

# Emissions of HFC-134a in Auto Dismantling and Recycling

California Air Resources Board  
Contract Number 06-334

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# Acknowledgements

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# Regulatory Background

- US EPA 40 CFR 82.154 prohibits the venting of refrigerant from vehicles during servicing and dismantling
- 40 CFR 82.154 establishes guidelines for the removal, recovery, and possible recycling of vehicle refrigerant
- These guidelines are rarely enforced as the potential benefits from an enforcement measure are not clearly understood

# Project Background

- California's Global Warming Solutions Act of 2006 (AB 32) mandates that California reduce its greenhouse gas emissions to 1990 levels by 2020
- In compliance with AB 32, the California Air Resources Board (CARB) adopted early action measures to reduce greenhouse gases emissions from vehicle air conditioning systems

# HFC-134a

- HFC-134a is the most commonly used vehicle refrigerant and a toxic greenhouse gas
- Replaced R-12 as of the 1995 model year
- HFC-134a can be slowly leaked from vehicle air conditioning systems as components deteriorate over time
- HFC-134a can also be emitted in large amounts when vehicles are in accidents, serviced, and when vehicles are dismantled at the end of their drivable lives

# Project Goal and Objectives

- Goal
  - Estimate the amount of HFC-134a remaining in the air conditioning systems of vehicles that have reached the end of their drivable lives, known as End of Life Vehicles (ELVs), on licensed vehicle dismantler lots in California
- Objectives
  - Characterize the ELV population in California
  - Describe the vehicle dismantlers handling California's population of ELVs
  - Sample and extrapolate findings to estimate the amount of HFC-134a remaining in vehicles on dismantler lots in California

# End of Life Vehicles (ELVs)

- Any vehicle that has been issued a junk title or salvage certificate by the California Department of Motor Vehicles (CA DMV)
- Used as an approximation for vehicles on dismantler lots in California
- No direct statistics were available regarding the number of ELVs in California
- Estimated using CA DMV registration data
  - Annual registration records from 2000 - 2008
  - Vehicle registration histories

39,645,818 vehicles had a lapse in registration status from 2000 - 2008

## Registration history of a vehicle with lapsed registration status

5XX1926U62161081909V	1FALP62WXSHI41XX	1
5XX1926 091110 95 FORD	1FALP62WXSH141XX OAKLAND 94621 01	2
5XX1926 PICK N PULL AUTO DISM INC	8451 SAN LEANDRO ST	3
5XX1926 01 090728 JUNK		5
5XX1926 31 041210 UPDATED SUBPLATE/REREG RECORD		5
5XX1926 071609 070809	JOE SMITH	7
5XX1926 1234 56TH ST APT D	EMERYVILLE	8



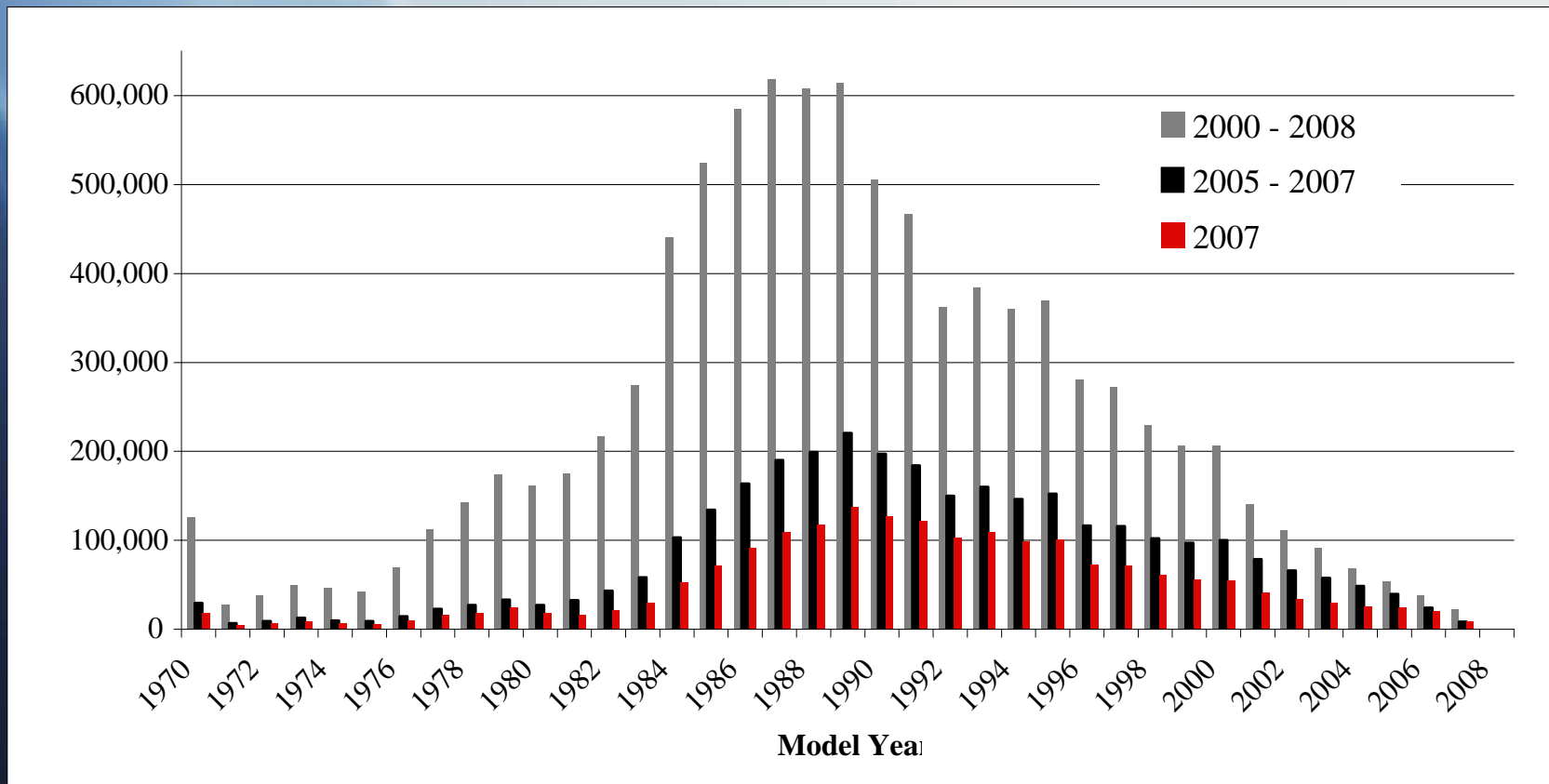
# Final CA DMV Status of Vehicles with Lapsed Registration Status

Category	% of vehicles with lapsed registration 2000 - 2008
Current registration status	32%
<b>ELV</b>	<b>22%</b>
Non-active CA DMV registration action	19%
PNO	9%
Out of state	6%
No CA DMV registration records	6%
Unclaimed registration	5%

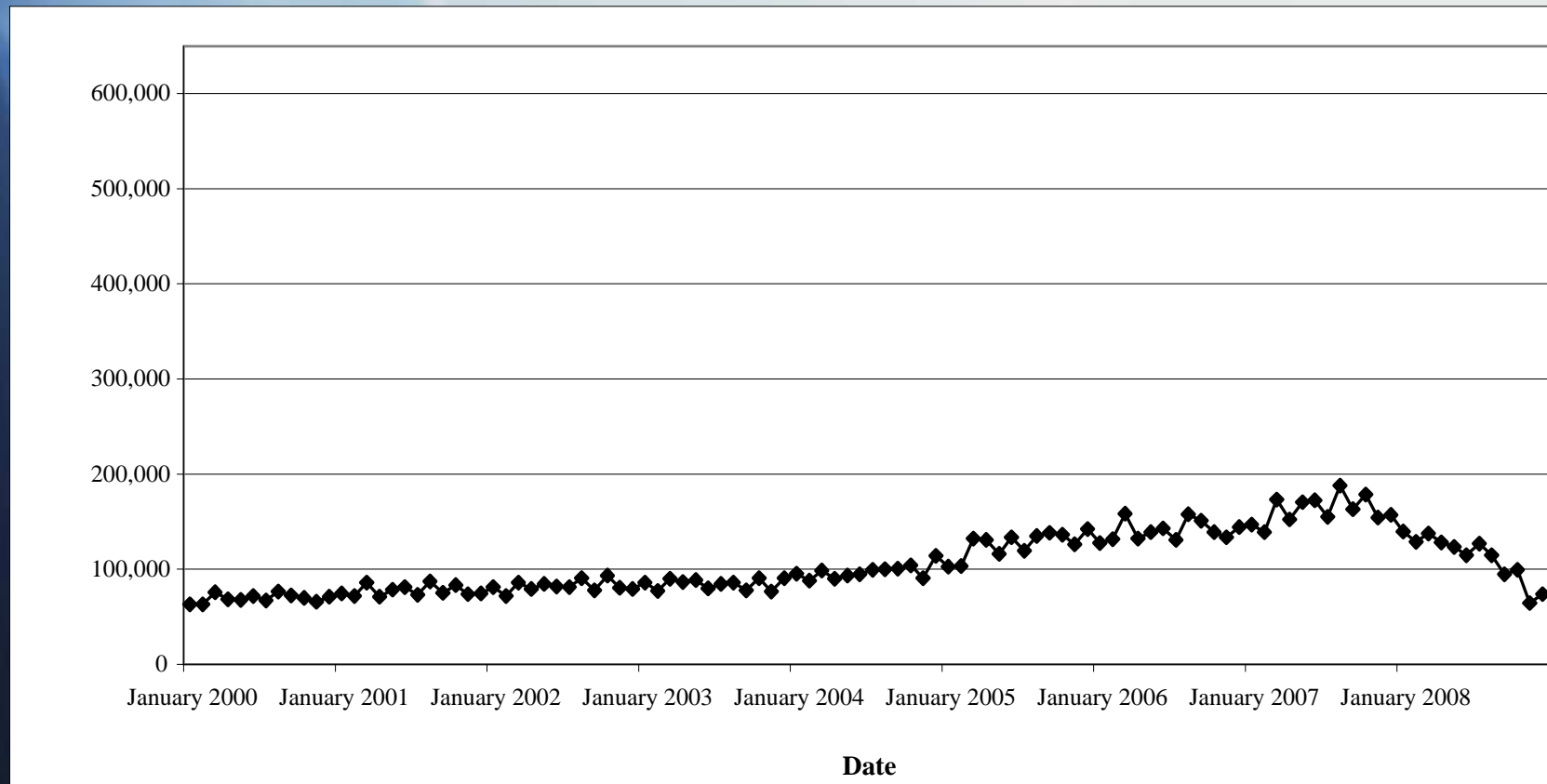
# ELV Population

Time Frame	Number of Vehicles	Mean Model Year	Standard Deviation	1995 and Newer
2000 - 2008	8,537,707	1989	7	25%
2005 - 2007	3,190,430	1991	7	32%
2007	1,952,338	1991	7	31%

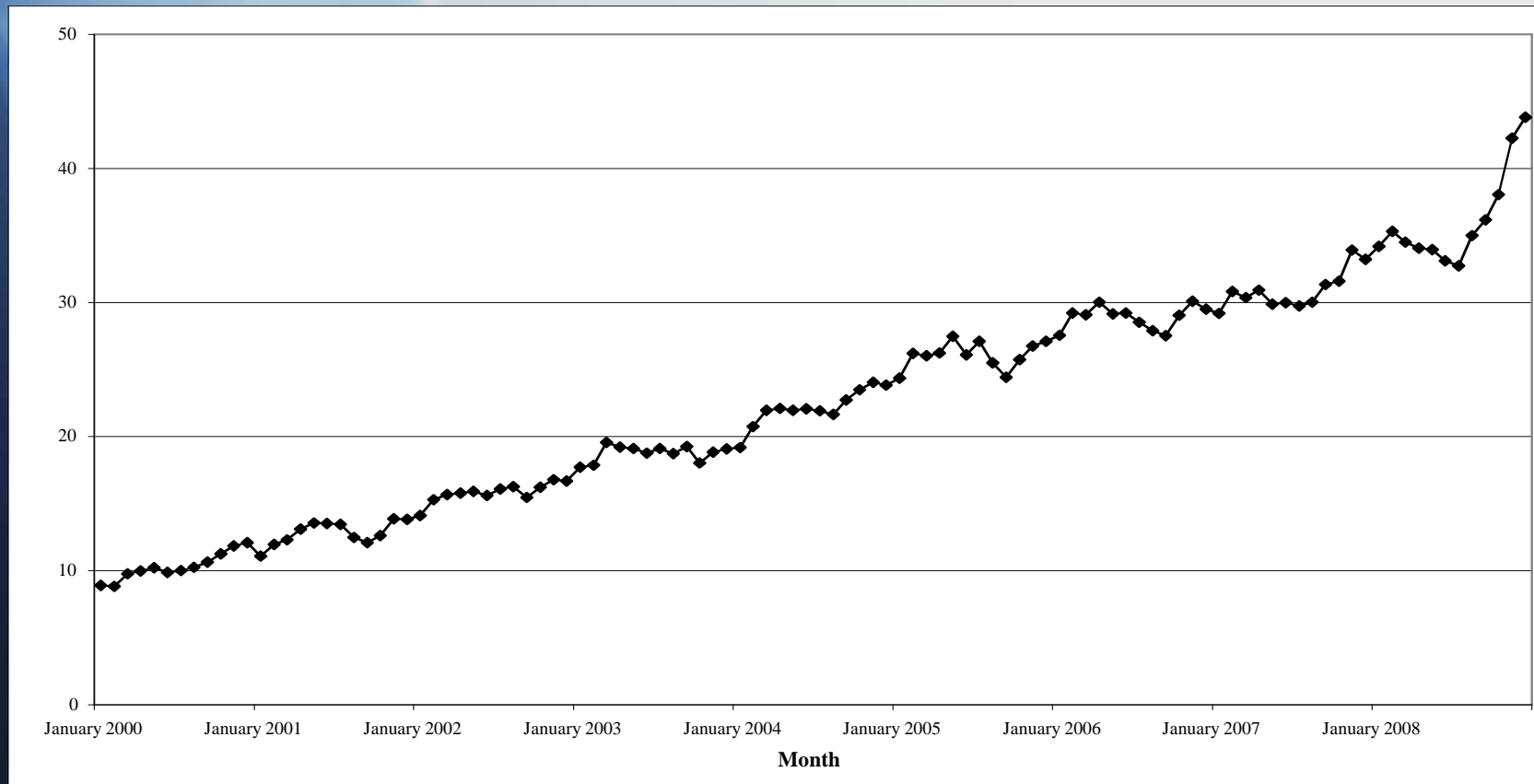
# ELV Population by Model Year



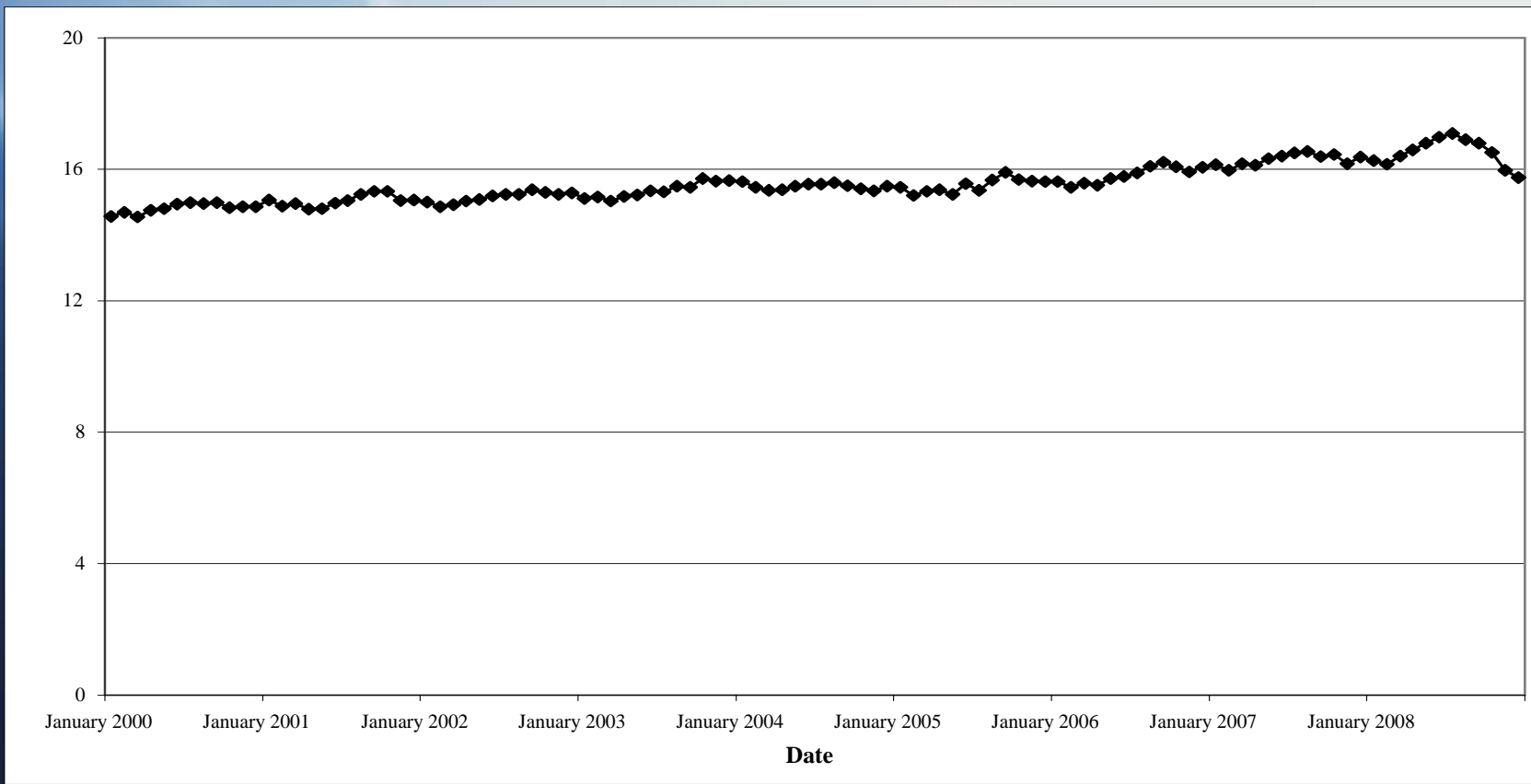
# Monthly Time Series of ELVs, 2000 - 2008



# Percentage of 1995 and Newer Model Year ELVs by Month



# Age of ELV Population



# Vehicle Dismantlers

- Defined by section 220 of the California Vehicle Code
  - Any person or business owning more than three ELVs per year, as outlined by section 220, is required to hold a valid vehicle dismantler license
- Identified using CA DMV registration histories
- Restricted to businesses or individuals that owned at least one ELV from 2000 - 2008

# Matching Dismantler Names & Addresses

123 EAST FIRST STREET SACRAMENTO

123 1ST E SAC

324 W WASHINGTON SAC

324 E WASHINGTON ST WSAC

DISMANTLING 789 CRANDALL LA

HARROLD'S DISM 789 CRANDAL

ZIPPY CAR DISM 982 E MAIN

ZIPPY CAR DISM 1127 W MAIN ST

ZIPPY CAR DISMANT 832 CLYDE AVE

- 161,682 unique name and address combinations
- 2,107 unique locations identified as vehicle dismantlers in California
- 487 out of state and non-dismantling businesses



# ELV Owners Over Time

Category	% of ELVs 2000 - 2008	Number of businesses 2000 - 2008	% of ELVs 2007	Number of businesses 2007
California dismantler	70%	2,107	80%	1,629
Out of state business	1%	33	0.3%	21
Vehicle auction	6%	87	4%	87
Insurance company	10%	59	10%	56
Fleet vehicle	1%	26	0.6%	19
Taxi service	0.1%	41	0.1%	27
Private individual or unknown entity	11%	241	5%	137

# ELV Volume Owned by Dismantlers of Varying Size, 2000 - 2008

	Licensed Dismantler Locations		Unlicensed Dismantler Locations	
	License Required 1,127 locations	No License Required 269 locations	License Required 203 locations	No License Required 508 locations
Total ELVs	5,766,084	51,126	111,048	21,698
Mean ELVs	5,116	190	547	43

# Two Rounds of Vehicle Sampling

- Initial Sampling: January 14 - January 19, 2008
  - 161 vehicles sampled on one dismantler lot in Antelope, CA
  - Robinair Cool-Tech 34134Z
    - Compliant with SAE standard J2210
    - Collected R-12 and HFC-134a
- Main Sampling: February 2 - August 27, 2009
  - 1,874 vehicles sampled on 29 dismantler lots throughout California
  - Robinair 34788
    - Compliant with SAE standard J2788
    - Collected HFC-134a only

# Sampling Logistics

- Sampling took an average of 30 minutes per vehicle during which time vehicle specific characteristics were recorded
- An average of 20 vehicles were sampled each work day
- Refrigerant collection took an average of additional 30 minutes at the end of each work day
- Sampled refrigerant was placed in storage bottles and reclaimed by US EPA sanctioned refrigerant handling and disposal service

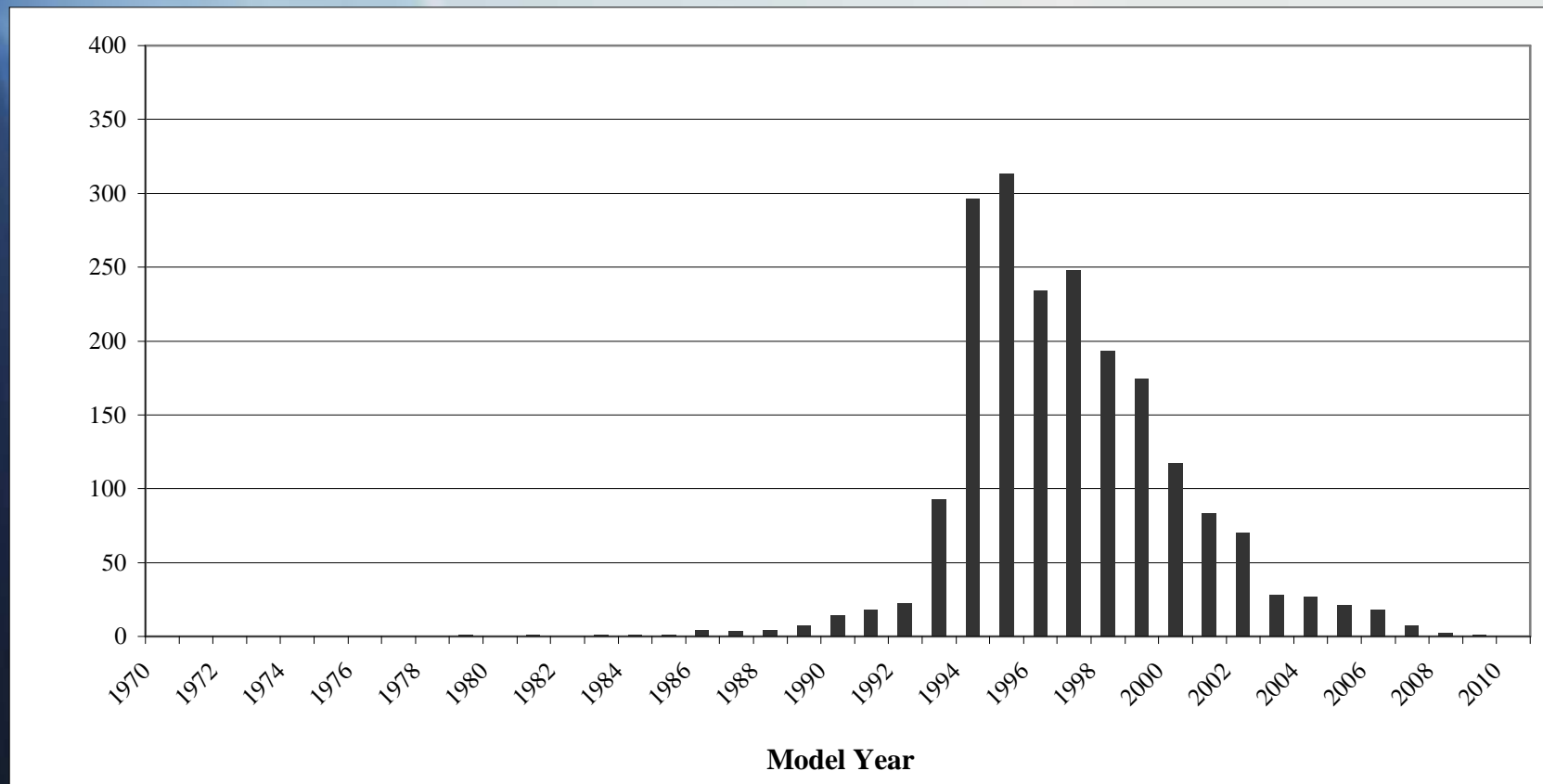
# Vehicle Sampling Accuracy

- 2,002 unique vehicles were sampled
  - 2,035 vehicles total were sampled
  - 33 sampled more than once
- 48 incorrect VINs identified and corrected using the check digit
- Vehicle refrigerant
  - 12 refrigerant capacities left blank were amended
  - 25 vehicles had over 100% of their refrigerant capacity recovered
- Stratification of sample not reflective of the vehicle population of California

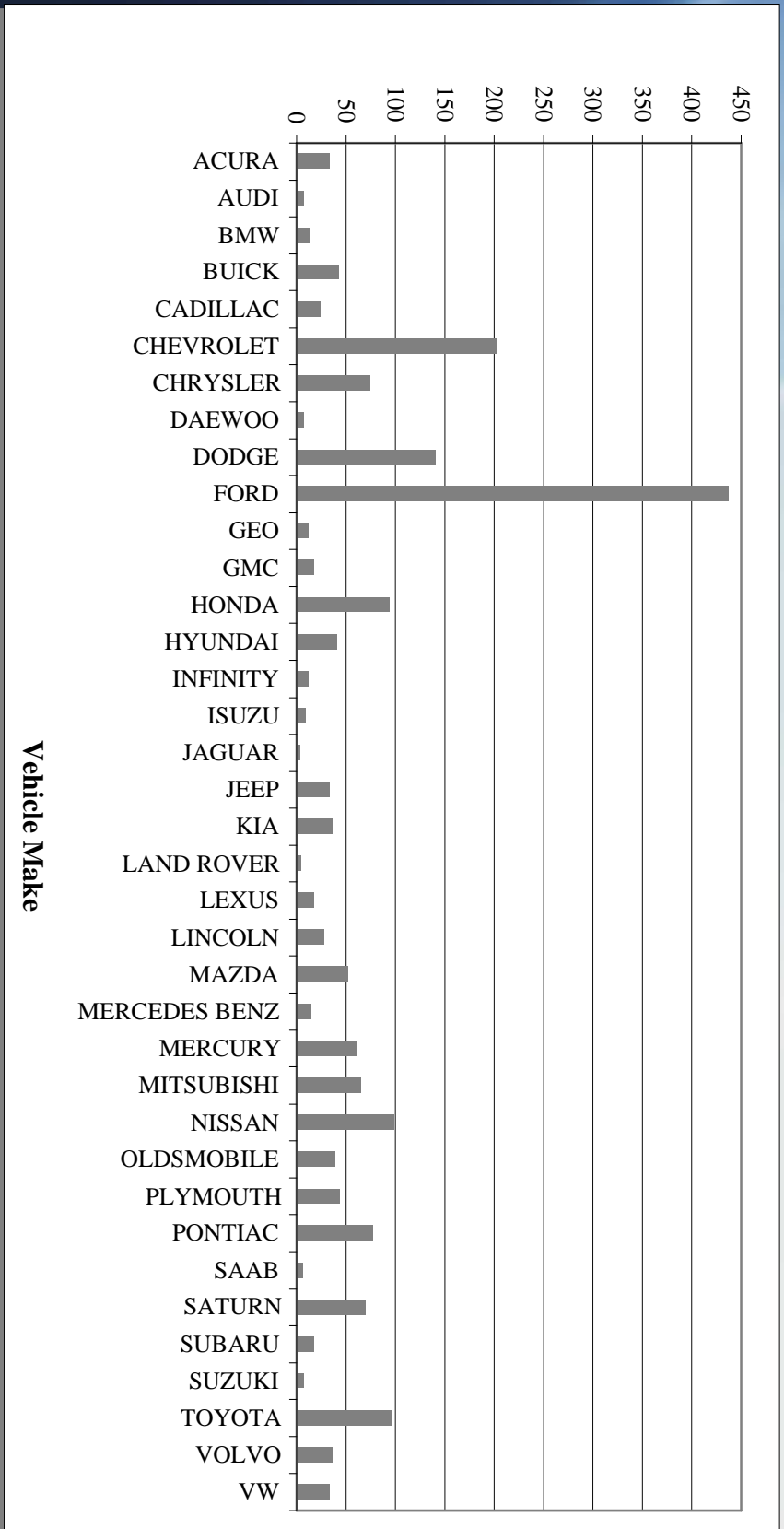
# 30 Sampling Locations



# Model Year Distribution for 2,002 Sampled Vehicles



# Vehicle Make for 2,002 Sampled Vehicles

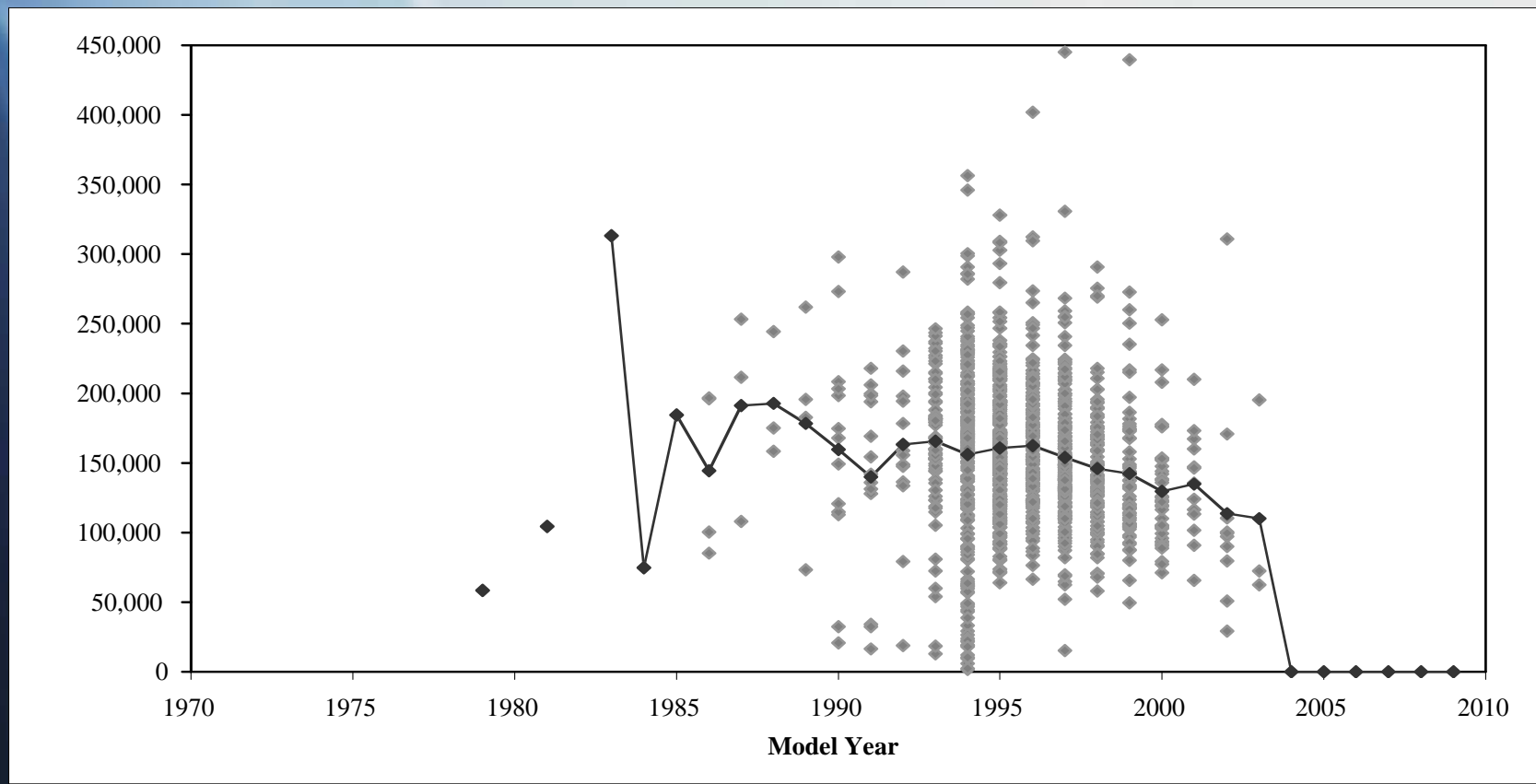




# Vehicle Type for 2,002 Sampled Vehicles

Vehicle type	Number of vehicles	Percentage of sample
Passenger car	1,427	71%
Full size van	34	2%
Mini van	205	10%
Pick up truck	101	5%
Station wagon	55	3%
Sports utility vehicle	180	9%

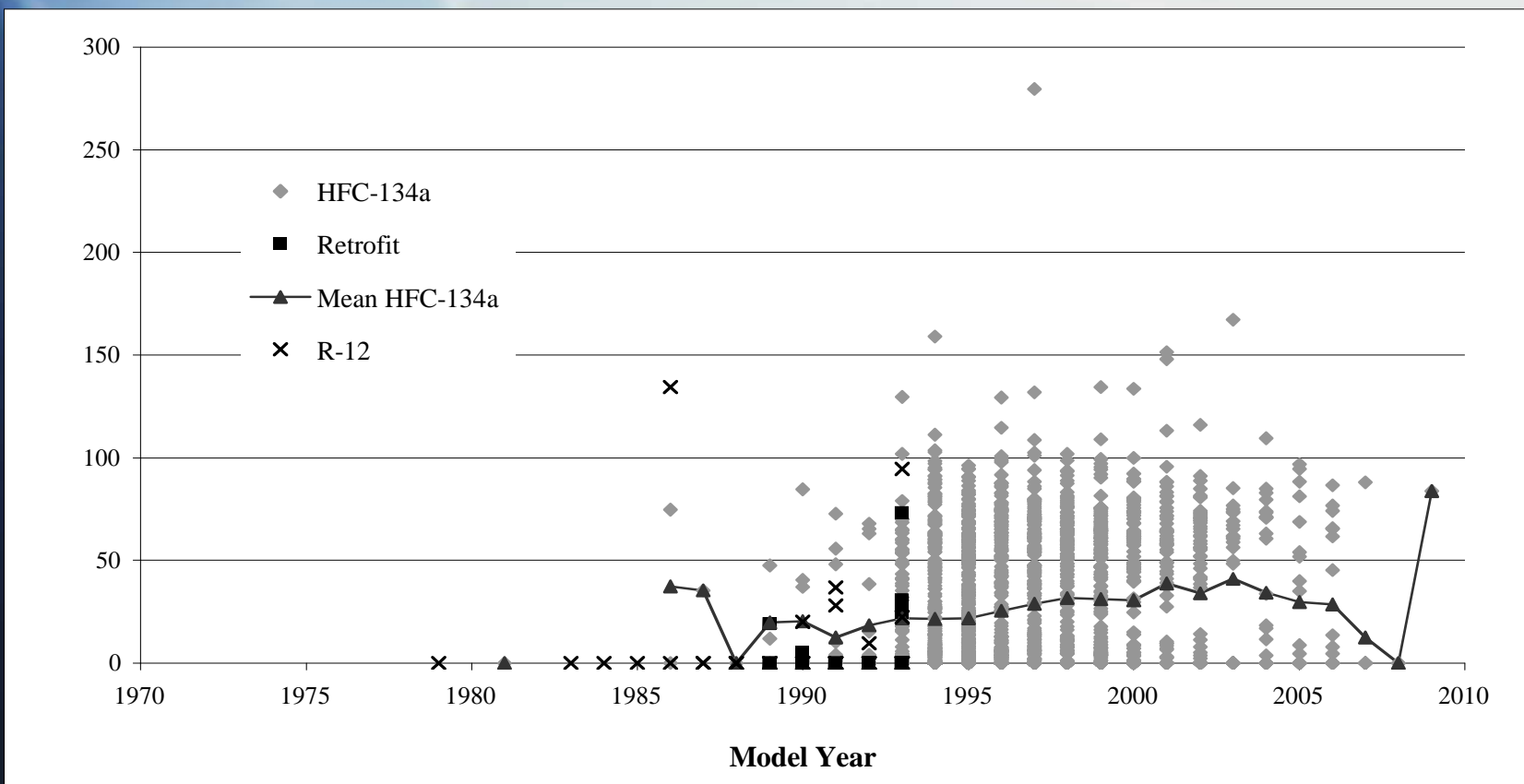
# Mileage by Model Year for 2,002 Sampled Vehicles



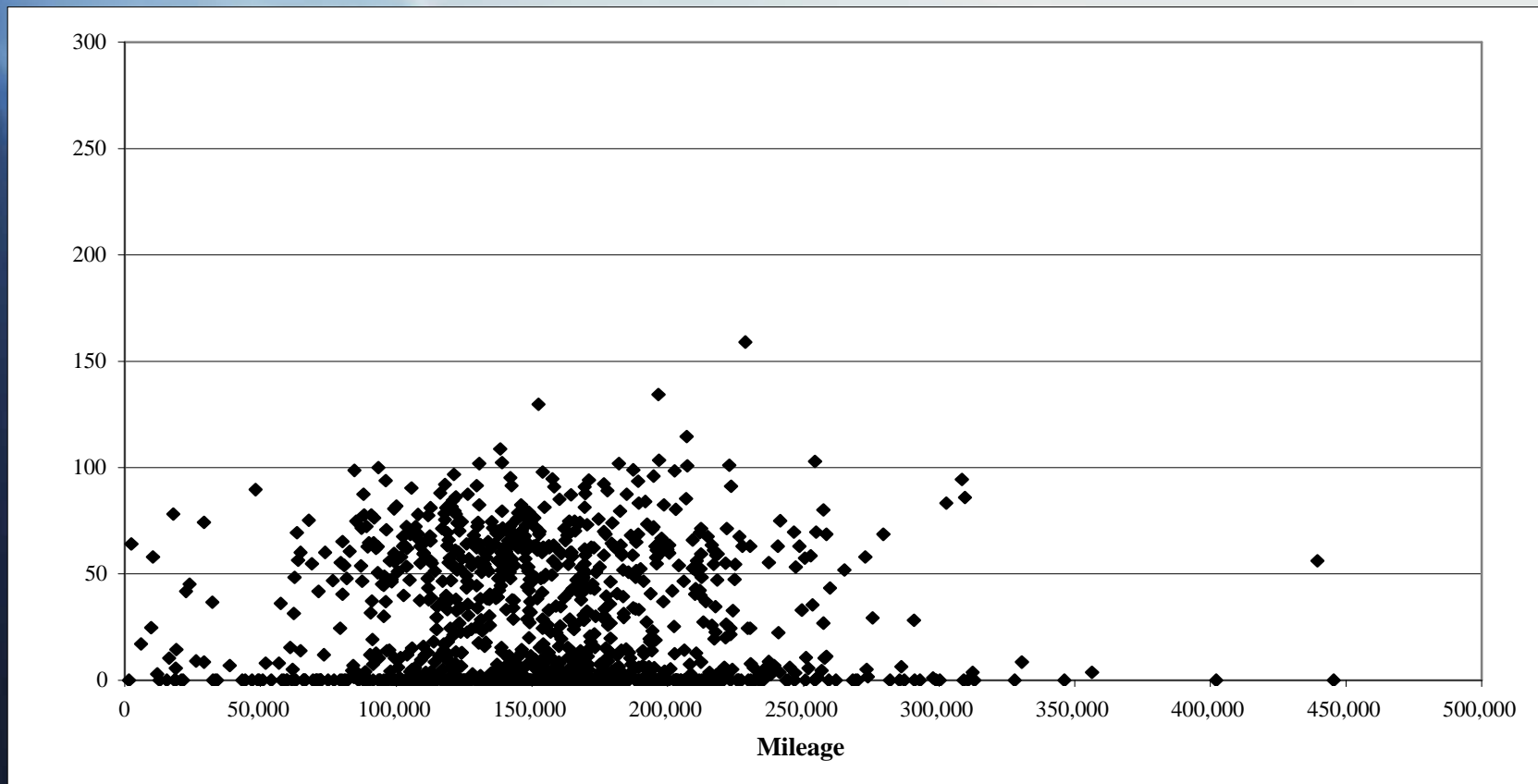
# Final CA DMV Status for 2,002 Sampled Vehicles

Sampled vehicles with CA DMV records	1,777
Issued a junk title	1,300
Issued a salvage certificate	24
PNO	17
Unclaimed registration	27
Other non-active registration status	410

# Recovered Refrigerant for 2,002 Sampled Vehicles by Refrigerant Type



# Mileage and Recovered Refrigerant for 2,002 Sampled Vehicles



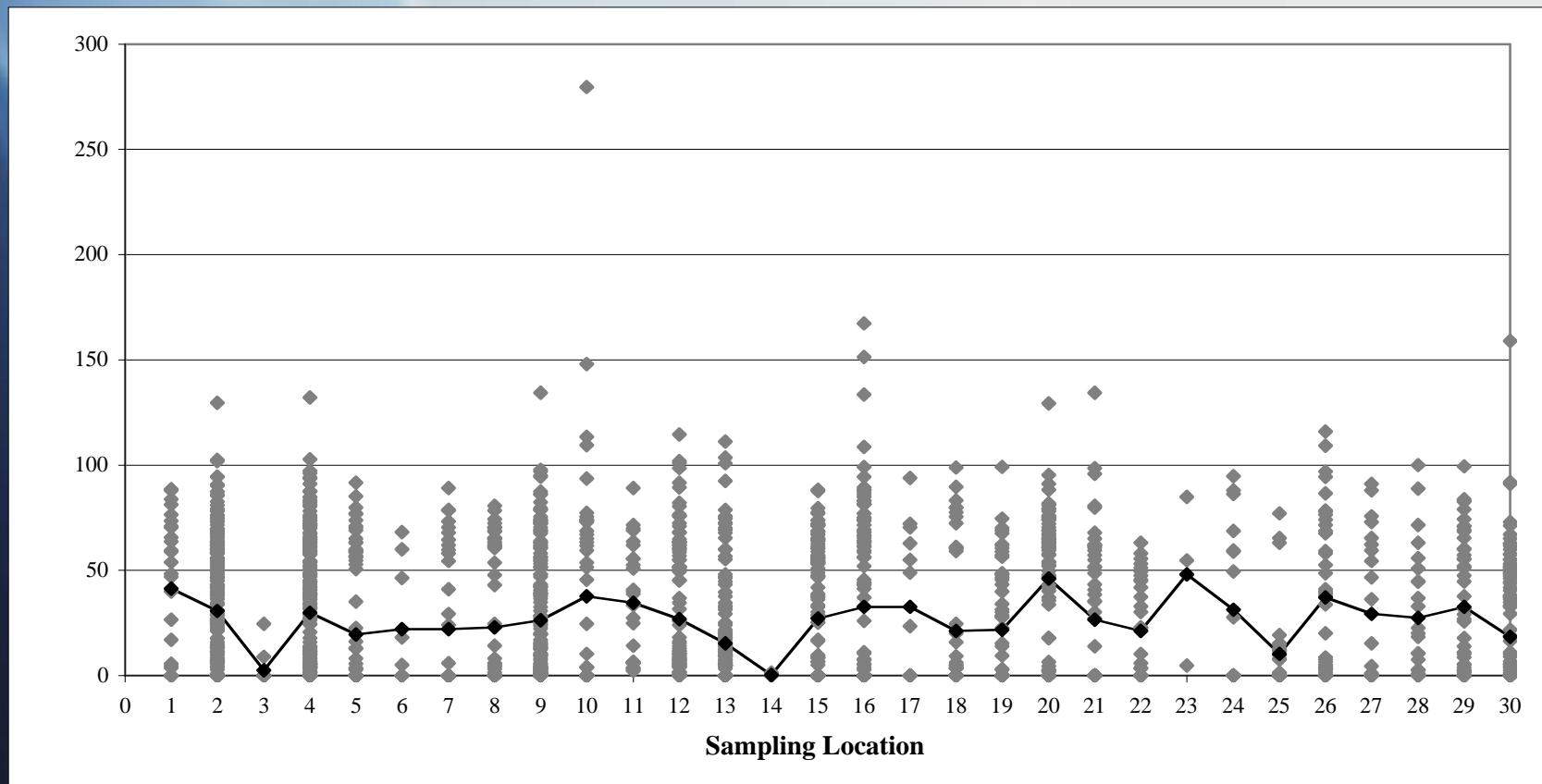
# Collision Status of Sampled Vehicles

Category	Number	Mean Model Year	Standard Deviation	Mean Refrigerant	Standard Deviation
No Collision	683	1996	3	30% 261 grams	29% 297 grams
Front End Collision	538	1998	3	21% 165 grams	30% 257 grams
Non-Front End Collision	375	1997	3	27% 251 grams	31% 294 grams
No Information	406	1997	4	30% 265 grams	37% 332 grams

## Model Year and Percentage Recovered Refrigerant by License Plate Status

Vehicle classification	Number	Mean model year	Model year standard deviation	Mean percentage recovered refrigerant	Percentage recovered refrigerant standard deviation
License plate	287	1996	3	38% 340 grams	35% 339 grams
No license plate	1,715	1997	3	25% 217 grams	31% 286 grams

# Percentage Recovered by Sampling Location

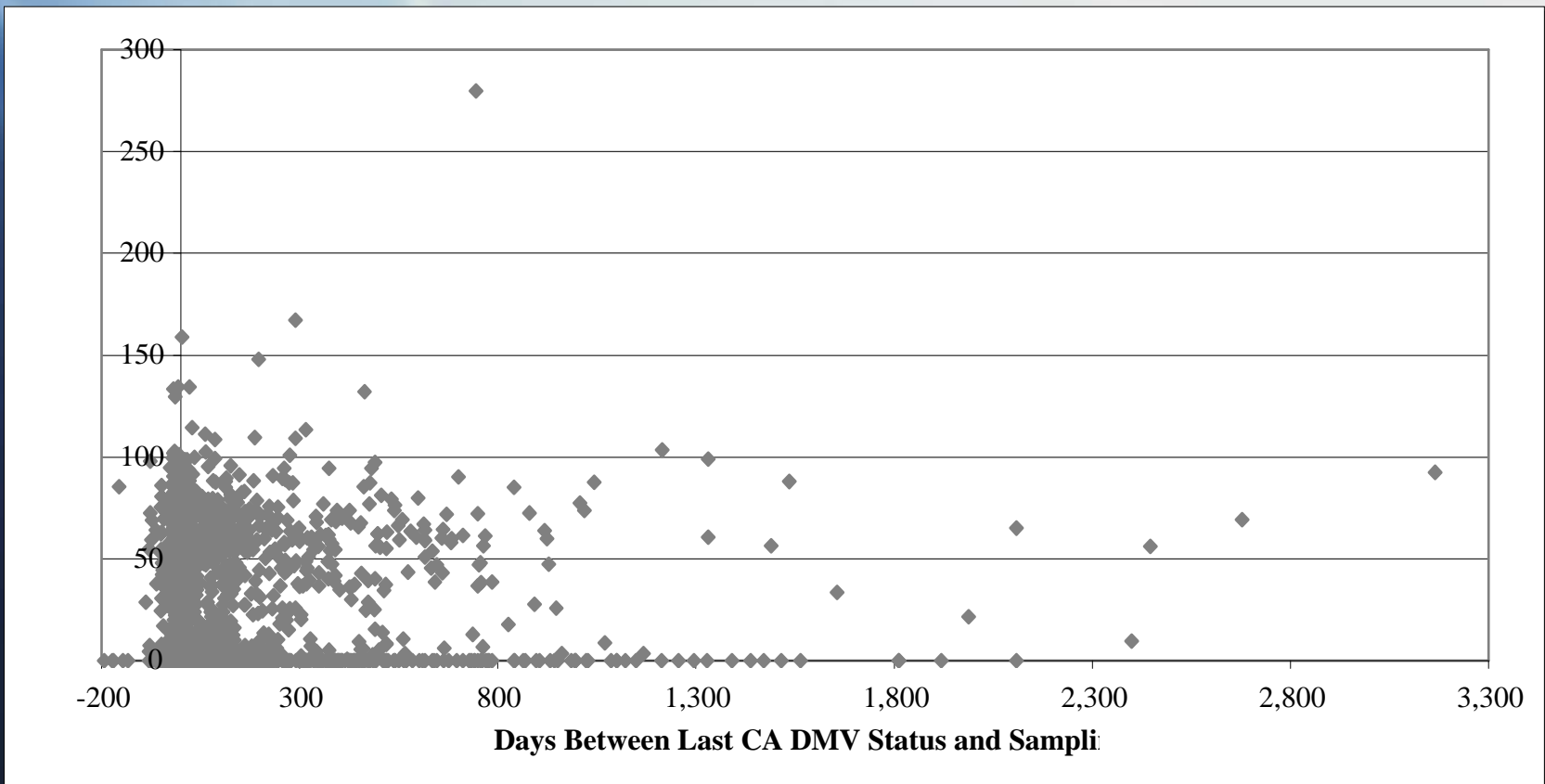




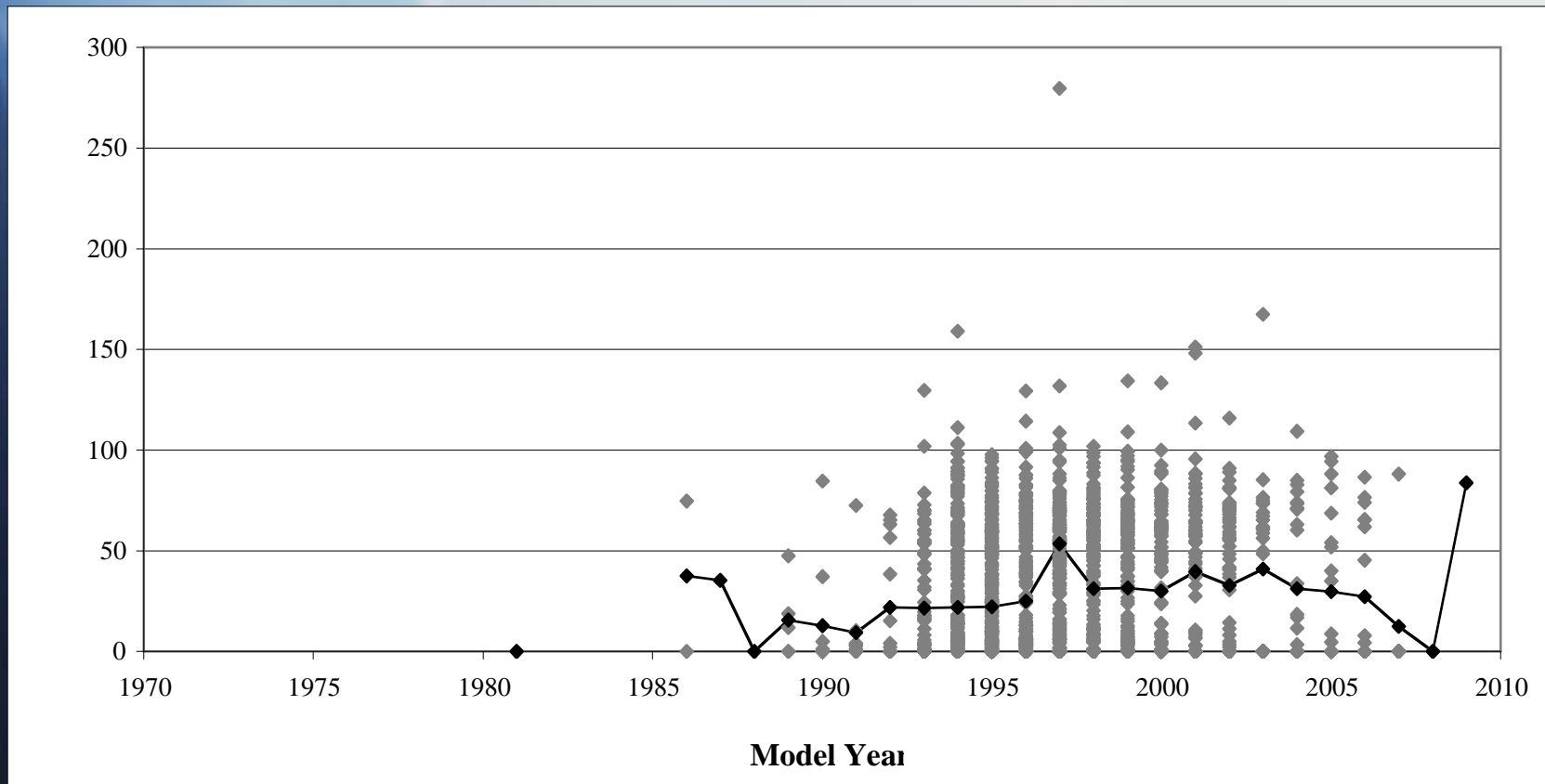
# Recovered Refrigerant by Last Smog Check Result for Sampled Vehicles

Final smog check result	Number of vehicles	Mean percentage recovered	Standard deviations
Abort	64	26% 260 grams	32% 331 grams
Fail	111	24% 206 grams	32% 287 grams
Pass	1,516	27% 238 grams	32% 295 grams
Tamper	4	36% 305 grams	40% 363 grams
No information	307	26% 221 grams	32% 305 grams

# Percentage Recovered and Days Between CA DMV Action and Sampling



# HFC-134a Recovered by Model Year for 1,340 Sampled ELVs



The background of the slide is an abstract composition of soft, flowing lines in various shades of blue and white. The lines are diagonal, creating a sense of movement and depth. The colors transition from a deep, dark blue on the left side to a very light, almost white blue on the right side. The overall effect is clean, modern, and professional.

In summation

# Caveats

- ELV Population and Vehicle Dismantlers
  - Missing CA DMV registration information 10% of vehicles with lapsed CA DMV registration status
  - Not a perfect proxy for vehicles on dismantler lots
    - 32% of sample were not classified as ELVs
  - Lack of data pertaining to unlicensed dismantlers
- Sampled Vehicles
  - High variance of recovered refrigerant across the sample
  - Stratification and sampling accuracy
  - Small sample relative to population

# California ELV Population, 2000 - 2008

- 8,537,707 ELVs
  - 2,098,887 were 1995 and newer model years
- 69% owned by licensed dismantlers in California
  - 1% owned by dismantlers without proper licenses in California
  - 30% owned by out of state and non-dismantling businesses

# California ELV Population, 2005 - 2007

- 3,190,430 ELVs
  - 32% were 1995 and newer model years
- 79% owned by licensed dismantlers in California
  - 1% owned by dismantlers without the proper licenses in California
  - 20 % owned by out of state and non-dismantling businesses

# Refrigerant Summary

- An average of 27% of refrigerant capacity, 234 grams, was recovered across all 2,002 sampled vehicles
  - 36 sampled vehicles contained R-12
  - On average, 10% of refrigerant capacity, 89 grams of R-12, was recovered from these vehicles
- 1,340 sampled vehicles contained HFC-134a and were classified as an ELV
  - On average, 26% of HFC-134a capacity, 220 grams of HFC-134a, was recovered from these vehicles



# California's ELV Population and HFC-134a

- From 2000 - 2008, an average of 35,398 kg of HFC-134a remained in ELVs on licensed vehicle dismantler lots each year
- By 2012, an average of 68,556 kg of HFC-14a will remain in ELVs on licensed vehicle dismantler lots each year