

# **Reducing air emissions from woodfuel**

Bioenergy – Inspiring the Industry with Opportunity and Vision

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# Woodfuel use, why and how?

- 2.4 billion people use woodfuel to provide basic energy services such as cooking, boiling water and heating their homes
- Sustainable woodfuel harvest and use has benefits for forest management – early thinning, residue removal (after leaf fall) - and for communities
- Bioenergy recognised by IPCC as part of solution to reducing greenhouse gas emissions and the achievement of the Paris Agreement (IPCC Special Report Climate Change and Land 2019)

# Woodfuel use ctd

- Woodfuel use needs to
  - meet greenhouse gas savings criteria laid down in REDII
  - be from sustainably managed forests
  - meet other sustainability criteria in REDII, including sourcing from countries that use a national carbon accounting framework that debits wood harvest (or an equivalent approach at sub national level)

# Air quality in Ireland 2018 – EPA report <sup>1</sup>

- Levels at monitoring sites in Ireland were below the EU legislative limit values in 2018.
- Ireland was above World Health Organization (WHO) air quality guideline value levels at a number of monitoring sites for fine particulate matter, ozone and nitrogen dioxide (NO<sub>2</sub>).
- Ireland was above the European Environment Agency reference level for PAH, a toxic chemical, at three monitoring sites.

<sup>1</sup> <https://www.epa.ie/pubs/reports/air/quality/Air%20Quality%20In%20Ireland%202018.pdf>

# How air quality is assessed

According to CAFÉ Directive limit values

Across National Ambient Air Quality Monitoring Network - 57 locations  
[airquality.ie](http://airquality.ie)

Network will be extended over time

Limit values of CAFE Directive 2008/50/EC

Pollutant	Limit Value Objective	Averaging Period	Limit Value $\mu\text{g}/\text{m}^3$	Limit Value ppb	Basis of Application of the Limit Value	Limit Value Attainment Date
SO <sub>2</sub>	Protection of human health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year	1 Jan 2005
SO <sub>2</sub>	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year	1 Jan 2005
SO <sub>2</sub>	Protection of vegetation	calendar year	20	7.5	Annual mean	19 July 2001
SO <sub>2</sub>	Protection of vegetation	1 Oct to 31 Mar	20	7.5	Winter mean	19 July 2001
NO <sub>2</sub>	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year	1 Jan 2010
NO <sub>2</sub>	Protection of human health	calendar year	40	21	Annual mean	1 Jan 2010
NO + NO <sub>2</sub>	Protection of ecosystems	calendar year	30	16	Annual mean	19 July 2001
PM <sub>10</sub>	Protection of human health	24 hours	50		Not to be exceeded more than 35 times in a calendar year	1 Jan 2005
PM <sub>10</sub>	Protection of human health	calendar year	40		Annual mean	1 Jan 2005
PM <sub>2.5</sub> - Stage 1	Protection of human health	calendar year	25		Annual mean	1 Jan 2015
PM <sub>2.5</sub> - Stage 2	Protection of human health	calendar year	20		Annual mean	1 Jan 2020
Lead	Protection of human health	calendar year	0.5		Annual mean	1 Jan 2005
Carbon Monoxide	Protection of human health	8 hours	10,000	8620	Not to be exceeded	1 Jan 2005
Benzene	Protection of human health	calendar year	5	1.5	Annual mean	1 Jan 2010

# **Air quality issues**

- Particulate matter from burning of solid fuel
- Nitrogen dioxide from transport emissions in urban areas

# **Solid fuel burning and air quality**

A direct link between solid fuel burning in Ireland and PM has been established both by EPA monitoring and EPA-funded research projects such as the SAPPHIRE project and AEROSOURCE project.

# **Implications of poor air quality**

Poor air quality has serious health implications both in the short-term (acute – temporary illnesses like headache, breathing difficulty or eye irritation) and the long-term (chronic–ongoing illnesses like asthma, reduced liver function or cardiovascular disease)



# Tackling air emissions

- Needs a comprehensive set of tailored measures across transport and across the range of solid fuels to improve air quality and protect human health – status quo not an option
- Evidence-based approaches
- Main issue from woodfuels is residential combustion in urban areas, which can be addressed through woodfuel quality and combustion appliance - and through public engagement and education

# Framing ways forward

**WHO report 2015:** *Residential heating with wood and coal: health impacts and policy options in Europe and North America*<sup>1</sup>

*p 2 : 'Residential heating with wood is a sector in which PM2.5 and [black carbon] emissions can potentially be reduced with greater cost-effectiveness than many other emission reduction options.'*

**Bioenergy Europe 2019:** *Slashing emissions from residential wood heating*<sup>2</sup>

*'Today, at time when a large number of European citizens rely on bioenergy to heat their homes, it is crucial to ensure they continue doing so in a clean way - a practice that also has spill over effects in terms of the employment figures in rural areas where the biomass feedstock is harvested, conditioned and sold'*

<sup>1</sup> [http://www.euro.who.int/\\_data/assets/pdf\\_file/0009/271836/ResidentialHeatingWoodCoalHealthImpacts.pdf?ua=1](http://www.euro.who.int/_data/assets/pdf_file/0009/271836/ResidentialHeatingWoodCoalHealthImpacts.pdf?ua=1)

<sup>2</sup> [file:///C:/Users/USER/Downloads/Air%20Emissions%20\(1\).pdf](file:///C:/Users/USER/Downloads/Air%20Emissions%20(1).pdf)

# Emissions from woodfuel combustion

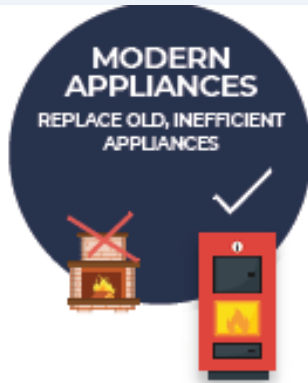
- *Type*: emissions arising from wood combustion - particulate matter (PM) (and its intermediate products) and NO<sub>x</sub> are considered to be the most relevant<sup>1</sup>
- *Scales*: Biomass combustion happens at different scales across Europe and in Ireland. While the basic principle is the same, technologies vary considerably depending on the size of the installation, from individual appliances found in households, to industrial-size boilers supplying heat and electricity. This presentation focuses on the residential sector and how to effectively tackle emissions from household appliances.

<sup>1</sup> [https://www.seai.ie/publications/2016\\_RDD\\_108.\\_Biomass\\_Combustion\\_Emissions\\_Study\\_-\\_IrBEA.pdf](https://www.seai.ie/publications/2016_RDD_108._Biomass_Combustion_Emissions_Study_-_IrBEA.pdf)

# Addressing air quality - woodfuels

- **Woodfuel type and quality – WFQA process, regulation**
- Combustion appliance type & design – Ecodesign for stoves from 1 January 2022, possible incentives/tax breaks, labelling display
- Combustion appliance operation, installation and maintenance - regulation of installers
- Advice to public on stove types, operation, fuels etc. etc.
- Future technology aiming for lower emissions - application of abatement technologies/processes and development – also relevant for larger non-residential bioenergy plant

## AIR QUALITY: guidelines for clean wood burning



# **Woodfuel type and quality**

# Woodfuel moisture content

- Moisture content is the primary quality parameter that influences emissions generation from woodfuel, is also directly linked to the calorific value (energy content) of the fuel – the higher the moisture content, the lower the calorific value
- High moisture content in woodfuel say >c. 20% firewood or above the recommended range for a woodchip boiler = prolonged combustion start up, moisture evaporation keeps the fire too cool to fully oxidise the volatile tars released = increased emissions.
- High moisture also promotes 'steam stripping' of tars which increases their release which, in combination with the cooler fire temperature, also contributes to higher emissions
- Many industrial scale boilers are designed to use woodchip with high moisture contents (>40%) and are able to comply with legislative emission levels

# Standards-based approach to woodfuel quality

- Essential when trading and specifying woodfuels, and especially in addressing firewood moisture content
- Woodfuel quality (including moisture content and its determination) is outlined in a series of International Organization for Standardisation - ISO standards
- ISO 17225 determines the fuel quality classes and specifications for solid biofuels of raw and processed materials originating from forestry and arboriculture and other sources
- *‘The objective of ISO 17225 is to provide unambiguous and clear classification systems for solid biofuels, to serve as a tool to enable efficient trading of biofuels, to enable good understanding between buyer and seller, as well as a tool for communication with equipment manufactures. It will also facilitate authority permission procedures and reporting. This part of ISO 17225 - Part 5 Firewood, outlines normative and informative properties of firewood and supports the use of graded firewood for residential, small commercial and public building applications’.*



- ISO 17225 Part 5 Firewood, outlines normative and informative properties of firewood
- WFQA certified firewood falls into class A1, M20 and M25
- Diameter classes are being extended to cater for larger size classes used in Ireland and elsewhere

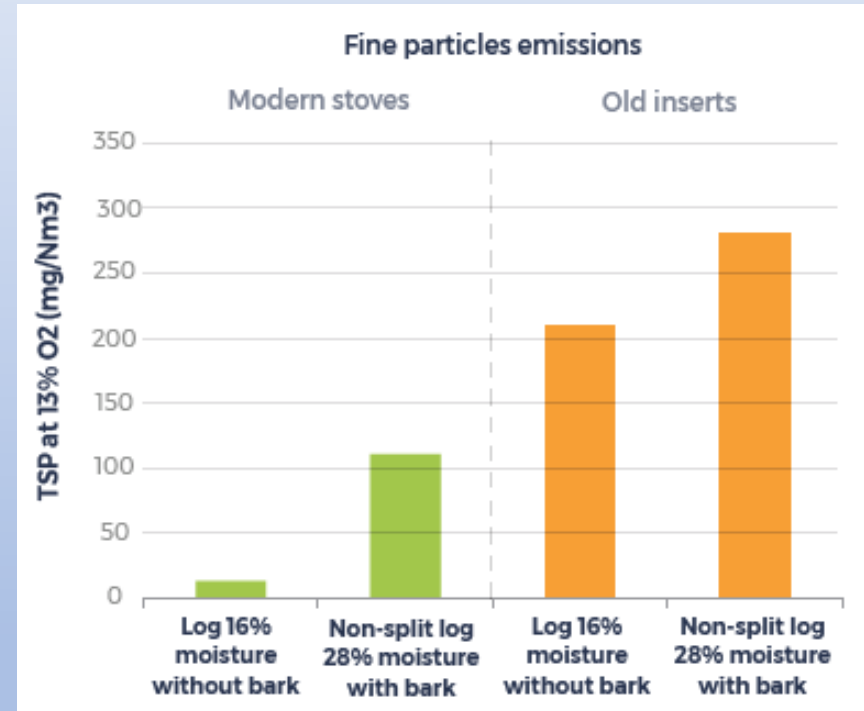
	Property class, Analysis method	Units	A1	A2	B
Normative	Origin and source, ISO 17225-1		1.1.3 Stemwood 1.2.1 Chemically untreated wood residues	1.1.1 Whole trees without roots 1.1.3 Stemwood 1.1.4 Logging residues 1.2.1 Chemically untreated wood residues	1.1.1 Whole trees without roots 1.1.3 Stemwood 1.1.4 Logging residues 1.2.1 Chemically untreated wood residues
	Wood species <sup>a</sup>		To be stated		To be stated
	Diameter, D <sup>b</sup>	cm	D2 ≤ 2 D5 2 < D ≤ 5 D15 5 < D ≤ 15 D15+ > 15 (actual value to be stated)		D15 5 < D ≤ 15 D15+ > 15 (actual value to be stated)
	Length, L <sup>c</sup>	cm	L20 ≤ 20 (± 2 cm) L25 ≤ 25 (± 2 cm) L30 ≤ 30 (± 2 cm) L33 ≤ 33 (± 2 cm) L40 ≤ 40 (± 2 cm) L50 ≤ 50 (± 4 cm) L100 ≤ 100 (± 5 cm)		L30 ≤ 30 (± 2 cm) L33 ≤ 33 (± 2 cm) L40 ≤ 40 (± 2 cm) L50 ≤ 50 (± 4 cm) L100 ≤ 100 (± 5 cm)
	Moisture, M <sup>d</sup> ISO 18134-1, ISO 18134-2	w-% as received wet basis	M20 ≤ 20 M25 ≤ 25		M20 ≤ 20 M25 ≤ 25 M35 ≤ 35
	Volume or weight	Volume m <sup>3</sup> stacked or loose or weight, kg as received	To be stated which unit is used when retailed (m <sup>3</sup> stacked or loose, kg) and/or packaged log woods weight.		
Informative	Energy density, E <sup>e</sup> or Net calorific value, Q, ISO 18125	MJ/m <sup>3</sup> or kWh/m <sup>3</sup> stacked or loose MJ/kg or kWh/kg, as received	Recommended to be stated.		
	Drying		Recommended to be stated, if firewood is dried by natural seasoning by ambient air or artificially by hot air.		
	Moisture, U <sup>d</sup>	w-% dry basis	U25 ≤ 25 U33 ≤ 33		U33 ≤ 33 U54 ≤ 54
	Decay and mould	% of pieces	No visible decay	≤ 5	If significant amount (more than 10 % of pieces) of decay or mould exists it should be stated.
	Proportion of split volume	% of pieces	≥ 90	≥ 50	No requirements
	The cut-off surface		Even and smooth <sup>f</sup>	No requirements	No requirements

# Evidence of firewood MC impact on emissions from woodfuel

1. 2018 report assessing residential wood combustion in Nordic countries found that moist fuel generally increased emission levels by a factor of 1.5 – 2 .

## 2. CERIC report 2017

Impact of the quality of log fuel and the evolution of the wood appliance stoves in use on air quality



<sup>1</sup> Emission factors for SLCP emissions from residential wood combustion in the Nordic countries; <https://www.diva-portal.org/smash/get/diva2:1174670/FULLTEXT01.pdf>

<sup>2</sup> Avis d'expert CERIC, 2017, Impact of the quality of firewood and the evolution of the wood burning appliances on the quality of air (<http://www.leboisenergie.be/wp-content/uploads/2017/09/etude-ceric-chauffage-au-bois-et-qualite-de-l-air-juillet-2017-web.pdf>)

# 'Firewood' being offered for sale today with no restriction

**Q** Would this lot of 'firewood' meet WFQA requirements

**A** Almost certainly not

**Q** What level of emissions would this firewood generate

**A** Probably twice those of properly seasoned, stored and bagged firewood

**Q** Should this type of fuel be offered for sale today or in the future

**A** Most definitely not!



# Answers to wet firewood

- WFQA is working to extend WFQA membership (for all wood fuels) and increase geographic coverage to provide firewood certified to ISO 17225



- Implement IrBEA/WFQA proposal for a statutory upper limit of 20% (wet weight basis in accordance with ISO 17225 – Part 5) be placed on the moisture content of firewood offered for sale, to enter into force from 1 January 2022, with an upper limit of 25% be set from [1 September 2020]
- Local Authorities take on a market surveillance role in relation firewood quality in conjunction with statutory limit
- Public awareness campaign led by government, agencies and local authorities, explaining value of dry firewood and advocating for move away from open fires to modern, ecodesign stoves

**IrBEA/WFQA is engaging with government, state agencies and firewood producers (workshops and seminars) to advocate and implement these measures**



**wfqa.org**

- WFQA works as part of IrBEA
- We work with our membership and stakeholders to secure and protect consumer confidence in WFQA woodfuels through a process of independent certification to ISO 17225, and associated product labelling
- We have close on 30 members covering the full range of woodfuels who supply quality product across the country -membership is expanding
- Our processes are independently audited on an annual basis
- Our membership is ready and able to meet the challenge of more demanding fuel quality standards

# Strategic approaches – district heating

- Strategic changes in heating supply – such as district heating or group scheme heating with fuels such as woodchip and pellet can also be a solution – capable of delivering very high efficiencies and low particulates
- Part of a larger debate, cost barriers are an issue and infrastructure retrofitting, but needs to be examined again in the context of a diversified energy supply and the need for increased competition in heat and energy supply generally
- Important also in the context of security of supply and the development of biomass supply chains for any potential BECCS and/or biorefining developments



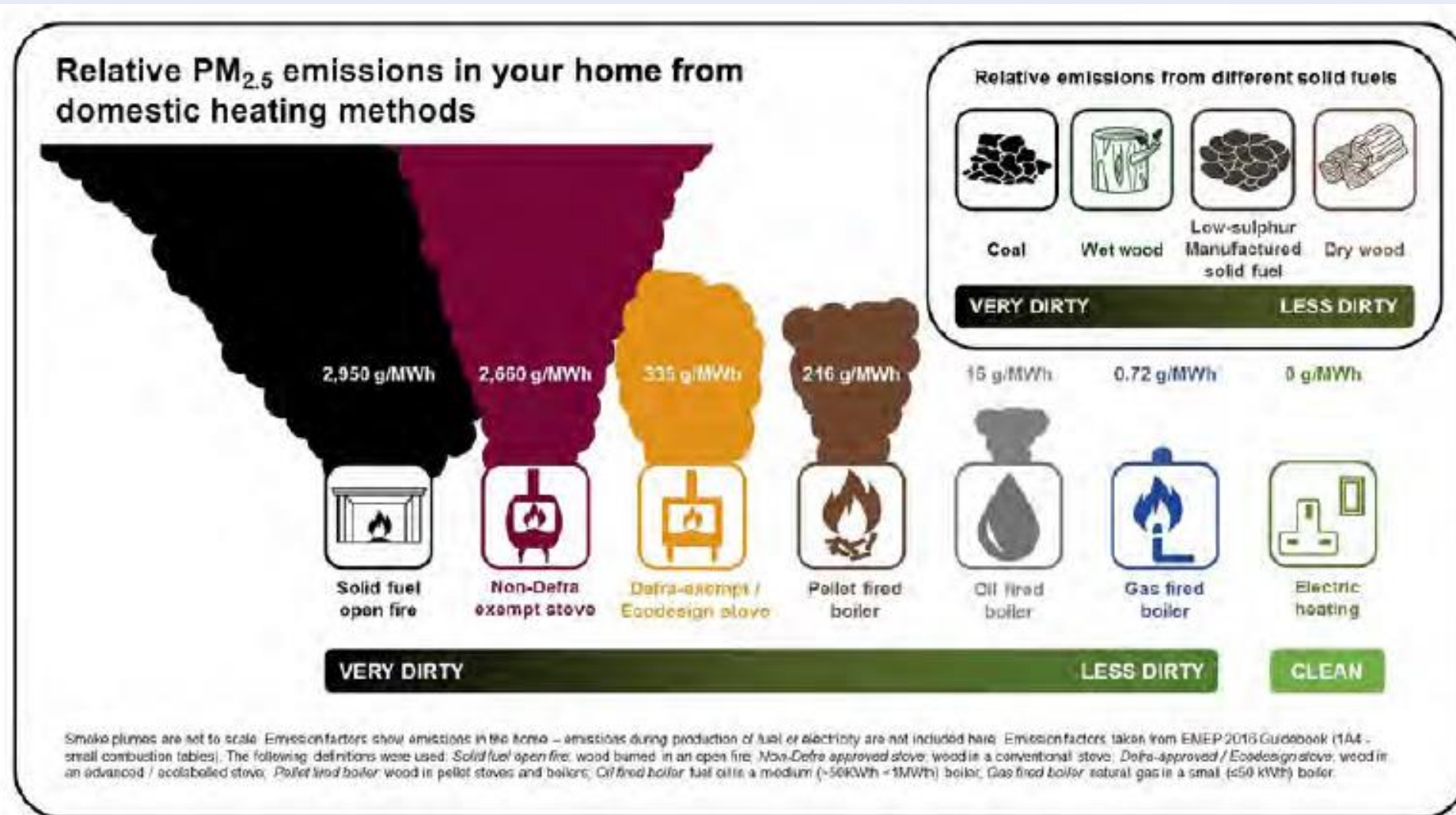
# **Combustion appliance type & design**

# Wood combustion appliances – past and future

*Old wood appliances in Europe are characterized by low efficiency rates and incomplete combustion performance: at the lower end of the spectrum, open fires are the most polluting because the least efficient combustion method (efficiency below 30%). This is due to the fact that in an open fire, it is impossible to control the combustion process, which increases the chances of incomplete and therefore particularly polluting combustion. On the contrary, newly designed stoves are proven to be many times more energy efficient than the obsolete ones - Bioenergy Europe*



# Impact of stove design on emissions <sup>1</sup>



<sup>1</sup>[https://consult.defra.gov.uk/environmental-quality/clean-air-strategy-consultation/user\\_uploads/clean-air-strategy-2018-consultation.pdf](https://consult.defra.gov.uk/environmental-quality/clean-air-strategy-consultation/user_uploads/clean-air-strategy-2018-consultation.pdf)

# Evidence of effectiveness of combustion appliance in reducing particulate emissions (per unit energy use) - AIRUSE project<sup>1</sup>

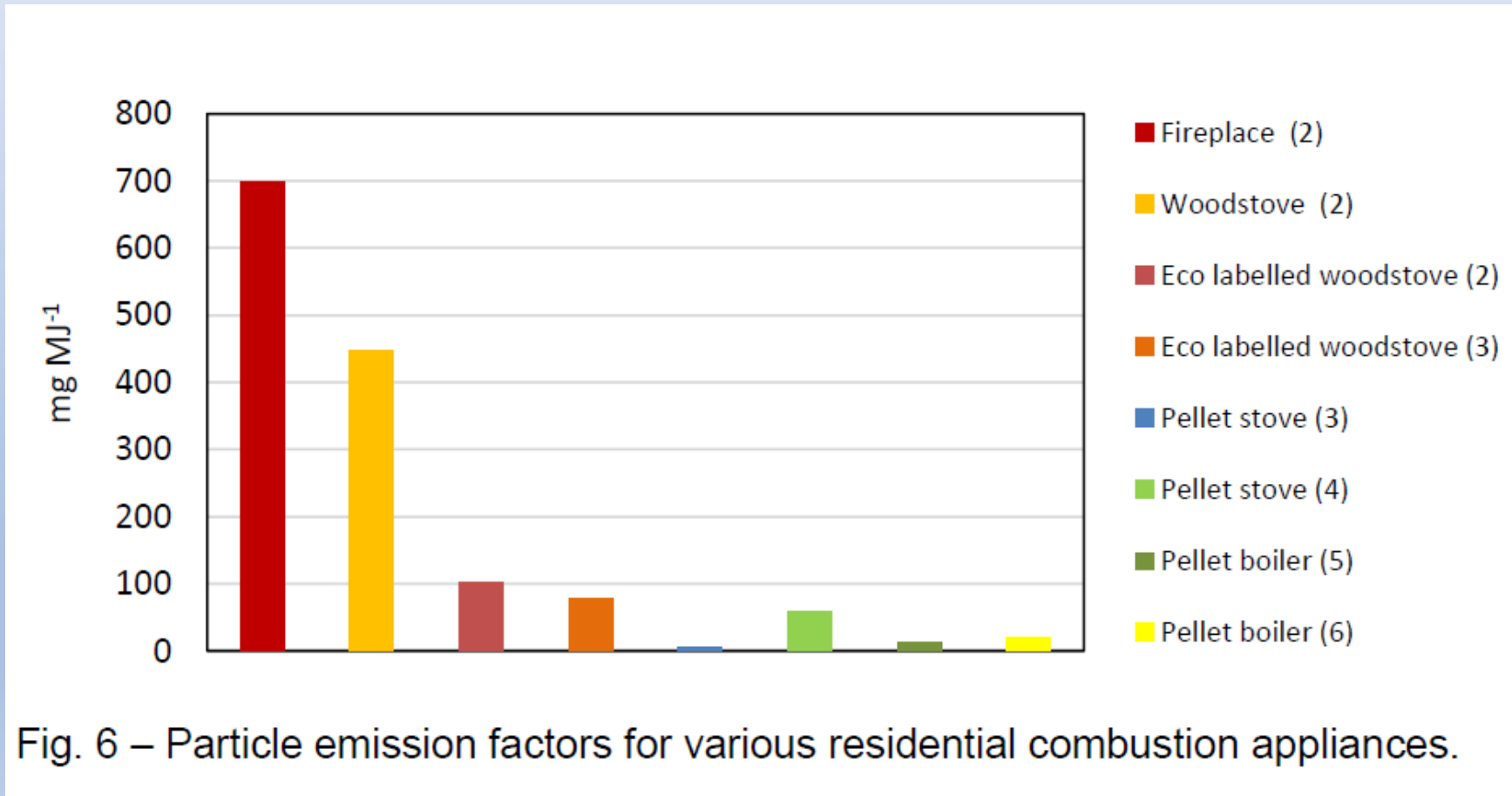


Fig. 6 – Particle emission factors for various residential combustion appliances.

<sup>1</sup> [http://airuse.eu/wp-content/uploads/2013/11/R27\\_AIRUSE-TechGuide-biomass-burning-emissions-reduction.pdf](http://airuse.eu/wp-content/uploads/2013/11/R27_AIRUSE-TechGuide-biomass-burning-emissions-reduction.pdf)

# Ecodesign boilers and stoves – a game changer

- The eco-design requirements for solid fuel boilers (2015/1189/EU)) came into force from 1 January and for local space heaters (2015/1185/EU) will be from 1 January 2022, and include emission limits
- Major role in improving efficiency of, and reducing emissions from residential woodfuel combustion, goes hand-in-hand with quality woodfuels, including graded firewood and pellets
- Need for public awareness, also how to incentivise take-up and use?

# EU Ecodesign Directive (2009/125/EC)<sup>1</sup>

- Ecodesign takes into account **all the environmental impacts** of a product right from the earliest stage of design
- Allows the Commission to set requirements for environmental performance of **energy-related products** (products with significant sales/trade in the EU)
- Main focus has been on energy in the use-phase
- **Can address other significant environmental parameters (e.g. emissions)**
- Requirements have to be met in order to place a product on the market
- Ecodesign requirements must **not lower the functionality** of a product, its safety, or have a negative impact on its affordability or consumers' health.
- Requirements are harmonised across the EU



<sup>1</sup> [https://www.unece.org/fileadmin/DAM/env/documents/2018/Air/WGSR/Roald\\_Wolters.pdf](https://www.unece.org/fileadmin/DAM/env/documents/2018/Air/WGSR/Roald_Wolters.pdf)

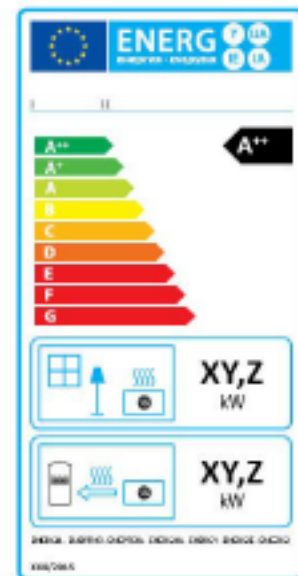
# Ecodesign solid fuel local space heaters

## Emission Requirements for 2020:

Product	PM mg/m <sup>3</sup> *	OGC mg/m <sup>3</sup>	CO mg/m <sup>3</sup>	NO <sub>x</sub> mg/m <sup>3</sup>
Open fronted	50	100	2000	200
Closed fronted	40	100	1500	200 (300 fossil fuel)
Closed fronted pellets	20	40	300	200
Cookers	40	100	1500	200 (300 fossil fuel)

## Labeling Requirements:

- One label for gas, liquid and solid fuel local space heaters
- A++ to G label from 1 Jan 2018 (except for flueless or open to chimney solid fuel heaters: from 1 Jan 2022)
- Best biomass appliances can reach A++
- Best fossil fuel appliances can reach A



**Advice to public on stove types,  
operation, fuels etc.**



# Example - impact of fuel loading and ignition on PM emissions - AIRUSE project <sup>1</sup>

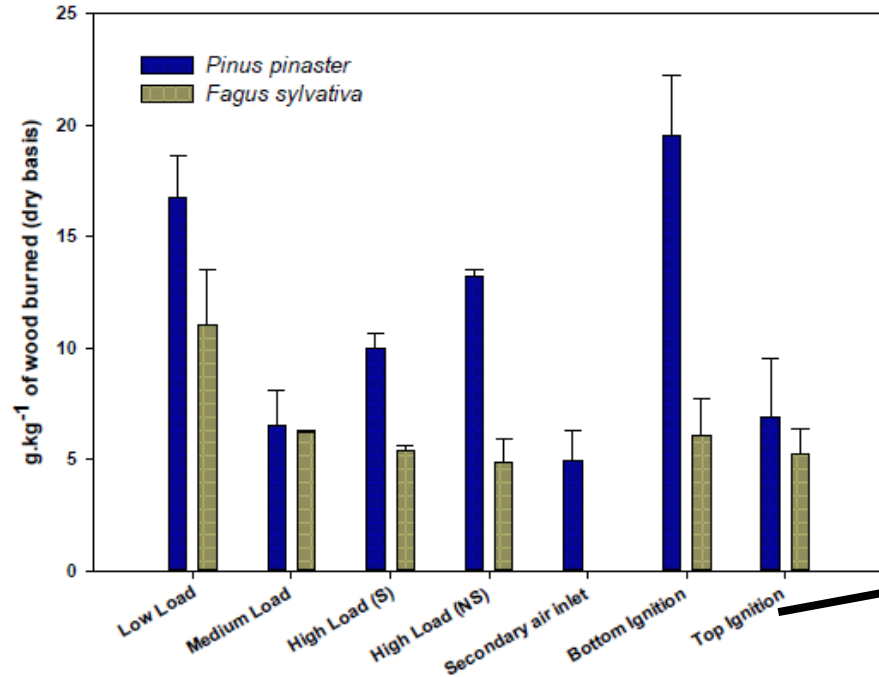


Figure 7 - PM emission factors for different burning conditions (S – split logs; NS – non-split logs). Results obtained within the European project AIRUSE.



Full information on top ignition and more about starting and fuelling a stove fire and on woodfuels in:

**COFORD Connects Note**

*Light my fire*

**by Pieter D Kofman**

<sup>1</sup> [http://airuse.eu/wp-content/uploads/2013/11/R27\\_AIRUSE-TechGuide-biomass-burning-emissions-reduction.pdf](http://airuse.eu/wp-content/uploads/2013/11/R27_AIRUSE-TechGuide-biomass-burning-emissions-reduction.pdf)

# Some sources of advice to public and producers on woodfuel specification and use

wfqa.org



woodenergy.ie





# Sources of advice ctd

US EPA Burn Wise programme - *burn the right wood, the right way, in the right heating appliance*



DEFRA guide



**Thank you for your attention**

**Eugene Hendrick**  
**[wfqa.org](http://wfqa.org)**