

The 's of GHGs

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's of GHGs

- A. **What** are GHGs?
- B. **Why** should you care about GHGs?
- C. **How** do you measure GHGs?

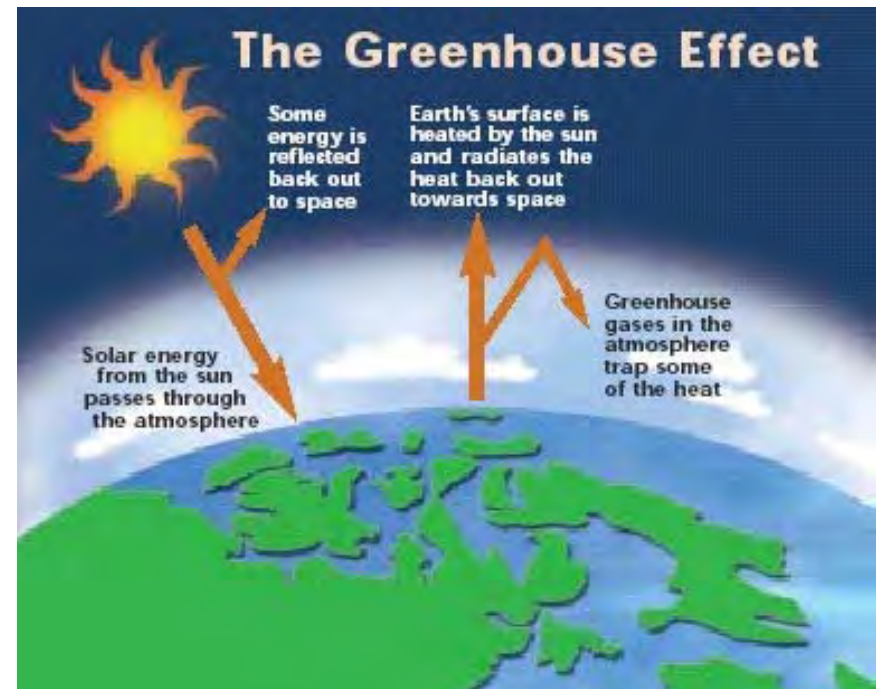
What are GHGs?

What

Why

How

- ▶ Greenhouse Gases (GHGs) allow sunlight to enter the atmosphere freely. GHGs absorb and re-radiate some of the heat that would otherwise return to space. The primary GHGs include
 - Carbon Dioxide (CO_2)
 - Methane (CH_4)
 - Nitrous Oxide (N_2O)
 - Sulfur Hexafluoride (SF_6)
 - Hydrofluorocarbons (HFCs)
 - Perfluorocarbons (PFCs)
 - Nitrogen Trifluoride (NF_3)



What

Why

How

Kyoto GHGs + 1

Greenhouse Gas	Pre-1950 Concentration	Current Concentration	Global Warming Potential ¹	Atmospheric Lifetime (yrs)
Carbon Dioxide (CO ₂)	280 ppm	384 ppm	1	50-200+
Methane (CH ₄)	700 ppb	1735-1857 ppb	25	12
Nitrous Oxide (N ₂ O)	270 ppb	320-321 ppb	298	114
Sulfur Hexafluoride (SF ₆)	0	6.03-6.40 ppt	22,800	3,200
Hydrofluorocarbons (HFCs)	0	3.2-197 ppt	124-14,800	< 15
Perfluorocarbons (PFCs)	0	77-246 ppt	7,390-12,200	50,000
Nitrogen Trifluoride (NF ₃) ²	0	454 ppt	6,800	550

¹100 year time span

²Not a Kyoto GHG, but regulated in proposed American Clean Energy and Security Act of 2009 (a.k.a. Waxman/Markey)



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Organic GHGs and some industrial gases: http://cdiac.ornl.gov/pns/current_ghg.html

4 High GWP gases: <http://www.epa.gov/highgwp/scientific.html>

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What

Why

How

Sources of GHGs

Greenhouse Gas	Common Sources
CO ₂	Fossil fuel combustion, land use and land use changes
CH ₄	Cattle, waste water treatment (WWT), landfills, rice fields, natural gas
N ₂ O	Agriculture, mobile & stationary combustion, WWT, incineration
PFCs	Aluminum production, semiconductors, health imaging
HFCs	Refrigerant leaks, fire extinguishers, solvents
SF ₆	Magnesium casting, transformers, switches, electron microscopes, other research equipment
NF ₃	Semiconductor manufacturing



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GHG Emissions

- **SCOPE 1: Direct GHG emissions owned or controlled by Federal agency**

- Stationary External Combustion
- Stationary Internal Combustion
- Fleet Vehicles
- Fugitive Emissions

- **SCOPE 2: Direct GHG emissions from purchased utilities**

- Electricity
- Heat
- Steam

- **SCOPE 3: Indirect GHG emissions**

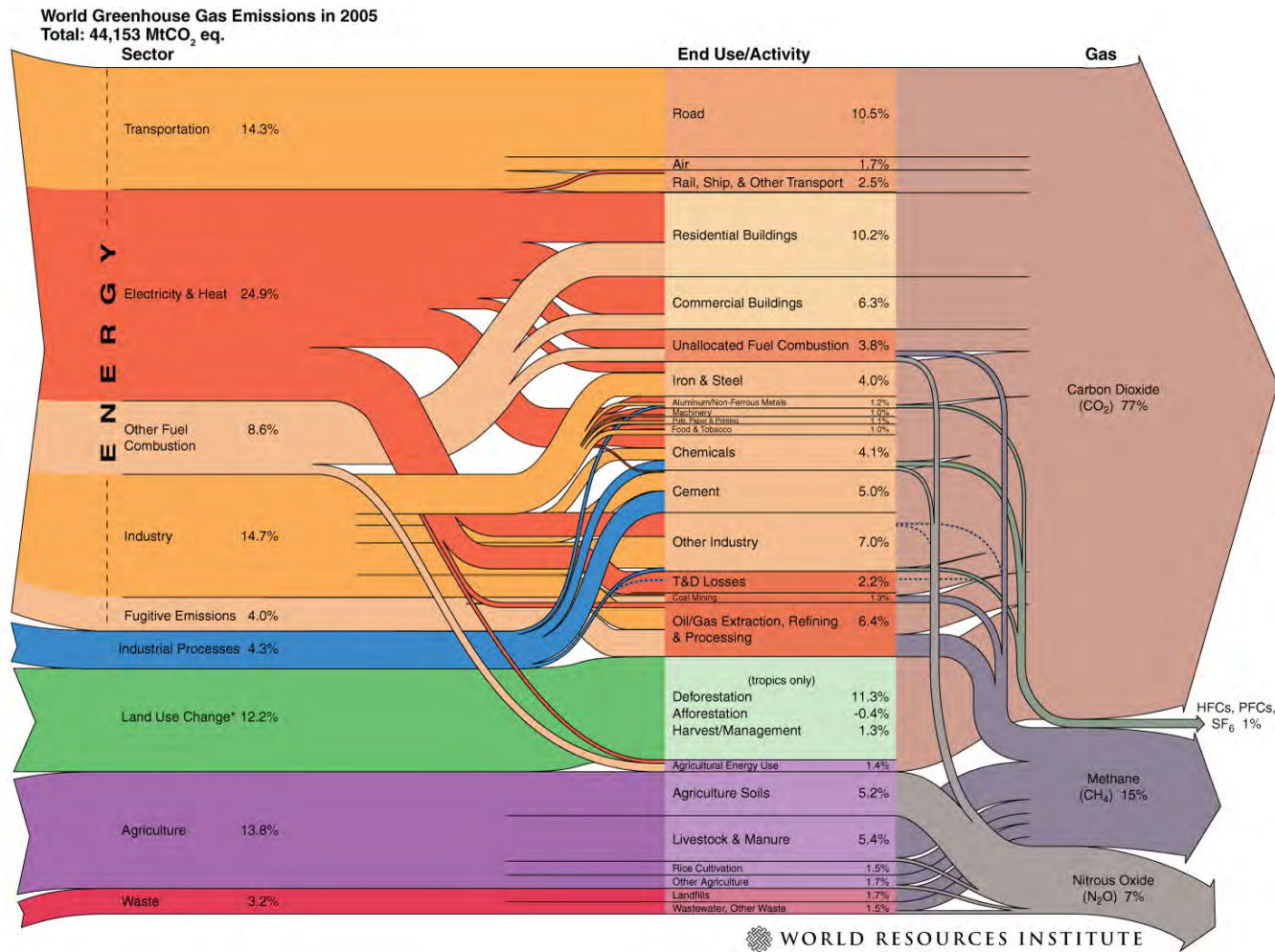
- Employee commuting
- Business travel
- Waste
- Production & transport of purchased material
- Other

What

Why

How

World GHG Emissions by Sector



Source: World Resources Institute, www.wri.org

WORLD RESOURCES INSTITUTE

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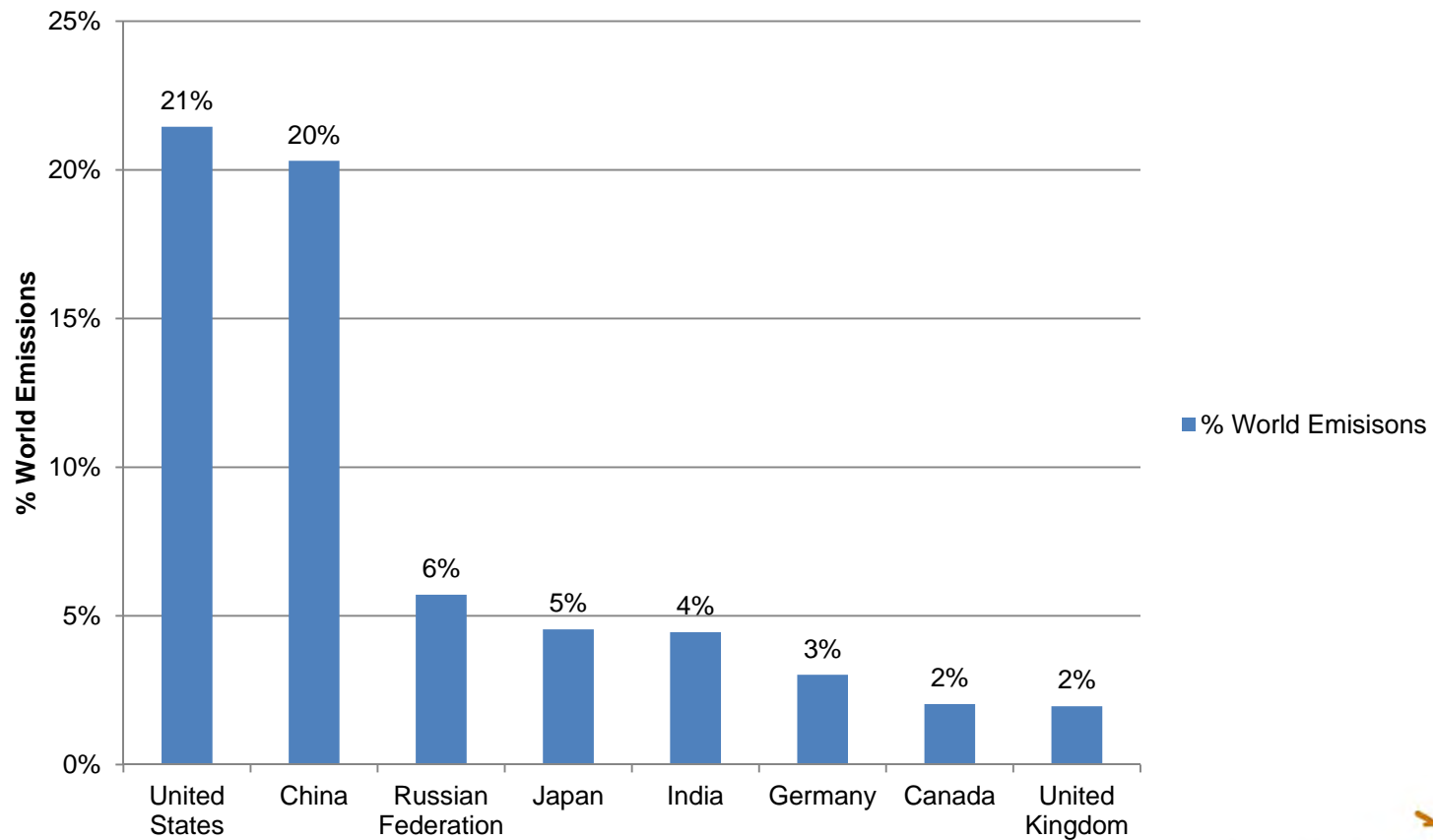
Why should I care about GHGs?

What

Why

How

Top 10 CO₂-emitting Countries (2005)



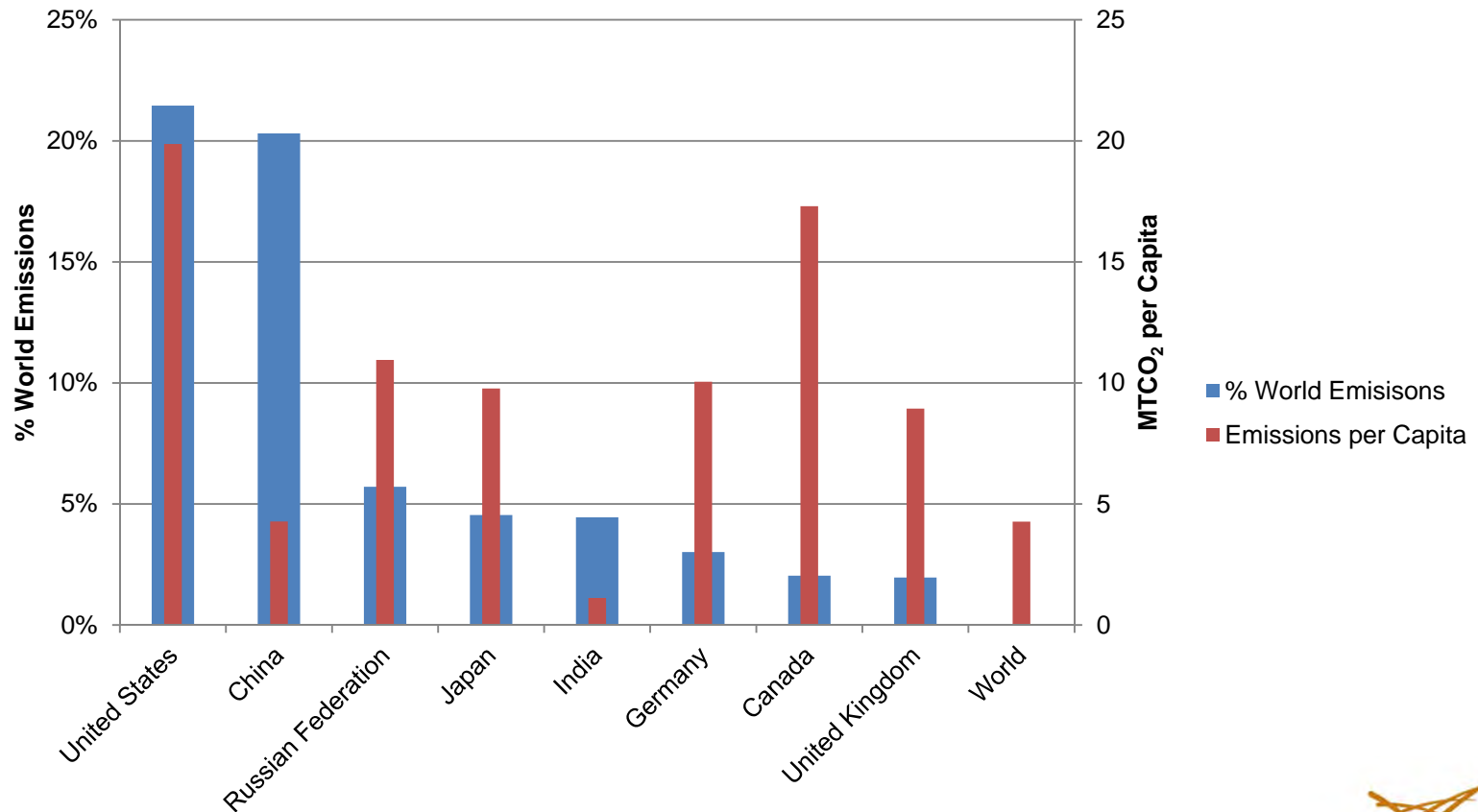
Why should I care about GHGs?

What

Why

How

Top 10 CO₂-emitting Countries (2005)

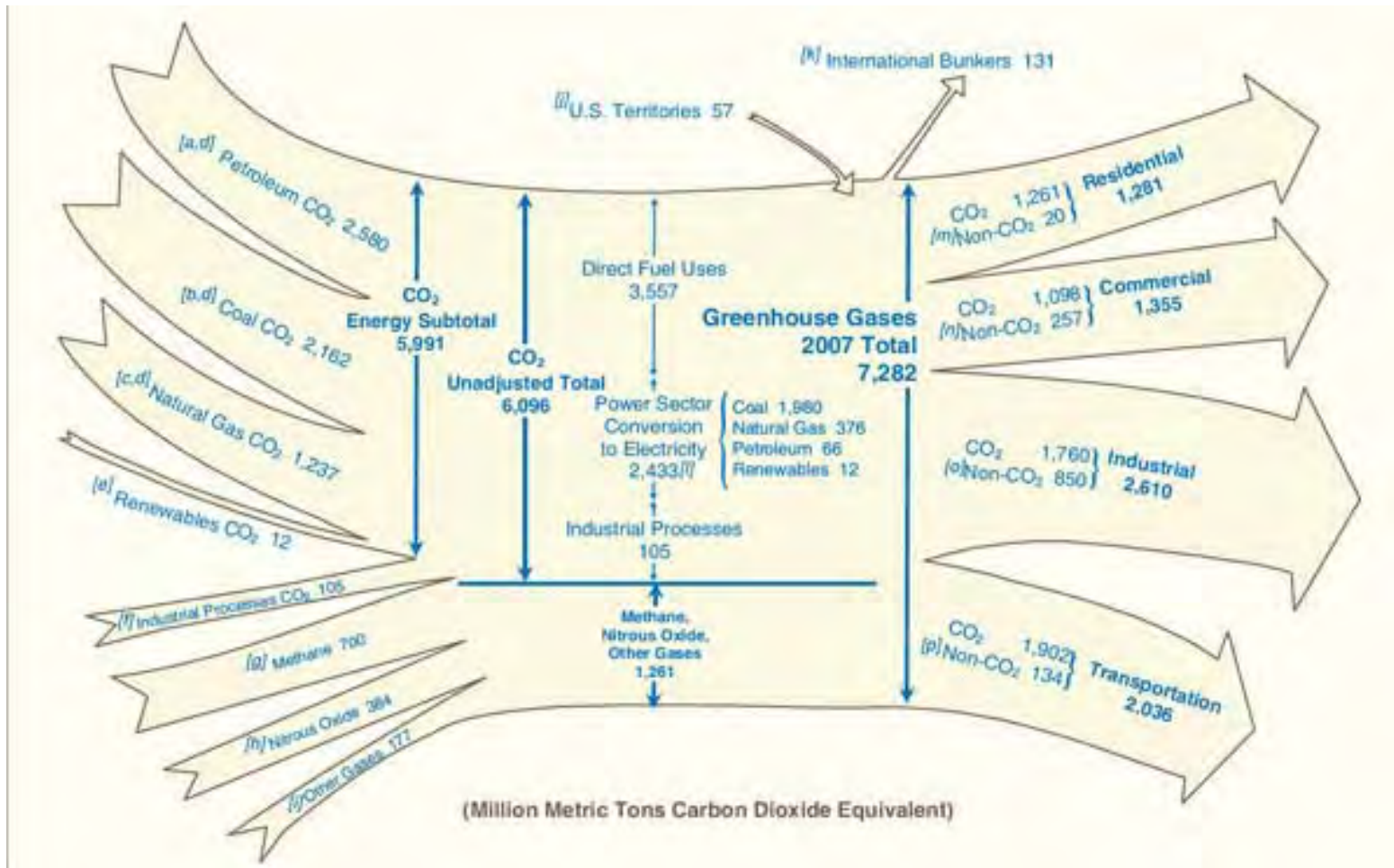


What

Why

How

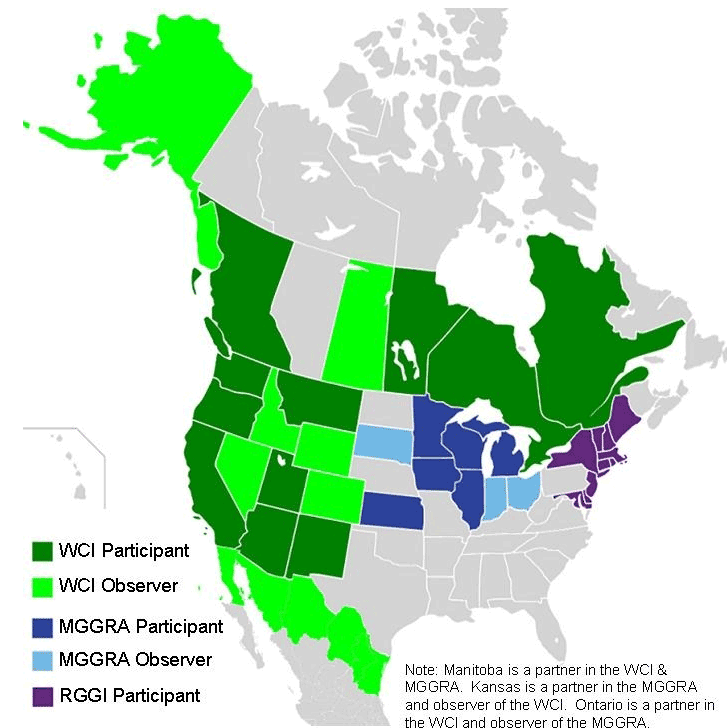
U.S. GHG Emissions by Sector, 2007



Source: Energy Information Administration, www.eia.org

Reporting Federal GHG Emissions

- ▶ **FEDERAL**: New Executive Order on sustainability and GHG management signed October 5, 2009
- ▶ **NATIONAL**: EPA *finalized* its GHG reporting rule 9/09; data collection in 2010, reporting begins 2011. EPA *proposed* rules on PSD and CAA permitting under development
- ▶ **NATIONAL**: *Proposed* American Clean Energy and Security Act of 2009 (ACESA) – Waxman/Markey
- ▶ **REGIONAL**: e.g. RGGI
- ▶ **STATE and LOCAL**: e.g. California
- ▶ **GHG REGISTRIES**: e.g. Climate Registry



Source: World Resources Institute (WRI) www.wri.org

What

Why

How

New Executive Order 13514: GHG Accounting and Reporting

- ▶ Administration has established requirements for reducing Federal sector GHG emissions.
- ▶ This will require DOE to conduct regular, comprehensive GHG emissions inventories, establish GHG reduction goals, and establish and manage programs to achieve the reductions.
- ▶ This requirement will likely flow down to the site level, but implementation strategy is still under development.
 - GHG reduction activities are already required under existing policy and regulatory framework (DOE O 430.2B, O 450.1A, EISA)

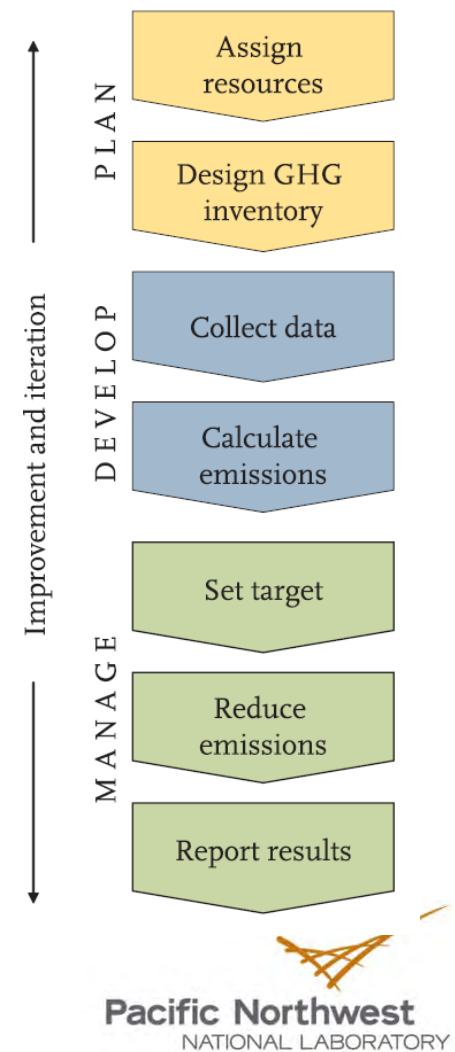
How do you measure GHGs?

What

Why

How

- ▶ Select measurement protocol/GHG accounting principles
 - Which metrics will be used?
- ▶ Define inventory boundaries – organizational and operational
 - What should be included?
- ▶ Identify data sources needed for selected metrics
 - Who will you need to contact to get access to the needed data?
- ▶ Calculate and report GHG emissions inventory
- ▶ Use compiled data to set goals for GHG reduction
 - How will your site reduce its GHGs?



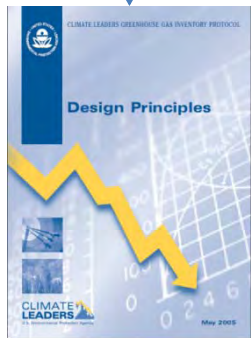
What

Why

How

GHG Inventory Protocols/Guidance

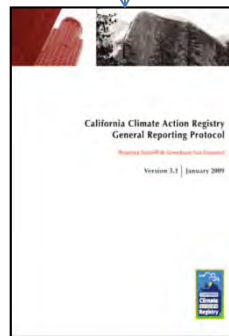
WBCSD/WRI
GHG Protocol



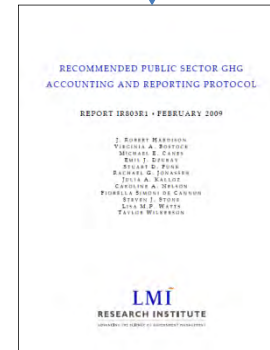
EPA Climate
Leaders
Guidance



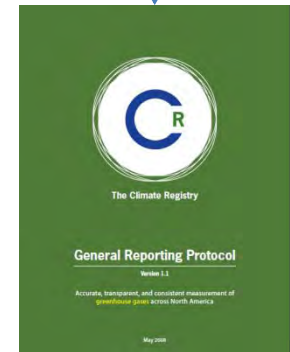
ISO 14064
Standards



CCAR Reporting
Protocol



Public Sector
Protocol



The Climate
Registry
Protocol

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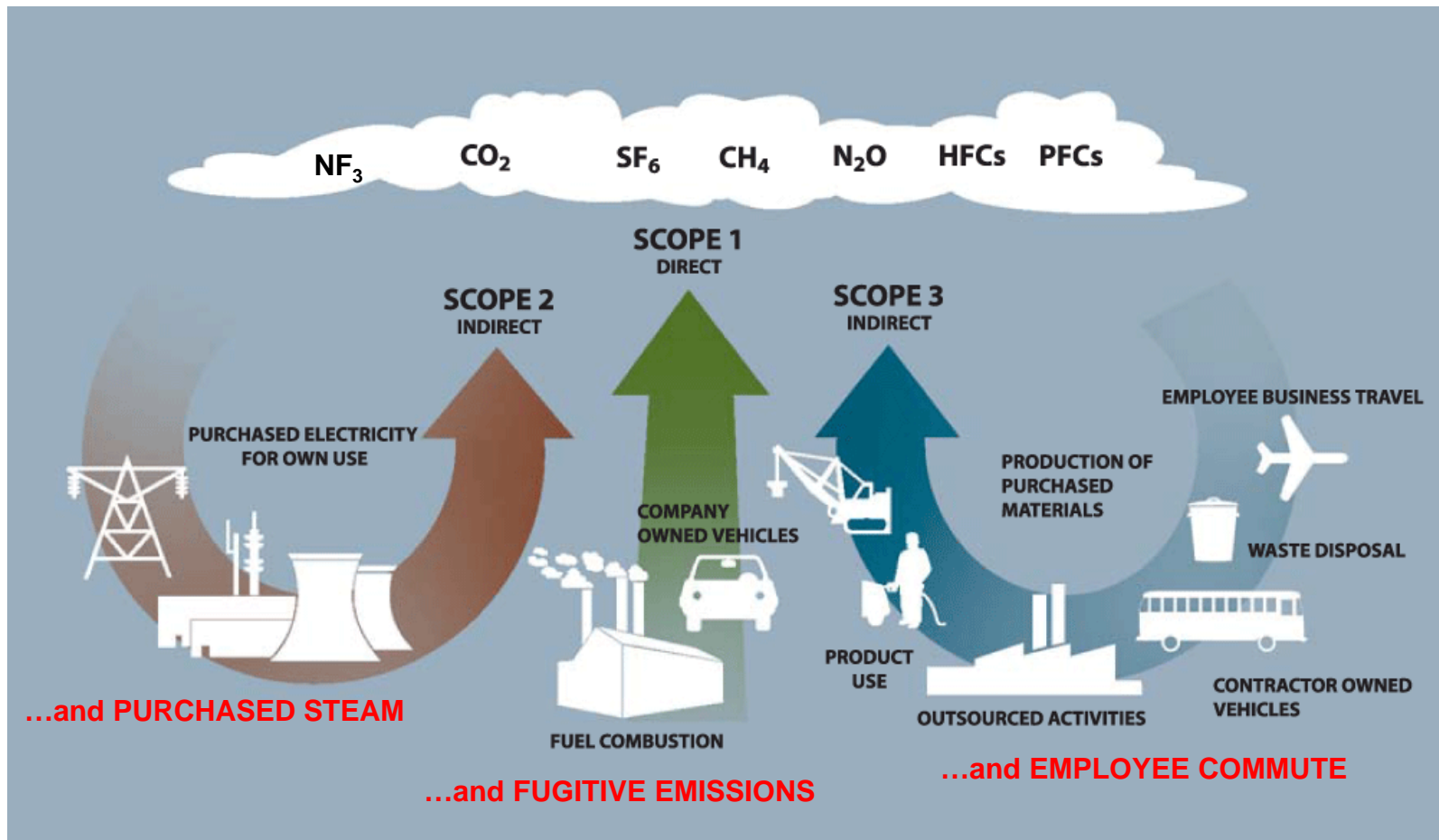
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What

Why

How

Scopes 1, 2, and 3



Source: World Resources Institute (WRI) www.wri.org

Scopes 1, 2, 3

What

Why

How

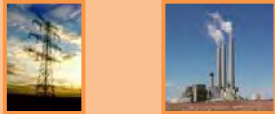
Scope 1 emissions

Scope 2 emissions

Scope 3 emissions

Upstream Emissions

Production of Electricity Consumed



Production of Raw Materials Purchased



Processing of Materials Purchased



Transportation of Materials Purchased



Corporate Emissions

On-site Fuel Combustion



Fleet Vehicles



Fugitive Emissions



Business Travel



Employee Commuting



Outsourced Support



Downstream Emissions

Waste Transportation and Disposal



Product Use



Distribution of Products



What

Why

How

Example: PNNL 2007 Carbon Footprint

Scope 1 emissions

Scope 2 emissions

Scope 3 emissions

Upstream Emissions

Production of Electricity Consumed



Corporate Emissions

On-site Fuel Combustion (NG, propane)



PNNL Fleet Vehicles



Business Travel (Air and Car Rental)



Employee Commuting



Downstream Emissions

Waste Transportation and Disposal

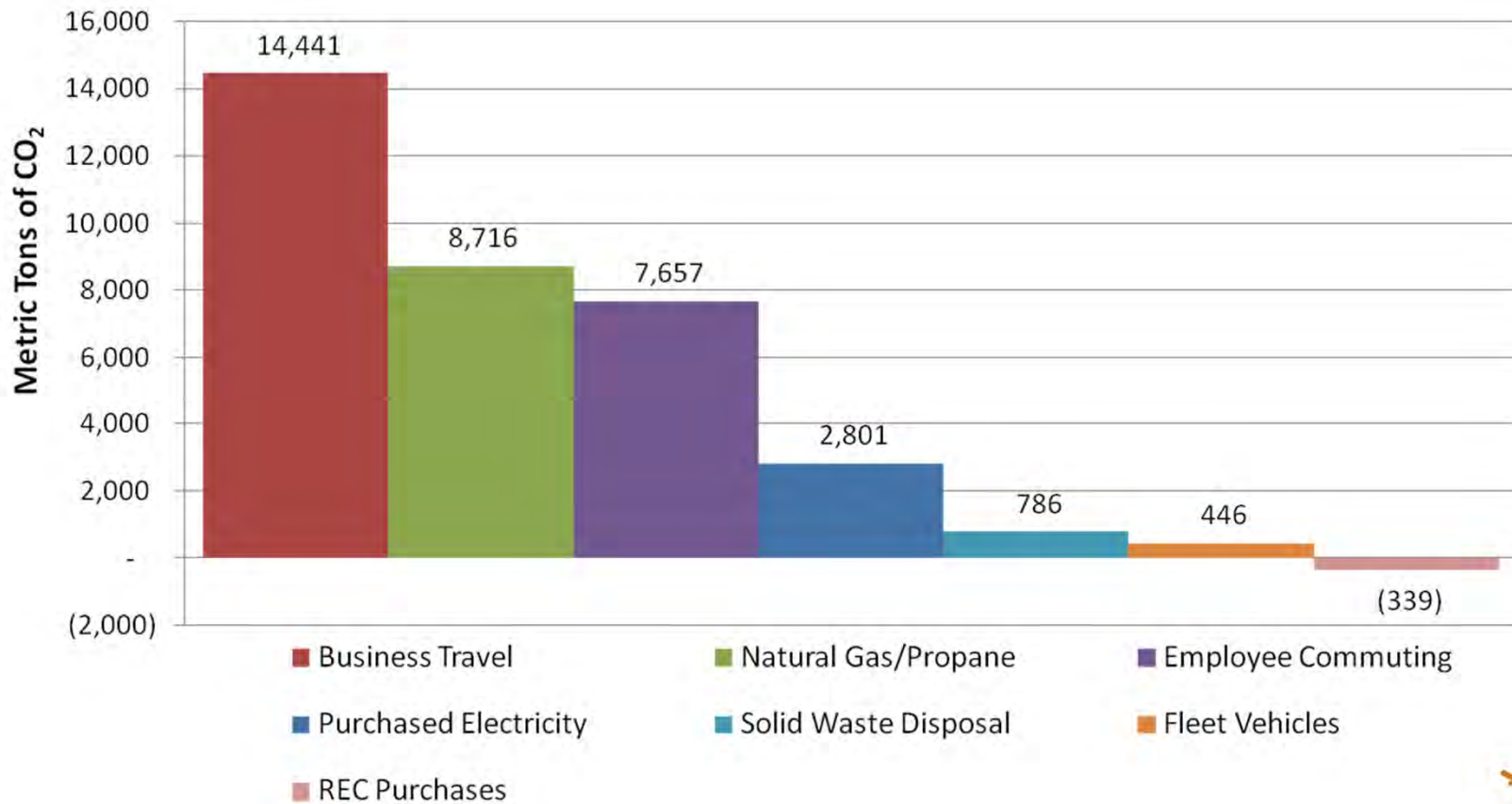


What

Why

How

Example: PNNL 2007 CO₂ Emissions



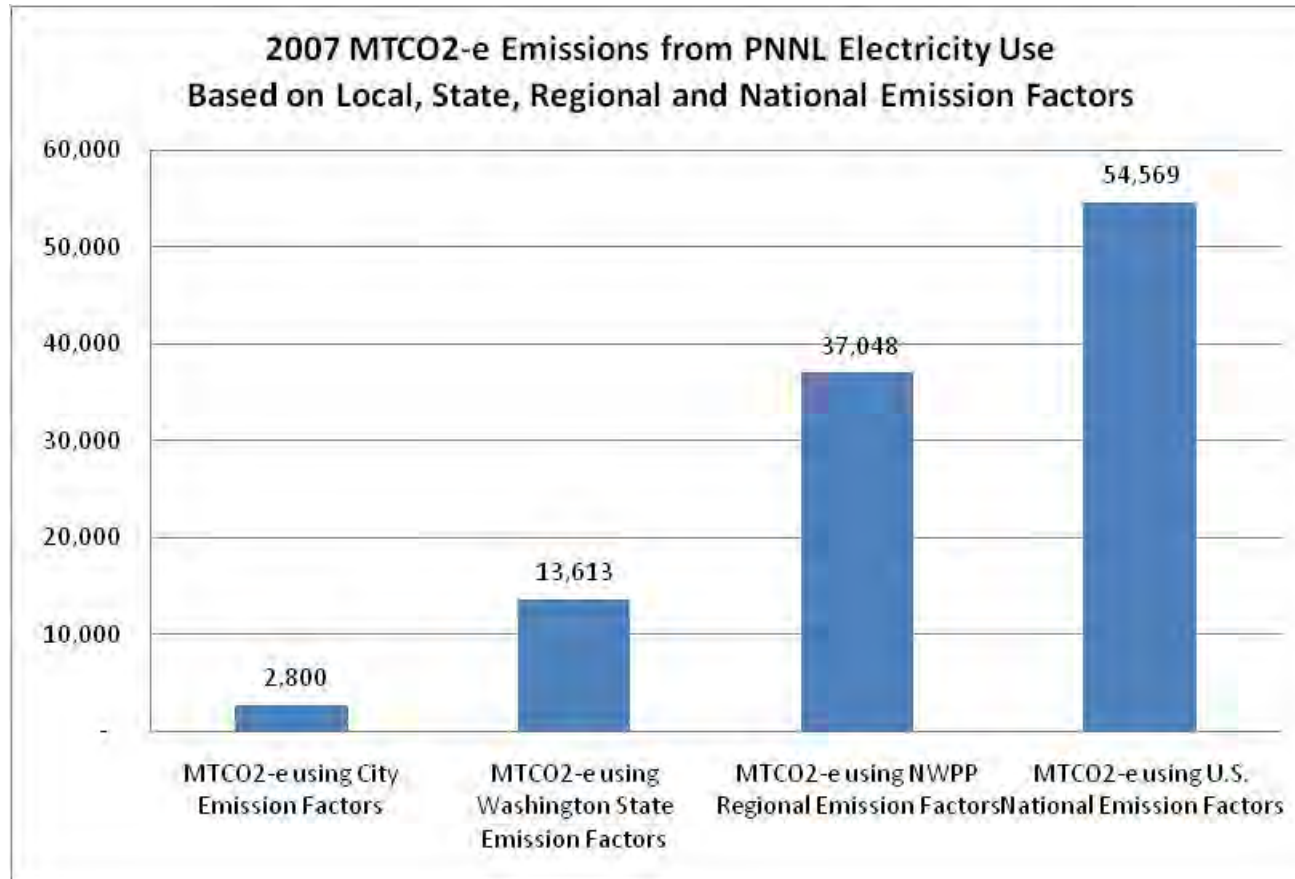
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Electricity – Which Emission Factors to use?

What

Why

How



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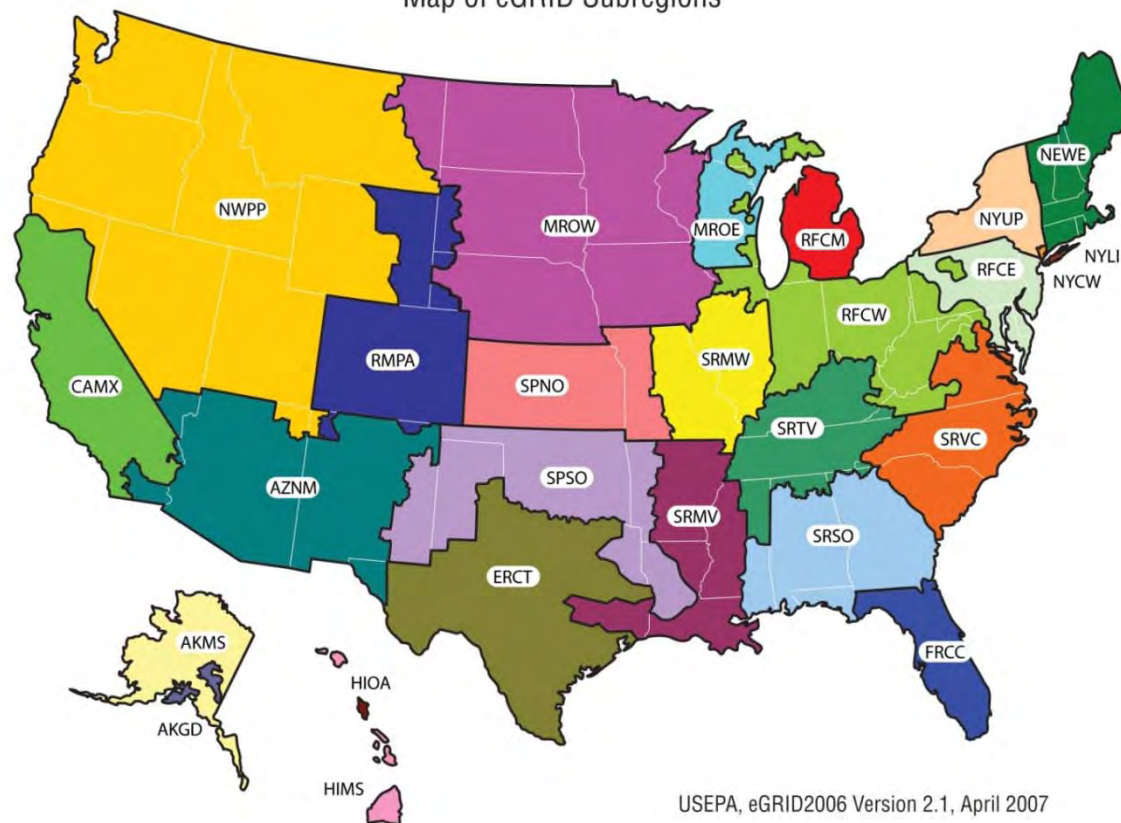
eGRID Sub-regions

What

Why

How

Map of eGRID Subregions



USEPA, eGRID2006 Version 2.1, April 2007



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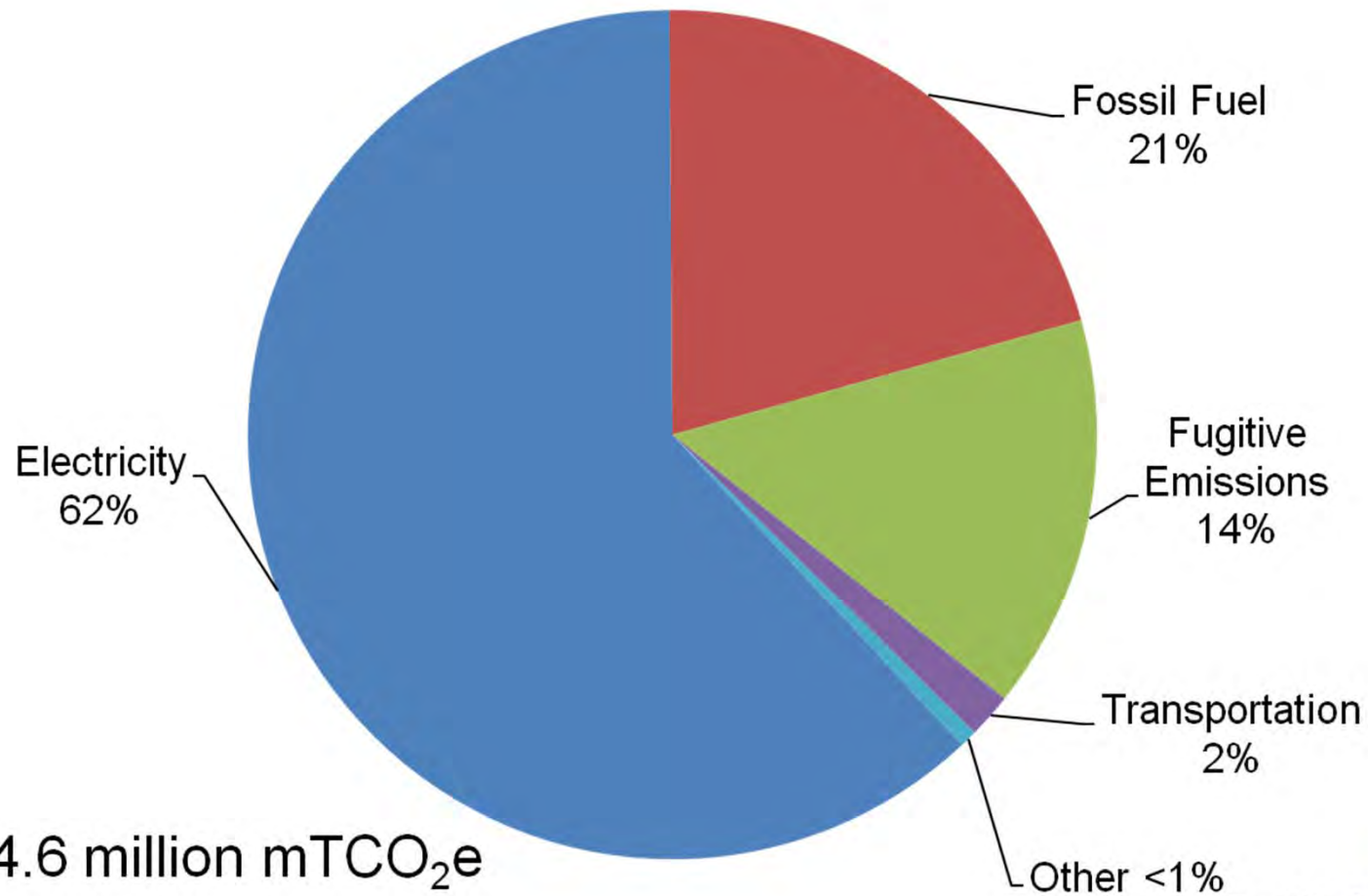
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DOE Baseline: FY 2008 GHG Inventory

What

Why

How



Total: 4.6 million mTCO₂e



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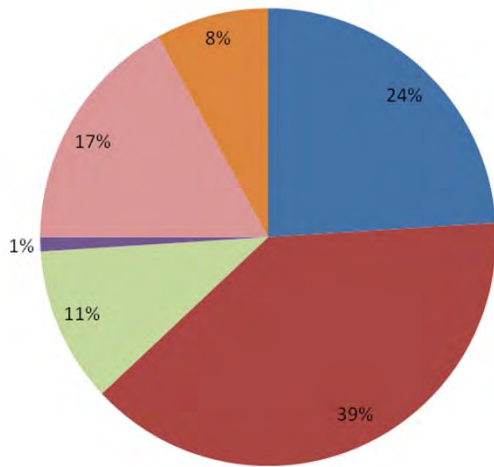
GHG Inventories at Multiple DOE Sites

Why

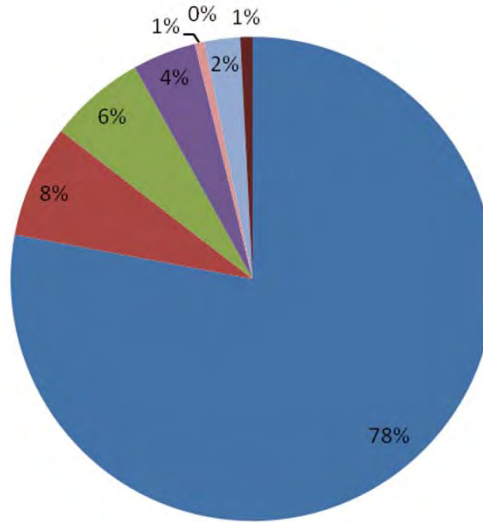
What

How

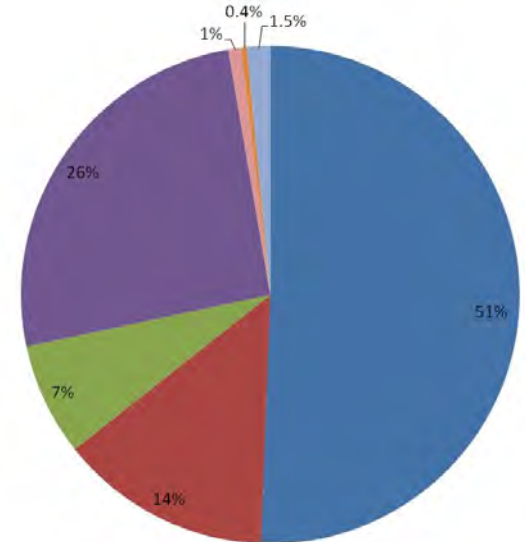
Site 1



Site 2

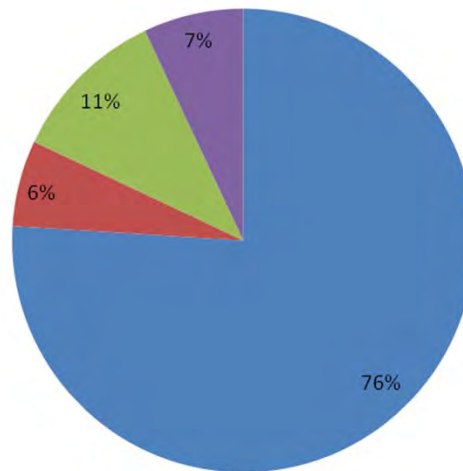


Site 3

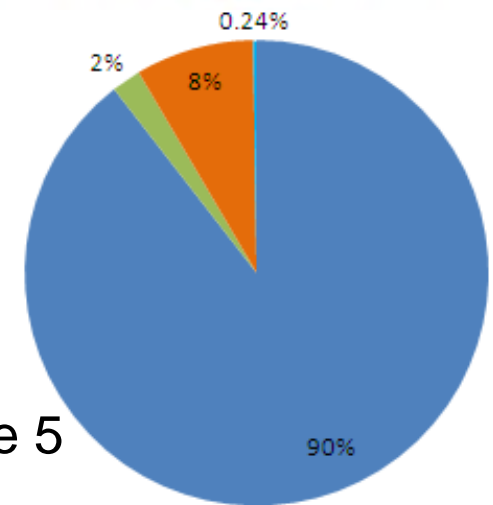


- Electricity
- Employee Commuting
- Natural Gas
- Business Air Travel
- Fleet Vehicles
- Solid Waste Disposal
- Rental Cars
- Fugitive Emissions

Site 4



Site 5



Tools Utilized

What

Why

How

Scope and Emission Source	Name	Title	Tools
Scope 1			
Facility Fuel: NG, Propane, Gas, Diesel, B5	Marc Berman*	Energy Manager	GHG Protocol
Fleet Vehicles: Diesel, Gas, E85	Hipolito Velez*	Fleet Manager	GHG Protocol
Fleet Vehicles: Jet Fuel	Marc Berman*	Energy Manager	GHG Protocol
Fugitive Emissions: SF6, HFC, PFC	Kevin Pfeifer	Emissions	
Scope 2			
Purchased Electricity	Marc Berman*	Energy Manager	Clean Air-Cool Planet
REC Purchases	Marc Berman*	Energy Manager	GHG Protocol
Scope 3			
Business Travel: Air Data	Tracy Stiles	Travel Manager, TMP	GHG Protocol
Business Travel: Rental Car Data	Ken Blaine	Travel	GHG Protocol
Business Travel: Personal Car Data	Ken Blaine	Travel	GHG Protocol
Employee Commuting	Vicki Watilo	Survey Development	GHG Protocol
Waste Disposal/Recycling	Laurie True*	Pollution Prevention	EPA WARM

PNNL used its EMS Core Team members to identify data sources, and is using its EMS process to track progress and implement changes.*



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Available Support

What

Why

How

- ▶ Briefings and General information
 - Public Sector Protocol (PSP) (www.ghgprotocol.org/psp)
 - Environmental Sustainability Network
- ▶ DOE Training and Technical assistance
- ▶ Inventory and reporting tools



The screenshot shows the homepage of The Greenhouse Gas Protocol Initiative. The header includes the logo and the text "The Greenhouse Gas Protocol Initiative" with the tagline "The foundation for sound and sustainable climate strategies". A search bar is located in the top right. The navigation menu includes "About", "Programs and Registries", "Standards", "Calculation Tools", "Newsletter", and "Media". The main content area features a yellow banner with the headline "THE PUBLIC SECTOR WORKS WITH GHG PROTOCOL TO DEVELOP A NEW STANDARD". Below this is a photograph of a government building and a text block explaining the development of the Public Sector Protocol (PSP). A sidebar on the right contains a "WHAT'S NEW" section with a link to a news item, a newsletter sign-up form, and "Supply Chain Partners" including the World Business Council for Sustainable Development and the World Resources Institute. An "ACKNOWLEDGEMENTS" button is also visible.

Where to Find Tools

▶ GHG Protocol Tools:

- <http://www.ghgprotocol.org/calculation-tools/service-sector>

▶ Clean Air-Cool Planet:

- <http://www.cleanair-coolplanet.org/toolkit/inv-calculator.php>

▶ EPA Climate Leaders:

- <http://www.epa.gov/stateply/resources/lowemitters.html>

▶ EPA WARM:

- http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html



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