



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

Bay Area Consumption-Based Greenhouse Gas Emissions Inventory

Bay Area Regional Collaborative

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Overview

- Description of consumption-based GHG inventory
- Methodology
- Results / Findings
- Potential uses
- Policy implications



What is a Consumption-Based Inventory?

- Conventional emissions inventory focuses on **supply**:
 - measures emissions from goods & services produced in a given area
- Consumption-based emissions inventory (CBEI) focuses on **demand**:
 - estimates emissions embedded in goods & services consumed in a given area
- CBEI attributes all emissions to the final user/consumer
 - regardless of where goods & services are produced
- Business sector is treated as an intermediary, not a final user
- Methodology used for Bay Area CBEI does not include emissions from federal, state or local government



Why develop a CBEI?

- Production-based inventory does not tell the whole story
- Modern economy is highly integrated, national & global in scale
- Major portion of goods & services are imported to region
- Quantify and account for (indirect) emissions that we generate beyond our boundaries
- Provide a more complete analysis of our true GHG footprint
- Especially relevant in affluent areas (like Bay Area) where:
 - high consumption of goods & services
 - economic output is dominated by service & information sectors
 - limited production of heavy-duty goods w high GHG content



Basic Concept

- Follow the money: Develop an expenditure profile to determine how much people spend for specific goods & services
- Apply full life-cycle emission factor for each product or service:
 - Production: extraction, processing, production & shipping
 - Use
 - Disposal / recycling

3 basic steps to calculate GHG footprint:

Step 1: Determine how many \$\$ spent for each product

Step 2: Multiply emissions factor by \$\$ expended for product

\$\$ (by product type) x GHG emission factor = GHG emissions

Step 3: Add emissions for each category to calculate total GHG footprint



CBEI Methodology

- Collaboration with UC Berkeley Energy Resources Group:
Cool Climate Network - Chris Jones, PhD. <http://coolclimate.berkeley.edu/>
- Develop expenditure profile for average household in each US Census Block Group in Bay Area: ~4,700 block groups
 - start at household level & scale up
- Life-cycle GHG emission factors for the “Kyoto 6” set of GHGs
 - Primary source: *Comprehensive Environmental Data Archive*
 - Used Bay Area-specific data & emissions factors whenever available
- Key input data:
 - BLS Consumer Expenditures Survey
 - National Household Travel Survey
 - Energy consumption data from utilities
 - Household demographics (US Census & other sources)



Major Expenditure Categories

Transportation:

- Motor vehicle production
- Vehicle maintenance
- Motor vehicle fuel consumption
- Public transportation
- Air travel

Housing:

- Construction
- Maintenance
- Residential energy use
- Water
- Waste

7.4

17.5

27.6

41.3

Food:

- Grains & cereals
- Fruits & vegetables
- Dairy
- Meat
- Other

Goods:

- Clothing
- Furniture & appliances
- Personal care products
- Books, newspapers, CDs

Services:

- Health care
- Education
- Financial services
- Communication
- Entertainment

Example for automobile

Upstream

Individual Parts

Production, including upstream emissions for each part

Vehicle Assembly

Shipping to Dealer

In-Use

Fuel Consumption

- Fuel economy
- Fuel type
- Driving conditions

Upstream emissions from refining gasoline

Vehicle Maintenance

Downstream

Landfill

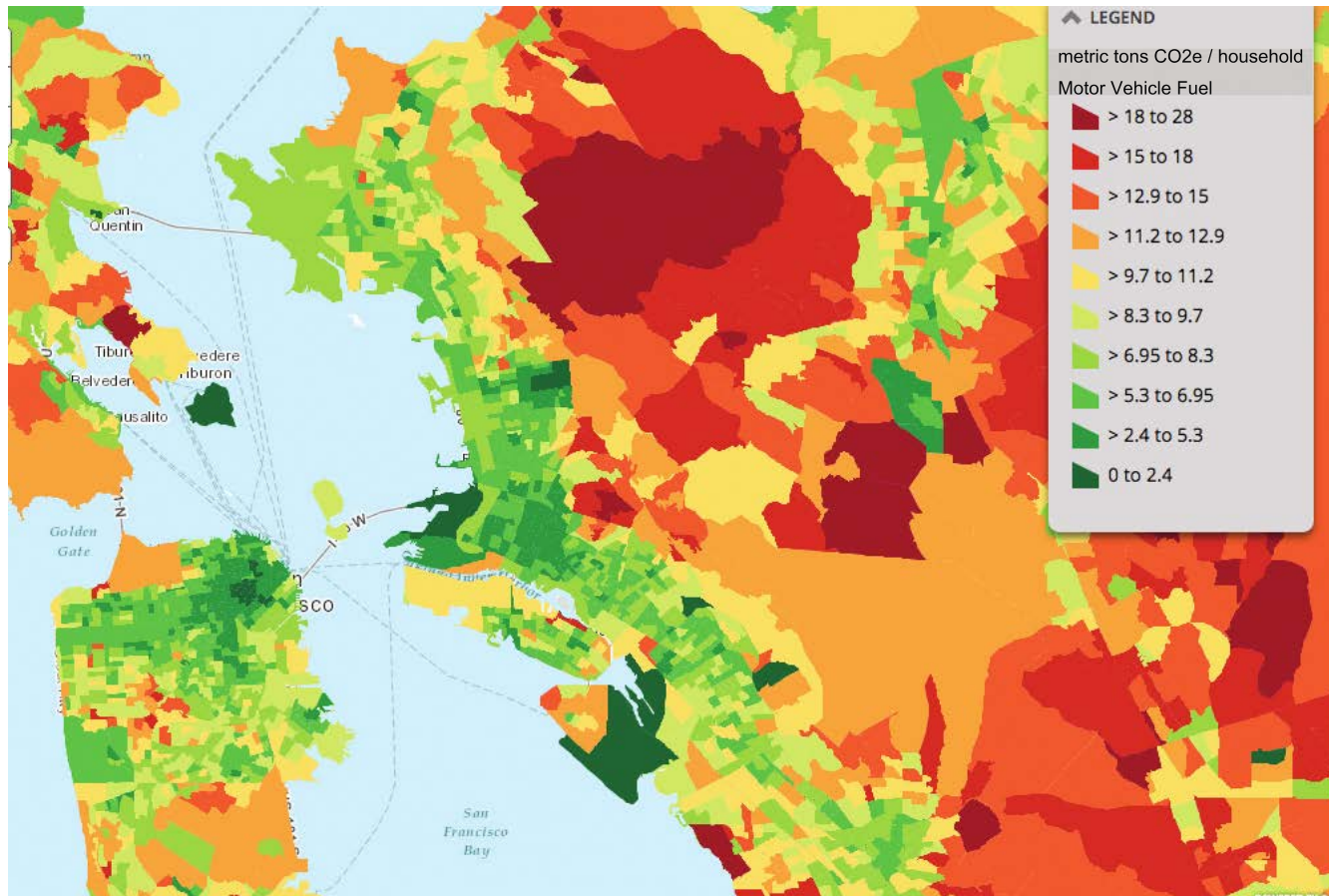
Recycling / re-use (credit)





CBEI Products

- Inventory tables & graphs at regional, county, and city scale
- Maps showing GHG footprint at fine-grained local scale





Potential Uses of CBEI

- Inform our Regional Climate Protection Strategy
- Identify potential GHG reduction policies
- Assist climate planning in local cities
- Help Bay Area residents reduce their GHG footprint
- Tailor strategies to reflect variation in emissions profile
- Compare Bay Area GHG footprint to other areas



Key Factors

Considerable variation in **size** of GHG footprint
and in its **composition**

Cool Climate Network model includes 30+ factors

But 6 factors account for 92% of variation in GHG footprint:

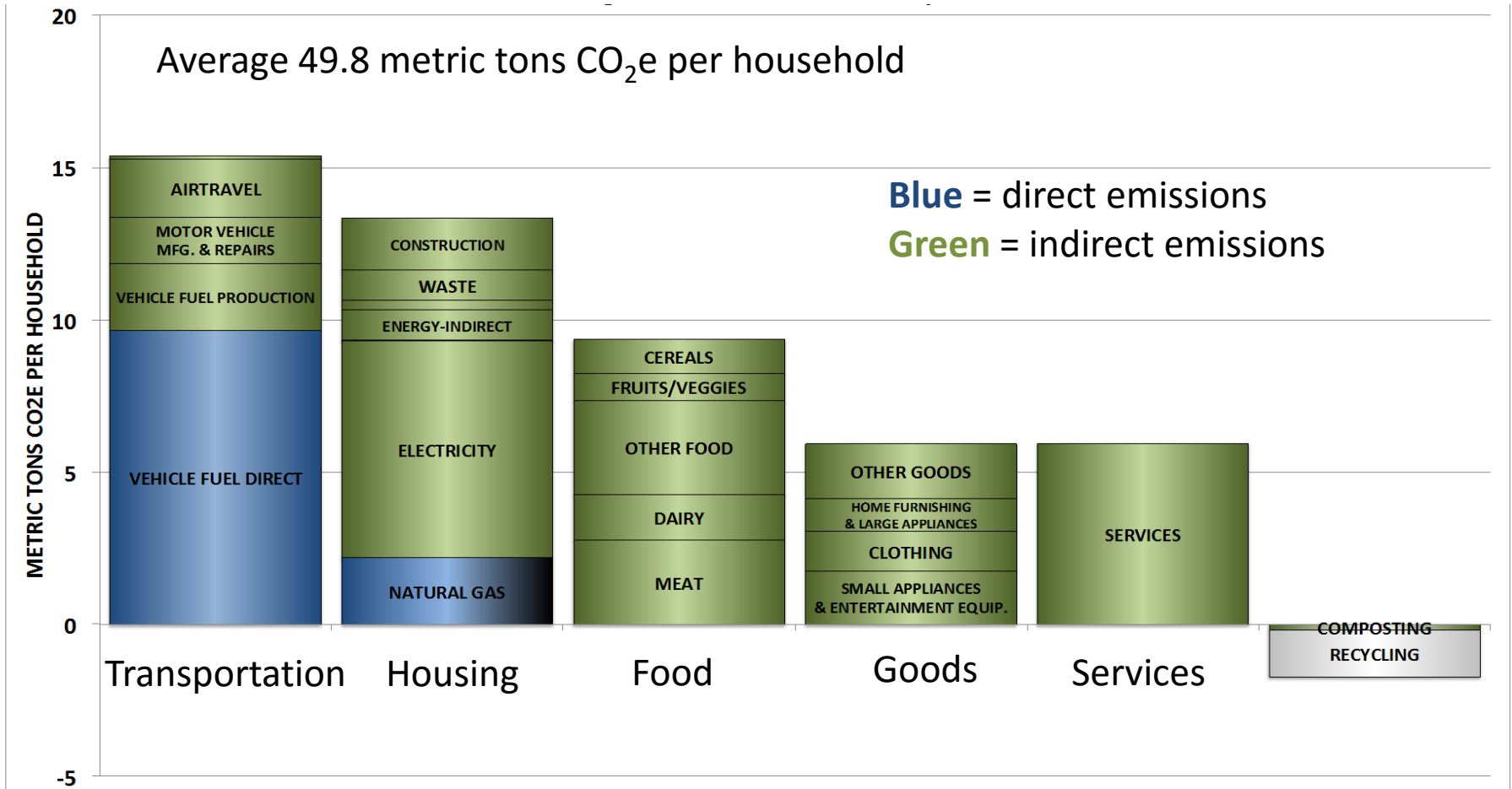
- household size (# people)
- size of home (square footage of dwelling unit)
- population density of neighborhood
- carbon intensity of electricity
- vehicle ownership rate
- household income



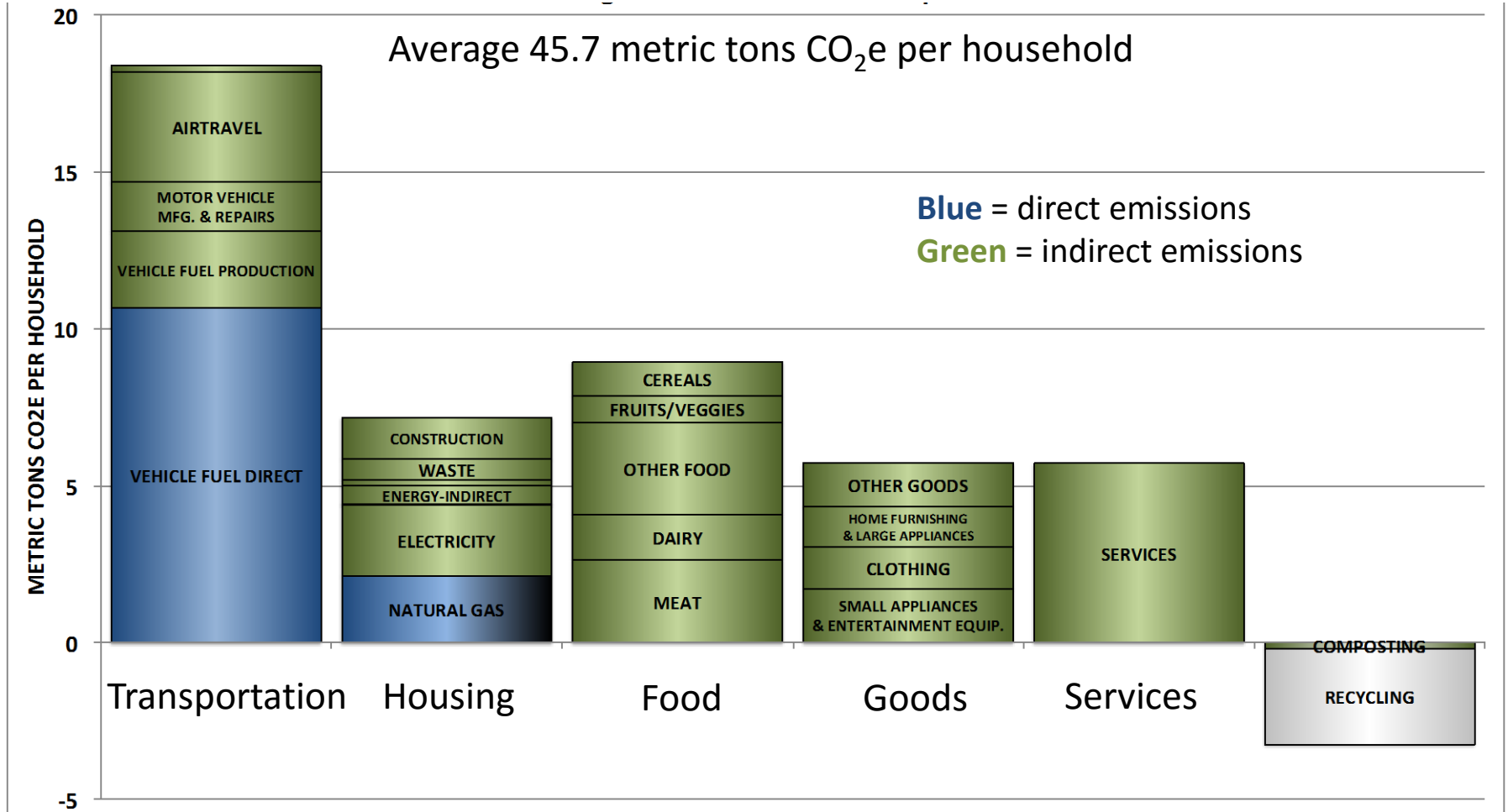
GHG Emissions and HH Income

- Household income has strong influence on emissions related to transportation, goods, and services
- Lower income households spend larger portion of income on basics of food & shelter (housing)
- As income increases, people spend more on discretionary goods & services

US Average Household GHG Footprint

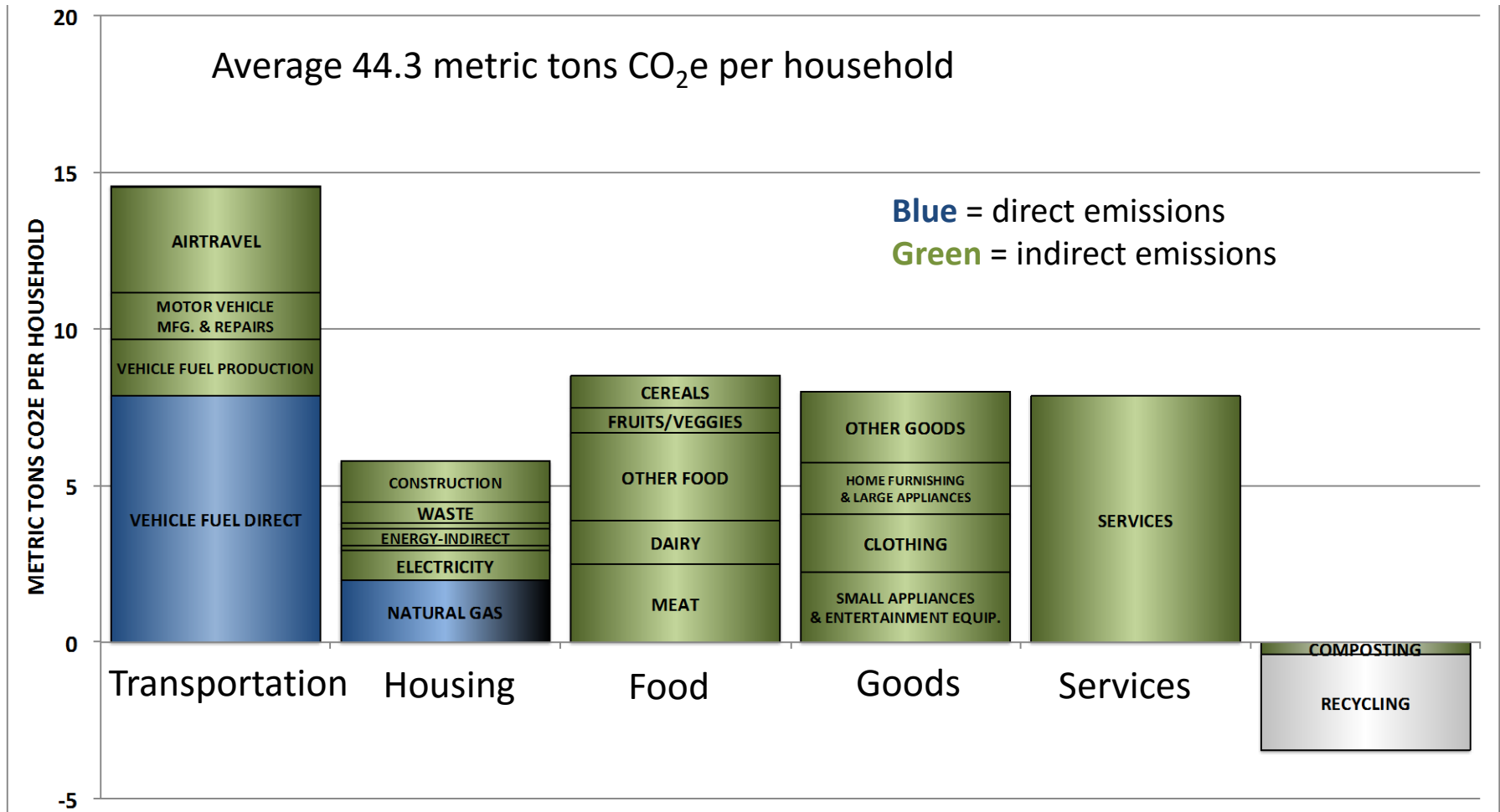


California Average Household GHG Footprint



SF Bay Area Average Household GHG Footprint

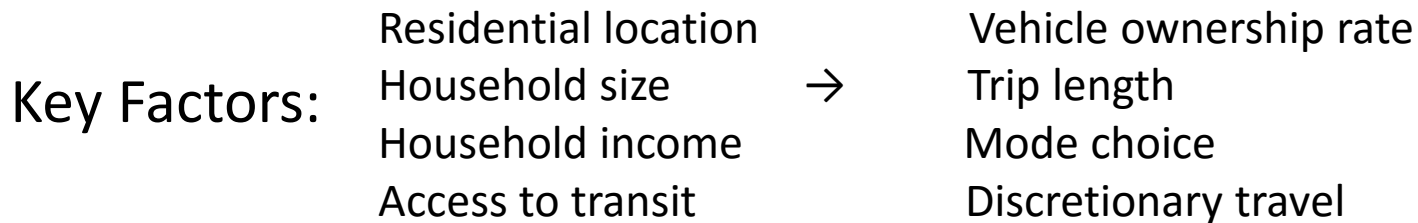
Average 44.3 metric tons CO₂e per household





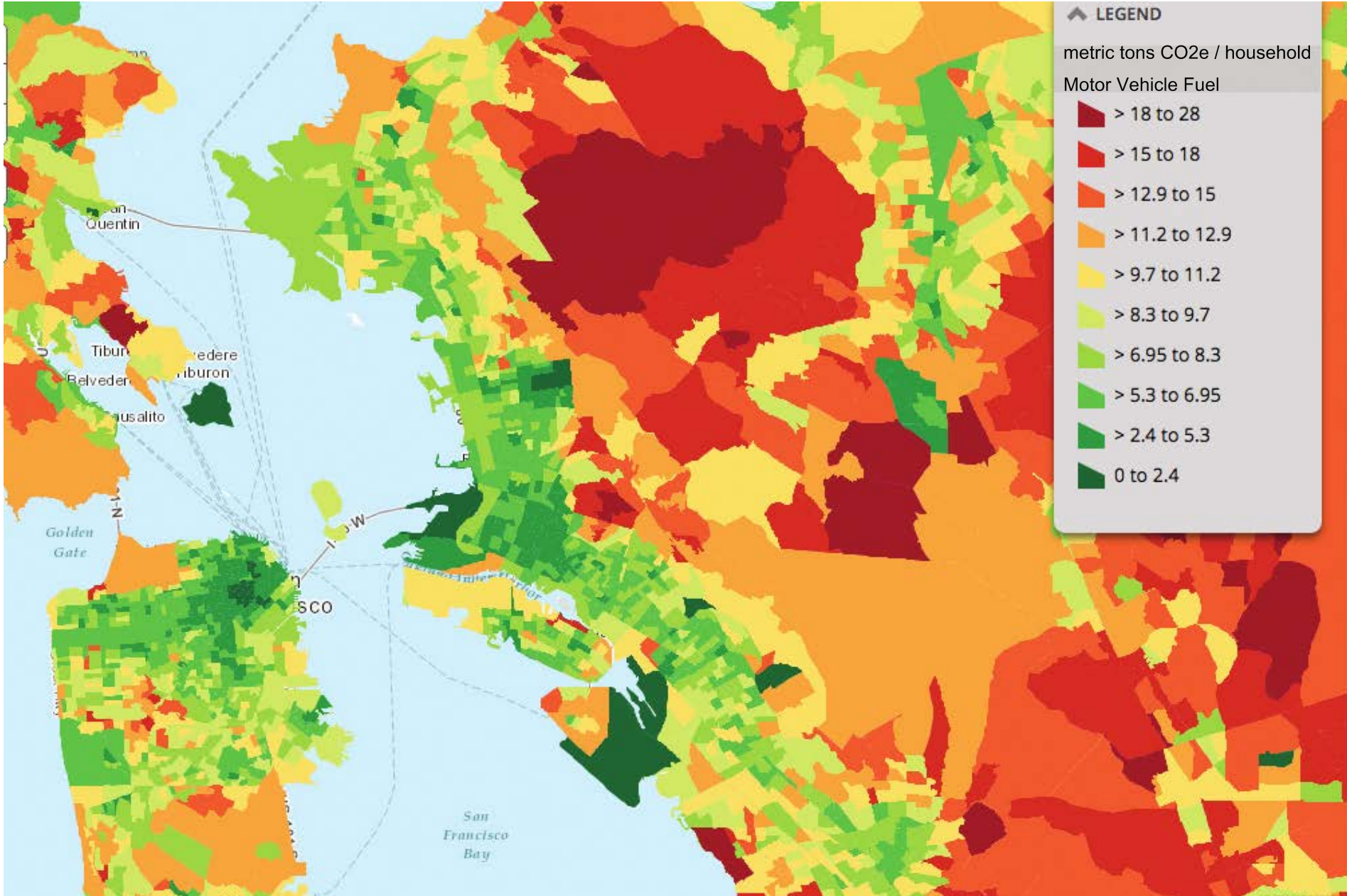
Example: Transportation Emissions

- Motor vehicle travel accounts for the largest slice of GHG footprint



- Need to reduce vehicle emissions, decarbonize transportation sector
- To reduce motor vehicle travel, residential density is *necessary, but not sufficient*. Housing must be well-served by transit & close to shopping & services
- Reducing motor vehicle travel will also reduce upstream emissions from oil refining
- Air travel is also a major contributor to transportation GHG
 - air travel is directly correlated with household income

Household GHG Emissions from Transportation by Block Group

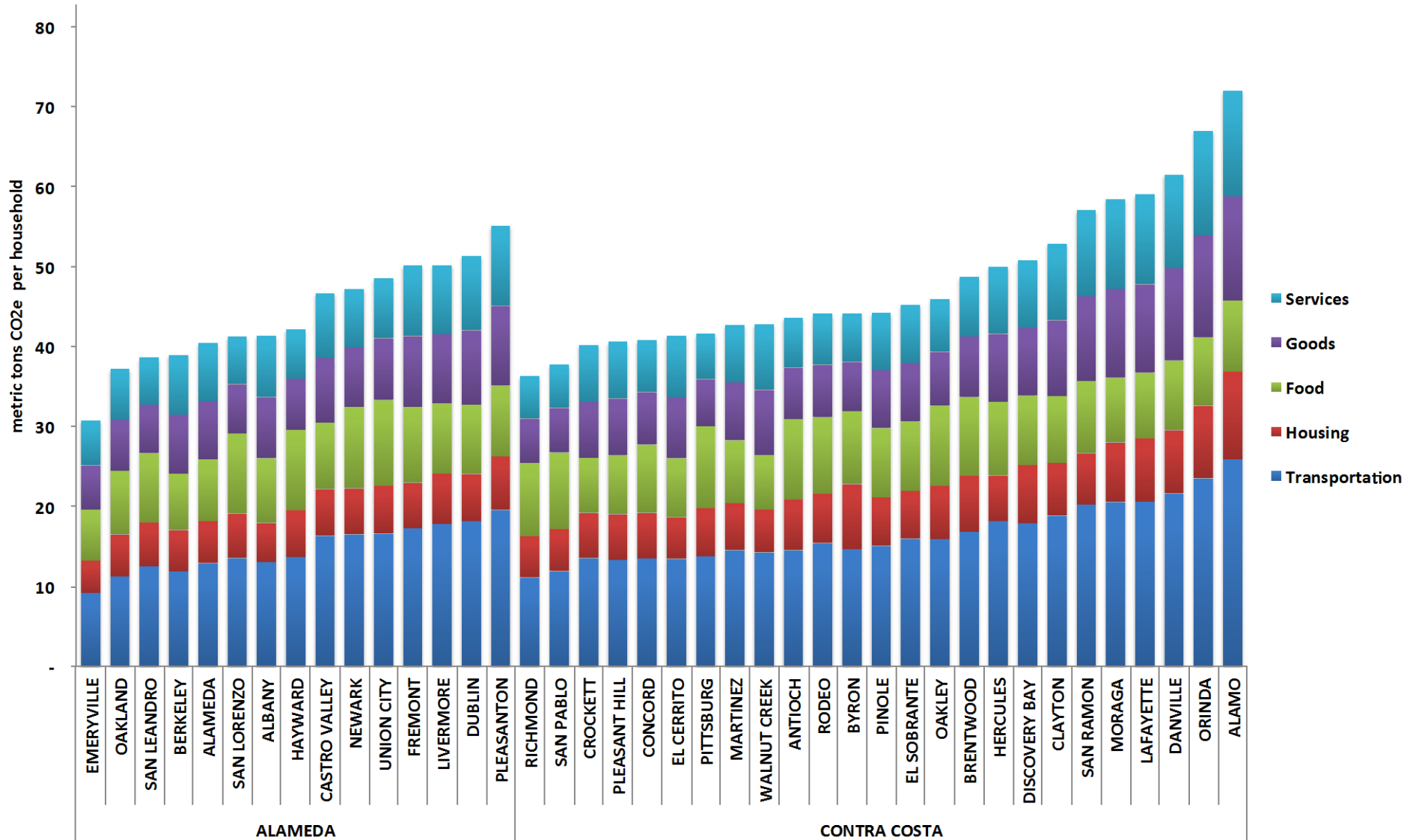




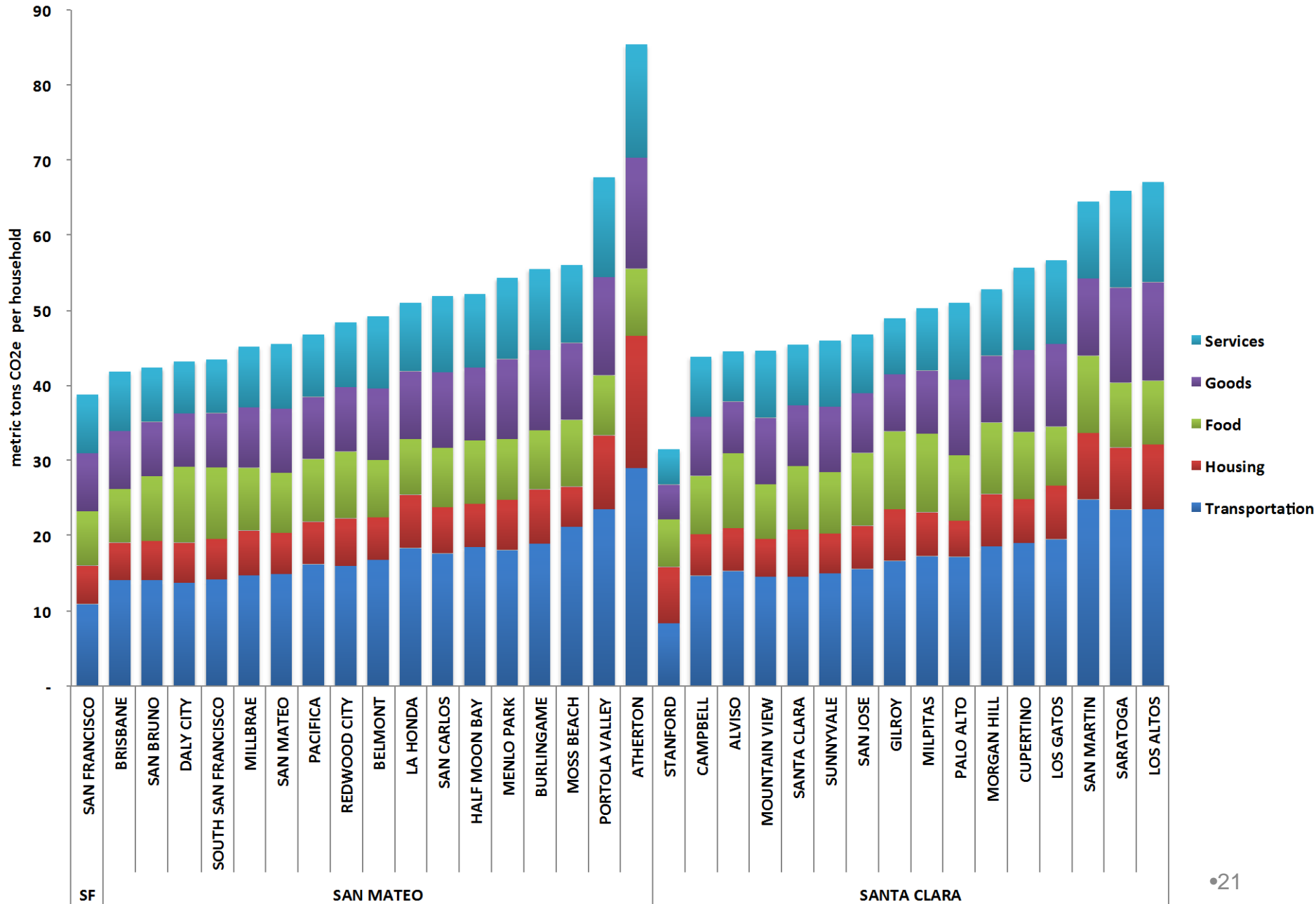
Bay Area GHG Footprint

- CBEI is ~ 35% larger than production-based inventory
- GHG footprint is generally lower in urban core areas
 - smaller homes, lower vehicle ownership rate, better transit
- Variation between block groups: ratio of 7 to 1
- Variation within (large cities): 4 or 5 to 1
- Variation between cities: ratio of 3 to 1
- Less variation between counties:
 - average annual GHG footprint ranges from 39 to 49 metric tons per household

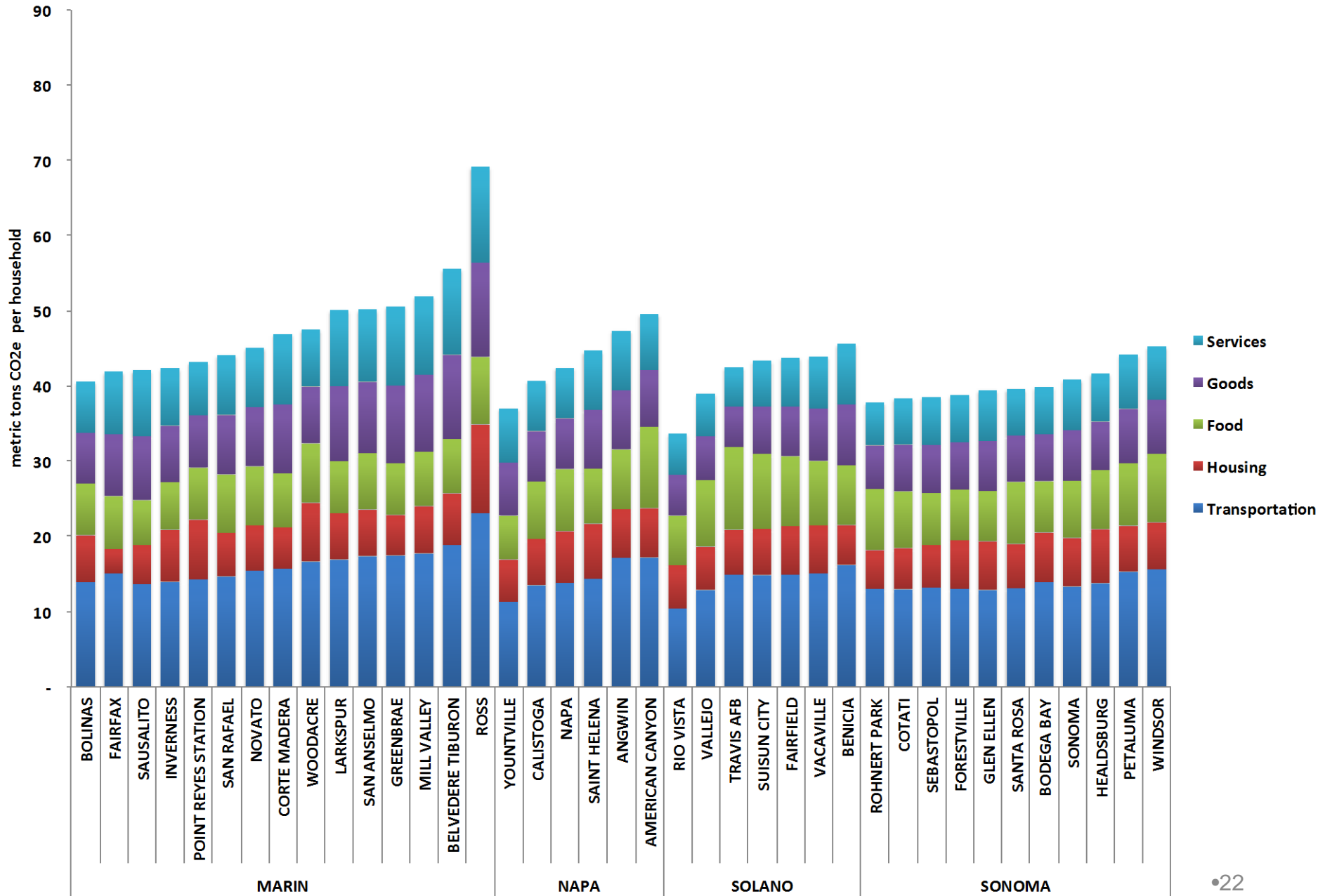
Average Carbon Footprint for Cities in Alameda & Contra Costa Counties



San Francisco & South Bay Cities - Average Household Carbon Footprint

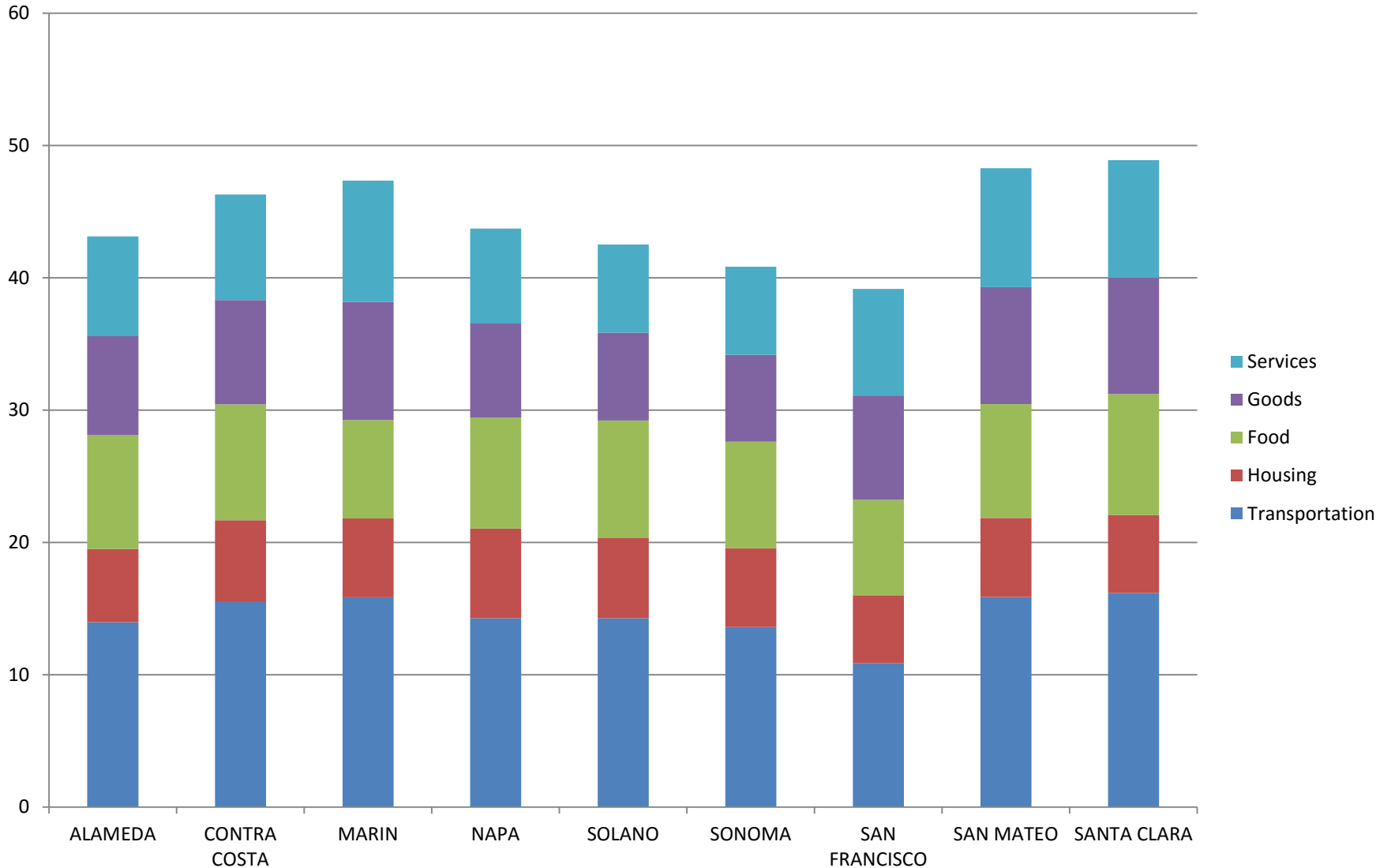


North Bay Cities - Average Household Carbon Footprint



Average GHG Footprint by County

(metric tons/year)





Key Points

- Consumption-based inventory complements production-based inventory; provides a more complete picture of our GHG impact
- GHG inventory larger when analyzed from consumption perspective
- CBEI can help to inform climate planning at regional & local scale
 - identify most promising opportunities for GHG reduction
- Should consider local variation in size & composition of GHG footprint in designing GHG reduction strategies
- CBEI findings may be most useful for public education

**Questions or
Comments?**

