

DEMAND FOR CLEAN-FUEL VEHICLE IN CHINA

Proposal
(1st Draft)

Jason Ni
Ph.D. Candidate

Institute of Transportation Studies
University of California at Davis
Davis, CA 95616

mni@ucdavis.edu

June, 2007

Summary

China, as the most populous country in the world, is at a low rate of motorization compared to other nations. However, China's pace of motorization is startlingly rapid – with local and regional implications for personal mobility, urban development, land use, and air quality and global implications for energy use and climate change – China had a 300 percent growth in terms of auto ownership from 1999 to 2002 (National Bureau of Statistic of China: 1999, 2002).

In light of the rapid growth of car ownership, the “future direction” of China’s motorization will have profound effects on car companies competing for China and global market. China started a car-buying craze in 2002 with more than 50% sales growth; however, most of the cars sold in China so far are conventional-fuel (i.e. gasoline and diesel) vehicles. In contrast to the conventional-fuel vehicle, the “clean-fuel” vehicle is defined to encompass electricity vehicle, alternative-fuel (e.g. methanol, ethanol) vehicle and hybrid vehicle (e.g. vehicle using both electricity and gasoline). As documented in previous literature, clean-fuel vehicles are likely to differ from conventional-fuel vehicles in terms of fuel costs and vehicle prices, but more importantly in non-monetary attributes: availability of the fuel, range between refueling or recharging, vehicle performance, refueling time and convenience and interior space in the vehicle, for example. (Bunch et al, 1993)

However, it is not possible to estimate above preferences by "revealed preference" (RP) methods of observing the acts of buying and not buying, because the clean-fuel vehicle is currently either in limited or no supply in China. Therefore, a “stated preference” (SP) survey is proposed to explore people’s purchase choice among hypothetical clean-fuel vehicles (electricity, alternative-fuel and hybrid) and conventional-fuel vehicle, although some innovative features of the clean-fuel vehicle are too new to be comprehended for some Chinese people who don’t even own a conventional-fuel vehicle. According to a survey (Ni et al, 2007) on vehicle purchase behavior in Shanghai, questions about the “future¹” proved the most difficult for the respondents. Many Chinese people may not be ready yet to imagine a future very different from their past and present, raising difficulties

¹ People were asked to imagine their future life in terms of income, social status and mobility options.

for studying some hypothetical topics.

Nevertheless, this research is designed to test six important attributes of the clean-fuel vehicle as mentioned in previous study. (Golob et al, 1991) In addition, other attributes related to vehicle, personality/life style, and exogenous environment will be first identified in focus group study and then tested in a survey.

The goal of this research is two-fold: first, we want to see if it is feasible to conduct a stated preference survey in China. Second, a vehicle purchase choice (logit) model will be developed. Although the clean-fuel vehicle may first be purchased by specific groups (e.g. affluent people, government) in a small scale, our model is expected to shed light on future market penetration of this new type of mobility option in China.

Research Question and Hypothesis

This research is designed to answer two important questions:

Research Question 1: *Who are potential clean-fuel vehicle buyers in China?*

Identify potential customer is the most critical and fundamental step for the demand study of clean-fuel vehicle. In a Shanghai vehicle purchase behavior survey (Ni et al, 2007), people are asked to respond to a statement “*I am aware of the information about new fuel or fuel efficient vehicles*” in Likert-scale². According to the results, 44.25% (327 out of 739 respondents) answers either agree or strongly agree. In Table 1, demographic characteristics of those 327 respondents are listed. As we can observe, most people in this group can be categorized as young professional – in mid-30s, high education level and having stable job (e.g. state-owned enterprise worker) In terms of family income, 28% of them are “mass affluent” and 26% of them are “upper middle-class” (Farrell et al., 2007).

² Strongly disagree, disagree, neutral, agree, strongly agree

<i>"I am aware of the information about new fuel or fuel efficient vehicles"</i>	
Demographic Characteristics	Percentage of Total (list the highest percentage and the second highest percentage)
Average Age	35
Gender	Male (61%) Female (39%)
Education Level	College graduate (40%) Some college (24%)
Occupation	State-owned enterprise worker (16%) Private-owned company worker (15%)
Owning Driver's License or Not	Yes, auto license only (44%) No, don't have any vehicle license (39%)
Personal Income (RMB ³ /month, after tax)	\$5,001 - \$10,000 (24%) \$2,001 - \$3,000 (17%)
Family Income (RMB/month, after tax)	\$10,001 - \$20,000 (28%) \$5,001 - \$10,000 (26%)

Table 1: Demographic characteristics of 327 respondents who are aware of "clean-fuel vehicle"

Hypothesis 1: *Clean-fuel vehicle will first be embraced by – the mass affluent class, upper middle-class and government agencies.*

Based on aforementioned, we assume the mass affluent and upper middle-class will be the two groups first consider the clean-fuel vehicle (if it is available on market). It is not only because of their purchase power but also their knowledge and awareness about this new option. As predicted in a study about the Chinese middle class (Farrell et al., 2007), the emergence of Chinese upper middle-class will happen around 2020 (Figure 1), which may provide a potential market niche for the clean-fuel vehicle in China.

³ 1 USD = 8 RMB

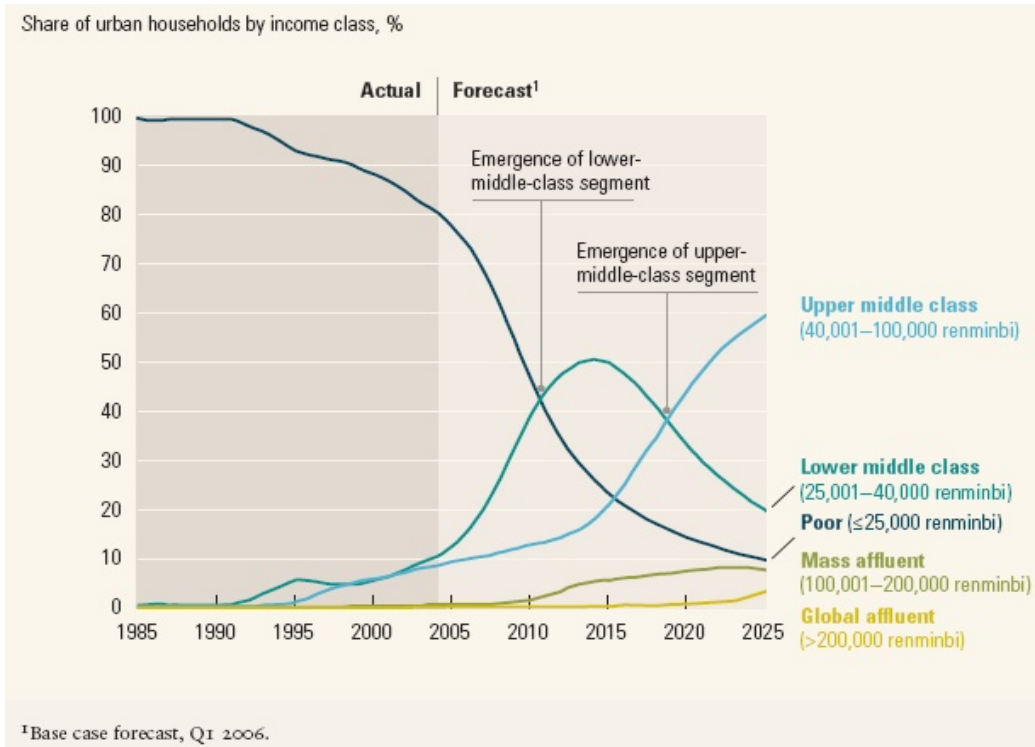


Figure 1: The Emergence of Middle Class in China

Source: National Bureau of Statistic in China. McKinsey Global Institute Analysis

In addition to above two groups, the government agencies might also play a role in the introduction of clean-fuel vehicle; because the government have enough funding to purchase the first fleet of clean-fuel vehicle, which is expected to be too expensive for common Chinese households to afford. This viewpoint is supported based on interview with experts from car companies and government research institutes in Beijing.

Research Question 2: *What attributes are significant for potential Chinese clean-fuel vehicle buyers?*

One interesting finding from Table 1 is: 39% of those “clean-fuel vehicle aware” people don’t have any driver’s license, which implies that they don’t own motorized vehicle yet. Thus, to identify what factors will affect their purchase decision of clean-fuel vehicle is critical.

As mentioned, China is at a low level of motorization compared to US. China had approximately the same number of cars per capita in 2003 (18 vehicles/1,000 people) as the United States had in 1910 (Schipper, et al. 2004). Nevertheless, we assume factors affecting the introduction of alternative fuel vehicle in the past US will also be influential in today's China. In addition, this research also aims for identifying some China-specific factors such as: local government policy, cultural belief, etc.

Hypothesis 2: *Six pre-identified US attributes and China-specific attributes will affect the purchase decision of clean-fuel vehicle.*

Based on focus group interviews conducted in US (Golob et al, 1991), it was found six attributes are most important for consumers to distinguish clean-fuel vehicle from conventional-fuel vehicle. They are: [1] vehicle purchase price, [2] fuel operating cost, [3] vehicle range between refueling, [4] availability of fuel, [5] dedicated versus multiple-fuel capability and [6] level of reduction in emissions (compared to current vehicles).

Besides, we assume that some China-specific (or even regional-specific) attributes in terms of vehicle purchase behavior will also be influential, as in the following:

Personal Attributes (including: personality, life-style, and demographic background): personal income (+), household income (+), education (+), age (+/-), status seeking (+), house purchase (-), saving (-), etc.

Exogenous Environment Attributes: government policies (regulations, incentives, fees) (+/-), availability of parking (+), convenience of public transportation (-), etc.

Research Design (Year 2008)

1. Focus Group and Expert Interview (January 2008 ~ May 2008)

The first phase research involves the focus group study and expert interview. Based on our hypothesis, we will recruit people who meet certain criteria as

affluent class or upper middle-class, for example, business owners or college professors. Government officials and experts of China auto market will also be interviewed.

The purpose of the first phase study is to understand the awareness and intention on purchasing clean-fuel vehicle. Taking the focus group study for example, we will first ask people to describe a clean-fuel vehicle to their best knowledge. Then, based on their description, we will ask each participant to list 3 to 5 most important factors affecting their purchase intention. The last, after discussion, the focus group is expected to come to a consensus on the final 3 to 5 most important attributes as the opinion of the entire group. Basically, a funnel approach is used to extract some influential attributes.

2. Survey (June 2008 ~ December 2008)

The second phase of this research will be a survey, and one or two pretests will be conducted before the final survey implementation. The final survey consists of two parts – in the first part, people will respond to stated preference questions asking respondents to express preferences for four hypothetical vehicles (gasoline, alternative fuel, electricity and hybrid) that have been characterized in terms of their attributes. Six pre-defined attributes plus some new attributes developed from previous focus group study will be tested in a vehicle choice question. (Table 2)

<i>Suppose that you were considering purchasing a new four-door sedan and the following three vehicles were available:</i>				
	1. Gasoline Vehicle	2. Alternative Fuel Vehicle	3. Electricity Vehicle	4. Hybrid Vehicle
Vehicle purchase price	hypothetical values	hypothetical values	hypothetical values	hypothetical values

Fuel operating cost	hypothetical values	hypothetical values	hypothetical values	hypothetical values
Vehicle range between refueling	hypothetical values	hypothetical values	hypothetical values	hypothetical values
Availability of fuel	hypothetical values	hypothetical values	hypothetical values	hypothetical values
dedicated vs. multiple-fuel capability	hypothetical values	hypothetical values	hypothetical values	hypothetical values
Level of reduction in emissions	hypothetical values	hypothetical values	hypothetical values	hypothetical values
<i>Add other Attributes...</i>				
<p><i>Given above choices, which vehicle would you choose?</i></p> <p><input type="checkbox"/> <i>Vehicle #1</i></p> <p><input type="checkbox"/> <i>Vehicle #2</i></p> <p><input type="checkbox"/> <i>Vehicle #3</i></p> <p><input type="checkbox"/> <i>Vehicle #4</i></p>				

Table 2: Example of Vehicle Choice Question (Stated Preference)

The second part of the final survey will include demographic information, and a series of Likert Scale questions about personality/life-style and exogenous environment. (Table 3)

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	For me, a lot of the fun of having something nice is showing it off.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	The vehicle that I own needs to be well-known.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3.	I enjoy catching everybody's eyes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	When many of my friends/colleagues own a certain type of vehicle, I will consider purchasing one of it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Table 3: Example of Question about Personality and Life-style (in Likert Scale)

Survey Implementation Scenarios (Year 2008)

In terms of the survey implementation, both high-budget and low-budget plans are proposed:

Low-budget Scenario: *Survey Shanghai only (1000 people)*

1000 people will be sampled from 17.4 million residents of Shanghai. Although the sample size is not big, it is feasible for us to develop vehicle purchase model based on a small sample size⁴.

High-budget Scenario: *Survey four 1st-tier cities and four 2nd-tier cities (500 people each)*

Based on the auto market research report of Mercer Management Consulting, the China cities are categorized into three types. 1st-tier cities are the wealthiest and they include: Beijing, Shanghai, Guangzhou and Shenzhen. 2nd-tier cities are GDP/capita over \$8,300 (RMB⁵) and 3rd-tier cities are GDP/capita below \$8,300 (RMB). Surveying both 1st and 2nd-tier cities will allow us to capture the most affluent people and the emerging middle-class in China.

⁴ The sample size will not matter for the explanation study. (i.e. identifying relationships among two or more variables)

⁵ \$8,300 RMB is close to \$1,000 USD. According to international convention, the GDP/capita threshold for vehicle purchase is US \$ 1,000.

Advisors

- Dr. Dan Sperling (Professor and Director of Institute of Transportation Studies, UC Davis)
- Dr. Ken Kurani (Associate Researcher, Institute of Transportation Studies, UC Davis)
- Dr. Tom Turrentine (Associate Researcher, Institute of Transportation Studies, UC Davis)
- Dr. David Bunch (Professor of Graduate School of Management, UC Davis)
- Prof. Ma Jun (Dean of Automobile Marketing and Management School, Tongji University)

Reference

Bunch D., Bradley M., Golob T., Kitamura R., and Occhiuzzo G., (1993) *Demand for Clean-Fuel Vehicles in California: A Discrete-Choice Stated Preference Pilot Project*, Transportation Research A, Vol. 27A, No. 3, pp. 237-253, Great Britain

Farrell D., Gersch U., Stephenson E., (2006) *The Value of China's Emerging Middle Class*, McKinsey Quarterly

National Bureau of Statistics of China (1999, 2002) *China Statistical Yearbook*, Beijing: China Statistics Press

Ni J., Fu B.F., Kurani K., Turrentine T., Sperling D., Chen X.H., (2007) *Doing Survey Research in China: Case Study of Motorization in Shanghai*, 7th Asia Pacific Transportation Development Conference proceedings, Los

Angeles

Golob T. F., Kitamura R., and Occhuizzo G. (1991) *An attitude-behavioral intention model of the market potential for alternative-fuel vehicles*. Presented at Annual Meeting of the Transportation Research Board, Washington, DC, January 13-17.

Schipper L., Wei-Shiuen N. (2004) *Rapid Motorization in China: Environmental and Social Challenges*, EMBARQ, World Resource Institute, Washington DC