



Choice factors in the adoption of alternative fuels and new technology vehicles: Results from a Pilot Survey

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Abstract:

Current transformations in vehicle technologies and fuels accelerated by concerns around rising petrol prices, pollution and climate change issues seem to lead to two potential outcomes. One is the technological ideal of a hydrogen fuelled vehicle fleet and the other is a fleet still powered by internal combustion engines with either conventional drive trains or hybrid drive with intervening battery and electric motor. Already available fuels such as LPG, biodiesel and ethanol, as well as advances such as biobutanol (a superior replacement for ethanol) seem to be favouring the internal combustion engine, in the medium term at least, until hydrogen becomes a viable alternative. However, unfamiliarity with the alternative technologies seems to create an inertia effect preventing the move away from the traditional petrol driven motor. In Australia, the most common alternative fuel is liquefied petroleum gas (LPG), used mainly by taxis but the uptake of LPG vehicles by private motorists has been limited despite the demonstrable savings.

This paper presents results from an early pilot study administered on a small sample of students at the University of Western Australia (UWA) in October 2005. The aim is to assess the influence of various choice factors in the decision to purchase a new vehicle: type and size of vehicle, type of fuel, operating cost, vehicle purchase price, and cargo space within a discrete choice model framework. The model also accounts for individual characteristics and latent lifestyle and belief factors. Preliminary results confirm the a priori hypotheses regarding the negative impact of fuel price and vehicle price.

Since this pilot study is not from a representative sample as it included mainly university students, the results should be interpreted with caution and they cannot be generalised to the general population level. However, it helped greatly in identifying design problems and provided suggestions towards further improvements/changes in the survey instrument: clearer presentation of information, use of pictures, and increasing the number of scenarios provided to each respondent.

1. INTRODUCTION

Current transformations in vehicle technologies and fuels accelerated by concerns around rising petrol prices, pollution and climate change issues seem to lead to two potential outcomes. One is the technological ideal of a hydrogen fuelled vehicle fleet and the other is a fleet still powered by internal combustion engines with either conventional drive trains or hybrid drive with intervening battery and electric motor.

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The aims of this study are to:

- measure preference functions for vehicle attributes related to four fuel technologies: petrol, LPG, dual petrol-LPG, and hybrid electric (running on petrol);
- estimate the influence of personal characteristics on choice for alternative fuel technologies;
- derive demand elasticities for the various types of vehicles.

The factors included in the stated choice design are: the type and size of vehicle, the vehicle purchase price, fuel technology, fuel efficiency (presented as weekly running costs), and availability of refuelling stations and boot space. These are consistent with previous studies on vehicle purchase (Brownstone et al., 2000; Green, 2001; Byun, 2001; Punj and Brookes, 2002; Dagsvik et al., 2002; Vekeman et al., 2004). The model also accounts for individual characteristics and latent lifestyle and belief factors.

2. EXPERIMENTAL DESIGN

A stated preference (SP) experimental design included the following *states of the world* affecting all the alternatives within a choice scenario (Table 1): the litre price of fuels (petrol and LPG), with three different combinations of levels and the availability of LPG in non-metropolitan area at 2 different levels, giving a possibility of 6 states of the world (3×2). These are called blocking factors².

Table 1: States of the world

States of the World	Litre cost of Petrol/LPG (\$)	Availability of LPG stations (%)
1	1.20 / 0.50	40%
2	1.40 / 0.60	
3	2.00 / 0.70	
4	1.20 / 0.50	80%
5	1.40 / 0.60	
6	2.00 / 0.70	

A fractional factorial design for main effects was obtained based on the following 4 attributes:

- 1) Fuel technologies: LPG dedicated, Dual fuel (LPG and petrol), Hybrid electric and conventional petrol.
- 2) Size of the vehicle: A four level factor (small, mid-size, large, 4WD).
- 3) Vehicle price: This three level factor (low, medium, high) is presented to respondents as a dollar value. To maintain realism, the size of the car and the fuel technology were taken into consideration when determining the vehicle price with a higher price for larger cars, and a marginally higher price for hybrid-electric vehicles and LPG conversions.
- 4) Boot Space: Respondents were given boot space expressed in litres. In the case of dual LPG vehicles, the boot space would be reduced by the size of the LPG tank used in each vehicle type, i.e., for a small car, a sedan, a wagon and a 4WD, the size of LPG tank that fits in the boot would be 45L, 70L, 70L and 90L respectively. Note that for 4WD's the tank is placed under the vehicle and does

² Factor that is repeated for every stimulus/configuration; therefore we have six blocks of 24 cards.

not affect boot size. However, this feature was not taken into account in the pilot survey.

Table 2: Average fuel efficiency of vehicle (L/100 km)

L/100 km	Petrol	Dedicated LPG	Dual Petrol-LPG*	Hybrid
Small car	6	7.6	8.4	3.5
Mid-size sedan	8	10.2	11.2	4.5
Mid-size wagon	9	11.4	12.6	5.5
Large sedan	9	11.4	12.6	5.5
Large wagon	10	12.7	14	6.5
4WD	12	15.2	16.8	8.5

* This is the efficiency if using LPG fuel.

Fuel efficiencies were obtained from various car manufacturers' web sites (Table 2). The hybrid electric vehicles (HEVs) were the most fuel efficient. While the price of LPG is less than half the price of petrol, it is a less efficient fuel technology. For dual-fuel vehicles, the extra weight of the tank is accounted for by decreasing the dedicated efficiency by 10%.

The weekly fuel cost is given to respondents on the scenario cards. However, it is not an attribute on its own. It is determined by the price of fuel (blocking factor), the fuel efficiency of the vehicle and the weekly distance travelled assumed to be 280 kms in the survey.

Using the SPSS software, a main effects design for the attributes produced 32 cards. After eliminating the dominated/dominating cards and after checking for correlations, 24 cards were kept. These cards were repeated through the six states of the world, such that all two way interactions between the vehicle attributes and the state of the world are accounted for. The experimental design was then tested for orthogonality and no correlations were found between main effects and two-order interactions.

3. SURVEY INSTRUMENT

Before the survey was handed out, each respondent was asked which car he/she currently owns and following that, those owning small cars were given scenarios

without the four wheel-drive (4WD) option; conversely, current 4WD owners were shown scenarios that did not include small cars.

The survey consisted of 4 parts (see Appendix). The first part was the information sheet, providing information to respondents about the purpose of the study as well as definitions of terms and concepts used in the survey. The second part of the survey asked respondents about their current vehicle and their current level of vehicle use. In the third section, six choice scenarios, each containing 4 alternatives were presented, conditional upon the current size of the vehicle owned. Previous qualitative unstructured interviews suggested that providing respondents with scenarios that contain their current type of vehicle owned would make the decision making process more relevant. Respondents were required to select the preferred alternative for each scenario.

The last part of the survey gathered additional socio-demographic information about respondents, measures they have adopted to reduce fuel expenditure in the face of current higher prices, their attitude towards environmental issues such as greenhouse gas emissions and air quality and their opinions about the evolution of fuel price. The survey concluded with four questions measuring the individual's level of awareness of alternative fuels and vehicle technologies before and after having completed the survey.

4. PILOT SURVEY

4.1 General descriptive statistics

The survey – administered as paper-and-pencil survey - was tested on 29 students and academics at UWA. Among the 29 respondents, 22 were males and 7 were females, and half of them were married. Twenty-one of them lived in Australia, and 27 owned a vehicle at the time of the survey. In terms of type of vehicle owned, the distribution across sizes was rather balanced: 10 respondents owned a small vehicle, 10 owned a sedan or a station wagon, the remaining owning 4WDs. The average weekly fuel expenditure approximated \$36 with a weekly average distance travelled of 265 km. It is worthwhile noting that about half of the respondents had inconsistent responses with

respect to fuel costs and km driven. This was reflected in either overestimated fuel expenses or underestimated distances and it shows that drivers are not necessarily aware of the performance of their car or their running costs. Kurani and Turrentine (2004) found that households do not pay much attention to fuel costs unless their budget constrains them severely. Moreover, the knowledge about fuel costs is “ephemeral” and individuals usually forget the price they paid for fuel over the next days of refuelling. In a few cases the fuel consumption derived from responses was more than 28L/100 km for small cars or less than 5L/100 km for 4WDs, showing clear inconsistencies.

All vehicles owned ran on petrol, except for one respondent who drove a diesel vehicle. The frequency of driving outside the metropolitan area varied across respondents; while eleven respondents said they drive at least 5 times a year, the remaining 18 either drive less frequently or not at all.

Respondents were also asked to select the measures that they have been taking or would take to reduce their petrol expenditures. Although past and future actions were combined in one question, in future research, they will be split in two separate questions to distinguish between them. As shown in Table 2, fourteen chose “drive less”, 12 considered “begin or increase use of public transport”, 10 chose to “walk or bike”, 4 selected “purchase a more fuel-efficient vehicle”, and another 4 indicated “carpool”. While none of the respondents stated that they would cancel a vacation trip, 3 would take no measures at all and two suggested other measures not found in the provided options (e.g., relocation solutions).

Table 3: Measures respondents have been taking or would take to reduce their petrol expenditures

	Drive less	Begin or increase use of public transport	Walk or bike	Purchase a more fuel-efficient vehicle	Carpool	Cancel vacation trip	Nothing
Number of respondents	14	12	10	4	4	0	3
% respondents	48%	41%	34%	14%	14%	0	10%

Another question aiming at obtaining respondents’ outlook on future petrol prices over the next six months revealed that 28 respondents believed that petrol prices will either be higher than their current prices or about the same.

When asked about the seriousness of the threat of global warming and air pollution, 19 responded “very serious”, and 9 responded “somewhat serious”. Only one respondent did not have any opinion on this matter. This reflects rather strong concerns over environmental issues among the respondents.

Respondents were also asked to select among a list of factors those they considered as very important in influencing their decisions to try a new fuel. The popularity of the factors came in the following order: “cost of fuel” (23), “vehicle cost” (19), “emissions” (17), “how far you can travel before refuelling” (10), “how safe the fuel is for drivers and passengers” (11), “convenience of refuelling” (8) and “cargo space” (8). It is clear that costs represent an important criterion in vehicle purchase decision.

Table 4: Factors considered as very important in influencing decision to try a new fuel

	Cost of fuel	Vehicle cost	Emissions	Driving range	Safety	Convenience of refuelling	Cargo space
No. of respondents	23	19	17	10	11	8	8
% of total respondents	79%	66%	59%	34%	38%	28%	28%

In terms of previous knowledge about alternative fuels and new vehicle technologies, 9 respondents knew nothing or very little and 8 knew “a great deal” before the survey. However, at the end of the survey, 18 out of the 29 respondents stated that they have acquired some new information about these alternative vehicles and fuels while another 6 mentioned that their level of awareness increased “a great deal”.

4.2 Model estimation

A total of 696 alternatives ($29 \times 6 \times 4$) were assessed by our 29 respondents and 174 choices (29×6) were made in the following proportions:

33% - alternative LPG (57/174)

31% - alternative Hybrid (54/174)

31% - alternative Dual (54/174)

5% -alternative Petrol (9/174)

Those who opted for LPG vehicles were more inclined towards smaller or mid-size vehicles. Similarly, those who chose a hybrid vehicle had a preference for small or mid-size vehicles and valued the low weekly fuel cost derived from the technology. For the dual fuel alternative, the respondents were more likely to select a small or large vehicle. As for respondents who chose petrol vehicles, they had a preference for larger vehicles.

The search for a suitable model involved selecting the structure of the model (multinomial logit, nested logit, etc.), the explanatory variables and the form by which they enter the utility function (linear, non-linear). We tested several model structures using the Limdep software. We present in the following three discrete choice models: multinomial logit (MNL), a nested logit (NL) and a latent classes model (LCM).

All three models are generic, i.e. the variables appear in the utility function of each alternative and their coefficients are assumed identical. The explanatory variables used are: the vehicle purchase price, the weekly fuel cost and the size of vehicle (as dummy variables)³.

Table 5: Success rate for MNL, NL

		Predicted choice (%)			
		MNL,NL,LCM			
		LPG	Hybrid	Dual-fuel	Petrol
Actual Choice	LPG	38, 38, 58	25, 25, 15	33, 31, 25	4, 4, 2
	Hybrid	27, 25, 19	42, 44, 58	27, 27, 21	6, 4, 2
	Dual	35, 35, 24	27, 24, 22	35, 37, 49	4, 4, 4
	Petrol	43, 43, 25	29, 29, 25	29, 29, 38	0, 0, 13

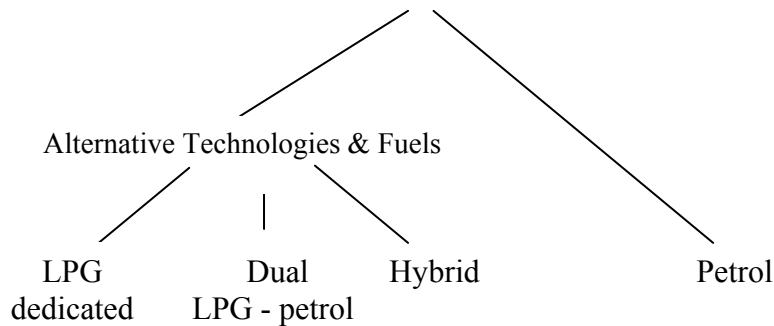
The proportions table for the models show that the NL choice model correctly predicted the LPG alternative 38% of the time, the Hybrid alternative correctly 44% of the time and Dual-fuel correctly, 37%. However, both MNL and NL models failed to classify correctly the choice for petrol vehicles within the sample (only 7 choices in the set) whereas the LCM performs better with 13% correct predictions. The NL model had a slightly improved predictive capability compared to the MNL model. Overall, the LCM

³ We also investigated models with additional variables: availability of LPG stations, boot space, and socio-demographic characteristics, but due to the small sample size they did not add significantly to the model fit.

shows considerable improvement in the predictive capability compared to the MNL and NL models. The overall proportion of correct predictions made by the NL model is 38% ($66/174 \times 100$), while for the LCM it is 53 %.

NL model addresses some of the limitations of MNL, by grouping together the “alike” alternatives into nests. In the NL model selected (Figure 1), the Petrol branch is degenerate, i.e. with only one alternative – petrol vehicles. The other branch includes the alternative technologies and fuels: LPG dedicated, Dual LPG-petrol, and Hybrid electric vehicles.

Figure 1: Structure of the nested model



Results from NL, compared to MNL, and LCM are given in the Table 5. The results show that both weekly fuel cost and vehicle price decrease the level of utility for each alternative, as their negative sign indicates, except for the counter-intuitive vehicle price parameter in the NL model. Various factors may have contributed to this “anomaly”: it may be due to the use of generic attributes confounding the effects from the two branches or that price acted a proxy for “quality” in some cases, for example the hybrid vehicles. The relative influence of the weekly fuel cost on the overall utility of an alternative is approximately twice as big as the impact of a unit change in vehicle purchase price. This is not surprising as the rising cost of petrol seems to come to individual’s attention every day through numerous sources.

The size of the vehicle also diminishes the utility of the alternative, with the small car having the lowest utility level. The alternative specific constant has the highest value for the hybrid vehicle. This may be due to elements such as the convenience/availability of refuelling stations, cargo and passenger space, inertia, willingness to adopt new

technologies and fuels - not explicitly included in the utility function - are higher for hybrid or LPG compared to petrol. Or there may be other unobserved elements of the technologies and individuals that contribute to this value.

The latent class logit model (LCM) structure was tested in order to capture the heterogeneity across individuals. In our case, we assumed that there are two different groups of individuals: one with a strong preference for conventional petrol vehicles and the other group being more inclined towards alternative fuels and new technology vehicles, as well as being more environmentally concerned. The goodness of fit of the latent class model with two classes is significantly superior to that of the MNL or NL model. Assuming that the latent classes correspond to underlying market segments, we considered as explanatory variables for class membership: gender, number of dependents, and employment status/number of paid hours per week.

The theta parameter estimates of the class revealed the composition of the groups: group 1 was made up predominantly of women, working less than 40 hours a week; the second class includes males who work at least 40 hours a week. Table 6 illustrates that class 1 exhibits a higher sensitivity to weekly fuel cost compared to class 2 (-0.4633 compared to -0.089) and presents a higher propensity to choose alternative fuels and technologies (high alternative specific constants for LPG, hybrid and dual).

Table 6: Parameter estimates from NL, MNL and Latent Classes Logit models

	MNL Parameter estimates	NL Parameter estimates	MNL P[Z > z]	NL P[Z > z]	LCM Parameter estimates (Latent class 1)	LCM Parameter estimates (Latent Class 2)	LCM1 P[Z > z]	LCM2 P[Z > z]
Attributes in the Utility Function								
$\beta_{\text{Vehicle Price}}$	-0.065	0.080	0.075	0.034	-0.111	-0.075	0.119	0.074
$\beta_{\text{Weekly Fuel Cost}}$	-0.131	-0.161	0.006	0.008	-0.463	-0.089	0.003	0.054
$\beta_{\text{Small Vehicle}}$	-1.249	-1.673	0.183	0.128	-4.557	-2.472	0.046	0.020
$\beta_{\text{Mid-size Vehicle}}$	-0.699	-0.958	0.314	0.237	-2.780	-1.1980	0.054	0.101
$\beta_{\text{Large vehicle}}$	-0.490	-0.644	0.273	0.208	-2.024	-0.461	0.028	0.329
Alternative Specific Constants								
α_{lpg}	-0.405	3.792	0.6550	0.172	24.567	-0.698	0.999	0.474
α_{hybrid}	0.552	4.933	0.4581	0.082	26.161	0.363	0.999	0.627
α_{dual}	-0.971	4.180	0.9075	0.137	25.309	-0.401	0.999	0.641
Inclusive Value Parameters								
Alternatives	-	1.159	-	0.166	-	-	-	-
Petrol	-	0.466	-	0.279	-	-	-	-
Theta Coefficient								
Constant	-	-	-	-	-0.497	0	0.678	0.630
Gender	-	-	-	-	-0.717	0	0.606	0.630
No. of dependents	-	-	-	-	0.363	0	0.632	0.630
Paid hours work	-	-	-	-	0.016	0	0.630	0.630
Log-Likelihood								
No coefficients	-192.17	-192.17	-	-	-192.17			
With variables	-175.24	-172.31	-	-	-167.92			
Chi-Square	MNL (5 d.f)	NL (10 d.f)	p-value	p-value	LCM (20 d.f)		p-value	
	33.87	39.73	0	0	48.5		0	

4.3 Elasticities

Probability weighted elasticities were estimated from the NL results (Table 7).

Table 7: Choice Elasticities with respect to weekly fuel cost of the choice in the column heading

Choice of Vehicle	Weekly fuel costs				Share
	LPG	Hybrid	Dual	Petrol	
Dedicated LPG	-1.880	0.839	0.153	1.088	0.333
Hybrid	0.746	-1.921	0.099	0.772	0.308
Dual-fuel	1.423	1.045	-2.713	1.247	0.314
Conventional petrol	1.060	0.845	0.128	-2.091	0.045

From Table 7, a 1% increase in the weekly cost of LPG fuel would result in a drop of about 1.88% in the choice for dedicated LPG vehicles, while increasing the choice for dual-fuel, conventional petrol and hybrid electric vehicle by 1.42%, 1.06%, and 0.75% respectively. Among the own-choice elasticities, the choice for dual-fuel vehicle is most sensitive to an increase in its weekly fuel cost, followed by that of conventional petrol vehicle, hybrid electric vehicle and dedicated LPG vehicle.

5. CONCLUSIONS AND EXTENSIONS

The signs and the magnitude of the parameter estimates from the pilot survey should be interpreted with caution as no inference can be made at this stage due to the small sample size.

However, the early results obtained provided useful insights:

- Fuel and vehicle prices are dominant in the adoption of alternative fuel and new vehicle technologies (discrete choice model results are consistent with the stated importance of these factors in purchase decision reported by the pilot respondents);
- There are significant socio-demographic characteristics that may affect the choice of an alternative fuel/new technology vehicle: family size seems to rule out the possibility of conversion to LPG due to boot space restrictions; numbers of paid hours (proxy for income) affect the choice for a more expensive

technology such as the hybrid electric vehicle. This suggests that financial incentives would encourage the adoption of hybrid vehicles;

- Attitudinal factors such as environmental concern were found statistically significant in the model. Therefore increasing awareness about energy security issues and the adverse environmental impact of the use of internal combustion engines and petrol may spur the transition to more fuel efficient vehicle technologies and fuels.
- Factors that were mentioned as important by the respondents when purchasing a car but omitted in the pilot survey were noted and will be included in the full deployment of the survey. Further improvements with the presentation will also be taken into account.

Although this study focused on stated preference (SP) data only, there are limitations to using such data which can be avoided by combining revealed preference and stated preference data. The latter method is being increasingly used and has proved to enhance SP data. In future research, combined RP/SP method will be employed.

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Appendix

SURVEY ON THE IMPACT OF FUEL PRICES ON THE NEW VEHICLE PURCHASE DECISION

Aim of this survey: To assess the impact of fuel prices on your decision to purchase a NEW vehicle

Imagine a situation where you are deciding upon buying a new car. You are not under any particular time pressure and therefore have adequate time to evaluate various options available. Consider the following four types of vehicles:

- Conventional petrol
- Dual-fuel (LPG/Petrol)* [*LPG-Liquefied Petroleum Gas]
- Dedicated LPG
- Petrol hybrid-electric

For the purpose of this survey, we assume that maintenance and insurance costs are equal for all vehicles.

Below is some information about the different types of vehicles:

	Engine type	Fuel used	No. of fuel tanks	Location of extra tank	Environmental benefits compared to conventional petrol vehicle
Conventional Petrol	Internal combustion engine	Petrol	1	-	-
Dual-fuel (LPG/Petrol)	Internal combustion engine	LPG or Petrol	2	-In the boot (cars) -Under the vehicle (4-wheel drives)	If using LPG: *20% less ozone forming potential *10%-15% lower greenhouse gases emissions *80% less toxic pollutants
Dedicated LPG	Internal combustion engine	LPG	1	-	*20% less ozone forming potential *10%-15% lower greenhouse gases emissions *80% less toxic pollutants
Petrol hybrid-electric	Internal combustion engine with a battery and an electric motor	Petrol	1	-	*90% reduction in smog forming pollutants *50% reduction in carbon dioxide emissions

This survey is divided in 3 parts:

1. Information about your current vehicle
2. The scenarios**
3. Additional information about you

In each given scenario, please choose the vehicle you are **most likely to purchase.

Calculations of weekly fuel costs given are based on the assumption that the average distance travelled per year is 14,500 km (approximately 280 km per week or 40 km per day).

Thank you for taking the time to participate in this survey. Your responses will be held in confidence.

Part 1- Information about Your Current Vehicle

1. Do you currently own a vehicle?

No Yes

2. If you have answered yes to the above, which type of vehicle do you own?

Small car Mid-size sedan Large sedan 4-wheel drive Other

3. How did you acquire your current vehicle?

Purchased new Purchased used

4. Which fuel do you currently use?

Petrol LPG Diesel Other (Please specify).....

5. What is your weekly approximate petrol expenditure?

.....

6. How many km do you drive in a week?

.....

7. How often do you drive outside the metropolitan area?

Once per week

Once-Twice per month

Once in a year

Two-Five times in a year

More than five times in a year

Not at all

Part 2 - Scenarios


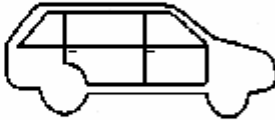
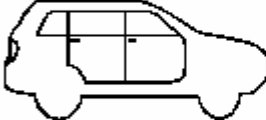
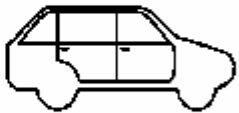
Scenario 1

Please compare the four alternatives below and select only the one that corresponds to your choice.

Petrol price is \$1.20.

LPG price is \$0.50.

Four out of ten service stations outside the metropolitan area carry LPG.

<input type="radio"/> Alternative1 Mid-size sedan Dedicated LPG	<input type="radio"/> Alternative2 Large wagon Hybrid	<input type="radio"/> Alternative3 4WD Petrol	<input type="radio"/> Alternative4 Mid-size wagon Dual
			
Number cylinders: 4 Boot space (seats up): 450 L	Number cylinders: 4 Boot space (seats up): 550 L	Number cylinders: 4 Boot space (seats up): 650 L	Number cylinders: 4 Boot space (seats up): 380 L
Purchase price: \$28,000	Purchase price: \$42,000	Purchase price: \$40,000	Purchase price: \$25,000
Weekly fuel cost: \$14.30	Weekly fuel cost: \$21.80	Weekly fuel cost: \$40.30	Weekly fuel cost: \$17.60


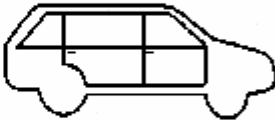
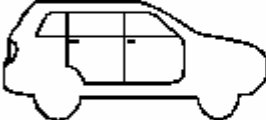
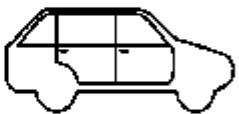
Scenario 2

Please compare the four alternatives below and select only the one that corresponds to your choice.

Petrol price is \$2.00.

LPG price is \$0.70.

Eight out of ten service stations outside the metropolitan area carry LPG.

<input type="radio"/> Alternative1 Mid-size sedan Dedicated LPG	<input type="radio"/> Alternative2 Large wagon Hybrid	<input type="radio"/> Alternative3 4WD Petrol	<input type="radio"/> Alternative4 Mid-size wagon Dual
			
Number cylinders: 4 Boot space (seats up): 450 L	Number cylinders: 4 Boot space (seats up): 550 L	Number cylinders: 4 Boot space (seats up): 650 L	Number cylinders: 4 Boot space (seats up): 380 L
Purchase price: \$28,000	Purchase price: \$42,000	Purchase price: \$40,000	Purchase price: \$25,000
Weekly fuel cost: \$20.00	Weekly fuel cost: \$36.40	Weekly fuel cost: \$67.20	Weekly fuel cost: \$24.70

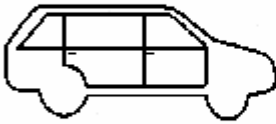
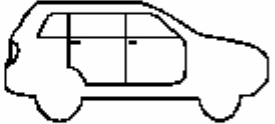
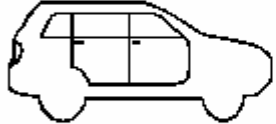

Scenario 3

Please compare the four alternatives below and select only the one that corresponds to your choice.

Petrol price is \$1.60.

LPG price is \$0.60.

Eight out of ten service stations outside the metropolitan area carry LPG.

<input type="radio"/> Alternative1 Large wagon Dedicated LPG	<input type="radio"/> Alternative2 4WD Dual	<input type="radio"/> Alternative3 4WD Hybrid	<input type="radio"/> Alternative4 Large sedan Petrol
			
Number cylinders: 4	Number cylinders: 6	Number cylinders: 4	Number cylinders: 4
Boot space (seats up): 550 L	Boot space (seats up): 580 L	Boot space (seats up): 650 L	Boot space (seats up): 550 L
Purchase price: \$27,000	Purchase price: \$34,000	Purchase price: \$41,000	Purchase price: \$30,000
Weekly fuel cost: \$21.30	Weekly fuel cost: \$28.20	Weekly fuel cost: \$38.10	Weekly fuel cost: \$35.30

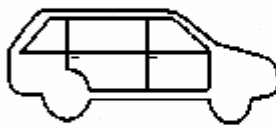
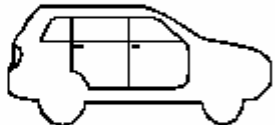
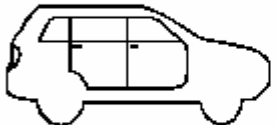

Scenario 4

Please compare the four alternatives below and select only the one that corresponds to your choice.

Petrol price is \$2.00.

LPG price is \$0.70.

Four out of ten service stations outside the metropolitan area carry LPG.

<input type="radio"/> Alternative1 Large wagon Dedicated LPG	<input type="radio"/> Alternative2 4WD Dual	<input type="radio"/> Alternative3 4WD Hybrid	<input type="radio"/> Alternative4 Large sedan Petrol
			
Number cylinders: 4	Number cylinders: 6	Number cylinders: 4	Number cylinders: 4
Boot space (seats up): 550 L	Boot space (seats up): 580 L	Boot space (seats up): 650 L	Boot space (seats up): 550 L
Purchase price: \$27,000	Purchase price: \$34,000	Purchase price: \$41,000	Purchase price: \$30,000
Weekly fuel cost: \$24.90	Weekly fuel cost: \$32.90	Weekly fuel cost: \$47.60	Weekly fuel cost: \$50.40



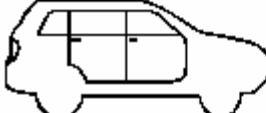
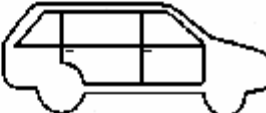
Scenario 5

Please compare the four alternatives below and select only the one that corresponds to your choice.

Petrol price is \$1.60.

LPG price is \$0.60.

Four out of ten service stations outside the metropolitan area carry LPG.

<input type="radio"/> Alternative1 Large sedan Hybrid	<input type="radio"/> Alternative2 Mid-size wagon Petrol	<input type="radio"/> Alternative3 4WD Dedicated LPG	<input type="radio"/> Alternative4 Large wagon Dual
			
Number cylinders: 4	Number cylinders: 4	Number cylinders: 4	Number cylinders: 4
Boot space (seats up): 550 L	Boot space (seats up): 450 L	Boot space (seats up): 650 L	Boot space (seats up): 480 L
Purchase price: \$41,000	Purchase price: \$29,000	Purchase price: \$32,000	Purchase price: \$29,000
Weekly fuel cost: \$21.60	Weekly fuel cost: \$40.30	Weekly fuel cost: \$25.50	Weekly fuel cost: \$23.50




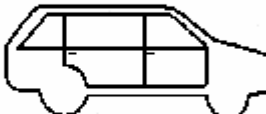
Scenario 6

Please compare the four alternatives below and select only the one that corresponds to your choice.

Petrol price is \$1.20.

LPG price is \$0.50.

Eight out of ten service stations outside the metropolitan area carry LPG.

<input type="radio"/> Alternative1 Large sedan Hybrid	<input type="radio"/> Alternative2 Mid-size wagon Petrol	<input type="radio"/> Alternative3 4WD Dedicated LPG	<input type="radio"/> Alternative4 Large wagon Dual
			
Number cylinders: 4	Number cylinders: 4	Number cylinders: 4	Number cylinders: 4
Boot space (seats up): 550 L	Boot space (seats up): 450 L	Boot space (seats up): 650 L	Boot space (seats up): 480 L
Purchase price: \$41,000	Purchase price: \$29,000	Purchase price: \$32,000	Purchase price: \$29,000
Weekly fuel cost: \$18.50	Weekly fuel cost: \$30.20	Weekly fuel cost: \$21.30	Weekly fuel cost: \$19.60

Part 3 – Additional Information About You

14. What is your gender?

- Male Female

15. What is your marital status?

.....

16. How many dependents do you have?

.....

17. What is your country of permanent residence?

- Australia Other

18. How many paid hours do you work in a week?

.....

19. Which, if any, of the following have you done in the past six months, or do you plan on doing in the near future, to reduce petrol expenditures? (Please tick one or more)

- Drive less
 Walk or bike
 Purchase more fuel-efficient vehicle
 Carpool
 Begin or increase use of public transport
 Cancel a vacation trip
 None of the above
 Other (Please specify).....

20. Looking ahead to six months from now, do you think petrol prices at that time will be:

- Higher than they are today
 About the same
 Lower than they are today
 No opinion

21. Generally speaking, how serious of a threat do you think the issues of global warming and pollution is today? (Please tick one only)

- Very serious Somewhat serious Not too serious Not serious at all Don't know

22. From the day you acquire a new vehicle, how many years do you plan on keeping it?

- 1-5 years 6-10 More than 10 years

23. Which factors do you consider to be very important in influencing decisions to try a new fuel?

- How safe the fuel is for drivers and passengers
The cost of the fuel
How far you can drive before refuelling
The cost of the vehicle
The convenience of refuelling
Environmental emissions
How the new fuel system affects passenger and cargo space
Other (Please specify).....

24. Before you completed this survey, how much did you know about the petrol hybrid-electric vehicle?

- A great deal Some Very little Nothing Don't know

25. Now that you have completed this survey, how much MORE do you know about the petrol hybrid-electric vehicle?

- A great deal Some Very little Nothing Don't know

26. Before you completed this survey, how much did you know about LPG vehicles?

- A great deal Some Very little Nothing Don't know

27. Now that you have completed this survey, how much MORE do you know about LPG vehicles?

- A great deal Some Very little Nothing Don't know

28. Would you be interested in having more information about the environmental impacts of new cars?

- Very interested
Moderately interested
Little interested
Not interested
Don't know