Nederlandse Emissieautoriteit

Dutch Emissions Authority

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Monitoring and reporting in EU-ETS

Standard methodology & Mass balance methodology

Monitoring standard methodology

Content

- Explanation MRR requirements for standard methodology (common for combustion)
- Example case study: coal fired power plant
  - ✓Monitoring standard methodology

Monitoring standard methodology

MRR Requirements

- Annex IV.1 : Specific rules for combustion processes
- Annex II : Tier Thresholds for combustion

Scope includes all emissions from:

- all combustion processes
- all emission sources which use fuel
- flue gas scrubbing
- flaring

- combustion engines for transportation purposes (trucks, forklifts, cranes) are excluded

Monitoring standard methodology

Standard calculation methodology:

Emission = AD * NCV * EF * OF

Where

AD..... Activity Data (t or Nm^3)
NCV... Net Calorific Value (TJ
EF..... Emission factor (t CO_2/TJ)
OF..... Oxidation Factor (-)

For each parameter tiers are defined (requirements)

Principle: highest tier, unless.....

- Unreasonable costs, technical feasibility
- Category A installation
- De-minimis source stream

Monitoring standard methodology

Standard calculation methodology:

Emission = AD * NCV * EF * OF

Where

AD..... Activity Data (t or Nm^3)

NCV... Net Calorific Value (TJ

EF..... Emission factor (t CO_2/TJ)

OF..... Oxidation Factor (-)

- Activity data: continuous or batch measurement (t or Nm^3)

Tier thresholds for uncertainty activity data

	1	2	3	4
Fuels (gas, liquid)	7,5%	5%	2,5%	1,5%
Fuels, solid	7,5%	5%	2,5%	1,5%
Flaring	17,5%	12,5%	7,5%	
Flue gas scrubbing	7,5%			

Monitoring standard methodology

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OF..... Oxidation Factor (-)

Tiers for net calorific value (TJ/t, TJ/nM^3)

Tier	Combustion	Flaring	Scrubbing
1	Standard factor	-	-
2a	Country specific standard	-	-
2b	Supplier data	-	-
3	Sampling and analysis	-	-

Monitoring standard methodology

Standard calculation methodology:

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Where

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EF..... Emission factor (t CO_2/TJ)

OF..... Oxidation Factor (-)

Tier for Emission factor

Tier	Combustion	Flaring	Scrubbing
1	Standard factor MRR	Ethane	Standard Factor
2a	Country specific standard	Modelling	-
2b	Empirical correlation (ρ)	-	-
3	Sampling and analysis	-	-

Monitoring standard methodology

Standard calculation methodology:

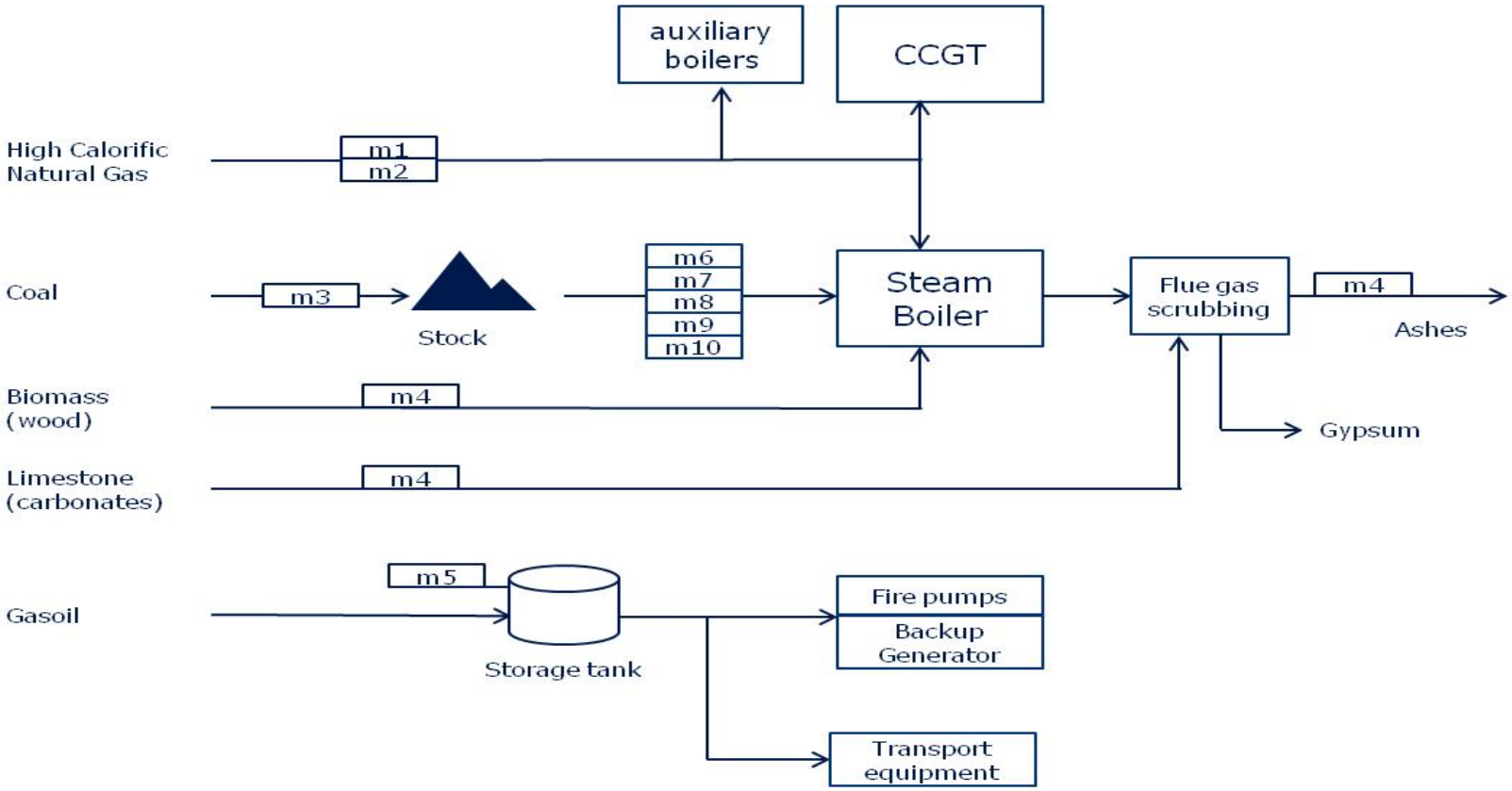
Emission = AD * NCV * EF * OF

Where

AD..... Activity Data (t or Nm^3)
NCV... Net Calorific Value (TJ
EF..... Emission factor (t CO_2/TJ)
OF..... Oxidation Factor (-)

Tiers for oxidation factor (non Oxidized Carbon)

Tier	All Combustion
1	Oxidation factor = 1
2a	Country specific standards or literature values
3	Based on analysis of carbon content ashes, effluents



Case Study: Setting up monitoring plan for Power Plant

Combustion, category C installation > 500 kton CO_2

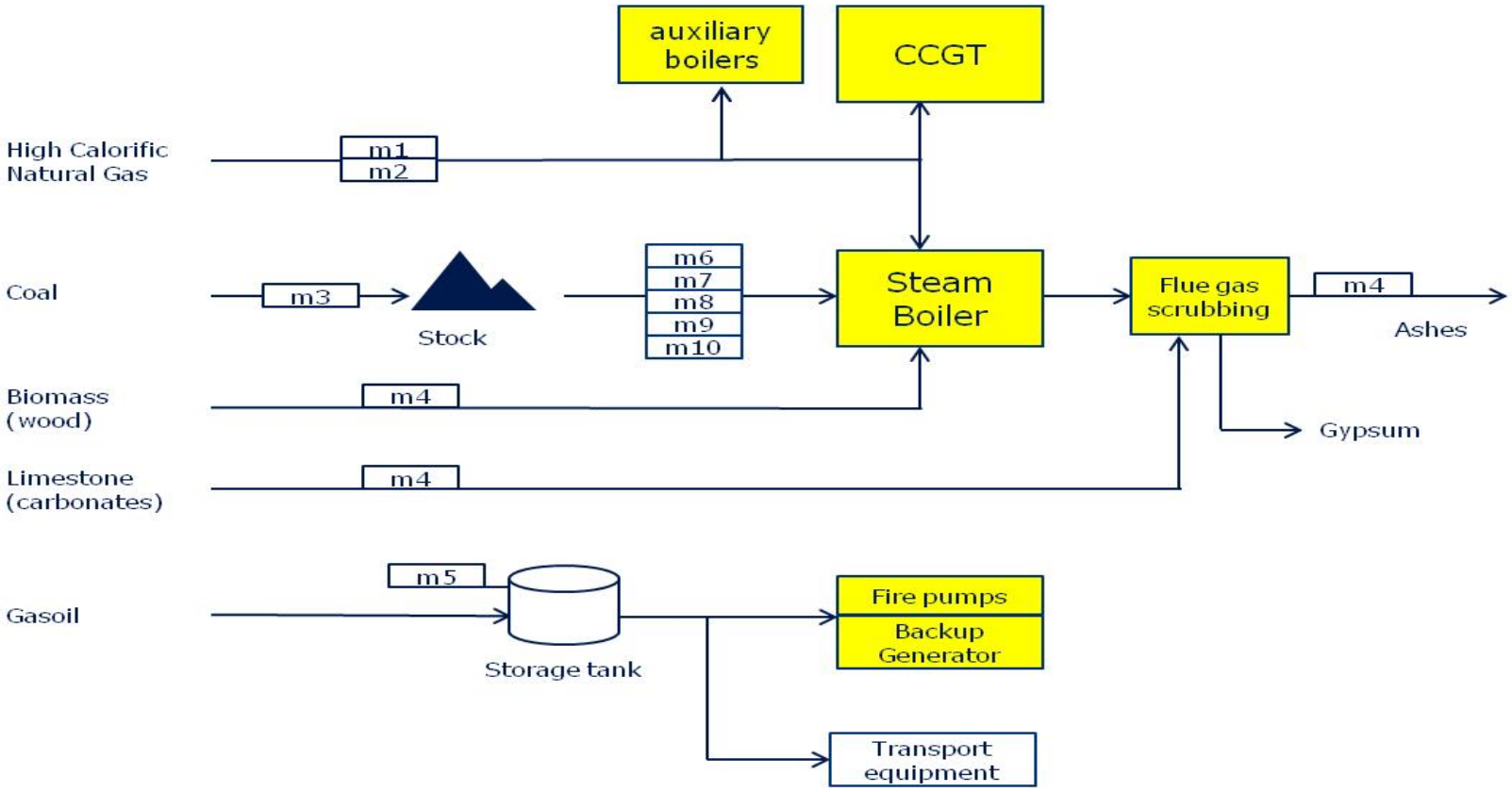
Setting up monitoring plan

1. Description of installation
2. Identify emissions sources, source streams
3. Identify measurement instruments and uncertainty
4. Description of calculation methodology + formulae
5. Monitoring methodology each source stream.
   ➔ Required and used tiers
6. Description dataflow + control activities

Setting up monitoring plan

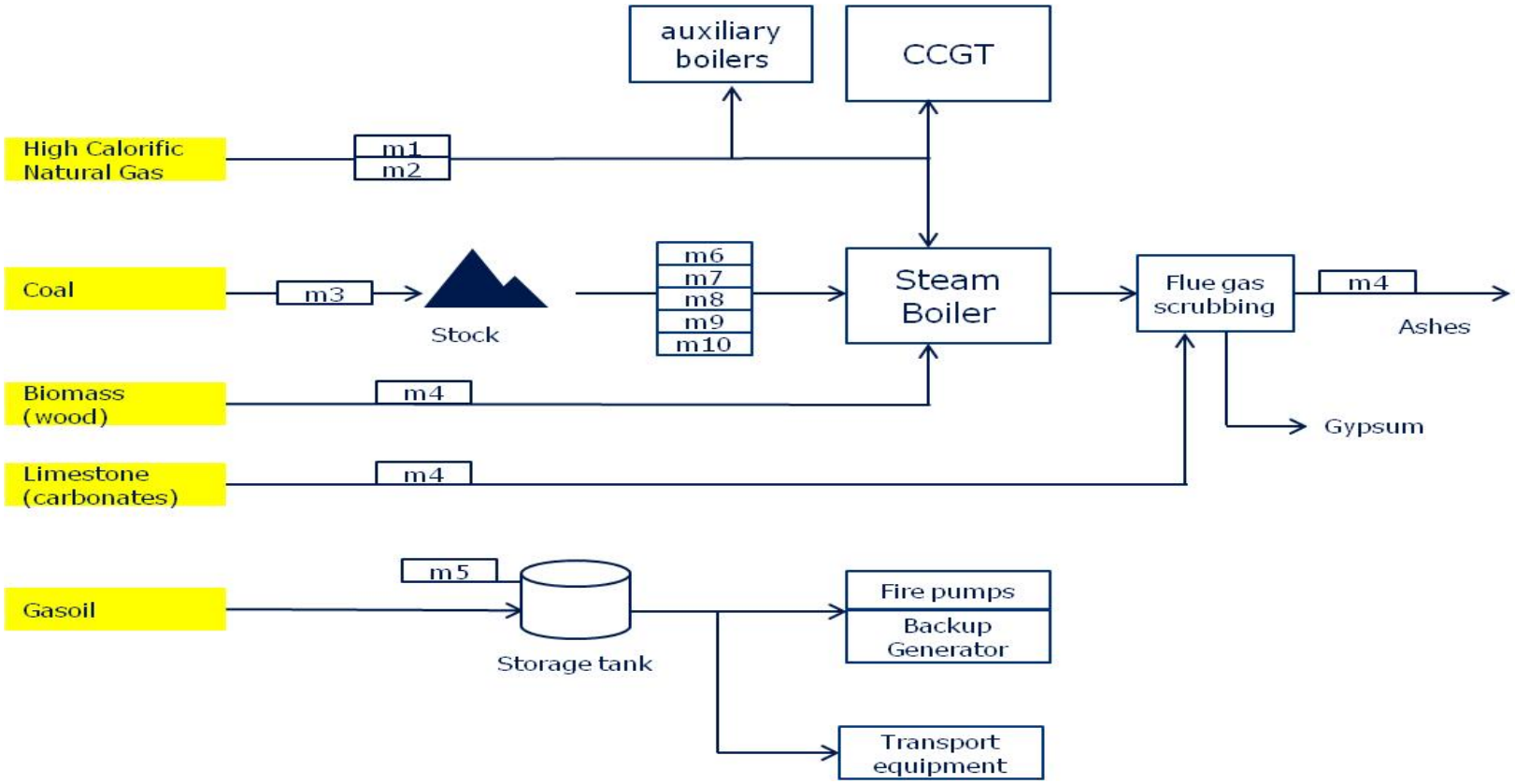
1. Description of installation
2. Identify emissions sources, source streams
3. Identify measurement instruments and uncertainty
4. **Description of calculation methodology + formulae**
5. **Monitoring methodology each source stream.**
   ➔ Required and used tiers
6. Description dataflow + control activities

1. Identification of emission sources



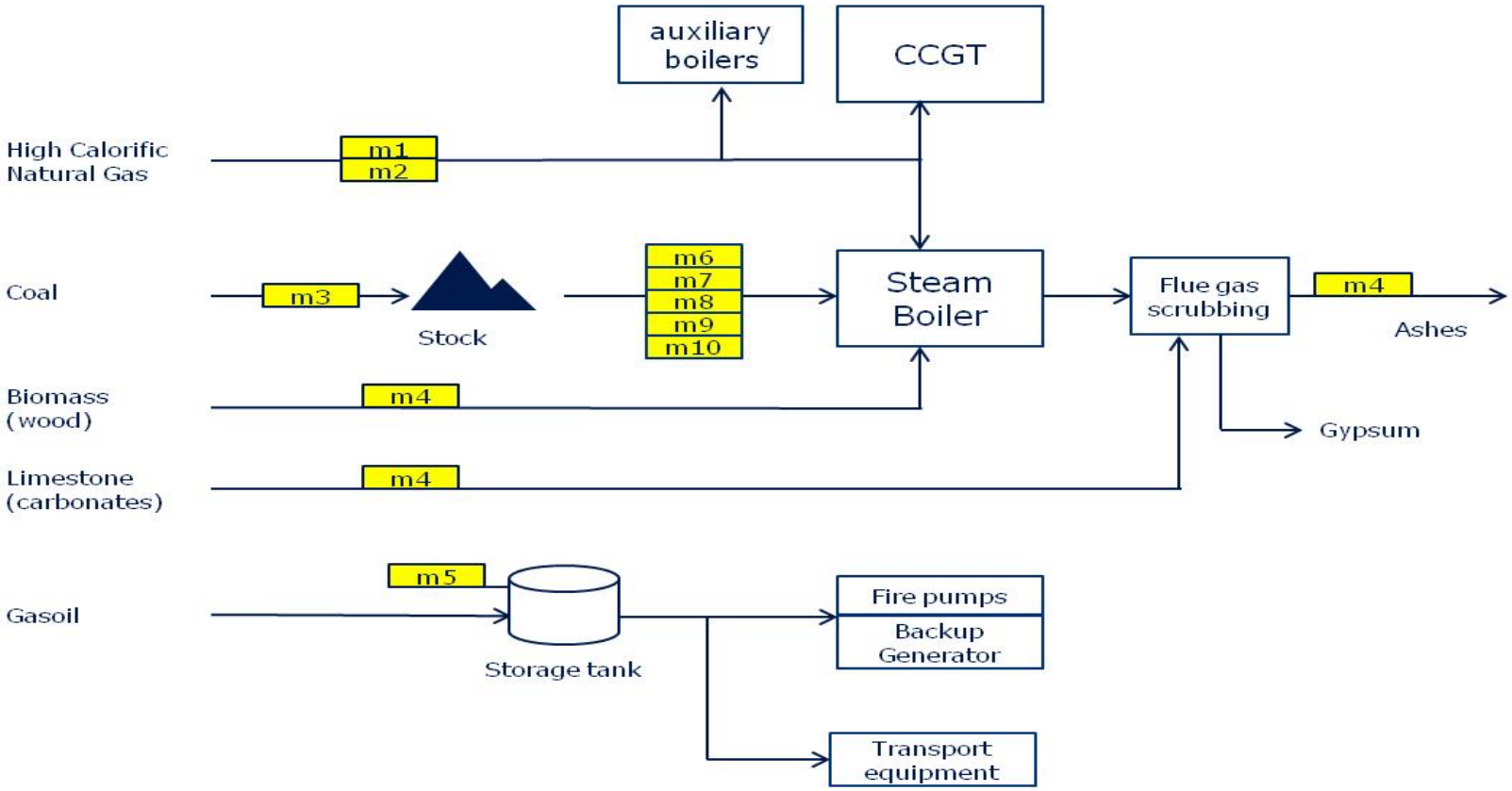
S1	Combined Cycle Gas Turbine	700 MWth
S2	Steam Boiler	1500 MWth
S3	Auxillary boilers	30 MWth
S4	Fire Pumps, Generators	10 MWth
S5	Flue gas scrubbing unit	-

2. Identify sourcestreams, types and categories



F1	Coal	Solid Fuel	2.000.000 t	Major
F2	Natural gas	Gaseous fuel	600.000 t	Major
F3	Limestone	Scrubbing	19.000 t	Minor
F4	Biomass	Solid Fuel	1.000 t	De-minimis
F5	Gasoil	Standard Fuel	2.500 t	De-minimis

3. Identify measurement devices and uncertainty



m1,m2	Turbine Gas Flow meters	<1%
m3	Draft Survey Ship Measurement	0,5%
m4	Weighing Bridge	1,0%
m5	Level indicator	7,5%
m6..m10	Weighing belts	4,0%

Coal : **Major** source stream, solid fuel

Emission = AD * NCV * EF * OF

	Monitoring plan		**Tier Req.**
Quantity	Measurement -Delivered batches u = 0,5% -Used quantity u = 4% ➔ Specify calculation and uncertainty		4 1.5%

Coal : **Major** source stream, solid fuel

Emission = AD * NCV * EF * OF

	Monitoring plan	**Tier Req.**
NCV **EF**	Sampling: Every 20.000 ton: sampling plan based on ISO norm Analysis : Specify list of laboratories and standards ➔Procedures for sampling and analysis	3
Oxidation factor	Measurement quantity of Ashes Sampling & Analysis; carbon content ➔Specify Calculation methods for OF	1

Requirements for sampling and analysis

- Sampling and analyses done by relevant standards if available;
- Results of analyses may only be used for the related batch of fuel or material;
- Sampling plan;
- Laboratory accredited according to ISO 17025 or equivalent to ISO 17025*.

*only if accredited laboratorium cannot be used due to unreasonable costs or technical infeasibility

Frequency of analysis

Table 1: Minimum frequency of analyses

Fuel/material	Minimum Frequency of Analyses
Natural gas	At least weekly
Process gas (refinery mixed gas, coke oven gas, blast-furnace gas and convertor gas)	At least daily - using appropriate procedures at different parts of the day
Fuel oil	Every 20,000 tonnes and at least six times a year
Coal, coking coal, petroleum coke	Every 20,000 tonnes and at least six times a year
Solid waste (pure fossil or mixed biomass fossil)	Every 5,000 tonnes and at least four times a year
Liquid waste	Every 10,000 tonnes and at least four times a year
Carbonate minerals (including limestone and dolomite)	Every 50,000 tonnes and at least four times a year
Clays and shales	Amounts of material corresponding to 50,000 tonnes of CO_2 and at least four times a year
Other input and output streams in the mass balance (not applicable for fuels or reducing agents)	Every 20,000 tonne and at least once every month
Other materials	Depending on the type of material and the variation, amounts of material corresponding to 50,000 tonnes of CO_2 and at least four times a year

Based on historical analyses the uncertainty is 1/3 of the requierement for activity data:

“1/3 rule”

E.g. for major source stream tier 4 applies for AD (1,5%), the uncertainty in EF should be <0,5% (1/3 of 1,5%).

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Standard methodology & **Mass balance methodology**

Monitoring with a mass balance

Content

- MRR requirements for sectors with Mass Balances
- Example case study mass balance
  - ✓ Chemical sector : bulk organic chemicals

Monitoring with a mass balance

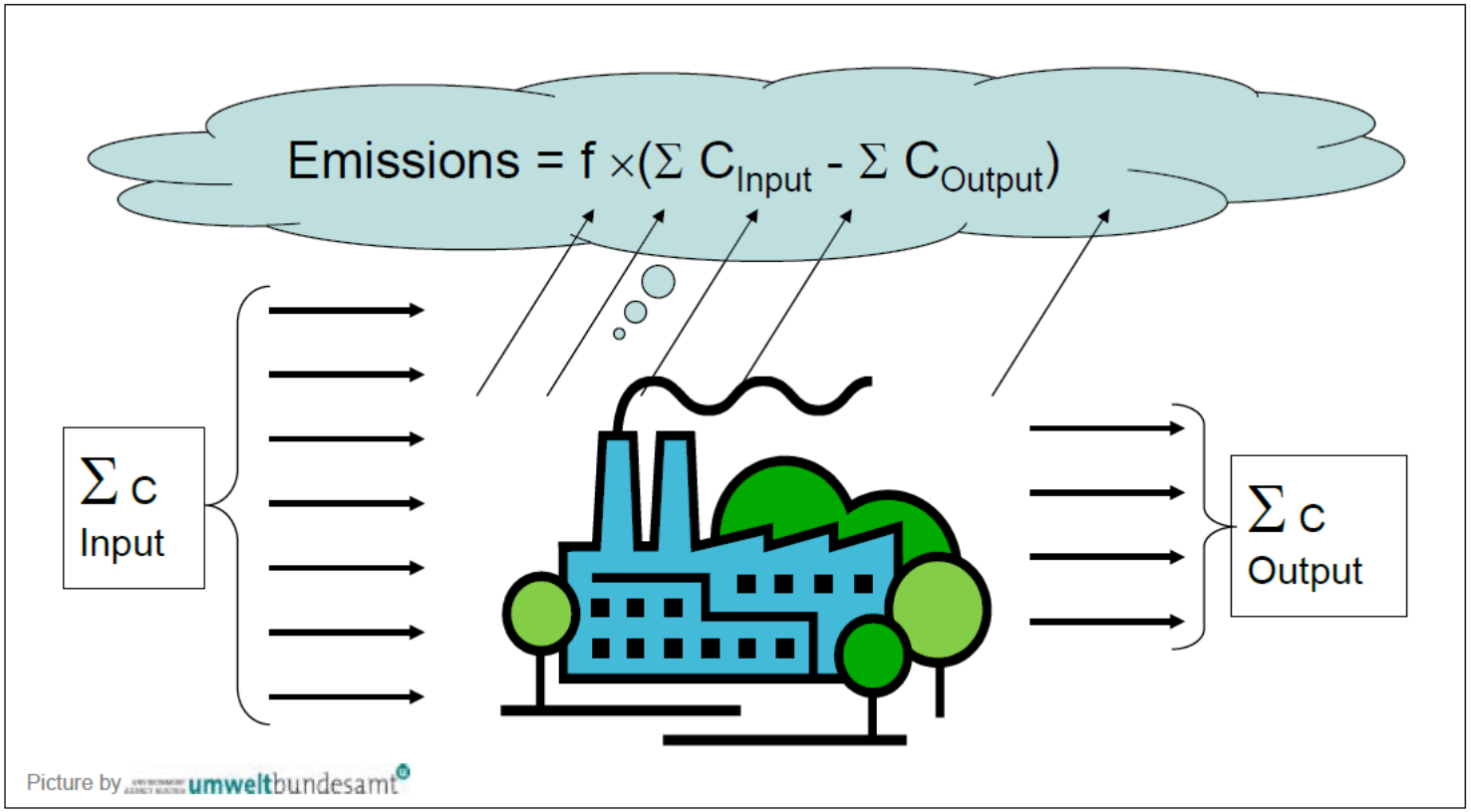
Standard calculation methodology

- For Combustion and process emissions
- Fuel/material directly related to emissions

Mass Balance methodology

- When difficult to relate emissions directly to input
- Products (and waste) contain carbon
- Oxidation/conversion factor alone is not sufficient

Monitoring with a mass balance



Complete balance of carbon entering and leaving (part of) the installation

Monitoring with a mass balance

MRR Requirements

- Annex IV.1 : Activity-specific Monitoring methodologies

Mass Balance **may** be used in

- Refining mineral oil
- Coke
- Metal Ore Roasting
- Pig Iron Production
- Carbon Black
- Bulk Organic Chemical

Mass Balance **shall** be used in

- Ferrous and Non-Ferrous metals
- Primary aluminium
- Synthesis Gas production

Each sector same principle

Monitoring with a mass balance

$$\text{Emission} = \sum (f * AD_i * CC_i)$$

Where

f :..... Factor to convert C to CO_2
3.664 t CO2/t C

AD_i..... Activity Data, mass in tons
(in = + and out = -)

CC_i ..... Carbon Content

For each parameter tiers are defined (requirements)

Principle: highest tier, unless.....

- Unreasonable costs, technical feasibility
- Category A installation
- De-minimis source streams

Monitoring with a mass balance

$$\text{Emission} = \sum (f * AD_i * CC_i)$$

Where

f :..... Factor to convert C to CO_2
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AD_i..... Activity Data, mass in tons
(in = + and out = -)

CC_i ..... Carbon Content

Activity data: continuous or batch measurement

Tier thresholds for uncertainty activity data

	1	2	3	4
All Sectors, all materials	7,5%	5%	2,5%	1,5%

Monitoring with a mass balance

$$\text{Emission} = \sum (f * AD_i * CC_i)$$

Where

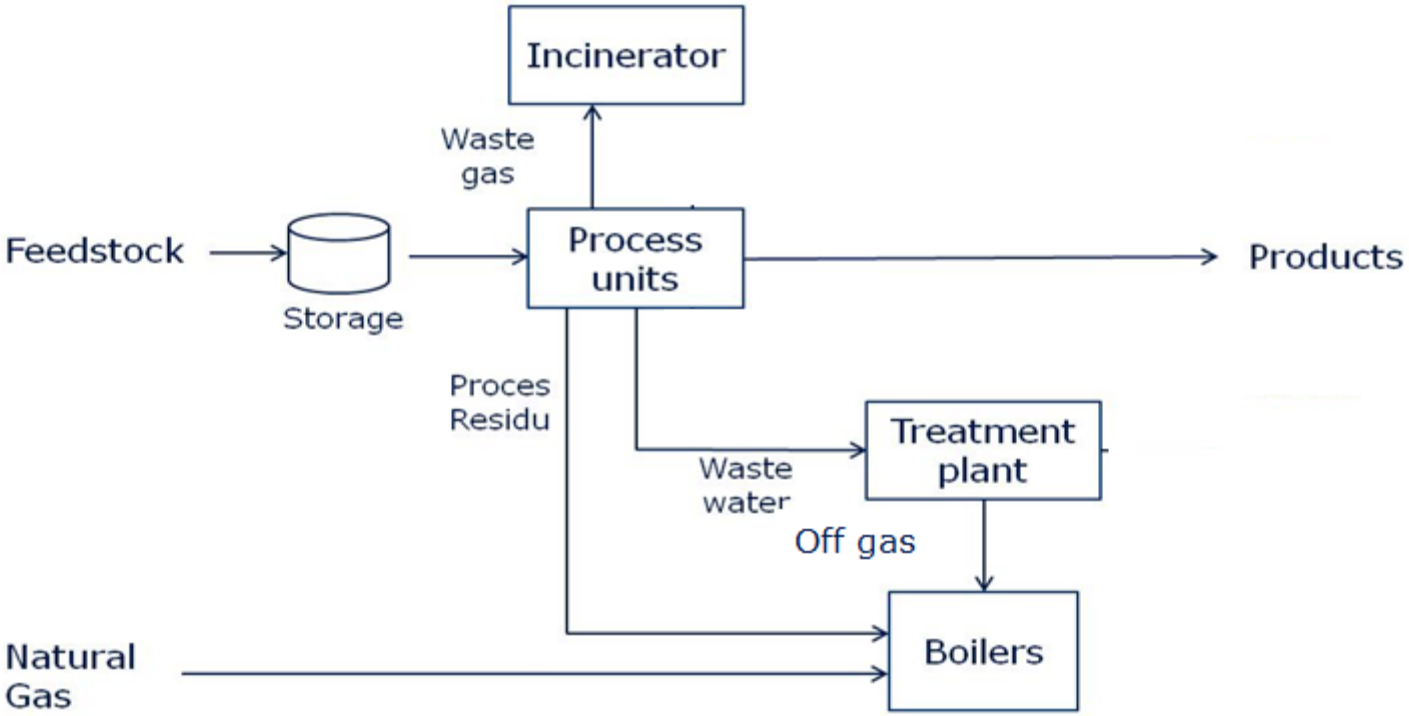
f :..... Factor to convert C to CO_2
3.664 t CO2/t C

AD_i..... Activity Data, mass in tons
(in = + and out = -)

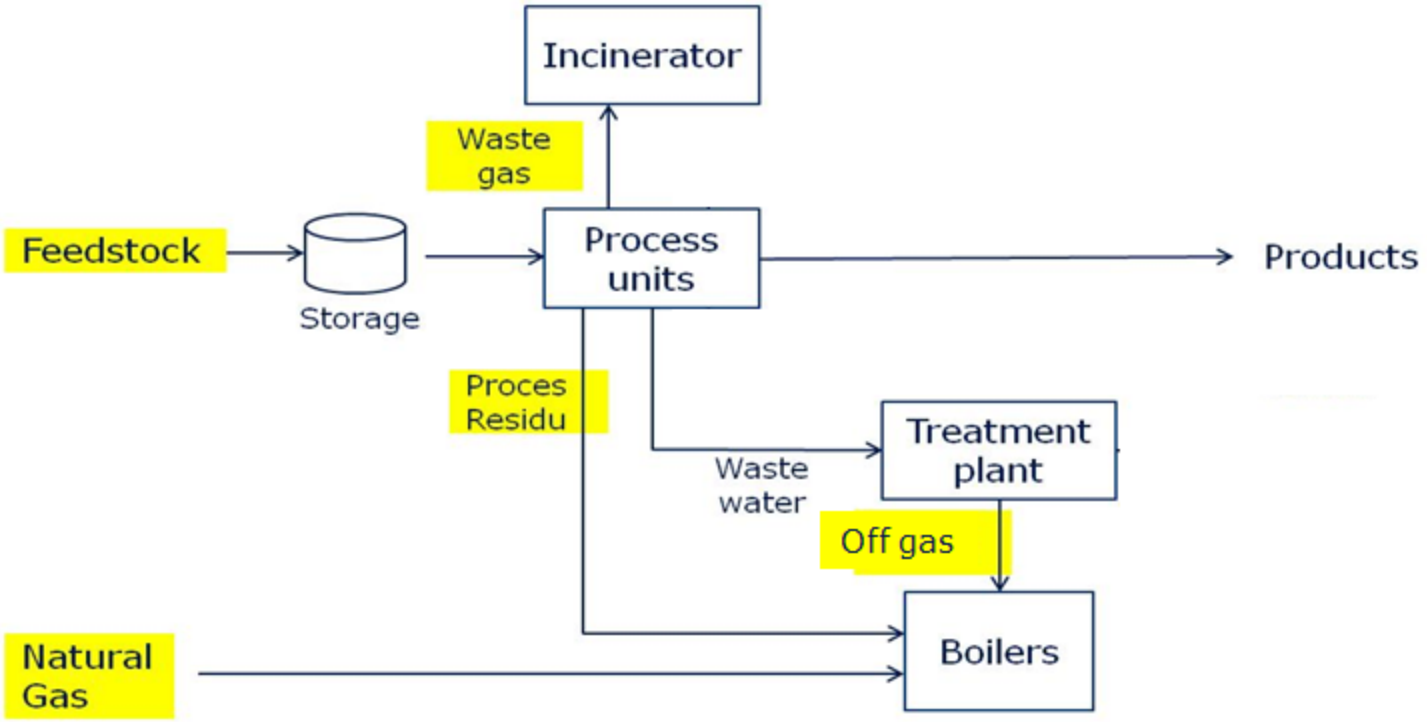
CC_i ..... Carbon Content

Tiers for determination of carbon content

Tier	All Sectors
1	Standard factor MRR
2a	Country specific standard
2b	Empirical Correlation
3	Sampling and analysis (frequency table)

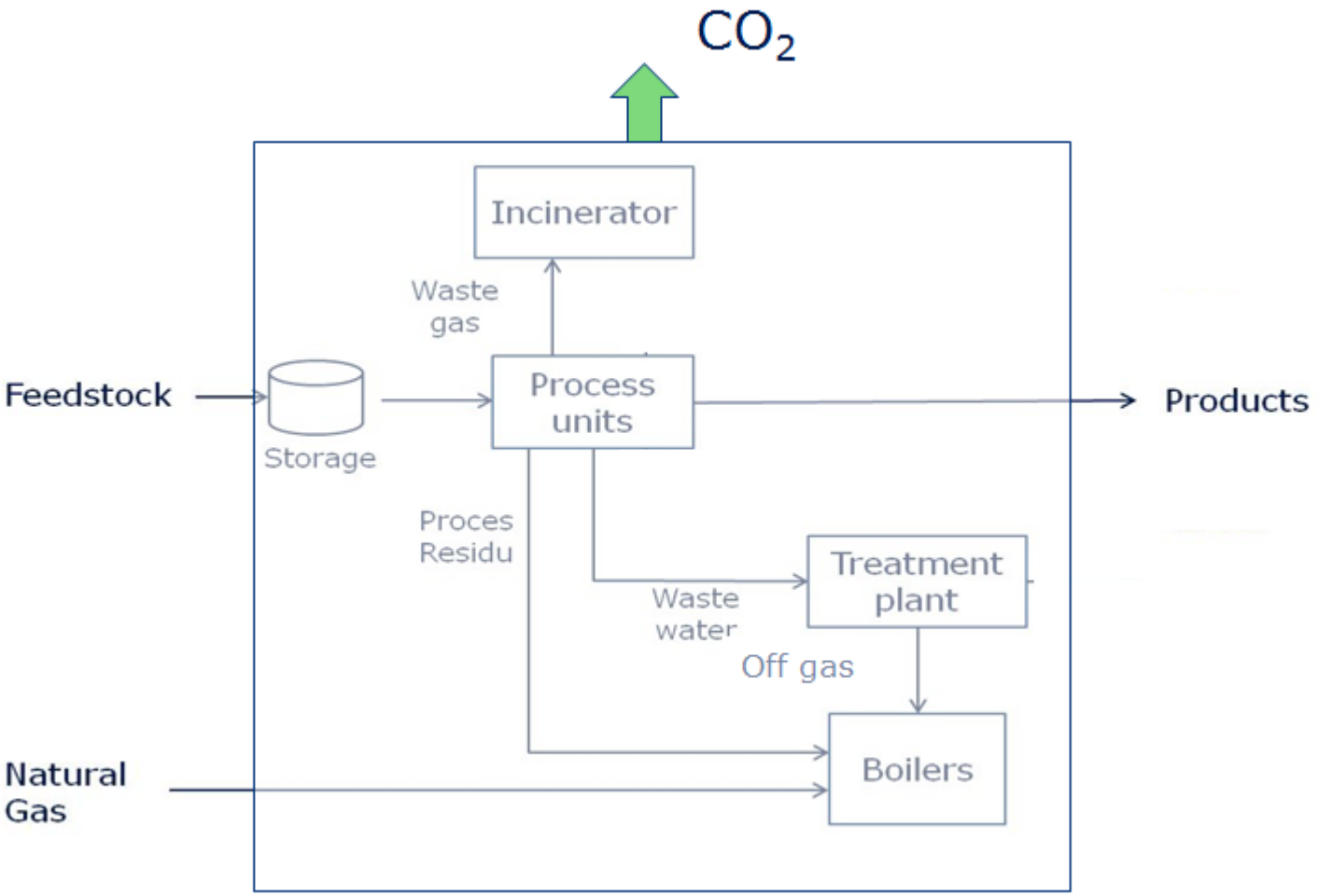


Case study: Combustion & Process emissions chemical plant



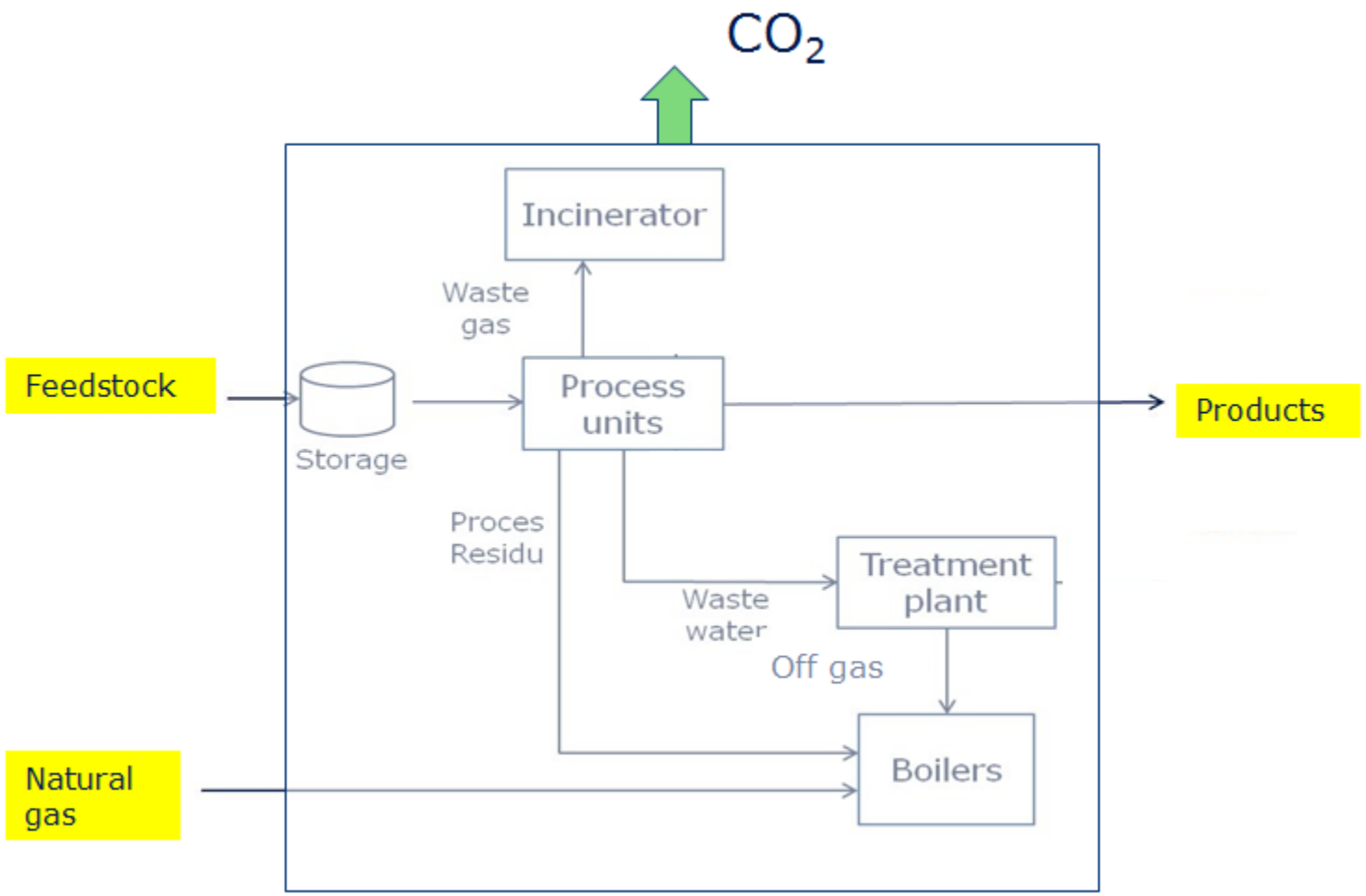
Standard methodology: source streams

- Conversion factor for feedstock difficult to obtain
- Extra sampling and analysis (residues)
- Measurements within tier requirements



Mass Balance

- Definition of system boundaries
- Emissions = carbon in – carbon out



Mass Balance:

- Indentify all carbon containing mass streams
- Source streams under mass balance

Example source stream classification

		tons of CO_2	Category
F1	Feedstock	400.000 t	Major
F2	Product	-300.000 t	Major
F3	Natural Gas	50.000 t	Minor*
Estimated emissions		**150.000 t**	

* < 10% of sum of absolute values
** < 2% of sum of absolute values

Typical Monitoring Methodology

Activity Data: Quantity

			tier
F1	Feedstock	Weighing via weigh bridge	4
F2	Products	Weighing under national metrological control	4
F3	Natural Gas	Flow measurement under national metrological control	4

Typical Monitoring Methodology

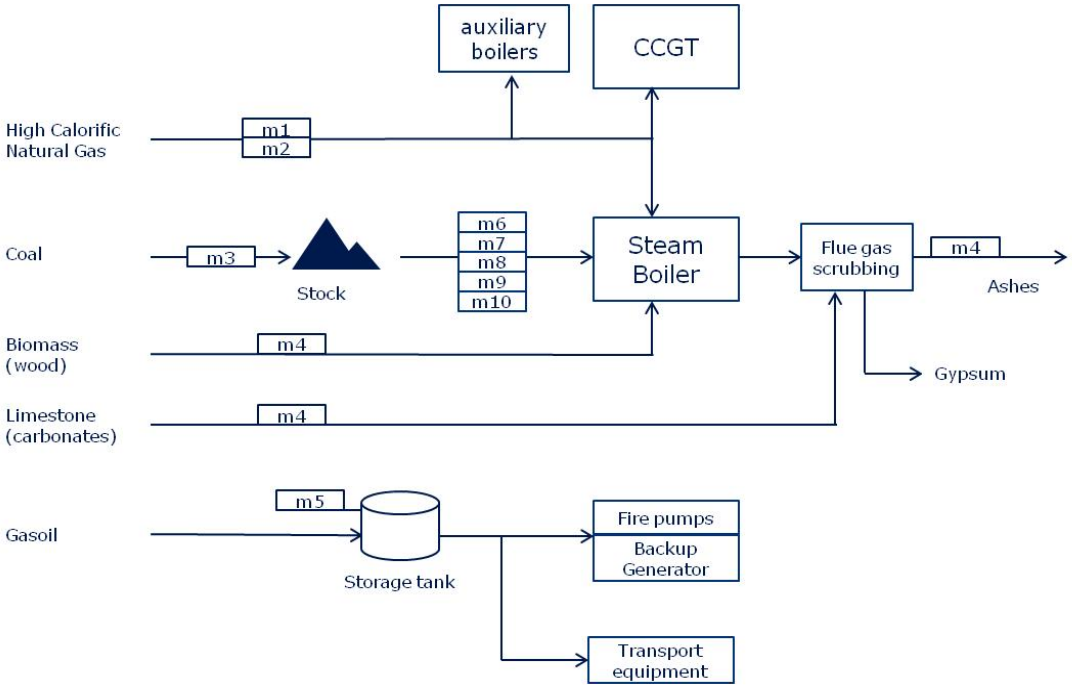
Carbon Content

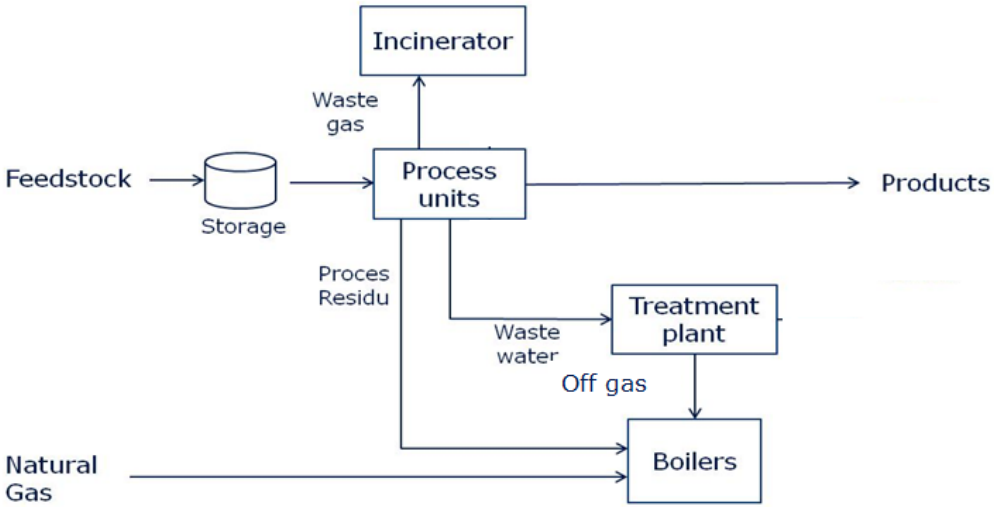
			tier
F1	Feedstock	Sampling and Analysis for quality control ➔ Every 20.000 tons /each month	3
F2	Product	Sampling and Analysis for quality control ➔ Every 20.000 tons /each month	3
F3	Natural Gas	On line chromatography	3

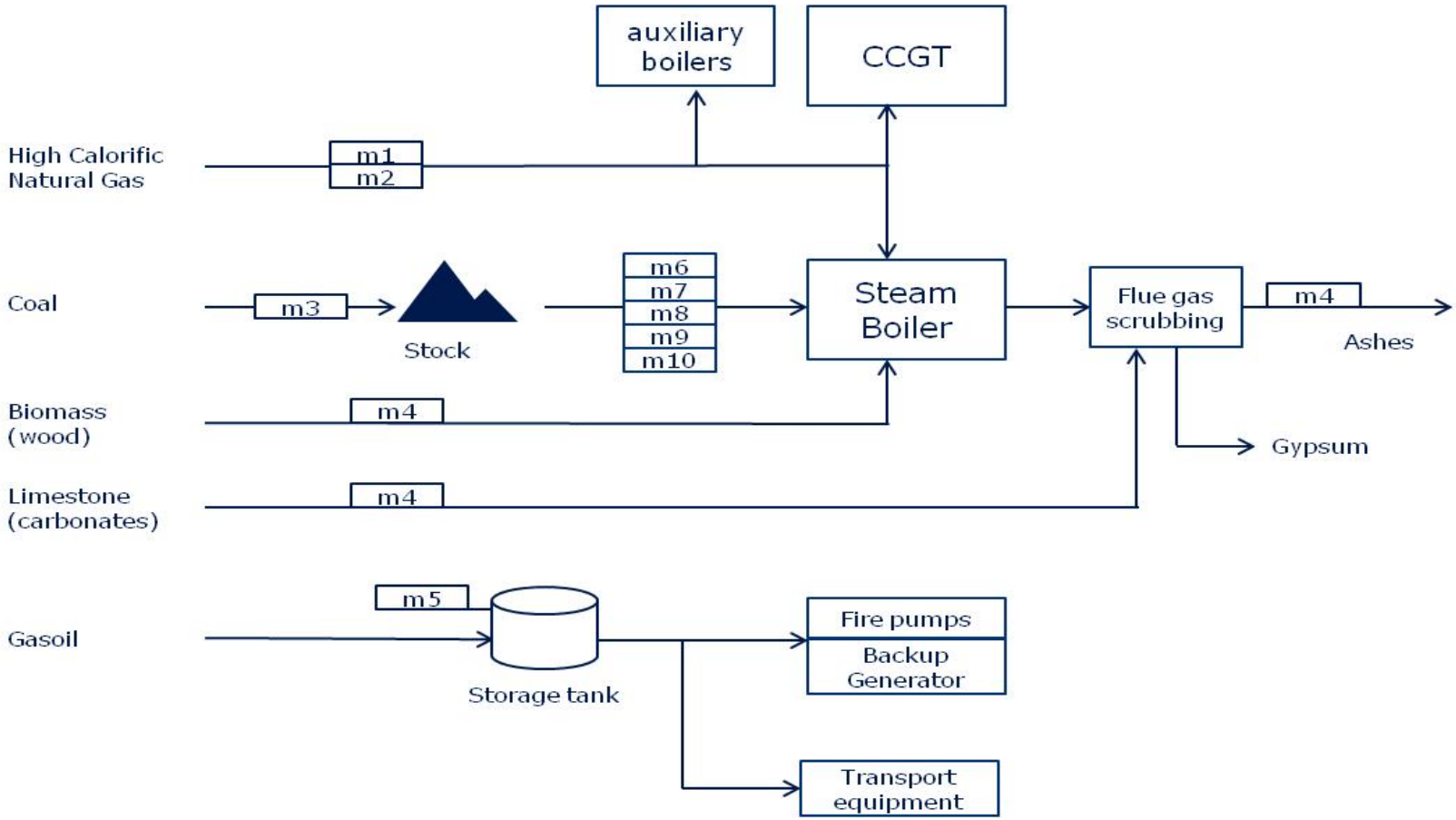
Thank you for your attention

Any questions?

Practical exercises


auxiliary boilers
CCGT
High Calorific Natural Gas
m1
m2
Coal
m3
Stock
m6
m7
m8
m9
m10
Steam Boiler
Flue gas scrubbing
m4
Ashes
Biomass (wood)
m4
Gypsum
Limestone (carbonates)
m4
Gasoil
m5
Storage tank
Fire pumps
Backup Generator
Transport equipment


Incinerator
Waste gas
Feedstock
Storage
Process units
Products
Proces Residu
Waste water
Treatment plant
Off gas
Natural Gas
Boilers


auxiliary boilers
CCGT
High Calorific Natural Gas
m1
m2
Coal
m3
Stock
m6
m7
m8
m9
m10
Steam Boiler
Flue gas scrubbing
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Ashes
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Gypsum
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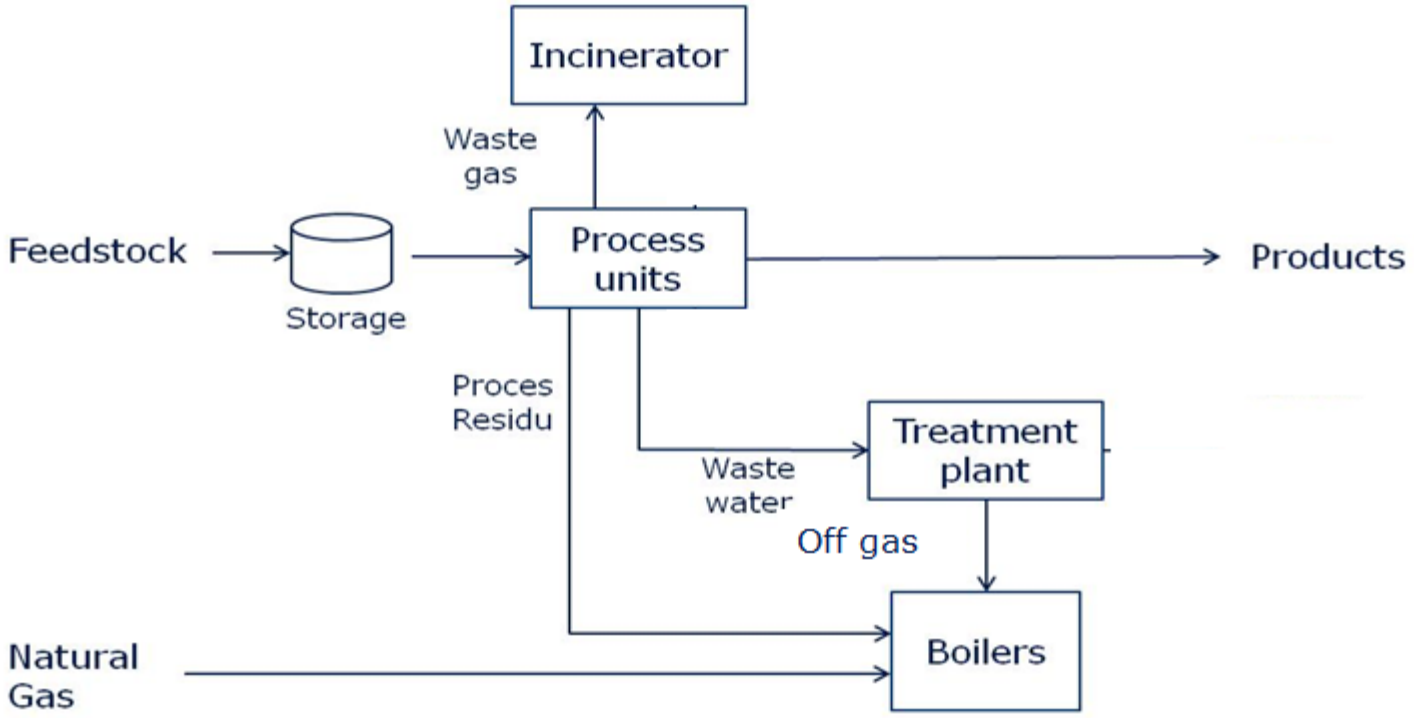
Incinerator
Waste
gas
Feedstock
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Proces
Residu
Treatment
plant
Waste
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Off gas
Natural
Gas
Boilers