MONITORING AND DATA MANAGEMENT
Monitoring at the source (emissions, inputs/outputs) and data management throughout the data life cycle ("data trail") enable quantification and verification.

Monitoring plans are customized to facilities:
- Sources and equipment, metering equipment, data management...

Robust data management systems:
- Data capture, validation, storage, processing, output, security...

Familiarity with facility operations and systems informs development of appropriate/practical requirements.
Facility Monitoring Systems

- Facility monitoring systems track most parameters for process control – Industrial Internet

- Program requirements prescribe specific information and data needs to be outlined in a monitoring plan

- Information to be submitted with GHG report, additional for audit purposes
Monitoring Approaches

- Monitoring requirements defined in the GHG reporting rules

- Generally there are 2 approaches of monitoring
  - Directly monitor GHG, e.g., continuous emission monitoring system (CEMS)
  - Monitor process/operational parameters, e.g., energy consumption, material inputs/outputs, operating conditions

- Monitoring parameters are specific to the source category and the facility operations
Monitoring Plans

- Personnel roles and responsibilities
- Description of monitoring procedures/methods for each source
- Meter installation, operation, maintenance, cleaning, calibration
- Data acquisition and management system
- Record keeping
- Links with manuals, SOPs, standards...
- Training, certifications
Monitoring Methods

- Option of monitoring methods according to quantification tiers
- What is monitored, how it is monitored, how often, and record keeping ...
- Validation of parameter properties (e.g., energy content or carbon) according to varying frequency
- Annual, semi-annual, every shipment received, ...
Monitoring Equipment Calibration

- Flow meters, weighing scales, gas analyzers...
- Calibration current and continues to be valid for the data collection period
- In accordance with manufacturer’s specifications, standards (industry, national), reporting requirements
- Qualified personnel, external service/certification
- Acceptable error range (e.g., less than # %)
- Record keeping
During a specified time period data is:

- not collected, e.g. meter or data logger not working
- invalid, e.g. collected while the measurement device not calibrated or otherwise non-compliant with QA requirements
Depending on the program, options to respond to missing data include:

- Re-analyze original data
- Analyze data back ups
- Generate new data if during the sample period and then analyze it
- Make up substitution values and document process (e.g. historical, similar equipment/facility, worse case scenario...)

Consequences

- Punitive measures
- Intentionally false – legal liability
Data/IMS vis-à-vis Data Trail

- Meter Setup
- Collect Data
- Test Data
- Process Data
- Report Data

- Storage | Data Integrity | Data Back Ups
- Security | Controlled Access | Confidentiality
- Staff Training | Resources | Infrastructure
Data Management System

- Custom-built or off-the-shelf (SaaS)
- Integrates with existing IT infrastructure
  - Monitoring and operational hardware and software, SCADA
  - Organizational software (documents, finance...)
  - Control room, servers...
- Security (authorization, firewalls), back-ups, auditability
- GHG data model, calculations, reporting
MRV Program Overview - China

China

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MRV Program Focus

❖ Experience with program
  ▪ Shenzhen ETS pilot MRV
  ▪ Beijing ETS pilot MRV
  ▪ Shanghai ETS pilot MRV
  ▪ National MR guidelines
Experience with pilots and national MR guidelines development

- **Sound foundation**
  - long standing energy consumption statistics
  - 1,000-enterprise energy saving program during 11th FYP,
    10,000-enterprise energy saving program during 12th FYP

- **Issues**
  - Enterprise level rather then facility or installation level
  - Lack of critical parameters: net heat value, carbon content, oxidization rate
  - Data quality varies by sector
  - Lack of data relevant to industrial process emissions
  - Institutional barriers
Challenges-1

- Develop MRV standard in short time period
- 7 pilots with different MRV systems
- Pilots have different social and economic situation, energy structures, require different arrangements
- Coverage: industrial sectors, tertiary industry
- Methodology: direct monitoring/calculation
- The treatment of direct and indirect emissions
- Different perception on monitoring plans
- Lack of knowledge and personnel on reporting and verification
Challenges-2:
Activity data and emission factors

• Boundary of emission sources to be monitored
• Type of fuel monitored: solid fuel classification
• Net heat value, carbon content, oxidation rate to be monitored, standards and methodology
• Frequency of monitoring: month, quarter, year
• Monitoring equipment
Monitoring plan: power sector

- **Boundaries**
- **Monitor 1: fossil fuel physical consumption**

<table>
<thead>
<tr>
<th>Fuel type</th>
<th>Data collection methodology</th>
<th>Standards/protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ quantity received, stock accounting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ belt scale, meters etc.</td>
<td></td>
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<tr>
<td></td>
<td>□ others ()</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ quantity received, stock accounting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ belt scale, meters etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ others ()</td>
<td></td>
</tr>
</tbody>
</table>
Monitor 2: Net heat value of fossil fuels

<table>
<thead>
<tr>
<th>Fuel type</th>
<th>Heat value</th>
<th>Sampling frequency</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Notes</td>
<td>Frequency</td>
<td>Notes</td>
</tr>
<tr>
<td>□ direct monitoring</td>
<td>□ default</td>
<td>□ self monitoring</td>
<td>□ contracting</td>
</tr>
</tbody>
</table>
## Monitor 3: Carbon content of fossil fuels

<table>
<thead>
<tr>
<th>Fuel type</th>
<th>Carbon content</th>
<th>Sampling frequency</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Source</td>
<td>Notes</td>
<td>Notes</td>
</tr>
<tr>
<td></td>
<td>□ direct monitoring</td>
<td>□ default</td>
<td>□ self monitor</td>
</tr>
</tbody>
</table>
## Monitor 4: Coal properties

<table>
<thead>
<tr>
<th>Coal type</th>
<th>Monitor</th>
<th>frequency</th>
<th>Sampling method</th>
<th>Chemical analysis method and protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coal for boilers</strong></td>
<td>Heat value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Industrial analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sulphur</td>
<td></td>
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<tr>
<td></td>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Coal purchased</strong></td>
<td>Heat value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Industrial analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sulphur</td>
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<td>C</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Monitor 5: Oxidation rate of coal-fired boilers

<table>
<thead>
<tr>
<th>Unit no.</th>
<th>Source</th>
<th>Slag and ash sampling /boiler thermal efficiency</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ direct monitoring □ default</td>
<td></td>
<td>□self monitor □ contracting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>Notes</th>
<th>Frequency /time</th>
<th>Notes</th>
<th>Source</th>
<th>protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lessons learned - 1

- Tier approach, encourage direct emission monitoring
- Strict requirements along with size of emission sources and sectors
- Provide method or default value for critical parameters
- Monitoring plan is essential
Lessons learned - 2

• Information tools, software are must
• Collect historical energy consumption data to validate baseline emissions, verified
• Verification: invoices, confidential information
• Training is important: enterprises, firms, plants, organizations, personnel
• Continuous improvement process
USA

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- Chiu.Kong@epa.gov
Monitoring/Recordkeeping support GHG methodologies
Methodologies developed from extensive review of existing GHG programs
Tiering approach used in many sub parts (lower order to higher order)
Example: Stationary Combustion employs 4 Tier Approach
In addition to calculation methodologies, the GHG Rule Requires
  - Adherence to and reference of Standards (ASTM, ISO etc…)
  - Calibration requirements
  - Missing data procedures
  - Extensive recordkeeping requirements
Monitoring/Recordkeeping General Requirements:

- Direct Measurement (certain units) and
- Facility-Specific GHG calculation methods
- Missing Data provisions
- Source-category specific Requirements for
  - Monitoring
  - Quality assurance
  - Missing Data
  - Record Keeping
Monitoring/Recordkeeping Special Provision:
- Best Available Monitoring Methods (BAMM)
- Certain circumstances, certain years
  - Parameter cannot reasonably be measured
  - Beginning of program (2010)
  - Beyond 2010 for certain sources (i.e. Hydrogen, Petrochemicals, Petroleum)
  - New for 2011 source categories
- Methods and Equations still apply (but use best information available to obtain data inputs)
- Monitoring Plan still required, covering BAMM time period
- Once BAMM period expires, must follow all applicable monitoring and QA/QC requirements.
### Iron and Steel Production Monitoring Checklist

**Final Rule: Mandatory Reporting of Greenhouse Gases**

**What Must Be Monitored Under the Carbon Mass Balance Method?**

Measure these parameters on an annual basis (unless otherwise noted)...

<table>
<thead>
<tr>
<th>For Each Taconite Indurating Furnace</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Mass of solid fuel combusted each month (metric tons)</td>
<td>□ Average carbon content of greenball (taconite) pellets (percent by weight)</td>
</tr>
<tr>
<td>□ Average carbon content of solid fuel (percent by weight)</td>
<td>□ Mass of fired pellets produced by furnace each month (metric tons)</td>
</tr>
<tr>
<td>□ Volume of gaseous fuel combusted each month (standard cubic foot [scf])</td>
<td>□ Average carbon content of the fired pellets (percent by weight)</td>
</tr>
<tr>
<td>□ Average carbon content of gaseous fuel (kilogram [kg] C per kg of fuel)</td>
<td>□ Mass of air pollution control residue collected each month (metric tons)</td>
</tr>
<tr>
<td>□ Average molecular weight of gaseous fuel (kg/kg-mole)</td>
<td>□ Average carbon content of air pollution control residue (percent by weight)</td>
</tr>
<tr>
<td>□ Volume of liquid fuel combusted each month (gallons)</td>
<td>□ Annual production quantity of taconite pellets (metric tons)</td>
</tr>
<tr>
<td>□ Average carbon content of liquid fuel (kg C per gallon of fuel)</td>
<td>□ Annual operating hours</td>
</tr>
<tr>
<td>□ Mass of greenball (taconite) pellets fed to furnace each month (metric tons)</td>
<td></td>
</tr>
</tbody>
</table>
Recordkeeping Requirements:

- 3 year retention
- Format suitable for inspection/review
- Include
  - List of units, operations, processes, activities
  - Data used to calculate GHG emissions
  - GHG emissions calculations and methods used
  - Documentation for site-specific emissions factors
  - Results of any required HHV, carbon content analyses
  - Facility operating data or process information
  - Missing data computations (+duration, cause, actions)
  - Written GHG Monitoring Plan
Monitoring Plans:

- Format suitable for inspection/review
- Include:
  - Positions of responsibility (job titles)
  - Explanation of processes and methods used to collect data for GHG calculations
  - Description of procedures and methods used for QA/QC, maintenance and repair of equipment, including CEMS, flow meters, instrumentation
  - Reference external documents, as appropriate (i.e. company procedures, QA/QC programs)
- Revise and update, as appropriate (i.e. changes in processes, procedures)
US GHG Reporting Program Data Management

Electronic Data Collection
Confidential Business Information (CBI)

EPA protects any data determined to be CBI in accordance with regulations (40CFR Part 2, Subpart B)

EPA publishes determinations of which data elements are CBI in the Federal Register

Emissions data collected under Clean Air Act sections 114 and 208 cannot be considered CBI

EPA deferred some deadlines for reporting data elements that are inputs to emissions equations to better assess implications of their collection and public release
Program administrators should have an understanding of the realities of facility operations

Leverage existing guidance, standards... (industry familiarity)

Guidance should be detailed and consolidated, as well as enable customization at the facility-level

Group exercise includes data trail, activities, key concepts, challenges/solutions
Place the word “accuracy” or “precision” in the following blanks.

- [ ] is the consistent repeatability of a measurement.
- [ ] is the correctness/closeness of data measurement to the true value.

What happens when there is missing data?

a) New data can be used if [fill in the blank]

b) Substitute data can be used if [fill in the blank]

c) Existing data can be used if [fill in the blank]
Quiz Answers

- **PRECISION** is the consistent repeatability of a measurement.
- **ACCURACY** is the correctness/closeness of data measurement to the true value.
  
a) New data can be used if **DURING THE SAMPLING PERIOD**.
  
b) Substitute data can be used if **FOLLOWS AN APPROVED PROCEDURE AND IS DOCUMENTED (HISTORICAL RECORDS, SIMILAR EQUIPMENT)**
  
c) Existing data can be used if **YOU CAN FIND IT (BACK UPS?)**
Thank You

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