

CAR FLEET RENEWAL: CO₂ EMISSIONS AND ANCILLARY BENEFITS

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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

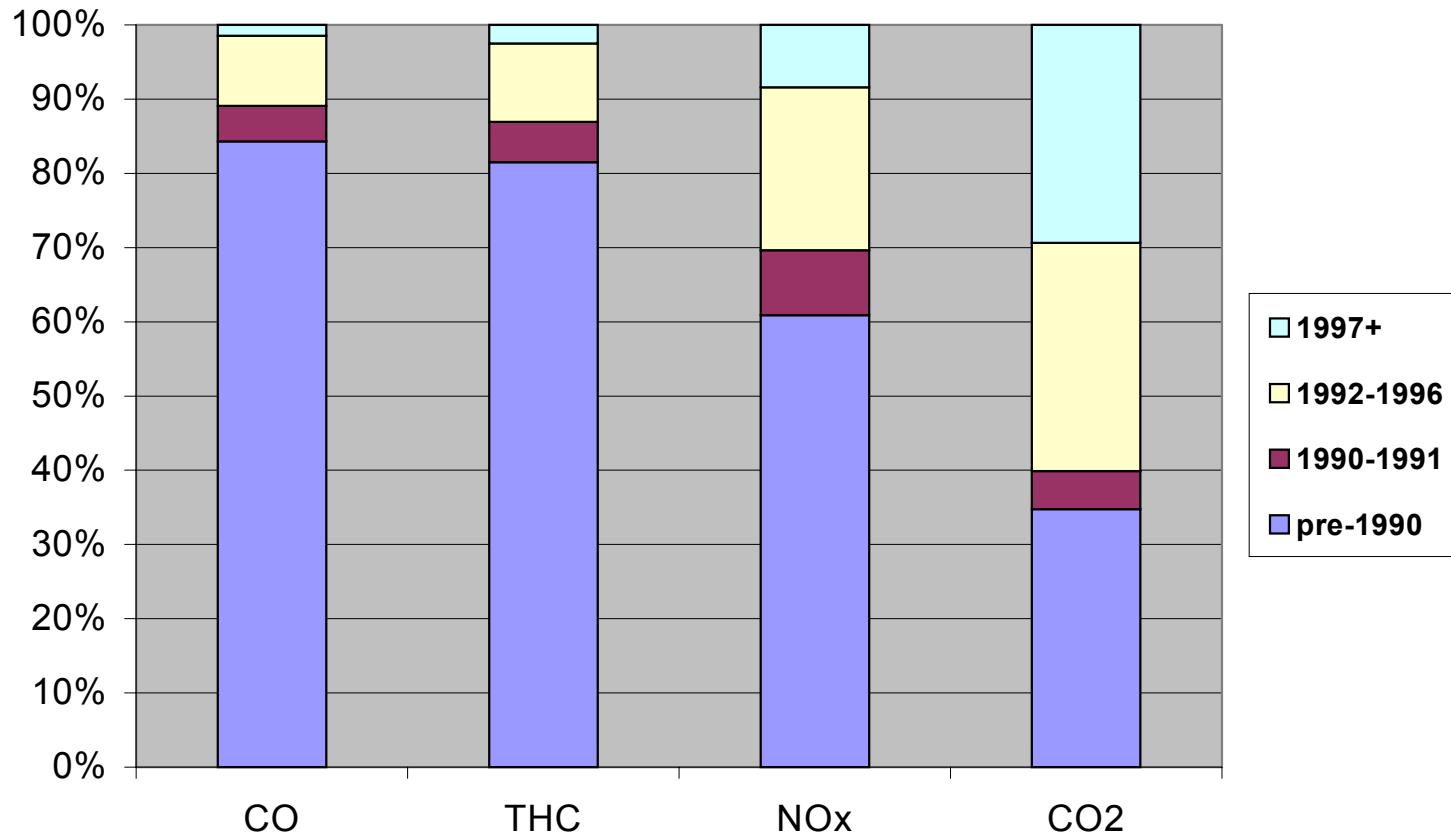
Vehicle Pollution

- 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:

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

$\mathcal{E}_{p,y}$ = 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 NOx) and MCT (CO₂)
- Average annual mileage from CETESB

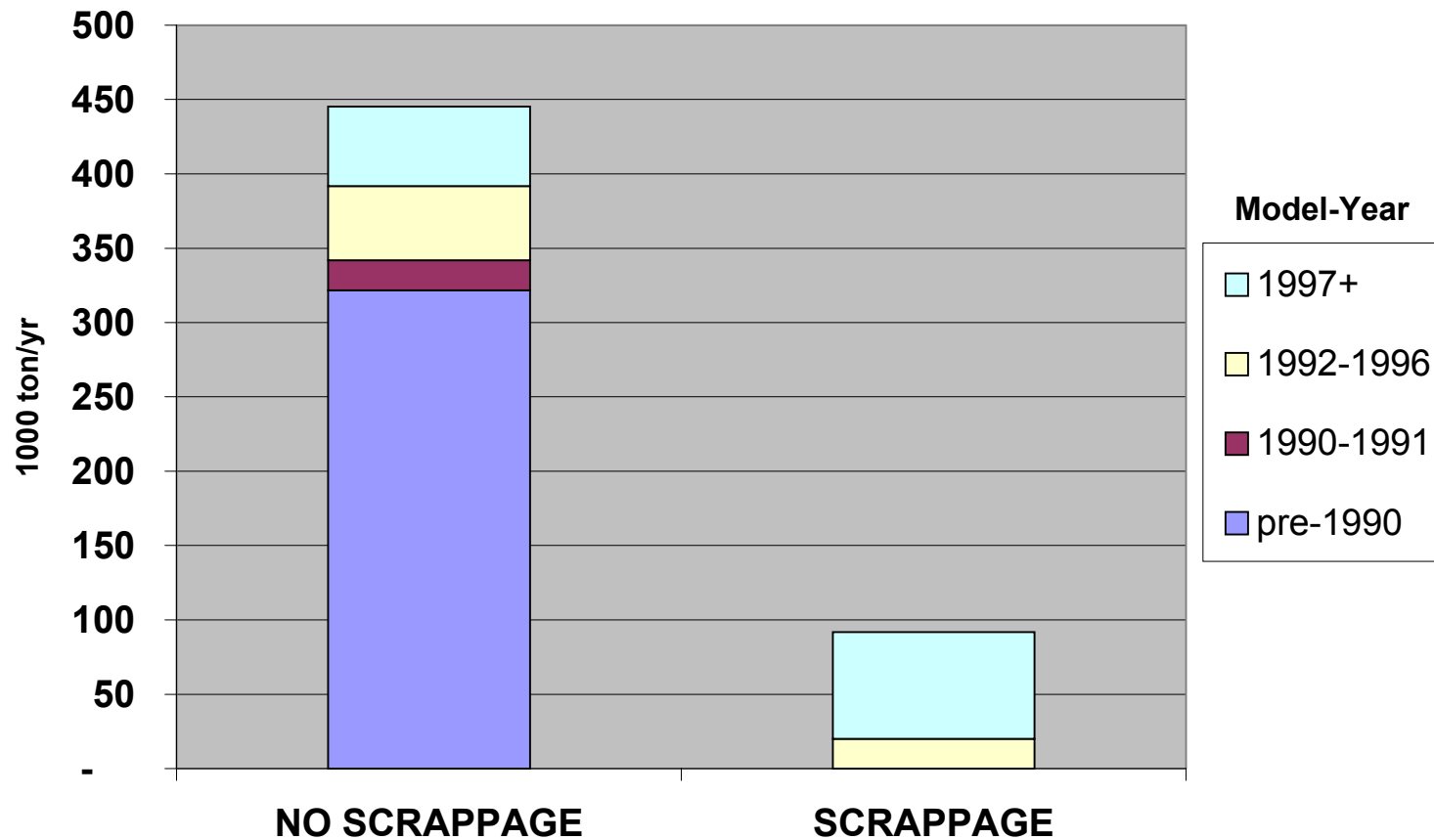
Methodology

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

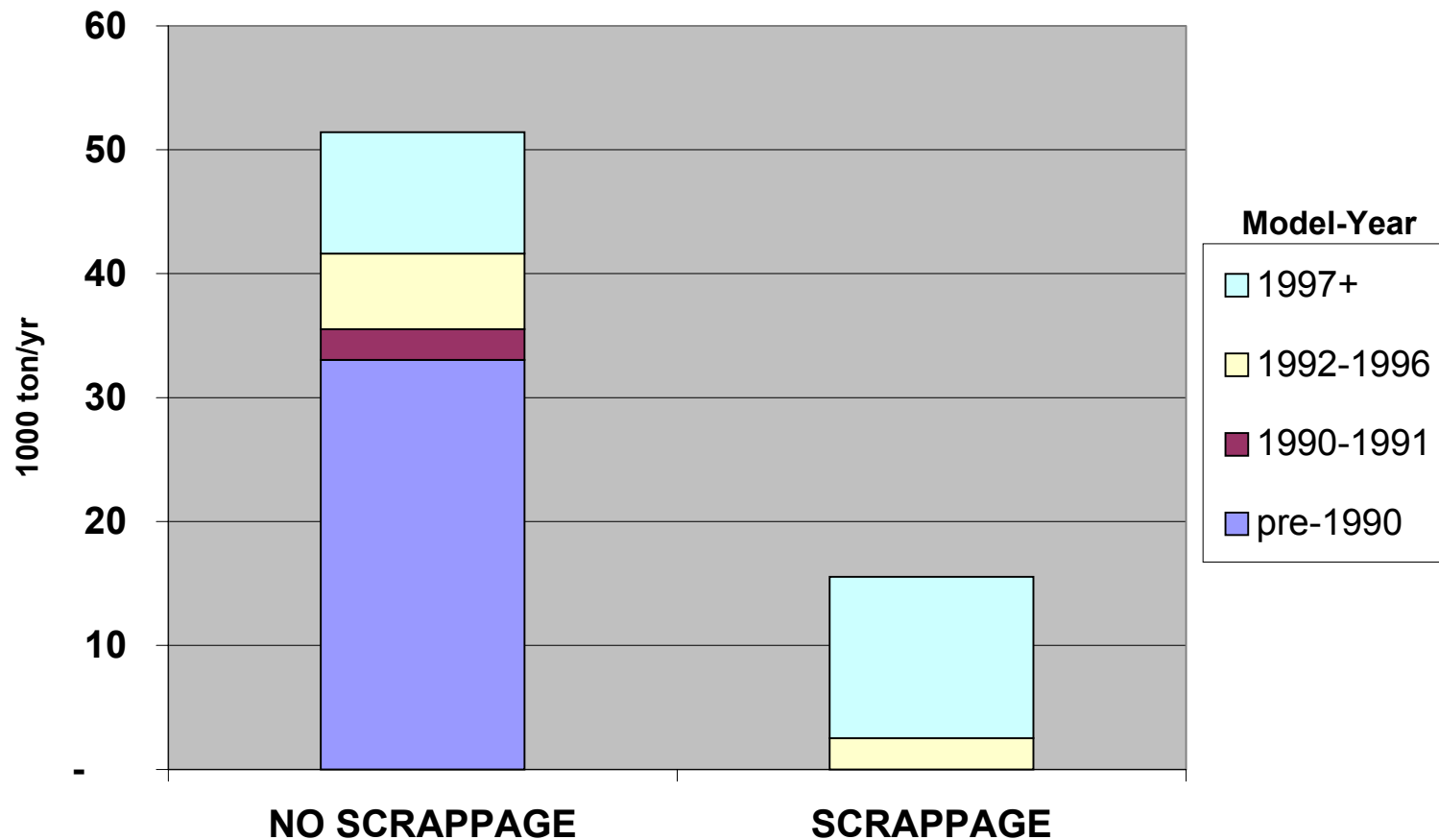
Results

- 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%

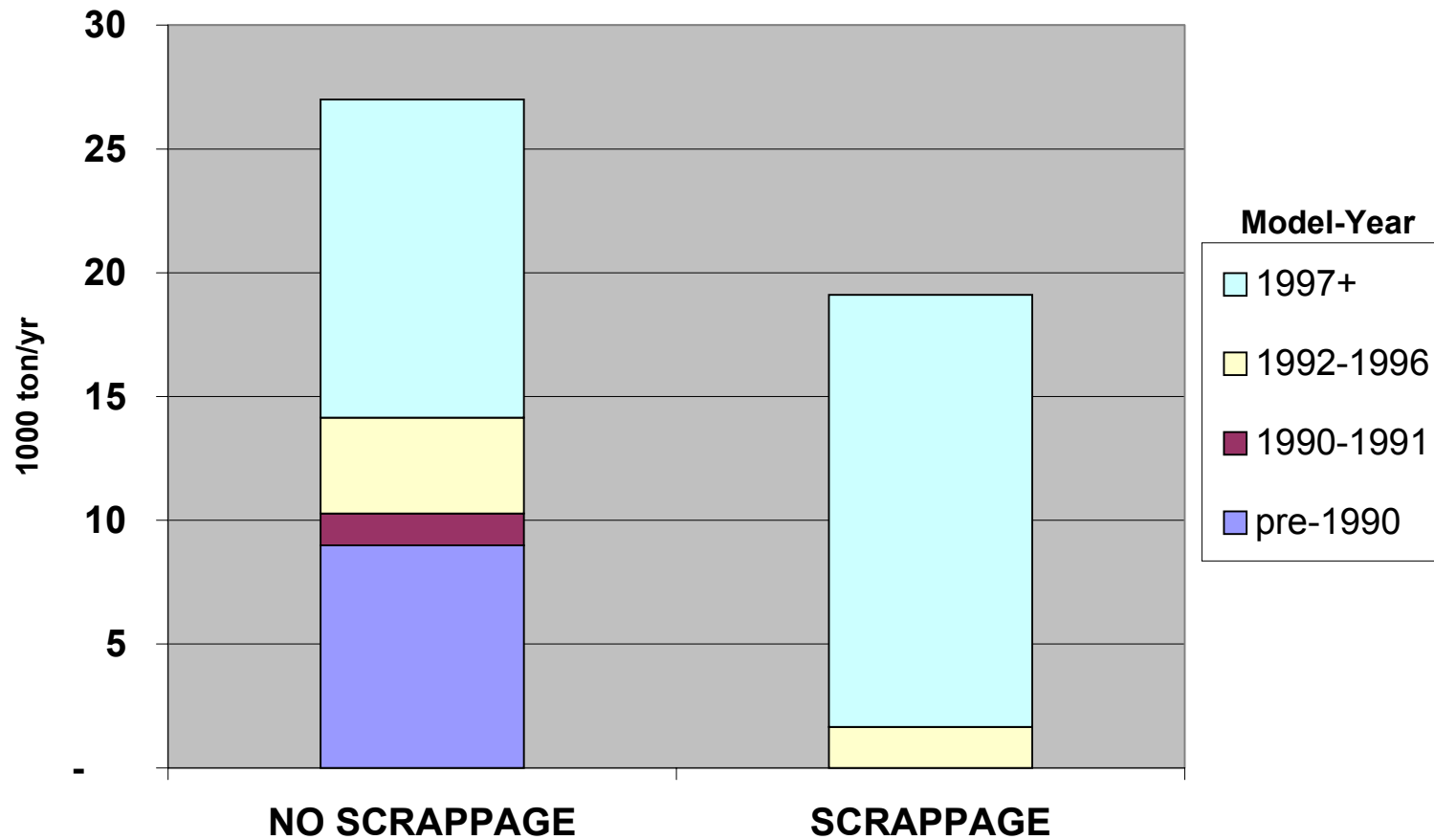
CO emissions in 2010



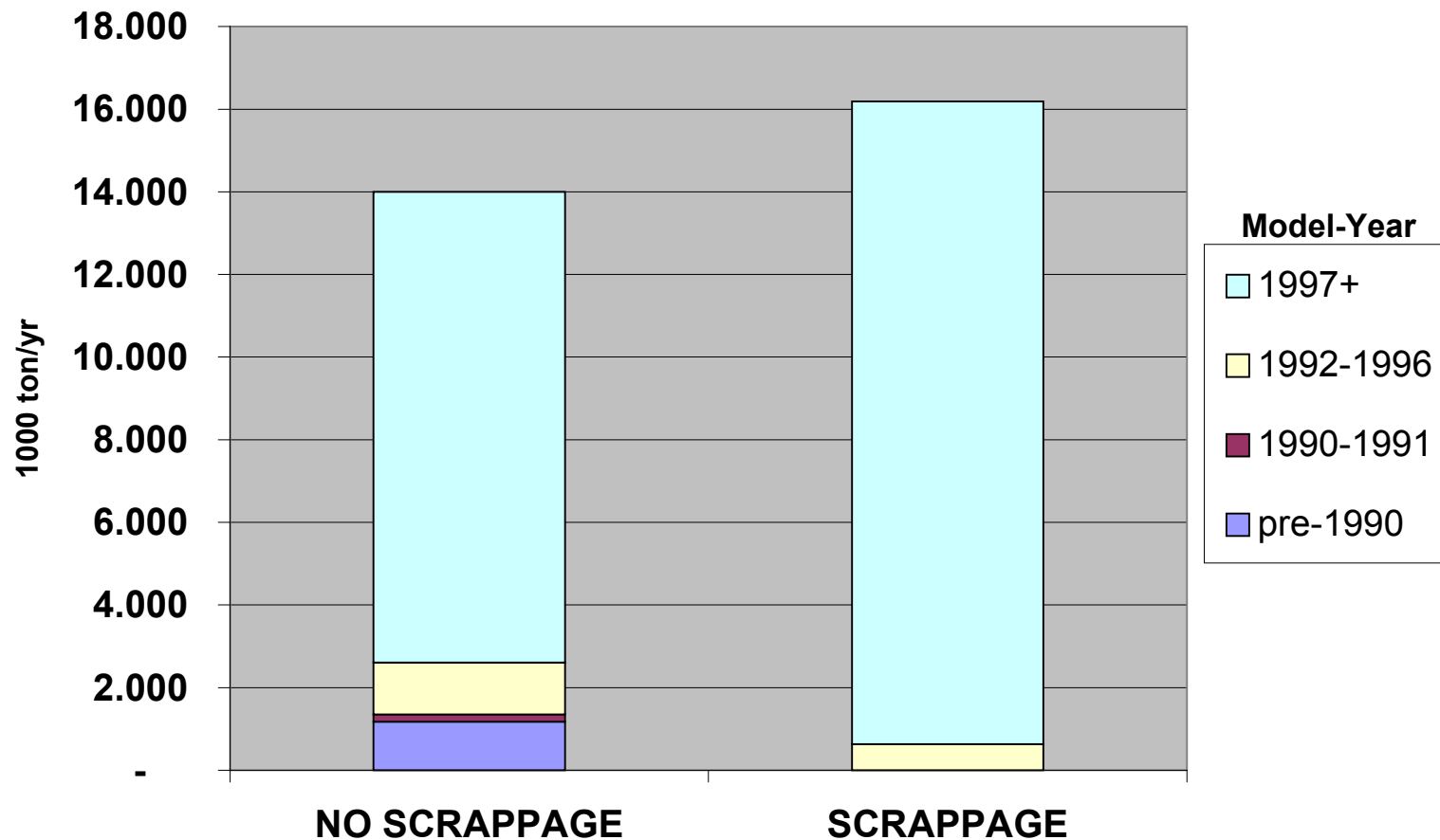
THC emissions in 2010



NOx emissions in 2010



CO₂ emissions in 2010



Conclusions

- Fleet renewal programs can reduce CO, THC and NO_x 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

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