

The Effect of NAFTA on Energy and Environmental Efficiency in Mexico

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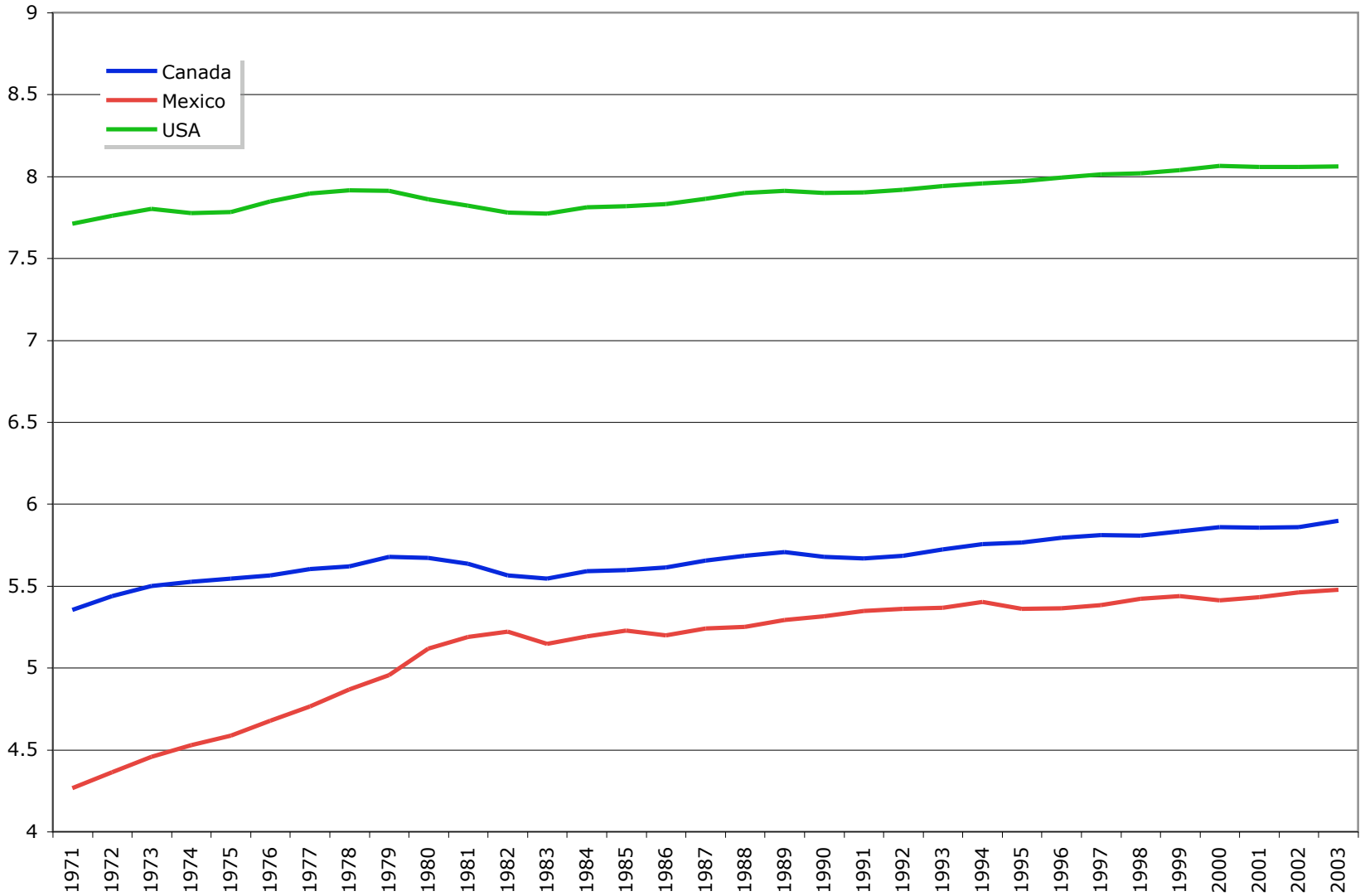
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Introduction

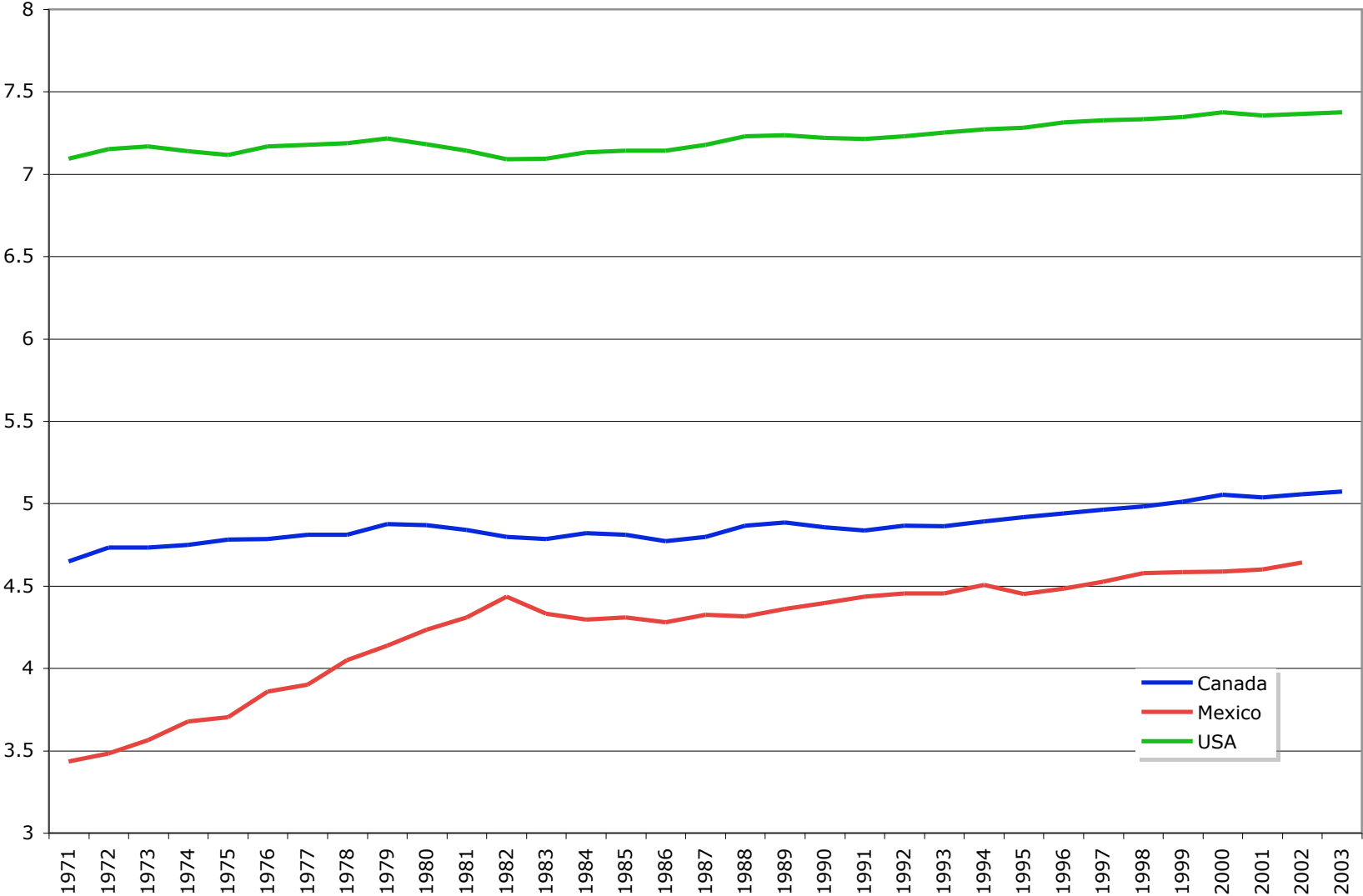
Research Question:

What has happened to environmental quality in Mexico post-NAFTA?

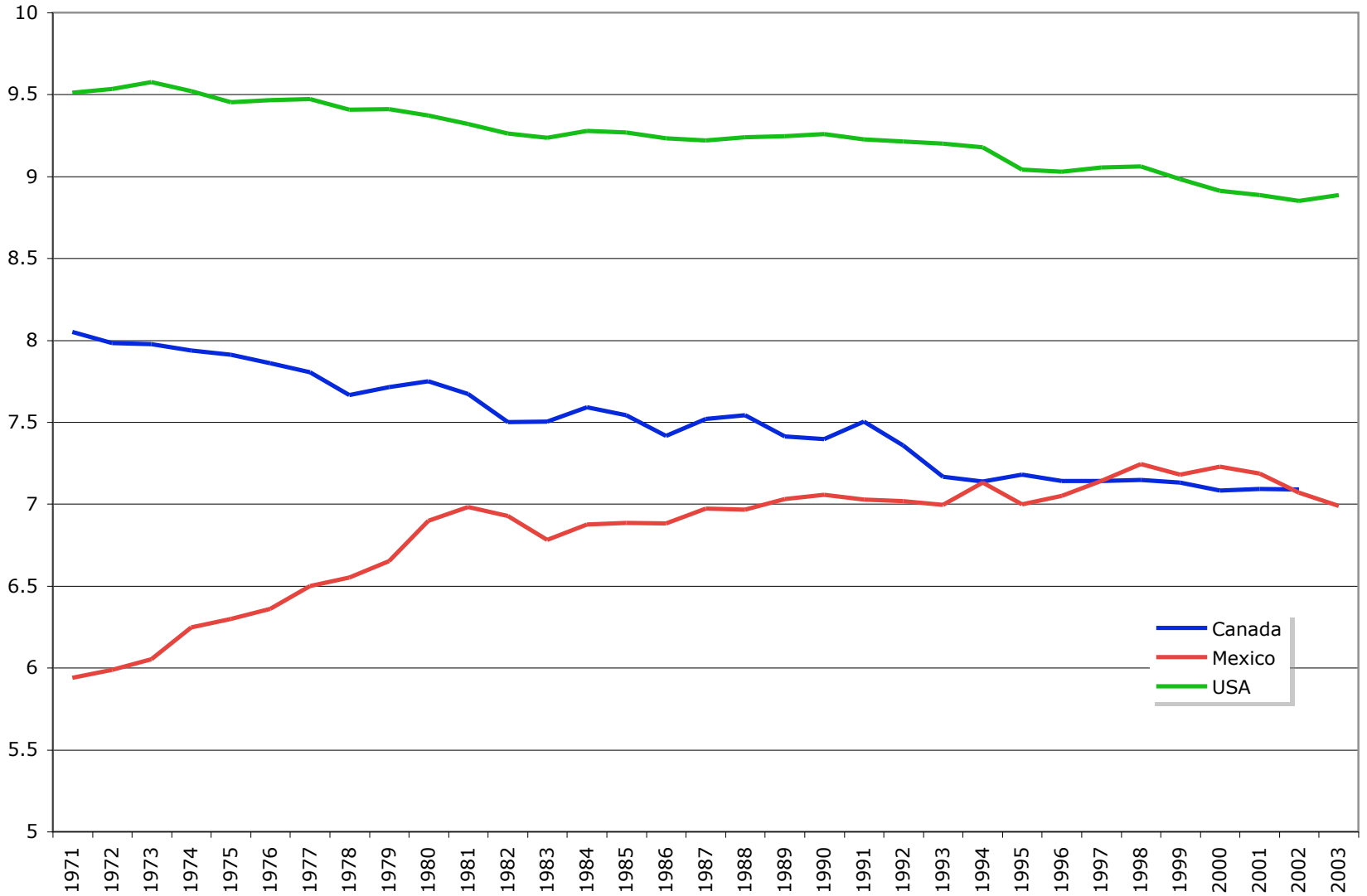
Log Energy Use



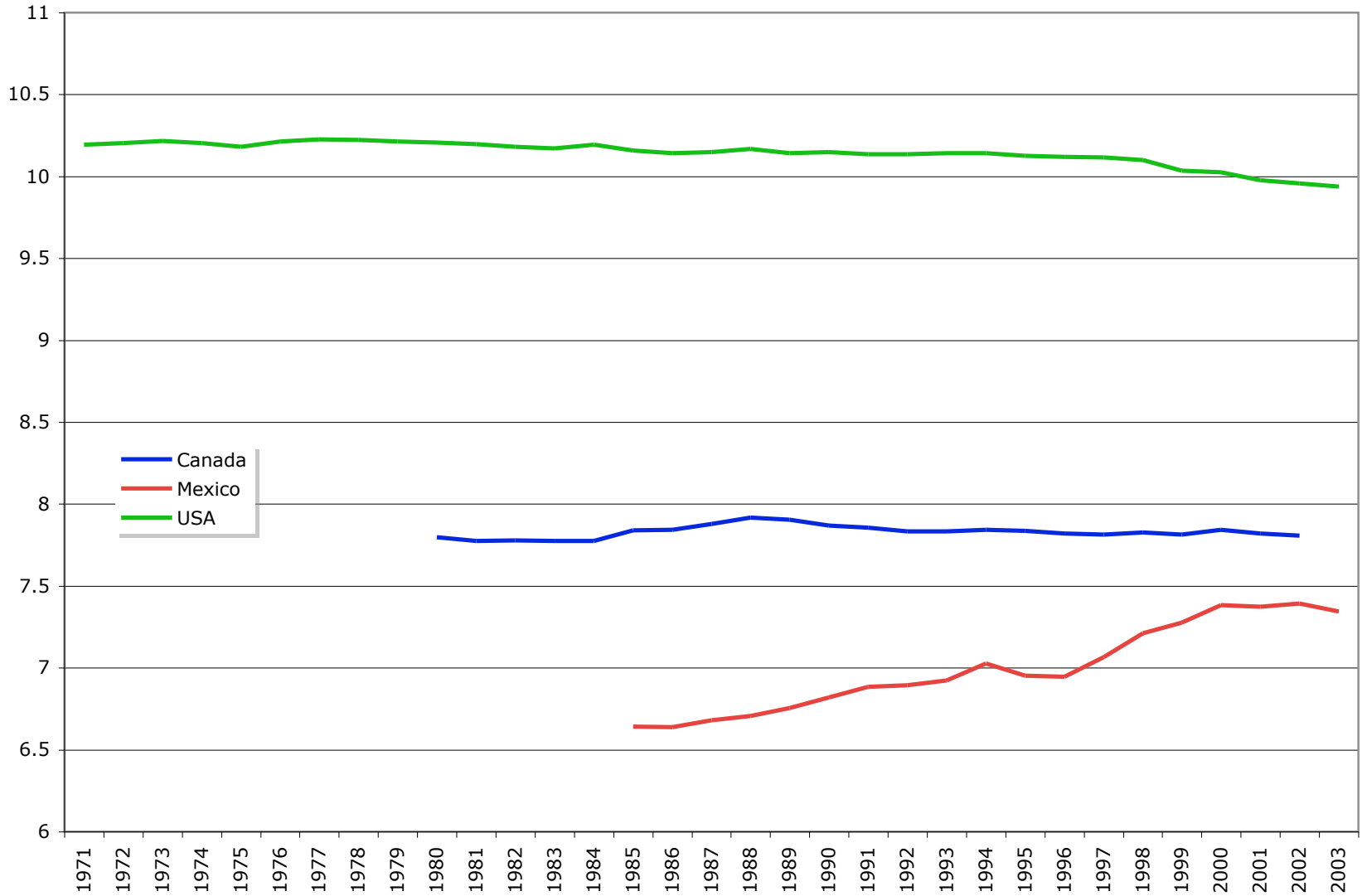
Log Carbon Emissions



Log Sulfur Emissions



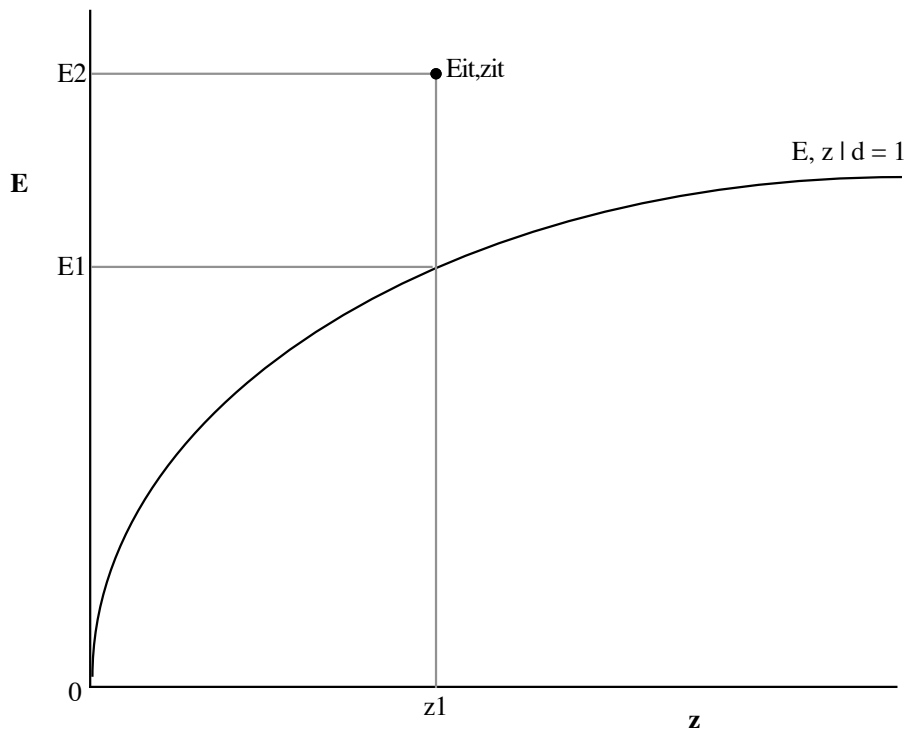
Log NOx Emissions

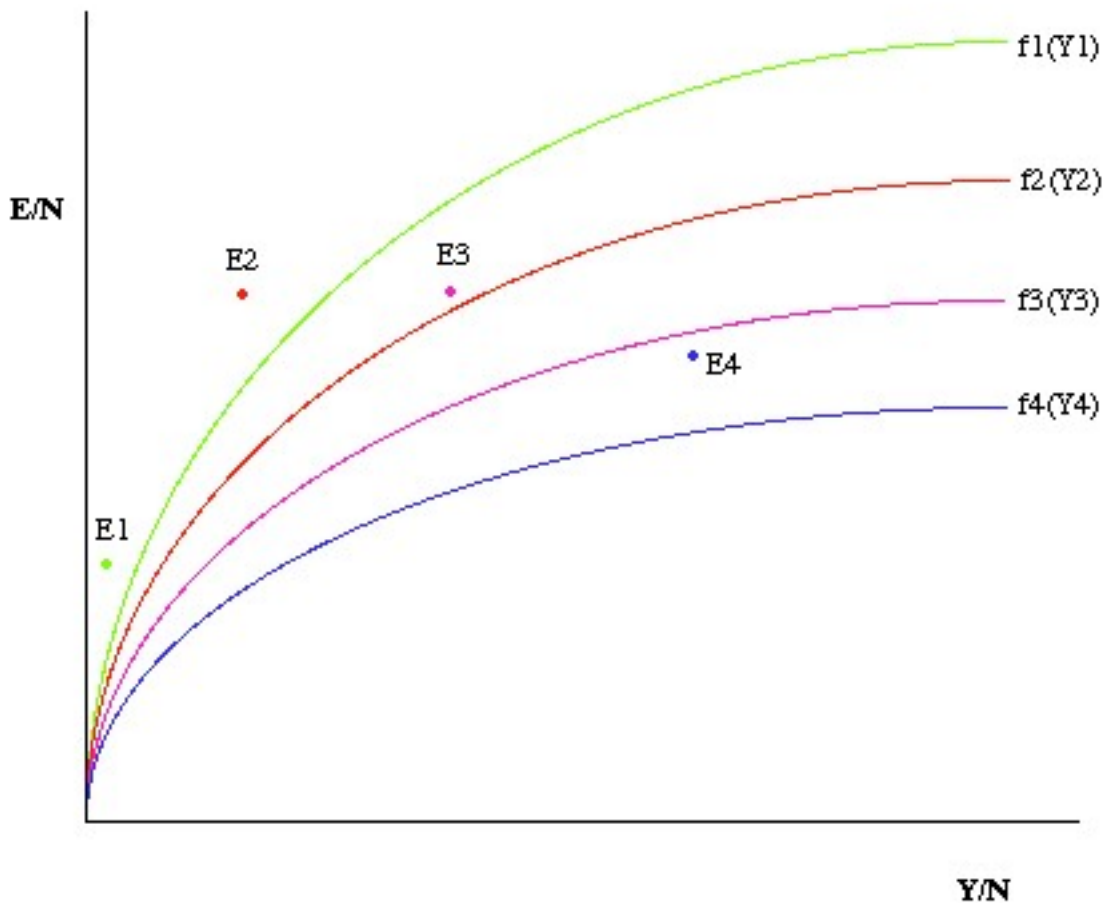


The New EKC Theory:

- Best practice frontier – role of technological change
- Solow growth and convergence
- Technology diffusion:
 - TFP
 - Emissions specific

Emissions Distance Function and Efficiency





Trade Liberalization and Integration:

- Scale, output composition, input mix, technology effects
 - Technology effect:
 - Direct – technology diffusion
 - Indirect – policy channel

Hypotheses/Tests:

- Convergence:
 - β -convergence – first difference panel test
 - σ -convergence
 - Cointegration test – Strazicich & List IPS test
- Structural break in slope in 1994:
 - Park and Sung t-test for unit root – known break in 1994
 - Unit root present – random walk structural break test
- Interaction - effect of NAFTA on Convergence:
 - Structural break dummies in β -convergence test
 - Sub-periods in Strazicich & List IPS test

Indicators

Energy, carbon dioxide, sulfur dioxide, NO_x

- E
- E/N - scale ($-\Delta N$), composition, technique
- E/GDP - composition, technique
- A_E - technology trend – energy & sulfur

Sulfur Emissions Frontier Model

$$\ln E_{it} = \ln A_{it} + \sum_{k=1}^4 \gamma_k \ln y_{kit} + \gamma_x \ln \left(\sum_{j=1}^n \beta_j x_{jit} \right) + u_{it}$$

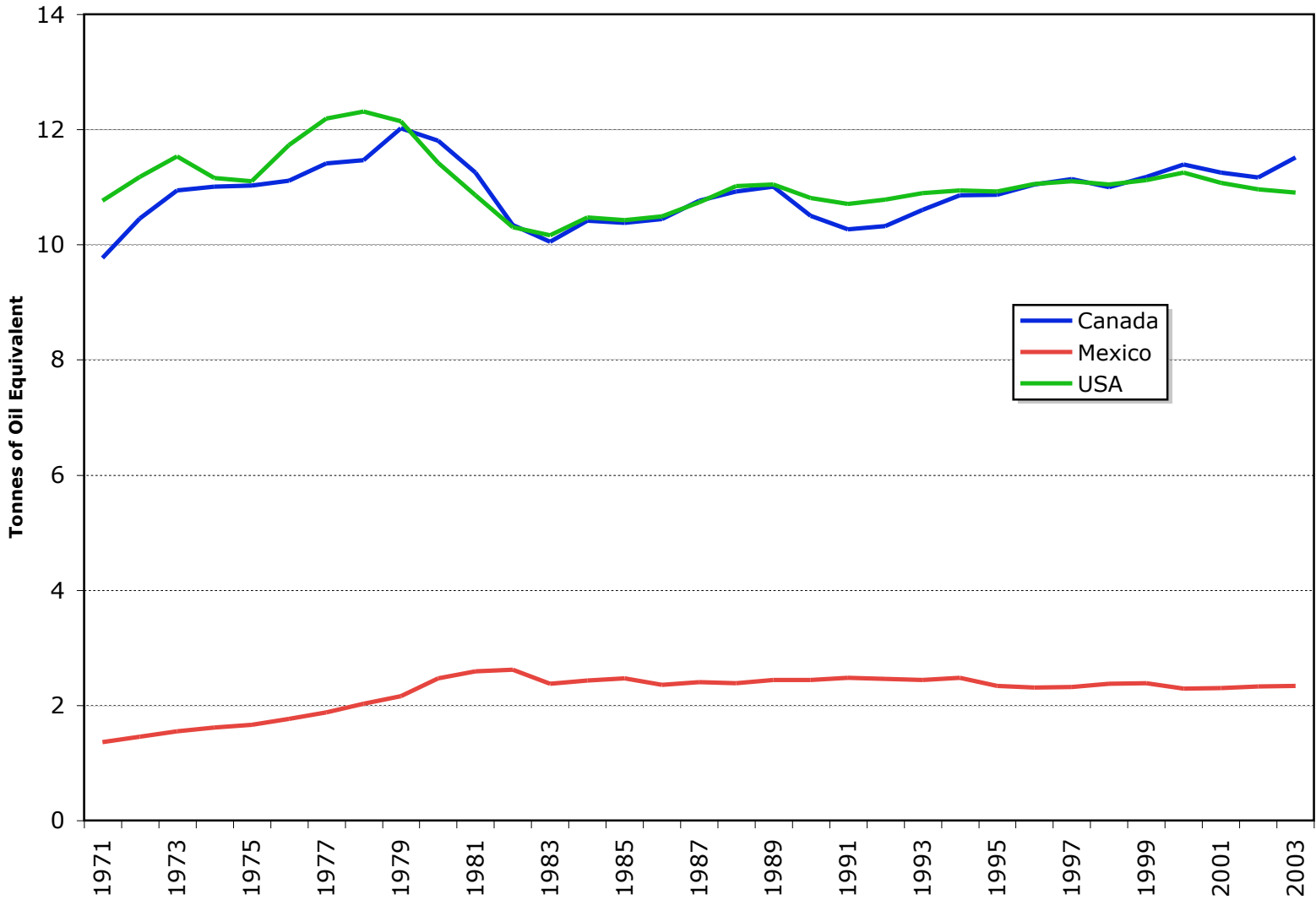
$$\sum \gamma_k = 0 \quad \sum \beta_j = 1$$

Energy Frontier Model

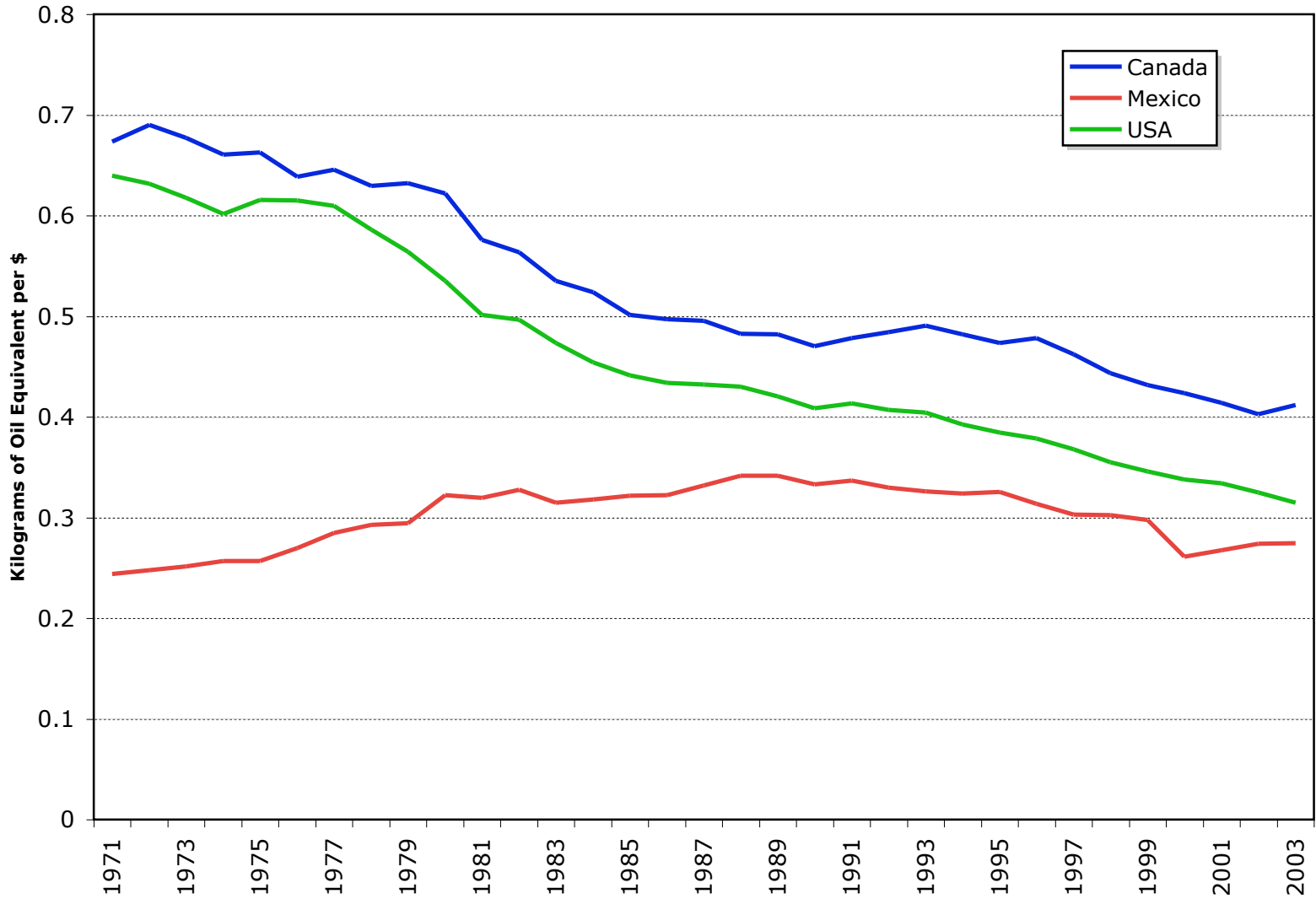
$$\sum_{k=1}^4 \gamma_k \ln y_{kit} + \gamma_x \ln \left(\sum_{j=1} \beta_j x_{jit} \right) = A_{it} + v_{it}$$

$$\sum \gamma_k = 1 \quad \sum \beta_j = 1$$

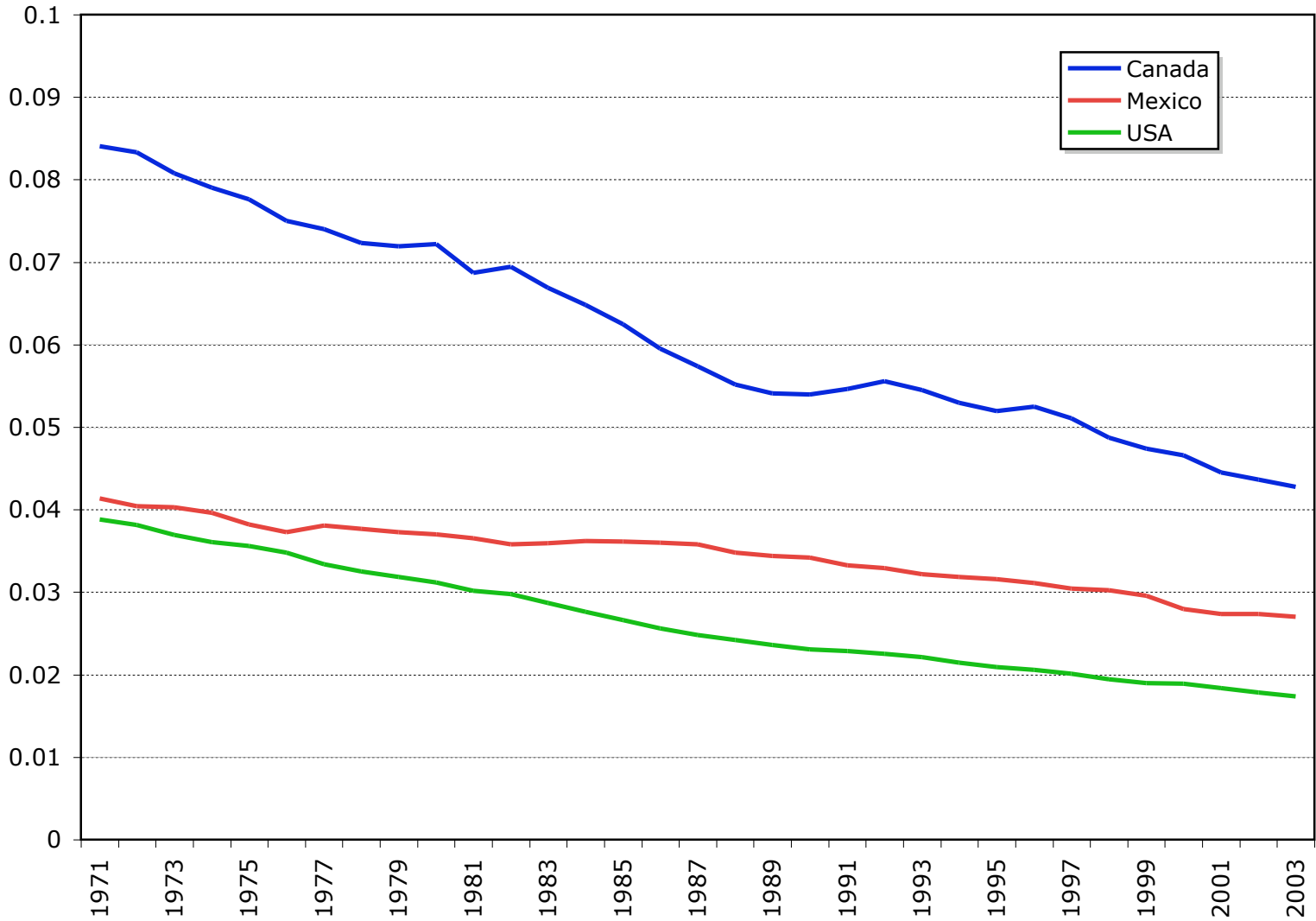
Energy Use per Capita



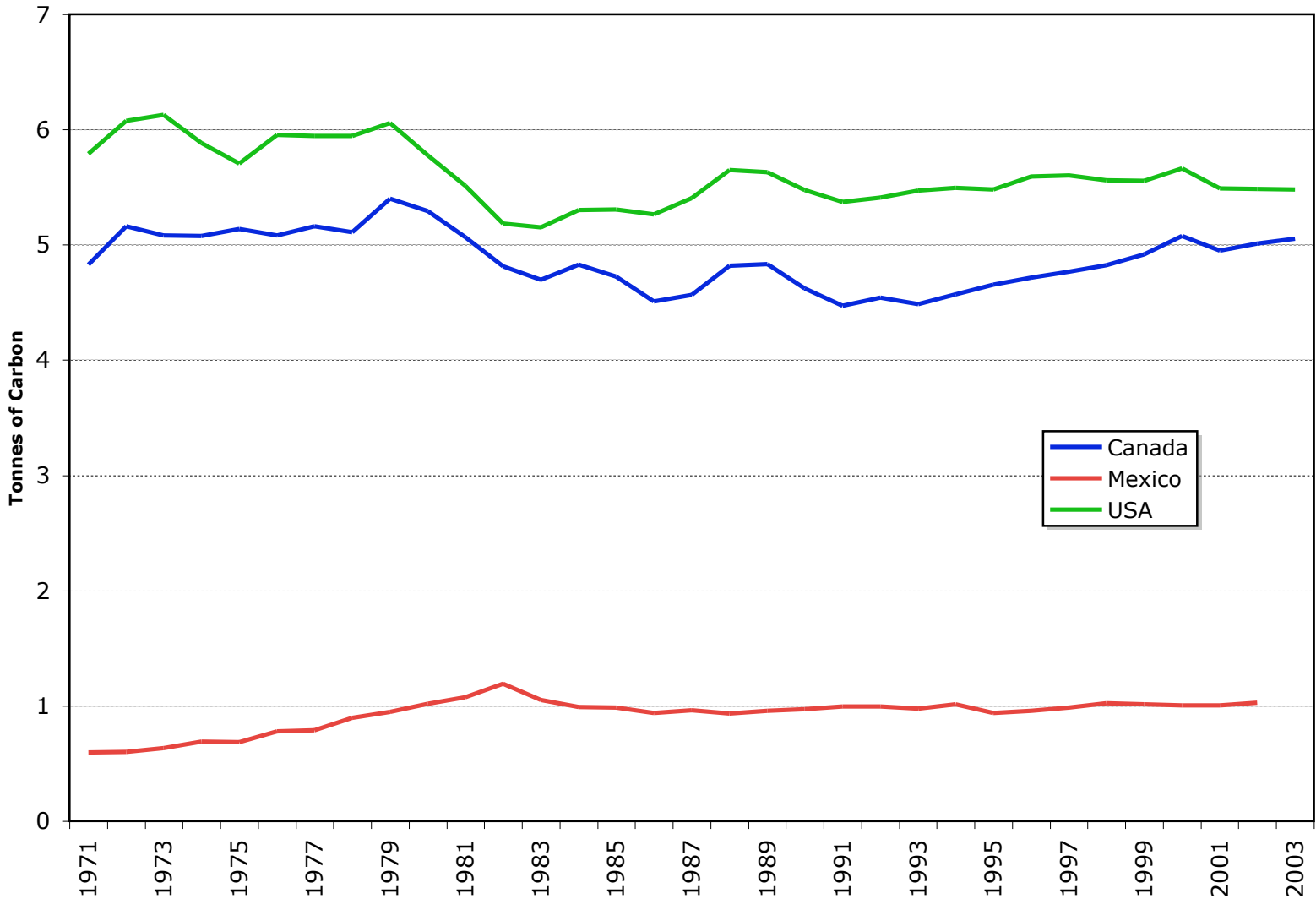
Energy Intensity



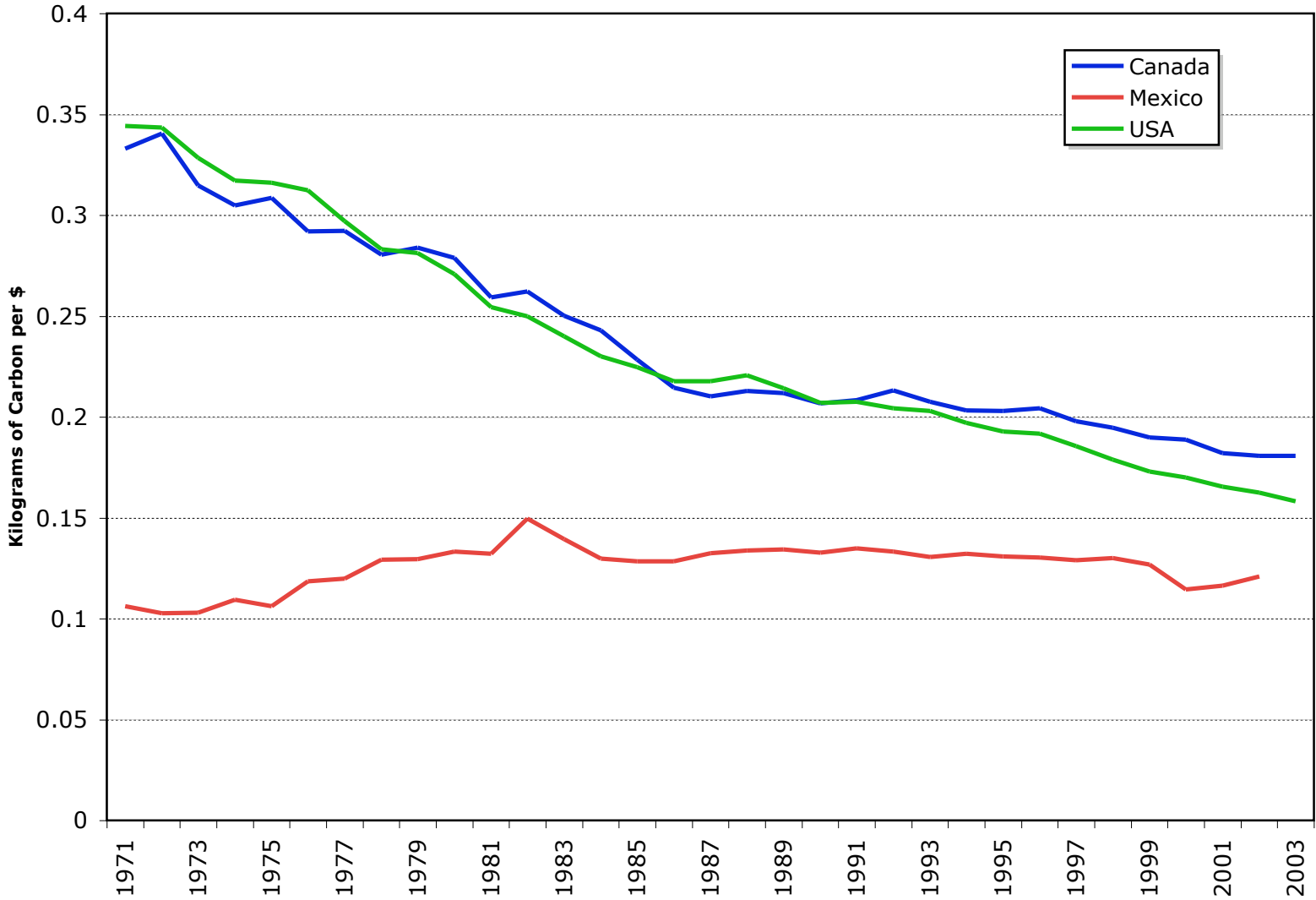
Energy Technology Trends



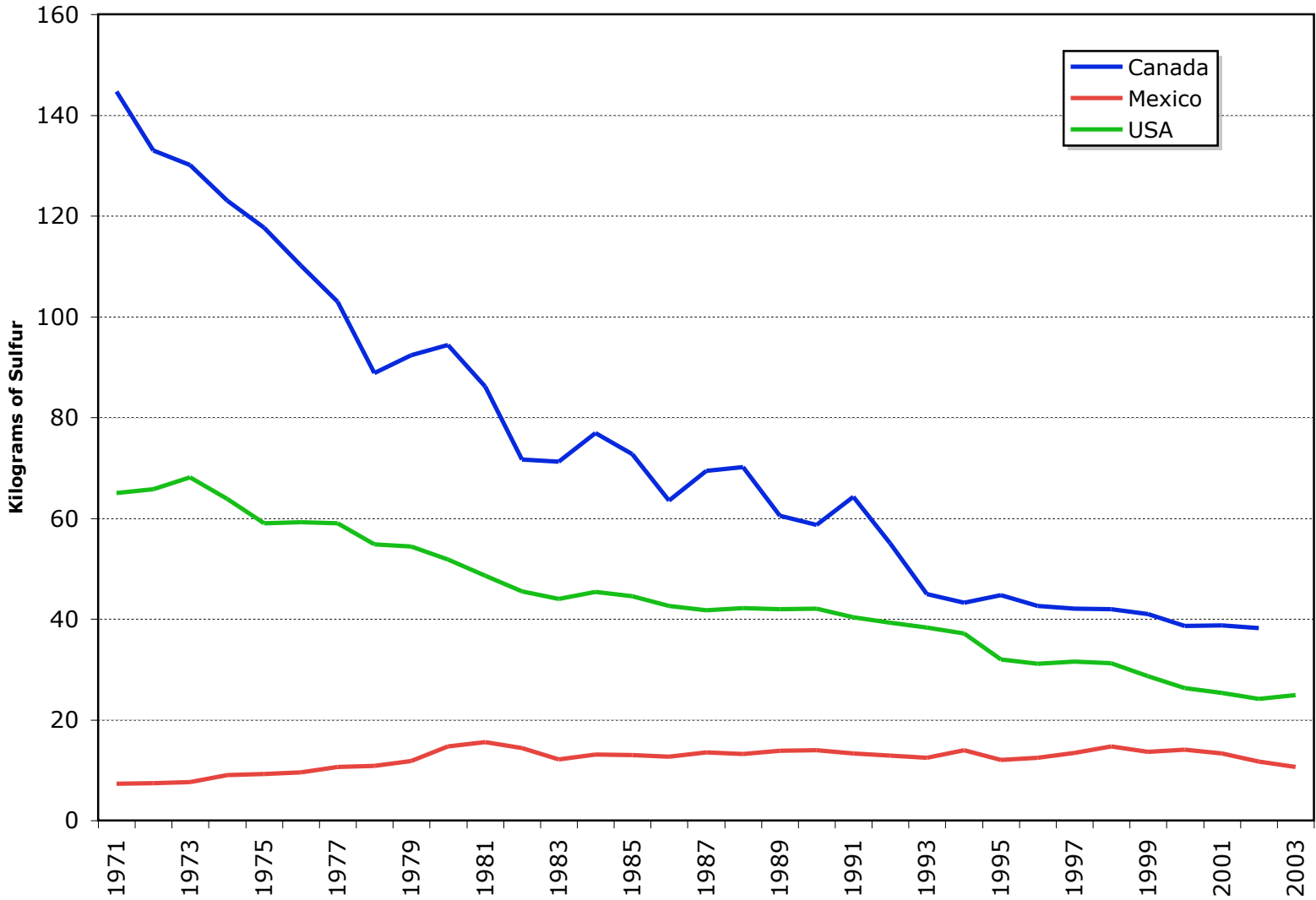
Carbon Emissions per Capita



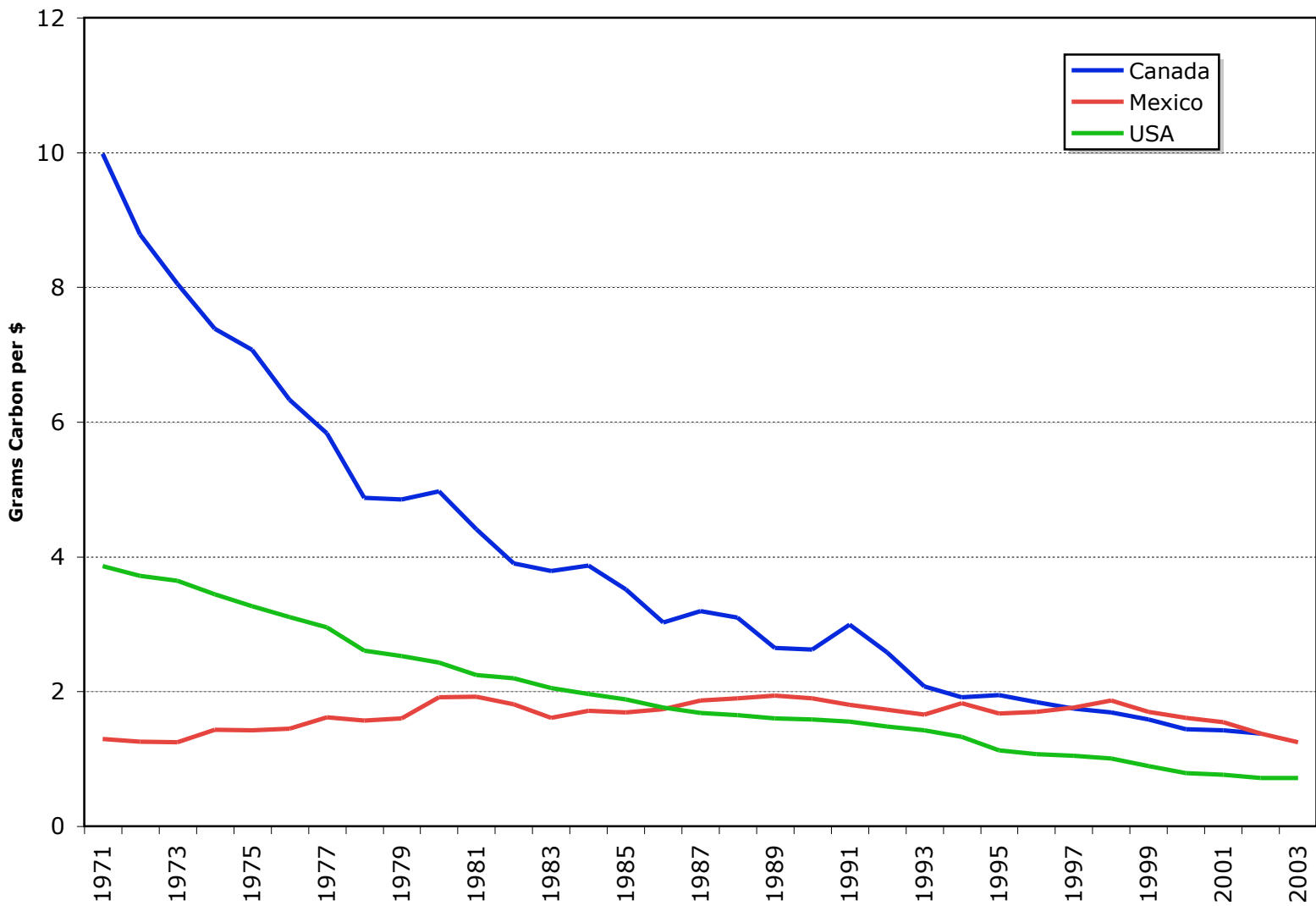
Carbon Intensity



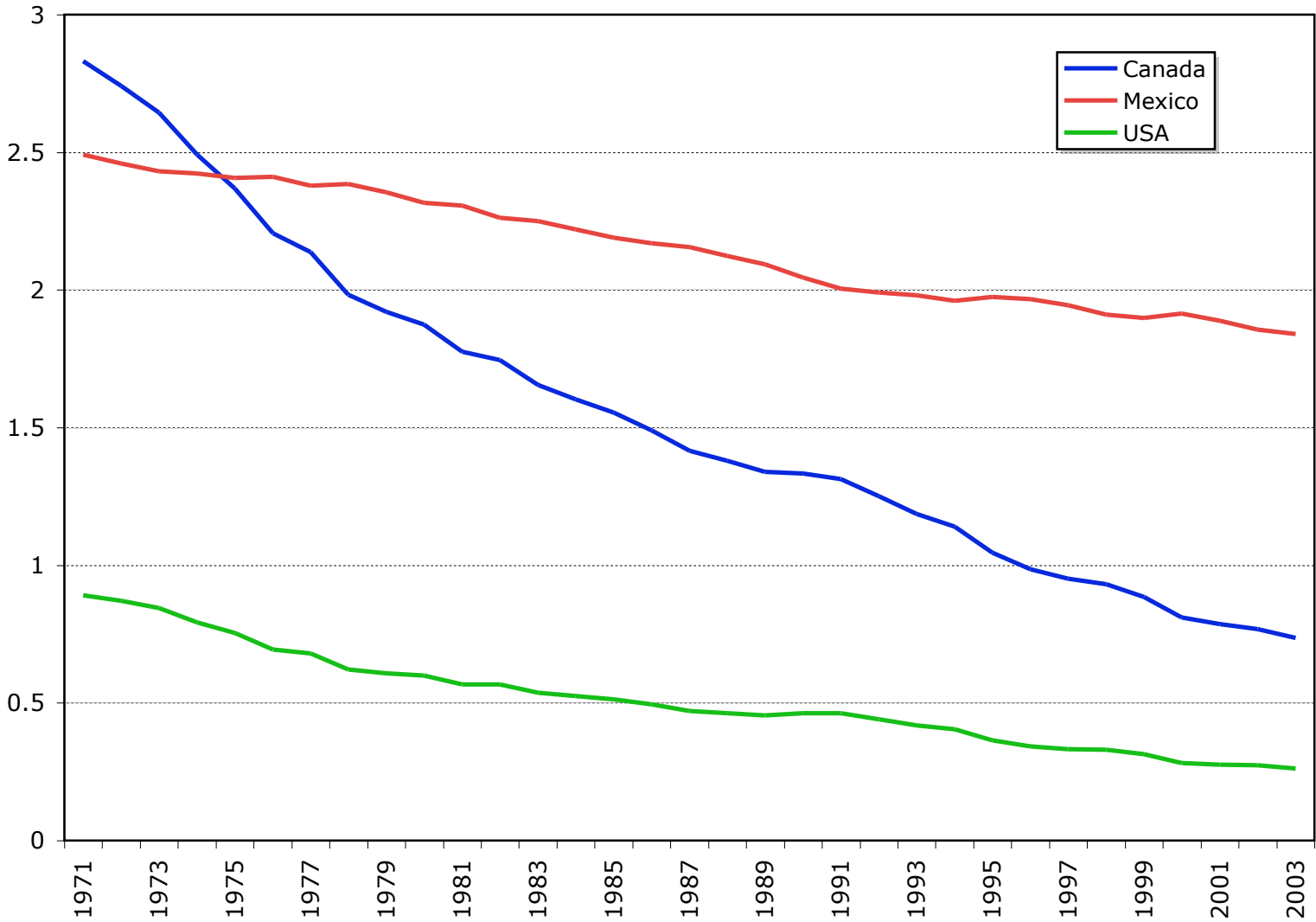
Sulfur Emissions per Capita



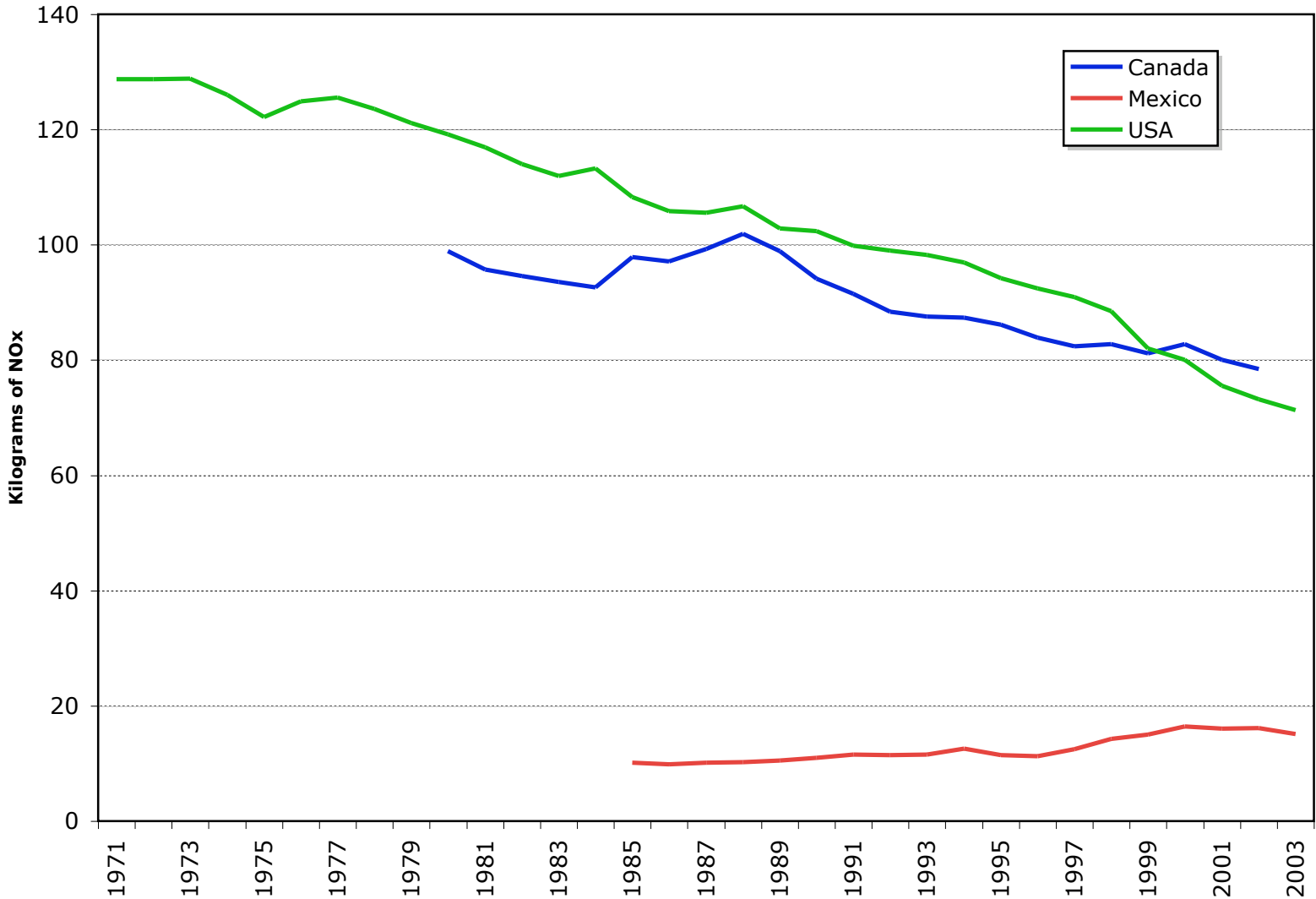
Sulfur Intensity



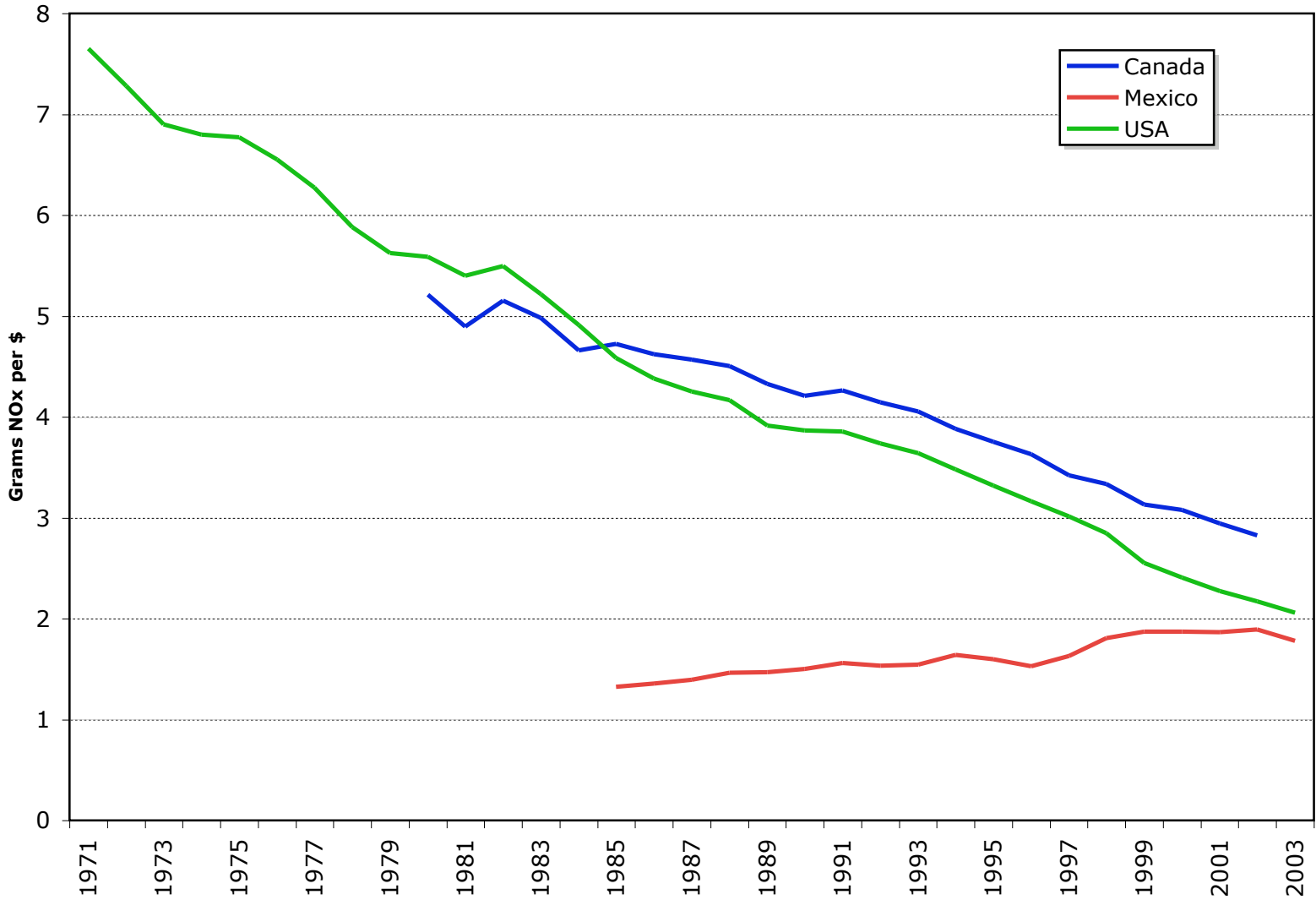
Sulfur Technology Trends



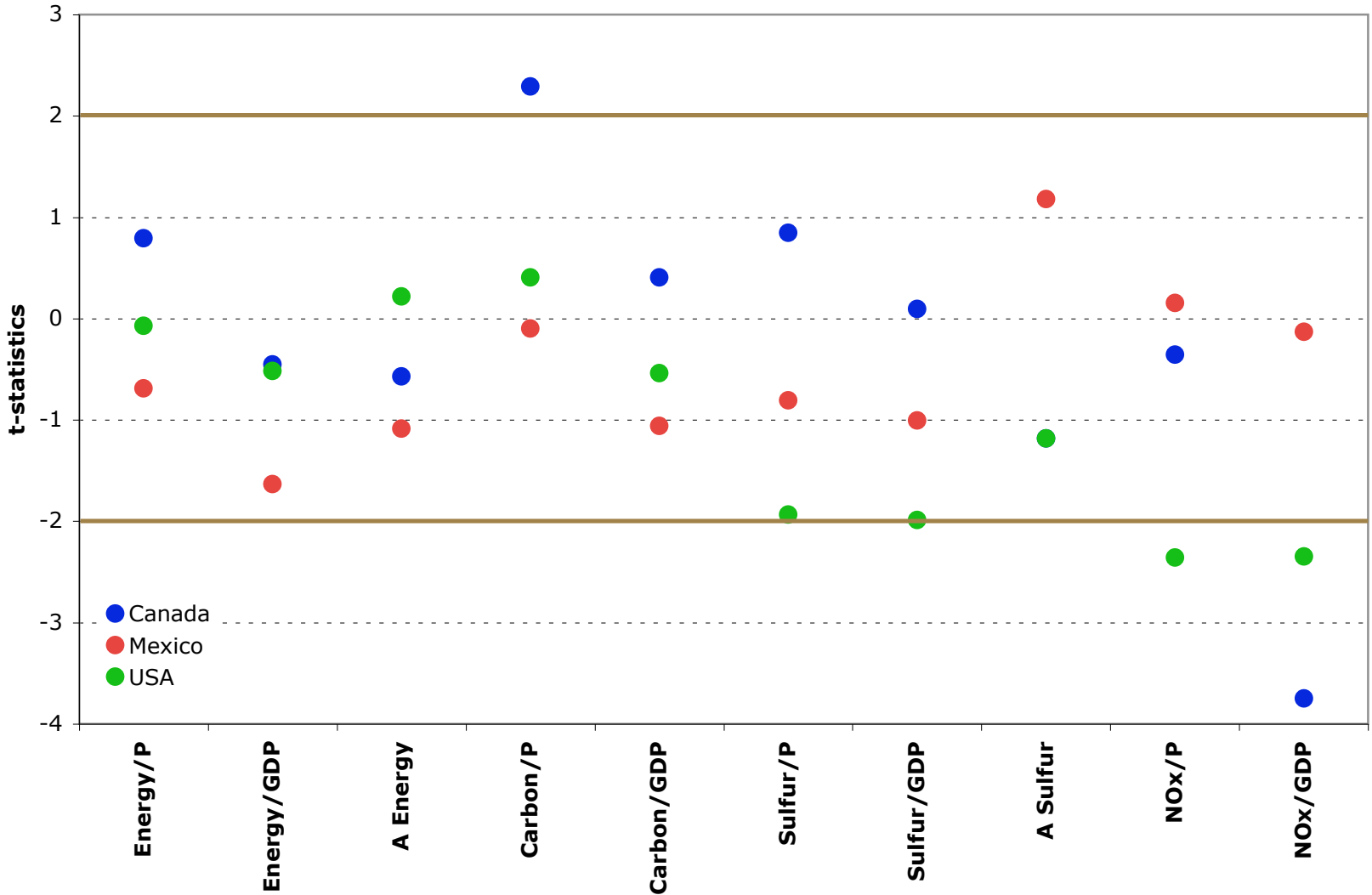
NOx per Capita



NOx Intensity



Structural Break Tests



Convergence Tests

β -Convergence:

- All but one (A_E) of the ten first difference series significantly (10%) negatively correlated with initial values.
- Post NAFTA rate of change becomes more negative or unchanged.
- Correlation with initial condition mostly diminishes.

Strazicich & List IPS Cointegration Test:

- Full period: Cointegration in energy, carbon, sulfur - per capita and intensity.
- Post NAFTA: Cointegration for energy and sulfur intensity – power?

Conclusions

- Good evidence of convergence for many of the indicators
- Improvements in criteria pollutants, intensity indicators, and technology
 - Criteria pollutants rise and fall in Mexico post NAFTA
- Pre NAFTA trends mostly continue as before or improve somewhat
- Extreme predictions not supported