BIOENERGY 2010

warming to wood energy




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AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

Department of Agriculture, Fisheries and Food
An Roinn Talmhaíochta, Iascaigh agus Bia

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Ireland's EU Structural Funds Programmes 2007 – 2013
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The Sustainable Energy Authority of Ireland is financed by Ireland's EU Structural Funds Programme co-funded by the Irish Government and the European Union.

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Clean Carbon Energy Combustion for Ireland

BioEnergy 2010: Carlton Hotel Tralee – 17th June 2010

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Introduction

- Biomass Combustion
  - Current Irish situation
  - Properties
  - Combustion principles
- Emissions
  - Gaseous
  - Particulate
  - Associated problems
  - Regulations

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Introduction Continued

- Current Research
- Emission Reduction
  - Strategies
    - Primary
    - Secondary
- Conclusion

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Biomass Combustion

- Current situation
  - Domestic: Greener homes scheme
  - Approx 6000 biomass stoves/boilers installed
  - Commercial/industrial: Reheat Scheme
    - 68 MW approx
    - 160 boilers approx
  - Future?

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Greener Homes Scheme

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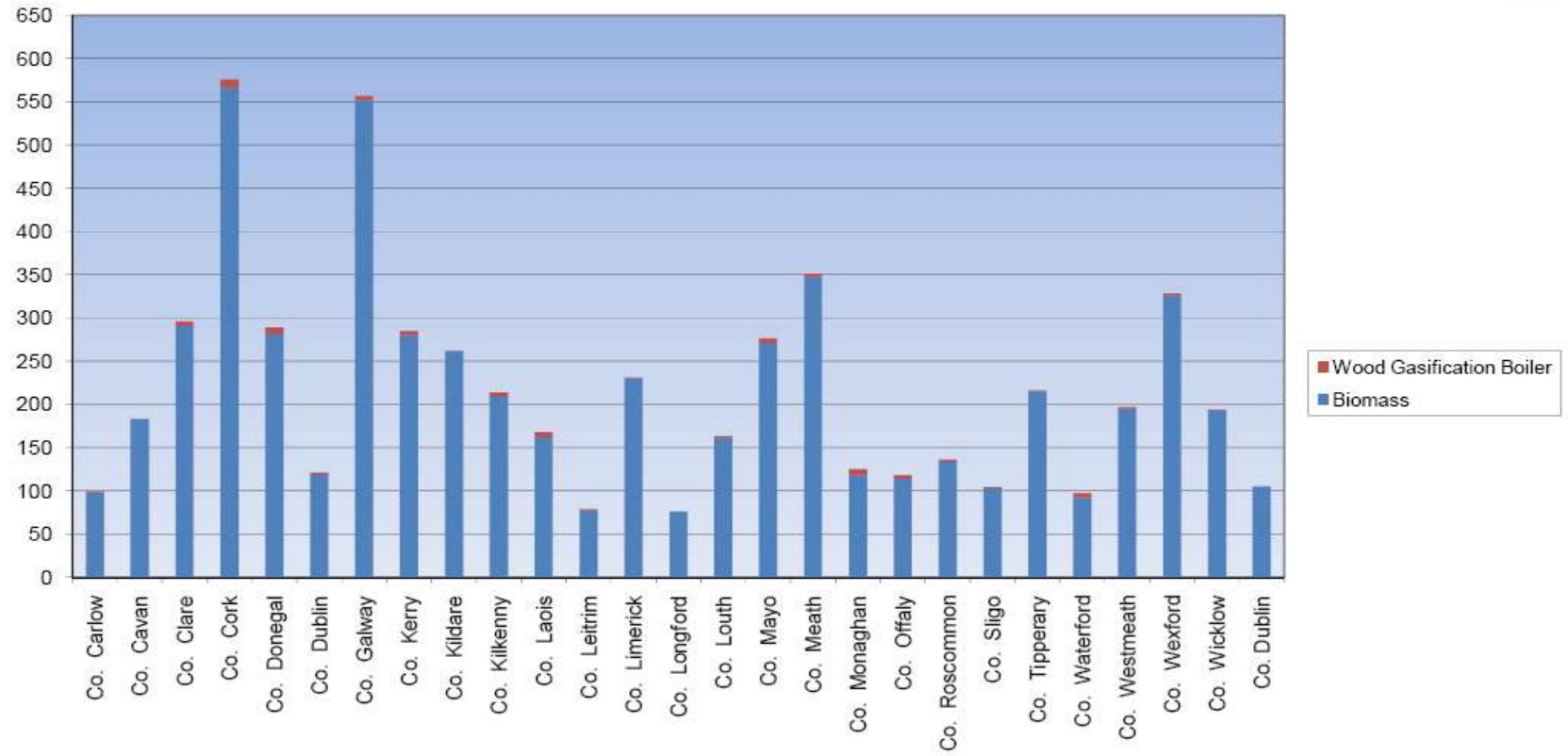
Greener Homes Scheme
Systems Installed by County - Biomass
March 2010

Greener Homes Scheme



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Material Combusted

- Wood
  - Logs
  - Pellets
  - Chips
  - Recycled
- Other biomass
  - Miscanthus
  - Straws
  - Other agricultural residues

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Biomass properties

	C.V. (MJ/kg)	Ash (%)	N (%)	Cl (%)	S (%)
Wood	20	< 0.5	0.15	0.03	0.025
Miscanthus	18.5	2	0.4	0.12	0.11
Straws	17 - 18	3 - 7	0.5 - 0.7	0.3 – 0.4	0.25 – 0.35
Grains	16.5 - 18	2 - 6	0.4 - 0.5	0.2 - 0.3	0.2 – 0.3

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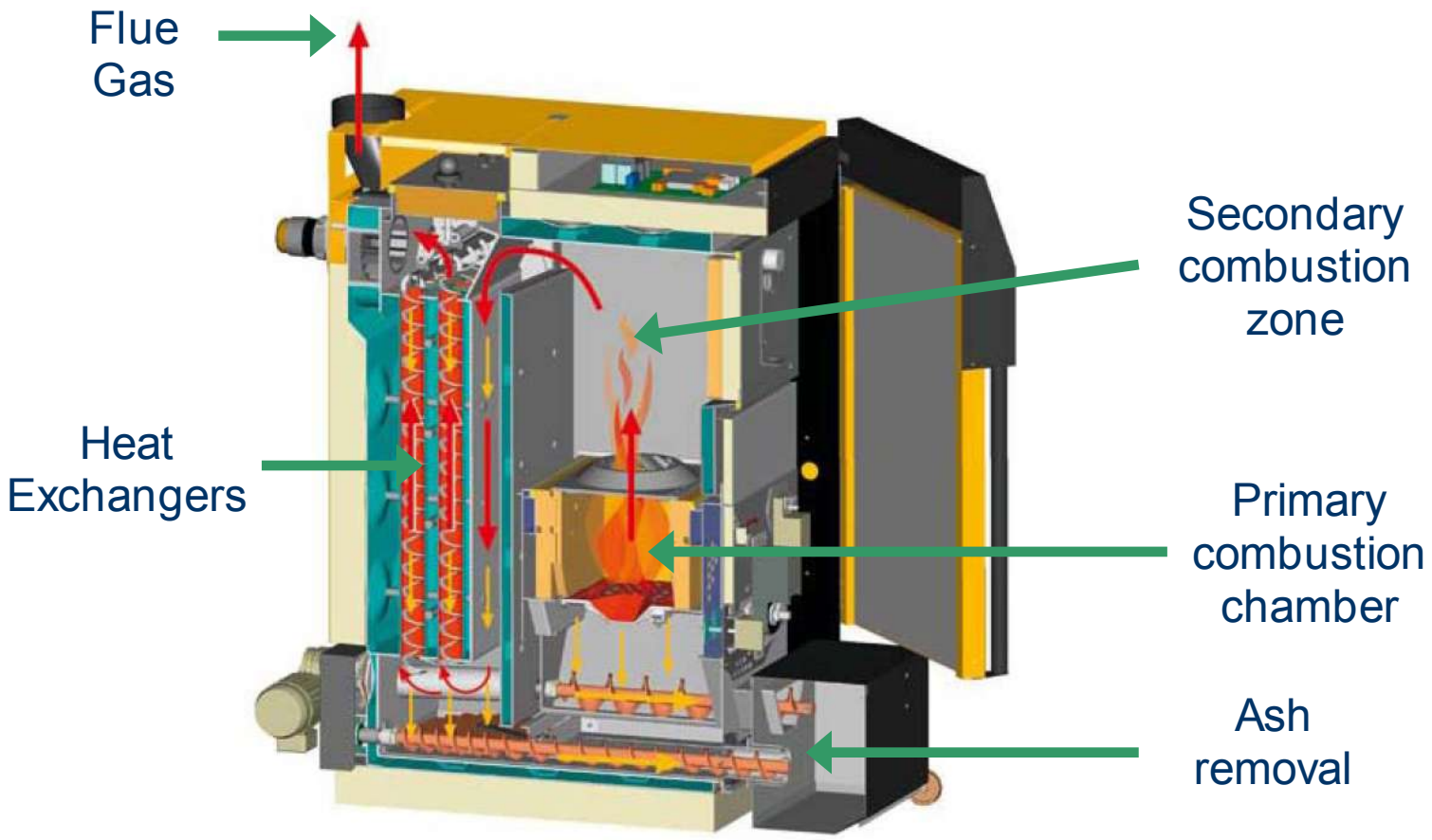
Combustion principles



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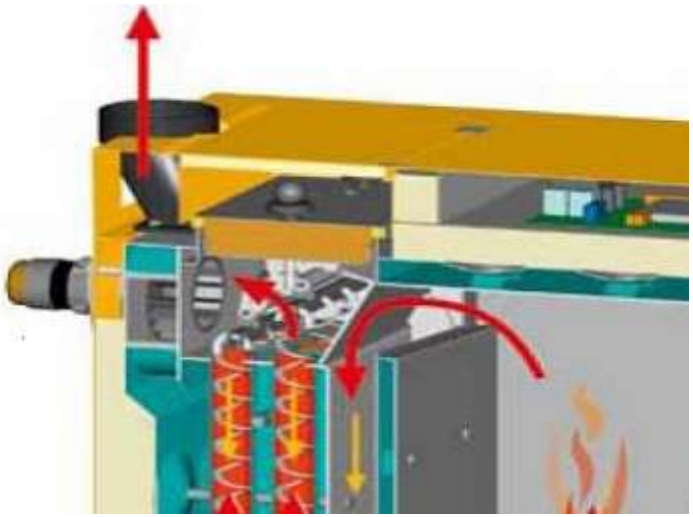
Emissions

Gaseous

Large particulates

Aerosols



Gaseous emissions

- CO_2
  - Released during any biomass combustion process
  - Greenhouse gas contributor
- CO
  - Mostly through inefficient combustion
  - Health problems at high levels in enclosed environments
- NO_x
  - Environmental: Smog and acid rain
  - Health: Respiratory effects
- SO_x
  - Environmental: Acid rain
  - Health: Respiratory effects

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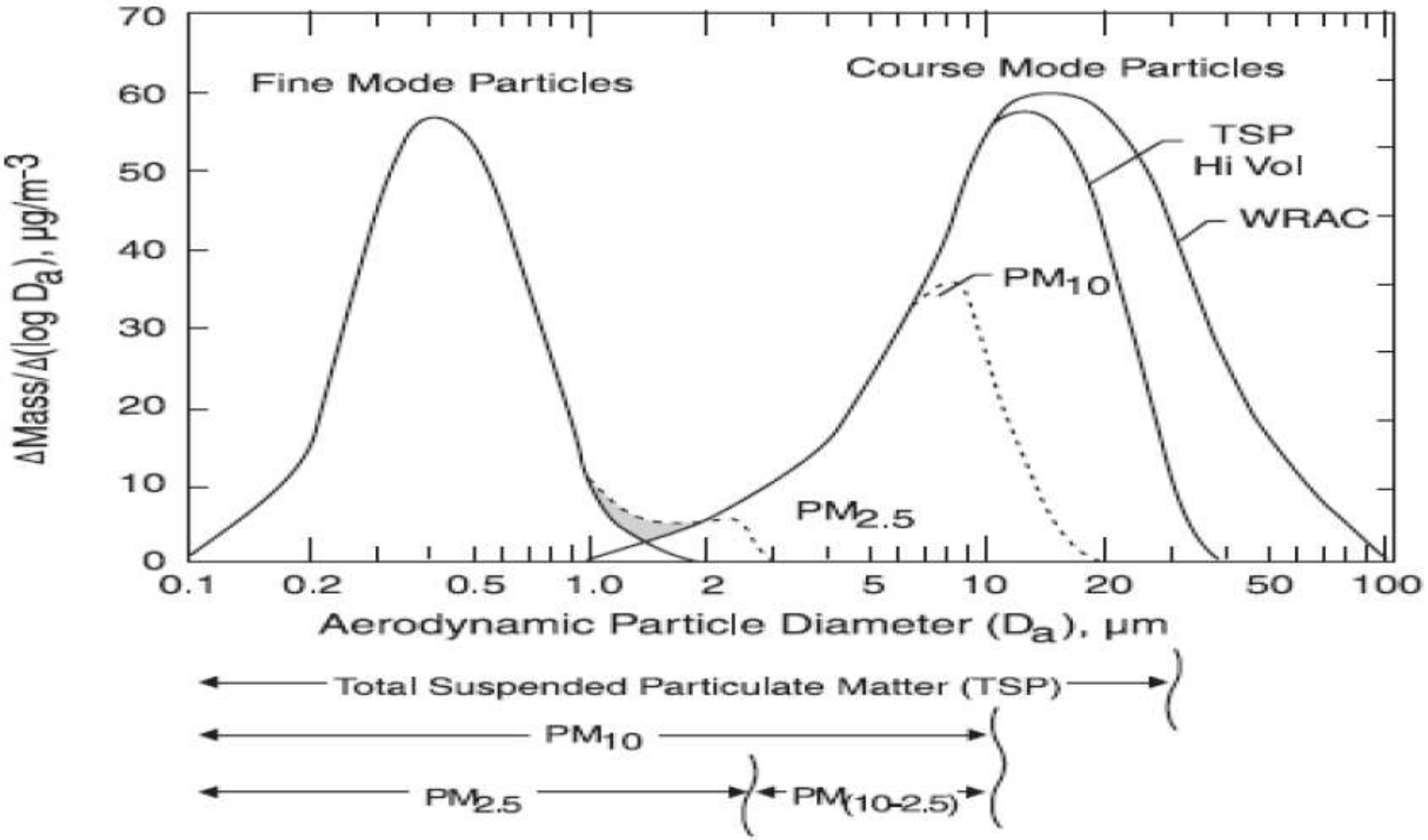
Particulate Emissions



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Typical Emission Levels

	TSP (mg/ m3)	NO_x (ppm)	SO_x (ppm)	CO (ppm)
Wood	30 - 100	80 - 150	20 – 60	Incomplete combustion
Miscanthus	80 - 250	150 - 250	40 – 70	
Straw	200 - 900	180 - 300	80 - 120	

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European Regulations (Germany)

Furnace type	Step 1: erected after regulation date		Step 2: erected after 31.12.2014		erected after regulation date
	CO [g/m³]	Dust [g/m³]	CO [g/m³]	Dust [g/m³]	minimum efficiency [%]
Room heaters with flat furnace	2,0	0,10	1,25	0,04	73
Room heaters with filling furnace	2,5	0,10	1,25	0,04	70
Heat storage stoves	2,0	0,10	1,25	0,04	75
Closed fireplaces	2,0	0,10	1,25	0,04	75
Tiled stoves (flat furnace)	2,0	0,10	1,25	0,04	80
Tiled stoves (filling furnace)	2,5	0,10	1,25	0,04	80
Cooking stoves	3,0	0,10	1,50	0,04	70
Central heating&cooking stoves	3,5	0,10	1,50	0,04	75
Pellet stoves without water jacket	0,40	0,05	0,25	0,03	85
Pellet stoves with water jacket	0,40	0,03	0,25	0,02	90

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Irish Regulations (EN 303-5:1999)

Table 7 — Emission limits

Stoking	Fuel	Nominal heat output kW	Emission limits								
			CO			OGC			dust		
			mg/m^3 at 10 % O_2 *)								
			class 1	class 2	class 3	class 1	class 2	class 3	class 1	class 2	class 3
manual	biogenic	≤ 50	25 000	8 000	5 000	2 000	300	150	200	180	150
		> 50 to 150	12 500	5 000	2 500	1 500	200	100	200	180	150
		> 150 to 300	12 500	2 000	1 200	1 500	200	100	200	180	150
	fossil	≤ 50	25 000	8 000	5 000	2 000	300	150	180	150	125
		> 50 to 150	12 500	5 000	2 500	1 500	200	100	180	150	125
		> 150 to 300	12 500	2 000	1 200	1 500	200	100	180	150	125
automatic	biogenic	≤ 50	15 000	5 000	3 000	1 750	200	100	200	180	150
		> 50 to 150	12 500	4 500	2 500	1 250	150	80	200	180	150
		> 150 to 300	12 500	2 000	1 200	1 250	150	80	200	180	150
	fossil	≤ 50	15 000	5 000	3 000	1 750	200	100	180	150	125
		> 50 to 150	12 500	4 500	2 500	1 250	150	80	180	150	125
		> 150 to 300	12 500	2 000	1 200	1 250	150	80	180	150	125

*) referred to dry exit flue gas, 0 °C, 1 013 mbar

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Future Regulations

- Switzerland: 50mg/m^3 and ESP fitted to all new boilers
- Germany: 40mg/m^3 by 2014
- Ireland: ?
- E.U. standards: ?

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Current Research

- ERANET project through SEAI and Teagasc
  - Investigating PM and NO_x reduction strategies
  - Small scale boilers and stoves
    - Blending
    - Additives
    - Air staging
    - Flue gas recirculation
    - Electrostatic precipitators
    - Filters
    - Scrubbers

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Emission reduction strategies

- Fuel blending
  - Alternative biomass + Wood
  - Best properties of both materials
- Additives
  - Types:
    - Clay based minerals
    - Lime
  - Change ash melting properties
- Air Staging

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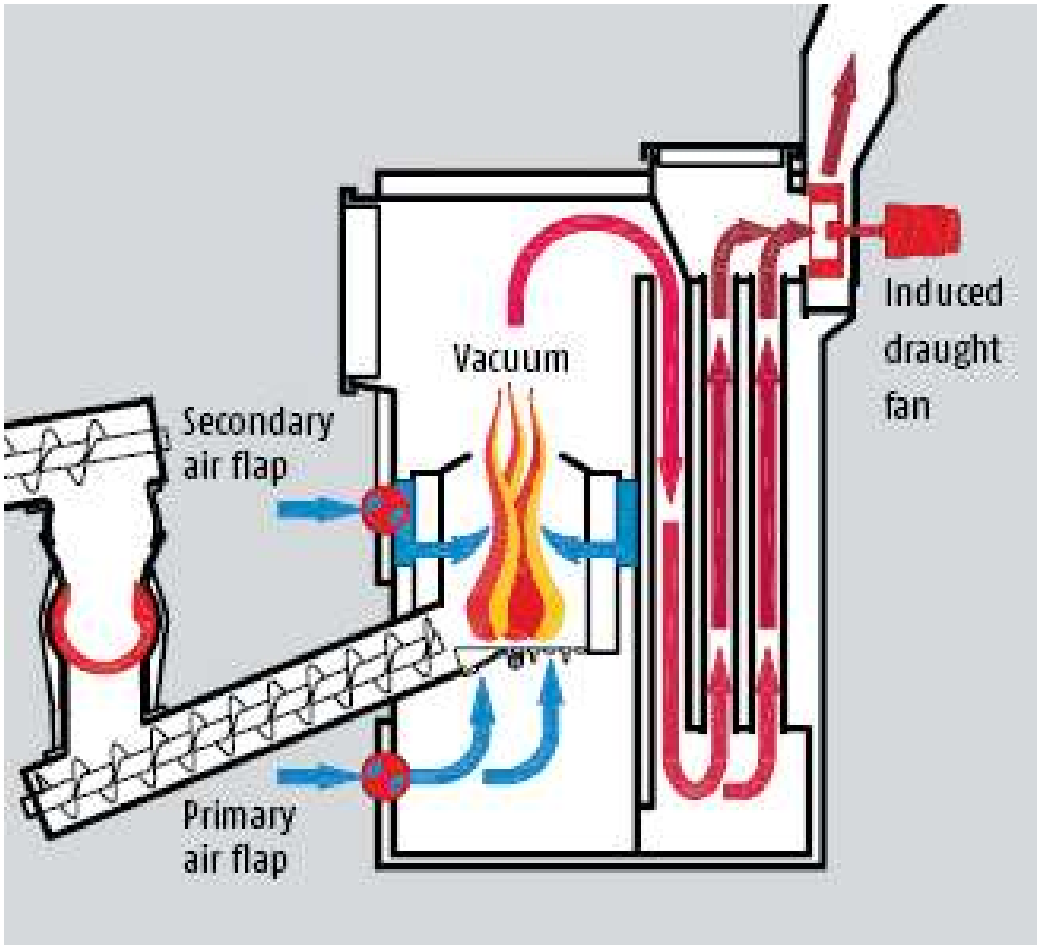
Air Staging



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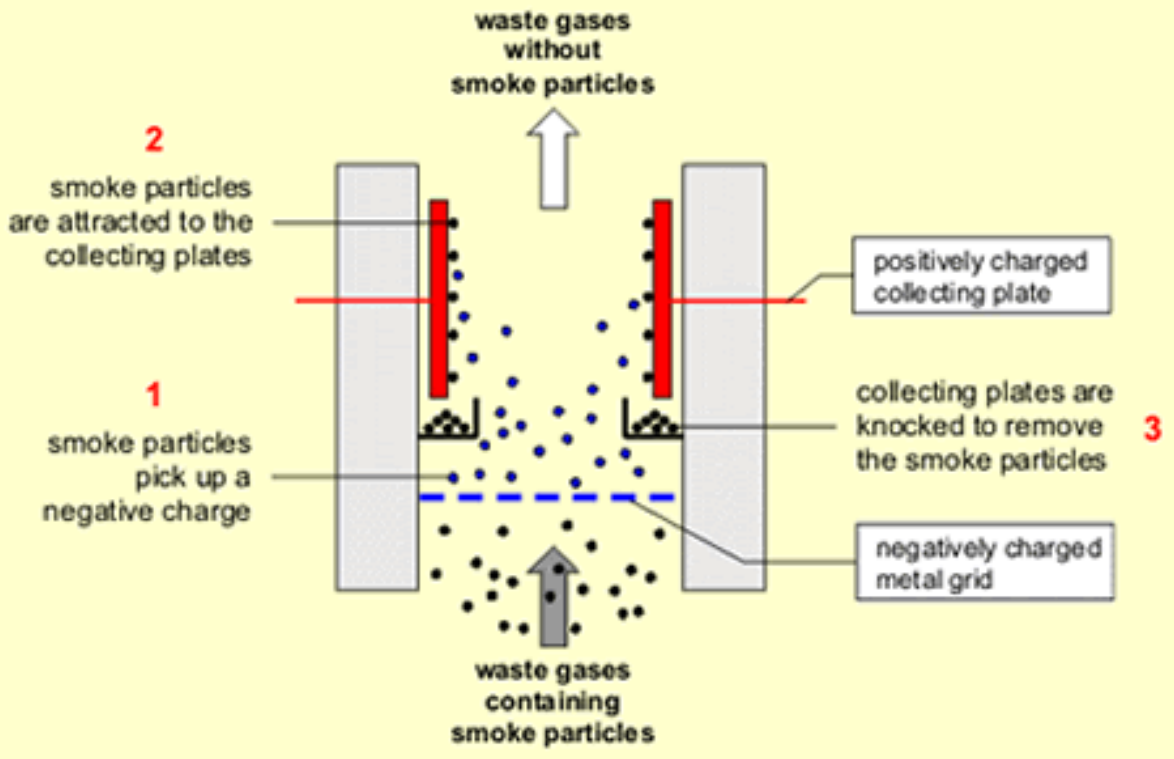
Air Staging

- Varying primary and secondary air flows
  - Changes combustion chamber atmosphere
  - Two stage burning
  - Formation of N_2 rather than NO_x
  - Up to 70% reduction can be achieved
- Flue gas recirculation
  - Flue gas at 350 – 400^{O}C mixed with combustion gases
  - Reduces amount of oxygen available for thermal NOx formation
  - 20 – 30% reductions possible

Secondary measures

- Electrostatic precipitators (ESPs)



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Secondary measures

- Electrostatic precipitators
  - Efficiency depends on PM size
  - Up to 60% on PM_1
  - Unproven technology on small scale
  - Costs may be prohibitive
- Scrubbers
  - Industrial scale
- Filters
  - Unproven on small scale

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Conclusion

- Biomass combustion increasing
- Alternatives to wood?
- Future direction of regulations very important
- Emission reduction strategies can achieve up to 80% NO_x and PM reduction
- Further research required

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Thank you for your attention

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