Conducting a Greenhouse Gas Emissions Inventory at the Metropolitan Level, Allocated to Municipalities and Counties

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Background

- DVRPC is the Metropolitan Planning Organization for Greater Philadelphia (9 counties, 353 municipalities, 5.5 million people)
- Significant state, county, and municipal activity on climate change
- Desire to reduce confusion, foster more efficient use of limited resources
- Opportunity for DVRPC to provide leadership, support, and coordination
- Interest from national organizations in partnering
- In January 2008, DVRPC Board created a new Climate Change Initiatives program area, starting July 1
GHG Emissions Inventory Process

- Kicked off in May 2008
- Inventory Advisory Group formed – close to 100 people: municipal, county, state, regional, national, federal, citizens, businesses
  - Total of four meetings
  - Very engaged participants
  - Managing expectations on both sides
- ICF International served as consultant
  - Anne Choate
  - Phillip Groth
Categories Included

- Energy use—mobile and stationary
- Waste disposal—solid waste and wastewater
- Agriculture—livestock and soils
- Industrial processes (non-energy)
- Fugitive emissions from fuel systems
- Land use, land use change, forestry

- Does not include emissions embedded in goods and services or activities from outside the region
Sources of Information

- Electricity and natural gas from utilities
- Other fuels from state-level inventories
  - Allocated in a variety of ways
- On-road vehicles: DVRPC model
- Transit: SEPTA, PATCO, NJT
- Land use change: DVRPC land use data
- Fugitive emissions: based on natural gas usage and refining capacity
- Waste disposal: state averages
## 2005 DVRPC Emissions Summary

<table>
<thead>
<tr>
<th>Emissions Source Category</th>
<th>Emissions (MMTCO$_2$E)</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary Energy Consumption—Residential</td>
<td>21.9</td>
<td>24.2%</td>
</tr>
<tr>
<td>Stationary Energy Consumption—Commercial &amp; Industrial</td>
<td>34.2</td>
<td>37.9%</td>
</tr>
<tr>
<td>Mobile Energy Consumption</td>
<td>27.1</td>
<td>30.1%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0.5</td>
<td>0.5%</td>
</tr>
<tr>
<td>Waste Management</td>
<td>2.6</td>
<td>2.8%</td>
</tr>
<tr>
<td>Industrial Processes</td>
<td>3.2</td>
<td>3.6%</td>
</tr>
<tr>
<td>Fugitive Emissions from Fuel Systems</td>
<td>0.8</td>
<td>0.9%</td>
</tr>
<tr>
<td><strong>Gross Emissions</strong></td>
<td><strong>90.3</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td>Land Use, Land Use Change, and Forestry</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td><strong>Net Emissions</strong></td>
<td><strong>90.4</strong></td>
<td></td>
</tr>
</tbody>
</table>

Regional total is 1.26% of national 2005 total of 7260 MMTCO$_2$Eq
16.5 MMTCO$_2$Eq per capita vs. 24.5 MMTCO$_2$Eq nationally
2005 DVRPC Emissions by Sector

Stationary Energy Consumption:
- Residential, 24.2%
- Commercial & Industrial, 37.9%

Mobile Energy Consumption, 30.1%

Agriculture, 0.5%

Waste Management, 2.8%

Industrial Processes, 3.6%

Fugitive Emissions from Fuel Systems, 0.9%
Electricity and Natural Gas

- Received from over a dozen utilities
  - Billing or consumption data
  - customer class
  - ZIP (70% of E, 60% of G) or municipality
  - holes
- Electricity: eGRID (PJM Interconnection)
  - Vampire power, transmission loss, CH₄ and N₂O
- Natural Gas: EPA
  - Leakage to “Fugitive Emissions”
Other Stationary Fuel Use

- State totals (EIA) by sector
  - Residential
    - To county by 2005 ACS
    - To MCD using 2000 Census
  - Commercial/Industrial
    - Used residential method for fuel oil, LPG, coal
    - Used employment for other fuels
    - Industrial fuels not allocated to MCD
Mobile Energy

- On-road vehicles:
  - Total: DVRPC travel demand model
  - Allocation: Following slides
- Aviation:
  - Regional allocation based on one-half portion of national flight miles to/from PHL (1.8%).
  - Not allocated below region
- Freight rail:
  - Based on region’s share of national rail tonnage
  - Not allocated below region
- Marine, off-road, public transit, intercity rail, through highway
How do you allocate VMT?

- A driver leaves home in municipality A for work in municipality C. This trip passes through municipality B. After work the driver travels to a restaurant in municipality D, then returns to home in municipality A, passing through municipality E.

<table>
<thead>
<tr>
<th>Trip:</th>
<th>Trip Summary</th>
<th>Miles traveled in Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home to work</td>
<td>A→B→C</td>
<td>A 2</td>
</tr>
<tr>
<td>Work to restaurant</td>
<td>C→D</td>
<td>A</td>
</tr>
<tr>
<td>Restaurant to home</td>
<td>D→E→A</td>
<td>A 3</td>
</tr>
</tbody>
</table>

---
## Four Ways to Allocate

<table>
<thead>
<tr>
<th>VMT Basis</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary based</td>
<td>5</td>
<td>3</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Origin based</td>
<td>10</td>
<td>7</td>
<td>11</td>
<td></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>Destination based</td>
<td>11</td>
<td>10</td>
<td>7</td>
<td></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>Origin-destination split</td>
<td>10.5</td>
<td>8.5</td>
<td>9</td>
<td></td>
<td></td>
<td>28</td>
</tr>
</tbody>
</table>

- Used origin-destination split
- Methodology widely applicable
- Through highway and airport trips not allocated
Leaving only . . .

- Waste disposal—solid waste and wastewater
- Agriculture—livestock and soils
- Industrial processes (non-energy)
- Fugitive emissions from fuel systems
- Land use, land use change, forestry
Allocation to Counties and MCDs

- Regional Totals Allocated to Counties and MCDs
- 90 percent of total to counties
- 84 percent of total to municipalities
- High confidence in over 90 of allocated emissions
- Should provide a good head start for local and county efforts
## Allocation summary (partial)

<table>
<thead>
<tr>
<th>Emissions Source Category</th>
<th>2005 Emissions (MMTCO₂E)</th>
<th>Allocated</th>
<th>Confidence in Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>County</td>
<td>MCD</td>
</tr>
<tr>
<td><strong>Stationary Energy — Residential</strong></td>
<td></td>
<td>Good</td>
<td>Better</td>
</tr>
<tr>
<td>Fuel Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td>6.65</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Coal</td>
<td>0.0039</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Distillate Fuel Oil</td>
<td>0.33</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Kerosene</td>
<td>0.16</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>LPG</td>
<td>0.26</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Purchased Electricity</td>
<td>12.49</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Stationary Energy — Commercial</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td>5.61</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Coal</td>
<td>0.04</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Distillate</td>
<td>0.87</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Kerosene</td>
<td>0.07</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>LPG</td>
<td>0.05</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Residual Fuel</td>
<td>0.11</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Motor Gasoline</td>
<td>0.01</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Purchased Electricity</td>
<td>0.84</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Stationary Energy — Industrial</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1.97</td>
<td>x</td>
<td>some MCDs</td>
</tr>
<tr>
<td>Coal</td>
<td>0.26</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Distillate</td>
<td>0.89</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Kerosene</td>
<td>0.11</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>LPG</td>
<td>0.12</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Residual Fuel</td>
<td>0.36</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Petroleum Coke</td>
<td>1.53</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Other Fuels</td>
<td>0.86</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Purchased Electricity</td>
<td>11.45</td>
<td>x</td>
<td>some MCDs</td>
</tr>
<tr>
<td><strong>Mobile Energy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highway (ex. thru &amp; airport traffic)</td>
<td>20.00</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Public transit (buses and rail)</td>
<td>0.34</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
DVRPC Greenhouse Gas Emissions
Inventory Allocation:
Emissions Per Acre
by Municipality (2005)

All emissions in MTCOE.

- < 8
- 8 - 20
- 20 - 40
- 40 - 60
- 60 - 100
- > 100

This allocation excludes the following sources: industrial energy consumption, highway through-traffic, aviation, marine vessels, off-road vehicles, livestock, cement, and iron/steel production.
DVRPC Greenhouse Gas Emissions Inventory Allocation:

All emissions in MT CO2E:
- < 6.5
- 6.5 - 7.5
- 7.5 - 8.25
- 8.25 - 9
- 9 - 11
- > 11

This allocation excludes the following sources:
industrial energy consumption, highway through-traffic, aviation, marine vessels, off-road vehicles, livestock, cement, and iron/steel production
Implications

- Energy use
- Household budgets
- Viability of place
- Land use planning
- Politics
For more information:
www.dvrpc.org/climate.htm

Or contact:
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