

EUROCHAMP Workshop in Andechs
Chemistry, Transport and Impacts of Atmospheric Pollutants
With Focus on Fine Particulates, 10. - 12. October 2005

World Wide Emission Trend 1950 to 2050

Road Transport and all Sources

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Emitrade - Herrsching

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World Wide Emission Trend 1950 to 2050 Road Transport and all Sources

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Summary and Conclusion

World Wide Emission Trend 1950 to 2050 Road Transport and all Sources

Introduction States considered

CANADA

USA

Latin America: Argentina, Brazil, Mexico, Chile, Colombia, Peru, Guatemala, ...

Africa : Morocco, Congo, Algeria, Kenya, Cote d'Ivoire, Angola, Ghana, ...

West Europe : EU-15, Switzerland, Norway

East Europe : Poland, Romania, Bulgaria, Czech Rep., Croatia, Baltic States, ...

Former Sovjet Union : Russian Fed., Ukraine, Uzbekistan, Kazakhstan, ...

Middle East : Israel, Lebanon, Egypt, Kuwait, Iran, Iraq, Jordan, Bahrain, ...

India

China

East Asia : Taipei, Indonesia, Malaysia, Thailand, Pakistan, Philippines, ...

Oceania : Australia, New Zealand, Fiji, Micronesia, Papua New Guinea, ...

Japan

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World Wide Emission Trend 1950 to 2050 Road Transport and all Sources

Population Trend

**reported in Worldbank data profiles for 1998 to 2004
for all States together with other relevant economic Data
Extrapolated before and after this time period 2004 - 2050**

Road Transport Data

reported in World Road Statistics, Eurostat, OECD, VDA, DIW

Methodology for the Estimation of Worldwide Road Transport Emissions

Methodology approach (Example for Passenger Cars)

$$E_{\text{Veh.}} = \sum (E_{\text{Canada}} + E_{\text{USA}} + E_{\text{Latinamer.}} + E_{\text{Africa}} + E_{\text{West Europe}} + \dots + E_{\text{Int.Ship.}})$$

$$E_{\text{PC:USA}} = (\text{Reg. Cars}_{\text{USA}} * \text{Av. Annual Mileage}_{\text{USA}} * \text{relat. E-Factor}_{\text{USA}})$$

Registered Passenger Car and goods vehicle numbers and average annual mileage from World Road statistics 1980 to 2004 of International Road Federation.

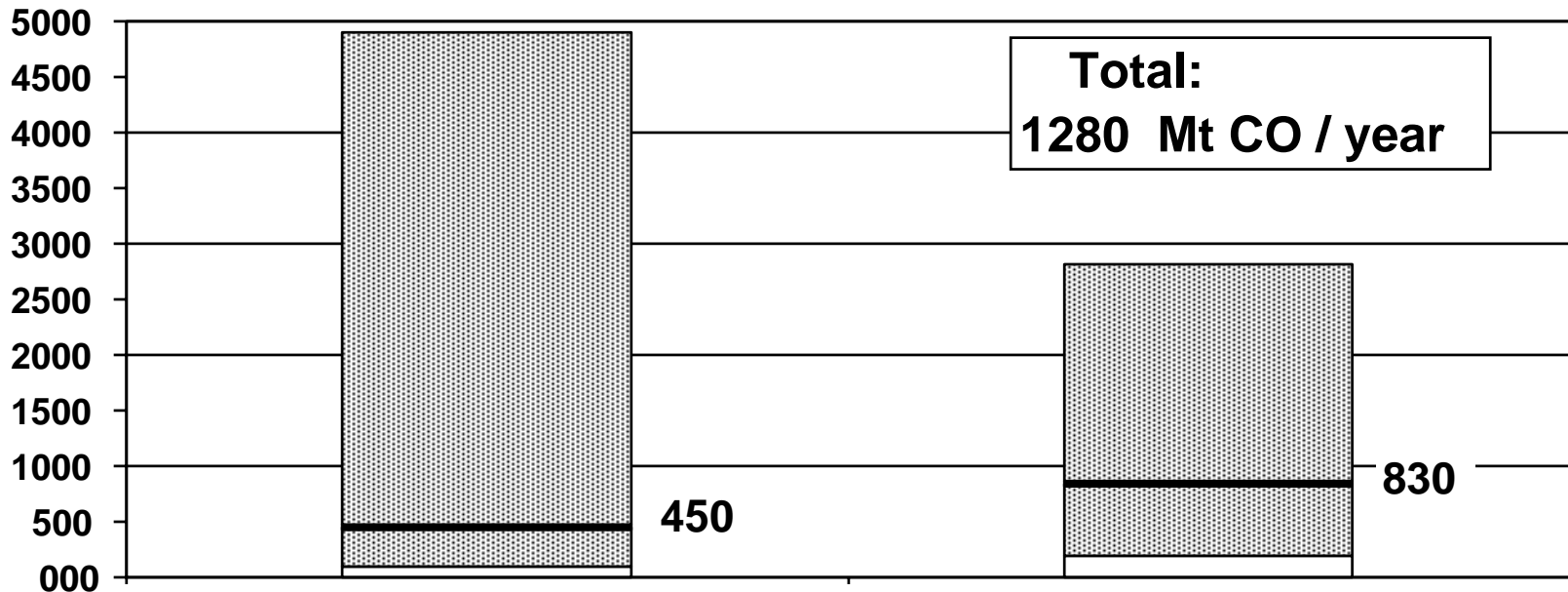
Emission-Factors partly from measurements in some countries and literature survey.

Forecast from 2003 to 2010 on the basis of experience of the past,

Growth of population, of gross net product and political stability.

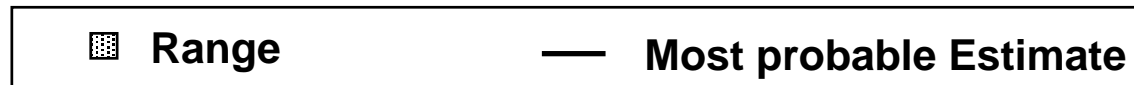
Global Annual CO-Emission

CO - Emission [Mio t/year]



Biogenic: 35 %

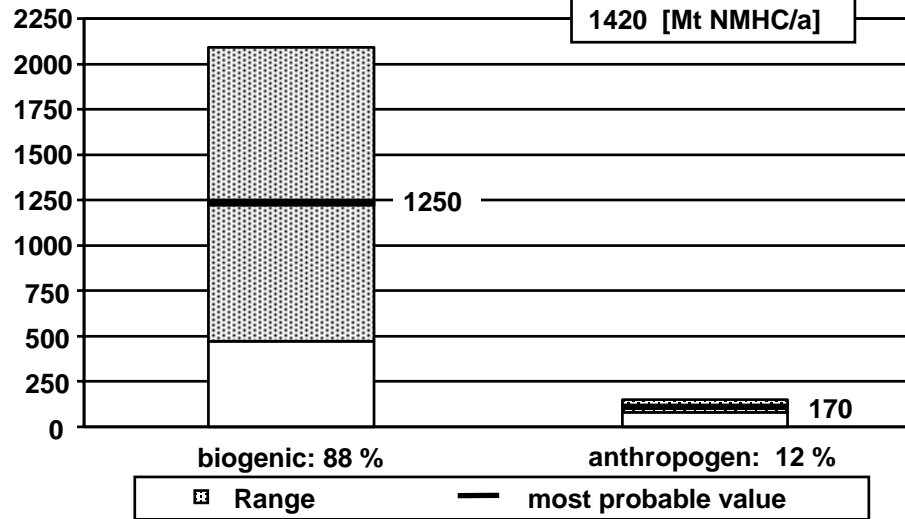
Anthropogenic: 65 %



Global Annual VOC-, NO_x-, PM- and SO₂ - Emissions including Ranges

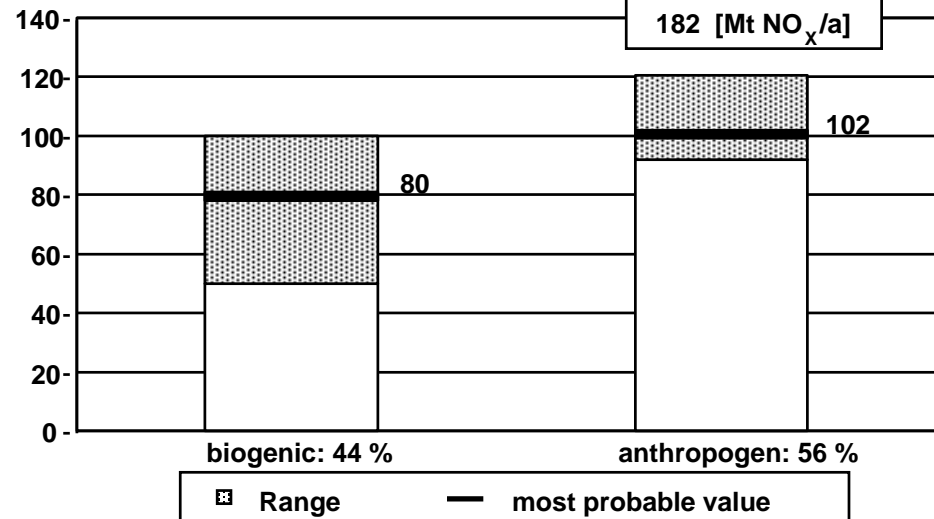
NMHC-Emissions in [Mt/a]

total:
1420 [Mt NMHC/a]



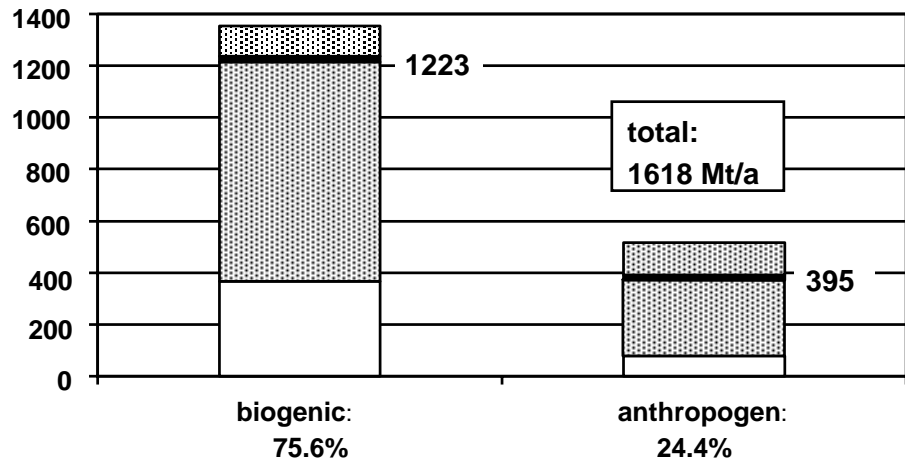
NO_x - Emissions in [Mt/a]

total:
182 [Mt NO_x/a]



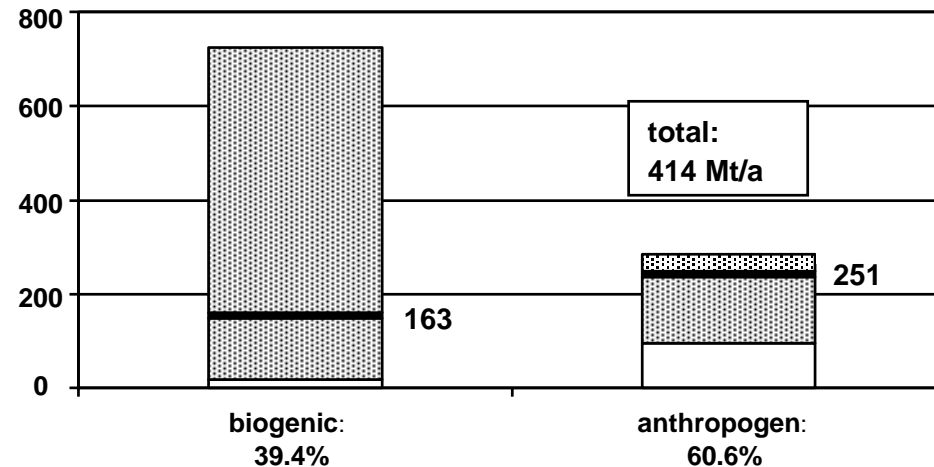
Particulate-Emissions in [Mt/a]

total:
1618 Mt/a



SO₂ -Emissions in [Mt/a]

total:
414 Mt/a

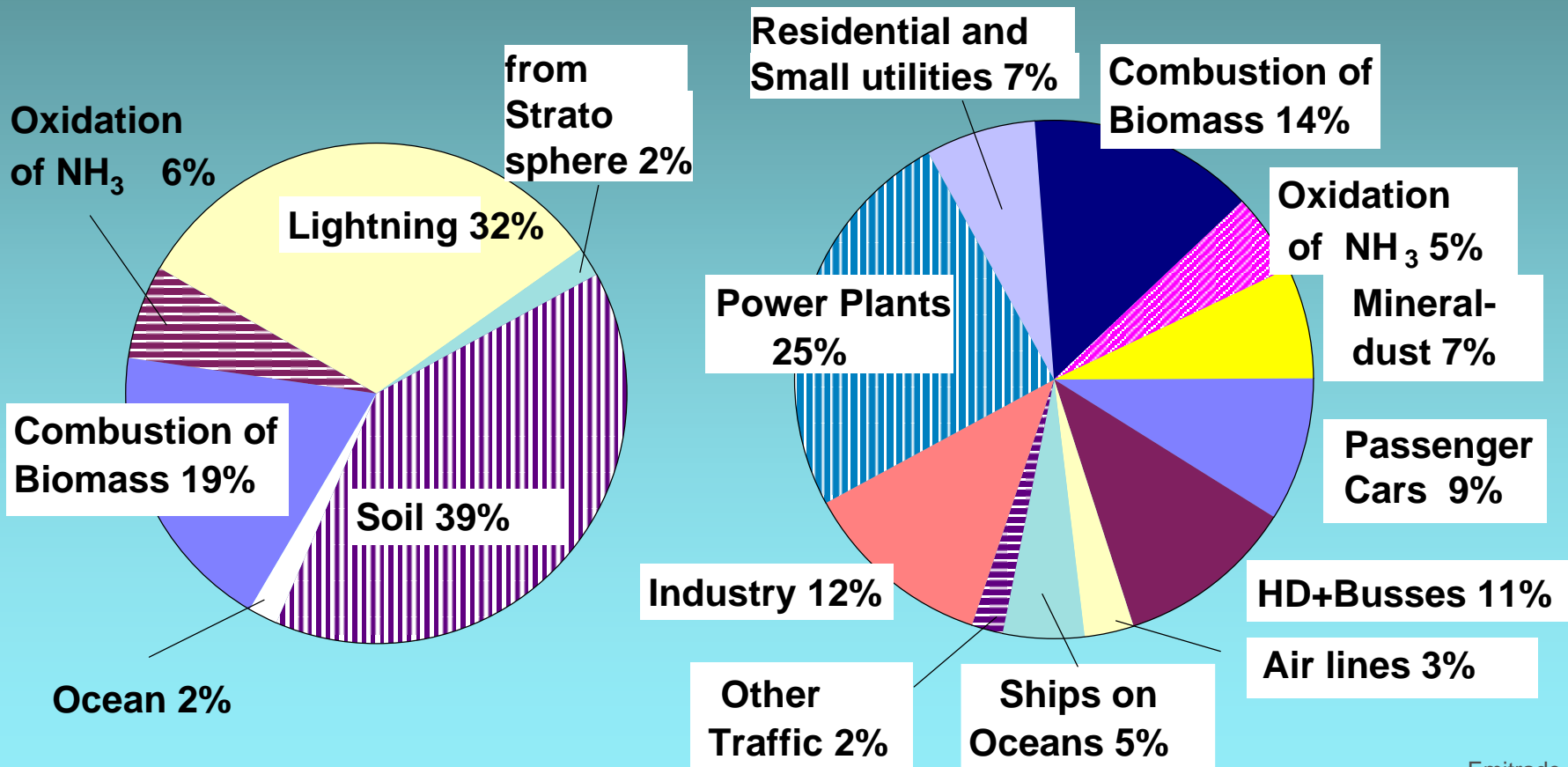


Global Annual NO_x-Emissions

Share of Different Sources

Biogenic NO_x-Emissions
Total 80 Mill. t/a

Anthropogenic NO_x-Emissions
Total 110 Mt/a

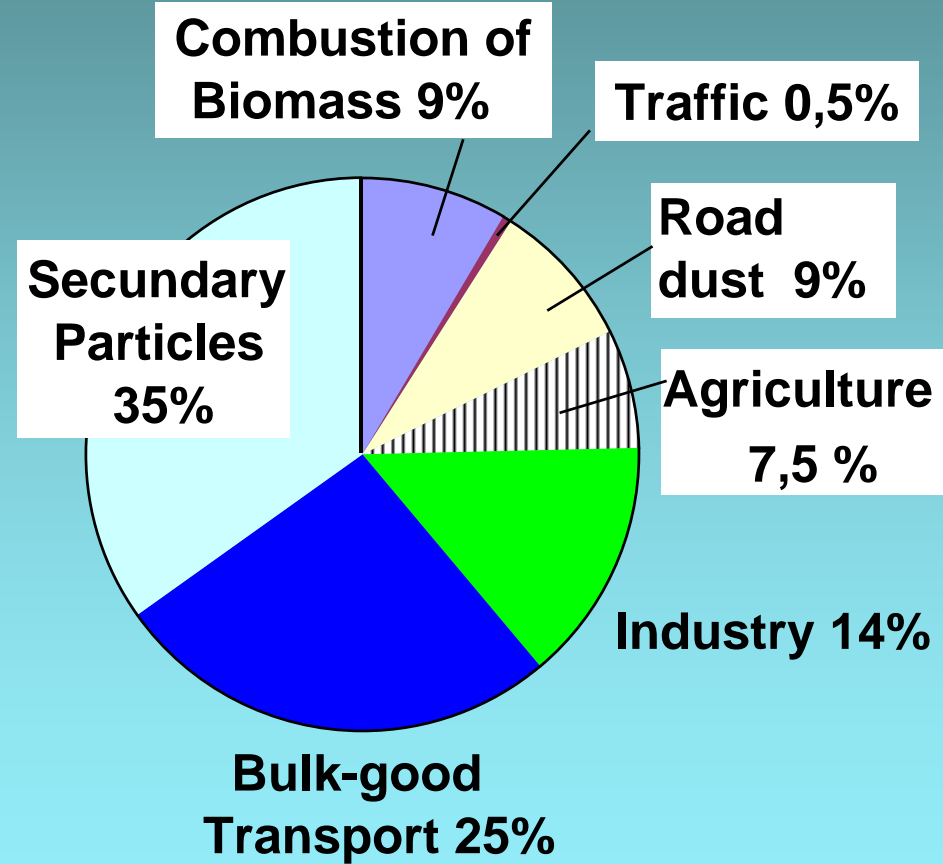
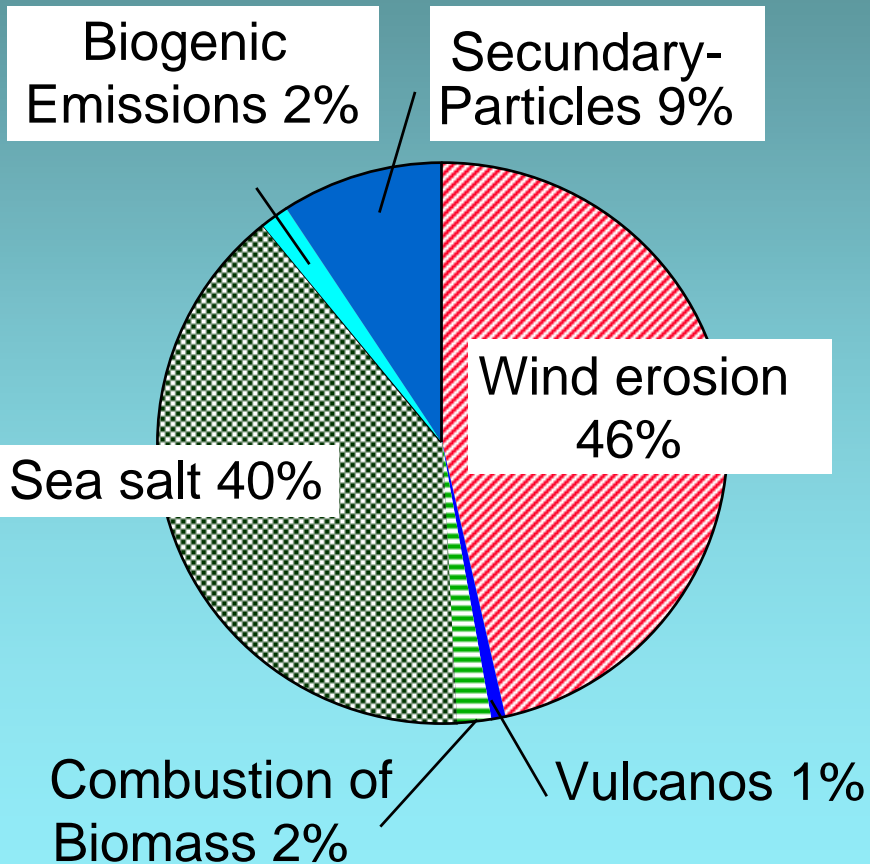


Global Annual PM-Emissions

Share of Different Sources

Biogenic PM-Emissions
Total 3250 Mt/a

Anthropogenic PM-Emissionen
Total 570 Mt/a



Methodology for the Estimation of Worldwide Total Emissions

$$E_{\text{Total}} = \sum_{n=1}^{n=14} (E_{\text{Canada}} + E_{\text{USA}} + E_{\text{Latinamer.}} + E_{\text{Africa}} + E_{\text{West Europe}} + \dots + E_{\text{Int.Ship.}})$$

$$E_{\text{State}} = \sum (E_{\text{Fossil Fuel}} + E_{\text{Biofuel}} + E_{\text{Industrial Processes}} + E_{\text{Landuse/Wastetreatment}})$$

Fossil Fuel includes

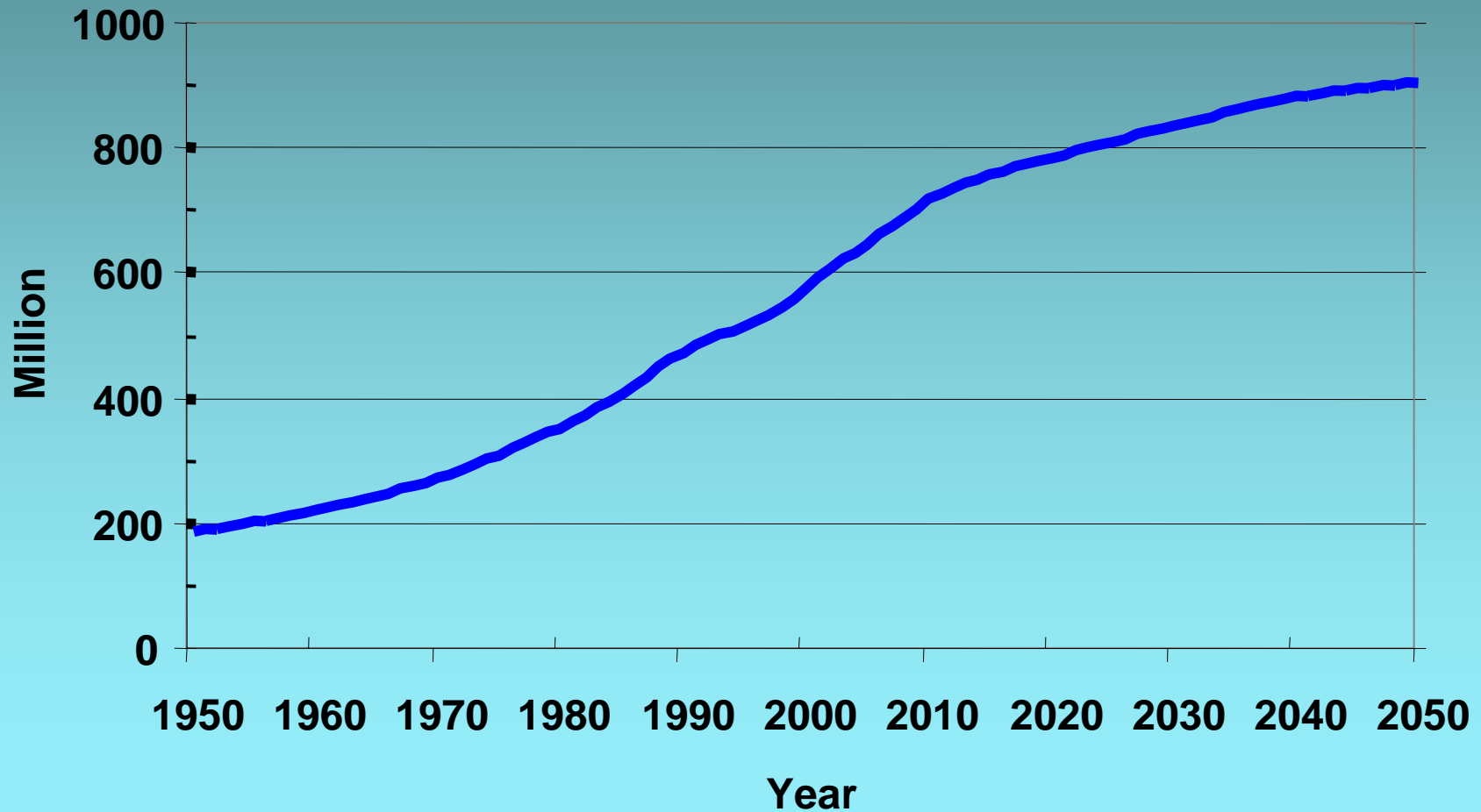
Industry, Power Generation, Residentials, Road Transport, Non Road Transport

Landuse/Wastetreatment includes

Deforestation, Biomass burning, Agrcultural wasteburning

- Extrapolation from 1980 to 2004 on the basis of available OECD Data
- Forecast from 2005 to 2050 on the basis of experience of the past, Growth of population, of gross net product and political stability

Trend of Worldwide Passenger Cars All Countries

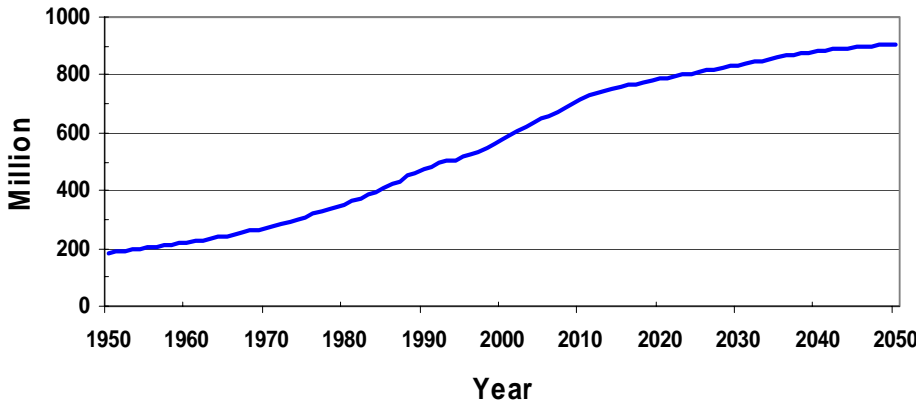


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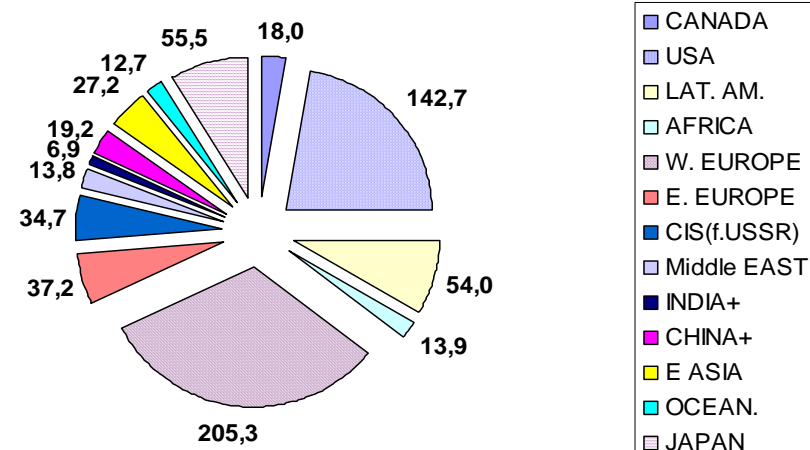
Worldwide Vehicle Trend

Passenger Cars, Duty Vehicles and Two Wheeler

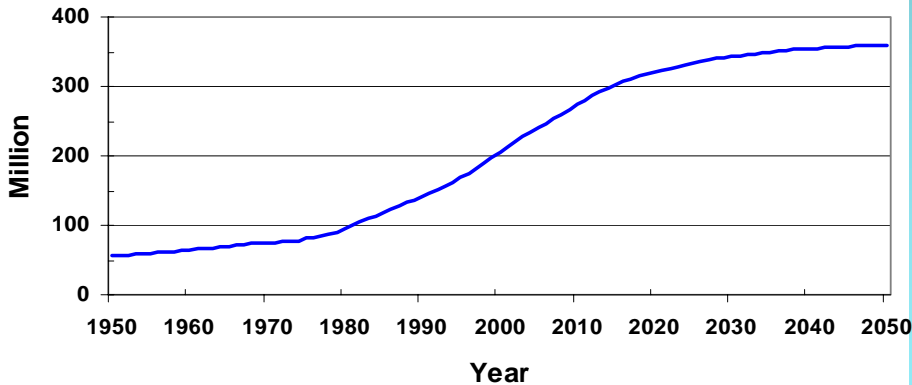
Passenger Car Trend



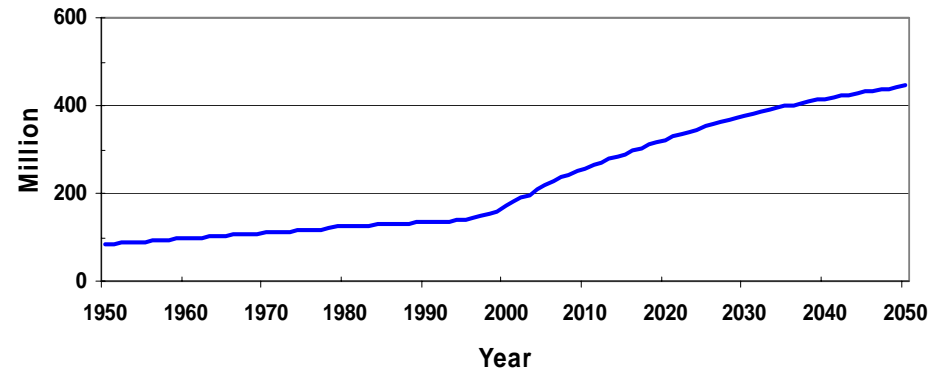
PC Contribution 2005



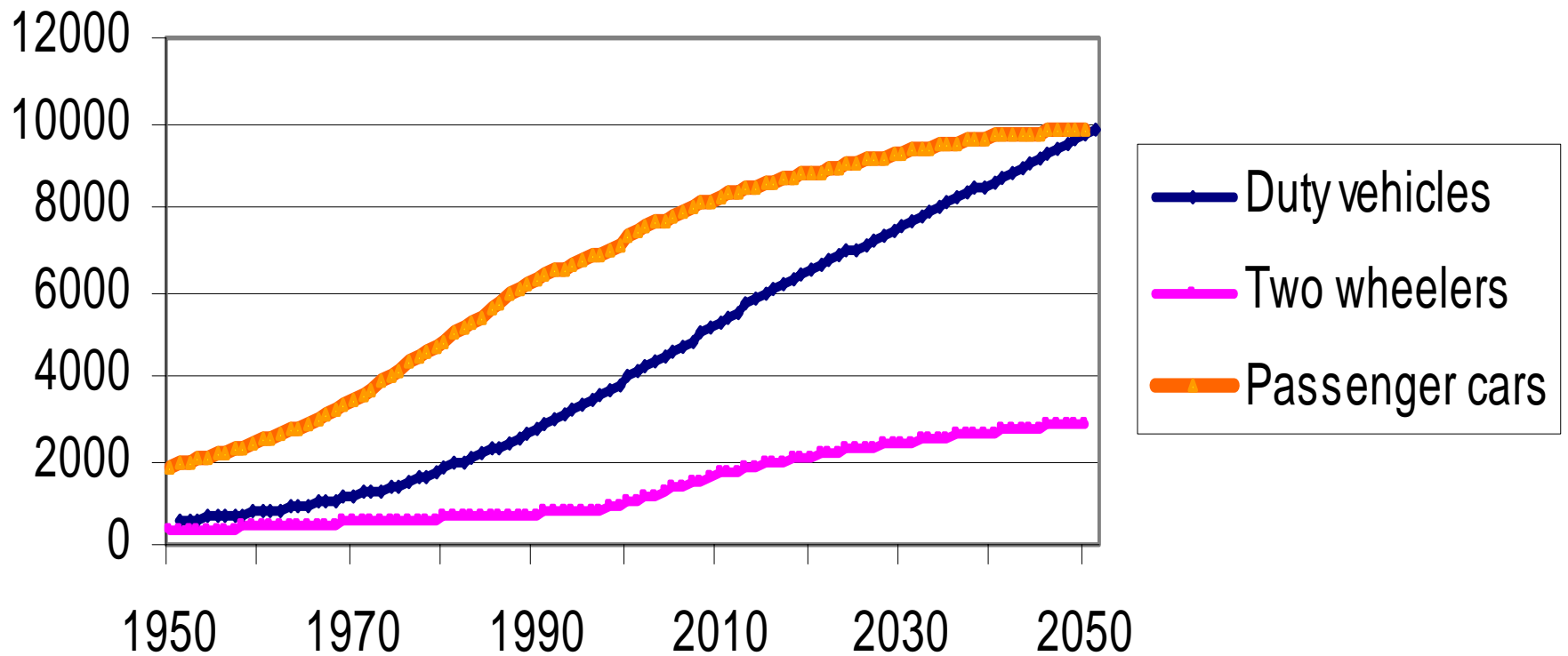
Duty Vehicle Trend



Two Wheeler Trend

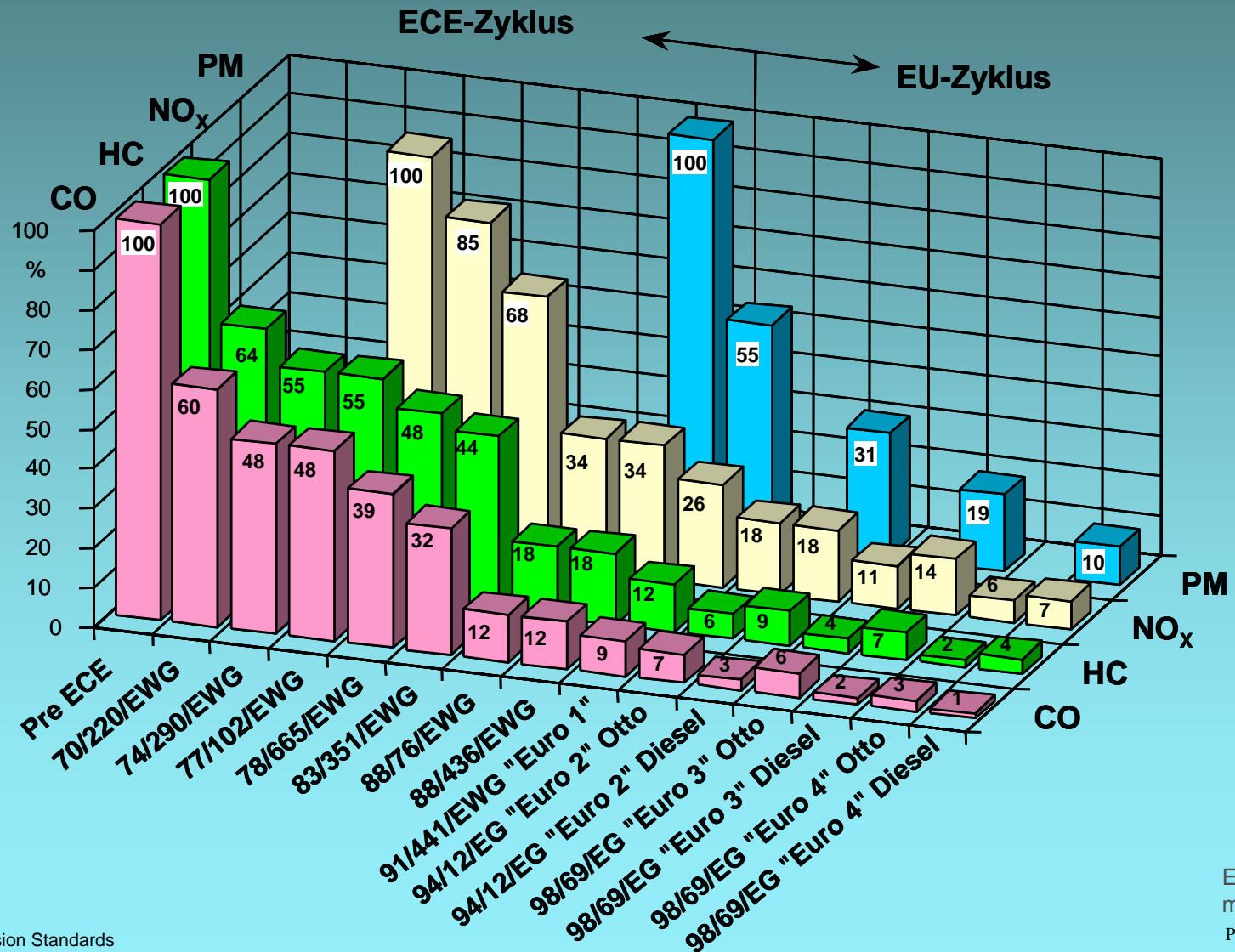


Total Mileage Trend Road Transport worldwide in Mio km



Trend of Worldwide Emission Standards

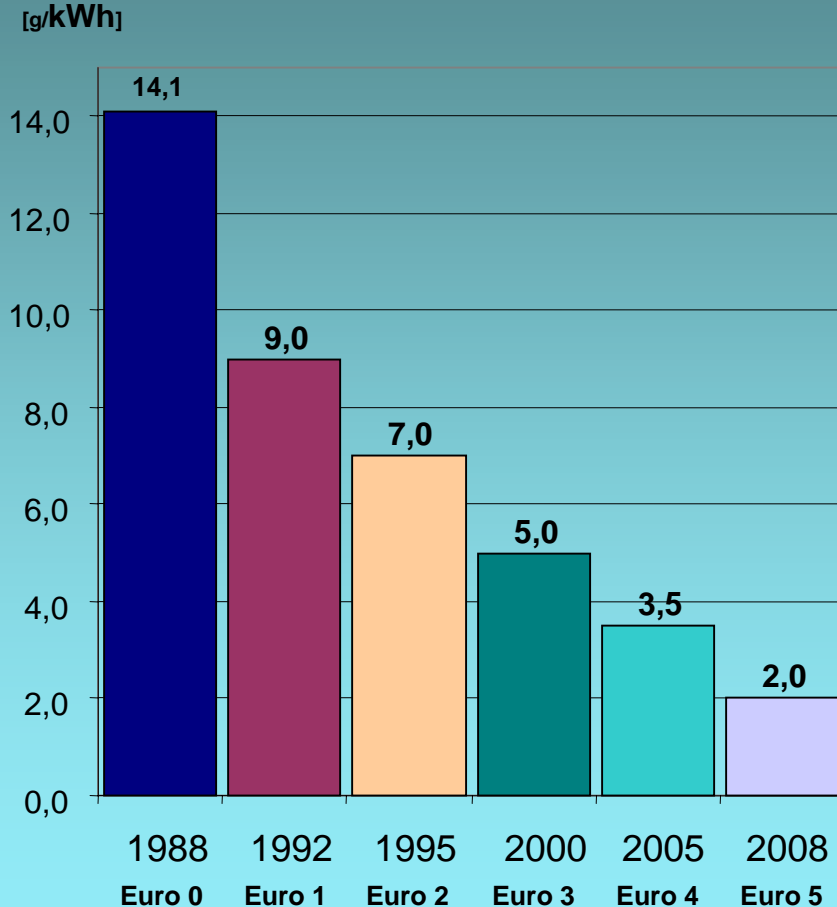
Example EU Passenger Cars



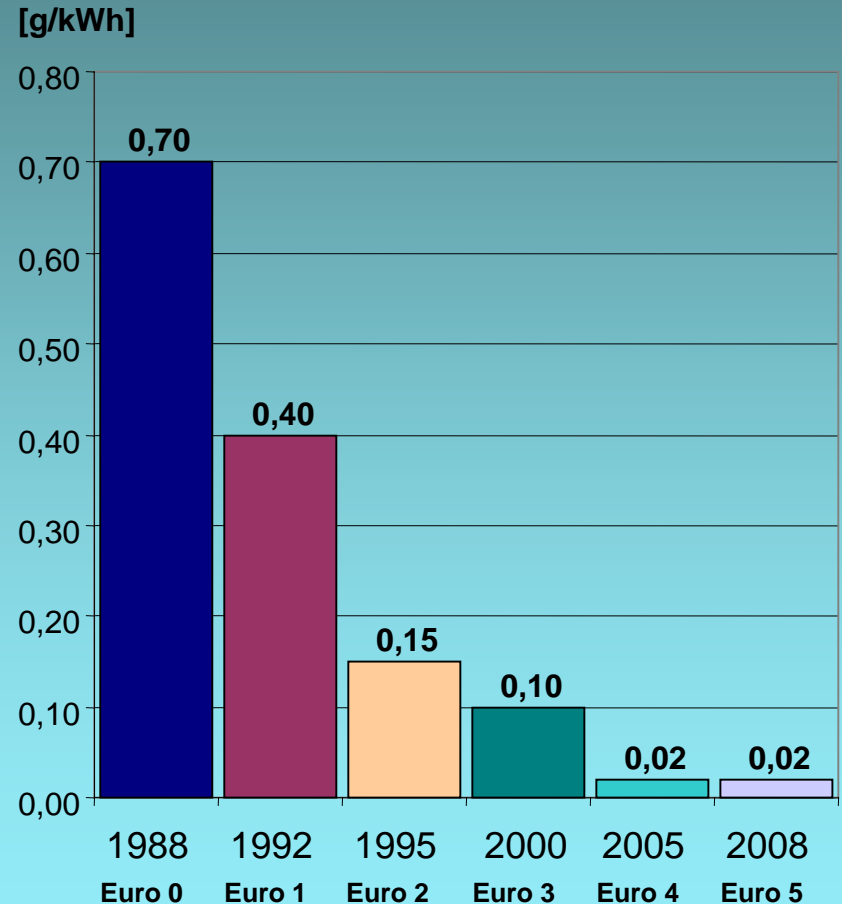
Trend of Worldwide Emission Standards

Example EU Duty Vehicles

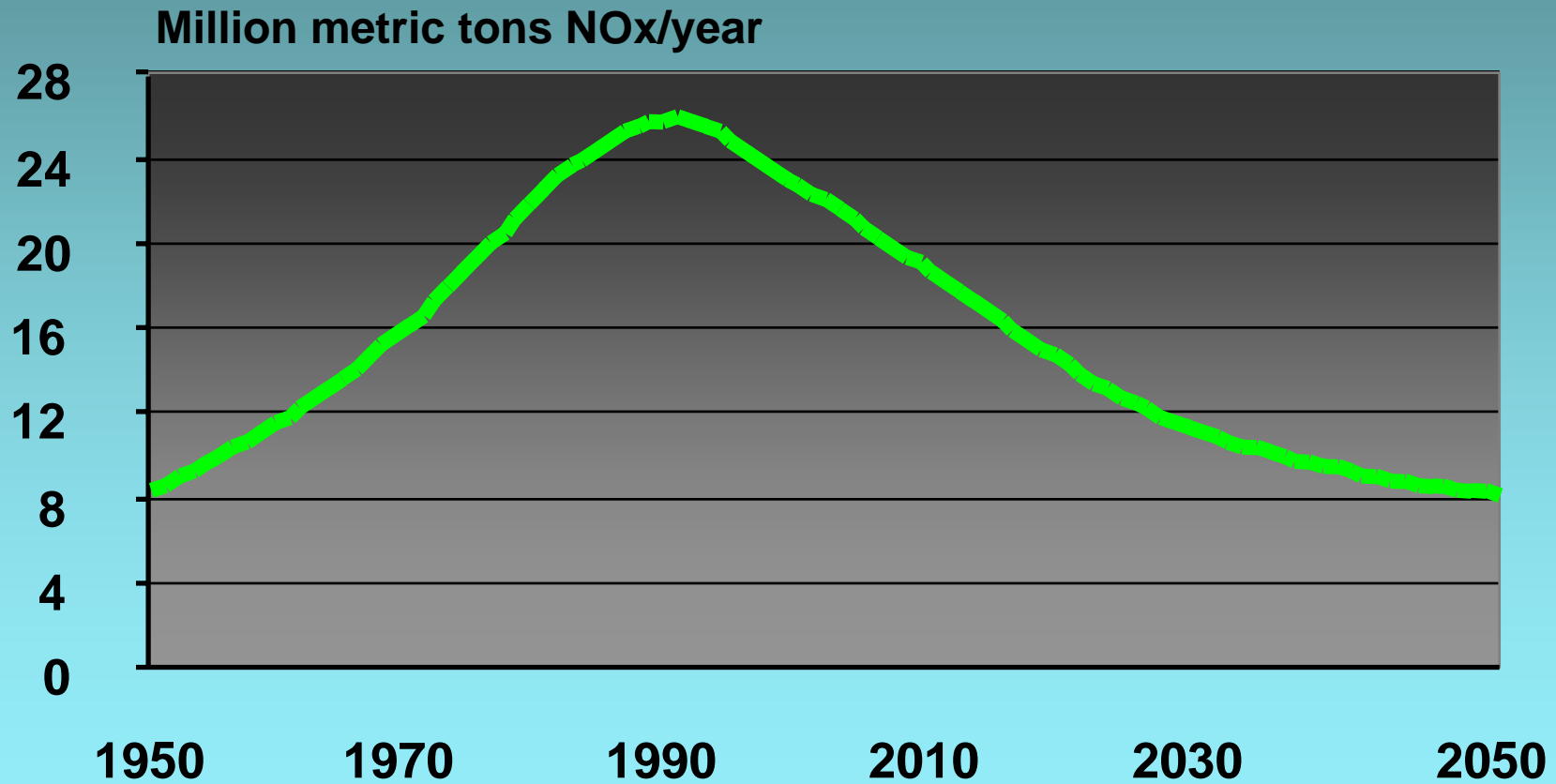
NOx Emission Standard



Particle Emission Standard



Trend of Worldwide NOx-Emissions All Vehicles Together

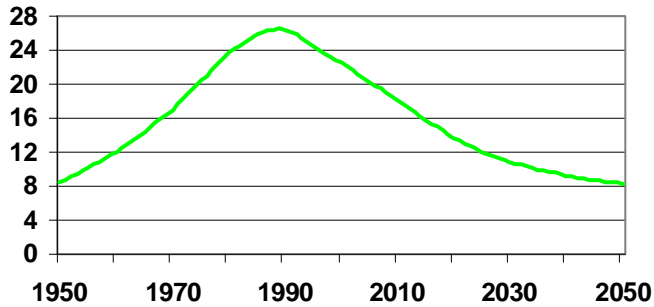


Emitrade
me-50 16

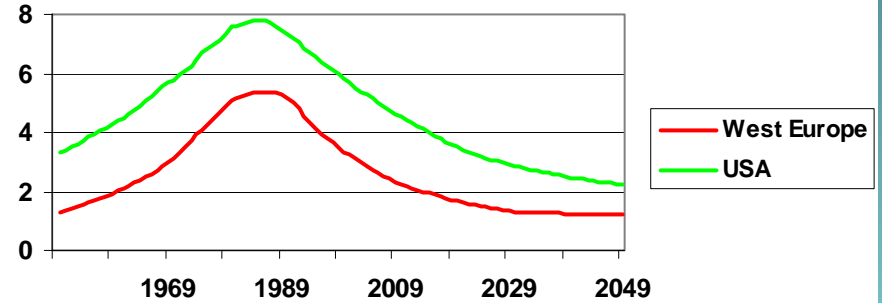
Emi-Nox-RT-
W

Trend of Worldwide NOx-Emissions All Vehicles Together

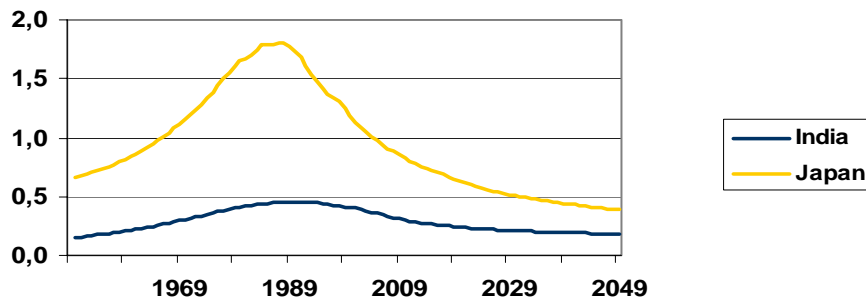
**NOx Emission Trend in Mio t
All Vehicles Worldwide**



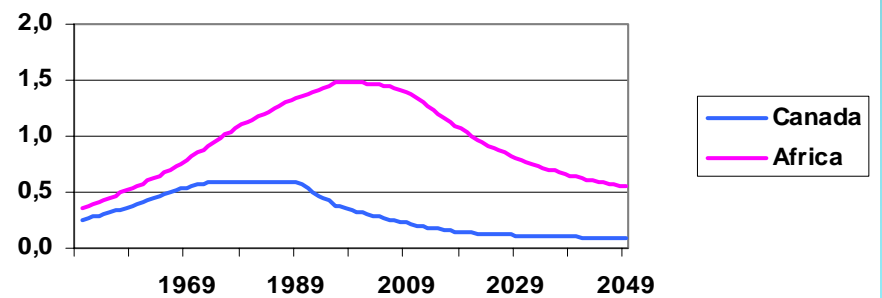
**NOx Emission Trend in Mio t
All Vehicles in USA and West Europe**



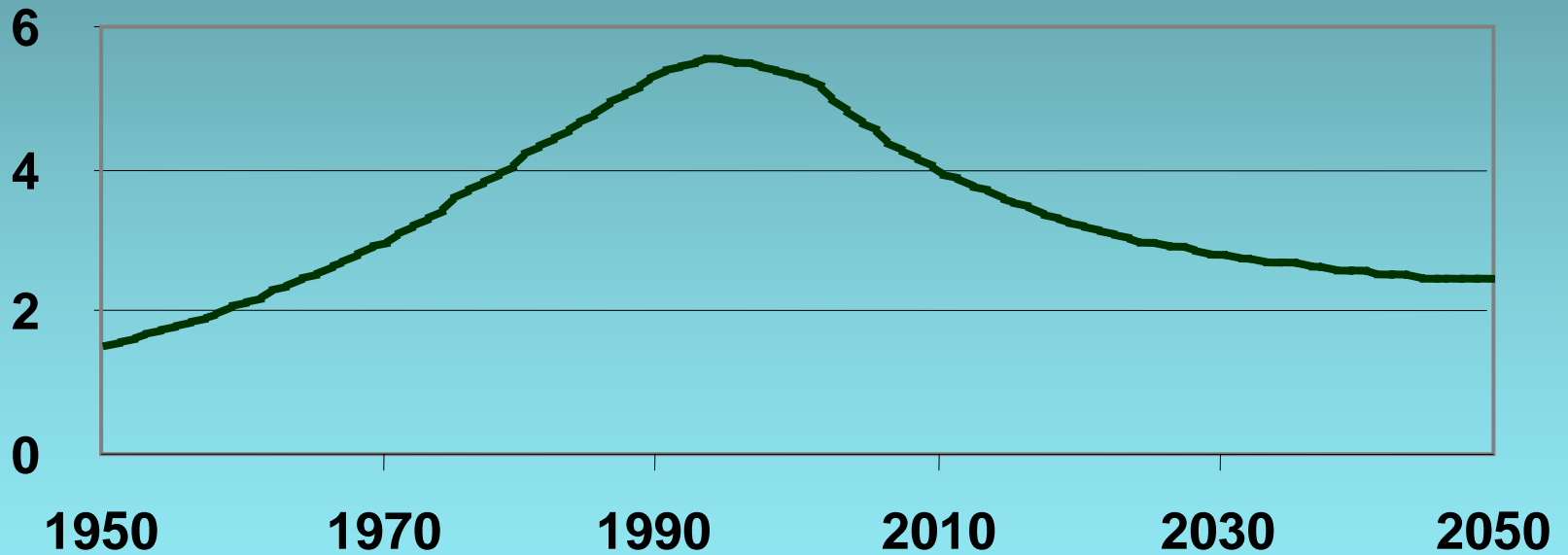
**NOx Emission Trend in Mio t
All Vehicles in India and Japan**



**NOx Emission Trend in Mio t
All Vehicles in Africa and Canada**

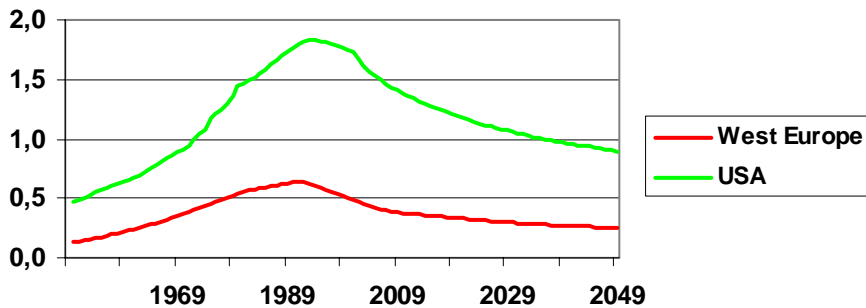


Trend of Worldwide PM-Emissions in Mio t All Vehicles Worldwide

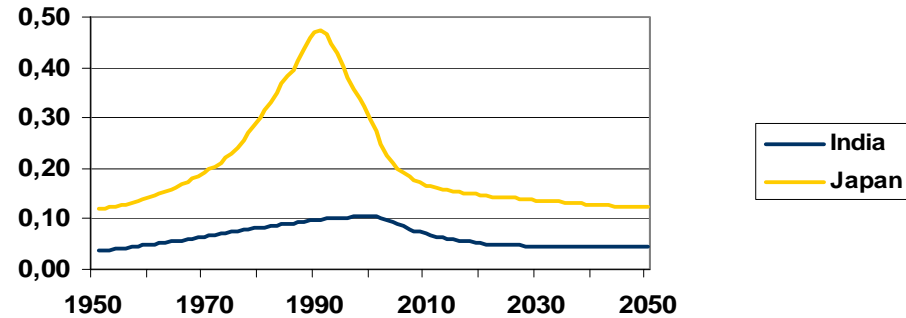


Trend of Worldwide PM-Emissions Passenger Cars, Duty Vehicles and Two Wheeler

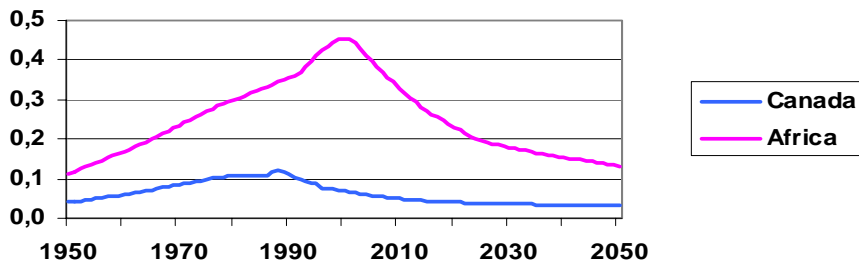
**PM Emission Trend in Mio t
All Vehicles in USA and West Europe**



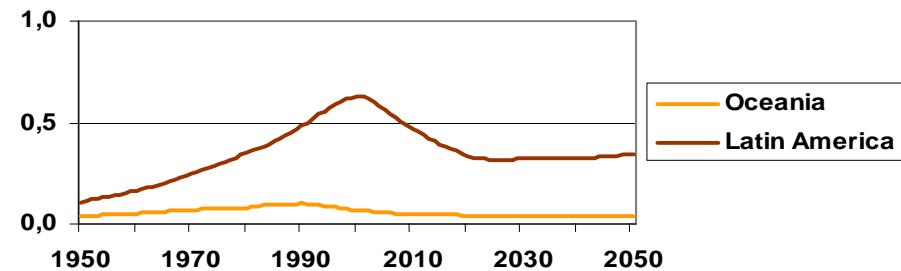
**PM Emission Trend in Mio t
All Vehicles in India and Japan**



**PM Emission Trend in Mio t
All Vehicles in Africa and Canada**

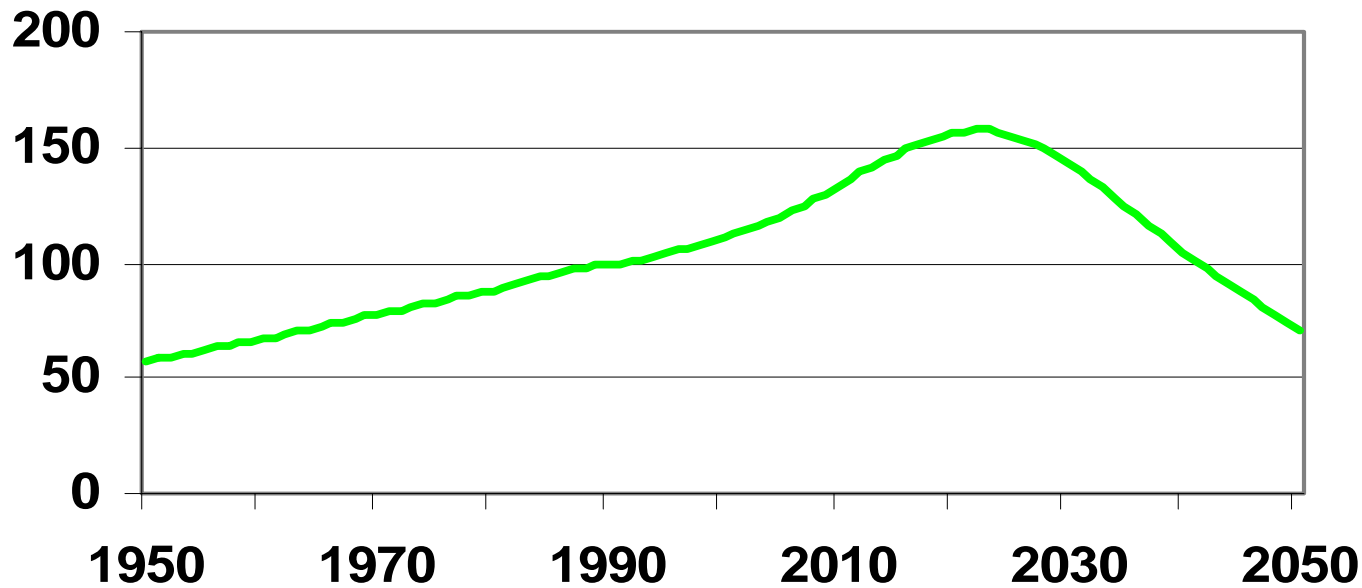


**PM Emission Trend in Mio t
All Vehicles in Latin America and Oceania**



Trend of Worldwide NOx-Emissions All Sources

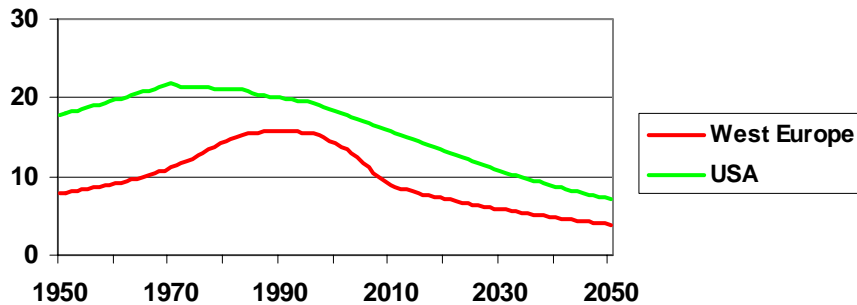
NOx Emission Trend in Mio t All Sources Worldwide



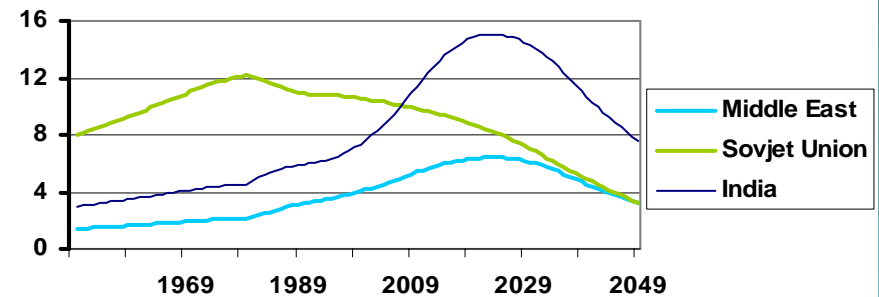
Trend of Worldwide NOx-Emissions

All Sources - Trend in Different Countries

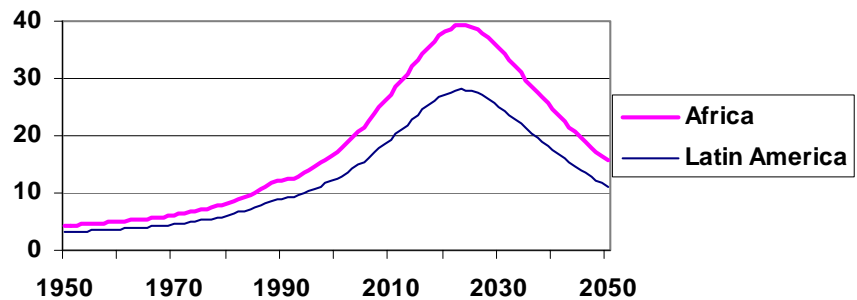
**NOx Emission Trend in Mio t
All Sources in USA and West Europe**



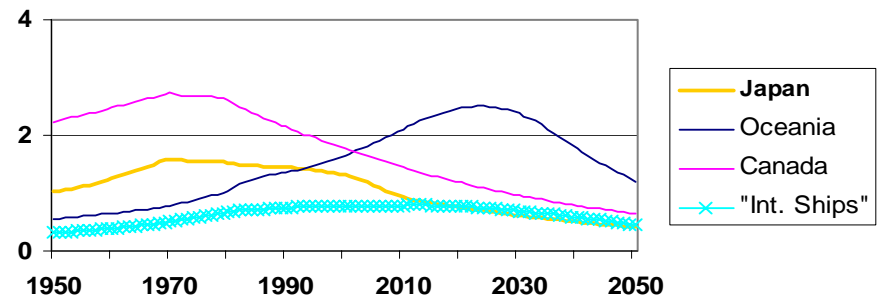
**NOx Emission Trend in Mio t
All Sources in Former Sovjet Union, India and Middle East**



**NOx Emission Trend in Mio t
All Sources in Africa and Latin America**

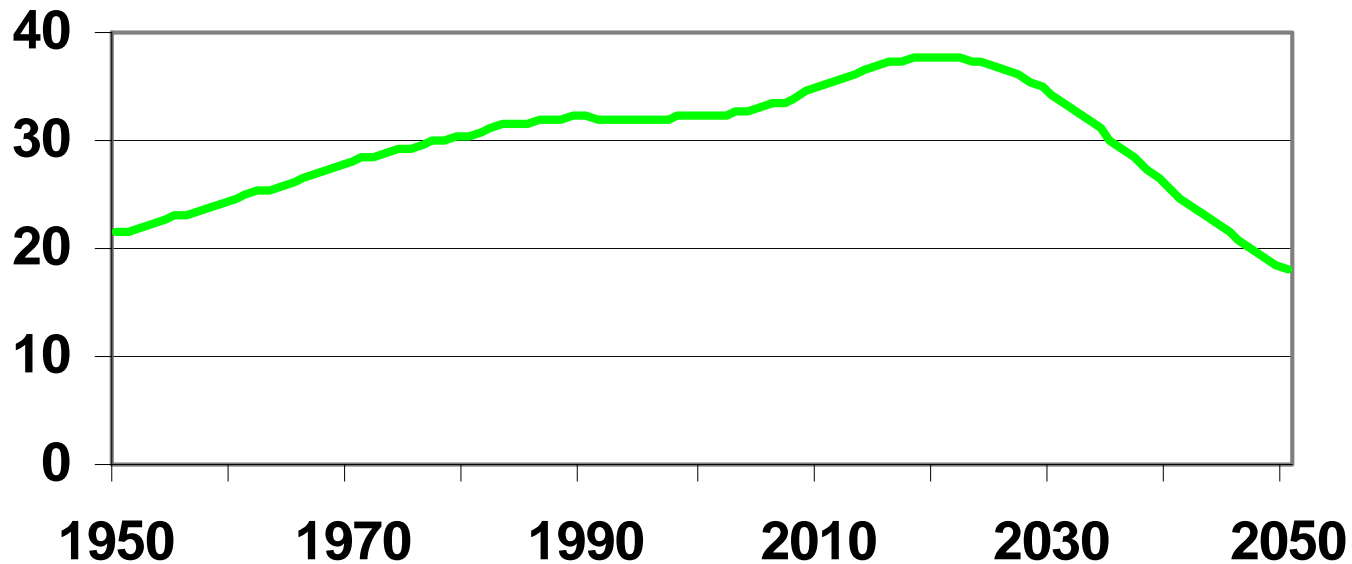


**NOx Emission Trend in Mio t
All Vehicles in Canada, Oceania, Japan and International Ships**



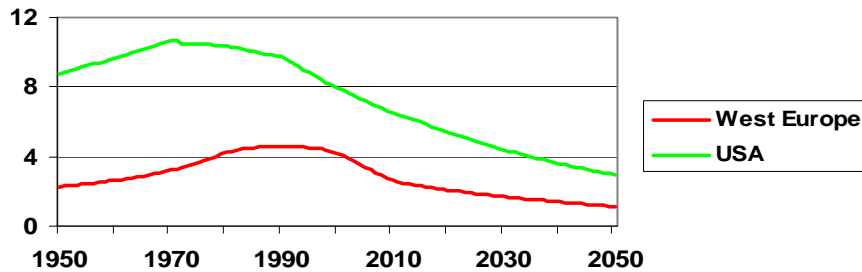
Trend of Worldwide PM-Emissions All Sources

PM Emission Trend in Mio t All Sources Worldwide

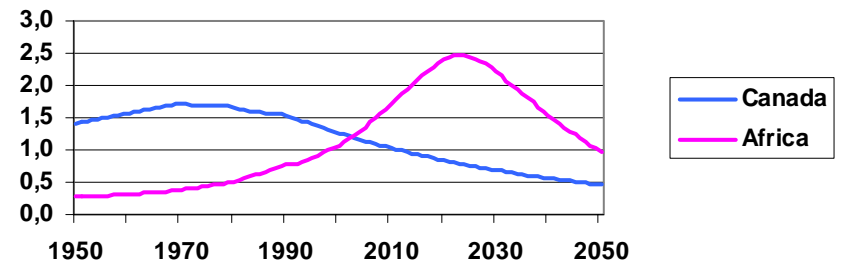


Trend of Worldwide PM-Emissions All Sources in Different Countries

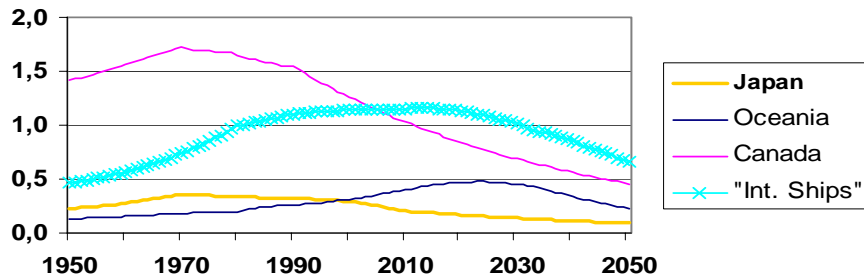
PM Emission Trend in Mio t
All Sources in USA and West Europe



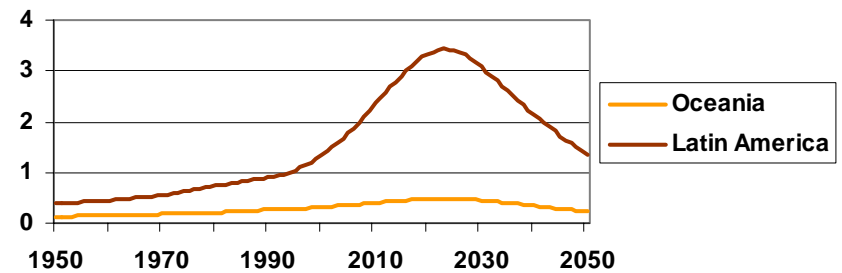
PM Emission Trend in Mio t
All Sources in Africa and Canada



PM Emission Trend in Mio t
All Vehicles in Canada, Oceania, Japan
and International Ships

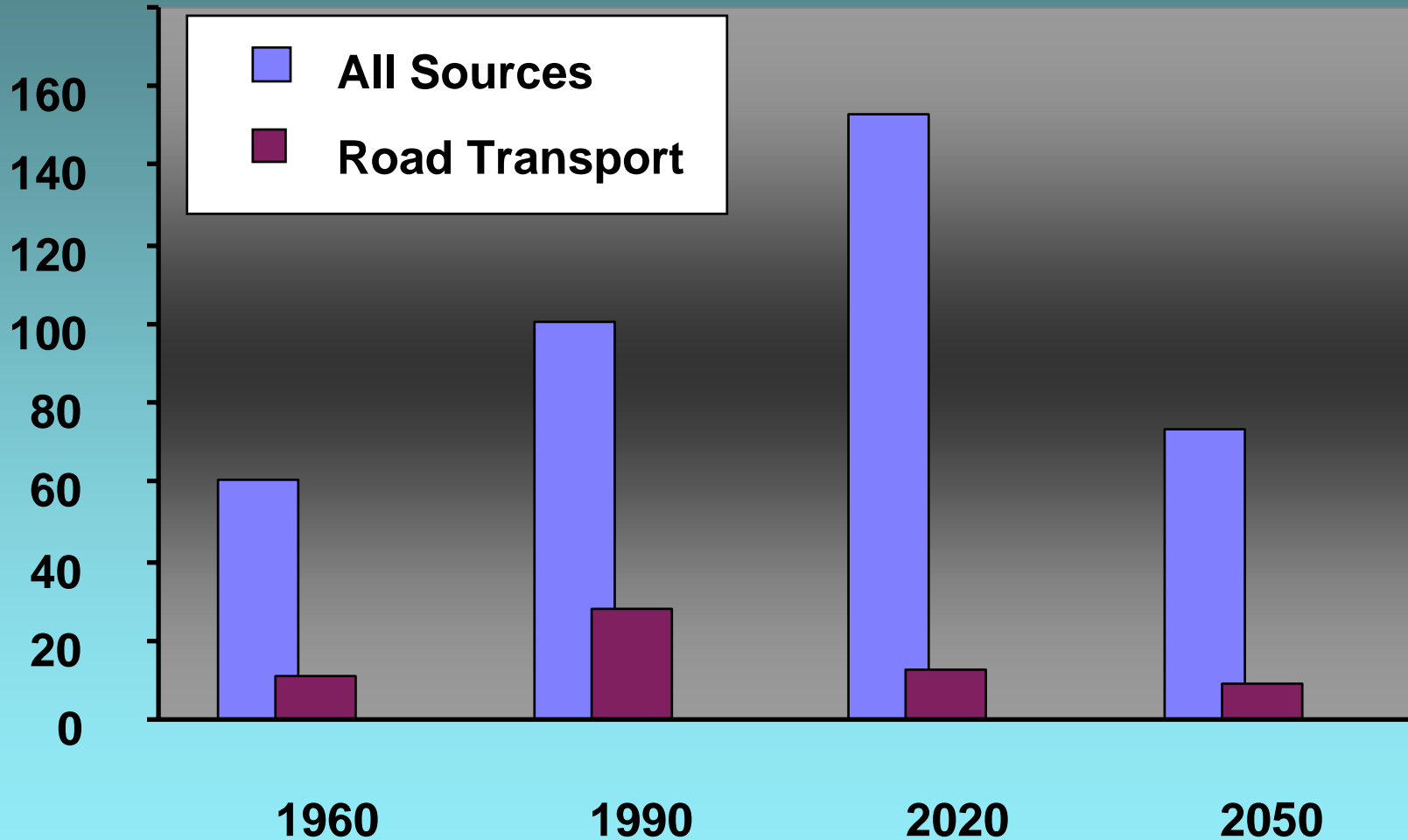


PM Emission Trend in Mio t
All Sources in Latin America and Oceania



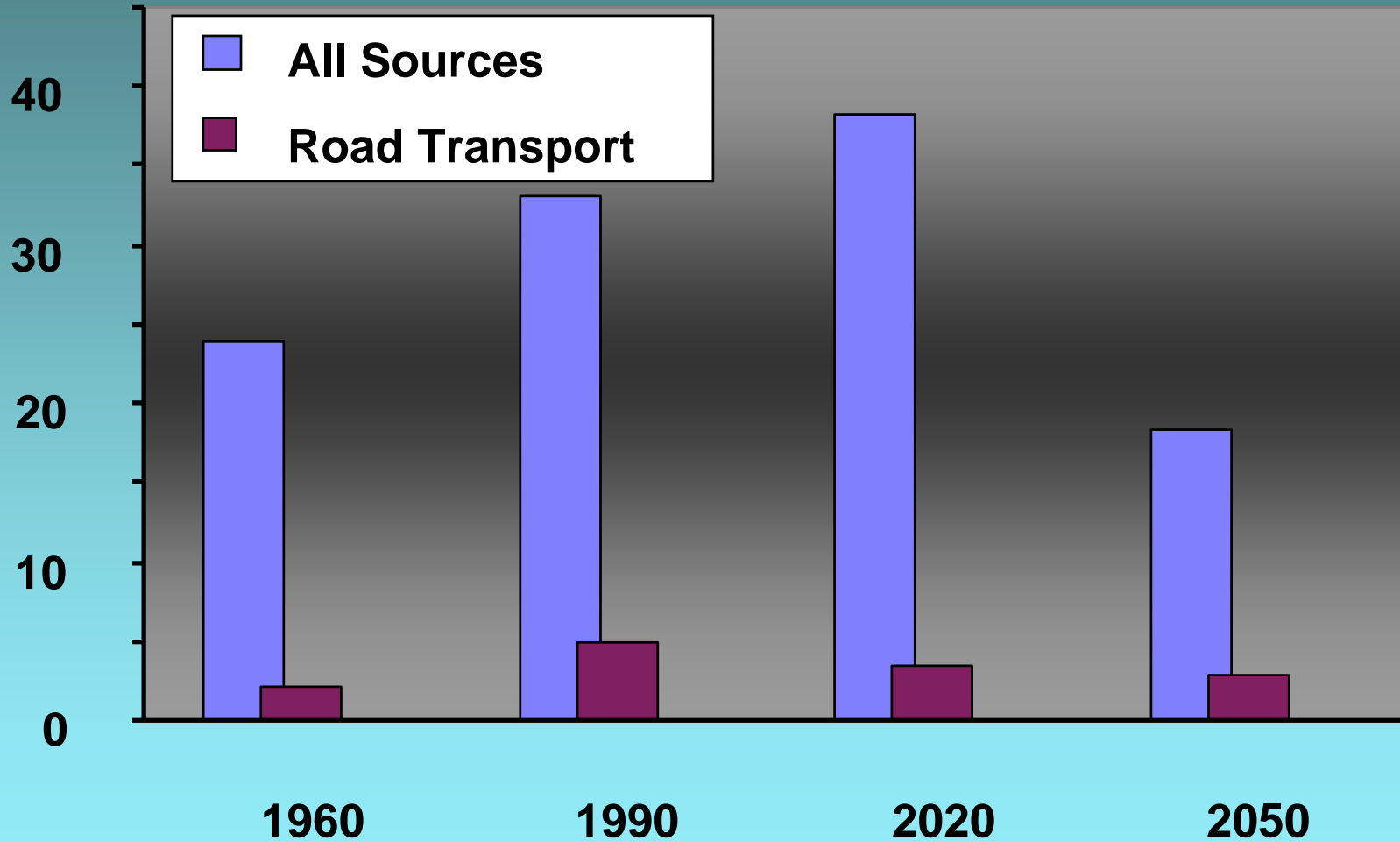
Trend of Worldwide NO_x-Emissions

Million metric tons NO_x/a



Trend of Worldwide PM-Emissions

Million metric tons PM/a



Worldwide Emissions Summary 1

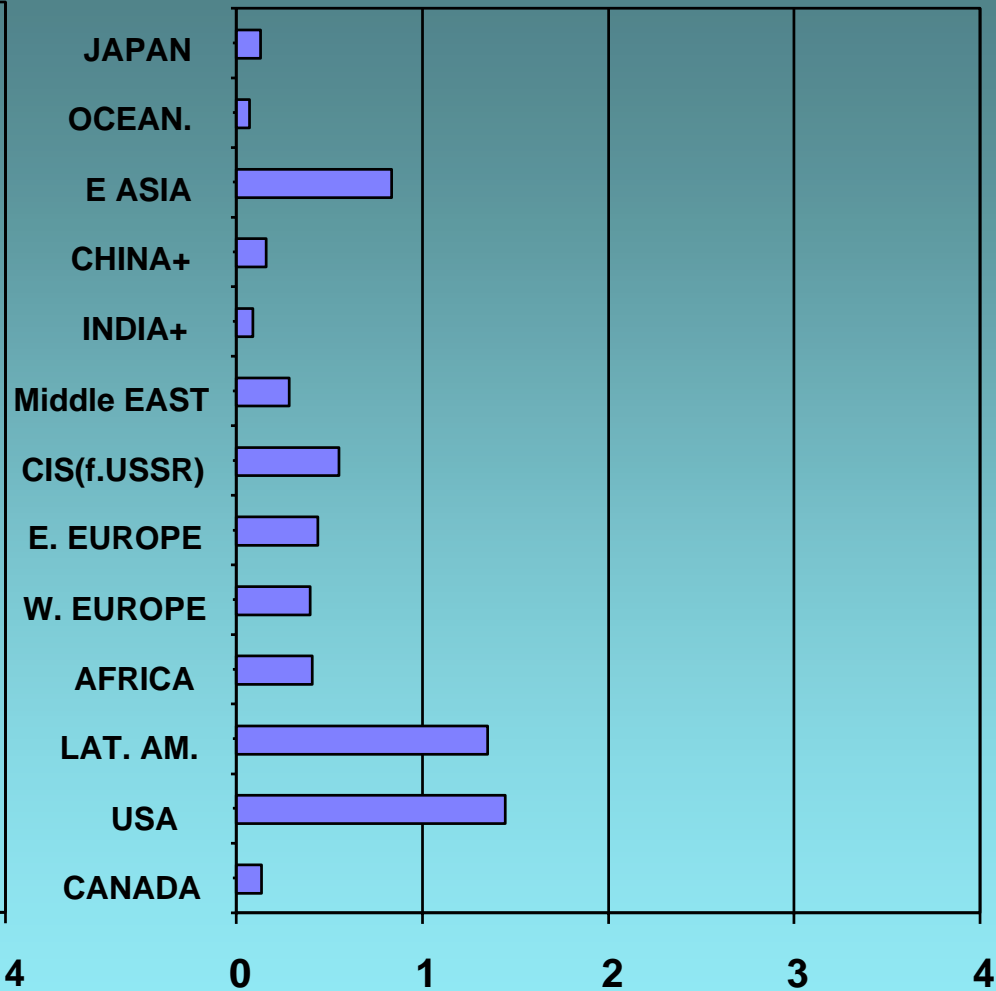
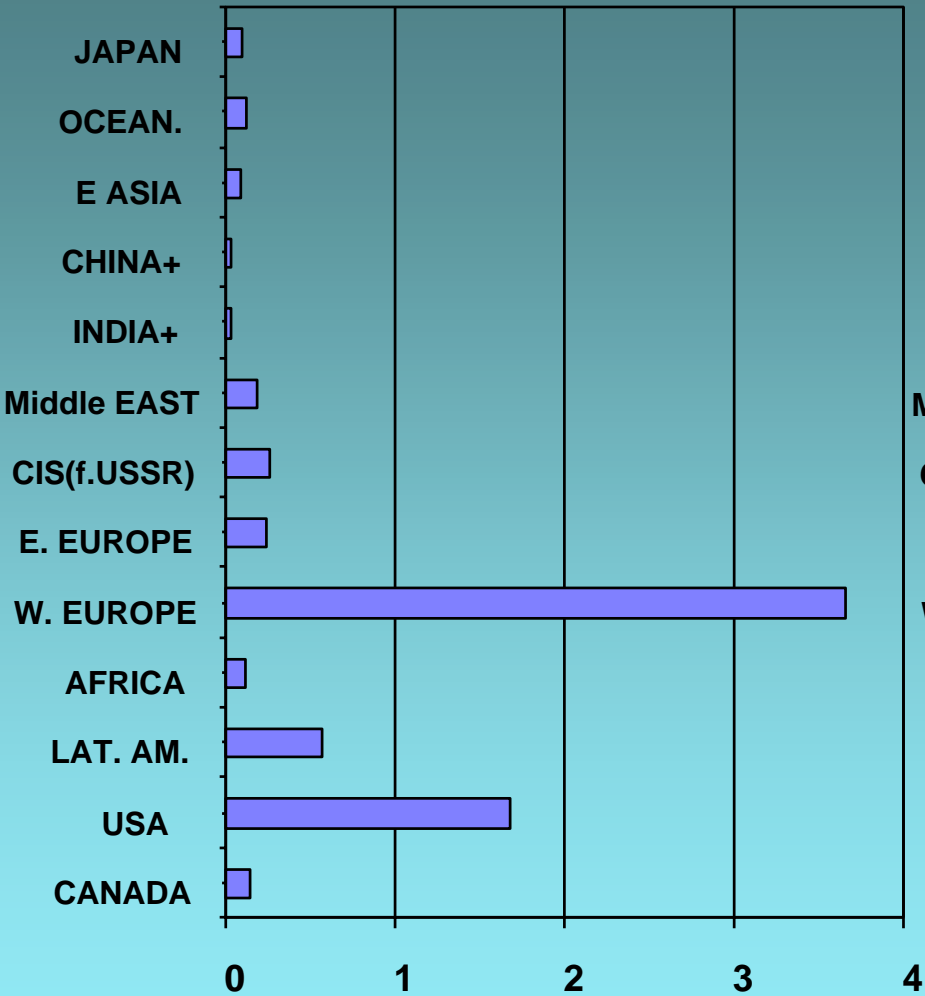
- **Ranges of global emissions are widespread. Manmade Emissions contribute to 12% to 65% dependend from the component.**
- **Road Transport Vehicle stock and Mileage increase steadily.**
- **Due to emission standards in all countries emissions decrease after 2020 for all sources and after 1990 for Road Transport.**
- **Estimations of all NOx emissions from Road Transport are highest in USA followed by Europe**
- **Estimations of all PM emissions from Road Transport are highest in USA followed by Europe, Japan, Latin America, and Africa**
- **Estimations of NOx emissions from all sources are highest in USA, followed by Africa, Latin America and India.**

Worldwide Emissions Summary 2

- **Estimations of NOx emissions from all sources are highest in USA, followed by Africa, Latin America and India.**
- **In West Europe PC-NOx-Emissions are decreasing distinctively, while NOx-Emissions of goods vehicles are higher with a slight decreasing trend after 2000.**
- **PM-Emissions from Duty vehicles are dominating and decrease in West Europe after 2000.
In USA the level in 2000 is four times in other states deeper**
- **In Industrial States the decreasing trend is starting about 10 years earlier as in Emerging and Developing States.**
- **For other Components the decrease is even more distinctive.**

Worldwide NO_x- Emissions

Passenger Cars statewise in 1980 and 2010

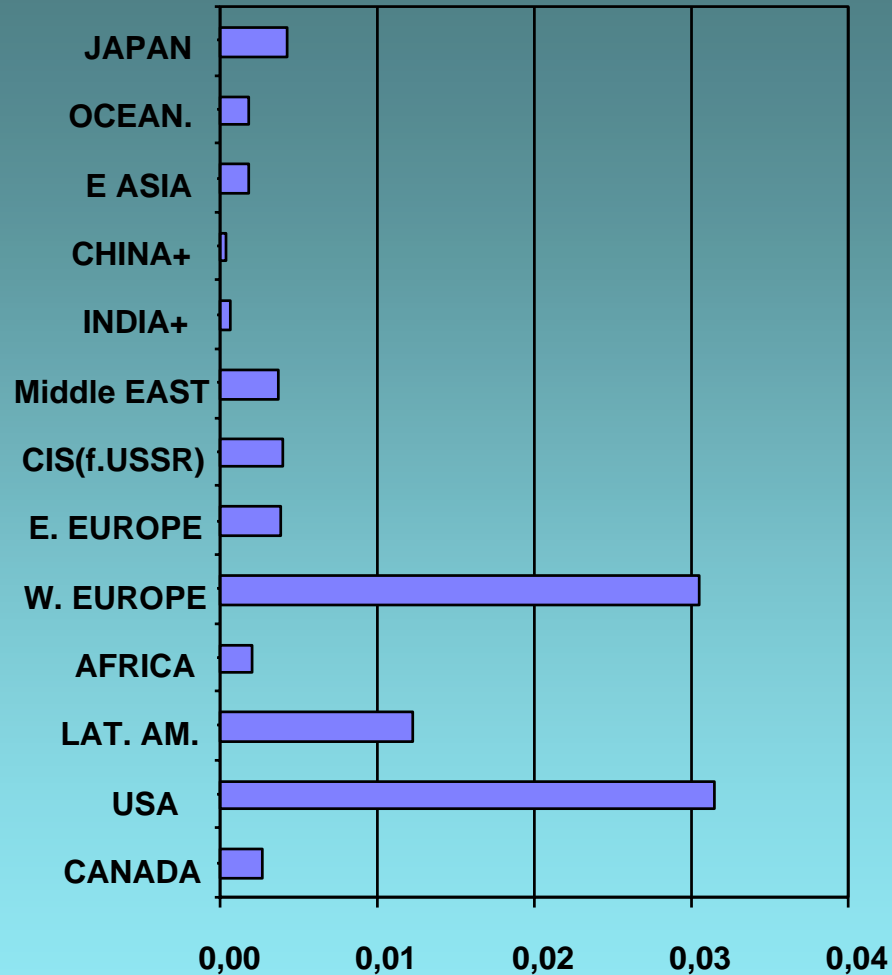


Million metric tons NO_x/a from PC in 1980

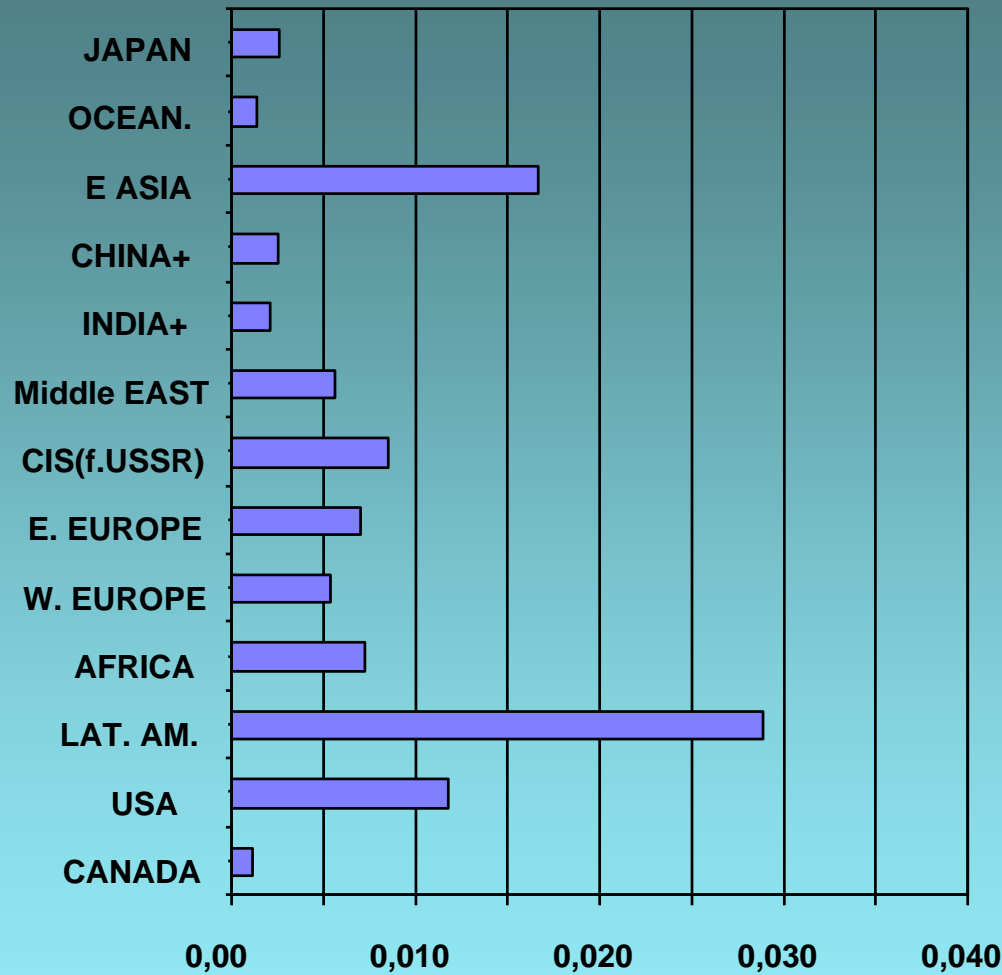
Million metric tons NO_x/a from PC in 2010

Worldwide PM- Emissions

Passenger Cars statewise in 1980 and 2010



Million metric tons PM/a from PC in 1980



Million metric tons PM/a from PC in 2010