

**uni
per**

**The Medium Combustion Plant
Directive – Power Industry
Perspective**

David Graham and Steve Griffiths
Air Quality & Emissions Show
21 November 2018

We are Uniper

Our operations:

- Power Generation
- Commodity Trading
- Energy Storage
- Energy Sales
- Energy Services

Where we operate:



40+ countries around the world
4th largest generator in Europe

Employees: 12,000



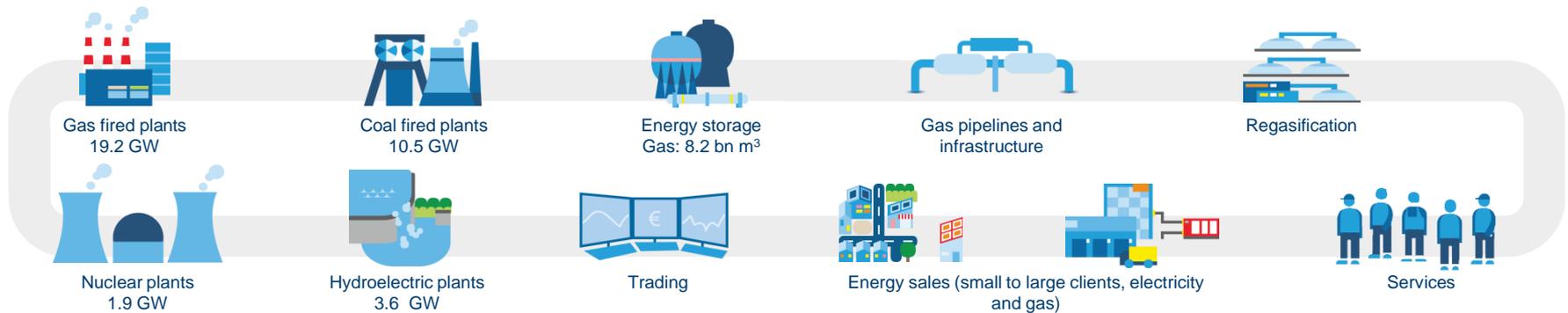
- Power generation, Storage, Services - Europe
- Power generation - International
- Commodity Trading, Energy Sales

€ 1.7 bn
EBITDA

100 years
Experience

36 GW
Total generation

Main activities:



MCPs on IED regulated sites I

The MCPD states the following in relation to the IED:

- The MCPD shall not apply to combustion plants covered by Chapter III or IV of the IED
- The MCPD ELVs apply without prejudice to Chapter II of the IED
- The MCPD permit and registration requirements are considered to be already fulfilled for plants covered by Chapter II of the IED

The IED applies to all plants on a site where the sum of the individual unit thermal ratings is $\geq 50\text{MW}_{\text{th}}$. Chapters I and II of the IED set general provisions for all combustion units on IED sites in terms of obligations to hold a permit, permit requirements and the need to set ELVs on the basis of Best Available Techniques (BAT).

Chapter III of the IED sets minimum ELVs and monitoring requirements for Large Combustion Plants (LCPs) of 50MW_{th} or more. LCPs are defined at the stack level with units of 15MW_{th} or greater aggregated when emitting through a common stack to calculate the total thermal rating of the LCP.

Chapter IV of the IED is specific to waste incineration and waste co-incineration plants.

The LCP BAT Reference (LCP BREF) document sets out BAT Associated Emission Levels (AELs) for units of 15MW_{th} or greater which are part of IED Chapter III plants.

MCPs on IED regulated sites II

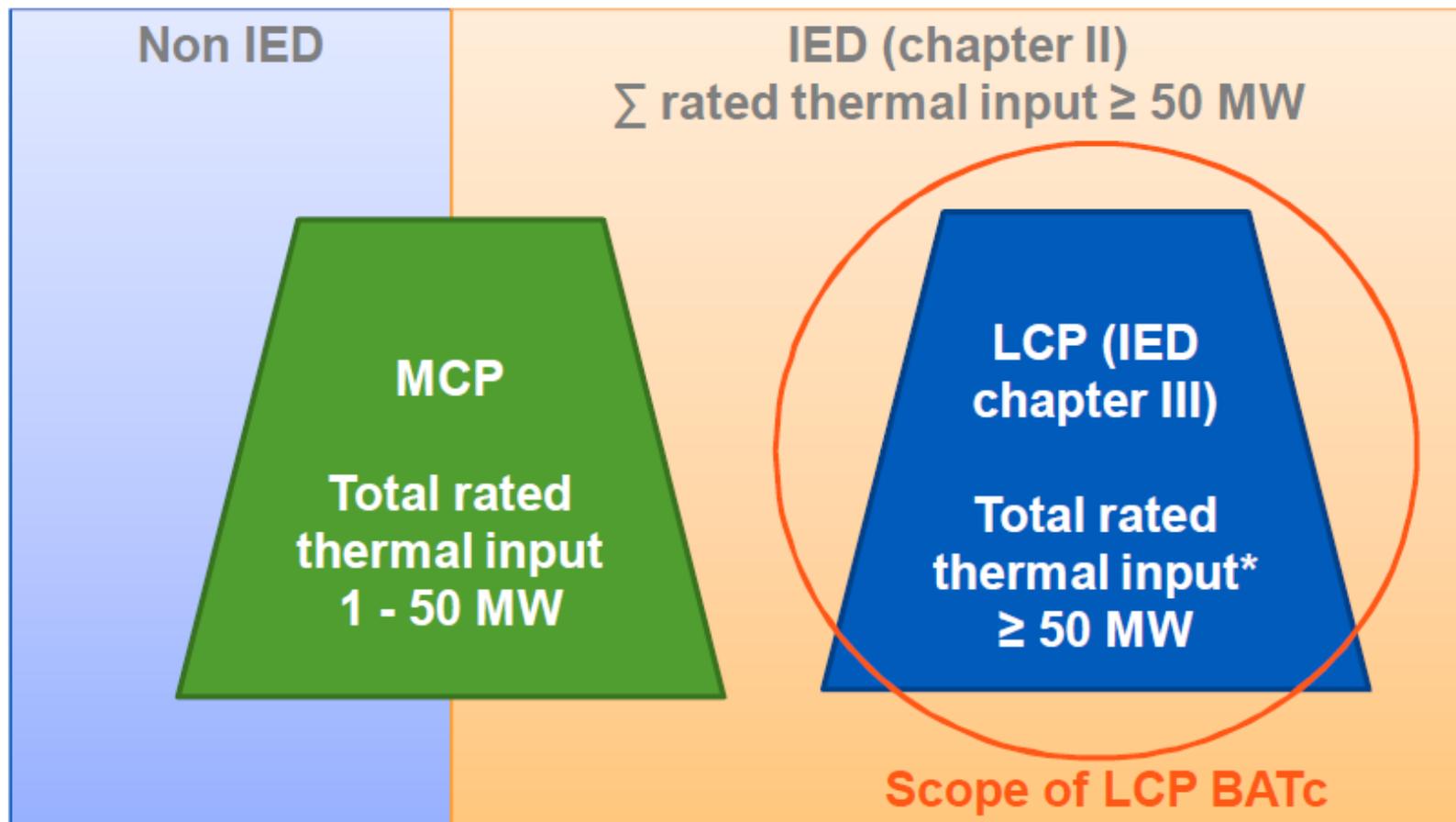
In practice, for MCPs on IED regulated sites

- There is scope for Member States to decide the regulatory detail
- No requirement to have a separate MCPD permit – in practice it is likely that the MCPD provisions will be added to the IED permit as appropriate
- The MCPD ELVs will apply as a minimum standard
- Where the BAT Reference (BREF) conclusions cover plants in the MCP size range, then the BREF emission limits, if stricter, take precedence

It should be noted that

- The LCP BREF only covers LCPs as defined under the IED. It does therefore not cover units of $<15 \text{ MW}_{\text{th}}$ which are part of an LCP or stand alone units within the MCP size range
- MCPs on IED sites which already have limits set are likely to retain those limits where stricter than the MCPD – this includes units $<15 \text{ MW}_{\text{th}}$ which are part of an LCP

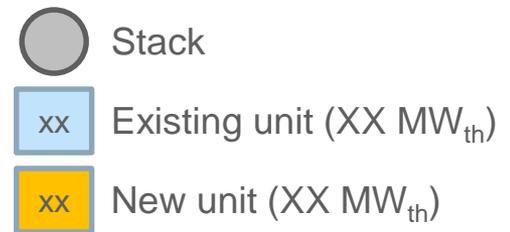
Overlap with IED Chapter II (Double regulation)



* For the purpose of LCP capacity calculation, units below 15 MW shall not be considered

Aggregation Examples

Defining MCPs and LCPs



Plant	Regulated as	Notes
	2 x 20 MW _{th} MCPs Both existing	<i>No aggregation of existing plants</i>
	2 x 20 MW _{th} MCPs 1 existing, 1 new	<i>No aggregation of existing with new plants</i>
	1 x 40 MW _{th} MCP New	<i>Aggregation rule applies for new plants</i>
	1x10 MW _{th} & 1x 45 MW _{th} MCP Both existing	<i>Below IED Ch III threshold of 50 MW_{th} due to 15MW_{th} minimum for IED aggregation. Subject to IED Ch II as above site threshold of 50MW_{th}.</i>
	1 x 55 MW _{th} MCP New	<i>As above, but subject to MCPD new plant aggregation rule.</i>
	1 x 55 MW _{th} LCP & 1x10 MW _{th} MCP	<i>1 unit above IED Ch III threshold. 1 unit below 15MW_{th} minimum for IED aggregation</i>
	1 x 60 MW _{th} LCP	<i>Aggregated value > IED Ch III threshold, so regulated as LCP</i>

Emission Limit Values – Boilers/General

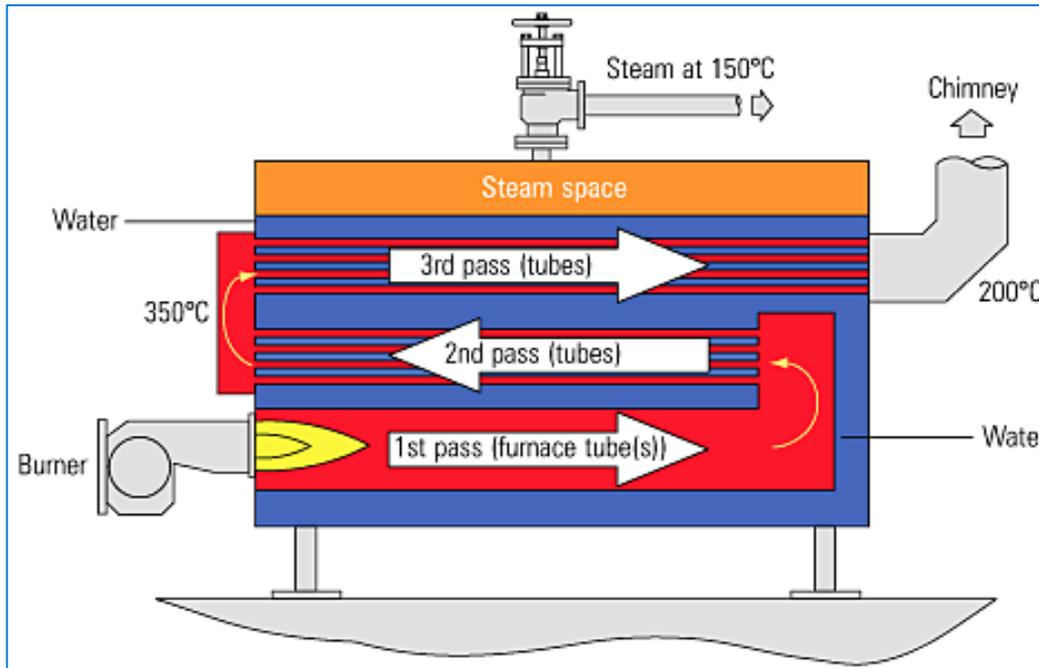
- ELVs in mg/m³ at 273K, 101.3 kPa at: 3% O₂ for gas and oil fired boilers and 6% O₂ for solid fuel fired boilers
- NEW plants

	Natural Gas	Other Gaseous	Gas Oil	Other Liquid	Solid Biomass	Other Solid
NO_x	100	200	200	300	300	300
SO₂	-	35	-	350	200	400
Dust	-	-	-	20	20	20

- Note that there are numerous derogations in specific sub-categories of thermal rating, fuel type, etcetera (consult the MCPD)
- Natural Gas NO_x: IED 100 mg/m³; LCP BREF 10 – 60 mg/m³
- Biomass Dust: IED 20 mg/m³ (> 50 MW_{th}); LCP BREF 2 – 5 mg/m³ (< 100 MW_{th})

Package Boiler Emissions (New Plant)

- Emissions are dependent upon boiler design and geometry (confinement)
- New burner–boiler combination can be optimised with low NO_x
- Natural Gas: 80 mg/m³ achievable; Gas Oil depends on N content of fuel
- MCPD new plant NO_x ELVs of 100 mg/m³ (Natural Gas) & 200 mg/m³ (Gas Oil) can be achieved if the boiler geometry is reasonably unconfined:



Three-pass wet back package boiler (high efficiency)

Source: Spirax Sarco

Emission Limit Values – Boilers/General

- EXISTING plants: $\geq 1 \text{ MW}_{\text{th}}$ to $\leq 5 \text{ MW}_{\text{th}}$

	Natural Gas	Other Gaseous	Gas Oil	Other Liquid	Solid Biomass	Other Solid
NO_x	250	250	200	650	650	650
SO₂	-	200	-	350	200	1100
Dust	-	-	-	50	50	50

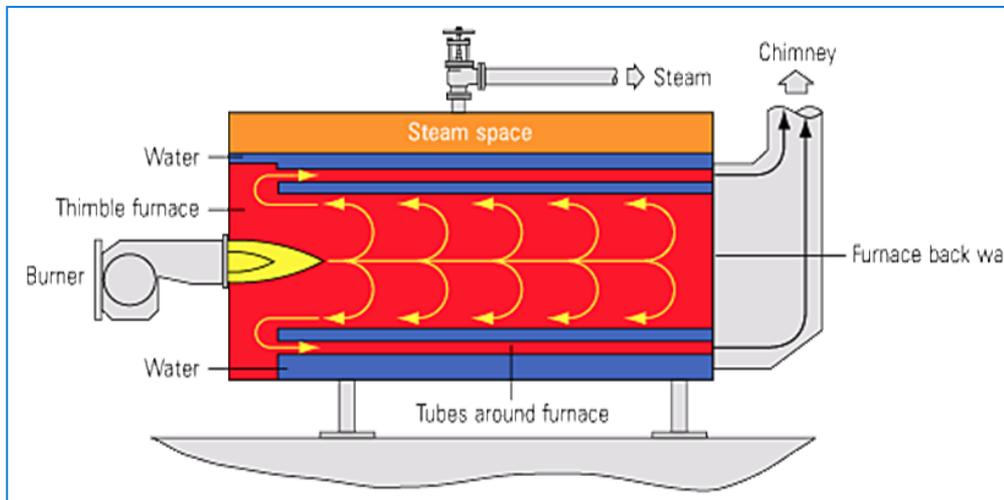
- EXISTING plants: $> 5 \text{ MW}_{\text{th}}$ to $< 50 \text{ MW}_{\text{th}}$

	Natural Gas	Other Gaseous	Gas Oil	Other Liquid	Solid Biomass	Other Solid
NO_x	200	250	200	650	650	650
SO₂	-	35	-	350	200	400
Dust	-	-	-	30	30	30

- Natural Gas: IED 100 mg/m³ ; LCP BREF 50 – 100 mg/m³
- Biomass Dust: IED 30 mg/m³ (50 – 100 MW_{th}); LCP BREF 2 – 15 mg/m³ (< 100 MW_{th})
- Note that there are numerous derogations in specific sub-categories of thermal rating, fuel type, etcetera (consult the MCPD)

Package Boiler Emissions (Existing Plant)

- Existing non-compliant burner–boiler combination can be retrofit with a new burner system but performance can be sub-optimal
- The most difficult system is the ‘reverse flame’ boiler since this combines tight confinement and difficult aerodynamics
- In most cases, performance close to the new plant ELV may be achieved
- MCPD existing plant NO_x ELVs of 200 – 250 mg/m^3 (Natural Gas) & 200 mg/m^3 (Gas Oil) can usually be achieved with burner retrofit but...
- In difficult cases, Flue Gas Recirculation (FGR) may be required



Pseudo three-pass dry back
Reverse Flame package boiler

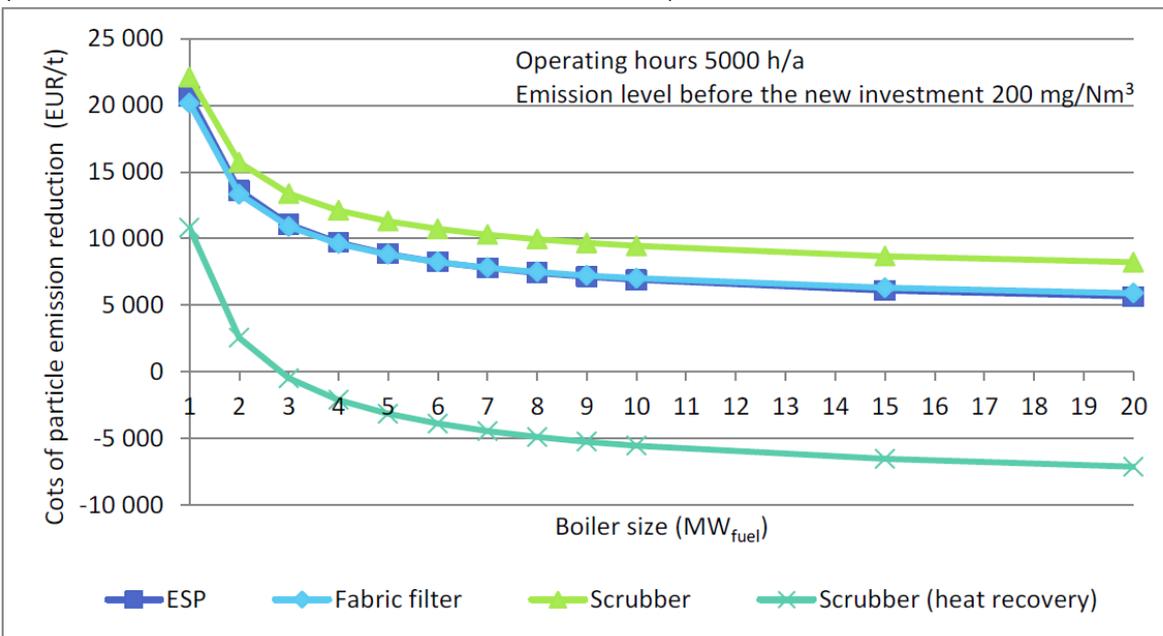
ELV Derogations in England & Wales

- 500h exemptions - implemented as a 5-year (existing plant) or three year (new plant) rolling average
- **Biomass plants – delayed dust ELVs - not implemented**
- District heating – delayed ELVs - not implemented
- Small and Micro Isolated Systems – delayed ELVs - implemented
- Gas compressor stations $> 5\text{MW}_{\text{th}}$ - delayed ELVs - implemented

Biomass fired boilers

- Dust ELVs of 20 – 50 mg/m³ are difficult/costly to achieve on small plant

Technology	Achievable Emission Level
Multicyclone	~200 mg/Nm ³
ESP (two fields)	< 30 mg/Nm ³
Fabric filter	< 20 mg/Nm ³
Cyclone/Multicyclone + Scrubber	~45 mg/Nm ³



Pirhonen L
Particle Emission Reduction
Cost Analysis for Existing 1-
20 MW_{fuel} Solid Biofuel
Plants in Finland
June 2014

Emission Limit Values – Gas Turbines (NEW)

- ELVs in mg/m³ at 273K, 101.3 kPa at: 15% O₂
- NEW plants (achievable with DLN for Natural Gas)

MCPD ELVs Gas Turbines - New Plant (mg/m ³ at 15% O ₂ dry, 0°C, 1 atm)					
	Natural Gas	Other Gaseous	Gas Oil	Other Liquid	Comment
NO_x	50	75	75	75	Only applicable over 70% load
SO₂	-	15	-	120	40 mg/m ³ for biogas
Dust	-	-	-	10	20 mg/m ³ for ≥ 1 to ≤ 5MW _{th} plant

- Natural Gas NO_x:
IED 50 mg/m³
LCP BREF 10/15 – 30/35 mg/m³ (CCGT/OCGT)

Emission Limit Values – Gas Turbines (EXISTING)

- ELVs in mg/m^3 at 273K, 101.3 kPa at: 15% O_2
- EXISTING plants (achievable with DLN or water injection but significant cost if currently uncontrolled)

MCPD ELVs Gas Turbines - Existing Plant (mg/m^3 at 15% O_2 dry, 0°C, 1 atm)					
	Natural Gas	Other Gaseous	Gas Oil	Other Liquid	Comment
NO_x	150	200	200	200	Only applicable over 70% load
SO₂	-	15	-	120	60 mg/m^3 for biogas; 130 mg/m^3 for coke oven gas; 65 mg/m^3 for blast furnace gas
Dust	-	-	-	10	20 mg/m^3 for ≥ 1 to $\leq 20\text{MW}_{\text{th}}$ plant

- Natural Gas NO_x :
IED 50 – 75 mg/m^3 (depending on efficiency)
LCP BREF 10/15 – 45/50 mg/m^3 (CCGT/OCGT)

Emission Limit Values - Engines

- ELVs in mg/m^3 at 273K, 101.3 kPa, **15% O₂** for recip engines
- Engine Emission Limit Values are subject to complex derogations
- For NEW plants, NO_x ELVs are 95 mg/m^3 for natural gas firing and 190 mg/m^3 for liquid fuel firing
- For EXISTING plants, NO_x ELVs are 190 mg/m^3 for all fuels.
- SO₂ ELVs apply to engines firing liquid fuels other than Gas Oil and gaseous fuels other than natural gas.
- Dust ELVs apply to engines firing liquid fuels other than Gas Oil

Monitoring Requirements

- Annex III Article 3 states that ‘Measurements shall be required only for (a) pollutants for which an ELV is laid down in this Directive for the plant concerned and (b) CO for all plants
- It is assumed that no monitoring is required for species for which a plant has an ELV exemption – although the wording is ambiguous, so Member States might have differing interpretations
- This suggests the following monitoring requirements:

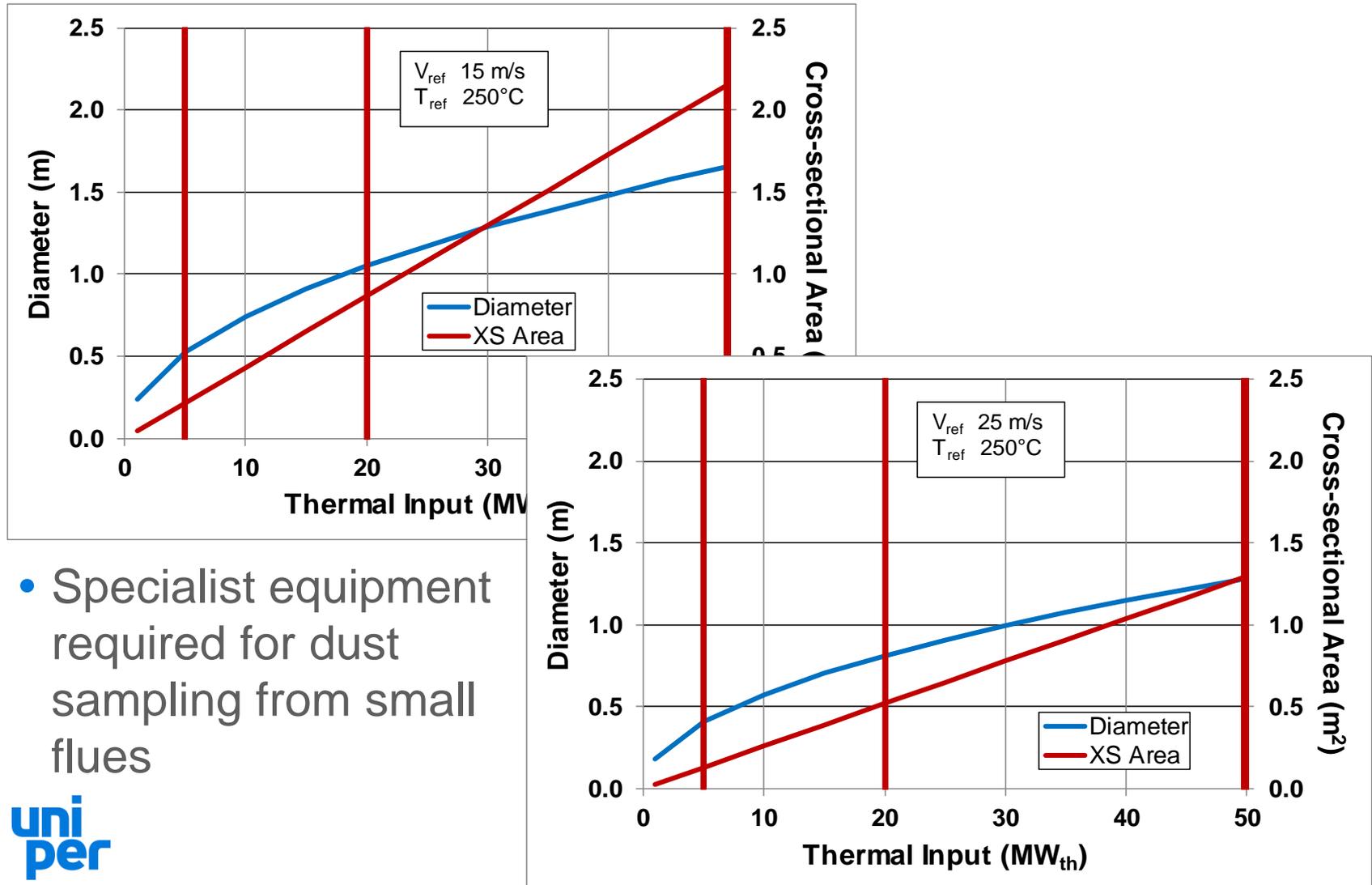
Plant fuel type	Species monitored
Natural gas or Gas oil	CO and NO _x
Gaseous fuels other than natural gas	CO, NO _x and SO ₂
Biomass, Other solid fuels or Liquid fuels other than Gas oil	CO, NO _x , SO ₂ and Dust
Gas and liquid fuelled plants under the 500 hour derogation	CO only
Biomass and Other solid fuel plants under the 500 hour derogation	CO and Dust

Monitoring Issues - timing

- The requirement to provide first measurements within 4 months of the permit being granted could lead to a very large number of individual MCPs requiring measurements within the first four months of 2024 or 2029 (based on the deadlines by which existing plant permits must be granted).
- Early scheduling of measurements, combined with early application for permits should mitigate this risk.
- The detailed requirements need to be defined.

Monitoring issues – minimum flue size

- Depends on velocity



- Specialist equipment required for dust sampling from small flues

Monitoring issues – Nitrogen Dioxide

- Proportion of NO_2 in NO_x is important for Air Quality – Dispersion Modelling studies (note requirements for certain Specified Generators)
- Difficult to measure NO_2 within the overall NO_x emission
- Inert sample probe material needed in addition to prescribed sample line materials (PTFE, stainless steel)
- NO_2 reduced to NO in steel probes $> 300^\circ\text{C}$ in engine and gas turbine exhausts
- NO_2 is water soluble
- Care needed in the direct measurement of NO_2 and interpretation of engine manufacturers' data

Conclusions

- Overlap with legislation affecting large sites regulated under the IED
- MCPD ELVs are similar to IED ELVs that apply to larger plant
- MCPD Boiler NO_x ELVs are largely achievable for Natural Gas firing, provided that LNB options are available, apart from the case of overly confined boiler geometries
- MCPD Boiler Dust ELVs require significant (excessive) investments for Biomass firing
- MCPD GT NO_x ELVs are largely achievable for Natural Gas firing providing that DLN or water injection options are available (but large investment if presently uncontrolled)
- Monitoring issues requiring further thought: time-scale of first monitoring; arrangements for small flues (especially Dust); direct NO₂ measurement

Thank you!

If you need any further information, please contact:

MCPDHelp@environment-agency.gov.uk

or

David Graham & Steve Griffiths

Uniper Technologies Ltd

Technology Centre, Ratcliffe-on-Soar

Nottingham NG11 0EE

www.uniper.energy

David.Graham@Uniper.Energy

Tel +44 7921 491164

Stephen.Griffiths@Uniper.Energy

Tel +44 7970 687312

Uniper disclaimer:

This presentation may contain forward-looking statements based on current assumptions and forecasts made by Uniper SE management and other information currently available to Uniper. Various known and unknown risks, uncertainties and other factors could lead to material differences between the actual future results, financial situation, development or performance of the company and the estimates given here. Uniper SE does not intend, and does not assume any liability whatsoever, to update these forward-looking statements or to conform them to future events or developments.

