Electric Bikes and Transportation Policy

Insights from Early Adopters

Jennifer Dill and Geoffrey Rose

Electric bikes (e-bikes) are increasingly common in China but are relatively rare in the United States. The findings from interviews with 28 e-bike owners in the Portland, Oregon, region provide insight into the potential market for and use of e-bikes in the United States. The interviews revealed several possible demographic markets for e-bikes that could expand the bicycling population: women, older adults, and people with physical limitations. Owners of e-bikes noted their ability to travel longer distances and over hills with relative ease and to arrive at a destination, such as work, less sweaty and less tired than a regular bicycle would allow. These features may overcome some of the common barriers to bicycling for all demographics. Most of the interviewed e-bike owners used their e-bikes to substitute for travel by either human-powered bicycles or traditional motor vehicles. Therefore, the e-bike can address concerns about health problems related to inactivity, pollution, and other public policy problems to which private vehicles contribute. Further research is needed to determine whether specific policies are needed to increase adoption of e-bikes. The potential for conflict between riders of e-bikes and of regular bikes because of speed differentials is a concern. Whether speed differentials will pose a significant problem will depend not only on the extent of adoption of e-bikes but the characteristics of the riders.

The bicycle has a valuable role to play in addressing such urban challenges as traffic congestion, injury and loss of life from road crashes, local air quality, climate change, obesity and physical inactivity, energy availability, and security. Many factors affect the extent to which bicycling can be a viable urban transportation mode, although research consistently highlights adequate infrastructure and supportive policies (*1–4*). The performance of the bicycle, in contrast to most other modes, is dependent on the physical ability of the rider and the rider's willingness to provide all the energy needed to reach a destination. Because of this, bicycle trips tend to be shorter than motor vehicle trips and cyclists tend to avoid hilly locations (*5*). Power assistance could expand the role of the bicycle in urban transport by addressing the limits of trip distance and terrain. In addition, power assistance could allow people with physical limitations, including older adults, to bicycle more (*6–8*).

Power-assisted bicycles are not new. At the beginning of the 20th century, the Singer Company in Britain began manufacturing motorized back wheels, powered by a small two-stroke engine, that could be fitted onto existing heavy-duty bicycle frames (*9*). Because of improvements in battery technology, which was commercialized in the 1990s (*10*), electric models now dominate the motorized bicycle market. Although electric bicycles, or e-bikes, are growing in popularity, they have received little attention from transportation researchers and policy makers. A recent review of e-bikes in the context of urban transportation highlighted that little research deals with demand, supply, and operational issues, particularly in western countries (*11*). E-bikes have received the most attention in China, where there is an estimated 120 million such bikes (*12, 13*). Two types of electric two-wheeled vehicles are available in China: bicycle style, for which pedaling is supplemented by battery power, and scooter style, for which electricity supplies nearly all the power. The latter often come with pedals to satisfy the legal definition that differentiates bicycles from motorcycles (*14*). Combined, these vehicles make up from less than 10% to more than 60% of two-wheel vehicle traffic in some Chinese cities (*13*).

The reasons for rapid adoption of e-bikes in China are numerous, including improvements in technology, rising incomes and falling prices, national standards and policies, and changing travel patterns (*14*), as well as bans or limits on gasoline-powered motorcycles in some cities (*12, 14*). National law in China classifies e-bikes as nonmotorized vehicles, giving owners the right to ride them in bike lanes and without a driver's license or helmet (*14*). Surveys in Shanghai and Kunming, China, found that e-bike riders are more educated and earn higher incomes than bicycle riders, but few lived in households with cars or motorcycles. For most riders the e-bike substitutes for taking the bus. Trips taken on e-bikes were longer than those made on bicycles. The primary motivation for choosing an e-bike was speed, and more than 70% of e-bike riders cited that factor; fewer than 30% of respondents cited reduced level of effort, lower cost than cars, and crowded public transit as motivations (*15*). Researchers in Kunming found that e-bikes averaged nearly 22 km/h, which is about 7 km/h faster than bicycles (*16*).

These findings from China, although enlightening, are not entirely transferable to the North American context. Some motivations for adoption, such as bans on motorcycles, are not on the near horizon, although speed and travel time are clear motivations in choice of travel mode nearly everywhere. China is not alone in its adoption of e-bikes. E-bikes are a growing share of the new bicycle market in the Netherlands (*6*), a country well known for supportive bicycle policies and infrastructure and whose model many U.S. cities are following. There is little research about e-bikes in North America and Europe. A qualitative examination of blogs that discuss e-bikes (*17*) identified topics for future research and found that e-bikes

- Are used for utilitarian travel, including commuting to work and shopping;
- Have replaced car trips on journeys of up to 24 km (15 mi);

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- Help to overcome constraints imposed by geography, such as long distances and hilly areas; and
- Could suit older riders or individuals who have a medical condition such as arthritis that makes riding a bicycle difficult.

However, not all comments were positive. Nonusers expressed concerns or negative opinions, such as the following:

- E-bikes are not "real" bikes.
- Costs and battery technology (specifically the battery's weight and its storage capacity, which limits the range for power assistance) may affect widespread adoption.
- Mixing of e-bikes and bicycles in bike lanes or paths is a concern because of differences in speed.
- Use of electricity to power bicycles raises questions about environmental impacts.

Technology diffusion is often characterized as following a somewhat predictable transition as the market grows from innovators, to early adopters, to the early majority, to the late majority, and finally to the laggards (*18*). Moore conceptualized that a chasm exists in the early-adopter market that can be difficult for some products to cross (*19*). Current North American users of e-bike can be considered early adopters because U.S. consumers can purchase e-bikes through a range of specialist bicycle stores and e-bike retail outlets (*11*).

An understanding of early adopters may help to identify issues of relevance to transportation planners, modelers, and policy makers. For example, a greater understanding is needed of the role that e-bikes could play in household mobility decisions, particularly their potential for substituting for bike, transit, or auto trips. E-bikes could moderate growth in the demand for motor scooters and motorcycles, which is a concern in many jurisdictions where strong growth in motorcycle and motorbike registrations is translating into more and more-severe crashes (*20, 21*). The growth of e-bikes in China has raised safety concerns (*22*), because lack of enforcement means that many vehicles in regular use in China are capable of much higher speeds than specified in regulations (*13*). Because of similar fears, some North American cities are considering limits on where e-bikes may operate (*6*).

There is considerable uncertainty about the potential of e-bike technology in the context of urban transportation. Will they cross Moore's chasm, remain a novelty, or carve out a niche market? Garrison and Levinson argued that technologies may rise to prominence where they fill a "transport gap" (*23,* p. 8), noting that the Segway personal transporter is marketed as filling a gap in the too-far-to-walk-and-too-close-to-drive market. Perhaps this is where the e-bike will find a niche, although there is no evidence that the Segway has crossed the chasm to win a larger share of the urban mobility market. Shaheen et al. suggested that e-bikes could be a feature of the next generation of city bike-sharing schemes (*24*). The launch of the first fully automated e-bike sharing system on a university campus in the United States will provide lessons in that context (*25*).

METHODS

Because e-bikes are still in the early adoption stage in the United States, their limited penetration into the urban transportation system presents a challenge to traditional quantitative research methods. There is growing recognition that qualitative research techniques can play an important role in transportation research in general and travel behavior research in particular (*26*). Qualitative research techniques, for example, have provided insight into understanding the factors motivating early adoption of hybrid motor vehicles in the United States (*27*). Qualitative techniques can be particularly insightful when little is known about a topic and can form the basis of future quantitative work. The analysis of discussions about e-bikes on popular blogs helped identify issues to explore further through in-depth interviews of e-bike owners (*17*).

To further the understanding of the potential market for and use of e-bikes in the United States, this paper presents findings from interviews with e-bike owners in the Portland, Oregon, region. The Oregon state code classifies electric assisted bikes as bicycles as long as they have fully operative pedals for human propulsion, have an electric motor with a power output no greater than 1,000 W, and are capable of operating at a speed no greater than 20 mph on level ground (*28*). Owners do not need to register or insure the vehicle (*28*). Riders must be 16 or older and be eligible for driving privileges (*28*). A person whose driving privileges have been suspended or revoked could be cited for operating any motorized vehicle on public roads (*28*). Because e-bikes are classified as bicycles, they may be ridden in travel lanes as well as in bike lanes or on paths. However, Oregon Statute Section 814.410 specifies that it is an offense to operate an electric assisted bicycle on a sidewalk.

A total of 28 people were interviewed. They were solicited through three primary methods: referrals by personnel of e-bike stores ($n = 3$), personal contacts ($n = 4$), and an invitation to participate in the study posted on a popular website, Bikeportland.org ($n = 21$). A structured interview script was used that covered information about the owner (demographics, housing characteristics, travel patterns, use of green energy), motivations for purchasing an e-bike, the purchase process (e.g., what options were considered), use of the e-bike, e-bike features, and policy issues. Each interview was conducted in person with one or two interviewers and lasted approximately 45 min. The interviews were taped and transcribed for analysis. The study was reviewed and approved by Portland State University's Human Subjects Research Review Committee. Because the subjects were not a random sample, findings from the interviews may not accurately represent the population of e-bike owners. All subjects lived in the Portland region; the sample was chosen for some gender balance and to focus on purchasers of bikes already equipped with electric assist units or installed by e-bike stores, rather than do-it-yourself owners. The latter may be considered innovators rather than early adopters.

RESULTS

Who Are E-Bike Owners?

The e-bike owners interviewed ranged in age from 24 to 64; the median age was 48. Twelve were women. The owners appeared to be concerned about the environment—about two-thirds purchased green or renewable energy from their electric utility for their homes. The owners lived in a range of terrains, five living in neighborhoods with steep hills. All but five of the owners indicated that there was at least one other motor vehicle (car, truck, SUV, etc.) in their household. Levels of bicycle ownership were high; 12 of the interviewees owned at least two other bicycles (non e-bikes), and all had at least one other bicycle (non e-bike) in their household.

Which E-Bikes Were Purchased and Why?

Only 10 of the e-bike owners converted an existing bike to an e-bike; the majority purchased e-bikes. Twelve of the e-bikes had a throttle, and most of these were conversions. Most bikes had detachable batteries, and of those owners who worked outside the home, more than half charged their batteries at work (as well as home). More than half the e-bike owners had little experience riding e-bikes, such as a single test ride, before their purchase. Knowledge of e-bikes varied before purchase with about one-quarter of interviewees having no or very little knowledge and one-third having extensive knowledge.

The top motivation for purchasing an e-bike was the capabilities it provided beyond a conventional bicycle ($n = 20$). This was consistent with the next most popular motivation—an alternative to a car ($n = 15$). Environmental concerns were mentioned by just under one-third of the owners. A handful of the owners had limited ability to ride a conventional bike, either because of age or because of health factors. One long-time bicyclist said, "I probably wouldn't have given these things a moment's thought 10 or 15 years ago." Another owner who had suffered serious injuries in a bike crash found that the e-bike was the only option for continuing to ride, given lasting health issues that also limited her ability to drive or use transit comfortably. She said, "I've been on my bike every day since I got it. I've been able to bike every day. . . . I felt like it, it kind of changed my life back. . . . I got back something I'd lost."

Several owners noted the potential for e-bikes to increase cycling among some populations:

- "I think for women especially there are benefits since there are less women on bikes than there are men."
- "I feel like the electric bike has the potential to reach people that wouldn't normally ride and to make cycling more attractive."
- "I think there's growing acceptance to augmented bicycle riding. I mean in particular people of my age that, you know, can't ride like they used to."

How Were E-Bikes Used?

The e-bikes were primarily used for utilitarian travel. Of the owners who worked outside the home, nearly all used their e-bike for commuting at least part of the time. About two-thirds rode their e-bikes for errands or shopping.

E-bikes appear to change owners' bicycling behavior and substitute for driving a motor vehicle to some extent. Most of the owners (23 of 28) indicated that they had increased their overall amount of cycling since purchasing their e-bikes. The increase in cycling was usually for commuting or other utilitarian purposes with only six owners saying that they increased their recreational cycling. In some cases, owning an e-bike was a reason to change from driving a car to bicycling to work. One owner said, "I was able to turn the worst part of the day, which is getting in the car and driving to work, into the best part of the day by bicycle commuting." Another was able to get rid of a car after the e-bike purchase. One owner had been an avid recreational cyclist before her e-bike purchase but lived in a very hilly area, which kept her from cycling from her home to any destination (or for recreation); the e-bike allowed her to commute by bike. A few owners said they ride their e-bikes in the rain more than they would a regular bicycle: "I'm more apt to ride in the rain. . . . Because I feel like it's safer. It's not as messy. Because I can go a little faster, I'm just not absorbing quite as many raindrops."

About half indicated that they ride to different destinations, and a similar share take different routes with the e-bike. In some cases, the e-bike allowed them to take more direct routes with more hills, compared with a regular bicycle, or to take a route with higher-speed traffic, where the e-bike helped them keep up and feel more confident.

What Are Positive and Negative Aspects of E-Bikes?

Positive Owner Experiences, Some Reservations

Owners noted several positive aspects of their e-bikes. The following characteristics were volunteered by a majority of the owners:

- Riders arrive at their destinations less sweaty or more energized: "I decided to use the electric bike because I didn't want to feel tired the rest of the day."
- Climbing hills is easier: "The e-bike just really helps flatten out the hills between my house and work."
- E-bikes can accelerate up to the speed of cars or go faster than conventional bikes: "I find I can actually ride the bike faster than the bus."
- E-bikes allow riders to carry more or heavier items.

Some owners tried to promote e-bike use by letting others test ride their e-bike:

- "Everyone that I've let try the bike has thought it was really fun. I don't know that I've ever actually sold anyone on getting their own."
- "I love letting people ride my e-bike, because whatever negative feeling they have about e-bikes is gone once they get on it."

Four of the owners said that allowing others to ride their e-bike lead to an e-bike purchase.

About half the owners said that the additional weight of an e-bike is a problem, making the bike difficult to lift generally, difficult to fit on a car rack, or difficult to lift or fit onto the bike racks on transit vehicles. Eight of the owners were concerned about an increased risk of theft. Five noted increased difficulty in fixing a flat tire or making other minor repairs. Several noted a need for a longer battery range.

Speed Benefits and Safety Implications

E-bike riders regarded increased speed as a positive factor for a variety of reasons. For example, one owner said that the e-bike made riding with her male partner a more positive experience: "What I love about it is he's a stronger biker than me, and it used to be with regular bikes that he'd periodically have to wait for me. . . . Now, you know, I let him get a little bit ahead, and then I just flip on the e-bike, and then I catch up with him." Another woman said, "As a woman, it just seems like that was the extra little oomph of power that put me at an advantage, or put me in line with some of the other zippier cyclists." One-third of the owners said that the e-bike allowed them to travel more like they travel with a motor vehicle ("vehicular cyclist").

In addition, about one-quarter of the owners said that the additional weight or size of the e-bike, compared with a conventional

bike, made them feel safer or more stable. Only three of the owners were worried about going too fast, and only two of the owners said that they wanted more power.

Several owners raised concerns related to public policy and e-bikes. One owner feared that potential conflict caused by differences in speeds could lead to government bans on use of e-bikes in bike lanes, so she tried to "tone it down" while riding. The fear of more regulation came up in a few interviews. One owner said, "When e-bikes become mainstream, there will be lots of laws controlling them," and another advocated for regulations that would prevent e-bikes from "getting to be too much like motorcycles."

Physical Activity Implications

Despite the electric assistance, several owners said that the e-bike provided a satisfactory level of physical activity:

- "It doesn't do it for you. You still have to work."
- "I personally feel that even riding an e-bike is healthier than not riding a bike at all. People with e-bikes are obviously people that are not in cars."
- "I lost about 12 pounds, I think, during the summer when I was riding. You get the physical fitness benefit from it."

However, one owner with a throttle-style e-bike said he switched back to a regular bike when he felt out of shape.

Legitimacy

There is some conflict in opinions about the legitimacy of e-bikes and their value relative to human-powered bikes, particularly from other bicyclists. For example, in response to the request for interview subjects on a local website, one reader said, "E-bikes are for overweight and lazy people." Of the interviewees who mentioned reactions from peers about their e-bikes, a slight majority noted positive feedback, whereas the others said that their peers expressed negative feelings toward e-bikes. One owner said, "I do hear a lot of snarky comments about it, like, oh that's cheating," and another said that cyclists he passed on a street with a bike lane "got bent out of shape." Another noted more negative reactions from other cyclists than from car drivers. Some of the owners themselves were conflicted or self-conscious:

- "Now, I do worry a little bit about people relying on them a little bit too much instead of pedaling, but I think it's a lesser evil than cars."
- "I feel like I'm cheating when I'm on the road with other bikers; I feel very self-conscious."
- "I haven't told a whole lot of people, because I think they're gonna go, Oh my gosh, she got old, she got an electric bike."
- "You know, I guess there is a little bit of feeling apologetic about it since you're out biking and everyone else is working hard and you're having an easy time."

CONCLUSIONS AND RESEARCH NEEDS

In the United States, e-bike owners should be considered early adopters. In Rogers' theory of diffusion, an innovation might transition from the stage of early adopters to an early majority (*18*). Whether e-bikes will follow that pattern is open to debate. The research presented in this paper offers insights about early adopters to help identify potential policy issues and areas for future research.

The interviews revealed several possible demographic markets for e-bikes that could expand the population that uses bicycles for transportation: women, older adults, and people with physical limitations. Most of the interviewed owners used their e-bikes to substitute for travel by either human-powered bicycles or traditional motor vehicles (cars, pickup trucks, etc.). The e-bikes were not viewed as an alternative to or substitute for motorcycles or scooters. When the e-bike substituted for a regular bike, the owner often had experienced some change (e.g., aging, injury, or change in travel distances) that would have reduced their bicycle travel if not for the e-bike.

E-bike features may overcome some of the common barriers to bicycling for all types of riders. Owners noted the ability to travel with relative ease for longer distances and over hills and to arrive at a destination, such as work, less sweaty or tired than with a regular bicycle. Although none of the owners specifically noted so, an e-bike could allow parents to transport small children who cannot yet ride a bike.

Even with the electric assist, e-bike riders get some physical activity while riding. Therefore, the e-bike can address concerns about how the reliance on private motor vehicles contributes to health problems through inactivity. However, further research is needed to consider the implications of e-bikes for physical activity. Future studies could examine how, when, and to what extent power assistance provided by the e-bike is used in conjunction with pedaling. More insight is needed into the extent to which e-bikes replace trips by conventional bike, transit, or car, because these modes have different implications for changes in physical activity levels associated with choice of an e-bike.

Whether specific policies are needed to increase adoption of e-bikes is unclear. Just as electric cars are more expensive than gasoline-powered cars, e-bikes are generally more expensive than regular bikes. Whereas e-bike conversion kits start at around $500, purpose-built e-bikes range from about $1,500 for a base model to more than $5,000 for a premium brand fitted with extended-range batteries. Purchases of electric cars are promoted through federal and state tax incentives and feebate schemes (*29*), and some of the interviewed e-bike owners suggested something similar for e-bikes. This research could not address whether a subsidy would increase adoption or the magnitude of a resulting sales increase, because the people interviewed had made their purchases without subsidies. Further focus group or survey research of potential owners could answer that question.

Other policy responses could perhaps promote e-bike adoption. Range anxiety has long been considered a factor that negatively affects consumer interest in electric vehicles. However, there is evidence that such anxiety affects participants in field trials of electric vehicles substantially less, because their experience using the vehicles results in improved understanding of vehicle capabilities, appropriate driving techniques, and journey planning (*30*). Public charging or battery swap stations could help overcome range limitations of e-bike, although the interviews did not reveal a clear need for these. Battery swapping has been deployed in Switzerland to support bicycle touring by e-bike (*31*). Many e-bike owners charged their bike batteries at work without problem. The ability to take their bikes on transit, as in Portland, also eased fears of dead batteries among some of the owners interviewed. However, other e-bike owners noted that bike racks on transit vehicles did not accom-

modate the weight or design (longer wheelbase) of their e-bikes. Design changes could address this problem. Therefore, the issues of range limitations and range anxiety that drive the need to install public charging stations and battery swap facilities for electric cars (*32*) may not be analogous to e-bikes. However, these interview participants were early adopters who may be more willing to take risks by trying a new technology. Accessible charging stations for e-bikes could appeal to later adopters. Further research could address this question. Rather than adopting policies or facilities specific to e-bikes, several e-bike owners suggested policies that would promote all bicycle use, including bike infrastructure and disincentives for car use (e.g., higher gasoline taxes).

The potential for conflict between e-bike riders and riders of regular bike should be a concern for planners and policy makers. About half the interviewed e-bike owners noted negative feedback from other cyclists, sometimes because of the speed differential. However, some negative feedback was related to perceptions of level of effort, that is, e-bike riders were seen as not working as hard, as cheating. The latter perceptions may be addressed only as the technology is more widely adopted and social networks increase awareness and acceptance. From a sociological perspective, e-bikes can be considered in the context of a city's underlying cycling culture because of increased awareness of the e-bike's role in promoting and sustaining increased levels of cycling (*33, 34*). Many current e-bike owners have acted as goodwill ambassadors for e-bikes, letting people test ride their bikes and answering questions.

However, managing speed differentials may require other approaches. Oregon's (and other states') vehicle code limits the performance speed of e-bikes, which can help reduce the differential. Wider bike lanes would allow faster cyclists to pass slower cyclists. Speed limits on bicycle facilities are another option. The extent of the potential problem is unclear, and the need for or type of policy intervention requires more research. Several of the e-bike owners interviewed, particularly women, noted that the e-bike allowed them to travel at speeds comparable to, not necessarily faster than, other cyclists. Others noted that they avoided riding too fast out of courtesy or fear of conflict. As with any mode of transportation, some road users will operate in a manner that annoys other users and poses potential safety risks. The appropriate policy response may need to target the particular behavior, regardless of mode of technology. Moreover, whether the speed differential will be a significant problem in the future will depend on not only the extent of adoption of e-bikes but also the characteristics of the riders. E-bikes may appeal more to riders who do not necessarily want to go significantly faster than other cyclists. More extensive quantitative research could be used to further assess this issue.

This study focused on e-bike users in one U.S. city; it would be useful to consider geographically diverse locations in such research. As the number of e-bike users grows, a broader range of quantitative data will be needed. Future research could include measuring travel behavior before and after the purchase of an e-bike to gain understanding of the impact on the use of other modes and on physical activity levels. It would be possible to monitor An e-bike rider's travel activity could be monitored with the Global Positioning System so their speed profiles and use of bicycle facilities (off-road paths versus bicycle lanes versus travel lanes) could be studied. Also valuable would be information about e-bike user experiences when sharing facilities with conventional bicycles and pedestrians, including details of interactions and cases of near misses and collisions.

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REFERENCES

1. Dill, J. Bicycling for Transportation and Health: The Role of Infrastructure. *Journal of Public Health Policy.* Vol. 30, 2009, pp. 95–110.
2. Pucher, J., C. Komanoff, and P. Schimek. Bicycling Renaissance in North America? Recent Trends and Alternative Policies to Promote Bicycling. *Transportation Research Part A,* Vol. 33, No. 7–8, 1999, pp. 625–654.
3. Pucher, J., R. Buehler, and M. Seinen. Bicycling Renaissance in North America? An Update and Re-appraisal of Cycling Trends and Policies. *Transportation Research Part A,* Vol. 45, No. 6, 2011, pp. 451–475.
4. Pucher, J., J. Dill, and S. Handy. Infrastructure, Programs, and Policies to Increase Bicycling: An International Review. *Preventative Medicine,* Vol. 50, 2010, pp. 106–125.
5. Broach, J., J. Gliebe, and J. Dill. Bicycle Route Choice Model Developed Using Revealed Preference GPS Data. Presented at 90th Annual Meeting of the Transportation Research Board, Washington, D.C., 2011.
6. Goodman, J. D. An Electric Boost for Bicyclists. *New York Times,* Feb. 1, 2010, p. B1.
7. Parker, A. A. Electric Power-Assisted Bicycles Reduce Oil Dependence and Enhance the Mobility of the Elderly. 29th Australasian Transport Research Forum, Gold Coast, Queensland, Australia, 2006. http://www.patrec.org/atrf/papers/2006/1564_Parker%20(2006).pdf. Accessed Aug. 18, 2008,
8. Parker, A. A. The Electric Power Assisted Bicycle: A Clean Vehicle to Reduce Oil Dependence and Enhance the Mobility of the Elderly. Presented at International Conference on Sustainability Engineering and Science, Auckland, New Zealand, 2004.
9. Parker, A. A. Green Products to Help Move the World Beyond Oil: Power Assisted Bicycles. *Proc., Solar 99: 37th Annual Conference of the Australia and New Zealand Solar Energy Society,* Deakin University, Geelong, Victoria, Australia, 1999.
10. Sperling, D., and D. Gordon. *Two Billion Cars: Driving Towards Sustainability.* Oxford University Press, New York, 2009.
11. Rose, G. E-Bikes and Urban Transportation: Emerging Issues and Unresolved Questions. *Transportation,* Vol. 39, No. 1, 2012, pp. 81–96.
12. Yang, C. J. Launching Strategy for Electric Vehicles: Lessons from China and Taiwan. *Technological Forecasting and Social Change,* Vol. 77, No. 5, 2010, pp. 831–834.
13. Weinert, J., J. Ogden, D. Sperling, and A. Burke. The Future of Electric Two-Wheelers and Electric Vehicles in China. *Energy Policy,* Vol. 36, No. 7, 2008, pp. 2544–2555.
14. Weinert, J., C. Ma, and C. Cherry. The Transition to Electric Bikes in China: History and Key Reasons for Rapid Growth. *Transportation,* Vol. 34, No. 3, 2007, pp. 301–318.
15. Cherry, C., and R. Cervero. Use Characteristics and Mode Choice Behavior of Electric Bike Users in China. *Transport Policy,* Vol. 14, No. 3, 2007, pp. 247–257.
16. Lin, S., M. He, Y. Tan, and M. He. Comparison Study on Operating Speeds of Electric Bicycles and Bicycles: Experience from Field Investigation in Kunming, China. In *Transportation Research Record: Journal of the Transportation Research Board, No. 2048,* Transportation Research Board of the National Academies, Washington, D.C., 2008, pp. 52–59.
17. Rose, G., and J. Dill. Reactions and Concerns with E-Bikes in the United States: Insight from an Exploratory, Blogological Study. Presented at 90th Annual Meeting of the Transportation Research Board, Washington, D.C., 2011.

18. Rogers, E. M. *Diffusion of Innovations.* Free Press, Glencoe, Ill., 1962.
19. Moore, G. A. *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers.* HarperCollins, New York, 2006.
20. Rose, G. Motorcycles: A Growing Dot on the Transport Policy Radar. Presented at 32nd Australasian Transport Research Forum, Auckland, New Zealand, 2009.
21. Haworth, N., K. Greig, and A. Nielson. A Comparison of Risk Taking in Moped and Motorcycle Crashes. Presented at 89th Annual Meeting of the Transportation Research Board, Washington, D.C., 2009.
22. Feng, Z. Y., R. P. Raghuwanshi, Z. G. Xu, D. Y. Huang, C. Zhang, and T. Jin. Electric-Bicycle-Related Injury: A Rising Traffic Injury Burden in China. *Injury Prevention,* Vol. 16, No. 6, 2010.
23. Garrison, W. L., and D. M. Levinson. *The Transportation Experience: Policy, Planning and Deployment.* Oxford University Press, New York, 2006.
24. Shaheen, S. A., S. Guzman, and H. Zhang. Bikesharing in Europe, the Americas, and Asia: Past, Present, and Future. In *Transportation Research Record: Journal of the Transportation Research Board, No. 2143,* Transportation Research Board of the National Academies, Washington, D.C., 2010, pp. 159–167.
25. University of Tennessee, Nashville. UT Launches Nations' First Fully Automated E-Bike Sharing System. Sept. 6, 2011. www.utk.edu/tntoday/2011/09/06/nations-first-automated-ebike-system. Accessed Nov. 2, 2011.
26. Grosvenor, T. *Transportation Research Circular E-C008: Qualitative Research in the Transport Sector.* TRB, National Research Council, Washington, D.C., 2008.
27. Heffner, R. R., K. S. Kurani, and T. S. Turrentine. Symbolism in California's Early Market for Hybrid Electric Vehicles. *Transportation Research Part D,* Vol. 12, No. 6, 2007, pp. 396–413.
28. Oregon Department of Transportation. Oregon Moped, Motorized Scooter, Pocket Bike Guide. http://www.oregon.gov/ODOT/DMV/docs/pocketbikeguide.pdf?ga=t. Accessed Aug. 1, 2011.
29. Martin, E., S. A. Shaheen, T. Lipman, and M. Camel. Public Perception of a Feebate Policy in California: 2009 Statewide Telephone Survey and Focus Group Results. Presented at 90th Annual Meeting of the Transportation Research Board, Washington, D.C., 2011.
30. EV Range Anxiety Disappears After Three Months. Cars 21. http://www.cars21.com/content/articles/65220110909.php?AlertDate=2011-09-08. Accessed Nov. 11, 2011.
31. Neville, T. Over the Alps on a Bike with a Boost. travel.nytimes.com/2011/08/28/travel/the-swiss-alps-on-an-electric-bicycle.html?pagewanted=all. Accessed Nov. 2, 2011.
32. Lidocker, J., T. Lipman, and B. Williams. Business Model for Subscription Service for Electric Vehicles Including Battery Swapping, for San Francisco Bay Area, California. In *Transportation Research Record: Journal of the Transportation Research Board, No. 2252,* Transportation Research Board of the National Academies, Washington, D.C., 2011, pp. 83–90.
33. Weiss, E. *Bike Snob: Systematically and Mercilessly Realigning the World of Cycling.* Hardie Grant Books, Richmond, Victoria, Australia, 2010.
34. Rosen, P., P. Cox, and D. Horton. *Cycling and Society.* Ashgate, Farnham, United Kingdom, 2007.

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