Considering Climate Change in Latin American Urban Transportation: Concepts, Applications, and Cases

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Congestion or Access?

Key Messages: Saving CO2 in Urban Transport

- **Transport Matters A Lot for CO2; CO2 Matters Little for Transport**

✓ Transport fastest rising CO2 emissions source (24% global 2006, “50% urban”)
✓ Light duty vehicles at center of urban transport problems and rising emissions
✓ High CO2 symptom of poor urban transport in most developing cities
✓ Technology improvements to LDV important, but VKT growth the major problem
✓ Frame problem as a transport problem, not a CO2 problem

- **Framework for Integrating CO2 into Transport Interventions**

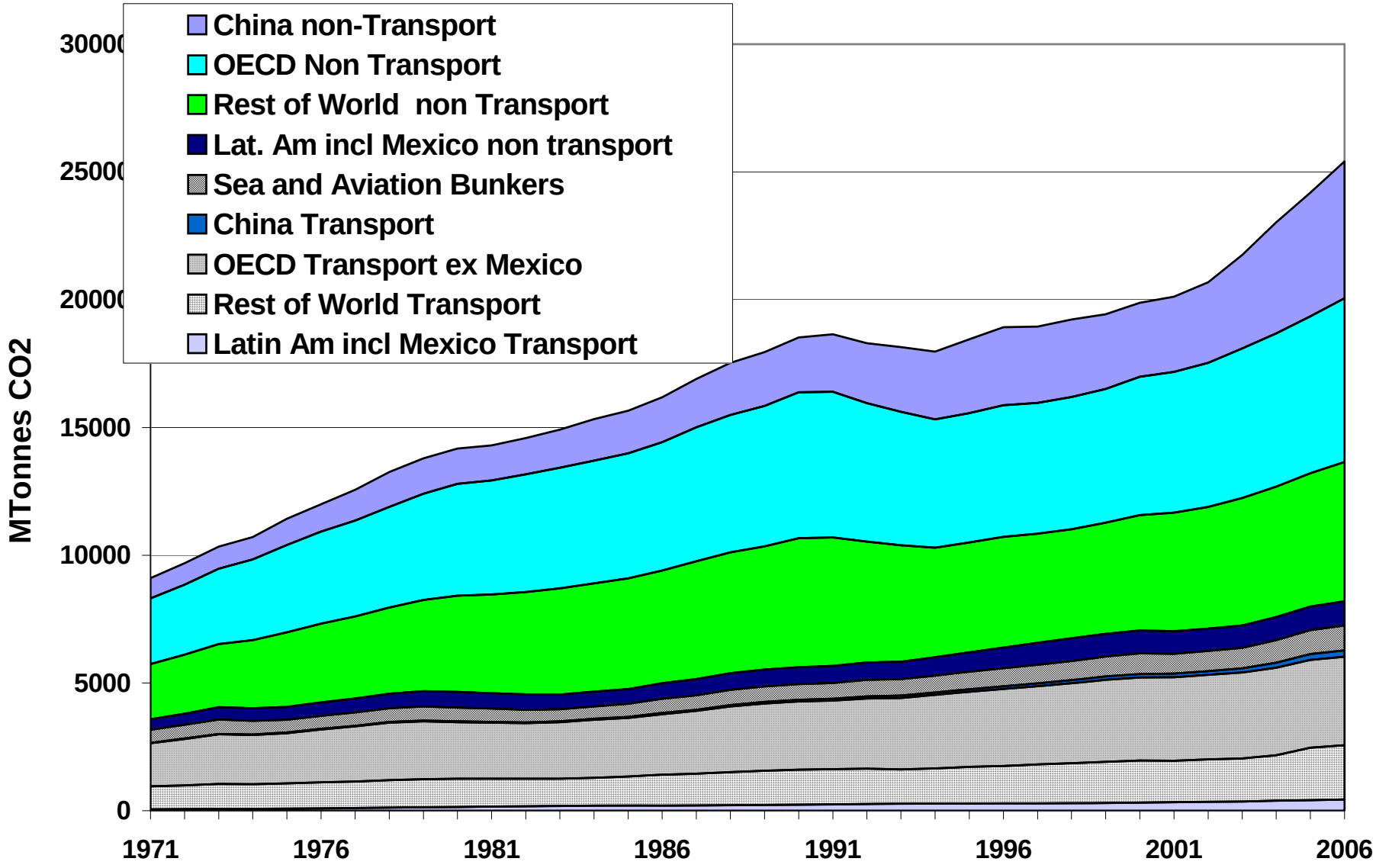
✓ Scope and Scale – from region wide urban development to individual vehicles
✓ CO2 (even at $85/tonne) not major determinant – take as cobenefit
✓ Impacts – Use transport, fuel models and observation to compare with/without
✓ Use models, data to estimate changes in travel, vkt, fuel; time, accidents, CO2
✓ Maximize welfare from transport for a given level of emissions

- **CO2 In Urban Transport – Not by Tailpipe Alone (Further thoughts)**

✓ **A**void – Sustainable urban development (Curitiba) served by good transport
✓ **S**hift - Improve access with collective modes, NMT, with restraint on car use
✓ **I**mprove – Reduce carbon intensity of vehicles, travel and freight
✓ **F**inance good transport, not just CO2 reductions

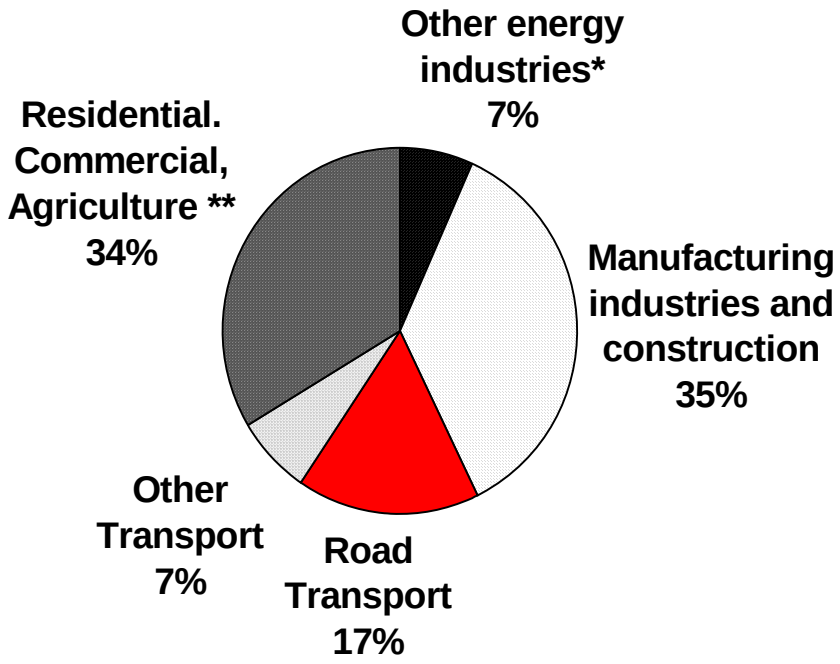
WORLD CARBON EMISSIONS: TRANSPORT

Despite the Small Share of Latin America, CO2 a Problem because Transport a problem

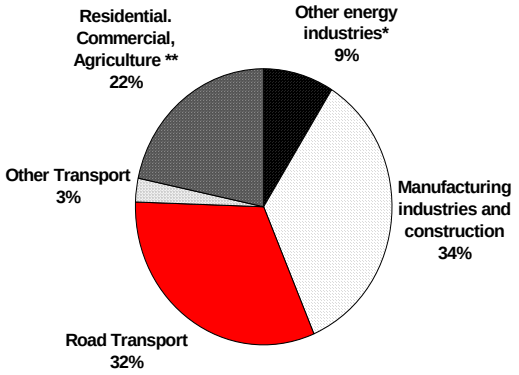


WORLD CARBON EMISSIONS: TRANSPORT Share in Latin America Larger than Elsewhere

CO2 Emissions for World in 2006 (total 4.3 tonnes/capita)



CO2 Emissions for Latin America in 2006 (total 2.5 tonnes/capita)

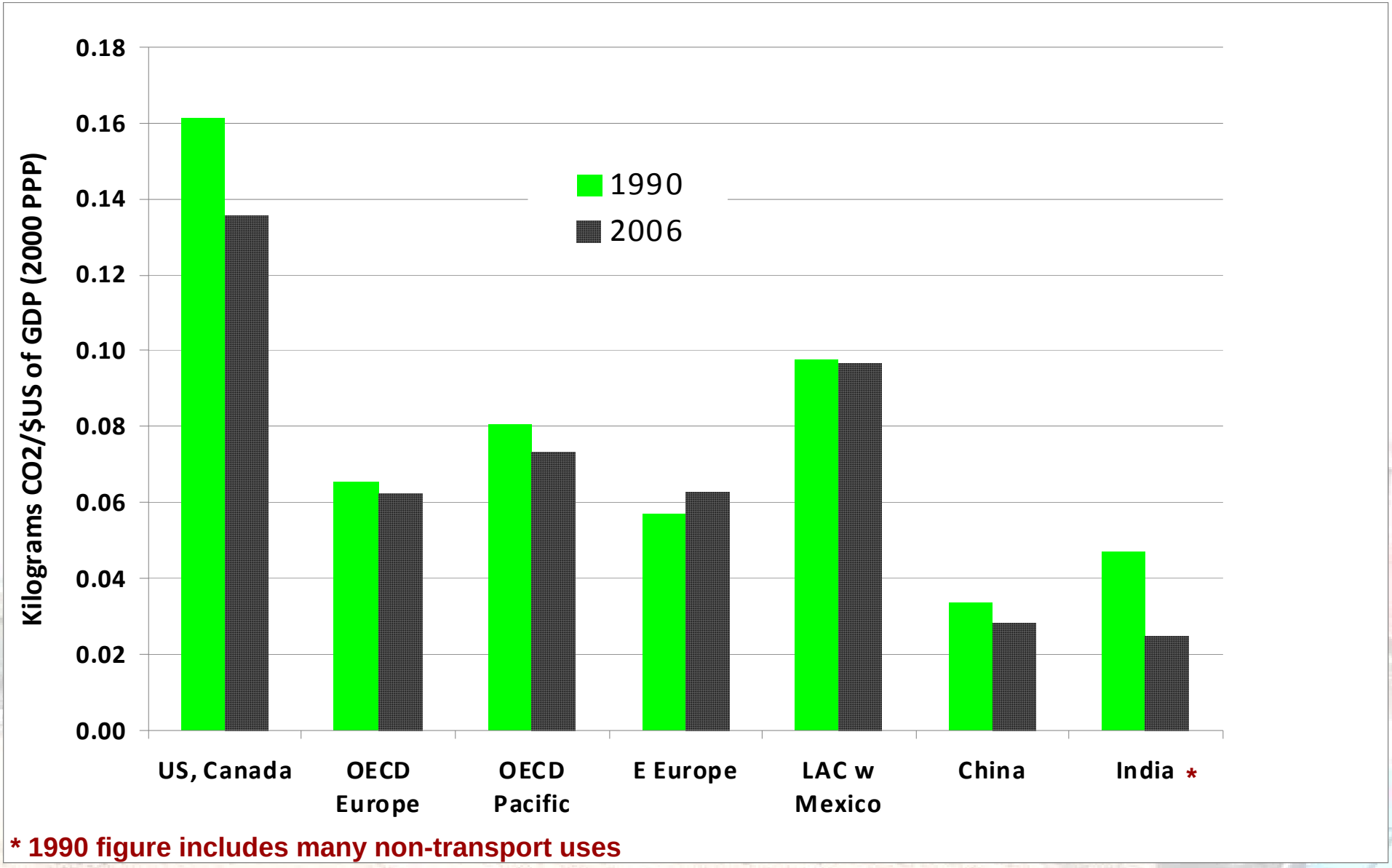


CO2 Emissions: Is Latin America Different?
Total, Per Capita, or Per GDP

- Low in Total CO2
  - Latin America below per capita world avg – Brasil hydro, ethanol (ETOH)
  - Road transport share of total emissions – relatively high despite ETOH
  - Road transport emissions high share of total transport emissions
- Per Capita or Per GDP?
  - Total per capita intermediate by developing country standards
  - Total per GDP high by developing country standards (ex ME)
  - Ratio of CO2 in road transport/GDP barely falling
- Trends over Time
  - Ratio fell before 1990 as Brazilian ETOH role increased
  - Barely fell 1990-2006 as ETOH could not keep pace
  - Ratio fell more in most other regions

High Or Low CO2 Not The Issue: The Issue is Transport

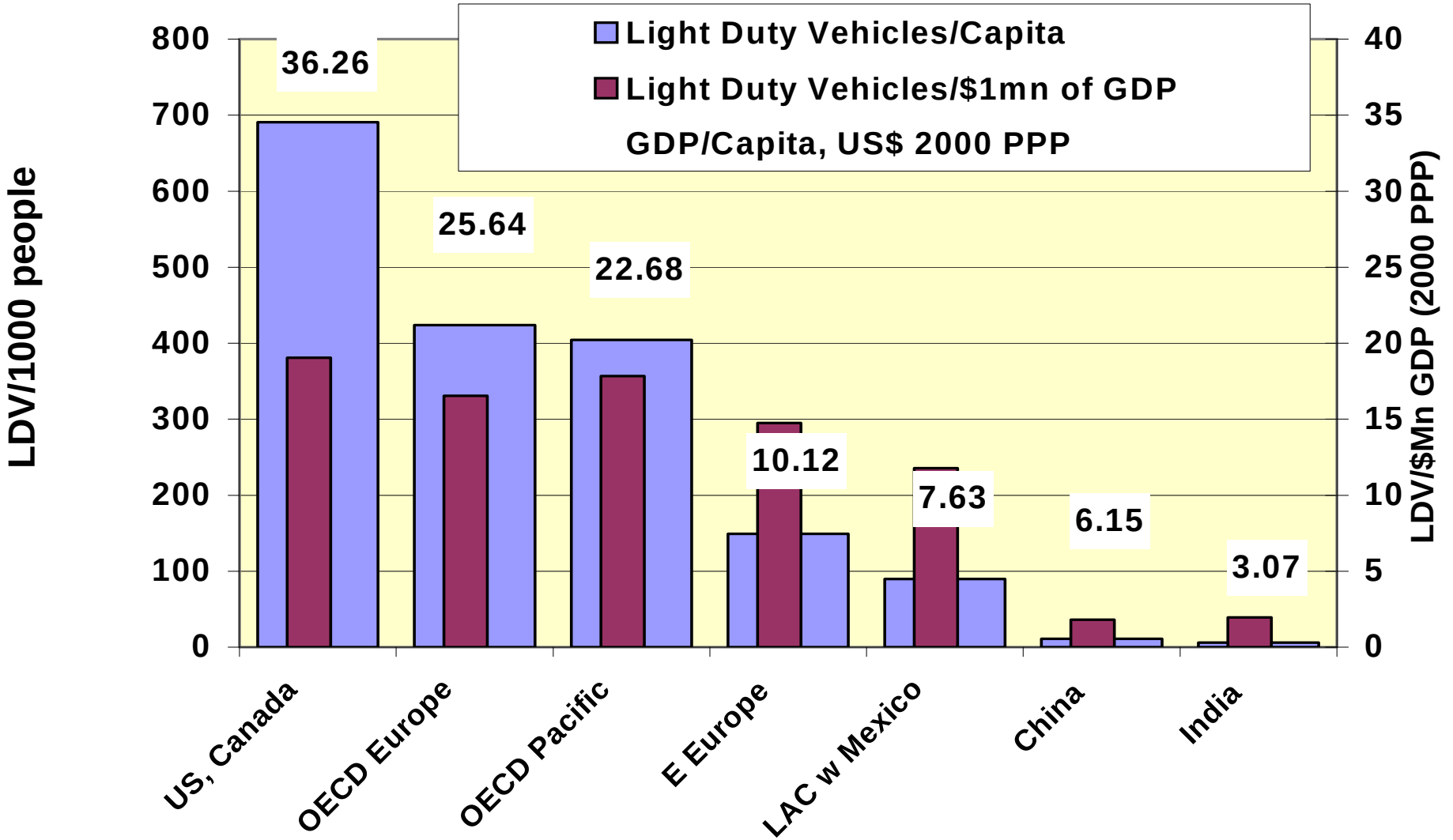
Road Transport Emissions Relative to GDP? Falling Only Very Slowly in Latin America



* 1990 figure includes many non-transport uses

Light Duty Vehicle Ownership and Income

Latin America is High for Its Income – the Link to CO2

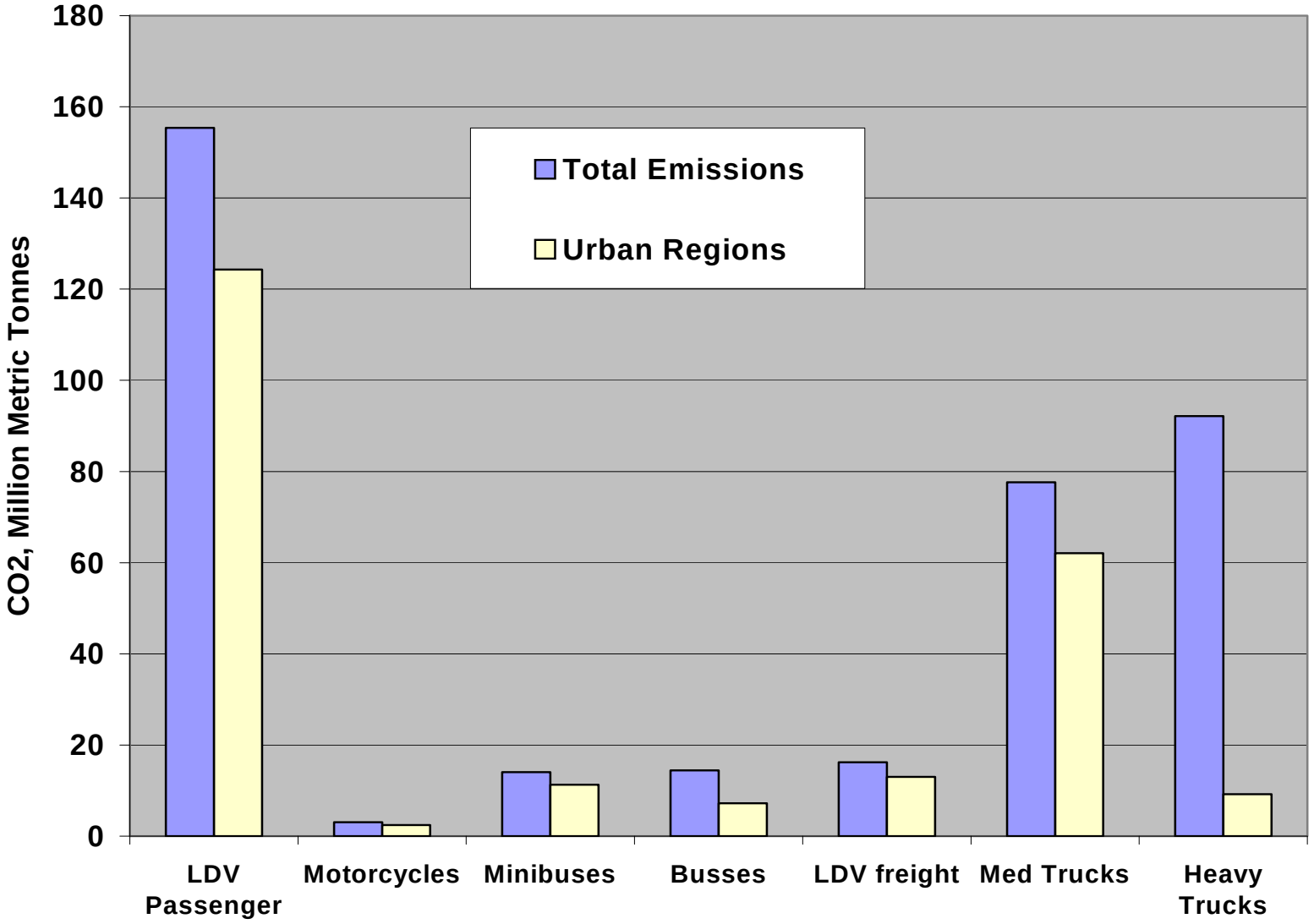


Light Duty Vehicles Dominate Urban Streets and CO2 Emissions

- Global Estimate for All of Latin America
  - WBCSD Estimates for 2000- 75% of VKT, 43% of rd. trans. emissions
  - If “Urban” 80% of LDV, minibus, 50% of bus, 10% of heavy freight –
  - Urban LDV are 80% of VKT and 55% of emissions
- Similar Results from Local Emissions Inventories
  - Mexico City, Bogota, S Paolo and Santiago
  - High car share means high congestion
  - High congestion itself worsens fuel use, local pollution
- High CO2 is Symptom of Poor Urban Transport
  - Light duty vehicles (and colectivos) clog streets
  - LDV -> 55% of urban-centered road transport CO2 emissions
  - Tough measures to address LDV required

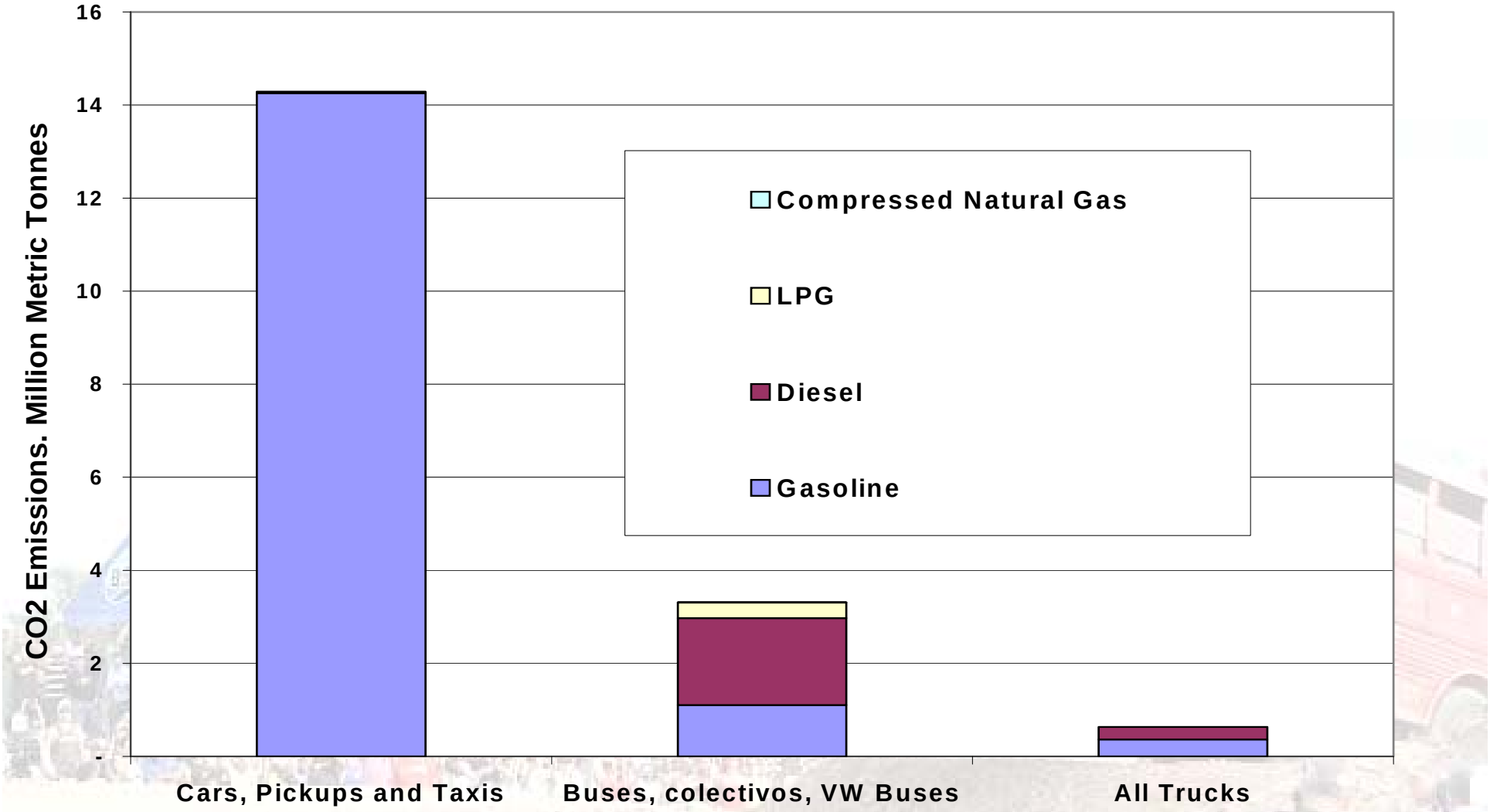
Hard to Address CO2 without Improving Urban Transport

CO2 Emissions from Road Transport in MCMA – The Urban Share by Vehicle Type



*Source: This study based on SMP/WBCSD and IEA/MOMO estimates by mode 2005

CO2 Emissions from Road Transport in MCMA – Similar Patterns for Bogota, Santiago, S Paulo*



*Source: MCMA Bottom-up Emissions Inventory

S. Paulo has lower emissions from LDV because of alcohol, but still bad traffic

The Future for Transport and Emissions
as LDV Dominance Grows

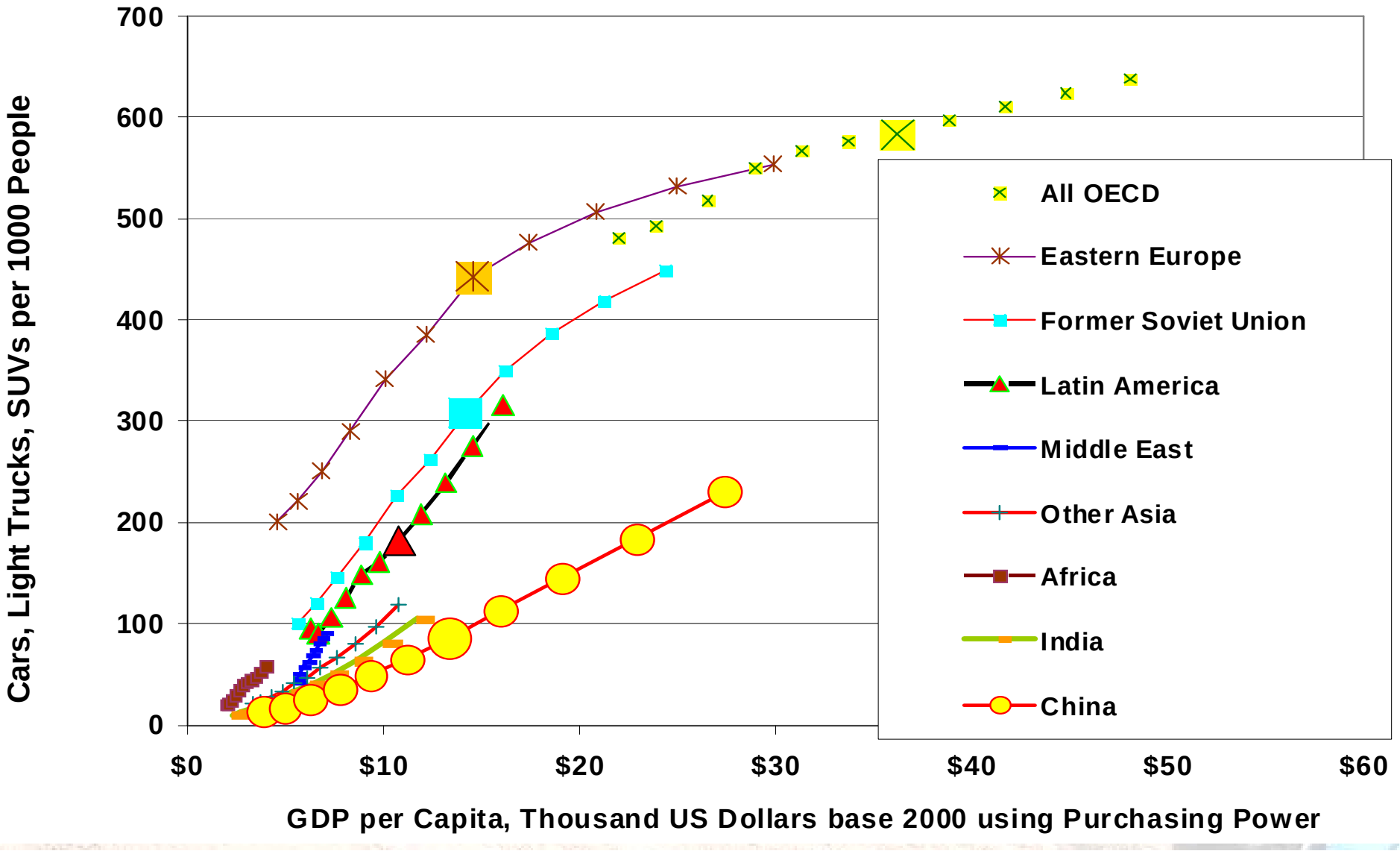
- WBCSD Projections: “Sustainable Mobility Project” (SMP)
  - First truly global mobility-CO2 study
  - Projected all major regions, all transport modes, all fuels
  - Signed by CEO of major oil and vehicle makers
- Latin America in Perspective by 2030 – According to SMP
  - Remains most motorized part of developing world
  - LDV dominate growth in fuel use despite 20% lower fuel/km
  - 2030 Emissions 250% of 2000 (other regions narrow gap)
- Dealing with CO2 in Urban Transport Means Facing LDV
  - “Good Transport” (Mitric) means fewer vkt, probably fewer cars
  - Transport measures (congestion pricing, vkt fees) and fuel economy
  - Low CO2 transit vehicles only have a minor impact

Needed: Strong Transport Actions Slowing Car VKT,
Strong National Actions on fuel/CO2 Taxes, Fuel Economy

Projections of GDP/Capita and Cars/Capita

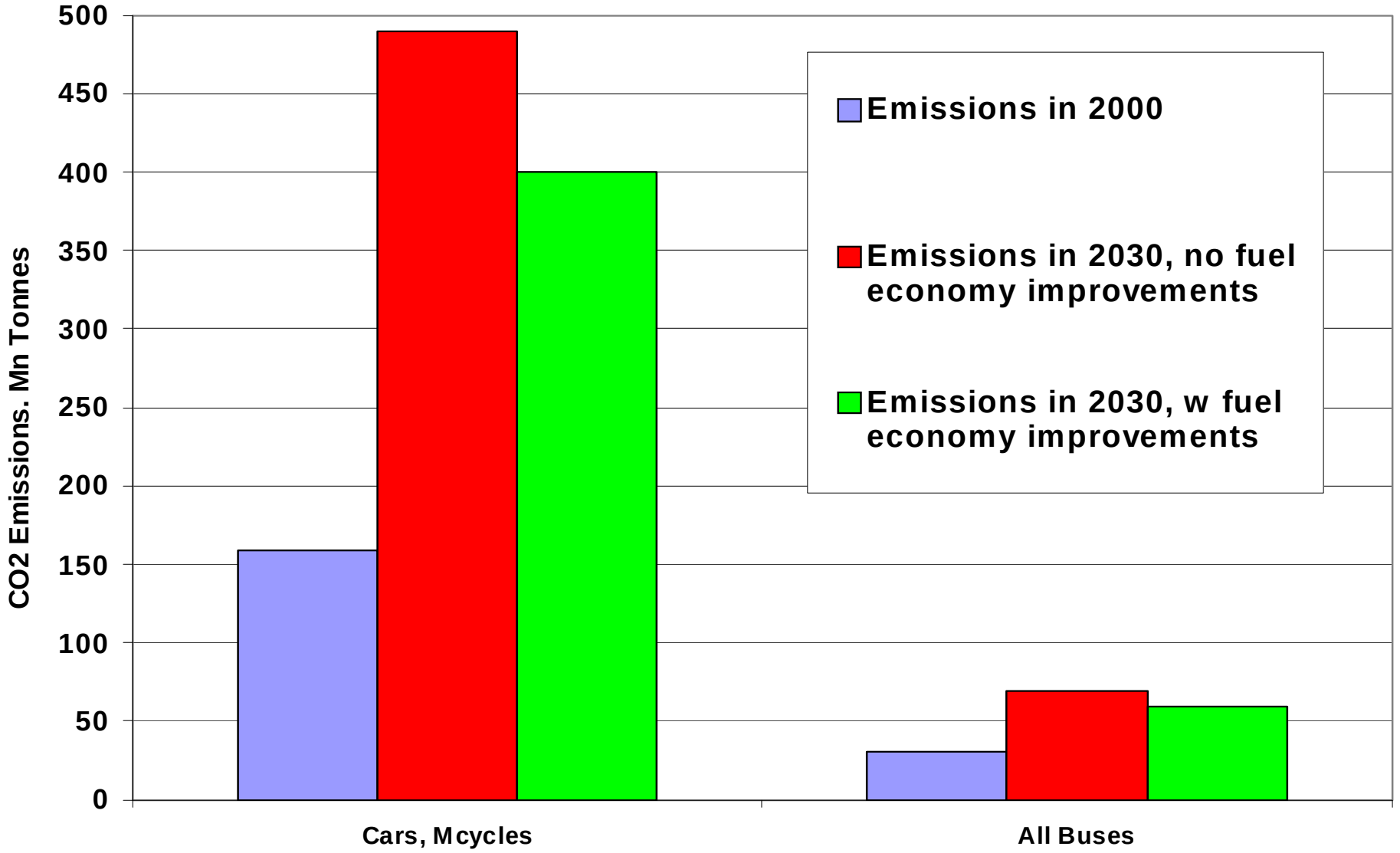
Latin America Remains Highly Motorized / GDP

Source WBCSD *Sustainable Mobility Project*



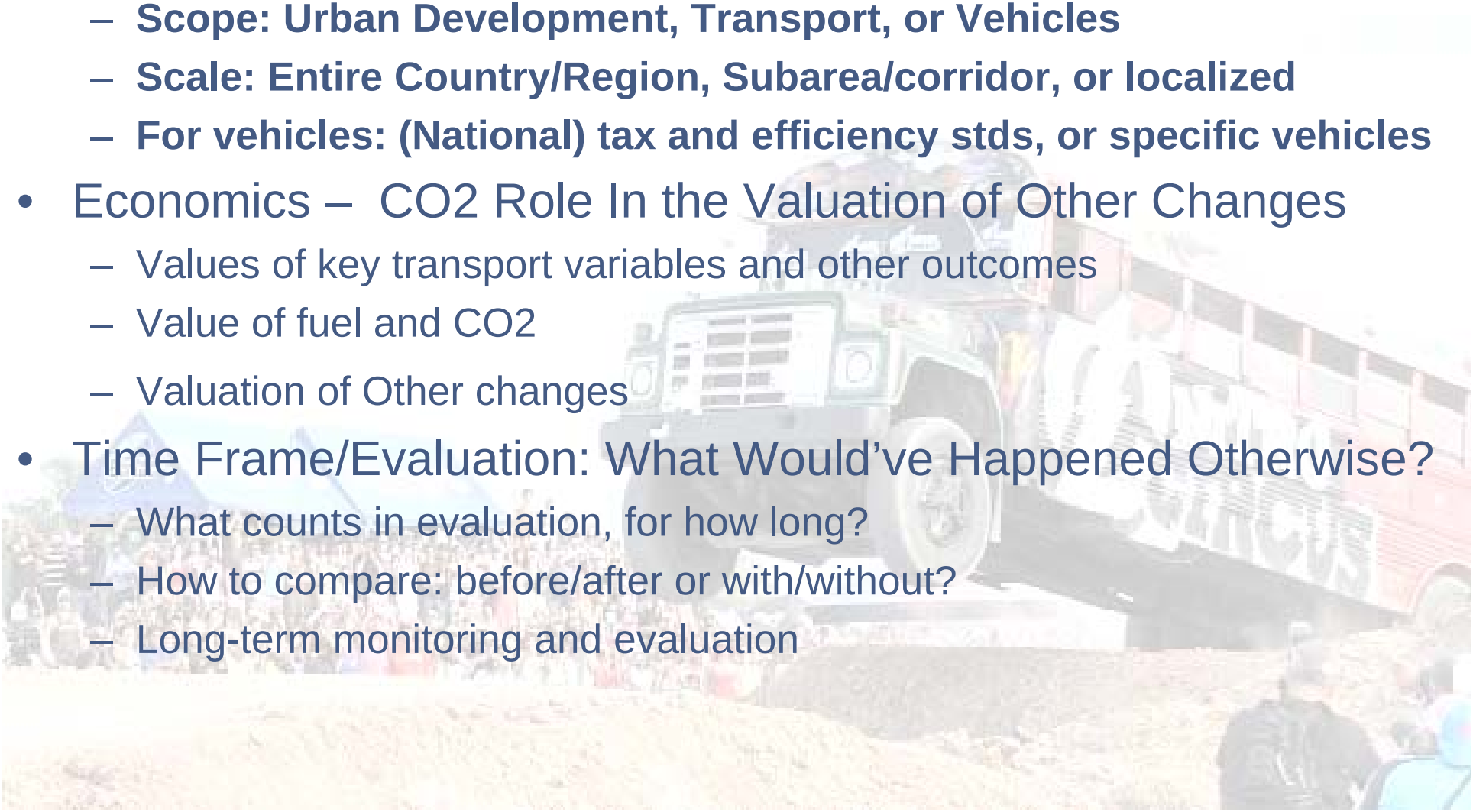
Future Latin America Passenger Road Transport CO2 Driving Force is LDV Ownership and Use

(Source WBCSD *Sustainable Mobility Project*)

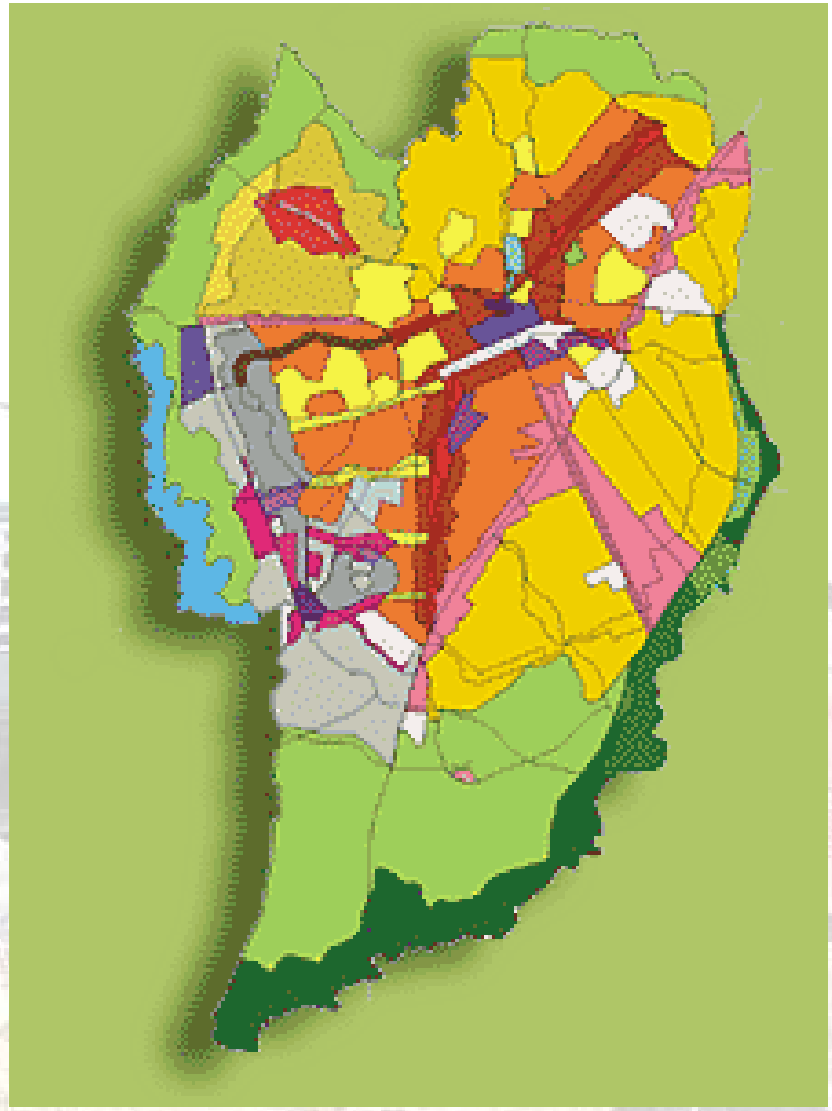


Framework for Integrating CO2 into Urban Transport: About Transport, Not Climate Change

- **Determine Scope and Scale of Intervention**
  - **Scope: Urban Development, Transport, or Vehicles**
  - **Scale: Entire Country/Region, Subarea/corridor, or localized**
  - **For vehicles: (National) tax and efficiency stds, or specific vehicles**
- Economics – CO2 Role In the Valuation of Other Changes
  - Values of key transport variables and other outcomes
  - Value of fuel and CO2
  - Valuation of Other changes
- Time Frame/Evaluation: What Would've Happened Otherwise?
  - What counts in evaluation, for how long?
  - How to compare: before/after or with/without?
  - Long-term monitoring and evaluation



Avoid High CO2 Emissions Through Development: Curitiba's street street and land use system



Scope and Scale: Shift and Strengthen
Low CO2 Transport: Region wide or One Route?

Scope and Scale: Low Emission Vehicles

Light Duty Vehicles Usually Depend on National Policies

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  - For vehicles: (National) tax and efficiency stds, or specific vehicles
- **Economics – Valuation of CO2 and Other Changes**
  - **Values of key transport variables and other outcomes**
  - **Value of fuel and CO2**
  - **Other Immediate Impacts**
- Time Frame and Evaluation: What Would Have Happened?
  - What counts in evaluation, for how long?
  - How to compare: before/after or with/without?
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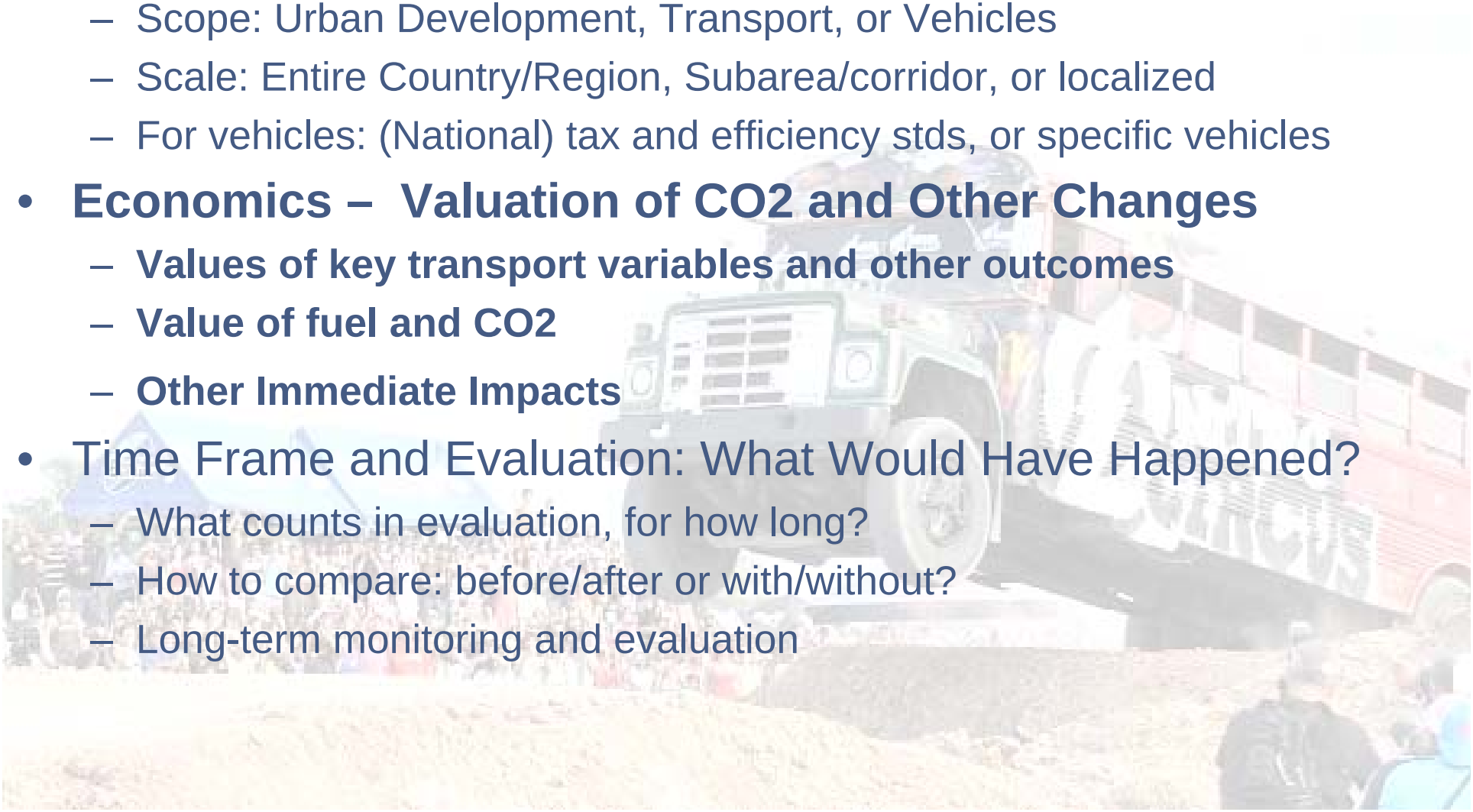

Transport Externalities in US Context

Range of Costs/Mile large- Which are Most Important?

Range External Costs in Cost-of-Driving Studies	Low	High	(JEL)Journal Of Economic Literature	Comments on Latin AM situation
Air Pollution	1	14	2.3	Values are probably higher for LAC cities because of higher levels of air pollution, even after adjusting for Quality-adjusted value of life. See Vergara et al 2002 and Harvard School of Public Health 2003
Climate Change	0.3	1.1	0.3-3.5	Value widely disputed (Nordhaus 2008; Stern 2006) and certainly dependent on national and local situation. 0.3 cents/mile = $10/tonne CO2; 3.5 cents/mile= $80/tonne CO2
Congestion	4	15	5-6.5	Does not apply to all travel. Depends on value of time (60% of wage rate?) and actual wages
Accidents	1	10	2-7	Depends on valuation of accidents and life. See INE 2006 for MC perspective
Energy Security	1.5	2.6	0-2.2	Values depend on local energy supply situation.

Range of academic national and local studies, official national studies (Canada): CO2 Externality (even at $85/tonne, Stern's value) small compared to others

This means CO2 should be a co-benefit of transport strategies

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  - Other changes
- **Time Frame and Evaluation: What Would Have Happened?**
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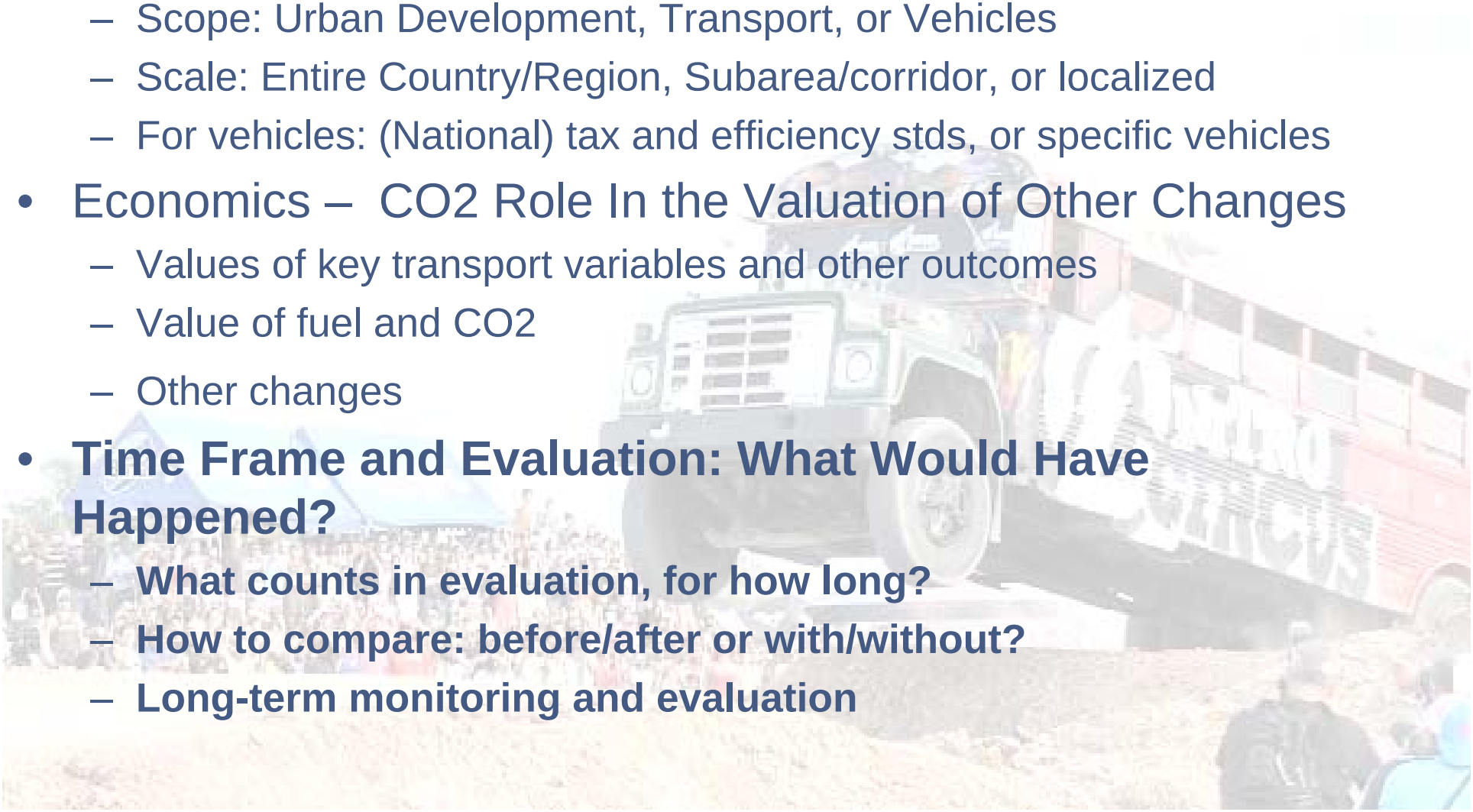
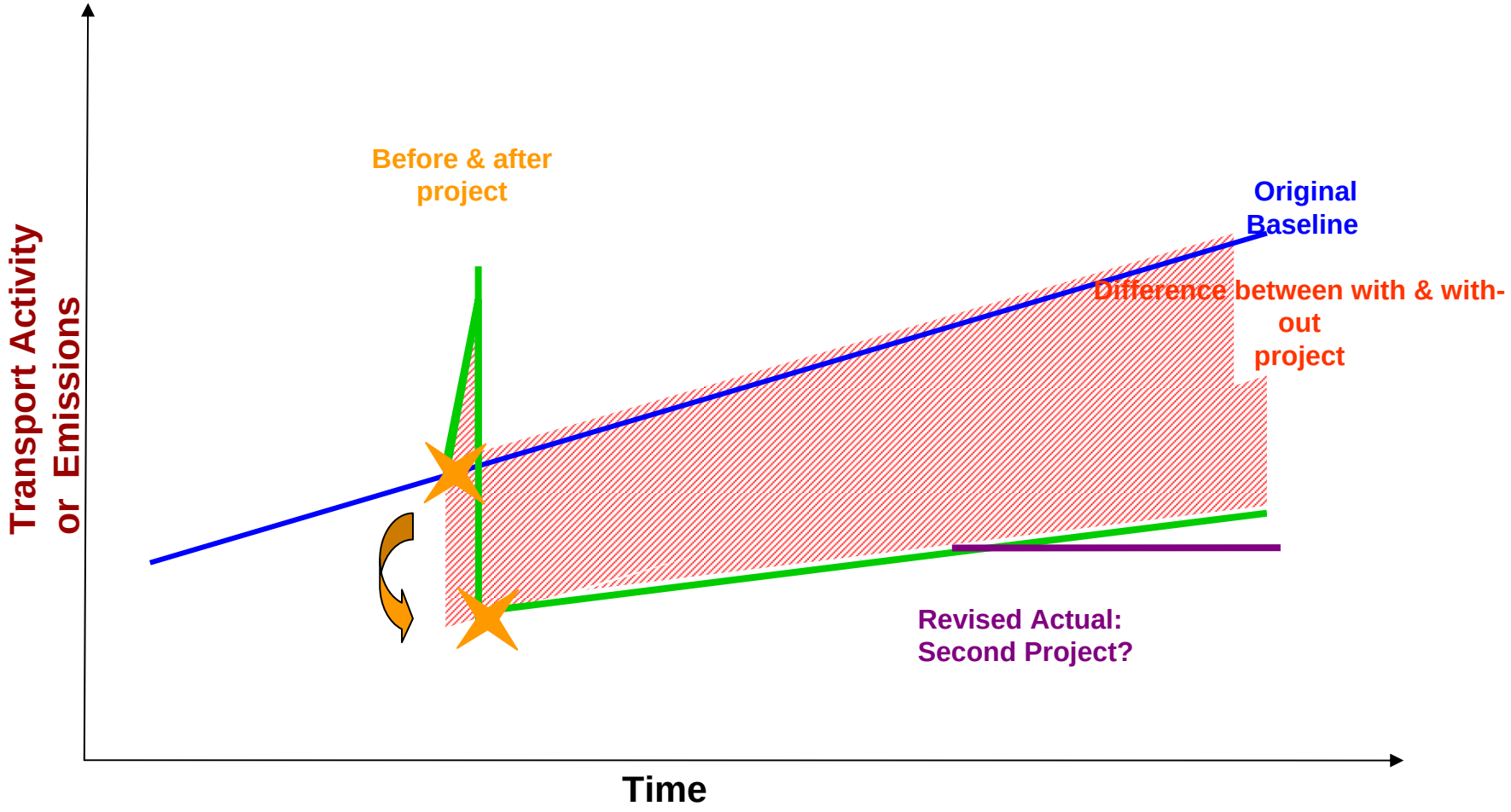
  - **Long-term monitoring and evaluation**



Impact of Intervention: Difference Between BAU (no intervention) and Actual

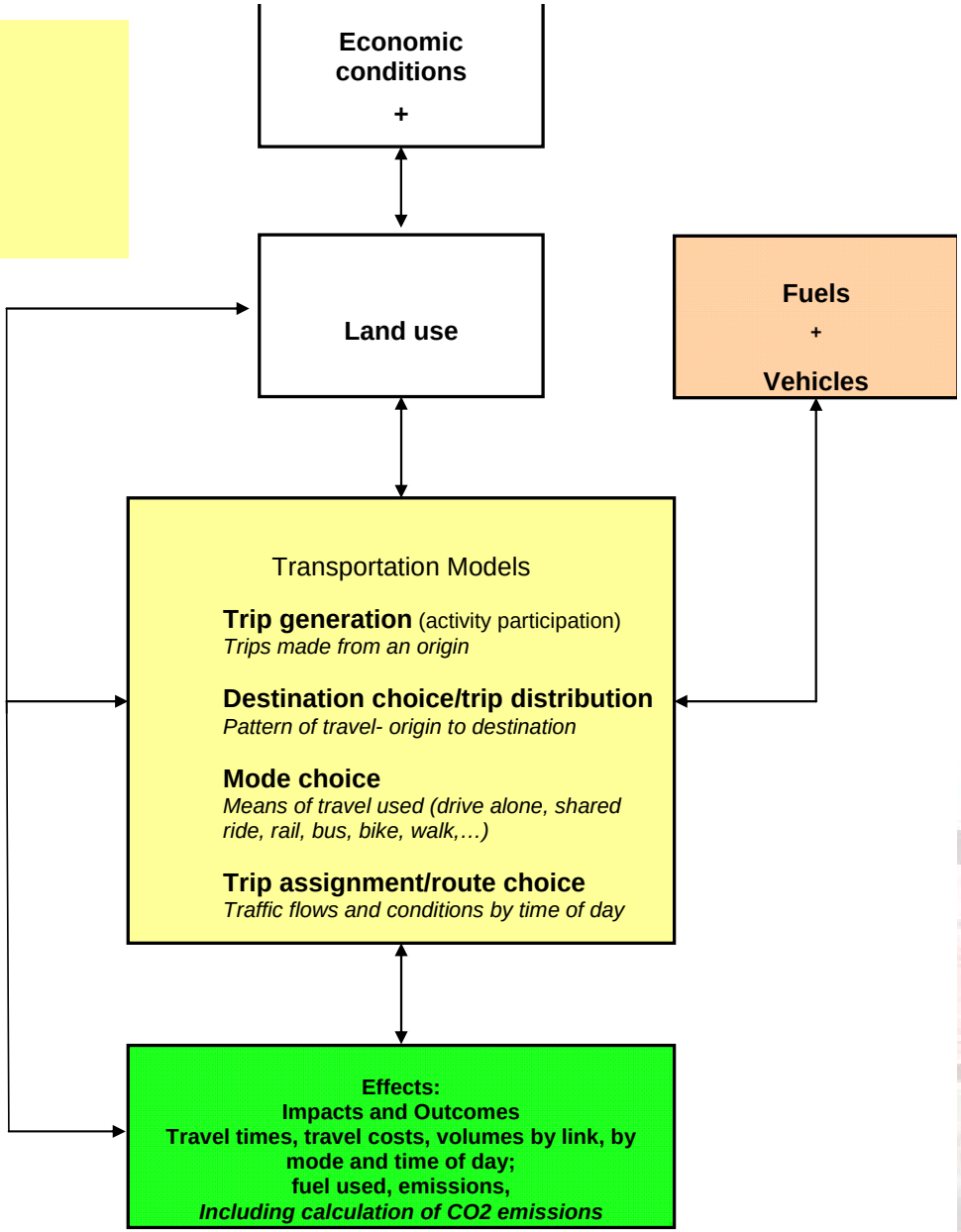


Assessing CO2 Impacts of Projects and Interventions

- Gold Standard: LU-T Model and Good Fuel Use Data
  - Good, calibrated LU-T Model (Santiago?)
  - Recent O-D and traffic flow data and “after” surveys
  - Fuel Use data by vehicle type, calibrate speed/vehicle emission model
- Simpler, ASIF-Style Approaches
  - Average travel and traffic data and est. changes caused by project
  - Observations on kinds of vehicles affected, speed and traffic changes
  - Average fuel use data for vehicle types
- Flags and other Problems
  - Understand limits of modeling and data
  - Unintended side effects
  - Long-term monitoring and evaluation strategies

Impact Evaluation

- Start with basic L.U and transport models and data
- Estimate from scope and scale zone of influence
- Determine impacts on people and vehicles
- Use fuel model to determine changes in fuel and CO2 emissions
- Track changes in major transport and environmental variables
- Try to model longer-term feedbacks on land use, trip generation



Bus Rapid Transit – Mexico's 1st Metrobus Line

260,000 people/day over 19km for US $80mn
Lower emissions, CO2, reduced car traffic

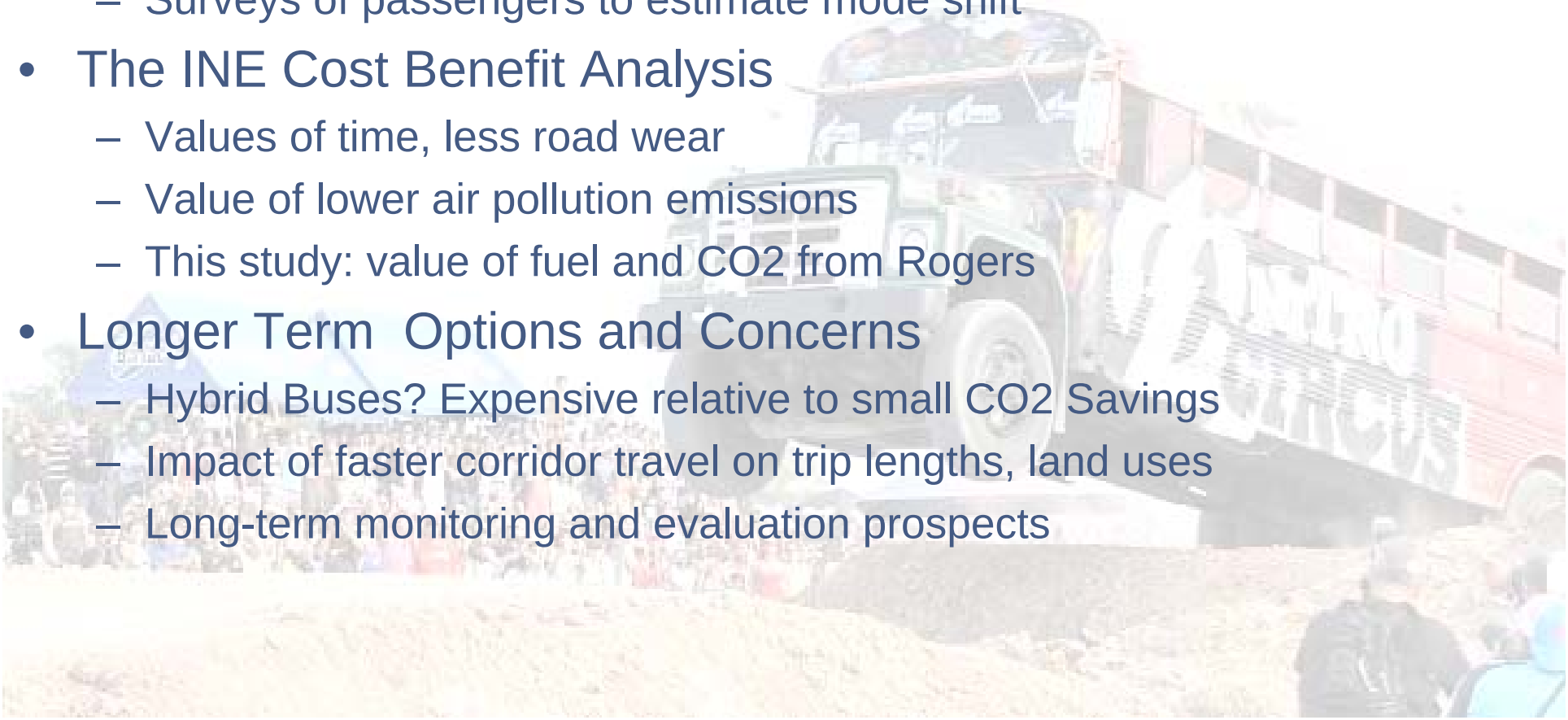
Metrobus as a Case Study in Co-Benefits

How to Save CO2 Without Even Trying

- Scope and Scale
  - Transport: BRT in heavily traveled Insurgentes corridor
  - Reform of model for operators in a corridor
  - Little direct concern for CO2 (hybrid buses would save little at high cost)
- Impacts – 50 000 tonnes/CO2 year
  - Roughly 1/3 from bus switch, 1/3 from better traffic, 1/3 from mode switch
  - Time saving, pollution, fewer accidents large benefits
  - In $, CO2 small benefit even at $85/tonne CO2
- Lessons: Transport First, CO2 as a Co-benefit
  - Most of CO2 saving comes from non-project vehicles (!)
  - Having good long-term data (Inventario) essential for CO2 monitoring
  - 1 good transport project can spark dozens (Insurgentes II, Eje 4)

Mexico City Case Study: Metrobus (with thanks to John Rogers)

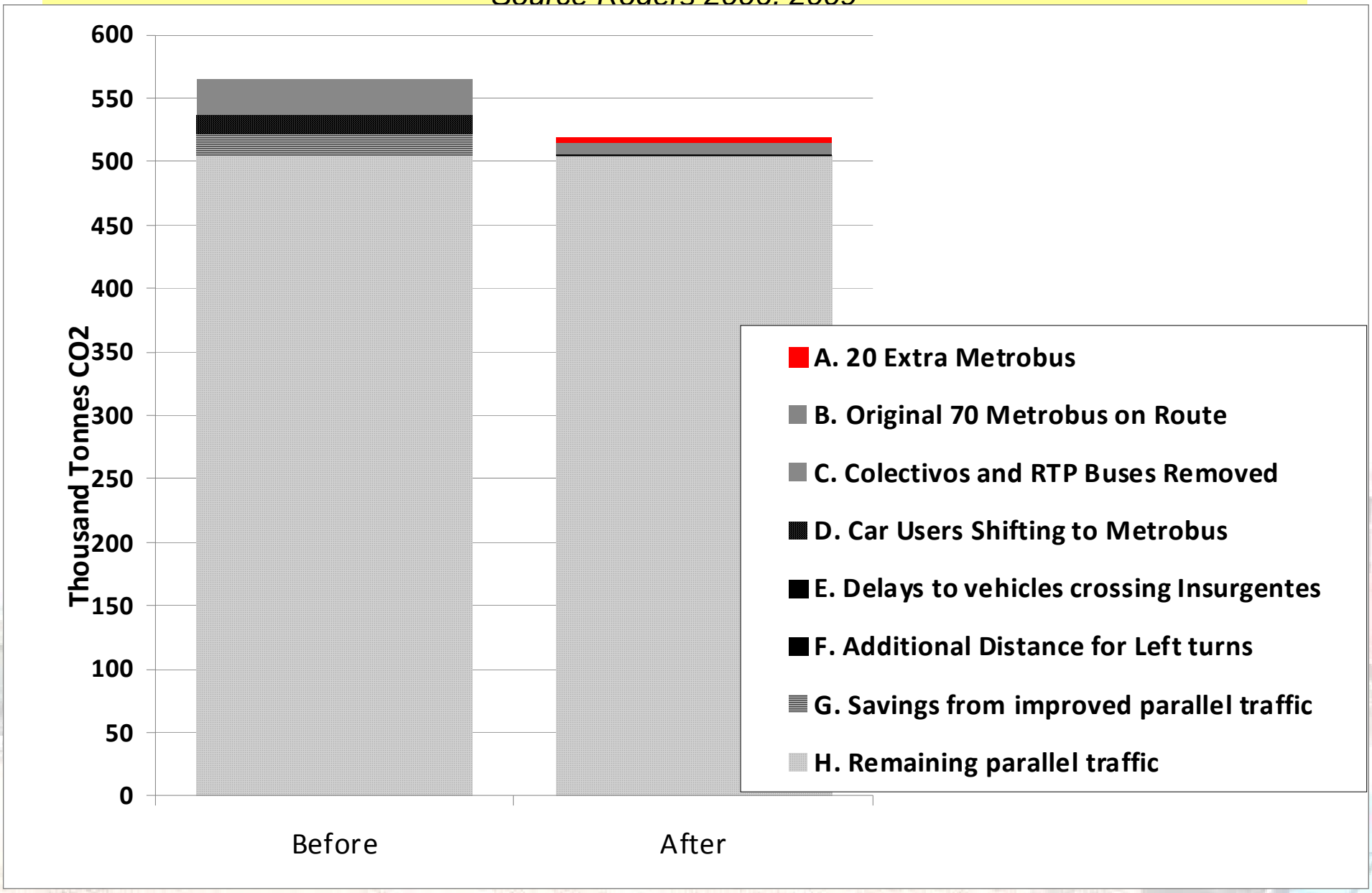
- The Basic Approach to Measuring Changes
  - "Route Based Approach" of Rogers
  - Use MCMA Inventory, observe vehicle flows, bus, colectivo fuel use
  - Surveys of passengers to estimate mode shift
- The INE Cost Benefit Analysis
  - Values of time, less road wear
  - Value of lower air pollution emissions
  - This study: value of fuel and CO2 from Rogers
- Longer Term Options and Concerns
  - Hybrid Buses? Expensive relative to small CO2 Savings
  - Impact of faster corridor travel on trip lengths, land uses
  - Long-term monitoring and evaluation prospects



Metrobus CO2 Changes by Component

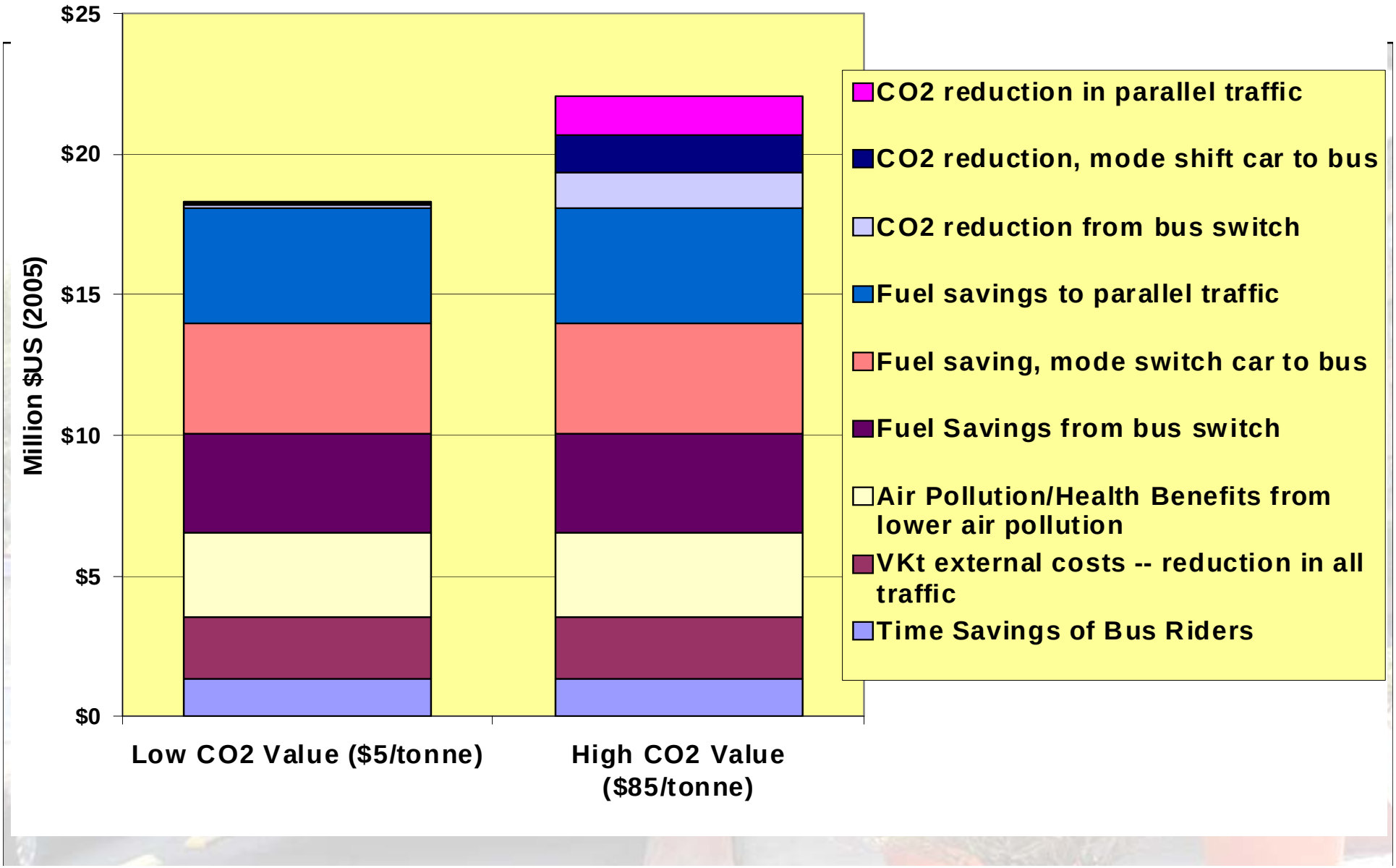
Savings roughly 1/3 mode shift, 1/3 parallel traffic, 1/3 bus switching)

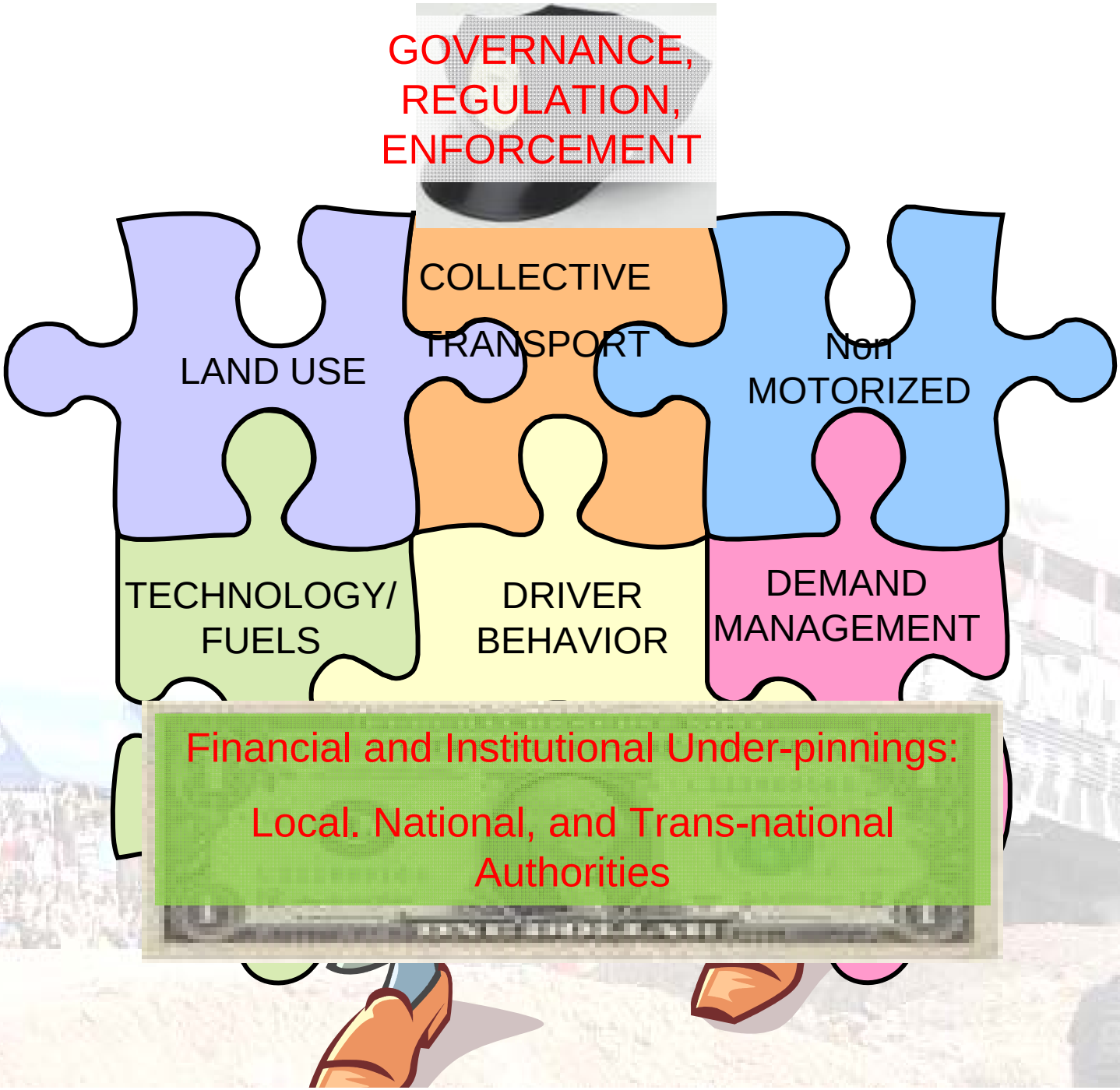
Source Rogers 2006, 2009



Benefits from Metrobus: Broad Than Just CO2

Transport, Health Benefits >> CO2 Benefits




GOVERNANCE, REGULATION, ENFORCEMENT
COLLECTIVE TRANSPORT
LAND USE
Non MOTORIZED
TECHNOLOGY/ FUELS
DRIVER BEHAVIOR
DEMAND MANAGEMENT
Financial and Institutional Under-pinnings:
Local. National, and Trans-national Authorities

Conclusions from UC/GMS Study
Treat CO2 as Symptom of Urban Transport Problem

- Urban Transport and CO2: Must address LDV head-on
  - Light duty vehicles are at the heart of the problem
  - Urban development and transport strategies must address car use
  - Technical measures, fiscal policies on fuel and CO2 emissions
- The Framework for Integrating CO2 into Urban Transport
  - Assess Scope and Scale
  - Estimate and monetize all benefits and quantify CO2 co-benefit
  - Compare results over time with “no intervention”
- Evaluation – Whether” Gold Standard LUT” Model or “ASIF”
  - First estimate changes in travel behavior and vehicle use
  - Then calculate fuel and CO2 changes and other effects
  - Look for unintended side effects

Schipper’s Take: Key Challenge is Gaining Political Will to Take on Car, not $$$$$

TECHNOLOGY LEAPFROGGING In PANAMA?

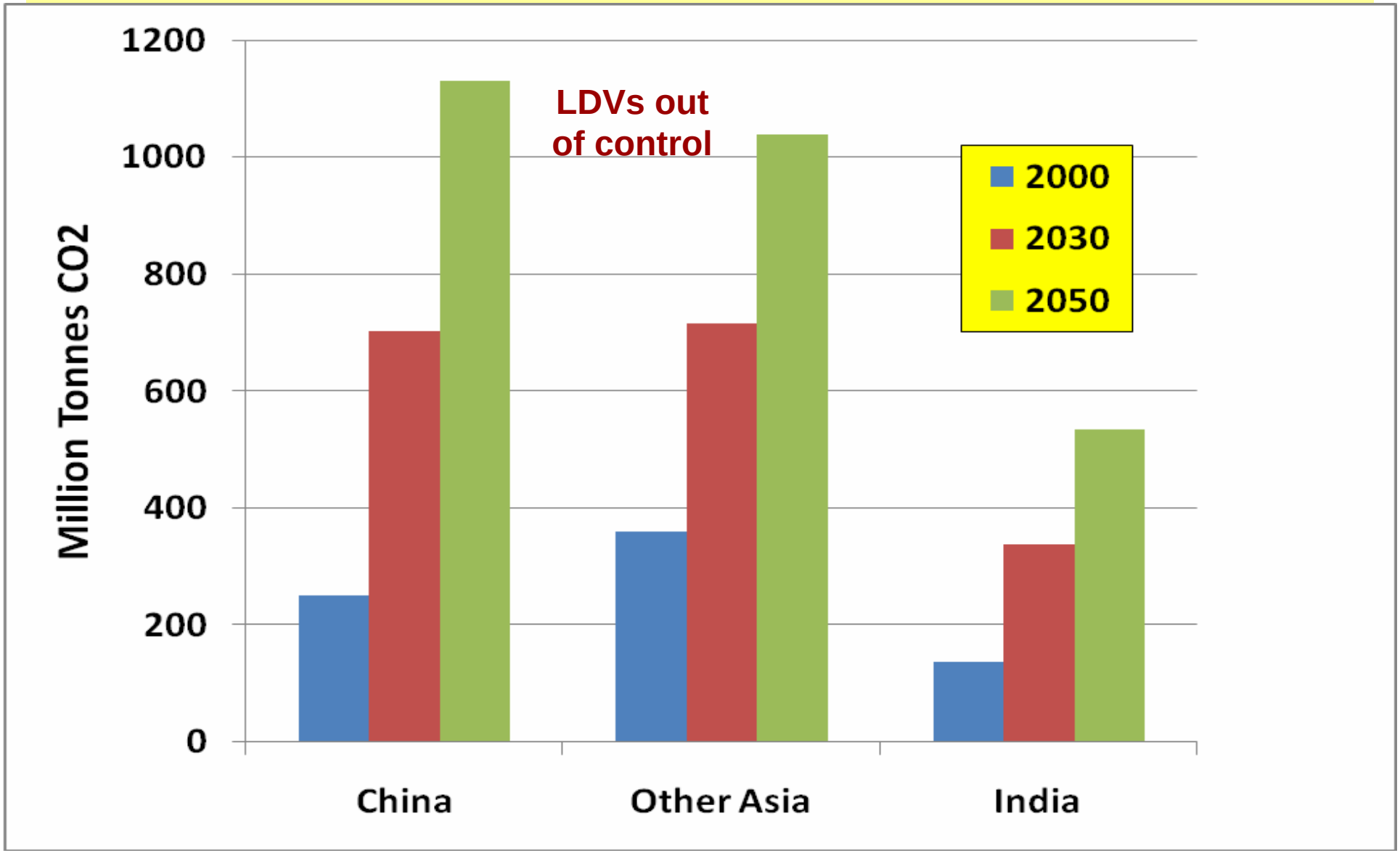
Application to Other Regions? Case of Asia

- Urban Transport and CO2: Gap Narrowing with L. America
  - CO2/$ or capita lower because of fewer cars (but more 2w)
  - Streets clogged at 10% of car ownership levels of L.A. – partly 2w
  - Urban transport systems vary from good to non existent
- The Framework for Integrating CO2 into Urban Transport
  - Similar issues about urban development and transport, just more urgent
  - Monetization similar: Different values for safety, air pollution, congestion
  - Asian cities growing much more rapidly – less time to act
- Evaluation: Latin Cities Ahead on Monitoring, Asia Catching Up
  - Fuels, congestion arguably worse because of high population densities
  - Very high share of travel “outdoors”, hence pollution exposure worse
  - Good news- pollution and (for China) fuel economy standards

Future CO2 Emissions from Transport in Asia

Even After 20% Reduction in Fuel/km, Still Out of control

(Source WBCSD *Sustainable Mobility Project*)



Dilemma for the Developing World?
Cheap Cars and Slow, Costly Transportation

Cheap Two Wheelers,
but No Sidewalks in Pune
1/3 of cities < 1mn in India
Have no public transport

Nano or Nono?
The Peoples' Car

Nano is not Efficient, Just Small

Millions Could Clog India's Streets, Slow Economic Growth

Additional Thoughts: De-Carbing Transport

the New ASIF

- **A**void – Saving Carbon Through Urban Development
  - Land Use: Building a city or differently (Singapore, Curitiba, Seoul)
  - Internalizing costs at an early stage of development
  - Shifting the balance away from high-carbon transport
- **S**witch: Co-benefits of Transport, Development
  - Bus Rapid Transit and other improvements to transport system
  - Careful transition from smaller to larger, better managed transit vehicles
  - Congestion pricing and other strategies to reduce externalities
- **I**mprove by Operations, Technology
  - Lower fuel use/km with improved traffic flow
  - Higher vehicle occupancy
  - Efficient vehicles, low carbon fuels – Mostly national initiatives, count C
- **F**inance: Local Authorities, MDBs – NOT MAIN PROBLEM

The Key Ingredient is not Money Or Technology
Rather, Political Will to Clear the Streets

Conclusions: Best Practices?
Challenge is About Sustainable Transport

- A New Framing of the Issue: NOT “Climate Change”
  - CO2 not a leading transport issue, but transport leading source of CO2
  - Developing countries don’t need to reduce, they need to avoid
  - Current CO2 emissions not the point; transport must be addressed
- Avoidance, Co Benefits, Direct Mitigation
  - Avoiding best long-term goal for developing countries
  - Co-benefits important everywhere, but requires strong governance
  - Mitigation important, but there is little to “mitigate”, much more to avoid
- Maximize Welfare/tonne of CO2, not Minimize CO2
  - Stronger urban development
  - Transport measures not focused on carbon (avoid the $/ton syndrome)
  - Mitigation of vehicles, fuels that do make economic sense w carbon tax

Avoid the “Carboncentric” Financing of Transport
As a Component of Mitigation CO2 Emissions

Gracias

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Car that absorbs its own carbon and needs no oil?
A carbon-free car does not solve transport problems