



# **The Impact of Biomass Burning on Air Quality**

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# Scope of presentation

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Drivers for biomass use

Air Quality Limit Values

Overview of biomass combustion in relation to air quality

Modelling work:

- City wide studies

- National scale studies

Screening tools for local authorities

Conclusions

# Drivers for biomass use

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The primary driver is climate change and the need to reduce greenhouse gases

The EU has agreed a 20 % renewable energy target for 2020

Biomass is one of the most promising of the renewable energy technologies that are currently feasible in the UK.

The Renewable Energy Strategy announced a number of initiatives related to biomass.

# National picture for PM<sub>10</sub>

The United Kingdom did not meet the limit values for PM<sub>10</sub> in 2005 in all locations.

Has applied for Time Extension Notification (TEN) for PM<sub>10</sub>.

These are essentially air quality management plans that show how UK government will meet Limit Values.

For PM<sub>10</sub> extension will (hopefully) be 2011


Agglomeration or zone	Limit value
Greater London Urban Area	Annual
Greater London Urban Area	Daily
West Midlands Urban Area	Daily
West Yorkshire Urban Area	Daily
Brighton/Worthing/Littlehampton	Daily
Glasgow Urban Area	Daily
Swansea Urban Area	Daily
Eastern	Daily
Yorkshire & Humberside	Daily


Likely to apply for NO<sub>2</sub> extension (2015)

[www.defra.gov.uk](http://www.defra.gov.uk)

Annex B - Technical report to accompany UK PM<sub>10</sub> Time Extensions Notification forms

January 2009

 Uywodaeth Cynulliad Cymru  
Welsh Assembly Government

 defra  
Department for Environment  
Food and Rural Affairs

# Air Quality Limit Values

## Air Quality Limit Values

Most relevant Air Quality Limit Values set out in the Ambient Air Quality Directive (2008/50/EC). They are:

- $\text{PM}_{10}$  40  $\mu\text{g m}^{-3}$  annual mean (2005);
- $\text{PM}_{10}$  50  $\mu\text{g m}^{-3}$  daily mean not to be exceeded more than 35 times per year (2005);
- $\text{PM}_{2.5}$  25  $\mu\text{g m}^{-3}$  annual mean (as a target value for 2010);
- $\text{PM}_{2.5}$  25  $\mu\text{g m}^{-3}$  annual mean (as a limit value for 2015);
- $\text{PM}_{2.5}$  20  $\mu\text{g m}^{-3}$  annual mean (as an indicative value for 2020);
- $\text{PM}_{2.5}$  10 % or 15 % Exposure Reduction Target from 2010 to 2020 (urban background locations across the UK).
  
- $\text{NO}_2$  40  $\mu\text{g m}^{-3}$  annual mean for nitrogen dioxide (2010)

# Air quality impact of biomass combustion - overview

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Air quality impacts of biomass wood combustion are principally related to particulate matter emissions

Particulate matter emissions for biomass heating depend on the design of the appliance and the installed particulate abatement equipment.

Particulate emissions from biomass heating are typically greater than for gas heating

However, there is some potential for significant air quality impact where a large heat demand is met by biomass combustion in urban areas.

Small biomass combustion appliances in isolated rural areas are not considered to affect air quality significantly

# Modelling studies

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- City wide studies
  - London (2007)
  - Edinburgh and Dundee (2008)
- National scale assessment
  - Renewable Energy Strategy Consultation (2008)

# City wide studies – London (2007)

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Study for the London Councils to investigate the potential impact of substantial biomass wood combustion

Based on stretch targets of potential biomass uptake:

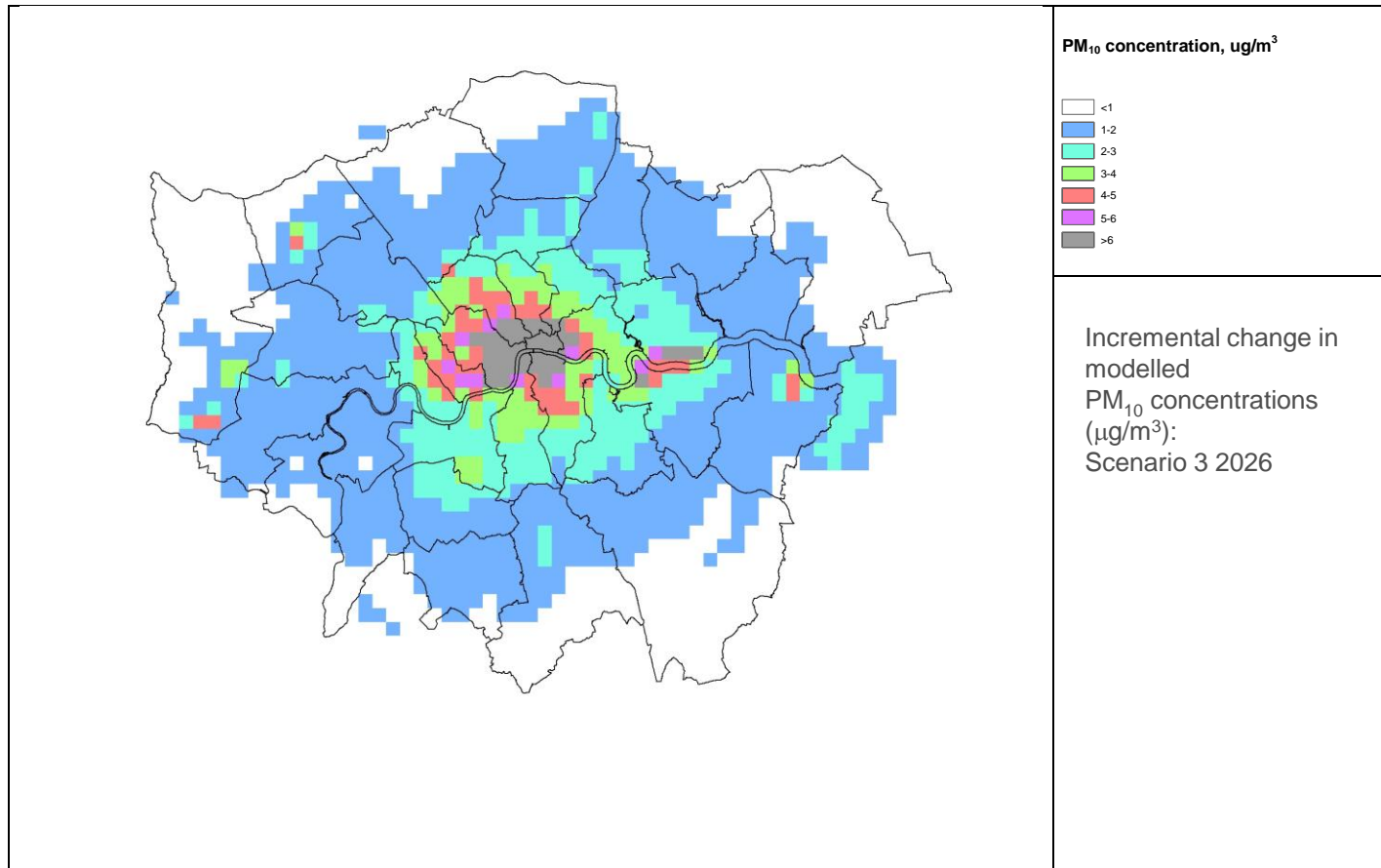
- 800 MW<sub>e</sub> biomass CHP
- 500 MW<sub>th</sub> biomass large (500 kW) boilers
- 50,000 dwellings with biomass boilers

New installations to replace gas boilers in their current locations  
(London Atmospheric Emissions Inventory)

Emission factors in the range 40-76 g/GJ based on Corinair default factors

- Less than limits imposed under the Clean Air Act for exempt appliances
- More than good current technology

# Modelled contribution to PM<sub>10</sub> concentrations- incremental increase



Scenario shown was for 3.3 kt increase in PM<sub>10</sub> emission throughout London  
=> Increase much too high

# Urban areas in Scotland

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Aim to quantify likely air quality impacts from sources of particulate matter – using a more refined approach

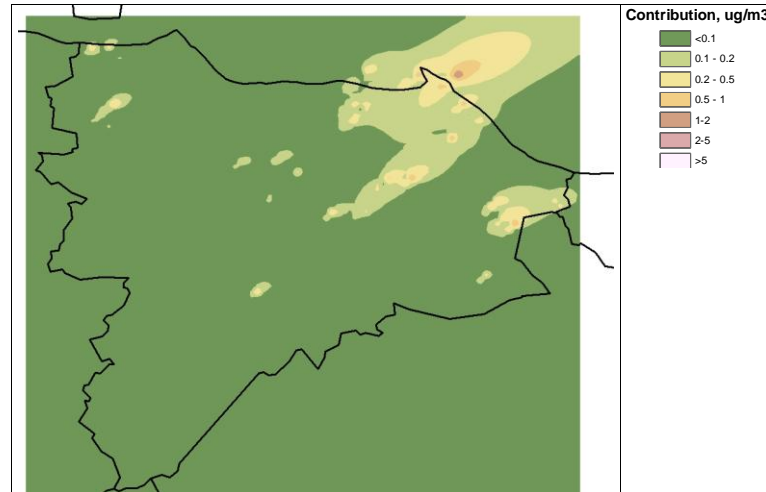
To measure fine particulate emissions ( $PM_{10}$  &  $PM_{2.5}$ ) from the most widely used types of biomass boilers

To model  $PM_{10}$  levels in Edinburgh and Dundee given the number of planned and/or existing biomass boilers, to evaluate if  $PM_{10}$  levels would exceed Air Quality Strategy Objectives for Scotland

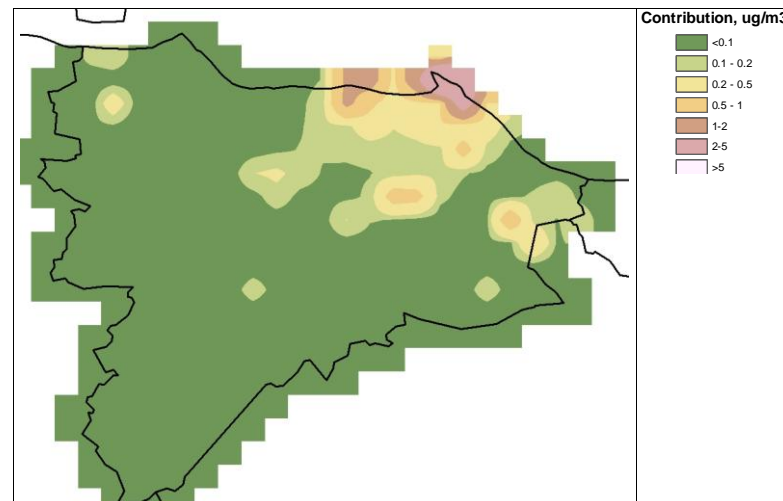
To provide advice on the potential cumulative impacts of  $PM_{10}$  emissions from biomass boilers in urban smoke control areas and compare to rural sites

# District vs distributed heating

- District heating, 60 g/GJ



- Distributed heating



# National scale modelling (1)

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Work undertaken as part of Renewable Energy Strategy Consultation

Need to supply 15 % of final energy demand from renewable sources by 2020

Main growth is expected for units in range 200 to 500 kW- within commercial, residential and public sectors

Five scenarios modelled:

1. Baseline
2. Good current technology at 38 TWh coverage
3. Good current technology at 50 TWh coverage
4. Best available technology at 38 TWh coverage
5. Best available technology at 50 TWh coverage

# National scale modelling (2)

## Emission factors used

	Biomass Uptake 38 MW <sub>th</sub>		Biomass Uptake 50 MW <sub>th</sub>	
	PM <sub>10</sub> g GJ <sup>-1</sup>	NOx g GJ <sup>-1</sup>	PM <sub>10</sub> g GJ <sup>-1</sup>	NOx g GJ <sup>-1</sup>
Current good technology	60	100	60	100
Best available	20	50	20	50

Exposure reduction target will depend on PM<sub>2.5</sub> measured at start of decade

If mean concentration at background locations is:  
< 13 µg m<sup>-3</sup>, then 10 % reduction is required

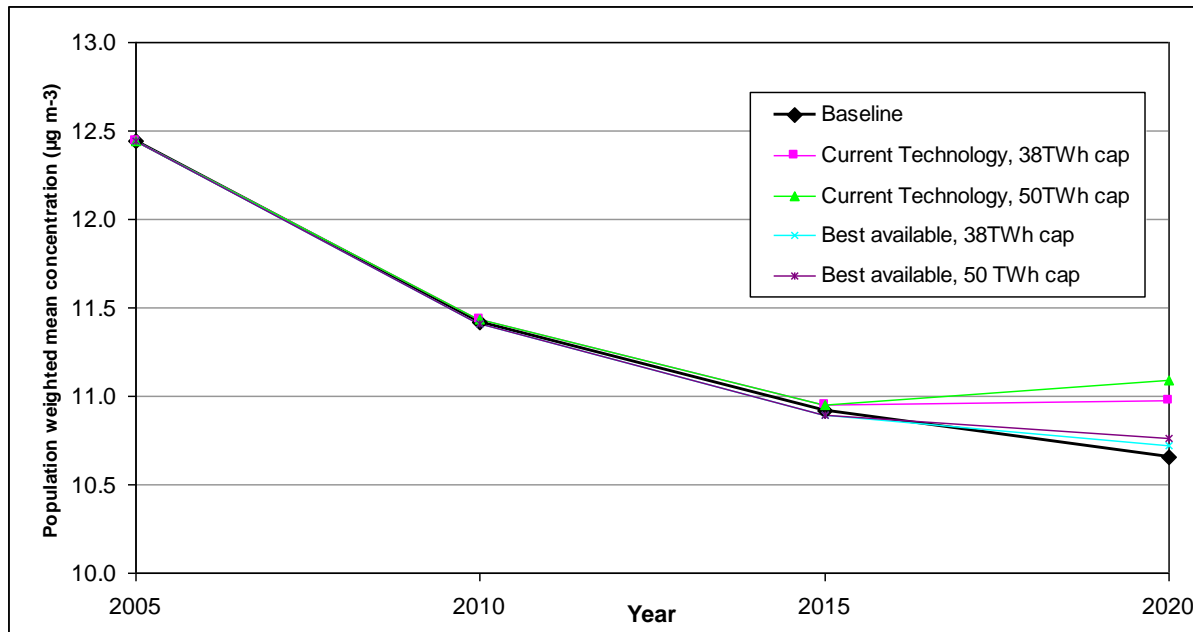
If mean concentration at background locations is:  
≥ 13 µg m<sup>-3</sup>, then 15 % reduction is required

Current PM<sub>2.5</sub> concentrations (µg m<sup>-3</sup>) measured by FDMS

Sampling Site	2008
Cardiff Centre	13.2
Newport St Julians Comp School	17.6
Port Talbot Margam	10.2
Swansea roadside	12.5

# National scale modelling (3)

Exposure reduction target modelled for each year



Exposure reduction target- baseline and current technology

	Baseline	Current Technology, 38TWh cap
Wales	6.5%	3.2%
UK	6.7%	4.0%

# Screening tools for Local Authorities

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The UK Government and the Devolved Administrations provide Technical Guidance to assist local authorities in carrying out these obligations.

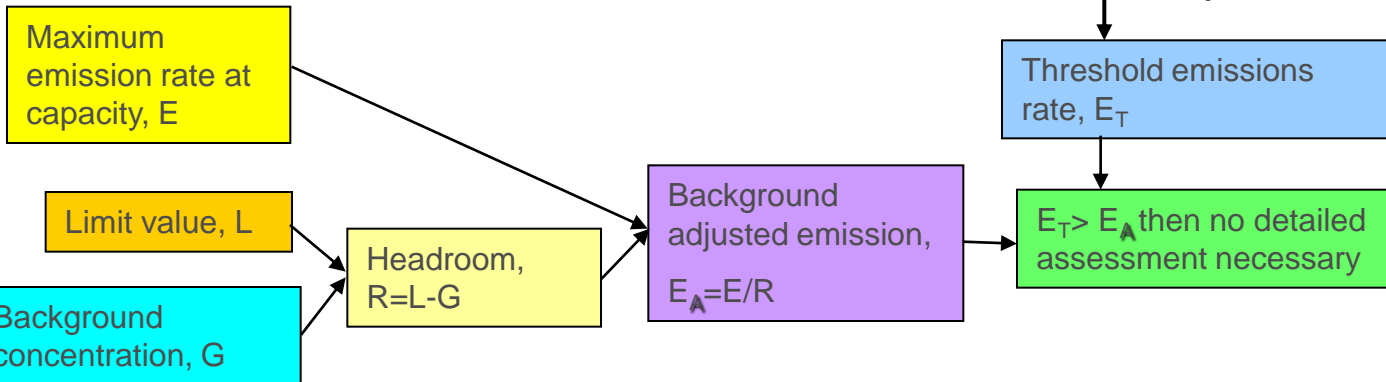
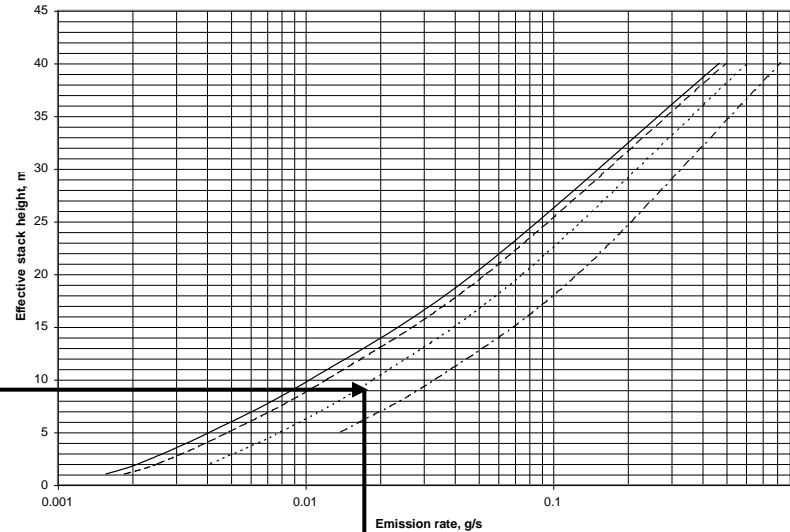
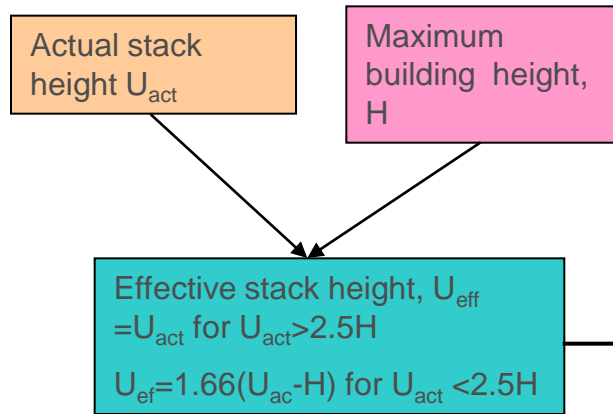
New Technical Guidance TG(09) for Local Authority Review and Assessment replaces TG(03)

Provides screening tools to assess whether there is a risk that biomass combustion will lead to exceedence of the air quality objectives for Local Authority review and Assessment

Small installations not covered by PPC regulation. Typically up to about 3 MW thermal, but potentially up to 20 MW

If the screening tools indicate that there is a risk of exceeding the objectives then the local authority should carry out more detailed assessment.

# Annual mean stack height nomograph



# LAQM Tool: Biomass combustion

## Review and Assessment Tool for PM<sub>10</sub> from biomass combustion stacks

The maximum emissions of PM<sub>10</sub> in g/s from biomass combustion source emissions are calculated for your given stack details. Greater emission rates may result in exceedence of the 24 hour objective for PM10 in England, Wales and Northern Ireland or the annual mean objective in Scotland.

Enter required information in Cream Cells  
Resulting Emission in Red Bold

Building height	<input type="text" value="15"/>	m
Stack diameter	<input type="text" value="0.2"/>	m
Stack height	<input type="text" value="25"/>	m
Location {Scotland, Rest of UK}	<input type="text" value="Scotland"/>	
PM <sub>10</sub> Annual mean background concentration (include roadside contribution at relevant receptors)	<input type="text" value="15"/>	µg/m <sup>3</sup>
Calculated Effective stack height	<input type="text" value="16.7"/>	m
Target Emission Rate	<input type="text" value="0.0753"/>	g/s

If the maximum stack emission rate is less than the target above then it is not likely that the most stringent objective for PM<sub>10</sub> will be exceeded

# Conclusions (1)

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Modelling studies have shown that wide scale biomass use will hinder ability to meet exposure reduction targets for PM<sub>2.5</sub>

Possible mitigation measures to limit the impact include:

- Reducing emissions from biomass combustion, either by regulation or agreement

- Installing the majority of biomass combustion in locations away from the city centre

- Encouraging the use of district heating for large developments

- Emissions reduction, geographical targeting and the use of effective stack heights

# Conclusions (2)

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The relative disbenefits of  $PM_{2.5}$  emissions from different sources might be assessed by cost benefit analysis.

Any changes to the Clean Air Act to limit emissions further from solid fuel appliances would require development of the emission measurement methods

Simple screening tools are available for local authorities to assess the impact on air quality of individual biomass combustion installations and the combined effect of many installations.