

## Comparison of Bus Rapid Transit System Introduction Effects in Asian Developing Cities -Bangkok, Thailand and Hanoi, Vietnam-



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## 1. Introduction

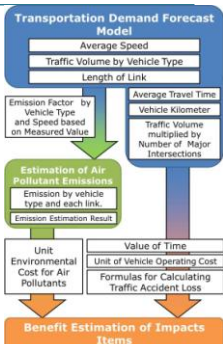
- Asian Developing Cities
  - Car ownership has been increasing: Traffic problem and global warming
  - To cope with these problem, Idea has introducing Bus Rapid Transit system
- Bus Rapid Transit (BRT) system
  - becoming increasingly attracting attention as eco-friendly transportation, especially in developing cities
  - operated as rail-based transportation
- Effect of BRT introduction should be numerically estimated.
  - This study focuses on Measuring BRT effect that
    - amount of reductions of GHG emission roadside emission
    - those benefits



## 2. Methodology

### 2.1 Estimation Process

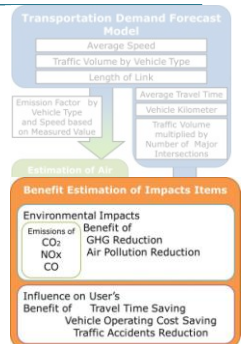
- Transportation Demand Forecast
  - To estimates
  - Whole city network
  - With/without BRT Introduction
  - Transportation demand
- Air Pollutant Emissions
  - Average speed→Emission Factor
  - Traffic volume by vehicle type
  - Link length
- Benefit Estimation
  - Unit of environmental cost
  - Unit for User's benefit



## 2. Methodology

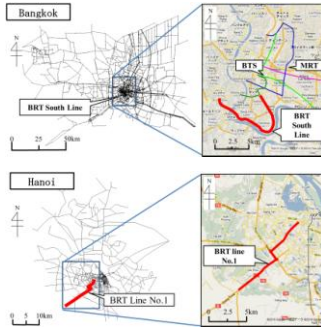
### 2.2 Estimation of Emission and Benefit

- Transportation Demand Forecast
  - By using Transportation Demand Forecast Model
  - BRT service level or Demand shift from car to BRT
- Air Pollutant Emissions
  - Emissions = Length\*Volume\*EF
$$E_{k,i,m} = D_k \times Q_{k,i} \times Ef_{k,i,m}(v_{k,i})$$
- Benefit Estimation
  - CO<sub>2</sub>: \$20 per ton
  - NOx, CO: Result of India case
  - Time Value, Operating cost: Thailand case value
  - Traffic Accident: Japan case



### 3. Study Area

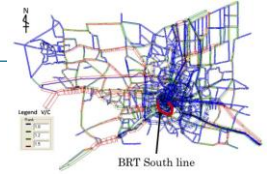
- Bangkok
  - Population: 12 million
  - Based on TDMC3 developed by OTP
  - 1521 zones
  - BRT South line
- Hanoi
  - Population: 3.2 million
  - Based on HAIDEP developed by JICA
  - 313 zones
  - BRT line No.1



### 4. Estimation Results

#### 4.1 Bangkok Case

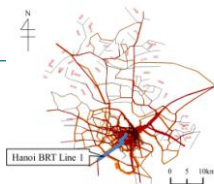
- BRT South line
  - Total length 15.9 km
  - Whole city network
- Estimation results
- Transportation Demand
  - Average speed: Increase 0.05 km/h
  - Total vehicle km, Total in-vehicle hours: Decrease
- Emissions Reduction
  - CO<sub>2</sub>, NO<sub>x</sub>, CO emissions reduction rate: 1% or less
- Benefit
  - User's benefit: large proportion of total benefit
  - Environmental benefit: CO<sub>2</sub> > NO<sub>x</sub> > CO



### 4. Estimation Results

#### 4.2 Hanoi Case

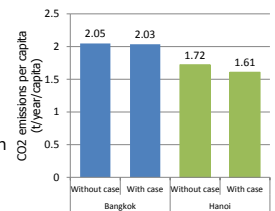
- BRT line No.1
  - Total length 13.25km
  - Whole city network
- Estimation Results
- Transportation Demand
  - Average speed: Increase 0.03 km/h
  - Total vehicle km, Total in-vehicle hours: greatly-reduced (Traffic volume decrease, average speed increase)
- Emissions Reduction
  - CO<sub>2</sub>, CO emissions: decrease, NO<sub>x</sub>: increase
  - NO<sub>x</sub>: Increasing by shift from motorcycle (small EF) to BRT
- Benefit
  - User's benefit: large proportion of total benefit



### 5. Comparison of Bangkok and Hanoi

#### 5.1 Population

- Benefit ratio
  - User's benefit account for the large portion of benefit
- Monetary term unit of air pollution
  - NO<sub>x</sub> is higher than other air pollutant substances
  - CO<sub>2</sub> 20.0 \$/ton
  - NO<sub>x</sub> 1863.8 \$/ton
  - CO 0.8 \$/ton
- Emissions Reduction by population
  - Population
  - Bangkok: 12 million
  - Hanoi: 3.2 million
  - CO<sub>2</sub> emission
  - Bangkok is higher than Hanoi



## 5. Comparison of Bangkok and Hanoi

### 5.2 Differences of Benefit and Reduction Rate

#### □ Differences of Benefit and Reduction Rate

##### ➢ CO2 and CO emissions

- Significantly reduced by BRT introduction
- CO emissions in Hanoi reduced by 23%

	CO2	NO <sub>x</sub>	CO
Bangkok	0.63%	0.45%	1.08%
Hanoi	6.68%	-4.34%	23.05%

##### ➢ User's benefit differences

- Travel time saving of Hanoi bigger than Bangkok

Urban area	Travel Time Saving	Vehicle Operating Cost Saving	Traffic Accidents Reduction
Bangkok	0.74%	0.60%	0.80%
Hanoi	5.10%	3.83%	16.04%
<b>BRT line</b>			
Bangkok	2.40%	0.43%	1.71%
Hanoi	10.80%	-218.04%	-31.91%

## 6. Conclusion

#### □ From Estimation Results

##### ➢ This study clarifies that

- Air pollutants emissions change
- User's benefit and environmental benefit
- BRT introduction effect by urban scale(Bangkok, Hanoi)

##### ➢ These comparison are

- provide a good indication of public transport introduction
- From now on, it will be comparing and clarify the impact of BRT introduction in some city
- Emission factor unit and monetary term unit has not yet been fully developed  
→It is necessary to consider.

**Thank you for your attention!**

**御清聴ありがとうございました**