

TRANSPORTATION FUEL DEMAND FORECAST HOUSEHOLD AND COMMERCIAL FLEET SURVEY

Revised Task 4 Report

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SURVEY AND SAMPLING DESIGN

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Background

This technical memorandum on Survey and Sampling Design will serve as an addendum to the final report of the 2008-2009 California Vehicle Survey (CVS) project. The purpose of this CVS project is to provide input data for California (light-duty) Conventional and Alternative Fuel Response Simulator (CALCARS) modeling.

The CVS project will be conducted among California households and California commercial fleet owners. To meet the objectives of CALCARS, the CVS will collect both stated and revealed preference data for vehicle ownership and choice in order to forecast the penetration and use of both conventional and alternative fuel vehicles (AFVs). The CVS will be the Energy Commission's primary updated source for light-duty vehicle choice and usage data. Another important application of the survey data will be to improve the Energy Commission's anticipated program to encourage the acquisition of energy efficient vehicles (referred to as the Advanced Technology and Efficient Vehicle Market Information program).

This memo presents documentation on survey and sample design.

Overview

The main objective of this task is to develop the overall survey and sample design, including the identification and development of sample frames for the household and commercial fleet owner surveys, the associated sample stratification schemes, and the establishment of the final sample size allocations.

The research team will recruit over 5,500 respondents for the household portion of the survey, resulting in a minimum of 3,000 completed stated preference surveys. Approximately, 3,600 respondents will be recruited for the commercial fleet owner portion of the survey, resulting in a minimum of 1,800 completed stated preference surveys.

Both the household and commercial fleet owner sample will be stratified by five regions in the State of California. The five target regions are defined by county as follows:

- **San Francisco region:** Alameda, Contra Costa, Marin, Napa, San Mateo, Santa Clara, Solano, Sonoma, and San Francisco Counties.
- **Los Angeles region:** Los Angeles, Orange, Imperial, Riverside, San Bernardino, and Ventura Counties.
- **San Diego region:** San Diego County.
- **Sacramento region:** El Dorado, Placer, Sacramento, Sutter, and Yolo, Yuba Counties.
- **Rest of State:** Alpine, Amador, Butte, Calaveras, Colusa, Del Norte, Fresno, Glenn, Humboldt, Inyo, Kern, Kings, Lake, Lassen, Madera, Mariposa, Mendocino, Merced, Modoc, Mono, Monterey, Nevada, Plumas, San Benito, San Joaquin, San Luis Obispo, Santa

Barbara, Santa Cruz, Shasta, Sierra, Siskiyou, Stanislaus, Tehama, Trinity, Tulare, and Tuolumne Counties.

The commercial fleet sample only includes light-duty vehicle size classes 1 through 16 (see attachment A). This allows for sampling of fleets that comprise most types of pick-up trucks, small delivery vans, other small walk-in vans, mini buses, and so forth (as well as cars).

Residential Recruit Survey

The personal light-duty vehicle ownership and choice forecasting methodology utilized by CALCARS relies on trends in growth of the number of households to predict vehicle class/vintage. Thus, the household is the sampling unit of interest for the residential portion of the California Vehicle Survey. Estimates of vehicle choice and quantity are simulated in the model given the number of vehicles owned (zero, one, or two+) by household.

The goal is to provide data input to the model from a representative sample of California households. Households will be sampled proportionally across the five regions of the state. Within each region, the research team will use Census 2000 counts of the number of households within counties to arrive at proportional sample sizes within the five regions. Overall, the completed sample size for the residential recruit survey is expected to be 5,500 households since it is expected that approximately 55 percent will complete the stage-two preference survey. A pre-test with 150 randomly selected households will assist in determining the number of samples to be drawn. Table 1 on the following page shows the proportional sample allocation for the residential recruit survey, given 2000 Census counts for the number of households by region.

In addition to stratification of respondent households by region, it will be important to assure that the residential sample is representative of households within regions by such characteristics as the number of persons in households, the number of vehicles, urban/suburban/rural location, number of workers, and income. Again, 2000 Census data or projected data will be used to monitor household sample recruitment by these characteristics.

The random-digit-dial household sample will be purchased from Survey Sampling Inc. (SSI) of Fairfield, Connecticut using land phone telephone banks within regions with at least one listed number. The sample will be screened by SSI to remove non-working and business numbers. The sample will then be matched for addresses by SSI. It is expected that 60 percent of household telephone numbers can be linked to an address. Advance letters describing the survey will be sent to those households for whom addresses have been obtained. The letters will be released in sampling replicates of 1,000 as the recruit phone interviewing proceeds.

As the study progresses, it is anticipated that a subsample of cell phones will be added and screened for cell phone only households. These households are largely concentrated among those under 35 years old. These households are only available through cell phone or Internet based samples, or through a lengthy process of identification through address-based samples. This completed sample of cell phone only households will be sufficient to ascertain whether these respondents differ from their age cohort with landlines, in terms of their travel and

vehicle purchase behaviors. The Abt SRBI consulting team will place emphasis in this study on ensuring a sufficient proportional completed sample size of 18 to 35 year old respondents, since this age group is often undersampled.

The first sampling option for the residential survey would be to construct a sample proportional to the number of households in each of five regions of the state defined, as shown below in Table 1.

Table 1
Proportional Sample Allocation Plan for Residential Recruit Survey
Based on 2000 Census Counts

Region	County	Number of Households	Percent of Households	Recruit Sample Allocation	Discrete Choice Sample
1 San Francisco	Alameda	523,366	21.2%	250	
	Contra Costa	344,129	14.0%	165	
	Marin	100,650	4.1%	48	
	Napa	45,402	1.8%	22	
	San Mateo	254,103	10.3%	121	
	Santa Clara	565,863	22.9%	271	
	Solano	130,403	5.3%	62	
	Sonoma	172,403	7.0%	82	
	San Francisco	329,700	13.4%	158	
	Total	2,466,019	100.0%		
	Percent of State		21.4%	1,179	643
2 Los Angeles	Los Angeles	3,133,774	58.2%	1,498	
	Orange	935,287	17.4%	447	
	Riverside	506,218	9.4%	242	
	San Bernardino	528,594	9.8%	253	
	Ventura	243,234	4.5%	116	
	Imperial	39,384	0.7%	19	
	Total	5,386,491	100.0%		
	Percent of State		46.8%	2,575	1,404
3 San Diego	San Diego	994,677	100.0%	476	
	Total	994,677	100.0%		
	Percent of State		8.6%	476	260
4 Sacramento	El Dorado	58,939	8.3%	28	
	Placer	93,382	13.1%	45	
	Sacramento	453,602	63.6%	217	
	Yolo	59,375	8.3%	28	
	Yuba	20,535	2.9%	10	
	Sutter	27,033	3.8%	13	
	Total	712,866	100.0%		
	Percent of State		6.2%	341	186
5 Rest of State	All Other Counties	1,942,817	100.0%	929	
	Total	1,942,817	100.0%		
	Percent of State		16.9%	929	507
TOTAL	Statewide	11,502,870		5,500	3,000

However, if this strictly proportional sample allocation is used as shown in Table 1, the resulting large sample size for the Los Angeles region translates to a low sampling ratio for the combined Northern California regions of San Francisco and Sacramento vs. the combined Southern regions of Los Angeles and San Diego. Since differences in the stated preference responses of Northern California residents vs. Southern California residents are expected to be significant, a minor adjustment to the proportional sampling option is recommended. Table 2 shows this final recommended sampling plan, which reduces the recruit sample allocation for the Los Angeles region by 200 households, while increasing recruit sample allocations for San Francisco and Sacramento by 100 households each. This plan will better accommodate regional segmentation.

Table 2
Final Adjusted Sample Allocation Plan for Residential Recruit Survey

Region	County	Number of Households	Percent of Households	Recruit Sample Allocation	Discrete Choice Sample
1 San Francisco	Alameda	523,366	21.2%	250	
	Alameda	344,129	14.0%	165	
	Marin	100,650	4.1%	48	
	Napa	45,402	1.8%	22	
	San Mateo	254,103	10.3%	121	
	Santa Clara	565,863	22.9%	271	
	Solano	130,403	5.3%	62	
	Sonoma	172,403	7.0%	82	
	San Francisco	329,700	13.4%	158	
	Total	2,466,019	100.0%		
	Percent of State		21.4%	1,279	697
2 Los Angeles	Los Angeles	3,133,774	58.2%	1,498	
	Orange	935,287	17.4%	447	
	Riverside	506,218	9.4%	242	
	San Bernardino	528,594	9.8%	253	
	Ventura	243,234	4.5%	116	
	Imperial	39,384	0.7%	19	
	Total	5,386,491	100.0%		
	Percent of State		46.8%	2,375	1,295
3 San Diego	San Diego	994,677	100.0%	476	
	Total	994,677	100.0%		
	Percent of State		8.6%	476	260
4 Sacramento	El Dorado	58,939	8.3%	28	
	Placer	93,382	13.1%	45	
	Sacramento	453,602	63.6%	217	
	Yolo	59,375	8.3%	28	
	Yuba	20,535	2.9%	10	
	Sutter	27,033	3.8%	13	
	Total	712,866	100.0%		
	Percent of State		6.2%	441	241
5 Rest of State	All Other Counties	1,942,817	100.0%	929	
	Total	1,942,817	100.0%		
	Percent of State		16.9%	929	507
TOTAL	Statewide	11,502,870		5,500	3,000

Residential Stated Preference Survey

The sample for the stated preference (retrieval) survey will be the respective recruited sample for the residential survey. It is anticipated that 54-55% percent of the households recruited will complete the purchase choice and preference follow-up questions of the retrieval survey. The percentage of fully completed interviews will be closely monitored during the pre-test and throughout the conduct of the survey. Additional phone calls or postcards will be made to recruited households as necessary. The research team will continually keep the Energy Commission informed of the survey's progress and document the reasons for final responses falling below the percent anticipated, if this should occur. The research team will also suggest remedies for addressing non-response issues as a part of each monthly interim report during the two-month data collection period. The status of any non-response items and corrective actions will be included weekly in progress reports.

Commercial Fleet Recruit and Stated Preference Survey

For the commercial portion of CALCARS, light-duty vehicle ownership and choice forecasting will rely on trends in growth of industry sectors to predict vehicle class/vintage. Thus the commercial establishment is the sampling unit of interest for the commercial portion of the California Vehicle Survey. Estimates of vehicle choice and quantity will be simulated in the model given fleet size and vehicle class/vintage ownership of establishments within sectors.

The complicating factors are as follows:

- The percent of establishments owning light-duty vehicles is estimated at 25 percent or less, and this proportion varies by industry sector.
- A "yellow pages" sampling frame of establishments would be needed instead of a Dunn & Bradstreet listing because the number of light-duty vehicles likely to be found in 1 to 2 fleet establishments is large, and these establishments are less likely to be listed in a Dunn & Bradstreet sample.
- A very large two-staged sample would be needed to interview establishments, identify the small portion with vehicles, inventory their fleets by size and vehicle class/vintage, and develop and carry out a second stage sampling and survey of vehicles for replacement choice and preference.
- The costs of such a large-scale commercial establishment universe survey are outside the budget scope of the 2008-2009 California Vehicle Survey.

Given these limitations, the California Department of Motor Vehicles (DMV) files of registration provide the most efficient sampling frame for vehicles in size classes of 1 to 16. Vehicles can be organized and sampled by fleet size and region. Once vehicles are selected from the stratified sampling frame, the research team can match vehicles with their establishment. Telephone numbers for 60 to 75 percent of these establishments can be obtained through address matching services such as SSI. As with the residential recruit survey, advance letters will be sent.

The California Department of Motor Vehicles (DMV) will supply the sample data and Energy Commission staff will construct the sampling frame of commercial vehicles. All vehicles identified in size classes 1 to 16 will be included in the sampling frame except for known governmental agency and daily rental car establishments. The sample will be proportional by region and size of fleet. Overall, approximately 3,600 establishments with approximately 6,500 sampled vehicles will be interviewed as a part of the commercial recruit survey. The exact number of establishments recruited will depend on the ratio of recruitments to stated preference interviews completed as the survey proceeds. (The anticipated recruit to SP interview ratio is 2:1). It is estimated that a sample listing of approximately 30,000 establishments will be needed. A pre-test of 100 randomly selected establishments of varying fleet size will assist in determining the samples to be drawn.

The commercial interviewing will be monitored to assure that the sample interviewed is representative of the DMV-based vehicle-sampling frame by region, fleet size, vehicle type, and vehicle class/vintage. Table 2 provides a count of commercial vehicle sizes 1 to 16 by region and fleet size, as contained in the DMV registration data file.

The commercial interview will identify the contact person for vehicle fleet and purchase information; inventory fleets by size, vehicle class and vintage, usage and travel behavior, and collect information about the establishment's industry sector, headquarters, number of employees, revenues, and links to other establishment fleets. The universe proportion of vehicles by industry sectors is unknown in the DMV database. This proportion will be estimated from the results of the commercial vehicle survey.

The stated preference interview for the commercial sample will be conducted with similar customized formats and procedures as have been developed for the residential survey.

The count of DMV registered class size 1-16 vehicles by region and fleet size is as shown in Table 3 below:

**Table 3
Count of Registered Commercial Vehicles in California DMV File
By Region and Fleet Size (October, 2007)**

FLEET SIZE	TOTAL	SAN FRANCISCO	LOS ANGELES	SAN DIEGO	SACRAMENTO	REST OF STATE
1	1,295,823	224,251	559,739	106,833	87,397	317,603
2	576,642	113,495	254,380	47,703	39,062	122,002
3-9	907,033	190,027	422,386	64,939	55,805	173,876
10+	668,485	103,898	375,985	36,116	31,664	120,822
TOTAL	3,447,983	631,671	1,612,490	255,591	213,928	734,303

**Table 4
Count of Commercial Fleets in California DMV File
By Region and Fleet Size (October, 2007)**

FLEET SIZE	TOTAL	SAN FRANCISCO	LOS ANGELES	SAN DIEGO	SACRAMENTO	REST OF STATE
1	1,295,823	224,251	559,739	106,833	87,397	317,603
2	316,870	60,953	139,938	26,115	21,383	68,481
3-9	262,359	53,382	121,269	18,987	16,315	52,406
10+	24,679	4,751	9,963	1,805	1,536	6,624
TOTAL	1,899,731	343,337	830,909	153,740	126,631	445,114

To test commercial establishments' response rates by region, a pretest sample of 5,000 vehicles was assembled by the California Energy Commission from DMV data, with equal proportions of vehicles per region. The composition of this pretest sample by region and fleet size is shown in Table 5 below.

**Table 5
Pretest Sample Allocation Plan for the Commercial Vehicle Survey
Based on DMV Counts**

REGION	FLEET SIZE				TOTAL
	1	2	3-9	10+	
San Francisco	374	186	291	149	1000
Los Angeles	362	160	246	232	1000
San Diego	441	190	245	124	1000
Sacramento	421	184	242	153	1000
Rest of State	461	173	230	136	1000
TOTAL	2059	893	1254	794	5000

Pretest response rates by region and vehicle fleet size will be used to set recruitment quotas by data cell for the main survey.

For the main survey, sampling allocation and completion counts are expected to be proportional to vehicle counts by region and fleet size as shown in Table 3 above, and by fleet counts as shown in Table 4. Recruitment of 3,600 establishments for the main survey will result in 1,800 stated complete interviews.

Some data cleaning of the DMV sample data files is necessary to eliminate duplicate addresses and to eliminate vehicles registered in California but with companies that have addresses outside the state of California.

Summary

The sample allocation plan for the residential survey will include minor adjustments to strictly proportional allocations of households across the designated five regions, based on Census 2000 data. This adjustment, as shown in Table 2, is designed to improve statistical comparisons of Northern California stated preference responses with those of Southern California resident. In addition to establishing regional quotas, the residential completes will be monitored to assure representativeness by household and person characteristics, such as household size, number of vehicles, number of workers in the household, age, and income.

The commercial survey sampling plan will establish quotas for selecting vehicles by fleet size (1, 2, 3-9, and 10+) in the same five designated regions as defined for the residential survey. The sampling will be proportional to the distribution of vehicles by these two variables as found in the California Department of Vehicle database. The vehicle sample will be sorted by establishment (address) and up to five sample vehicles will be designated for full interviewing per establishment. Throughout the data collection period, complete interviews will also be monitored for representativeness to the DMV database by type of vehicle, size class, and vintage.

Attachment A

DMV Light Duty Vehicle Class Sizes

	CLASS	INTERIOR VOLUME DEFINITION	EXAMPLE MODELS
1	SUBCOMPACT (1-6,000 lbs.)	LESS THAN 89 CU.FT.	TOYOTA ECHO, HYUNDAI ACCENT, VW GOLF
2	COMPACT (1-6,000 lbs)	89 TO 95 CU.FT.	HONDA CIVIC, CHEVY CAVALIER, FORD FOCUS
3	MIDSIZE (1-6,000 lbs.)	96 TO 105 CU.FT.	HONDA ACCORD, FORD TAURUS, TOYOTA CAMRY
4	LARGE (1-6,000 lbs.)	OVER 105 CU.FT.	BUICK LESABRE, FORD CROWN VICTORIA
5	SPORT (1-6,000 lbs.)	TWO DOOR HIGH PERF. SUBCOMPACT CARS (Wt/HP ratio less than 18)	FORD MUSTANG, CHEVY CAMARO, TOYOTA CELICA
6	CROSS UTILITY - SMALL ² (1-6,000 lbs.)	SMALL WAGONS (Passenger volume less than 95 cu.ft) WITH FLEXIBLE SEATING (Fold down rear seat to provide flat floor to front seat)	CHRYSLER PT CRUISER, TOYOTA MATRIX

LIGHT TRUCK CLASSES

	CLASS	TOTAL VOLUME DEFINITION (x\pickups)	EXAMPLE MODELS
7	CROSS UTILITY - SMALL ² (1-6,000 lbs.)	UNIBODY SUV LESS THAN 140 CU.FT.	TOYOTA RAV4, HONDA CRV, FORD ESCAPE
8	CROSS UTILITY - MIDSIZE (1-6,000 lbs.)	UNIBODY SUV OVER 140 CU.FT.	TOYOTA HIGHLANDER, HONDA PILOT, LEXUS RX300
9	SPORTS UTILITY - COMPACT (1-6,000 lbs.)	BODY ON FRAME SUV LESS THAN 140 CU.FT.	CHEVY BLAZER, NISSAN XTERRA, ISUZU AMIGO
10	SPORTS UTILITY - MIDSIZE (1-6,000 lbs.)	BODY ON FRAME SUV 140 TO 180 CU.FT.	GMC ENVOY, DODGE DURANGO, ISUZU TROOPER
11A	SPORTS UTILITY - LARGE (6,001-8,500 lbs.)	BODY ON FRAME SUV OVER 180 CU.FT	CHEVY TAHOE, TOYOTA SEQUOIA, FORD EXPEDITION
11B	SPORTS UTILITY - HEAVY (8,501-10,000 lbs.)	BODY ON FRAME SUV OVER 180 CU.FT & 8,501 to 10,000 GVW	CHEVY R2500 SUBURBAN, FORD EXCURSION
12	VAN COMPACT (1-6,000 lbs.)	LESS THAN 180 CU.FT	FORD WINDSTAR, DODGE CARAVAN, HONDA ODYSSEY
13A	VAN - LARGE (6,001-8,500 lbs.)	OVER 180 CU.FT.	FORD ECONOLINE, CHEVY EXPRESS, DODGE RAMVAN
13B	VAN - HEAVY (8,501-10,000 lbs.)	OVER 180 CU.FT. & 8,501 to 10,000 GVW	CHEVY EXPRESS VAN G30, FORD COMM STRIP E350, DODGE RAM VAN b350
14	PICKUP - COMPACT (1-6,000 lbs.)	INERTIA WT. LESS THAN 4250LBS (2WD) IWT= curb wt.+300lbs rounded to nearest 250 lb)	CHEVY S10, FORD RANGER, NISSAN FRONTIER
15A	PICKUP - STANDARD (6,001-8,500 lbs.)	INERTIA WT. OVER 4250 LBS (2WD)	FORD F150, GMC SIERRA, TOYOTA TUNDRA
15B	PICKUP - HEAVY	INERTIA WT. OVER 4250 LBS	GMC SIERRA C3500, DODGE

	(8,501-10,000 lbs.)	(2WD) & 8,501 to 10,000 GVW	D300/350, FORD F350
16	NEIGHBORHOOD ELECTRIC CAR (1-6,000 lbs.)	SMALL CAR with Top Speed of 25 MPH (per NHTSA Definition 49 CFR Part 571)	FORD THINK, CLUB CAR, GLOBAL ELECTRIC, DYNASTY

² Cross Utility-Small is bifurcated into "Car" and "Truck" due to CAFÉ differences. Manufacturers vary in their designation of "car" vs. "truck" for cross-utility vehicles to suit their particular CAFÉ needs. CAFÉ regulations apparently provide this latitude based on particular characteristics of the vehicle's floor slant.

Class	Description	Class
11A	Subcompact	1
12A	Subcompact	1
21A	Compact	2
22A	Compact	2
31A	Midsize	3
32A	Midsize	3
41A	Large	4
42A	Large	4
51A	Sports	5
52A	Sports	5
61A	Cross Utility - Small	6
62A	Cross Utility - Small	6
71A	Cross Utility - Small	7
72A	Cross Utility - Small	7
81A	Cross Utility - Midsize	8
82A	Cross Utility - Midsize	8
91A	Sports Utility - Compact	9
92A	Sports Utility - Compact	9
101A	Sports Utility - Midsize	10
102A	Sports Utility - Midsize	10
111A	Sports Utility - Large	11
112A	Sports Utility - Large	11
111B	Sports Utility - Heavy	11
112B	Sports Utility - Heavy	11
121A	Van - Compact	12
121B	Van - Compact	12
122A	Van - Compact	12
131A	Van - Large	13
132A	Van - Large	13
131B	Van - Heavy	13

132B	Van - Heavy	13
141A	Pickup - Compact	14
142A	Pickup - Compact	14
151A	Pickup - Standard	15
152A	Pickup - Standard	15
151B	Pickup - Heavy	15
152B	Pickup - Heavy	15
161A	Neighborhood Electric	16