Reducing emissions from motor vehicles

- Scoping the problem
  - emissions from transport concentrating on passenger vehicles
  - projected increase in cars and emissions
  - comparing Australia and China
- Technology roadmaps
- Policy challenges and responses
Reducing emissions from motor vehicles

- CSES has been undertaking a joint project with Energy Research Institute (part of National Development and Reform Commission) in Beijing on Sustainable Energy Use in China.
- A number of components including 3 case studies on natural gas, air conditioners and motor vehicles.
- Australia and China present two very different scenarios for emissions from motor vehicles and policy responses.

Emissions from motor vehicles

- Road transport motor vehicles in the form of cars, cycles, vans, trucks and buses are responsible for 12.6% of GHG emissions in Australia. Domestic air, rail and sea transport accounts for another 1.9%.
- Passenger vehicles - cars – are 7.7%
- According to the ABS there were 12.0 million passenger vehicles (including SUVs) in March 2009, growing at about 2.5% per annum. Average age is 9.7 years.

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger vehicles</td>
<td>12,023,098</td>
</tr>
<tr>
<td>Campervans</td>
<td>46,535</td>
</tr>
<tr>
<td>Light commercial vehicles</td>
<td>2,371,082</td>
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<tr>
<td>Rigid trucks</td>
<td>421,702</td>
</tr>
<tr>
<td>Articulated trucks</td>
<td>81,217</td>
</tr>
<tr>
<td>Non-freight carrying trucks</td>
<td>22,299</td>
</tr>
<tr>
<td>Buses</td>
<td>84,413</td>
</tr>
<tr>
<td>Motor cycles</td>
<td>624,090</td>
</tr>
<tr>
<td>Total motor vehicles</td>
<td>15,674,436</td>
</tr>
</tbody>
</table>
Scoping the problem

Australian passenger vehicle fleet, millions

Scoping the problem

Projected Australian passenger vehicle fleet, millions assuming 2% growth per year

67.6%
53.3%
2010
2000
Scoping the problem

**China Emissions Target**

China should set firm targets to limit greenhouse gas emissions so they peak around 2030, a new study by some of the nation's top climate change policy advisers has proposed ahead of key talks on a new global warming pact.

### CARBON DIOXIDE OUTPUT
From fossil-fuels, measured in billions of tonnes of pure carbon.

**POSSIBLE APPROACHES**

- **Business as usual**
- **Low Carbon**
- **Enhanced**

### China passenger vehicle fleet, millions

- **China**
- **Australia**

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Scoping the problem

- Passenger vehicle fleet in **China** was 38.4 million at the end of 2008 with sales of about 9.3 million in the year ending October 2009.
Scoping the problem

- Modelling by ERI assumes that the motor vehicle fleet in China will grow from 49 million in 2010 to 354 million in 2030 (x 7.3) or 323 million under the low carbon scenario.

![Projected China passenger vehicle fleet, millions](image)

Scoping the problem

- Fleet in China in 2030 is 7.3 times 2010 value compared to 1.5 times in Australia
- To maintain 2010 emission levels, Chinese fleet in 2030 needs to emit 14% of 2010 levels compared to 68% for Australian fleet
- China is relying on hybrid diesel and fully electric vehicles to achieve their emission reduction goals
- ERI reviewed about 600 technologies as part of the research behind their modelling
Responses to the problem

- Two interlinked responses to reducing emissions from motor vehicles – engineers and economists
- Development of new technologies or improvement to existing technologies for engines and fuels – set out in technology roadmaps.
- Policies to encourage development and greater use of new vehicles and fuels and to influence demand for transport

Technology roadmaps

- Roadmaps have been developed by Governments and industry and others in Europe, USA and elsewhere
- One of the most developed strategies is in the United Kingdom which has made a commitment to reduce GHG emissions from all sources by at least 34% by 2020 and 80% by 2050.
- In July 2009, the UK Government released its Carbon Reduction Strategy for Transport
- Incorporates European emission targets of 130 g CO2/km from 2012 to 95 g/km by 2020
- Includes UK OEM Consensus Technology Roadmap, identifying priorities and timing of technology development and R&D program
Technology roadmaps

The Consensus Product Roadmap, mutually agreed by OEMs, defines future direction to develop products that will benefit UK plc.

![Diagram of technology roadmaps]

Source: New Automotive Innovation and Growth Team 2009

Technology strategies

Short term carbon reduction strategies

- GHG emissions could be reduced by 25% if consumers bought the make with the most fuel efficient technology within each model class – scope to mandate emission levels within current technologies.
- 30% reductions with adoption of most efficient technologies and near term technologies – eg mild hybrid incorporating electric stop-start, biofuels
- Reduction required for Australia to have 2030 levels at 2010 levels.
Technology strategies

Medium term carbon reduction strategies

- Hybrid and fully electric vehicles
- Needs improvements in battery technology with respect to cost, weight, energy density, and recharge times
- GHG benefits depend strongly on how electricity is generated

Technology strategies

Longer term decarbonisation strategies

- Hydrogen powered vehicles
- Hydrogen as fuel is possible reasonably soon but on-board storage, generation and distribution infrastructure are major issues
- If hydrogen produced by electrolysis of water then GHG benefits depend strongly on how electricity is generated
- Fuel cells are still expensive and again the benefits depend on how the hydrogen is manufactured
**Policies to reduce emissions**

- The UK Energy Research Centre (ERC) has written a thorough review of over 500 reports and papers on policies for reducing carbon emissions from road transport.
- In their 2009 report, they review the evidence for reducing carbon emissions and the cost-effectiveness of policies divided into two categories – (i) those that target car technology and consumer choice of cars and (ii) those that target wider travel choices.
- They found that the evidence for the first category of policies was better than for the second category.
- The review concentrates on transport policies but recognises that land use planning pays a significant role in effecting the demand for travel, choice of travel mode and the viability of public transport.

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**Policies to reduce emissions**

CSES has concentrated on 5 major policy areas

1. Carbon emission and fuel efficiency standards for vehicles
2. Fuel taxes and subsidies
3. Vehicle purchase taxes and registration fees
4. Development of alternative fuel infrastructure
5. Promotion of alternative transport modes
Carbon emission standards

- Carbon emission and fuel efficiency standards for vehicles.
- Different standards defined in different ways in different countries. Some mandatory some not.
- European (130 g/km in 2015) and Japanese (125) standards targets are the strictest but China (130) is pretty close. USA (170 in 2016) and Australia (180 in 2010) are the worst.
- Japanese Top Runner program provides template for setting standards – not only for motor vehicles – computers, whitegoods, air conditioners, space heaters, electric toilet seats etc.
- In July 2009 the Council of Australian Governments (COAG) decided to “undertake a detailed assessment of possible vehicle efficiency measures, such as CO₂ emission standards, which international studies have indicated have the capacity to reduce fuel consumption by 30 per cent over the medium term, and significantly contribute to emissions reductions”.

Carbon emission standards

- Economists like standards because they do not involve choosing technology winners – leave this to the manufacturers. Engineers like roadmaps
- Standards for motor vehicles should be set on a well-to-wheel (life cycle) basis rather than a tank-to-wheel basis - important in considering alternative fuels such as electricity.
- Harmonisation or convergence of standards is likely because of global trade in motor vehicles but could be agreed internationally. This would provide level playing field for all producers.
Fuel taxes and subsidies

- Standards control the efficiency of the vehicle but not how many there are or how far they are driven
- There are a range of measures to make transport more expensive by making cars and fuel more expensive and/or to encourage alternative transport modalities
- Problem is that the price elasticity of petrol is low in the short run at least and still pretty low in the long run.
- Therefore you need a large increase in the price of petrol to get a significant reduction in use.
- This is very difficult for Governments to do, not least because of equity problems.

Motor vehicle use

- Average kilometres per car in Australia in 2007 was 13,700 at 11.5 l/100 km so average annual fuel consumption was 1,570 litres, say 1,600.
- If fuel is $1.25 per litre then average annual expenditure is $2,000.
China’s advantages

• Roland Berger consultants have reviewed the plans by China to become a market leader in electric vehicles (April 2009).
• China has competitive advantages in electrified powertrains and particularly in Lithium-ion batteries which are expected to be the dominant means of energy storage in electric vehicles.
• BYD is leading in the development of LiFePO4 batteries and has developed both hybrid and fully electric passenger cars.

Conclusions

• Timing of introduction of new automotive technologies and their uptake in the market depends on the timing and level of GHG targets and accompanying Government policies.
• If the goal is to reduce emissions from transport, then medium and longer term solutions depend not only on the development of automotive technology but on how electricity is generated.