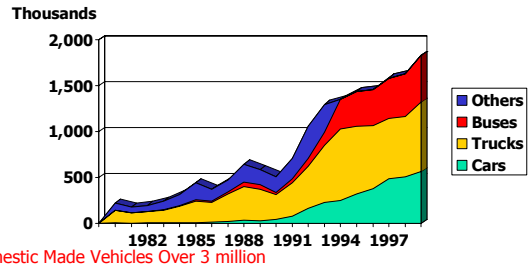
The Need For and Potential Benefits of Advanced Technology Vehicles in China

Workshop On Advanced Technology Vehicles
April 24-25, 2003
Beijing, PRC

Outline:
Vehicle Trends & Forecasts
- Associated Problems
  - Air Pollution
  - Global Warming
  - Oil Imports

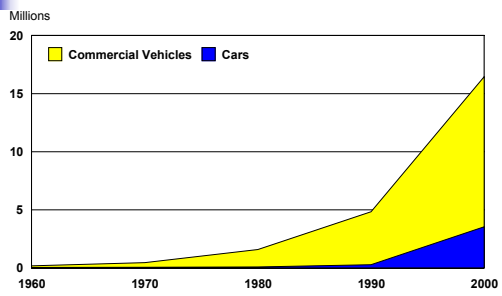
Advanced Technologies Could Help Solve These Problems

Motor Vehicle Production in China



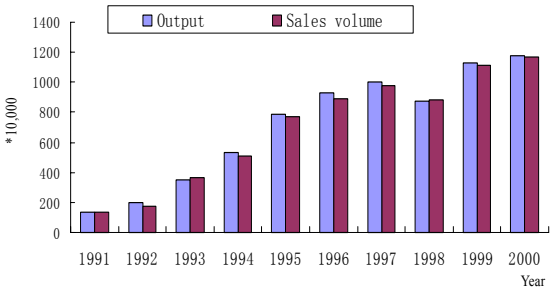
2002:Domestic Made Vehicles Over 3 million
2003: Already Growing Rapidly

China Vehicle Population Has Grown Rapidly



Forecast: 4 to 7 times More Cars By 2020

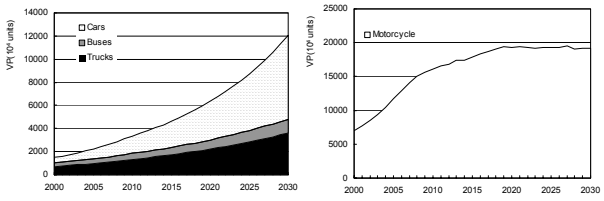
Motorcycle Annual Production and Sales



Recent Developments in China's Vehicle Industry Indicate Substantial Future Growth

- FAW – VW; $1 Billion Venture with Toyota
- DMC – recent link with Honda; $1 Billion Venture with Nissan; Peugeot JV
- SAIC – joint venture with VW & GM; Already Largest Car Sales in China; GM-Daewoo JV

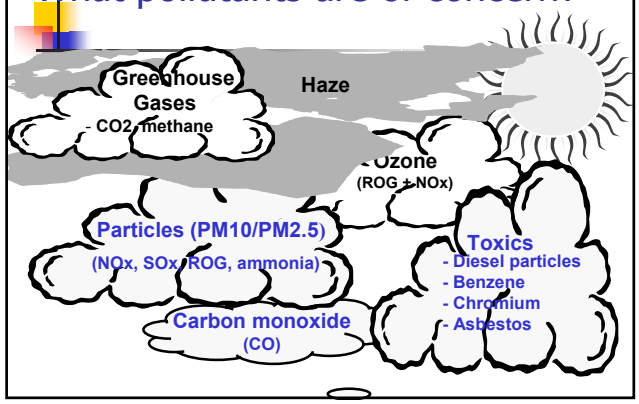
The Vehicle Population Is Forecast To Grow Rapidly



A Median Estimate is 120 million Vehicles & 200 Million Motorcycles by 2030 – Tsinghua University

Air Pollution Problem is Already Severe

What pollutants are of concern?



BEIJING: O3 Concentration in 1997-1999

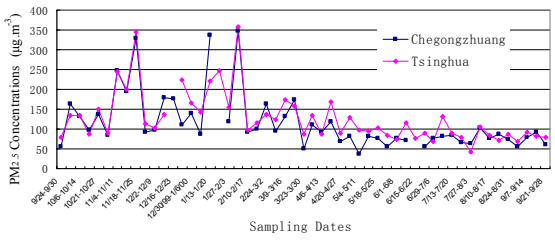
Ozone concentration in Beijing

O_3 Concentration in Beijing

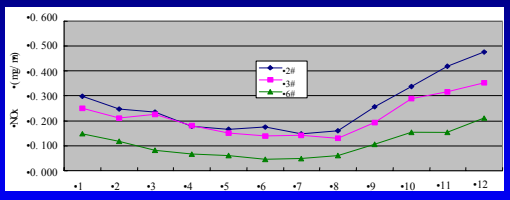
	Number of non-attainment days	Number of non-attainment hours	Max. Hourly concentration ($\mu g/m^3$)
1997	71	434	346
1998	101	504	384
1999	119	777	

Beijing: $PM_{2.5}$ Mass Concentration Levels 1999-2000

Weekly variations



BEIJING: NOx Concentration In 1998



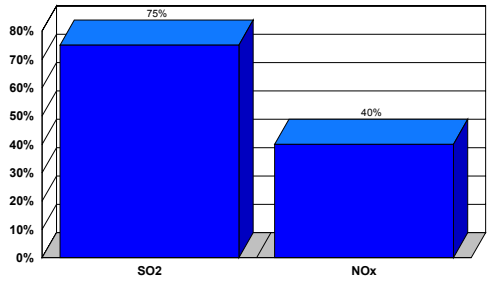
2# and 3# monitoring stations are near to the arteries, and 6# monitoring station is far away from the arteries.

China: Urban NOx Problems

NOx Concentration in Chinese cities

year	No. Of cities	Non-attainment cities		Non-attainment for Class II standard		Non-attainment for Class III standard		Non-attainment cities for Class III
		number	rate (%)	number	rate (%)	number	rate (%)	
1995	88	32	36.4	3	3.4	0	0	
1996	88	27	30.7	25	28.4	2	2.3	Beijing, Guangzhou
1997	94	32	34.1	29	30.9	3	3.2	Beijing, Guangzhou, Shanghai
1998	96	32	33.3	29	30.2	3	3.1	Beijing, Guangzhou, Shanghai

Projected Increase in Emissions in Pearl River Delta Without Additional Controls

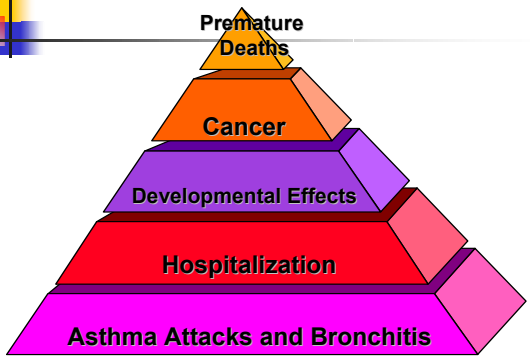


Motor Vehicle Pollution in Urban Areas

- Motor vehicles contribute nearly 50% of NOx emissions in metropolitan cities
- About 1/3 of Major Cities Exceed ambient NOx NAAQS;
- CO concentration generally higher than national standard in traffic areas;
- Photochemical pollution emerging in big cities;
- Vehicles becoming a main source of air pollution in urban areas.

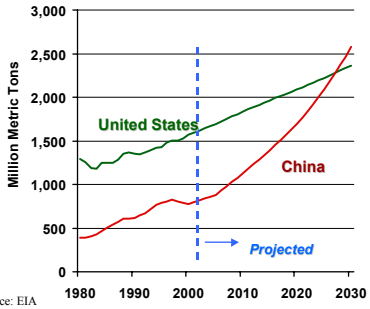
Air Pollution Causes Adverse Health Effects

Health Impacts of Air Pollution



Global Warming

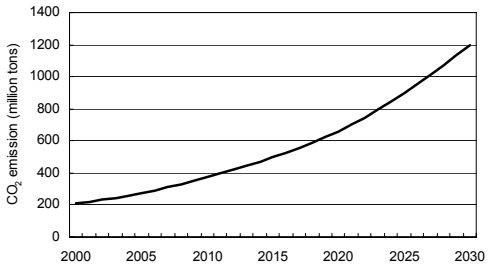
Carbon Emissions



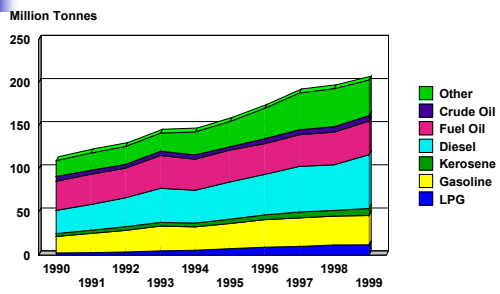
Source: EIA

- Fastest carbon growth globally
- 2nd largest after U.S. in Energy:
  - Production
  - Consumption
  - CO_2 emissions

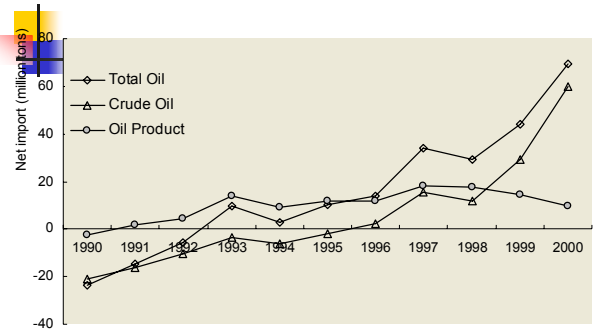
Carbon Dioxide Emissions From the Road Transport Sector



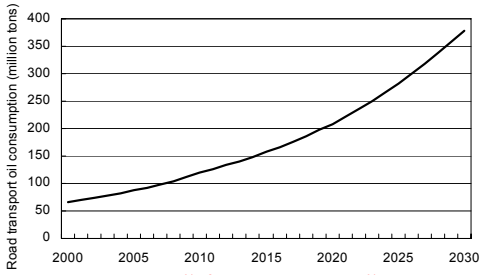
Fuel Consumption Trends in China



Oil Imports Have Been Rising Rapidly Since 1993



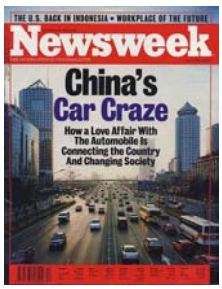
Road Transport Oil Consumption Will Increase Fivefold by 2030

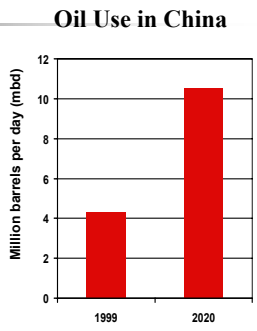


Road transport oil demand will be 57% of the total in 2020, and 87% in 2030, making it the principal source of oil demand and oil imports at that time. - Tsinghua

Growing Dependence on Imported Oil

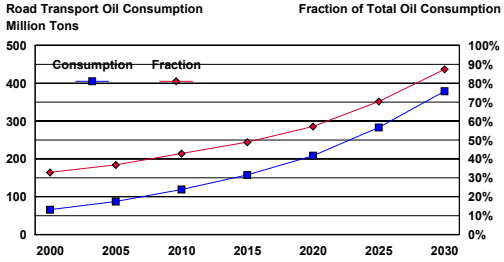
- By 2020, China will import 60%of its oil demand





Source: IEA

Current and Projected Road Transport Oil Demand in China



Source: Tsinghua University

Efforts in China To Address Urban Air Pollution

- Initial Clean Air Strategy Developed
  - Complete Lead Phase Out by 2000
  - European Emissions Standards Introduced For Cars & Trucks
- Individual Cities Supplementing National Actions
  - I/M Pilot Being Developed in Shanghai
  - Alternative Fuels For Buses & Taxis
  - Catalyst Retrofits in Beijing

Control Measures on Motor Vehicle Pollution

Emission Standards For New Vehicles

Time / Category	Before 2000	2000	2001	2002	2003	2004	2005
PC	ECE 1503	EURO I	←	←	←	EURO II	←
LDV& LDT	ECE 1503	←	EURO I	←	←	←	EURO II
HDDV	None	←	EURO I	←	←	EURO II	←
Motorcycle	ECE R 40	←	EURO I	←	←	←	EURO II

Beijing, Shanghai Introduced Euro 2 in 2003

Overview of Fuel Quality

Specifications for Gasoline

ITEM	LIMITS	
Code of Standards	GB 484-1993	GB 17930-1999 1)
Lead (g/L, max.)	0.35, (0.45)	0.005
Sulphur (% Mass, max.)	0.15	0.08
Manganese (g/L, max.)		0.018
Phosphorus (g/L, max.)		0.0013
RON, Min.	90, 93, 97	90
(RON+MON)/2, Min.	85, 89, 92	85
Aromatics HC (vol. %, max.)		40
Olefins (vol. %, max)		35
Benzene (vol.%, max)		2.5
Vapour pressure		
Wnter(Sep. - Feb.), kPa max.	88	88
Summer(Mr. - Aug.), kPa max.	74	74
Oxygen (wt. %, max.)		2.7

Note: 1) Implemented from Jan. 1, 2000

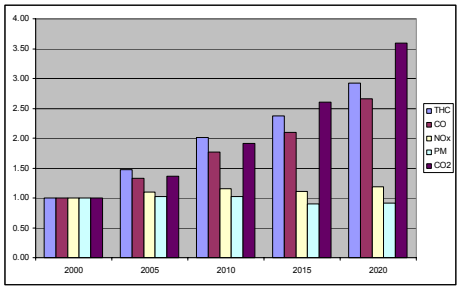
Overview of Fuel Quality

Specifications for Light Diesel in China

ITEM	LIMITS 1)	
Code of Standard	GB 252-94	GB 252-2000 2)
Cetane Number, min	45 (40)	45
Sulfur, %(m/m), max	0.2 (0.5, 1.0)	0.2
Flash point PM, ℃, min	65 (45)	55 (45)
Ash, wt%, max	0.01 (0.02)	0.01 (0.02)
Acidity, mg/KOH/100ml, max	5 (10)	5 (10)
Oxidation stability, mg/100ml, max.	2. 0	2.5
Density@20℃, kg/m3	——	——
CCR 10%, wt %, max	0. 3	0. 3

Note: 1) Limits in ( ) are for basic qualified diesel;
2) GB 252-2000 went into effect on Jan. 1, 2002.

Motor Vehicle Emissions Trends in China With Current Program



China Addressing Emissions & Energy Consumption But More is Needed

- 10th 5-Year Plan
  - Hybrid Vehicles Ready For Production
  - Prototype Fuel Cell Vehicle
  - Parity With EU Emissions Standards by 2010
- Beijing "Green" Olympics
- Shanghai World Expo
- SETC Developing Fuel Economy Program

Advanced Technologies Could Help Address These Problems

- Substantially Reduce Conventional Urban Pollutants
- Reduce Oil Consumption Through High Efficiency
- Major Challenges:
  - Cost
  - Vehicle Availability

Advanced Technology Alternatives

- Hybrid Vehicles
  - Available in Short Term
  - Very Low Pollution
  - Very Good Fuel Economy
  - Low Noise
  - Urban Buses & Trucks
    - Very Good in Stop&Go
    - Lowers Pollution Exposure
- Fuel Cell Vehicles
  - Longer Term
  - Near Zero or Zero Pollution
  - 2 X Fuel Economy or More
  - Low Noise
  - Significant Challenges Remain
    - Cost
    - Infrastructure

Next Steps

- Near Zero Sulfur Fuels
- Euro 4/5 Emissions Standards
- Fuel Efficiency Standards For Light Duty Vehicles
- Emphasize Hybrids For Special Events
  - Olympics
  - World Expo
- MOST Investment
- Offer Incentives To Offset Higher Price
- Special Concessions
  - Manufacturers
  - Fleet Managers

Conclusions

- High Vehicle Growth Is Leading To Rapid Increases in Vehicle Emissions
- Air Quality Already Degrading
- Initial Pollution Control Effort Reflects A Good Start
  - Unleaded Gasoline
  - Euro 1/Euro 2 Standards For New Vehicles
  - In Use Vehicle Controls

Conclusions (2)

- Most Vehicle Pollutants Will Continue To Go Up Without Additional Controls
- Goal Should Be State of the Art Controls by About 2010
- Much Cleaner Fuels Will Be Required
- Fuel Consumption/CO2 Must Also Be Addressed
- Hybrids Could Help Substantially in Short Term
- Fuel Cells Could Play Important Long Term Role if Challenges Can Be Overcome