

# Impact of Neighborhood EV (NEV) Use in California on Air Quality



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# **NEV use was determined from three surveys conducted by telephone interviews of NEV owners in California**

- **July 2003: Survey of 260 2001-2 model year owners**
  - ~100 were business owners, some with small fleets of NEVs
- **July 2005: Re-survey of 2003 respondents**
- **August 2005: Survey of ~100 2005 model year owners**
  - ~65 were business owners, some with small fleets of NEVs

**Each survey examined the use behavior**

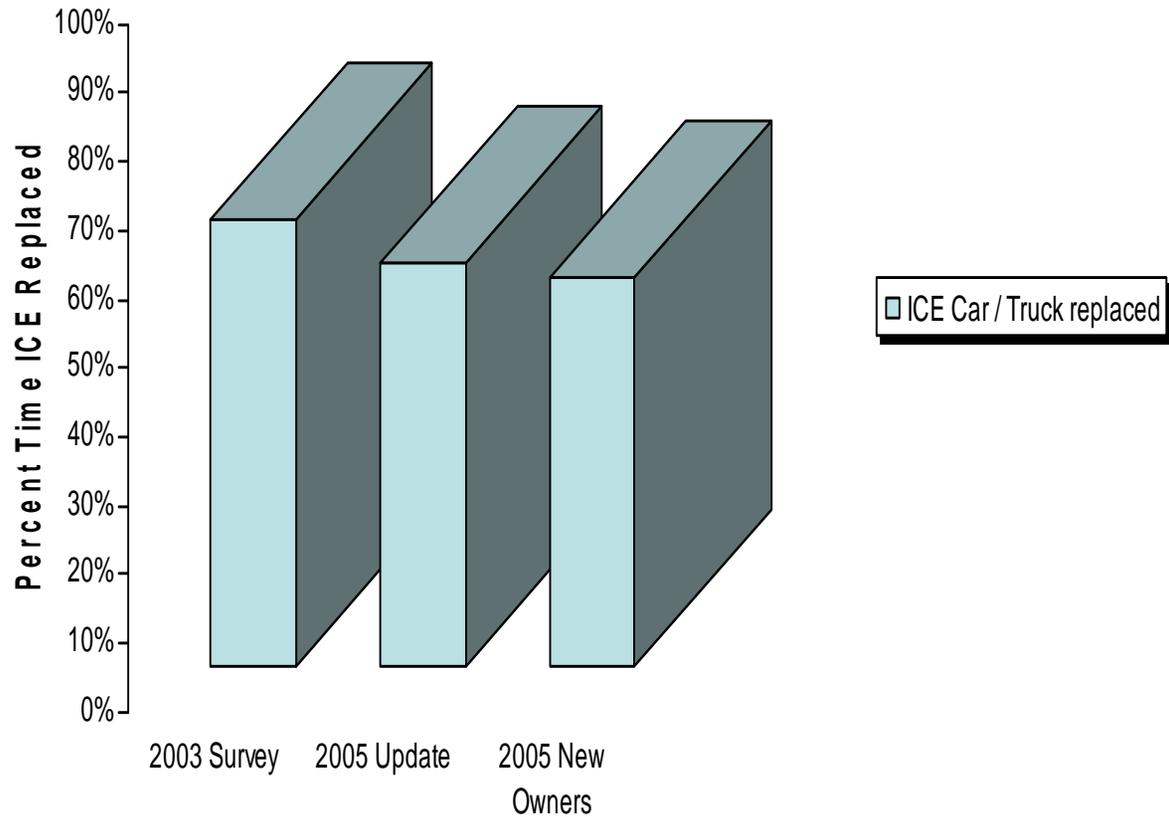
**From this use behavior, air quality impact was calculated**

# **First, some general observations about use**

- **More than 16,000 NEVs are on the road today in California**
- **The dominant manufacturer is GEM, with ~13,500 on the road**
- **Sales began in 1998 and continue today with the fleet growing at over 1000 per year**
- **There was a sharp spike in sales from 2001 through 2003 when maximum “Zero Emission Vehicle” credits were offered (4 credits per vehicle placed into service)**
- **NEVs are well entrenched as an important mode of personal, commercial and small fleet transportation in California**

# NEV owners prefer to travel in NEVs

NEVs replace the use of cars and light trucks approximately two-thirds of the time, reducing congestion and cold-start emissions

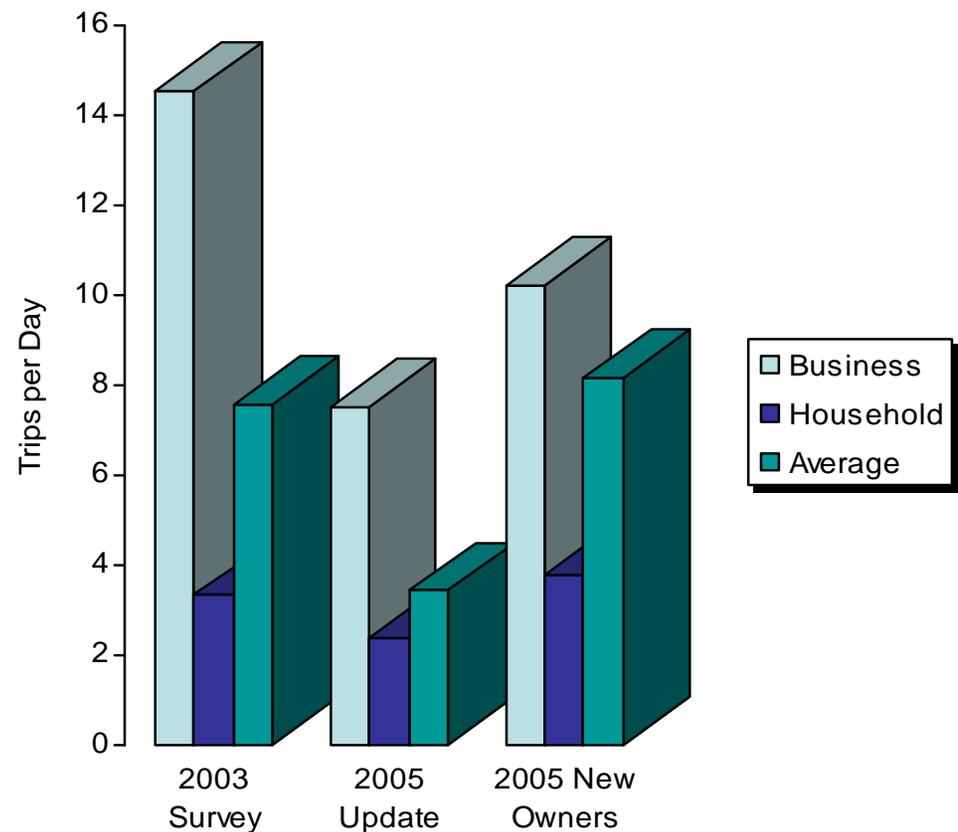


# NEV owners use their NEVs every day

All three studies found NEVs in use every day by their owners

Both business users and household users utilize their NEVs for multiple trips each day

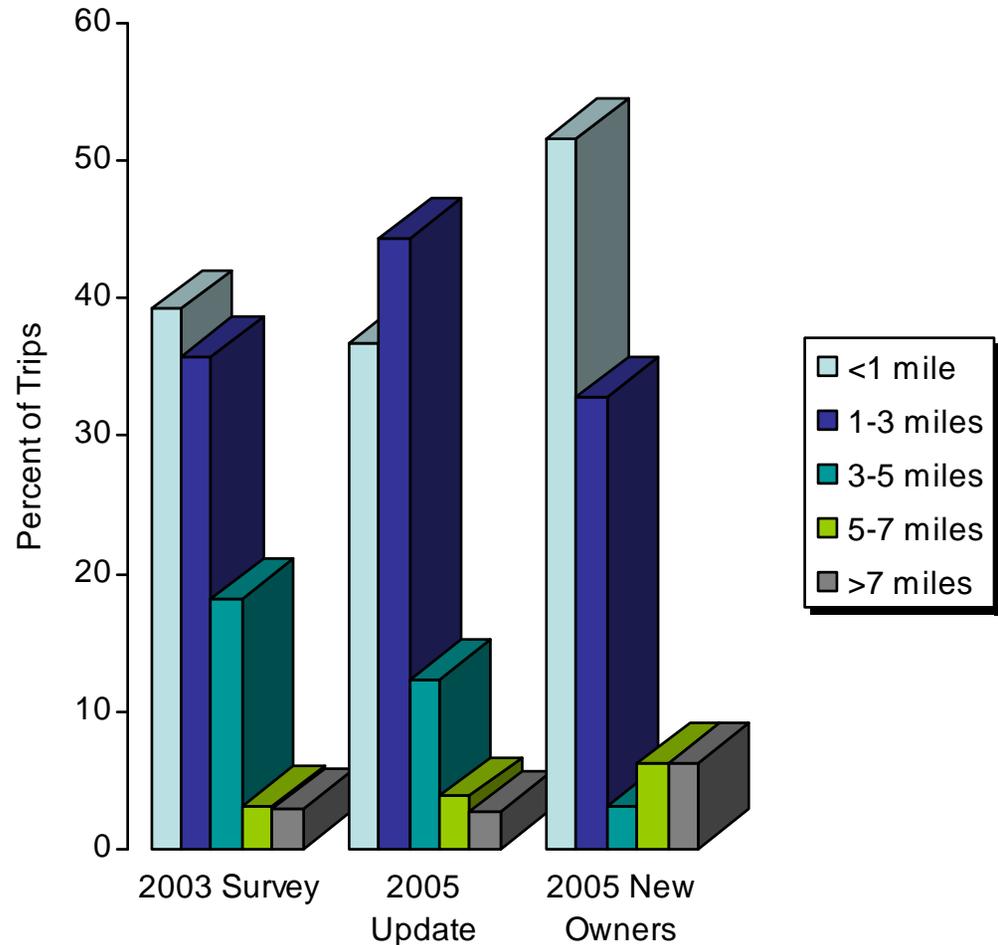
Business users rely on them more frequently than individual household users



# NEV owners make short trips

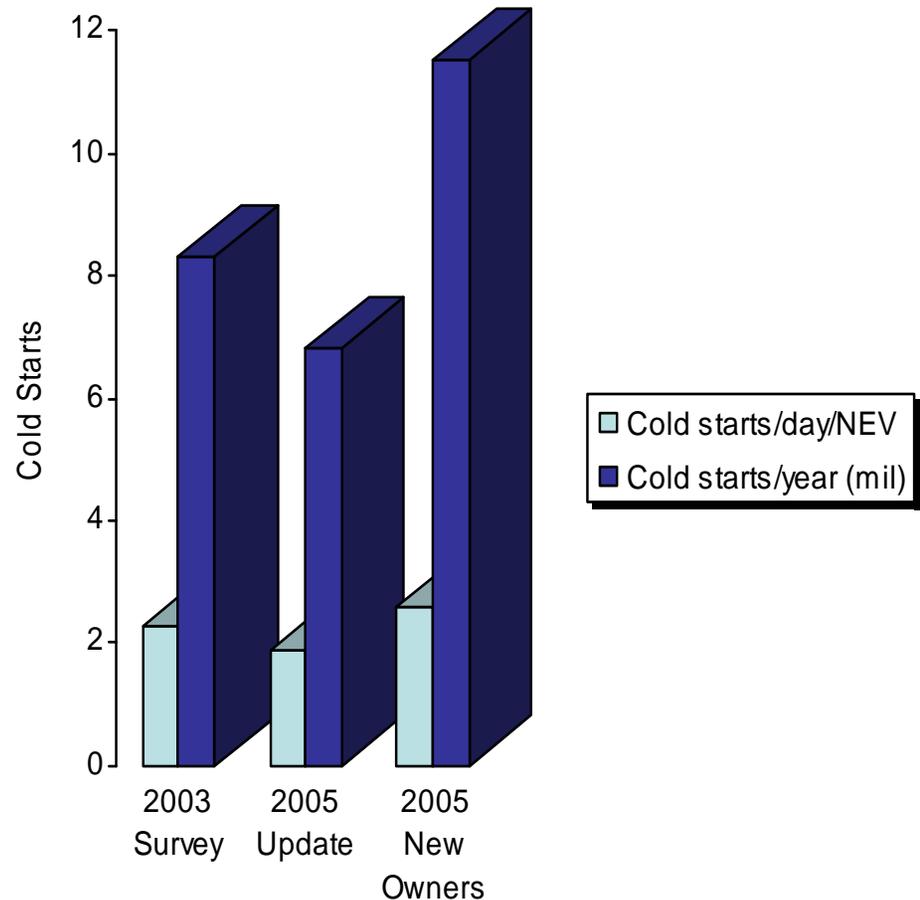
While NEV owners live in rural, urban, dense and disbursed population centers with infinite destinations, their trip distances remain consistent and are relatively short

- >75% of trips are 3 miles or less
- >40% are 1 mile or less



# And, these NEV trips add up

- Daily cold starts eliminated by NEV use has remained consistent in all three surveys at approximately 2 per day when averaged over the whole year
- Vehicles left in the driveway when a NEV is used reflect the typical California vehicle fleet – cars, trucks, SUVs, and minivans



# Importance of cold start elimination

- The biggest gain in air quality from ICE vehicle emissions is lowering (or eliminating) cold start emissions, especially NMOG and NOx that are Ozone precursors

Example: Emissions of a 2.4L PT Cruiser certified to ULEV II

	NMOG		NOx	
	gm	gm/mi	gm	gm/mi
Bag 1	0.5928	0.1644	0.1442	0.0400
Bag 2	0.0150	0.0038	0.0255	0.0065
Bag 3	0.0335	0.0093	0.0242	0.0067
Weighted		0.0385		0.0135

- Note: Bag 1 contains the emissions from the cold start and ~1 mile of driving on the emissions cycle

# Cold starts eliminated by each NEV have a significant impact on California air quality

On a yearly basis, a NEV that eliminates, on average, 2 colds starts per day eliminates

$$\begin{aligned} 2 * 350 \text{ days} * 0.5928 \text{ NMOG grams per cold start} &= 415 \text{ grams} \\ 2 * 350 \text{ days} * 0.1442 \text{ NOx grams per cold start} &= \underline{101 \text{ grams}} \\ &516 \text{ grams} \end{aligned}$$

An ULEV II vehicle, would have generated, assuming 12,000 miles of driving, with ULEV II standards at:

$$\begin{aligned} 0.055 \text{ gm/mi NMOG} &\rightarrow 660 \text{ grams} \\ 0.07 \text{ gm/mi NOx} &\rightarrow \underline{840 \text{ grams}} \\ &1500 \text{ grams} \end{aligned}$$

In other words, NEV use typically eliminates more than one-third of an owners yearly ozone precursor emissions as compared to before ownership of the NEV

# **The fleet of NEVs in California is having a VERY significant impact on air quality**

**If all 16,000 California NEV owners also owned a ULEV II car or truck, by driving their NEVs and eliminating, on average, 2 cold starts per day, they are saving from California's air:**

$$\begin{aligned} & 16,000 \text{ NEVs} * 516 \text{ grams per NEV} \\ & = 8,256,000 \text{ grams of ozone precursors a year} \\ & = 9.1 \text{ tons per year} \end{aligned}$$

**In reality, the saving is MUCH more than this because California's fleet average emissions is MUCH higher than ULEV II**

# Conclusions

- **The air quality improvement in California due to NEV use is significant**
  - **~1/3 of a NEV owners yearly harmful tailpipe emissions are eliminated simply by the avoidance of cold starts during the short trips taken**
- **This improvement will grow because NEV ownership and use is growing**
- **While it was not discussed, NEV use likewise eliminates petroleum consumption**
  - **The surveys indicate ~15% reduction in yearly petroleum consumption per NEV owner**

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## Questions?



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# Backup

# Just a word on “equivalent fuel economy”

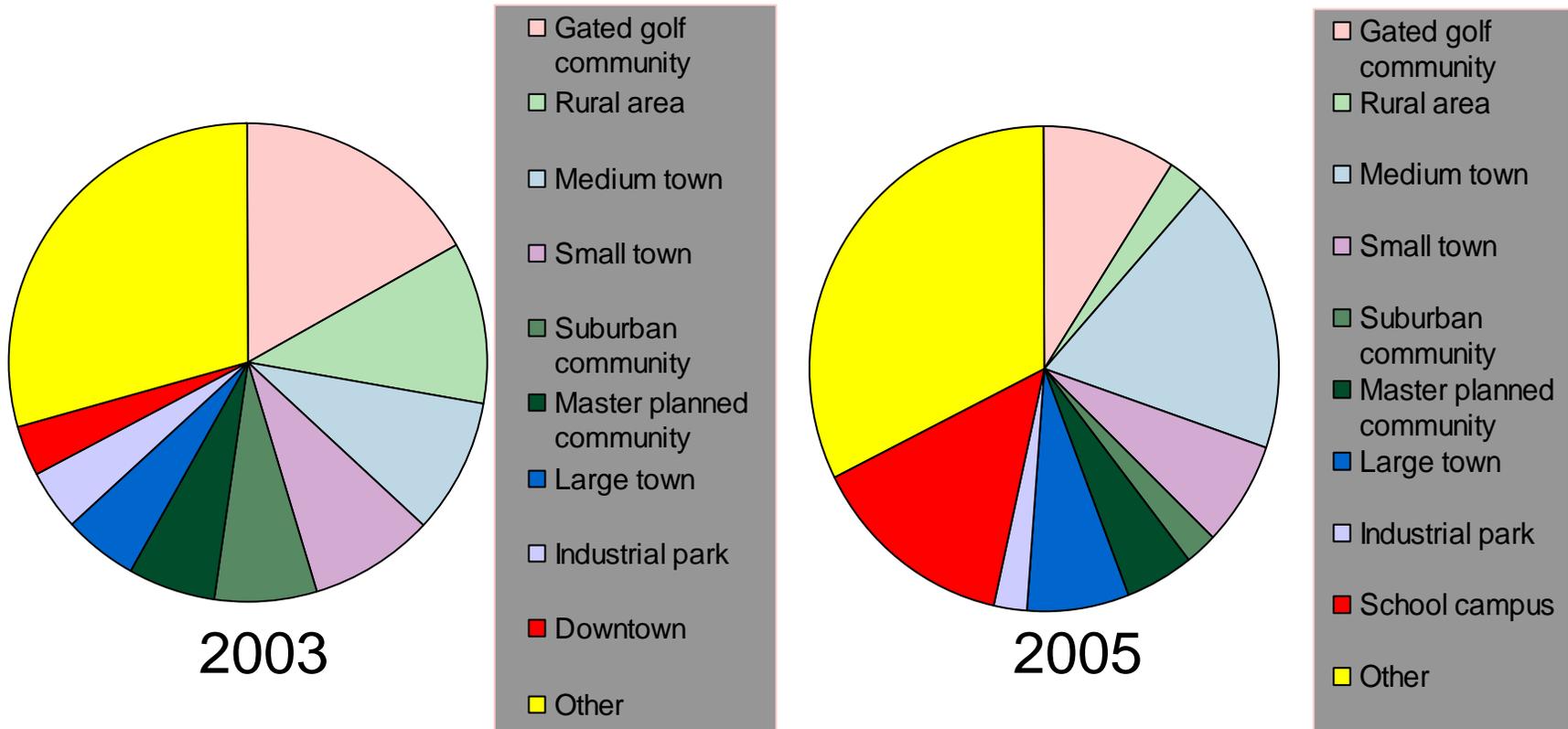
- GEM NEVs use between 200 and 240 watt-hour of electric energy from the wall for each mile driven on a typical “neighborhood driving cycle”
- One gallon of gasoline contains 33,700 watt-hour per gallon of energy
- Therefore, a combustion-powered vehicle would have to have a fuel economy of

$$\frac{33,700 \text{ watt-hours/gallon}}{220 \text{ watt-hour/mile}}$$

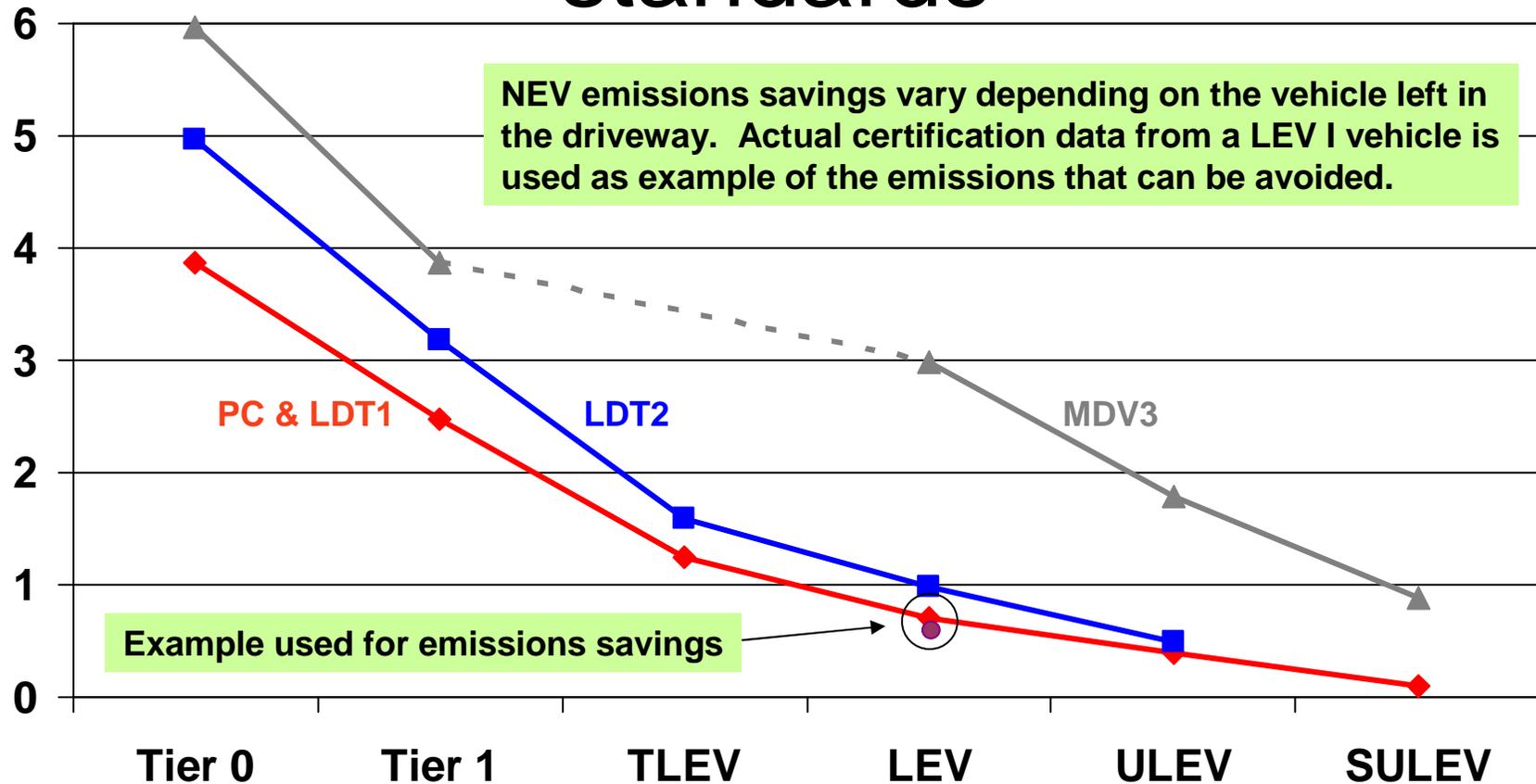
$$= 153 \text{ mpg}$$

to have the same energy efficiency as a GEM NEV

# NEVs are used in a wide array of land use settings



# Bag 1 NMOG emissions for different standards



Bag 1 emissions based on meeting 70% of standard with aged parts and 85% of emissions occurring in Bag 1.