Can electric bikes get more people in the United States to cycle?
Presentation Outline

• Why do e-bikes matter in the US?
• What is an e-bike?
• North American e-bike user survey
• Demonstration project
• US regulations & policy
• Conclusions
WHY DO E-BIKES MATTER IN THE US?
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\textsubscript{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.
Large US Cities Ranked by % Bicycle Commuting

Source: US Census Bureau, 2012 American Community Survey
Shifting the four types of cyclists

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

Why don’t people bike more in the US?

• Safety
• Lack of infrastructure
• Weather
• Inconvenience
• Logistic issues
• Lack of fitness or physical limitations
• Lack of time
• Too much effort
• Can’t carry what you need
• Lack of confidence
WHAT IS AN E-BIKE?
What is an electric bike?

- Battery
- Motor (Hub or Chain drive)
- Power controls & Gear shifts
Different types of the e-bikes

**Throttle**
- Powered bicycle (PB)

**Pedelec**
- Powered-assisted bicycle (PAB)
Not considered “e-bikes”

Moped

Scooter
Market for E-bikes

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

Source: Navigant/Pike Research
Projected US Growth

Source: Navigant/Pike Research
NORTH AMERICAN E-BIKE USER SURVEY
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%
- Female: 15%

n = 553

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

n = 451

Education
- High School: 4%
- Some College: 25%
- College Graduate: 37%
- Graduate Degree: 34%

n = 448

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

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
- Very Good
- Good
- Fair
- Poor

n=449
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

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

- **Commute to work/school**
  - Male Respondents
  - Female Respondents
  - Respondents w/ physical limitation
  - Respondents w/out a physical limitation

- **Local trips (shopping and errands)**
  - Male Respondents
  - Female Respondents
  - Respondents w/ physical limitation
  - Respondents w/out a physical limitation

- **Recreation**
  - Male Respondents
  - Female Respondents
  - Respondents w/ physical limitation
  - Respondents w/out a physical limitation

- **Other**
  - Male Respondents
  - Female Respondents
  - Respondents w/ physical limitation
  - Respondents w/out a physical limitation
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

“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
What are the main advantages to riding an e-bike?

- Increased speed/range: 20%
- Ride with less effort/Help on hills: 18%
- Health: 15%
- Cheaper transportation: 12%
- Fun: 11%
- Car replacement/environmental: 10%
- Allow to ride when otherwise: 9%
- Increased cargo capacity: 5%
What are the main disadvantage to riding an e-bike?

- Weight: 25%
- Inclement weather: 15%
- None: 10%
- Cost: 8%
- Limited range: 7%
- Increased complexity, more things to...
- Cars, having to deal with other road...
- Security/Fear of theft/Vandalism: 5%
- Battery charging time: 4%
Limitations of survey

- No response rate
- Method of delivery
- Online survey and self reporting use
- Not random and potential basis
Survey conclusions

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

I live in a hilly town and would never commute to work on a standard bike -- I wouldn't be able to make it up the hills. My electric assist bike makes commuting by bike possible.

I am age 78, legally blind, live alone in a semi-rural area. 4 miles to the nearest scheduled bus route and town, 7 miles to my favorite shopping area, 12 miles to my church.
Survey 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.
DEMONSTRATION PROJECT
Kaiser Permanente E-bike Project

- Currie iZip E3 Compact
  - Top Speed: 18 mph (29 kph)
  - Range: 15-22 miles (24-35 kph)
  - Weight: 42 lbs
  - Folding

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

- 18 month trial & 180 people
### Top motivations for participating in project

<table>
<thead>
<tr>
<th>Top reasons cited</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I'm curious how an e-bike would fit into my commute.</td>
<td>20</td>
<td>26</td>
</tr>
<tr>
<td>E-bikes may be good alternative transportation</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td>It may help me get more exercise or increase my activity level</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>I'm curious about features and performance of e-bikes</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>It might be a good way to cut commuting costs (gas, time, parking)</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>It may help me climb hills easier</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Number of respondents (n)</td>
<td>77</td>
<td></td>
</tr>
</tbody>
</table>
Biking habits of participants who ride a bike regularly or frequently

<table>
<thead>
<tr>
<th></th>
<th>Commute to work or school</th>
<th>Personal errands</th>
<th>Visit family or friends</th>
<th>Entertainment or socializing</th>
<th>Exercise or recreation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#</td>
<td>%</td>
<td>#</td>
<td>%</td>
<td>#</td>
</tr>
<tr>
<td>4-7 days/week</td>
<td>10</td>
<td>14%</td>
<td>3</td>
<td>4%</td>
<td>2</td>
</tr>
<tr>
<td>1-3 days/week</td>
<td>10</td>
<td>14%</td>
<td>16</td>
<td>23%</td>
<td>5</td>
</tr>
<tr>
<td>1-4 days/month</td>
<td>11</td>
<td>15%</td>
<td>16</td>
<td>23%</td>
<td>14</td>
</tr>
<tr>
<td>7+ times/year</td>
<td>5</td>
<td>7%</td>
<td>4</td>
<td>6%</td>
<td>5</td>
</tr>
<tr>
<td>1-6 times/year</td>
<td>3</td>
<td>4%</td>
<td>6</td>
<td>8%</td>
<td>5</td>
</tr>
<tr>
<td>Rarely/never</td>
<td>32</td>
<td>45%</td>
<td>26</td>
<td>37%</td>
<td>40</td>
</tr>
</tbody>
</table>

n = 71
How often participants e-bike commuted to work, disaggregated by employment campus

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Central #</th>
<th>Central %</th>
<th>Westside #</th>
<th>Westside %</th>
<th>Eastside #</th>
<th>Eastside %</th>
<th>Total #</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than once per week</td>
<td>5 (29%)</td>
<td>4 (27%)</td>
<td>8 (40%)</td>
<td>18 (34%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - 2 times per week</td>
<td>8 (47%)</td>
<td>7 (47%)</td>
<td>7 (35%)</td>
<td>22 (42%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 - 4 times per week</td>
<td>4 (24%)</td>
<td>4 (27%)</td>
<td>3 (15%)</td>
<td>11 (21%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 or more times per week</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>2 (10%)</td>
<td>2 (4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n = 53
Have you used an e-bike for travel where you had previously...

- ...used a motor vehicle?
  - Yes: 79%
  - No: 21%
  - Not applicable: 0%
  - Total: 100%

- ...used public transportation?
  - Yes: 38%
  - No: 45%
  - Not applicable: 17%
  - Total: 100%

- ...walked?
  - Yes: 74%
  - No: 23%
  - Not applicable: 4%
  - Total: 100%

- ...ridden a standard bicycle?
  - Yes: 66%
  - No: 30%
  - Not applicable: 4%
  - Total: 100%

n = 53
Participants’ overall experience with the e-bike

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Don't know</th>
<th>Somewhat disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The e-bike was comfortable to ride</td>
<td>55%</td>
<td>33%</td>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The e-bike was fun to ride</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The e-bike was easy to use overall</td>
<td>60%</td>
<td>35%</td>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The e-bike allowed me to go farther/faster than a standard bicycle</td>
<td>50%</td>
<td>13%</td>
<td>28%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>The e-bike made me feel more comfortable riding in traffic</td>
<td>33%</td>
<td>23%</td>
<td>33%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>The e-bike allowed me to keep up with friends or family on bikes</td>
<td>30%</td>
<td>15%</td>
<td>30%</td>
<td>15%</td>
<td>10%</td>
</tr>
</tbody>
</table>

n = 40
How likely are you to ride a standard bicycle now

<table>
<thead>
<tr>
<th>Activity</th>
<th>More likely</th>
<th>Neither more nor less likely</th>
<th>Less likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise or recreation</td>
<td>65%</td>
<td>25%</td>
<td>10%</td>
</tr>
<tr>
<td>Commuting to work/school</td>
<td>50%</td>
<td>33%</td>
<td>18%</td>
</tr>
<tr>
<td>Personal errands</td>
<td>45%</td>
<td>35%</td>
<td>20%</td>
</tr>
<tr>
<td>Visit family or friends</td>
<td>30%</td>
<td>40%</td>
<td>30%</td>
</tr>
<tr>
<td>Entertainment/socializing</td>
<td>25%</td>
<td>50%</td>
<td>25%</td>
</tr>
<tr>
<td>Total bicycle activity</td>
<td>43%</td>
<td>37%</td>
<td>21%</td>
</tr>
</tbody>
</table>

n = 40
U.S. REGULATIONS REVIEW
## 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>200W / 250W</td>
<td>Not specified</td>
<td>Yes</td>
<td>Yes</td>
<td>Has operating pedals</td>
</tr>
</tbody>
</table>
State & local regulations

- States define the device & determine where it can be used.
- Many states use regulations in place governing "moped", "motorcycle", "motorized bicycle", "motorcycle", "motorized bicycle", "motorcycle", "motorcycle", "motorscooter", "scooter", and/or "motor-driven cycle."

- 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.”

- Many cities defer to the state regulation and classification.

- Some cities are addressing e-bikes: Boulder, Eugene, Bloomfield (CO), Toronto, Chicago, Tucson, New York City.
E-bike-specific definition

- No
- Yes
- No “home rule”
Maximum power output specified

- Data unavailable
- 500 W / 0.67 HP
- 750 W / 1 H.P.
- 1000 W / 1.34 H.P.
- > 1000 W / 1.34 H.P.
- Piston displacement (cc)
- Unspecified limit
Driver’s license and vehicle registration

- **No**
- **Yes**
- **Vehicle registration required**
Policy Questions & Implications

• Technology
  • Motor size; Speed; Weight; Dimensions; Pedals (Functional?)

• Rider/Passenger
  • Age; Helmet; License; Registration

• Use
  • Separated/protected bike path; Bike lane; Shared use path; Sidewalk & Trails
CONCLUSIONS
Conclusions

• Evidence suggests that e-bikes are becoming more prevalent in North America.

• E-bikes can help get more people biking and biking more often.

• The federal & state regulatory landscape needs to be standardized to decrease confusion and help the market grow.

• Transportation agencies need to be aware of emerging technologies and their implications for how the transportation system should be designed, regulated and operated.

• More research on the safety implications of these new emerging technologies is needed.
Contact Information

John MacArthur
• macarthur@pdx.edu
• 503-725-2866
• trec.pdx.edu

For more information and reports: ebike.research.pdx.edu

For US E-bike Regulatory Review: http://nitc.us/research/project/564/

Special thanks to Geoffrey Rose & Marilyn Johnson, Institute of Transport Studies at Monash University for the use of the survey instrument and Chris Cherry, University of Tennessee, for his assistance.
Questions