



# Greenhouse Gas Inventory 101: What to Consider When Starting an Inventory

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## *State and Local Clean Energy/Climate Program*

Assist state and local governments in their clean energy and climate efforts by providing technical assistance, analytical tools, and outreach support.

### **Clean Energy-Environment State Program:**

- Formal Partnership with 16 leading states to advance clean energy policies that achieve economic, public health, and environmental goals.
- Guidance, tools, and other assistance available to all states.

### **Clean Energy-Environment Municipal Network:**

- Informational network to facilitate access to tools, technical assistance, funding, and peer exchange for local governments.

<http://epa.gov/cleanenergy/energy-programs/state-and-local>





## *State and Local Clean Energy/Climate Program*

### EPA's Climate Change Website

- Greenhouse Gas Emissions—State
  - Energy CO<sub>2</sub> Emissions by State
  - State GHG Inventories
  - Inventory Guidance
  - <http://epa.gov/climatechange/emissions/state.html>
  
- What You Can Do—State and Local Governments
  - State and Regional Climate Action Maps
  - State Climate Action Plans
  - Local Actions
  - <http://epa.gov/climatechange/wycd/stateandlocalgov>





# *Topics to Consider*

- Purpose of inventory
- Inventory vs. registry
- Setting boundaries
- Sources and Gases
- Direct and Indirect Emissions
- Quantification approach
- Setting a baseline
- Timelines and level of effort
- Engaging stakeholders
- Certification
- Inventory results in context
- Tools, Protocols, and Resources



# *Why prepare an inventory?*

- To identify the greatest sources of GHG emissions within your geographic region
- To understand emission trends
- To quantify the benefits of specific activities that result in GHG emissions
- To provide a basis for developing an action plan
- To track progress at reducing emissions
- To set goals and targets for future reductions



## *What level of inventory?*

- Multi-state
- State
- Regional (e.g., MPO, COG, RPA)
- Local (e.g., cities participating in the Mayor's Climate Protection Agreement)
- Corporate
  - Entity-level
  - Project-level



# *Inventory vs. Registry-What's the Difference?*

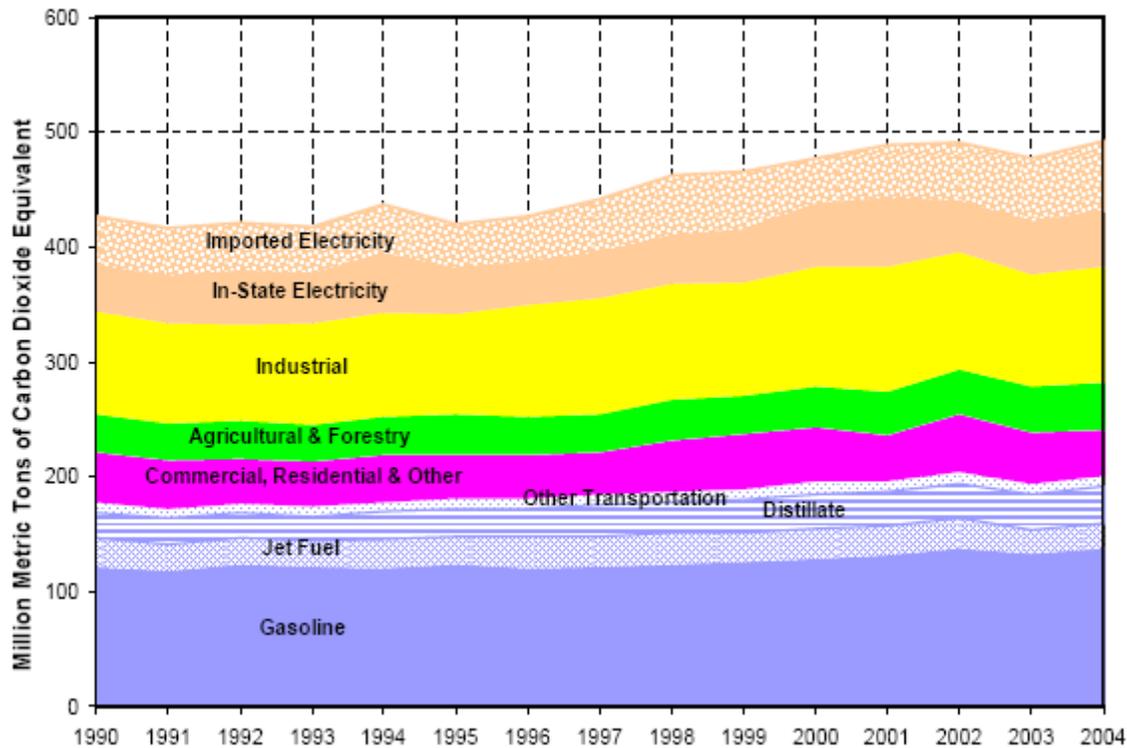
- Inventory
  - Accounts for GHG's emitted and removed from the atmosphere over a specific timeframe
  - Gives a snapshot of emissions from within a defined boundary
  - Follows established accounting guidance (e.g., IPCC, EIIP, WRI/WBCSD)
- Example: California GHG Inventory
  - All emissions within state borders (electric power, transportation, industrial, ag & forestry, and other)
  - Annual totals for each year, 1990-2004





# Inventories quantify the magnitude of emissions by source and by gas

## California's Gross GHG Emissions Trends



Source: CEC 2006





# *Inventory vs. Registry-What's the Difference?*

- Registry
  - An organized reporting system
  - May record GHG emissions or emission reductions
  - Can be voluntary or mandatory
  - Varying reporting level (project or entity-level)
  - May require verification (none, self, or 3<sup>rd</sup> party)
- Example: California Climate Action Registry
  - 344 total registry members
  - Each member conducts/submits an inventory





# Registries are a repository of inventories and reduction actions

## Some CA Climate Action Registry Members





## *Boundaries: Physical or Organizational?*

- Physical: emissions within a certain geographic region
  - the state of California
- Organizational: emissions within a certain entity's control
  - municipal operations in King County
- Project: emissions/reductions associated with a particular project



# *Which GHGs are included?*

	National (IPCC)	States (EIIP)	Cities for Climate Protection (CCP)
<b>CO<sub>2</sub></b>	✓	✓	✓
<b>N<sub>2</sub>O</b>	✓	✓	✓
<b>CH<sub>4</sub></b>	✓	✓	✓
<b>PFCs</b>	✓	✓	
<b>HFCs</b>	✓	✓	
<b>SF<sub>6</sub></b>	✓	✓	





## *Which sources should be included?*

- Energy (consumption, production, transport)
- Industrial Processes (non-energy process emissions)
- Solvent and Other Product Use
- Agriculture (animal and crop related)
- Land-Use Change and Forestry
- Waste (waste and wastewater management)

*Consider what is practical and useful to include*





# *What are Direct and Indirect Emissions?*

- Direct Emissions (aka scope 1)
  - Emissions that are released from activities within the inventory boundary
    - Fossil fuel combustion
    - Fertilizer application
    - Landfill operation
- Indirect Emissions (aka scope 2 and 3)
  - Emissions that occur outside the boundary because of activity or demand within the boundary
    - Purchased electricity
    - Off-site waste disposal
    - Lifecycle related emissions



## *Quiz: Direct or Indirect?*

Anycity, USA quantifies emissions from:

- **Direct** Municipal Waste to Energy plant that burns Anycity and Neighborcity's garbage
- Gasoline and diesel used by fleet **Direct**
- **Indirect** Electricity used in municipal buildings
- Natural gas used in municipal buildings **Direct**
- **Indirect** Gasoline used by municipal employee commuting
- Local wastewater treatment plant **It Depends**





## *Doublecounting Emissions?*

- Your indirect emissions are someone else's direct emissions, and possibly vice versa
- Neighborcity sent waste to your WTE plant:
  - they calculate the emissions associated with that waste as indirect emissions
  - your inventory includes all emissions from the plant as direct emissions
- What happens when Home County adds your inventories together to get total county emissions?
- Always report your emissions as direct or indirect to facilitate comparison and avoid erroneous accounting





## *What Quantification Approach to Use?*

- Top-down
  - Uses Aggregated Data (often compiled by govt agencies) to provide a big-picture view of total emissions
- Bottom-up
  - Uses more detailed data (often representing end use information) to provide more detailed but often less inclusive picture.



## *Examples of Quantification Approaches— State Level Industrial Energy Use*

- Top-down
  - Use DOE’s State Energy Data Reports on state-wide industrial fossil fuel consumption
- Bottom-up
  - Request data from each industrial facility in the state on their fossil fuel consumption



## *Examples of Quantification Approaches— Local Government Building Energy Use*

- Top-down
  - Acquire total energy consumption data from utility or calculate based on energy expenditures to generate total emissions from local government fossil fuel use
- Bottom-up
  - Track each building's fossil fuel consumption individually and calculate resultant emissions





# *Pros and Cons of Quantification Approaches*

- Top-down-Advantages
  - Quick, efficient, and comprehensive estimates
  - Good for tracking large trends over time
  - Keeps data manageable for large sectors
  - Errors tend to average out across sector
- Top-down-Disadvantages
  - Lose ability to compare different facilities/buildings/industries
  - Aggregated data isn't always available or credible—especially at the sub-state level





# *Pros and Cons of Quantification Approaches*

- **Bottom-up Advantages**
  - More detailed analysis is possible
  - May better identify targets for mitigation planning
  - Can be used when high-level data is unavailable
- **Bottom-up Disadvantages**
  - Requires more data—more time consuming to collect and manage
  - Detailed data isn't always complete or consistent





# *How do I Choose a Baseline Year?*

- Think it through!
  - How will baseline data be used?
  - Are there anomalies present in the baseline (uncharacteristically high or low emissions)?
  - How will regulatory or voluntary efforts proposed or in progress affect baseline and/or future emissions?
  - Will the baseline be compatible with baselines being used elsewhere?
  - Is the data available?



## *It All Comes Down to Data*

- Availability
  - 1990 data can be difficult to obtain
- Quality
  - Bottom-up v. top-down
  - How is it collected?
  - Is it verified? Is it credible?
- Scale
  - Entity-level, state-level, national-level



# *How Long Does an Inventory Take?*

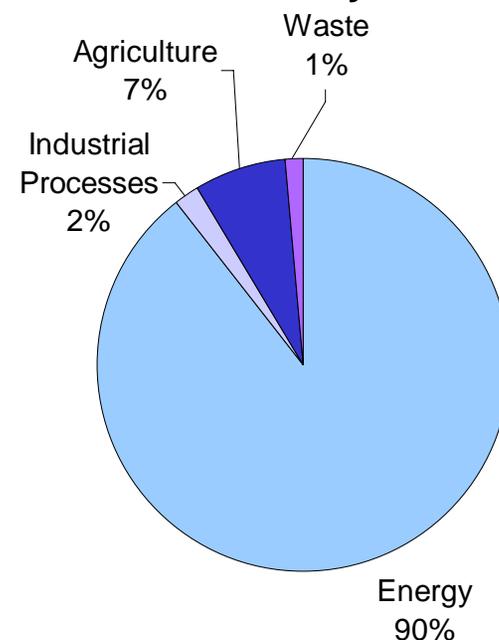
- Timeline dependent on:
  - Data availability and vintage
  - Reporting requirements
  - Reduction commitments
- Level of effort dependant on:
  - Resources (human, and economic)
  - Data availability and access
  - Level of detail (number of gases, number of sources, level of disaggregation)
  - Top-down vs bottom-up
  - Adoption of 80/20 rule



## *What is the 80/20 rule?*

- Focus efforts on the “most important” sources
- Sometimes only 20% of the effort is needed to quantify 80% of emissions
- Focus on:
  - Energy use: Stationary and Transportation

**New Mexico Inventory Year 2000**





## *Why Engage Stakeholders?*

- How can they contribute?
  - Data, resources, outreach, public support
- Who to Engage?
  - NGOs
  - Community groups
  - Schools and Universities
  - Other Government Agencies



# *Does an Inventory Need Certification?*

- Certification: 3<sup>rd</sup> party review of methodology and underlying data to ensure inventory is complete, consistent and accurate
- Requirements Depend on Reporting Framework
- A Few Certification Protocols
  - California Climate Action Registry *General Reporting Protocol*, version 2.2 (March 2007)
  - ISO 14064-1 (inventory) and 14064-3 (verification) standards
  - Environmental Resources Trust, Inc.'s Corporate Greenhouse Gas Verification Guideline (CGVG)



# *Putting Inventory Results in Context*

- Comparison to other inventories
  - State summaries available on EPA website
  - Climate Analysis Indicator Tool (CAIT)
  - Adding local links to EPA site this summer
- Make sure to compare equivalent numbers
- Order of magnitude checks
- Use of Indicators
  - Per capita or per household
  - Per unity of economic activity





# *What Tools Can I Use?*

	Source	Tools/Protocols
National	EPA (2006 IPCC Guidelines for National GHG Inventories)	U.S. Inventory Report
State	EPA	EIIP Guidance, EPA State Inventory Tool
Local	ICLEI/NACAA/EPA	Clean Air and Climate Protection Software
	ICLEI/CA Registry/Climate Registry	Local Government Protocol (under development)
	EPA/DVRPC	Regional Inventory Protocol (under development)
Corporate	WRI/WBCSD/EPA	worksheets and calculators
	CA Registry/The Climate Registry	Registry worksheets/software





# Additional EPA Quantification Tools

Tool	Purpose
eGRID and Power Profiler	Database on emissions attributes of all U.S. electric power generation and accompanying tool interface
Portfolio Manager	web tool tracks building energy performance and emissions over time
Waste Reduction Model (WARM) and LandGEM	Calculate emissions from landfill and waste management
Climate CHange Emissions Calculator Kit (Climate CHECK)	Educational school inventory tool for middle and high school students
Personal Emissions Calculator	Estimates household GHG emissions
GHG Equivalencies Calculator	Converts raw emissions data into everyday terms





## *Additional Resources*

### **Greenhouse Gas Inventory Basic Information:**

- <http://epa.gov/climatechange/emissions/index.html#inv>

### **State Greenhouse Gas Data and Protocols:**

- <http://epa.gov/climatechange/emissions/state.html>

### **Climate Analysis Indicators Tool (WRI)**

- <http://cait.wri.org/>

### **California Climate Action Registry and Protocols:**

- <http://www.climateregistry.org>

### **Clean Air and Climate Protection Software (CACCP)**

- <http://www.cacpsoftware.org/>

### **Greenhouse Gas Equivalencies Calculator**

<http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

### **Personal GHG Emissions Calculator**

[http://www.epa.gov/climatechange/emissions/ind\\_calculator.html](http://www.epa.gov/climatechange/emissions/ind_calculator.html)





# *Additional resources*

## **Portfolio Manager**

- [http://www.energystar.gov/index.cfm?c=evaluate\\_performance.bus\\_portfolio.manager](http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfolio.manager)

## **Emissions & Generation Resource Integrated Database (eGRID)**

- <http://www.epa.gov/egrid>

## **Power Profiler**

- <http://www.epa.gov/cleanenergy/energy-and-you/how-clean.html>

## **Climate CHange Emissions Calculator Kit (Climate CHECK)**

- <http://www.epa.gov/climatechange/wycd/school.html>

## **Waste Management Related Tools**

- <http://www.epa.gov/climatechange/wycd/waste/tools.html>
- <http://www.epa.gov/lmop/res/index.htm#5>

## **Transportation Related Tools**

- <http://www.epa.gov/otaq/stateresources/tools.htm>
- <http://www.epa.gov/greenvehicles>





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