Evaluating Environmental Emissions of Pittsburgh Brownfields

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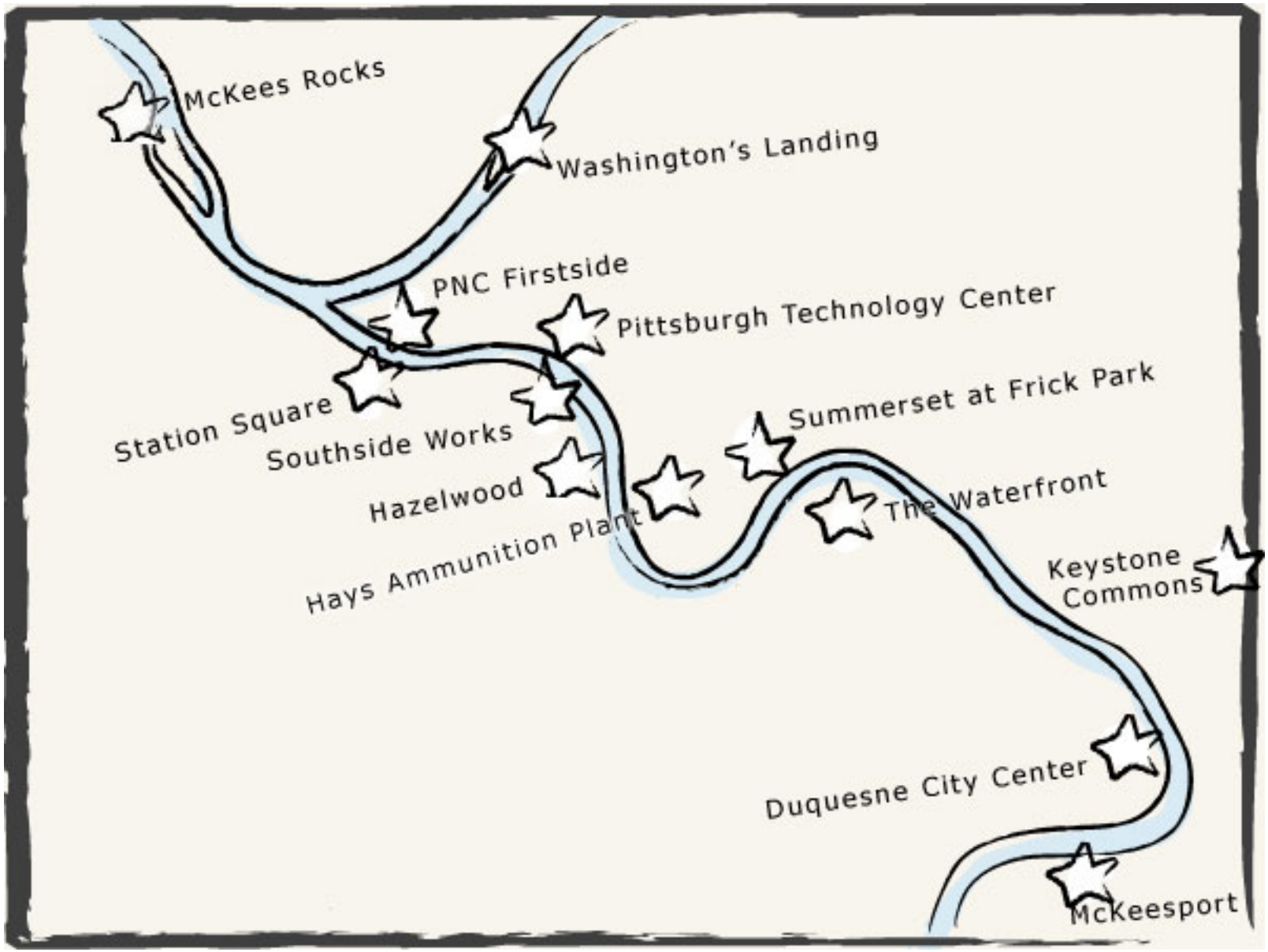
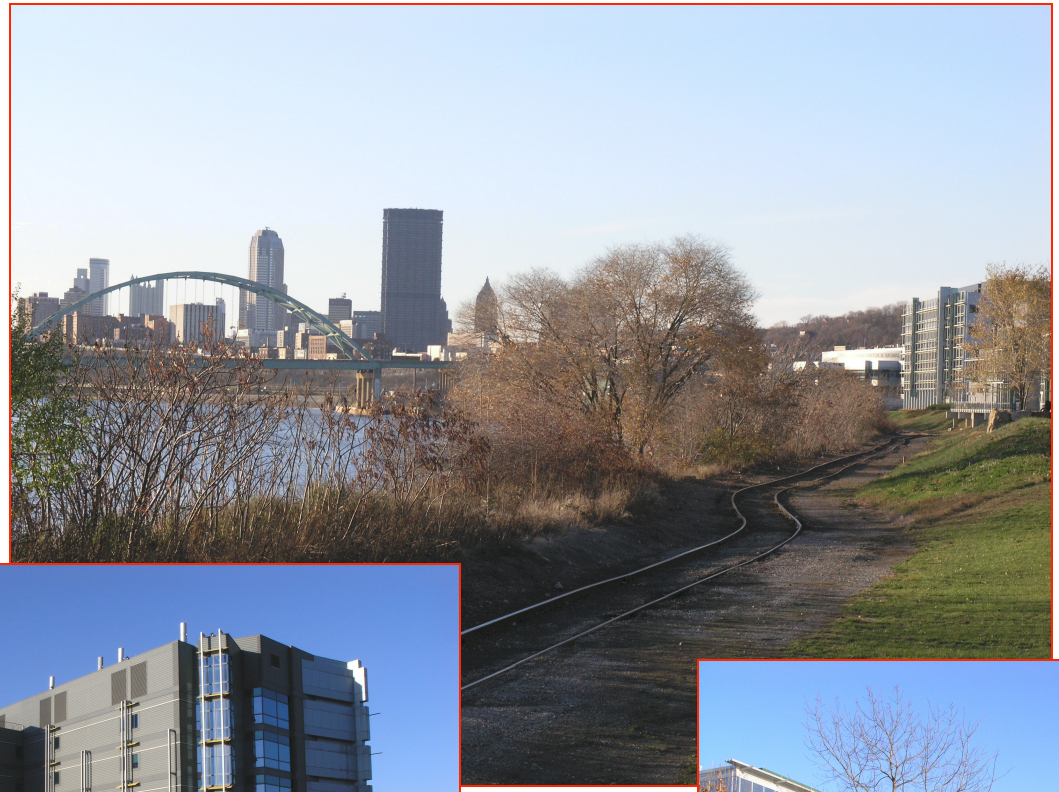
Carnegie Mellon University

Brownfields

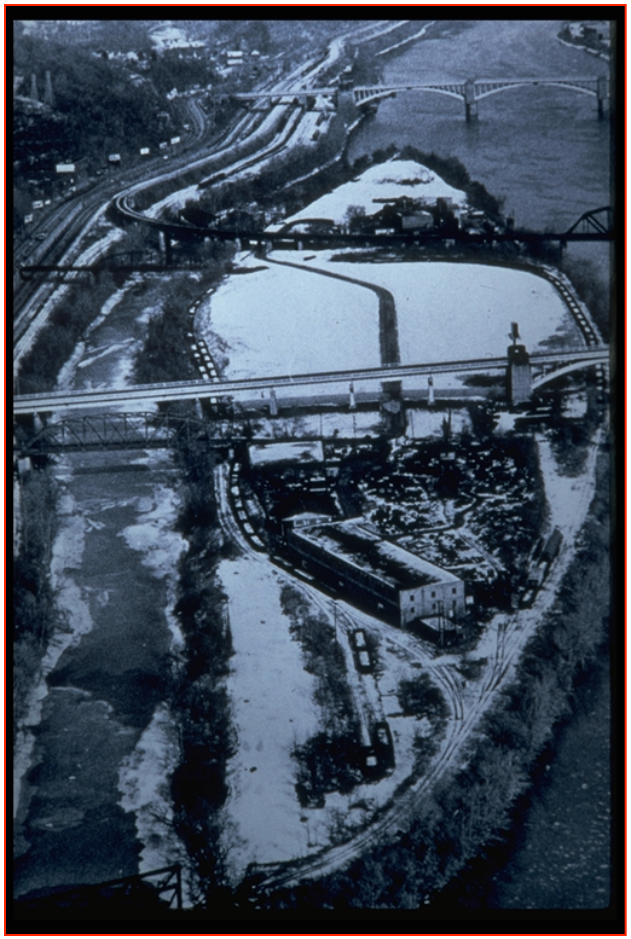
Real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant (HR 2869 - 2002)

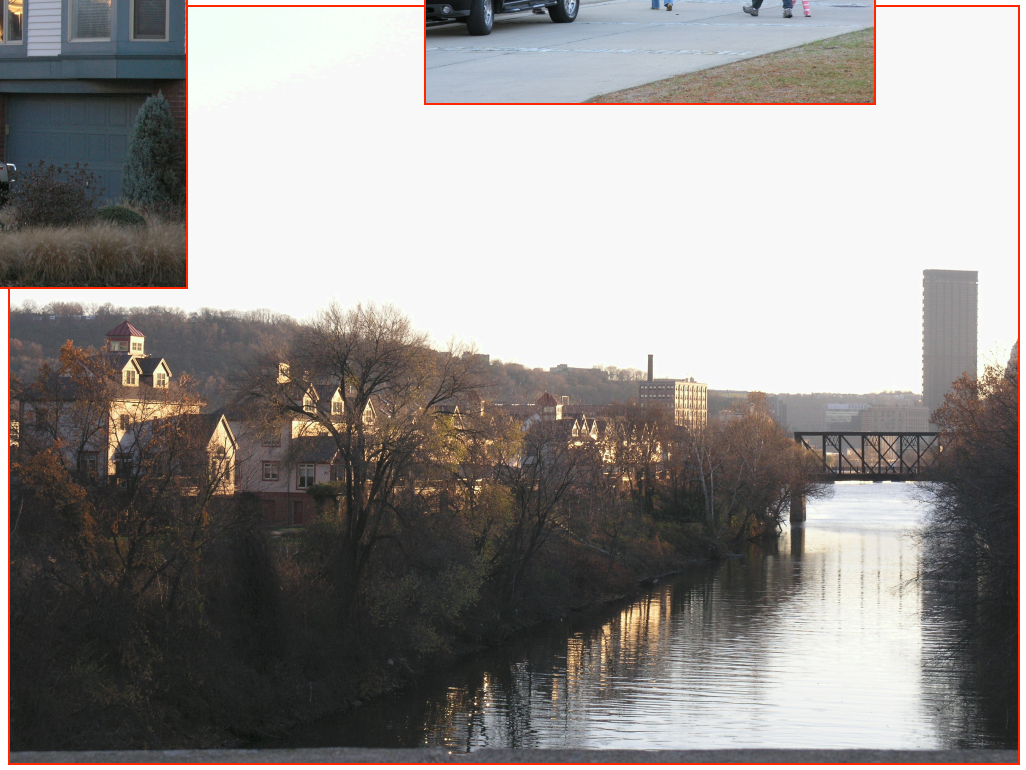

McKees Rocks
Washington's Landing
PNC Firstside
Pittsburgh Technology Center
Station Square
Southside Works
Summerset at Frick Park
Hazelwood
Hays Ammunition Plant
The Waterfront
Keystone Commons
Duquesne City Center
McKeesport

Pittsburgh Technology Center



Washington's Landing






Gamma Sports
Technology Center
ATS·Total Sports
Ferrari Importing Co.
200
SHIPPING &
RECEIVING

South Side Works


The Cheesecake Factory
BAKERY · BAR


SOUTHSIDE WORKS

EPA Training, Research and Technical Assistance Project

- Training - working with network of Main Street and Elm Street Managers across PA
- Technical Assistance - developing a multi-attribute decision-making tool to assist in prioritizing sites
- Research:

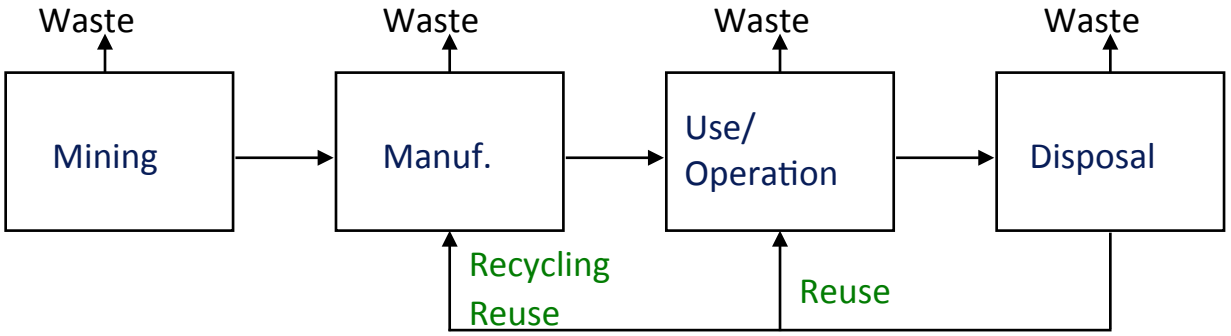
What is the environmental footprint of a Brownfield development as compared to a Greenfield development?

Quantifying a Sustainable Brownfield

- Goal to evaluate life cycle implications of brownfield development vs greenfield development
- Impact on climate change - until now, there has been no mechanism to quantify
- Carbon footprint as well as environmental contaminants
  - NO_2, SO_2, CO, VOC's
- Base tool: EIO-LCA Model developed at Carnegie Mellon (plus other process models)

EIO-LCA

- Economic Input-Output -- “General interdependency” model: quantifies the inter-relationships among sectors of an economic system
- Life Cycle Assessment -- studies analyze the environmental aspects and potential impacts throughout a product's life cycle (e.g., cradle-to-grave) from raw material acquisition through production, use and disposal



Caveat Emptor

- Data reliability and quality is often questionable.
- Models based on assumptions - and national level data
- Problem boundaries are often arbitrary.
- Scale issues - global -> local, etc.
- Uncertainty is everywhere
- Spatial and temporal issues increase uncertainty
- Comparisons between studies difficult without pushing into study details
- Cost and time of conducting life cycle assessment study is considerable.

What to compare?

- Construction Phase
  - Remediation
  - Site development
    - Grading
    - Infrastructure improvements
  - Structures
- Use Phase
  - Private residents
    - Utilities
    - Travel
    - Maintenance
  - Common space
    - Utilities
    - Maintenance
  - CO_2 Terrestrial sequestration

Note that we are not addressing the 'disposal' phase

How to Compare: Construction Phase

- Economic Input Output - Life Cycle Assessment
- Based on dollars spent in certain economic sector - data assembled by Dept of Commerce, Bureau of Economic Analysis
- 'Breakdown' construction costs into sectors that match BEA sectors
- Environmental data also maps onto sectors
  - Source: Environmental Protection Agency, Energy Information Administration

Specifically, the EIO-LCA model:

- Can
  - Use publicly available data
  - Consider many sectors in the supply chain
  - Estimate emissions on the basis of the magnitude of the effort ($$)
- Cannot
  - Differentiate between remediation and other similar construction
  - Account for site specific 'greening' improvements

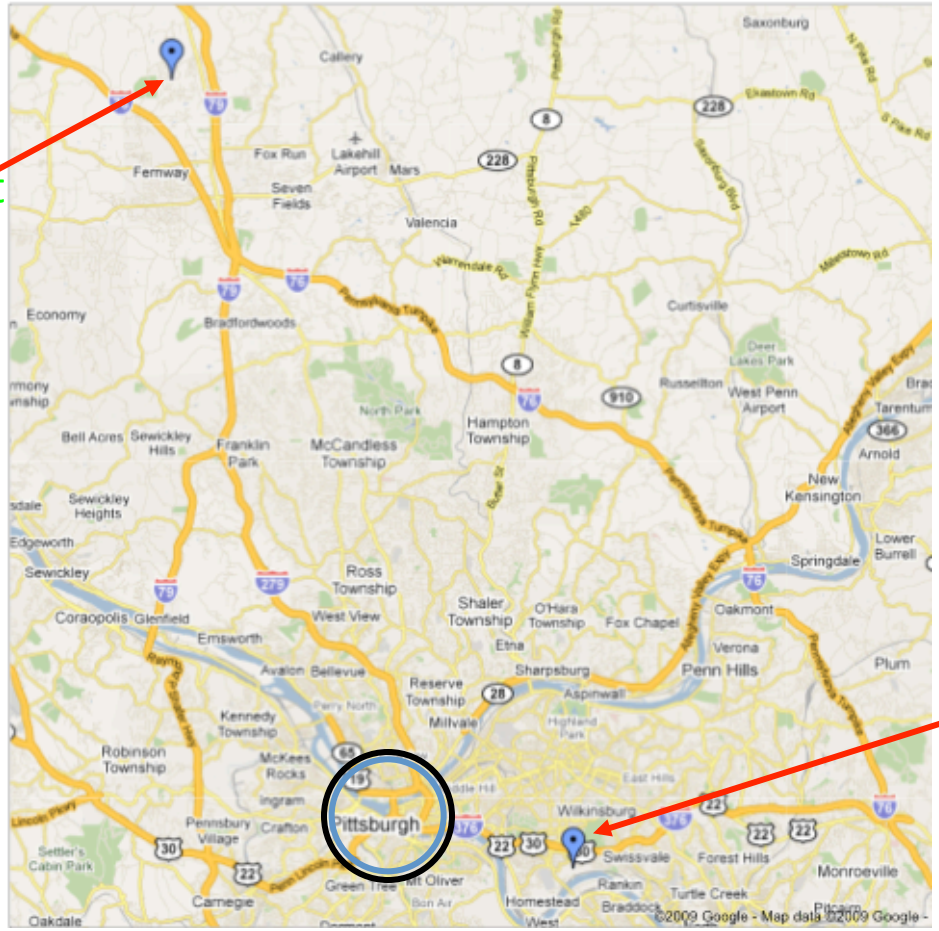
But, process methods might be used to supplement

Sectors that Might be Applied to BF/ GF Development

- Broad Sector: Construction
  - Manufacturing and Industrial Buildings
  - Highway, Street, Bridge and Tunnel Construction
  - Water, Sewer and Pipeline Construction
- Broad Sector: Professional and Technical Services
  - Architectural and Engineering Services
  - Environmental and Other Technical Consulting Services

Comparing a Brownfield and a Greenfield in Pittsburgh

Cranberry Height



Summerset at Frick Park

Our Two Residential Sites

	BF: Summerset	GF: Cranberry Heights
• Area (acres)	32	269
• Number of Units	159	244
• Persons per Unit	2.1	3.7
• Living Space / Unit (average sf)	2,700	2,700
• Distance to Work (miles)	5.4	21
• Distance to School (miles)	2.9	6
• Annual Private Vehicle Usage (miles)	14,700	30,450
• Surveys Returned	40	75

Site Analysis – Interview Based

Item	Unit	Greenfield (Cranberry Heights)	Brownfield (Summerset Phase I)	% Difference from Greenfield
Initial Cost	$ Million 2002	3.4	23.4	688
CO2E Emissions	Metric Ton (Millions)	2,200	9,090	413
Allocated Initial Cost (0% interest)	$/person/year	74	1,176	1589
Annualized Initial Cost (5% interest)	$/person/year	203	3,204	1578
Allocated CO2E Emissions	Metric ton/person/year	0.05	0.46	930

Site Analysis – Interview Based

Item	Unit	Greenfield (Cranberry Heights)	Brownfield (Summerset Phase I)	% Difference Relative to Greenfield
Private Vehicle	Miles/year/person	8230	7350	-11
Public Transit	Miles/year/person	2040	600	-71
Other	Miles/year/person	240	325	35
Private Vehicle	$/year/person	4,100	3,700	-10
Public Transit	$/year/person	580	170	-71
Private Vehicle GHG	Mt CO2E /year/person	3.9	3.5	-10
Public Transit GHG	Mt CO2E /year/person	1	0.3	-70

Site Analysis – Interview Based

Item	Unit	Greenfield (Cranberry Heights)	Brownfield (Summerset Phase I)	% Difference Relative to Greenfield
Average Floor Space	Sq. ft./residence	2,700	2,460	-9
Land Area	Acres/residence	1.1	0.16	-85
Natural Gas	$/residence	170	89	-52
Electricity	$/residence	133	94	-29
Water/Sewer	$/residence	79	27	-66
Total Utilities	$/residence	382	210	-45
Total Utilities	$/person	103	105	3
Floor Space	Sq. ft./person	730	1,230	68
Development Area	Acres/person	0.3	0.08	-73
Building Construction GHG	Mt Million	61,400	30,909	-50
Allocated Building Construction GHG	Mt/person/year	1.3	1.5	15
Utility GHG	Mt/person/year	5.9	9.6	63

Site Analyses – Internet Based

- Remediation
  - USEPA Acres
  - Sanborn Maps
  - State Environmental Databases
  - USEPA Remediation Technology Cost Compendium
- Site Preparation
  - Google earth
  - Clearing, grubbing and grading – RS Means
  - Roads and utility infrastructure – ARTBA (American Road and Transportation Builders Association)

Site Analyses – Internet Based

- Residential construction
  - Google earth
  - RS Means, regionally adjusted
- Operation
  - Utilities
    - Duquesne Energy Calculator
    - County Assessment webpage
  - Transportation

Preliminary Findings

- Construction phase: Emissions from brownfield site preparation efforts are greater than greenfield
  - Excess earthwork
- Use phase: Utility and travel related emissions seem to be less for brownfield residents than for greenfield residents
  - Shorter commutes
  - Smaller houses

Challenges (for instance)

- Construction Phase
  - Defining limit of remediation
  - Accounting for offsite infrastructure
  - Mapping costs to EIO-LCA sectors

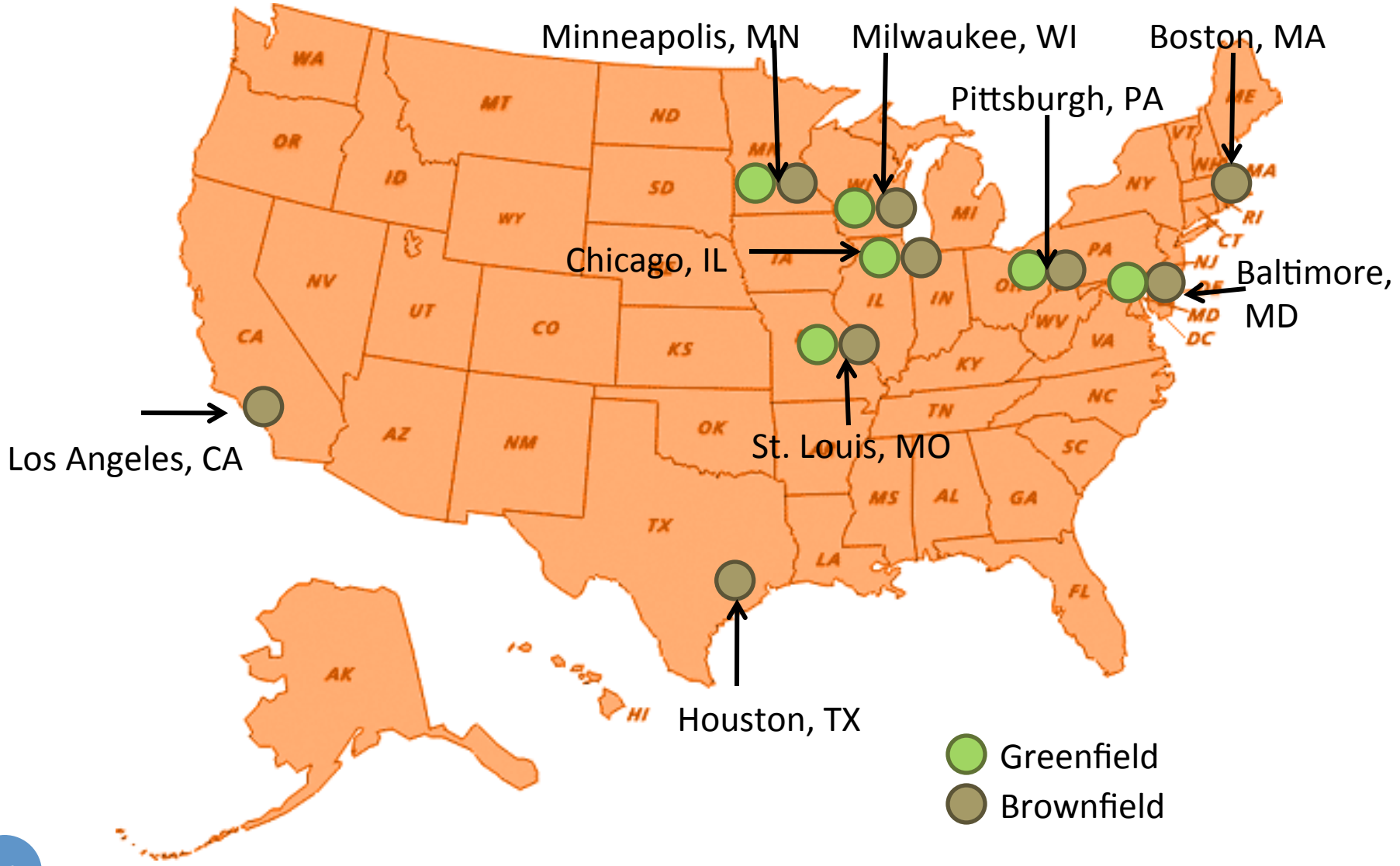
Reporting units:
✓…per household
✓…per capita
✓…per acre
✓…per square foot of living space

???

- Use Phase
  - Response rate of residents
  - Accounting for common space
  - Accounting for 'school buses'

Transportation
Using Census Commuting Data

Brownfield and Greenfield Locations



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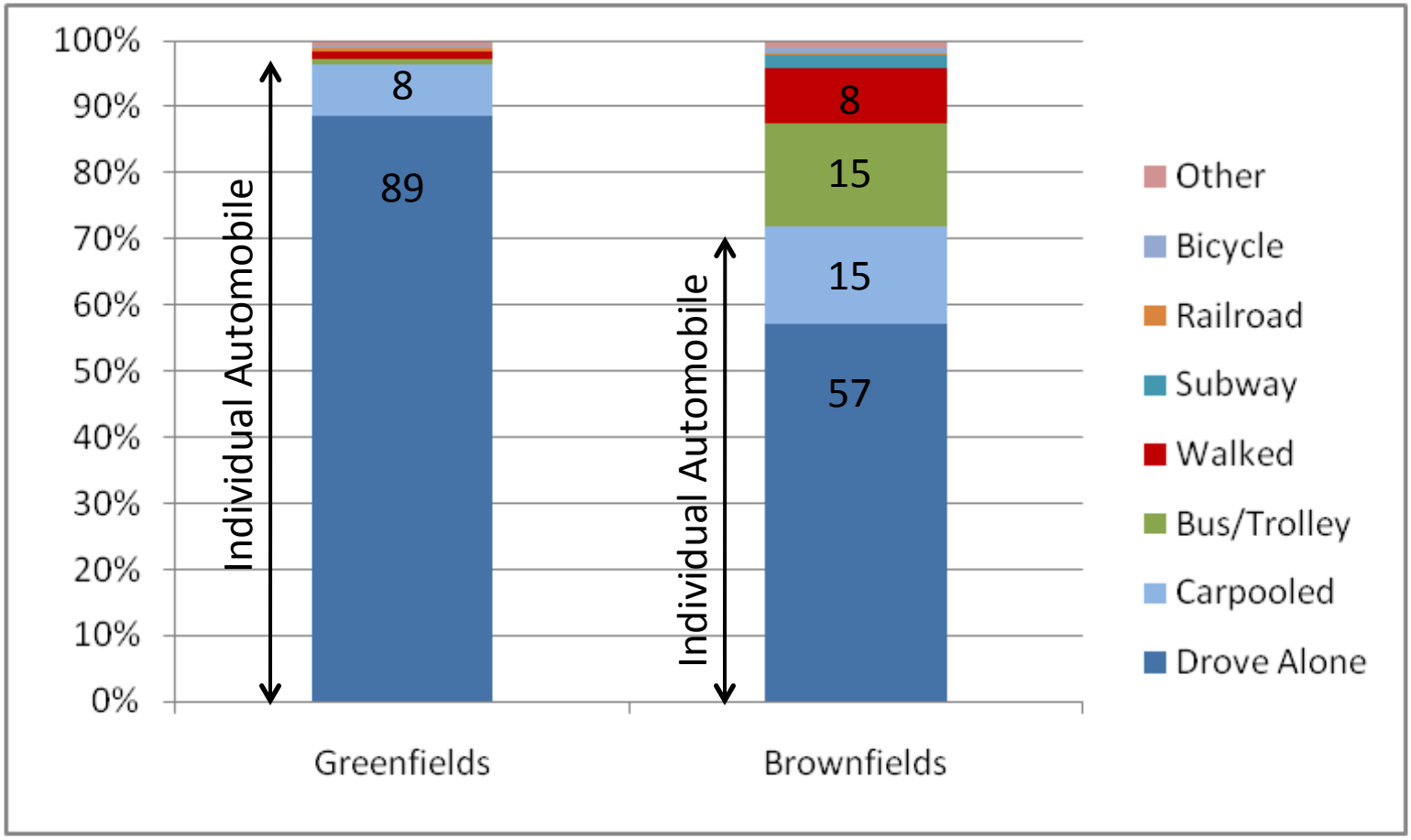
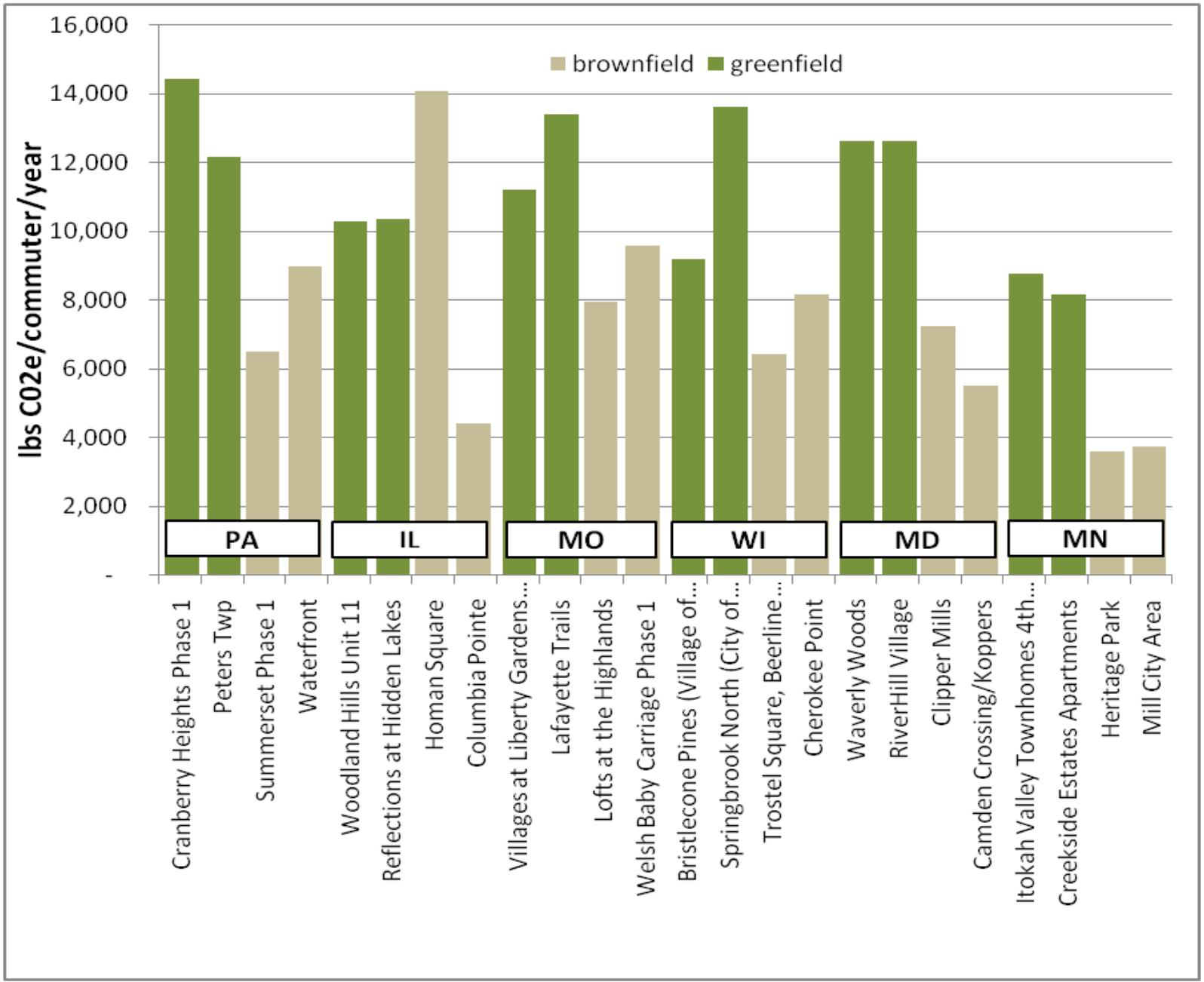
Commuting Modal Shares

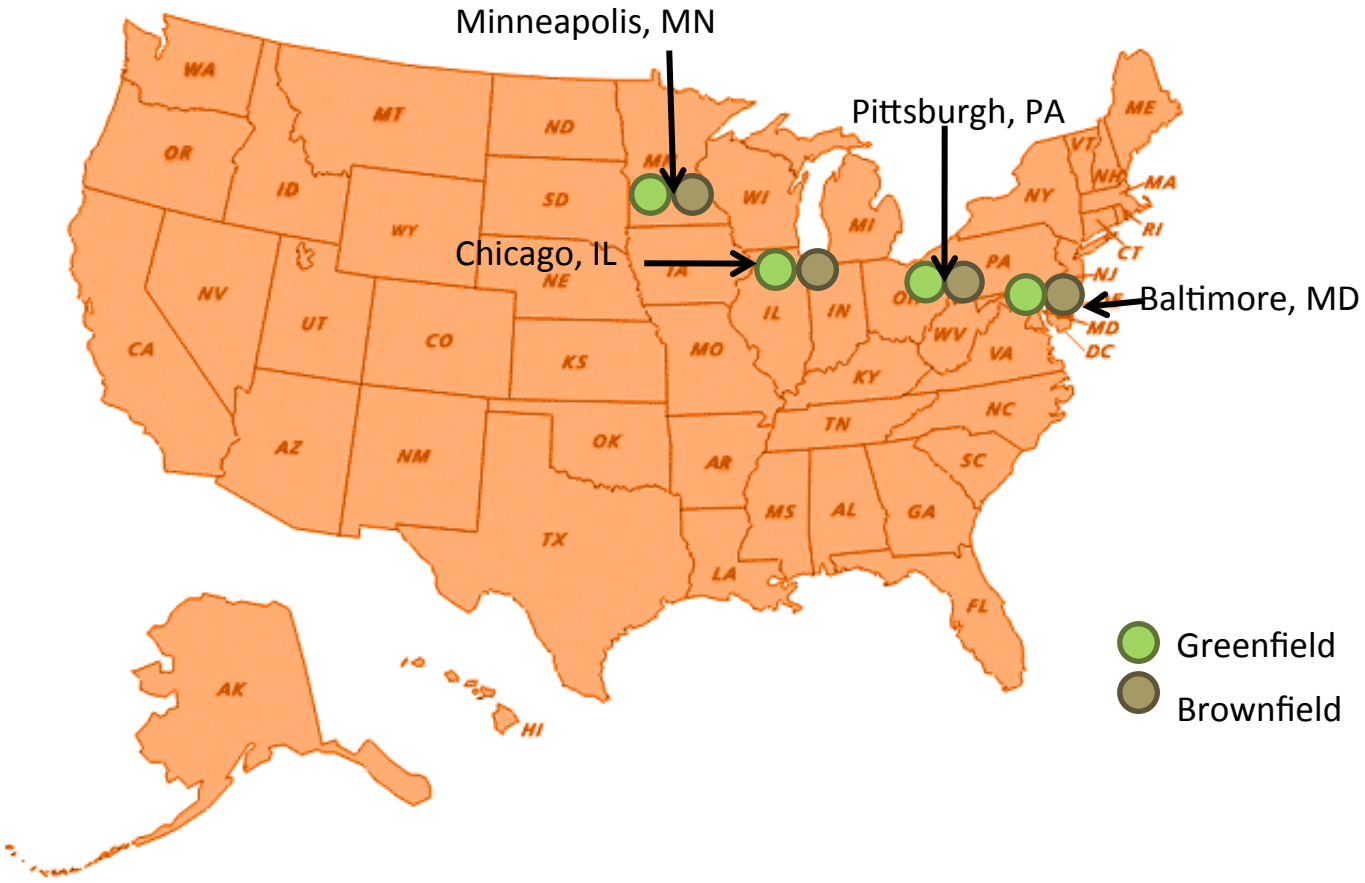


Largest differences are in Individual Automobile, Public Transportation and Walking categories

Total Greenhouse Gas Emissions from Commuting

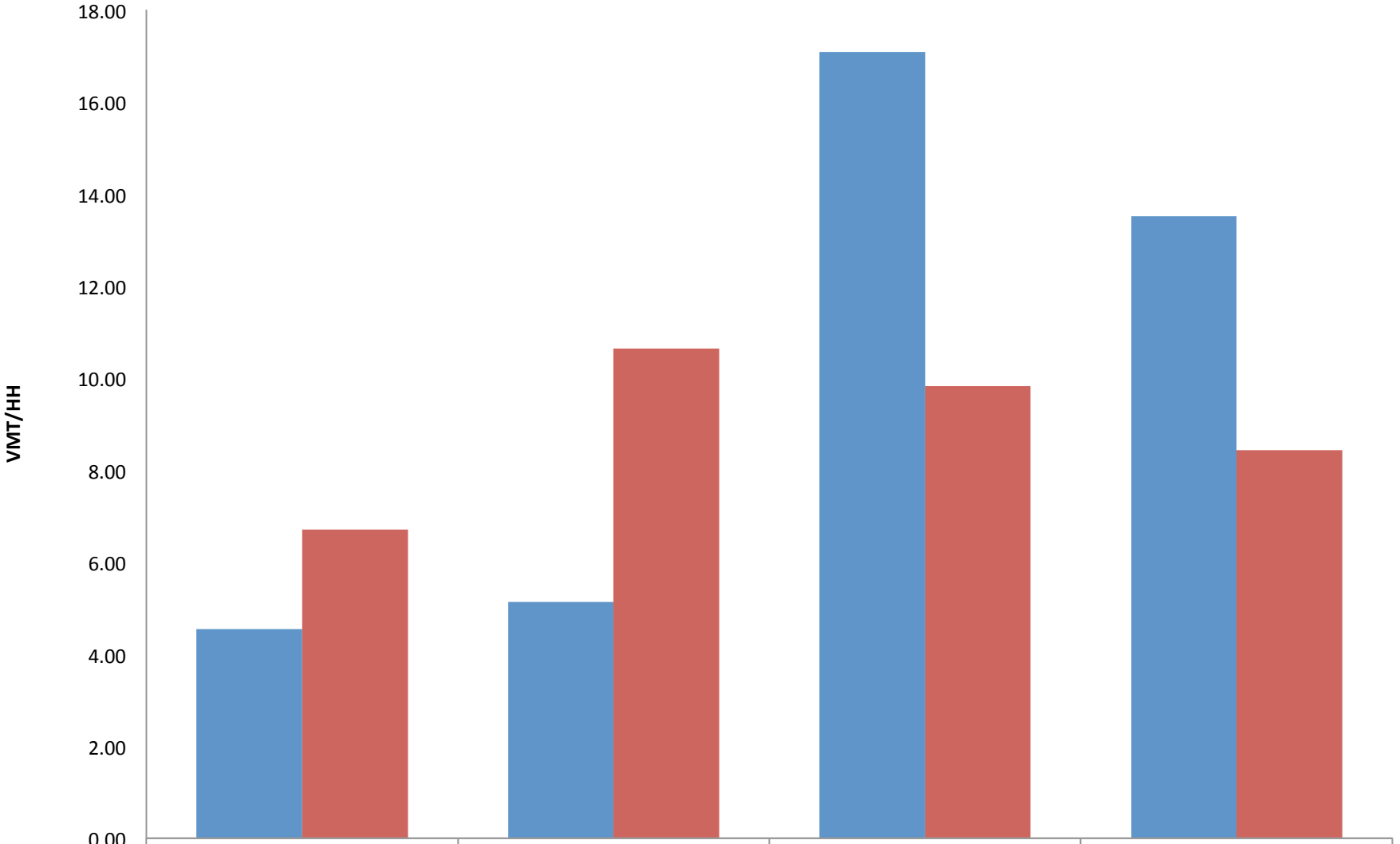


Transportation – Using TAZ Data



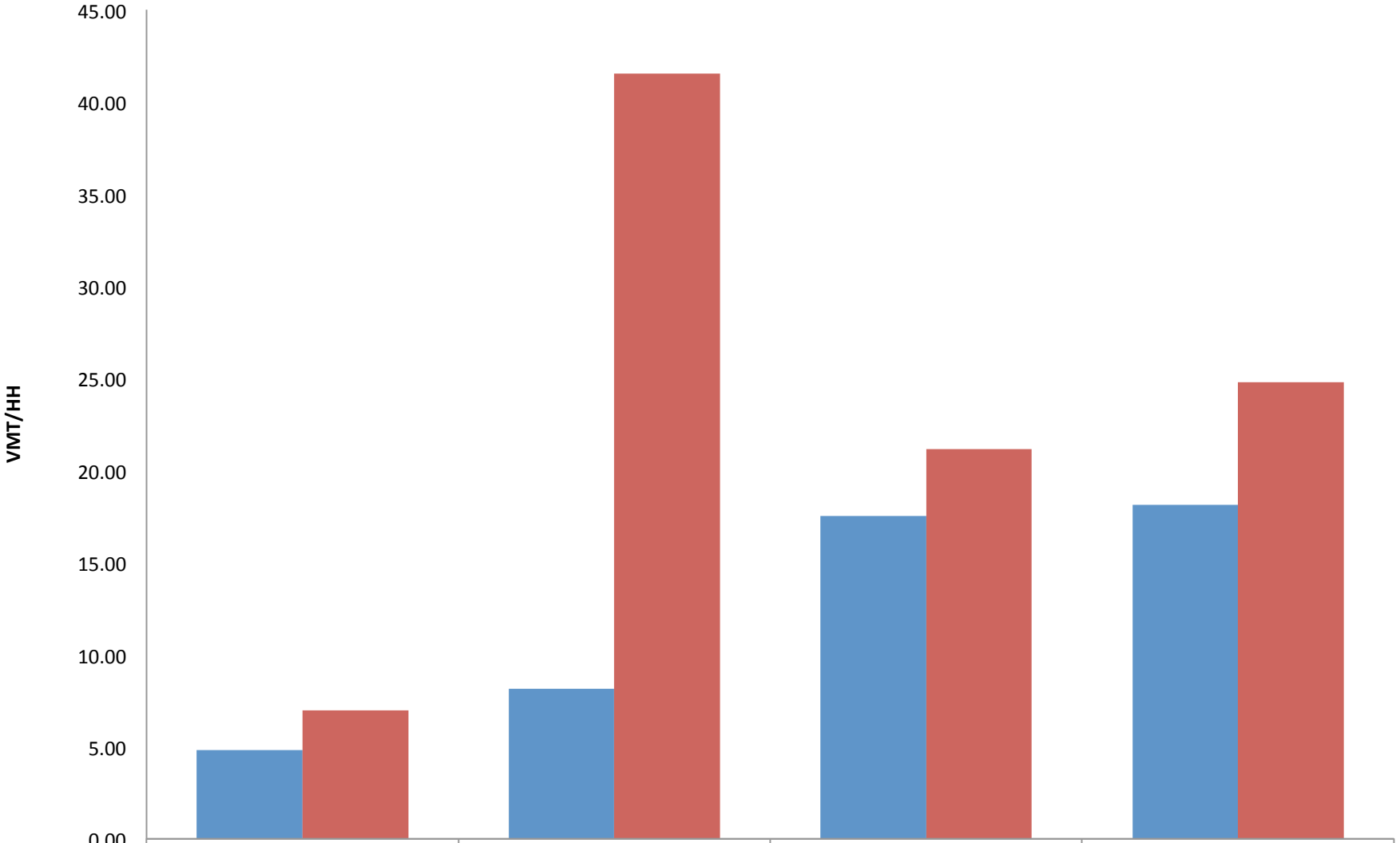
Data from Metropolitan Planning Organizations' Travel Demand Models

Average VMT/HH by Trip Purpose for Brownfield and Green Field Developments - Automobile Only - Pittsburgh



	Waterfront	Summerset	Cranberry	Peters
HBW / HH	4.55	5.13	17.09	13.51
HBNW / HH	6.70	10.64	9.82	8.43

Average VMT/HH by Trip Purpose for Brownfield and Green Field Developments - Automobile Only - Minneapolis



	412-BF	383-BF	207-GF	661-GF
HBW / HH	4.82	8.13	17.52	18.13
HBNW / HH	6.97	41.52	21.15	24.79