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E-Bikes in the United States

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Presentation Outline

- Why do e-bikes matter?
- What is an e-bike?
- US e-bike user survey
- Conclusions
WHY DO E-BIKES MATTER?
US Transport Sector Impacts

Safety
- 32,788 fatalities in 2010 (-3% from 2009)
- 1.09 fatalities per 100 MVMT (VMT +0.7% in 2010)
- 2.2 M injuries in 2009
- 5.3 M crashes in 2011
- $230 B total cost (including medical)
- Leading cause of death for ages 4 to 34

Accessibility, Reliability and Mobility
- 4.8B hours travel delay (34 hours/auto commuter)
- $121 billion cost of urban congestion

Household Expenses
- Second biggest monthly expense, after housing

Environmental
- 28% of GHG emissions (78% CO, 58% NO$_x$, 36% VOCs)
- 29% of energy consumed (mostly petroleum)
- 70% of petroleum consumption (60% imported)
- 3.9 billion gallons of wasted fuel

Source: Prof. Robert Bertini
Commute Mode Share for Portland

Reduce per capita daily vehicle-miles traveled (VMT) by 30% from 2008 levels.

2009
- Bike
- Walk
- Carpool
- Transit
- Drive Alone

2030
- Bike
- Walk
- Telecommute
- Carpool
- Transit
- Drive Alone

Portland Climate Action Plan, 2009
Large US Cities Ranked by % Bicycle Commuting

Source: US Census Bureau, 2012 American Community Survey
Factors why people don’t bike

- Safety
- Lack of infrastructure
- Weather
- Inconvenience
- Logistic issues
- Lack of fitness
- Lack of time
- Being tired
- Too much effort
Shifting the four types of cyclists

- 4% Strong & Fearless
- 9% Enthused & Confident
- 56% Interested but Concerned
- 31% No Way, No How

People that are older
People who live in areas that are hilly
People who commute distances greater than 5 miles
People that have a physical limitation that makes cycling difficult.
Woman tend to bike less than men. Women make up approx. 25% of all bike trips in the US.
People don’t always feel safe biking in traffic
People who don’t want to sweat or wear special clothes to commute
People who need to carry or haul items or people
What are the critical pieces to increase cycling?

- Critical Mass
- Infrastructure
- Cost
- Technology
- Access
- Attitudes
WHAT IS AN E-BIKE?
What is an electric bike?

- Battery
- Motor (Hub or Chain drive)
- Power controls & Gear shifts
Come in all shapes and sizes
Different types of the e-bikes

Throttle

Pedelec

Powered bicycle (PB) versus Powered-assisted bicycle (PAB)
Not considered “e-bikes”

Moped

Scooter
Definition of an E-bike

- The Consumer Product Safety Act regulates the use of low-speed electric bicycles to “two-or three-wheeled vehicle with fully operable pedals and an electric motor of less than 750 watts (1 horse power), whose maximum speed on a paved level surface, when powered solely by such a motor while ridden by an operator who weighs 170 pounds, is less than 20 mph” Sec. 38 [15 U.S.C. § 2085]

- Oregon - ORS 801.258 “Has a power output of not more than 1,000 watts” but ORS 807.020(15) “A person may operate an electric assisted bicycle without a driver license or driver permit if the person is 16 years of age or older.”
## International Definitions Compared

<table>
<thead>
<tr>
<th>Region</th>
<th>Power Limit</th>
<th>Top Speed</th>
<th>PB allowed</th>
<th>PAB allowed</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>750W</td>
<td>20 mph</td>
<td>Yes</td>
<td>Yes</td>
<td>Has operating pedals</td>
</tr>
<tr>
<td>Canada</td>
<td>500W</td>
<td>20 mph</td>
<td>Yes</td>
<td>Yes</td>
<td>Has operating pedals, &lt;265 lbs.</td>
</tr>
<tr>
<td>EU</td>
<td>250W</td>
<td>15.5 mph</td>
<td>No</td>
<td>Yes</td>
<td>Motor operates during pedaling only</td>
</tr>
<tr>
<td>China</td>
<td>No limit</td>
<td>12.4 mph</td>
<td>Yes</td>
<td>Yes</td>
<td>Has operating pedals, &lt; 88 lbs.</td>
</tr>
<tr>
<td>Rest of Asia</td>
<td>250W</td>
<td>15 mph</td>
<td>No</td>
<td>Yes</td>
<td>Has operating pedals</td>
</tr>
<tr>
<td>Australia</td>
<td>250W</td>
<td>Not specified</td>
<td>Yes</td>
<td>Yes</td>
<td>Has operating pedals</td>
</tr>
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</table>
Market for E-bikes

Electric Bicycle Sales by Region, World Markets: 2012-2018

Source: Navigant/Pike Research
Projected US Growth

Source: Navigant/Pike Research
What Is Our Research Question?

Will e-bikes...

- Get more people to bike, and
- Get people to bike more often.
Survey Methodology

- Adapted a survey instrument from the Institute of Transport Studies at Monash University
- The survey was distributed through e-bike blogs & forums, Facebook pages, Twitter accounts, e-mails to manufacturers and retailers, and via postcards to retailers in the Portland region.
- March 7 – July 1, 2013
- 553 e-bike owners responded to the survey
Geography of survey respondents
Demographics

Gender
- Male: 85% (n=553)
- Female: 15%

Age
- 65 and over: 13%
- 55 to 64: 26%
- 45 to 54: 18%
- 35 to 44: 10%
- 25 to 34: 1%
- 18 to 24: 1%

Education
- High School: 4% (n=448)
- Some College: 25%
- College Graduate: 37%
- Graduate Degree: 34%

Income
- Under $15,000: 5%
- $15,000 to $25,000: 7%
- $25,000 to $35,000: 13%
- $35,000 to $50,000: 18%
- $50,000 to $75,000: 18%
- $75,000 to $100,000: 16%
- $100,000 to $150,000: 18%
- $150,000 or more: 16%

N = 448
Demographic summary

- 90% White, 5% Asian, 5% other (n=428)
- 90% have access to a motor vehicle, 7% no vehicle
- 30% indicated that they have a physical condition that makes riding a standard bike difficult (n=450)

How would you rate your general health?

- Excellent: 20%
- Very Good: 40%
- Good: 30%
- Fair: 10%
- Poor: 0%

n=449
Purchase Decisions

48% purchased an e-bike, while 52% converted a standard bike to electric-assist.

What type of bike did you convert?

- Mountain: 40%
- Hybrid: 16%
- Folding: 2%
- Recumbent: 10%
- Women's/Commuter: 7%
- Cargo/Xtracycle: 13%
- Other: 1%
In which year did you purchase your electric bike or conversion kit?

- 2005 or before: 3%
- 2006: 3%
- 2007: 2%
- 2008: 5%
- 2009: 11%
- 2010: 11%
- 2011: 20%
- 2012: 34%
- 2013: 13%

n=421
How much did your electric bike or conversion kit cost to purchase?

- 10% purchased for $500 or less
- 18% purchased for $501 - $1,000
- 18% purchased for $1,001 - $1,500
- 18% purchased for $1,501 - $2,000
- 24% purchased for $2,001 - $2,500
- 25% purchased for $2,501 or more

- 14% converted for $500 or less
- 8% converted for $501 - $1,000
- 18% converted for $1,001 - $1,500
- 17% converted for $1,501 - $2,000
- 14% converted for $2,001 - $2,500
- 16% converted for $2,501 or more

n=414
What were the main reasons you bought an electric bike, or converted a standard bicycle?

- To replace some car trips
- Health - medical condition reduced your ability to ride a standard bike
- Health - to increase physical fitness
- Because you live or work in a hilly area
- To ride with less effort
- To be able to keep up with friends/family when I go for rides

- Male
- Respondents w/ physical limitation
- Respondents <55
- Female
- Respondents w/out a physical limitation
- Respondents >55
What is the main reason that you use your electric bike (purpose of trips)?

![Bar chart showing reasons for using electric bikes](chart)

- **Commute to work/school**: 60% (Male: 65%, Respondents with physical limitation: 60%, Respondents < 55: 62%)
- **Local trips (shopping and errands)**: 40% (Male: 35%, Respondents with physical limitation: 45%, Respondents > 55: 40%)
- **Recreation**: 20% (Female: 25%, Respondents without physical limitation: 15%, Respondents > 55: 30%)
- **Other**: 10% (Male: 10%, Respondents with physical limitation: 5%, Respondents < 55: 15%)

“*I have bad knees (I’m retired, 68 years old). If I pedal a bike my range is limited by pain to about 5 to 6 miles. The e-bikes has a range per charge of 30 to 35 miles.*” – Survey Respondent
Bike Use

- 94% indicated they had rode a standard bike as an adult
- 55% rode their standard bike weekly or daily prior to e-bike purchase -- this went up to 93% after purchase
- Of the 6% that hadn’t rode a bike as an adult, of those 89% ride their e-bike daily or weekly
- Over 90% use their e-bikes weekly or daily

“To replace 95% of car trips and make commuting fun”
– Survey Respondent
Getting around

- 45% indicated that they take a different route on their e-bike than a standard bike
- 35% don’t avoid hills on e-bike and 31% will take more direct or higher traffic route on e-bike but 30% say they take lower traffic or less direct route
- Three quarters (73%) ride to different destinations on their e-bikes than they did on a standard bike
What are the different destinations you ride to on your electric bike?

- 52% of women responded that they take a different route on their electric bike than they did on their standard bike as compared to 42 percent of men.
- 82% of women responded that they ride to different destinations on their electric bike than they did on their standard bike compared to 73 percent of men.
My top speed is higher than when I rode a standard bike.
My average speed is higher than when I rode a standard bike

<table>
<thead>
<tr>
<th>Respondents without physical limitation</th>
<th>Disagree or Strongly Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree or Strongly Agree</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondents with physical limitation</td>
<td>8%</td>
<td>85%</td>
<td>77%</td>
<td>12%</td>
</tr>
<tr>
<td>55 and Older</td>
<td>12%</td>
<td>82%</td>
<td>74%</td>
<td>10%</td>
</tr>
<tr>
<td>Under 55</td>
<td>9%</td>
<td>86%</td>
<td>85%</td>
<td>8%</td>
</tr>
<tr>
<td>Female</td>
<td>12%</td>
<td>77%</td>
<td>86%</td>
<td>10%</td>
</tr>
<tr>
<td>Male</td>
<td>10%</td>
<td>86%</td>
<td>77%</td>
<td>12%</td>
</tr>
<tr>
<td>All respondents</td>
<td>10%</td>
<td>74%</td>
<td>84%</td>
<td>8%</td>
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</table>
I don't need to shower at the end of the trip

<table>
<thead>
<tr>
<th></th>
<th>Disagree or Strongly Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree or Strongly Agree</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondents without physical limitation</td>
<td>10% 12%</td>
<td>77%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respondents with physical limitation</td>
<td>11% 19%</td>
<td>69%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55 and Older</td>
<td>13% 18%</td>
<td>68%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 55</td>
<td>8% 12%</td>
<td>80%</td>
<td></td>
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<tr>
<td>Female</td>
<td>6% 18%</td>
<td>77%</td>
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<td></td>
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<tr>
<td>Male</td>
<td>11% 14%</td>
<td>74%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All respondents</td>
<td>10% 14%</td>
<td>74%</td>
<td></td>
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</tr>
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</table>
To ride the same trip by standard bike I would need a shower

<table>
<thead>
<tr>
<th>Category</th>
<th>Disagree or Strongly Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree or Strongly Agree</th>
<th>Don't know</th>
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</thead>
<tbody>
<tr>
<td>Respondents without physical limitation</td>
<td>13%</td>
<td>19%</td>
<td>65%</td>
<td></td>
</tr>
<tr>
<td>Respondents with physical limitation</td>
<td>8%</td>
<td>20%</td>
<td>70%</td>
<td></td>
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<tr>
<td>55 and Older</td>
<td>6%</td>
<td>25%</td>
<td>66%</td>
<td></td>
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<tr>
<td>Under 55</td>
<td>17%</td>
<td>15%</td>
<td>67%</td>
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<td>Female</td>
<td>19%</td>
<td>24%</td>
<td>55%</td>
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<td>Male</td>
<td>11%</td>
<td>19%</td>
<td>69%</td>
<td></td>
</tr>
<tr>
<td>All respondents</td>
<td>12%</td>
<td>20%</td>
<td>67%</td>
<td></td>
</tr>
</tbody>
</table>
I feel safer on the e-bike than on a standard bike

- Respondents without physical limitation:
  - 16% Disagree or Strongly Disagree
  - 24% Neither agree or disagree
  - 60% Agree or Strongly Agree

- Respondents with physical limitation:
  - 15% Disagree or Strongly Disagree
  - 21% Neither agree or disagree
  - 61% Agree or Strongly Agree

- 55 and Older:
  - 20% Disagree or Strongly Disagree
  - 21% Neither agree or disagree
  - 56% Agree or Strongly Agree

- Under 55:
  - 12% Disagree or Strongly Disagree
  - 25% Neither agree or disagree
  - 63% Agree or Strongly Agree

- Female:
  - 12% Disagree or Strongly Disagree
  - 28% Neither agree or disagree
  - 54% Agree or Strongly Agree

- Male:
  - 16% Disagree or Strongly Disagree
  - 22% Neither agree or disagree
  - 61% Agree or Strongly Agree

- All respondents:
  - 15% Disagree or Strongly Disagree
  - 23% Neither agree or disagree
  - 60% Agree or Strongly Agree
What are the main advantages to riding an e-bike?

- Increased speed/range: 20%
- Ride with less effort/Help on hills: 17%
- Health: 15%
- Cheaper transportation: 13%
- Fun: 11%
- Car replacement/environmental: 10%
- Allow to ride when otherwise couldn’t: 9%
- Increased cargo capacity: 5%
What are the main disadvantage to riding an e-bike?

- Weight: 25%
- Inclement weather: 15%
- None: 10%
- Cost: 7.5%
- Limited range: 10%
- Increased complexity/more things to fail: 7.5%
- Cars, having to deal with other road users: 5%
- Security/Fear of theft/Vandalism: 5%
- Battery charging time: 2.5%
Conclusions

- Have a potential to get more people on bikes
  - Older adults
  - People with physical limitations
  - Women (?)

I cannot drive due to epilepsy. I cannot bus due to severe motion sickness. Biking is my only way to work other than getting a ride. Bike commuting maintains my fitness level. I can ride even when I don't feel physically well or am overtired. I get to work faster than it takes when I get a car ride. I love the time outdoors, seeing the city and feeling like part of the bike community.
Conclusions

- Encourages more people to bike more often & to more distant locations
  - Commuters
    - Less sweaty, not strenuous
    - Not avoiding trips or locations
    - Enjoy biking!
  - Reported increase in bike usage

I use the e-bike primarily as a substitute for the car where I would have otherwise would have driven a car.

I can carry my son and a week’s worth of groceries.

I can ride to and from work without needing to shower at my destination.
Limitations

- No response rate
- Method of delivery
- Online survey and self reporting use
- Not random and potential basis
Additional Research Needs

- Comparative analysis with different regions (e.g., Australia)
- Infrastructure planning
- More evaluations of existing users
- Studies of potential e-bike users, especially women and older adults
- Safety
- Impacts on physical activity
- Interactions with other road users (perceptions & attitudes)
- Policy and legal
Kaiser Permanente E-bike Project

- Currie iZip E3 Compact
  - Top Speed: 18 mph
  - Range: 15-22 miles
  - Weight: 42 lbs
  - Folding

- Kaiser Employees at 3 campuses (1st/last mile commuting)

- 18 month trail & 180 people
Contact Information

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- 503-725-2866

- ebike.research.pdx.edu

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