

# Can Electric Bicycles Play A Small But Substantial Role in Reducing CO<sub>2</sub> Emissions

—Lessons Learned from China (1): Electric Bicycle Usage of Western US Residents

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## Background

In the United States, the e-bike, like all non-auto modes, must struggle against decades of auto-centric development. However, some of its characteristics may allow it to appeal to certain population groups, specifically the aging Baby Boomers, for whom the traditional bicycle is becoming increasingly ill-suited, and possibly allow it to serve as a light duty automobile alternative in situations that are not as acceptable for a traditional bike.

Some early adopters have started using e-bikes for (primarily) transportation and recreation in the United States. Our research team conducted 27 interviews in the greater Sacramento area to glean some understanding about their attitudes and experiences.

Volunteers were recruited for the interviews primarily by distributing fliers at local businesses that sell e-bikes and through snowball sampling method, i.e. asking a respondent to refer other people who also fit the research requirements.

## Who Are the Users?

The characteristics of e-bike users in our research can thus be described as the group of people who are more likely to be at middle-age or over and highly educated males with higher income.

### Socio-demographic Characteristics of E-bike Users in Sacramento Area

	Females %	Age			Education		Median HH* income (s.d.)
		20--34	35-64	>=65	>=High School	>=Bachelor	
CA census	50.3% <sup>1</sup>	-	-	11.4% <sup>1</sup>	80.5% <sup>2</sup>	29.7% <sup>2</sup>	\$58,925 <sup>3</sup>
Survey	37.00%	14.8%	63.0%	22.2%	100%	77.80%	\$72,708.30 (-30395.3)

<sup>1</sup>2010 census data  
<sup>2</sup>2005-2009 census data  
<sup>3</sup>2009 census data  
Cite: <http://quickfacts.census.gov/qfd/states/06000.html>

- Only 37% of the participants are females, which is much less than the percentage of females (50.3%) in population, implying that relatively more e-bike users in our research are males.
- People who are 65 years old or over account for a higher percentage (22.2%) in our survey than that (11.4%) of population, indicating that older people are more likely to be e-bike users.
- These e-bike users are also found to have higher education and household income levels, which are usually closely correlated

## Why Do They Choose E-bikes? SAGE

**Speed.** Users noted that the faster speed allowed them to cut down their commute time and ride through hot and windy days. Investing in the e-bike was seen as a way (usually motivated by pro-environmental values) to enable a bicycle commute.

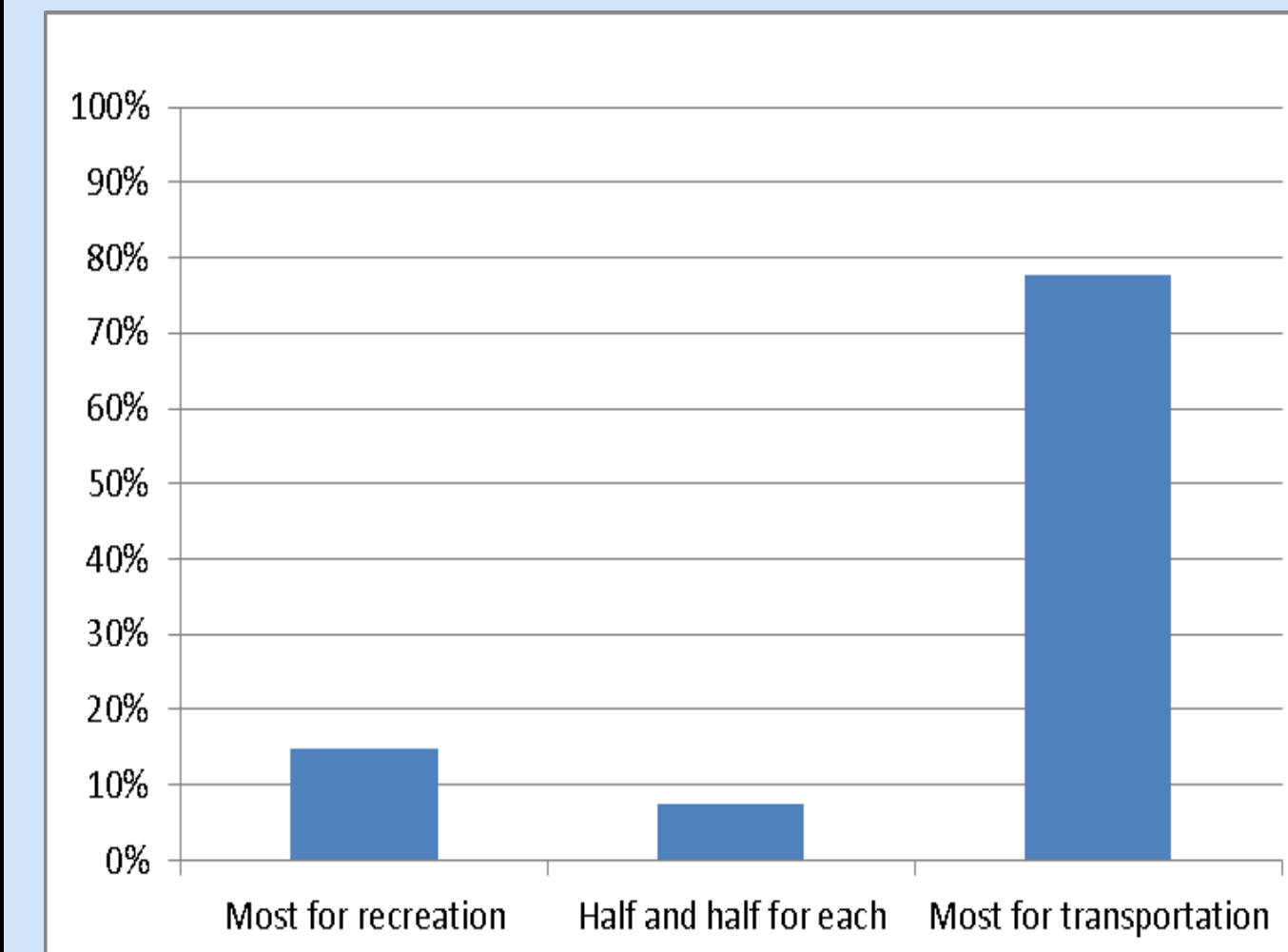
**Acceleration.** E-bikes allowed users' riders to negotiate traffic conditions and regulations. Many of the respondents noted that their ability to travel around 20 to 25 miles an hour made them more confident on the occasions that their travel route requires them to occupy a vehicle lane, as opposed to a bike lane or path. The pedal assist or throttle of the e-bike also makes obeying stop signs less onerous.

**Green.** Many respondents looked into the e-bike specifically so that they could meet their goals that were motivated by their environmental values to drive their cars less frequently. They specifically cited desires not to burn gas, which contributes to global warming and poor local air quality.

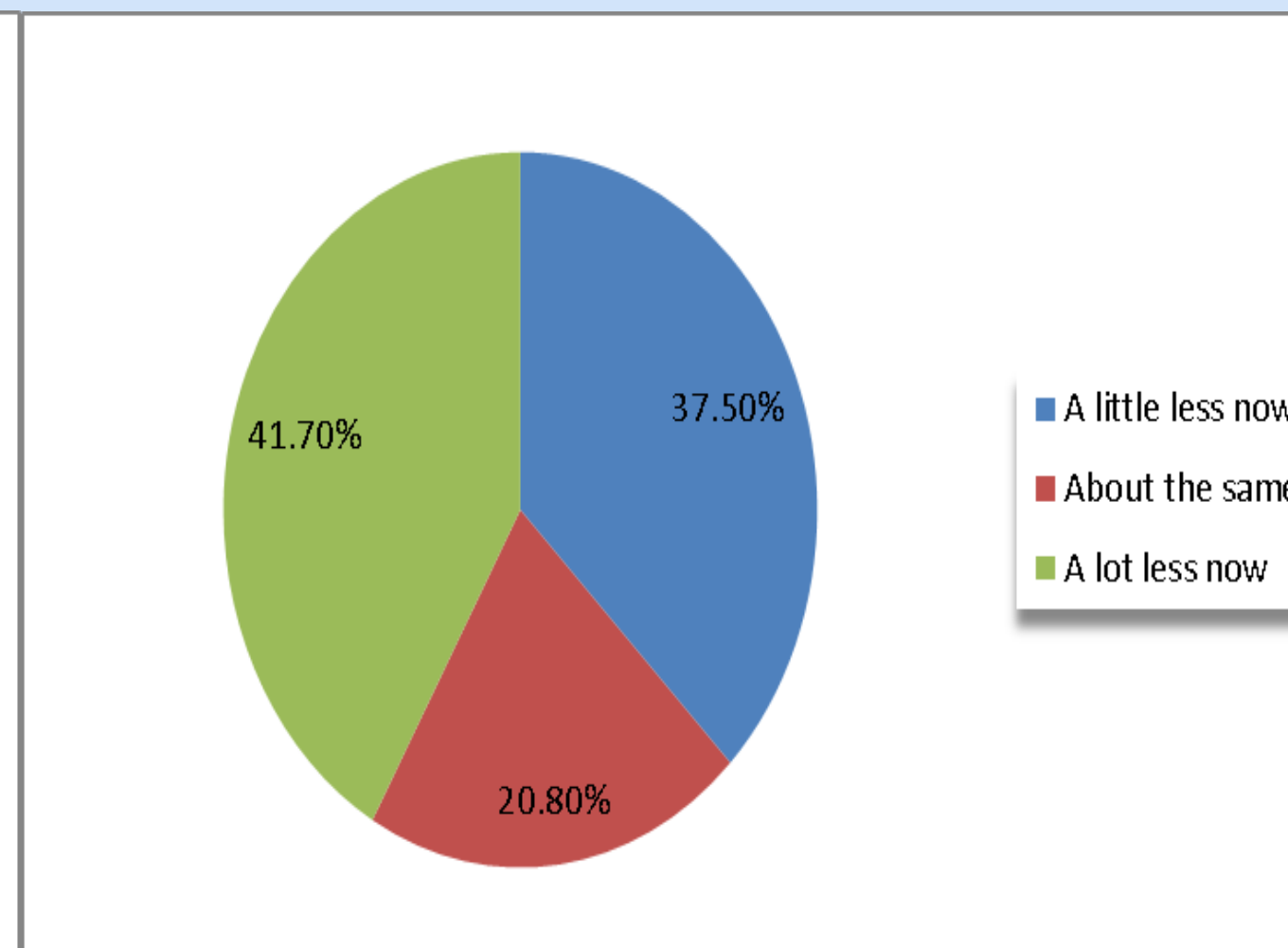
**Enabling.** Bicycle advocates must remember that all of the potential advantages of shifting more trips to the bicycle mode are essentially only open to the very able-bodied. Respondents to our interviews pointed out the ways in which the e-bike enables people with certain disabilities or symptoms of aging or time-constraint to begin or continue participating in bicycle transportation.

## How Do They Use E-bikes?

### Trip Purpose by E-Bike



### Change of Driving Behavior of E-Bike Users after Riding an E-Bike



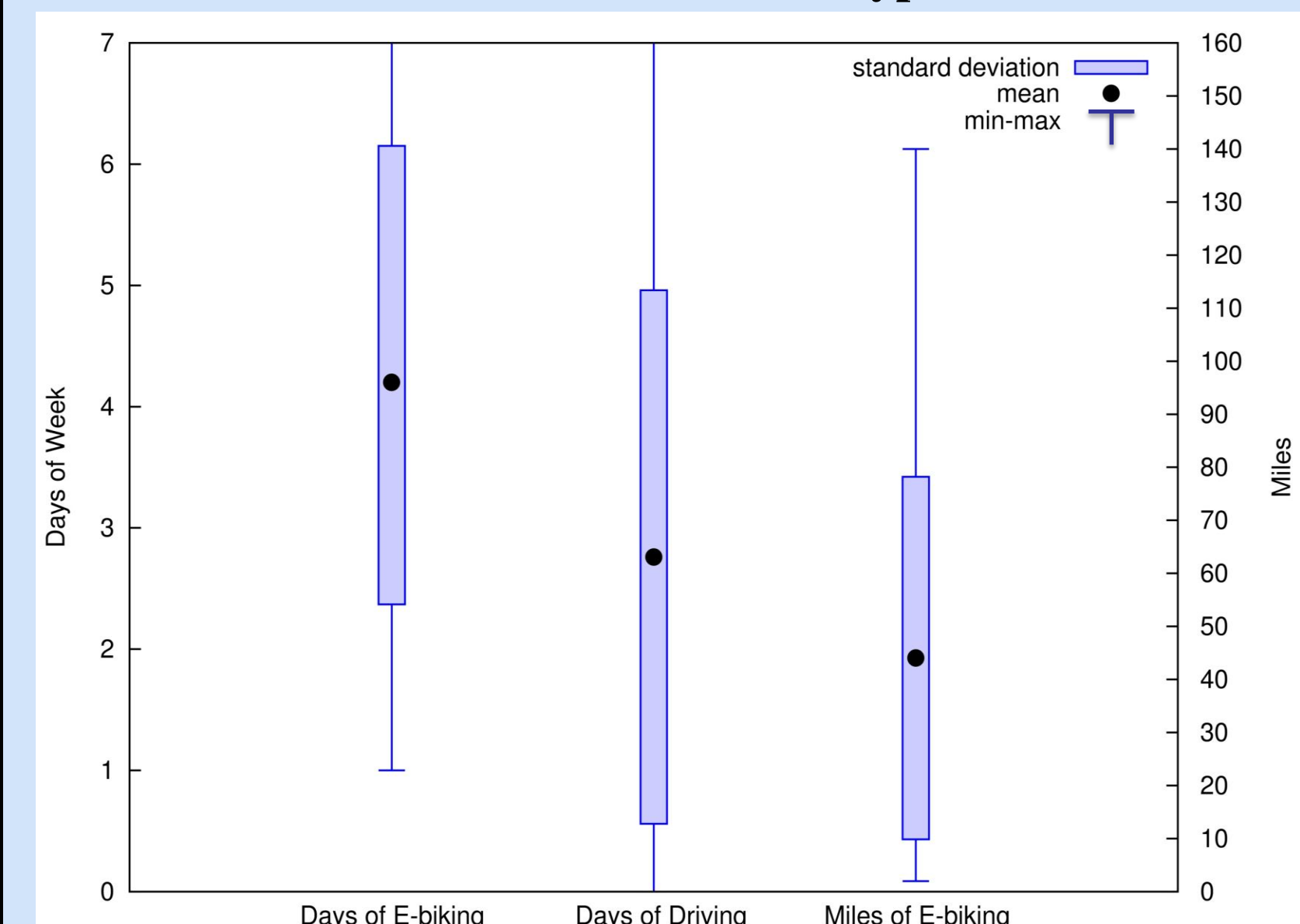
The purposes of e-bike trips are categorized into two general groups, transportation (including commuting, shopping, visiting people) and recreation (exercise, pleasure rides, adventure).

- 77.8 percent of people interviewed stated that they ride e-bikes mostly for transportation purpose.
- 37 percent said that they ride exclusively for transportation purposes.
- 85 percent of them use e-bikes for transportation or for both transportation and recreation.
- Several respondents indicated that they had changed the usage of e-bikes from recreation, which was the reason they first purchased the product, to transportation, after they found it convenient, safe and fun to ride.

whether the usage of an e-bike can fully or partly substitute driving was examined by asking change of the driving behaviors of the respondents after they receive an e-bike.

- 79.2 percent of people stated that they drive a lot less or a little less now compared with the time when they did not get an e-bike.
- Only 20.8% of them drive about the same as before.
- Many of these people used to be regular bicyclists before they got an e-bike.

### Travel Behavior of E-Biker Users in a Typical Week



The participants were asked to report the days and approximate miles they rode e-bikes in an average week with good weather.

- E-bike users ride e-bikes more frequently (4.26 days/week) than driving a car (2.76 days/week).
- 2/3 of the e-bikers said that they ride e-bikes for at least 4 days a week.
- 67 percent of those interviewed ride e-bikes for 5 miles or more per day; 44 percent for 10 miles or more, and 22 percent for 20 miles or more.

## Economics and CO<sub>2</sub> Emissions

We compare the fuel cost and CO<sub>2</sub> emissions between e-bikes and cars for two different daily trips, one between Sacramento and Davis (15 miles) and the other within the city (5 miles).

- Riding e-bikes presents substantial savings, its environmental benefits are even more significant.
- Rather than subsidizing electric vehicles, a targeted, small incentive for e-bikes could reap a much larger CO<sub>2</sub> emissions reduction in California and in the United States.

### Fuel Cost and CO<sub>2</sub> Emissions for Daily Round Trips Comparison

Distance	Round Trip per Day		200 Days per Year		300 Days per Year	
	By Car	By e-Bike	By Car	By e-Bike	By Car	By e-Bike
15 Miles	\$4.08	\$0.12	\$816	\$25	\$1,224	\$37
5 Miles	\$1.36	\$0.04	\$272	\$8	\$408	\$12
<b>CO<sub>2</sub>, lbs per Year</b>						
15 Miles	21	0.53	4233	106	6349	159
5 Miles	7	0.18	1411	35	2116	53

- Utilities could also provide programs that disperse the initial cost of e-bikes with a higher first-year electricity rate or arrange to purchase e-bikes in large quantity from cheap sources with discount price.
- E-bikes provide new and welcome business to utilities, given the fact that many of the batteries will be charged during the off-peak period of the day.

## What Are the Barriers? CHIP

**Cost.** In the Sacramento area, e-bikes sold at dealerships start at around \$1,500, including e-bikes that are electric conversion kits installed on a bicycle the customer already owns. There are some kits available on the internet that are less expensive, but require some technical knowledge to install. Due to the high cost, respondents often expressed that theft of their e-bike was a cause for concern.

**Heavy Weight.** The weight of the e-bike was mentioned as a negative factor across all groups of participants, but especially prominently among women and older respondents. The fact that the motor and battery pack add about 50 pounds to the weight of the bicycle caused some respondents to have trouble maneuvering the bike with the motor off. The weight also contributed to the already often expressed issue of range anxiety. That means that once the battery dies the e-bike does not simply function as a regular bike, but instead takes a great deal of effort to pedal.

**Infrastructure.** Many participants also mentioned that they still felt unsafe interacting on the road with cars, in many settings. Safe and e-bike/bicycle friendly community or neighborhood is also a key factor that works positively on participants' e-biking/biking behavior. Charging station for e-bikes is another infrastructure improvement that almost all the respondents expect. Because of the range anxiety, the respondents carefully calculate their battery range. This reduces the fun and frequency of riding e-bikes for transportation and recreation purposes.

**Policy.** Currently, California state law prohibits e-bikes from using Class One separated bike paths. Several of these respondents noted, however, that operating at the maximum possible speed of the e-bike (current models are governed at 20 mph) would be inappropriate on these facilities, and may be scary or unsafe for pedestrian and non-electric bicycle users, especially on the bike-crowded routes. 15 mile per hour speed limits already exist for these paths, and if enforcement is consistent and signs are more prevalent, these paths should be safe both bikers and e-bikers.

## Future Use of E-bikes

Most participants stated that they would use e-bikes more. Many of the users feel that the more they e-bike, the more likely they will use e-bikes for their trips. Possible scenarios that may increase their riding are listed below.

- Incentives such as subsidies given by employers to e-biking and biking to work
- At-the-pump gas price increases to \$6/gallon (E-bikes are much more popular in Europe)
- Improving the infrastructure on the routes from home to work to increase safety, comfort, and range-confidence for e-biking.
- Simply finding ways to reduce the cost of e-bikes, or some combination of these measures.
- A e-bike/bike-friendly community.
- Improving conditions for conventional bikers and e-bikers.

When the participants were asked what their families, peers and colleagues thought about their e-biking, though some viewed as "interesting" and "cool," a very common response was that they were told using a bike with an electric motor was "cheating." If the primary purpose of a bicycle is indeed to get exercise, then this contention makes sense. However, it makes no sense when talking about something that is primarily a transportation vehicle; it would seem ludicrous to most people to make the suggestion that using a motorized car was "cheating."

## Next Steps

Academically, this study tries to fill this important gap in the transportation research field, but more importantly, it sheds some light on the potential of e-biking in the United States by offering valuable insights into the importance of socio-demographical, attitudinal, infrastructure, and other factors including policies in explaining the usage of the e-bike.

- A larger sample of both e-bike users and non-e-bike users is needed to explore more representative attributes of the population who may ride e-bikes in place of cars if certain conditions are met.
- The significant role of individual attitudes shown in the interviews also suggests a need for further cultural and behavioral probe,
- Potential relationships between some social factors need to be further explored.

The answers to these questions will help policy makers to identify special needs of e-bike users and provide effective and comprehensive strategies for sustainable transportation.

