

Latin America in Global Models

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Goals of the Project

- Improve representation of Latin America (LA) in global models
 - Focus global modelers' attention on LA
 - Draw on regional expertise
 - Consider approaches to addressing key modeling gaps
 - Determine appropriate level of aggregation in models

Goals (continued)

- Strengthen participation of Latin American experts in the climate and economic modeling community
 - Participate in EMF, IPCC, etc meetings
 - Work with regional and global modelers to improve regional representation
 - Involvement in development of new scenarios

Outline

1. Definition of the region and source of emissions
2. Latin America in global models – and regional
3. Key gaps to consider
4. Criteria to include countries
5. Suggested approach(es) to address gaps, benefits and discussion

1. Definition ... and sources

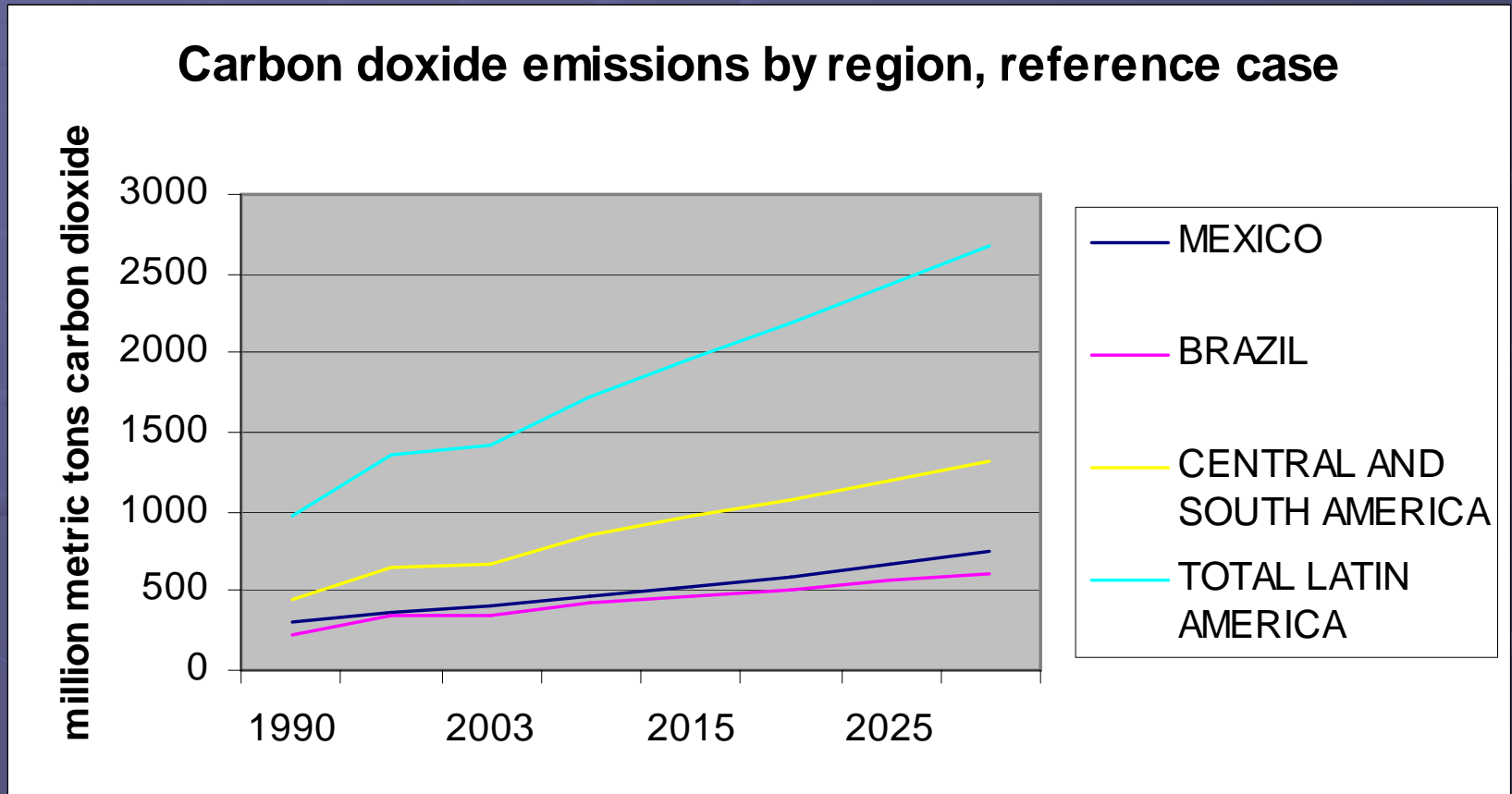
● Latin America covers the following countries and regions:

- Mexico
- Central America
- Caribbean
- South America and islands

Relevance

- Carbon dioxide emissions from LA went from 4.5% of world carbon dioxide emissions in 1990 to 5.3% in 2003.
- They are expected to increase to 6.1% in 2030, according to projections (EIA, 2006).
- Mexico and Brazil represent roughly 50% of emissions from Latin America – last 20 years
- Mexico, Brazil, Venezuela and Argentina generate over 70% of the region's emissions

Trends in carbon dioxide emissions



Source: Energy Information Administration/International Energy Outlook 2006.

Where do emissions come from?

- Fossil fuel consumption and flaring
- Deforestation and land use change
- And non-CO₂, i.e. landfills
- Main sources vary by country

Carbon emissions from fossil fuel consumption and flaring

(million metric tons of carbon dioxide)

| Country | 1980 | 1985 | 1990 | 1995 | 2000 | 2002 | Percentage Change (1980-2002) |
|----------------------|-------|-------|-------|-------|-------|-------|-------------------------------|
| Mexico | 237 | 274 | 308 | 319 | 376 | 363 | 52.9 |
| Brazil | 191 | 190 | 253 | 302 | 338 | 346 | 81.6 |
| Argentina | 95 | 96 | 104 | 122 | 135 | 120 | 26.7 |
| Venezuela | 96 | 95 | 110 | 123 | 133 | 143 | 54.2 |
| Colombia | 40 | 44 | 41 | 53 | 59 | 59 | 48.9 |
| Chile | 24 | 20 | 32 | 40 | 55 | 54 | 125.0 |
| Cuba | 32 | 35 | 36 | 30 | 33 | 34 | 4.5 |
| Puerto Rico | 28 | 22 | 20 | 24 | 27 | 35 | 21.2 |
| Peru | 23 | 23 | 20 | 25 | 29 | 28 | 22.6 |
| Latin American Total | 876 | 897 | 1041 | 1188 | 1358 | 1368 | 56.2 |
| World | 18636 | 19628 | 21638 | 22107 | 23891 | 24533 | 31.6 |

Source: EIA, 2002.

2. Representation of LAC in global models

- **GTape-LTD**
 - Mexico, Venezuela, Brazil, Argentina, Rest of Latin America
- **AIM**
 - Argentina, Brazil; Other Latin America and Caribbean in Rest of World
- **MESSAGE**
 - Latin America and the Caribbean (LAM)
- **MiniCAM**
 - Latin America
- **SGM**
 - Mexico, Latin America in Rest of the World. Brazil is not incorporated yet
- **Env-Linkage**
 - Mexico, Brazil, Central America, Latin America
- **IMAGE**
 - Central America (includes Mexico and Caribbean) and South America

So, how is Latin America really represented?

- Some countries are modeled individually, specially when a local modeler is involved
- Other countries are lumped together, either in a Latin American region or in the Rest of the World, but...
- Socioeconomic data reflecting individual countries are averaged into regional trends (IADB, GTAP, EIA, UN)

Discussion of inputs and results of global models

- Population: usually weighted growth rate (IADB and UN population projections, or directly from SRES)
- GDP: weighted growth rate, IMF, GTAP
- Factor productivity: for different levels of income, applied according to best guess
- Energy consumption: based on initial structure, then projected depending on income growth
- Other: exports, technological change, representative crop yield (some), energy consumption by fuel type, energy consumption by use (electricity and non-electricity), energy prices, land use and coverage, GHG emissions (fossil fuels and cement CO₂, CO₂ from land use, non-CO₂ like N₂O and CH₄).

On regional models

- Not really regional, they are country level!
- Very different modeling techniques:
 - Mexico: CGE, MARKAL, MODEMA, LEAP, STAIR-M, BRUS-M, MOSDEC
 - Brazil: IMACLIM (CGE), MAED for energy demand and MESSAGE for energy supply
 - Colombia: MARKAL
 - Argentina: LEAP
- No consistency in data and models across countries on the region

3. Key gaps to consider

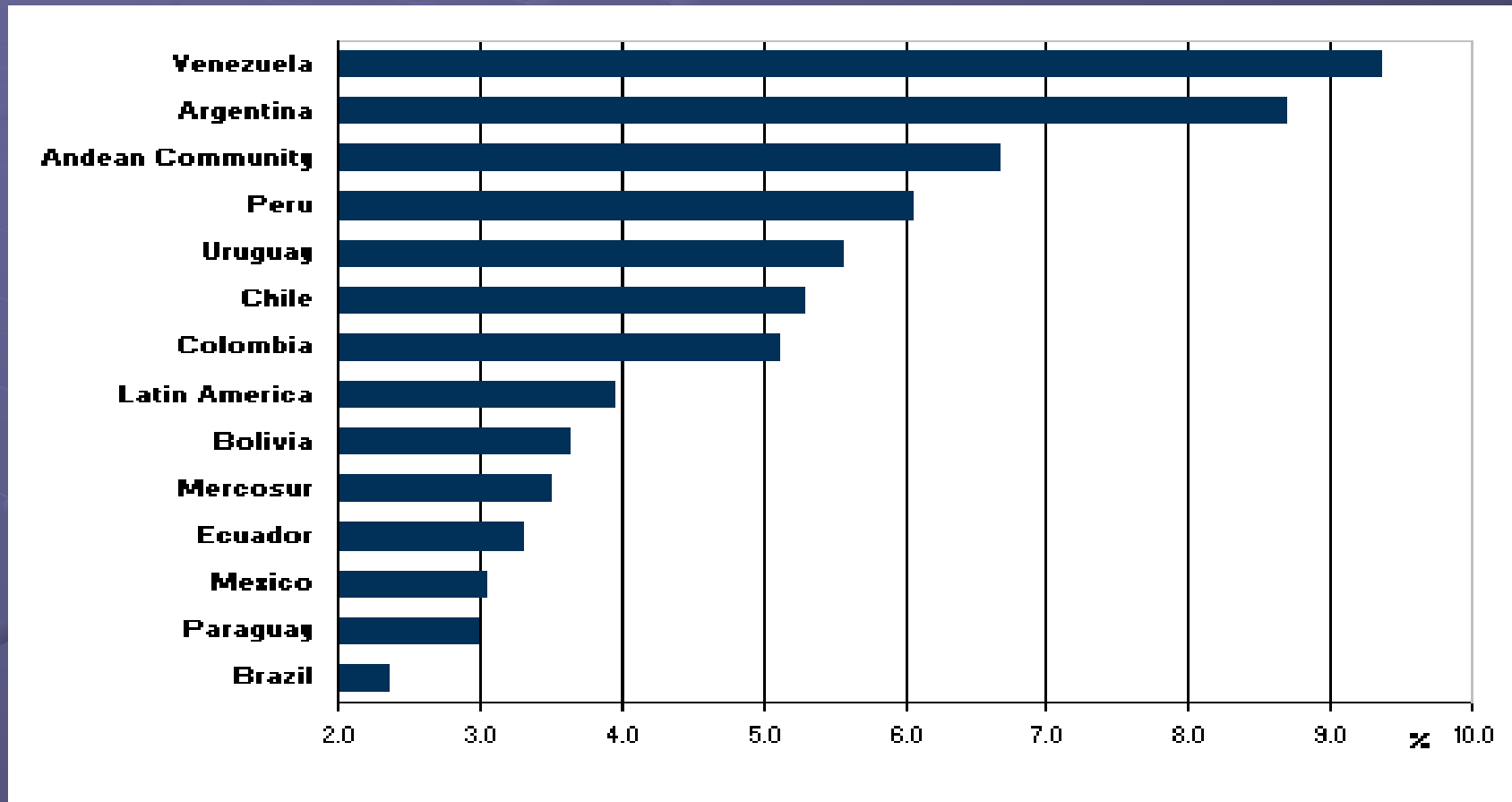
- Population growth
- Economic growth
- Energy use
- Energy sources
- Technology, production and consumption mix
- Sources and types of GHG emissions

Population growth, 1998

(annual percentage change)



GDP growth rates in real terms, 2005



Sources: National statistical institutes, central banks and calculations by LatinFocus.

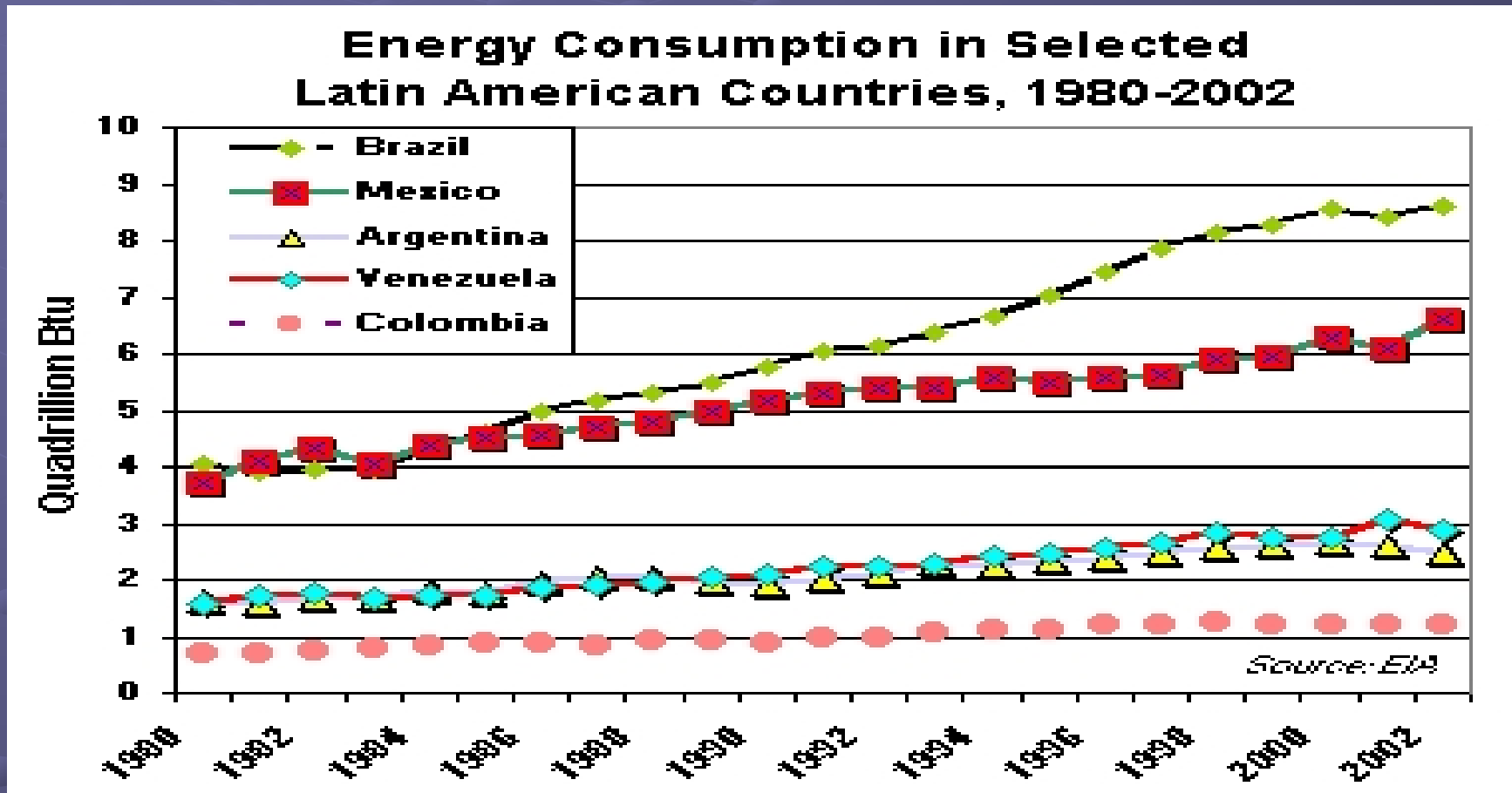
<http://www.latin-focus.com/latinfocus/countries/latam/latgdpgrowth.htm>

Output growth

| Country or Region | 95-03 | 2004 | 2005 | 2006 projected | 2007 projected |
|---------------------------------|-------|------|------|----------------|----------------|
| | | | | | |
| Mexico | 2.6 | 4.2 | 3.0 | 4.4 | 3.3 |
| Argentina | 0.4 | 9.0 | 9.2 | 8.0 | 6.0 |
| Brazil | 2.1 | 4.9 | 2.3 | 3.2 | 4.0 |
| Chile | 4.6 | 6.2 | 6.3 | 5.2 | 5.5 |
| Colombia | 1.9 | 4.8 | 5.2 | 5.2 | 4.5 |
| Venezuela | -0.6 | 17.9 | 9.3 | 7.5 | 3.7 |
| | | | | | |
| Central America | 3.7 | 3.9 | 4.4 | 5.1 | 4.7 |
| Caribbean | 4.2 | 2.4 | 6.7 | 7.7 | 5.5 |
| Latin America and the Caribbean | 2.2 | 5.7 | 4.4 | 4.8 | 4.3 |

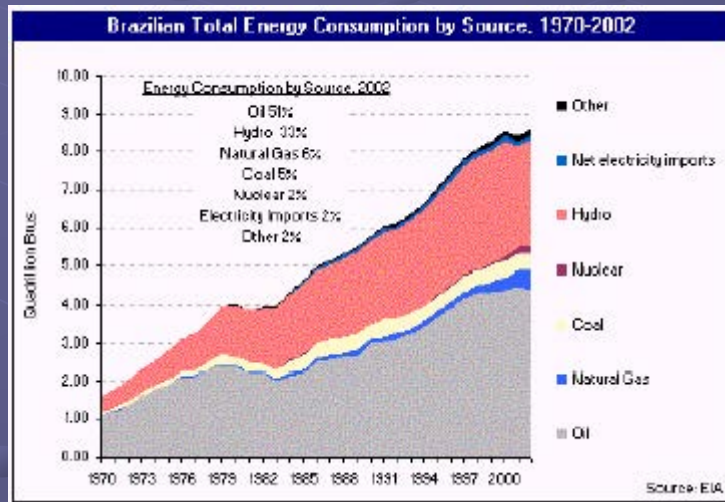
Source: IMF, 2006.

Mexico and Brazil more have a much higher energy consumption than Venezuela, Argentina and Colombia.

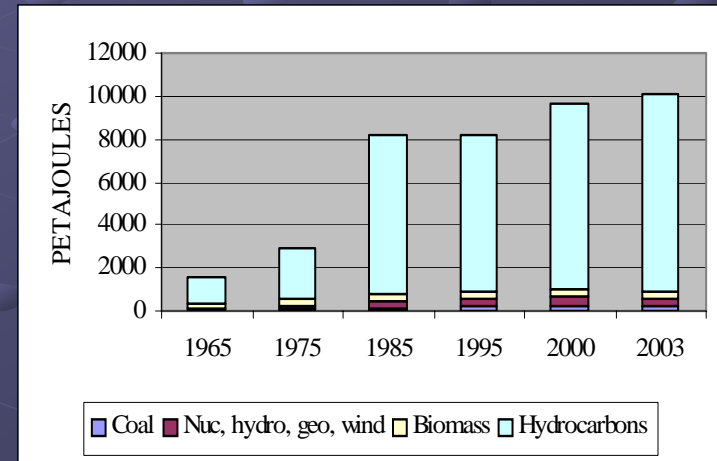


Energy sources are very different: Brazil produced energy from hydropower and Mexico from oil mainly.

Brazilian total energy consumption by source, 1970-2002

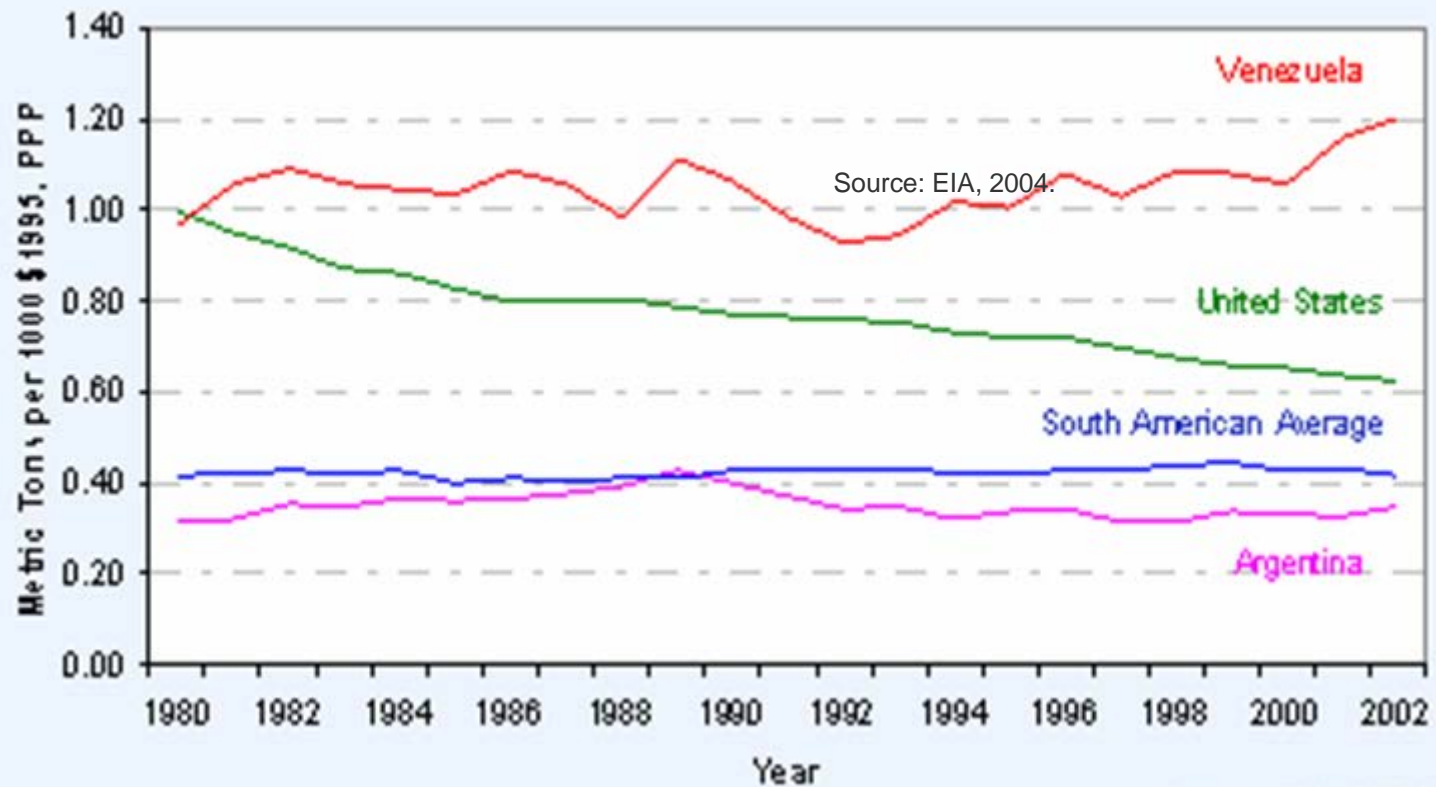


Mexican primary energy supply by fuel use, 1965-2003



Energy intensity varies accross countries and sub-regions.

Carbon Dioxide Intensity of Selected Countries, 1980-2002



Source: EIA, 2004.

Source: EIA; OECD

Other issues

- Technology, production and consumption: great variety, yet taken as one! Technology improvement rate for each region is used, but significant differences across technologies are not reflected
- Source and type of GHG emissions: vary widely across countries
- Different time horizons and time steps
- Used as planning and policy making tools, rather than forecasting the long term

Key issues in Latin American modeling and scenario development (Rio)

- Divergent purposes of model development and use and aims of global and Latin American modelers
 - Policy analysis and energy planning tools to support economic policy
 - Long-term energy decision making and global trends of GHGs (levels and/or concentrations) using aggregate regions
- Divergences among models in choices of base-year and baselines
- Lack of institutional durability and consistent data gathering
 - modelers needed
 - need datasets and data gathering protocols
 - Government not obliged to relate modeling to climate change due to non-binding commitments (non-Annex 1)
- Shifting dynamics of demographic and socioeconomic patterns
 - Urbanization
 - Population growth
 - Labor force
 - Trade
- Challenges of Non-CO2 greenhouse gas emissions characterization

4. Criteria to select breakdown of LA

1. Interest of local modelers
2. Data availability
3. Size of country:
 - population and economy-wise
 - Energy use and production
 - Emissions-wise
4. Country-level models to compare results from breakdown
5. Other...?

Suggestion

- Mexico
- Brazil
- Venezuela (?)
- Argentina
- Central America and Caribbean
- Rest of South America

Yet, further detail for LA has a tradeoff with other regions in the model!

5. Suggestions to address gaps

Option 1 (or Phase 1)

1. Set framework to build a set of country-level models.
2. Integrate those models into a Latin American regional model
3. Use this model within global models and get new global results with details for Latin American countries and regions

Option 2

1. Select a global model based on willingness of modelers, simplicity, and how well suited it is to answer specific questions.
2. Decide on breakdown of the region
3. Global and regional modelers jointly define data for extended global model.
4. Global modeler runs the model under the same scenarios but under different breakdowns.
5. Analyze if this breakdown is worthwhile.

Benefits of collaboration

Global Modelers:

- Better understanding of underlying trends in particular countries and in the region
- Access to adequate data to improve their models that would be very hard to gather on their own
- Output will be more detailed and therefore used as input for impact analysis
- Testing of regional strategies will be more meaningful (post-Kyoto negotiations)

Regional modelers:

- Build a consistent set of country-level level models
- Integrate country-level models into a truly regional model
- Improved representation of countries and region in global models
- Specific sectors' interactions may be better shown
- Scenarios of interest for regional decision makers may be run in country, regional and global models

Discussion questions

- Feedback/advise on how to improve representation of region in global models?
- Is this the appropriate level of disaggregation? Pros and cons...
- Is there interest of global modelers?