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· August 15-18, 2010 · Dallas, Texas ·
· Dallas Convention Center ·

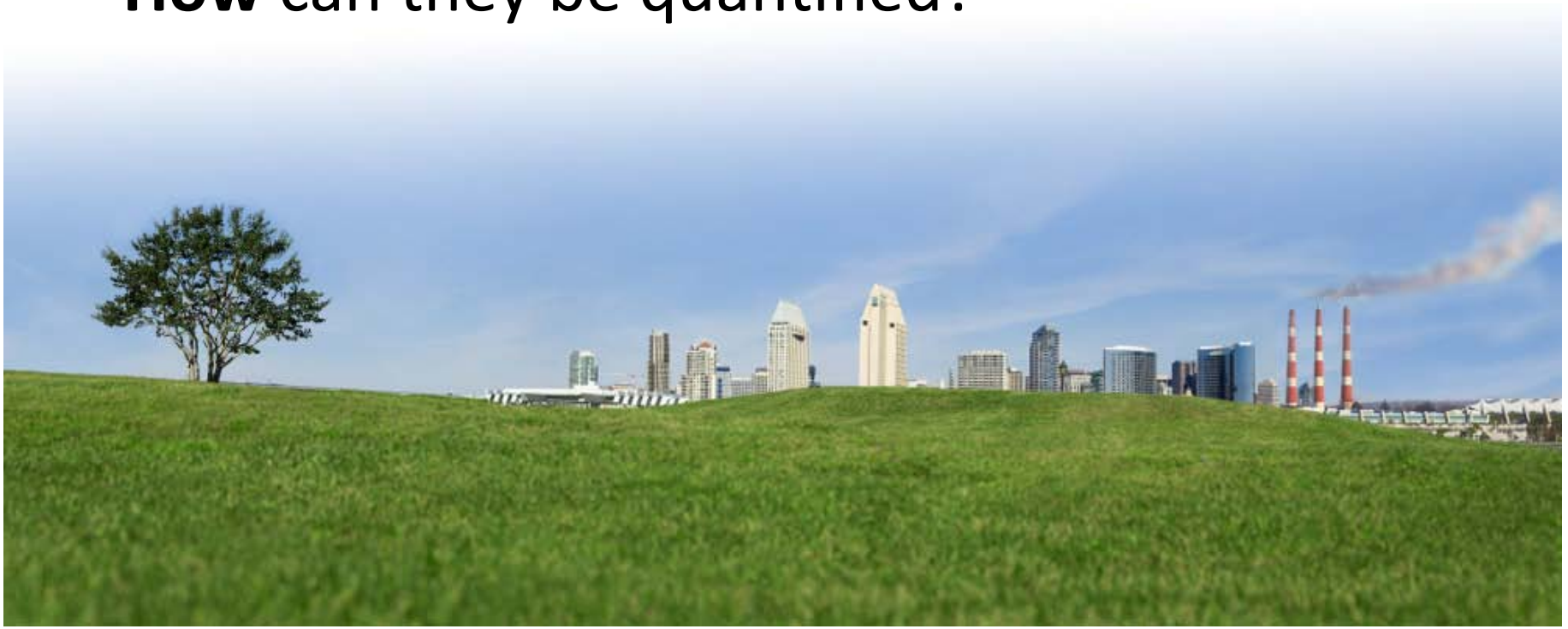
GHG-101

An Introduction to the Basics of Greenhouse Gases

Stephen P. Sain, PE, CEM, CRM *Sain Engineering Associates, Inc.*

3 Questions

- **What** are greenhouse gases (GHGs)?
- **Why** should we care?
- **How** can they be quantified?



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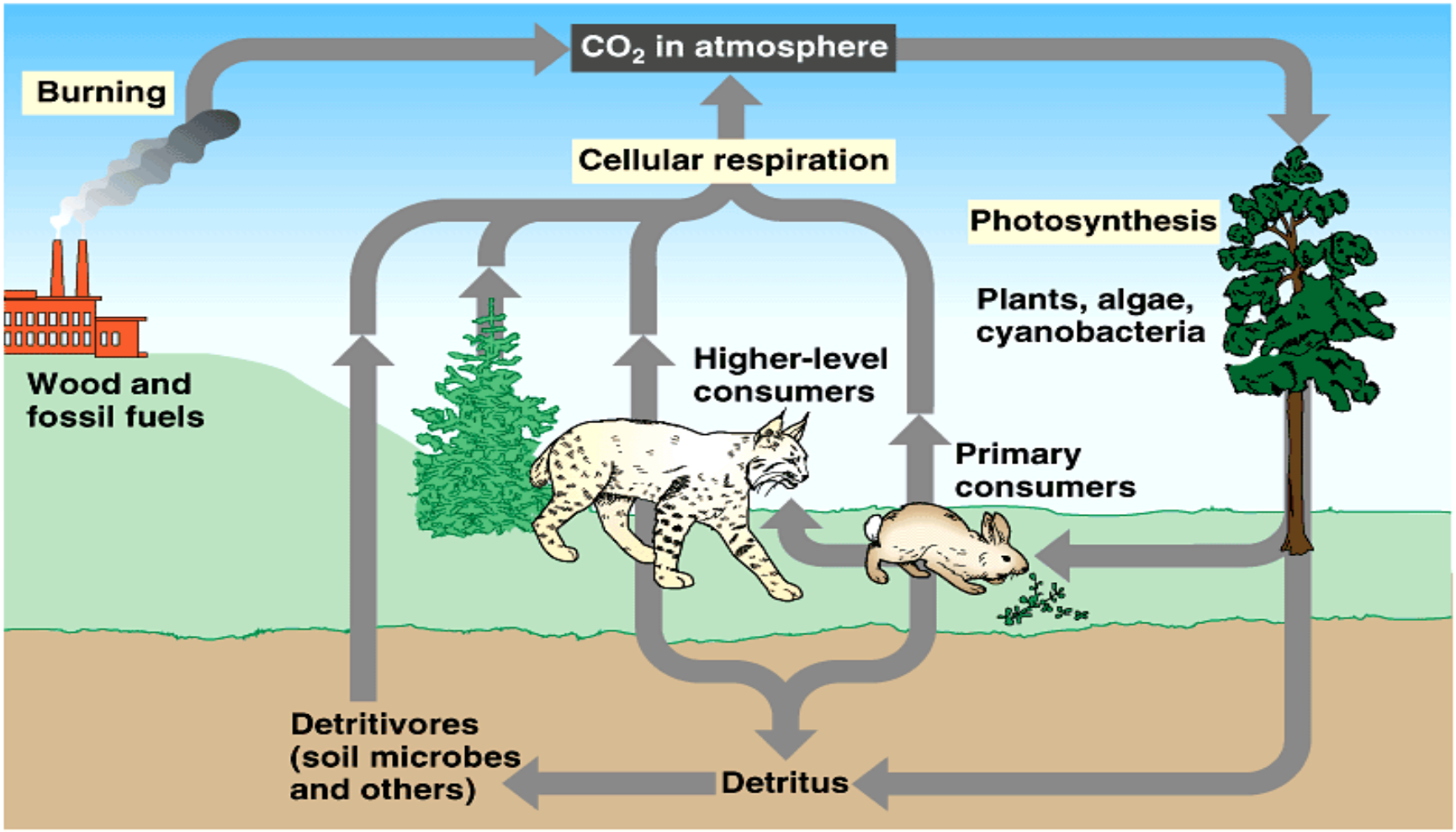
Carbon Cycle



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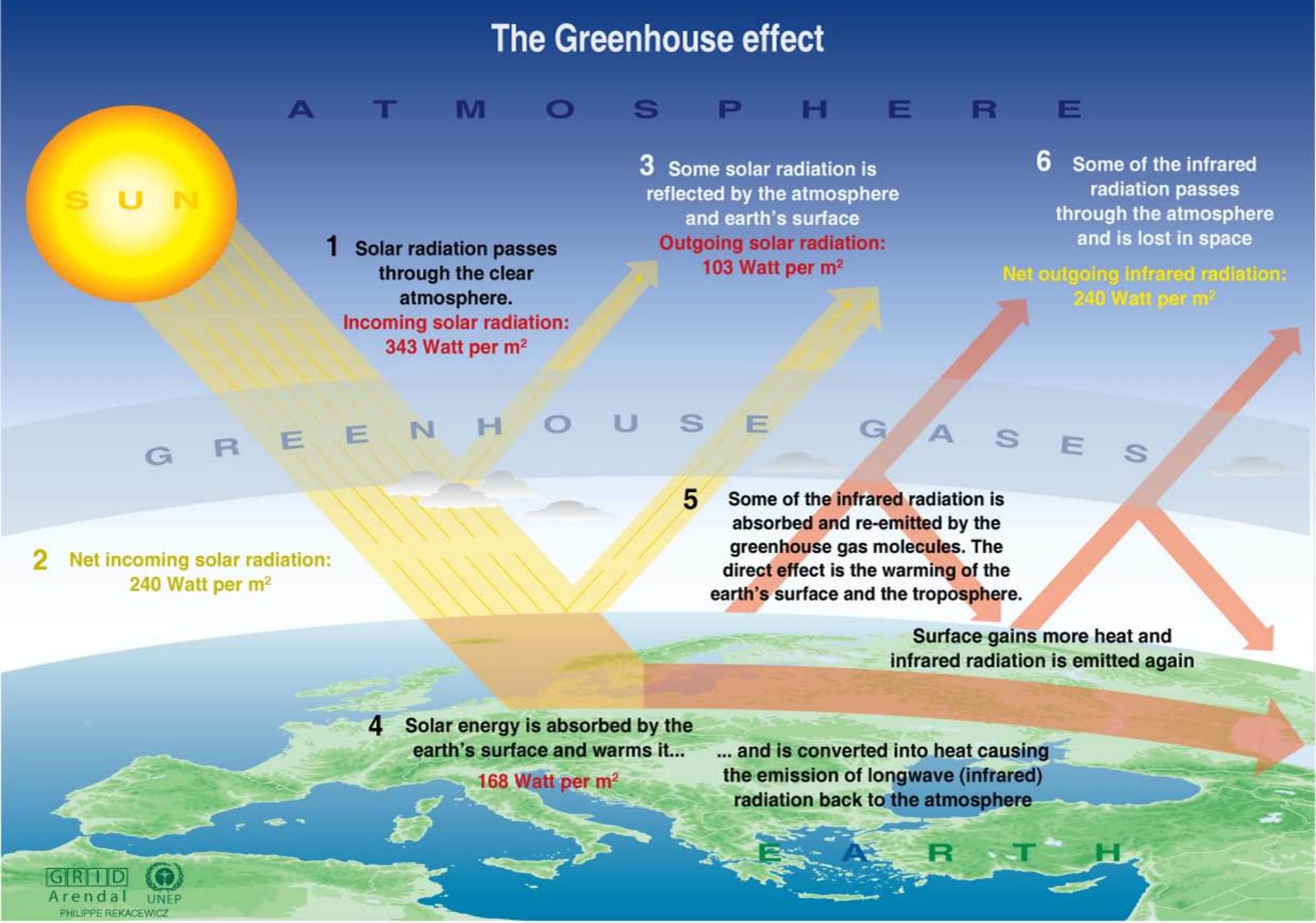
The Greenhouse effect



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

The Big 6

Greenhouse Gases	Common Sources/Uses	Global Warming Potential
Carbon Dioxide (CO_2)	Mobile and stationary combustion	1
Methane (CH_4)	Coal mining, fuel combustion	21
Nitrous Oxide (N_2O)	Fuel combustion, fertilizers	310
Hydrofluorocarbon group of gases (HFCs)	Refrigerants, fire suppressants, manufacturing processes	140-11,700
Perfluorocarbon group of gases (PFCs)	Electrical equipment, manufacturing processes, refrigerants, medicine	6,500 - 17,700
Sulfur hexafluoride (SF_6)	Electrical equipment, manufacturing processes, tracer in air modeling, medicine	23,900

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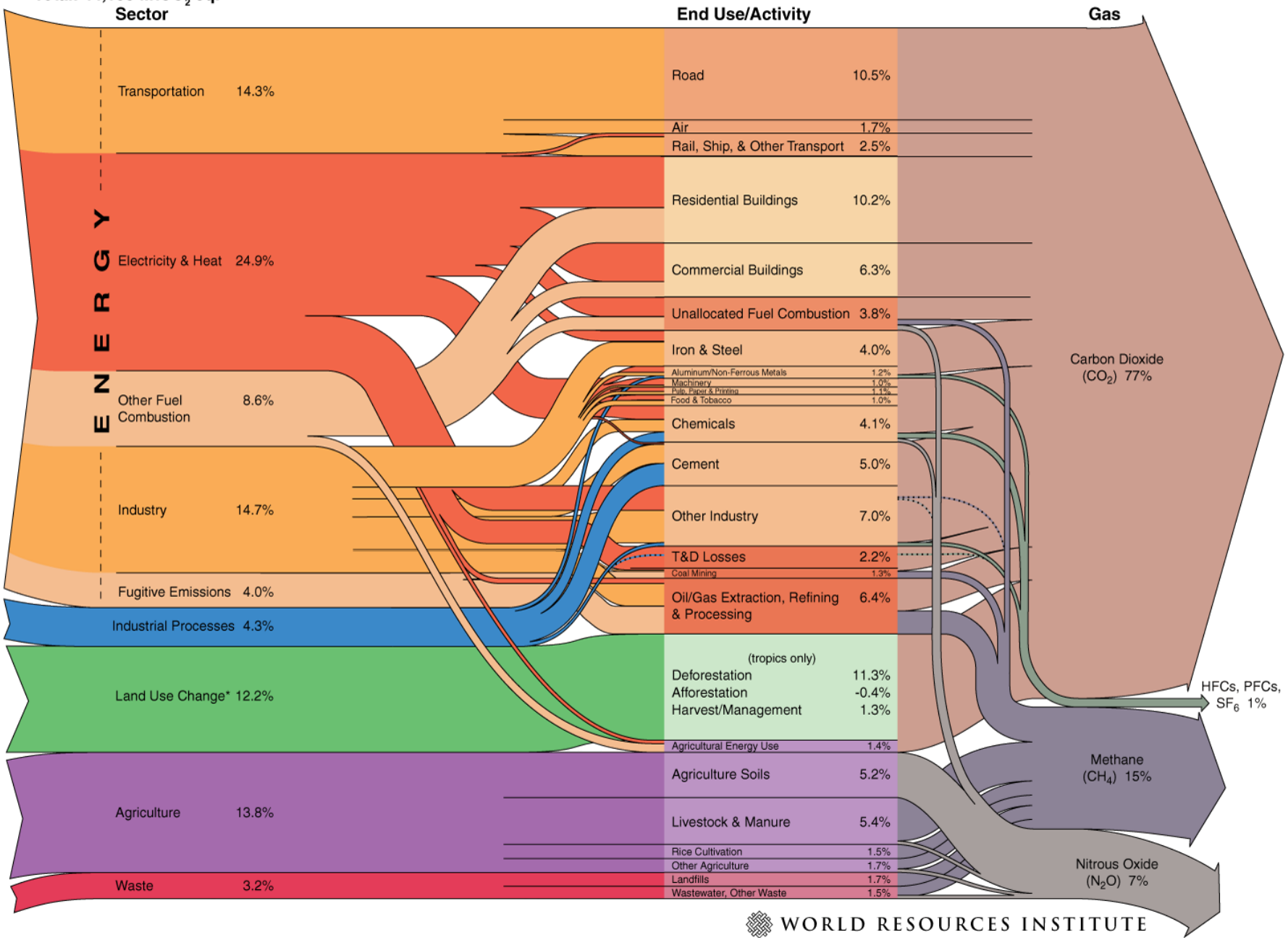
World Greenhouse Gas Emissions in 2005
Total: 44,153 MtCO2 eq.
Sector
End Use/Activity
Gas
ENERGY
Transportation 14.3%
Electricity & Heat 24.9%
Other Fuel Combustion 8.6%
Industry 14.7%
Fugitive Emissions 4.0%
Industrial Processes 4.3%
Land Use Change* 12.2%
Agriculture 13.8%
Waste 3.2%
Road 10.5%
Air 1.7%
Rail, Ship, & Other Transport 2.5%
Residential Buildings 10.2%
Commercial Buildings 6.3%
Unallocated Fuel Combustion 3.8%
Iron & Steel 4.0%
Aluminum/Non-Ferrous Metals 1.2%
Machinery 1.0%
Pulp, Paper & Printing 1.1%
Food & Tobacco 1.0%
Chemicals 4.1%
Cement 5.0%
Other Industry 7.0%
T&D Losses 2.2%
Coal Mining 1.3%
Oil/Gas Extraction, Refining & Processing 6.4%
(tropics only)
Deforestation 11.3%
Afforestation -0.4%
Harvest/Management 1.3%
Agricultural Energy Use 1.4%
Agriculture Soils 5.2%
Livestock & Manure 5.4%
Rice Cultivation 1.5%
Other Agriculture 1.7%
Landfills 1.7%
Wastewater, Other Waste 1.5%
Carbon Dioxide (CO2) 77%
HFCs, PFCs, SF6 1%
Methane (CH4) 15%
Nitrous Oxide (N2O) 7%
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3 Questions

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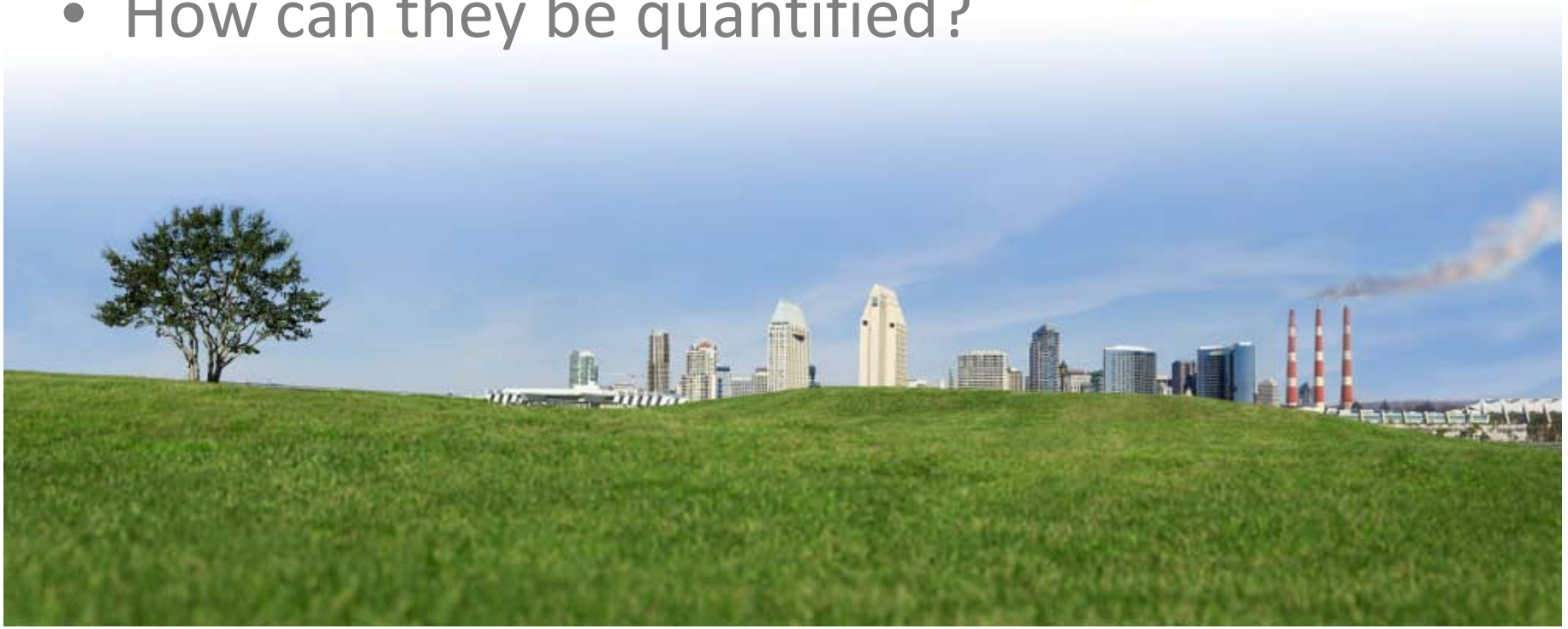

They're Multiplying

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 (N20)	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

[1]100 year time span
[2]Not a Kyoto GHG, but regulated in Waxman-Markey

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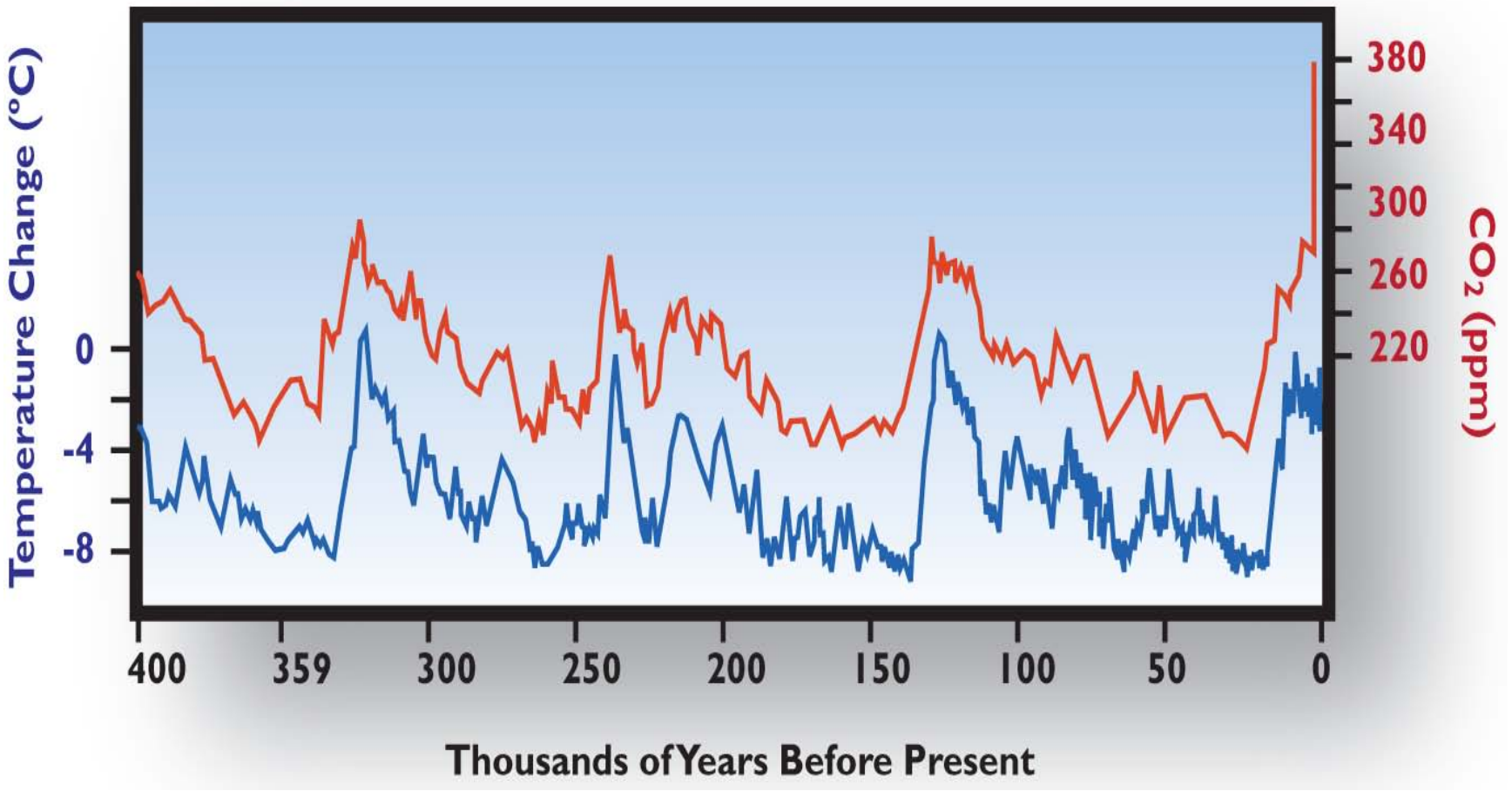
It Ain't the Heat, It's the Carbon



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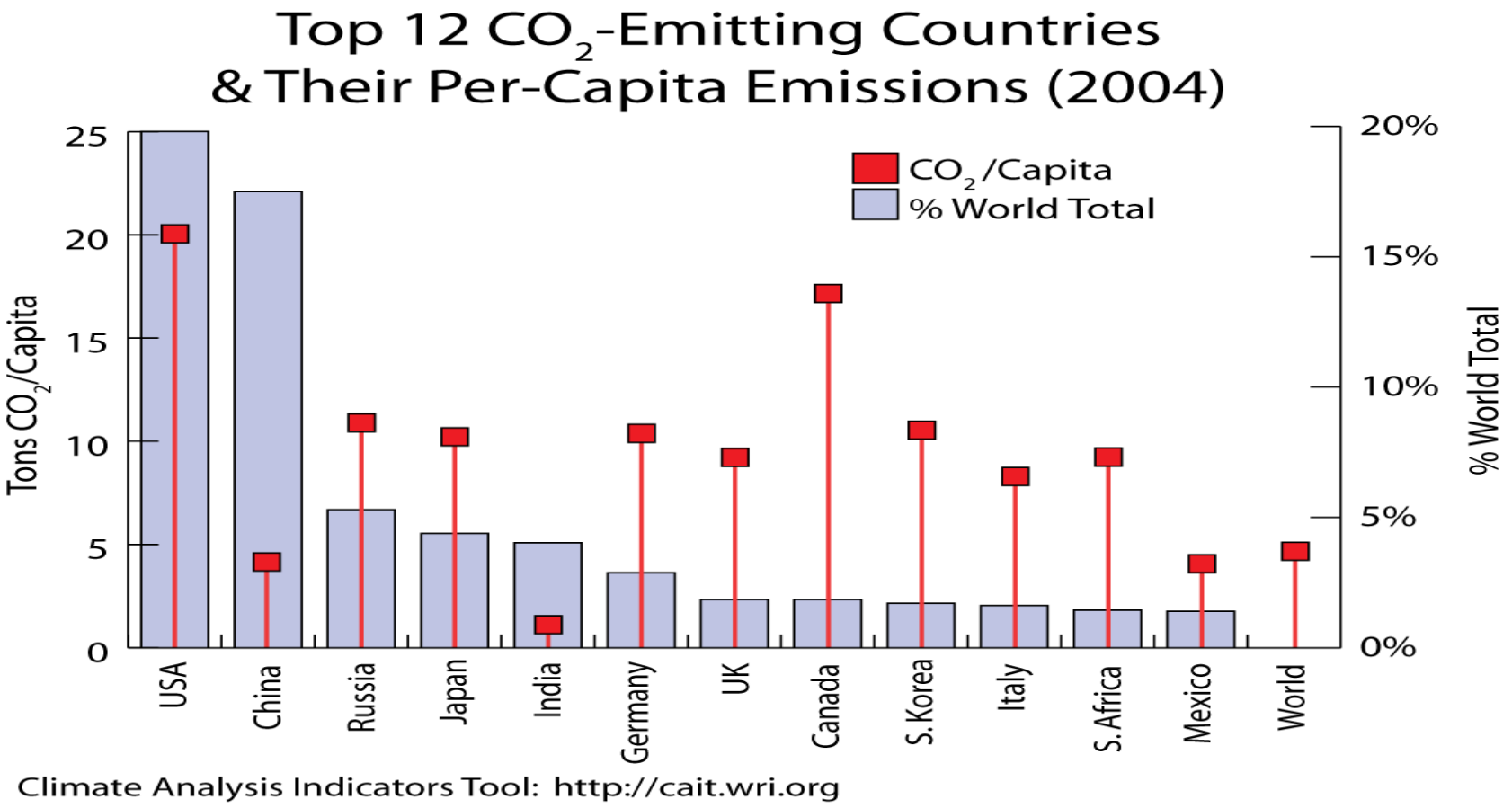
We're #1



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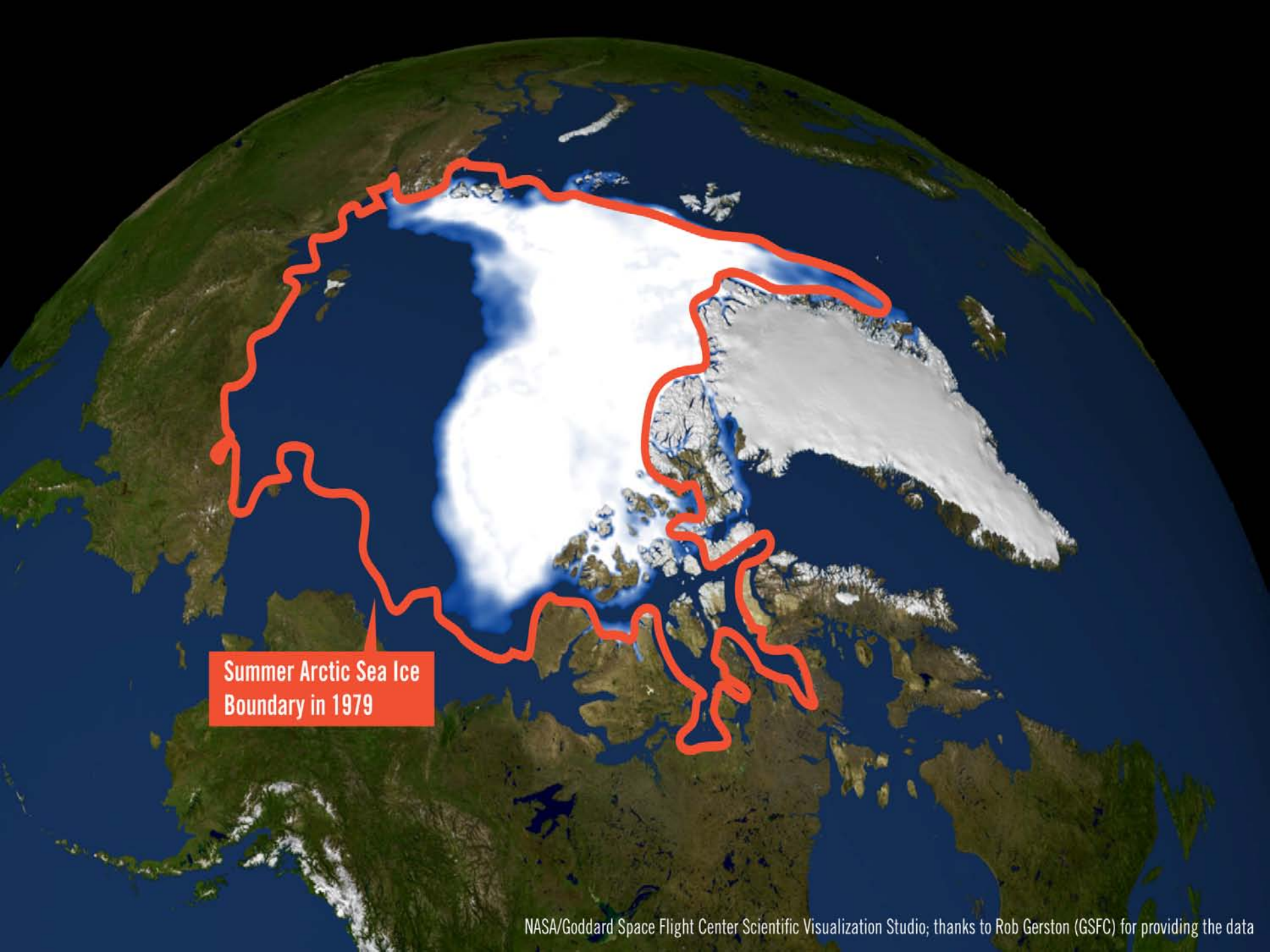


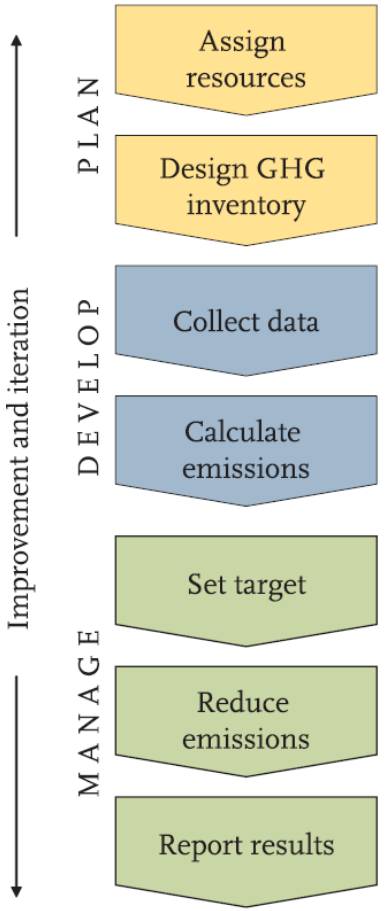
NASA/Goddard Space Flight Center Scientific Visualization Studio; thanks to Rob Gerston (GSFC) for providing the data

3 Questions

- What are greenhouse gases (GHGs)?
- Why should we care?
- **How can they be quantified?**

Quantification?

- 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?*



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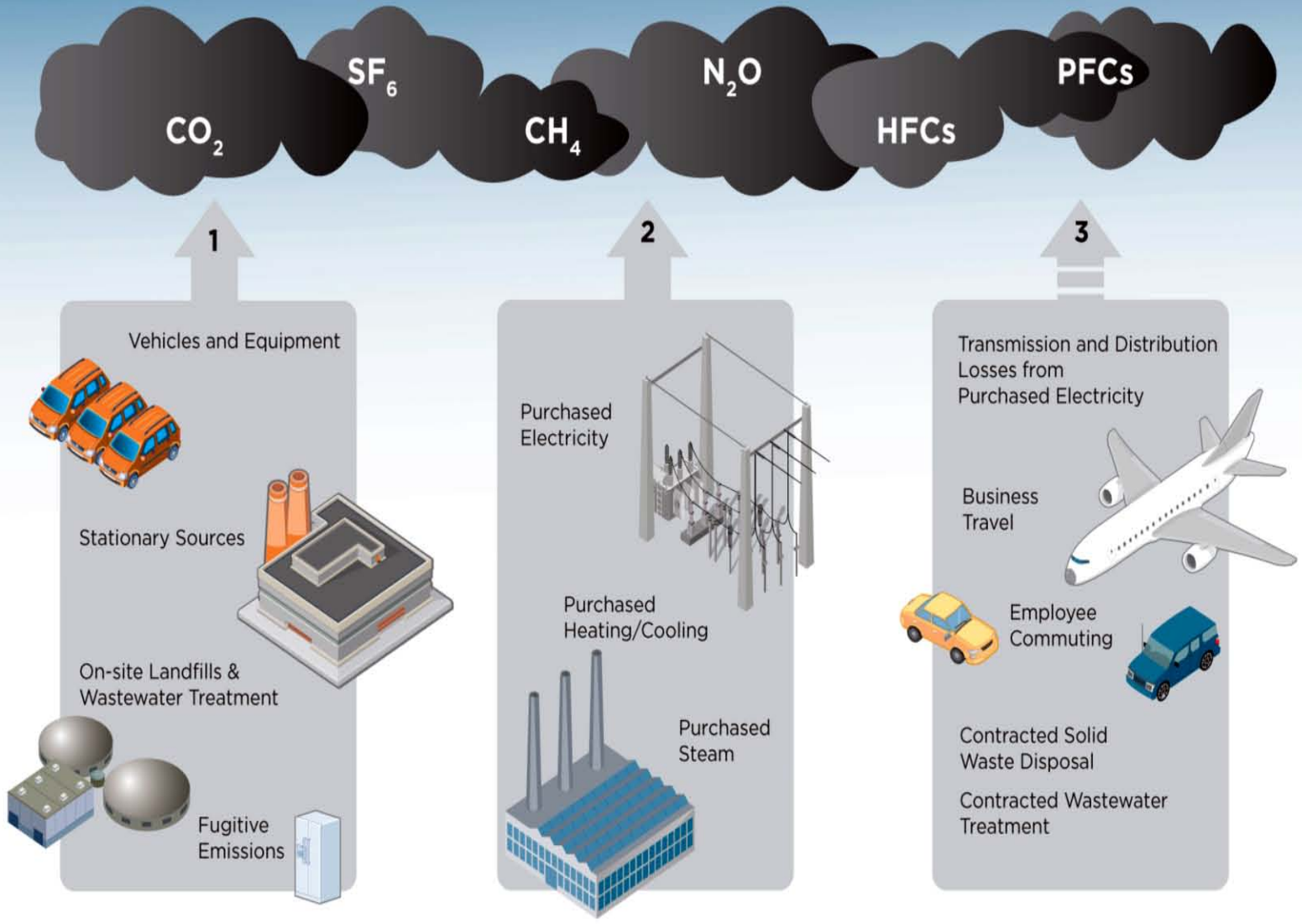
Common Sources of Federal Greenhouse Gas Emissions



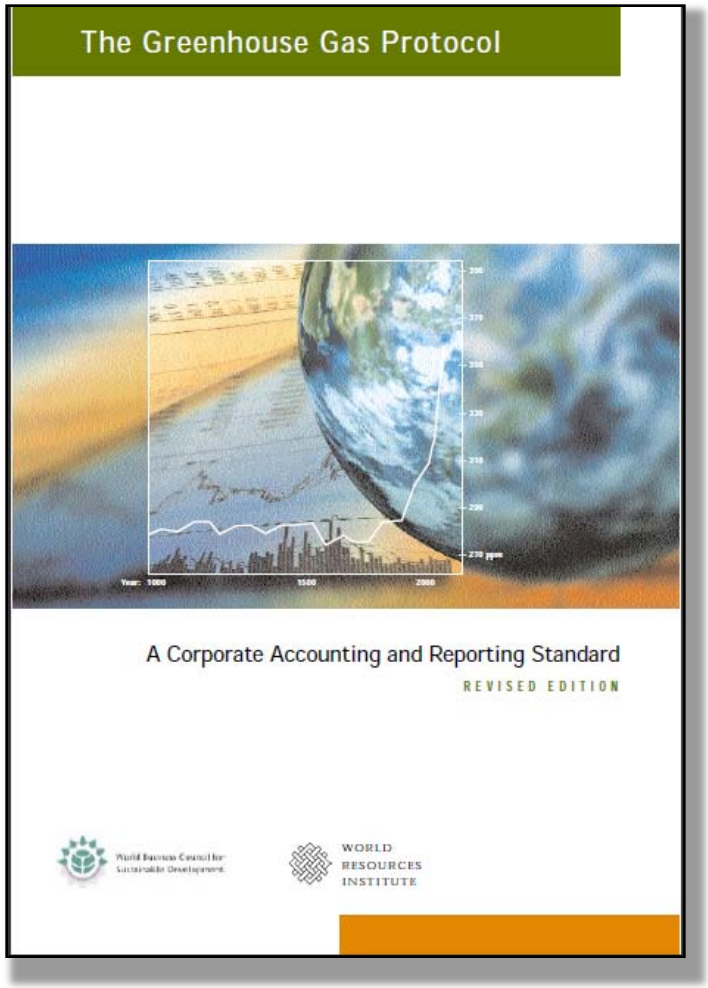
SCOPE 1:
Greenhouse gas emissions from sources that are owned or controlled by a Federal agency.

SCOPE 2:
Greenhouse gas emissions resulting from the generation of electricity, heat, or steam purchased by a Federal agency.

SCOPE 3:
Greenhouse gas emissions from sources not owned or directly controlled by a Federal agency but related to agency activities.

World Resources Institute Protocol

- Convened in 1998 by WRI & WBCSD
- Two main objectives:
  - *Standards development (Corporate and Project)*
  - *Harmonization of GHG practices*
- Calculation tools available
- For entity-level inventories
- Published in 2004
- Stakeholder process with over 200 businesses, NGOs, industry representatives
- Principles form the basis of major reporting programs



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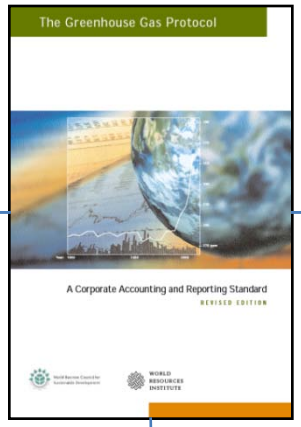
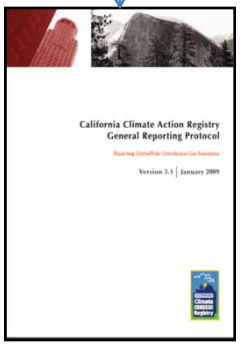
Protocols / Guidance

WBCSD/WRI
GHG Protocol

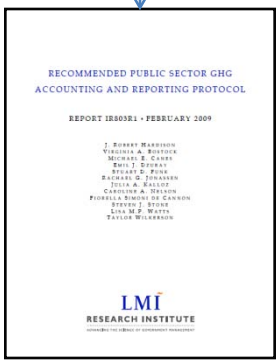


EPA Climate
Leaders
Guidance

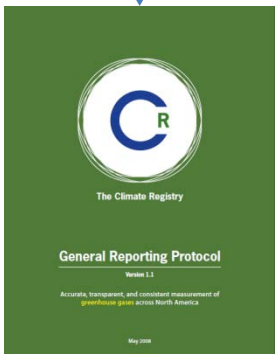
ISO 14064
Standards



CCAR Reporting
Protocol



Public Sector
Protocol



The Climate
Registry
Protocol

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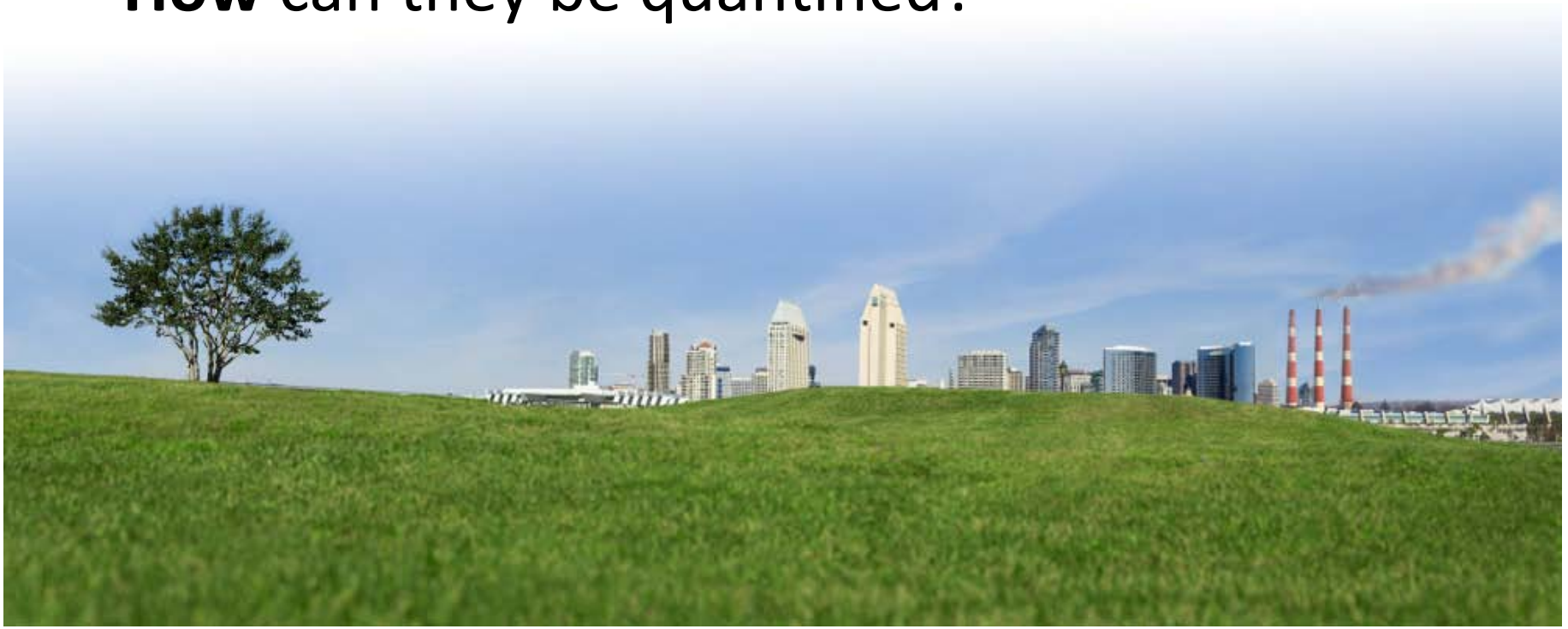

More Questions?

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