

The Path to Near-Zero Vehicle Emissions: Applying California's Experience To China 通向零排放汽车之路—加州的经验

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顾问



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Overview 概述

- California
- 加州
 - ◆ Air Quality and Emission Reduction Strategy
 - ◆ 空气质量和排放控制策略
 - ◆ Status of the Zero Emission Vehicle (ZEV) Regulation
 - ◆ 零排放车辆法规现状
 - ◆ The California Fuel Cell Partnership
 - ◆ 加州燃料电池伙伴计划
 - ◆ Reducing Climate Change Emissions from Vehicles
 - ◆ 减少交通温室气体排放

Overview 概述

- China
- 中国
 - ◆ Rapid Vehicle Growth
 - ◆ 机动车快速增长
 - ◆ Environmental & Energy Impacts
 - ◆ 环境与能源影响
 - ◆ The Path Forward- Applying California's Experience
 - ◆ 应用加州的经验

Air Pollution is Widespread

空气污染在扩展

Days Over State
Ozone Standard

臭氧超标天数

Days Over State
PM10 Standard

颗粒物超标天数

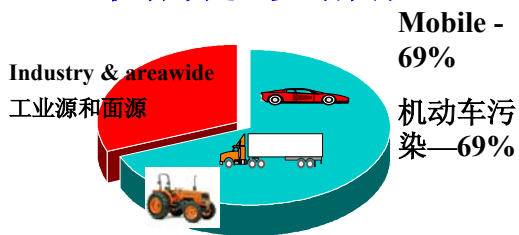


Based on 2000
Monitoring Data
2000年测试数据

0-5 Days 6-50 Days 50-100 Days >100 Days
0-5 天 6-50 天 50-100 天 >100 天

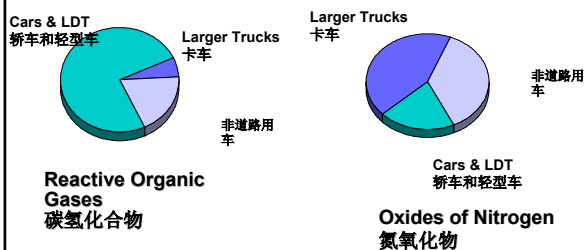
Motor Vehicles are Significant Emission Source

机动车是主要污染源



Many Vehicle Sources are Major Emitters

机动车是主要排放源



The Challenge 面对的挑战

- 22 million cars in California
- 2200万轿车
- Average age of passenger cars is 10 years
- 平均寿命：10年
- Average daily mileage of 35 miles
- 日行驶里程：35英里
- California VMT continues to grow ~2% per year
- 加州总行驶里程：年增长2%

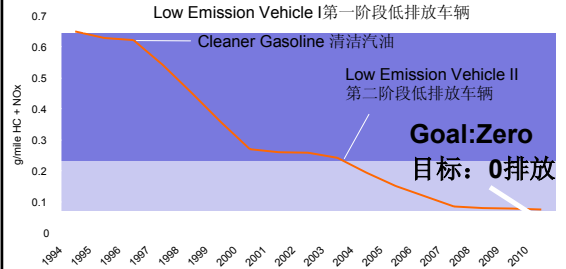
The Low-Emission Vehicle/Zero Emission Vehicle Solution 低排放/零排放车辆政策

- Analysis in 1990 showed that conventional technology would not be sufficient
- 1990年的研究表明传统技术对解决污染问题是不足的
- Some part of the fleet had to emit near “zero” levels
- 部分车辆必须是接近零排放的
- LEV/ZEV program adopted
- 采用低排放/零排放计划

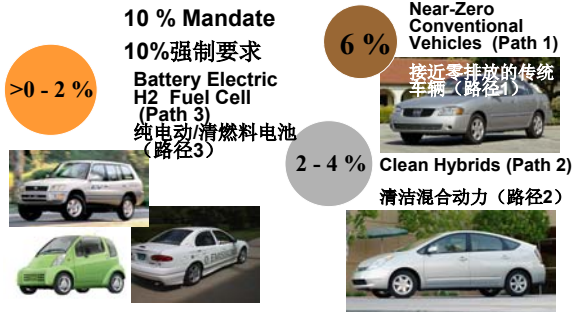
What Has Happened Since 1990? 1990年来的变化

- Batteries fell short 纯电动车辆减少
 - ◆ Performance 性能
 - ◆ Cost 成本
- Conventional technology over-achieved (matched battery vehicle charging emissions)
- 传统车辆技术有了突破（如果计算发电的排放，达到电动车的水平）
- New near-zero emission technologies introduced 新的接近零排放的技术的引入
 - ◆ Hybrids 混合动力
 - ◆ gaseous fuels 气体燃料
 - ◆ Performance 性能提高

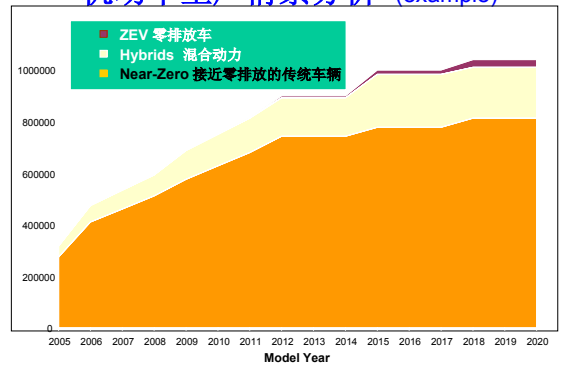
Evolution of ARB Auto Controls ARB机动车污染控制沿革 Implementation: 1994 – 2010



ZEV Regulation Restructured in 2003 for More Flexibility 2003年ZEV项目修改，提供更多的灵活性



Vehicle Production Scenario 机动车生产情景分析 (example)



Path 1: Near-Zero Emission Conventional Vehicles

路径1: 接近零排放的传统车辆

Near zero exhaust emissions
接近零排放
Zero evaporative emissions
零蒸发排放
15 year/150,000 mile warranty
15年15万英里耐久性
On-board diagnostics
车在诊断系统
140,000 sales in 2003
2003年销售量: 14万
200,000 sales in 2004
2004年销售量: 20万



Path 2: Hybrid Electric Vehicles

路径2: 混合动力车辆

- Three models now available
- 已有三种车型
- More models coming
- 车型会很快增加
- ~ 20,000 sales expected in 2005
- 预计2005年销售量约2万



Hybrid Electric Vehicles

混合动力车辆

“ZEV enabling” technology:

可以达到零排放的技术

- electric drive train
- 电驱动系统
- batteries
- 电池
- power management
- 动力控制



Incentives for Near-Zero Emission Hybrid Electric Vehicles

接近零排放的混合动力车辆的激励政策

- Extra regulatory incentives (credits) encourage “strong” hybridization
- 更多的法规和激励政策推动混合动力技术
- Incentives based on:
- 激励政策基于:
 - ◆ system voltage
 - ◆ 系统电压
 - ◆ power output of the electric motor
 - ◆ 电机输出功率
- Short term incentives for 42-volt systems
- 短期对42V系统的激励政策

Path 3: Battery Electric and Fuel Cell Vehicles

路径3: 纯电动和燃料电池车辆

- Full size battery electric
- 全尺寸纯电动车辆
- Neighborhood electric
- 社区电动车
- Fuel cell
- 燃料电池

Full-Sized Battery Electric Vehicles

全尺寸纯电动车



- Over 2,500 sold or leased
- 约2500台售出或租出
- Cost and range issues shifts focus:
- 由于成本和续驶里程的原因转向:
 - ◆ smaller vehicles
 - ◆ 小型车辆
 - ◆ fuel cells
 - ◆ 燃料电池

Neighborhood Electric Vehicles

社区电动车

25 mph top speed
limited range
2-4 passengers
最高速度: 40km/h
有限的运行范围
2-4乘客



Over 8,000 sold or leased in response to ZEV regulation
作为对ZEV法规的响应, 约8000辆车售出或租出



Fuel Cell Vehicles

燃料电池车辆

- Promising technology
- 具有前途
- Significant cost, manufacturing and performance challenges
- 面临成本, 制造以及性能改善的巨大挑战
- Volume production expected 2010 or later
- 预期在2010以后才可能批量生产



Hydrogen Fuel Cell Benefits 氢燃料电池的优势

- No direct smog-forming or greenhouse gas emissions
- 没有直接的污染物和温室气体排放
- Potential for extremely low lifecycle (“well to wheel”) emissions
- 有整个生命周期低排放的潜力
- Better fuel economy, greater efficiency
- 高燃油效率
- Quiet and smooth operation
- 运行安静平顺

Transition to Fuel Cells 向燃料电池过渡

- Prototype fuel cell vehicles now being demonstrated
- 一些燃料电池原型车已经开始示范
- California Fuel Cell Partnership
- 加州燃料电池伙伴计划

California Fuel Cell Partnership 加州燃料电池伙伴计划



- Promotes fuel cell vehicle commercialization
- 推动燃料电池车辆商业化
- Infrastructure
- 基础设施
- Safety
- 安全
- Public Education
- 公众教育



Fuel Infrastructure 燃料基础设施



- Liquid H₂ storage
- 液氢存储
- Delivers gaseous hydrogen at two pressures:
- 两种压力下加氢
 - 3600 psi & 5000 psi
- Fill time ≤ 4 minutes
- 加氢时间 ≤ 4分钟



2400+ fueling events

2400多次加油



Fuel Cell Vehicles - Today 今天的燃料电池技术



41 cars

41辆车

Over 122,000 miles

运行超过12.2万英里

5,000+ riders/drivers

超过5000人试驾

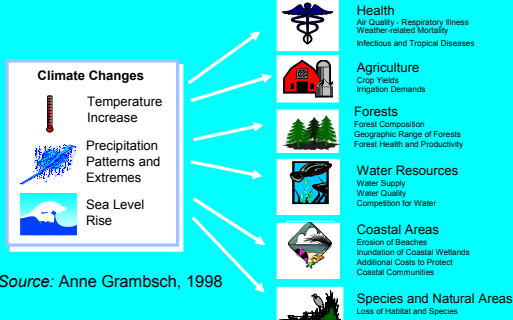


Global Climate Change is a Major Challenge 全球气候变化的挑战

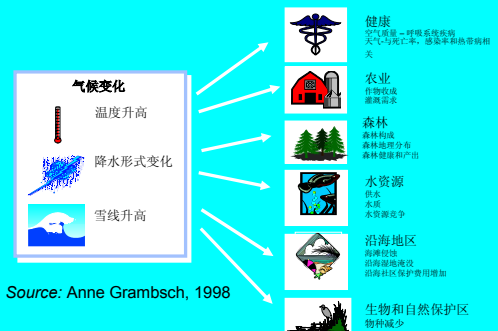
- May be an opportunity for hybrid vehicles
- 可能是混合动力技术发展的契机
- Technology mix will depend on fuel cell progress
- 技术结构依赖于燃料电池技术的发展

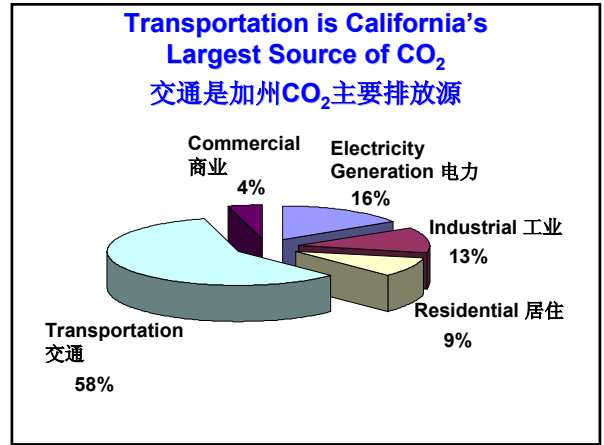
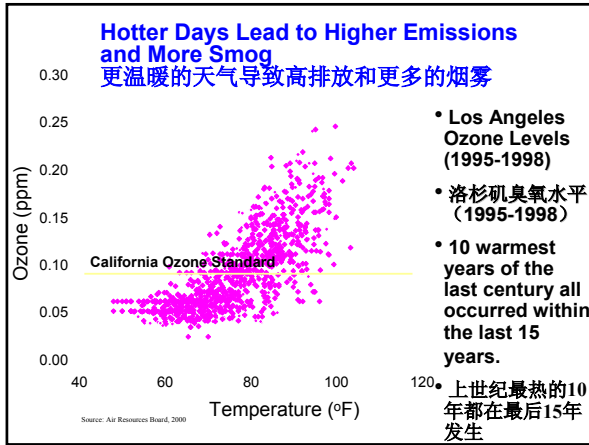
Climate Change is a Major Concern for California 气候变化是加州关注的焦点

气候变化是加州关注的焦点



气候变化是加州关注的焦点





- ### Climate Change Legislation in California 加州的气候变化立法
- Achieve maximum feasible and cost-effective reduction of greenhouse gas emissions from cars and light trucks
 - 通过最灵活和成本效益最佳的方法减少轿车和轻型车的温室气体排放
 - 2009 and later model years
 - 针对2009年以后生产的车型

- ### Climate Change Regulation 气候变化法规
- Regulations will provide flexibility, not mandate specific technology
 - 法规应该提供灵活性，不能强制采用某一项技术
 - Hybrid vehicles will compete with other emerging technologies
 - 混合动力技术将和目前新出现的技术竞争
 - Hybrid's role will depend on developments in conventional and fuel cell technology - but increased sales seems certain
 - 混合动力技术的发展与其他技术如传统车辆技术和燃料电池技术的发展相关，但可以肯定销售量会增加。

Long-Term Vision 长期的发展

- The ultimate goal remains - zero-emission technology
- 最终目标不变—零排放车辆
- Must be energy-efficient; reduced climate impact
- 必须是高效的，以减少气候变化的影响
- California is taking the necessary steps now
- 加州正在进行实施



Where Do We Stand in China?



Outline:

大纲:

Vehicle Trends & Forecasts
汽车发展趋势及预测

Associated Problems
相关问题

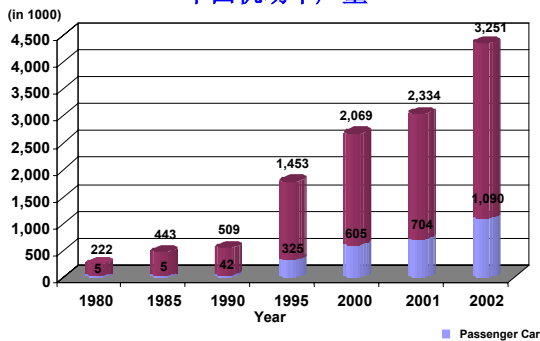
Air Pollution
空气污染

Global Warming
全球性气候变暖

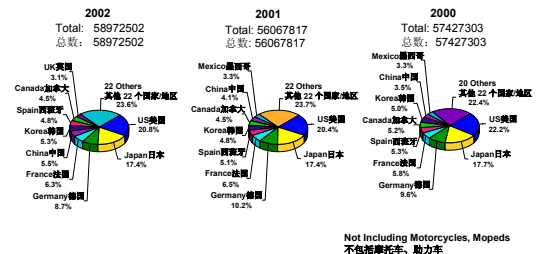
Oil Imports
石油进口

Advanced Technologies Could Help Solve These Problems
先进技术将有助于解决这些问题

Motor Vehicle Production in China 1980 – 2002 中国机动车产量



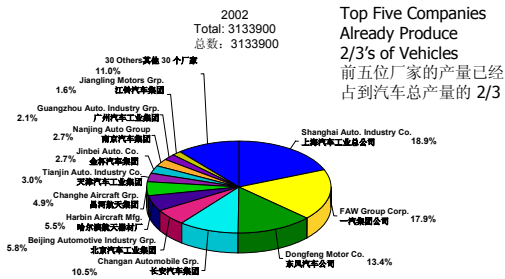
Vehicle Production By Country 各国汽车产量



Not Including Motorcycles, Mopeds
不包括摩托车、助力车

China Is Now 5th Largest Producer in the World
中国目前已经是世界上第五大汽车生产国

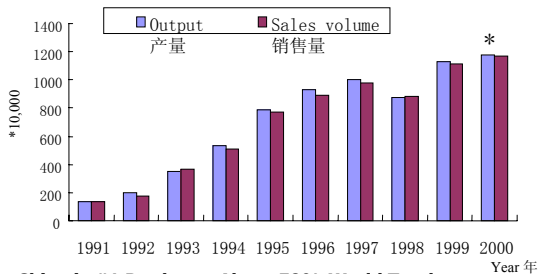
Motor Vehicle Production in China by Manufacturer 中国各大机动车厂家的产量分布



Recent Investments in China's Vehicle Industry Indicate Substantial Future Growth 未来的增长

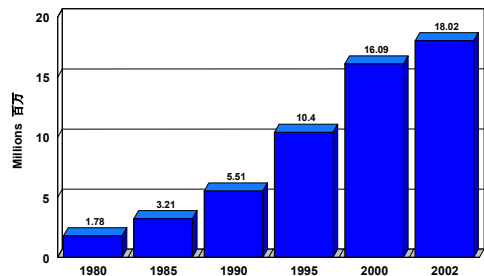
- FAW – VW; \$1 Billion Venture with Toyota
一汽大众与丰田投资 10 亿美元建立合资企业
- DMC – recent link with Honda; \$1 Billion Venture with Nissan; Peugeot JV
戴克—最近联合本田, 日产和标致投资 10 亿美元建立合资公司;
- SAIC – joint venture with VW & GM; Already Largest Car Sales in China; GM-Daewoo JV
上汽奇瑞与大众通用 (中国最大的汽车厂)、通用大宇合资企业
- Chang'an Automotive Group - Ford Increased Investment By \$1.5 Billion
长安汽车集团—福特追加投资 15 亿美元

Motorcycle Annual Production and Sales 摩托车的年产量和销售量



China is #1 Producer; About 50% World Total
中国是最大的生产国, 约占世界总产量的 50%

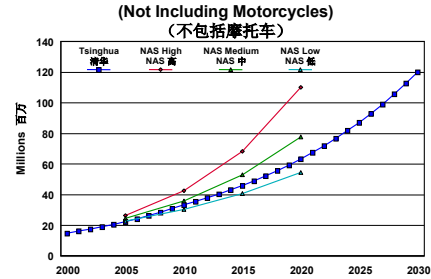
China's Vehicle Population (Cars, Trucks & Buses) 中国汽车保有量 (小汽车、卡车、客车)



Vehicle Growth in Beijing is Exploding 北京的汽车数量

- **Growth in the Number of Cars in Beijing 北京汽车的增长数字**
 - ▶ From 0 to 1 million - 48 years 从零到一百万-48年
 - ▶ From 1 to 2 million - 6.5 years 从一百万到两百万-6.5年
 - ▶ From 2 to 3 million - est 3 years 从两百万到三百万-3年
- **Relative Growth Rates 相对增长率**
 - ▶ **Average Annual Growth in Vehicles ~20%/year**
汽车平均年增长率~20%/年
 - ▶ **Average Annual Growth in Road Network ~3.5%/year**
公路网的平均年增长率~3.5%/年

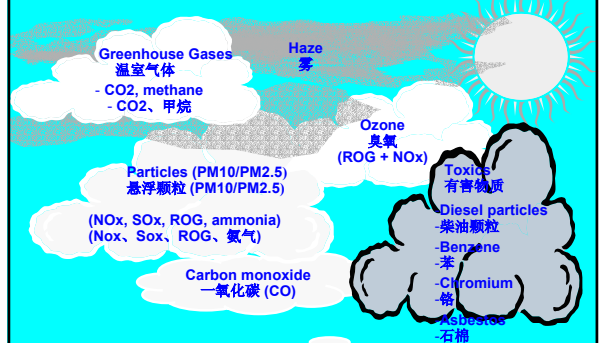
Recent Forecasts of Chinese Vehicle Population 中国汽车保有量



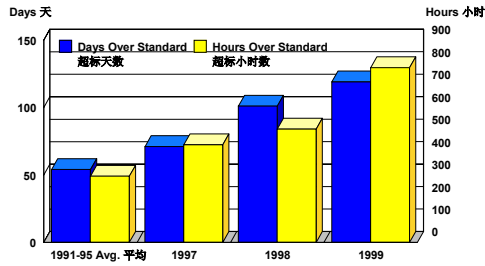
Tsinghua Also Predicts About 200 Million MC By 2030
清华同时预测到2030年摩托车将达到2亿辆

Air Pollution Problem is Already Severe 污染问题极为严重

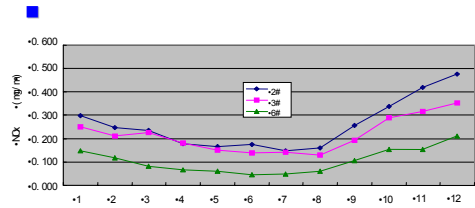
What pollutants are of concern? 主要污染物?



Ozone Trends in Beijing 北京臭氧变化趋势



BEIJING: NOx Concentration In 1998 北京：1998年 Nox 的浓度情况



2# and 3# monitoring stations are near to the arteries, and 6# monitoring station is far away from the arteries.
2# 和 3# 监控站靠近主干道，而 6# 监控站远离主干道。

China: Urban NOx Problems 中国：城市 Nox 问题

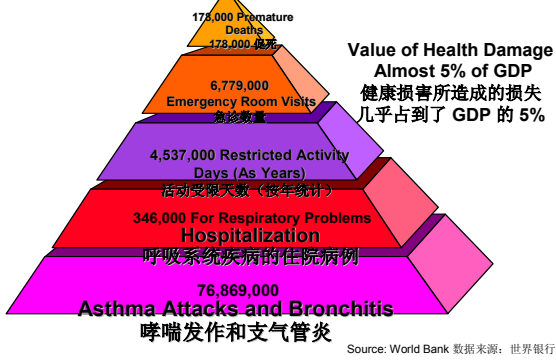
NOx Concentration in Chinese cities
中国各城市的 NOx 浓度

Year 年份	No. Of cities 城市数	Non-attainment for Class I standard 一类标准未达标		Non-attainment for Class II standard 二类标准未达标		Non-attainment for Class III standard 三类标准未达标		Non-attainment cities for Class III 三类未达标城市
		Number 数字	rate (%) 所占比率	Number 数字	rate (%) 所占比率	Number 数字	rate (%) 所占比率	
1995	88	32	36.4	3	3.4	0	0	
1996	88	27	30.7	25	28.4	2	2.3	Beijing 北京, Guangzhou 广州
1997	94	32	34.1	29	30.9	3	3.2	Beijing 北京, Guangzhou 广州, Shanghai 上海
1998	96	32	33.3	29	30.2	3	3.1	Beijing 北京, Guangzhou 广州, Shanghai 上海

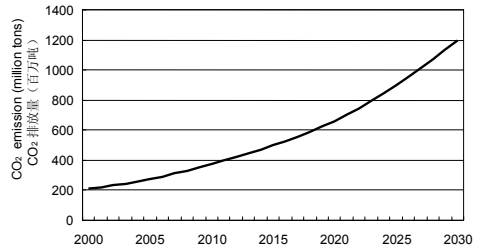
Motor Vehicle Pollution in Urban Areas 城区机动车污染

- Motor vehicles contribute nearly 50% of NOx emissions in metropolitan cities
在大城市，机动车造成了几乎 50% 的氮氧化物排放量
- About 1/3 of Major Cities Exceed ambient NOx NAAQS;
在主要城市中有 1/3 都超过了氮氧化物空气质量标准;
- CO concentration generally higher than national standard in traffic areas;
在交通区 CO 浓度通常高于国家标准;
- Photochemical pollution emerging in big cities;
大城市出现光化学污染;
- Vehicles becoming a main source of air pollution in urban areas.
城区汽车成为空气污染的主要来源。

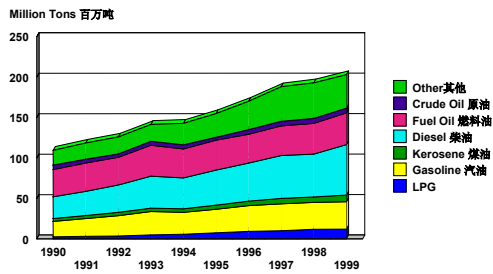
Health Impacts of Air Pollution in China 中国空气污染对健康的影响



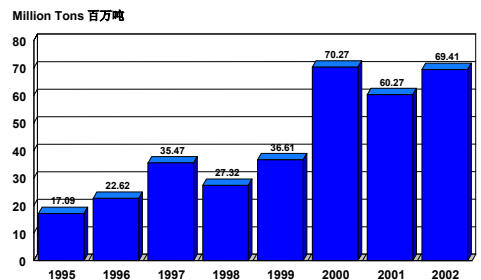
Carbon Dioxide Emissions From the Road Transport Sector 交通二氧化碳排放量



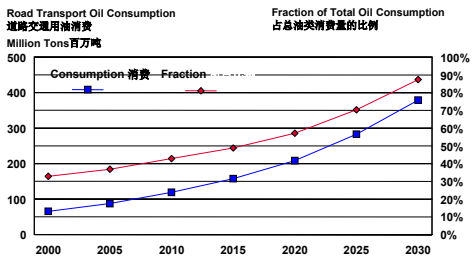
Fuel Consumption Trends in China 中国的燃料消费趋势



Oil Imports Have Grown Rapidly in China 中国的石油进口增长迅速



Current and Projected Road Transport Oil Demand in China 中国道路交通用油需求



Source: Tsinghua University 数据来源: 清华大学
Road transport oil demand will be over 50% of the total by 2020, and almost 90% by 2030, making it the principal source of oil demand and oil imports at that time.
到 2020 年, 道路交通用油将超过总需求量的 50%, 而到 2030 年, 将几乎占到 90%, 这将使其成为那时用油和石油进口的主要需求来源。

Efforts in China To Address Urban Air Pollution 解决市区空气污染的主要举措

- Initial Clean Air Strategy Developed
已发展的初步清洁空气策略
 - ▶ Complete Lead Phase Out by 2000
到 2000 年完全停止使用有铅汽油
 - ▶ European Emissions Standards Introduced For Cars & Trucks
为小汽车和卡车引入欧洲排放标准
 - ▶ Tax Incentives For Euro 2 Vehicles
为符合 2 类标准的汽车提供激励措施
- Individual Cities Supplementing National Actions
各城市对国家法规的补充性规定
 - ▶ I/M Pilot Being Developed in Shanghai
上海开发了 I/M Pilot 项目
 - ▶ Alternative Fuels For Buses & Taxis
公交车和出租车的替代燃料
 - ▶ Catalyst Retrofits in Beijing
北京采取了催化剂换代的措施

Fuel Quality Improvements 燃料质量的提高

- Eliminated Very Low Octane Fuels 消除低辛烷燃料
- Eliminated Lead Additives But 消除含铅添加剂 (以下两种除外)
 - ◆ MTBE
 - ◆ MMT
- Gasoline Aromatics Limited To 40%
汽油中的芳香族化合物限制在 40%
- Gasoline Olefins Limited to 35%
汽油石蜡限制在 35%
- Sulfur Levels Reduced But Still High
降低硫的含量 (但仍很高)

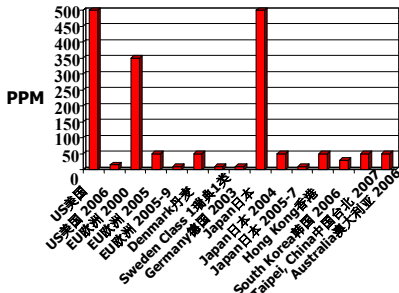
Control Measures on Motor Vehicle Pollution 机动车污染的控制手段

Emission Standards For New Vehicles
新车的排放标准

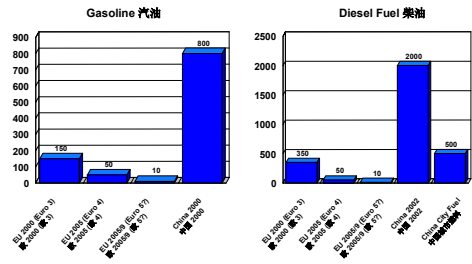
Time 时间	Before 2000 2000 前	2000	2001	2002	2003	2004	2005
Category 类别							
PC	ECE 1503	EURO I 欧 I	←	←	←	EURO II 欧 II	←
LDV& LDT	ECE 1503	←	EURO I 欧 I	←	←	←	EURO II 欧 II
HDDV	无	←	EURO I 欧 I	←	←	EURO II 欧 II	←
摩托车	ECE R 40	←	EURO I 欧 I	←	←	←	EURO II 欧 II

Beijing, Shanghai Introduced Euro 2 in 2003
北京、上海在 2003 年引入了欧 2 标准

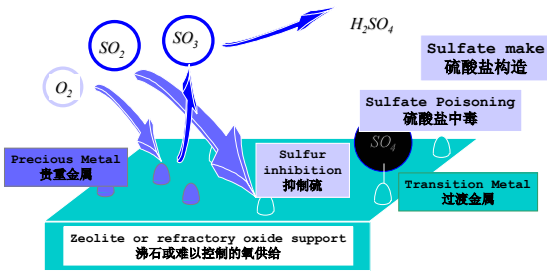
Ultra Low Sulfur Diesel Fuel Is Necessary For Continued Progress
超低硫含量柴油是实现可持续发展所必需的



Maximum Sulfur Levels in Chinese & EU Fuels (PPM)
燃料标准最大硫含量限制



Sulfur Effects
硫的影响



Control Technology
控制技术

- TWC 三元催化器
- Oxidation Catalyst 氧化催化器
- Lean NOx Catalyst 贫氮氧化物催化器
- SCR with Urea 含尿素的 SCR
- Catalytic Filters 催化滤网
- NOx Adsorbers 氮氧化物吸收装置
- Hybrid With TWC 与 TWC 混合

Sulfur Effects
硫的影响

- Sulfur Inhibition 硫抑制
- Sulfur Inhibition, Sulfation 硫抑制, 硫酸盐
- Sulfur Inhibition, Sulfation 硫抑制, 硫酸盐
- Sulfur Inhibition, Sulfation 硫抑制, 硫酸盐
- Sulfur Inhibition, Sulfation 硫抑制, 硫酸盐
- Sulfur Inhibition, Sulfation 硫抑制, 硫酸盐
- Extreme Sulfur Inhibition 极度硫抑制
- Sulfur Inhibition 硫抑制

China Addressing Emissions & Energy Consumption But Not Yet On The Path To Zero Emissions 已有的工作

- 10th 5-Year Plan
第十个五年计划
 - ◆ Hybrid Vehicles Ready For Production
混合动力汽车已可投产
 - ◆ Prototype Fuel Cell Vehicle
已设计出燃料电池车原型
 - ◆ Parity With EU Emissions Standards by 2010
到 2010 年采用欧洲排放标准检验
- Beijing "Green" Olympics
北京“绿色”奥运
- Shanghai World Expo
上海世博会
- Developing Fuel Economy Program
正在开发燃料经济性项目

Advanced Technologies Could Play A Critical Role 先进技术的作用

- Substantially Reduce Conventional Urban Pollutants
在很大程度上减少传统的城市污染物
- Reduce Oil Consumption Through High Efficiency
通过提高效率减少油的消费量
- Major Challenges:
主要挑战:
 - ◆ Cost成本
 - ◆ Vehicle Availability汽车的可行性

Advanced Technology Alternatives 先进技术的选择

- | | |
|--|--|
| <ul style="list-style-type: none"> ■ Hybrid Vehicles
混合动力汽车 <ul style="list-style-type: none"> ◆ Available in Short Term
在短时间内可投入使用 ◆ Very Low Pollution
很低的污染程度 ◆ Very Good Fuel Economy
很好的燃料经济性 ◆ Low Noise
低噪音 ◆ Urban Buses & Trucks
城区公交车和卡车 <ul style="list-style-type: none"> ◆ Very Good in Stop&Go
停止和起步性能很好 ◆ Lowers Pollution 污染低 ◆ Exposure 暴露量小 | <ul style="list-style-type: none"> ■ Fuel Cell Vehicles
燃料电池汽车 <ul style="list-style-type: none"> ◆ Longer Term
长期目标 ◆ Near Zero or Zero Pollution
接近或达到零污染 ◆ 2 X Fuel Economy or More
2 倍或更高的燃料经济性 ◆ Low Noise
低噪音 ◆ Significant Challenges Remain
尚待解决的重大挑战 <ul style="list-style-type: none"> ◆ Cost 成本 ◆ Infrastructure 基础设施 |
|--|--|

Next Steps 下一步

- Near Zero Sulfur Fuels
几乎不含硫的燃料
- Euro 4/5 Emissions Standards
欧 4/5 排放标准
- Fuel Efficiency Standards For Light Duty Vehicles
轻型汽车燃料效率的标准
- Emphasize Hybrids For Special Events
为重大事件而将混合动力提上日程
 - ◆ Olympics 奥运会
 - ◆ World Expo 世博会
- MOST Investment
科技部的投资
- Offer Incentives To Offset Higher Price
为抵消高价格提供激励政策
- Special Concessions
特许
 - ◆ Manufacturers 制造厂家
 - ◆ Fleet Managers 交通管理者

Conclusions 结论

- High Vehicle Growth Is Leading To Rapid Increases in Vehicle Emissions
机动车数量的快速增长导致排放的增加
- Air Quality Already Degrading
空气质量开始恶化
- Oil Imports Soaring
燃料进口增加
- Initial Pollution Control Effort Reflects A Good Start
已经开始了有效的工作
- New Fuel Economy Program A Big Step Forward
燃料经济性立法是良好的开端

Conclusions 结论

- Most Vehicle Pollutants Will Continue To Go Up Without Additional Controls
如不采取进一步措施，多数汽车污染物将继续增长
- Goal Should Be State of the Art Controls by About 2010
目标应该是在 2010 年左右实现一套完备的控制措施
- Much Cleaner Fuels Will Be Required
需要更清洁的燃料
- Fuel Consumption/CO2 Must Continue To Improve
燃料消费/CO2 也必须解决
- Hybrids Could Help Substantially in Short Term
混合动力车在近期将很有帮助
- Fuel Cells Could Play Important Long Term Role if Challenges Can Be Overcome
从长远来看，如果能够解决关键性的挑战，燃料电池将充当重要的角色