

Use of National Surveys For Estimating “Full” PHEV Potential For Oil Use Reduction

Presented at the PLUG-IN 2008 Conference held at
the McEnergy Convention Center, San Jose, California,
July 21-24, 2008

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Two Surveys Were Used For Estimating “Full” PHEV* Potential For Oil Use Reduction

1. 2001 National Household Travel Survey (NHTS)

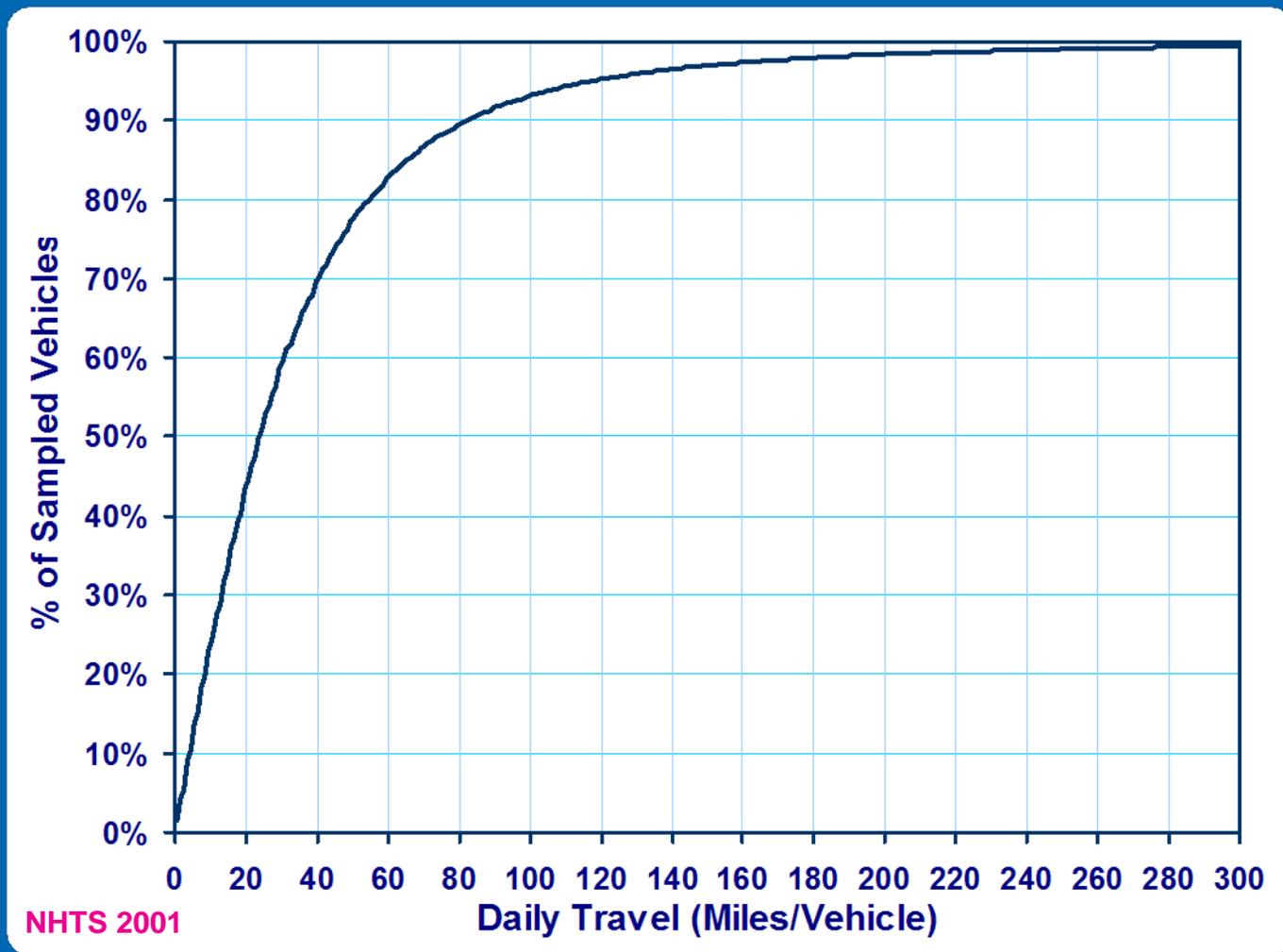
- ❖ Covered 69,817 households
- ❖ One-day travel data covered 642,292 person trips of which 387,431 were by vehicle drivers
- ❖ Useable data covered 84,916 vehicles making 366,084 trips

2. 2005 American Housing survey (AHS)

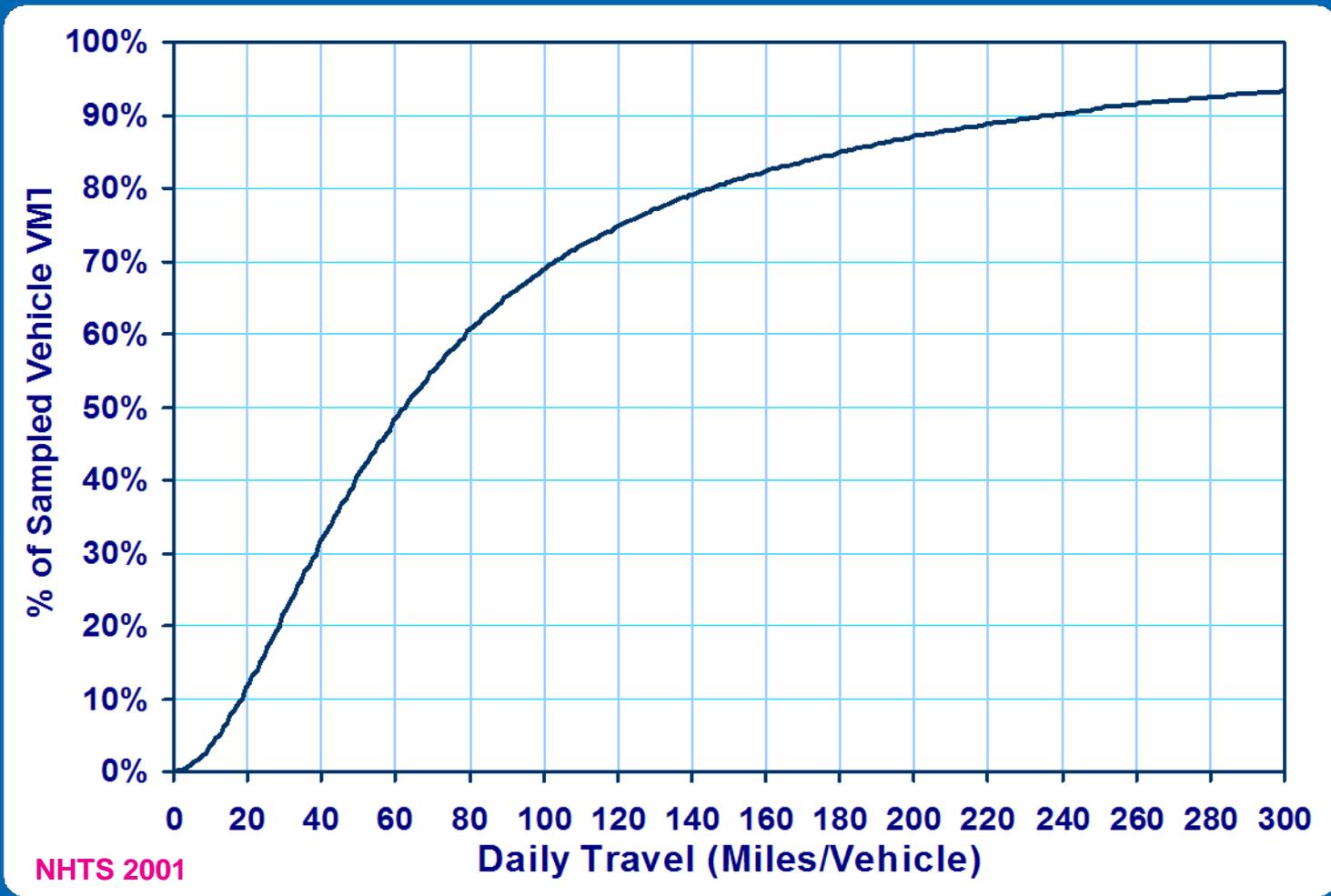
- ❖ Covered 56,650 interviews relating to 124.4 million housing units of which 108.9 million were occupied
- ❖ 64.3% of the occupied housing units are detached single units, 80.1% of those with a garage or carport
- ❖ 51.2% of detached single units are in MSA suburbs, 83.5% with a garage or carport

* A theoretical “full” PHEV is one capable of all electric operation at any speed

NHTS 2001 Shows 43.5% Vehicles Are Driven ≤ 20 Miles/Day and 83.7% Driven ≤ 60 Miles



Daily VMT Pattern shows 11.4% by Those Traveling ≤ 20 Miles and 48.2% for ≤ 60 Miles

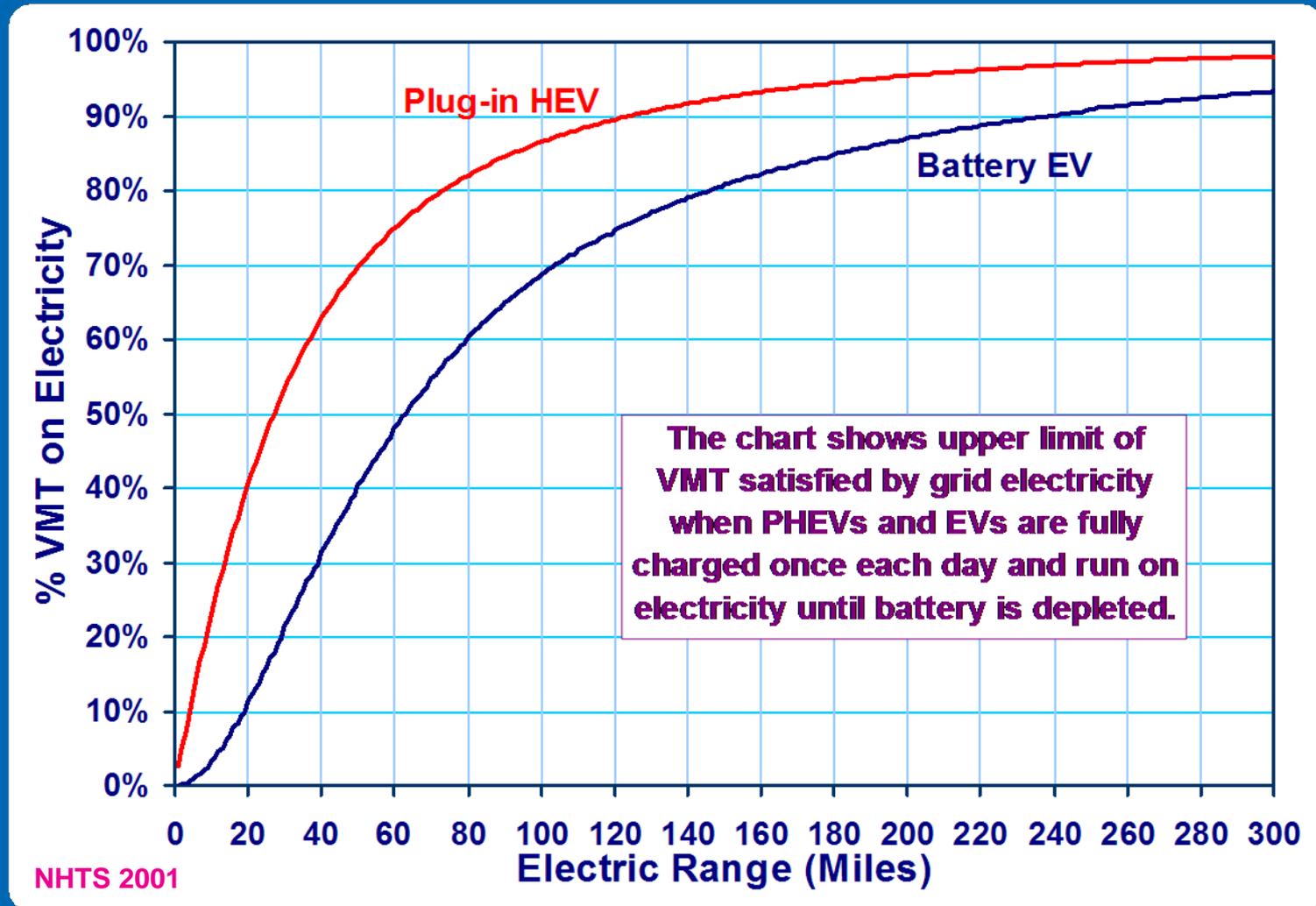


After an Overnight Charge All PHEVs Can Travel First Several Miles of the Day On Grid Electricity

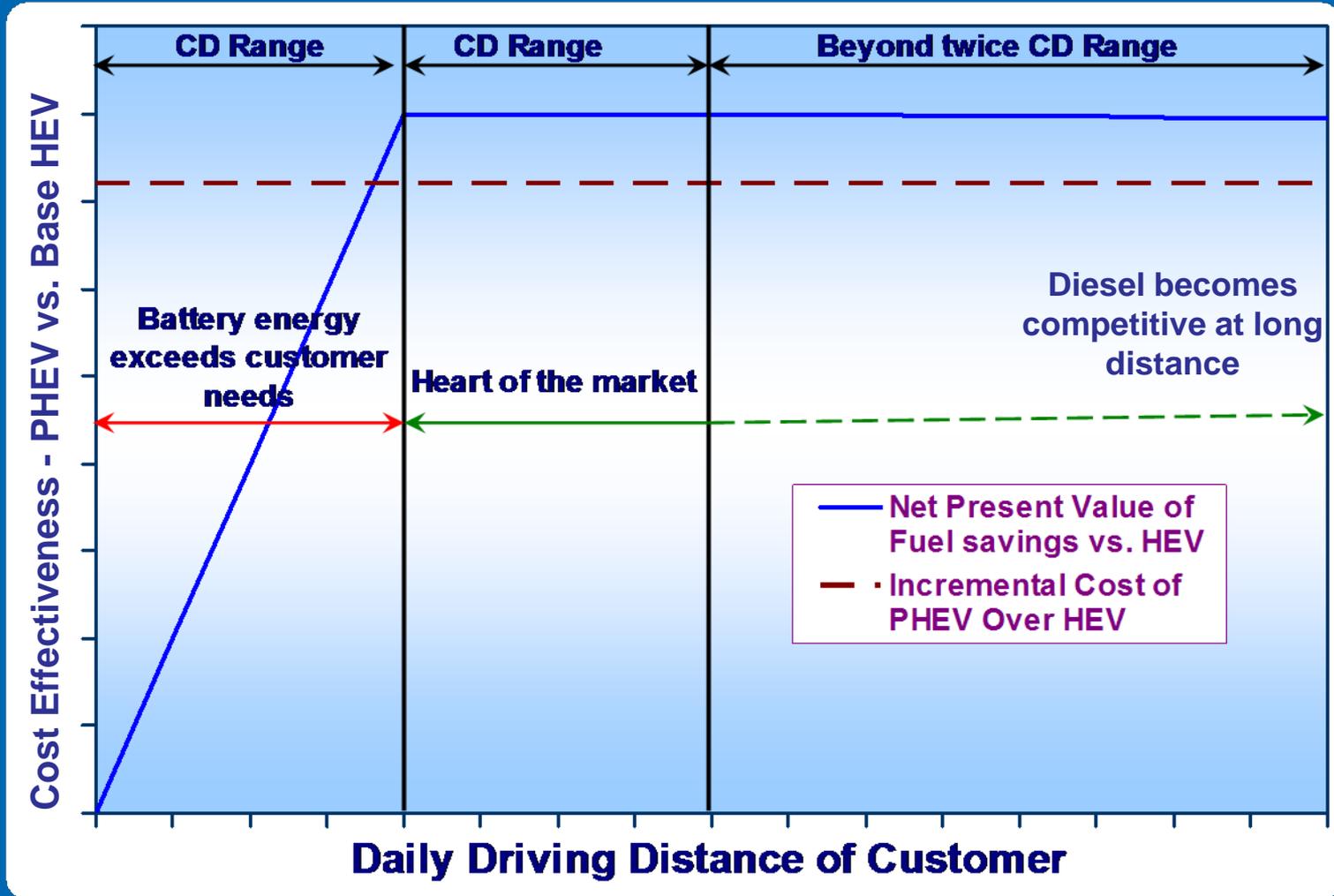
Daily Travel Range of Vehicle	VMT Share in NHTS 2001	1 charge/day - % “electric” VMT by EV or PHEV Type (Black = EV or PHEV, Red = PHEV only)				
		10 EV miles	20 EV miles	30 EV miles	40 EV miles	60 EV miles
Up to 10 Miles	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%
10.01-20 Miles	8.1%	5.3%	8.1%	8.1%	8.1%	8.1%
20.01-30 Miles	10.0%	3.9%	7.9%	10.0%	10.0%	10.0%
30.01-40 Miles	10.0%	2.8%	5.7%	8.5%	10.0%	10.0%
40.01-60 Miles	16.8%	3.4%	6.7%	10.1%	13.5%	16.8%
Over 60 Miles	51.8%	4.5%	8.9%	13.4%	17.9%	26.7%
PHEV Sum	100.0%	23.2%	40.6%	53.4%	62.8%	74.9%

Assumes one charge per day, 100% market penetration of only the specified EV or PHEV technology, and 100% EV CD mode until battery depletion (not blended charge depletion). Blended charge depletion requires more miles to use a given amount of kWh from the grid.

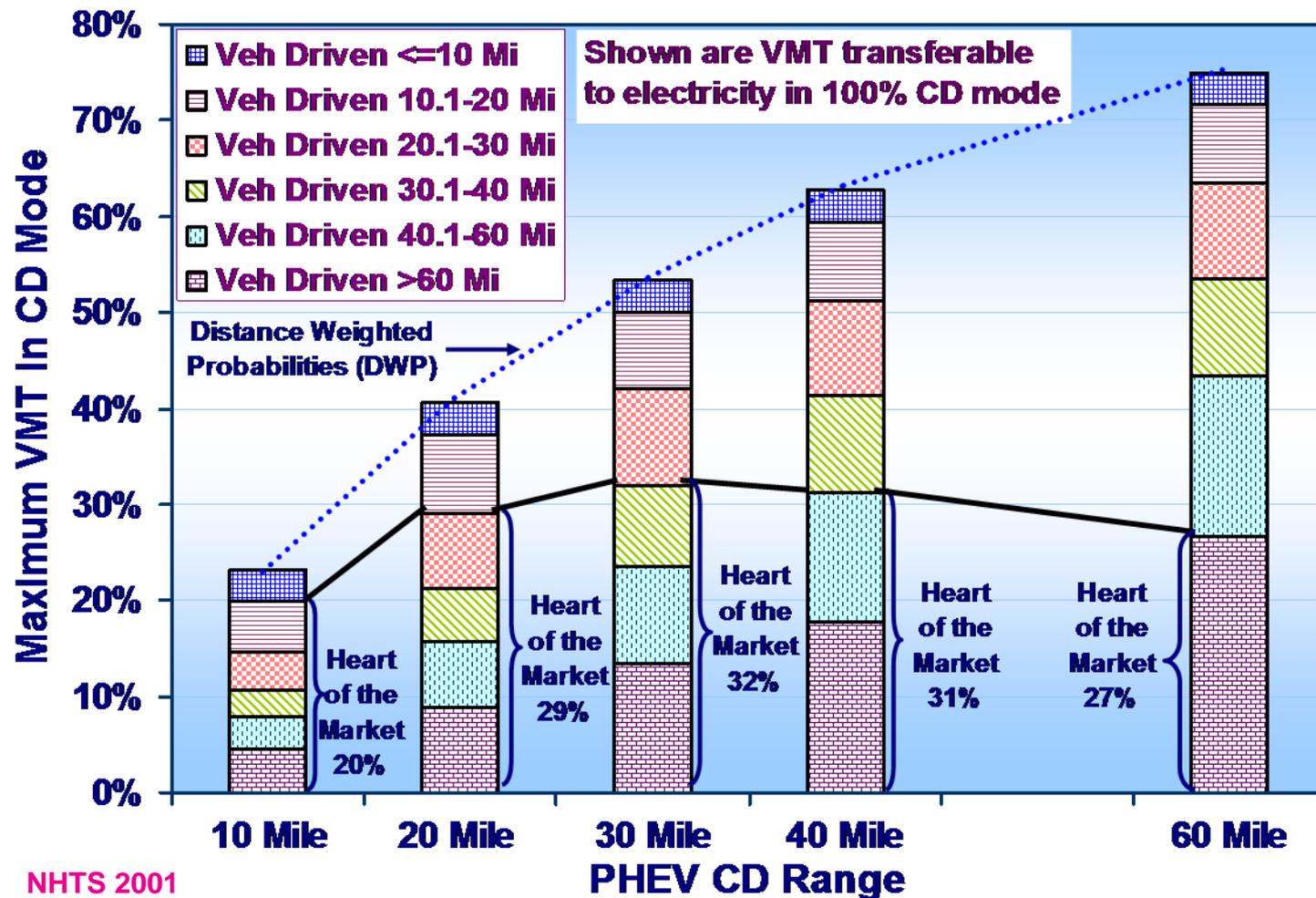
1 Charge/day “Full” PHEVs Can Convert ~ 40% of VMT if ~ 20-Mi. Electric Range, ~ 75% if ~ 60-Mi.



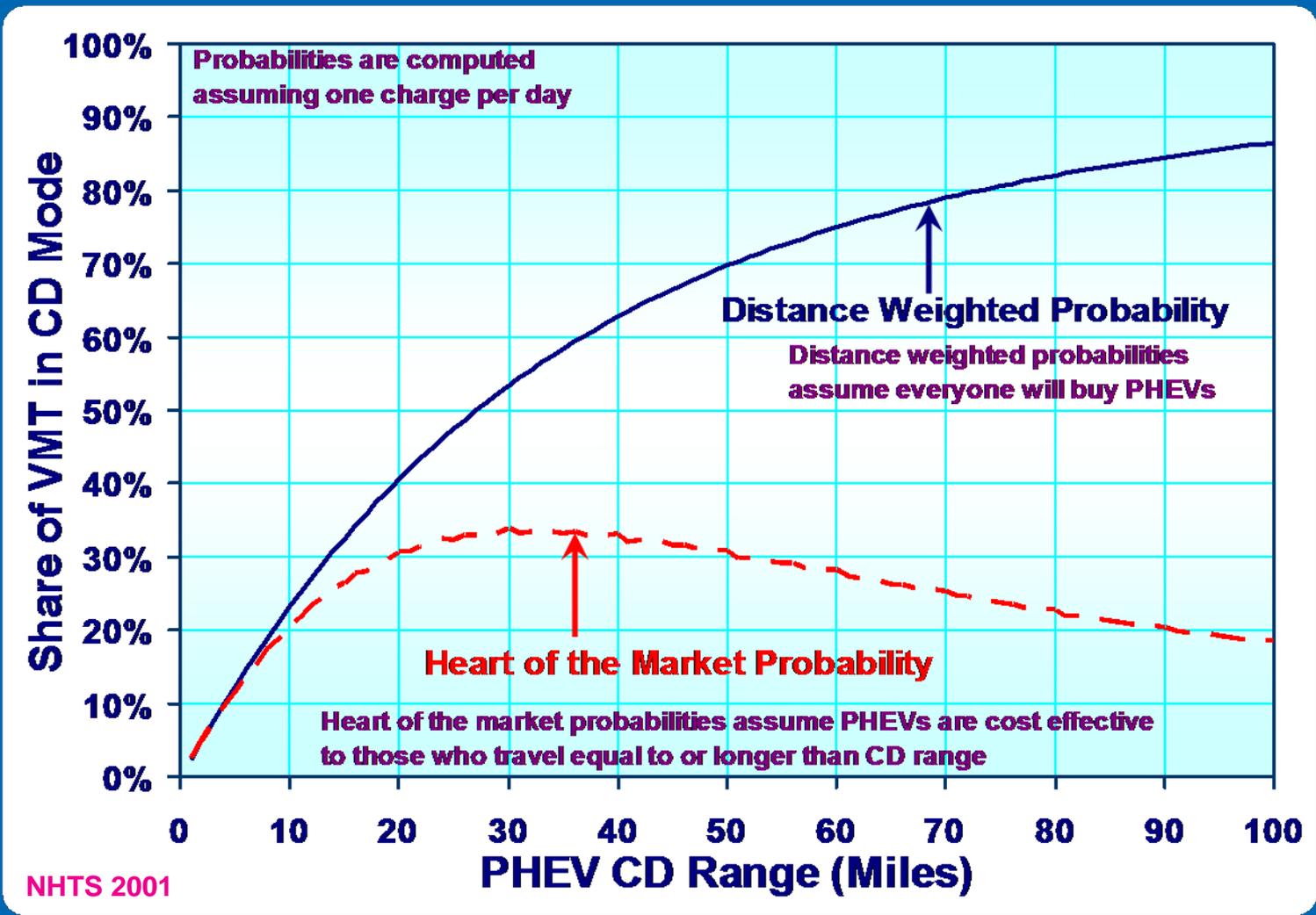
PHEV Cost Effectiveness Depends On Its Incremental Cost and Range vs. Customer Use



If Only One Charge Depletion Range Were Chosen for PHEV R&D, ~ 20-30 Mi. Seems Best



Cost Effectiveness – Selecting the Right Range – Would Determine Single PHEV Design Oil Reduction Potential



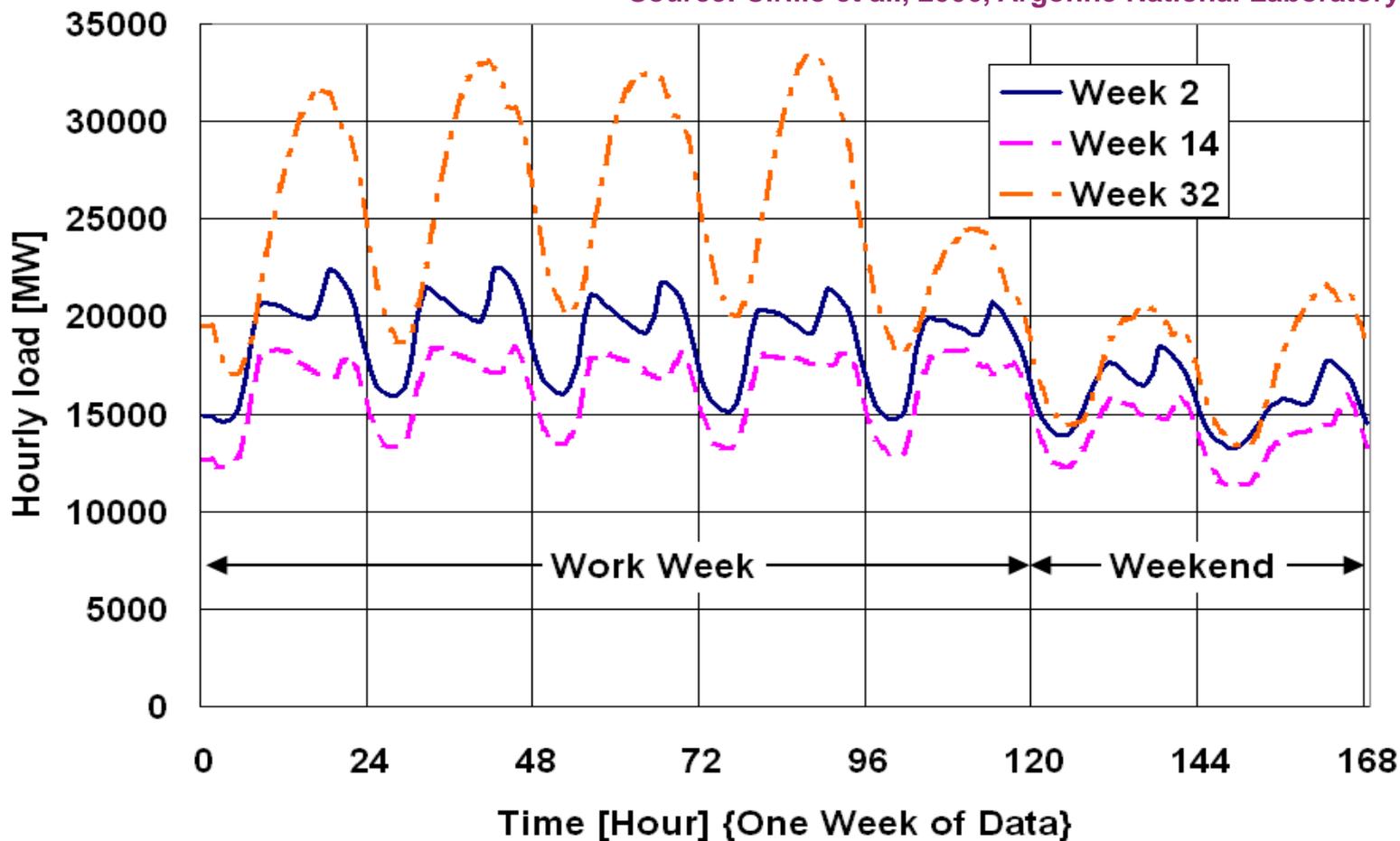
Changing Assumptions Changes Answers – What About Multiple Charges per Day?

- An attractive feature for PHEVs is excess electric capacity for overnight charging
- Which is less expensive, more marketable?
 - More battery capacity with faster(?) at home charging once/night, perhaps circuit upgrades
 - Less battery capacity, but more than 1 charge per day

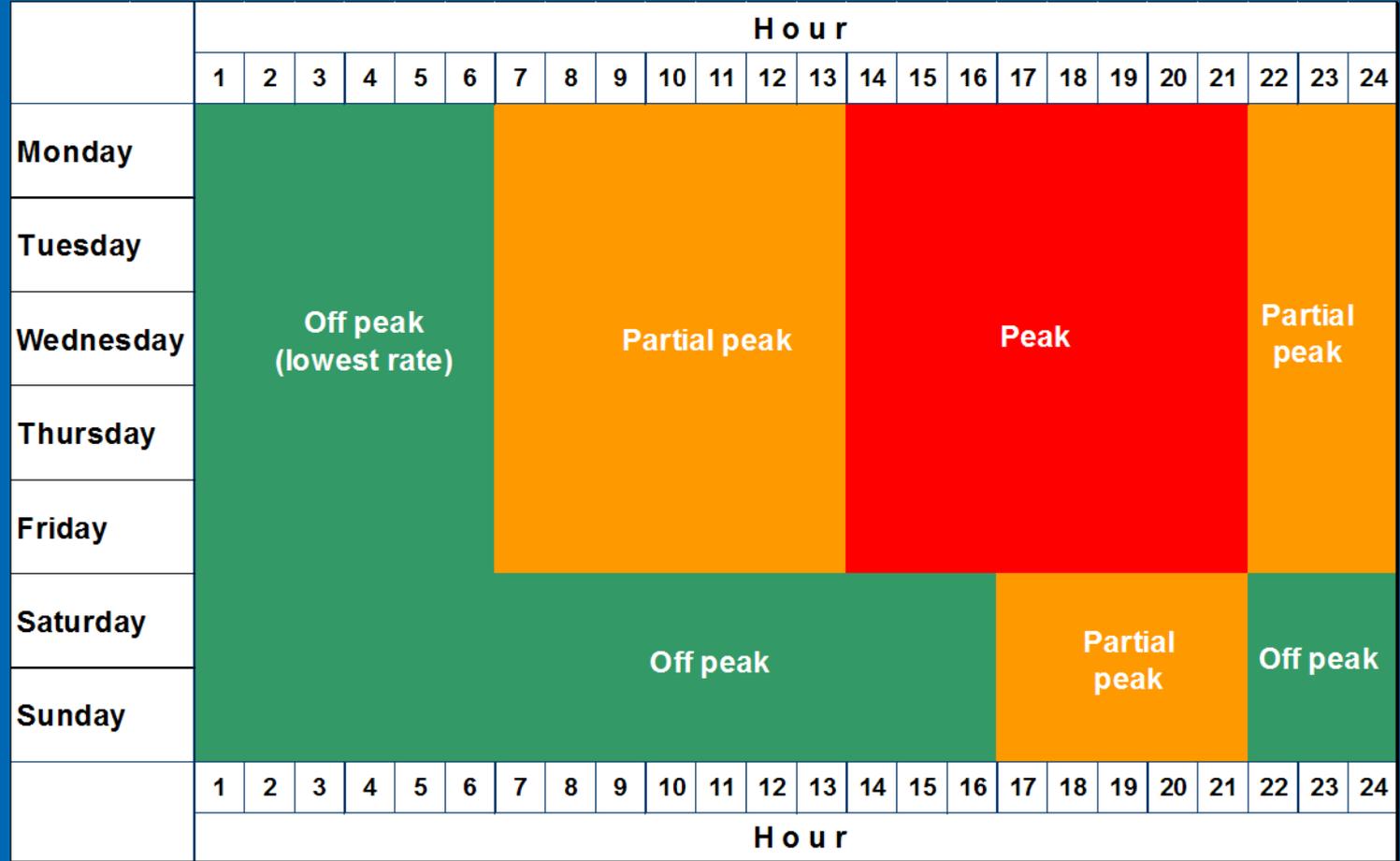
The topic is under study. Initial investigations of non-home charging patterns by trip type follow.

Night “Troughs” in Utility Load are Available to PHEVs All Year. Summer Afternoon Peaks Must be Avoided

Source: Cirillo et al., 2006, Argonne National Laboratory

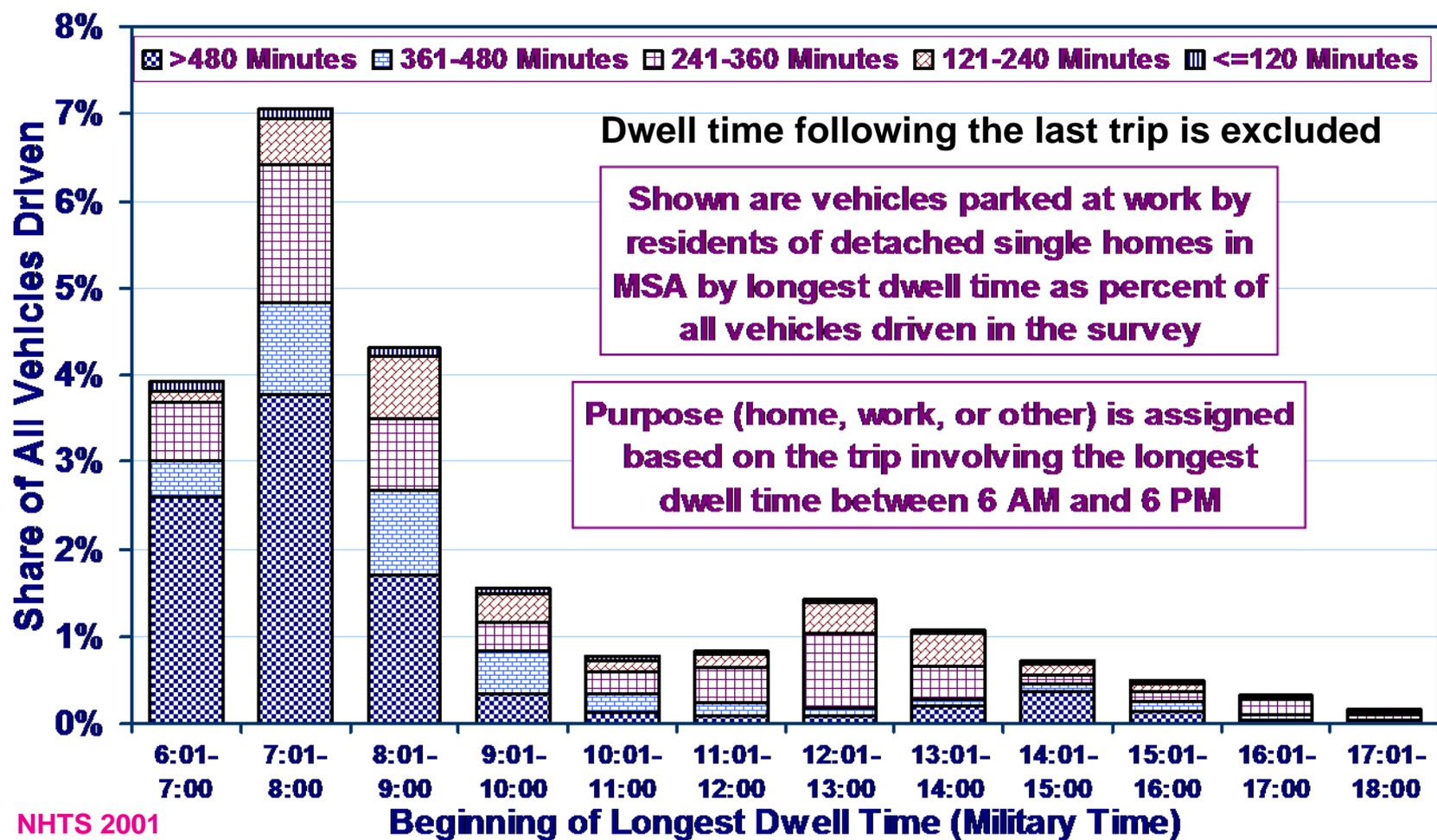


Electric Rate Structures Can Discourage/Promote Charging by Hour, Day, and/or Season

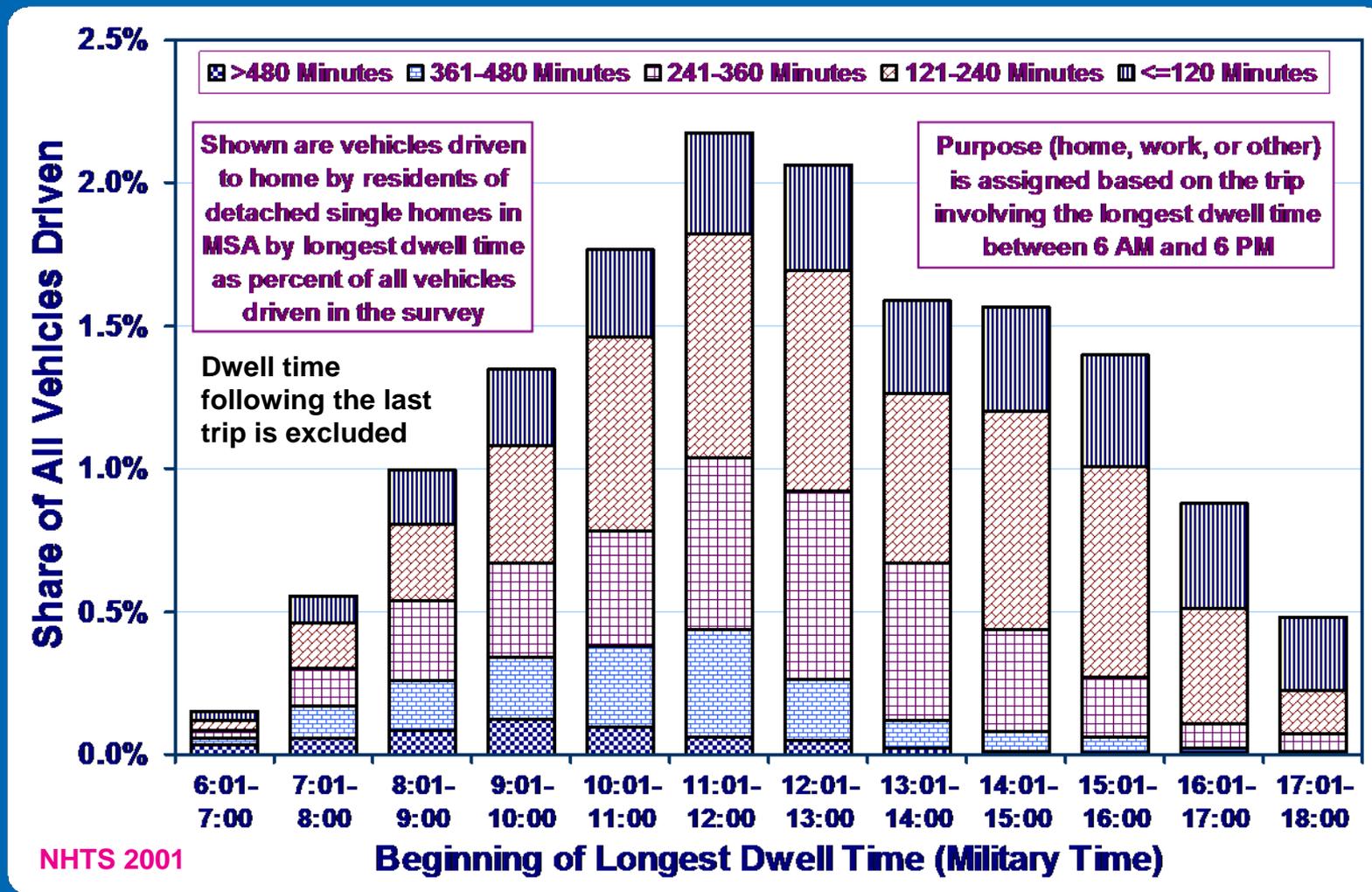


Pacific Gas and Electric summer rate blocks as a function of time and day

Early Starts & Long Dwell Times At Work Make Recharging Before Afternoon Peaks Possible



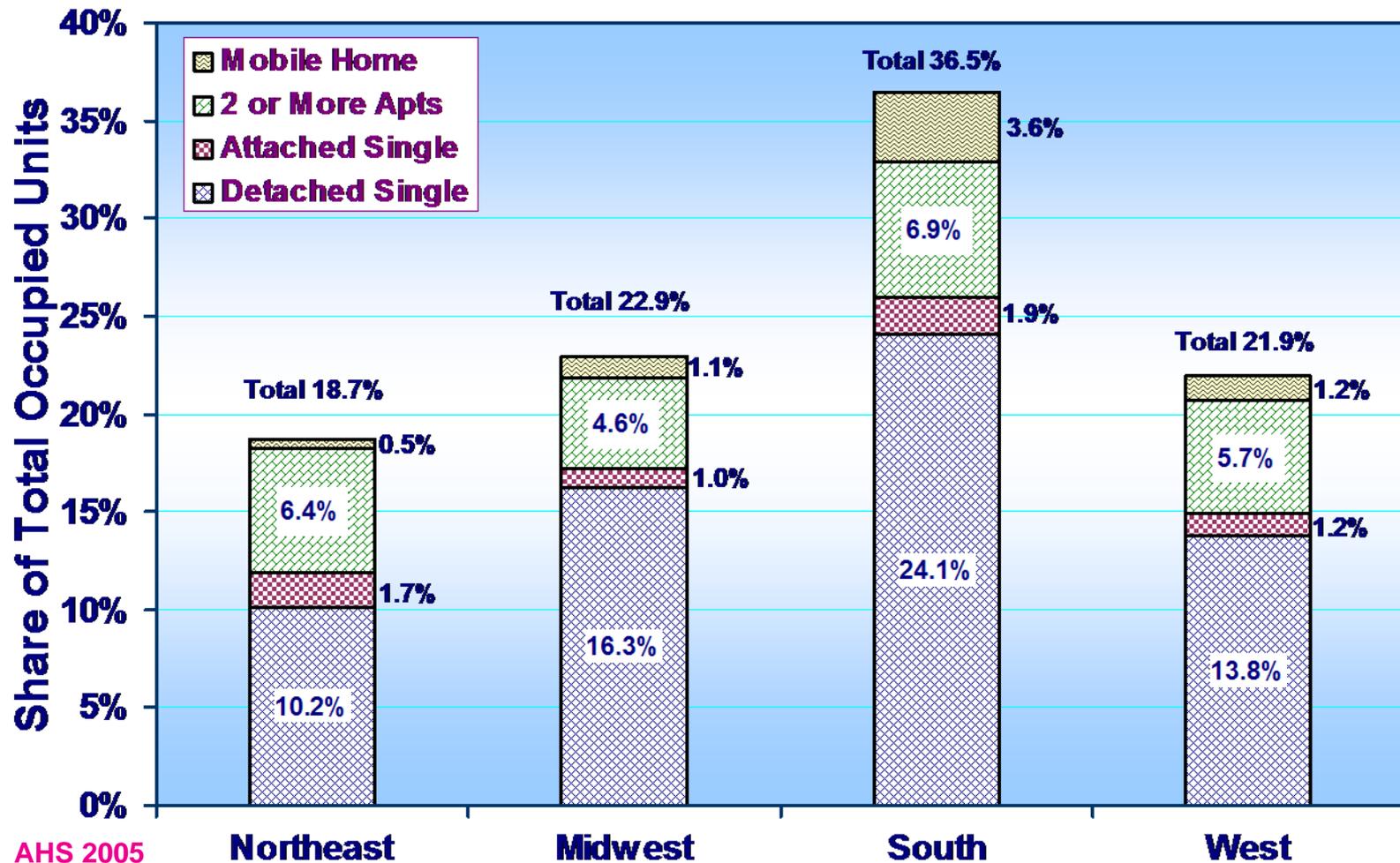
Workweek Afternoon Home Recharging May Clash With Utilities' Summer Peak Demand



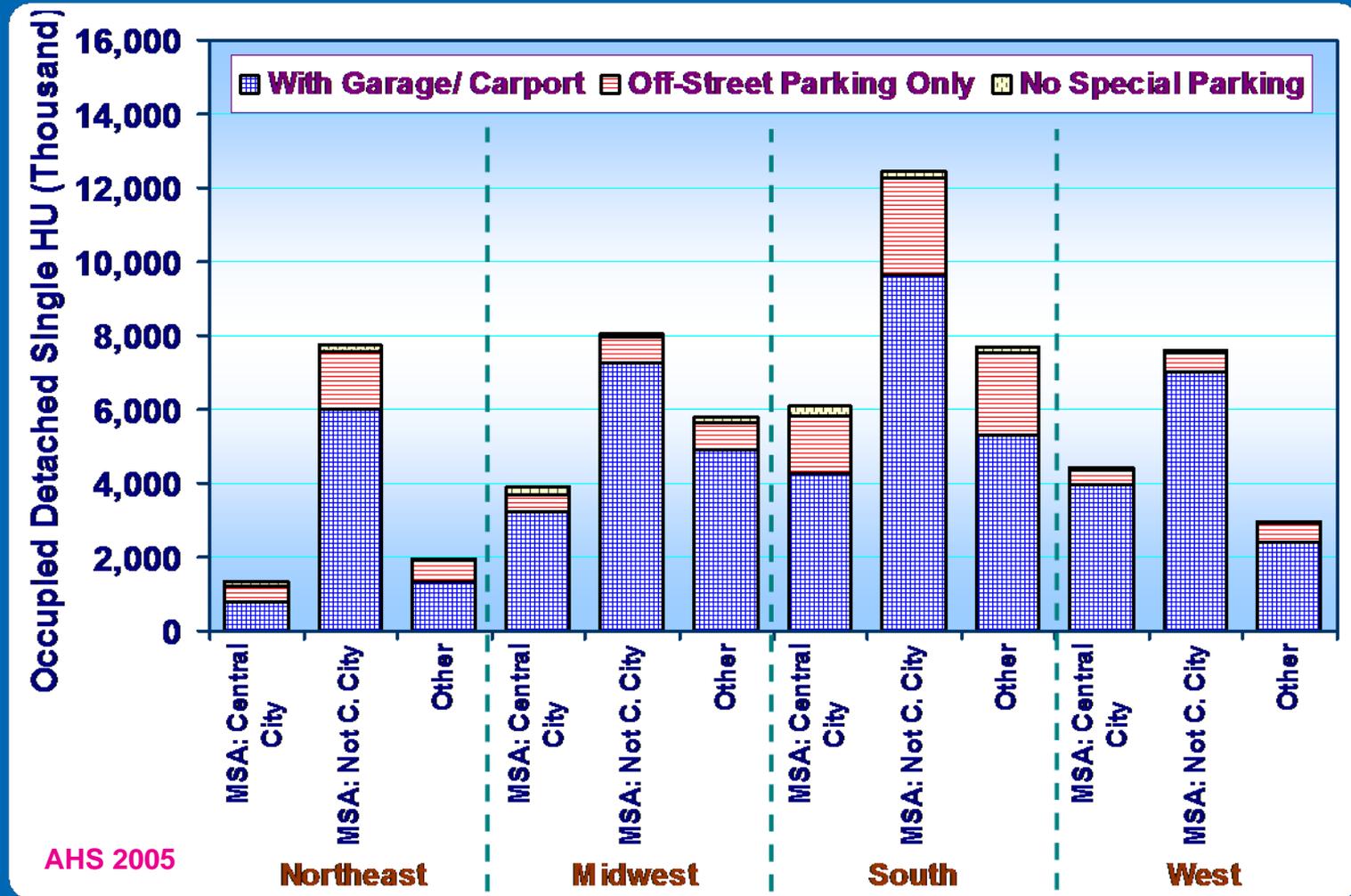
The Needed Match of Garages and PHEVs for Easy Charging will Constrain & Define the Market

- Residents of detached single units with garage or carport are most likely to buy PHEVs
- The South Region has more detached single units
- The highest proportion of detached single units are in MSA suburbs, most with a garage or carport
- Detached single home residents of low population density areas drive most vehicles
- As population density decreases
 - the mix of vehicles shifts from cars toward trucks
 - daily miles per vehicle increase

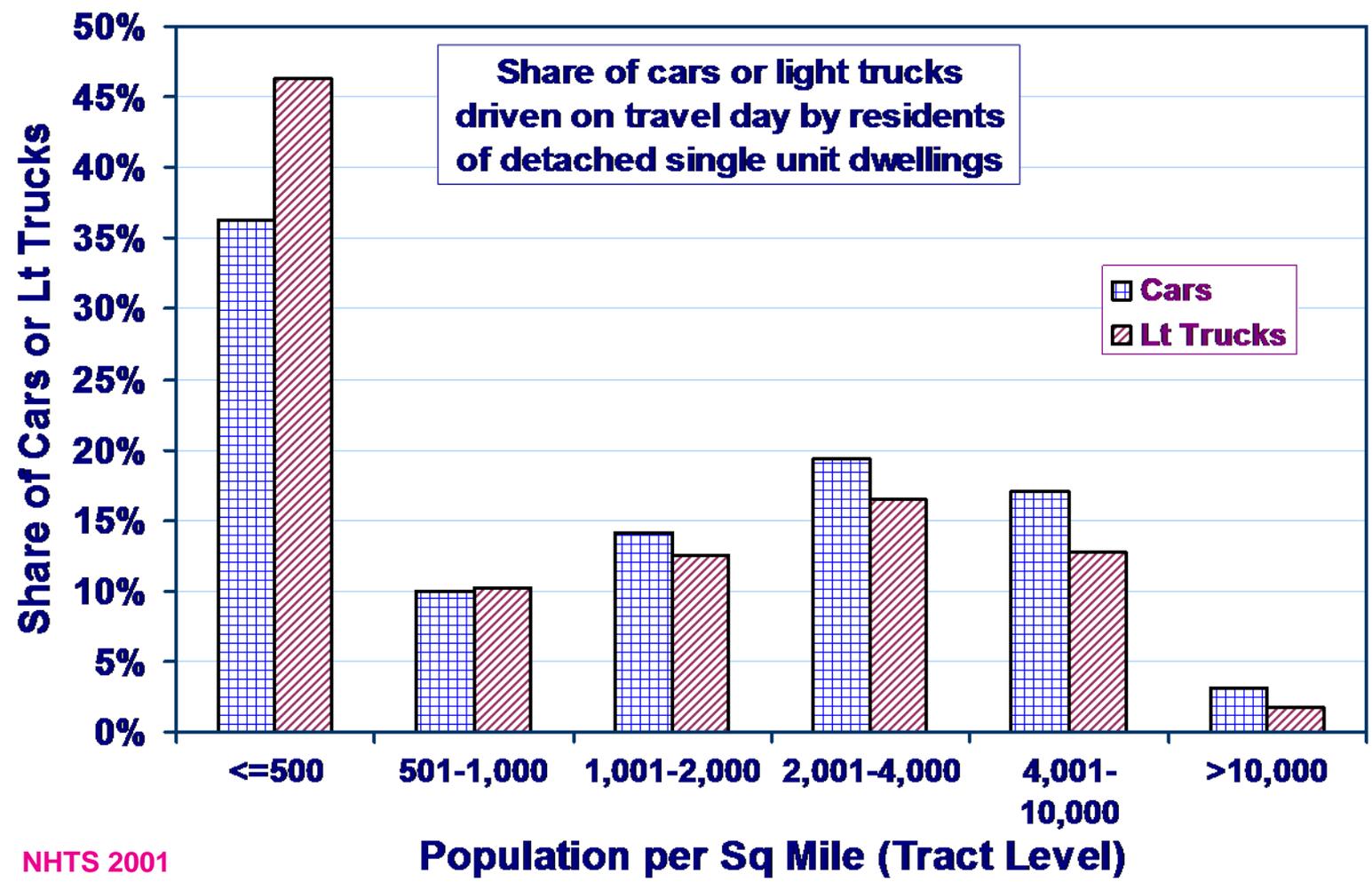
South Region (Stretching from Delaware to Texas) Has More Detached Single Units



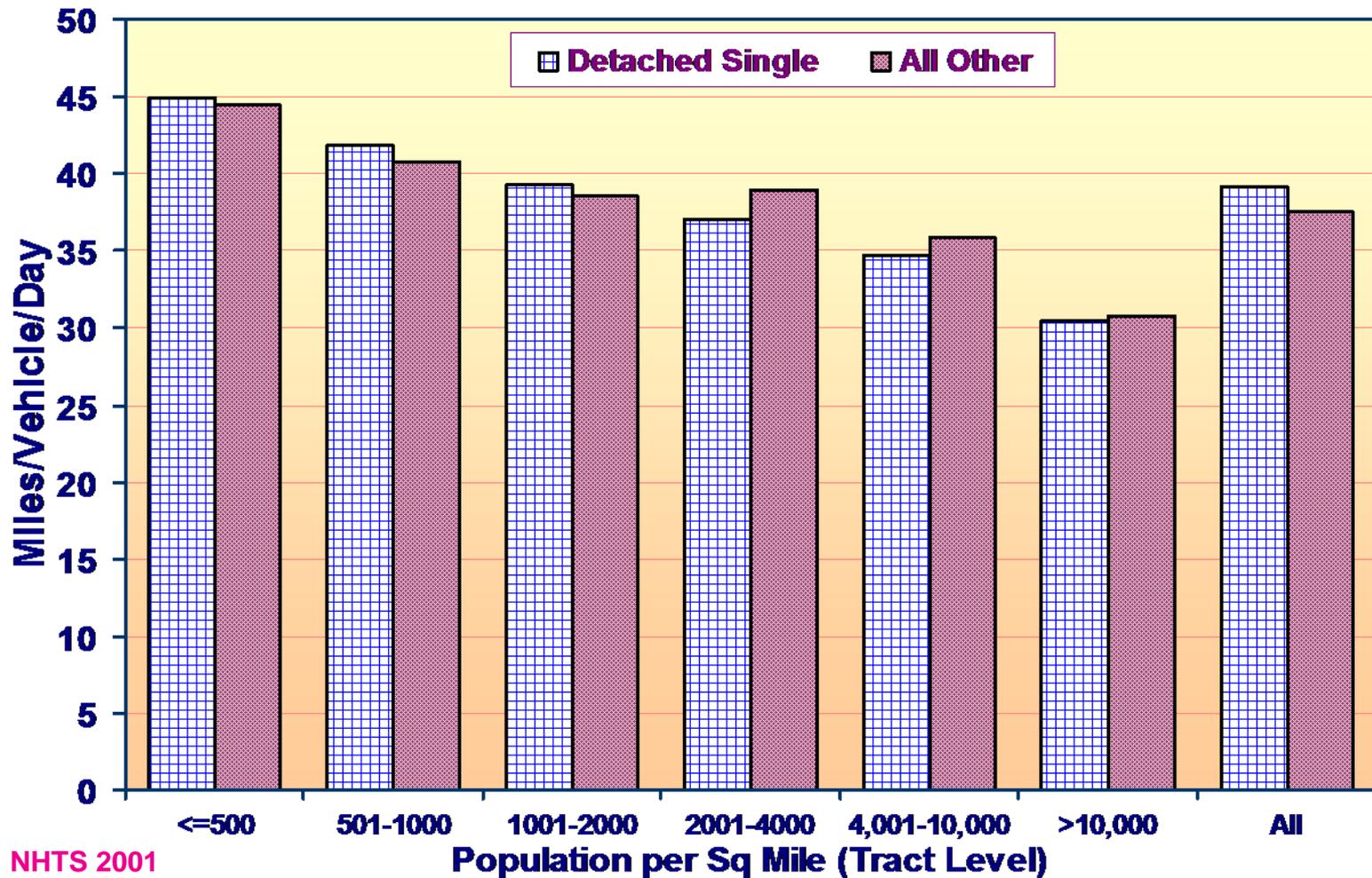
A Majority of Detached Single Units Are in MSA Suburbs, Most With Garage or Carport



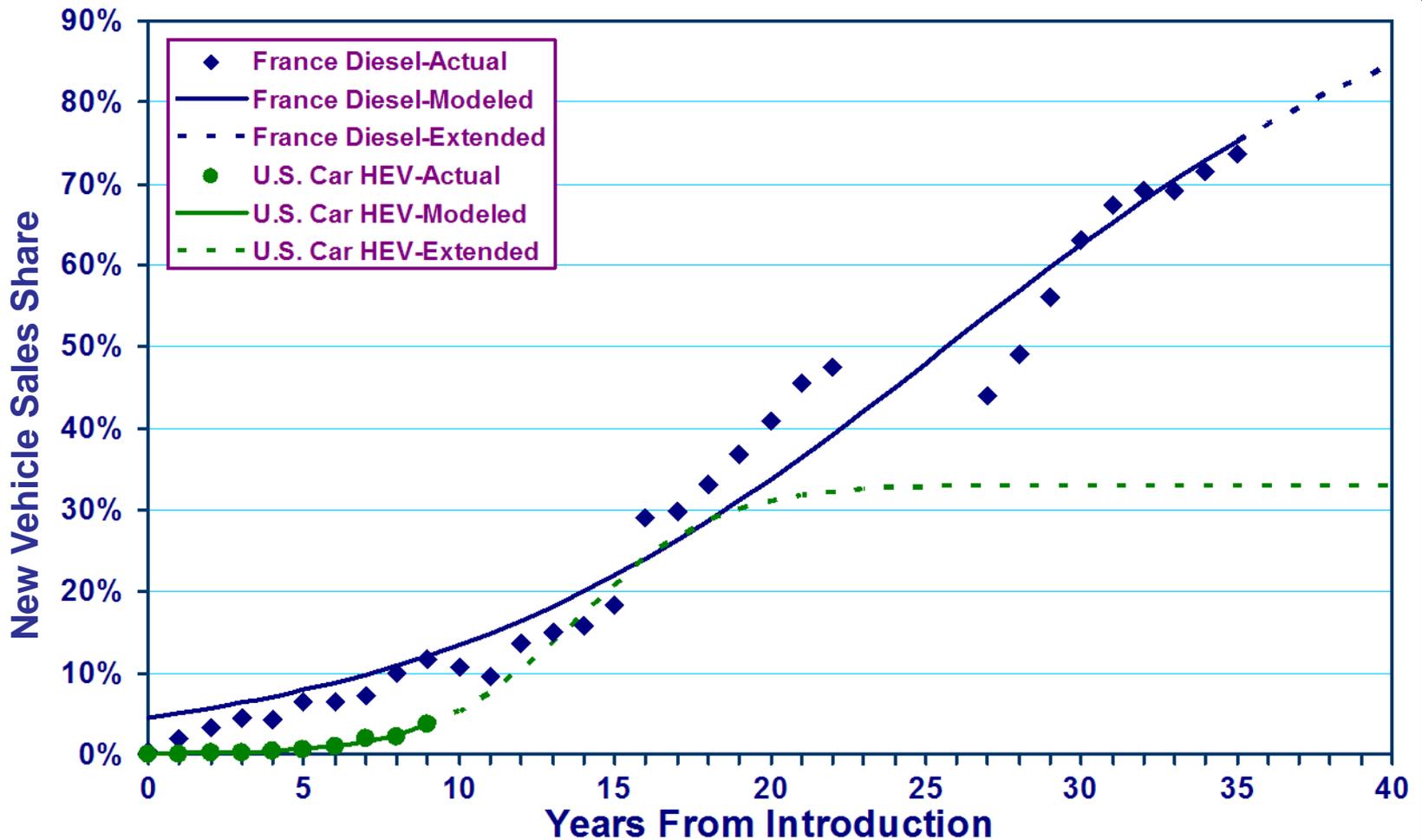
Single Home Residents of Low Population Density Areas Drive More Vehicles



Daily Miles per Vehicle Geographically Vary, Increasing As Population Density Decreases



A Powertrain Technology May Take 20-40 Yrs to Reach its Potential New Vehicle Sales Share



PHEVs May Not Ever be a Universal Powertrain, and Will Take Time to Reduce Oil Use

- **Matching widely varying customer driving to the “right” PHEV electric range with only a few PHEV designs is challenging**
- **Multiple off-peak charges per day would increase oil use reduction per PHEV, but new charging infrastructure would be needed**
- **Although widely available, garages and carports for PHEV charging are not everywhere**
- **Even with technical success, production capabilities and new PHEV sales will be built up slowly**
- **Finally, slow fleet turnover (~7-8%/year) requires time to accomplish large scale change**

THANK YOU

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The Following Methodology Was Used In Analyzing the 2001 NHTS

- ❖ **Travel day driver trips with a valid vehicle number, non-zero travel distance, and non-zero travel time were selected**
- ❖ **For each vehicle within a household, travel distances and travel times were summed**
- ❖ **Average trip time is computed as sum of time divided by number of vehicles within control variables**
- ❖ **Average speed is computed as sum of miles divided by sum of hours within control variables**
- ❖ **All trips by a vehicle within a household were compiled by start time with several other attributes for future analysis**