Major trends in urbanization and urban environment

Shobhakar Dhakal

Global urbanization since early 1900 has been unprecedented and Asia is the front runner

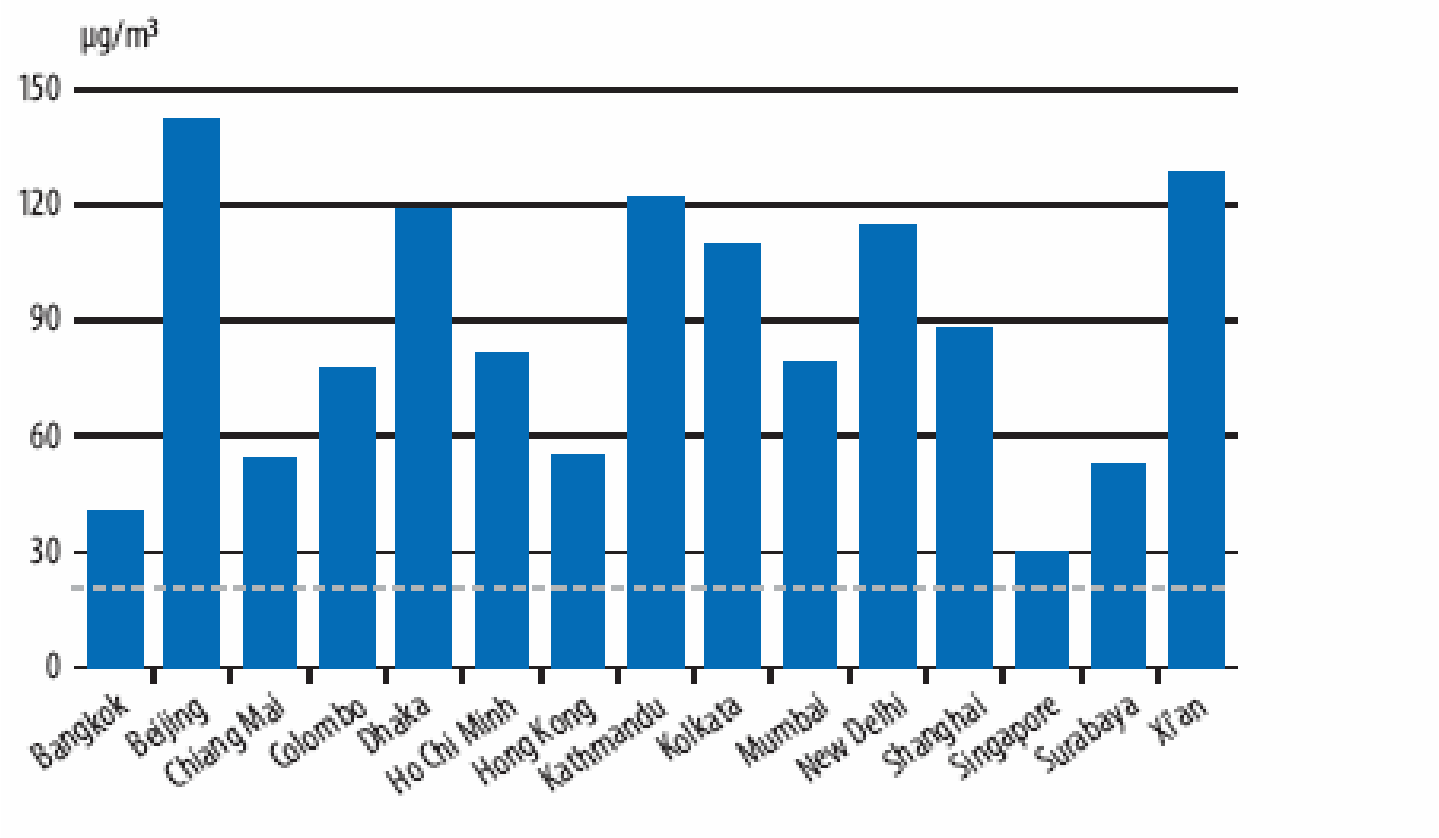
- World urban population: 3.2 billion (49% of world population of 6.5 billion in 2005, will be 50% by 2008?)
- Asia hosts largest world urban population (Asia 1.6 billion, Europe 0.5, Africa 0.3, North America 0.3, Latin America, Caribbean and Oceania 0.4 - in 2005)
- China, India, USA have largest urban population in 2005 as countries
- Cities and Asia (2005):
  - 11 out of 20 mega-cities (over 10 million)
  - 17 out of 30 cities of 5-10 million
  - 184 out of 364 cities of 1-5 million
  - 225 out of 455 cities of 0.5-1 million

Source: United Nations, Department of Economic and Social Affairs, Population Division (2006). World Urbanization Prospects:The 2005 Revision. Working Paper No. ESA/P/WP/200.

Asian cities are facing severe challenges already

- High density settlements demand better planning and management which have proved challenging
- Congestion: Bangkok looses 6% of its GDP due to congestion
- Air pollution: Most of the Asian cities have PM10 levels higher than WHO/USEPA guideline value
- Solid waste: Generation rates are increasing with rising income; management and disposal are becoming serious concerns
- Waste water: Volume is getting bigger and bigger

Annual Average Ambient Concentrations of PM_{10} in selected Asian Cities (2005)



None of the large Asian cities meets the WHO guideline for PM_{10}

Average concentration of PM_{10} is approx. 80 ug/m³ has changed little since 1995

Slide courtesy: Dr Gary Haq and Dr Dieter Schwela, SEI

What went wrong- in general?

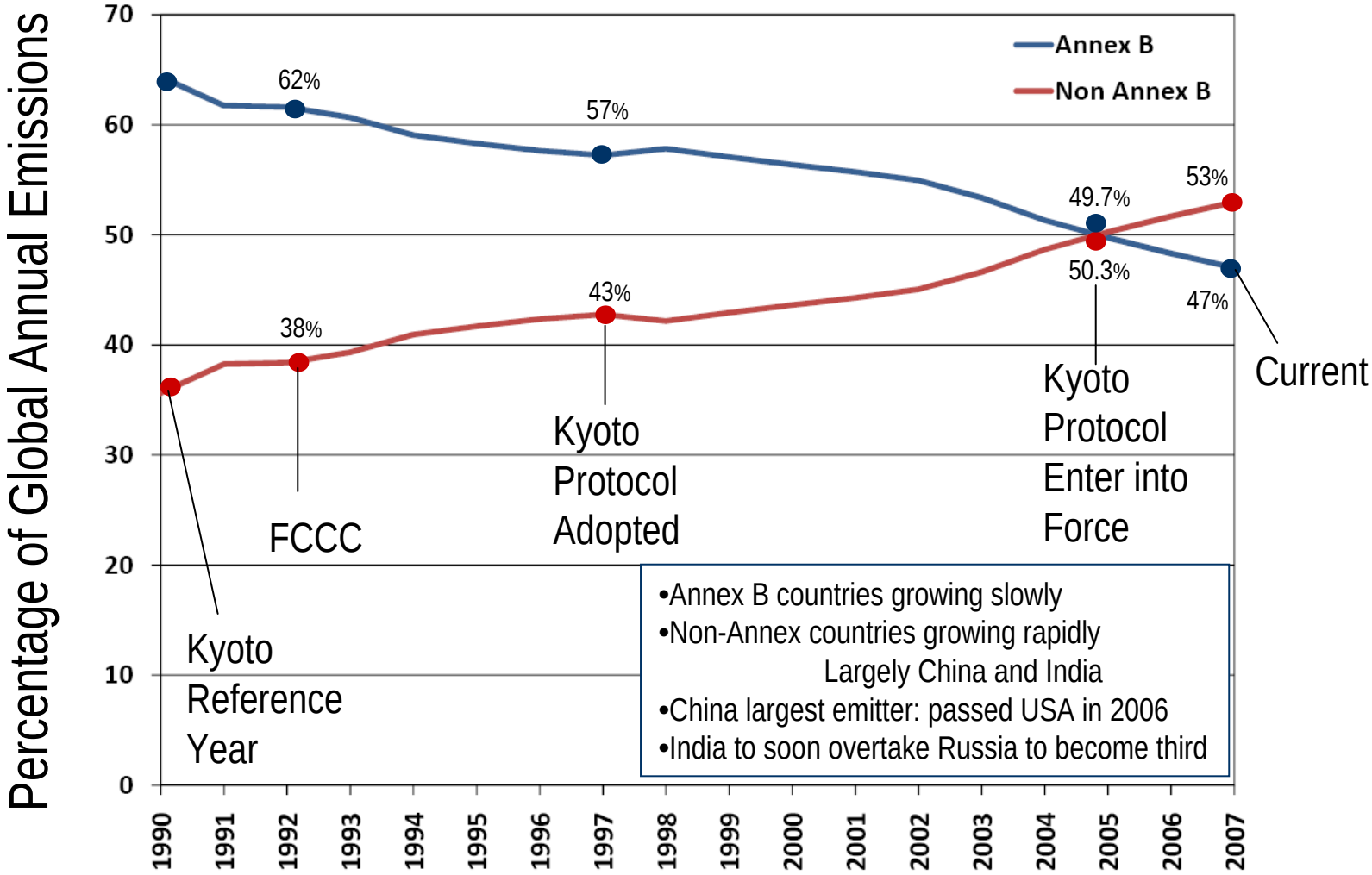
- Gross failure of urban planning
- Urban growth without enough time, resources, institutions, and capacity to put infrastructure and system at place
  - Too much pressure from motorization at early stage of economic development
- Lack of serious political will/commitment and poor institutional arrangements
- More than policy/plan- implementation failure

Further urbanization forces us to think innovatively

- Urban population will grow twice as faster as compared to total population growth (1.78% vs. 0.95%- annual rate for 2005-2030 projected) resulting 4.9 billion (about 60% of total population) by 2030 (out of 8.2 billion)
- Almost all global population increase come from urban population in developing world
- 1.8 billion urban population will be added in 2005-2030 out of which 1.1 billion will be added in Asia alone

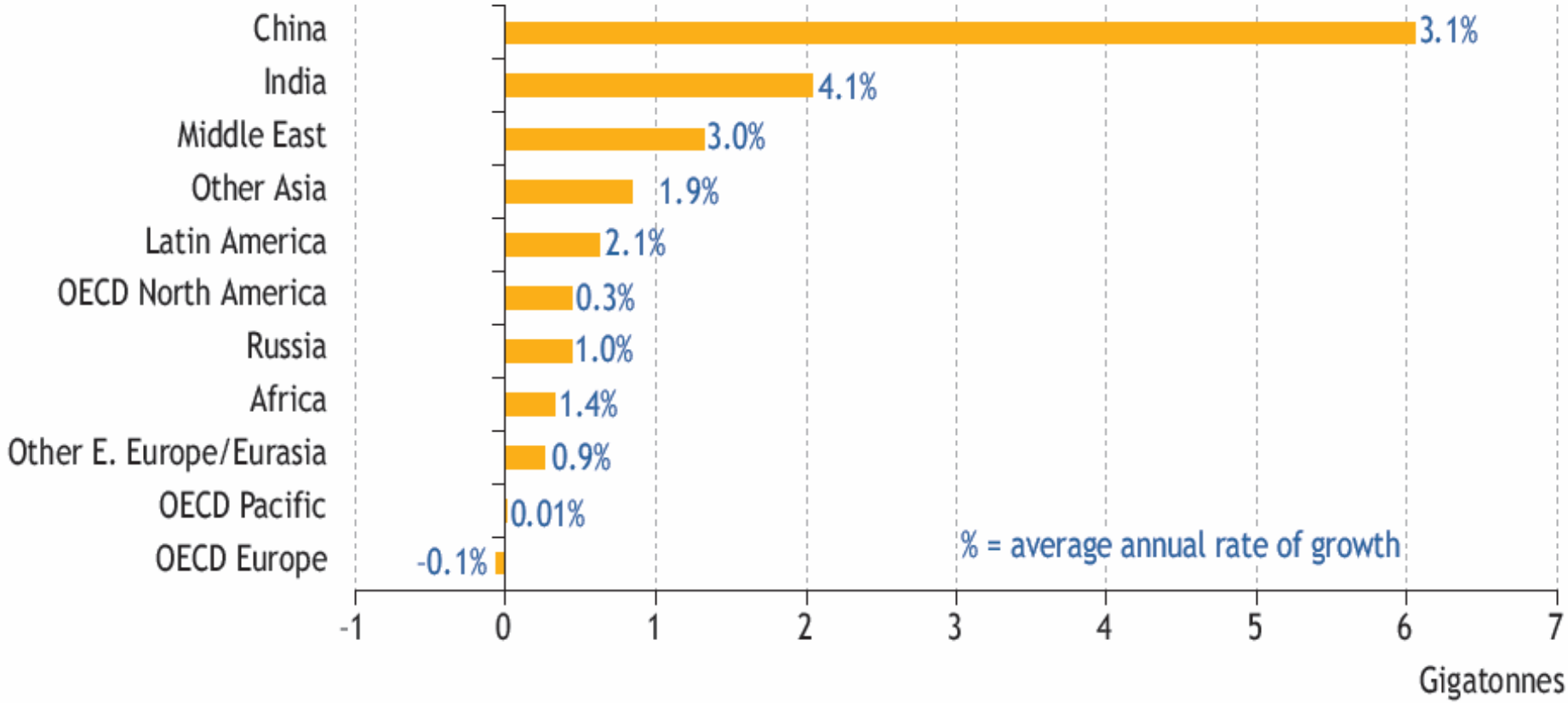
UN, 2005 update

A new issue- climate change has emerged which cities can no longer ignore



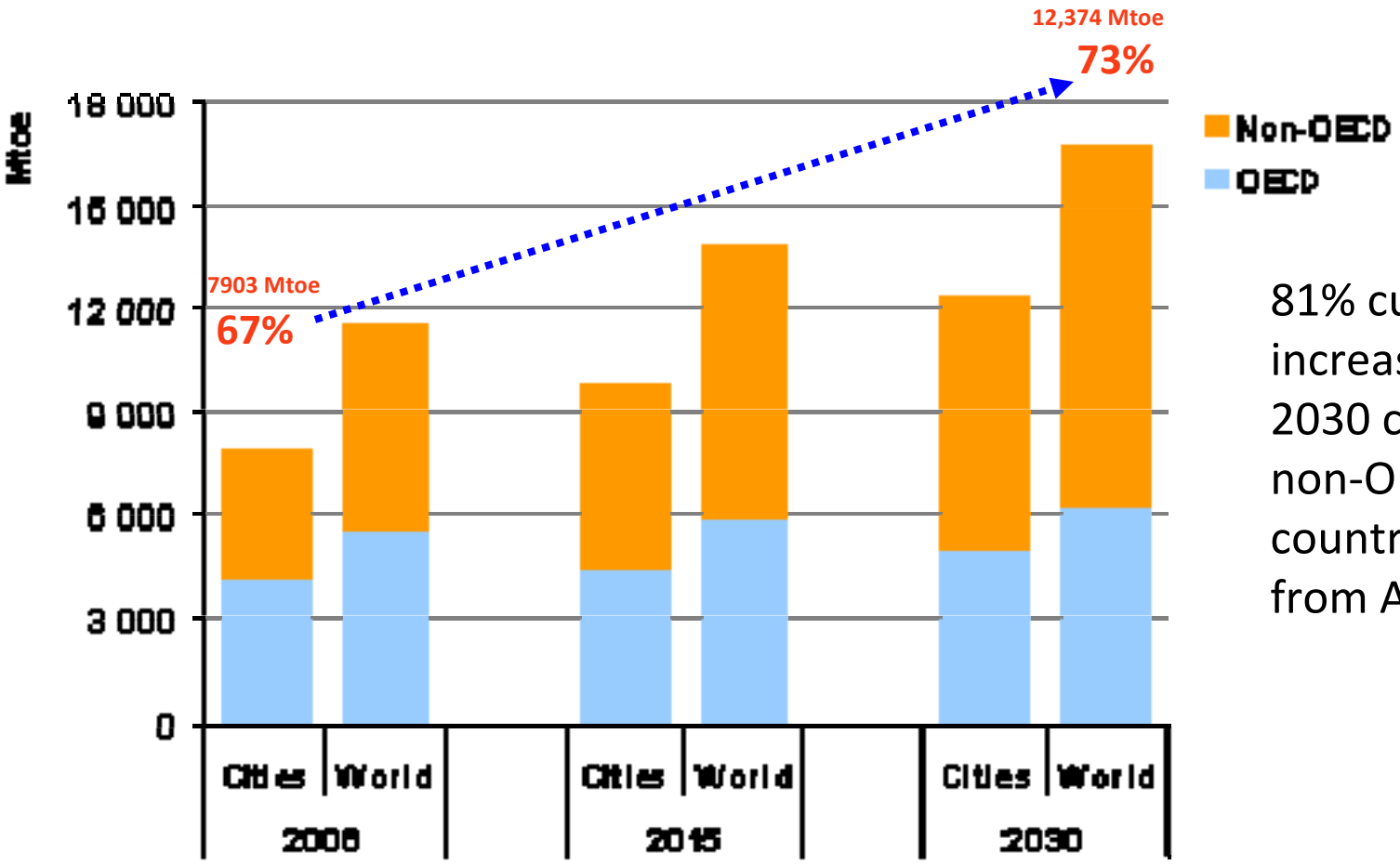
J. Gregg and G. Marland, 2008, personal communication

Incremental energy-related CO2 emissions by country and region, 2006-2030



WEO, 2008

City primary energy consumption in the Reference Scenario

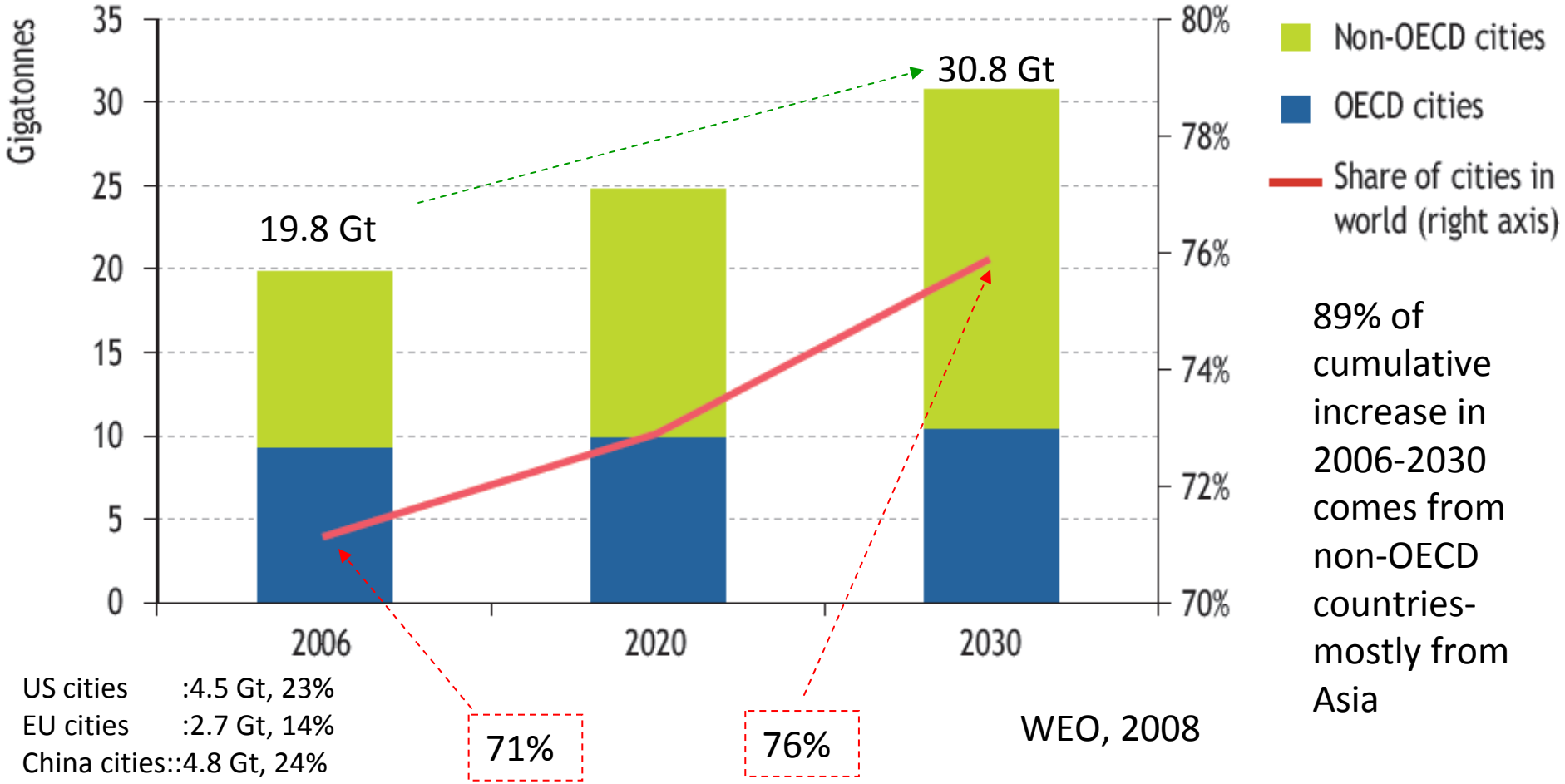


81% cumulative increase in 2006-2030 come from non-OECD countries- mostly from Asia

% are cities' share in global

Source: WEO, 2008

Energy-related CO2 emissions in cities by region in the Reference Scenario



US cities :4.5 Gt, 23%
EU cities :2.7 Gt, 14%
China cities::4.8 Gt, 24%

WEO, 2008

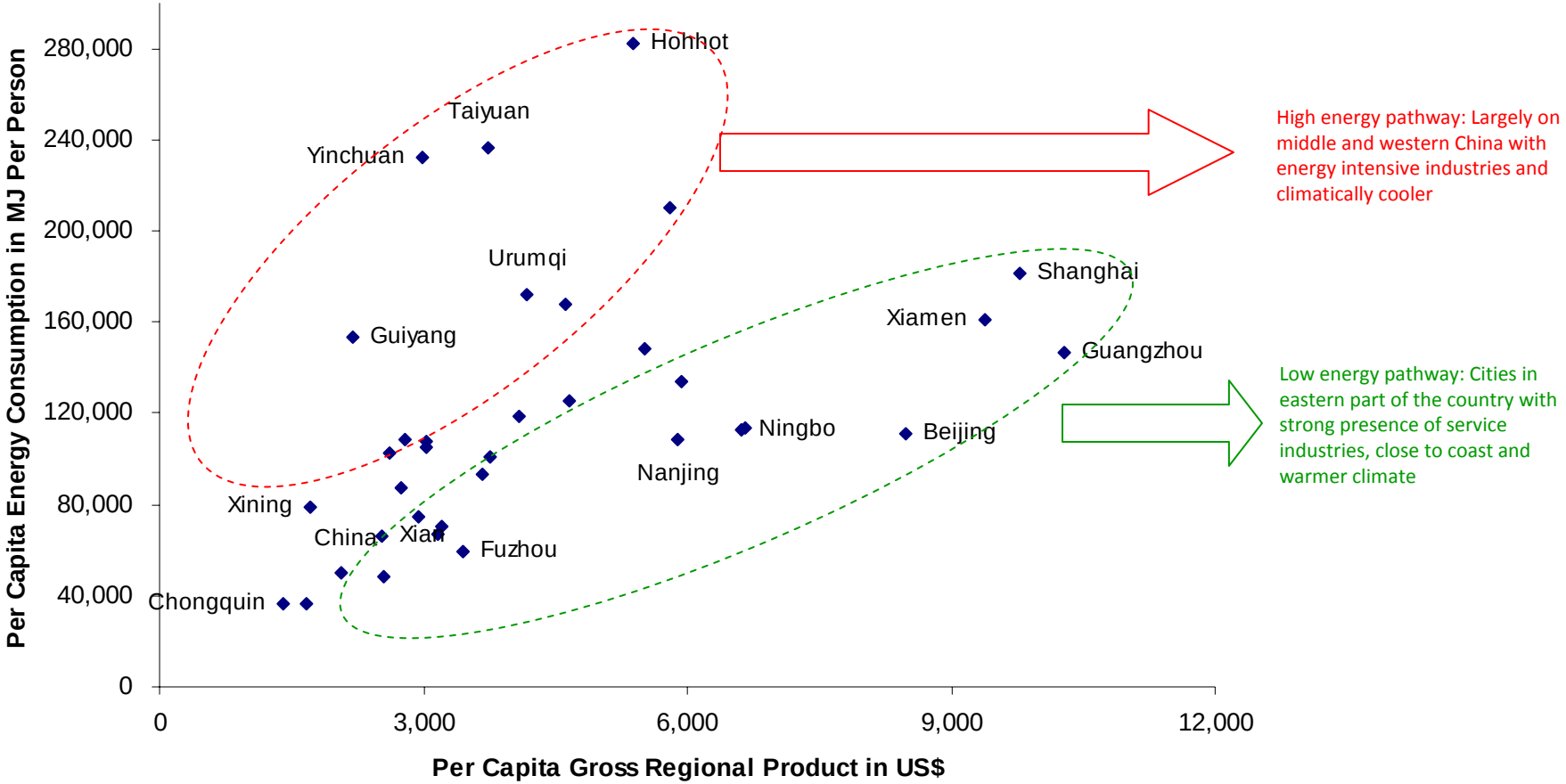
89% of cumulative increase in 2006-2030 comes from non-OECD countries- mostly from Asia

Urban's contribution to energy related CO2 emissions of China

- Large volume: 4.8 Gt in 2006
  - More than whole of Europe (4.06 Gt)
- Global importance: 24% of global urban CO2 emission from energy use
- Local importance: 85% of total energy related CO2 emissions of China
- Dominated by key largest cities: 35 key cities account for 18% of China population but consume 40% energy and emit 41% of China's energy related CO2 emissions

Source: Dhakal, 2008; WEO 2008

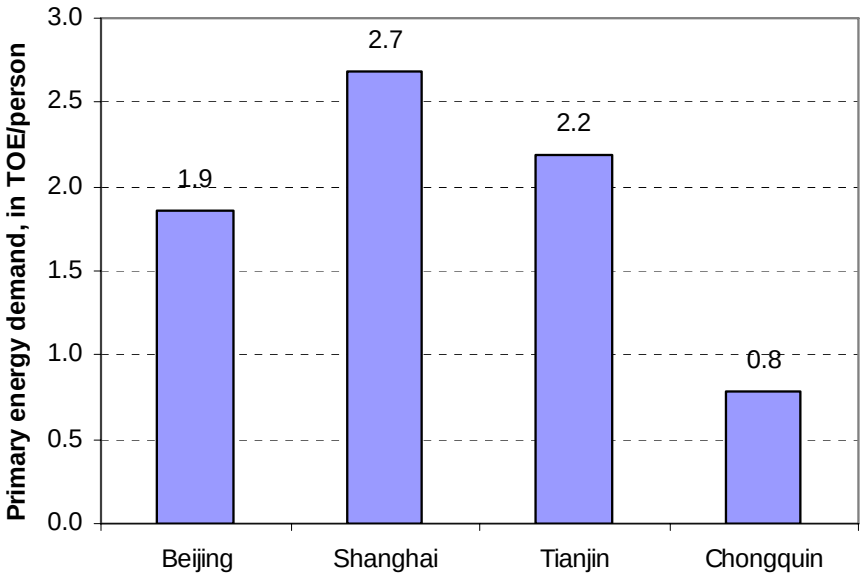
Varying energy-economy pathways within China's cities



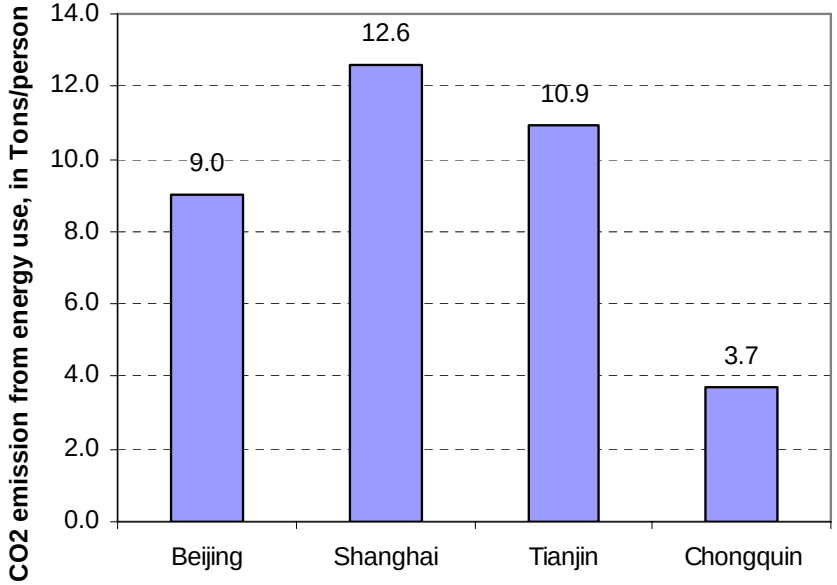
List of 35 most important cities that are mentioned in national plan: Beijing, Tianjin, Shijiazhuang, Taiyuan, Hohhot, Shenyang, Dalian, Changchun, Harbin, Shanghai, Nanjing, Hangzhou, Ningbo, Hefei, Fuzhou, Xiamen, Nanchang, Jinan, Qingdao, Zhengzhou, Wuhan, Changsha, Guangzhou, Shenzhen, Nanning, Haikou, Chongqing, Chengdu, Guiyang, Kunming, Xi'an, Lanzhou, Xining, Yinchuan, and Urumqi.

Source: Dhakal (2008)

Per capita energy and CO2 of key Chinese cities are not necessarily smaller



Per capita final energy consumption, 2006



Per capita CO2 emissions, 2006

*Based on permanent **resident** population, source: Dhakal(2008*)

<u>Year 2003</u>

Tokyo Metropolis: 5.9 tons CO2/person (pop12.06 mn) for 2003
New York State: 10.9 tons CO2/person (pop 18.95 mn) for 2003
New York City: 7.1 tons/CO2 (pop 8.1 mn) for 2006 (PLANYC)
Greater London: 6.95 tons CO2/person (pop 7.3 mn) for 2003
Bangkok City: 6 tons CO2/person (electricity and transport only, 2005)

Source: TMG , PLANYC, BMA

Therefore…….

- Asia is/will be leader in unprecedented global urbanization
- Local impacts are/will be serious: urban environmental impacts- air, water, waste
- Global impacts are/will be tremendous: Asia's (urban) energy use and carbon trajectories are of serious concern globally
- It forces us to think new way to address the problem:
  - How to address telescopic compression of a range of urban environmental problem in Asia which the West experienced in some kind of stages?
  - Cities have started to act for global concerns
  - How to streamline energy and carbon mitigation concerns into the urban development activities?

Strategic needs

- Tackling “urban” in integrated and holistically in opposed to fragmented pieces here are there

- Demand dampening- energy, material
- Better infrastructure supply- without rebound effects
- Providing incentives for actions that entail co-benefits (to global and local concerns)
- Better institutional arrangements (within and across) with focus on “implementation” of policies
- Creating committed and accountable political champions

- Thank you

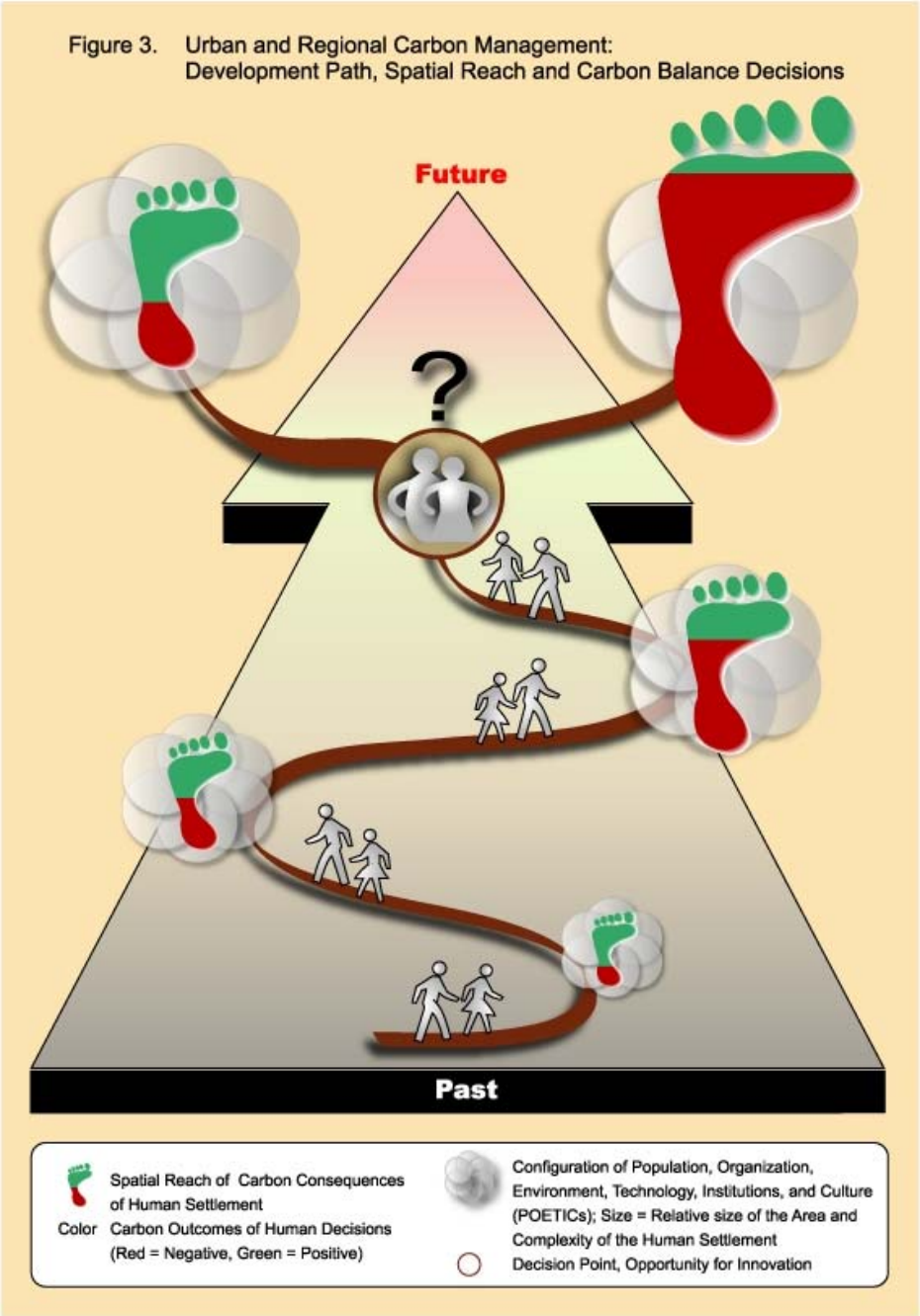
Needs for reasonable infrastructure supply

Students return home in an overloaded “tempo” (three-wheeler) after taking the SLC examinations (Grade 10 of school) from Haripur exam center in Sarlahi on 9th April 2007 (Nepal)

Needs for demand management

Beijing © Shobhakar Dhakal

- Asian development is at cross-roads
- How donor communities can help

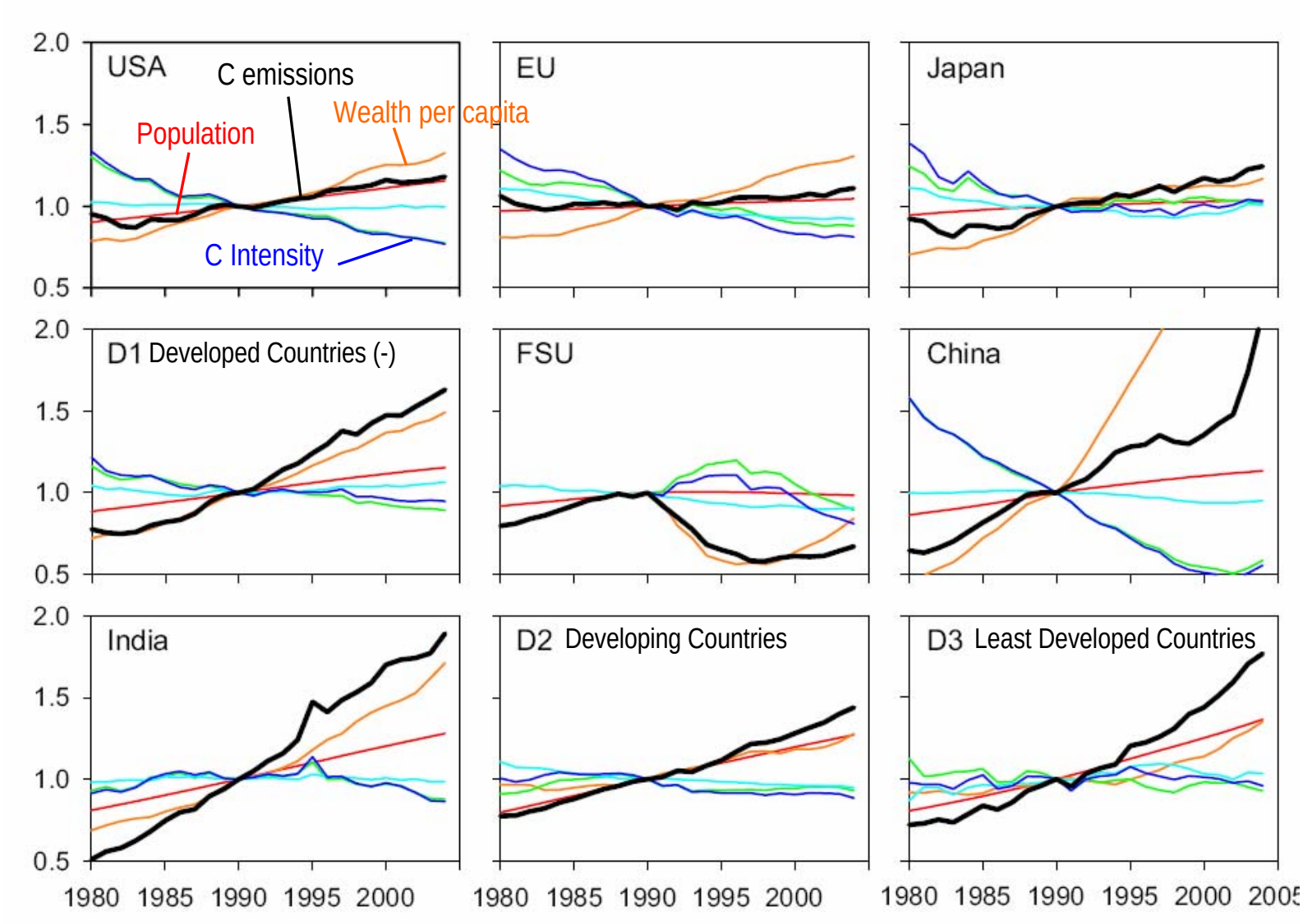


National definitions of “urban” in UN Urban population statistics

Criterion	Countries
Administrative	83
Economic	1
Population size	57
Urban characteristic	4
Any combination	48
Entire population	6
No urban population	3
Unclear definition	1
No definition	25
Total	228

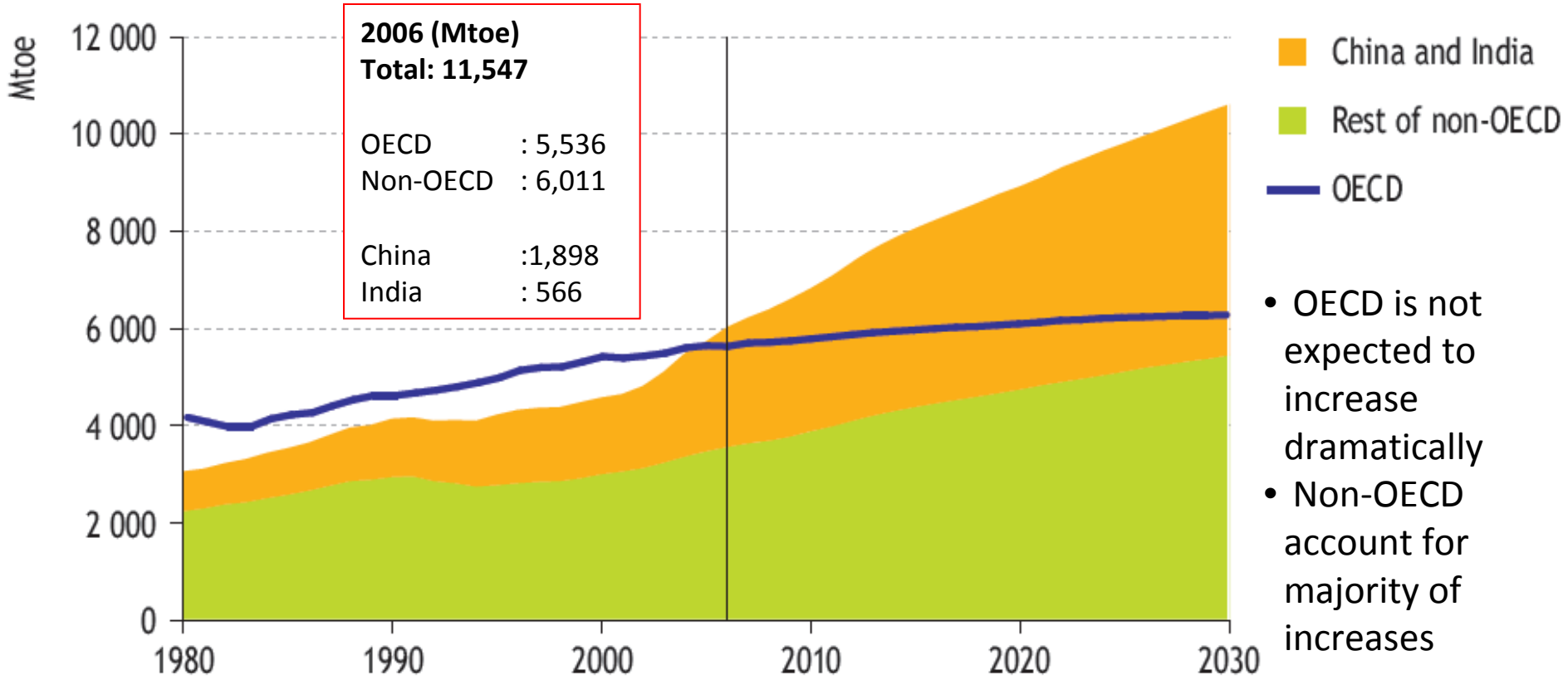
Source: Thomas Buettner, UN Population Division

Regional Emission Pathways (1980-2005)



Raupach et al 2007, PNAS

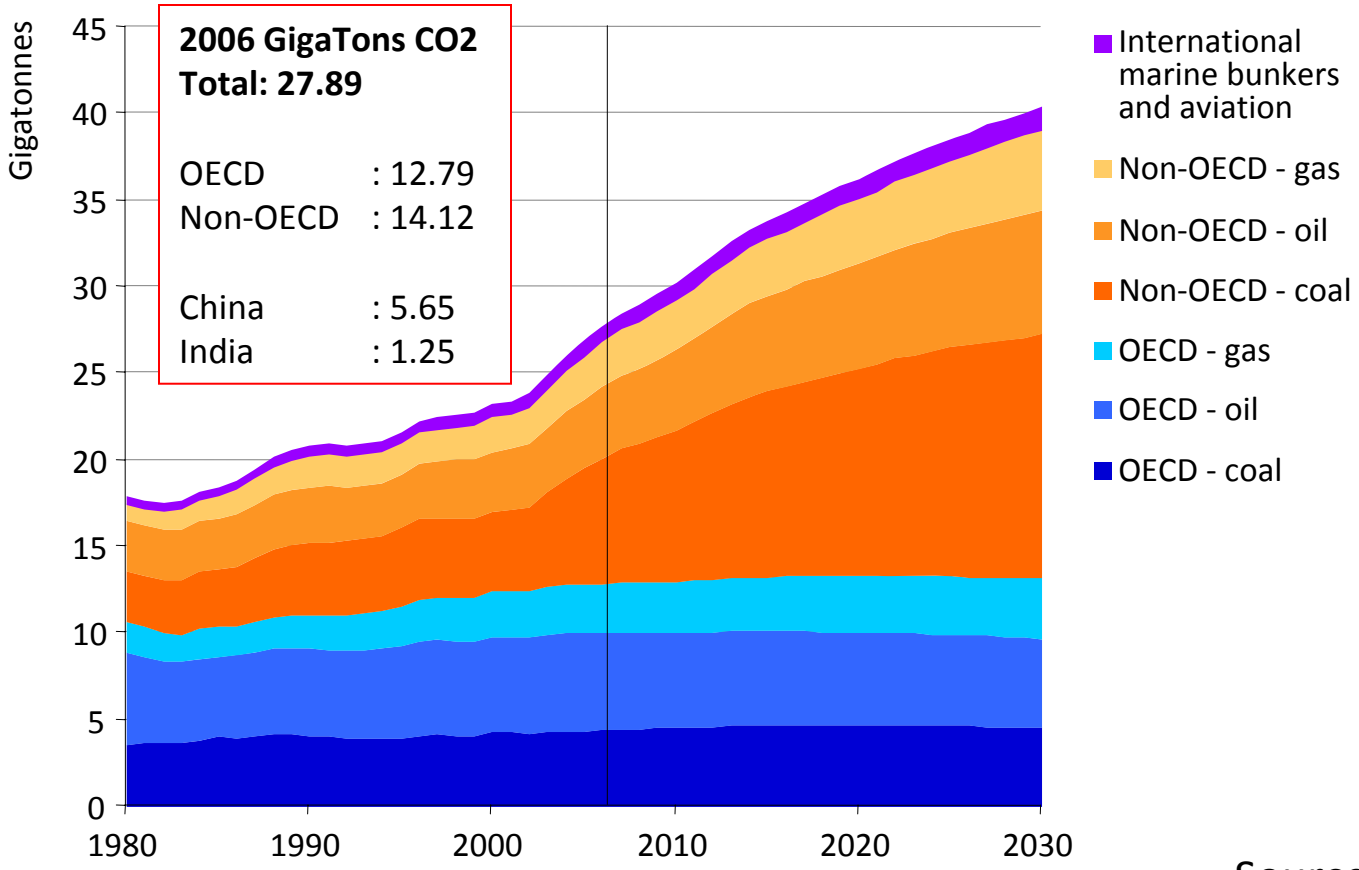
World primary energy use



- OECD is not expected to increase dramatically
- Non-OECD account for majority of increases

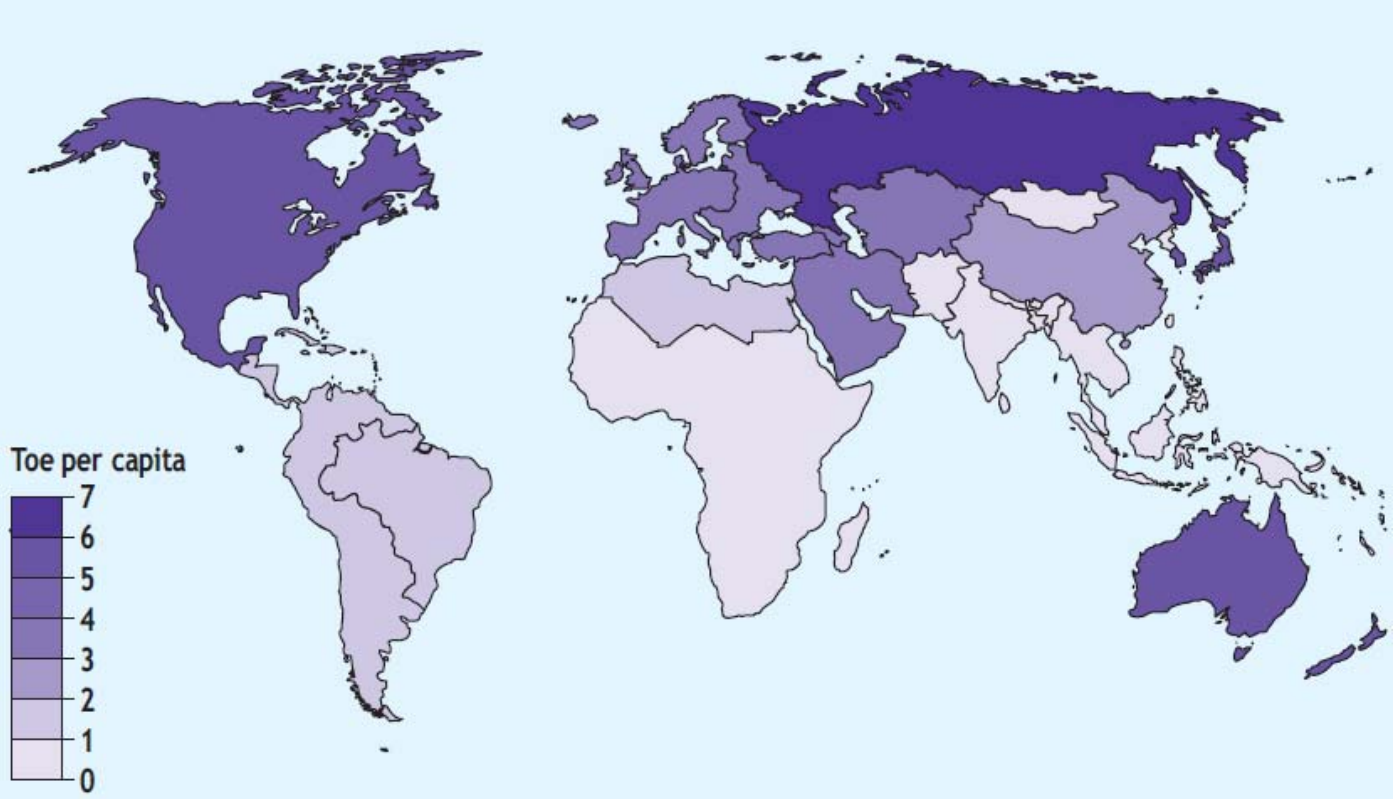
WEO, 2008

Energy-related CO_2 emissions result in human sustainability challenges



Source: WEO 2008

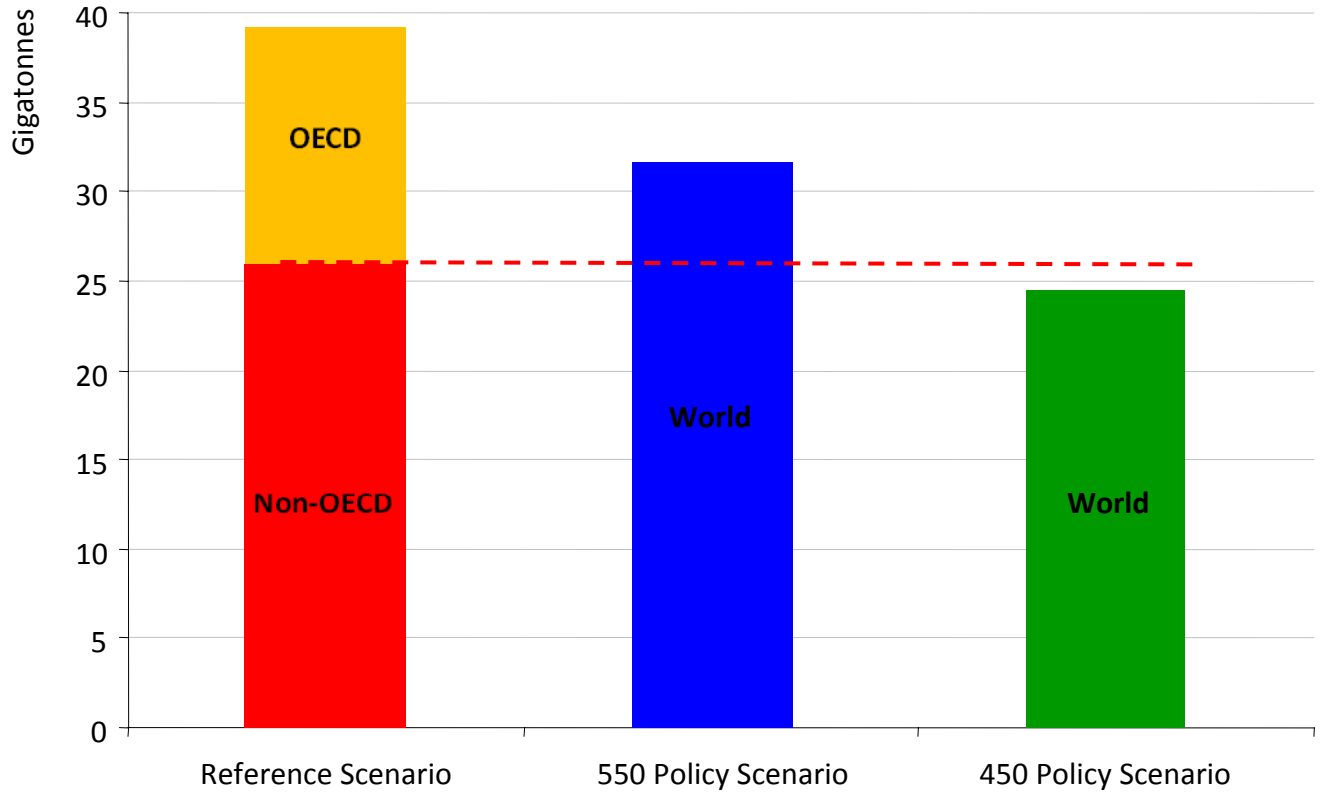
The Reference Scenario: Per-capita primary energy demand, 2030



WEO, 2008

In 2030, disparities in per-capita energy consumption remain stark, ranging from 7 toe in Russia to 0.5 toe in sub-Saharan Africa

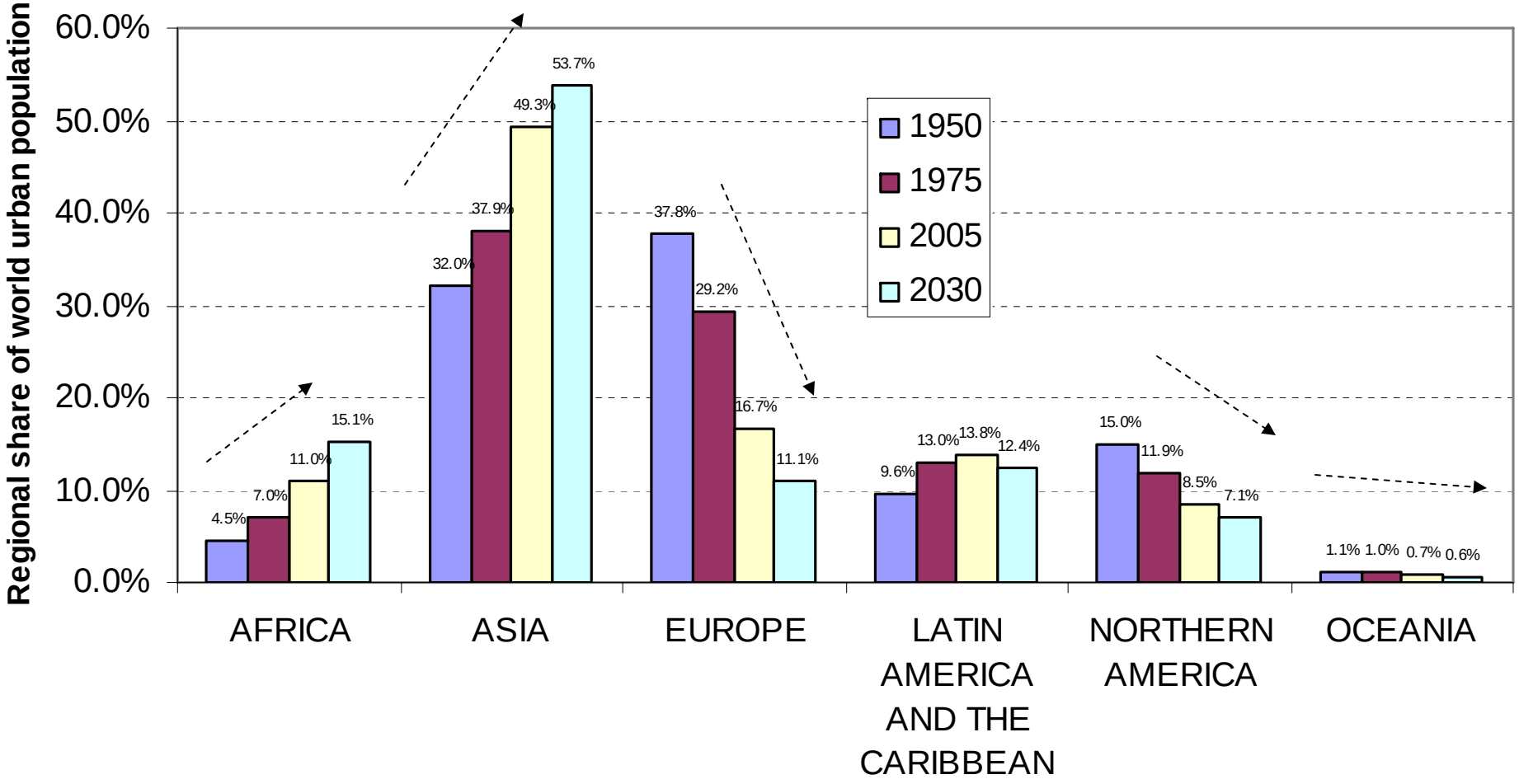
World energy-related CO_2 emissions in 2030 by scenario



OECD countries alone cannot put the world onto a 450-ppm trajectory, even if they were to reduce their emissions to zero

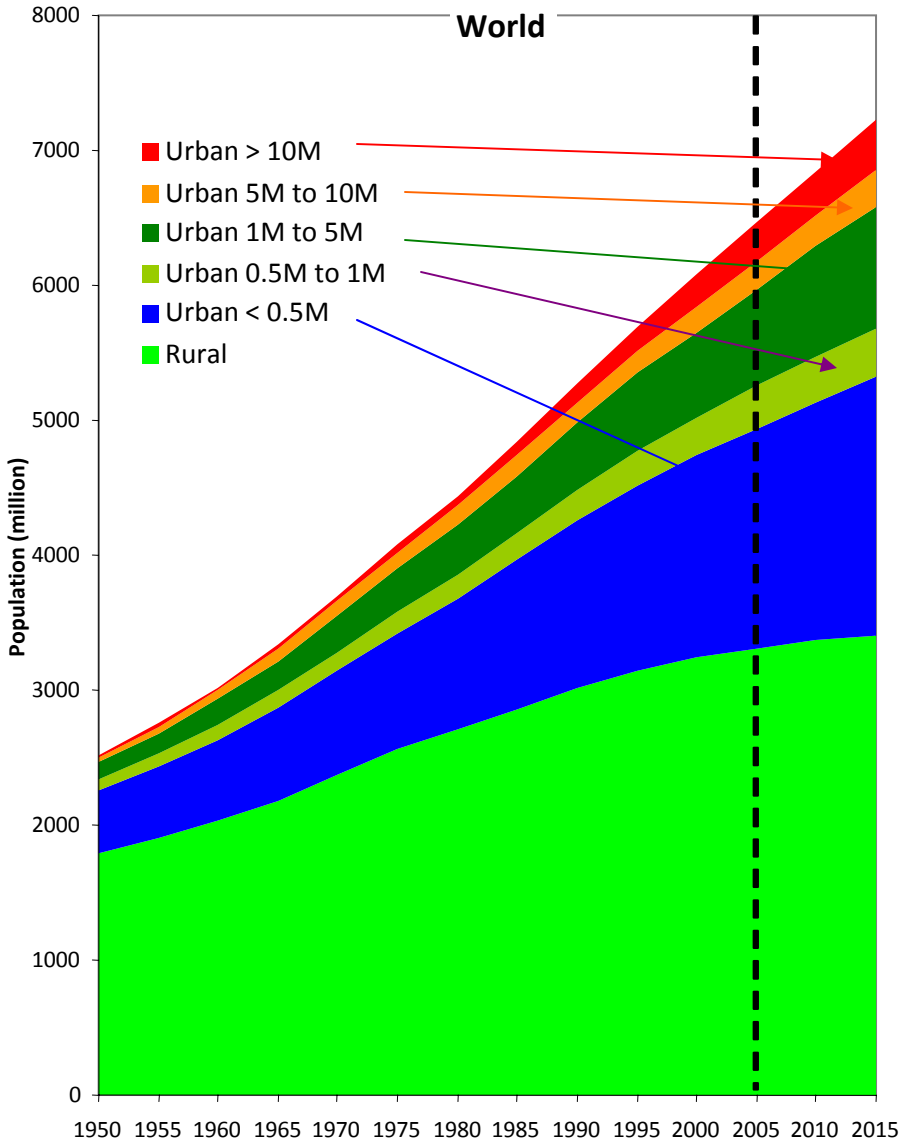
Regional distribution within world's urban population

Shift in the geographical distribution of urban population



Source: United Nations, Department of Economic and Social Affairs, Population Division (2006). World Urbanization Prospects:The 2005 Revision. Working Paper No. ESA/P/WP/200.

Cities by size



No of agglomeration in 2005	% of urban population in 2005
20	9.3%
30	6.5%
364	22.6%
455	10.1%
	51.5%

- Mega-cities are few and collectively makes small share
- Urban settlements with less than half-million make over half of urban population

Source: United Nations, Department of Economic and Social Affairs, Population Division (2006). World Urbanization Prospects:
The 2005 Revision. Working Paper No. ESA/P/WP/200.

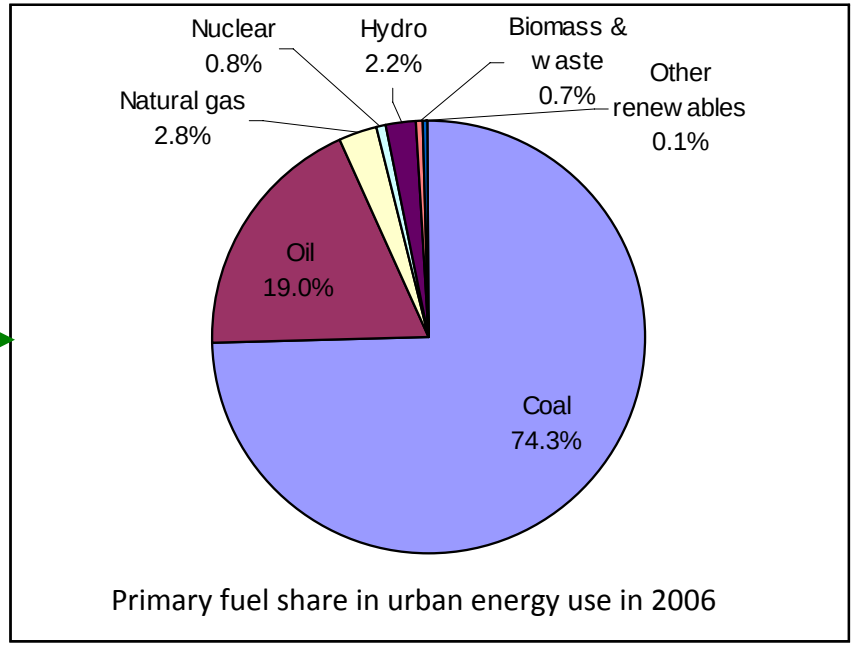
The China case

- China contributes significantly
  - 16.8 % of global urban population (UN 2007)
  - 16% of global primary energy demand, and
  - 20% of global energy-related CO2 (WEO 2008)
- China's primary energy demand will increase further
  - By 2.2 times in 2005-2030 to 3,819 Mtoe (WEO, 2007)
- Urbanization in China will increase further
  - 60% (880 million) by 2030 from 41 % (545 million) in 2005. MGI (2008) projects is to one billion for 2030
- 90% of GDP by 2025 from urban economy (MGI, 2008)
- Urban energy use will increase further
  - Per capita energy in cities are 1.8 times higher than national averages in 2006 (WEO, 2008)
  - Such gap will narrow in the future but rapid urbanization will ultimately lead to increasing urban energy use

Urban primary energy use in China

	2006		2030	
	Mtoe	City as a % of national	Mtoe	City as a % of national
Coal	1 059	87%	2 206	90%
Oil	271	77%	648	80%
Natural gas	40	81%	158	84%
Nuclear	12	84%	67	87%
Hydro	31	84%	76	87%
Biomass & waste	10	4%	37	16%
Other renewables	2	45%	27	67%
Total	**1 424**	**75%**	**3 220**	**83%**
Electricity	*161*	80%	*495*	83%

Reference Scenario



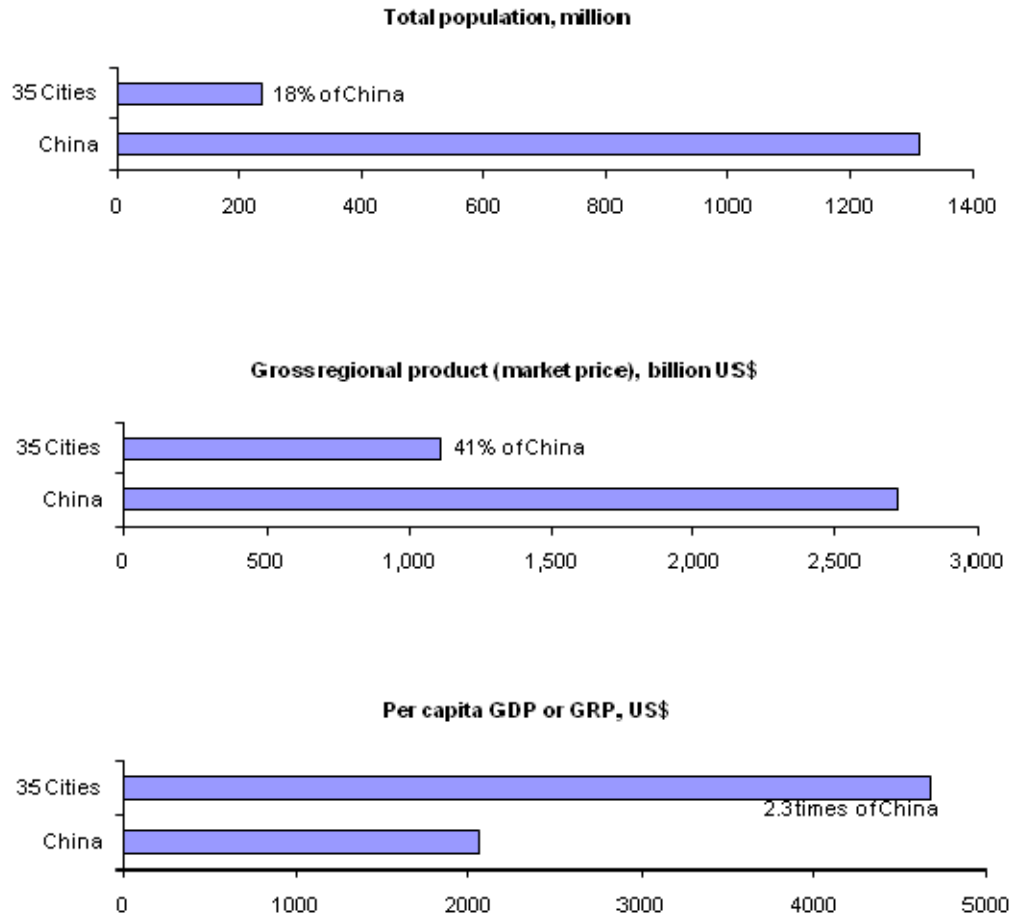
Primary fuel share in urban energy use in 2006

WEO, 2008

For commercial energy, urban's share is much higher i.e. 84%

(Source: Dhakal (2008)

Enormous influence of China's largest and most important 35 cities



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Source: Dhakal (2008)

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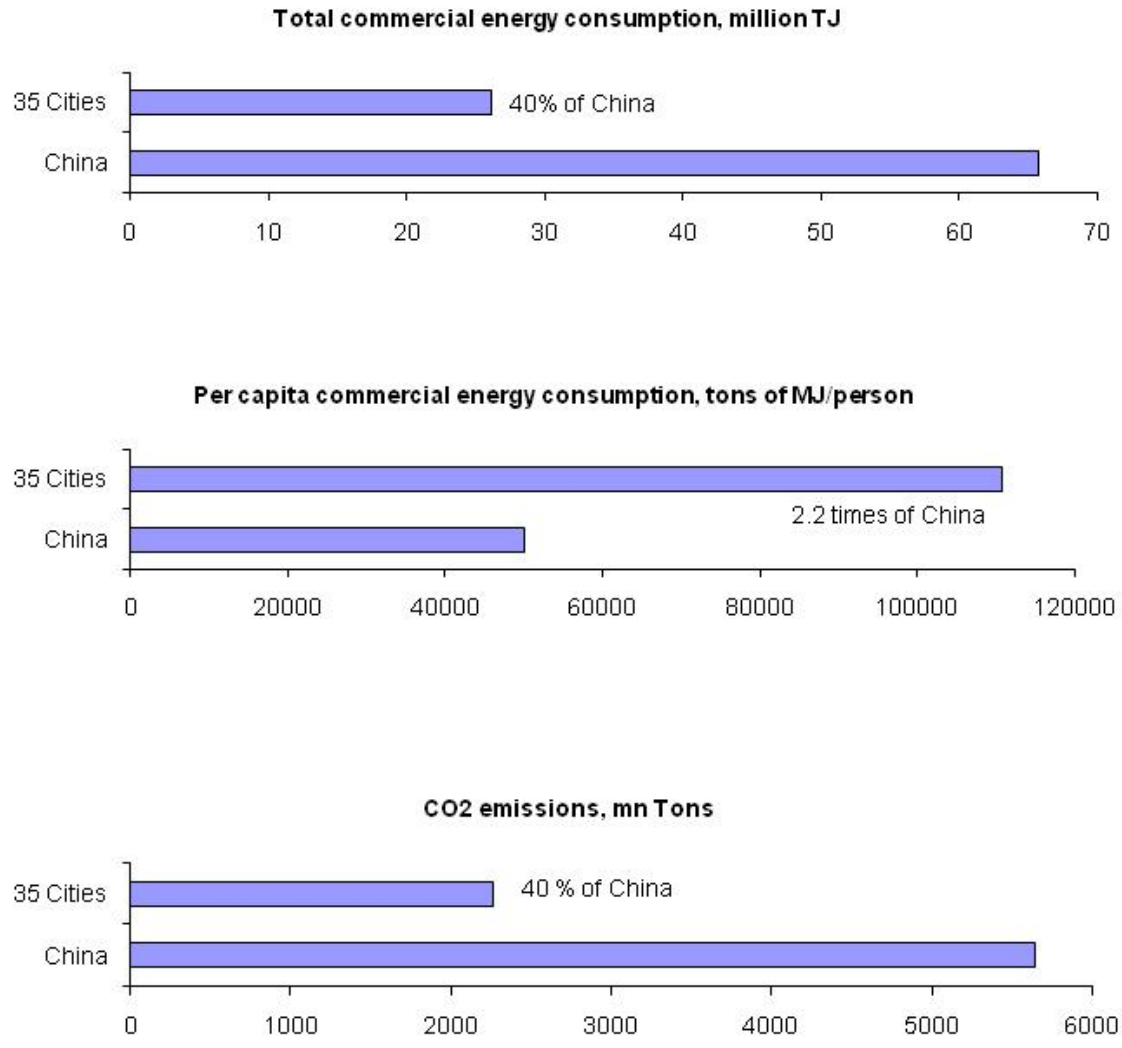


Source: Dhakal (2008)

Four cities

Basic indicators of Beijing, Shanghai, Tianjin and Chongqing, 2006

City	Beijing	Shanghai	Tianjin	Chongqing
Area, Sq Km	16,410	6,340	11,920	82,400
Resident population, million	15.81	18.15	10.75	2,808
Registered population, million	11.98	13.68	9.49	3,199
Urban share in resident population (%)	84%	89%	76%	47%
Gross regional product, billion US$	98.7	130.0	54.7	43.8
Total energy use, thousand TJ [a]	1,332	2,480	1,271	1,160
Total energy related CO2 emissions, million tons [a]	142.10	228.74	117.61	103.97

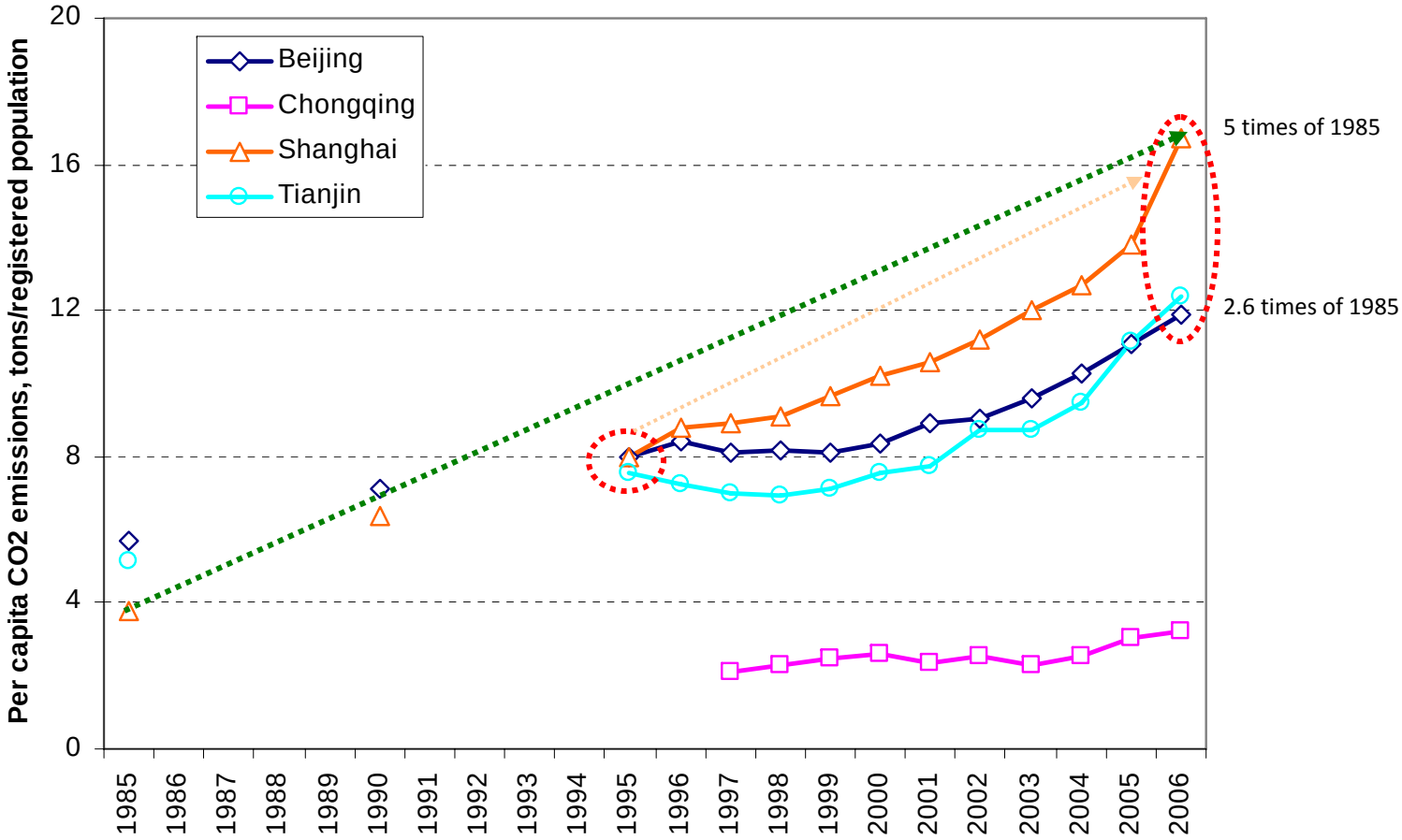
Note the difference between resident and registered population

a Total energy means sum of TFC, distribution/transmission losses and conversion losses

Source: Dhakal (2008)

Per capita CO2 emissions

- **Rapidly rising energy use and CO2 emissions**
- **Diverging trends within cities**



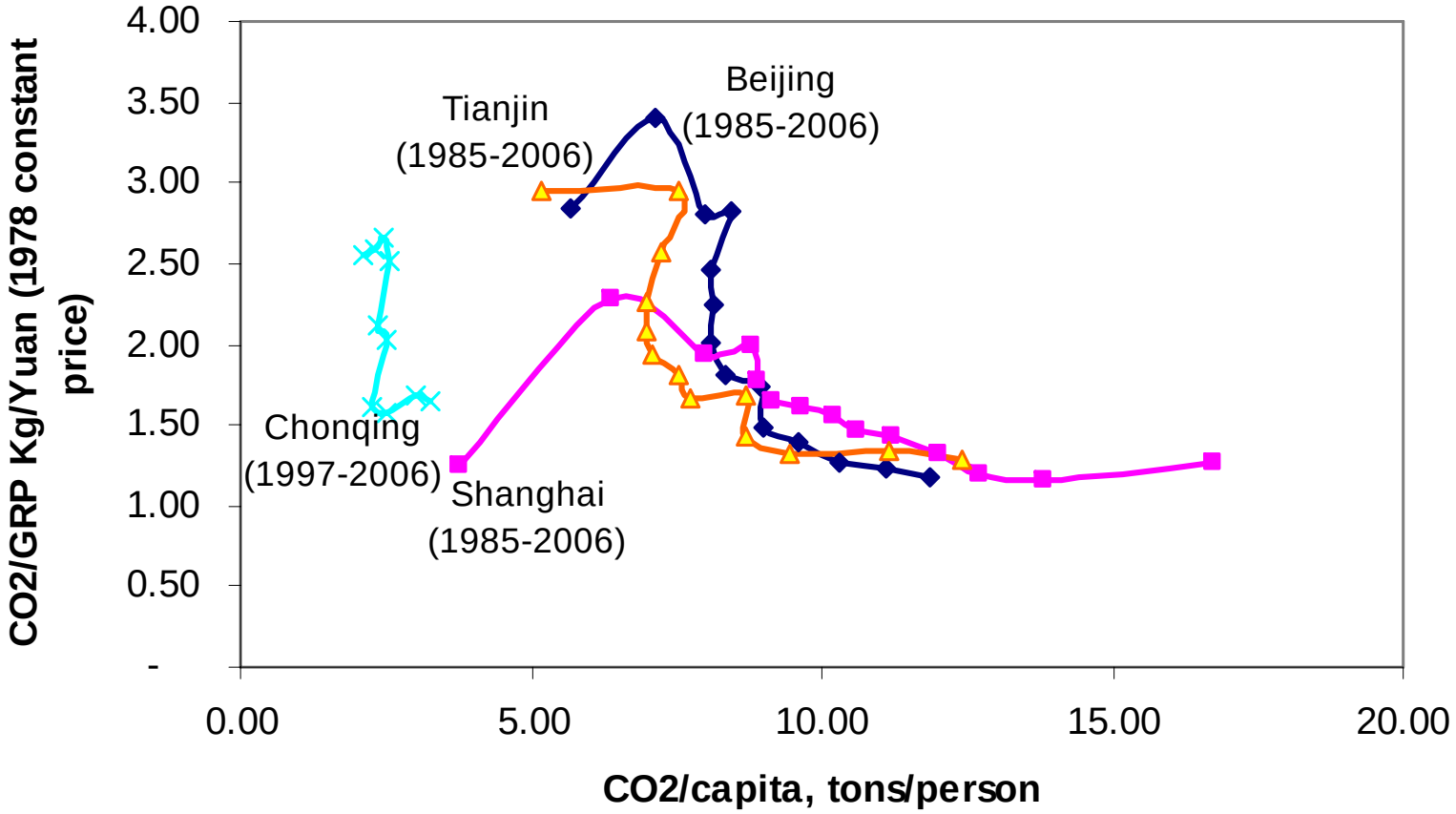
Based on permanent **registered** population

Dhakal(2008)

Common trends in CO2 contribution

- Sectoral CO2 transition
  - Decreasing share of industry sector (except Tianjin)
  - Rising share of commercial and transports sectors
  - Largely unchanged share of residential sector
- Fuel's CO2 transition
  - Declining share of direct coal burning
  - Rising share of electricity and oil
  - Smaller role of natural gas then expected in Shanghai and Tianjin

Carbon intensity of economy and per capita trends



- Failed to perform well, in general (ideally should move towards origin over time)
- Large gain in carbon intensity of economy but this has slowed or even worsened in recent years
- No way to reduce control per capita emission for now – but clearly great need to be dampened the growth and in carbon intensity terms

Final observations

- The speed and size of urbanization keeps urban CO2 and Asia in the center-stage
- 67% of global energy is used in urban areas and urban areas are responsible for 71% of the energy related CO2 – this will increases to 73% and 76% respectively by 2030
- Asia, and in particular China and India is and will play bigger role in determining global urban energy and emissions in the future

Final observations- China

- Already about 75% of total energy are used in urban areas (85% of commercial energy) and such share will further increase to 83% despite narrowing urban to national per capita energy gaps
- China's 35 largest cities have and will have enormous and disproportionate influence to energy and carbon. Big cities are economic powerhouses and important. However, there are different pathways within too.
- As seen from Beijing, Shanghai, Tianjin, and Chongqing analyses, a rapid energy transition taking place in cities- a low carbon path in evidently important to explore despite obvious difficulties
- In Chinese cities policy interventions in energy system has synergies with the CO2 reduction (Clean energy, economic structure change, energy efficiency, strengthening of public and mass transportation system)
- But that is not enough if current fuel structure persists and rapid technology deployment for coal such as CCS or IGCC is not used