RACQ Congested Roads Report:
The Effects on Fuel Consumption and Vehicle Emissions

A field test comparing the effects of travelling in peak-hour traffic compared to normal daytime running conditions

Prepared by RACQ Vehicle Technologies Department

May 2008

Contact: Steve Spalding
Executive Manager, Vehicle Technologies
(07) 3666 9749

Background

Vehicle running costs are an ongoing issue for motorists, as are the environmental impacts of using a motor vehicle. Fuel consumption is one of the more visible elements of vehicle running costs, not least because of the regularity (usually weekly) of refilling and rising fuel prices.

Fuel consumption is also linked to the quantity of CO_2 emitted by a vehicle, so conditions that cause fuel consumption to increase create correspondingly higher greenhouse gas emissions. Driving in congested conditions therefore impacts negatively on the environment and is a financial cost to the motorist - one that, along with the inconvenience and time cost, most drivers would prefer to avoid.

In view of these significant financial, time and environmental costs associated with congestion, there exists both a rationale and an opportunity for governments to tackle the causes that lead to stop-start vehicle movement and general under-speed traffic conditions.

Additionally, for unavoidable stop-start driving conditions, there is also an opportunity for the adoption of vehicle technologies, such as idle shutdown, that lessen the environmental impact of a vehicle's engine during stationary periods.

Purpose of test

To determine what effects driving in congested conditions has on fuel consumption, CO_2 emissions and journey times.

Overview

To better understand the effects on fuel consumption and emissions of driving in congested conditions, a comparison test was carried out using two vehicles travelling along recognised commuter routes into the Brisbane central area. The two family sized vehicles travelled a set route for five consecutive days to replicate a typical return commuter journey to and from a city based work location. The travel times, fuel consumption and calculated CO_2 emissions were then compared with another five trips made during the daytime between morning and afternoon peak-hour times.

The two routes chosen were:

- Tingalpa to Fortitude Valley via Wynnum Road and Story Bridge. A round trip of 22.5km.

- Banyo to Fortitude Valley via Sandgate Road. A round trip of 26.5km.

This report has been prepared to present the key findings of the test and to provide an overview of the relevance of undertaking the test.

Key results

As expected, both fuel consumption and journey times increased in congested traffic conditions. The comparison test showed the following key results:

- Fuel consumption, and therefore CO_2 emissions, increased by an average of 30% for the two vehicles when travelling in congested conditions compared to daytime traffic.

- Average fuel consumption increased from 12.4 to 16.2 L/100km, an increase of 3.8 L/100km.

- Calculated average CO_2 emissions increased from 311 to 404.5g/km, an increase of 93.5g/km.

- Inbound peak-hour journey times increased by an average of 85% over daytime trips for the two routes.

- Outbound peak-hour journey times increased by an average of 38% over daytime trips for the two routes.

Test observations

Both drivers were familiar with the selected routes and vehicles. The following observations were noted during testing:

- No abnormal delays or incidents were experienced during either peak-hour or daytime test conditions. Based on observations of the drivers and feedback from other drivers familiar with the routes, overall traffic volumes during the testing period were considered lighter than normal.

- Daytime trip times were less variable than peak-hour times, particularly on the Tingalpa to Fortitude Valley route where inbound daytime trip times varied by only 1 minute for the five journeys.

- Peak-hour return trips were most variable with the largest variation being 14 minutes on the Tingalpa to Fortitude Valley route.

- Both the inbound routes experienced comparatively longer journey times in peak-hour than daytime ones. The Tingalpa to Fortitude Valley inbound trip time was nearly 90% longer than the daytime journey time.

Other observations:

- Inbound peak-hour traffic consistently slowed to a crawl in the vicinity where Wynnum Road intersects with Bennett's Road at East Brisbane.

- For the Banyo to Fortitude Valley trip, traffic was typically slow from Toombul to Mayne.

- On the return peak-hour trip to Banyo congestion was usually experienced from Albion to Toombul.

Analysis

A vehicle's fuel consumption is a consequence, in part, of its operating environment. Traffic density forms part of this environment, impacting levels of congestion and travel times.

Denser traffic conditions result in increased fuel consumption and longer travel times. Fuel consumption, in terms of the quantity of fuel consumed, also affects the quantity of CO_2 emissions from a vehicle. A vehicle with higher fuel consumption will emit correspondingly higher levels of CO_2.

With increased community awareness of CO_2 emissions, reducing a vehicle's fuel usage contributes to providing environmental benefits to society. Additionally, motorists benefit from lower overall fuel costs.

Denser traffic conditions lead to lower overall vehicle speeds, increased journey times and higher vehicle operating costs. The negative effect congested roads has on the environment attracts attention from various sectors of the community and congestion in general remains an ongoing topical issue for many motorists and media commentary.

While there would be widespread community acceptance that congested roads result in higher overall exhaust gas emissions from slow moving traffic, an accurate understanding of the impact such congestion has is less clear.

In February 2008 RACQ released a brochure that provided information on practical steps that motorists could take to improve their vehicle's economy and thereby reduce its emissions. Clearly, avoiding congested conditions is one such step.

Similarly, new vehicle fuel consumption labelling has for some time provided information on an individual vehicle's comparative fuel efficiency. More recently this information has been expanded to include CO_2 emissions expressed as grams per kilometre. In February 2008 the Commonwealth Government released an updated label showing a further expansion of information by breaking down the previous 'Combined' fuel consumption figure to now include 'Urban' and 'Extra Urban' figures.

These figures, drawn from vehicle testing under Australian Design Rule ADR81/02, not only provide the consumer with valuable information but also show the difference in fuel consumption between the various driving conditions the testing represents.

So, while compliance testing under ADR requirements provides this guide information on fuel consumption and CO_2 emissions under standardised conditions, adding a 'real-world' dimension to a common daily component of many people's motoring provides both relevance and interest.

Additionally, information gained from real-world testing can be utilised in raising awareness and understanding for motorists and compliments other forms of communications such as RACQ's 'Tips For Greener Motoring' Brochure.

Discussion point

Advice to motorists often relates to purchasing more fuel-efficient vehicles and making more efficient use of their existing vehicle.

With enhancements in vehicle technology, fuel consumption can be lowered thereby reducing CO_2 emissions. Achieving technological improvements can involve long lead times for manufacturers. For the motorist, this requires costly upgrading to newer more fuel-efficient vehicles.

Similarly, consumers can choose vehicles of different fuel types that may, subject to their usage patterns, offer reductions in the quantity of fuel consumed, operating costs, and CO_2 emissions.

Bio-blended fuels can also offer small reductions in CO_2 emissions even though fuel consumption and costs for the motorist may increase. To show this RACQ carried out a field test in 2007 that compared two similar vehicles using E10 and normal ULP fuel over an extended test cycle. The results showed use of E10 increased fuel consumption by an average of 3%.

Given the substantial differences in fuel consumption found during this test there needs to be recognition of the effects that congested traffic conditions have on vehicle emissions. The fuel consumption penalties of travelling on congested roads are significant compared to the relatively small gains achieved via fuel and vehicle technology improvements. The 30% increase found during this test needs to be put in perspective when considering other methods of reducing emissions and the savings they may claim to deliver.

Notes on field testing

Testing the fuel consumption of vehicles under 'real-world' conditions does not offer the consistency or rigours of laboratory based scientific testing. Field-testing includes the effects of many variables such as driving style, road and traffic conditions, vehicle condition, weather conditions and location factors.

Field-testing does, however, permit a representative test of a particular set of circumstances or conditions. For this comparison test, the effects of the above points were taken into consideration when designing the test, selecting the vehicles and the routes. This is further discussed in the methodology section.

Regarding the fuel consumption results and travel times reported, we believe they are representative of the effects of driving in congested conditions compared to that of normal daytime travel.

Methodology

Vehicle selection:

- A large sedan was chosen to represent a typical family or fleet vehicle.

- Two late model family sized vehicles of similar make and model were sought from a vehicle rental group. The purpose in sourcing two similar vehicles was to minimise the differences that exist between vehicles of different size, weight and style configurations.

- The vehicles used for the test were:
    - Ford Fairmont BF2 six cylinder automatic sedan.
    - Ford Falcon BF2 six cylinder automatic sedan.

Route selection:

- The two chosen routes were considered representative of typical commuter journeys from the East and North areas into the central Brisbane area. The starting points were 11 and 13 kilometres respectively from the destination.

- The route selection included consideration of the provision of vehicle overnight and daytime parking so that they were not disturbed once the test commenced. This ensured each vehicle was only driven under test conditions and for either an inbound or outbound trip only.

- The starting point locations were:
    - RACQ Tingalpa.
    - Private address in Banyo.

- The central Brisbane location was:
    - RACQ House 300 St Paul's Terrace, Fortitude Valley.

Journey planning:

- Peak-hour trips commenced within the following times:
    - Inbound, between 7:45am and 8:10am.
    - Outbound, between 4:00pm and 4:50pm.

- Daytime trips, both inbound and outbound, were completed between 9:30am and 2:30pm ensuring traffic encountered was generally not commuter related.

- Daytime trips were undertaken, rather than late evening/overnight, so as to provide a representative comparison to peak-hour conditions and one that is more relevant to most motorists. It is assumed that use of late evening or overnight conditions would have created data based on overly light traffic flows and could therefore have suggested the effects of congested traffic conditions were far greater on fuel consumption and journey times.

Fuel consumption and CO_2 calculations:

- Each vehicle was fully filled at the start of the daytime test cycle. On completion of the five return trips the vehicle was returned to the same service station and fuel pump for refilling. This ensured fuel consumption reflected only the daytime cycle journeys.

- For the peak-hour test cycle, the above was repeated. At the conclusion of the test both daytime and peak-hour fuel consumption readings could be compared.

- Both vehicles were driven in automatic mode with the air-conditioner on.

- Only non-ethanol blended fuel was used for the test. This enabled CO_2 emissions to be calculated using the *National Greenhouse Accounts (NGA) Factors* reference data for transport fuels. The Australian Government's Department of Climate Change released this reference source in January 2008 as an update and replacement of the *AGO Factors and Methods workbook*.

- Using the above reference source, CO_2 emissions were calculated using a 'Full fuel cycle emission factor' of 2.5kg CO_2/litre for motor gasoline. The 'full cycle' figure was used as this takes account of the vehicle's combustion emissions along with the fuel's associated production, distribution and related emissions.

- Use of 'full cycle' emissions data is considered a more representative factor given that it is assumed the purpose for the production and transport of liquid petroleum fuel is primarily for use in motor vehicles. For reference, 2.3kg CO_2/litre is the combustion-only amount for direct emissions.

Fuel consumption and CO_2 data

	Vehicle 1 Ford Fairmont BF2 sedan	Vehicle 2 Ford Falcon BF2 sedan
	Route 1 Tingalpa to Fortitude Valley	Route 2 Banyo to Fortitude Valley
Daytime running:		
Fuel used (Litres)	14.79	16.43
Calculated CO_2 emissions (Kg)	36.97	41.07
Kms between refills	118	133
Fuel consumption L/100km	12.53	12.35
CO_2 g/km	313.3	308.8
Peak-hour running:		
Fuel used (Litres)	18.95	21.84
Calculated CO_2 emissions (Kg)	47.37	54.60
Kms between refills	118	133
Fuel consumption L/100km	16.06	16.29
CO_2 g/km	401.4	407.5
Change:		
Fuel consumption (L/100km)	+3.53	+3.94
Quantity of CO_2 (kg)	+10.4	+13.5
CO_2 g/km	+88.1	+98.7

Note: the small variations in fuel consumption between the two vehicles are a characteristic of in-field testing and the effects of variables previously noted.

Journey times

Route 1 - Tingalpa to Fortitude Valley Return trip distance = 22.5km					Route 2 - Banyo to Fortitude Valley Return trip distance = 26.5km				
Inbound trip distance = 11km Outbound trip distance = 11.5km					Inbound trip distance = 13km Outbound trip distance = 13.5km				
	Peak-hour trip minutes		Daytime trip minutes			Peak-hour trip minutes		Daytime trip minutes	
In	37		17		In	36		22	
Out		24		23	Out		28		22
In	37		17		In	41		20	
Out		28		19	Out		28		20
In	30		18		In	43		24	
Out		38		22	Out		31		27
In	38		18		In	36		18	
Out		38		24	Out		35		28
In	30		18		In	34		20	
Out		32		24	Out		27		20
Variation in times:	8	14	1	5	Variation in times:	7	8	6	7
Avg: (rounded)	34	32	18	22	Avg: (rounded)	38	30	21	23
Avg peak hour increase:	88.8%	45.5%			Avg peak hour increase:	80.9%	30.4%		

Project undertaken by:

Steve Spalding, Executive Manager, Vehicle Technologies.
Russell Manning, Technical Researcher.

May 2008