

CAR FLEET RENEWAL: CO₂ EMISSIONS AND ANCILLARY BENEFITS

Francisco Eduardo Mendes
Lila Szwarcfiter
Cláudia do Valle Costa



Introduction

- Research project for Brazilian Environment Ministry to evaluate the effects of PROCONVE (Brazilian Program for Vehicle Emissions Control)
- Objective: to analyze potential impact on CO₂ emissions and locally-relevant atmospheric pollutants of an accelerated scrappage program of light-duty vehicles



Vehicle Pollution

- Automobile use has increased, especially in large urban centers, causing:
 - A great increase in CO₂ emissions
 - A great increase of other pollutant emissions such as carbon monoxide (CO), nitrogen oxides (NO_x) and total hydrocarbons (THC)

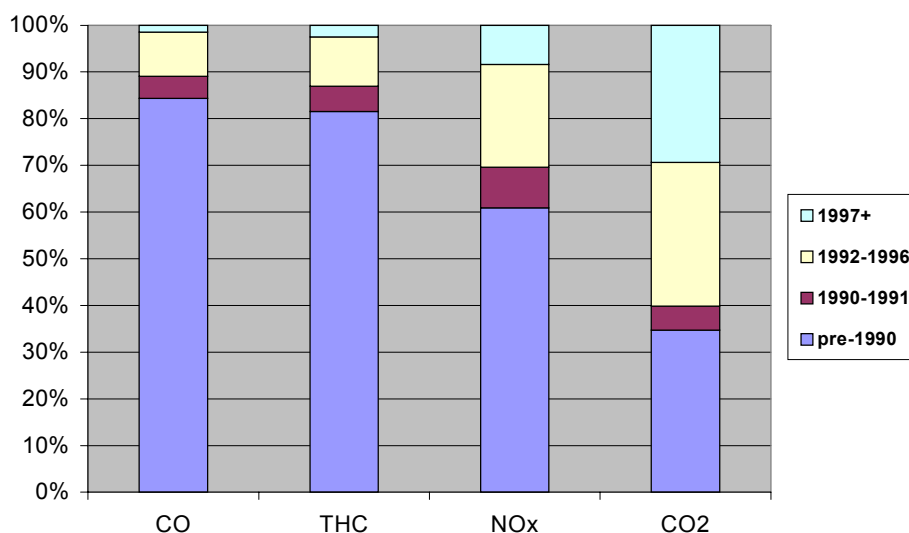


A strategy to reduce vehicle emissions

- Development in vehicle technology: production of more efficient engines and introduction of emission control systems
- Older vehicles bear a large portion of responsibility for vehicular emissions, especially for local pollutants



Emissions share by model-year in São Paulo Metropolitan Area (RMSP), 1999



Methodology

- Scrappage program:
 - As originally proposed by ANFAVEA (2000)
 - 142,000/year additional sales of new gasoline automobiles to replace older ones from 2002 to 2010
 - All new cars sold in RMSP only
 - 142,000 new cars represent about 54% of total RMSP car sales in 2002 and 34% in 2010
 - About 24% RMSP fleet replacement by 2010
 - No new alcohol or NG cars sold
 - Only vehicles older than 10 years will be scrapped



Methodology

- Emissions were estimated based on the following model for each pollutant:

$$\epsilon_{p,y} = \sum(\pi_{\alpha} * v_{\alpha} * \mu_{\alpha} * \rho_{\alpha}), \text{ where:}$$

$\epsilon_{p,y}$ = total emissions of pollutant p in the year y

π_{α} = emission factor for average fleet of age α

v_{α} = number of vehicles in circulation of age α

μ_{α} = average mileage of vehicles in circulation of age α

ρ_{α} = emissions deterioration rate for vehicles in circulation of age α



Methodology

- **Fleet characteristics:**
 - São Paulo Metropolitan Area (RMSP)
 - Light-duty automobiles only
 - Sales 1999-2010 based on GNP growth projection by CCPE/CTEM/MME
 - Scrappage curve from Petrobrás
 - Average emission factors from CETESB (CO, THC and NO_x) and MCT (CO₂)
 - Average annual mileage from CETESB



Methodology

- New car emission factors and deterioration rates would remain the same from 1999 to 2010
- No alcohol and NG vehicle sales after 2002

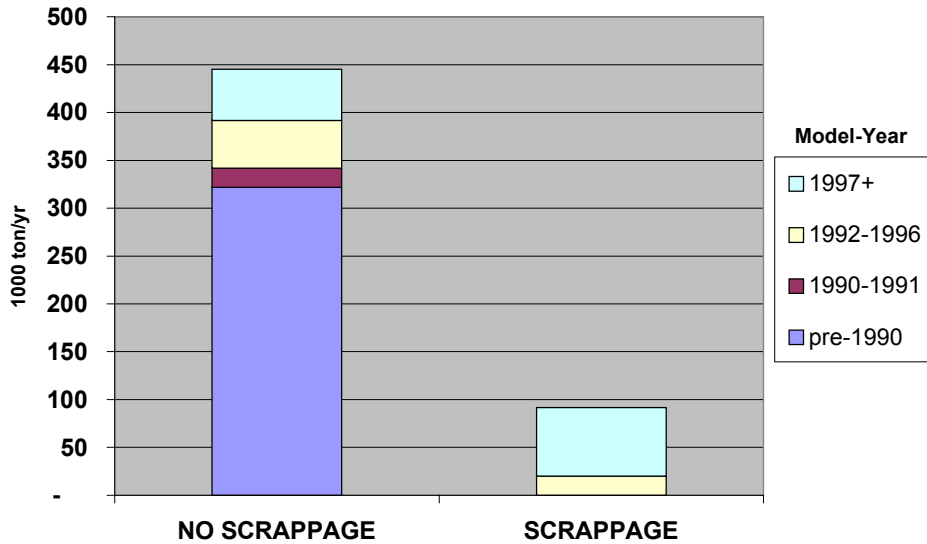


Results

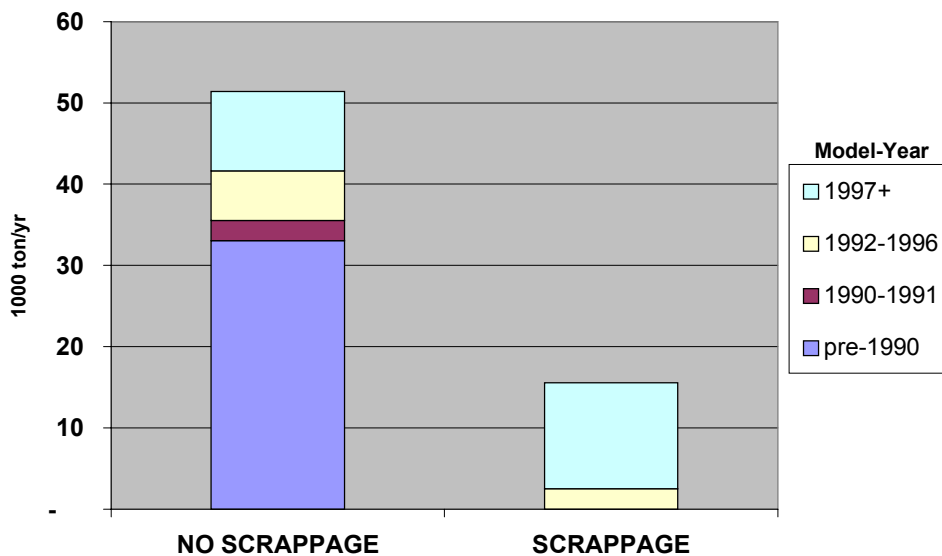
- Scrappage of older cars (142,000/year) would reduce in 2010:
 - CO emissions by 79.4%
 - THC emissions by 69.8%
 - NOx emissions by 29.2%
- But would increase CO₂ emissions by 15.6%



CO emissions in 2010

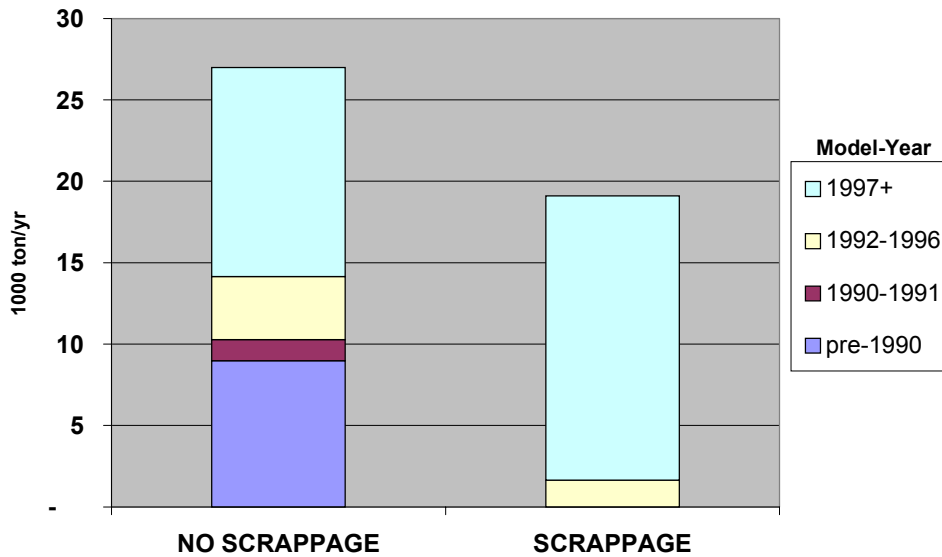


THC emissions in 2010

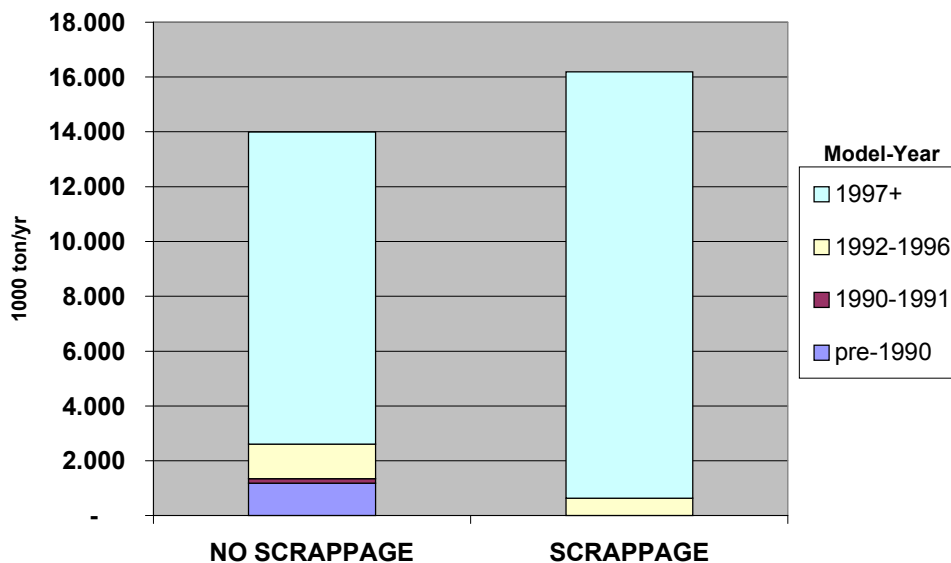




NOx emissions in 2010



CO₂ emissions in 2010





Conclusions

- Fleet renewal programs can reduce CO, THC and NOx emissions
- Fleet renewal programs would actually increase CO₂ emissions



Future research

- Compare emissions abatement in terms of GWP
- Model different scrappage schemes
- Study implementation strategies of scrappage schemes
- Study cost-effectiveness of scrappage schemes



Acknowledgments

- MMA - Brazilian Environment Ministry
- CETESB
- FEEMA
- Fundação COPPETEC



Contacts

LIMA – Laboratório Interdisciplinar de Meio Ambiente – COPPE/UFRJ

+55-21-2562-8805

femendes@lima.coppe.ufrj.br

lila@lima.coppe.ufrj.br

cvalle@lima.coppe.ufrj.br