Capturing and Conveying the Full Value of Cycling

2013 National Bike Summit
March 5, 2013

Ken Colburn and Chris James
Disclaimers...

- Billing disclaimer:
  - Not about health
  - Affiliation wrong
  - No “latest study”...

- But hopefully a useful unifying framework for you

- Kudos to co-author, Chris James
  - He’d do twice as good a job – 4k vs. 2K

- Also greetings from another colleague Jim Lazar
The Regulatory Assistance Project (RAP) is a global, non-profit team of energy experts, mostly veteran regulators, advising current regulators on long-term economic and environmental sustainability. ([www.raponline.org](http://www.raponline.org))

- Ken Colburn is a Senior Associate at RAP; he previously directed the air quality division at the New Hampshire Department of Environmental Services. He is an LCI and rides \(~2,000\) mpy.

- Chris James is a Principal at RAP; he previously led Connecticut’s climate and energy efforts at the state’s Department of Environmental Protection. He rides over \(4,000\) mpy all over the world.
Energy and Transportation
“Demand Curves” Are Similar

Little time at very high, very expensive, peak demand levels. Isn’t there a better way?
• Energy efficiency is the answer.
• What was the question?
Most analyses of EE are incomplete:

- Some look only at avoided energy costs.
- Many include production capacity costs, but not transmission or distribution capacity or line losses.
- Few include other resource savings (water, gas, oil).
- Very few quantity "externalities" (non-energy benefits.)
Build a Bike/Walk “Layer Cake”!

• Just as LAB was soliciting proposals in late 2012, Darren Flusche and Todd Litman were (unbeknownst to us) developing their best works yet.

• Our “layers” draw heavily upon their analyses.
Layer 1: Vehicle Cost Savings

• **What:**
  - Purchase, lease, interest, depreciation
  - Gasoline, oil, tire wear, repairs
  - Registration, insurance
  - Other

• **How Much:**
  - 56.5¢/mile: IRS cost/mile (2013)
Capturing and Conveying the Full Value of Cycling Benefits in $/mile Ridden

Vehicle Cost Savings, 56.5¢
Layer 2: User Benefits

• What:
  – Convenience, comfort, safety, accessibility, mobility, exercise, and enjoyment
  – Higher *property values*
    • +1 Walkscore point = +$700-$3,000
    • +1’ closer to trail = +$7.05
    • Indy: <1/2 m = +11%; Delaware: <50 m = +4.5%

• How Much:
  – 25¢/mile (low estimate)
Capturing and Conveying the Full Value of Cycling

Benefits in $/mile Ridden

- User Benefits, 25¢
- Vehicle Cost Savings, 56.5¢
Layer 3: Physical Fitness & Health

• What:
  – Longevity, morbidity, quality of life
    • Heart disease, stroke, hypertension, cancer, diabetes, cancer
    • Depression/stress, dementia
  – Accident risk

• How Much:
  – 20¢/mile
    • (New Zealand puts health+congestion at $1.92!)
Capturing and Conveying the Full Value of Cycling Benefits in $/mile Ridden

- Physical Fitness & Health, 20¢
- User Benefits, 25¢
- Vehicle Cost Savings, 56.5¢
Layer 4: Air, Water & Noise Pollution

• What:
  – Auto production and use pollutes
  – Fine particles, ozone, toxics/carcinogens, global warming pollution
  – Impacts vary locally, regionally, globally, but near-highways elevates exposure markedly

• How Much:
  – 10¢/mile (Colburn & James)
    • Litman (2012) – 4.4¢ (1¢-10¢ range) but excludes particles, toxics, and global warming pollutants.
Capturing and Conveying the Full Value of Cycling Benefits in $/mile Ridden

Air, water, noise pollution, 10¢
Physical Fitness & Health, 20¢
User Benefits, 25¢
Vehicle Cost Savings, 56.5¢
Layer 5: Option Value & Equity

• What:
  – Value people place on having an option available that they don’t now use (e.g., lifeboats)
  – Provide equitable share of resources to non-drivers and basic mobility to less-advantaged people

• How Much:
  – 7¢/mile
Capturing and Conveying the Full Value of Cycling
Benefits in $/mile Ridden

Option Value and Equity, 7¢
Air, water, noise pollution, 10¢
Physical Fitness & Health, 20¢
User Benefits, 25¢
Vehicle Cost Savings, 56.5¢
Layer 6: Reduced Congestion

• What:
  – Increased travel time, vehicle operating costs, stress and pollution emissions
  – Comparable to electricity load duration curve: Small reductions at peak make a big difference

• How Much:
  – 6¢/mile; range 1¢-20¢/mile, but 10¢-35¢ per urban-peak-mile
Capturing and Conveying the Full Value of Cycling
Benefits in $/mile Ridden

- Reduced Congestion, 6¢
- Option Value and Equity, 7¢
- Air, water, noise pollution, 10¢
- Physical Fitness & Health, 20¢
- User Benefits, 25¢
- Vehicle Cost Savings, 56.5¢
Layer 7: Land Use Impacts

• What:
  – Reduce sprawl impacts; less need for land for highway and parking facilities
  – Create more accessible, compact, mixed, infill development (smart growth)
  – Provide community and other environmental benefits

• How Much:
  – 5.3¢/mile; likely low
Capturing and Conveying the Full Value of Cycling
Benefits in $/mile Ridden

- Land Use Impacts, 5.3¢
- Reduced Congestion, 6¢
- Option Value and Equity, 7¢
- Air, water, noise pollution, 10¢
- Physical Fitness & Health, 20¢
- User Benefits, 25¢
- Vehicle Cost Savings, 56.5¢
Layer 8: Reduced Parking

• What:
  – Urban parking spaces cost $5,000-$50,000 ($500-$3,000/year)
  – 3+ spaces/vehicle, rural & suburban highest (where parking is provided)

• How Much:
  – 5¢/mile; range $1-$4/trip; assume $1/trip and 20 mile trip
Capturing and Conveying the Full Value of Cycling
Benefits in $/mile Ridden

- Parking, 5¢
- Land Use Impacts, 5.3¢
- Reduced Congestion, 6¢
- Option Value and Equity, 7¢
- Air, water, noise pollution, 10¢
- Physical Fitness & Health, 20¢
- User Benefits, 25¢
- Vehicle Cost Savings, 56.5¢
Layer 9: Roadway Cost Savings

• What:
  – Roadways cost ~$700/person/year in US, paid through taxes and fees
  – Cycling and walking need less road space, impose far less wear, and so cost much less per mile of travel

• How Much:
  – 4.2¢/mile; range 3¢-5¢/mile
Capturing and Conveying the Full Value of Cycling

Benefits in $/mile Ridden

- Roadway Cost Savings, 4.2¢
- Parking, 5¢
- Land Use Impacts, 5.3¢
- Reduced Congestions, 6¢
- Option Value and Equity, 7¢
- Air, water, noise pollution, 10¢
- Physical Fitness & Health, 20¢
- User Benefits, 25¢
- Vehicle Cost Savings, 56.5¢
Layer 10: Traffic Safety

• What:
  – Crashes are among the largest of “external” transportation costs (~2¢-12¢ per vehicle-mile)
  – Cycling/walking reduces crash costs because risks are lower and distances less

• How Much:
  – 4¢/mile; range 3¢-5¢/mile
Capturing and Conveying the Full Value of Cycling Benefits in $/mile Ridden

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Safety</td>
<td>4¢</td>
</tr>
<tr>
<td>Roadway Cost Savings</td>
<td>4.2¢</td>
</tr>
<tr>
<td>Parking</td>
<td>5¢</td>
</tr>
<tr>
<td>Land Use Impacts</td>
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<td>User Benefits</td>
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<td>Vehicle Cost Savings</td>
<td>56.5¢</td>
</tr>
</tbody>
</table>
Layer 11: Energy Conservation

• What:
  – Vehicle production and use consumes much energy, imposing high external costs (economic and national security impacts, foreign oil dependence, environmental and health damages)
  – Each 1% mode shift can reduce fuel use 2-4%

• How Much:
  – 3¢/mile; range 1¢-4¢/mile
Capturing and Conveying the Full Value of Cycling
Benefits in $/mile Ridden

- Energy Conservation, 3¢
- Traffic Safety, 4¢
- Roadway Cost Savings, 4.2¢
- Parking, 5¢
- Land Use Impacts, 5.3¢
- Reduced Congestion, 6¢
- Option Value and Equity, 7¢
- Air, water, noise pollution, 10¢
- Physical Fitness & Health, 20¢
- User Benefits, 25¢
- Vehicle Cost Savings, 56.5¢
Layer 12: Reduced Barriers

• **What:**
  - Travel delays, access restrictions, & costs due to “road improvement” projects
  - Impose direct and indirect costs on cycling/walking; causing shift to vehicles
  - Example: No sidewalks/bike lanes to schools

• **How Much:**
  - 1¢/mile; range 0.5¢-1.5¢/mile
Capturing and Conveying the Full Value of Cycling
Benefits in $/mile Ridden

- Reduced Barrier Effect, 1¢
- Energy Conservation, 3¢
- Traffic Safety, 4¢
- Roadway Cost Savings, 4.2¢
- Parking, 5¢
- Land Use Impacts, 5.3¢
- Reduced Congestion, 6¢
- Option Value and Equity, 7¢
- Air, water, noise pollution, 10¢
- Physical Fitness & Health, 20¢
- User Benefits, 25¢
- Vehicle Cost Savings, 56.5¢
Layer 13: Economic Development - Transport Efficiency

• What:
  – Reduced costs to commuters, businesses and governments also reduce production costs, increasing economic productivity and competitiveness.

• How Much:
  – Difficult-to-Quantify (DTQ)
  – Placeholder: 1¢/mile
Layer 13: Economic Development - Transport Efficiency

- Examples (1):
  - New 4-lane urban highways: $40-$80 million per mile (higher in sensitive areas)
  - MAP-21’s entire 2013 Transportation Alternatives budget: **$809 million**
  - By contrast, new urban bike lanes: <$1 million per mile; rural just ~1/20th that
  - *Entire TA budget = just 10-20 miles?*
  - *How efficient is that?*
Layer 13: Economic Development - Transport Efficiency

• Examples (2):

  - Cincinnati is as costly as “expensive Chicago”!

  - “Expensive Boston” is less so than Tampa!
Capturing and Conveying the Full Value of Cycling
Benefits in $/mile Ridden

DTQ-ED = Difficult-to-Quantify Economic Development
Layer 14: Economic Development
- Labor Productivity

• What:
  – Improved access to education and jobs increases the quality and quantity of the labor pool, reducing business costs and increasing productivity and competitiveness.
  – Also increases labor productivity by enhancing worker fitness.

• How Much:
  – Placeholder: 1¢/mile
Layer 14: Economic Development - Labor Productivity

• Examples:
  - IPMBA: Arrest rates rose ~24% when bicycles were introduced into patrol areas; then fell and crime stabilized, due to the bike deterrent
    • *Stealth: a bike cop sees more – and is seen less – than a police cruiser*
  - Vancouver parking enforcement 30-100% more productive on bikes; officers easily navigate congested areas and don’t waste time searching for parking spaces
Capturing and Conveying the Full Value of Cycling

Benefits in $/mile Ridden

- DTQ-ED: Labor Productivity, 1¢
- DTQ-ED: Transport Efficiency, 1¢
- Reduced Barrier Effect, 1¢
- Energy Conservation, 3¢
- Traffic Safety, 4¢
- Roadway Cost Savings, 4.2¢
- Parking, 5¢
- Land Use Impacts, 5.3¢
- Reduced Congestion, 6¢
- Option Value and Equity, 7¢
- Air, water, noise pollution, 10¢
- Physical Fitness & Health, 20¢
- User Benefits, 25¢
- Vehicle Cost Savings, 56.5¢
Layer 15: Economic Development - Land Use Efficiency

• What:
  - More accessible and compact land use patterns provide accessibility benefits, creating agglomeration efficiencies and resource cost savings.
    • e.g., Density; cluster development

• How Much:
  - Placeholder: 1¢/mile
Capturing and Conveying the Full Value of Cycling
Benefits in $/mile Ridden

- DTQ-ED: Land Use Efficiency, 1¢
- DTQ-ED: Labor Productivity, 1¢
- DTQ-ED: Transport Efficiency, 1¢
- Reduced Barrier Effect, 1¢
- Energy Conservation, 3¢
- Traffic Safety, 4¢
- Roadway Cost Savings, 4.2¢
- Parking, 5¢
- Land Use Impacts, 5.3¢
- Reduced Congestion, 6¢
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- Air, water, noise pollution, 10¢
- Physical Fitness & Health, 20¢
- User Benefits, 25¢
- Vehicle Cost Savings, 56.5¢
Layer 16: Economic Development
- Consumer Spending

• What:
  – Consumer spending changes (especially less on vehicles and fuel), which can affect regional economic activity:
    • More money circulating in local economy
    • Less money is exported from the region/nation

• How Much:
  – Placeholder: 1¢/mile
Layer 16: Economic Development
- Consumer Spending

• Examples:
  – Autos and oil are major industries, but:
    • Much is imported;
    • Capital intensive with relatively little labor input;
    Economic activity *increases* as spending shifts to other goods
  – NH: ~$6-7 billion/year for energy (all forms);
    ~2/3 ($4.5 billion) leaves the State immediately, mostly for petroleum
Capturing and Conveying the Full Value of Cycling
Benefits in $/mile Ridden

- DTQ-ED: Consumer Expenditures, 1¢
- DTQ-ED: Land Use Efficiency, 1¢
- DTQ-ED: Labor Productivity, 1¢
- DTQ-ED: Transport Efficiency, 1¢
- Reduced Barrier Effect, 1¢
- Energy Conservation, 3¢
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- Parking, 5¢
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Layer 17: Economic Development
- Specific Industries

• What:
  – Certain industries benefit greatly including bike shops, tourism, retail activity, and construction/real estate development that highlights livability.
  – NCDOT $60m; Portland $90m; Boulder $52m economic activity annually

• How Much:
  – Placeholder: 1¢/mile
Layer 17: Economic Development
- Specific Industries

• Examples:
  – Bike shops & tourism sure, but construction & real estate?
  – More money in pocket => greater home ownership
    • Top reason for mortgage disapproval: Car payments too high
    • Probability of mortgage foreclosure increases as vehicle ownership levels rise

Reducing Foreclosures and Environmental Impacts through Location-Efficient Neighborhood Design
Capturing and Conveying the Full Value of Cycling
Benefits in $/mile Ridden

- DTQ-ED: Specific Industries, 1¢
- DTQ-ED: Consumer Expenditures, 1¢
- DTQ-ED: Land Use Efficiency, 1¢
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Cumulative Layer Cake

• Total: $1.52/mile benefits (conservative, yet nearly 3x IRS $-per-mile figure)

<table>
<thead>
<tr>
<th>Table 14</th>
<th>Automobile to Nonmotorized Travel Monetized Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban Peak</td>
</tr>
<tr>
<td>Total Per Mile</td>
<td>&gt; $2.75</td>
</tr>
<tr>
<td>Average Walking Trip (0.6 miles)</td>
<td>&gt; $1.68</td>
</tr>
<tr>
<td>Average Cycling Trip (2.0 miles)</td>
<td>&gt; $5.60</td>
</tr>
</tbody>
</table>

This table indicates the monetized benefits of shifts from automobile to nonmotorized modes. Additional benefits are not monetized, so total benefits are likely to be much greater.

• **Build your own “Layer Cake”!**

• Caveats:
  - Overlaps; risk of double-counting
  - Who pays/who benefits questions
  - Difficult-to-quantify does not mean unimportant
Jobs, Jobs, Jobs...

• Litman (2012):
  – “Reducing vehicle and fuel spending tends to support economic development. Because non-motorized facility construction is relatively labor intensive [and local], it tends to create more employment and regional business activity than other capital projects.”

• Garrett-Peltier (2010):
  – Direct, indirect, and induced employment created in infrastructure design, construction, and materials:
    – Cycling: **11.4 jobs** per $1 million
    – Roadway: **7.8 jobs** per $1 million
It’s Happened in Energy (RPS & EERS), Now It’s Happening in Transportation: GDP & VMT are “Decoupling”

Off ~15% and just getting started?

Question for Members of Congress:

“This is happening; are you going to lead, follow, or just get run over?”

Data Sources: VMT: US DOT, BTS, Table 1-32: US Vehicle Miles, FHWA Traffic Volume Trends August 2010. GDP: BEA National Income and Product Account Table, Table 1.1.6 Real GDP, Chained (2005) Dollars

Center for Clean Air Policy
Close with Some Stories...

• Epiphanies yesterday: Bruce Katz was talking about me/us (Roberta Flack – “with his song”)
  – Real Estate decisions:
    • 2008 Durango closing anecdote: Jeans, Ride, & LTE
    • 2012 Bar Harbor: 1 mi. to Park Loop Road (top 10); wife giggles on the carriage trails
  – And my generation isn’t the “leading edge”;
    • Two kids, 30 and 27, “crowning achievement: both can drive a stick”, but today, neither owns a car

• Bicycling is the answer!
What was the question?
About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power and natural gas sectors. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raponline.org

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• Analogue to debits & credits: A “double-swing” in magnitude occurs when mode shift changes.