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**Quantifying GHG Emissions Using the
General Reporting Protocol (GRP)**

**December 10 & 11, 2009
Kati Price and Robyn Camp
GHG Reporting Workshop**



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Tools for reporting

- **Regulation**
 - Details what facilities are required to report, what emissions must be reported, and deadlines
- **General Reporting Protocol (GRP)**
 - Provides calculation methodologies for CO₂ and five other GHGs
- **MA greenhouse gas registry software (CRIS)**
 - Calculates your emission totals based on the information you provide:
 - Annual fuel consumption totals, CEM readings, specific emission factors



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Reporting Basics

Collect
required
emissions
data

Quantify
emissions
according to
Registry
methods into
CRIS

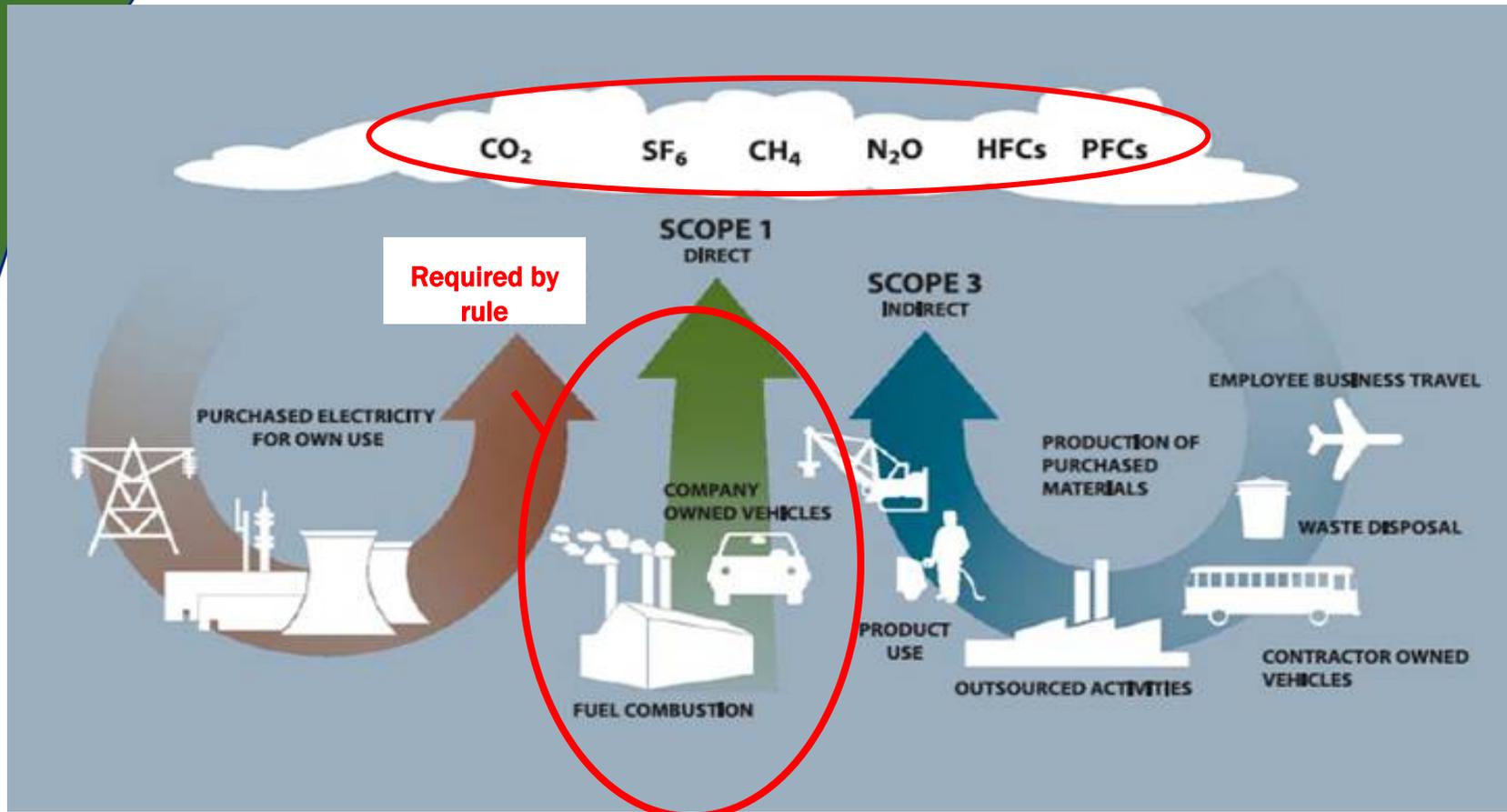
Report
Massachusetts
emissions

Verify
(Triennial)
emissions
with a
Verification
Body



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Reporting Requirements



- CRIS will provide calculation tools for some activities:
 - CO₂, CH₄, N₂O



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Collecting the data: Common Sources

Emission Source	Emission Type	Gases Reported	Activity Data Needed	Where to find Activity Data for CRIS
Boilers, Generators On site heating and cooling	Stationary Combustion	CO ₂ , CH ₄ , N ₂ O	Fuel consumption, Equipment type	Fuel supplier, Fuel purchase records, onsite meter
Vehicle Fleets, etc.	Mobile Sources	CO ₂ , CH ₄ , N ₂ O	Fuel consumption, total Vehicle miles traveled, vehicle fuel economy, etc.	Fleet management, Accounts payable
Electricity T&D activities	Fugitive Emissions	SF ₆	Inventory purchased and used	Purchase records, fuel purchase records, maintenance records
Refrigeration	Fugitive Emissions	HFCs & PFCs	Type and quantity of refrigerant, quantity of refrigerant used to charge.	Maintenance records, Coolant purchase records, charge of new equipment, etc.



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Integrating data collection

- Creating and reporting a verifiable inventory is an annual process
- Data collection can be built into your existing data management systems
 - Accounting records
 - Fleet records
 - Facility management



What gets measured gets managed



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Calculate Emissions



The General Reporting Protocol (GRP) is organized into three parts:

Part I: Introduction

Part II: Determining What You Should Report

- For MassDEP reporters this is determined by regulation
- Chapter 6: Aggregation

Part III: Quantifying Emissions

- Chapter 10: Intro to Quantifying your Emissions - Tiers
- Chapter 11: Simplified Estimation Methods
- Chapter 12: Direct Emissions from Stationary combustion
- Chapter 13: Direct Emissions from Mobile combustion
- Chapter 16: Direct Fugitive Emissions from the Use of Refrigeration and Air Conditioning Equipment.
- Appendix E: Direct Emissions from Sector-Specific Sources



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Calculate Emissions

For each source, you will enter one of these:

A. CEM data

Or

B. Annual Fuel Usage and an Emission Factor*

Annual Fuel Usage X Emission Factor X Conversion Factor = Tons of CO₂/CO₂e

* For emission factors

a. Customize an emission factor for a Tier A method based on fuel specific characteristics

$$\text{Emission Factor} = \text{Fuel Density} \times \text{Carbon Content} \times \% \text{Oxidized} \times 44/12$$

(kg CO₂/gallon) (kg/gallon) (kg C/MMBtu) (default=100) (CO₂/C)

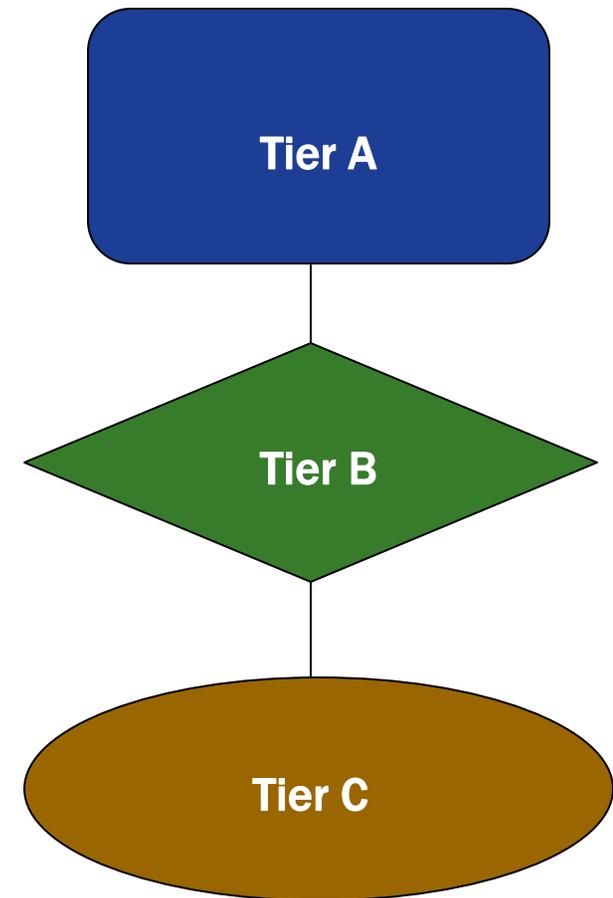
b. CRIS automatically assigns a default factor for Tier B or C that for you based on the equipment type you choose

and then CRIS will calculate your GHG emissions...



Calculation Tiers

- Each Chapter includes a set of data calculation tiers.
- Tier A represents the preferred approach for a given emissions source; Tier B represents the second best approach, etc.
- In some cases there may be multiple, equally accurate, approaches within the same tiered ranking (such as A1 and A2)





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Calculating CO₂ for Stationary Combustion

1. Determine annual fuel consumption of each type of fuel or use direct measurement
2. Determine the appropriate CO₂ emission factor for each fuel

Tier	Quantification	CRIS will...
Tier A1	Direct Measurement	Calculate CO ₂ e
Tier A2	Collect carbon, heat content of each fuel and annual fuel consumption.	Calculate CO ₂ e and CO ₂ based on your custom emission factor
Tier B	Collect either carbon or heat content of each fuel and annual fuel consumption. Use the defaults from Tables 12.1-12.4 to combine with your more specific data.	Calculate CO ₂ e and CO ₂ based on your custom emission factor
Tier C	Collect annual fuel consumption, CRIS will assign an emission factor based on Tables 12.1 & 12.2	Calculate CO ₂ e and CO ₂ using a default factor

See CRB Chapter 12



Example: CO₂ for stationary combustion

Step 1: Determine annual consumption of each fuel combusted at the facility

Fuel Type	Sector	Annual Consumption
Natural Gas	Industrial	769,921,800 scf

Step 2: Determine the appropriate emission factors for each fuel for Tier A if there is no CEM (company obtained fuel characteristics from its fuel suppliers)

$$\text{Emission Factor} = \text{Heat Content} \times \text{Carbon Content} \times \% \text{Oxidized} \times \frac{44}{12}$$

(kg CO₂/gallon) (MMBtu/gallon) (kg C/MMBtu) (default=100) (CO₂/C)

Step 3: Enter specific emissions factor and annual fuel consumption (769,921,800 scf) into software to calculate total CO₂ emissions

Slide 12

k3

Include screen shots from CRIS (Larix if possible!)

kprice, 12/3/2009



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Calculating CH₄ & N₂O for Stationary Combustion

1. Determine annual fuel consumption of each type of fuel
2. Determine the appropriate CH₄ & N₂O emission factor for each fuel

Tier	Quantification	CRIS will...
Tier A	Use direct monitoring to obtain specific emission factors	Calculate CO ₂ e emissions
Tier B/C	Collect annual fuel consumption and based on the specific type of combustion equipment used at your facilities, CRIS will assign the appropriate emission factor (see GRP Tables 12.5-12.8)	Calculate CO ₂ e and CH ₄ & N ₂ O emissions using a default factor

See GRP Chapter 12



Calculating CO₂ for Mobile Combustion

1. Identify total annual fuel consumption by fuel type.
2. Select the appropriate CO₂ emission factor for each fuel.

Tiers	Quantification	CRIS will...
Tier A1	Collect either fuel density & carbon content or heat content & carbon content of each fuel and annual fuel consumption.	Calculate CO ₂ e and CO ₂ based on your custom emission factor
Tier A2	Collect measured carbon content data and annual fuel consumption and use a default heat content factor from Table 13.1.	Calculate CO ₂ e and CO ₂ based on your custom emission factor
Tier B/C	Collect annual fuel consumption and use the default factors from Tables 13.1.	Calculate CO ₂ e and CO ₂ based on a default emission factor

Slide 14

k7

You can have vehicle information (you are not *required* to have fuel information

kprice, 12/3/2009



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Example: CO₂ for mobile emissions

Step 1: Identify annual fuel consumption by fuel type

Vehicle Type	Fuel	Model Year	No. of Vehicles	Annual Gallons
Passenger Cars	Motor Gasoline	2000	20	40,000

Annual Total Gasoline Consumption: 40,000 gallons

Step 2: Determine the appropriate emission factors for each fuel for Tier A (company obtained fuel characteristics from its fuel suppliers)

Emission Factor = Fuel Density × Carbon Content × % Oxidized × 44/12
(kg CO₂/gallon) (kg/gallon) (kg C/MMBtu) (default=100) (CO₂/C)

Step 3: Enter specific emissions factor and annual fuel consumption (40,000 gallons) into software to calculate total CO₂ emissions



Calculating CH₄ and N₂O for Mobile Combustion

1. Identify the vehicle type, fuel type, and technology type of model year for each vehicle you own and operate.
2. Identify the annual mileage by vehicle type.
3. Select the appropriate emission factor for each vehicle type.

Tier	Quantification	CRIS will...
Tier A	Enter annual mileage driven and specify the actual control technology employed in each vehicle in CRIS (see GRP Tables 13.3, 13.5-6)	Calculate CH ₄ & N ₂ O using a default factor
Tier B	Enter annual mileage driven and specify vehicle model year - software will assign an emission factor based on Tables 13.4, 13.5-6	Calculate CH ₄ & N ₂ O using a default factor
Tier C	Determine your vehicle model years and use your fuel use and fuel economy to calculate mileage to enter into CRIS.	Calculate CH ₄ & N ₂ O using a default factor

See GRP Chapter 13

Slide 16

RC4

Will says: most people will probably use this, will be reassured to think they can use vehicle info

Robyn Camp, 12/3/2009



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Example: CH₄ & N₂O for mobile emissions

Tier A:

Step 1: Identify vehicle type and vehicle technology

Vehicle Type: Passenger Car, Low emission vehicle or model Year 2000

Step 2: Identify the annual mileage by fuel type

Number of vehicles: 20, **Annual Mileage:** 400,000

Step 3: Select vehicle type and technology and enter annual miles driven (400,000) into software to calculate total CH₄ & N₂O emissions



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Quantifying Process Emissions

■ GRP Appendix E

- ❑ Adipic acid production
- ❑ Aluminum production
- ❑ Ammonia production
- ❑ Cement production
- ❑ Electricity transmission and distribution
- ❑ HCFC-22 production
- ❑ Iron and steel production
- ❑ Lime production
- ❑ Nitric acid production
- ❑ Pulp and paper production
- ❑ Refrigeration and air condition equipment manufacturing
- ❑ Semiconductor manufacturing



- If the Registry has not endorsed guidelines for quantifying emissions from a particular emissions source, you should use existing industry best practice methods.
- Industry best practice is information that has been peer reviewed and published, e.g., EPA, Mass protocols, TCR protocols, etc.



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Quantifying Fugitive Emissions

From refrigeration and air conditioning

Tier	Quantification	CRIS will...
Tier A	Calculate Changes to the base inventory for each HFC and PFC	Convert to units of CO ₂ e
Tier B	Determine types and quantities of refrigerants present in the inventory; estimate annual emissions of each type of refrigerant	Convert to units of CO ₂ e

From SF₆ from the Electric Power Sector

- Use Industry Best Practice

See GRP Chapter 16



Simplified Estimation Methods

- To ease the reporting burden, reporters may estimate up to 1000 short tons of **CO₂e**
 - from any combination of sources and/or gases

- Simplified Estimation Methods use upper-bound assumptions following the principle of conservativeness, i.e. erring on the side of overestimating rather than underestimating your emissions

- Estimated emissions must be documented *and* verified
 - Assumptions can be re-used



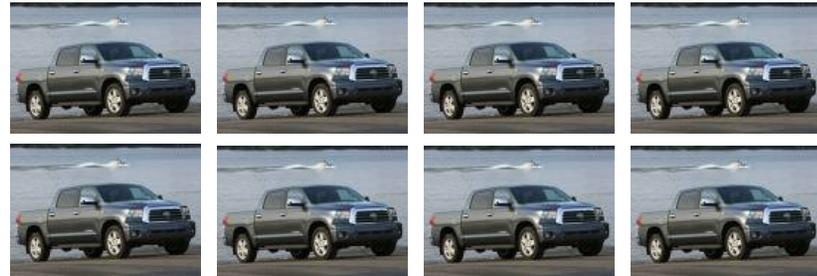
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Example: How to use simplified estimation

Massachusetts Manufacturing (MAM). has 10 vehicles that support a facility:



Two (2) 2004 Toyota Camrys



Eight (8) 2000 Toyota Tundras

They don't track mileage or fuel consumption.

They can identify the truck that was driven the most by checking vehicle mileage logs.

MAM made the following conservative estimate:

- 1) 20,000 annual miles driven by the highest-mileage Toyota Tundra
- 2) 20,000 x 10 vehicles in fleet

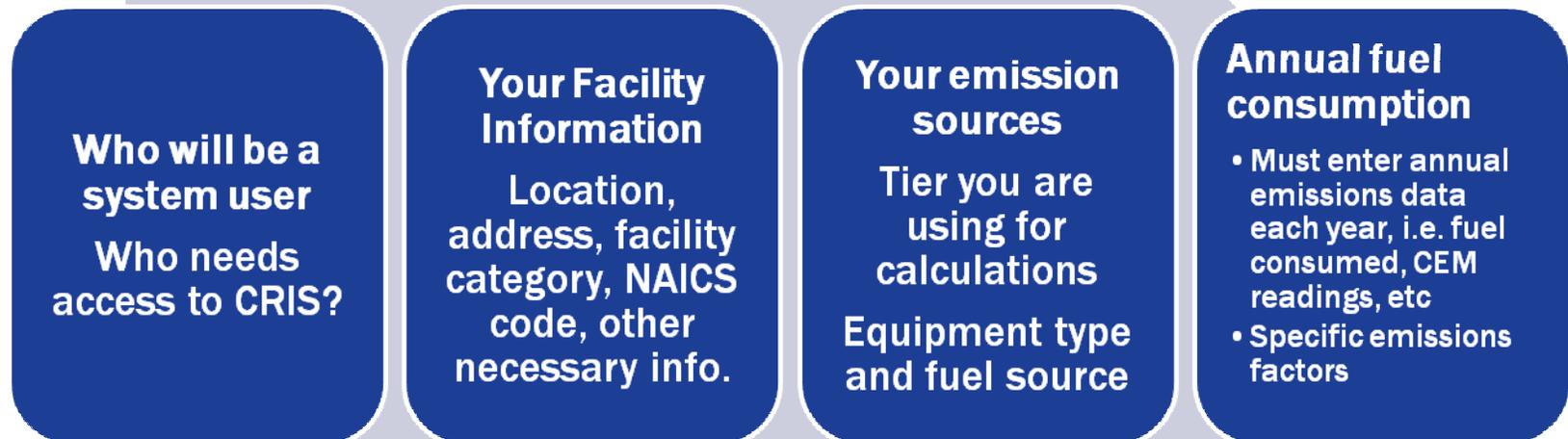
These methods were described and disclosed in the CRIS report.



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Report data into the MA Greenhouse Gas Registry

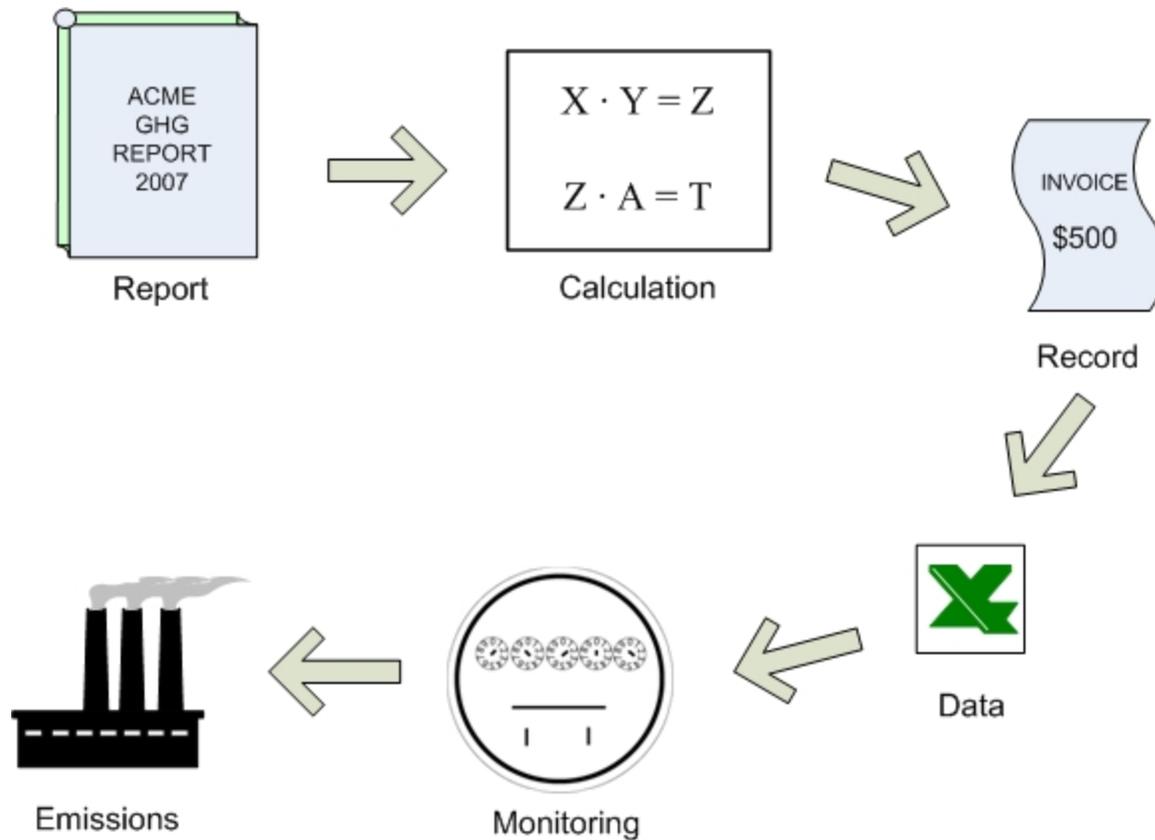
To report in CRIS you will need to know:





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Good data management establishes a clear trail for compliance and verification



Graphic courtesy of:

First Environment



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Additional Trainings

- Sign up for trainings at MassDEP's website
www.mass.gov/dep/air/climate/reporting.htm
- Trainings are on-line through *GoToWebinar*
 - You will need to download a plug-in to participate
 - Online trainings on the GRP and CRIS:
 - 1 hour module each
 - Offered during reporting season
 - Recorded presentations will also be available
 - Reporting Tips page under Reporting Toolkit:
<http://www.theclimateretry.org/resources/reporting-toolkit/>



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For More Information

**Check MassDEP's website
in January/February**

www.mass.gov/dep/air/climate/reporting.htm

**Upcoming training schedule and helpline
and help email**

www.TheClimateRegistry.org