Kyushu University Platform of Inter- / Transdisciplinary Energy Research

KYUSHU UNIVERSITY

# Quantifying Co-benefits in Asia: Models and Applications

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ASIA-PACIFIC NETWORK FOR GLOBAL CHANGE RESEARCH

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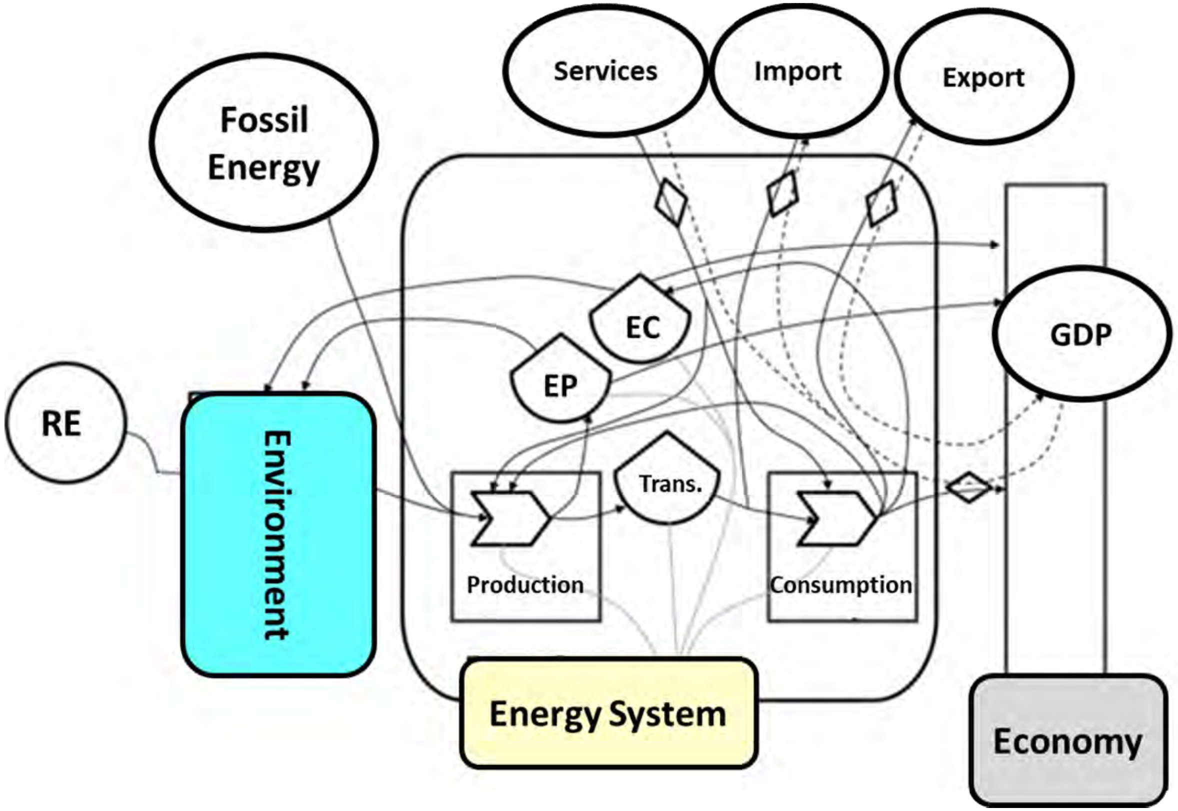
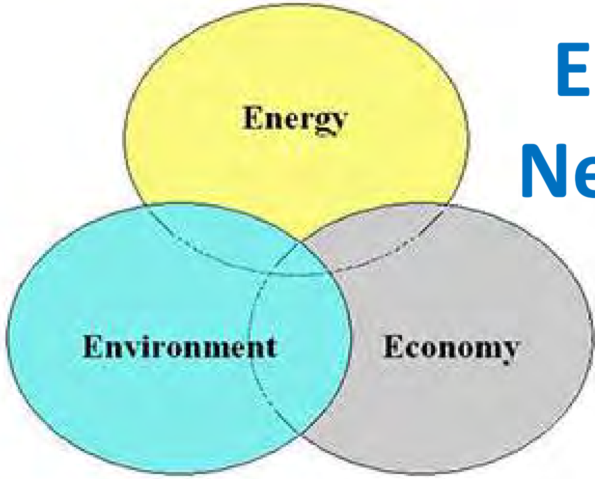
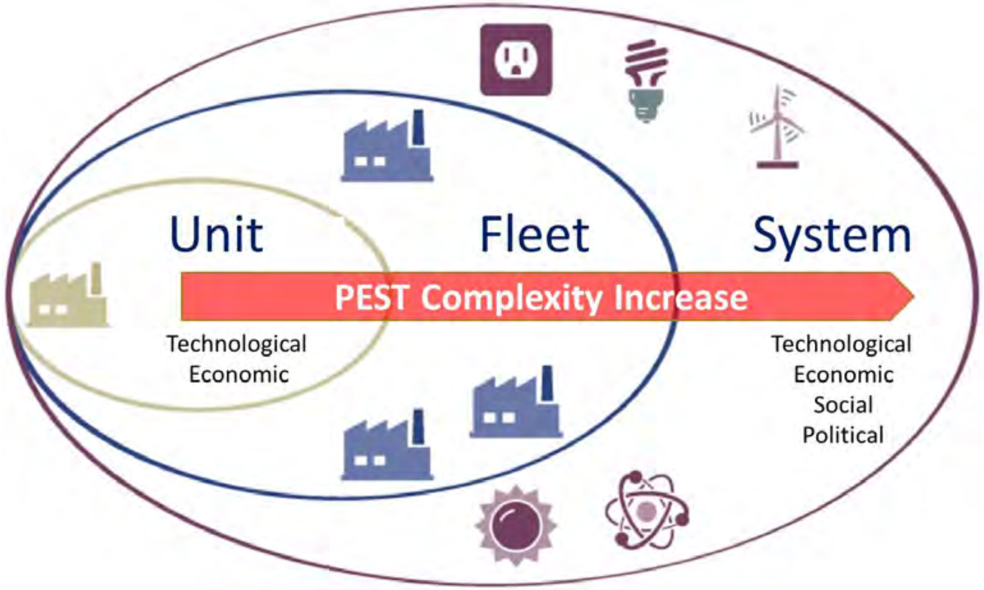
# Why Multiple Impacts Assessment?



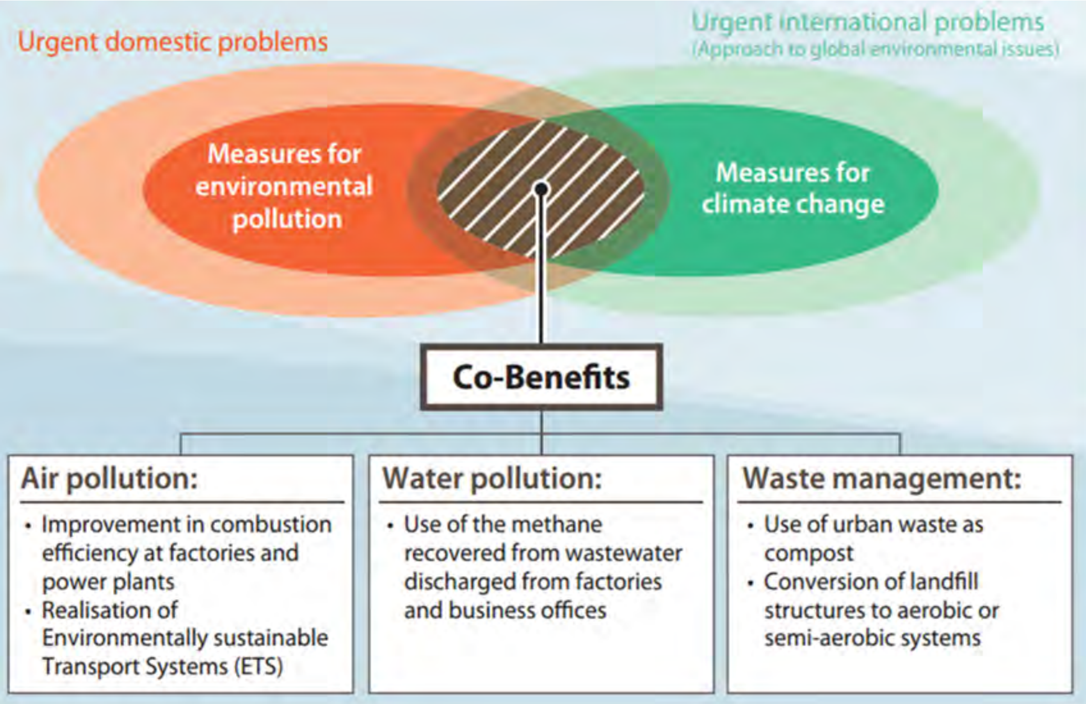

Energy and Complexity




EEE Nexus



# Co-benefits Approach




Addressing **climate change concerns** while also improving the **local benefits.**


Linking **climate change mitigation** to the achievement of **sustainable development** in the economic systems.

# Tools for Planning Urban Co-benefits

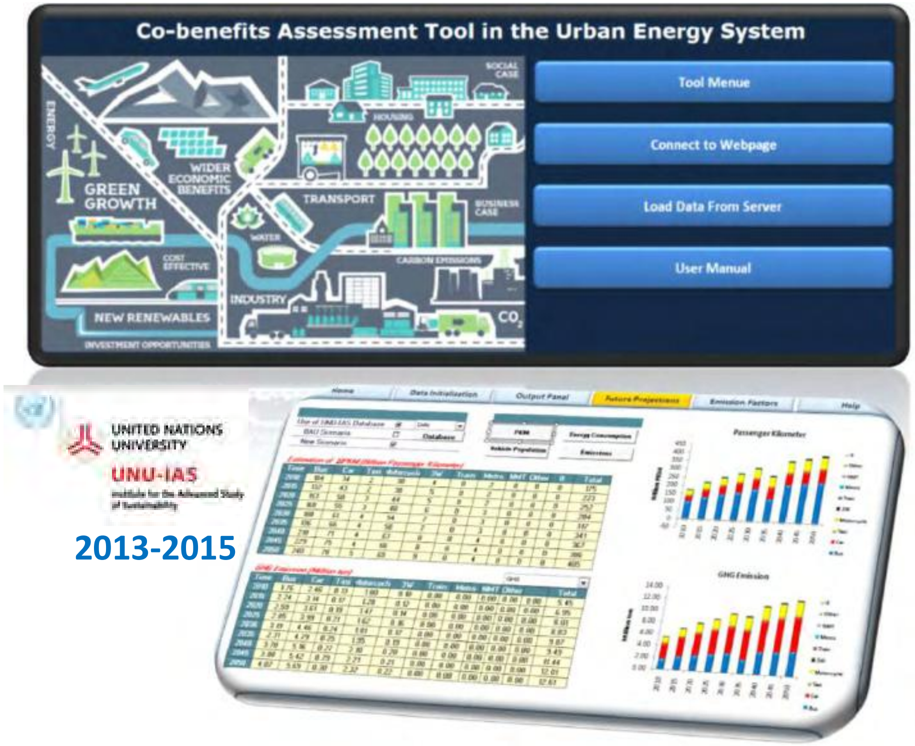
## Avoid-Shift-Improve

| Avoid | Shift | Improve |
|---|---|---|
| Reduce the need for energy or avoid polluting the air | Shift to clean alternative energy sources | Improve the efficiency of technology |
| Improve the overall efficiency of system | Improve the efficiency of the supply side | Improve the efficiency of the demand side |

Transport

Building

Waste

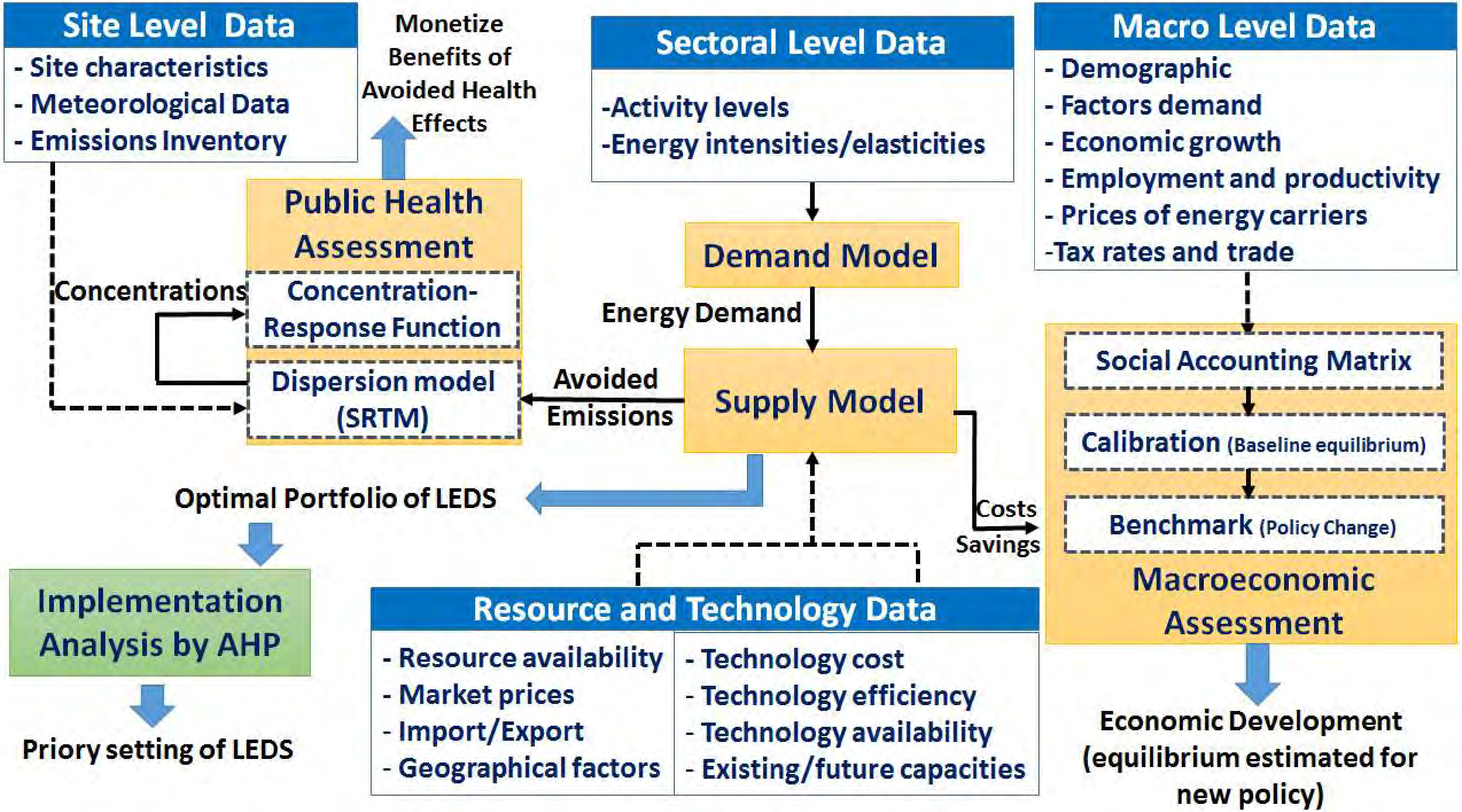



**Transport**
- ✓ Travel activity
- ✓ Mode share
- ✓ Fuel efficiency
- ✓ Fuel Type

**Building**
- ✓ Dwelling sizes
- ✓ End user tech & appliances
- ✓ Energy sources

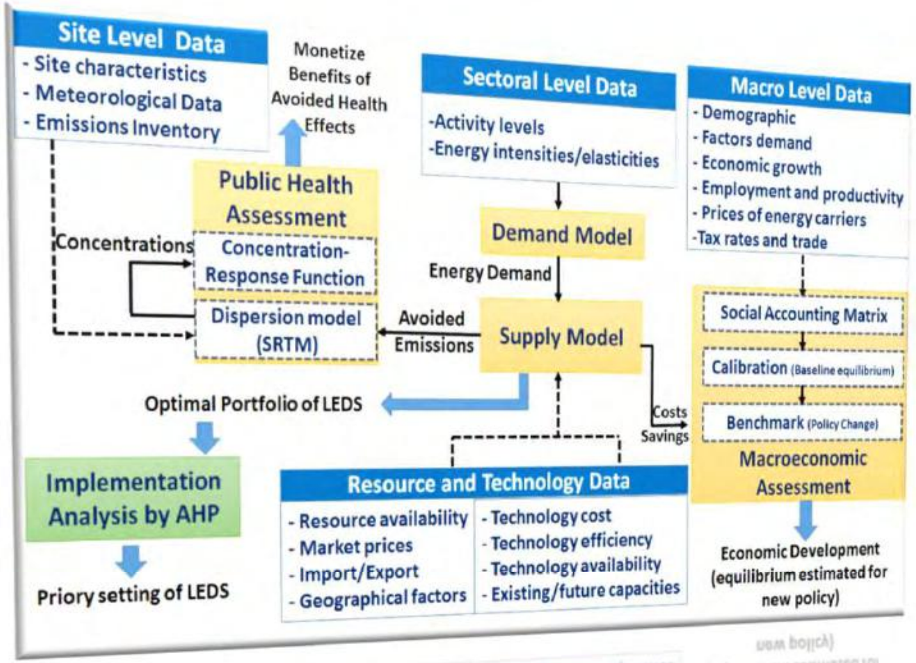
**Waste**
- ✓ Waste generation, waste composition
- ✓ Waste processing method (compost, incineration..)
- ✓ Technology used within a processing method

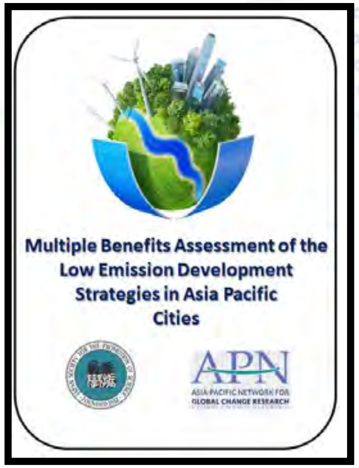
# Multiple Benefits Assessment Framework




Farzaneh et al., 2018

# Multiple Benefits Assessment Framework



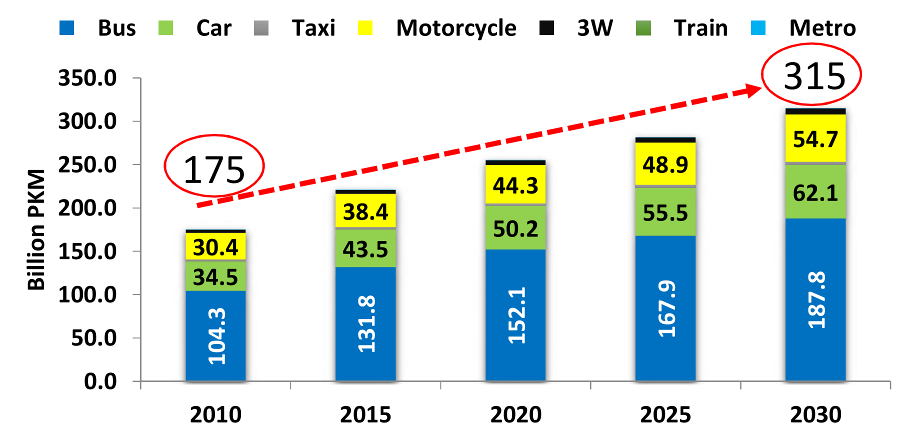


- **Need for Data**:
  - Macro level
  - Sectoral Level
  - Site Level
- **Need for the interdisciplinary studies**:
  - Engineering Sciences
  - Programming and Software
  - Economics (Micro and Macro)
  - Public Health Science
  - Environmental Science

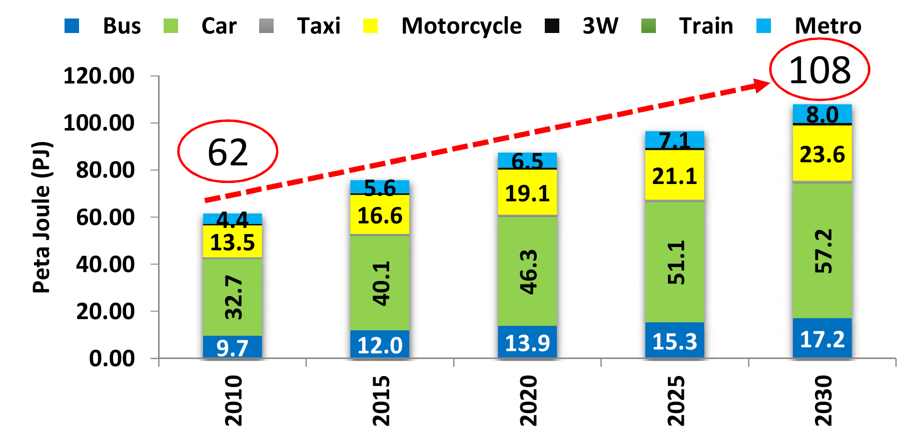
# Case of Delhi, India (Baseline Scenario)

## Examine initial baseline

**Transport**

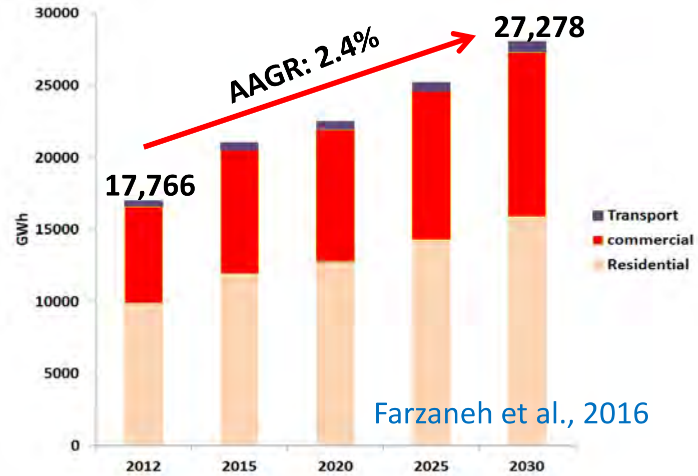



Farzaneh et al., 2018

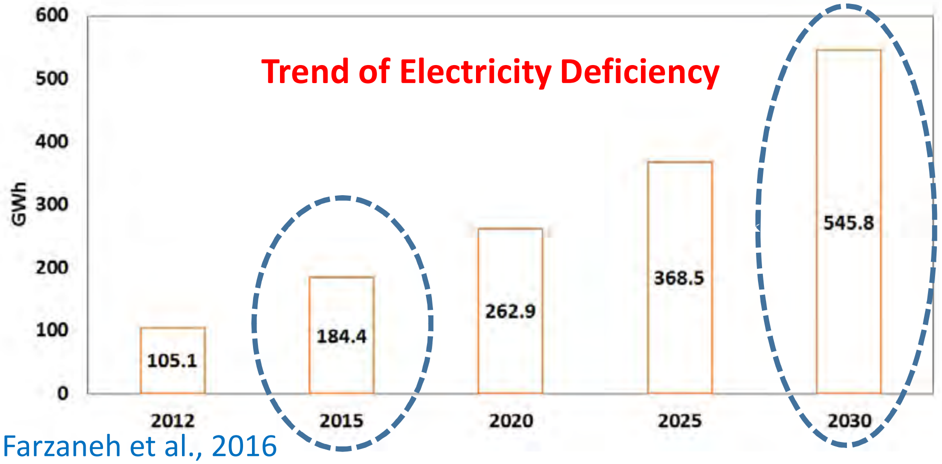



Farzaneh et al., 2018

**Electricity**




Farzaneh et al., 2016




Farzaneh et al., 2016

# Case of Delhi, India (Clean Energy Scenarios)

## Transport sector

### Promotion of fuel efficiency


### Promotion of Battery Operated Vehicles/ EVs

| No. | Type of Vehicles | Cost of Vehicles (base price) | Subsidy given by Govt. of Delhi (in Rs.) |
|---|---|---|---|
| 1. | 4 Wheeler | Upto 5 lakhs | 30,000/- |
| 2. | 4 Wheeler | More than 5 lakhs | 1,50,000/- |
| 3. | 2 Wheeler | Upto 20,000/- | 1,000/- |
| 4. | 2 Wheeler | 20,001/- 25,000/- | 2,000/- |
| 5. | 2 Wheeler | More than 25,000/- | 5,500/- |

### Increase ridership in public transport

Rapid Metrorail Gurgaon with a total length of 11.7 kilometers serving 11 stations

## Energy sector

### Rooftop solar PV

2.5 GW using only 1.6% of the city's roof space

### W-t-E

8000 tonnes per day


65%

35%

**Current capacity**
Okhla & Timapour 16 MW

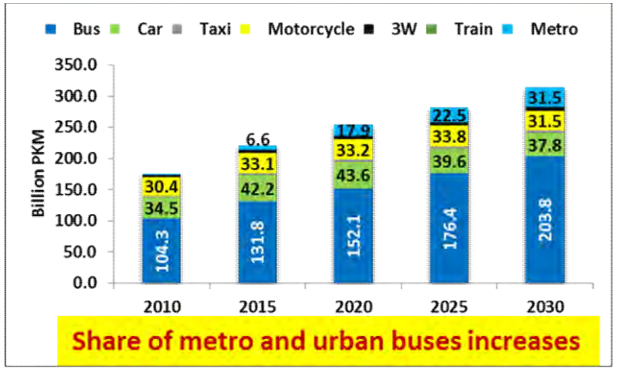
**Future plan**
Ghazipour 12 MW
Narela 12 MW

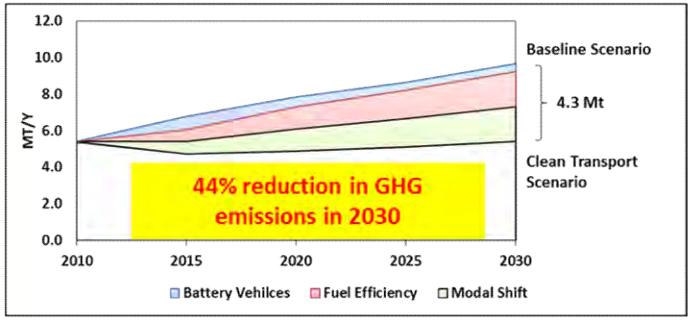
### Energy Efficiency

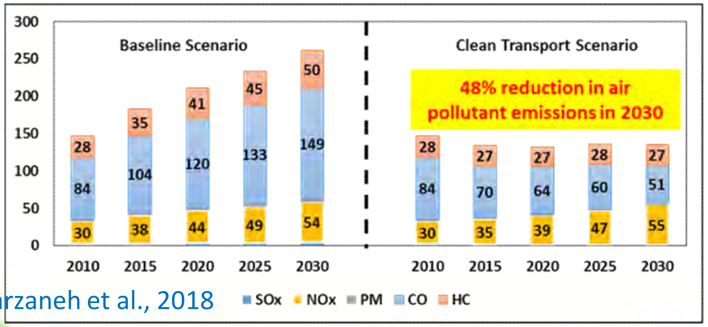
Replacing the regular lighting system in 3 million households with CFL

# Case of Delhi, India (Co-benefits)

## Clean Transport Scenario

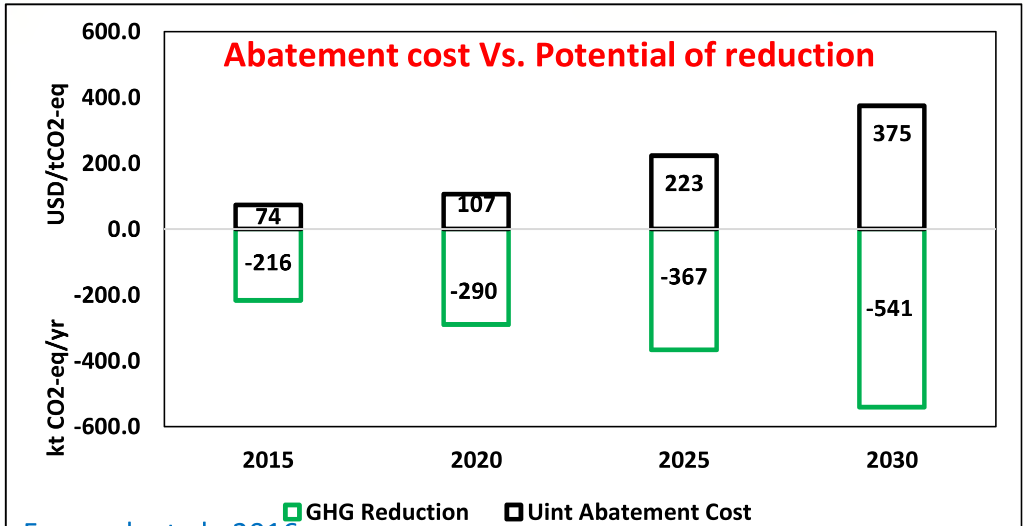


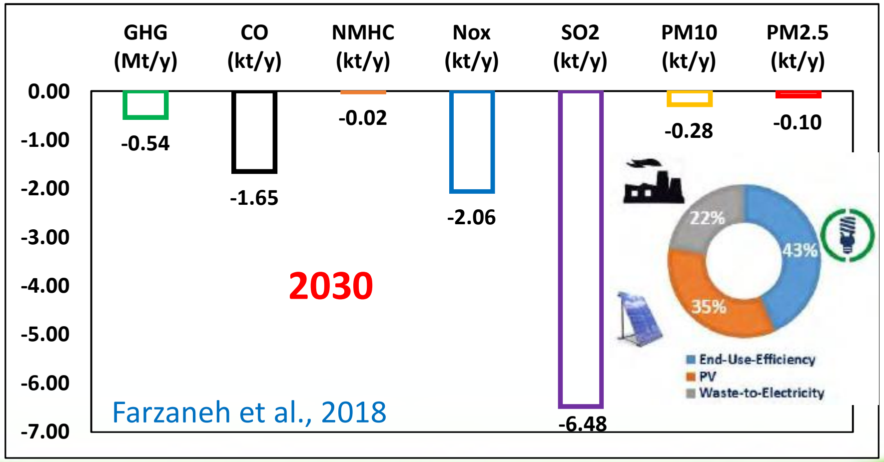




Farzaneh et al., 2018

## Zero Electricity Deficiency Scenario

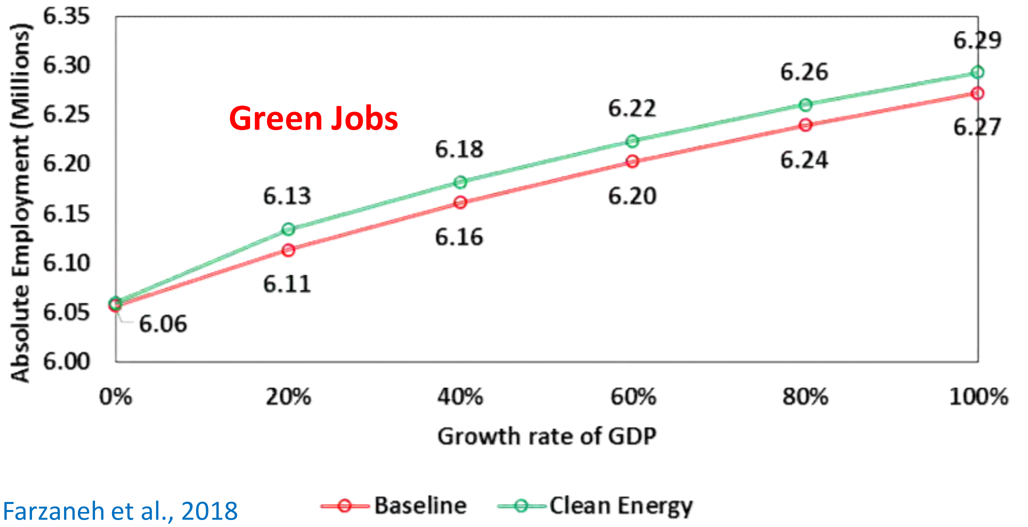



Farzaneh et al., 2016

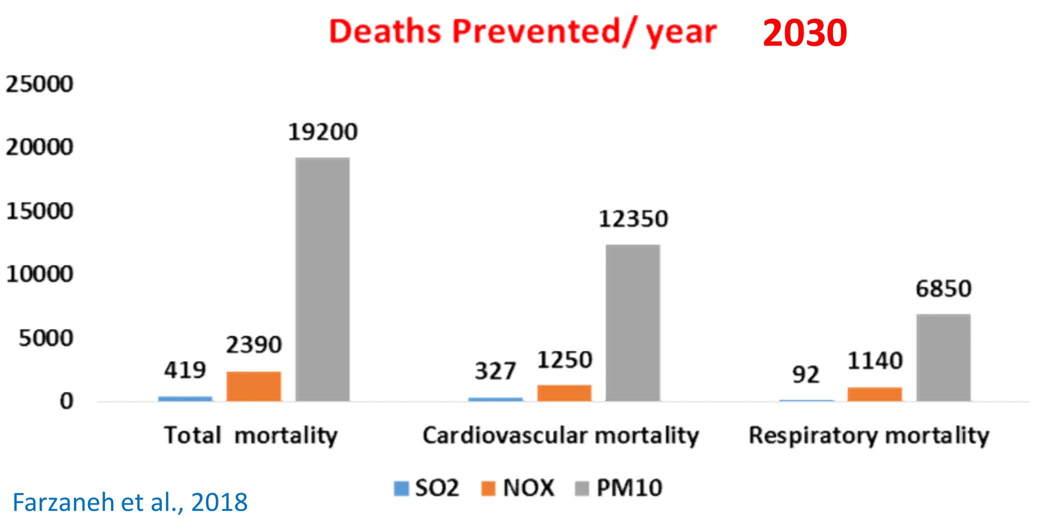



Farzaneh et al., 2018

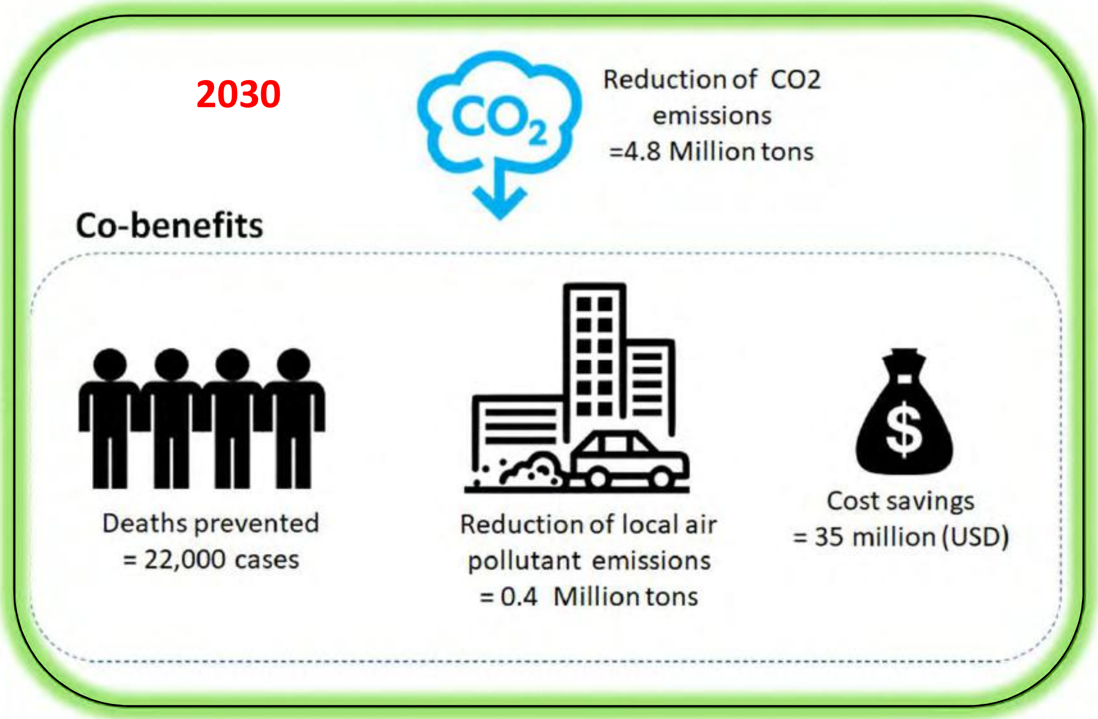
# Case of Delhi, India (Multiple benefits)



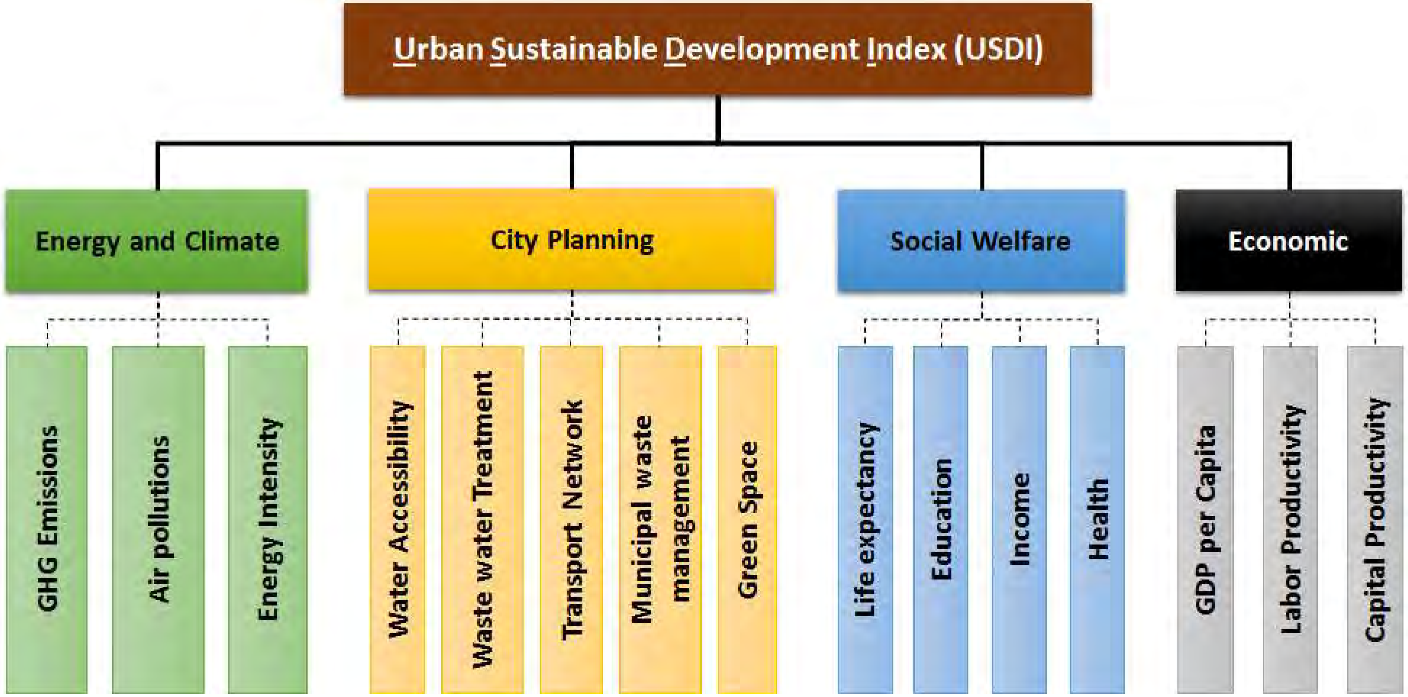

Farzaneh et al., 2018




Farzaneh et al., 2018



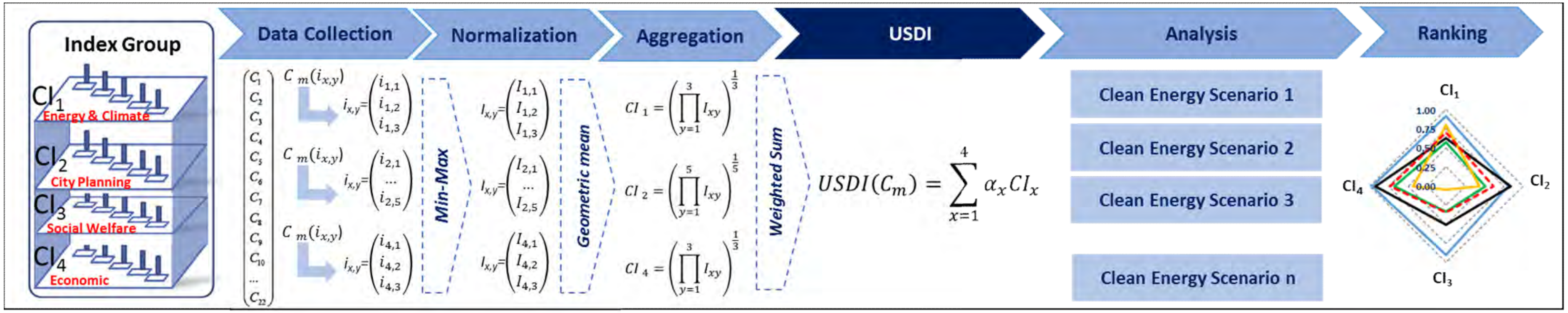
# Comparative Analysis




Farzaneh et al., 2018

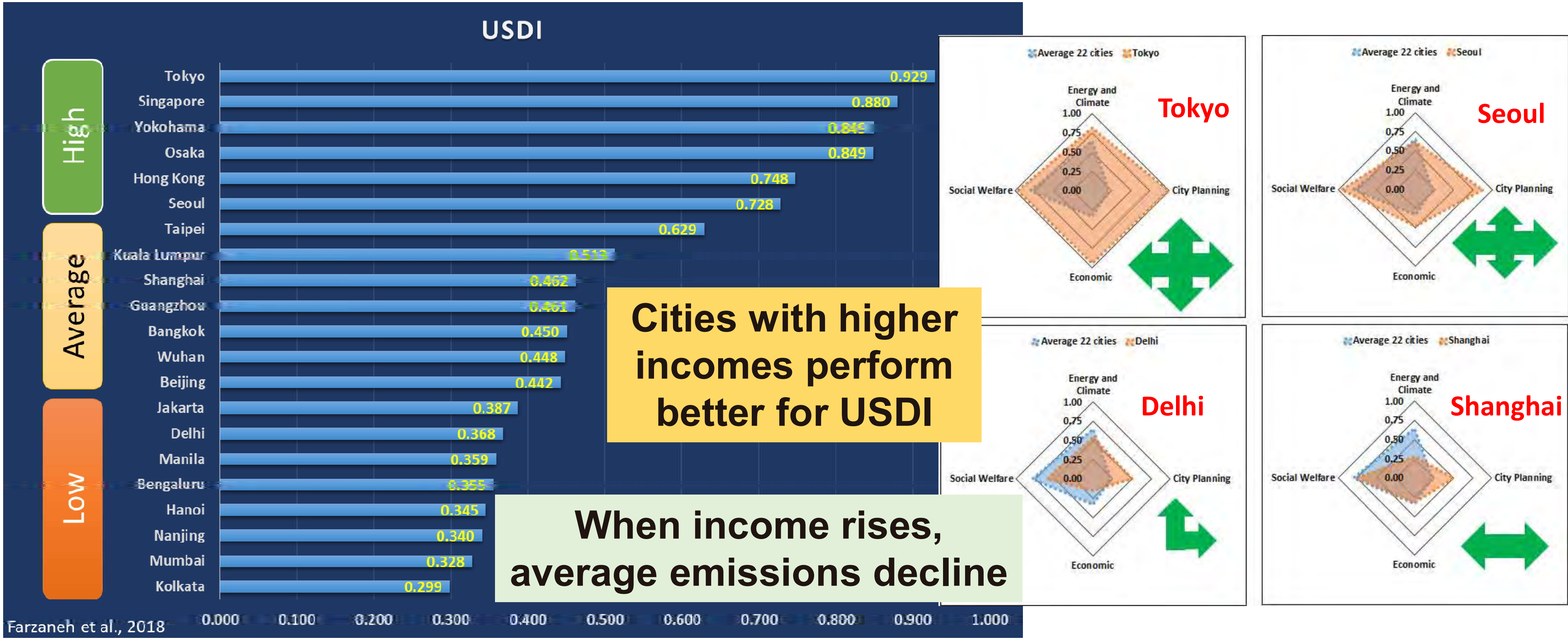
**Desk research on the environmental performance of Asia's major cities**

- Bangkok
- Beijing
- Bengaluru
- Delhi
- Guangzhou
- Hanoi
- Hong Kong
- Jakarta
- Karachi
- Kolkata
- Kuala Lumpur
- Manila
- Mumbai
- Nanjing
- Osaka
- Seoul
- Shanghai
- Singapore
- Taipei
- Tokyo
- Wuhan
- Yokohama




Adopted from: (Kılkıs,2015)

# Comparative Analysis




**Cities with higher incomes perform better for USDI**

**When income rises, average emissions decline**

**Tokyo performs reasonably well in USDI with almost equal share of different indicators**

# Case of Delhi, India (Impact Assessment )

**Before**

| | | City | USDI |
|---|---|---|---|
| High | 1 | Tokyo | 0.929 |
| | 2 | Singapore | 0.880 |
| | 3 | Yokohama | 0.849 |
| | 4 | Osaka | 0.849 |
| | 5 | Hong Kong | 0.748 |
| | 6 | Seoul | 0.728 |
| Average | 7 | Taipei | 0.629 |
| | 8 | Kuala Lumpur | 0.513 |
| | 9 | Shanghai | 0.462 |
| | 10 | Guangzhou | 0.461 |
| | 11 | Bangkok | 0.450 |
| | 12 | Wuhan | 0.448 |
| | 13 | Beijing | 0.442 |
| Low | 14 | Jakarta | 0.387 |
| | 15 | Delhi | 0.368 |
| | 16 | Manila | 0.359 |
| | 17 | Bengaluru | 0.355 |
| | 18 | Hanoi | 0.345 |
| | 19 | Nanjing | 0.340 |
| | 20 | Mumbai | 0.328 |
| | 21 | Kolkata | 0.299 |
| | 22 | Karachi | 0.264 |

**Clean Energy Development**

| | | |
|---|---|---|
| Energy and Climate | ↑ | 0.210 |
| City Planning | ↑ | 0.081 |
| Economic | ↑ | 0.012 |
| Health Index | ↑ | 0.050 |
| USDI | ↑ | 0.081 |

**After**

| | | City | USDI |
|---|---|---|---|
| High | 1 | Tokyo | 0.929 |
| | 2 | Singapore | 0.880 |
| | 3 | Yokohama | 0.849 |
| | 4 | Osaka | 0.849 |
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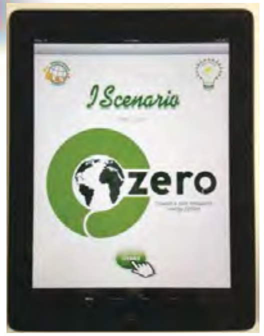
| | 19 | Nanjing | 0.340 |
| | 20 | Mumbai | 0.328 |
| | 21 | Kolkata | 0.299 |
| | 22 | Karachi | 0.264 |

# Stakeholder engagement in quantifying co-benefits in Asia


iOS App.

## Expert Workshops on Low Emission Development Strategies in Asian Cities (2018)

University of Malaya,. Malaysia

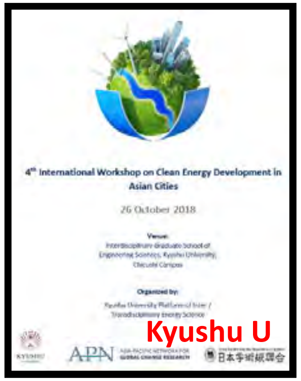
Tongji University, Shanghai

ISARD, New Delhi

http://farzaneh-lab.kyushu-u.ac.jp/Events.html

## International Workshop Series (2015-2018)



# Quantitative Evaluation on Co-benefit Projects

- Heat Only Boiler Technology Improvement
- Water Treatment Technology, The Case of

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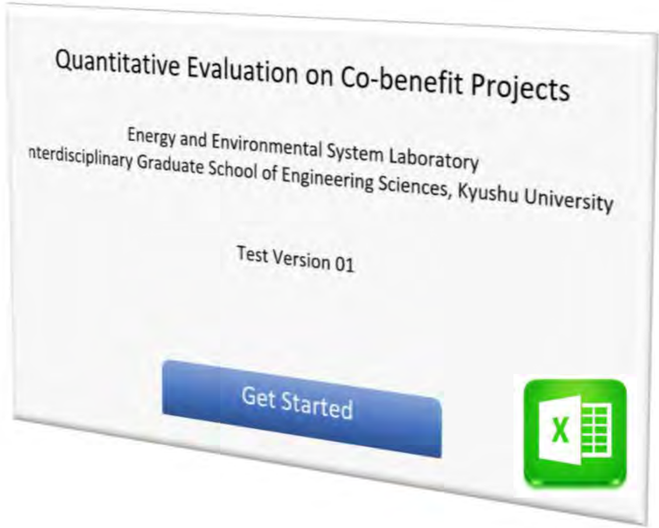
Institute for Global Environmental Strategies

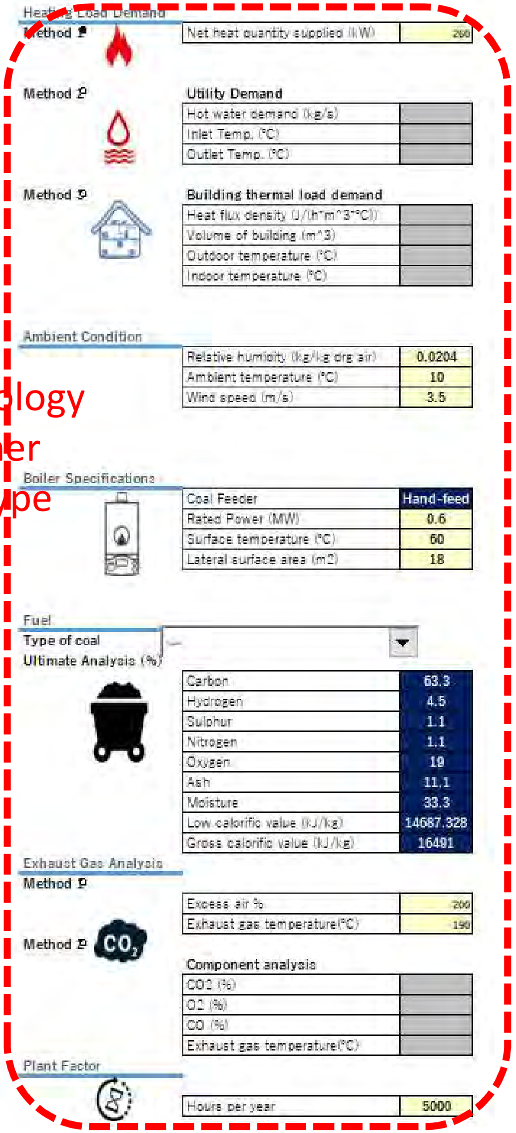

Ulan Bator, Mongolia


Fish Processing Industry in Indonesia



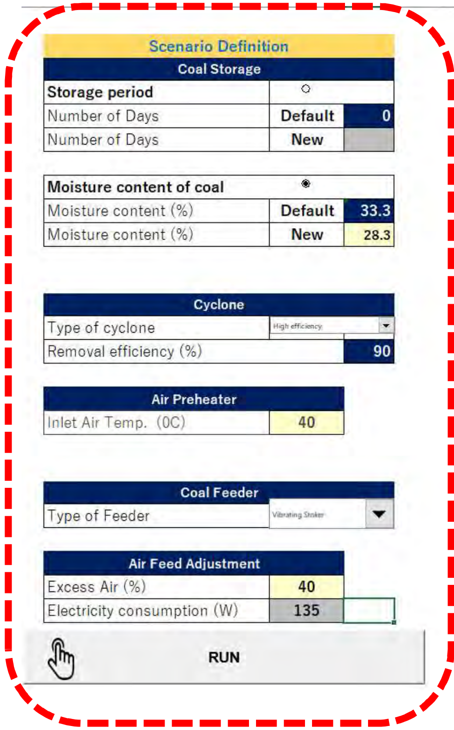

**Excel based technology assessment model, designed to evaluate co-benefits of interventions for first order policy screening**

# Quantitative Evaluation on Co-benefit Projects

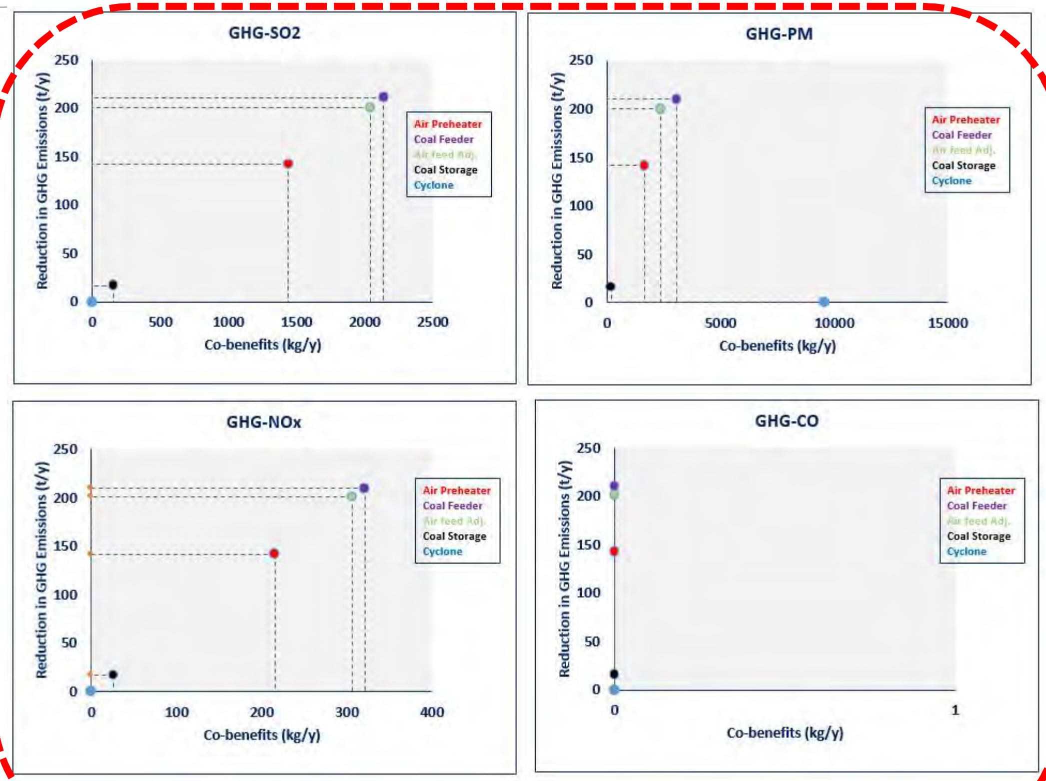

**Input**

- ✓ Technology
- ✓ Weather
- ✓ Coal type




**Scenario Definition**

- ✓ Coal Feeder
- ✓ Air Preheater
- ✓ Cyclone dust removal
- ✓ Air Feed Adjustment
- ✓ Moisture Control




**GHG emissions reduction vs Co-benefits**

coal consumptions × emission factor

**Thermal Efficiency (ASME method)**

# Recent Publications