Shrinking the Carbon Footprint of Metropolitan America

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Shrinking the Carbon Footprint of Metropolitan America

America’s challenge

New footprint estimates & findings

Federal flaws & 10 policy options
America’s challenge
Carbon dioxide is the most prevalent greenhouse gas (GHG) emitted in the United States. Buildings account for 39% of carbon dioxide emissions, industry for 28%, and transport for 33%. Carbon dioxide emissions come primarily from the energy used in buildings and transportation. 

Source: U.S. Environmental Protection Agency and the Energy Information Administration
Autos and trucks produced three-quarters of the nation’s transportation carbon emissions in 2005.

- **Automobiles**: 30%
- **Light Trucks**: 27%
- **Freight Trucks**: 20%
- **Air**: 11%
- **Water**: 6%
- **Other**: 3%
- **Rail**: 2%
- **Buses**: 1%

Source: Energy Information Administration
The majority of residential energy use came from space and water heating, lights, and cooling in 2005.

- **Space Heating**: 34%
- **Water Heating**: 14%
- **Lights**: 13%
- **Cooling**: 10%
- **Electronics**: 5%
- **Refrigeration**: 9%
- **Wash**: 5%
- **Cooking**: 5%
- **Other**: 4%
- **Computers**: 1%

*Source: Energy Information Administration*
America’s Challenge

**U.S. projected to add 73 million residents and 30 million new housing units by 2030**

Projected growth

(millions)

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>296.5</td>
<td>369.8</td>
</tr>
<tr>
<td>Housing Units</td>
<td>122.1</td>
<td>152.3</td>
</tr>
</tbody>
</table>

Source: Chris Nelson
Carbon emissions in the U.S. have increased about 1 percent annually since 1980 and are projected to increase 16 percent from 2006 to 2030.

Source: Energy Information Administration
Reducing the nation’s carbon footprint will require adaptation and innovation in metropolitan America.

The nation’s built environment is concentrated in its largest metropolitan areas, making them central to achieving meaningful carbon reductions.

But, prior to this project, little emissions data existed at the metropolitan level—data critical for understanding the link between emissions and metropolitan America’s built environment.
New footprint estimates and findings
This study fills an important data gap by producing comparable partial carbon footprints for metro areas.

Partial carbon footprints were estimated for transportation and residential energy use.

**Transportation**

- Passenger and freight VMT was estimated at the metro-level using HPMS data.
- Fuel consumption was estimated by incorporating VMT, types of vehicles, and fuel cycle multipliers.
- Fuel consumption was then converted to carbon emissions.
This study fills an important data gap by producing comparable partial carbon footprints for metro areas.

Partial carbon footprints were estimated for transportation and residential energy use.

**Residential Buildings**

- Residential electricity data was obtained from Platts Analytics.
- Fuel data was obtained from EIA and the Residential Energy Consumption Survey.
- All energy consumption data was aggregated to the metro-level and converted to equivalent carbon emissions.
This study fills an important data gap by producing comparable partial carbon footprints for metro areas.

**Per Capita Footprints**

- This report uses *individual* or *per capita* carbon footprints.
- This way we can compare metro area footprints across metro areas of varying size (New York vs. Boise).
- This gets at the relative efficiency of energy use in one metro area compared to other metro areas and the national average.
Analysis reveals **five major findings**

1. Large metro areas offer greater energy and carbon efficiency than the nation as a whole.
2. Carbon emissions increased slower in metropolitan America than the rest of the country between 2000 and 2005.
3. Per capita emissions vary substantially by metro area.
4. Development patterns and rail transit play an important role in determining carbon emissions.
5. Fuel mix and electricity prices are also important determinants of emissions.
1- Large metro areas offer greater energy and carbon efficiency than the nation as a whole

Percentage of national activity in 100 largest metro areas, 2005

- National total
- GDP: 76%
- Population: 65%
- Carbon emissions: 56%
- Land area: 12%
1- The carbon footprint of the largest 100 metros is 14% smaller than the U.S. average.
1- The largest 10 metros are especially carbon-efficient
Carbon emissions increased slower in metropolitan America than the rest of the country between 2000 and 2005.
3 - Per capita emissions vary substantially by metro area

<table>
<thead>
<tr>
<th>Largest per capita carbon footprints, 2005</th>
<th>Tons of carbon per capita</th>
<th>Smallest per capita carbon footprints, 2005</th>
<th>Tons of carbon per capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lexington, KY</td>
<td>3.455</td>
<td>Honolulu, HI</td>
<td>1.356</td>
</tr>
<tr>
<td>Indianapolis, IN</td>
<td>3.364</td>
<td>Los Angeles, CA</td>
<td>1.413</td>
</tr>
<tr>
<td>Cincinnati, OH</td>
<td>3.281</td>
<td>Portland, OR</td>
<td>1.446</td>
</tr>
<tr>
<td>Toledo, OH</td>
<td>3.240</td>
<td>New York, NY</td>
<td>1.495</td>
</tr>
<tr>
<td>Louisville, KY</td>
<td>3.233</td>
<td>Boise City, ID</td>
<td>1.507</td>
</tr>
<tr>
<td>Nashville, TN</td>
<td>3.222</td>
<td>Seattle, WA</td>
<td>1.556</td>
</tr>
<tr>
<td>St. Louis, MO</td>
<td>3.217</td>
<td>San Jose, CA</td>
<td>1.573</td>
</tr>
<tr>
<td>Oklahoma City, OK</td>
<td>3.204</td>
<td>San Francisco, CA</td>
<td>1.585</td>
</tr>
<tr>
<td>Harrisburg, PA</td>
<td>3.190</td>
<td>El Paso, TX</td>
<td>1.613</td>
</tr>
<tr>
<td>Knoxville, TN</td>
<td>3.134</td>
<td>San Diego, CA</td>
<td>1.630</td>
</tr>
</tbody>
</table>
3 - The Mississippi River roughly divides the country into high and low emitting metros.

Carbon emissions per capita by quintile, 2005:
- Lowest quintile
- Second-lowest quintile
- Middle quintile
- Second-highest quintile
- Highest quintile
3 - Southern and Midwestern metros have larger carbon footprints
Development patterns and rail transit play an important role in determining carbon emissions

- Density and concentration of development tend to be higher in the lowest-emitting metro areas.
- Many metro areas with small per capita carbon footprints also have sizeable rail transit ridership.
  - There are exceptions: Washington, Baltimore, and Atlanta have high rail transit ridership but also have larger than average carbon footprints.
4 - Denser metro areas tend to have lower per capita carbon footprints
4 – High levels of freight transport characterize metros with large footprints.
5 - Fuel mix and electricity prices are also important determinants of emissions

- The fuel mix used to generate electricity matters in residential footprints.
- Electricity pricing appears to influence the electricity component of the residential footprints.
- Areas with lower residential building carbon footprints tend to be located in mild climates with low heating and cooling requirements.
Federal flaws & 10 policy options

Economy-wide Policy Instruments

- Federal Housing
- Finance Levers
- Transit Oriented Development
- National Renewable Electricity Standard
- Carbon Pricing
- Information Collection to Maximize Performance

Targeted Policy Instruments

- Energy R&D
- Utility Rate Reform
- Home Energy Cost Disclosure and “On-Bill” Financing
- Regional Freight Planning

Metropolitan Challenge

strong linkage possible
positive linkage possible
Washington should address several economy-wide flaws to shrink the nation’s carbon footprint

<table>
<thead>
<tr>
<th>Economy-wide flaws</th>
<th>Recommended federal response</th>
</tr>
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<tbody>
<tr>
<td>Carbon based energy is underpriced</td>
<td>Price carbon to account for the external costs of fossil fuel combustion</td>
</tr>
<tr>
<td>Federal energy RD&amp;D is underfunded</td>
<td>Increase energy RD&amp;D funding to catalyze innovation and market uptake</td>
</tr>
<tr>
<td>National energy standards are lacking</td>
<td>Establish a national renewable electricity standard</td>
</tr>
<tr>
<td>State utility pricing policies and regulation thwart energy efficiency improvements</td>
<td>Help states reform electricity regulations to incentivize efficiency</td>
</tr>
</tbody>
</table>
Information collection to maximize performance

• Collect and disseminate the data needed to make informed decisions
  – Transportation/Housing/Energy Index
  – Energy consumption and carbon footprints

• Disseminate information on best practices
• Set performance goals and tie funding streams to outcomes achieved
Transform metropolitan transportation decision making

• Adopt a position of “modal neutrality” to make transit and compact development options more feasible
• Engage in regional freight planning to introduce more energy efficient freight operations

ARLINGTON, VA TOD CORRIDOR

Manchester, England
Source: F. Southworth (2007)

San Diego, CA light rail station
http://transitorienteddevelopment.dot.ca.gov
Reform housing policies

• Require energy cost disclosure through RESPA and create opportunities for “on-bill” financing of energy-efficient retrofitting
• Re-examine federal housing finance levers to incentivize location efficient mortgages and reform policies that lead to the overconsumption of housing
  – Energy-efficient retrofits
  – Location-efficient decisions
• Issue metropolitan challenge grants to reward metro areas for developing innovative policies that integrate transportation, housing, land use, environmental, and energy policies across entire metropolitan areas
For more information, see:

www.brookings.edu/metro/CarbonFootprint.aspx

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