

Market Research Report:
**The Demand for Retrofitted Electric Hybrid Vehicles in
Adelaide**

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1. Introduction and background

The University of South Australia's Institute for Sustainable Systems and Technologies is investigating the technical feasibility of fitting an electric drive system to existing motor vehicles to create an electric hybrid vehicle. The purpose is to offer an alternative to a factory made electric hybrid vehicle, such as the Toyota Prius.

The Institute requires information about the likely market potential for an electric hybrid conversion service to support an application for funding for prototype development. The specific objectives of this market evaluation exercise are to:

1. identify the characteristics of potential market segments for this type of service
2. understand the purchase decision making process relating to this service
3. identify possible motivations leading to purchase
4. identify possible barriers to purchase/adoption
5. estimate the likely adoption of this innovation

Market information was obtained using a multistage process. This was designed by Peter Balan and Dr Dennis List, and was carried out by 89 University of South Australia students who were enrolled in the undergraduate course "Entrepreneurial Marketing for New Ventures". Peter Balan (Course Coordinator and lecturer) delivered this course as a general elective in the winter study period for students from across the University. Whereas in the past students were able to select their own business idea for which they would write a marketing plan as a team of three or four, for this course delivery all students were required to contribute to the electric hybrid conversion project. Sections of the course were tailored to address the needs of this project.

Ethics approval was obtained from the University of South Australia for this project. Students were allocated into teams of three or four, and each team was allocated to carry out one of the following market information gathering activities:

- secondary data collection
- qualitative research
- quantitative survey

Each team was required to write a short summary of the outcomes of their market information gathering activity, and the summaries were made accessible to all students through the course website.

Students also took part in a Scenario Network Mapping exercise. They were given access to the results of each market information gathering activity, and used these as inputs to their team marketing plans. In total, 23 separate marketing plans were written for the electric hybrid conversion project. These team reports represented 40% of the assessment for the course for each student.

There has been very little consumer research carried out to identify the barriers to adoption of alternative powered motor vehicles. For example, Byrne and Polonsky (2001) review the limited literature on impediments to consumer adoption for this type of product, but provide very little guidance in the area of buyer behaviour. Sartzentakis and Tsigaris (2005) use economic modelling to estimate adoption of low emission technologies, but this ignores buyer behaviour. Although there have been some theses that address this area (Williams 2004; Mau 2005), these do not explicitly explore consumer behaviour towards electric hybrid as an alternative to conventional internal combustion engines.

There have been a number of industry reports that address alternative fuels and power systems for motor vehicles. For example, the McKinsey Quarterly speculated on the longevity of the internal combustion engine (Ealey & Mercer 2002), the European Union published a report reviewing trends in alternative technologies (ESTO 2003), Struben (2004) examines challenges facing hydrogen vehicles in the US, and May (2004) reviewed the potential in Europe for alternative technologies in general. More recent articles have explored the potential for electric hybrid vehicles in particular (Carr-Ruffina & Acheson 2007; Nathanson 2007). However these reports do not investigate in detail the purchasing behaviour of potential customers for alternative technologies, and for electric hybrid vehicles in particular. There is currently a large amount of press and magazine information about electric hybrid vehicles, reflecting the increasing interest in this field.

Acknowledgement

The authors acknowledge the contributions of the 89 University of South Australia students in gathering market information and in taking part in the Scenario Network Mapping exercise as part of the course "Entrepreneurial Marketing for New Ventures", that was delivered in July - August 2007 (and whose names appear in Appendix 5). However, the opinions, comments and conclusions in this report are those of the authors.

2. The electric hybrid retrofit proposal

Dr Brain Kirke and Dr John Pockett of The University of South Australia's Institute for Sustainable Systems and Technologies are investigating the technical feasibility of fitting an electric drive system to existing motor vehicles to create an electric hybrid vehicle.

This conversion could be carried out in two different ways:

- an electric motor could be fitted in place of an existing starter motor and alternator next to the engine
- electric motors could be fitted to the rear wheels of a front wheel drive vehicle

In each case, 4 to 6 deep cycle car batteries would be installed under the rear seat of the vehicle. An appropriate electronic control system would allow the conventional engine to be turned off when the vehicle is stationary so that car would start from rest using the electric drive before the petrol engine would be started. It would also allow regenerative braking to recharge the batteries. The batteries would not be recharged from an external source, such as mains electricity (as that variation of hybrid electric vehicle would be more expensive as it would require more batteries as well as more complex electronic systems).

This conversion would allow a conventional motor vehicle to perform in a similar manner to existing factory made electric hybrid vehicles, such as the Toyota Prius and the Honda Civic Hybrid, and would offer the same environmental benefits.

In particular this conversion would offer a range of benefits compared with factory made electric hybrid vehicles:

- Existing motor vehicles could be converted, thus using the current stock of motor vehicles.
- Customers could buy a cheap new vehicle of their choice and have it converted. This would give them a wider choice of vehicle styles and brands compared with the existing range of electric hybrid vehicles.
- The estimated conversion cost of about \$5,000 is much less than the current premium that is charged for factory made electric hybrid vehicles (the Toyota Prius retails for

approximately \$37,000 – approximately 50% more than the comparably equipped Toyota Corolla).

Dr Kirke gave the students two technical briefings, and he and Dr Pockett provided background materials on the technical aspects of the conversion project.

3. Methodology of this study

The course content was tailored to meet the needs of the electric hybrid conversion project. In particular, lectures and workshop sessions addressed each of the activities discussed below. In addition, they were given classroom simulation exercises to prepare them to carry out the interviews, and very detailed guidelines were prepared for the students and made available through the course website. In this way, students were given a great deal of guidance to help them understand and apply the approaches to be used.

3.1 Secondary research methodology

Two teams were allocated to gather secondary data. As a starting point, they were given access to a range of secondary materials that had been identified by the lecturer. These teams were given two weeks to collect background information on the market for electric hybrid vehicles, as well as other related information, using as wide a range of sources as possible. Each team produced a summary of their work, using a template that was provided by the lecturer. These summaries, including a list of references, were placed on the course website, and were thus available to all of the students in the class. The summaries formed part of the assessment for this course.

3.2 Qualitative research methodology

Six teams were allocated to carry out interviews with four separate groups, each made up of three target customers. Four teams were allocated to carry out in-depth interviews with 10 individual target customers. One team was allocated to carry out in-depth interviews with 6 managers of motor vehicle fleets.

Teams were given two weeks to carry out these interviews. During this time, workshops were scheduled to discuss key aspects including recruitment of the participants and the management of interviews. Students were given very detailed guidelines including specifications for the profile of participants. Each team produced a summary of their work, using a format that was provided by the lecturer. These summaries were placed on the course website, and were thus available to all of the students in the class. The summaries formed part of the assessment for this course.

3.3 Survey methodology

Dr List and Peter Balan developed a survey questionnaire, based on the results of the secondary research and the qualitative interviews. This was a personal interview survey, to be carried out face to face. Student teams practised carrying out these interviews among themselves before interviewing members of the public.

The remaining 11 teams were then given 10 days (including two weekends) to each survey 20 individual target customers. The population sampled was drivers in the Adelaide metropolitan area, between Grand Junction Road in the north, O'Halloran Hill in the south, and excluding eastern parts of Adelaide beyond the Hills face (in the postcode areas 5000 to 5098). The reason for this boundary was that people living beyond this central metropolitan

area would have less financial gain from using a hybrid car, because the qualitative interviews indicated that it is inside this area that stop-start driving is most prevalent (with heavier traffic volumes and many intersections with traffic lights).

Students were given detailed guidelines for sampling within this boundary, and were given quotas, based on gender, age group and employment status, using these three factors in a quota sampling matrix. Within those quotas, location of interviews was left to the students. Venues for the survey included private homes, in the vicinity of parking areas, public transport stops, and other public places.

Teams were provided with an Excel spreadsheet into which they entered their data. These spreadsheets were consolidated by Dr List who cleaned up the data and provided SPSS output in the form of frequencies for the whole sample (212 participants) and for the 36 participants that indicated a greater than 30% probability of buying the conversion service. Each team produced a summary of the surveys that their team had carried out, using a format that was provided by the lecturer. These summaries were placed on the course website, and were thus available to all of the students in the class (together with the SPSS outputs described above). The team summaries formed part of the assessment for this course.

3.4 Scenario Network Mapping methodology

Dr List introduced the students to Scenario Network Mapping in one of the lectures and exercise sessions that was delivered as part of the course. This approach was presented as a systematic and practical method for developing the sales forecasts for the first year of operation of this new service. All students were invited to take part in a practical exercise that was conducted during one of the optional workshop sessions for this course. They were given guidelines on this approach as well as starting points for the workshop exercise; this information was provided through the course website and was therefore available to all students.

Dr List conducted this workshop session when all of the market information gathering activities had been carried out, and all of the results described above had been made available to students through the course website.

Students were allocated into workshop teams of three or four and were provided with butcher's paper and post-it notes. Teams were allocated to develop five possible general outcomes for this project; a huge success, a limited public success, a limited fleet success, a "slow death", and a "quick death". As only two hours was available to carry out this exercise, it was possible to only make a start on this exercise (a business would typically take at least a full day to do this). Dr List and Peter Balan subsequently developed scenario network maps for each of the five general outcomes listed above, using some of the materials generated in this workshop. The five maps were then posted on the course website, and were thus made available to all students in the class.

3.5 How this information was used

It was explained to students, during the lecture and workshop sessions, how they could use the information collected using these different approaches to write their individual team marketing plans. All the results collected were made available through the course teaching website, and students were advised when new sets of information were posted.

The value of this approach for the students is that they were introduced to a range of important market information gathering activities, and contributed to a professionally designed and managed market research exercise. They were also given access to a very

comprehensive range of market research summaries and outputs. This was a significant improvement over the previous approach in this course, where each team had investigated its own business idea, and had access only to its own secondary data collection and the information contained from carrying out 20 consumer interviews exploring their concept.

4. The adoption model

Questions in the survey were based on a model which the authors developed as a series of plausible routes through which consumers (whether individual or fleet) might come to purchase a hybrid conversion.

The model proposed three main sets of reasons for which consumers might be interested in buying a hybrid conversion:

- A1. Propensity to buy innovative products and services
- A2. Altruistic interest in preserving and enhancing the environment
- A3. Propensity to make money-saving investments

The more strongly that people concurred with all three of these sets of reasons, the more likely it would be (according to this theory) that they would purchase a hybrid conversion or competing product. The competing products identified were:

Hybrid vehicles

- B1. New hybrid car
- B2. Hybrid conversion of existing vehicle

Other competitors

- B3. LPG conversion
- B4. Diesel powered new vehicle

Those who would be mainly interested in the hybrid conversion were hypothesized to be (as well as meeting most of the reasons A1 to A3, above)

- C1. Unable to afford new hybrid car, or
- C2. Want a type of vehicle not available in hybrid format (e.g. small delivery van, or a particular style of passenger vehicle)

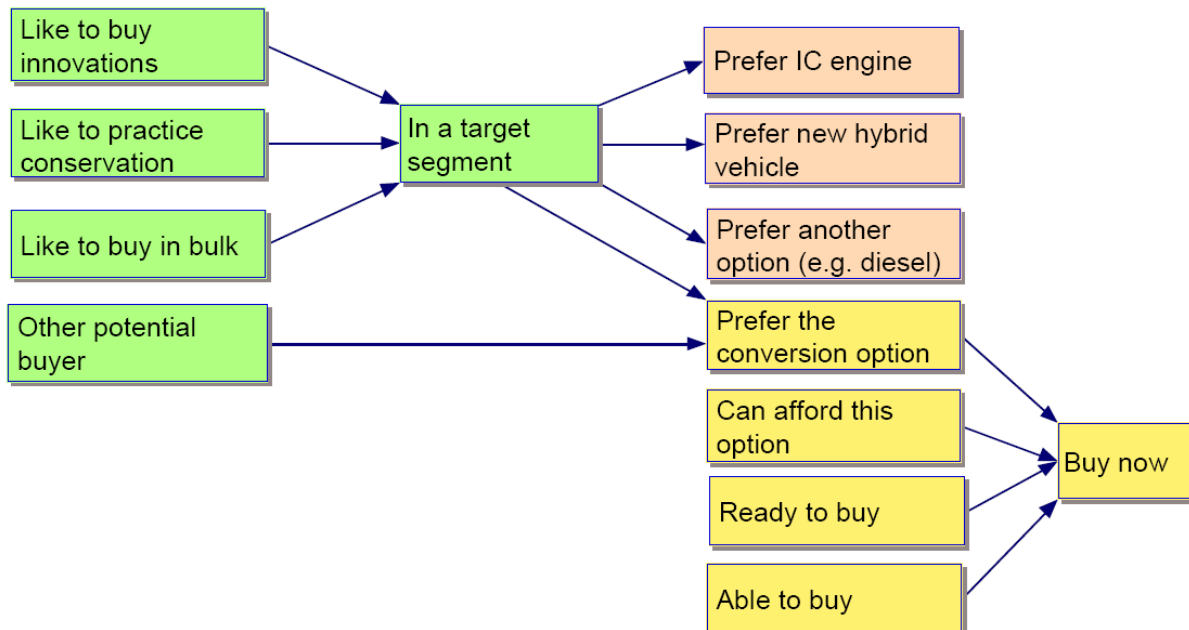
Having passed all those hurdles, the next was the time frame of proposed purchase. For this business idea to be viable, there would need to be a substantial number wanting to buy within the next few years. Therefore the next set of criteria covered readiness to buy:

- D1. Willing and able to buy soon
- D2. Willing to buy soon, but not able, due to
 - need to convince others
 - lack of funds
 - lack of priority
- D3. Interested, but need more information

Thus the group focused on is those who have a high score on A1 to A3 combined,
AND
express a high probability of purchase of a hybrid conversion of existing vehicle (B2)
AND
meet criteria C1 or C2
AND
are willing and able to buy soon (D1)

Each of these criteria was measured using a question (or group of questions) in the survey questionnaire.

The model is shown below:



The adoption model used for this research.

5. Findings

Findings are presented in this sequence: the most relevant data from secondary research, the qualitative study, the survey, and the finally the scenario network mapping.

5.1 Secondary Research

When the students engaged in the secondary research, using published sources, a vast amount was found. To keep this report concise and relevant, the only secondary research cited here is that which is strictly relevant to the current hybrid car retrofit proposal and the South Australian market.

Teams gathered a range of secondary data under the following categories:

- the market (its definition, size, location and growth trends)
- industry conditions (barriers to entry, substitutes, industry profitability)
- competition
- general business environment trends

The major observations and conclusions are summarised briefly under these headings.

5.1.1 The Market

- the market was defined as an electric hybrid conversion service for passenger vehicles located in Adelaide, South Australia.

- This market is considered to be at the embryonic stage of growth
- there were 449,153 private cars registered in March 2006 in the Adelaide area (postcode areas 5000 to 5098) (ABS 2006).
- The adoption of electric hybrid cars in Australia has lagged behind other countries. There are only two models of hybrid cars readily available at the moment; the Toyota Prius (that retails for about \$37,000) and the Honda Civic (that retails for about \$32,000). General Motors and Ford in Australia are investigating hybrid technology, but have no plans to introduce hybrid vehicles (Hinchcliffe 2007).
- in the United States, hybrid cars were said to represent 4.8% of the market share of new motor vehicles sold in 2005, with an expected increase to 11% in 2012. It is also estimated that by that time there will be over 40 models of hybrid vehicle available in the US market (www.hybridcars.com)

5.1.2 Industry Conditions

- This sector has relatively high barriers to entry, particularly for the first entrant. This suggests that profitability would initially be attractive (the Toyota Prius sells at a significant premium over a similarly sized motor vehicle). However, this initial profitability is likely to attract a significant number of competitors as the market continues to grow rapidly. Profitability is therefore likely to decrease over time.

5.1.3 Competition

Competitors to the electric hybrid conversion service can be considered to be:

- Diesel powered cars, as these are more economical than petrol engined cars.
 - However, diesel engines by themselves do not give the same fuel economy as a hybrid vehicle, so could be considered as part of an electric hybrid combination.
 - There is concern with the emission of pollutants from diesel engines.
- LPG powered vehicles
 - in March 2006, only 7,744 or 1% of all vehicles registered in the Adelaide Statistical Division were powered by LPG or by dual fuels. (ABS 2006).
 - In August 2006, the Federal government introduced a national "LPG Vehicle Scheme" to subsidise the conversion of an existing motor vehicle (by \$2000) or the purchase of a new motor vehicle with an LPG unit fitted (by \$1000). In the first full year of operation 72,582 conversions and 688 new vehicles were subsidised. This represents a taxpayer subsidy of almost \$146 million in one year to that industry sector. (AusIndustry 2007).
- Factory-made electric hybrid vehicles, such as the Toyota Prius. in the last few months there has been a regular stream of news items relating to new models of electric hybrid concept vehicles being launched internationally. For example:
 - Volvo launched its ReCharge Concept at the 2007 Frankfurt motor show. This is a plug-in hybrid with a battery-only range of 100 km and a 1.6 L engine that runs on ethanol fuel as a backup it has an electric motor at each wheel and the batteries can be recharged in three hours from the mains. Volvo claims that running costs can be as low as 20% of the similar petrol model. ("The Australian", Sep 8, 2007, page 43)
 - Citroen launched the C-Cactus at the 2007 Frankfurt motor show. This is a diesel electric hybrid. ("The Australian", Sep 8, 2007, page 43)
 - Toyota has teamed up with the French utility EDF to set up an electricity distribution system to serve plug-in electric vehicles. Toyota has launched this type of vehicle in Japan. A plug-in vehicle promises "to deliver a longer driving range and lower running costs than the current hybrid cars". ("The Australian", Sep 3, 2007, page 35)
 - General Motors launched the diesel-electric hybrid Opal Flexstreame concept car at the 2007 Frankfurt motor show. The same company displayed the gas

- engine electric hybrid Chevrolet Volt at the Detroit motor show in January 2007. ("The Australian", Sep 3, 2007, page 35)
- in June 2007, Ford announced a pilot of 20 Ford Escape SUVs fitted with batteries that would be recharged by Southern California Edison in the US. ("The Australian", Sep 3, 2007, page 35)
- Associated Press reported that the Toyota Prius has sold more than one million vehicles worldwide and that GM plans to introduce four new electric hybrid models in the next year (<http://www.msnbc.msn.com/id/19088667/>)
- Similar conversion services. There do not appear to be any in Australia. However, a Google search using the terms "hybrid electric retrofit" resulted in 380,000 references, including a business in the US that provides parts for conversions (www.enovasystems.com)

5.1.4. General business environment trends

- There is a general increase in community awareness of climate change and of the desirability to take action to reduce fuel consumption, and this is driving an increase in demand for alternative fuels
- There is extensive research being carried out to improve the storage capacity of batteries to improve the performance characteristics of electric and electric hybrid vehicles, as reported by Associated Press (<http://www.msnbc.msn.com/id/19088667/>)

Overall, the secondary data indicated that this is a market in its embryonic/early growth stage in Australia, that there is considerable product proliferation on the way, that the major motor vehicle manufacturers are planning to introduce vehicles into this market, and there are already businesses providing parts for electric hybrid conversions.

5.2 Qualitative research findings

5.2.1 Interviews with consumers

Four student teams carried out in-depth one-on-one interviews (a total of 40 participants), and six student teams carried out in-depth interviews with groups of three consumers (a total of 96 participants).

Most people expected that petrol prices would increase but would stay under the \$2 per litre level.

Overall, most people were aware of electric hybrid vehicles, although they had little knowledge about how these vehicles operate. The general perception was that these are good for the environment and that they save money by reducing fuel costs. However, a number thought that electric hybrid vehicles were slow and did not perform as well as conventional petrol cars. In addition, most people thought that these vehicles are very expensive in comparison to conventional cars of similar size and features.

A number of those interviewed thought that the idea of a conversion service was an interesting one. They would be interested in this option on account of perceived environmental benefits and the savings from reduced fuel costs.

A significant proportion consider that this would be an expensive exercise, and this would discourage purchase. Price estimates of a conversion ranged up to \$10,000, but averaged about \$5,000. A number considered that the fuel cost savings would not compensate for the cost of conversion. There was an opinion that this concept would need government support, along the lines of existing support for LPG conversion. If people were to buy a new car, it would be a small fuel-efficient vehicle for city driving. A proportion also said that they would

not convert their existing car but would wait until they purchased a new car. Nevertheless, some people appreciated that the conversion would cost less than buying a factory hybrid car.

Some participants wished to have more information on how the conversion would work and the effects on their car. In particular, some were concerned about the compatibility of the conversion with the technology already in their car. Some would not consider a conversion until it became popular. They would also want mechanics to know about and be confident with the fitting and maintenance of the conversion, for them to have confidence in this product.

In summary, the major barriers to purchase appeared to be the perceived expense of the conversion, doubts about the technology, and concerns about after sales service.

5.2.2 Interviews with Fleet Managers

One student team carried out interviews with six managers of motor vehicle fleets, including a taxi company, private and public medical companies, a Federal government department, and a statewide car leasing business. Estimates of the conversion cost were around \$5,000.

The taxi company primarily used one type of vehicle which was retained for about six years and travelled an average of about 100,000 kilometres per year. Other businesses used a broad range of makes and models which were retained for two to three years, and travelled an average of about 20,000 km per year.

There was general reservation about the conversion service which was perceived as a new, untried technology, and most respondents would prefer a factory fitted conversion, due to perceived higher reliability and warranty issues (which was similar to their perception regarding LPG conversions). There was concern about resale value of the converted fleet vehicles. Most fleet managers would be unwilling to consider a conversion without an initial trial (preferably free). It was noted that federal and state government fleets need to meet environmental guidelines; for example a Federal fleet must have 28% of vehicles with a "green vehicle guide" score of 10.5 or higher. Several fleets already included a number of Toyota Prius vehicles.

5.3 Survey findings

This section summarizes the findings of the survey undertaken with 212 drivers in Adelaide in August 2007. From among those 212, we identified the most likely buyers as a group of 36 (17% of the total) who estimated at least a 30% chance that they would purchase a hybrid conversion within the next three years. These 36 people are labelled the "target group"

This section summarizes findings in point form, grouped as follows

1. Demographic data about respondents
2. Current vehicle and driving habits
3. Propensity for interest in hybrid cars
4. Purchase plans for next vehicle
5. Awareness of hybrid vehicles
6. Interest in purchasing hybrid vehicles

Appendix 3 contains the tables from which these findings were drawn.

5.3.1 Demographic data about respondents

The target customers were a little younger than the others – though the entire sample was a little younger than the Adelaide population of people aged 18 and over, probably because this survey was restricted to regular drivers, which would exclude some older people.

Target customers are slightly less likely to be full time workers, very likely because they were younger on the whole.

There was no different in interest level between men and women in the target group; this finding will have implications for publicity.

5.3.2 Current vehicle and driving habits

The target customers tend to have smaller cars than those who are less interested: 53% of the target customers have cars with less than 2-litre engines, while only 44% of the total sample have such cars.

Among the whole sample, 57% had sedans, 23% hatchbacks, and 20% a wide range of other vehicle types. Among the target group 36% had hatchbacks, and only 47% had sedans.

The median age of the current car was 7 years for all respondents, but markedly less, at only 5 years, for the target customers.

Among those who knew of the driven wheels (76% of all), two thirds were front wheel drive and one third rear wheel drive or four wheel drive. Target group members had a much higher proportion of front wheel drive cars.

Patterns of driving were divided evenly between “stop-start city driving, less than 10km per trip”, and “longer trips, 10-30km, mainly around Adelaide”.

The median weekly petrol spending was \$35 to \$40 for both groups.

The median residential distance from the city centre among the whole sample was about 6 to 7 km, while for the target customers it was a little closer - just over 5km.

The median daily travel distance for the whole sample was 20km. For the target group it was a little less, at 18km.

5.3.3. Propensity for interest in hybrid conversion

This section provides data to test the Adoption Model set out in Section 4 above.

Respondents were asked about four innovative purchases: GPS navigation, a solar power system, a PDA, and digital TV. 50% of the total sample and 64% of the target group owned at least one of these.

They were then asked about four conservation-related activities: having a small or fuel-efficient car, using public transport more, riding a bike, and using “green” electricity. 64% had done at least one of these activities. There were no significant differences between the whole sample and the target group on these conservation activities.

The third area asked about that was believed to be related to propensity to buy a hybrid car was spending money upfront to save costs later (a “saving money” motivation). Three

options were offered: reregistering a car for a full year, buying groceries in bulk, and using discount petrol vouchers. 82% of the total sample and 94% of the target group had engaged in at least one of these activities, which suggests the criteria used were too weak.

The target customers were less likely than others to reregister their car for a full year, but made greater use of discount petrol vouchers. On the whole, there were no substantial differences between the two groups in this area.

To summarize the differences between the target customers and the three sets of reasons in the Adoption Model proposed in Section 4 above, the model was not strongly supported at all. The only set of behaviours that indicated high interest in a hybrid conversion was in the area of innovative purchases – but not in conservation behaviour or bulk buying – at least on the small number of variables asked about in this questionnaire. In fact, the most likely buyers of the hybrid conversion were clearly less interested in conservation behaviour than were those people expressed a lower probability of buying the hybrid conversion service

5.3.4. Plans for purchase of next vehicle

The median time expected till purchasing another vehicle was 3 years - i.e. in 2010.

The median amount that both groups expected to pay was \$20,000.

The median expected price of petrol in 3 years' time for both groups was \$2.00 per litre. 13% of the total sample and 17% of the target buyers expected it to be more than \$2.50 per litre.

5.3.5 Awareness of hybrid vehicles

78% of the total sample and 75% of likely buyers said they had heard of hybrid cars. Though the difference between the two groups was not significant, it was a little surprising that target buyers were slightly less likely to have heard of hybrid cars than others in the sample.

Those who had heard of electric hybrid cars were asked to name any electric hybrid car on the market in Australia; 62% named the Toyota Prius, while other models were mentioned by far fewer.

When people who had heard of electric hybrid cars were asked "Do hybrid cars need to be plugged into a power point for recharging? 37% of all gave the correct answer of "No" (correct in Australia, that is, at the moment). Once again, the target customers were not as well informed as the others in the sample.

At this point, respondents were given a brief explanation of the hybrid car conversion proposal, and were then asked "How much do you expect it would cost for such a conversion?" The median expected cost for both groups was around \$4500, though many gave much higher estimates. The middle half of the respondents made estimates in the range between \$2500 and \$8000. Compared with the projected cost of \$5000, a median of \$4500 was much closer than in many surveys in which likely customers are asked to estimate costs.

5.3.6. Purchase intentions for hybrid cars

When asked for reasons why they might buy a hybrid car, or get their current car converted, compared with the whole sample, the target customers were marginally more interested in "liking to try new things" (though the difference between 5% and 8% was not statistically

significant), less interested in conserving the environment, but more interested in saving money on running costs.

Respondents were then asked for reasons why they might not buy a hybrid car, or get their current car converted. The most common reasons were:

Too expensive	54%
Don't know enough about them – too new	29%
Doubtful about resale value	13%
Doubtful about reliability or maintenance	18%
Prefer rival energy source, e.g. LPG or diesel	7%
Other doubts	15%

Total >100% due to multiple responses

By combining reasons for buying and for not buying a hybrid, a net number of reasons was calculated. More negative than positive reasons were given.

When asked to nominate their estimated probability of buying a new hybrid car in the next 3 years, the median probability for all respondents was 7%; for target customers 30%. It should be strongly stressed that this probability estimate was the result of only a brief interview, in which some respondents would have been trying to please the interviewer by giving optimistic estimates, and that many other factors are likely to intervene in the next three years – for example, a possible drastic reduction in cost.

When asked their estimated probability of converting current car to hybrid power in next 3 years, the following results were obtained.

	% of all	% of likely
0 chance	51	0*
1% to 9% chance	18	0*
10% to 29%	19	0*
30% to 49%	10	44
50% or more	2	56
Total	100%	100%
Valid responses	211	36

* These 3 figures are zero, because this is the question on which the target group was defined; i.e. 30% or more stated probability of converting their existing car to hybrid power.

The median probability for all respondents was 0%; for target customers it was 45%. The same strictures apply as above: that these probabilities were given at a particular point in time, and in response to a particular interview situation. However, the fact that 17% of this sample of Adelaide drivers expressed fairly positive conversion intentions reflects a large number of drivers in the entire population. With the break-even level presumably low – as the technology is available almost off the shelf – it seems that the proposal should be commercially viable – subject, of course, to other relevant developments.

5.4 Scenario network mapping: likely trajectories

From the secondary research, the qualitative research, and the survey, we identified five possible scenario trajectories. (These are summaries of the scenario network maps.) The five trajectories were:

Trajectory 1. Huge success

This would result in a national franchise conversion service being developed within a few years. A large budget would be needed initially for marketing to prospective franchisees, for training in conversion methods, and bulk-buying of components. Such success would require early support from government, including an equivalent of the LPG conversion subsidy. This huge success will probably not happen without a large and apparently irreversible increase in petrol prices, to around double the present level within several years. Issues relating to warranties, insurance, etc, would need to be resolved quickly. Customers would mainly be commuters in central-city areas.

Trajectory 2. Limited public success

This would apply only within Adelaide, without spreading interstate. There would be a small group of specialist converters scattered across Adelaide. An important element here would be state government support, and major agencies leading by example, e.g. with clear identification of the converted cars. This outcome would require a large and seemingly permanent increase in petrol prices.

Trajectory 3. Limited fleet success

Following a moderate and sustained increase in petrol prices, fleet operators in Adelaide would adapt their vehicles using hybrid conversions. This would apply particularly to types of vehicle that are not currently being offered in hybrid form – small delivery vans, taxis (and vehicles that could serve as taxis – not necessarily the handful of existing models), and metropolitan buses. With fleets, it is anticipated that mostly brand-new vehicles would undergo the conversion.

Trajectory 4. Slow death

With this model, hybrid car conversions would begin with an initial flurry of interest, but tail off within a few years for reasons such as lack of increase in petrol price, a high rate of mechanical problems following the conversion (leading to bad press), poor resale value, and car manufacturers introducing a wider range of hybrid models and decreasing prices on existing models.

Trajectory 5. Quick death

This would result from lack of government action, inability to convince stakeholders of the value of the proposal, lack of funding for publicity, inability to demonstrate the theoretically stated efficiency gains, and no increase in petrol prices.

The more detailed scenario maps in Appendix 2 show the above trajectories in graphical form.

6. Discussion and conclusions

Although 17% of those interviewed gave greater than 30% probability of buying the electric hybrid conversion service within 3 years, this response was based on the participants having a limited amount of information on this new service (with which they would have not been familiar). There would be a long process between the interview and actual purchase, and several barriers to purchase would need to be overcome (as detailed in the qualitative and quantitative research results).

In addition, actual purchase would depend on a range of events in the external environment, such as the introduction of a government incentive scheme to support this conversion process. For this reason, it is more realistic to discuss possible sales estimates in relation to the scenarios that were developed as part of this project.

6.1 Sales estimate for the "huge success" trajectory

The sequence of events is similar to that for the "limited public success" trajectory, with the exception that in this situation franchise systems would need to be set up for interstate commercialisation.

However, further research would be needed in those markets. For example, a higher proportion of Sydney and Melbourne residents use public transport, and many who drive are commuting across these cities and hence driving relatively large distances, and perhaps not doing enough stop start driving to make an electric hybrid conversion viable.

6.2 Sales estimate for the "limited public success" trajectory (in South Australia)

This was the trajectory for which most data was available, as the survey covered this group, i.e. the South Australian public. We consider that the most accurate and relevant sales estimate that can be drawn from the survey data comes from a combination of Question 10 (Expected time till purchase of next vehicle) and Question 21 (self-estimated probability of buying a hybrid car conversion within three years). Considering only the 74 respondents who gave an answer of up to 3 years in Q.10, estimated probabilities were:

Probability	Count	% of all 212
Zero	38	18
1% to 25%	23	11
30%	6	3
40%	2	1
50%	4	2
80%	1	0.5

So at this stage, 5 people of the 212 surveyed gave a 50% or higher probability of making this purchase. This is 2.4% of the sample, which was designed to be representative of drivers in the central Adelaide area, defined as postcodes 5000 to 5098. We could not obtain data on drivers in this area, so have used private car registrations as a proxy (the assumption here is that each driver has one car). The Adelaide Region Vehicle Census (ABS, 2006) shows that there were 449,153 private cars registered in March 2006, or very close to 450,000. Applying the figure of 2.4% to the 450,000 cars, this represents a market of 10,800 conversions over three years. With the normal business cycle the number would be expected to steadily increase, along the lines of 2000, 3000, and 4000 sales in successive years.

Of course, as with any such projection, there are many ifs and buts: many factors could intervene between the stated intention to convert and the actual purchase, some of which (like higher petrol prices and more awareness of hybrids) would increase the conversion rate, and others which might decrease the rate (e.g. lack of official support and public awareness). However, it seems to us that there is clearly a niche market for such conversions, and that as the fixed costs of this conversion system would be relatively low, break-even could easily be achieved with much smaller sales than the above forecast indicates.

One factor which would markedly increase the take-up rate would be a government subsidy. In August 2006 the Federal government introduced a national "LPG Vehicle Scheme" (as described above in 5.1.3). In South Australia, this incentive scheme almost doubled the number of conversions, from an average of 690 per month in the period August 2005 to July 2006, to an average of 1280 per month in the period August 2006 to August 2007 (pers. comm. Baker 2007). This shows the effectiveness of this incentive scheme. A key justification for extending this subsidy to electric hybrid conversion would be that, with motors not idling when stopped, air pollution around intersections would be much reduced with the widespread use of hybrid cars.

6.3 Sales estimate for the "limited fleet success" trajectory (in South Australia)

Sales will depend totally on adoption by fleet managers, and this will depend on the effectiveness of selling activities, as well as on increases in petrol prices.

If petrol prices increased significantly, and LPG prices follow, then taxi fleets would find this option attractive, as long as conversions could be fitted to larger cars with larger boots. However, we note that the West Australian government provided a \$15,000 subsidy for ten Toyota Prius electric hybrid taxis (and there were more than that number of applications), so that government incentives could make a difference. (Perth "Sunday Times", 8 July 2007)

State and federal government fleets provide an attractive target market as governments have imposed or will impose energy conservation and sustainability requirements on these fleets.

Delivery vans may offer the greatest potential, as many of these are new, and there should be less difficulty in fitting storage batteries.

If fleets adopt electric hybrid vehicles, and they are appropriately identified (for example by bumper stickers or differently coloured licence plates) then consumer awareness will increase as people see these vehicles and demand will be stimulated in the consumer market.

Arriving at a quantitative sales estimate for this segment would require a pre-selling exercise with decision-makers.

6.4 Sales estimate for the "slow death" trajectory

In the situation there is likely to be a continuing low level of sales, retrofitting older vehicles as the major manufacturers introduce a wider range of electric hybrid vehicles at lower prices. As the conversion service is likely to have low fixed costs, it could be financially viable at small volumes. The level of activity will depend very largely on successive increases in the price of petrol.

6.5 Sales estimate for the "quick death" trajectory

This possible set of events would result in zero sales, as the conversion project would simply not get off the ground.

Appendixes

- 1 Survey questionnaire
- 2 Scenario network trajectories
- 3 Survey results in detail
- 4 References

Appendix 3 – Tables of survey results

In this appendix, each of the 25 questions in the questionnaire has findings presented – generally in the same sequence as the questionnaire.

Each table has two sets of percentages (adding vertically to 100 or more). These compare findings from the total sample of 212 with those from the 36 most likely buyers of a hybrid electric conversion. The bottom row of each table shows the number of respondents: a maximum of 212 for all respondents, and 36 for the target group.

DEMOGRAPHIC DETAILS

This section gives details of the respondents selected for the survey. Quotas were used for employment status, age group, and gender, to ensure that the sample closely matched the Adelaide metropolitan adult population. It would have been more desirable to match the sample to the Adelaide metropolitan adult population of habitual drivers, but no accurate data was available for that measure.

Age group

	% of all	% of likely
18-34	50	56
35-54	27	22
55-plus	22	22
Total	100%	100%
Valid responses	211	36

The target customers were a little younger than the others – though the entire sample was a little younger than the Adelaide population of people aged 18 and over, probably because this survey was restricted to regular drivers, which would exclude some older people.

Employment status

	% of all	% of likely
Full time worker	47	40
Part time worker	21	23
Student only	16	20
Not working or studying	16	17
Total	100%	100%
Valid responses	210	35

So target customers are slightly less likely to be full time workers, very likely because they were younger on the whole.

Gender

	% of all	% of likely
Male	50	50
Female	50	50
Total	100%	100%
Valid responses	207	36

Location of interview

Because it was not possible for this survey to use strictly random population selection, a maximum-diversity strategy was used for interview locations, which were as follows. The main location chosen was car parks and shopping centres, where drivers could easily be found.

	% of all
Car park, shopping centre	42
Café, restaurant	6
Other public place, e.g. gym, uni	8
Interviewee's home	18
Other home	10
Workplace	8
Elsewhere, e.g. bus stop	8
Total	100%
Valid responses	208

DETAILS OF CURRENT VEHICLE AND DRIVING HABITS

Q1. Make and model

(Summarized into size of vehicle)

	% of all	% of likely
Small cars (engine size up to 1.5L)	15	19
Small-medium (1.5 to 2L)	29	31
Medium (2 to 3L)	26	11
Large (3L or more)	23	22
4-wheel drive	6	8
Total	100%	100%
Valid responses	189	36

Q2. Type of vehicle

	% of all	% of likely
Sedan	57	47
Hatchback	23	36
Wagon	3	3
Sports car, coupe	8	6
Convertible	0.5	0
4WD	5	8
Van	1	0
Utility	1	0
Total	100%	100%
Valid responses	208	36

Q3. Age of current car

	% of all	% of likely
Up to 2 years	17	19
2-5 years	16	39
5.5 to 7 years	17	11
7.5 to 10 years	21	20
10.5 to 15 years	14	8
More than 15 years (max = 38)	15	3
Total	100%	100%
Valid responses	208	36

Q4. Driven wheels on current car

	% of all	% of likely
Front wheel drive	48	67
Rear wheel drive	19	11
4WD	9	8
Don't know	24	14
Total	100%	100%
Valid responses	208	36

Q5. Pattern of driving

	% of all	% of likely
Stop-start city driving, <10km/trip	48	50
Longer trips, 10-30km, mainly around Adelaide	40	42
Country driving, >30km/trip	6	6
Other pattern, or irregular	3	0
No driving	0.5	0
Stop-start plus some longer	1	3
Longer city + country	0.5	0
Total	100%	100%
Valid responses	210	36

Q6. Weekly petrol spending

	All	Target
Lowest 10%	\$15	\$20
Median	\$35-40	\$35-40
Highest 10%	\$70	\$55-60

Q23. Suburb of residence

	No. in all	% of all	% of likely
Adelaide city, CBD	16	8	3
Inner suburb, up to 5km from city	70	34	44
Middle suburb, 5-10km	68	33	33
Middle suburb, 10-20km	29	14	17
More than 20km from city	24	12	3
Total	207	100%	100%
Valid responses		207	36

Q24. Suburb commuted to

	% of all	% of likely
Adelaide city, CBD	47	49
Inner suburb, up to 5km from city	16	18
Middle suburb, 5-10km	11	12
Middle suburb, 10-20km	10	9
More than 20km from city	10	6
Various	6	6
Total	100%	100%
Valid responses	196	33

Q25. Daily travel distance

km	% of all	% of likely
Less than 5km	4	3
5-9km	10	3
10-19km	34	28
20-39km	30	46
40-79km	16	17
80km or more (max=500)	5	3
Total	100%	100%
Valid responses	196	35

PROPENSITY TO PURCHASE HYBRID CAR

Q7. Innovative purchases

	% of all	% of likely
GPS navigation	14	33
Solar power system	4	6
Palm Pilot, Blackberry, etc	13	14
Digital TV	29	22
None of these	50	36
Total	>100%	>100%
Valid responses	211	36

Percentages in each column total more than 100% due to multiple responses

Number of innovative purchases

	% of all	% of likely
0 purchases	50	36
1	40	52
2	9	11
3	0.5	0
4	0.5	0
Total	100%	100%
Valid responses	211	36

Q8. Conservation activities

	% of all	% of likely
Small or fuel-efficient car	22	28
Used public transport more	32	28
Riding a bike	12	3
Using "green" electricity	9	8
None of these	36	36
Total	>100%	>100%
Valid responses	211	36

Percentages in each column total more than 100% due to multiple responses

Number of conservation activities

	% of all	% of likely
0 activities	35	36
1	55	61
2	7	3
3	2	0
4	1	0
Total	100%	100%
Valid responses	211	36

Q9. Bulk-buying investments

	% of all	% of likely
Reregistered car for full year	39	25
Buying groceries in bulk	26	25
Using discount petrol vouchers	58	67
None of these	18	6
Total	>100%	>100%
Valid responses	211	36

Percentages in each column total more than 100% due to multiple responses

Number of bulk-buying investments

	% of all	% of likely
0 investments	18	6
1	48	75
2	26	17
3	8	3
Total	100%	100%
Valid responses	211	36

PLANS FOR PURCHASE OF NEXT VEHICLE

Q10. Years till purchase of next vehicle

	% of all	% of likely
Within 6 months	4	4
1 year	15	13
2 years	27	29
3 years	13	8
4 years	10	12
5 years	10	12
6-8 years	2	0
9 or more	19	21
Total	100%	100%
Valid responses	127	36

Q11. How much expecting to pay for next vehicle

\$	% of all	% of likely
Less than \$10 000	8	6
10 000	15	12
11 000 to 15 000	16	18
16 000 to 20 000	19	29
21 000 to 30 000	21	24
35 000 to 50 000	19	6
50 000 or more	3	6
Total	100%	100%
Valid responses	194	34

Q12. Expected price of petrol in 3 years' time

\$/litre	% of all	% of likely
Up to 1.40	10	14
1.41 to 1.50	19	17
1.51 to 1.90	18	6
2.00	26	37
2.01 to 2.50	15	9
2.51 to 4.00	13	17
Total	100%	100%
Valid responses	206	35

AWARENESS OF HYBRID VEHICLES

Q13. Heard of electric hybrid cars?

	% of all	% of likely
Yes	78	75
No, or not sure	21	25
Total	100	100
Valid responses	210	35

Q14. Can you name any electric hybrid car on the market in Australia?

Asked only of those who had heard of electric hybrid cars

	% of all	% of likely
Yes: Toyota Prius	62	56
Yes: other (Honda Civic, Lexus)	21	4
Yes: other/doubtful or wrong	4	11
Cannot name any	32	41
Total	>100%	>100%
Valid responses	165	27

Percentages in each column total to more than 100 due to multiple responses.

Number of electric hybrids named (whether correct or not)

Asked only of people who had heard of electric hybrid cars

	% of all	% of likely
0 models	32	41
1 model	50	51
2 models	18	8
3 models	1	0
Total	100%	100%
Valid responses	163	27

Again (though the difference is not statistically significant) the target customers were able to name fewer hybrid models than the respondents at large.

Q15. Do hybrid cars need to be plugged into a powerpoint for recharging?

Asked only of people who had heard of electric hybrid cars

	% of all	% of likely
No (correct)	37	27
Yes (wrong)	28	27
Not sure	35	46
Total	100%	100%
Valid responses	165	26

At this point, respondents were given a brief explanation of the hybrid car conversion proposal, and were then asked:

Q17. How much do you expect it would cost for such a conversion?

\$	% of all	% of likely
Up to \$1000	7	15
\$1001 to 2000	11	9
\$2001 to 3000	10	3
\$3001 to 4999	12	15
\$5000	20	18
\$5001 to 9999	20	12
\$10 000	16	27
More than \$10 000 (max: \$150 000)	5	0
Total	100%	100%
Valid responses	197	33

PURCHASE INTENTIONS FOR HYBRID CARS

Q18. Reasons why you might buy a hybrid car, or get current car converted

	% of all	% of likely
Not interested	19	8
Better for environment	51	36
Like to try new things	5	8
Save money on running costs	54	72
Other reasons (1 each)	3	0
Total	>100%	>100%
Valid responses	211	36

Percentages in each column total to more than 100 due to multiple responses.

Number of reasons for buying a hybrid

	% of all	% of likely
0 reasons	19	11
1	50	64
2	28	22
3	2	3
Total	100%	100%
Valid responses	211	36

Q19. Reasons why you might not buy a hybrid car, or get current car converted

	% of all	% of likely
Too expensive	54	58
Don't know enough about them – too new	29	31
Doubtful about resale value	13	11
Doubtful about reliability or maintenance	18	22
Prefer rival energy source, e.g. LPG or diesel	7	8
Other doubts	15	6
Total	>100%	>100%
Valid responses	211	36

Percentages in each column total to more than 100 due to multiple responses.

Number of reasons for not buying a hybrid

	% of all	% of likely
0 reasons	1	0
1	64	67
2	25	28
3	8	5
4	2	0
5	0.5	0
Total	100%	100%
Valid responses	211	36

Net number of reasons for buying a hybrid

The following table summarizes the net level of interest in buying a hybrid car, by subtracting reasons for not buying (Q19) from reasons for not buying (Q18)

	% of all	% of likely
-4 reasons (most negative)	0.5	0
-3	1	0
-2	8	0
-1	28	33
0	46	56
1 (most positive)	16	11
Total	100%	100%
Valid responses	211	36

Q20. Estimated probability of buying new hybrid car in next 3 years

	% of all	% of likely
0 chance	42	19
1% to 9% chance	6	0
10% to 29%	25	20
30% to 49%	11	28
50% or more	17	33
Total	100%	100%
Valid responses	211	36

Q21. Estimated probability of converting current car to hybrid power in next 3 years

	% of all	% of likely
0 chance	51	0*
1% to 9% chance	18	0*
10% to 29%	19	0*
30% to 49%	10	44
50% or more	2	56
Total	100%	100%
Valid responses	211	36

* These 3 figures are zero, because this is the question on which the target group was defined; i.e. 30% or more stated probability of converting their existing car to hybrid power.

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