Carbon Footprint Assessments: What & Why

April 28, 2011

Sponsored by:

Northeast Waste Management Officials' Association

Pacific Northwest Pollution Prevention Resource Center

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Good Company

Eugene, OR

overview

- introductions
- brief background: terms, science, emissions
- GHG inventories: context, strategy, boundaries
- topics for next time (May 12): how-to

- everyone is muted, but please type questions into the chat window; also, we'll pause at 30 minutes in (for people to compose questions)

Good Company

- sustainability research and consulting firm
- mission-driven, for-profit
- clients: government, higher ed, private sector

my background: economist, consultant, LEED™ AP, instructor in various professional development settings, adjunct faculty in two MBA programs

background on climate issues

- terminology
- climate science
  - Short version: Science has told us enough that we can get working on the details.
- overview of US and global emissions
- a warning: Don’t get carbon goggles!
- life-cycle carbon, inventory examples

topics that won't be covered in depth

- carbon markets, offsets and RECs
- climate risk (regulatory and physical)
- cost of carbon
- possible climate policy instruments
- implicit climate policy currently underway

terminology

- global warming vs. climate change
- *life-cycle GHG emissions, life-cycle carbon*
- *cost of carbon*
- GHG inventory, carbon (or climate) footprint
- climate risk, carbon risk, cost-of-carbon risk
- carbon disclosure, emissions disclosure
- climate action, climate action planning
- global warming potential (GWP)
- greenhouse gases, GHG emissions, GHGs, global warming pollution, GWP, carbon, CO_2e
  - "carbon" is inaccurate
  - really, all carbon dioxide equivalent (CO_2e) emissions
- carbon footprint ≠ Ecological Footprint

IPCC summary climate science (2007)

- observable climate changes
  artic temperatures and ice, precipitation amounts, ocean salinity and warming, extreme weather and temperatures
- anthropogenic warming
  fossil fuel use, land-use change, agriculture all increase greenhouse gas concentration and global warming
- future changes in climate
  global models used in climate change simulations predict larger changes for future unless something is done

IPCC AR4 Working Group 2, http://www.ipcc.ch/ipccreports/ar4-wg2.htm

consensus on (un)certainty

From the IPCC in 2007:

1. The Working Group I Fourth Assessment concluded that most of the observed increase in the globally averaged temperature since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.

Description of likelihood

Likelihood refers to a probabilistic assessment of some well-defined outcome having occurred or occurring in the future, and may be based on quantitative analysis or an elicitation of expert views. In the Summary for Policymakers, when authors evaluate the likelihood of certain outcomes, the associated meanings are:

Terminology	*Likelihood of the occurrence/ outcome*
Virtually certain	>99% probability of occurrence
Very likely	90 to 99% probability
Likely	66 to 90% probability
About as likely as not	33 to 66% probability
Unlikely	10 to 33% probability
Very unlikely	1 to 10% probability
Exceptionally unlikely	<1% probability

cornerstone concept: life-cycle GHGs

- definition: the GHG emissions associated with the entire life cycle of a product, service, infrastructure component or other activity
- What do we know now about life-cycle GHGs for most of what we do and buy?
  - Some of the emissions belong to us (owned).
  - Some of them belong to others (shared).
  - We've never had to calculate them before.
  - We should approach this concept with humility, as it is complex and not always intuitive.
- life-cycle GHG thinking is about boundaries

GHGs and their GWP

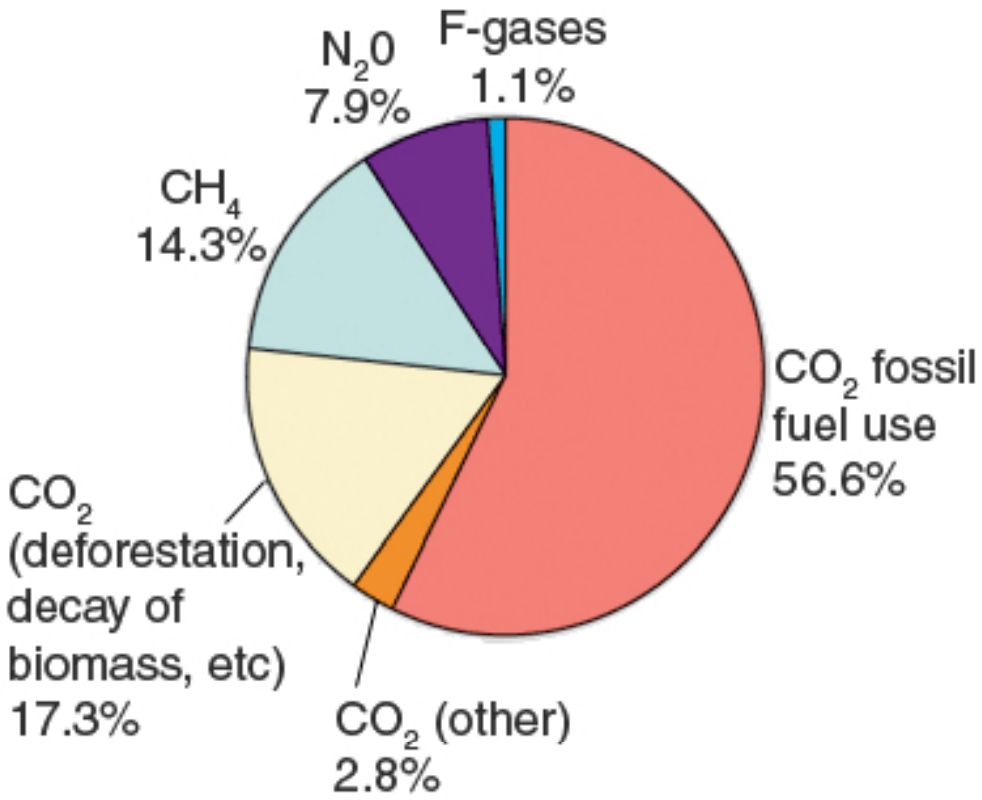
Greenhouse Gases		Global Warming Potential (100 yrs)
Carbon dioxide	CO_2	1
Methane	CH_4	21
Nitrous oxide	N_2O	310
Hydrofluorocarbons	HFC	140 to 11700
Sulphur hexafluoride	SF_6	23900
Perfluorinated compounds	PFC	6500
Black carbon*	C	?

black carbon is of growing concern and its impact is not yet fully understood

Source: UNEP (2011) *Summary for decision makers of the integrated assessment of black carbon and tropospheric ozone*

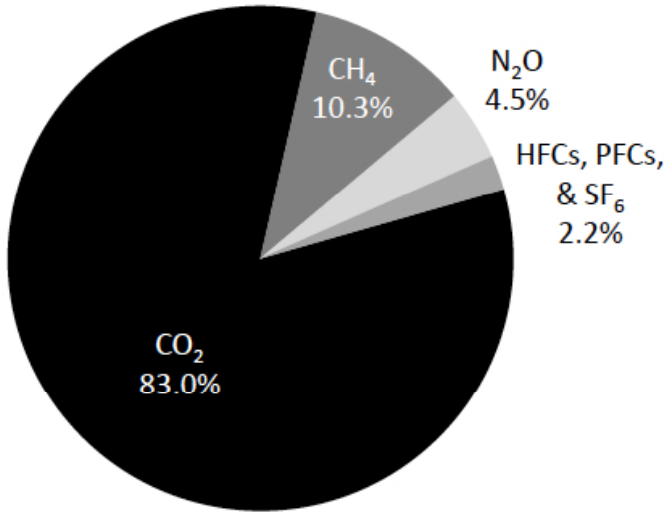
overview of emissions by GHG type

World GHG emissions, 2004



Reference: IPCC 4th Assessment Report:Climate Change 2007: Synthesis Report

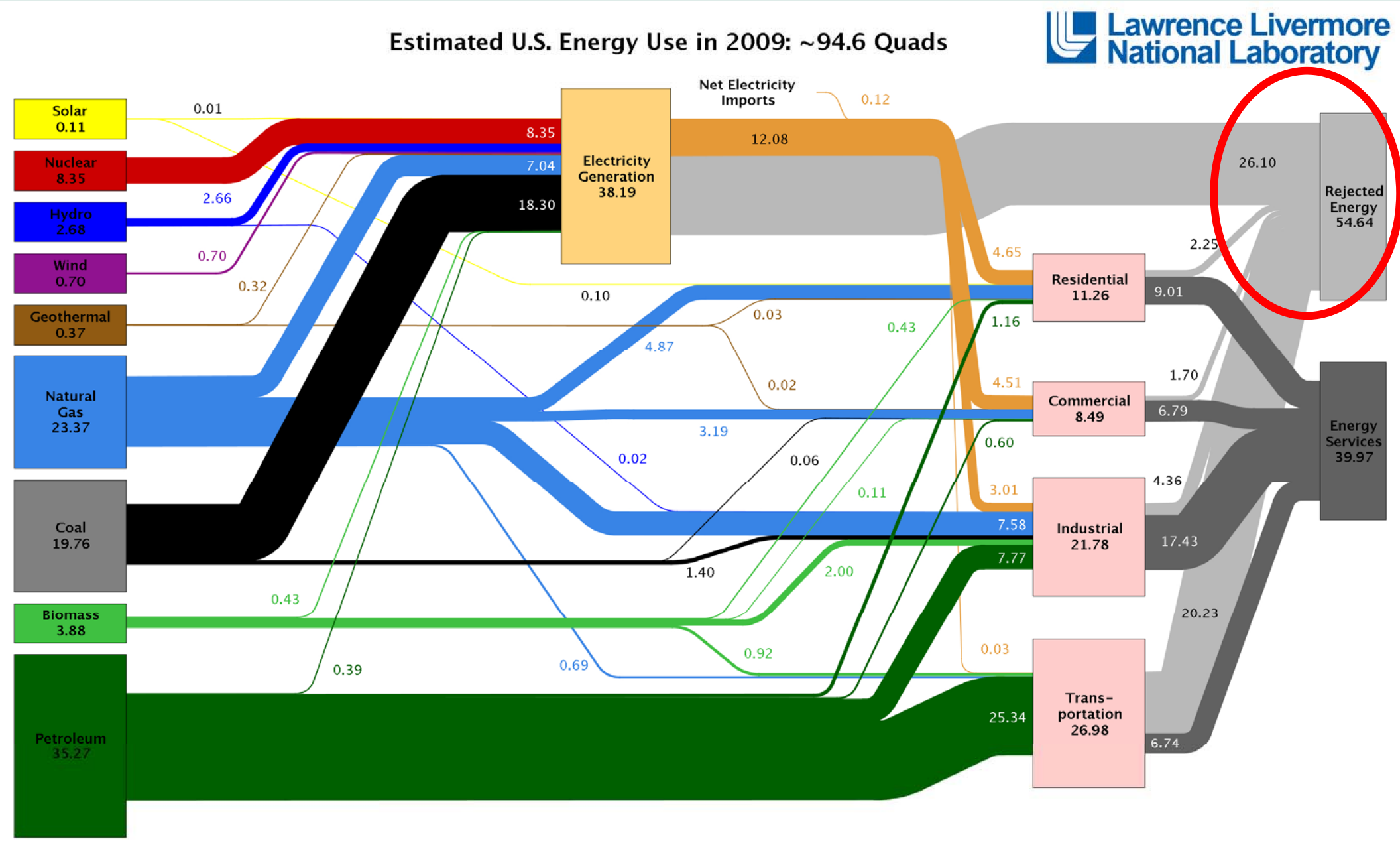
US GHG emissions, 2009

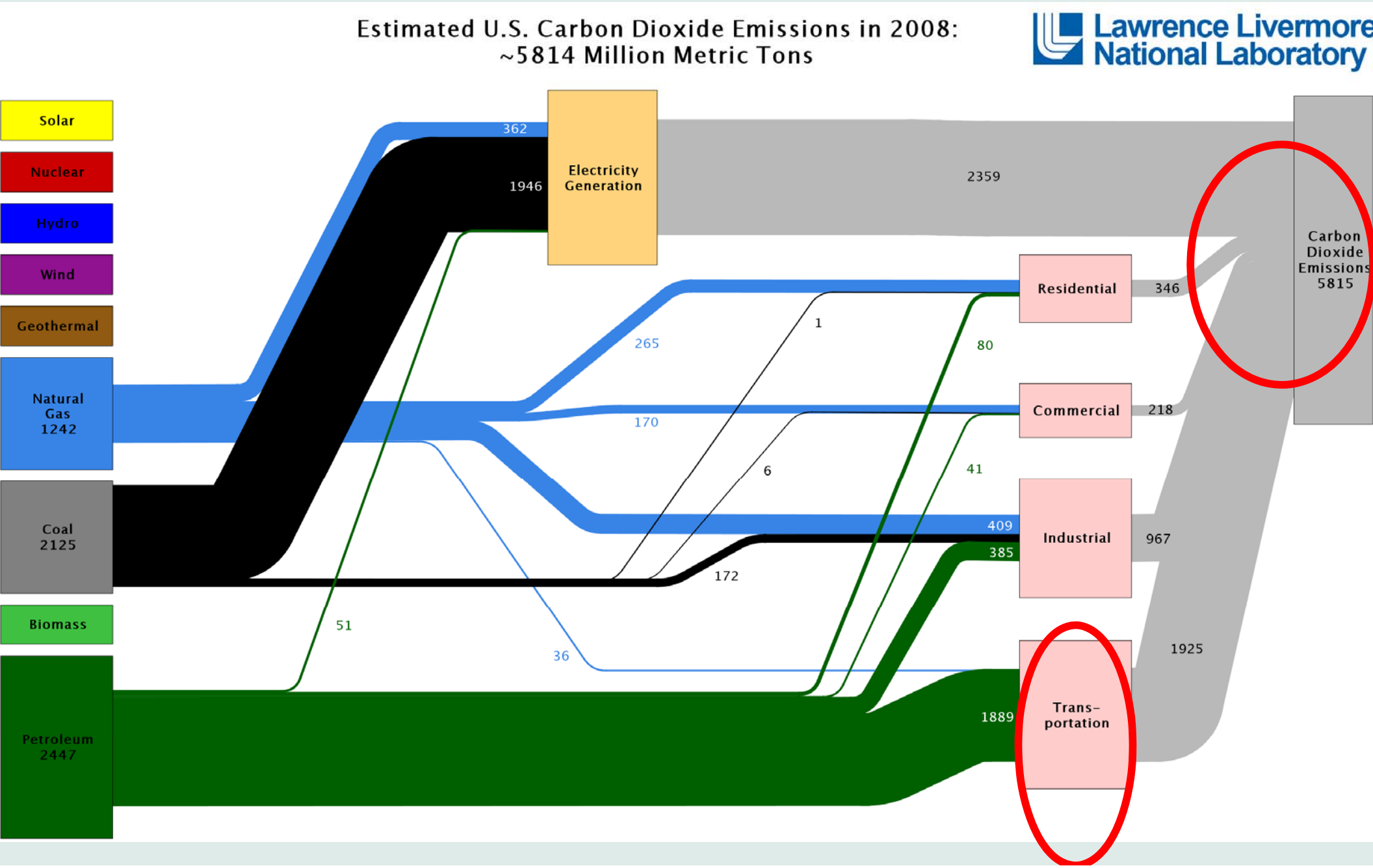


EPA, 2011 U.S. Greenhouse Gas Inventory Report

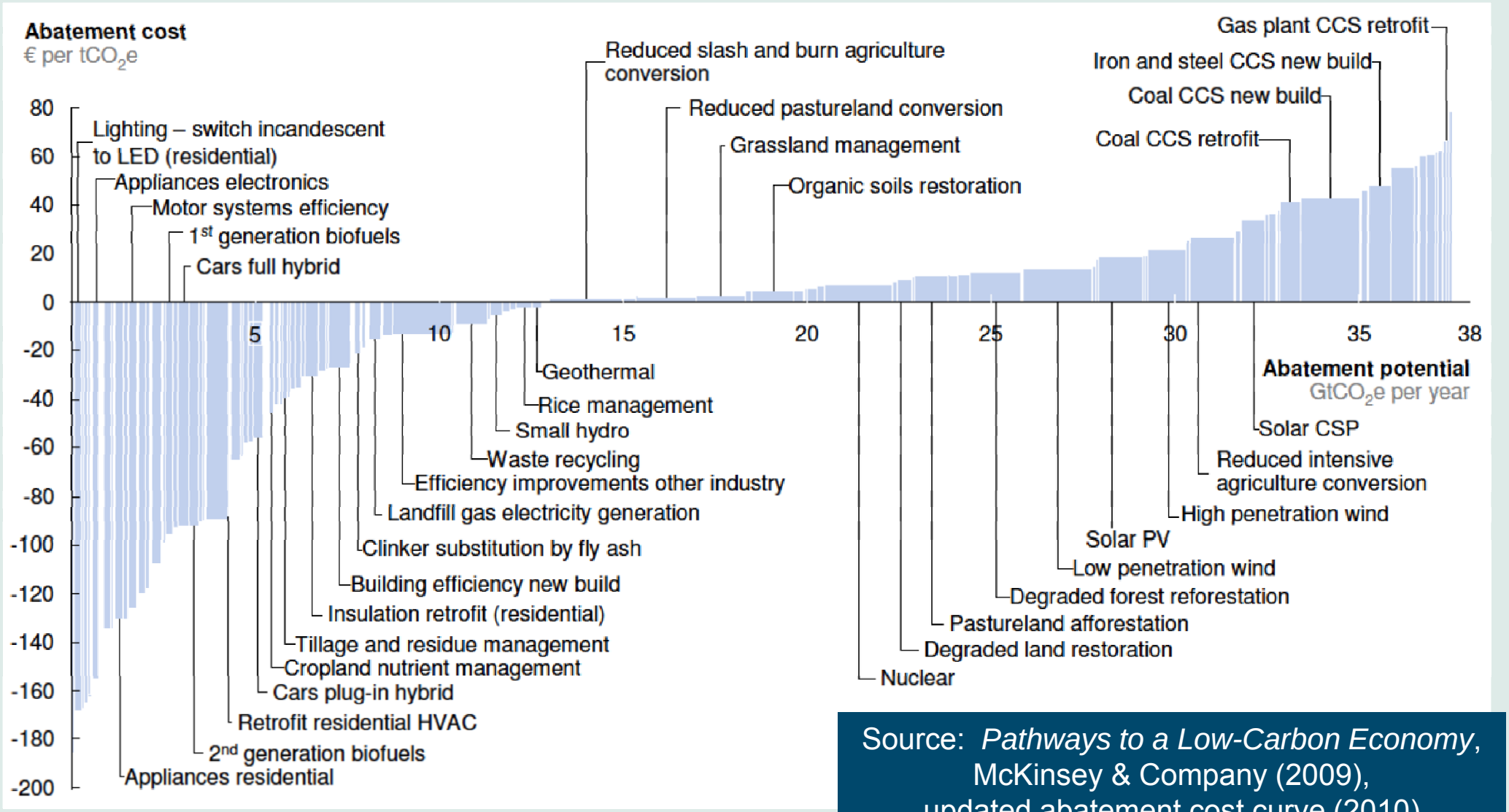
energy and climate: the punch line(s)

1. The **climate crisis** is first and foremost an **energy challenge**.
2. Right now, the **energy challenge** is first and foremost an **efficiency opportunity**.
3. In the long term, the **energy challenge** is also a **transition challenge**.

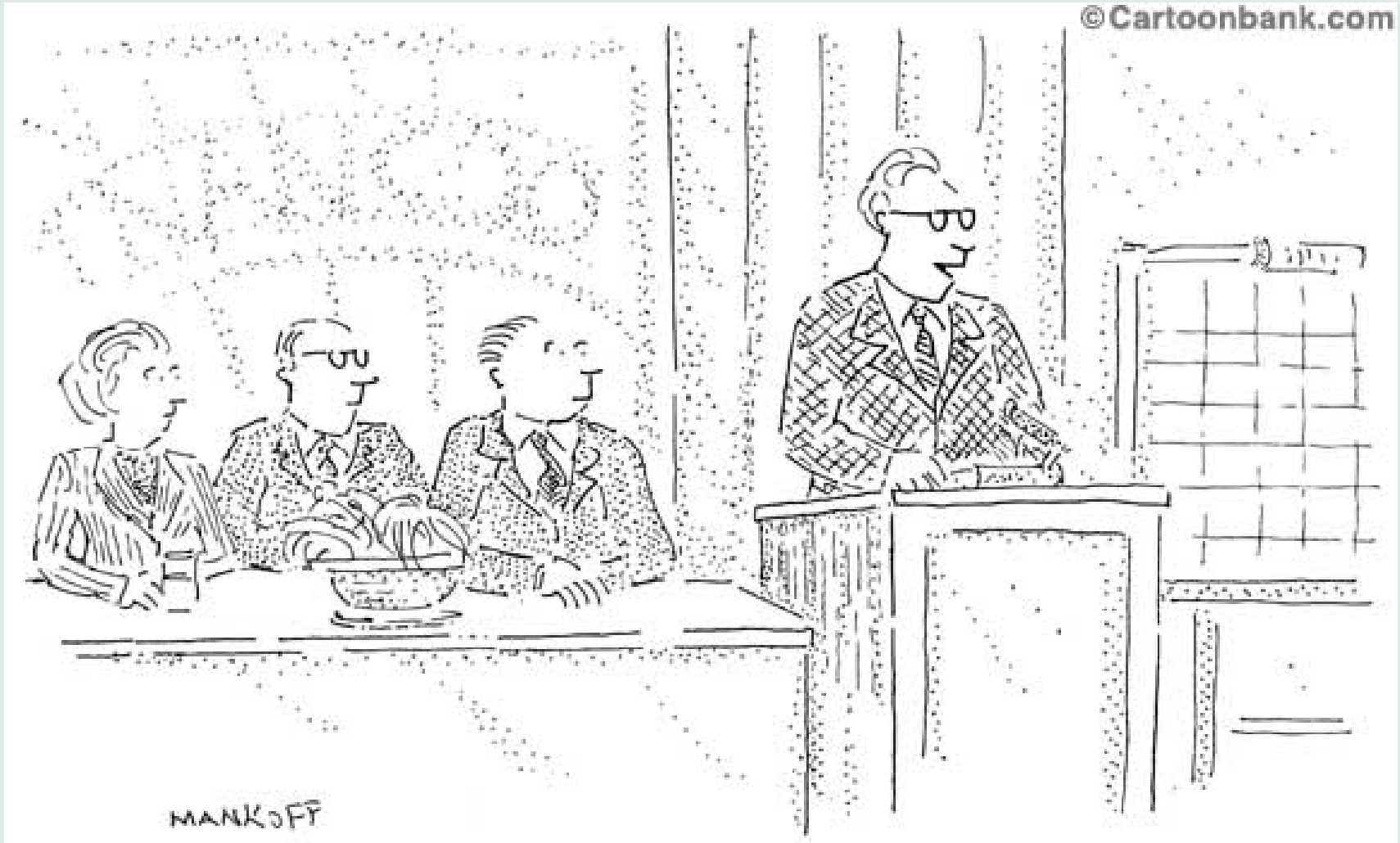

Estimated U.S. Energy Use in 2009: ~94.6 Quads
Lawrence Livermore National Laboratory
Solar 0.11
Nuclear 8.35
Hydro 2.68
Wind 0.70
Geothermal 0.37
Natural Gas 23.37
Coal 19.76
Biomass 3.88
Petroleum 35.27
Electricity Generation 38.19
Net Electricity Imports
Residential 11.26
Commercial 8.49
Industrial 21.78
Trans-portation 26.98
Rejected Energy 54.64
Energy Services 39.97
0.01
8.35
7.04
18.30
2.66
0.70
0.32
0.10
0.03
0.02
4.87
3.19
0.02
0.06
1.40
0.43
0.39
0.69
0.92
2.00
0.11
0.12
12.08
4.65
1.16
4.51
0.60
3.01
7.58
7.77
0.03
25.34
26.10
2.25
9.01
1.70
6.79
4.36
17.43
20.23
6.74


Estimated U.S. Carbon Dioxide Emissions in 2008:
~5814 Million Metric Tons
Lawrence Livermore National Laboratory
Solar
Nuclear
Hydro
Wind
Geothermal
Natural Gas 1242
Coal 2125
Biomass
Petroleum 2447
362
1946
Electricity Generation
2359
Residential
346
Commercial
218
Industrial
967
Trans-portation
1925
Carbon Dioxide Emissions 5815
265
170
409
1889
1
80
6
41
385
172
51
36

carbon = energy = opportunity

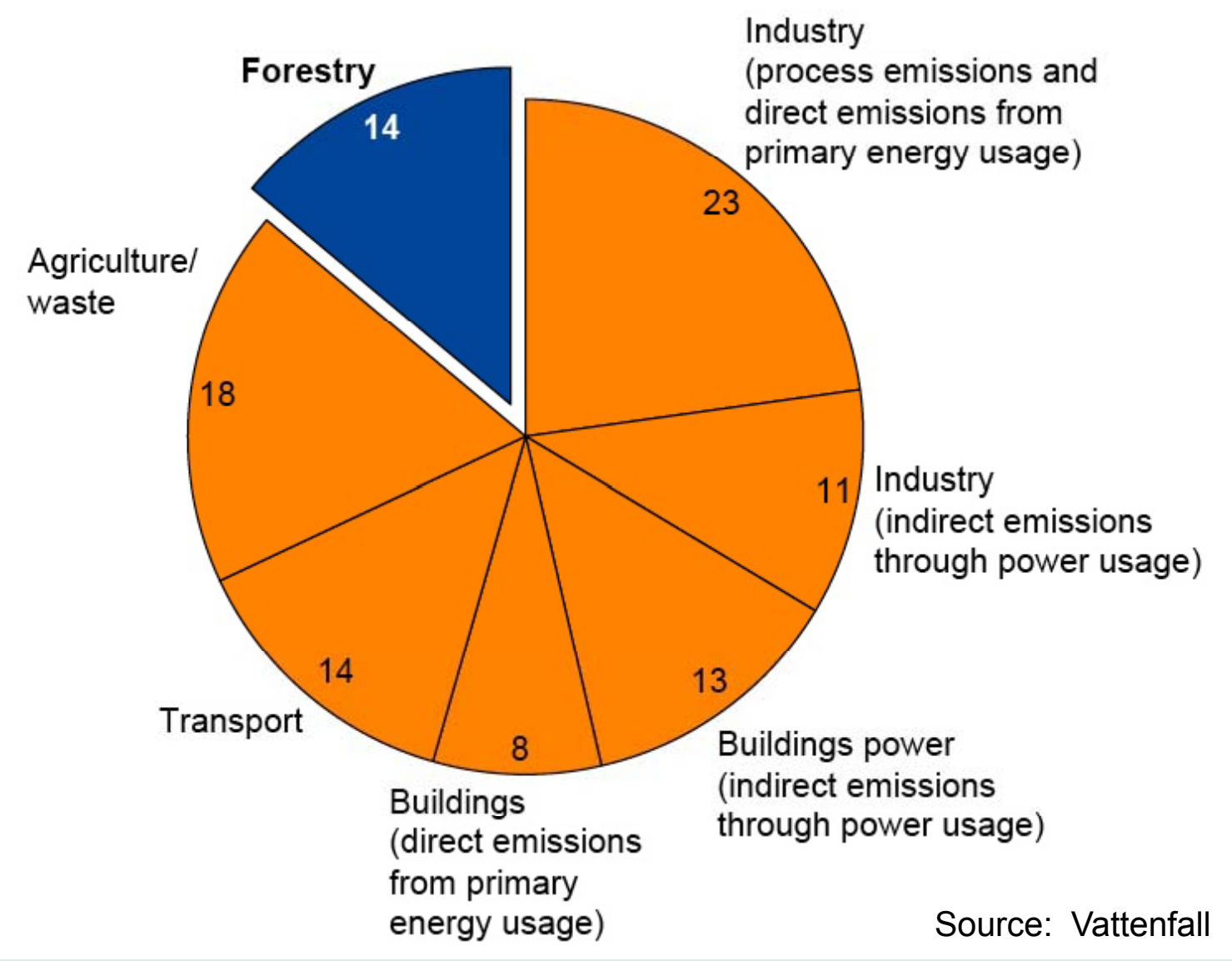


Source: *Pathways to a Low-Carbon Economy*, McKinsey & Company (2009), updated abatement cost curve (2010)



"And so, while the end-of-the-world scenario will be rife with unimaginable horrors, we believe that the pre-end period will be filled with unprecedented opportunities for profit."

overview of global emissions



Source: Vattenfall

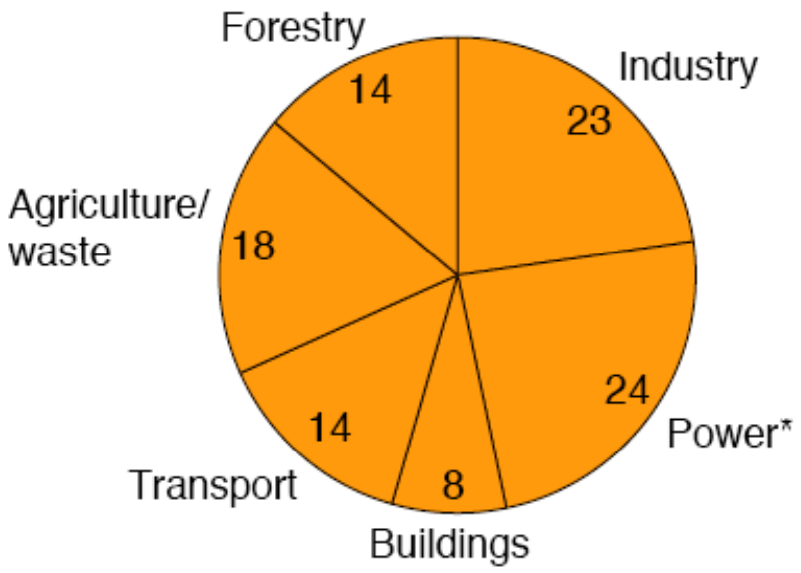
Current sources of greenhouse gas emissions

2002; Percent

BACKUP

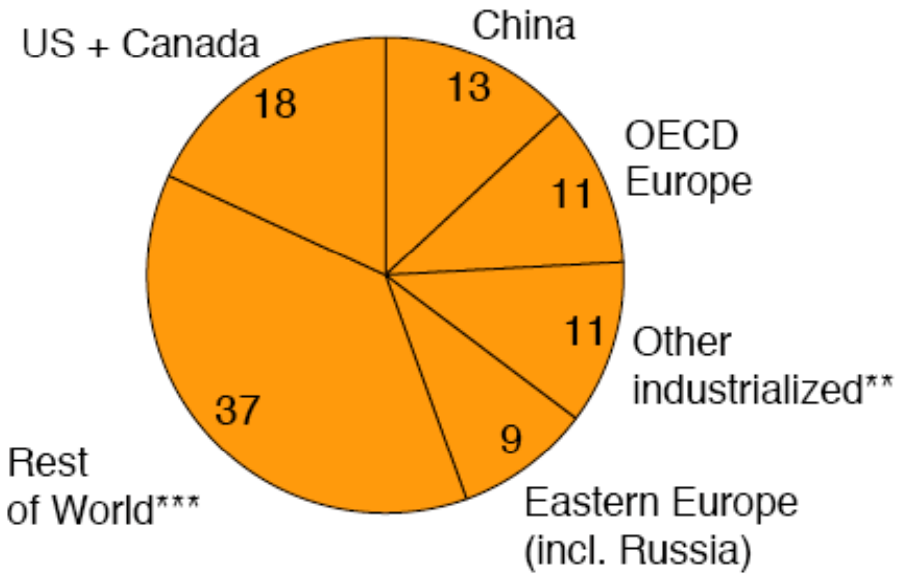
By sector

100% = 40 $GtCO_2e$



By region

100% = 40 $GtCO_2e$



Source: Vattenfall

WARNING: Don't get carbon goggles!

- today's focus: GHG emissions
- …but GHG-generating activities have other impacts, e.g.:
  - diesel/petroleum combustion: air pollution
  - fossil-fuel extraction: oil spills
  - atmospheric CO_2: ocean acidification
  - in all cases, cost
- "solutions" have unintended consequences, e.g., biofuels:
  - habitat degradation/destruction
  - stress on water resources
  - food vs. fuel
- learn to put the goggles on and take them off, as appropriate to the circumstances

carbon footprints

- carbon footprints: why bother?
- conducting an inventory
  - inventory protocols and calculation tools
  - *overview of the steps involved*
  - *typical emission sources and issues*
  - *data needs systems to collect data*
- setting boundaries for your carbon footprint
  - responsibility and mission-critical/related activities
  - control vs. influence, owned vs. shared
  - data availability
- *reporting on climate performance (prelude to climate action planning)*

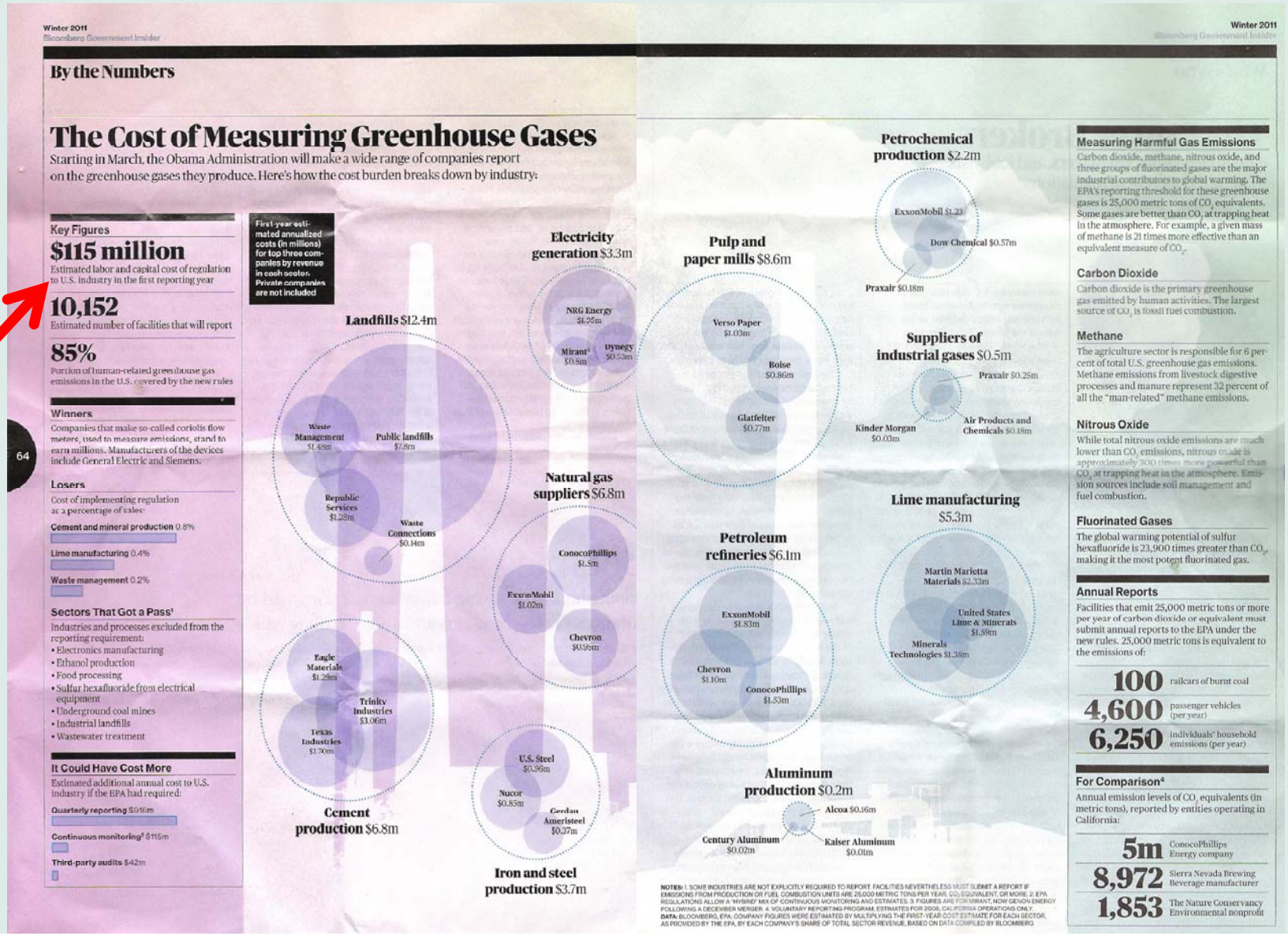
carbon footprints: why bother?

- you have to do it
- understand your *climate risk* (more later)
  - impending regulation
  - impending non-regulatory risk (e.g., supply chain)
  - potential disruption to your business model or practices
- proactively manage a challenge that might matter to stakeholders
- live up to institutional commitments
- it might also be “the right thing” (your mission)

costly regulation or strategic self-knowledge?

Seems like a costly regulation….

Is it?



Winter 2011
Bloomberg Government Insider

By the Numbers

The Cost of Measuring Greenhouse Gases

Starting in March, the Obama Administration will make a wide range of companies report on the greenhouse gases they produce. Here's how the cost burden breaks down by industry:

Key Figures

$115 million
Estimated labor and capital cost of regulation to U.S. industry in the first reporting year

10,152
Estimated number of facilities that will report

85%
Portion of human-related greenhouse gas emissions in the U.S. covered by the new rules

Winners
Companies that make so-called coriolis flow meters, used to measure emissions, stand to earn millions. Manufacturers of the devices include General Electric and Siemens.

Losers
Cost of implementing regulation as a percentage of sales:

Cement and mineral production 0.8%
Lime manufacturing 0.4%
Waste management 0.2%

Sectors That Got a Pass[1]
Industries and processes excluded from the reporting requirement:
- Electronics manufacturing
- Ethanol production
- Food processing
- Sulfur hexafluoride from electrical equipment
- Underground coal mines
- Industrial landfills
- Wastewater treatment

It Could Have Cost More
Estimated additional annual cost to U.S. industry if the EPA had required:

Quarterly reporting $916m
Continuous monitoring[2] $115m
Third-party audits $42m

First-year estimated annualized costs (in millions) for top three companies by revenue in each sector. Private companies are not included

Landfills $12.4m
Waste Management $1.48m
Public landfills $7.8m
Republic Services $1.28m
Waste Connections $0.14m

Electricity generation $3.3m
NRG Energy $1.25m
Mirant[3] $0.5m
Dynegy $0.53m

Natural gas suppliers $6.8m
ConocoPhillips $1.5m
ExxonMobil $1.02m
Chevron $0.96m

Cement production $6.8m
Eagle Materials $1.29m
Trinity Industries $3.06m
Texas Industries $1.70m

Iron and steel production $3.7m
U.S. Steel $0.96m
Nucor $0.85m
Gerdau Ameristeel $0.37m

Pulp and paper mills $8.6m
Verso Paper $1.03m
Boise $0.86m
Glatfelter $0.77m

Petrochemical production $2.2m
ExxonMobil $1.23
Dow Chemical $0.57m
Praxair $0.18m

Suppliers of industrial gases $0.5m
Praxair $0.25m
Kinder Morgan $0.03m
Air Products and Chemicals $0.18m

Petroleum refineries $6.1m
ExxonMobil $1.83m
Chevron $1.10m
ConocoPhillips $1.53m

Lime manufacturing $5.3m
Martin Marietta Materials $2.33m
United States Lime & Minerals $1.59m
Minerals Technologies $1.38m

Aluminum production $0.2m
Alcoa $0.16m
Century Aluminum $0.02m
Kaiser Aluminum $0.01m

NOTES: 1. SOME INDUSTRIES ARE NOT EXPLICITLY REQUIRED TO REPORT. FACILITIES NEVERTHELESS MUST SUBMIT A REPORT IF EMISSIONS FROM PRODUCTION OR FUEL COMBUSTION UNITS ARE 25,000 METRIC TONS PER YEAR, CO_2 EQUIVALENT, OR MORE. 2. EPA REGULATIONS ALLOW A "HYBRID" MIX OF CONTINUOUS MONITORING AND ESTIMATES. 3. FIGURES ARE FOR MIRANT, NOW GENON ENERGY FOLLOWING A DECEMBER MERGER. 4. VOLUNTARY REPORTING PROGRAM. ESTIMATES FOR 2008, CALIFORNIA OPERATIONS ONLY.
DATA: BLOOMBERG, EPA. COMPANY FIGURES WERE ESTIMATED BY MULTIPLYING THE FIRST-YEAR COST ESTIMATE FOR EACH SECTOR, AS PROVIDED BY THE EPA, BY EACH COMPANY'S SHARE OF TOTAL SECTOR REVENUE, BASED ON DATA COMPILED BY BLOOMBERG

Measuring Harmful Gas Emissions
Carbon dioxide, methane, nitrous oxide, and three groups of fluorinated gases are the major industrial contributors to global warming. The EPA's reporting threshold for these greenhouse gases is 25,000 metric tons of CO_2 equivalents. Some gases are better than CO_2 at trapping heat in the atmosphere. For example, a given mass of methane is 21 times more effective than an equivalent measure of CO_2.

Carbon Dioxide
Carbon dioxide is the primary greenhouse gas emitted by human activities. The largest source of CO_2 is fossil fuel combustion.

Methane
The agriculture sector is responsible for 6 percent of total U.S. greenhouse gas emissions. Methane emissions from livestock digestive processes and manure represent 32 percent of all the "man-related" methane emissions.

Nitrous Oxide
While total nitrous oxide emissions are much lower than CO_2 emissions, nitrous oxide is approximately 300 times more powerful than CO_2 at trapping heat in the atmosphere. Emission sources include soil management and fuel combustion.

Fluorinated Gases
The global warming potential of sulfur hexafluoride is 23,900 times greater than CO_2, making it the most potent fluorinated gas.

Annual Reports
Facilities that emit 25,000 metric tons or more per year of carbon dioxide or equivalent must submit annual reports to the EPA under the new rules. 25,000 metric tons is equivalent to the emissions of:

100 railcars of burnt coal
4,600 passenger vehicles (per year)
6,250 individuals' household emissions (per year)

For Comparison[4]
Annual emission levels of CO_2 equivalents (in metric tons), reported by entities operating in California:

5m ConocoPhillips Energy company
8,972 Sierra Nevada Brewing Beverage manufacturer
1,853 The Nature Conservancy Environmental nonprofit

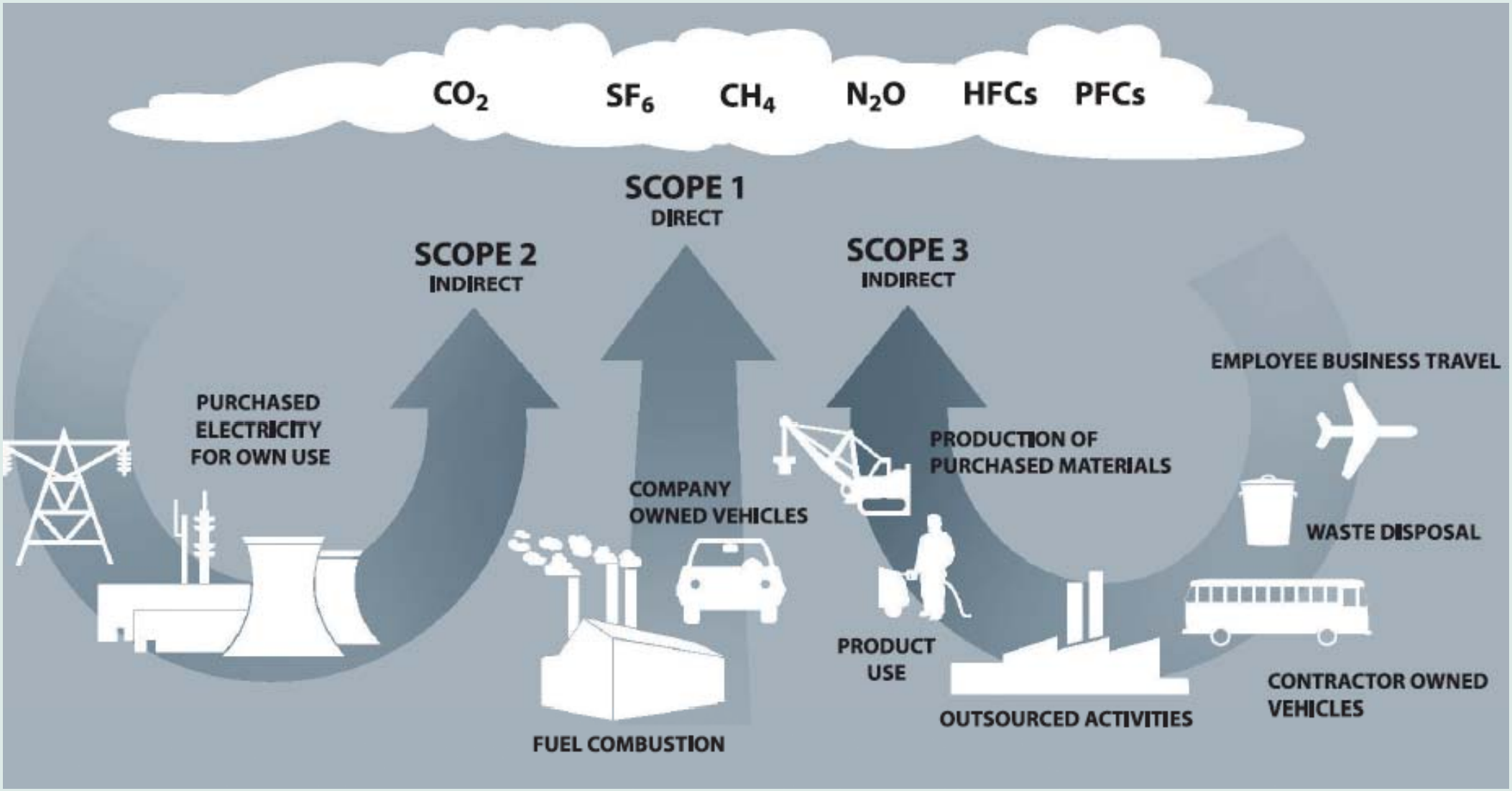
64

Source:
Bloomberg Government Insider, Winter 2011

carbon footprints: setting boundaries

- What *must* the boundaries of your inventory be?
  - regulatory requirements
  - internal and external expectations
- What *should* your boundaries be?
  - responsibility and/or liability: mission-critical or mission-related activities
  - control vs. influence
- What *can* your boundaries be?
  - data availability (proprietary data / trade secrets, state of scientific/academic knowledge)
  - trade-offs in the inventory process itself

GHG accounting 101

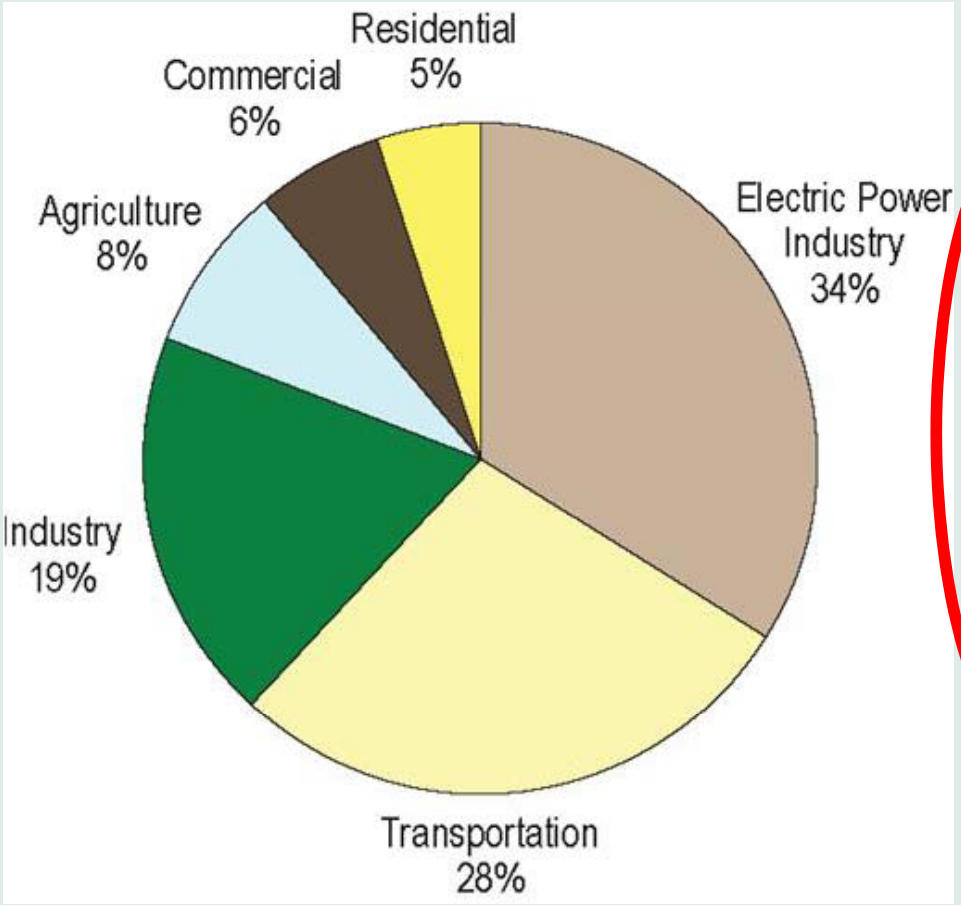


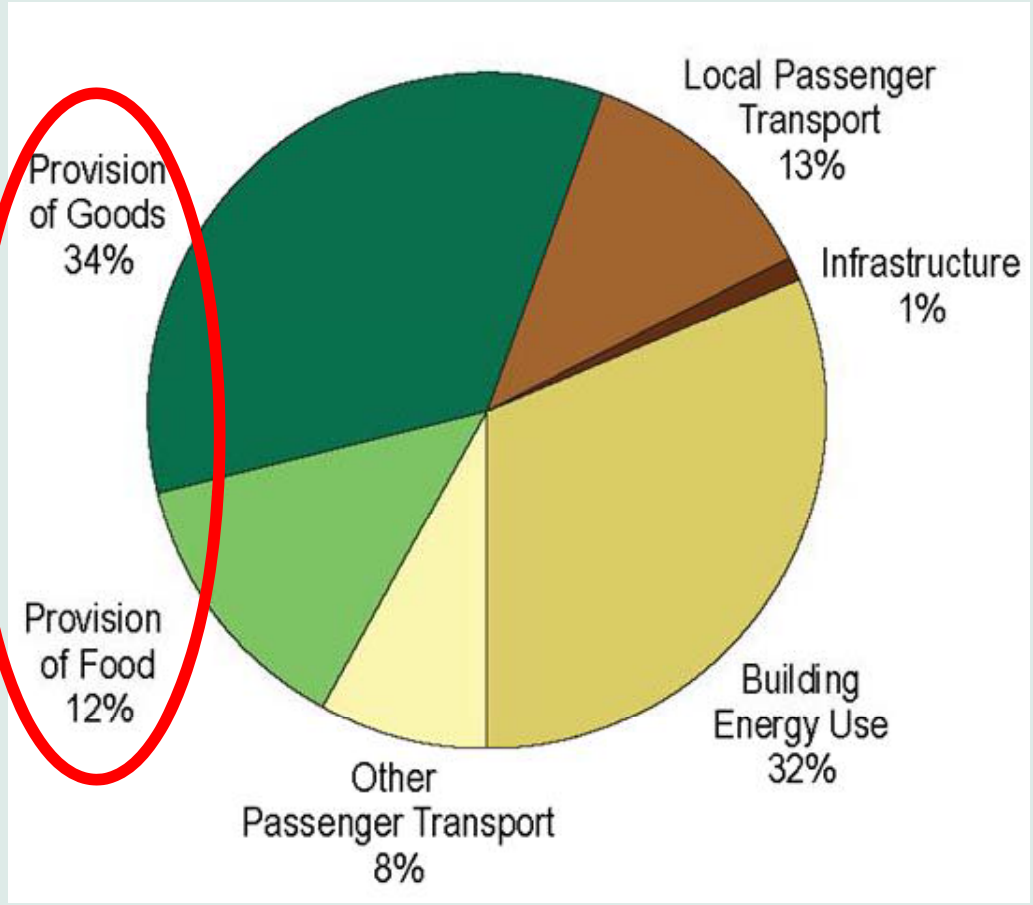
Source: World Resources Institute

insights from inventory results

- the whole country
- a metropolitan area
- a municipal government
- a company

two views of US emissions





Source: EPA's *Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices*

Metro Area Greenhouse Gas Emissions

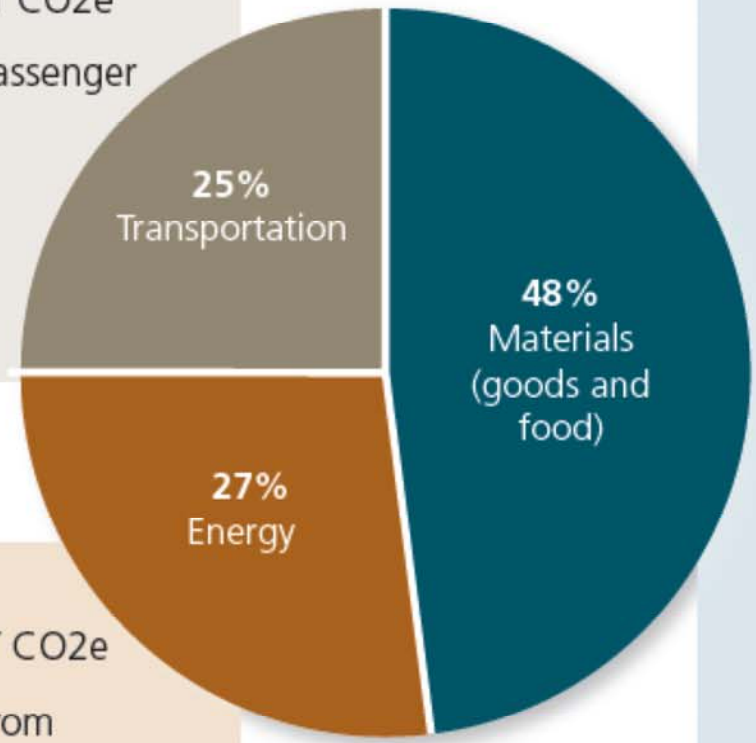
31 Million Metric Tons Carbon Dioxide Equivalent (MMT CO2e)

Metro | People places. Open spaces.

Transportation

Estimated emissions: 7.8 MMT CO2e

- Vehicle miles traveled by passenger vehicles and light trucks
- Operation of public transportation system (TriMet)



Materials (goods and food)

Emissions related to the production, manufacture and disposal of materials, goods and food

Estimated emissions 14.9 MMT CO2e

- Manufacture of products and food (from inside and outside the region) consumed by metro residents and businesses
- Freight movement of materials, goods and food (heavy truck, rail, air)
- Waste management and recycling system (collection, landfills)

Energy

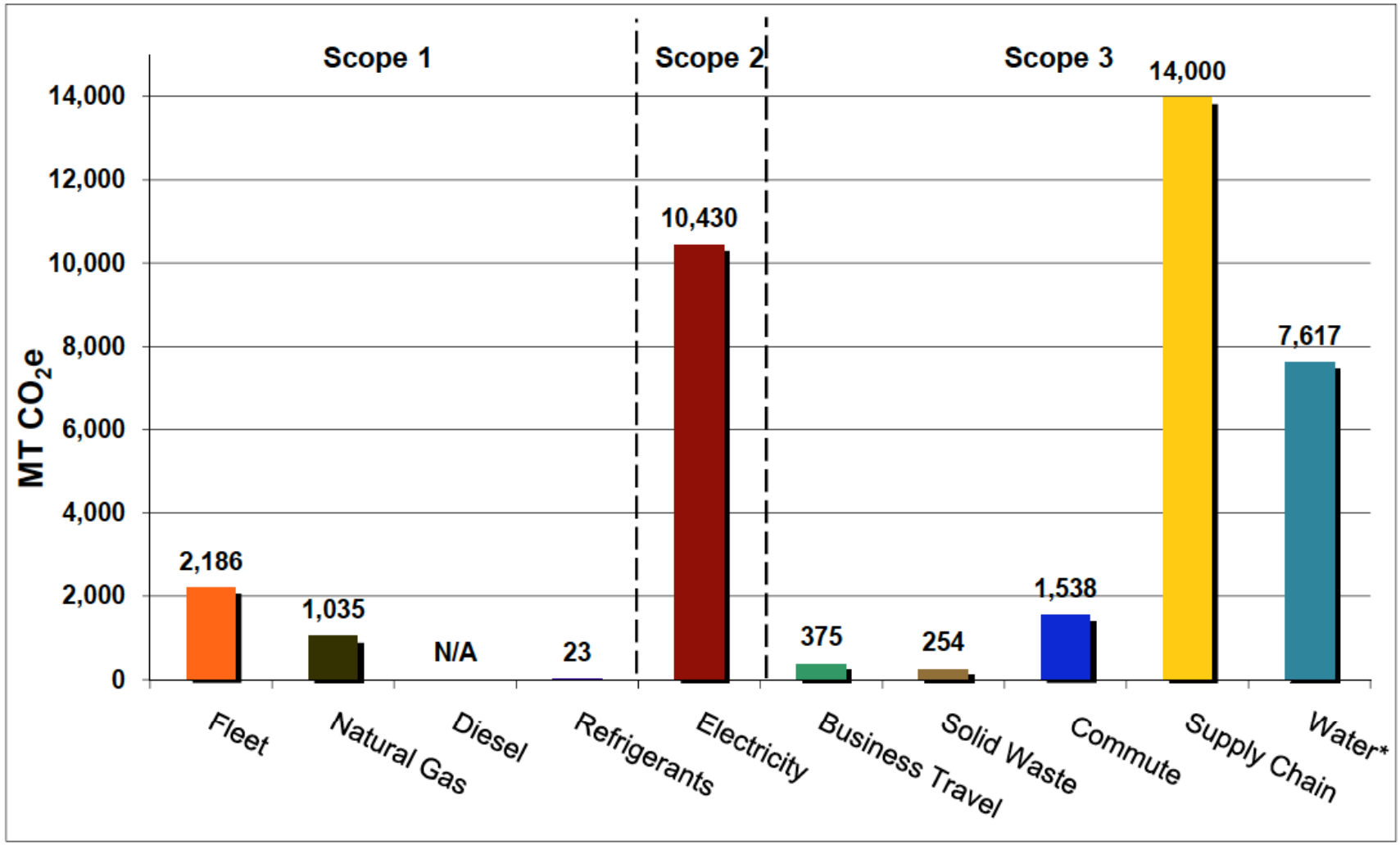
Estimated emissions: 8.2 MMT CO2e

- Natural gas consumption from residents and businesses
- Fossil fuel consumption from utilities' imported electricity

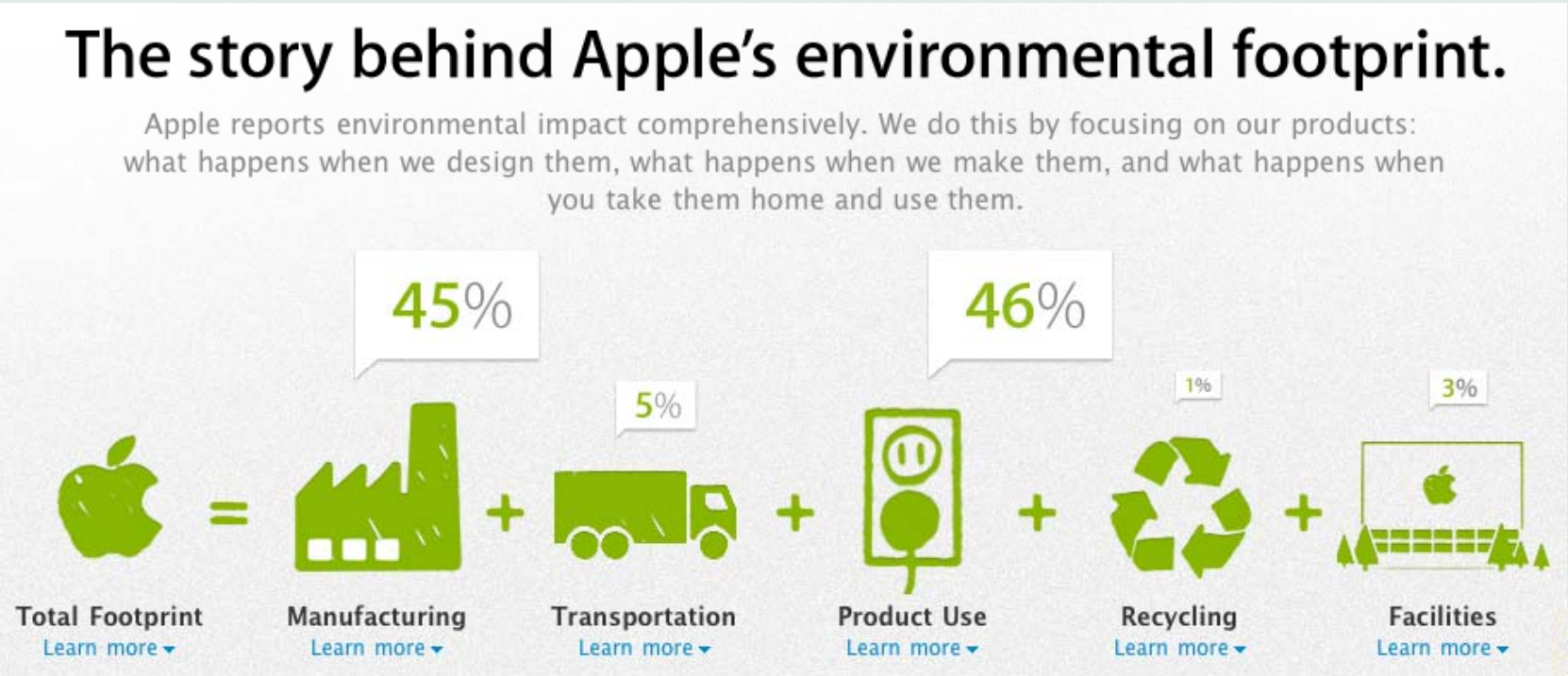
http://library.oregonmetro.gov/files//regional_greenhouse_gas_inventory.pdf

LGO inventory example: City of Hillsboro

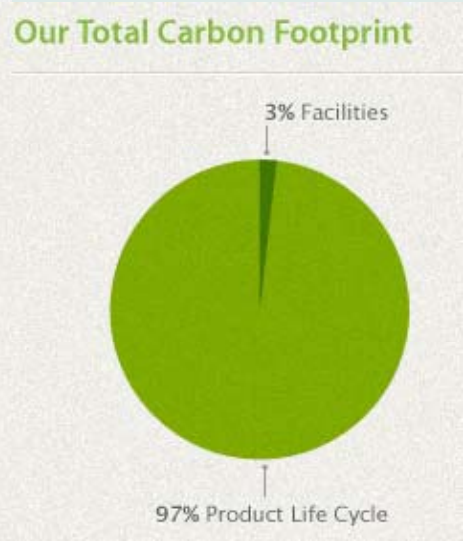
Figure 2: City of Hillsboro's Greenhouse Gas Emissions from Local Government Operations (2007)



carbon footprint: Apple

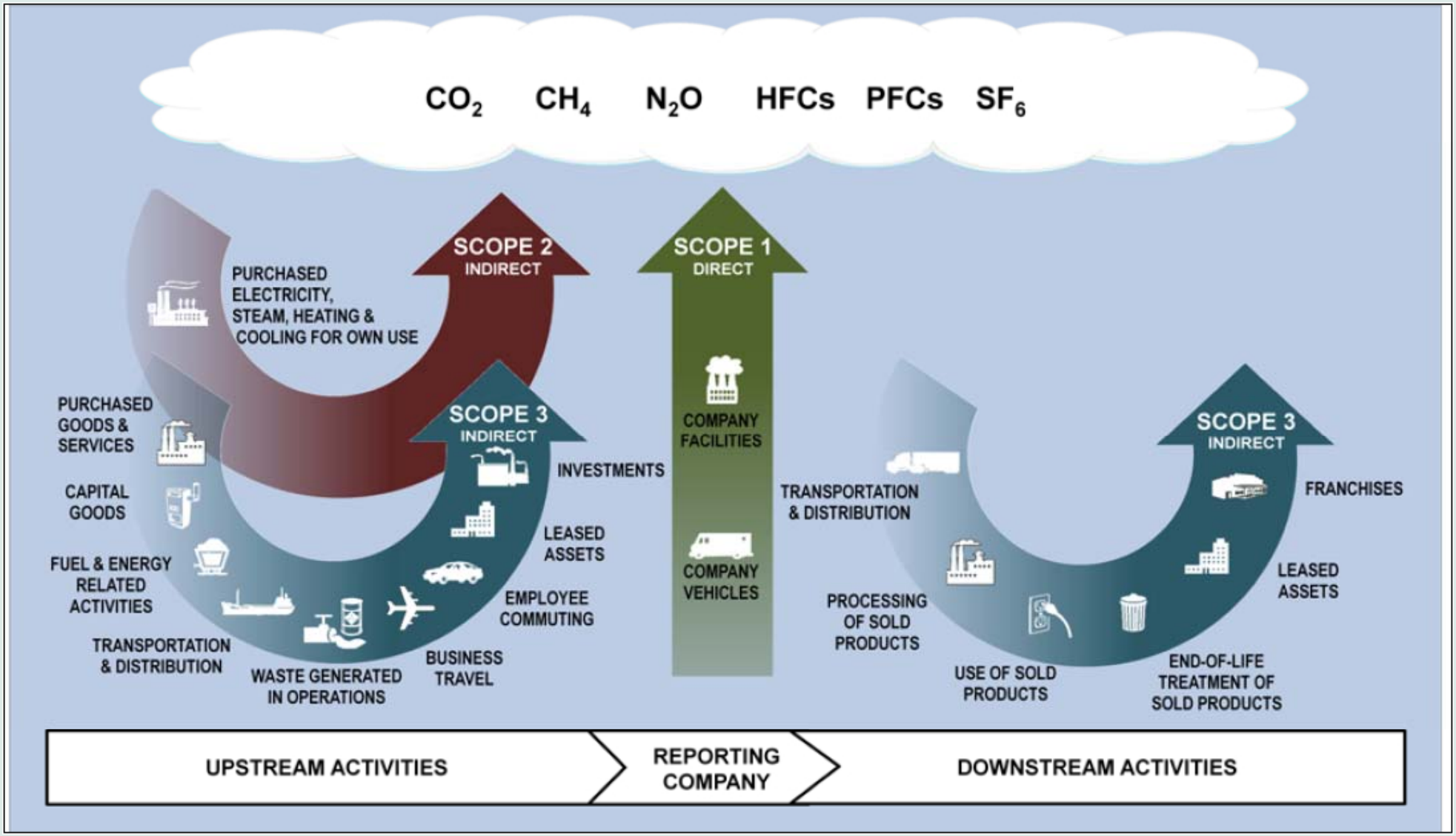


Look – the whole life cycle!
Owned emissions, shared emissions.



Source: www.apple.com/environment

GHG accounting 101



Source: World Resources Institute

inventory protocols and calculation tools

- protocols (general application)
  - World Resources Institute (WRI) / World Business Council for Sustainable Development (WBCSD), www.ghgprotocol.org
  - **The Climate Registry, *General Reporting Protocol***
  - California Climate Action Registry (now Climate Action Reserve)
- tools (specific contexts or narrow applications)
  - individual WRI protocols
  - EPA Climate Leaders (various tools)
  - Clean Air-Cool Planet *Campus Carbon Calculator*™
  - Good Company's Carbon Calculator (**G3C**)
  - Seattle Climate Partnership Carbon Calculator
  - Economic Input-Output Life-Cycle Analysis – www.eiolca.net
  - Building for Environmental & Economic Sustainability (BEES)
  - EPA GHG Equivalency calculator and other tools (www.epa.gov/cleanenergy/energy-resources/)

what's happening right now

- Washington (starting in 2010 for 2009)
  - threshold: 10,000 MT CO_2e total Scope I *or* 2,500 MT CO_2e for a fleet
  - Scope I trips reporting thresholds, but must then also report Scope II
- Oregon (starting in 2010 for 2009)
  - threshold: 2,500 MT CO_2e; permit-level reporting (not entity-level), only certain types of entities)
  - Scope I only (thresholds *and* reporting)
- California (starting in 2009 for 2008)
  - threshold: 2,500 MT CO_2e for electricity generation and 25,000 MT CO_2e for certain industries
- Other states with mandatory reporting:
  - NM, IA, WI, FL, NC, MD, DE, NJ, NY, VT, CT, RI, MA, NH, ME
- US EPA
  - threshold: 25,000 MT CO_2e (not entity-level)
  - Scope I only (for certain industries or permit holders)
- generally: regulatory process, not strategy

carbon footprints–from mandatory to useful?

Comprehensive reporting for informed climate strategy:
- all of Scopes I and II
- risk assessment of and scenarios for Scope II
- quantify and/or estimate all Scope III sources

Current proactive voluntary reporting beyond Scopes I and II:
- dabbling in Scope III

The Climate Registry's (TCR) *General Reporting Protocol (GRP)*
- Scopes I and II, except for *de minimis* emissions

Mandatory reporting (e.g. WA, OR, CA):
- Scope I, maybe Scope II
- or worse, permit-based

inevitable / likely directions

- where we will inevitably go
  - mandatory reporting of Scopes I and II, with thresholds tripped by the sum of I and II
  - pervasive strategic understanding of cost-of-carbon risk via both Scopes I and II
- reasons for this perspective
  - regulatory capacity / knowledge will grow quickly
  - broader geographic and source coverage likely
  - reality of life-cycle emissions profiles of many business models and entire sectors
  - ease of meeting all reporting obligations with *highest* common denominator

Look forward to sessions 2 and 3

Session 2: Carbon Footprints: Step by Step – May 12, 2011

Session 3: Case Studies of Activities in Scope 1, 2, and 3 – June 2, 2011

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Thank you!

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