oil demand barring a major technological breakthrough.
    - By 2030, the transport sector will lead about 70 percent of incremental oil demand growth.
    - By 2030, oil is expected to continue to be the major energy source for the transport sector.
    - By 2030, road transport is projected to account for about 80 percent of total transport energy demand.
- **Climate Change and Transport**
  - Transport is one of the fastest growing sector in terms of CO2 emissions.
  - The IPCC's fourth assessment report identified modal shift as the key mitigation practices.
- **Urban Population Growth**
  - About 25 million population in APEC move from rural to urban areas annually.

How to reduce oil use in the transport sector

	Policy Instruments	Economic Instruments	Technology/Infrastructure
Land Use	Urban Planning, Zoning Regulation, Parking Requirements	Fixed Property Tax (?)	Mass Transit System, Road Infrastructure Development
Traffic Flow	Traffic Demand Management, Priority Lanes for Buses	Road Pricing	Intelligent Transport System (ITS), Teleworking?
Vehicles	Policy for Automobile Industry, Fuel Economy Standards	Vehicle Ownership Tax, Auctioning for Vehicle Number Plate, Vehicle Registration Fee, Incentives for Efficient Vehicles	Alternative Transport
Fuels	Regulation for Emissions	Gasolin/Diesel Tax	(Technology for Refinery)

Findings from the phase I

Findings – from the first phase of study

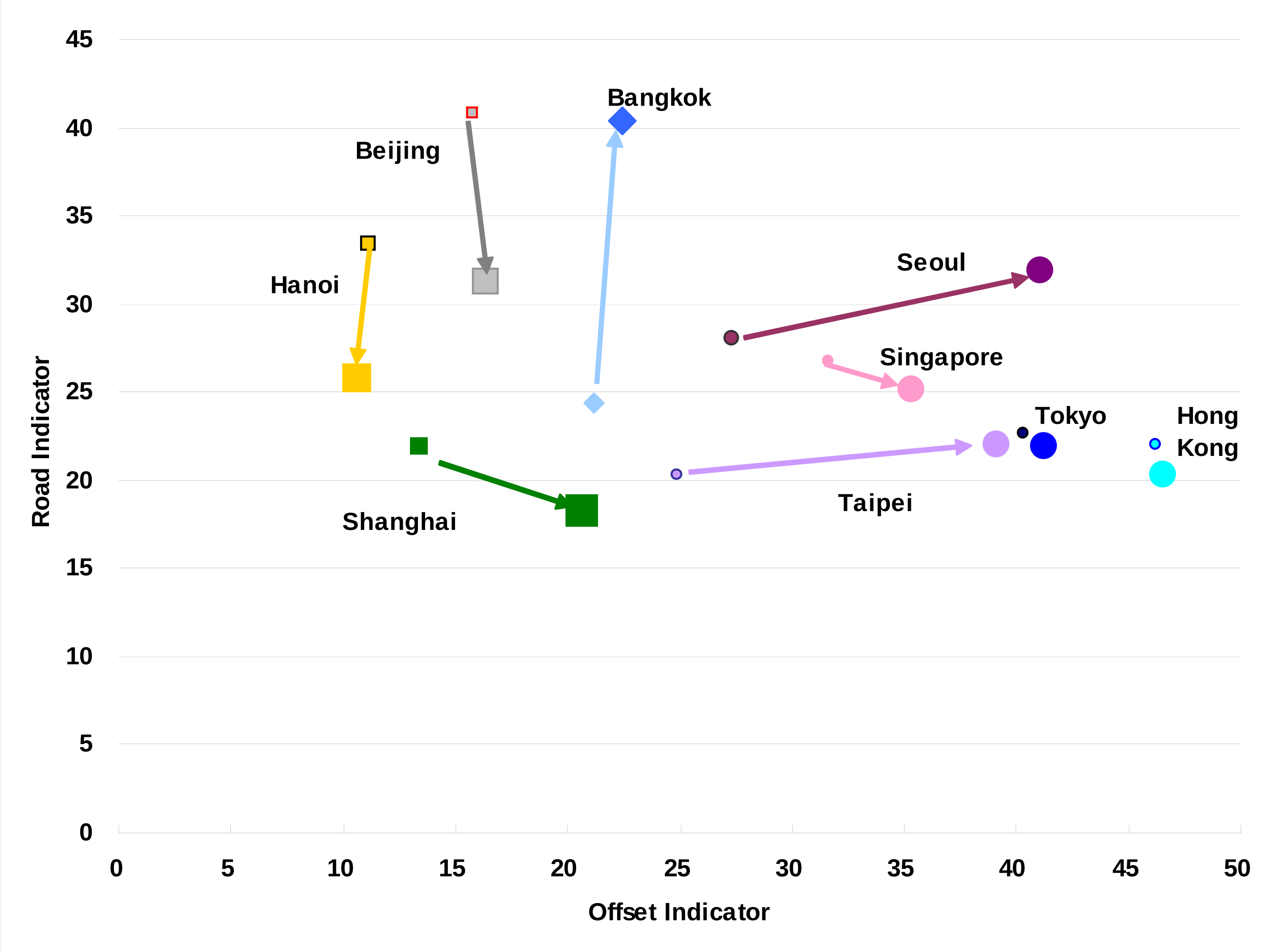
- Passenger transport energy consumption results from diverse socioeconomic factors.
  - Income, Length of road
  - Accessibility to alternative transport modes
  - Urban form, population density
- Accessibility to rail/subway is the key component that can reduce passenger vehicle dependence and improve energy intensity of the urban passenger transport sector in Asia.
- City planners, especially at the early stage of development, need to appropriately assess their future transport requirements and plan appropriate timing in investment towards rail/subway infrastructure.
- Smaller systems in the US require twice as much energy per passenger-km as an automobile requires, while larger ones utilise less energy per passenger-km as an automobile requires.
  - System ridership is the key to improve energy intensities of urban mass transit systems.

Urban Transport Indicators (1995 and 2005)

Cities in Group I represent relatively high accessibility to subway/rail stations – key to offset growth in road energy consumption.

Cities in Group II have relatively high vehicle stocks compared with income levels, while accessibility to subway/rail is low.

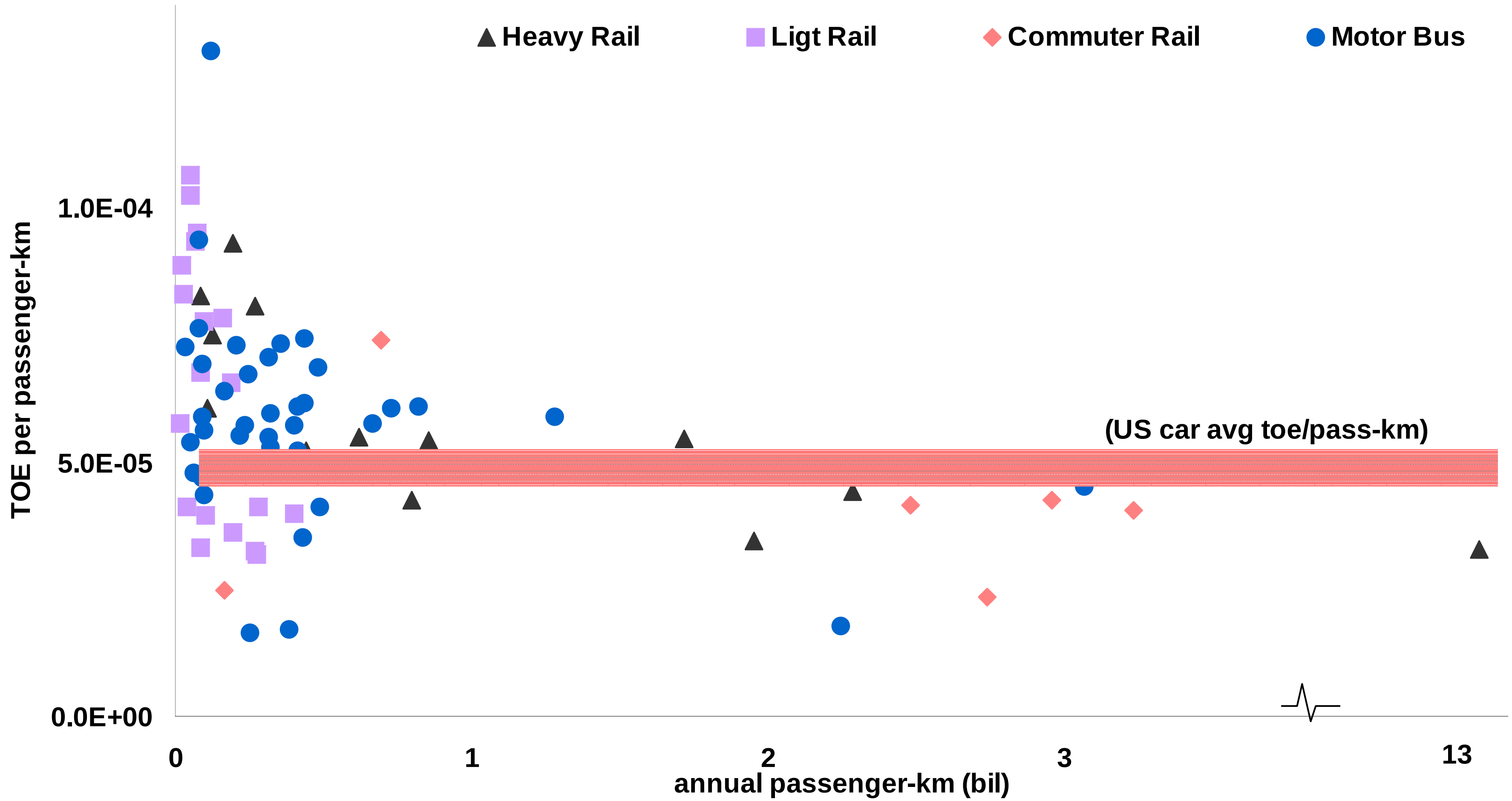
Cities in Group III are at the early stage of development.



(Source) APERC Analysis (2007)

Transport Energy Intensities in the US Cities (Average 2002 and 2005)

Energy Requirements to Produce Electricity for Rail/psk vs Bus/Car Energy/psk



(Source) APERC Analysis (2007) based on data from National Transit Bureau

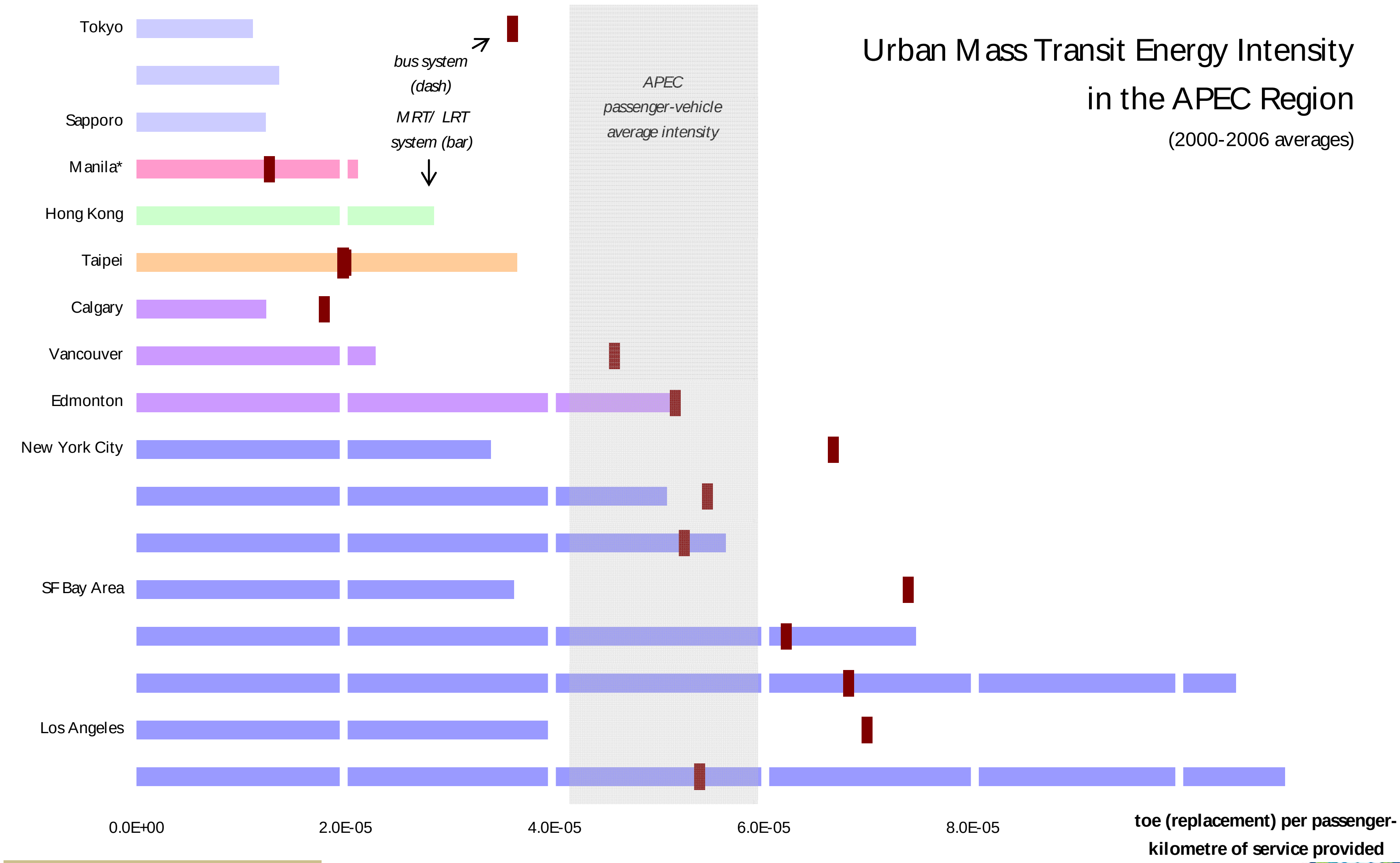
(Note) Energy intensities for heavy rail, light rail and commuter rail represent energy requirements to produce electricity for a unit of passenger km.

Findings from the phase II

Study Objectives in the Second Phase

- To analyse energy/CO_2 intensities of urban mass transits in the major APEC cities
- To analyse financial performance of mass transits
- To quantify socio-economic benefits of mass transits
- To analyse the institutional issues in developing urban mass transits

Urban Mass Transit Energy Intensities in the APEC Region



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(Source) APERC Analysis (2008)

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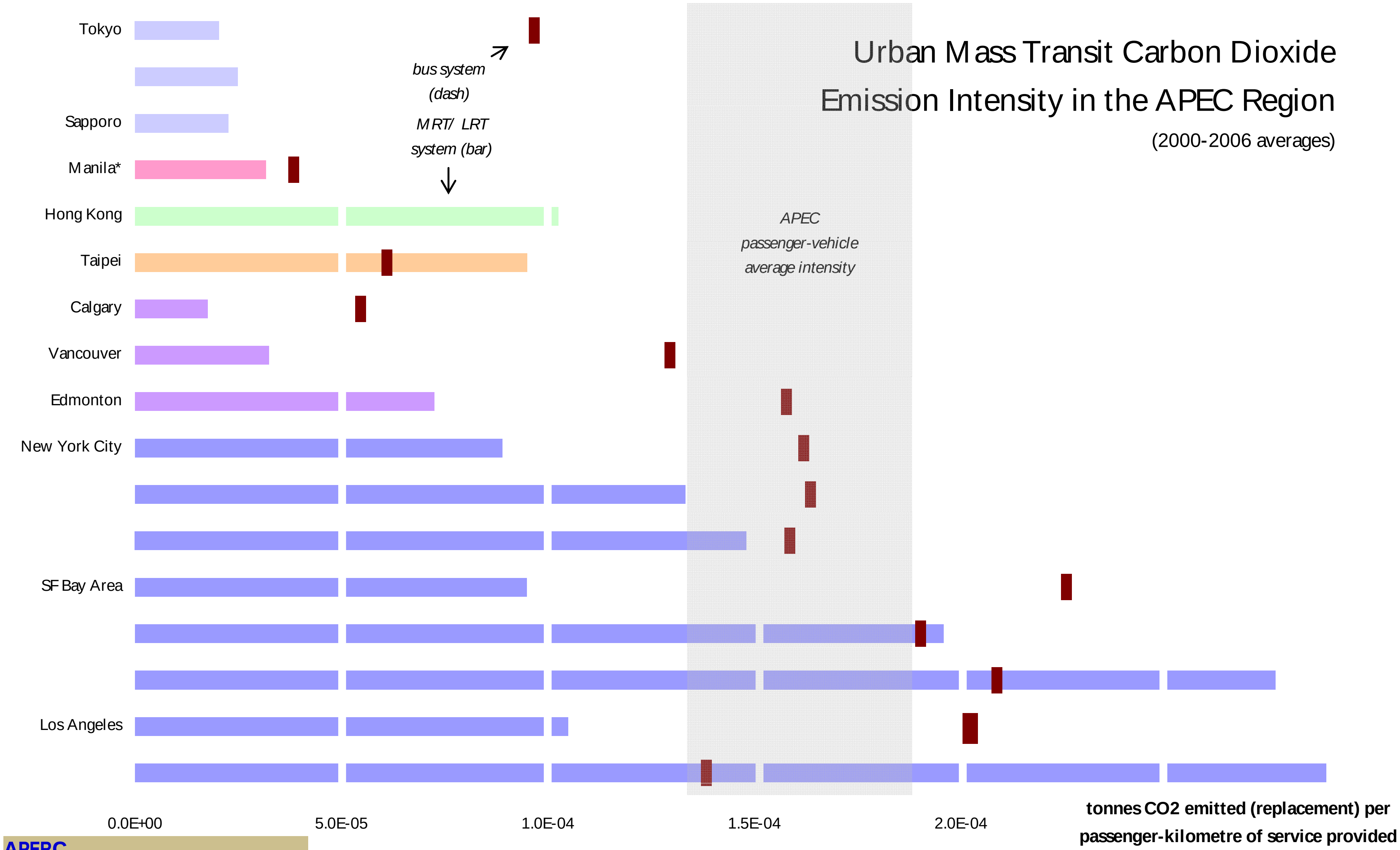
Urban Mass Transit CO_2 Intensities in the APEC Region



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(Source) APERC Analysis (2008)

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Urban Mass Transits – Characteristics by Mode

	Metro	Light Rail	Suburban Rail	Bus Rapid Transits
Initial Capital Cost (Million US$/km)	15-30 at-grade 30-75 elevated 60-180 underground	10-30	-	1-5
Capacity (Passenger/hour/direction)	60,000	10-12,000	30,000	10-20,000
Operating Speed (km/hour)	30-40	20	40-50	17-20
Construction Time (Years)	10 Years for 19km Line	-	-	-

Risks affecting Mass Transit Projects

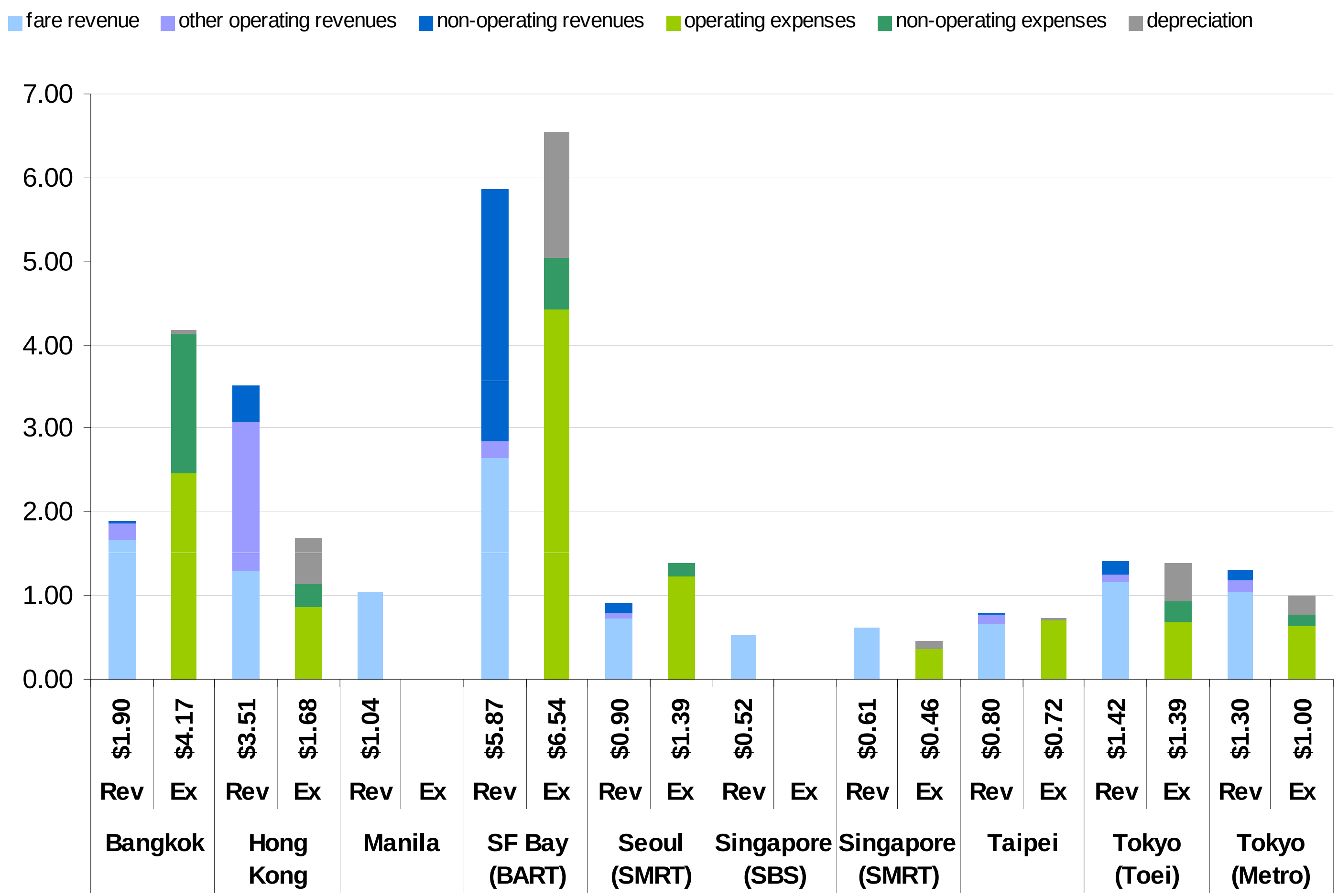
- Cost overrun during construction period
  - Unexpected ground conditions
  - Rise in material and equipment costs
  - Disruption in financial and labour supply
- Lower number of passengers than expected
  - Planners tend to produce overly optimistic passenger numbers
    - Real ridership of mass transits in Asia (Bangkok, Manila and KL) in the first year – about 25 percent of forecast
- Currency risk
  - Financial crisis in Asia -> huge debt repayment problem

Financial Performance of Major Rail Systems

Generally, fare revenue does not cover the expenditure.

Hong Kong, Taipei, Tokyo systems add extra revenue through business diversification.

Revenue and Expenditure per Capita in 2006 (Unit: USD, PPP)



(Source) APERC Analysis (2008)

Costs and Benefits of Mass Transits

- Costs
  - Capital investment
  - Operational cost
  - Interest payment

- Benefits
  - Energy saving
  - CO_2 emissions saving
  - Time saving
  - Vehicle operational cost saving

Costs and Benefits of Mass Transits – Framework of the Analysis

Macro Economic Assumptions by 2030 (GRP, Population)

Provision of Mass Transit's Target Share in Modal Split (2030)

Passenger Demand (person-trip, person-km)

Infrastructure Requirements (Length)

With *Mass Transits Case*

- Energy
- CO2 Emissions
- Time
- Vehicle Use

Without *Mass Transits Case*

- Energy
- CO2 Emissions
- Time
- Vehicle Use

Capital Investment

Operational Costs

Ticket Price

Net Savings ×Monetary Value

Economic Internal Rate of Return (EIRR) and Financial Internal Rate of Return (FIRR) Estimation

Basis for Simulation Exercise

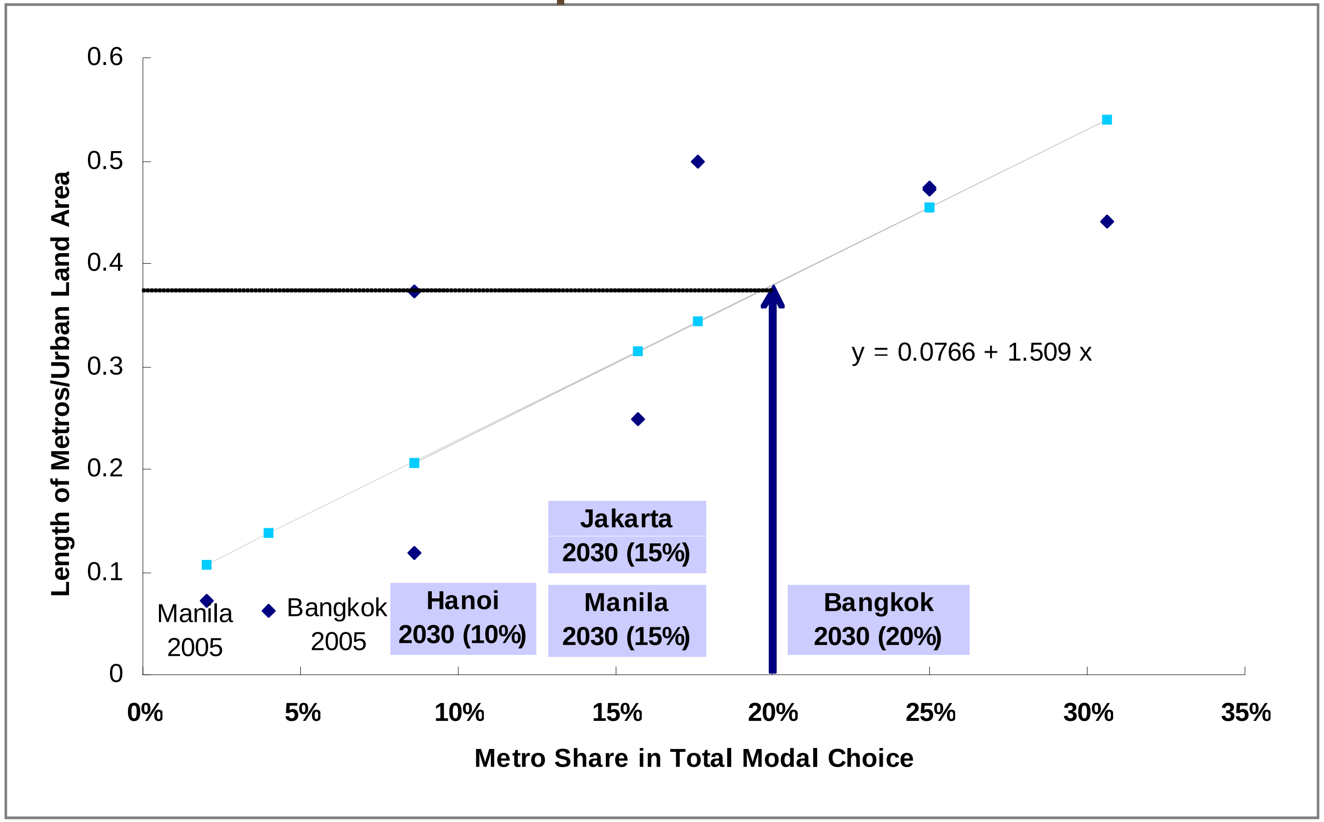
Infrastructure requirements are estimated based on the following equation.

Y = 0.0766 + 1.509 X

Y: Length of metro/urban land area

X: Metro Share in Modal Split

Mass Transits Modal Share in 2030 and Infrastructure Requirements



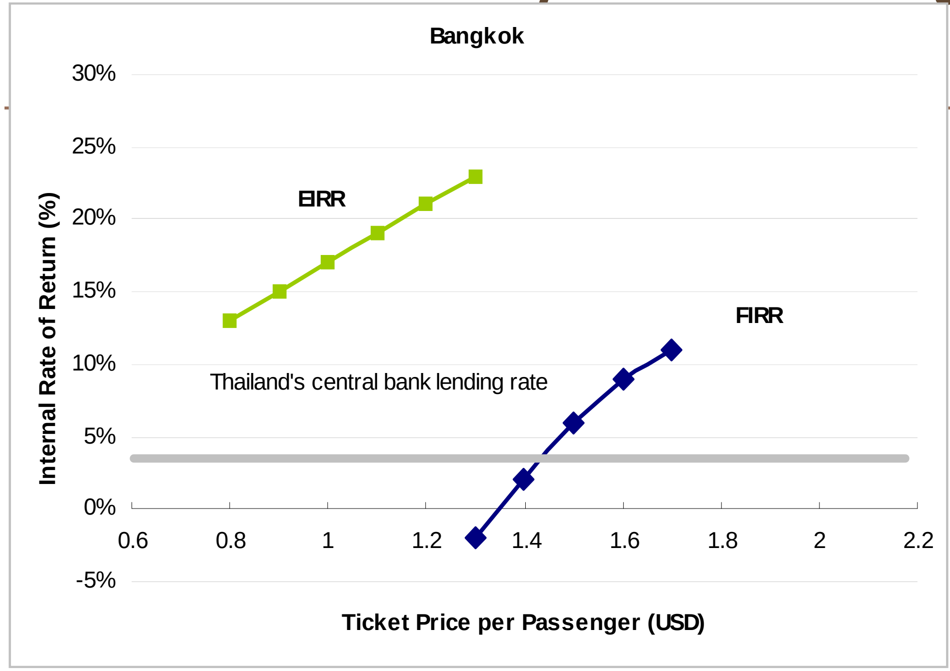
(Source) APERC Analysis (2008)

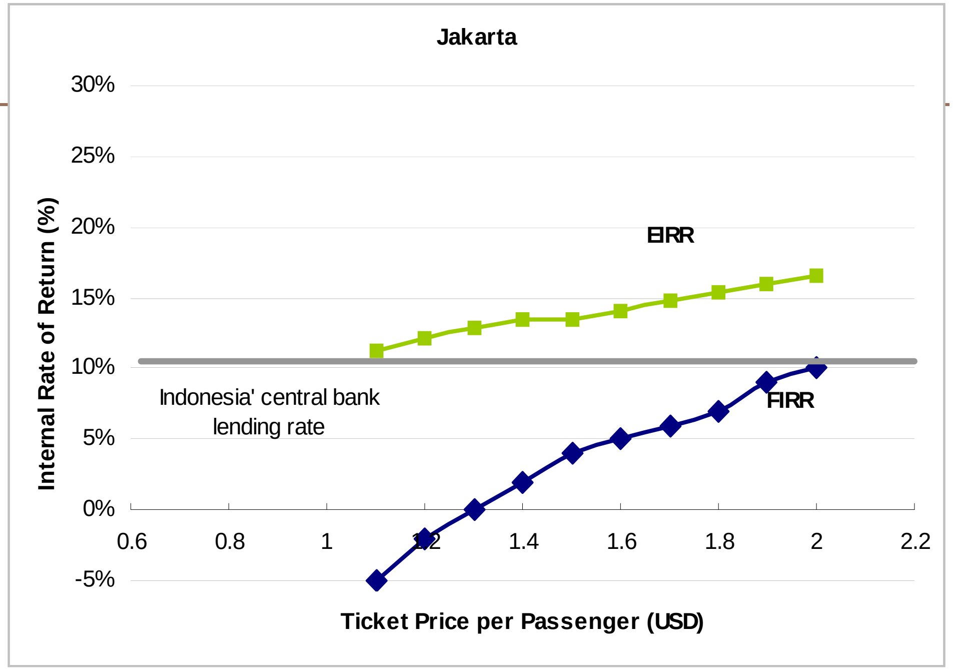
Basic Assumptions

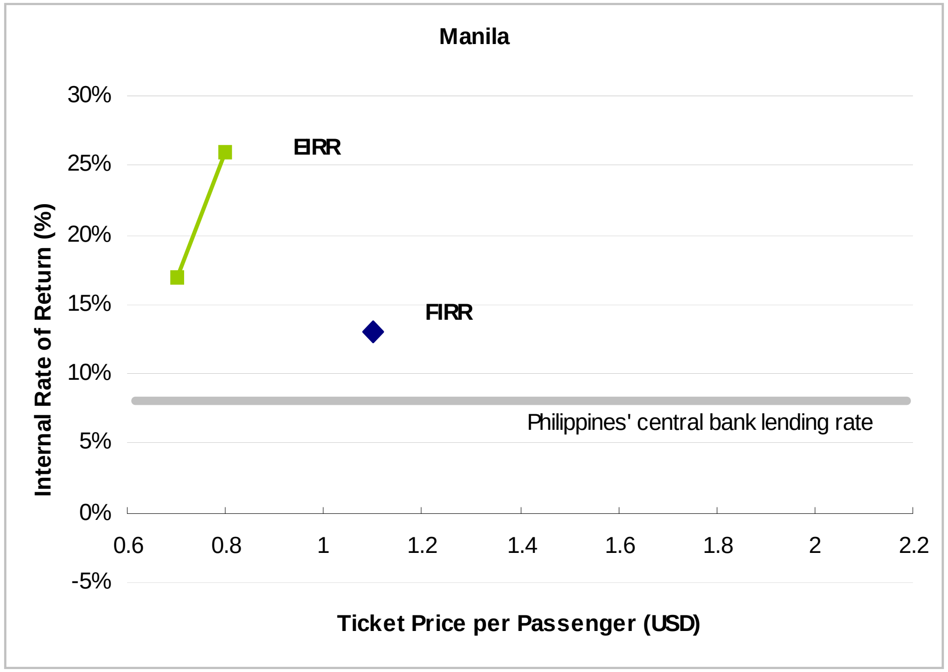
	Bangkok		Hanoi		Jakarta		Manila	
	2005	2030	2005	2030	2005	2030	2005	2030
Target Metro Share in Modal Split [%]	4%	20%	0%	10%	1%	15%	2%	15%
Metro Length [km]	43	197		108		132	46	137
Urban Land Area [km^2]	700		636		661		636	
Income [US$ PPP, 2000]	25,896	37,574	1,599	10,215	11,325	26,764	11,196	26,459
Urban Population [Million]	5.5	7.1	3.2	7.0	8.4	9.6	10.9	11.2

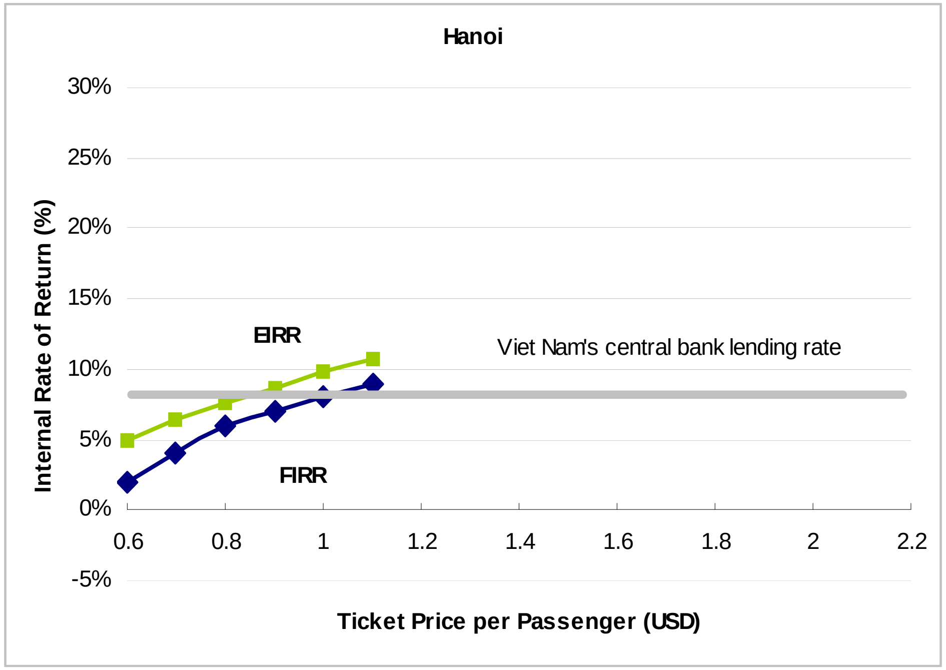
(Source) APERC Analysis (2008)

EIRR/FIRR Comparisons – Bangkok, Jakarta, Manila and Hanoi

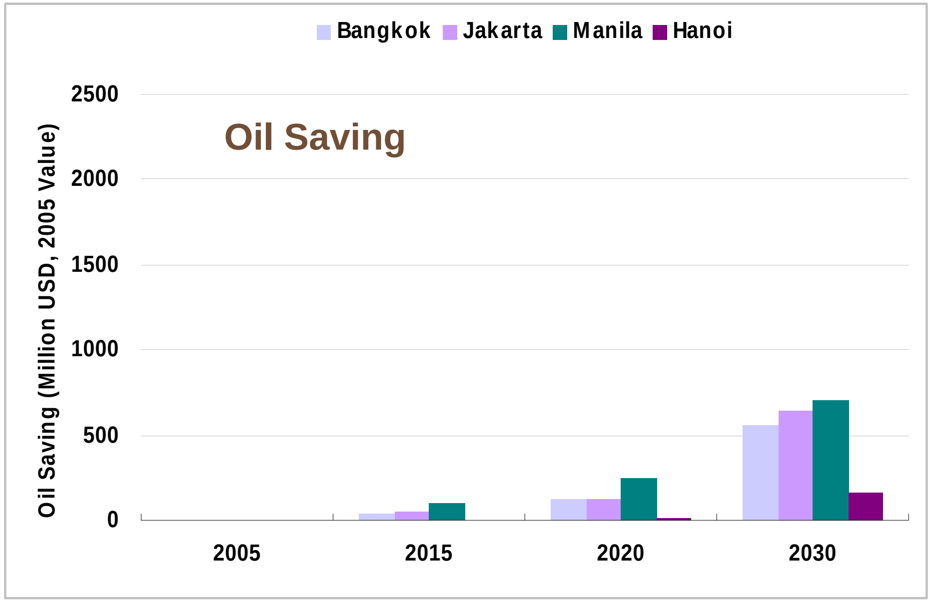


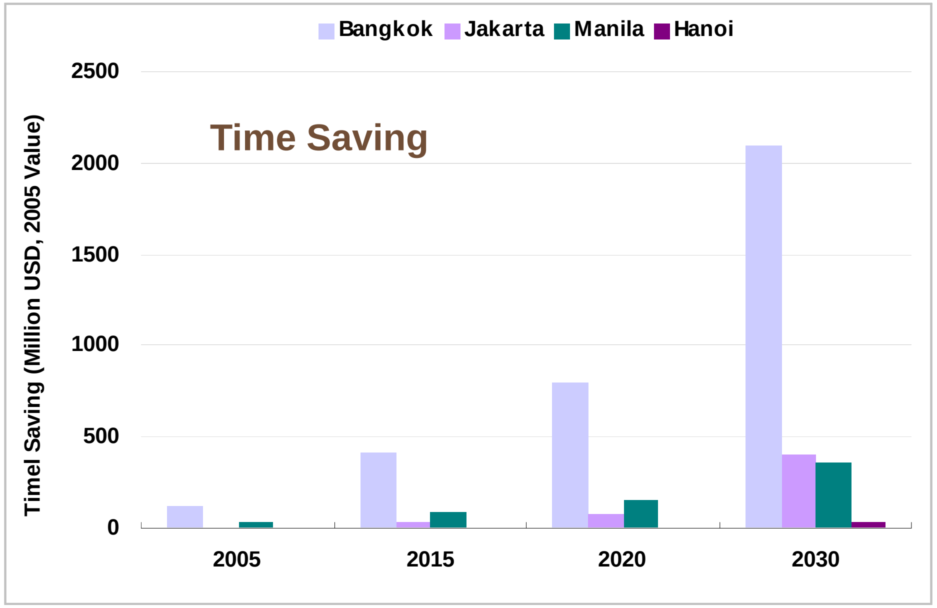


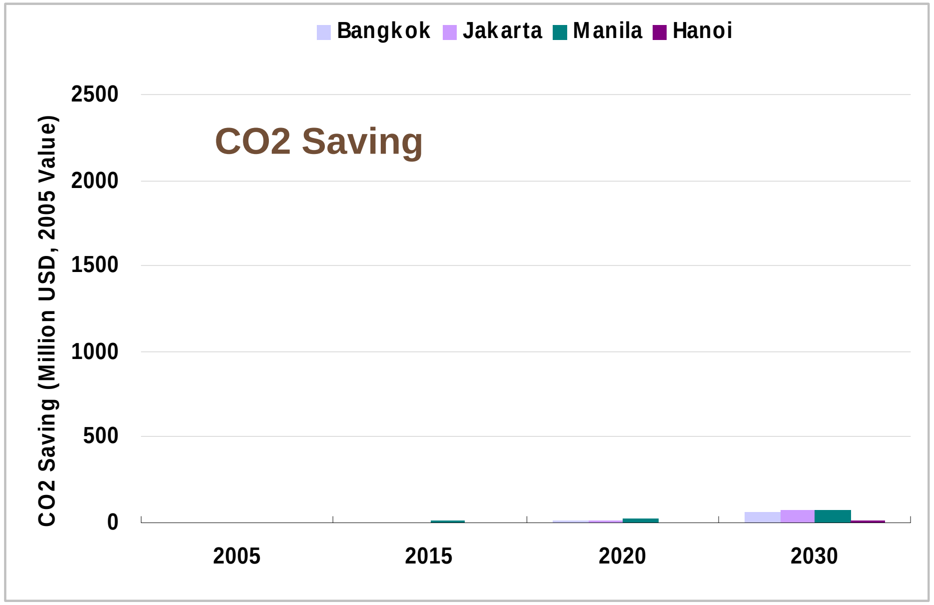


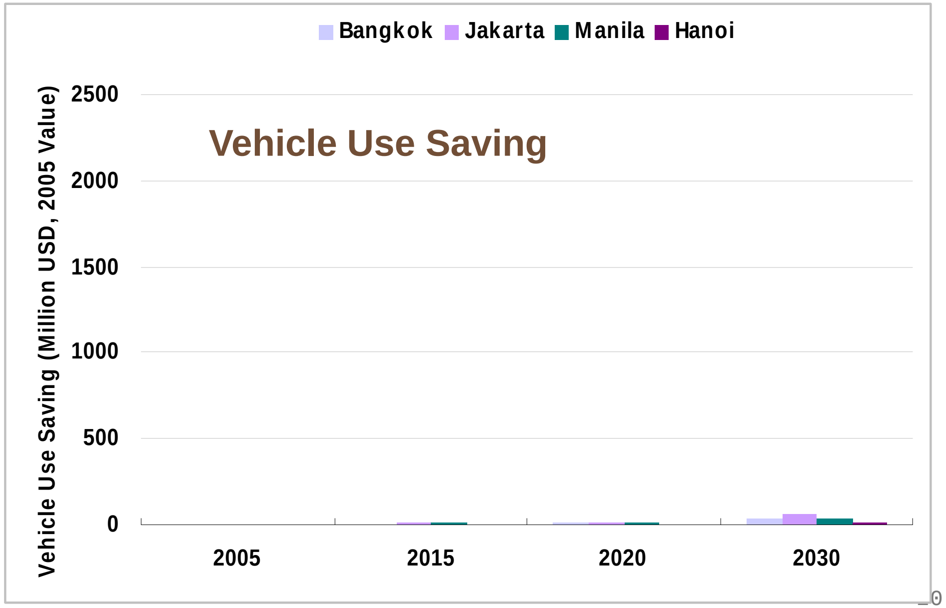


Net Savings Comparison – Bangkok, Jakarta, Manila and Hanoi



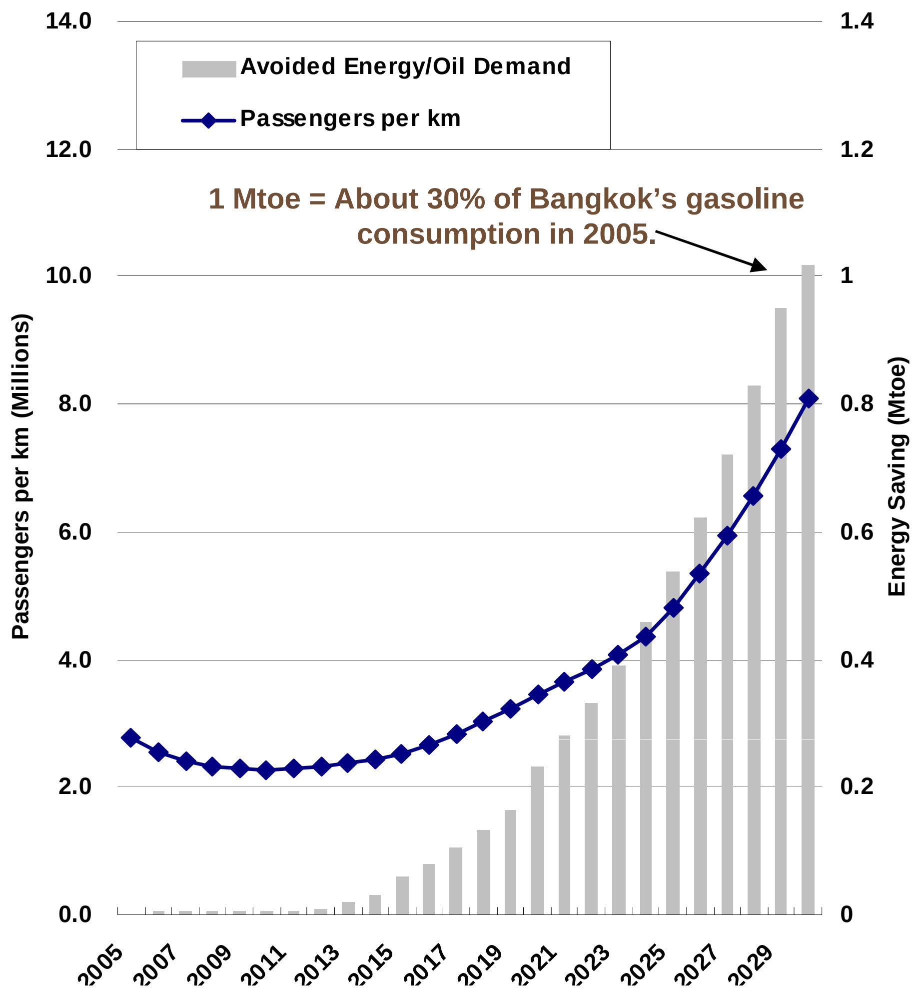




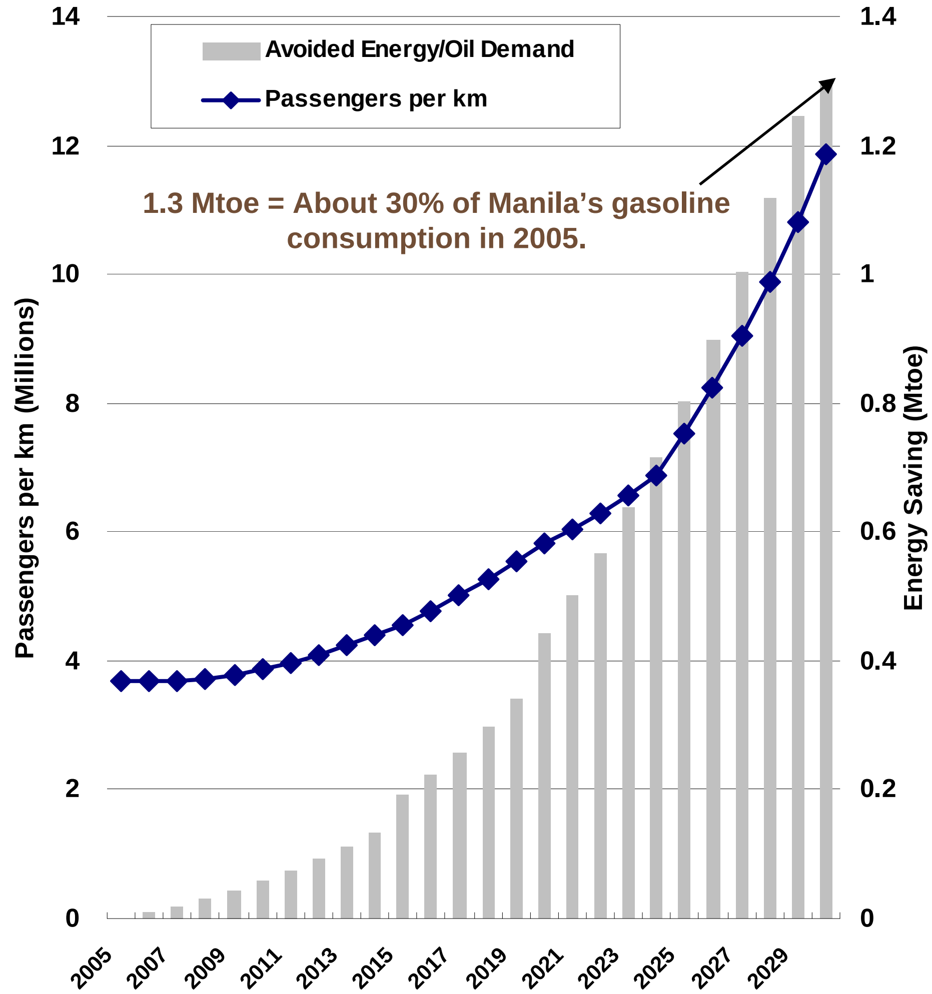


Passenger per km and Oil Saving (Mtoe) – Bangkok and Manila

Bangkok (Metro Share Target: 20% in 2030)



Manila (Metro Share Target: 15% in 2030)



Densely populated cities have a big potential to save energy.

Institutional Issues

- Jakarta
  - Lack of coordination between different bus systems
- Manila
  - Weak coordination among the government agencies on transport
    - Central level
    - Central – Local levels
      - Various agencies compete for a same project

Conclusions - 1

- Urban mass transits can serve as an effective tool to improve energy intensity of urban transport, and to reduce CO_2 emissions. However, mass transits' energy/CO_2 intensities within APEC cities vary greatly.
  - Ridership – Urban density, operational frequency and infrastructure accessibility
  - Power generation characteristics – thermal efficiency, and generation mix
- Planners and transit operators need to make efforts to increase ridership to fully realise the mass transit's effectiveness in terms of energy/CO_2 intensity improvement.
  - System frequency, intra-system *physical* integration and *fare system* integration
- Despite the perceived benefits of mass transit systems, their financial performance tends to be low. Again, efforts are necessary to increase ridership, and government assistance is necessary to help support the financial aspect.
  - Subsidy
  - Low interest rate

Conclusions - 2

- Change in lifestyle – away from passenger vehicle dependence to mass transits –takes long time, typically requiring two decades.
  - Planning, pre-feasibility study, feasibility study and construction
- Earlier implementation of mass transit project may lead to bigger socio-economic benefits from the savings for time loss, energy use, CO_2 emissions and vehicle use costs.
- In addition, higher income cities with higher population density may enjoy larger socio-economic benefits.
- Therefore, planners need to assess the appropriate timing for introducing urban mass transits, and the appropriate mass transit modes based on the city context.
  - Economic development and density
- Planning for urban transport should be an integral part of energy and environmental policy.
  - Inter-agency coordination