Challenges for Integrated Response (GHG and air pollution) to Urban Transportation in Asian Cities

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About this presentation

- Urban transport context, facts and reality in Asian cities
- Does existing measures for controlling air pollutants contribute to GHGs reductions?
- Activities at different levels and their success and challenges
- Transport and CDM
- Way forward

Role of urban transport in air pollutants is rising in Asian cities…….

- Decreasing SOx, dusts and smoke
- Increasing NOx, particulate matters, and Ozone

- 70% of air pollution in Delhi comes from transportation (1998 World Bank Study)
- SPM is several times higher than WHO guidelines in Shanghai, New Delhi, Mumbai, Guangzhou, Chongquin, Calcutta, Beijing, Bangkok – ADB 2003

…….. irrespective of city characteristics

- SPM in Tokyo 40 μ g/m^3 in 1980 to 70 μ g/m^3 in early 1990 – stagnating/little decreasing since then
- Ozone, SPM continue to be of concerns in Seoul

Reasons

- Relocation of industries outside or towards peripheries of cities
- Success of end-of-pipe technologies
- Declining share of primary industries in value-added and rapid growth of service sector

- Rapid rise in travel demand
- Rapid motorization
- Increased car dependency
- Rising share of car-size in some cases

Major issues in Asian developing countries

(extracted from Dhakal and Schipper (2005) – paper available upon request)

- Cities are trying to develop efficient transport but less or no attentions are being paid to reduce the need for transportation
- Choice of transport modes has been skewed towards motorized and private modes (cars, two wheelers) in early stage of economic development
- Gap between demand for motorized demand and capacity of infrastructure is high (road length doubled but vehicles increased by 17 times in 1979-1999 in Beijing)

Major issues in Asian developing countries

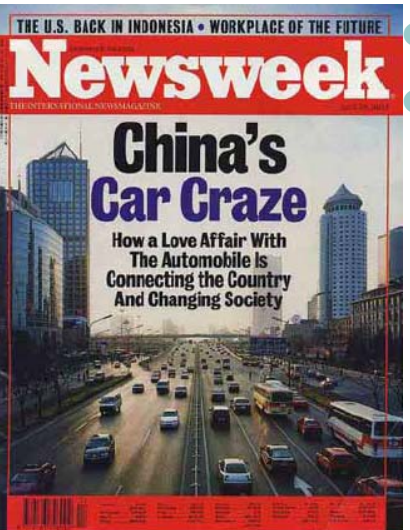
- On-road energy/emission performance of vehicles is poorer despite significant penetration of EURO I vehicles
- Low Sulfur diesel is slowly penetrating and CNG is becoming increasingly popular – yet pace is slow
- Emission reductions are mostly viewed by policy makers as tailpipe-problem and upstream drivers are often ignored in problem solving

Major policy challenges in Asian cities

- Policy inadequacy (over dependency on end-of-pipe solution and short term measures etc., poorly formulated)
- Weak implementation of existing standards, regulations and measures
- Transport and poverty inter-linkages – equity issue
- Resource constraints for infrastructure
- Institutional problems (less capacity, coordination problems, and vested-interests)

Role of urban transport

- Share of transport sector in total energy use in rapidly increasing
  - Hi Chi Minh: 20%, Tokyo and Seoul >35%, Beijing and Shanghai 7-10%
  - Transport energy use doubled in Beijing and Shanghai in 1990-2000, increased by a quarter in Tokyo and by a half in Seoul
- Transportation and CO2
  - Rapidly rising
  - WBCSD Mobility report: Indian and China collectively surpasses rests of Asia already



Transport and GHGs – global and local views

- Mitigating GHGs are necessary as its impacts on climate changes are evident (8% of global CO2 emissions come from road transport alone, IEA; 23% in OECD)
- Transport sector is closely linked to issues such as oil security and air pollution, more importantly, this is a rapidly rising sector. GHG mitigation will have multiple good effects

- Local priorities are not GHGs but local issues such as “air pollution” and congestions (not even energy saving!!)
- Cannot compromise with limited-available-resources that are crucial for solving local problems

Energy performance improvement is a key

- All air pollution control measures that targets at improving energy performance reduce CO2
  - Fuel economy standards
  - Phasing out older vehicles
  - Promoting compact cars
  - Controlling vehicle-idling
  - Etc.

Point of departure for GHG mitigation from air pollution control

- Technological-fix at tailpipe works for air pollutants – which does not work for GHGs
- Fuel quality improvement has a lot of role to play for controlling air pollutants - which do not apply to GHGs
- NOx and particulates that are more problematic for cities comes from diesel – which could be GHG friendlier than gasoline
- While going for new technology and new way: life cycle CO2 is more important than at tailpipe – there are uncertainties-

Local-global: Synergies and conflicts

Local countermeasures	Synergy with global concerns	Conflicts with global concerns
Introducing CNG or propane as fuels	CNG has been introduced for air quality improvement in cities such as Delhi, Beijing, and Bangkok. CNG or propane vehicles emit less NO_x and PM than conventional vehicles, generally speaking.	While CNG reduces CO_2 emissions, it may also outweigh benefits by increasing unburnt CH_4 (due to poor maintenance) in heavy-duty engines. Effects would be different for dual-fuel or retrofitted vehicles and those exclusively designed for CNG.
Introducing low sulfur doesel	High-quality diesel fuel, with a maximum sulphur content of 50 PPM, may help reduce CO_2 emissions if additional CO_2 emissions at refineries do not offset such gains.	
Promoting electric and hybrid vehicles	Electric vehicles have no tailpipe emissions, including all air pollutants and CO_2. Hybrid vehicles reduce air pollutants and CO_2 significantly.	Electric and hybrid vehicles have compromised-driving performance and are expensive. The CO_2 benefits depend on the fuel mix of electricity generation. Only lifecycle assessments can provide a clear picture.

Local-global: Synergies and conflicts

Introducing category-based emissions/fuel-efficiency standards for vehicles	Such standards help to reduce local air pollutants and CO_2 emissions per vehicle-km for particular vehicle categories (type or size).	If distance traveled by individual vehicles increases or if people switch to vehicles with bigger engines, the total volume of CO_2 might increase even if the standards are met.
Promoting mass transport and discouraging use of private cars	Usually such measures can reduce CO_2 emissions because they improve overall energy performance and reduce gasoline use. This further reduces congestion and associated CO_2 penalties from vehicles.	Inefficiency in operation of mass transport systems may tend to reduce their occupancy and promote private modes of transport; the gain may be less than expected.
Introducing reformulated gasoline.	Reformulated gasolines can help reduce smog, VOC, and toxic air pollutant emissions.	Reformulated gasoline compromises with fuel economy nominally by 1 or 2%; therefore, CO_2 might increase.

Local-global: Synergies and conflicts

Local countermeasures	**Synergy with global concerns**	**Conflicts with global concerns**
Bio-fuels (ethanol blended gasoline or bio-diesel)	Reduces CO2 emissions	
Inspection and maintenance systems; changing driving conditions and driving behaviors	May improve fuel efficiency and thereby reduce CO_2 emissions.	Rebound effects need to be monitored
Congestion pricing and traffic management	Reduces congestion, discourages car use, and results in fuel savings; however the exact impact on CO_2 emissions depends on various factors.	

Co-benefit at different scale

- *Improvement of air pollution and urban transportation as co-benefits of GHG mitigation*
  - *Agents: Global climate policy community*
- *Reduction in GHG emissions as co-benefits of air pollution control and urban transport management*
  - *Agents: Local environmental policy community*
- *Common goal*
  - *Integrated response to local and global issues*

Harmonizing actions at different levels

- **Scaling down the global actions**
  - **Target:** Globally tailored actions for greenhouse gas reduction
- **Scaling up the local actions**
  - **Target**: Locally tailored actions for air pollution control from urban transportation
- Matching resources and need
  - Where are the resources for actions?
  - Where action should physically take place?
  - Who should do what?

Role of international organizations and others

- Multilateral organizations: limited resources and capacity allocated to this area, not-proactive
- Bilateral organizations (USAID, Sida, GTZ) – fragmented approach
- Development banks – dual approach with focus on economic development
- Research initiatives (IIASA, AIT, IGES and others such as SEI and ECN): Only “quantifications” in selected cities but no strong policy push and advocacy so far
- Pew Center series of reports on transport and GHG – Shanghai, Delhi, Chile, South Africa , USA etc.

Where we are on co-benefits?

- Everybody agrees its importance but no serious thrust
- Better prospects for stationary sources than diffused number of mobile emissions sources
- There are a number of project going on but not designed as such
- International organization are not sufficiently challenged to come up with structured programs

Existing relatively bigger initiatives

- USEPA – Integrated Environmental Strategies
  - Quantifications of health, social and environmental impacts of policy measures, policy dialogues for awareness raising) – Argentine, Brazil, Chile, China, India, Mexico, Philippines, South Korea
- ICLEI – Cities for Climate Protection
  - Works with city governments, development of software tool such as CAP and HEAT to track targets
  - Weak, in general, in Asia
- Clean Air Initiatives- Asia
  - Facilitator to bring topic on focus but is just a network
- Challenges
  - Reliable data at city level in Asia (activity, emission factors etc..)
  - Few examples of actual policy impacts other than limited awareness-raising and estimating co-benefits

CDM in urban transportation

- May present a crucial opportunity in developing country through
  - Increased funding flows
  - Enhanced local capacity
  - Enhanced technology transfer
- However…
  - Requires ‘exotic’ methodology
    - Complicated to measure, especially demand side initiatives
    - Less rewarding than other sectors such as waste and landfill, utilization of gas, leakage reduction, electricity generation, cement, steam optimization, water pumping etc.

CDM in urban transport

- The project-based framework required by current rules is limiting and makes quantification complicated
  - Multiple small sources governed by personal choices are difficult to capture at project level
  - Such framework miss emission reduction opportunities such as fuel economy programs, renewable fuel standards, comprehensive “smart growth” efforts etc

CDM in urban transport

- Most transport projects don't fit well within the CDM as it currently functions
  - Given high cost it is unlikely that CDM pushes projects over the margin into feasibility
  - There are uncertainties over implementation of future transport plans, complexities with modeling travel/emission impacts of policies and monitoring challenges
  - Projects that fit under CDM (such as fuel/tech switch) are often have low emissions and minimal impact

Case of CDM for Mexico City Bus Rapid Transit

- Pilot BRT: 19.1 km, 34 stations
- Small financial impact of CER revenue
  - 46 Kton CO2e per annum, <6% of investment (with 5$/t CO2e, 10 years, 5% interest rate)
- Difficult for financial barrier analyses because of use of public funds
- Political projects aimed at sector reforms (price, laws) – the rules for common practice is not clear
- Methodology could be complex- 59 variables, 38 formula

Information Credits to John Rogers

Status of CDM in transportation

- Out of 1,192 projects in Point Carbon database , only 206 have reached the PDD stage. (as of Feb 2005 – Browne et al, 2005)
- Out of these 206, only four have been developed for transport sector (as of Feb 2005 – Browne et al, 2005)
- The current CDM projects under pipeline for in transportation are about 10 (as of Feb 2005 – www.cdmwatch.org/)
  - Fuel switch (Bangladesh), ethanol (Brazil, India, Thailand), BRT (Peru, Chile, Colombia), bio-diesel (India), electric mass transit (Peru)

Way forward for Co-benefits: Push and pull is needed

Support and continue local level efforts

- Implement those measures that reduce the energy use per per km traveled by automobile fleet on road
- More penetration of carbon neutral fuels
- Promote high occupancy public transport that can carry more people at reduced per unit environmental problem and discourage cars/two-wheelers use
- Support quantifying the level of synergies and conflicts of GHG mitigation and air pollution control measures

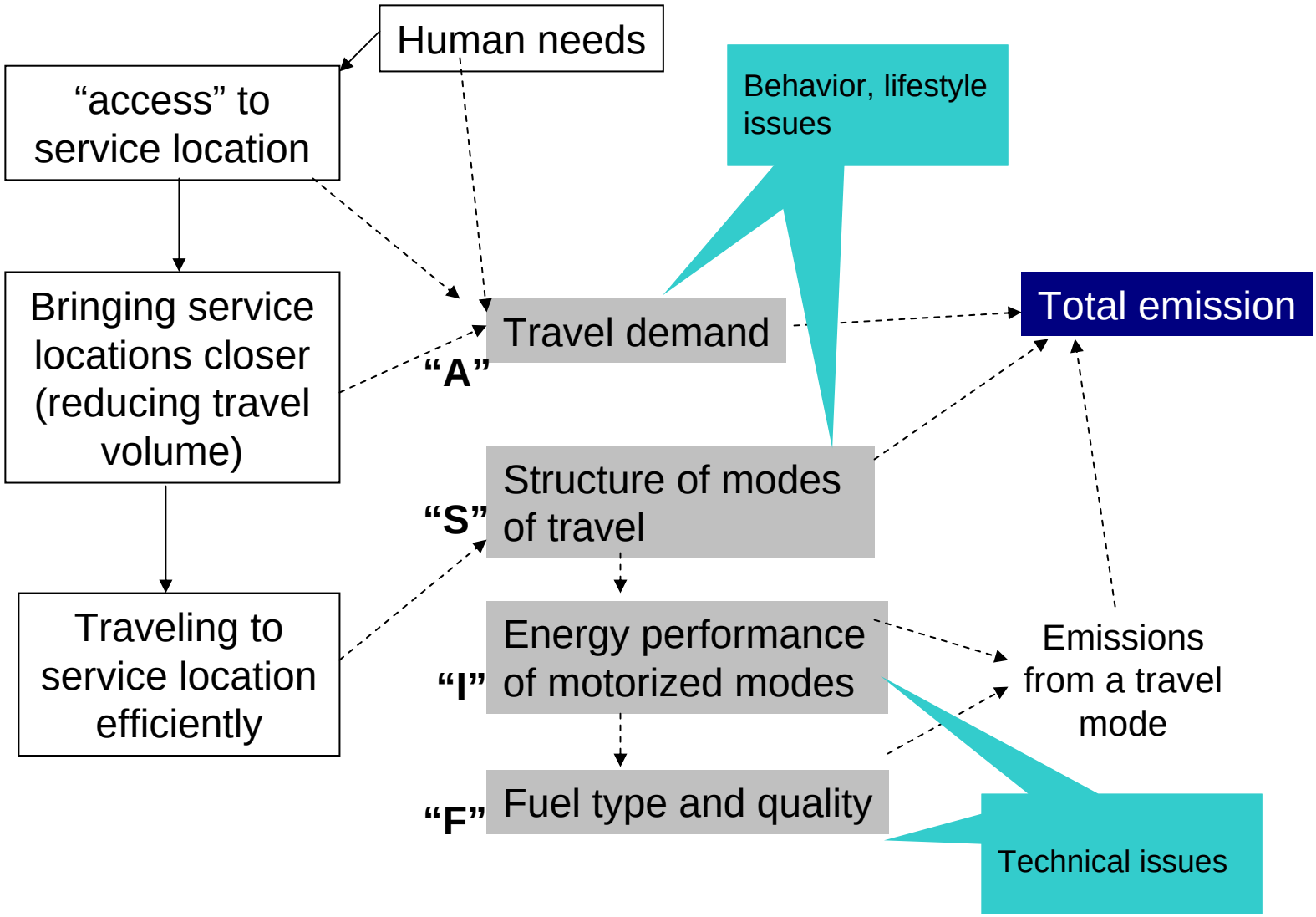
Way forward for Co-benefits: Push and pull is needed

Scaling up the effort

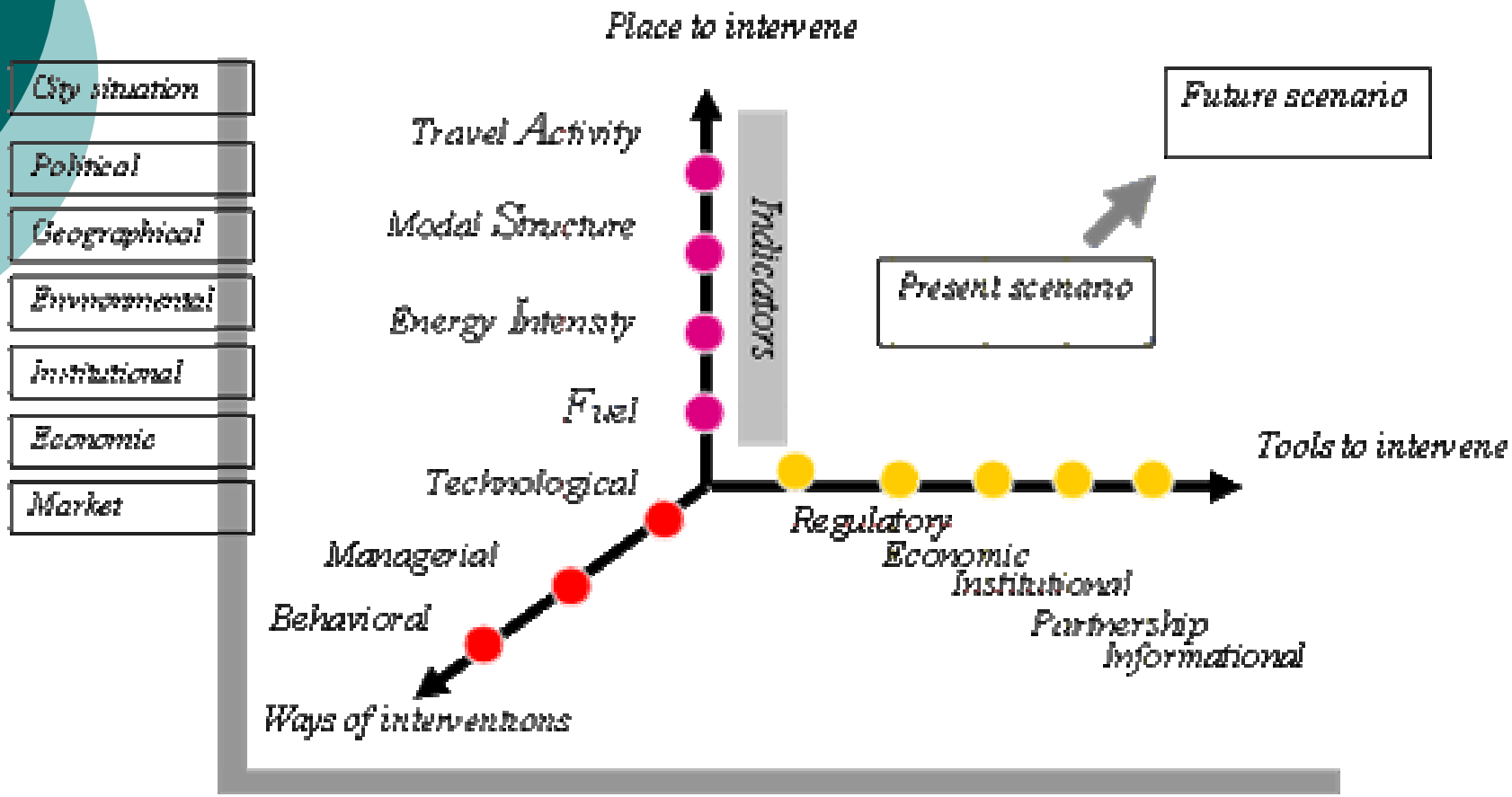
- Re-orient international financial mechanisms to cover the “incremental” financial burden of GHG friendly measures – “at least” dialogue should start now.
- In post 2012 context, allowing policy-based or sectoral CDM could better accommodate system-wide changes such as transit and land use strategies, fuel economy standards etc.
- Continued capacity building and awareness raising for local policy makers
- Create pressure for new technology development and more use of bio-fuels

- Thank you

Pollutant emission is not only a matter of vehicle-tailpipe when motorization is rampant



Dimensions of transport-env problems



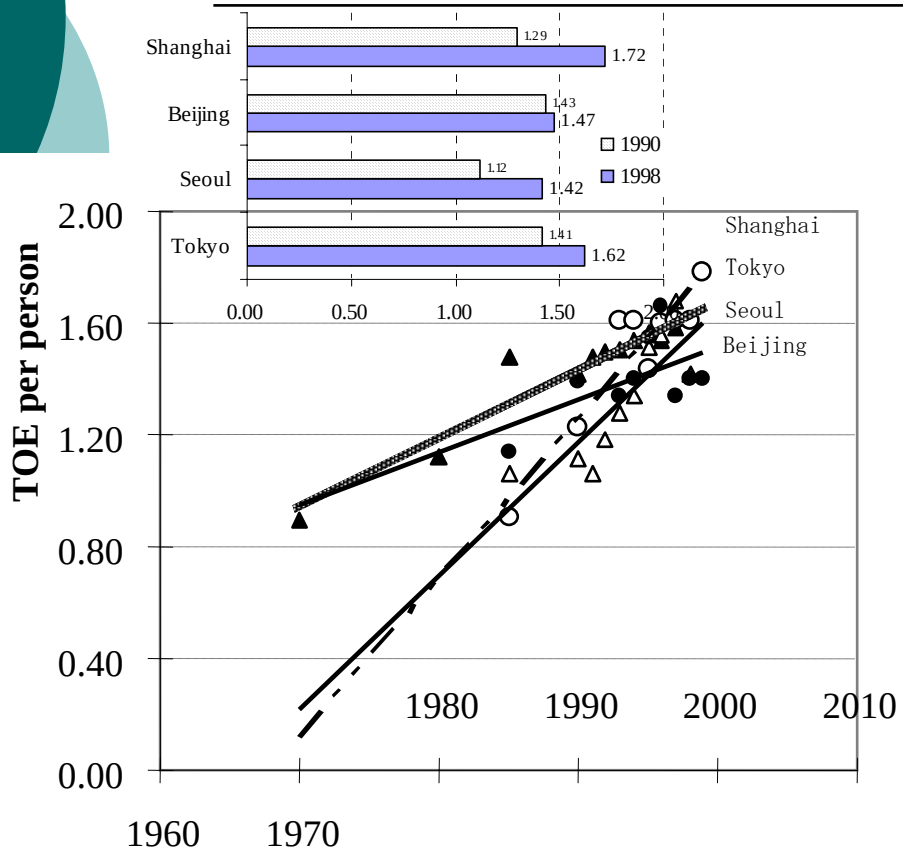
Stakeholder dimension

Dhakal and Schipper, 2005

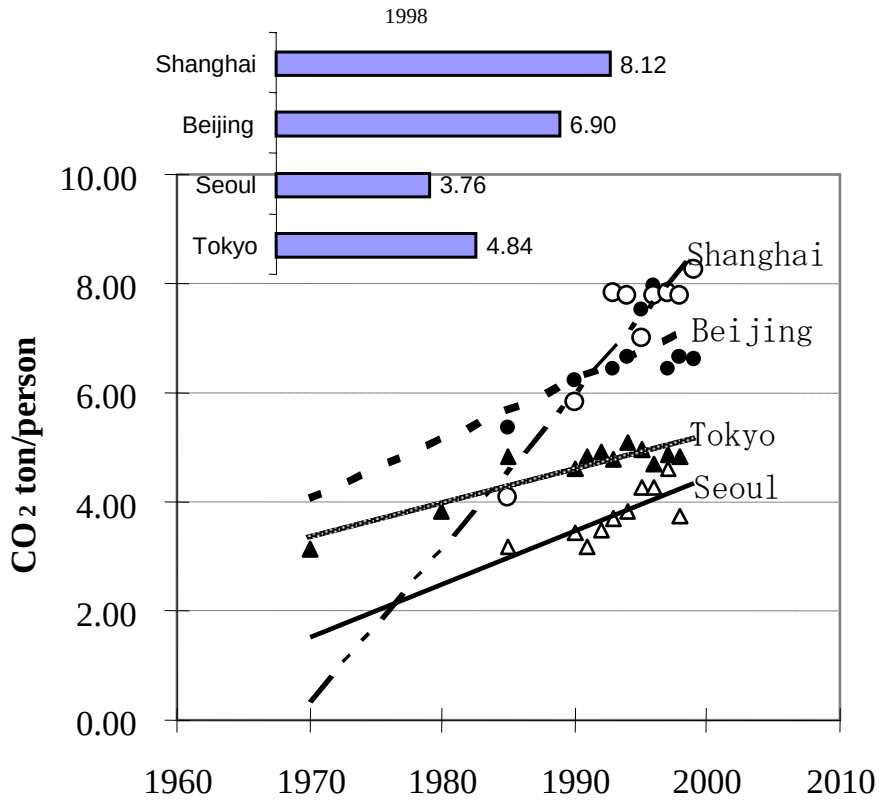
Technology and GHG

- Hydrogen economy and fuel cell vehicles
  - To see effects of fuel cell vehicles to CO2 or air pollution takes decades (3 or so)
- Hybrid could be medium term solution
- Diesel could be medium term solution – Europe's path
- Mixed bio-fuel
- Electricity mix and source of hydrogen
- Niche sectors can keep ongoing momentum

Choice of energy use



Trend of per capita energy consumption



Trend of per capita CO2 emission

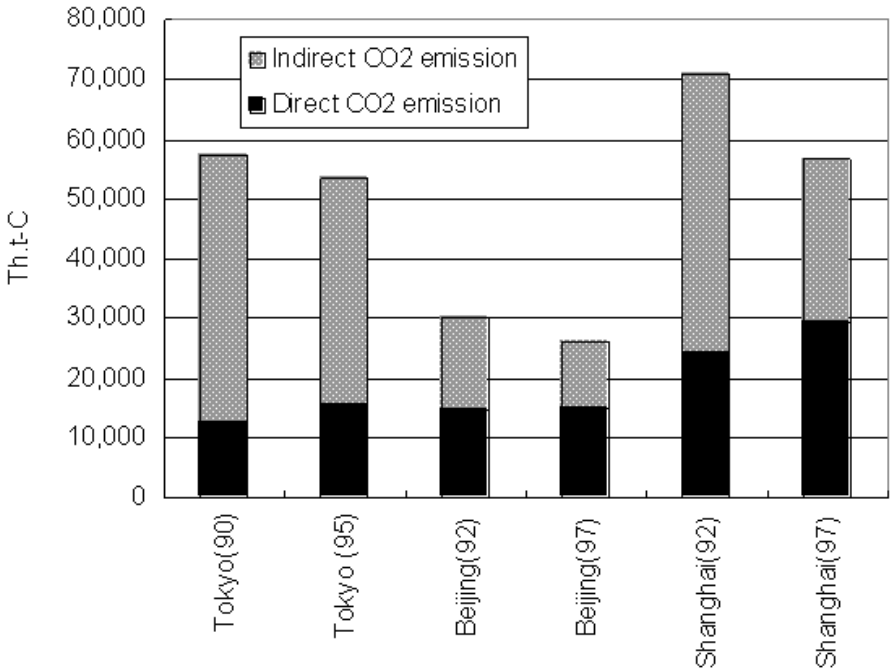
Sources: IGES 2004

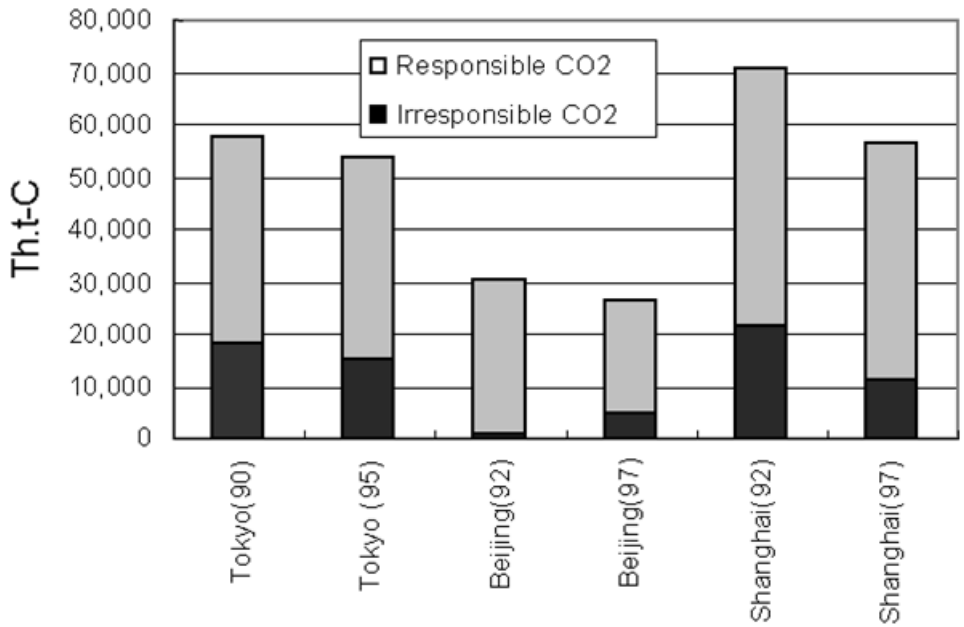
Efficiency of energy use

City	1970-80	1980-90		1990-98	
		1980-85	1985-90	1990-97	1997-98
Tokyo	High economic growth (8.5%) Moderate emission growth (2.5%)	High economic growth (6.3%) Moderate emission growth (2.3%)		Negative economic growth (-0.4%) Low emission growth (0.7%)	
Seoul				High economic growth (5.9%) Moderate emission growth (4.57%)	Negative economic growth (-16.3%) Negative emission growth (-19%)
Beijing			High economic growth (7.25) High emissions growth (6.5%)	High economic growth (14.5%) Low emissions growth (2.7%)	
Shanghai			Low economic growth (2.3%) High emissions growth (11%)	High economic growth (20.7%) Moderate emissions growth (5.6%)	

Sources: IGES, 2004

Emission footprints of cities…..



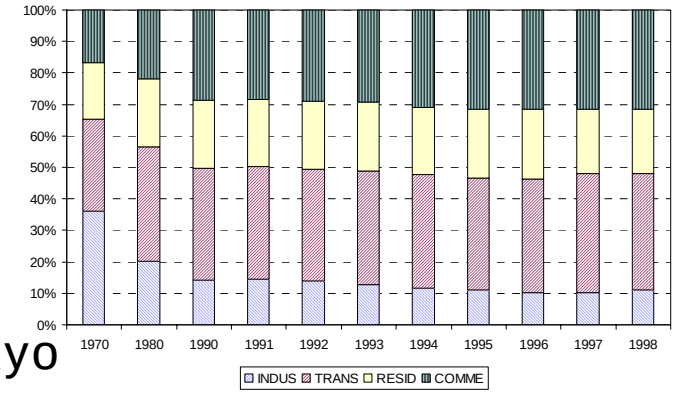


Beijing: direct emission is more than Tokyo but total is less than Tokyo

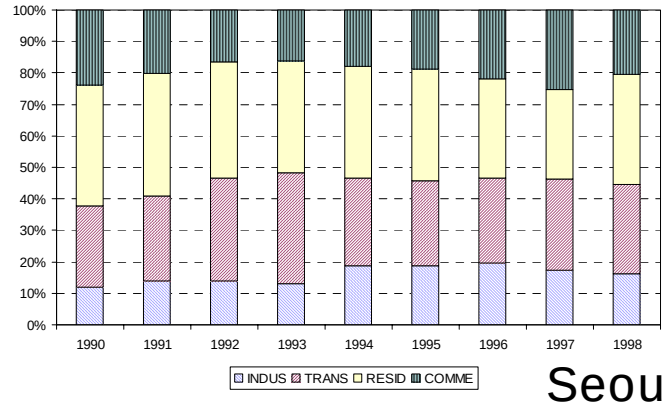
Responsible emission = Direct emissions + CO_2 embodied in material goods - embedded in exported material goods

Source: Kaneko, Nakayama, 2003

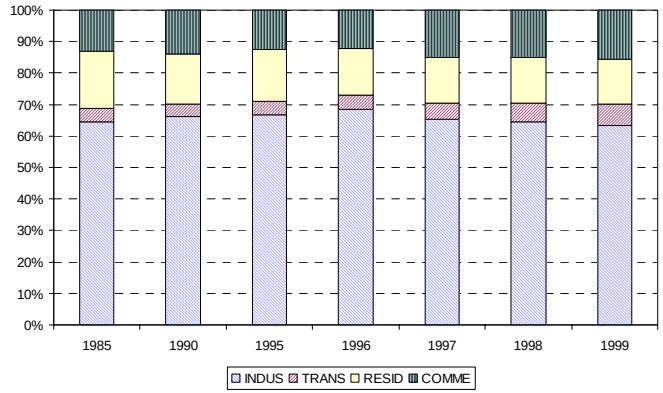
Energy use by sectors



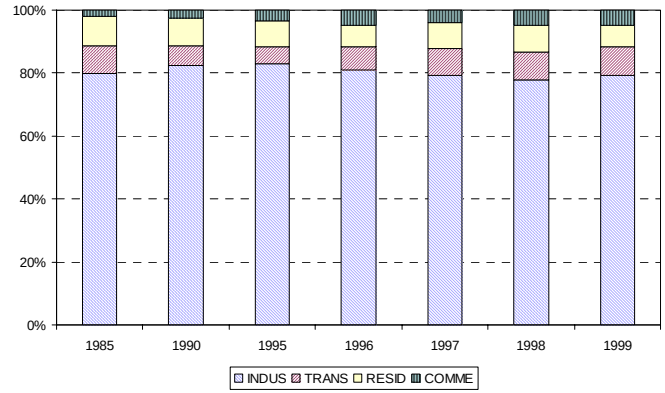
Tokyo



Seoul



Beijing

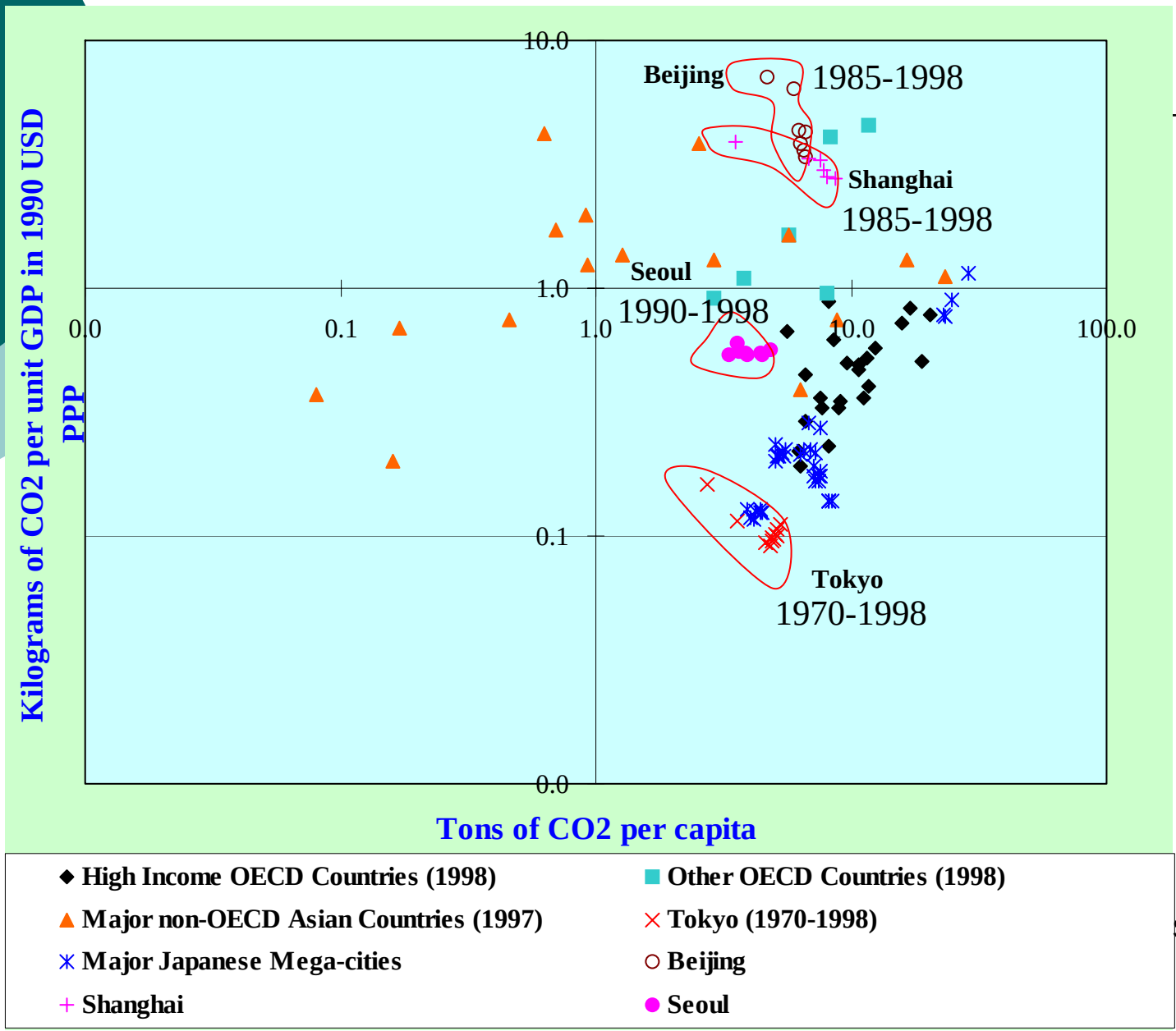


Shanghai

Sectoral Transition of CO_2 Emissions

- **Tokyo (1970-1998)**: Dominated by commercial and transportation sector (each about 35%), declining industry sector's share (35% to less than 10%), increasing electricity's share (22% to 48%), declining oil's share (65% to 38%)
- **Seoul (1990-1998)**: Dominated by residential and transport sectors, declining residential sector's share (as well as absolute volume), Rising electricity's share (16 to 24%), Coal is virtually eliminated (28 to 1%), oil contributes almost 60%, 1997 crash have evident effect but effect on other than oil (major contributor) in nominal
- **Beijing**: Dominant industry sector (peak of 77% in 1996), small transport sector share (5-8%) but growth rate is over 10%, coal responsible for over 85% emissions (including electricity)
- **Shanghai**: Dominant industry sector (83% in 1996), coal responsible for over 75% emissions (including electricity)

City performance - log scale



Tokyo: Outstanding compared to other cities yet worsening per capita emission

Seoul: Rapidly worsening per capita emissions

Beijing: Improving per unit GRP greatly but worsening per capita emission

Shanghai: Improving per unit GRP moderately but worsening per capita rapidly

Source: Dhakal and Kaneko, 2002

Recent developments in Tokyo

Institutional Responses to NOx and SPM

- Low sulphur content fuel[1]
- Tougher standards and inspection system for diesel vehicles[2]
- Incentives to low emissions vehicles[3] and
- Others, such as travel demand management (TDM) and joint initiatives amongst neighbouring cities

[1] Petroleum Association of Japan, under Tokyo's requests decided to start supplying the diesel containing 50 PPM (0.005 % S by weight) Sulphur by April 2003 in contrast to national target by the end of 2004.

[2] Ordinance on Environmental Preservation of TMG enforces diesel vehicle control regulation from October 2003, applicable to buses and trucks. Non –complying diesel vehicle (for PM regulation) will faces stricter penalties based on age of vehicles (if more than 7 years old, it should be replaced by low-pollution vehicles or equipped with certified PM reduction system. Sticker system is introduced for vehicles in which PM reduction system is installed.

[3] Includes preferential car tax for low emission vehicles, financial benefits for CNG bus operators and fuelling stations, discounted parking fee system for certified ultra-low emission vehicles. The categorisation for low-emission vehicles are made depending on how much less a vehicle emit compared to the national standards: fairly low –25% less; highly low – 50% less; and ultra low- 75% less. These vehicles are distinguished by one-, two- and

Recent developments in Tokyo

Institutional Responses to CO2

- Well placed regulatory frameworks and plans for GHG emissions control
- Ambitious numerical targets (6% of 1990 or 12% of 2000 or 20% of BAU 2010)
- Institutional arrangements (separate division)
- Stop Global Warming Campaigns
- Energy efficiency improvements by appliances labeling, green building plan, corporate energy use
- Sink Enhancement through Tokyo Green Plan and Green Building Plan

Opportunities in Tokyo

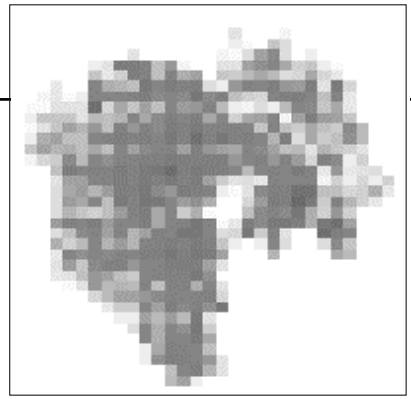
- Growing public awareness: A recent survey in Tokyo concluded that more than 90% of respondent felt threatened by rising temperature in the city and were concerned about global warming
- Urban warming (heat island) – greening, land use, space planning
- Political leadership and institutional initiative
- Stimulating corporate obligation in energy and emissions
- Emission standards for vehicles such as CAFÉ standards

Challenges in Tokyo

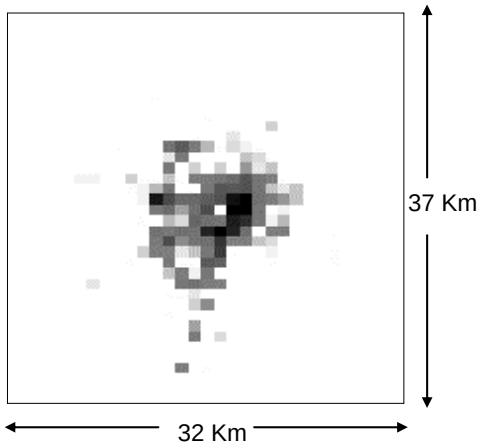
- Diesel interventions: may shift towards more gasoline vehicles
- Consensus building with big businesses and firms for corporate obligation
- Further technological innovation
- Comprehensive planning and sectoral coordination pre-requite

Urban warming in Tokyo

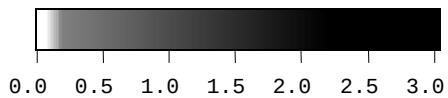
Detached houses



Apartment buildings

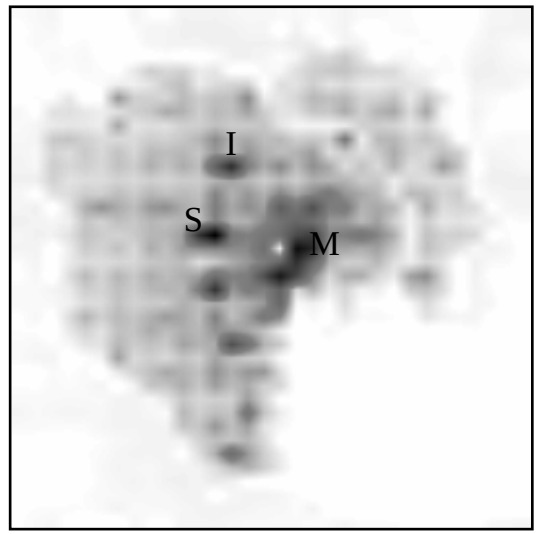


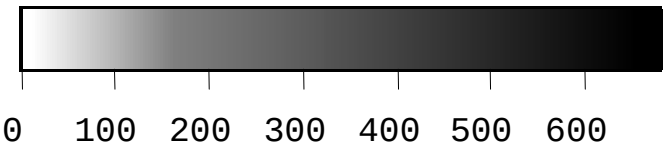
Office buildings



Floor area, in Million m^2

Floor area distribution in 1Km mesh in Tokyo 23-wards.





Heat discharges, watts/m^2

S: Shinjuku, I: Ikebukuro, M: Marunouchi

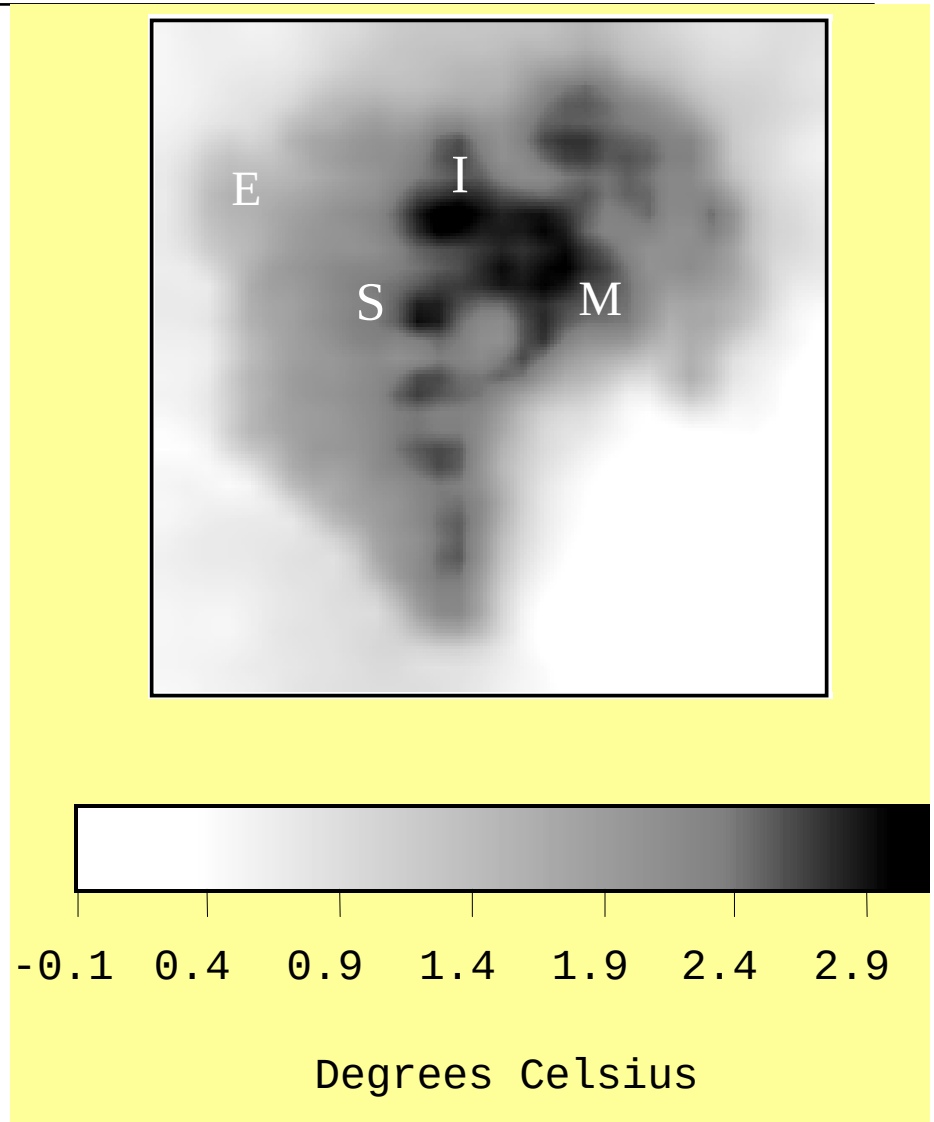
Distribution of heat discharges in 1 km meshes at 6 PM in Tokyo 23 wards for a typical day in July

Source: Dhakal and Hanaki, 2002 and 2003

Heat island/Urban warming

What affects heat island?

- Energy use/heat discharge
- Height of buildings
- Sensible vs. latent heat (type and location of air conditioners)
- Rooftop colors
- road pavements
- Urban greenery (land use)
- Water surface
- Urban canopy and wind pattern



Contribution of energy use to urban heat island in Tokyo wards (32x37 km) at 9 pm for typical calm summer day of July (M: Marunouchi, S: Shinjuku, I: Ikebukuro, E: Itabashi)

Source: Dhakal and Hanaki (2002)

Developments in Seoul

- Comprehensive plan for GHG mitigation doesn't exist but pressure is mounting
- Some emphasis on GHG mitigation through interventions on air pollution (CO2 as co-benefit)
- Some of the key programs affecting CO2 are:
  - District heating (about 453,000 by 2007)
  - Interventions for cleaner fuel (such as LNG for boilers)
  - Building energy performance improvement measures such as insulation and rating system
  - Usual air pollution control measures in transportation sector including CNG buses, stringent standards by 2006
  - Law concerning vehicle engine idle-ing prohibition in certain places
- Ambitious 2003-2012 Plan to reduce PM10 to 40 mg/m^3 and to NO_2 to 22 $microgram/m^3$

Developments in Beijing

- No CO2 countermeasure plans
- Six stages of emergency measures (1998 December) to combat air pollution (coal quality, natural gas use, CHP systems, traffic, tighter emissions standards, old vehicle scrapping, in-use vehicles inspection, retro-fitting taxies with dual engine etc.)
- Impact: SO_2 concentration reduced to 80μg/m^3, a significant decrease rate of 33%, while the PM_{10} concentration reduced to 162μg/m^3, a decrease ratio of only 8%
- Ambitious plan to meet the WHO standards before 2008 involving energy structure changes, infrastructure development, tougher emission standards, improved I/M systems, public transport on gas (LPG and NGV)

Developments in Shanghai (2)

- No explicit policies for GHG reductions apart from co-benefits of energy saving and air pollution management
- In 1999, Shanghai Municipal Government drafted a plan where energy and environmental policy are addressed
  - 55% reduction of coal as a primary energy source by the year 2010
  - Securing 3 GW electricity imports from the Three Gorges Dam and the nuclear plant at Qinshan
  - Increasing natural gas share to 10-12% in primary energy supply in 2010

Developments in Shanghai (2)

- Regulatory measures for prohibiting new coal-boilers in core city
- Controlling the number of registered vehicles to 16 million in 2010
- Limiting SO_2 emission to 420 kt/year in 2010

- Singapore style auctioning of registration permits for new vehicles

Realities in cities.....

- **Less developed cities**: capacity of local policy makers are weaker, resources are scarce, institutions for urban environmental governance are less developed, involvement of stakeholders are less pronounced, local issues dominates priority
- **Rapidly developing/industrialising cities**: capacity of local policy makers are improving rapidly, resources are scarce but starting to build up, local institutions are being built up, local issues dominated attention but there has been growing awareness on need to consider newly emerging issues such as global warming
- **Relatively developed/matured cities**: condition are better than rest of the Asia and local government are under growing pressure to tackle emerging global environmental issues.

Urgent needs: Identifying the prospects for synergy and constraints for integrated approach promoting such measures

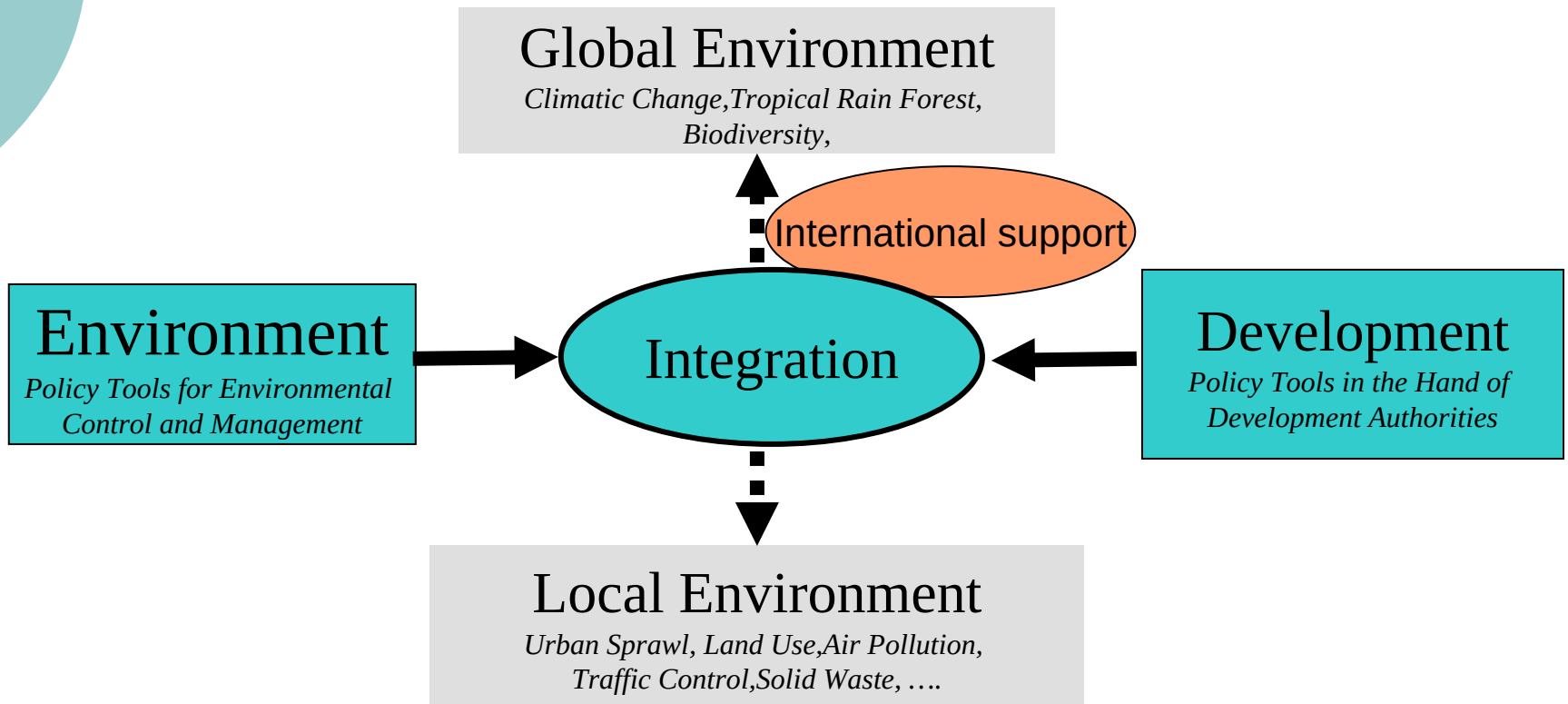
- Strengthening CO_2 concerns from urban transportation
- Transitions from sectoral approach to holistic planning
- Exploiting existing niche opportunity for CO2 abatement and creating momentum for change
- Promoting exchange of experiences
- Strengthening institutional capacity and local-national cooperation
- Enhancing the role of international institutions in promoting integrated measures

Integrated approach at multiple dimensions

- Integrating local development decision with environment
  - Air pollution control + Measures against climatic change + Urban planning + Economic development
- Consorted effort at difference scale
  - Domestic solution + Regional cooperation
- International financial mechanisms + local mechanisms for promoting GHG friendly measures
- Right mix of policy tools
  - Regulation + Economic incentives
- Concerted efforts of stakeholders at different levels
  - Government, private sector and citizens

Integration of global and local environmental actions

"Think Globally and Act Locally"



What cities can do?

- Local government initiatives
- Enforce regulation and standards and other locally viable instruments
- Traffic control, parking regulation, car inspection, etc.
- Encourage local people participation
- Promote education and campaign
- Disseminate information about health risks to local people