GHG Emissions Accounting

Life Cycle and Upstream Emissions from Power Generation Technologies
Agenda

1. Greenhouse Gas (GHG) Emission Accounting Overview
2. Typical Reporting Practices
3. Lifecycle Emissions of Power Generation Technologies
4. SMUD Upstream Emissions from Natural Gas
5. Expected Reductions in Upstream Emissions
Indirect emissions resulting from the generation of electricity, steam, hot or chilled water purchased by the reporting entity.

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.

Direct emissions where the source is owned and or operated by the reporting entity (e.g. SMUD’s electricity generation, company vehicles).

## Scope 3 Emissions - Upstream

### Emission Categories

<table>
<thead>
<tr>
<th>Emission Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Purchased goods and services</td>
<td>All upstream (i.e., cradle-to-gate) emissions from the production of products/services purchased or acquired</td>
</tr>
<tr>
<td>2 Capital goods</td>
<td>All upstream (i.e., cradle-to-gate) emissions from the production of capital goods purchased or acquired.</td>
</tr>
<tr>
<td>3 Fuel-and-energy-related activities</td>
<td>Emissions related to the production of fuels and energy purchased and consumed that are not included in scope 1 or scope 2.</td>
</tr>
<tr>
<td>4 Upstream transportation and distribution</td>
<td>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.</td>
</tr>
<tr>
<td>5 Waste generated in operations</td>
<td>Emissions from third-party disposal and treatment of waste that is generated in owned or controlled operations.</td>
</tr>
<tr>
<td>6 Business travel</td>
<td>Emissions from the transportation of employees for business-related activities in vehicles owned or operated by third parties.</td>
</tr>
<tr>
<td>7 Employee commuting</td>
<td>Includes emissions from the transportation of employees between their homes and their worksites.</td>
</tr>
<tr>
<td>8 Upstream leased assets</td>
<td>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.</td>
</tr>
</tbody>
</table>

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.

### Scope 3 Emissions - Downstream

<table>
<thead>
<tr>
<th>Emission Categories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Downstream transportation and distribution</td>
</tr>
<tr>
<td>10</td>
<td>Processing of sold products</td>
</tr>
<tr>
<td>11</td>
<td>Use of sold products</td>
</tr>
<tr>
<td>12</td>
<td>End of life treatment of sold products</td>
</tr>
<tr>
<td>13</td>
<td>Downstream leased assets</td>
</tr>
<tr>
<td>14</td>
<td>Franchises</td>
</tr>
<tr>
<td>15</td>
<td>Investments</td>
</tr>
</tbody>
</table>

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.
**Standard GHG Emissions Reporting Practices**

### SCOPE 1

**Always Reported**

- Standard practice to always report Scope 1 emission in voluntary disclosures
  - *e.g.* corporate sustainability reports, CDP, TCR, TCFD, DJSI,
- Well established calculation methodologies with limited uncertainty
- Included in corporate GHG reduction targets

### SCOPE 2

**Always Reported in Voluntary Programs / Future Reporting for New Mandatory Programs**

- Standard practice to always report Scope 2 emission in voluntary disclosures
  - *e.g.* corporate sustainability reports, CDP, TCFD, DJSI,
- Dual reporting requirements
  - Location-based - grid average factors
  - Market-based - contractual mechanisms (e.g. RECs/PPAs) accounted for
- Included in all corporate GHG reduction targets (typically using market-based)

### SCOPE 3

**Voluntary / Partially Reported / High Uncertainty / Sector Dependent**

- Reporting Scope 3 emissions for all relevant and material categories is a leading/best practice
  - *Worth additional points in scored schemes, e.g. CDP*
- Certain sectors slower to adopt Scope 3 reporting due to lack of standard calculation protocols
  - *E.g. utility and financial sectors*
- Business travel most common Scope 3 category reported
- Required for setting a Science Based Target through SBTi

### Voluntary Reporting

- Scope 1 is always required where entity has regulatory mandate to report emissions
  - *CA Cap and Trade*
  - *US EPA GHG RP*
  - *RGGI*
  - *Massachusetts MassDEP GHG Emissions RP*

### Mandatory Reporting

- Not typically included in current mandatory reporting programs
  - Power plant emissions captured directly, no need to capture from end users as Scope 2 emissions
- Newer requirements targeting building performance, rather than entity-level emissions do require scope 2 emissions
  - *E.g. NY Local Law 97*

- No current mandatory requirements to account for or report Scope 3 emissions.
  - *Often occur outside jurisdictional boundaries*
  - *Some cities are looking at this for potential future requirements*
    - *E.g. Washington DC Public Utilities Commission Embodied Carbon in Building Materials*
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 worst-case 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.

<table>
<thead>
<tr>
<th>EMISSION ESTIMATION METHOD</th>
<th>TOTAL SMUD GAS PURCHASES (MMBTU)</th>
<th>EMISSION FACTOR</th>
<th>TOTAL EMISSIONS (MTCO₂E)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scope 3 Natural Gas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method 1. EPA Aligned Factors (no adjustment)</td>
<td>50,318,121</td>
<td>0.94% (loss rate of total throughput)</td>
<td>526,162</td>
</tr>
<tr>
<td>Method 2. LCA GaBi</td>
<td>50,318,121</td>
<td>17.04 kgCO₂e/MBtu</td>
<td>855,092</td>
</tr>
<tr>
<td>Method 3. Argonne National Lab 2016 GREET</td>
<td>50,318,121</td>
<td>22.25 kgCO₂e/MBtu</td>
<td>1,119,578</td>
</tr>
</tbody>
</table>
Upstream Emissions from National Gas Production Expected to Decline

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

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.”
Upstream Emissions from National Gas Production Expected to Decline

JAN 2021
Biden Executive Order

MAR 2021
Climate Leadership and Environmental Action for our Nation’s Future Act (CLEAN Future Act)

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.
Upstream Emissions from National Gas Production Expected to Decline

FEDERAL GOVERNMENT ACTIONS

- **JAN 2021**
  - Biden Executive Order

- **MAR 2021**
  - Climate Leadership and Environmental Action for our Nation's Future Act (CLEAN Future Act)

- **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.
Upstream Emissions from National Gas Production Expected to Decline

- 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 Installed Solar PV System Price Trends**

**US Battery Storage System Price Trends**

Source: NREL Q2/Q3 2020 Solar Industry Update
Source: BNEF 2020 Battery Price Survey
Questions

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