AGENDA: 4

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Bay Area Consumption-Based Greenhouse Gas Emissions Inventory

Climate Protection Committee
November 19, 2015

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Principal Environmental Planner

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 economic output: emissions from goods & services produced in a given area
- Consumption-based emissions inventory (CBEI) estimates GHG emissions embedded in goods & services consumed by people residing within a given area
- CBEI attributes all emissions to the end user/consumer
  - Regardless of where goods & services are produced
- CBEI includes full life-cycle emissions for each product or service:
  - Production: extraction, processing, production & shipping
  - Use
  - Disposal / recycling
- Deliverables: inventory tables & graphs at regional & city scale
  - Maps showing GHG footprint at fine-grained local scale

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 with high GHG content

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
- Compare Bay Area GHG footprint to other areas

CBEI Methodology

- Collaboration with UC Berkeley Energy Resources Group:
  - Cool Climate Network - Chris Jones, PhD. http://coolclimate.berkeley.edu/
- Bottom-up approach: Start at household level & scale up
- Follow the money: Develop an expenditure profile for average household in each US Census Block Group in the Bay Area
- Apply appropriate emissions factor for each type of good or service:
  - **$$ (by expenditure type) x GHG emission factor = GHG emissions**
- Emission factors include full life-cycle emissions for each product:
  - Key source: *Comprehensive Environmental Data Archive*
  - Used Bay Area-specific data & emissions factors whenever available

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

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)

Key Factors

Cool Climate Network model includes 30+ factors

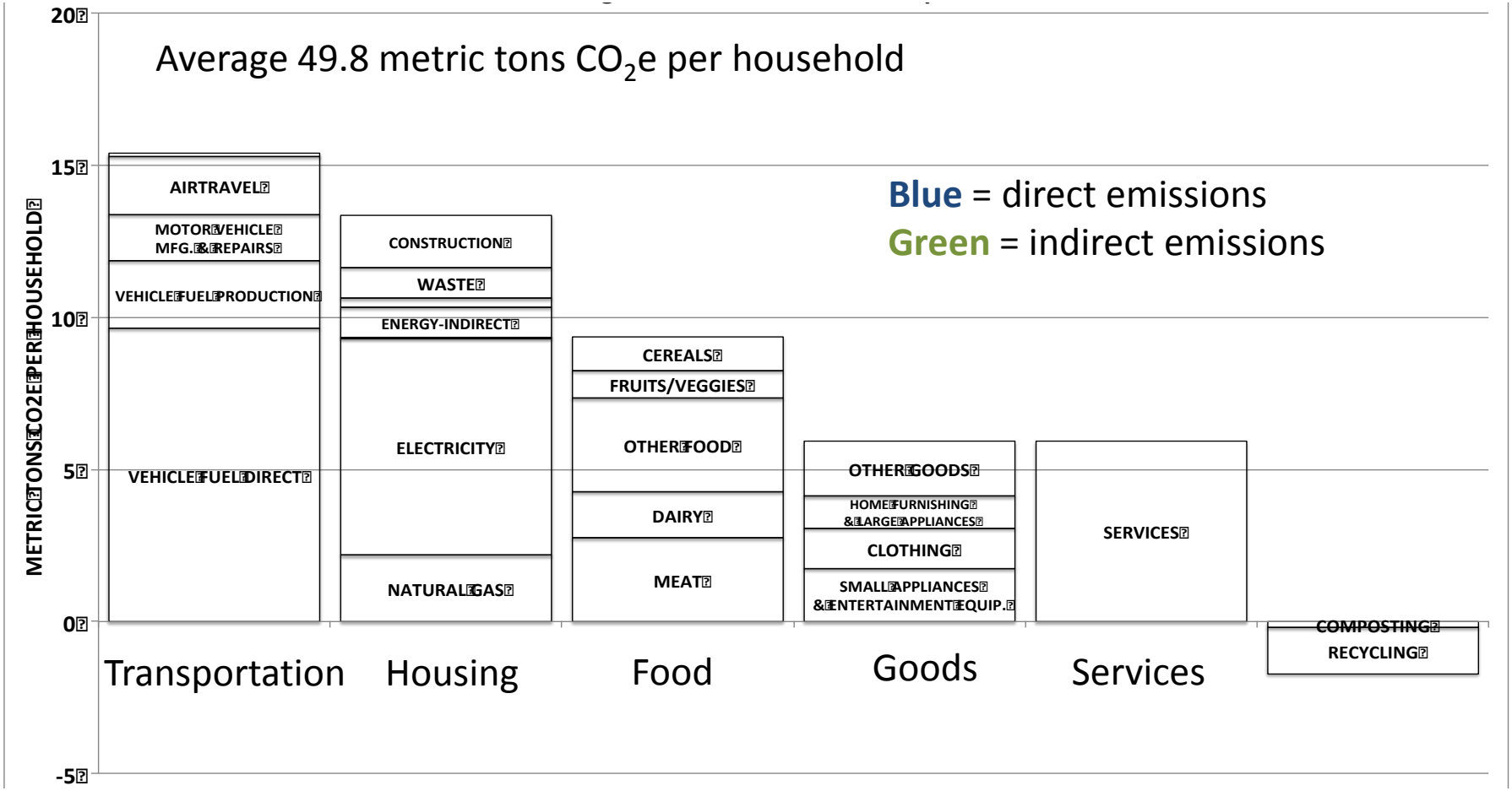
But six factors account for 92% of variation in GHG footprint:

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

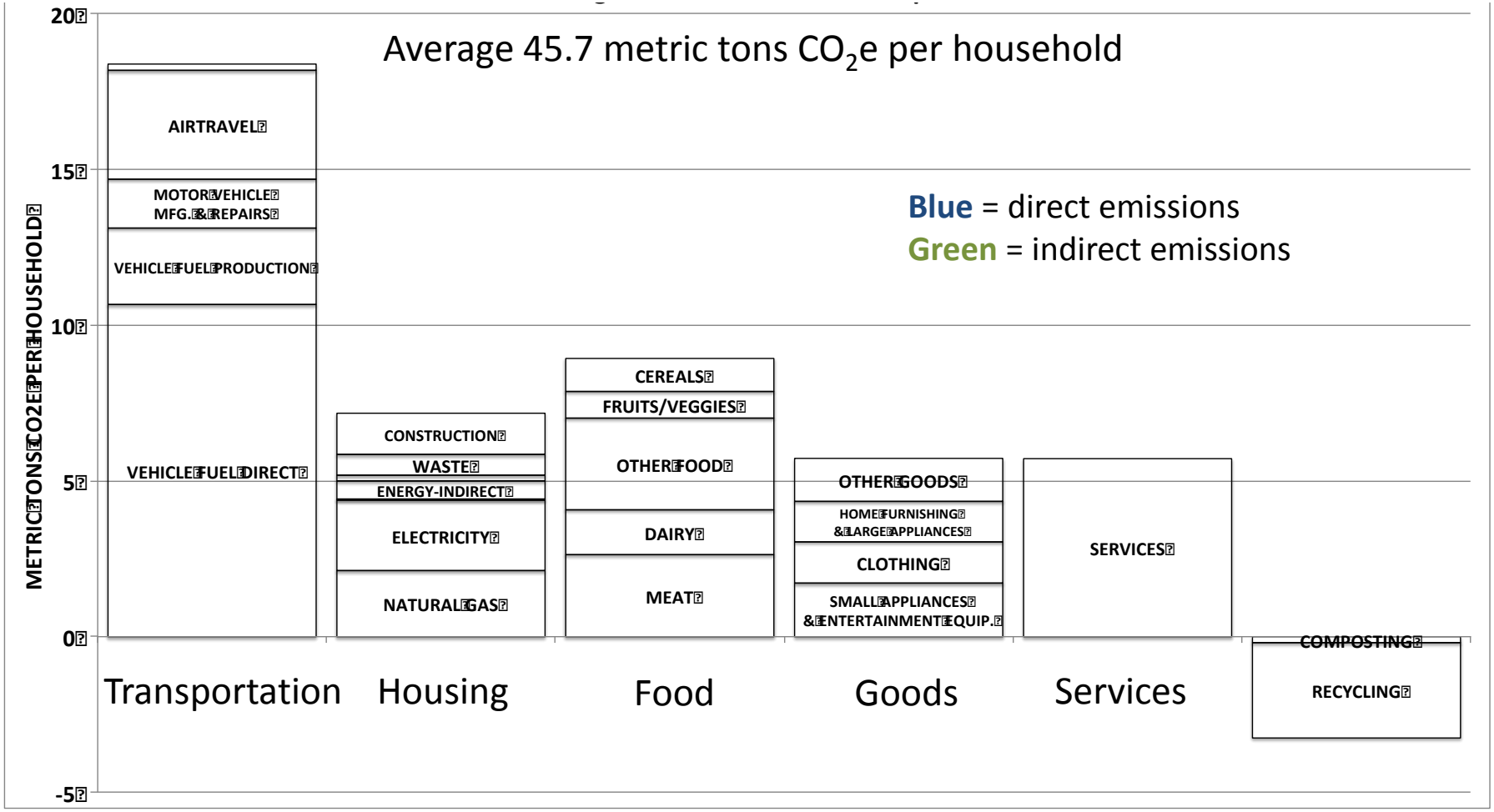
GHG Emissions and HH Income

- 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

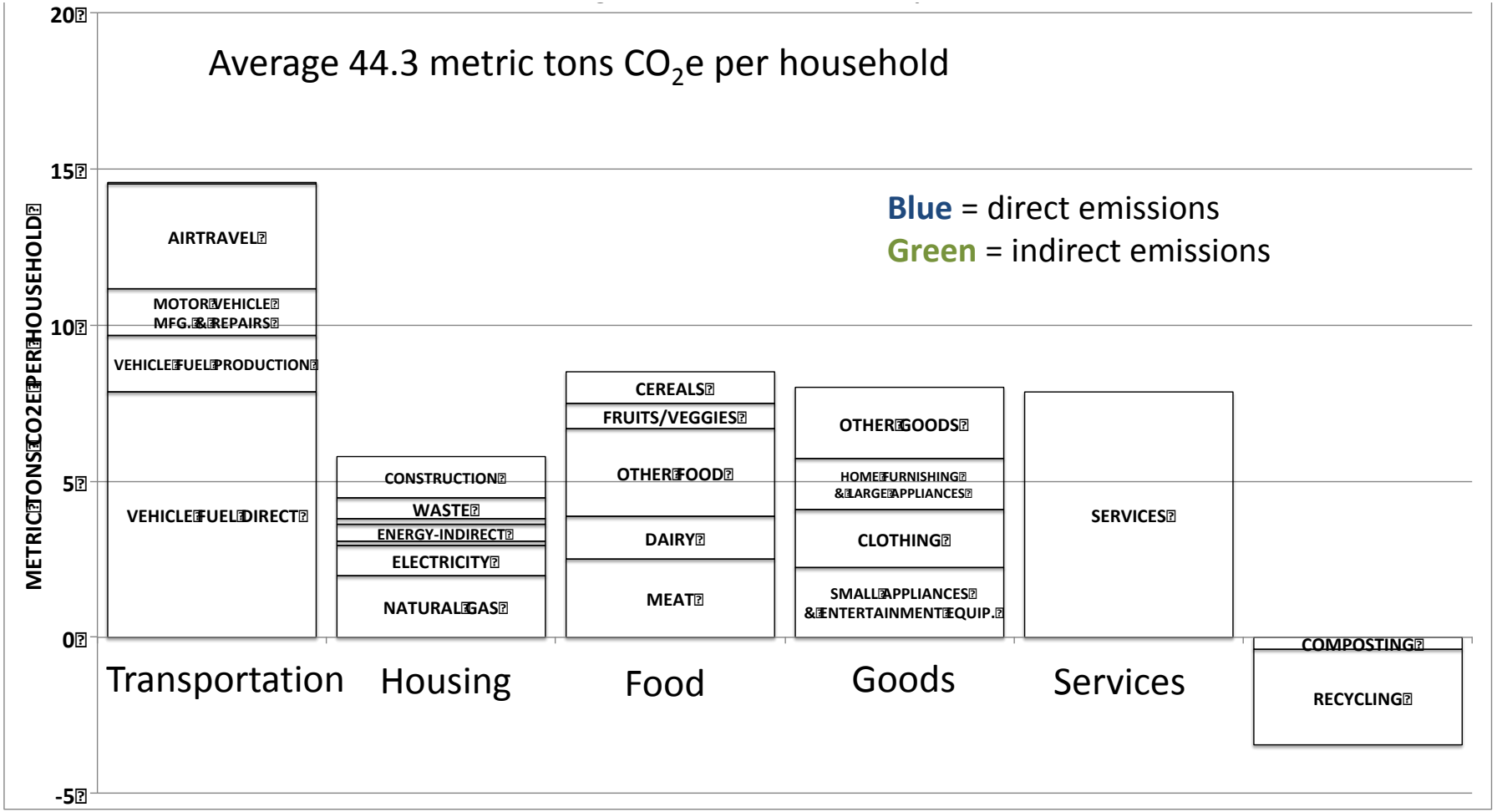
US Average Household GHG Footprint

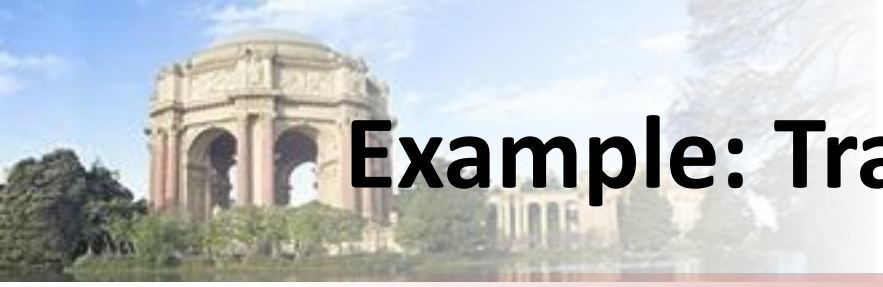


California Average Household GHG Footprint



SF Bay Area Average Household GHG Footprint





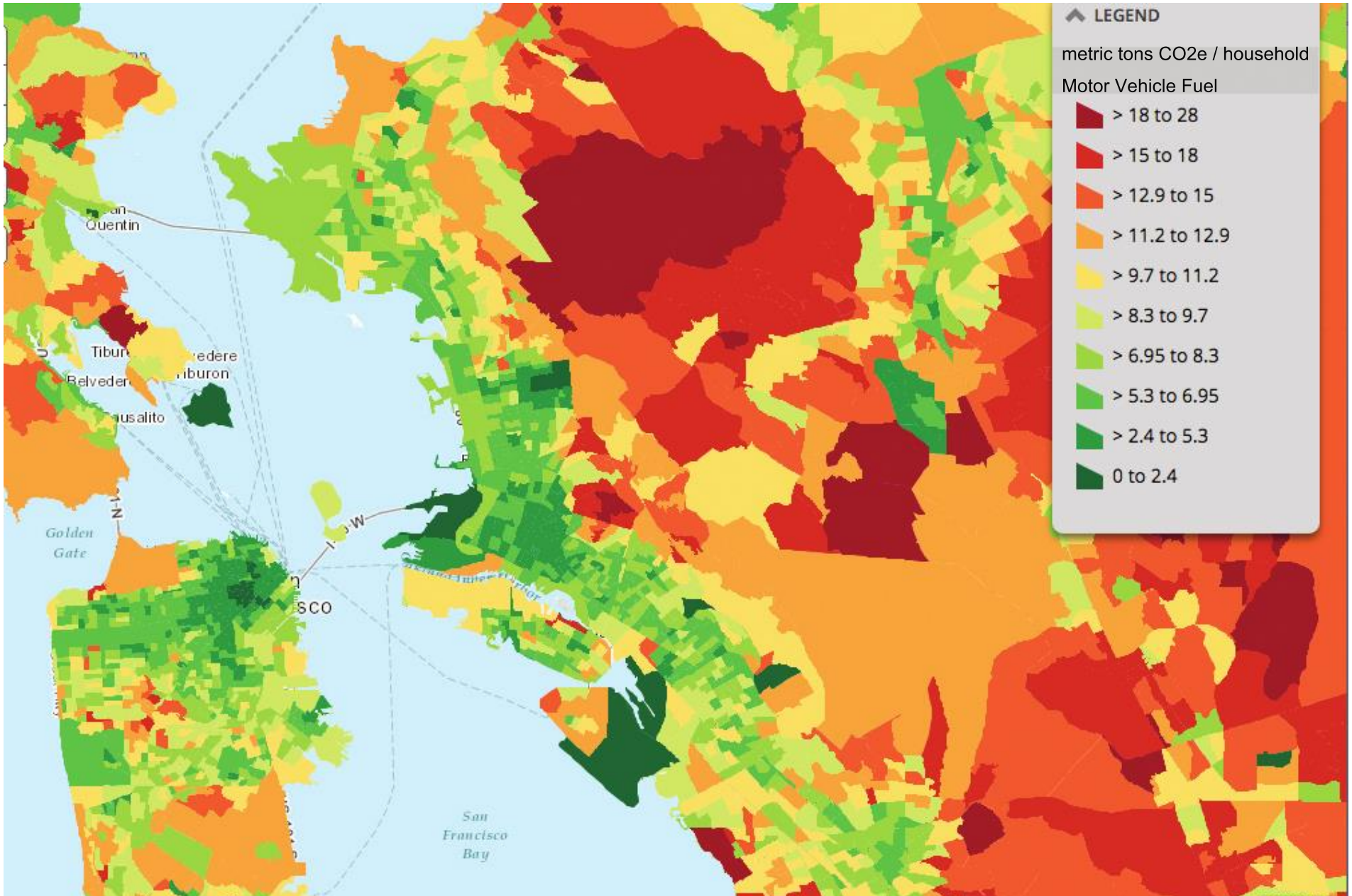
Example: Transportation Emissions

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

Key Factors:	Residential location Household size Household income Access to transit	→	Vehicle ownership rate Trip length Mode choice Discretionary travel

- 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

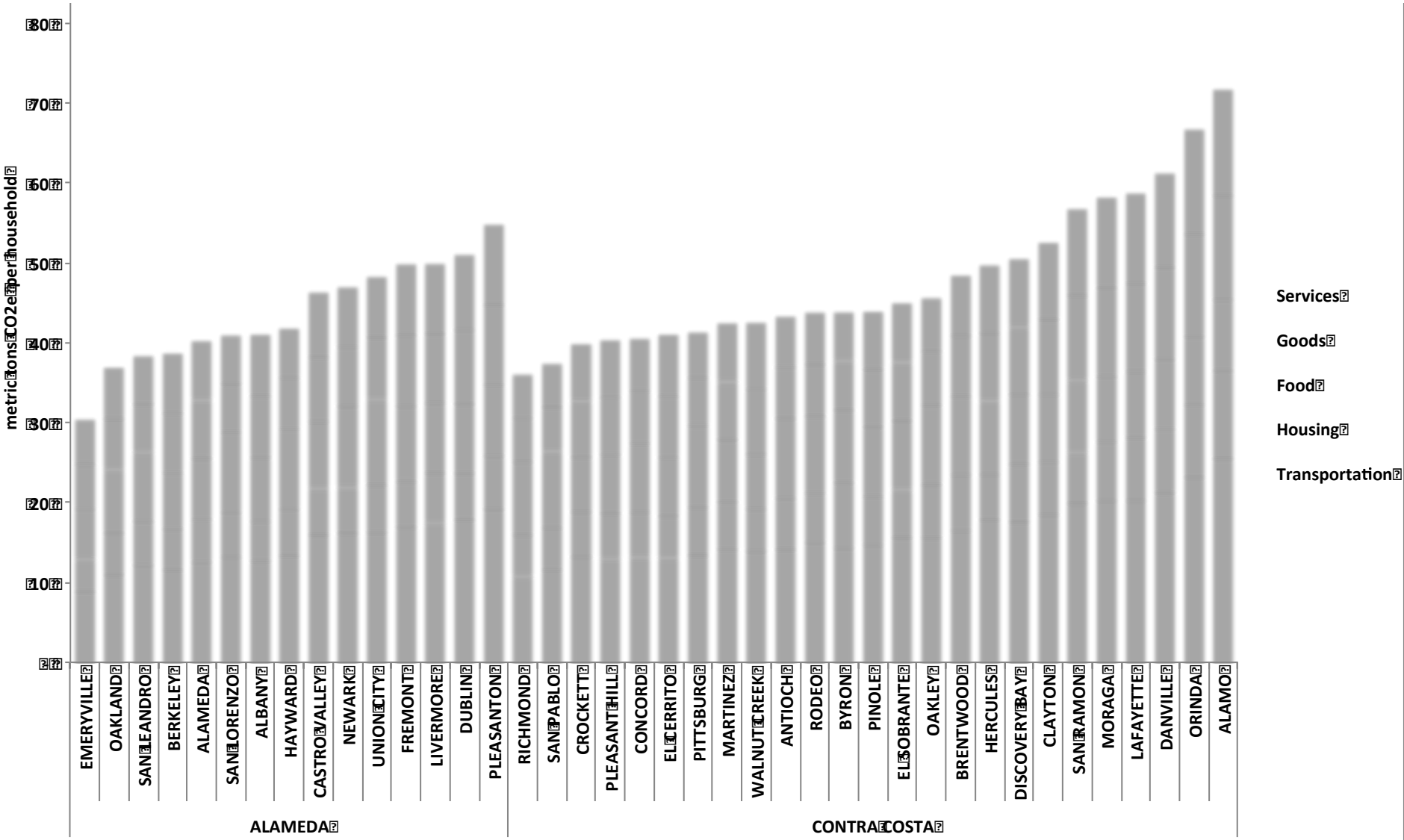
Household GHG Emissions from Transportation by Block Group



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 seven to one
- Variation between cities: ratio of three to one
- 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



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?

CBEI Examples

Entity	Year	Scale / Resolution
Kings County, WA (Seattle)	2008	County-wide
State of Oregon, Dept of Environmental Quality	2010	Statewide
City & County of San Francisco	2011	City-wide
New York City	2013	Zip code

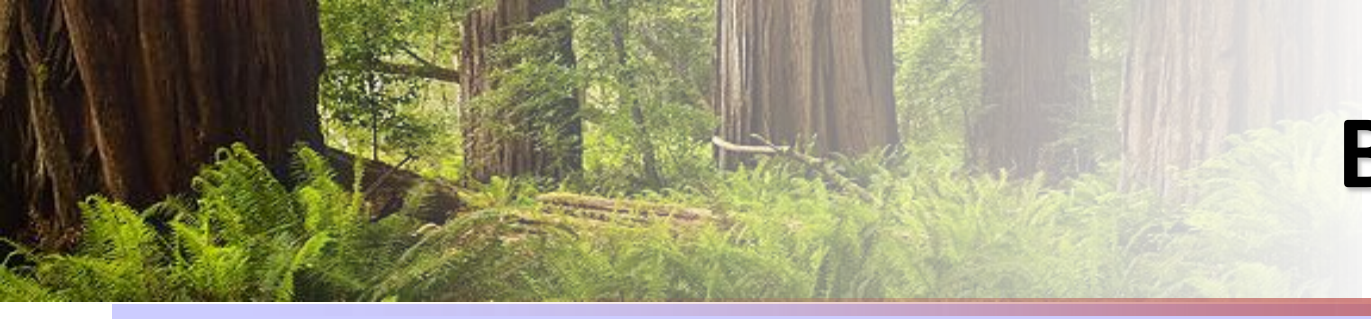
ICLEI GHG Inventory Protocol:
Appendix I: Consumption-Based Emissions (October 2012)

Agenda: 5

California Air Resources Board Draft Short-Lived Climate Pollutant Strategy

Climate Protection Committee
November 19, 2015

Abby Young
Manager, Climate Protection Program



Background

The California Air Resources Board (ARB) is preparing a strategy to significantly reduce emissions of "short-lived climate pollutants" (SLCPs):

- One of Governor Brown's five "Pillars" for achieving 80% reduction in greenhouse gas emissions (GHGs) by 2050
- SB 605 (Lara, 2014) directs ARB to develop a SLCP reduction strategy by the end of 2015
- Coordination with Air District's own process to develop a strategy addressing SLCPs in the Regional Climate Protection Strategy

What Are Short-lived Climate Pollutants?

Characteristics:

- Remain in atmosphere much less time than other climate pollutants like CO_2
- Have high heat-trapping ability (global warming potential, or GWP)

Pollutants:

- Methane
- Black carbon
- Fluorinated gases
  - Human-made (no natural sources)
  - Some were introduced as substitutes for ozone-depleting substances

Why SLCPs are Important

According to the Air Resources Board, significantly reducing emissions of SLCPs by 2030 can:

- Cut global warming in half by 2050
- Reduce warming in the Arctic by two-thirds by 2040
- Slow the rate of sea level rise by 24 – 50%
- Increase the chances of keeping average warming below 2°C to greater than 90% by 2050

Reducing statewide emissions of SLCPs is one of Governor Brown's five "Pillars" of climate action.

The Climate Warming Impact of SLCPs

From ARB's *Draft Short-lived Climate Pollutant Strategy*, 2015:

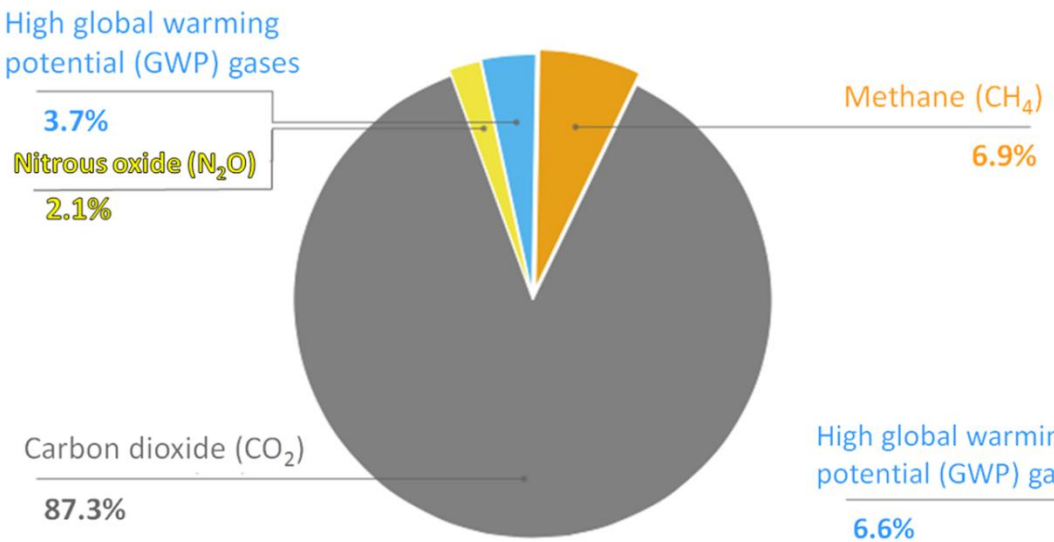
Table 4: Global Warming Potential for SLCPs

Pollutant	Lifetime (years)	20-year GWP*	100-year GWP
Carbon Dioxide	~100	1	1
Methane	12	72	34
Fluorinated Gases	1.4 – 52	437 – 6,350	124 – 3,500
Black Carbon	Days to weeks	3,200	900

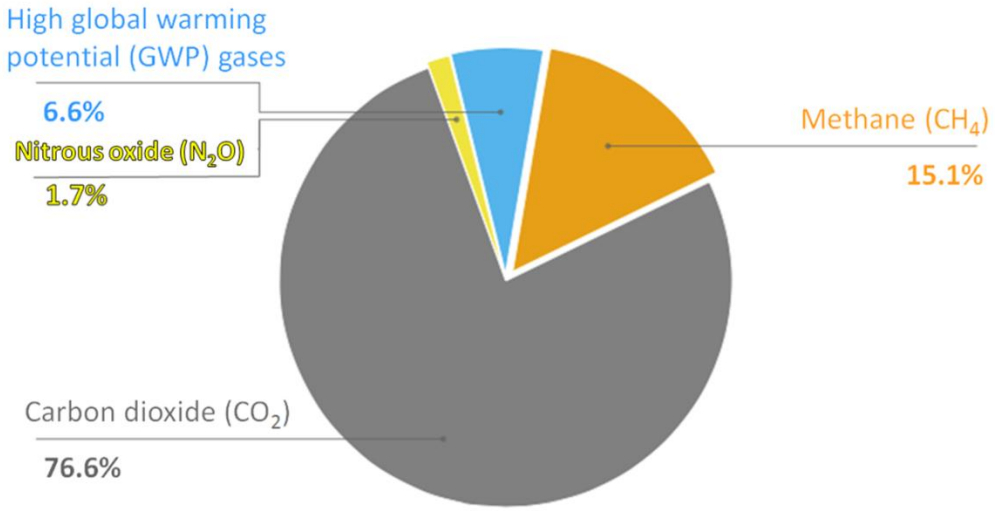
*The use of a 20-year GWP time horizon better captures the importance of SLCPs and gives a better perspective on the speed at which SLCP emission controls will impact the atmosphere relative to CO_2 emission controls.

SLCPs in the Bay Area GHG Inventory

100 Year Timeframe

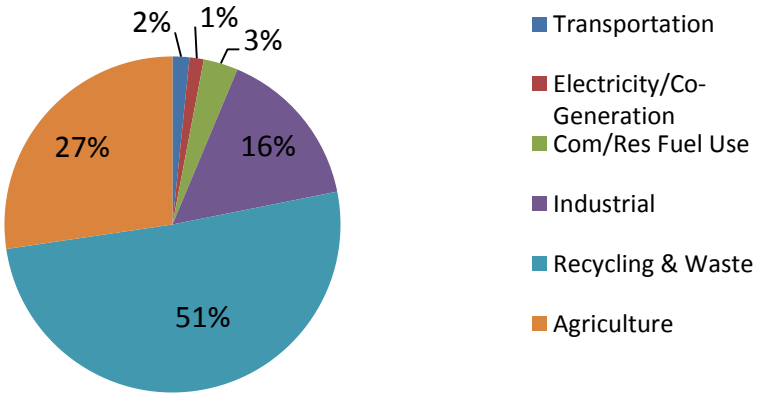


20 Year Timeframe

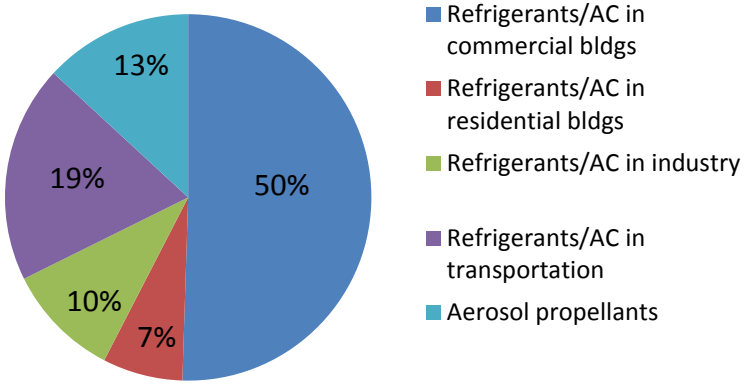


Sources in the Bay Area

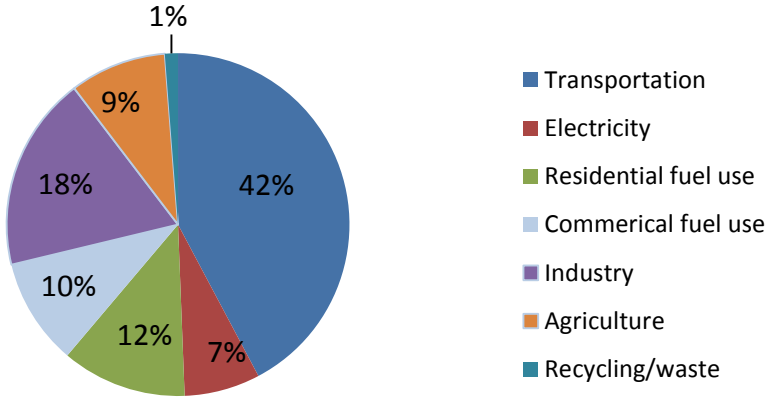
Bay Area Methane Emissions by Source



Bay Area HFC Emissions by Source



Bay Area Black Carbon Emissions by Source



ARB and Air District Efforts to Date

Reducing Methane:

- California has strongest standards in the nation for limiting emissions from landfills; Air District assists ARB with enforcement
- Cap-and-Trade offset protocols to encourage methane reduction
- Rule-making underway to limit methane leaks from the natural gas pipeline system and oil & gas wells

Reducing Black Carbon:

- California human-caused emissions have been reduced 90% since 1960
- Regulations & incentives addressing diesel fuel and engines
- Air District wood smoke rule

Reducing Fluorinated Gases:

- Current ARB regulations will cut emissions 25% below projected levels by 2020
- Air District collaborating with ARB to enforce regulations on semi-conductor manufacturing and non-motor vehicle air-conditioning

ARB's SLCP Reduction Targets

California SLCP Emissions & Proposed Reduction Targets

Pollutant	Baseline	Forecast	Year 2030 Targets	
	Year 2013	Year 2030	Tons	% Reduction
Black Carbon	38	26	19	50%
Methane	118	117	71	40%
F-gases	40	65	24	40%

- In MMT CO_2e based on 20-year GWP
- "Forecast" includes anticipated reductions from implementation of current regulations

"The science unequivocally underscores the need to immediately reduce emissions of Short-lived Climate Pollutants (SLCPs)…cutting emissions of SLCPs can immediately slow global warming and reduce the impacts of climate change."

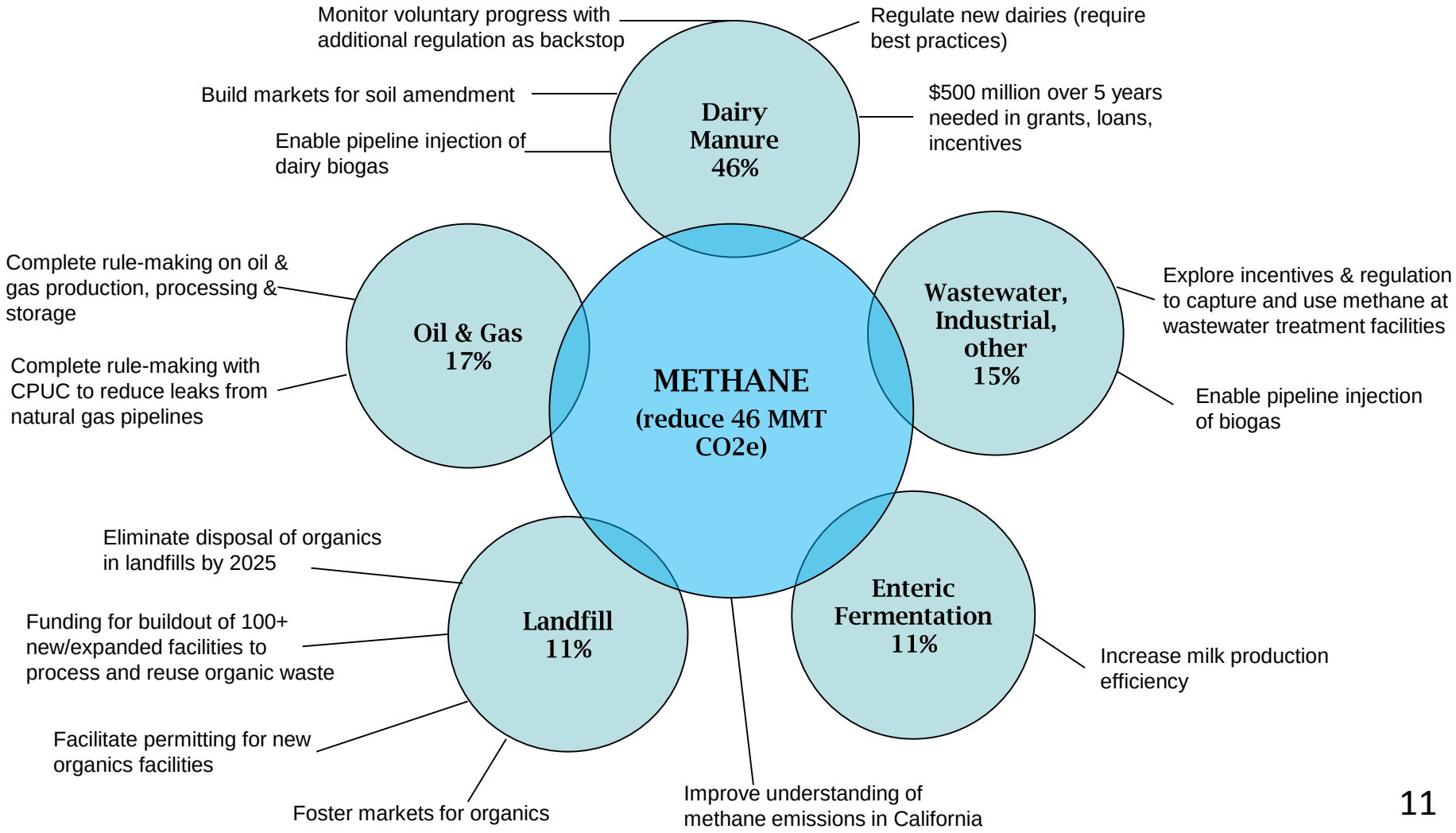
-- ARB's Draft Short-lived Climate Pollutant Reduction Strategy

ARB's Reduction Strategy

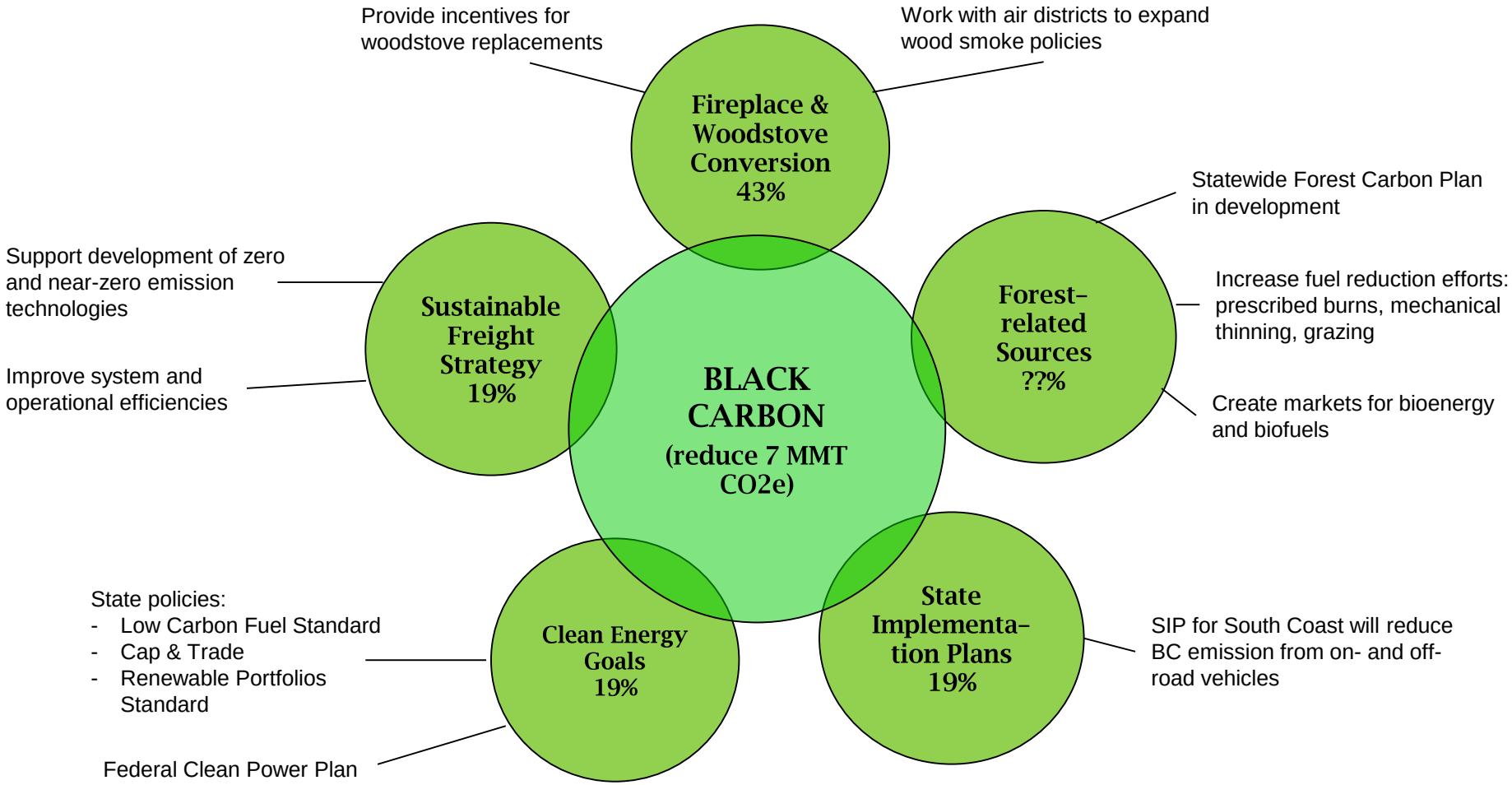
Driving Principles:

- Prioritize actions with diverse benefits
- Put organic waste to beneficial use
- Identify practical solutions to overcome barriers
- Invest in SLCP emission reductions and communities
- Advance the science of SLCP sources and emissions

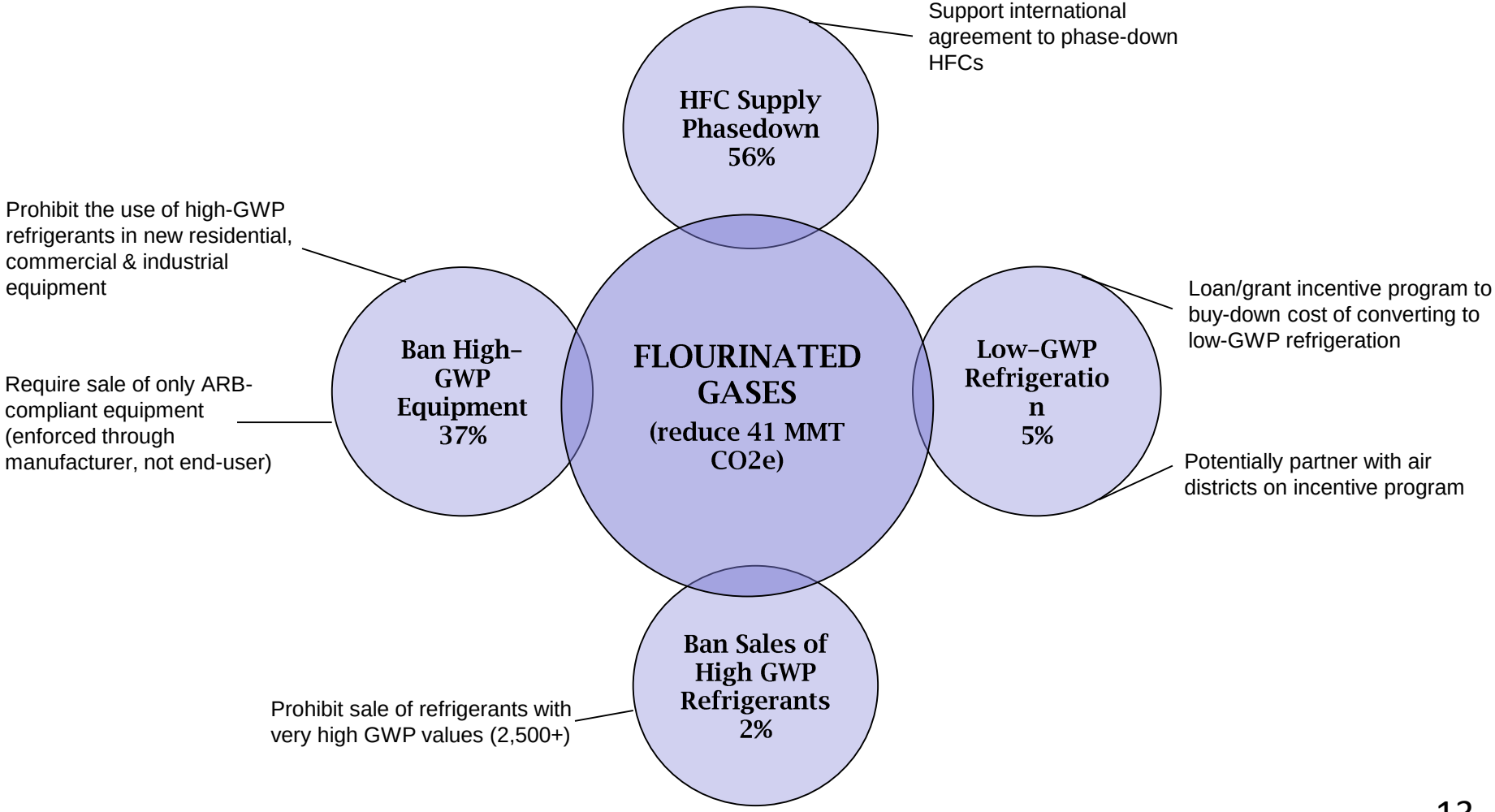
ARB's Reduction Strategy



ARB's Reduction Strategy



ARB's Reduction Strategy



Collaboration Moving Forward

"Local Air Districts have a key role to play…"

- Continue collaboration with ARB in rule development and enforcement
- Work with local governments to include measurement, tracking and policies for reducing SLCPs in local climate action plans
- Include specific SLCP reduction measures in the 2016 Clean Air Plan / Regional Climate Protection Strategy
- Explore new source categories, approaches and partnerships for reducing SLCPs in the Bay Area
  - Soil carbon sequestration in rangelands