EMISSIONS QUANTIFICATION

PARTNERSHIP FOR MARKET READINESS

MRV TRAINING WORKSHOP

BEIJING, CHINA

SEPTEMBER 23-25, 2013

- Key Concepts, Options and Trade-offs
  - Approaches for emissions quantification
  - Quantification methods
  - Uncertainty and the use of “tiers”
- Input from experts
  - Using direct measurements vs activity based estimates for quantification
  - How “tiers” work in practice
- Summary

Approaches for emissions quantification

- Two general approaches to quantification
- **Direct measurement**: Measurement of the actual GHG emissions from a source
  - *Example*. Metering the composition & volume of gases released from stack
- **Activity based estimates**: Monitoring of process parameters and activity data, and the use of formulas, factors and models to calculate GHG emissions
  - *Example*. Metering the volume of fuel used and multiplying by emissions factor

Quantification methods

- A quantification method **prescribes how an estimate for emissions is to be compiled**, either from direct measurement of emissions, or via calculations involving operational parameters and factors
- There are many different quantification methods used in GHG inventories and they range from **simple** to **complex**

- *What are the quantification methods used for each of these situations?*
  - Emissions from combustion of liquid fuel
  - Emissions from combustion of coal
  - Methane extracted from land fill sites
  - Continuous emissions monitoring systems installed in smoke stacks
  - Emissions from a blast furnace in a steel mill
  - PFC emissions from aluminum smelting
  - **What other examples can you think of?**

Uncertainty

- The word “uncertainty” is used in many different ways
- Statistical definition: dispersion of the values that could be reasonably attributed to the measured quantity
- Practical definition: lack of certainty in data resulting from non-representative factors or methods or assumptions, incomplete data, inaccurate measurements

- Uncertainty in quantification of GHG emissions is a key issue for facility-level MRV programs
- There are usually two types of uncertainty which must be considered
  - Parameter uncertainty
  - Model uncertainty
- Some programs require uncertainty levels to be quantified by reporting entities

Use of Tiers

- There are usually multiple quantification methods for the same emissions situation
- The key differences in the methods are:
  - Disaggregation in the quantification method
  - Uncertainty in the estimates produced
- More complex and accurate methods require collection of more detailed data and a more thorough understanding of a facility
  - They also usually cost more to implement

Use of Tiers

- The IPCC Guidelines and many MRV programs use "Tiers" to provide structure to for choosing a quantification method
- Tier 1 - simplest method
  - Only requires broad parameters and uses aggregate factors (national, regional, global)
- Tier 3 - most complex method
  - Requires disaggregation into sub-categories and uses specific emissions factors

China

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Note to Tang Jin:

- Provide examples from China's facility-level MRV program
  - Are diff calculation approaches allowed – i.e., are tiers used in MRV programs?
  - What do reporting entities consider when they look at which tier they need to use?
  - Cost and complexity implications?
  - Accuracy vs conservatism and how this impacts the results in either overstating or understating the emissions from a facility

EU

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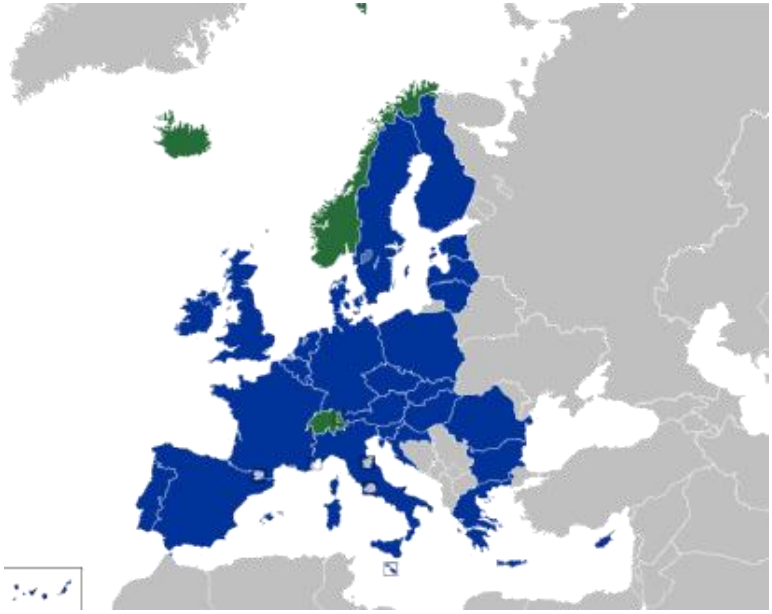
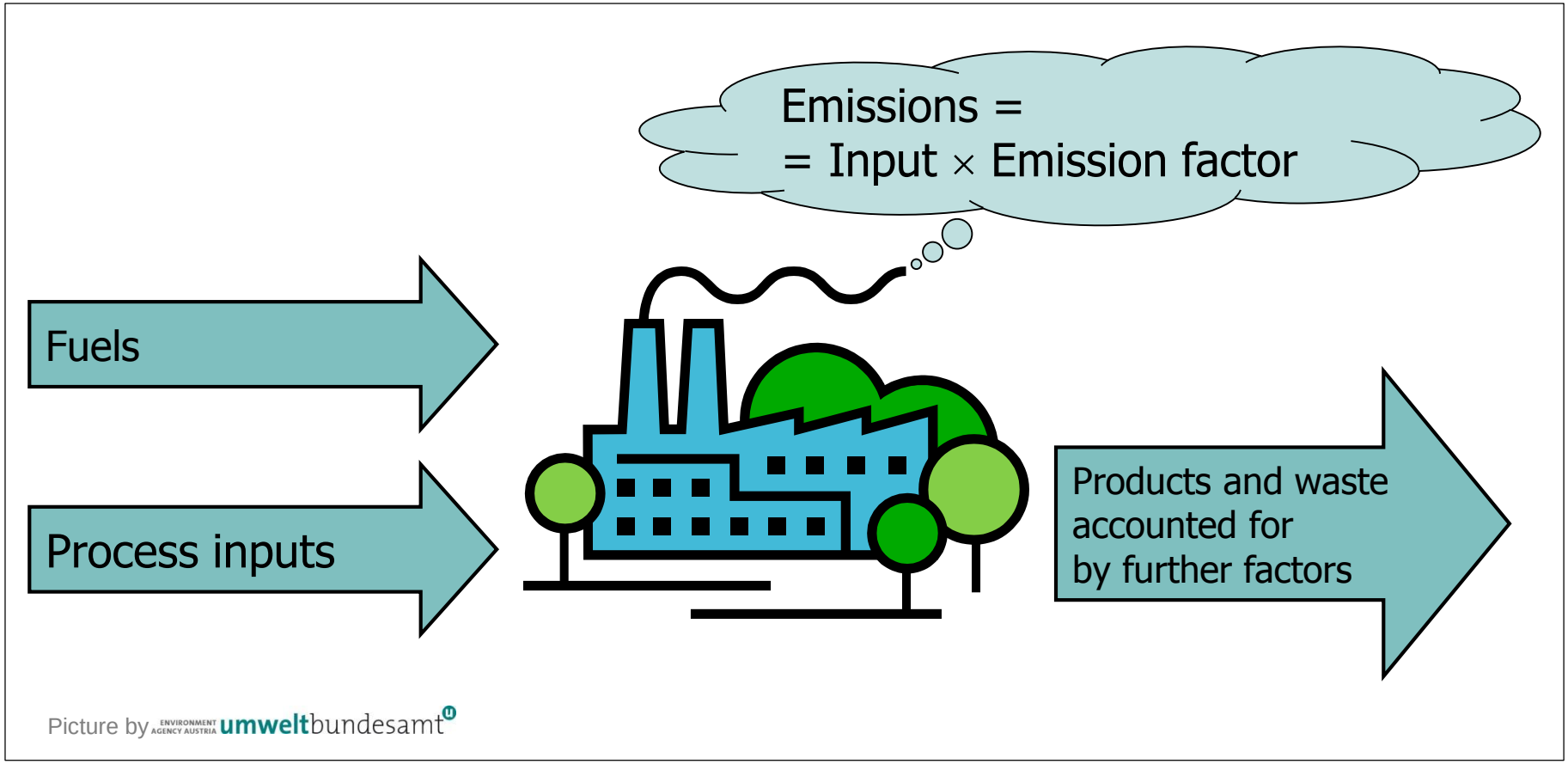
EU – Quantification approaches for ETS



- Calculation methods
  - Standard calculation
  - Mass balance
- Measurement
  - CEMS Continuous Emissions Measurement Systems
- "Fall-back approaches" (No-tier methodologies)
  - If lowest tiers can't be met
  - If overall uncertainty is demonstrated to be within allowed limits
  - Hardly ever applied

Standard methodology:



EU – Monitoring and Reporting Regulation

- The MRR (Monitoring and Reporting Regulation) contains general and sector specific requirements for
  - System boundaries
  - Which method to use
  - Tier definitions (if deviating from default)
  - Rules and tiers for specific source streams (e.g. cement kiln dust, PFCs for primary aluminium production, N_2O measurement)
  - Minimum tiers required
  - What are unreasonable costs?
- EU-wide legally binding

EU – MRR (II)

MRR contains specific rules for:

- Content of monitoring plan and annual emissions report
- Required "Procedures" (supplement the Monitoring Plan)
- Uncertainty assessment, Risk assessment
- Competence (accreditation) of laboratories
- Sampling plans for (chemical) analyses
- QA/QC procedures, in particular
  - Defining data flows and setting up an effective control system
  - Calibration and maintenance of measuring instruments
  - QA for information technology
  - Segregation of duties
  - Internal review of data
  - Treatment of data gaps…

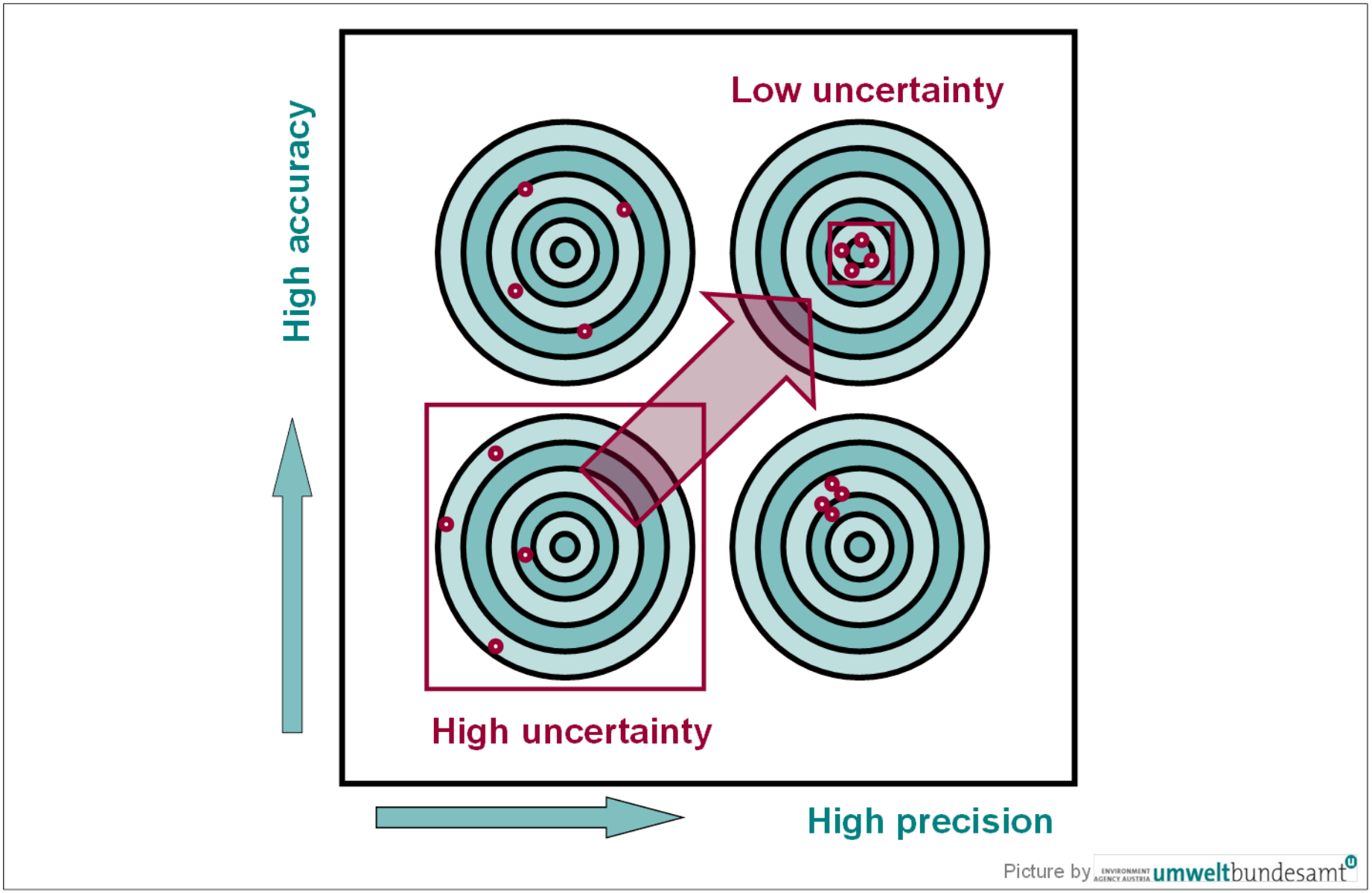
Summary

- Two different approaches to quantification:
  - Direct measurement and activity data
- Many different quantification methods to cover all of the different emissions sources and situations
- Uncertainty in emissions estimates is a key issue for MRV programs
- Programs can prescribe which tiers must be used in certain situations

Quiz Questions

- What is the difference between “accuracy” and “precision”?
- Which is more complex and accurate, Tier 1 or Tier 3?
- What should a facility consider when choosing which tier to use?

Quiz Questions



- Accuracy vs precision
  - Accuracy is the correctness/closeness of data measurement to the true value
  - Precision is the consistent repeatability of a measurement
- Tier 3 is more complex and accurate
- Facility should consider:
  - Program requirements, costs, practicalities, internal capabilities, timing, how the improved accuracy will impact them in the MRV program

Appendix

- **Combustion emissions:**

$$Em = AD \cdot EF \cdot OF$$

- *Em* Emissions [t CO_2]
- *AD* Activity data [TJ, t or Nm^3]
- *EF* Emission factor [t CO_2/TJ, t CO_2/t or t CO_2/Nm^3]
- *OF* Oxidation factor [--]

- **Process emissions:**

$$Em = AD \cdot EF \cdot CF$$

- *EF* Emission factor [t CO_2/t or t CO_2/Nm^3]
- *CF* Conversion factor [dimensionless]

- **Combustion emissions:**

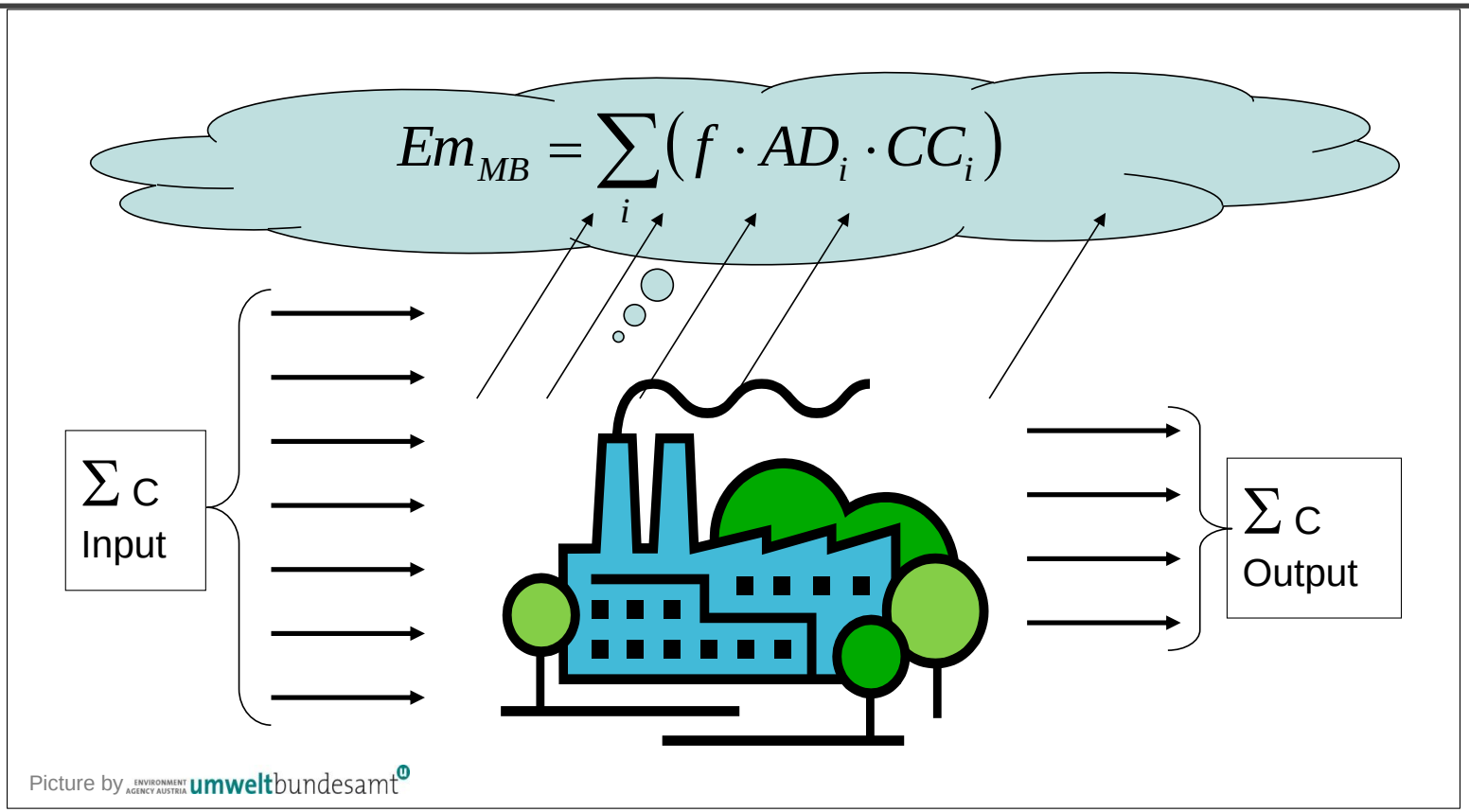
$$AD = FQ \cdot NCV$$

- *FQ* Fuel quantity [t or Nm3]
- *NCV* Net Calorific Value [TJ/t or TJ/Nm3]

$$EF = EF_{pre} \cdot (1 - BF)$$

- EF_{pre} Preliminary emission factor (total CO_2 incl. biomass)
- *BF* Biomass fraction

EU ETS – Calculation (Mass balance)



f... Factor for converting carbon to CO_2. f =3.664 t CO_2/t

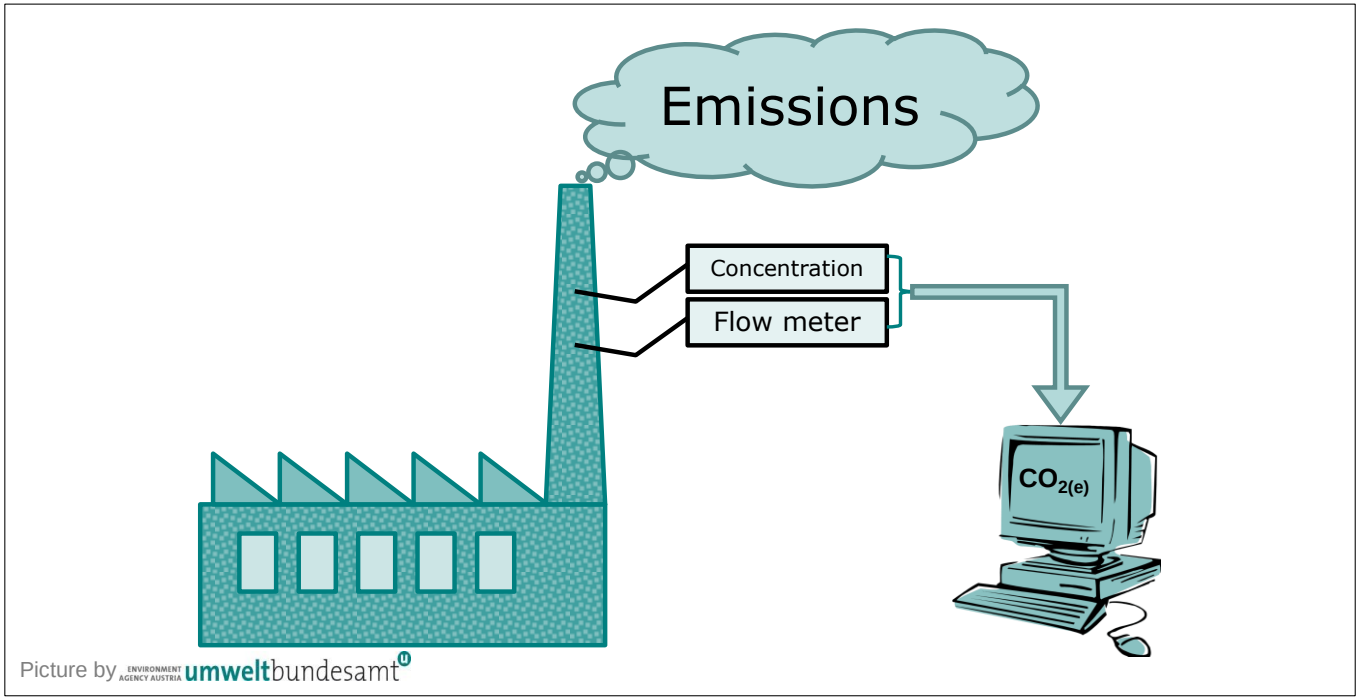
i... Index for the material or fuel under consideration

AD_i…Activity data (i.e. the mass in tonnes) of the material or fuel under consideration.

Ingoing…positive, outgoing…negative activity data

CC_i… Carbon content

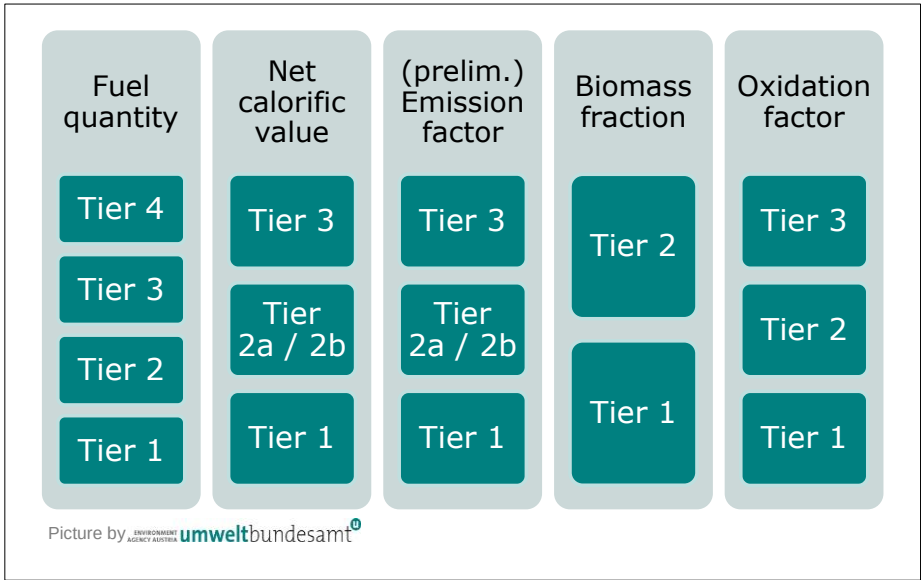
EU ETS – Measurement based methodology



- Measurement of the GHG concentration
- Measurement of volumetric flow of the gas
- Sum up hourly averages over year
- Extensive QA/QC measures required
- Corroborating calculations

EU ETS – Some tier definitions

- Activity data:
  - Tier 1: Uncertainty ± 7.5%
  - Tier 2: Uncertainty ± 5.0%
  - Tier 3: Uncertainty ± 2.5%
  - Tier 4: Uncertainty ± 1.5%
- Emission factors, other factors:
  - Tier 1: IPCC standard factors
  - Tier 2: Standard factors from national inventories
  - Tier 3: Based on chemical analysis
- Sector specific deviations possible



EU ETS – Cost effectiveness

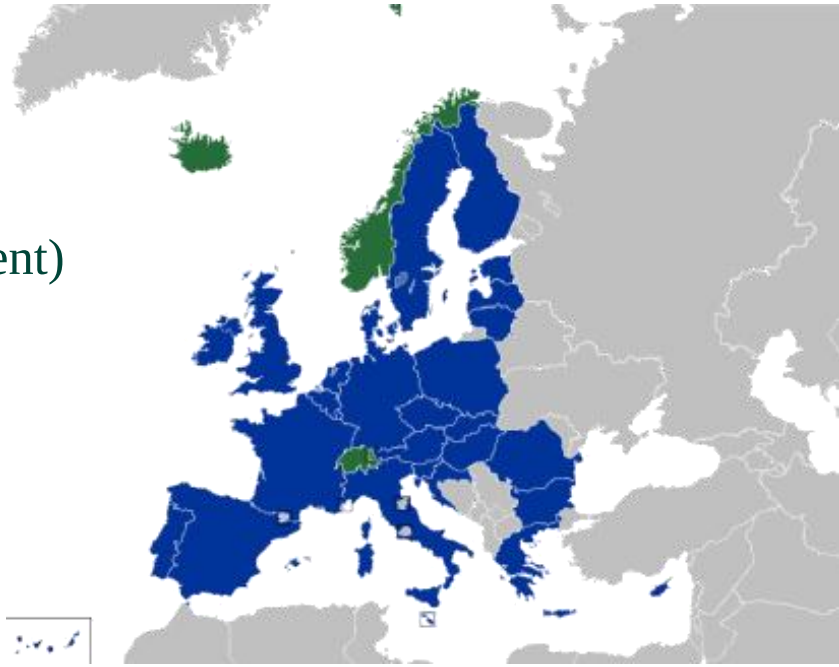
- The bigger the emissions, the higher the tiers required

- Classification of installations:
  - Category A ≤ 50,000 t $CO_{2(e)}$ /year
  - Category B > 50,000 t $CO_{2(e)}$ /year
  - Category C > 500,000 t $CO_{2(e)}$ /year
  - "small emitter" < 25.000 t $CO_{2(e)}$ /year
- Classification of source streams
  - Major source streams
  - Minor source streams (jointly < 5 kt CO_2 or 10% of installation's emissions, max. 100 kt CO_2/year)
  - De-minimis source streams (< 1 kt CO_2 or 2%, max. 20kt CO_2)

EU ETS – MRV Information sources

http://ec.europa.eu/clima/policies/ets/monitoring/

- Regulations:
  - Monitoring and Reporting Regulation (MRR): Regulation (EU) 601/2012
  - Accreditation and Verification Regulation (AVR): Regulation (EU) 600/2012
- Guidance documents:
  - GD 1: General guidance for installations"
  - GD 2: General guidance for aircraft operators
  - GD 3: Biomass issues
  - GD 4: Uncertainty Assessment
  - GD 5: Guidance on sampling and analysis
  - GD 6: Data flow activities and control system
  - GD 7: CEMS (Currently under development)
  - Exemplars, FAQs (Currently under development)
- Templates (MS Excel based):
  - Monitoring Plans
  - Annual emissions reports
  - Improvement Reports
- Guidance and templates for AVR



Thank You

For more information on the Partnership for Market Readiness (PMR), please contact:

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