Civil & Environmental Consultants, Inc.

Scope 1, 2, & 3 GHG Emission Inventories

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PIOGATech Air Quality Technical Seminar

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Agenda

- GHG Inventory Purposes and Requirements
- GHG Emission Sources
  - Scope 1: Direct Emissions
  - Scope 2: Indirect Emissions
  - Scope 3: Value Chain Emissions
- Inventory Development Challenges
- Inventory Best Practices
- Q&A

Greenhouse Gases

Six Key GHGs

GHG	100-year GWP	Common Sources
Carbon Dioxide (CO_2)	1	Combustion, Gas Venting
Methane (CH_4)	25	Gas Venting, Agriculture, Combustion
Nitrous Oxide (N_2O)	298	Agriculture, Combustion
Sulfur Hexafluoride (SF_6)	22,800	Electrical Transmission Equipment
Perfluorocarbons (PFCs)	6,288 – 17,340	Aluminum & Semiconductor Production
Hydrofluorocarbons (HFCs)	12 – 14,800	ODS Substitutes

Greenhouse Gas Reporting

- EPA Mandatory Reporting Rule for Greenhouse Gas Emission
  - 40 CFR Part 98
  - Subpart W: Petroleum and Natural Gas Systems
- Annual Emission Statement
- Benchmarking, sustainability, and other voluntary reports
  - Carbon Disclosure Project (CDP)
  - ONE Future
  - Corporate Responsibility or Sustainability Reports
- Quantification towards Net Zero or other science-based targets

Where does the data go?

- Regulators and private organizations
  - Can be tied to annual fees
  - May include confidential business information
  - Benchmarking studies often blind data for analysis or publication
- Nearly all reported data becomes public information for those willing to look
  - Peers
  - NGOs
  - Media
  - Stockholders
  - FOIA Requests

Where does the data go?

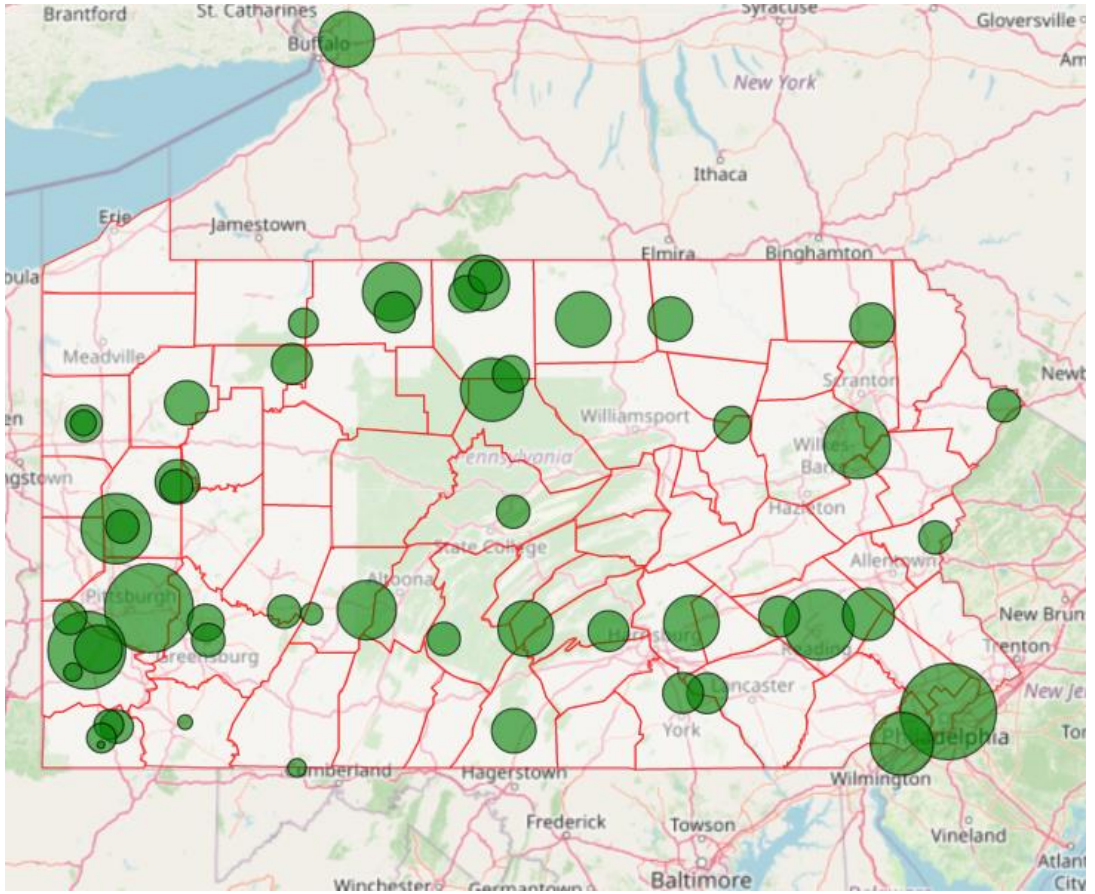
EPA

flight
Facility Level Information on GreenHouse gases Tool

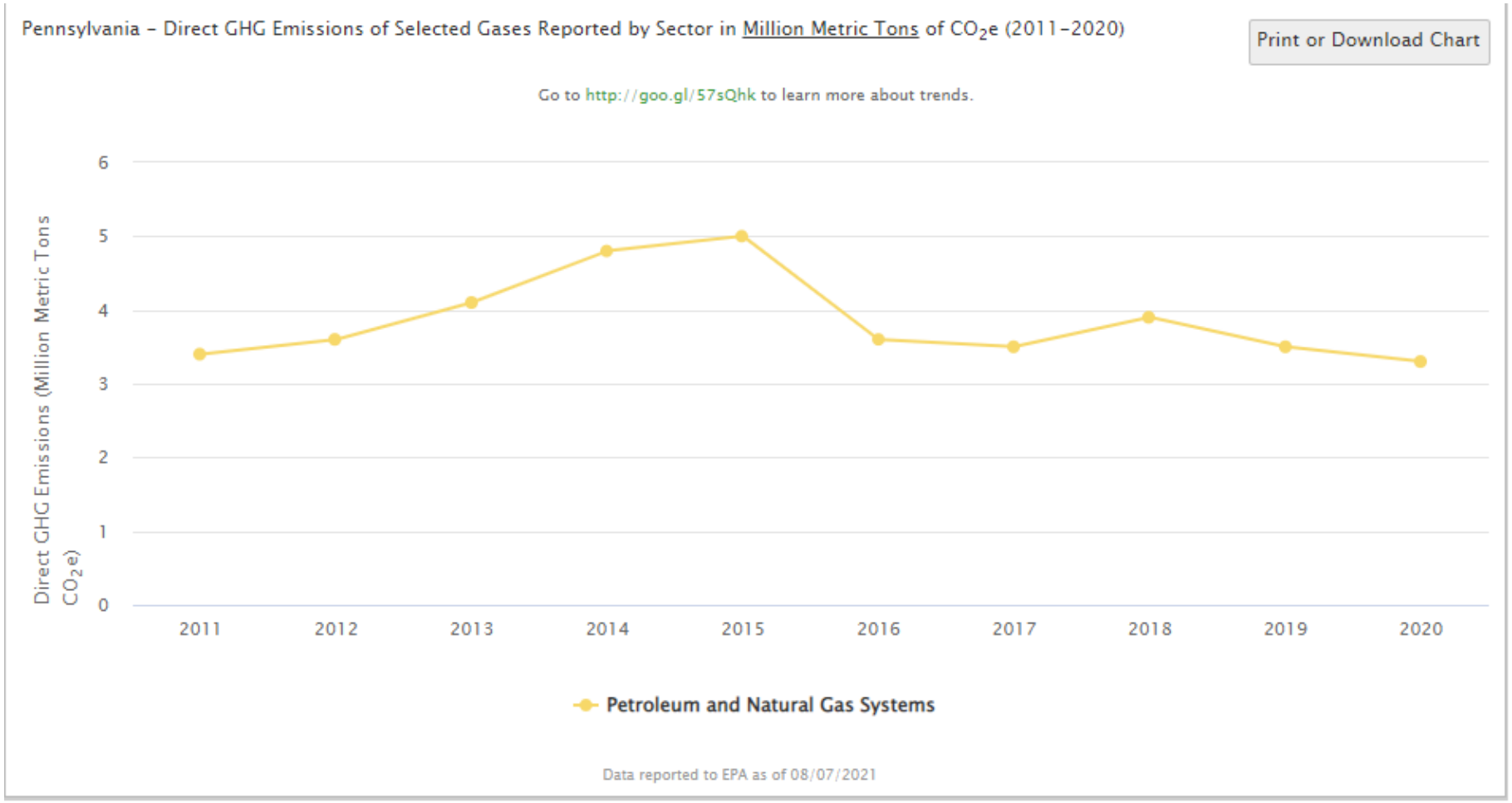
Refresh View

2020 Greenhouse Gas Emissions from Large Facilities

Sector	Filter Sectors (filtered)	Petroleum and Natural Gas Systems
2020 GHG Emissions (Million Metric Tons CO_2e)		3.3
# of Reporting Facilities		53



Where does the data go?



Inventory Development

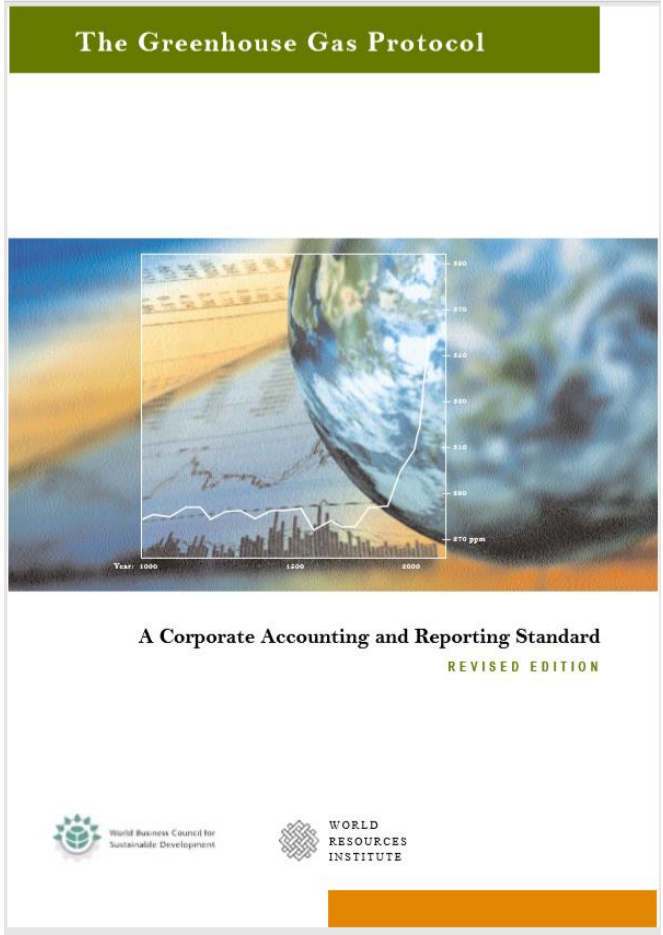
1. Determine requirements or inventory goals.
2. Identify emission sources.
3. Determine calculation methodologies.
4. Identify raw data sources.
5. Document.

Greenhouse Gas Protocol

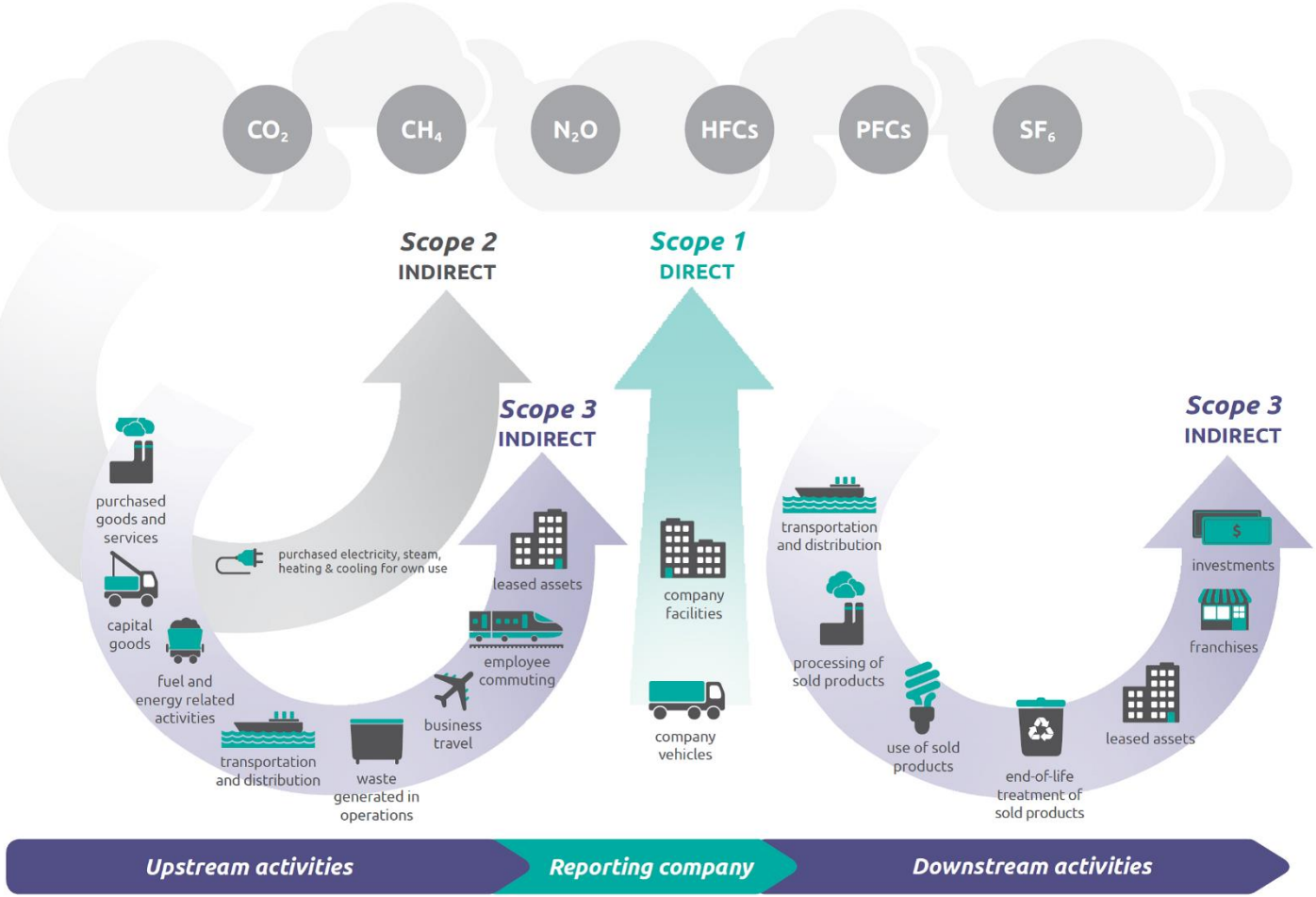
- Greenhouse Gas Protocol
  - World Resources Institute (WRI) & World Business Council for Sustainable Development (WBCSD) partnership
  - First published in 2001
  - Provides global standardized frameworks to measure and manage GHG emissions
- In 2016, 92% of Fortune 500 companies responding to the CDP used GHG Protocol directly or indirectly through a program based on GHG Protocol.

GHG Protocol Corporate Standard

- Designed to streamline and standardize corporate-level GHG inventories
- Includes five GHG accounting and reporting principles
  - Relevance
  - Completeness
  - Consistency
  - Transparency
  - Accuracy
- Accounting and reporting principles easily translate to any reporting program



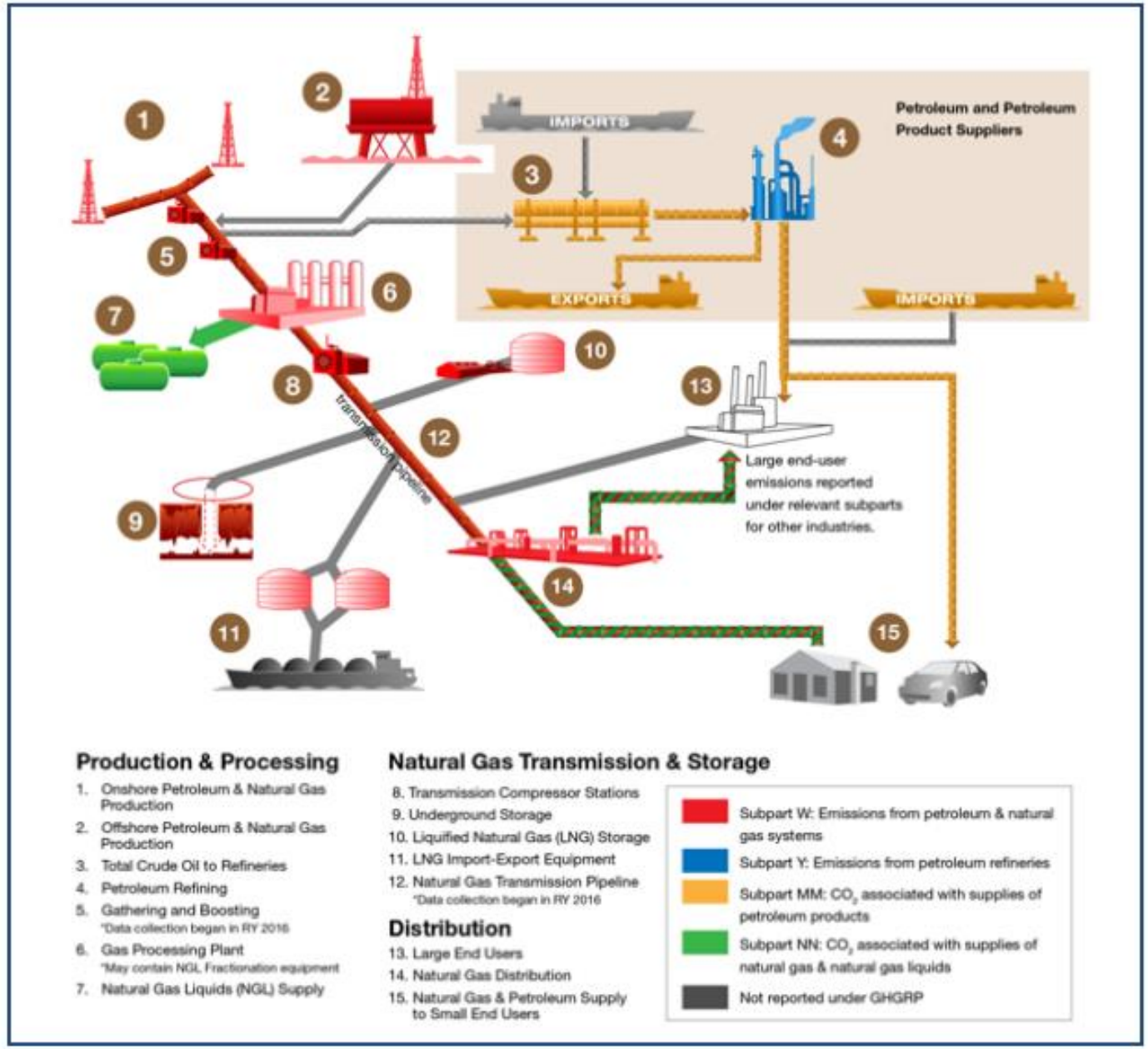
GHG Emission Sources



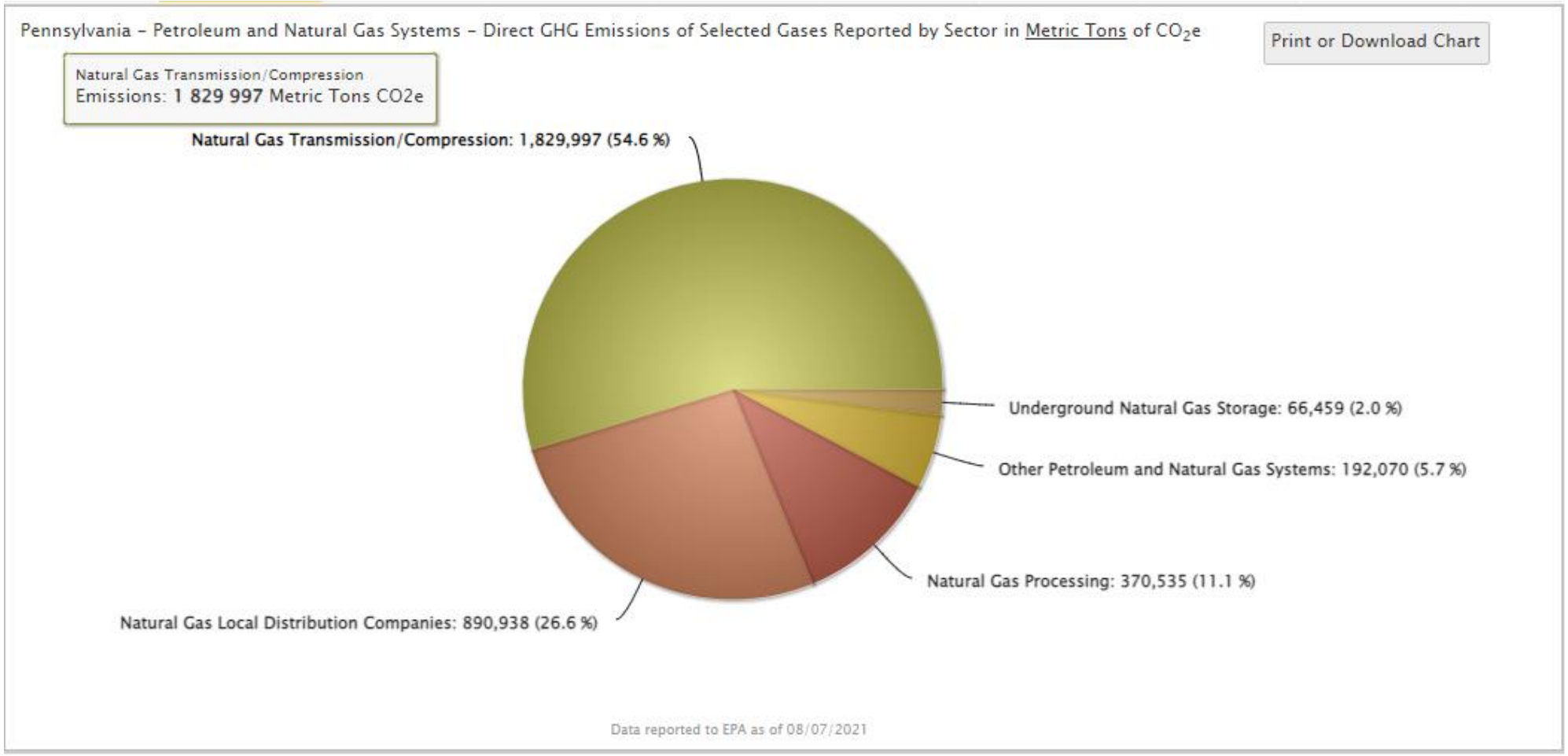
Scope 1

- Emissions generated by the facility within the facility fenceline.
- Largest contributions are typically combustion (i.e., compressor engines) and venting.
- Company vehicles can be considered as Scope 1 emissions if they are solely used for business purposes (not commuting), but they are not included in EPA Mandatory Reporting.

Figure 1: Petroleum and Natural Gas Operations Covered by the GHG Reporting Program

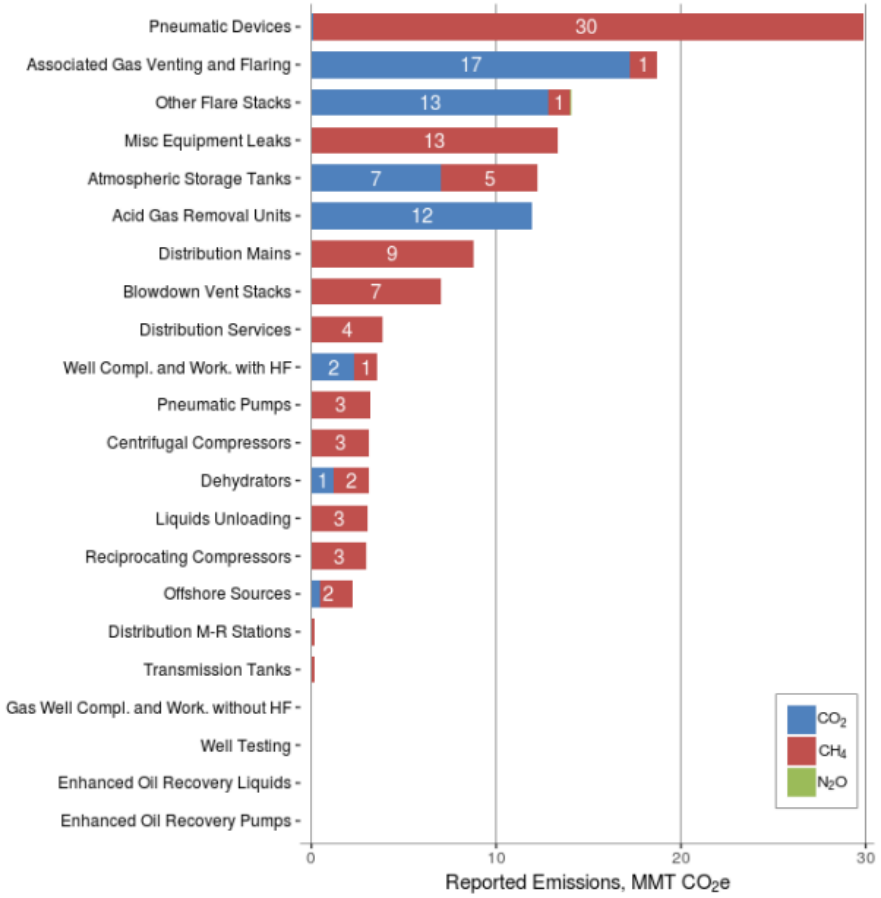


Subpart W Source Categories



Subpart W Emission Source Types

Figure 4: 2018 Reported Process Emission Sources



- Natural gas pneumatic device and pump venting
- Well venting for liquids unloading, workovers and completions
- Flare stack emissions
- Storage tank emissions
- Compressor venting
- Well testing venting and flaring
- Associated gas venting and flaring
- Dehydrator vents
- Blowdowns venting
- Acid gas removal vents
- Equipment leaks
- Combustion

Scope 1 Emission Calculation

- Emission Factors (i.e. combustion)

$$E_{CO_2}\left(\frac{lb\ CO_2}{hr}\right) = natural\ gas\ combusted\left(\frac{MMscf}{hr}\right) \times HHV\left(\frac{BTU}{scf}\right) \times EF\left(\frac{lb\ CO_2}{MMBtu}\right)$$

- Use best available data that meets all reporting framework requirements.

Scope 1 Emission Calculation

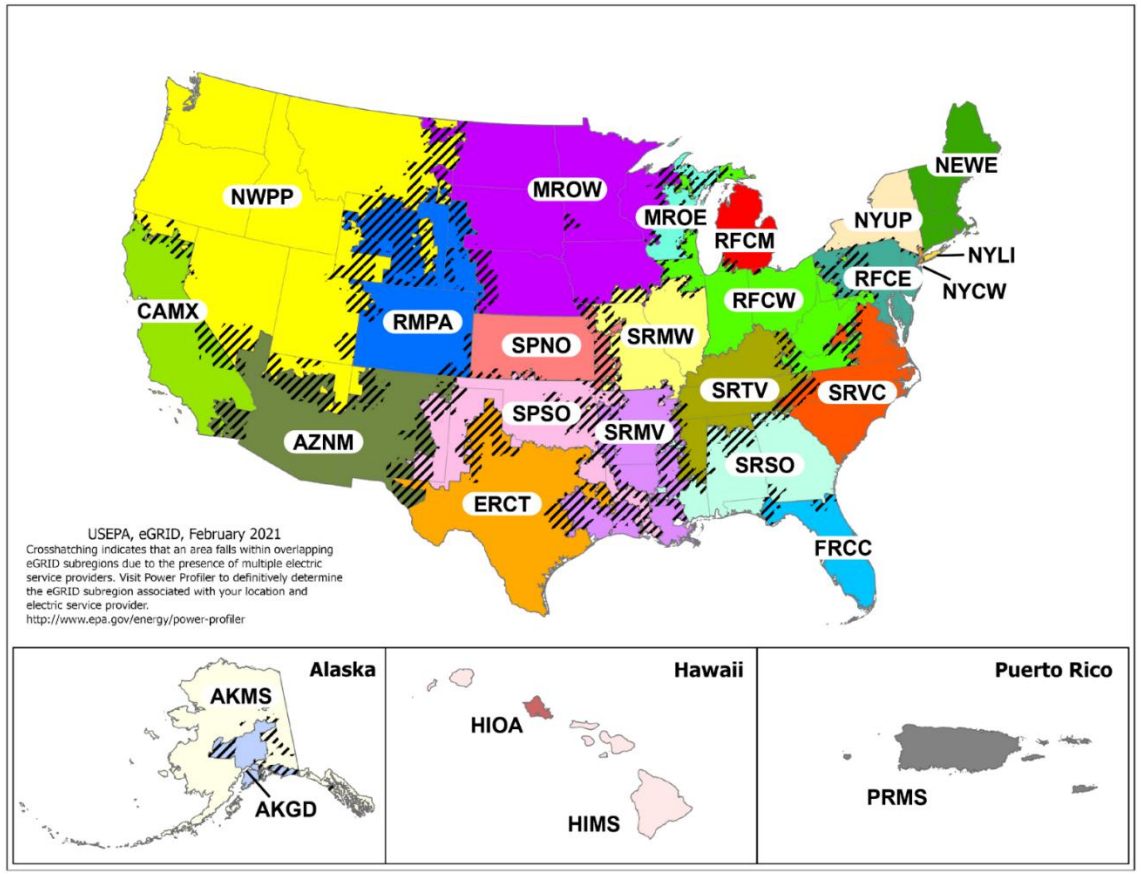
- Mass Balance or Other Engineering Estimate (i.e. venting and flaring)

$$E_{CO_2}\left(\frac{lb\ CO_2}{hr}\right) = gas\ vented\ \left(\frac{scf}{hr}\right) \times CO_2\ concentration\ (mol\ fraction) \times density\ \left(\frac{lb\ CO_2}{scf\ CO_2}\right)$$

- Use best available data that meets all reporting framework requirements.

Scope 2

- Emissions from the generation of electricity and steam on the facilities' behalf.
- Utility bill are the most accurate source of usage data.
- If known, generation location can refine emission factors.

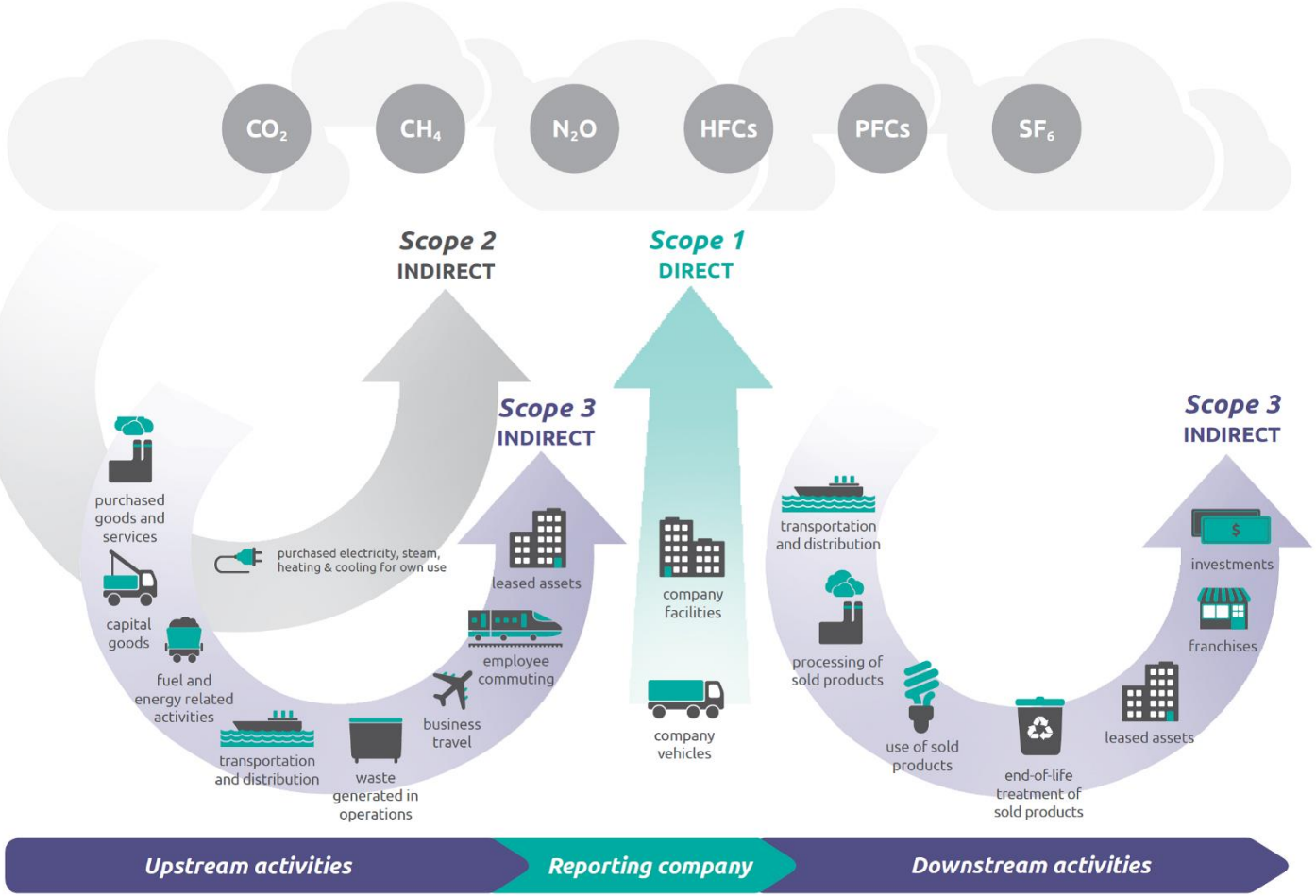


Scope 1 & 2 Questions?

Scope 3

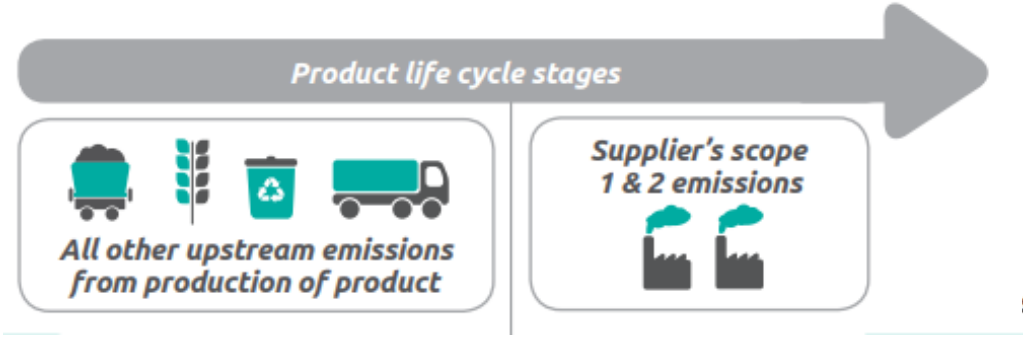
- Indirect emissions that occur up or downstream in the value chain from the facility such as production of purchased products or use of sold products.
- Combustion of oil and natural gas sold can dwarf all Scope 1 and 2 emissions from a facility.
- It is up to the company to determine which Scope 3 emission categories are relevant and material to their operations.
  - GHG Protocol identifies 15 categories of Scope 3 activities.

Scope 3


CO_2
CH_4
N_2O
HFCs
PFCs
SF_6
Scope 2
INDIRECT
Scope 1
DIRECT
Scope 3
INDIRECT
Scope 3
INDIRECT
purchased goods and services
capital goods
fuel and energy related activities
transportation and distribution
waste generated in operations
business travel
employee commuting
leased assets
purchased electricity, steam, heating & cooling for own use
company facilities
company vehicles
transportation and distribution
processing of sold products
use of sold products
end-of-life treatment of sold products
leased assets
franchises
investments
Upstream activities
Reporting company
Downstream activities

“Upstream” Scope 3 Emissions

1. Purchased Goods and Services
   - Includes all emissions from the production of tangible products purchased or acquired and intangible services purchased or acquired.
2. Capital Goods
   - i.e., plant, property, and equipment



“Upstream” Scope 3 Emissions

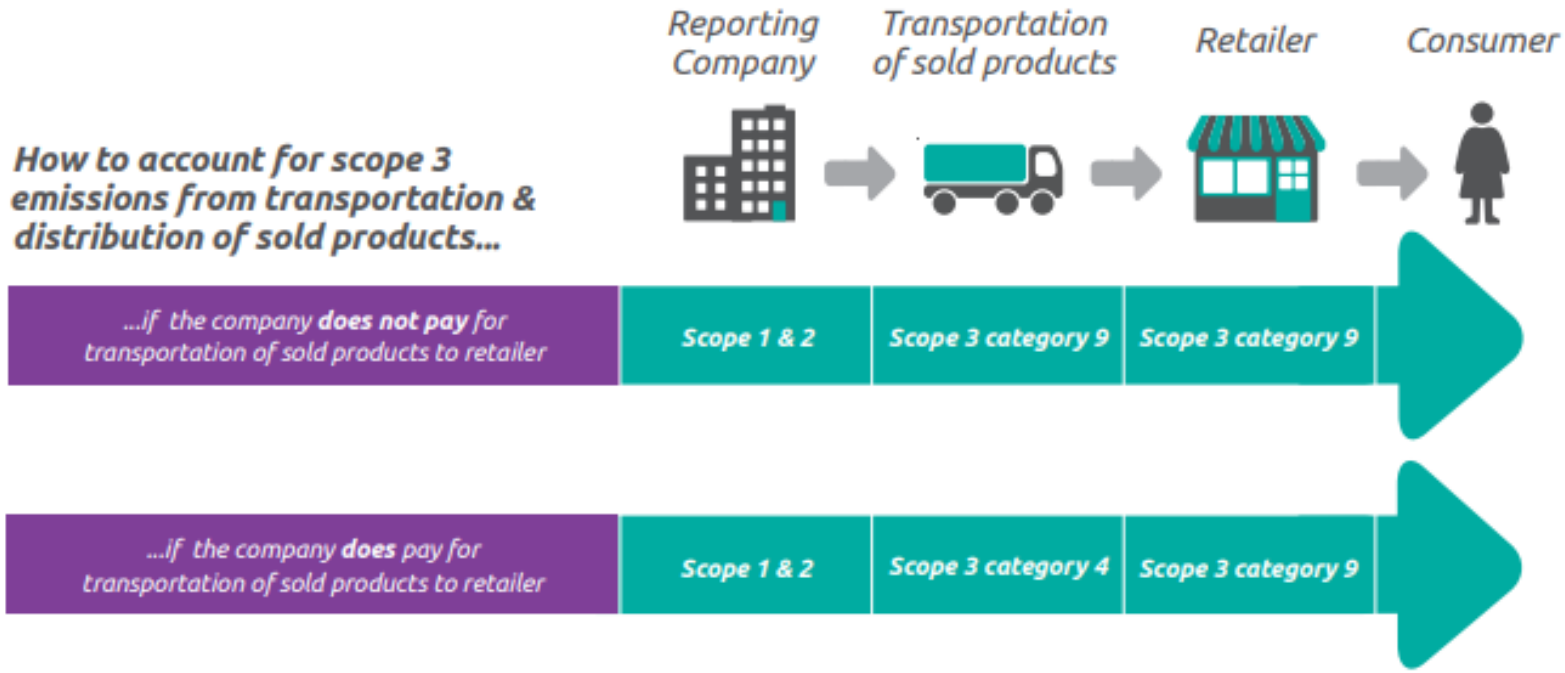
3. Fuel- and Energy-Related Activities Not Included in Scopes 1 or 2
   - Upstream emissions of purchased fuels,
   - Upstream emissions of purchased electricity,
   - Transmission and distribution losses, and
   - Generation of purchased electricity that is sold to end users
4. Upstream Transportation and Distribution
5. Waste Generated by Operations
   - Third-party waste treatment
   - May include transportation of waste in vehicles operated by a third party

“Upstream” Scope 3 Emissions

6. Business Travel
   - Travel for business-related activities in vehicles (including aircraft) owned or operated by third parties.
7. Employee Commuting
   - Transportation of employees between their homes and worksites.
   - Emissions from teleworking may be included in this category
8. Leased Assets
   - Emissions from the operation of assets leased by the reporting company not already included in Scope 1 or 2.

“Downstream” Scope 3 Emissions

9. Downstream Transportation and Distribution
   - Transportation and distribution of sold products



“Downstream” Scope 3 Emissions

10. Processing of Sold Products
    - Emissions from the processing of intermediate products by other manufacturers.
11. Use of Sold Products
    - Emissions from the final use of sold products, such as the combustion of natural gas produced from a well pad.
12. End-of-Life Treatment of Sold Products
    - Emissions from the waste disposal and treatment of sold products at the end of their life.

“Downstream” Scope 3 Emissions

13. Downstream Leased Assets
    - Emissions from the operation of assets leased by the reporting company not already included in Scope 1 or 2.
14. Franchises
    - Scope 1 and 2 emissions from the reporting company’s franchises.
15. Investments
    - Category applicable to investors and companies that provide financial services.

Scope 3 Emission Calculation

- If data is available, Scope 1 and 2 emission factors are used to calculate Scope 3 emissions.
  - i.e., natural gas product combustion, franchise or investment asset emissions
- EPA Emission Factor Hub contains factors for some Scope 3 emission categories.
  - Upstream Transportation and Distribution
  - Downstream Transportation and Distribution
  - Waste Generated in Operations
  - End-of-life Treatment of Sold Products
  - Business Travel
  - Employee Commuting

Inventory Development Challenges

- Differences in scope, definitions, units, requirements, etc.
  - Accounting standards
  - Calculation methodologies
  - Reporting exclusions

Code of Federal Regulations
A point in time eCFR system

SUSTAINABILITY ACCOUNTING STANDARDS BOARD
SASB

CDSB
Climate Disclosure Standards Board

TCFD | TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

IPIECA

Inventory Development Challenges

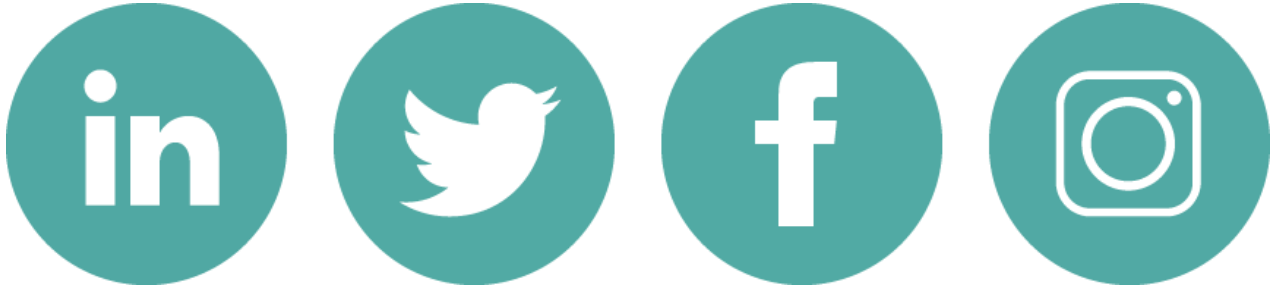
- Different people, departments, or companies involved
  - Reporting program selection
  - Data gathering and calculation
- Ownership changes
- Regulatory/NGO Interest

Inventory Development Best Practices

- Inventory Scope
  - Scope 1 and 2 are baseline expectations
- Raw Data Selection
  - Plan Ahead
  - Involve Appropriate Personnel – Environmental, Engineering, Etc.
  - Use Best Available Data
- Documentation
  - EPA Mandatory Reporting Rule requires a monitoring plan.
  - GHG Protocol can be used to develop a robust program.

Questions?

CONNECT WITH US!



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