



Public Hearing: 'Cars for the Future'

Mobile Air Conditioning (MAC): Higher Efficiency, Lower Emissions



Marc Chasserot, 4th July 2007



Main Messages

- CO2 Emission targets do not reflect REALITY
- Revise EU Test procedure to include Air Conditioning
- 2006 EU MAC Directive: main driver for alternative technologies



CO2 Emission targets do not reflect REALITY

Should include Mobile Air Conditioning



Variety in Fuel Consumption

- Consumers need to know that MAC consumes extra fuel and produces extra CO2 Emissions
- MACs are a standard feature across the EU/World
- Large differences in fuel consumption between MACs
 - Well engineered A/C- Systems account for around 5% of the car's real fuel consumption
 - Poorly engineered and low cost A/C- Systems are responsible for around 20% of the car's real fuel consumption



Revise EU Test procedure to include MAC

Best incentive for Car Industry to
develop highly efficient MACs



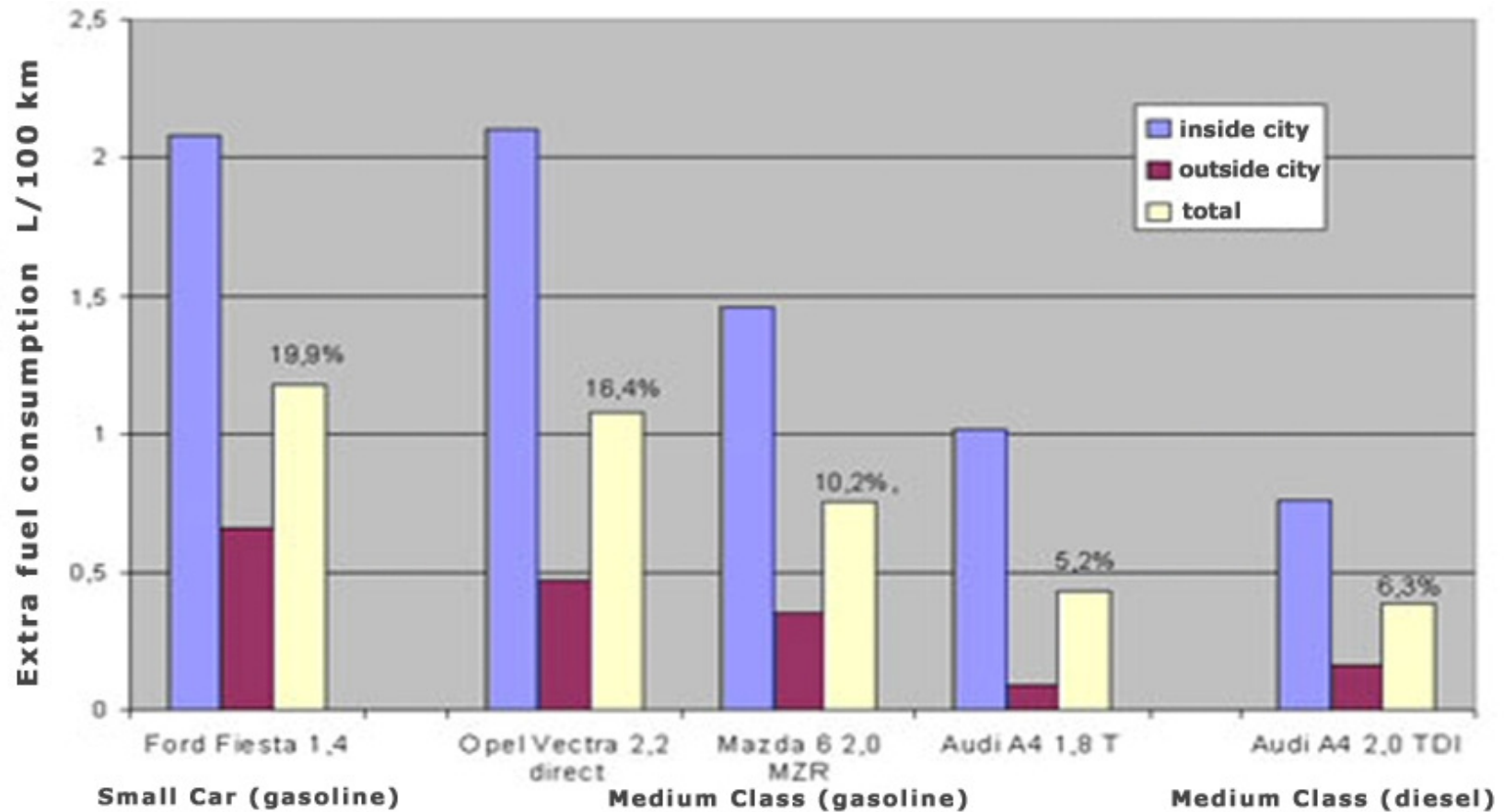
ADAC Test Conditions & Results

(German Car Consumers Association)

- Main Conclusion: Efficient MACs and Inefficient MACs
- Inefficient MACs can increase fuel consumption by 20%
- Depending on vehicle type and design this could cost the driver extra 5-8 EUR for an 8 hours' summer drive
- Between 2.47 to 4.15 litres/100 km of fuel needed to cool down a car from 31°C to 22°C after parking in the sun
- After first cool down, constant operation will raise consumption by up to 2 litres/100km (46g CO₂ /km)
- Test conditions:
 - Driving Cycle: NEDC
 - Ambient Temperature: 28°C, Relative Humidity 40-50%
 - Solar Load: 750W (simulated by electrical heater)
 - Start Conditions: 28°C



ADAC results



Source: ADAC



USA EPA SC 03 Test

- Dec 2006: USA EPA announced new test method to take into account more realistic driving conditions:
 - Includes MACs
 - Estimates that MACs can use extra 25% fuel
 - 2008 Model year vehicles will have 'stickers' indicating 'REAL' Fuel efficiency (from Sept 2007 onwards)
 - 2011 OEMs will need to perform mandatory testing of MACs
- Test Conditions:
 - Driving Cycle: SC 03, Low speed cycle / 35 km/h
 - Ambient Temperature: 35°C, Relative Humidity 40%
 - Solar Load: 850W
 - Start Conditions: Soaked 10 mins.
 - Comment: Compressor runs 100% of the time



New MPG Ratings

New MPG Ratings

[New Window Sticker](#)
[Compare Old and New MPG](#)

[Your Mileage Will Still Vary](#)

[Fuel Economy Tests](#)

EPA has changed the way it estimates MPG.

Starting in model year 2008, estimates will reflect the effects of

- Faster Speeds & Acceleration
- Air Conditioner Use
- Colder Outside Temperatures



What else do I need to know about the new ratings?

- The tests lower MPG estimates for most vehicles.
 - [View old/new MPG ratings for a specific vehicle](#)
 - [Convert old MPG estimates to new estimate](#)
- The actual mileage you get **will still vary** based on your driving habits, traffic conditions, and other factors.
- All MPG estimates in [Find-a-Car](#) have been converted to the to the new ratings system to help consumers compare the MPG of older and newer cars.



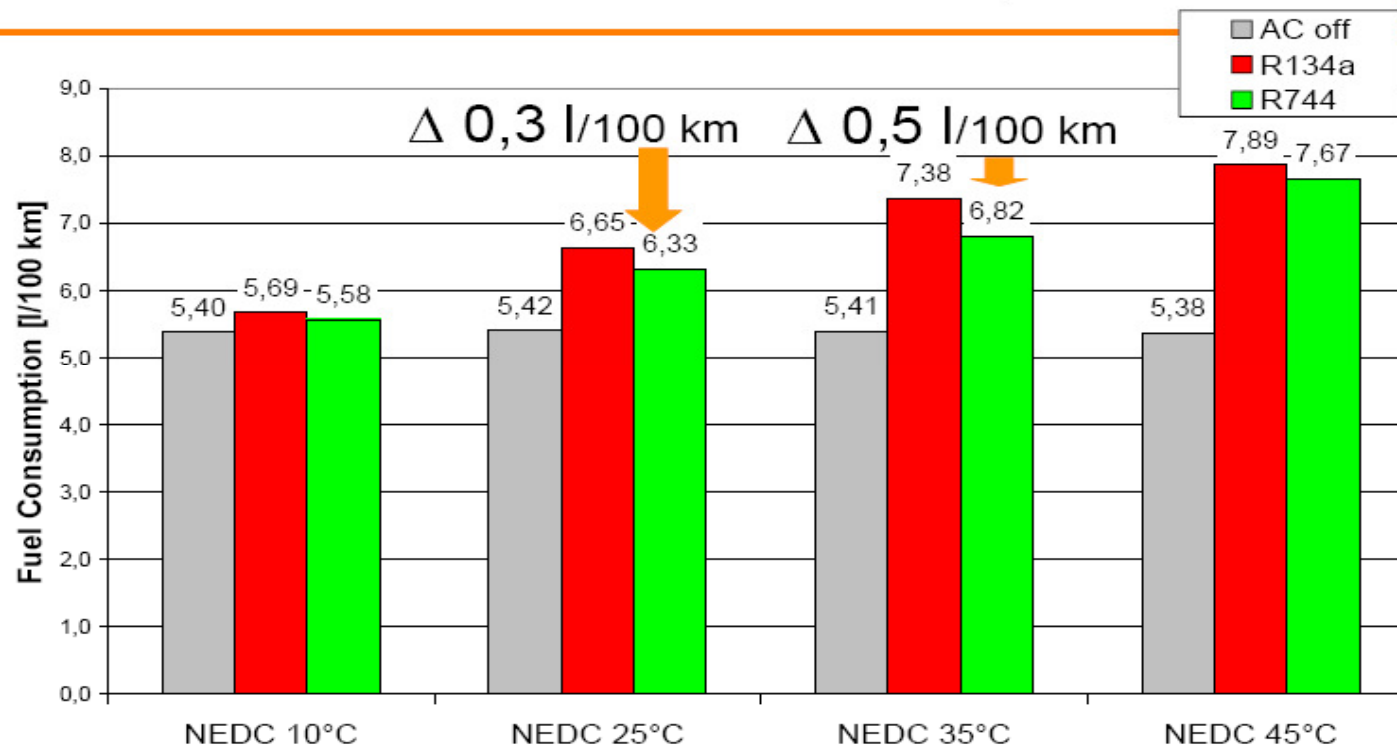
Leading Supplier Tests

- Visteon (leading TIER 1 supplier)
 - 25°C, extra fuel consumption of 1.23 litres/100km
 - (28g CO₂/km)
 - 35°C, extra fuel consumption of 1.97 litres/100km
 - (45g CO₂/km)
- Test Conditions:
 - Driving Cycle: NEDC
 - Ambient Temperatures: 10°C, 25°C, 35°C and 45°C, with relative Humidity ~40%
 - Solar Load: 750W
 - Start Conditions: Soaked at 50°C



Visteon Results

Test Results: Fuel Consumption



- ⇒ Significant, absolute fuel reduction of 0,3 and 0,5 l/100 km at ambient temperature of 25°C and 35°C for R744
- ⇒ Add on fuel reduction of 25 % at 25°C and 35°C of R744 in comparison to R134a



Overview: Fuel Consumption Test

Test	Ambient conditions	Solar load	Driving cycle	Start Cond. Test duration	Comment
SC03	95°F / 35°C 40% rh	850 W/m ³	Low speed cycle ~21,5 mph / 35km/h	Soaked 10 min	Compressor runs 100% of the time
Visteon	95°F / 35°C (~40% rh)	750 W/m ³	NEDC	Soaked (122°F / 50°C)	Blower step 4, recirc. mode
ADAC	82°F / 28°C 40-50% rh	750 W (solar load simulated by electrical heater)	NEDC	82°F / 28°C	



Recommendations

- USA (SC 03) already includes MAC in Tests today
- Obvious differences in system performance
- Urgent need for minimum efficiency requirements in the EU in order to minimise this additional fuel use
- Choice:
 - Low cost solution test, similar to the ADAC procedure
 - High cost solution test, similar to the Visteon procedure



EU MAC Directive (2006)

- Main driver for next generation MAC
- European technology leading the way
- Global solution



Choice for next generation MAC

- Car Industry currently discussing next generation MAC to replace HFC 134a
- Focus on higher efficiency and lower emissions
- Choose this summer between;
 - New Chemical BlendsOR
 - Natural Refrigerant, CO₂

THE CHOICE TODAY - NEW CHEMICAL BLENDS OR CO₂

QUESTION	CRITERIA	TODAY	ALTERNATIVES FOR TOMORROW			
		HFC 134a (To be phased out)	Fluid H By Honeywell	DP1 By DuPont	AC1 By Ineos	CO ₂ (R744)
ENVIRONMENTALLY FRIENDLY?	Global Warming (Over 100 years)		??*	??*	??*	
	Global Warming (Over 20 years)		??*			
	Ozone Depletion					
	Toxicity		??*	??*	??*	
	Flammable Substances					
COST - EFFECTIVE?	Cost of Refrigerant					
	Initial Cost for Carmakers					
	Servicing/End of Life Cost					
	Cost of Operation (Fuel Consumption)					
TECHNICALLY READY?	Substance Complexity					
	Unknown Substances and Decomposition					
	Medium/Long Term Testing					

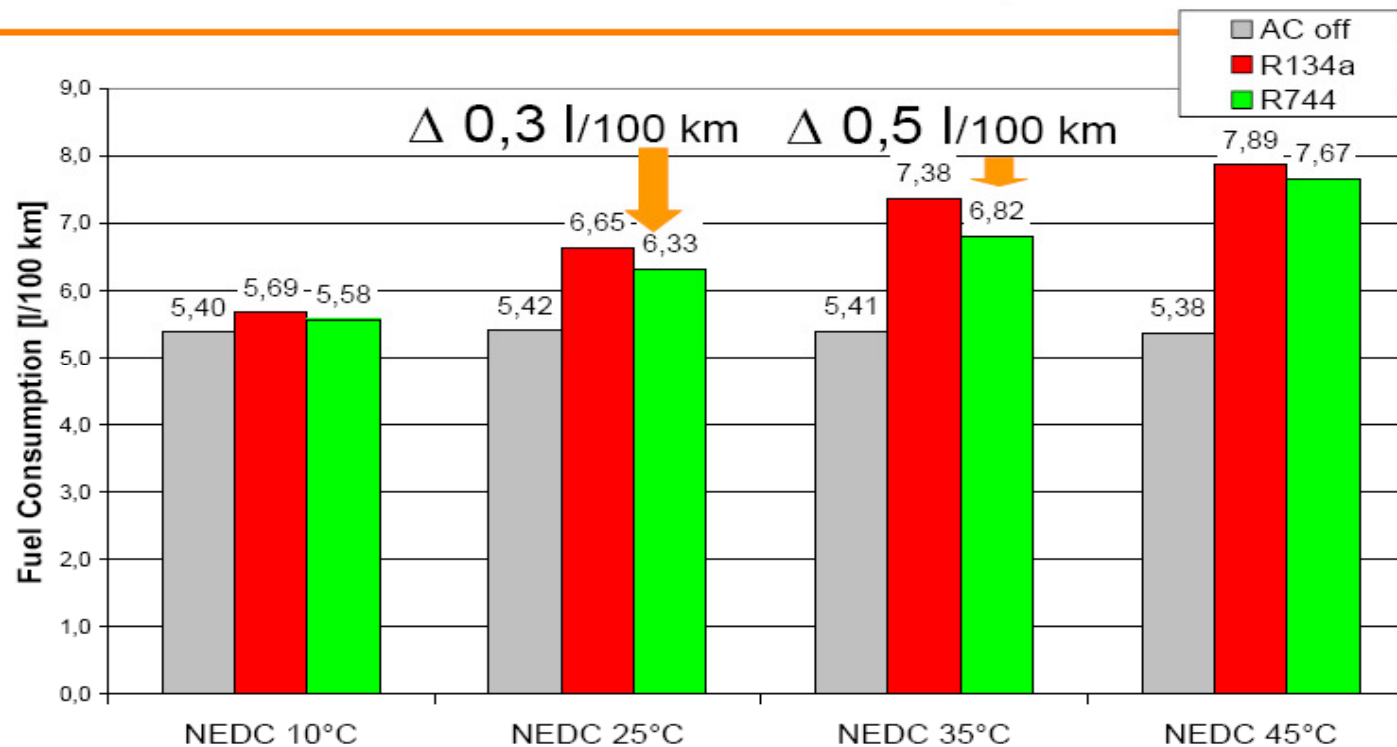
Source: Alliance for CO₂ Solutions

* Not enough information for the car industry to decide.



C02 MACs Better Fuel Efficiency

Test Results: Fuel Consumption



- ⇒ Significant, absolute fuel reduction of 0,3 and 0,5 l/100 km at ambient temperature of 25°C and 35°C for R744
- ⇒ Add on fuel reduction of 25 % at 25°C and 35°C of R744 in comparison to R134a



CO2 Technology, Sustainable MAC

- *"Turning the problem into the solution"*
- CO2 Technology (R744) is best option for Fuel Efficiency and emissions in all cars and ambient temperatures
 - More efficient in all sizes of cars
 - More efficient in all ambient temperatures
 - GWP = 1
 - Natural Refrigerant, non flammable and non-toxic
- Potential to save 10% of Total Car Emissions



Main Conclusions

- Revise EU Test procedure to include MAC, thereby reflect real driving conditions
- Several Test methods already exist
- Car Industry working on next generation MAC, offering higher efficiency and lower emissions
- « *CO2 Technology is Car Industry's Best Insurance policy against future MAC legislation* »



More Information

- Mobile Air Conditioning: www.R744.com
- Next Generation MAC: www.Alliance-CO2-Solutions.org
- Tel: +32 2 230 3700
- Email: marc.chasserot@shecco.com