



Carbon Footprints: Step by Step

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Sponsored by:

Northeast Waste Management Officials' Association
Pacific Northwest Pollution Prevention Resource Center

Joshua Skov

Good Company

Eugene, OR



extent of guidance for the next hour





overview

- introduction
- brief background
- greenhouse gas emissions inventories
 - *why bother?*
 - protocols, tools and scope categories
 - what you measure: gases, activities and emissions
 - *setting inventory boundaries*
 - data collection and calculations
 - farm it out, do it yourself, or a combination?
 - examples
- next steps / first steps



topics not covered in depth or at all

- how to estimate or calculate supply chain emissions
- how to select carbon offsets, RECs
- climate risk and a cost of carbon
- mandatory reporting (state or federal)
- “biological” vs. “anthropogenic” GHG emissions, related issues of biofuels and biomass energy
- absence of a *community* inventory protocol
- electricity: trickier than you think
- an idea: “audit trail”



Good Company

- sustainability research and consulting firm
- mission-driven, for-profit
- clients: government, higher ed, private sector
- *over 75 GHG inventories and analyses in wide range of contexts*

Josh: economist, consultant, LEED™ AP, adjunct instructor in MBA programs



background on climate issues

- terms
- GWP vs. CO₂e
- reminder of context: US emissions
- *a warning: Don't get carbon goggles!*

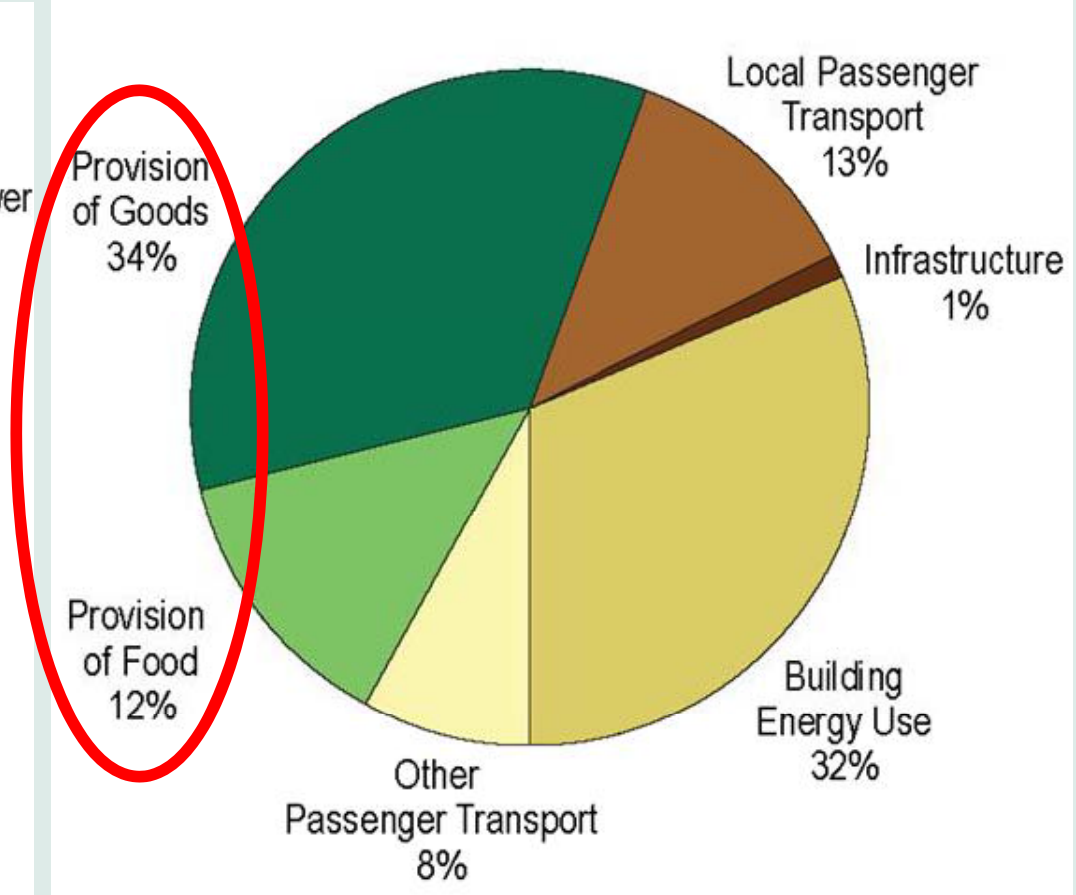
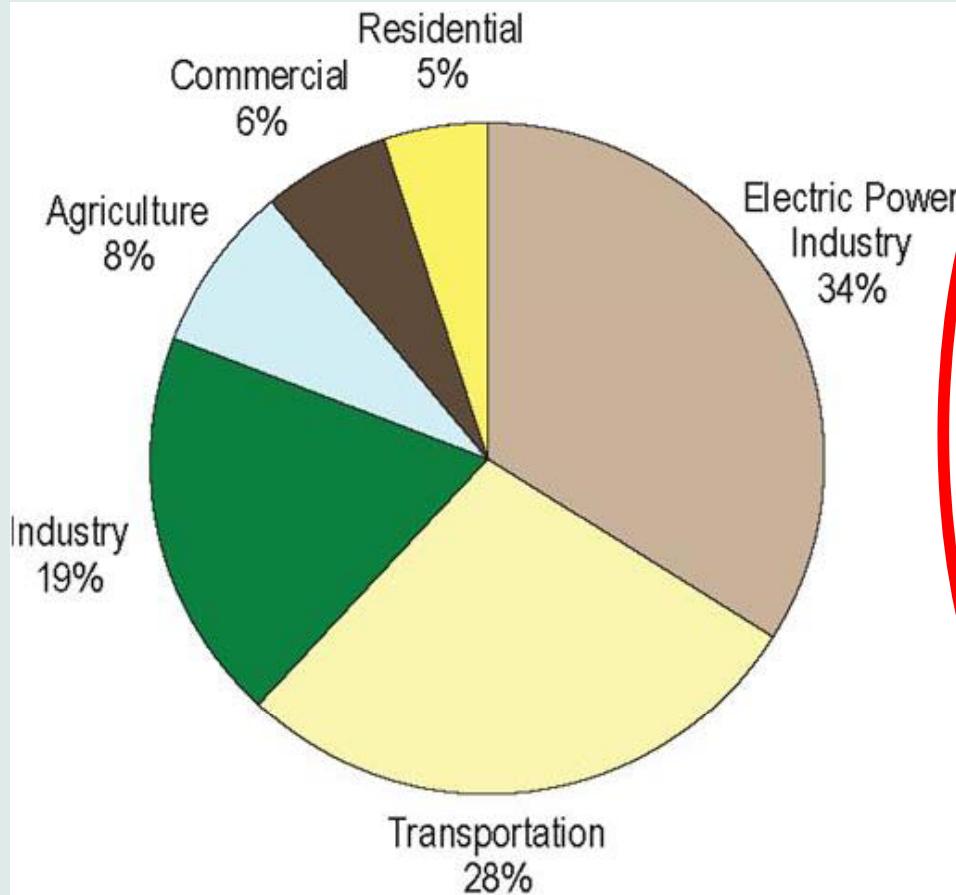


terminology

- GHG inventory, carbon (or climate) footprint
- life-cycle GHG emissions, life-cycle carbon
- 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, CO₂e
 - “carbon” is inaccurate
 - really, all carbon dioxide equivalent (CO₂e) emissions



two views of US emissions

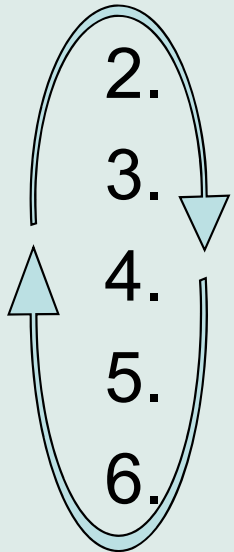


Source: EPA's *Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices*



conducting a GHG inventory – an overview

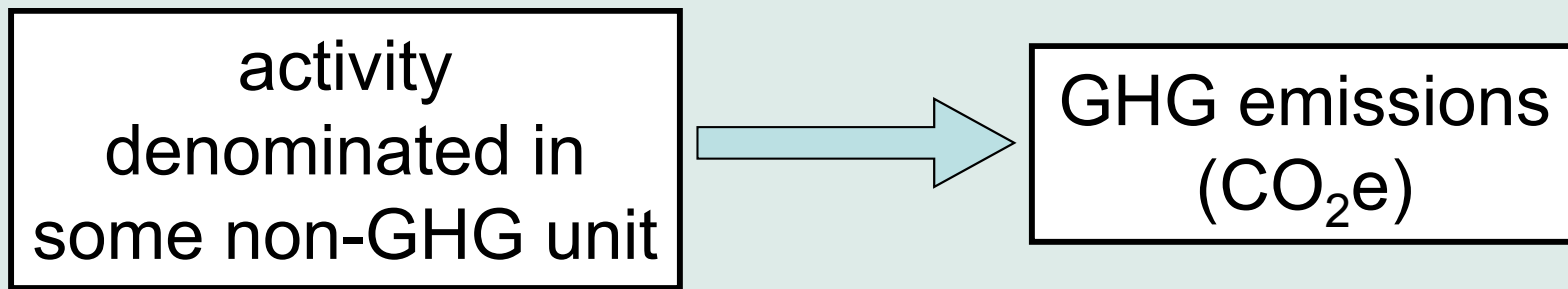
1. identify relevant protocols and tools
2. set inventory boundaries
3. collect data
4. revisit inventory boundaries
5. finish data collection
6. calculate emissions
7. write report
8. share results with stakeholders
9. develop climate action plan



(Plan as much as reasonable. Be ready for loops.)



understanding calculations

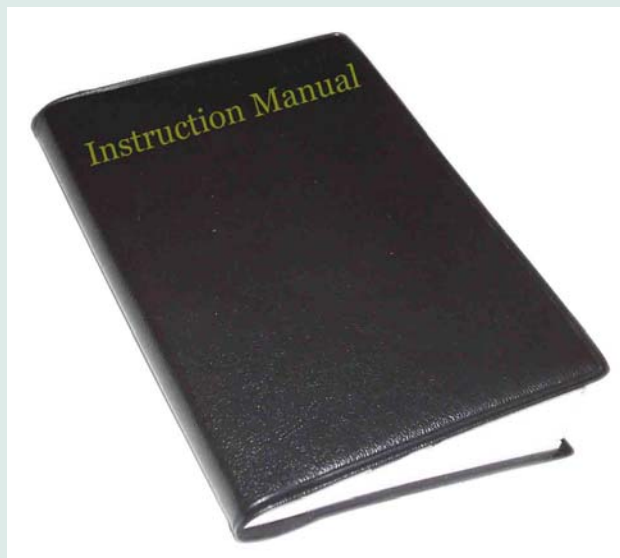


$$X \cdot \frac{CO_2e}{X} = CO_2e$$



to clarify: protocol \neq tool

- protocol
 - “code of correct conduct”
 - “rules for determining data format and transmission”
- tool
 - “an implement used in the practice of a vocation”
 - “the means whereby some act is accomplished”



\neq



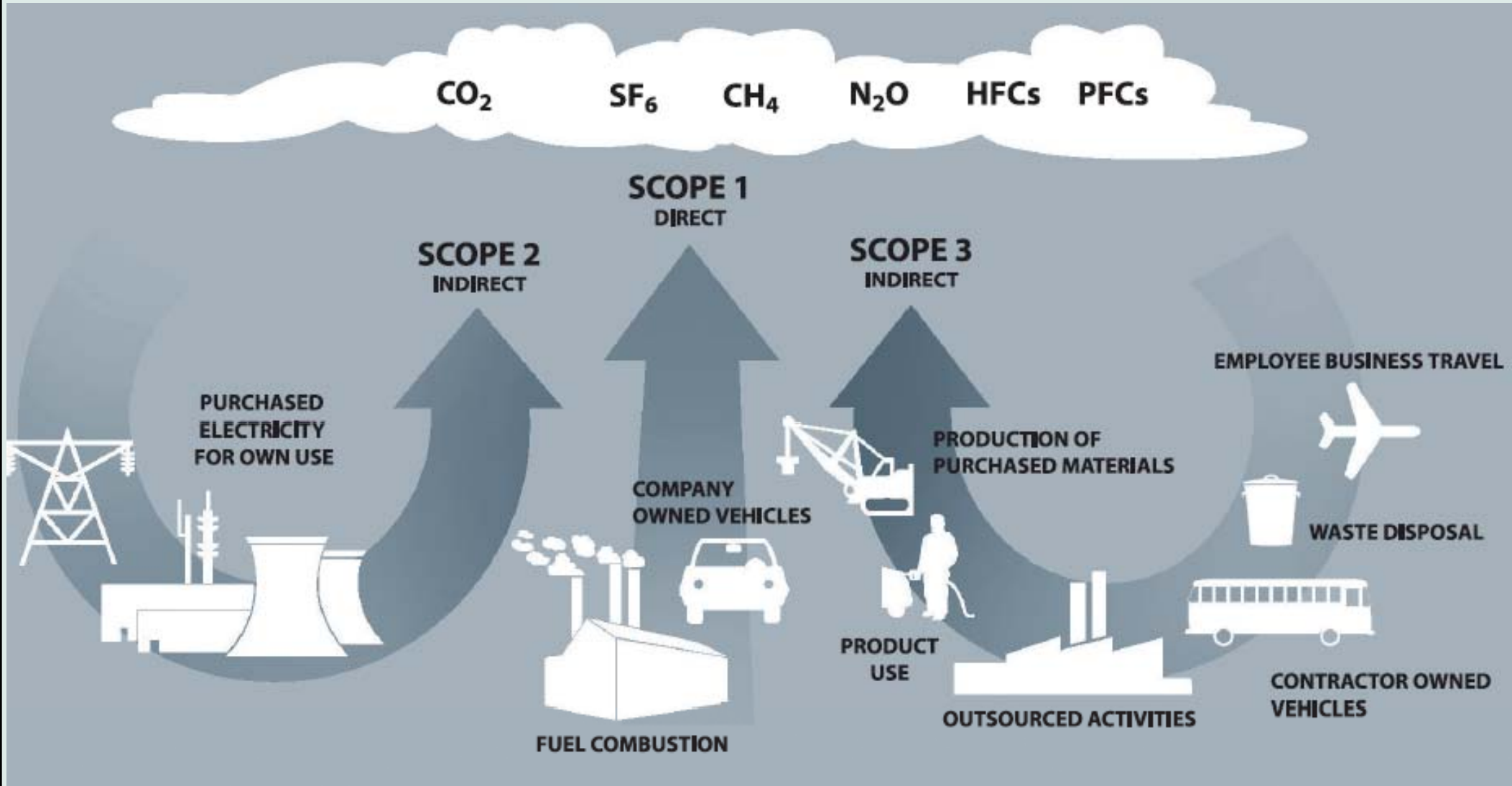


inventory protocols

- general application
 - **The Climate Registry (TCR), *General Reporting Protocol***
 - World Resources Institute (WRI) / World Business Council on Sustainable Development (WBCSD), *Greenhouse Gas Protocol* (www.ghgprotocol.org)
 - Council on Environmental Quality: *Guidance on Federal GHG Reporting and Accounting (expanded boundaries)*
- specific application
 - WRI protocols for Scope 3 (products, supply chains)
 - TCR / CCAR / CARB / ICLEI: *Local Government Operations*
 - The Climate Registry (TCR): *Electric Power Sector*
 - Climate Action Registry (CAR): GHG offset protocols for livestock, landfill, forest and urban forest emissions reduction projects



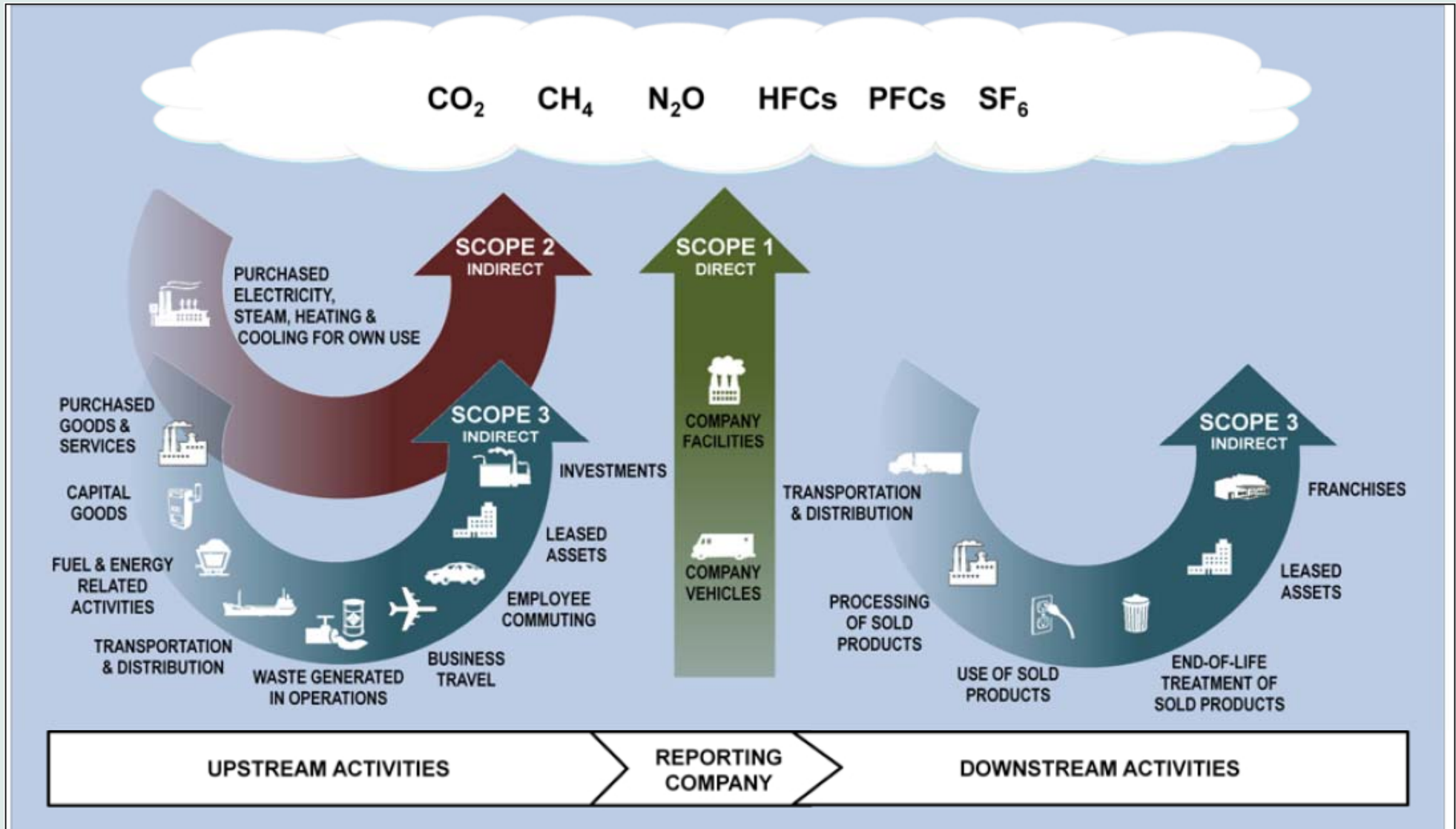
GHG accounting 101



Source: World Resources Institute



GHG accounting 201





tools, examples

- protocol that act like tools (general application)
 - **The Climate Registry, *General Reporting Protocol***
 - TCR et al LGO protocol
- on-line calculation tools from registries
 - The Climate Registry Information System (CRIS)
- tools (specific or narrow applications)
 - Clean Air-Cool Planet *Campus Carbon Calculator™*
 - Seattle Climate Partnership Carbon Calculator
 - Economic Input-Output Life-Cycle Analysis – EIO-LCA.net
 - Building for Environmental & Economic Sustainability (BEES)
 - federal tools: CEQ guidance, 1605(b), WARM, Climate Leaders, EPA e-GGRT, EPA GHG Equivalency calculator and other tools (www.epa.gov/cleanenergy/energy-resources/)
 - WRI: many sector-specific tools
 - Good Company's Carbon Calculator (G3C)
 - ICLEI Clean Air and Climate Protection Software
 - *proprietary enterprise carbon accounting software (still emerging, still being refined, often expensive, usually overkill)*



tools, how to choose

- start from the boundary you want to set
- look for sector- and context-specific tools
- check with your network and peers, but don't follow the pack blindly
- prize simplicity, flexibility, transparency



typical emission sources

- building-based energy use (utilities)
 - electricity
 - natural gas
 - other fuels (propane, fuel oil, coal, etc.)
- refrigerants (“fugitive emissions”)
- transportation
 - fuel use for business travel (air, car, bus, train)
 - fuel use for employee commute (single occupancy vehicle, carpool, mass transport)
 - distribution
- embodied GHGs in supply chain
- waste stream
- land use (on a large scale)



data collection process

1. establish inventory year
2. identify relevant emissions sources and locations
3. identify desired units of measure
4. identify internal / external data sources/contacts
5. collect and organize data records
6. review data and identify holes
7. collect more data to fill data gaps



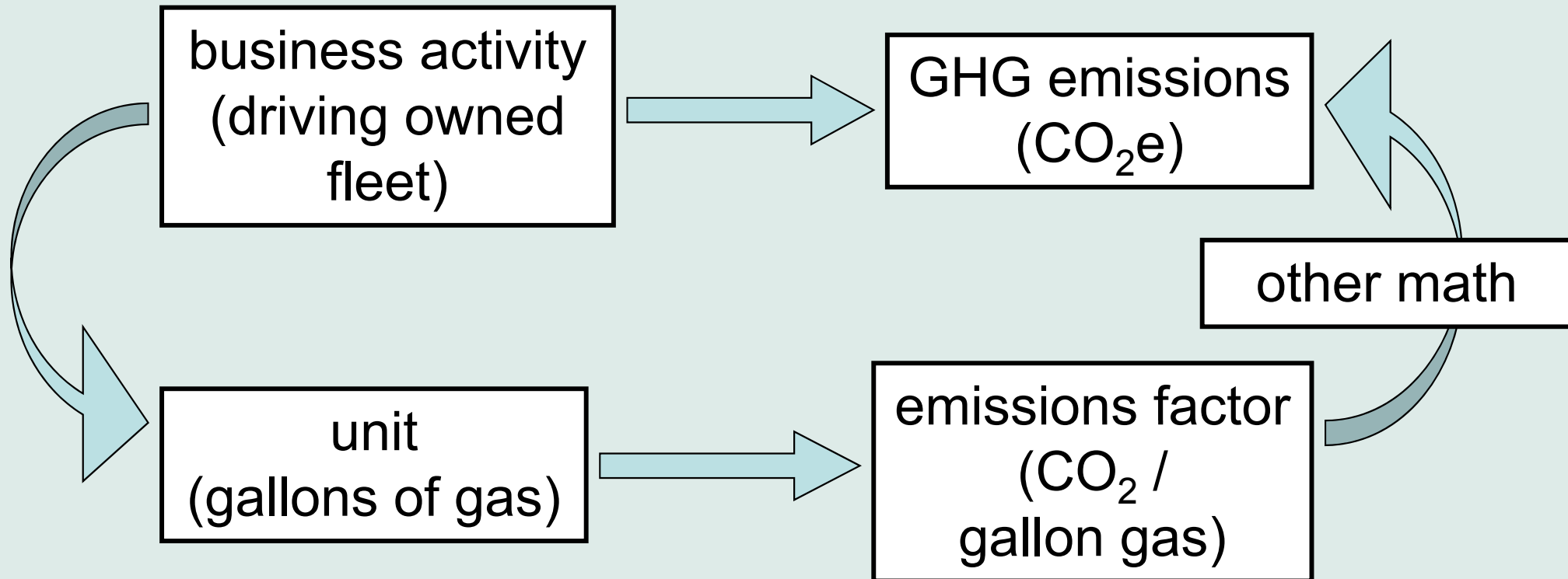
identify units of measure

- building energy
 - therms / cubic feet, kWh / MWh, gallons
- fleet / business travel information
 - gallons, miles, dollars spent
- refrigerants
 - pounds
- solid waste
 - cubic yards, pounds / tons
- embodied emissions in purchases
 - dollars spent
- employee commute
 - miles traveled by mode

**Note: Use
your carbon
calculator or
available
emissions factors
as a guide!**



understanding calculations: math is fun!



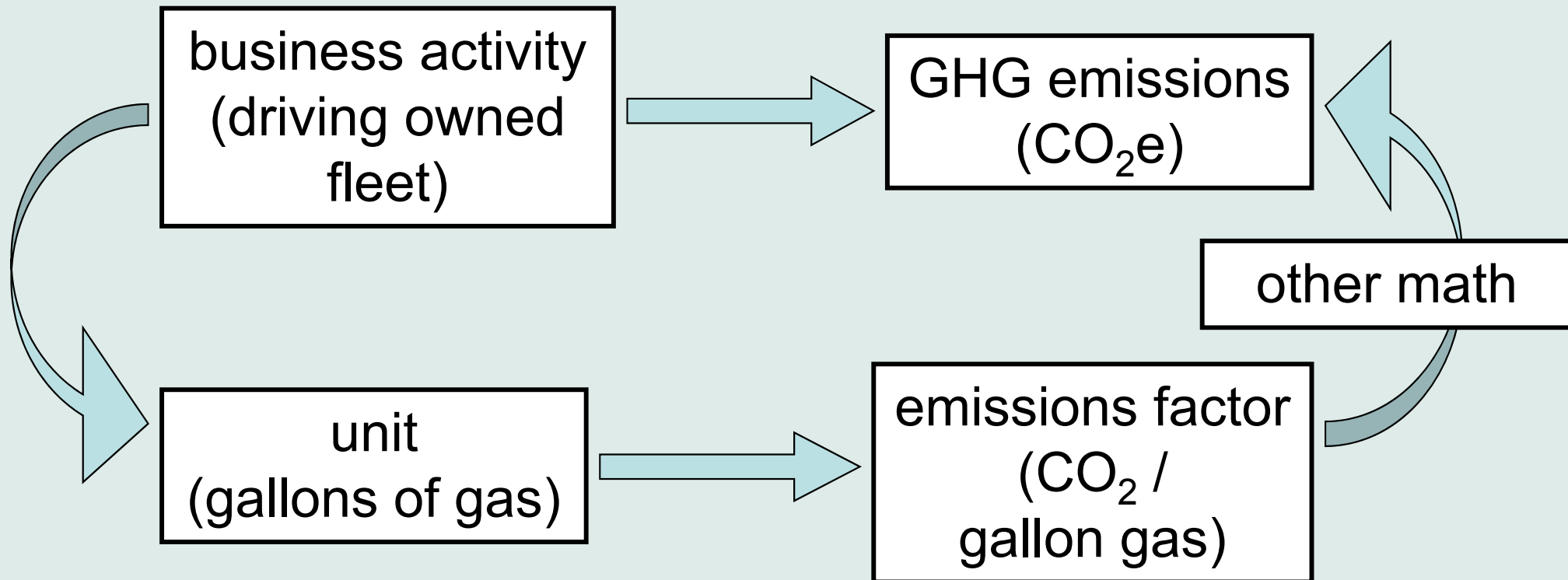


calculate emissions - it's as easy as 1,2,3!

1. activity data (kWh, therms, gallons, etc.)
2. emissions factors for each activity
3. unit conversion factors



understanding calculations



$$5000 \text{ gal.} \times \frac{8.81 \text{ kg CO}_2}{\text{gallon}} \times \frac{1 \text{ metric ton}}{1000 \text{ kg}} \times 1 \text{ (GWP)} = 44.05 \text{ MT CO}_2\text{e}$$



use a calculator

- know your calculator, let it lead you
- know its shortcomings, make changes as needed
- beware of black boxes

[G3C Map \(click here\)](#)



Building Energy Emissions

Worksheet

Inventory Year / Facilities Description	Electricity		Natural Gas			Diesel (Non-mobile sources)	
	kWh	MT CO ₂ e	quantity	unit	MT CO ₂ e	gallons	MT CO ₂ e
Resource Center	24,377	18.0	682	therms	3.6		0.0
Police Training Center	15,479	11.4	690	therms	3.7		0.0
Operations Center	314,600	231.9	15,475	therms	82.1	306	3.1
Main Library	1,151,600	849.0	10,771	therms	57.1	641	6.6
Community Center	40,608	29.9	1,840	therms	9.8	189	1.9
City Park	75,017	55.3	0		0.0		0.0
City Hall	1,631,200	1,202.5	15,287	therms	81.1	561	5.8
TOTAL FACILITIES	0	0.0	0		0.0		0.0
2008	11,512,805	8,487			789	2,252	23



scope 1: stationary combustion

1. data: annual consumption by fuel type
 - source: bills, operations records, etc.
2. emissions factors: CO_2 , CH_4 , N_2O / unit
 - source: TCR GRP page 75
3. unit conversions: therms to cubic feet; kg to MT
 - source: <http://www.onlineconversion.com/>



scope 2: electricity

1. data: kilowatt-hours (kWh)
 - source: bills, spreadsheet, etc.
2. emissions factors: lbs CO₂, CH₄, N₂O / MWh
 - source: utility specific and regional emissions factors from EPA eGRID <http://cfpub.epa.gov/egridweb/>
 - source: TCR GRP page 104
3. unit conversions: lbs per MT
 - source: <http://www.onlineconversion.com/>

Warning: Electricity is not what it seems. (1) Your kWh do not necessarily come mainly from your utility's portfolio, especially if your utility is small. (2) Average and marginal impacts can be quite different.



examples of inventory results

- a municipal government
- a medical complex



LGO inventory example: City of Hillsboro

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

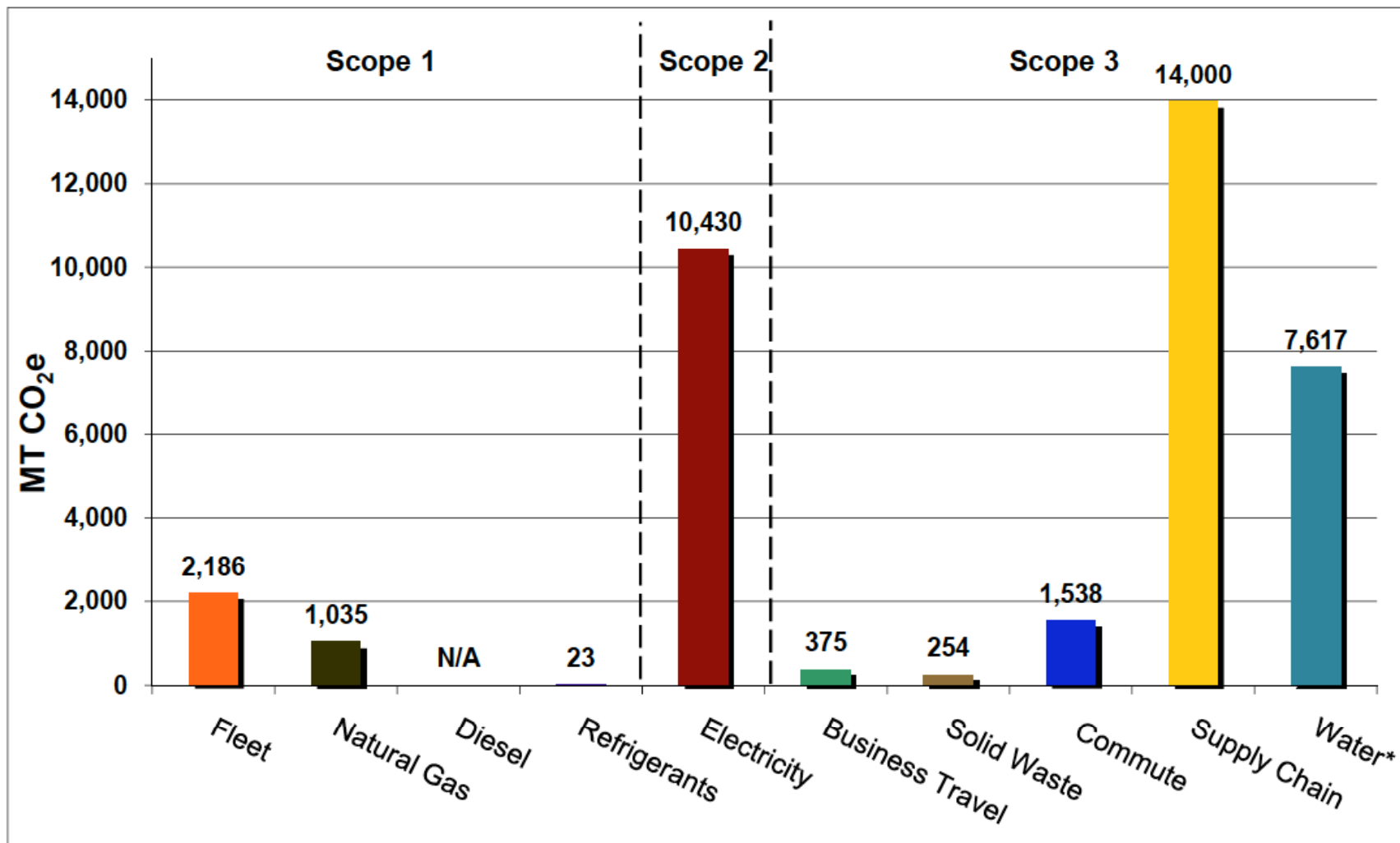
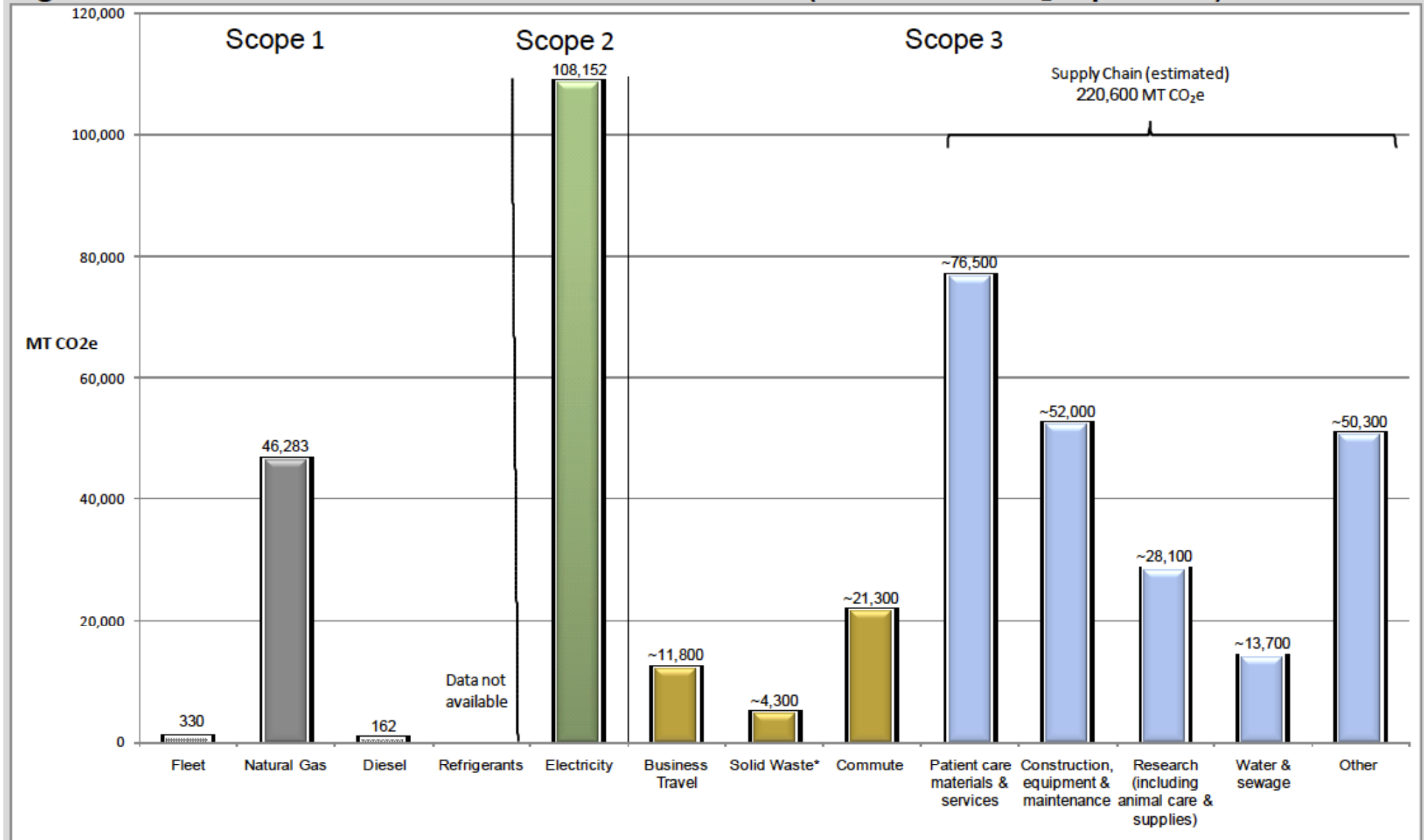




Figure 3: OHSU Greenhouse Gas Emissions – CY 2008 (Metric Tons CO₂ Equivalent)



*Includes disposal of generic solid waste, hazardous waste, and radioactive waste.



next steps / first steps

- *not mysterious*
- climate action planning, in brief
- priority: identify capacity needs, build capacity
- purchasing offsets and/or RECs (briefly)
- discussion?



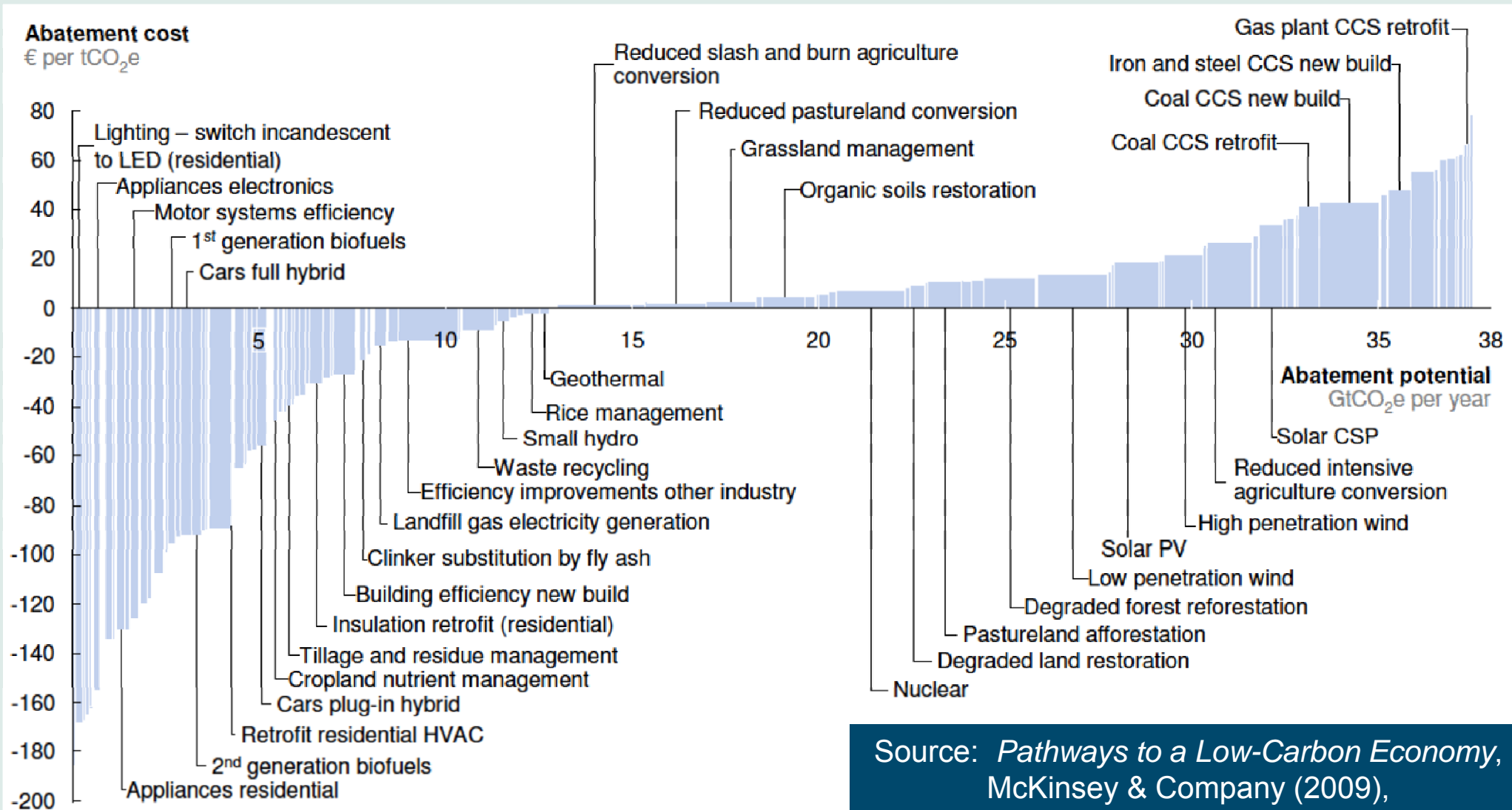
climate action planning

- having a good inventory as a starting point
- setting reduction targets and timetables
 - absolute targets: reduce absolute emissions over time
example: reduce total CO₂e by 25% by 2015
 - intensity targets: reduce ratio of emissions relative to a business metric over time
example: reduce CO₂e by 15% per \$1 million of sales between 2005 and 2015
- aligning with organizational priorities
- finding the win-win opportunities (e.g., \$)

Source: WRI and World Business Council for Sustainable Development GHG Protocol



carbon = energy = opportunity



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



community climate action planning - ICLEI

- I. Introduction/Local Affects & Current Actions
- II. Emissions Inventory
 - Reasoning, Methodology & Model
 - Inventory Results
- III. Forecast for Greenhouse Gas Emissions
- IV. Greenhouse Gas Emissions Reduction Target
- V. Existing Measures & Policies
- VI. Proposed New Measures & Policies (Include New Target Reduction Goals)
 - List Focus Areas (e.g., transport, land Use, building, energy, solid waste,)
- VII. Measures Implemented External to Jurisdiction
- VIII. Conclusion
 - Appendix



Cambridge Climate Protection Plan

In 2002, the City Council adopted the Climate Protection Plan.
Goal: Reduce GHG by 20 % below 1990 levels - by 2010.
Over 100 actions are proposed to achieve the goal.

Table of Content:

[Section 1](#) - Introduction (311 KB)

[Section 2](#) - Greenhouse Gas Emissions

[Section 3](#) - Vision and Strategy

[Section 4](#) - Energy (1.2 MB)

[Section 5](#) - Transportation (277 KB)

[Section 6](#) - Land Use (221 KB)

[Section 7](#) - Waste

[Section 8](#) - Implementation

[Appendix I](#) - City Council Resolution (1.3 MB)

[Appendix II](#) - Task Force Principles

[Appendix III](#) - Proposed Actions by Sector



sidebar topic: low-carbon purchasing

- context
 - dramatic increase in awareness/evidence regarding carbon footprints, especially in consumption
 - still at an early stage (or no stage for most things)
- observations
 - “low-carbon purchasing” possible only in a few areas
 - tools will undoubtedly emerge over time
 - probably worthwhile only for major purchases
 - challenge: integrate with other sustainability criteria
- suggested focuses
 - buildings, materials, infrastructure
 - information requests from vendors (even informal)



sidebar topic: low-carbon purchasing





Look forward to session 3!

Session 1: Carbon Footprints: What and Why –
April 28, 2011 (previous session)

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

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Thank you!

Joshua Skov

joshua.skov@goodcompany.com

(541) 341-GOOD (4663), ext. 211



carbon footprints: three options

1. DIY
2. outsource
3. pay for capacity building, not spoon-feeding

Things to think about to help you choose:

- What are your desired outcomes?
 - capacity building, glossy report, knowledge for emissions reductions, data for authentic claims, etc.
- What internal resources are available?
 - staff time, budget
- Are the right people available to help?
- Is the boss on board?



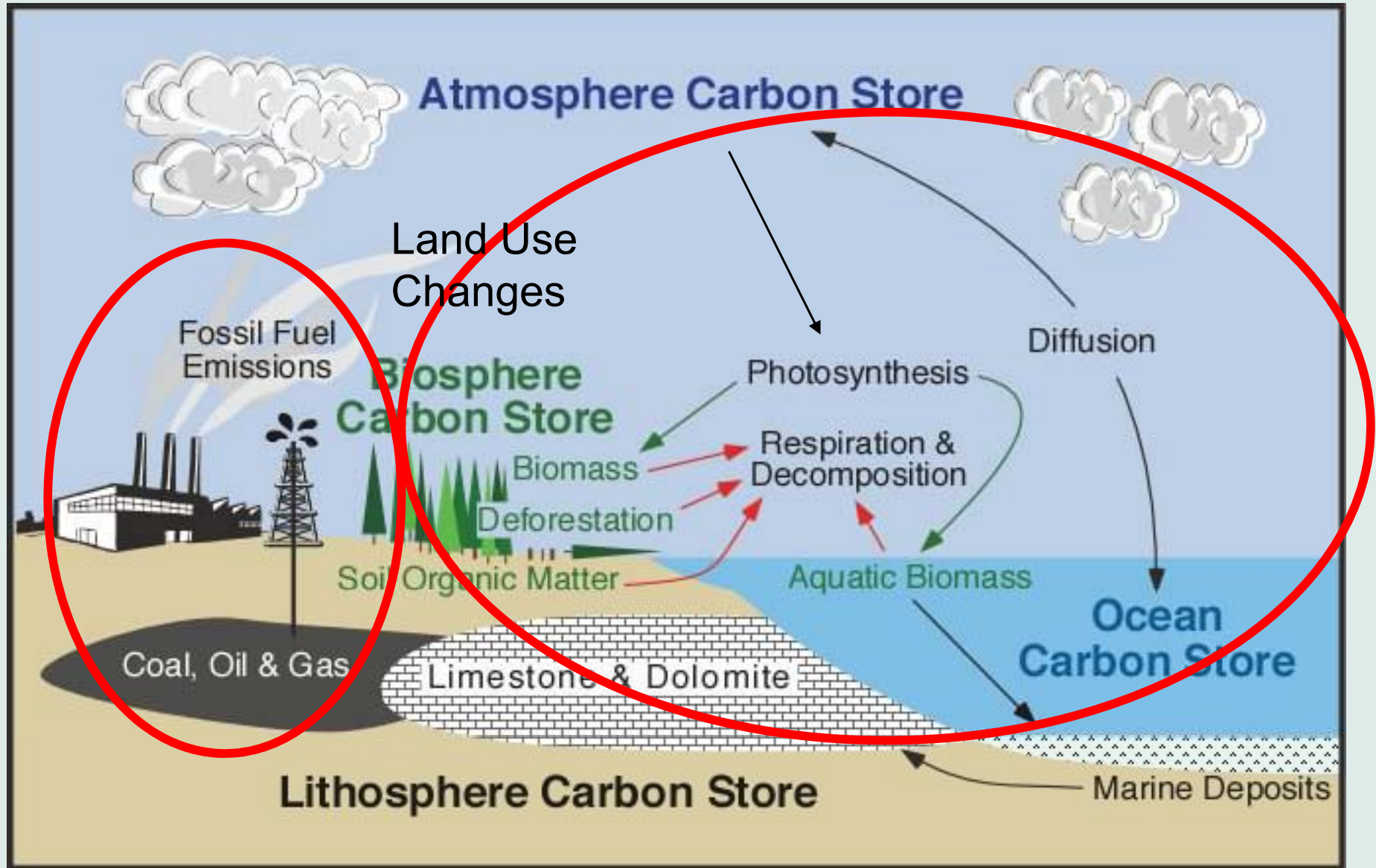
offline activity: boundaries and data

Availability- Control Matrix	strong control	some control, maybe strong influence	little or no control, maybe some influence
complete and comprehensive data available			
data available with some effort, or incompletely			
not much data available, or only at great cost/effort			

- place your emissions categories in the matrix
- goals: acknowledge trade-offs in the inventory process; communicate these realities to other stakeholders



biofuels: biological vs. fossil carbon cycle





EPA mandatory reporting

- EPA rule for mandatory reporting of GHGs – 40 CFR part 98
 - Also known as GHGRP (Greenhouse Gas Reporting Program)
 - will provide better understanding of where GHGs are coming from and help inform policies and programs to reduce GHGs
- who reports?
 - direct GHG emitters, fossil fuel suppliers, industrial gas suppliers
 - threshold for reporting at 25,000 MTCO₂e
 - covers an estimated 85-90% of total U.S. emissions
 - includes an estimated 10,000 facilities



source specific EPA reporting guidance

- | | |
|--|--|
| 98.30 Subpart C-General Stationary Fuel Combustion Sources | 98.320 Subpart FF-Underground Coal Mines |
| 98.40 Subpart D-Electricity Generation | 98.330 Subpart GG-Zinc Production |
| 98.50 Subpart E-Adipic Acid Production | 98.340 Subpart HH-Landfills |
| 98.60 Subpart F-Aluminum Production | 98.350 Subpart II-Industrial Wastewater Treatment |
| 98.70 Subpart G-Ammonia Manufacturing | 98.360 Subpart JJ—Manure Management |
| 98.80 Subpart H-Cement Production | 98.380 Subpart LL-Suppliers of Coal-based Liquids |
| 98.110 Subpart K-Ferroalloy Production | 98.390 Subpart MM-Suppliers of Petroleum Products |
| 98.140 Subpart N-Glass Production | 98.400 Subpart NN- Natural Gas and Natural Gas Liquids |
| 98.150 Subpart O-HCFC-22 Production and HFC-23 Destruction | 98.410 Subpart OO-Suppliers of Industrial GHG |
| 98.160 Subpart P-Hydrogen Production | 98.420 Subpart PP-Suppliers of Carbon Dioxide |
| 98.170 Subpart Q-Iron and Steel Production | 98.340 Subpart TT-Industrial Waste Landfills |
| 98.180 Subpart R-Lead Production | |
| 98.190 Subpart S-Lime Manufacturing | Yet to be finalized |
| 98.200 Subpart T-Magnesium Production | 98.90 Subpart I—Electronics Manufacturing |
| 98.210 Subpart U-Miscellaneous Uses of Carbonate | 98.100 Subpart J—Ethanol Production |
| 98.220 Subpart V-Nitric Acid Production | 98.120 Subpart L—Fluorinated Greenhouse Gas Production |
| 98.240 Subpart X-Petrochemical Production | 98.130 Subpart M—Food Processing |
| 98.250 Subpart Y-Petroleum Refineries | 98.230 Subpart W—Oil and Natural Gas Systems |
| 98.260 Subpart Z-Phosphoric Acid Production | 98.300 Subpart DD—SF6 from Electrical Equipment |
| 98.270 Subpart AA-Pulp and Paper Manufacturing | 98.370 Subpart KK—Suppliers of Coal |
| 98.280 Subpart BB-Silicon Carbide Production | |
| 98.290 Subpart CC-Soda Ash Manufacturing | |
| 98.310 Subpart EE-Titanium Dioxide Production | |