

GHG Emissions Accounting

Life Cycle and Upstream Emissions from Power Generation Technologies





Agenda

Greenhouse Gas (GHG) Emission Accounting Overview

Typical Reporting Practices

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Lifecycle Emissions of Power Generation Technologies

SMUD Upstream Emissions from Natural Gas

Expected Reductions in Upstream Emissions



KEY CONCEPTS

Scope 3 Emissions - Upstream

EMISSION CATEGORIES		DESCRIPTION	
1	Purchased goods and services	All upstream (i.e., cradle-to-gate) emissions from the production of products/services purchased or acquired	
2	Capital goods	All upstream (i.e., cradle-to-gate) emissions from the production of capital goods purchased or acquired.	
3	Fuel-and-energy- related activities	Emissions related to the production of fuels and energy purchased and consumed that are not included in scope 1 or scope 2.	
4	Upstream transportation and distribution	Emissions from the transportation and distribution of products (excluding fuel and energy products) purchased or acquired in vehicles not owned or operated by the reporting entity.	
5	Waste generated in operations	Emissions from third-party disposal and treatment of waste that is generated in owned or controlled operations.	
6	Business travel	Emissions from the transportation of employees for business-related activities in vehicles owned or operated by third parties	
7	Employee commuting	Includes emissions from the transportation of employees between their homes and their worksites	
8	Upstream leased assets	Emissions from the operation of assets that are leased by the reporting company in the reporting year and not already included in the reporting company's scope 1 or scope 2 inventories	

Other indirect emissions where the source is owned or operated by a third-party but the emissions are the result of the reporting entity's operations. Also known as **value chain** emissions.



Source: WRI & WBCSD, 2013. Greenhouse Gas Protocol, Technical Guidance for Calculating Scope 3 Emissions (Version 1.0).

KEY CONCEPTS

Scope 3 Emissions - Downstream

EMISSION CATEGORIES		ION CATEGORIES	DESCRIPTION		
	9	Downstream transportation and distributionEmissions from transportation and distribution of products sold to the end consumer in vehicles not owned by the reporting entity.		Other ind by a third entity	
	10	Processing of sold products	Emissions from processing of sold intermediate products by third parties (e.g., manufacturers) subsequent to sale by the reporting entity.		
	n	Use of sold products	Emissions from the use of goods and services sold by the reporting entity.	the use of goods and the reporting entity.	
	12	End of life treatment of sold products	Emissions from the waste disposal and treatment of products sold by the reporting entity at the end of their life.	transp and dis	
	13	Downstream leased assets	Emissions from the operation of assets that are owned by the reporting entity (acting as lessor) and leased to other entities.	processold	
	14	Franchises	Emissions from the operation of franchises not included in scope 1 or scope 2.		
	15	Investments	Emissions associated with the reporting company's investments in the reporting year, not already included in scope 1 or scope 2.		

Other indirect emissions where the source is owned or operated by a third-party but the emissions are the result of the reporting entity's operations. Also known as **value chain** emissions.



Source: WRI & WBCSD, 2013. Greenhouse Gas Protocol, Technical Guidance for Calculating Scope 3 Emissions (Version 1.0). Voluntary

Standard GHG Emissions Reporting Practices

» E.g. NY Local Law 97

SCOPE 1

SCOPE 2

SCOPE 3 Always Reported in Voluntary Voluntary / Partially **Programs / Future Reporting Reported / High Uncertainty / Always Reported** for New Mandatory Programs **Sector Dependent** Reporting Scope 3 emissions for all relevant and Standard practice to always report Scope 1 Standard practice to always report Scope 2 emission in voluntary disclosures emission in voluntary disclosures material categories is a leading/best practice » *e.q.* corporate sustainability reports, CDP, TCR, » e.g. corporate sustainability reports, CDP, TCFD, DJSI, » Worth additional points in scored schemes, e.g. CDP TCFD, DJSI, Reporting Dual reporting requirements Certain sectors slower to adopt Scope 3 reporting Well established calculation methodologies due to lack of standard calculation protocols » Location-based – grid average factors with limited uncertainty » E.g. utility and financial sectors » Market-based - contractual mechanisms (e.g. Included in corporate GHG reduction targets *RECs/PPAs)* accounted for Business travel most common Scope 3 category reported Included in all corporate GHG reduction targets (typically using market-based) Required for setting a Science Based Target through SBTi Scope 1 is always required where entity has Not typically included in current mandatory No current mandatory requirements to account regulatory mandate to report emissions reporting programs for or report Scope 3 emissions. Mandatory Reporting » CA Cap and Trade » Power plant emissions captured directly, no need to » Often occur outside jurisdictional boundaries capture from end users as Scope 2 emissions Some cities are looking at this for potential » US EPA GHG RP future requirements Newer requirements targeting building » RGGI performance, rather than entity-level emissions » E.g. Washington DC Public Utilities Commission » Massachusetts MassDEP GHG Emissions RP do require scope 2 emissions Embodied Carbon in Building Materials

Boundaries and Sources

- Life Cycle Assessment (LCA) emissions of a product or fuel are different than Scope 1, 2 and 3 emissions, which are corporate or entity-based accounting concepts.
- LCA emissions are also referred to as "Embedded Emissions" or "Embedded Carbon".
- LCA can be defined with different Boundaries
 - » E.g. Cradle to Gate, Cradle to Grave, Well to Wheel, Well to Pump
 - » No right or wrong definition, but transparency and consistency is key when evaluating life cycle emissions



Power Generation Technologies

Emissions estimate per kWh of generation allows for a consistent comparison across lifespan for all renewables and fossil fuel technologies



Source: NREL Life Cycle Assessment Harmonization Study (2012)

Power Generation Technologies

There is significant variability within each technology, however the worstcase life cycle GHG emissions for renewable energy are significantly lower than the best-case life cycle GHG emissions for fossil power generation



Source: NREL Life Cycle Assessment Harmonization Study (2012)

SMUD's Upstream Emissions from National Gas

Estimate of SMUD's upstream Scope 3 emission completed by WSP in 2017 on 2015 gas purchase data. SMUD's total Scope 1 emissions from stationary combustion in 2015 were 2,375,620 metric tons CO2e.

» Based on the methods evaluated, the estimate of the upstream emissions associated with SMUD's 2015 natural gas use ranges from roughly 23% to 48% of the total Scope 1 emissions

EMISSION ESTIMATION METHOD	TOTAL SMUD GAS PURCHASES (MMBTU)	EMISSION FACTOR	TOTAL EMISSIONS (MTCO ₂ E)			
Scope 3 Natural Gas						
Method 1. EPA Aligned Factors (no adjustment)		0.94% (loss rate of total throughput)	526,162			
Method 2. LCA GaBi	50,318,121	17.04 kgCO ₂ e/MMBtu	855,092			
Method 3. Argonne National Lab 2016 GREET		22.25 kgCO ₂ e/MMBtu	1,119,578			



Upstream Emissions from National Gas Production Expected to Decline

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Biden Executive Order

Calls for the EPA to consider new methane regulations in the oil and gas sector by September 2021. These regulations would establish standards of performance and emission guidelines for methane and VOC emissions from existing operations, including exploration and production, transmission, processing and storage. This goes beyond Obama's regulations that only covered new oil and gas operations to the much larger problem of leaks from existing operations.



Upstream Emissions from National Gas Production Expected to Decline

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Biden Executive Order

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Climate Leadership and Environmental Action for our Nation's Future Act (CLEAN Future Act)

A House Committee on Energy & Commerce bill includes provisions for reducing methane emissions from the oil and gas sector by 65% below 2012 levels by 2025, and 90% below 2012 levels by 2030. To do this, the bill directs the EPA to finalize regulations by the end of 2022 to meet the 2025 goal, and regulations by the end of 2023 to meet the 2030 goal. The bill also directs the EPA to finalize regulations by the end of 2022 to prohibit routine flaring from natural gas sources, as well as regulations to reduce routine flaring from existing sources by 80% and 100% below 2017 levels by 2025 and 2028, respectively. The bill would allow for "safety flaring."



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APR 2021

Senate Resolution

Senate Majority Leader Chuck Schumer brought a resolution to the floor in April to use the Congressional Review Act to reverse one of the Trump administration's final climate policy rollbacks, lifting requirements for oil and gas companies to monitor and fix methane leaks from wells and other infrastructure.



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APR 2021

Senate Resolution

Biden American Jobs Plan

Fixing methane leaks is one of the key job-creation items Biden included in his American Jobs Plan submitted in April 2021, focusing on "orphaned" wells, those that have been abandoned by defunct companies. The plan includes \$16 billion to employ workers to cap oil and gas wells and reclaim old coal mines. ۱۱SD



Upstream Emissions from National Gas Production Expected to Decline

INDUSTRY ACTIONS

- The ONE Future Coalition is a group of more than 40 Natural Gas companies working together to voluntarily reduce methane emissions across the natural gas value chain to 1% (or less) by 2025
 - » Comprised of some of the largest natural gas companies in the U.S. and represents more than 15% of the U.S. natural gas industry
 - » In 2019 the coalition registered a methane intensity number of 0.334%
 - One Future achievement strategies include: Optical gas imaging cameras, Capital investment planning for pipeline and services replacement, Reducing or eliminating gas venting (flaring)
- American Petroleum Institute Climate Action Proposal - supports methane regulation and also included an endorsement of a carbon tax
- Industry looking to decarbonize gas supply through increase use of Biomethane / Renewable Natural Gas (RNG).
 - » Biomethane/RNG typically sourced locally, no drilling or extraction required, carbon emission from combustion are biogenic and it can be accounted for as an avoided emission, all resulting in lower upstream and operational phase emissions.

Upstream Emissions from Solar PV and Battery Storage Expected to Decline

Solar and Li-Ion battery storage production and operational efficiencies will continue to increase, driving down cost and emissions. *Efficiency increases lead to system price declines and market share increases*

More efficient and cleaner steel production and design improvements leading to longer infrastructure lifetime and lower maintenance cost and related emissions

Lithium-ion battery pack prices have fallen from \$1,100/kWh in 2010 to \$137/kWh in 2020

Electric vehicle growth has led to the rechargeable battery segment doubling between 2013 and 2018.



US Battery Storage System Price Trends



Cell Pack

Questions

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