Getting Used to Electric Vehicles...
Two Wheels at a Time

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What is an Electric Vehicle?
Why would you want one?

At 50mph, electricity use is about 235 Wh/mi.

Electricity is Cheap, about 12¢/1000Wh=2.4¢/mi

Gas is not so cheap... at $2.50/gal a 55mpg Prius burns 4.5¢/mi.

But they can be expensive...

Nissan Leaf is trying hard to meet the $20-25k price. Tesla>$100k
Sticker Shock on Unproven Technology=Too Risky

- Incremental approach
  Gas HEV→PHEV→Full Battery EV
What are other ways to get acquainted

Carshare

• Trip-scale car rental
• Pay by the mile
• Cheaper than rental
• Cheaper than (second) car ownership
• Full average cost paid for marginal use
• Car is not parked 95% of the time
• Try that EV without committing
  • what about range/recharge problems?
Which Country has 100+ million EVs on the road now?
• Electric two wheelers are very efficient about 12Wh/mi (vs 120-230Wh/mi for e-car)

• Electric two wheelers are no longer “new”

• Electric two wheelers could help China transition

Yearly E-bike Production in China
Why the success in China

- China’s growth due to bicycle culture (and infrastructure)
- E-bikes are relatively cheap (around $300)
- Trips are short
- Transit is crowded
- Streets are congested
Sample E2W Emissions (gCO$_2$/km)

- Bus$_{50\text{pax}}$~25 g/pax-km
- Motorcycle~55 g/pax-km
- Car$_{1.5\text{pax}}$~120 g/pax-km
Sustainable Urban Mobility Asia (SUMA)

Chris Cherry (UT)
Jonathan Weinert (UC-Davis)
Xinmiao Yang (Tsinghua)
Eric Van Gelder (UC-Davis)

Also See Article in TR Part D

Report Online (adb.org)
Also Online (adb.org)
Article in Prep, Likely to TR Part A

Chris Cherry (UT)
Luke Jones (UT)
Could E-bikes Usher in EV’s in USA?

Barriers to Bicycling
- Range/Fatigue
- Terrain
- Show up to work sweaty
- Transport stuff
- Infrastructure
- Weather

Some E-bike Solutions
- About 20 miles
- Electric Assist
- Need Infrastructure
- Weather gear avail.
- Moderate exercise
Similar to E-Car, E-bikes New and Expensive

- Price range around $700-1500
- What if it doesn’t work for me?
- Can I draw the line between commute and recreation?
- It would be great to try one?
- Very cheap operation
  - electricity ≈ 0.2¢/mile
  - battery depreciation ≈ 3¢/mile
What about sharing electric bikes

Bicycle Sharing Programs Growing Worldwide

115,000 trips/day / 20,600 bikes = 5.6 trips/bike/day

Trip length could be 3-4 miles

5.6 trips/bike/day x 4 miles = 22 miles/bike/day

We run into a range problem, but we have the technology

26 Cities In Process
E-bike Share Proof of Concept on UT Campus

Small Scale Project to Test Technology and Market

- How to recharge batteries?
- Can we exchange batteries?
- How are vehicles secured?
- How much energy is used - f(speed, weight, terrain)?
- Can we tie in solar power (truly zero emission)?
- What are environmental impacts?
- Is there a positive public health impact?
- How will students/faculty/staff use or pay?
- What is the preference relationship with bicycles?
E-bike Share Proof of Concept on UT Campus

Scope:

15-25 bikes (sensored)
   10-15 e-bikes
   5-10 bicycles

1-2 stations (unattended)
   auto-locking rental kiosks
   removable battery vending
   scan card/credit card checkout

Serving

on-campus housing
staff and faculty day trips
campus delivery (library)
E-bike Share Expected Outcome

Technology:
- Re-charging Protocol
- Energy Use per Mile
- Bike Locking
- Solar Recharge

Market:
- Students/faculty/staff Use
- Willingness to Pay
- System Design
- Beyond UT
- Business Plan
Can Shared E-bikes Usher In EV’s?

• E-bikes eliminate a few of the barriers to bicycling
• E-bikes can be shared, because their batteries can be easily removed
• E-bikes can introduce riders to EV technology
• E-bikes are the greenest motorized mode (efficient and light)
• Planning and infrastructure required
Next Steps

- Publish findings
- If barriers can be overcome:
  - Develop operating business model
  - Find funding to capitalize system
  - Expand system on UT campus and beyond
  - Integrate e-bikes into existing bikeshare systems worldwide
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