

**Imperial College
London**

Dr Gary Fuller

gary.fuller@imperial.ac.uk

@drgaryfuller

www.imperial.ac.uk/people/g.fuller

www.theguardian.com/profile/gary-fuller

Wood (and solid fuel) burning in the UK- a new challenge from an old problem



www.ukcleanair.org

Last winter marked the 70th anniversary of London's Great Smog



#1: the 1956 Clean Air Act

4 & 5 ELIZ. 2

Clean Air Act, 1956

CH. 52



CHAPTER 52

An Act to make provision for abating the pollution of the air. [5th July, 1956]

BE it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

Dark Smoke

1.—(1) Subject to the provisions of this Act, dark smoke shall not be emitted from a chimney of any building, and if, on any day, dark smoke is so emitted, the occupier of the building shall be guilty of an offence.

(2) Emissions of smoke from any chimney lasting for not longer than such periods as may be specified by the Minister by regulations shall, in such classes of case and subject to such limitations as may be so specified, be left out of account for the purposes of this section.

(3) In any proceedings for an offence under this section, it shall be a defence to prove either—

- (a) that the contravention complained of was solely due to the lighting up of a furnace which was cold and that all practicable steps had been taken to prevent or minimise the emission of dark smoke; or
- (b) that the contravention complained of was solely due to some failure of a furnace or of apparatus used in connection with a furnace, that that failure could not reasonably have been foreseen, or, if foreseen, could not reasonably have been provided against, and that the contravention could not reasonably have been prevented by action taken after the failure occurred; or
- (c) that the contravention complained of was solely due to the use of unsuitable fuel, that suitable fuel was

#2 Homes in the 1990s



Let's go back to Paris in the noughties - 2005



20 +/- 10% winter PM_{2.5} in Paris was coming from wood burning in the city - 2005

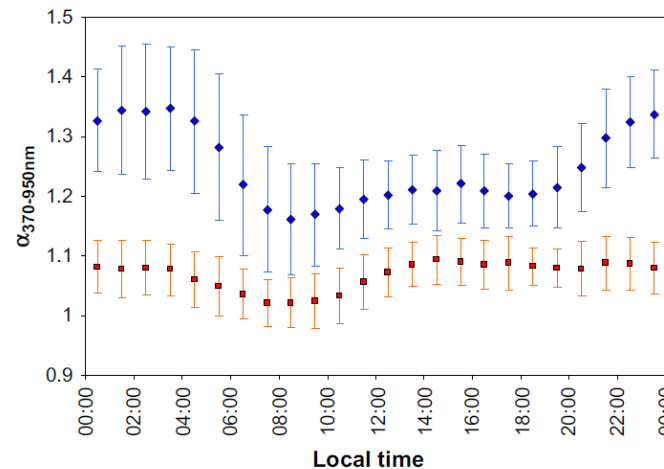
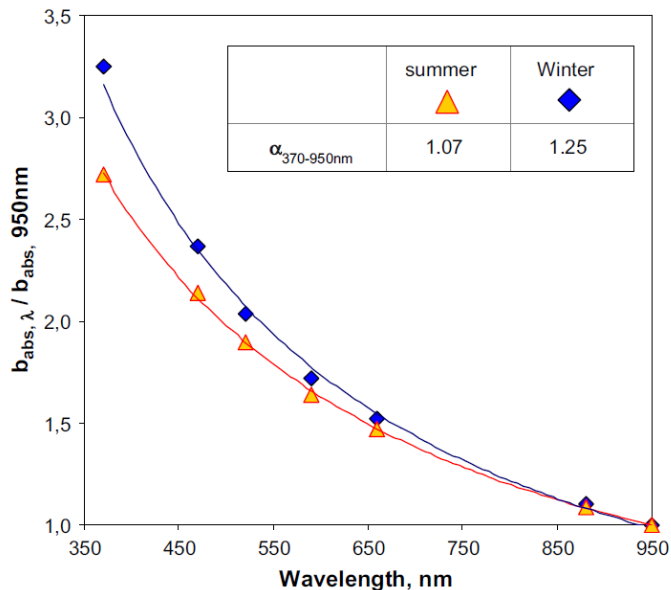
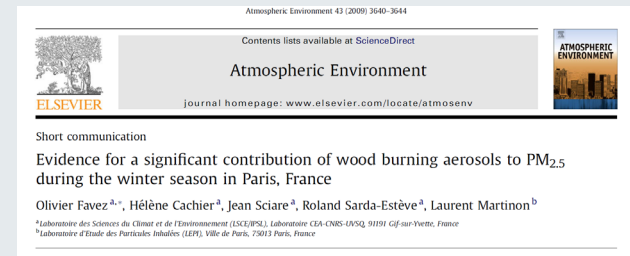


Fig. 3. Mean diurnal pattern of the absorption Angstrom exponent ($\alpha_{370-950\text{nm}}$) during the winter and summer field campaigns (mean value \pm standard deviation).

Let's go back to the noughties

Atmospheric Environment 68 (2013) 295–296

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NEW DIRECTIONS

ATMOSPHERIC ENVIRONMENT

New Directions: Time to tackle urban wood burning?

Gary W. Fuller
MRC HPA Centre for Environment and Health, King's College London,
London SE1 7NL, UK
E-mail address: gary.fuller@kcl.ac.uk

Jean Sciare
LSCE, CNRS-CEA-UVSQ, CEA Orme des Merisiers, 91191 Gif-sur-Yvette,
France

Martin Lutz
Senate Department for Urban Development and Environment,
D-10179 Berlin, Germany

Sophie Moukhtar
AirParif, 7 rue Crillon, 75004 Paris, France

Sandra Wagener
Humboldt-Universität Berlin, D-10099 Berlin, Germany

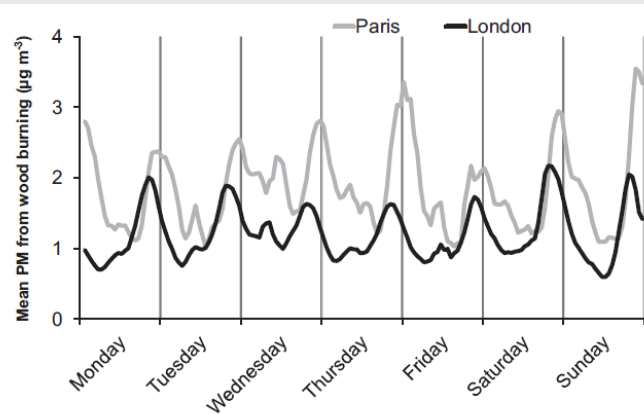


Fig. 1. Winter (October–March) 2009 and 2010 mean concentrations of PM₁₀ from wood burning in suburban London and central Paris.

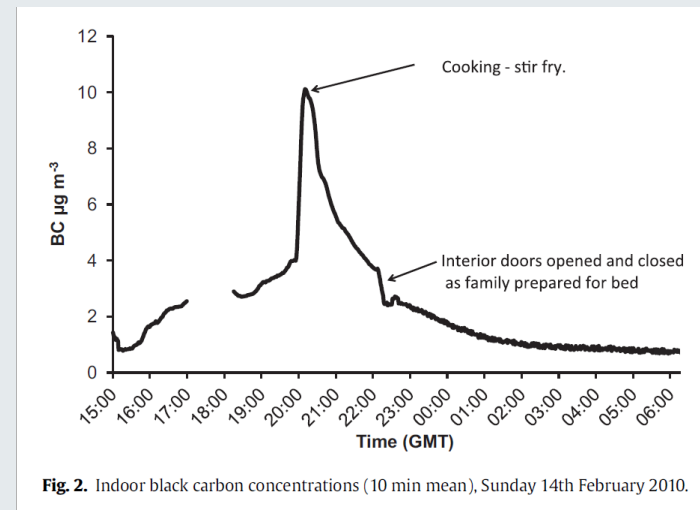


Fig. 2. Indoor black carbon concentrations (10 min mean), Sunday 14th February 2010.

“There is a risk that the European Union commitment to obtain 20% energy from renewable sources is leading to a return to urban wood combustion.

There is a clear need to expand the current focus of air quality management in major urban areas to ensure that increased wood burning does not off-set the substantial investment in schemes to abate traffic pollution.” Fuller et al (2013).





What do we know today?

Kantar (2020) survey in 2018/2019 (~50 k homes), Defra (2023)

27% of primary PM2.5 from solid fuel (3/4 is wood) nearly 2x that from transport exhausts.

Just 8% of UK homes burn wood indoors (12% in Wales, 27% in NI, 38% in rural homes*)

Only 4% wood burning homes rely on solid fuel for heating. Only 8% burnt wood for “necessity” 46% burnt for “tradition” or “aesthetics”

46% wood burner were in social grades AB

14% of home burnt outdoors (mostly cooking)

Wood burning is not climate neutral over decades / ~ century

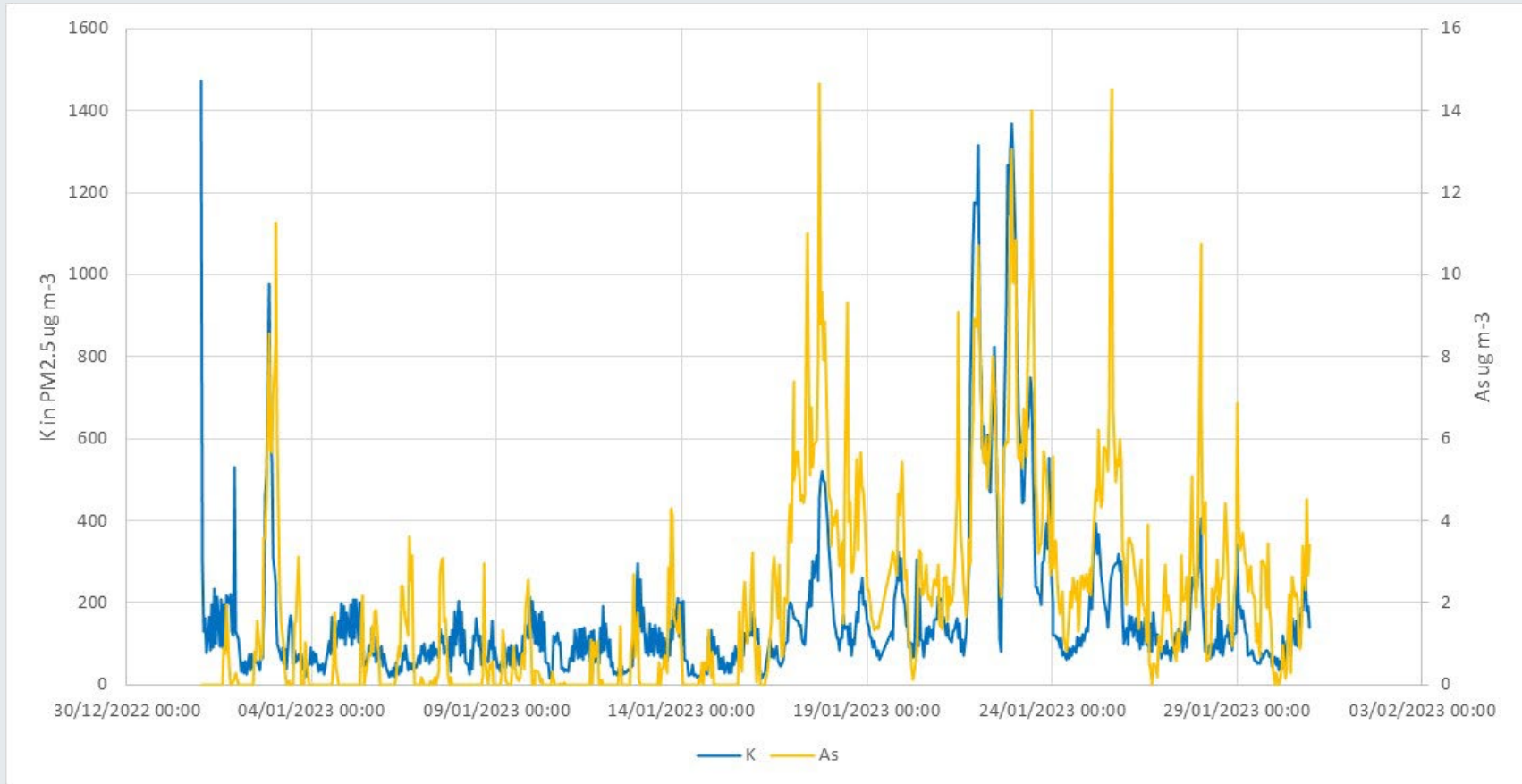
What will be the impacts of rising energy prices – gas, heating oil etc.?

Around 50,000 extra wood stoves annually in the UK (2-3% growth)*

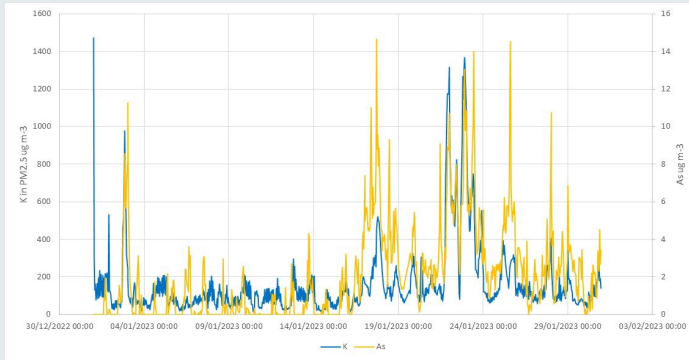
*Survey work in progress! Thanks to Dr Jez Zahra, Defra

What on earth are people burning?

Arsenic measurements at the London Supersite by Anja Tremper et al shows that people are burning waste construction wood – provisional results.



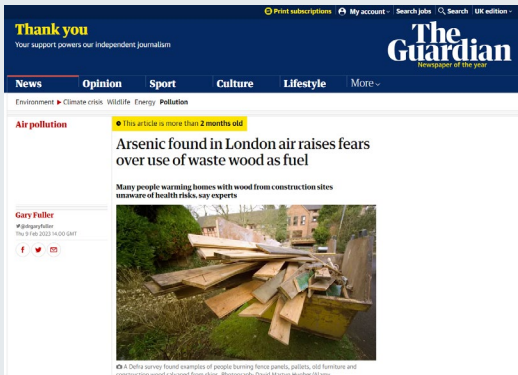
What on earth are people burning?



Kantar (2021) - 9% of wood burning homes are burning salvaged wood.

“..husband also collects waste wood from skips using a wheelbarrow: ‘I don't know we just seem to accumulate wood.’” (Elizabeth from London).

“My husband's a carpenter by trade, so whenever he's doing a job we burn whatever wood he's got left over, skirtings, architraves, bits of furniture” (Wales, Rural – Off grid)



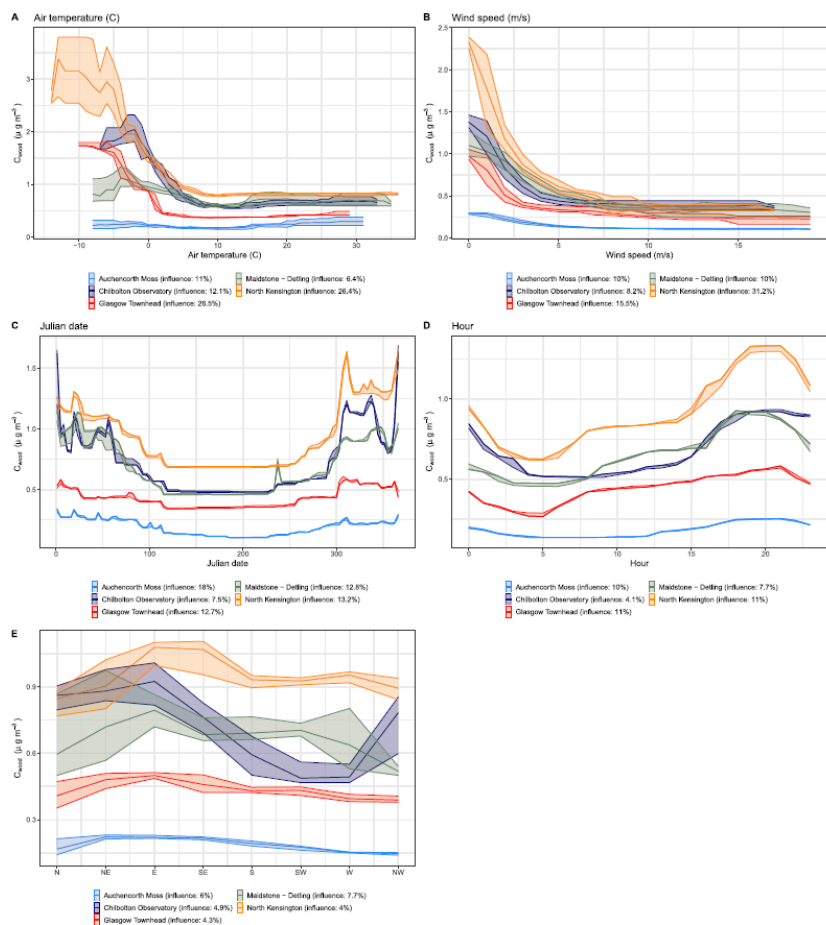
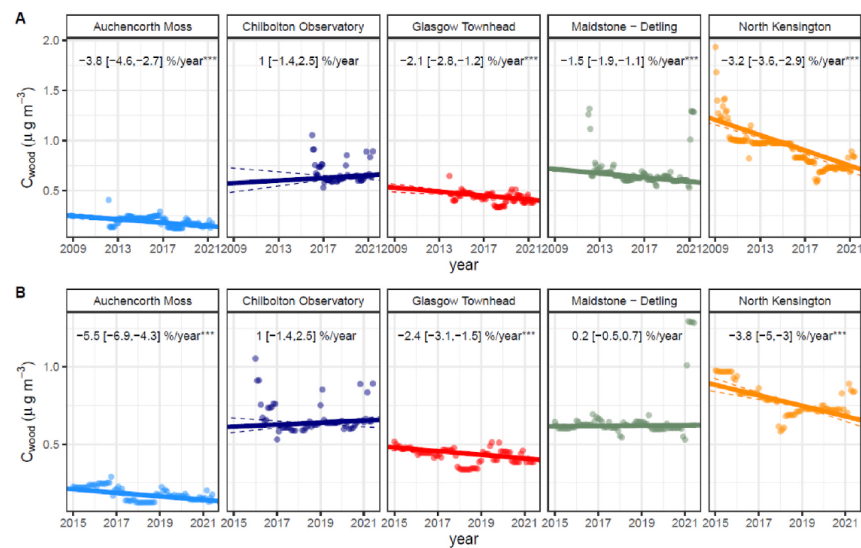


Fig. 5. Partial dependency plots (mean and 95% confidence interval) for each monitoring site for air temperature (A), wind speed (B), Julian date (C), hour (D) and wind direction (E). Influence from each explanatory variable is included and expressed in %.



Environmental Pollution 314 (2022) 120105

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Long-term trends in particulate matter from wood burning in the United Kingdom: Dependence on weather and social factors^{a,c}

A. Font^{a,*}, K. Ciupek^{a,b}, D. Butterfield^b, G.W. Fuller^a

^a MRC Centre for Environment and Health, Environmental Research Group, Imperial College, London, UK
^b Air Quality and Aerosol Metrology Group, National Physical Laboratory, Teddington, UK

No clear upwards trends since 2010 – to my surprise.

But now, ~ 50,000 extra wood stoves annually in the UK (2-3% growth)*

*Survey work in progress! Thanks to Dr Jez Zahra, Defra

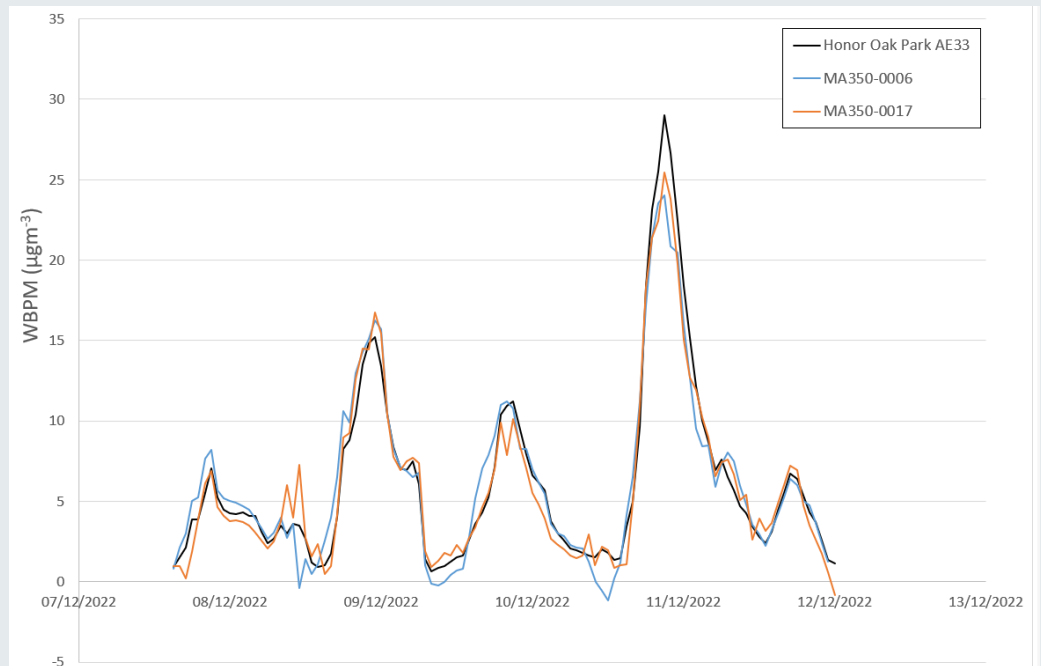


Still being finalised but here's a sneaky peak at some results

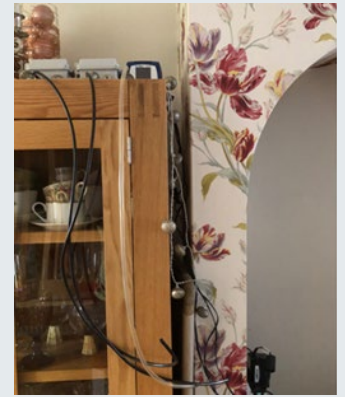
Instrument trials



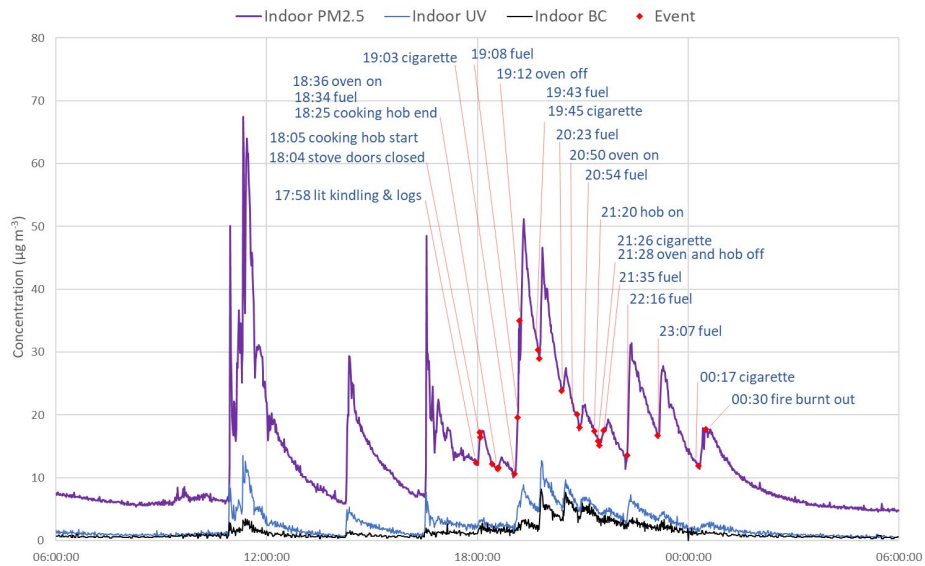
Consistent wood burning quantification between “reference” & portable aethalometers



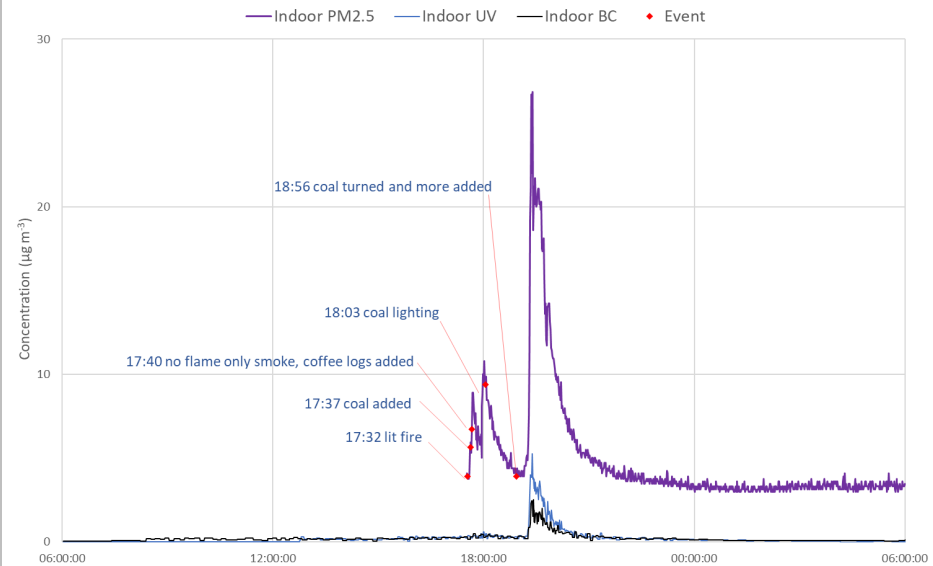
Inside homes



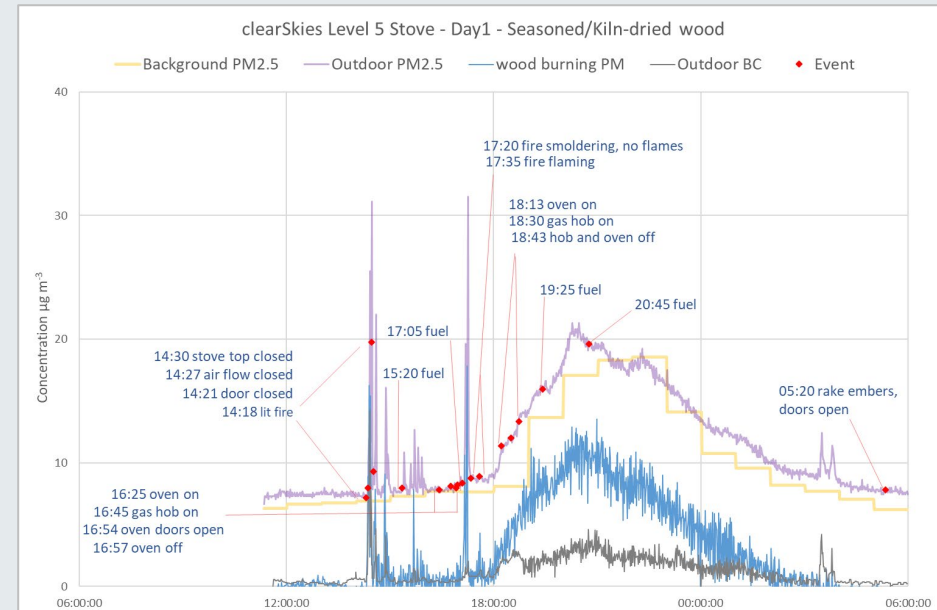
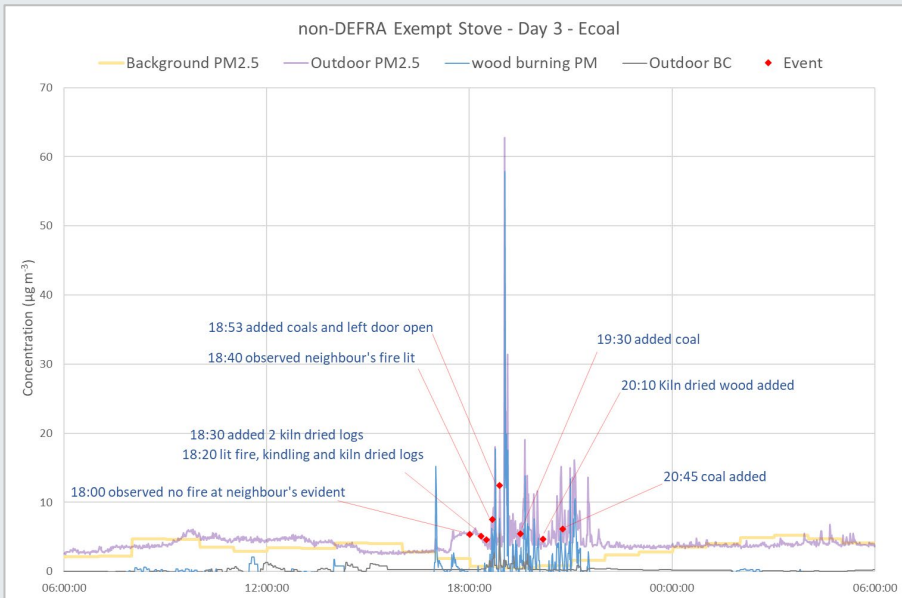
DEFRA Exempt Stove - Day 2 - Coffee Logs



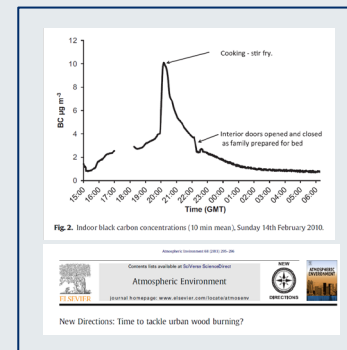
Open Fire - Day 5 - Newflame Plus



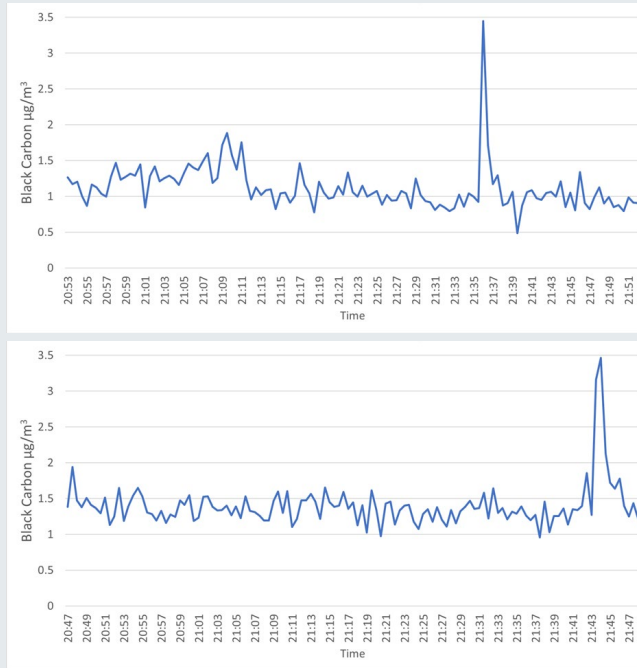
Outside homes <~10 m



Supports the concerned emails that I get every winter from people concerned that their child or elderly relative's bedroom is being filled with harmful wood / coal smoke.



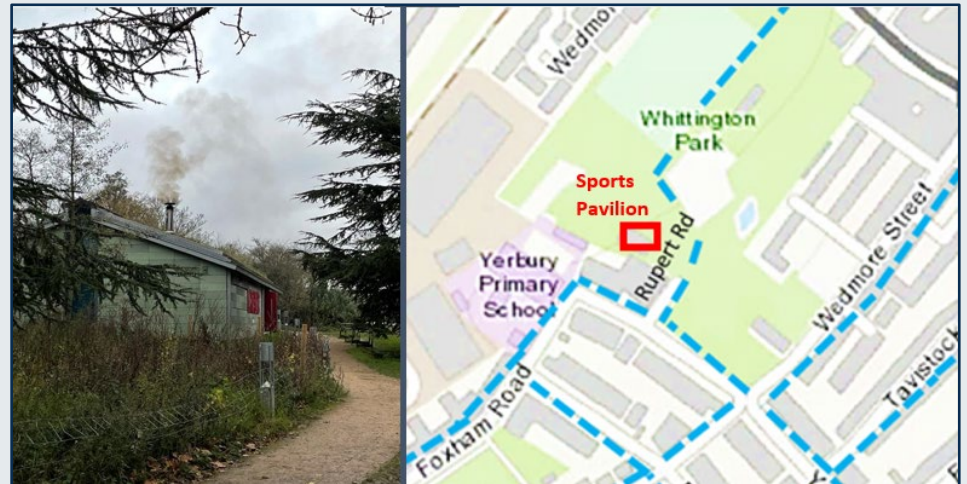
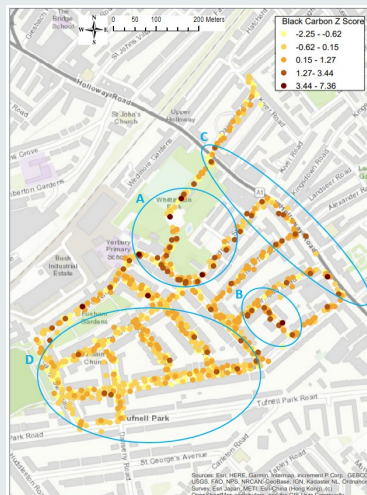
Across neighbourhoods and streets



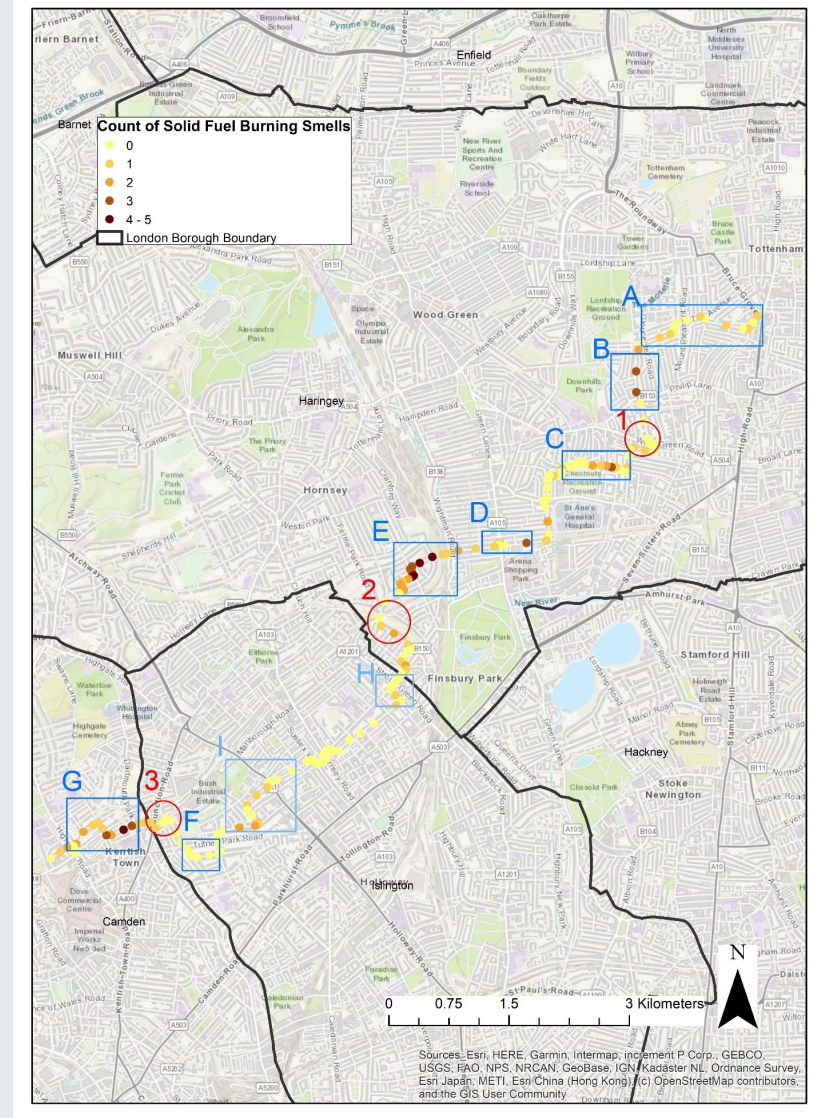
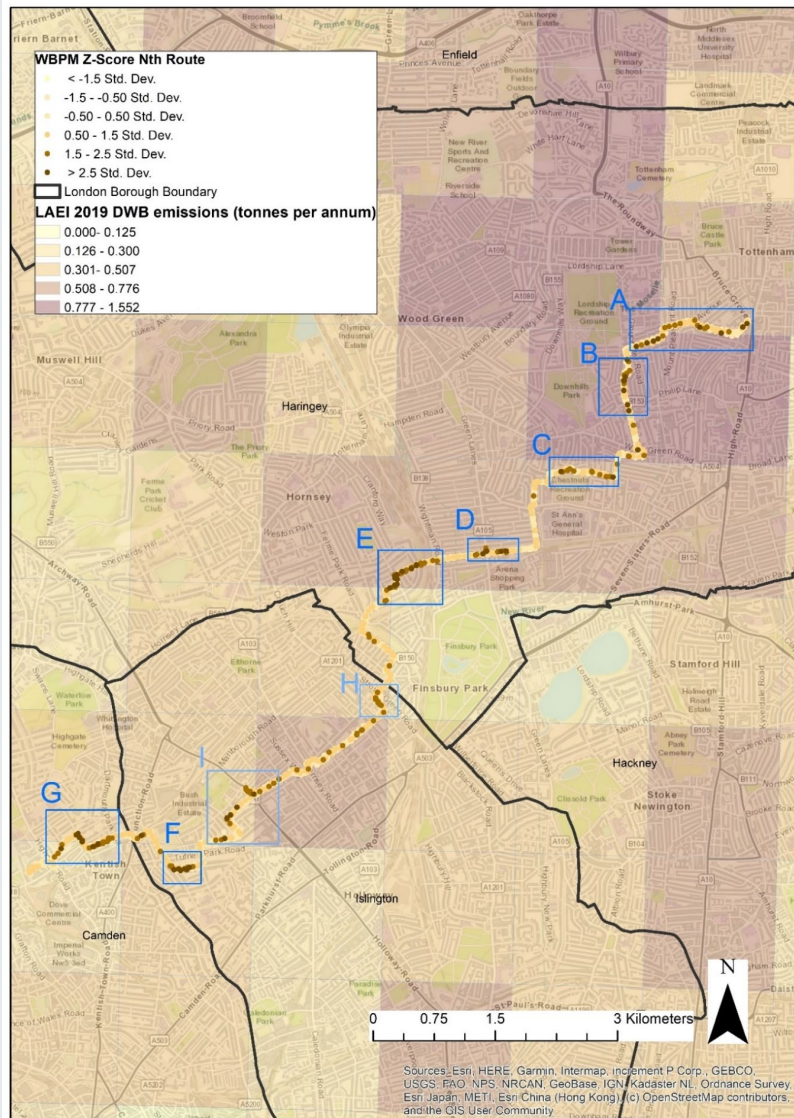
Rule of thumb: (Fuller et al 2014)

Black carbon is about 10% of total ambient PM from wood burning.

\Rightarrow Max PM_{2,5} \sim 30 – 40 $\mu\text{g m}^{-3}$



Across neighbourhoods and streets



Health impacts

In final preparation!

Authors and Affiliations:

Ms Rachael Piper¹, Dr Anja Tremper^{1,2}, Professor Klea Katsouyanni^{1,4}, Dr Gary Fuller³

Dr David Green^{1,2,5}, Dr Anna Font⁶, Dr Heather Walton^{1,2,5}, Dr Ioar Rivas⁶, Dr Dimitris Evangelopoulos^{1,2,7}.

¹Environmental Research Group, School of Public Health, Imperial College, London, UK

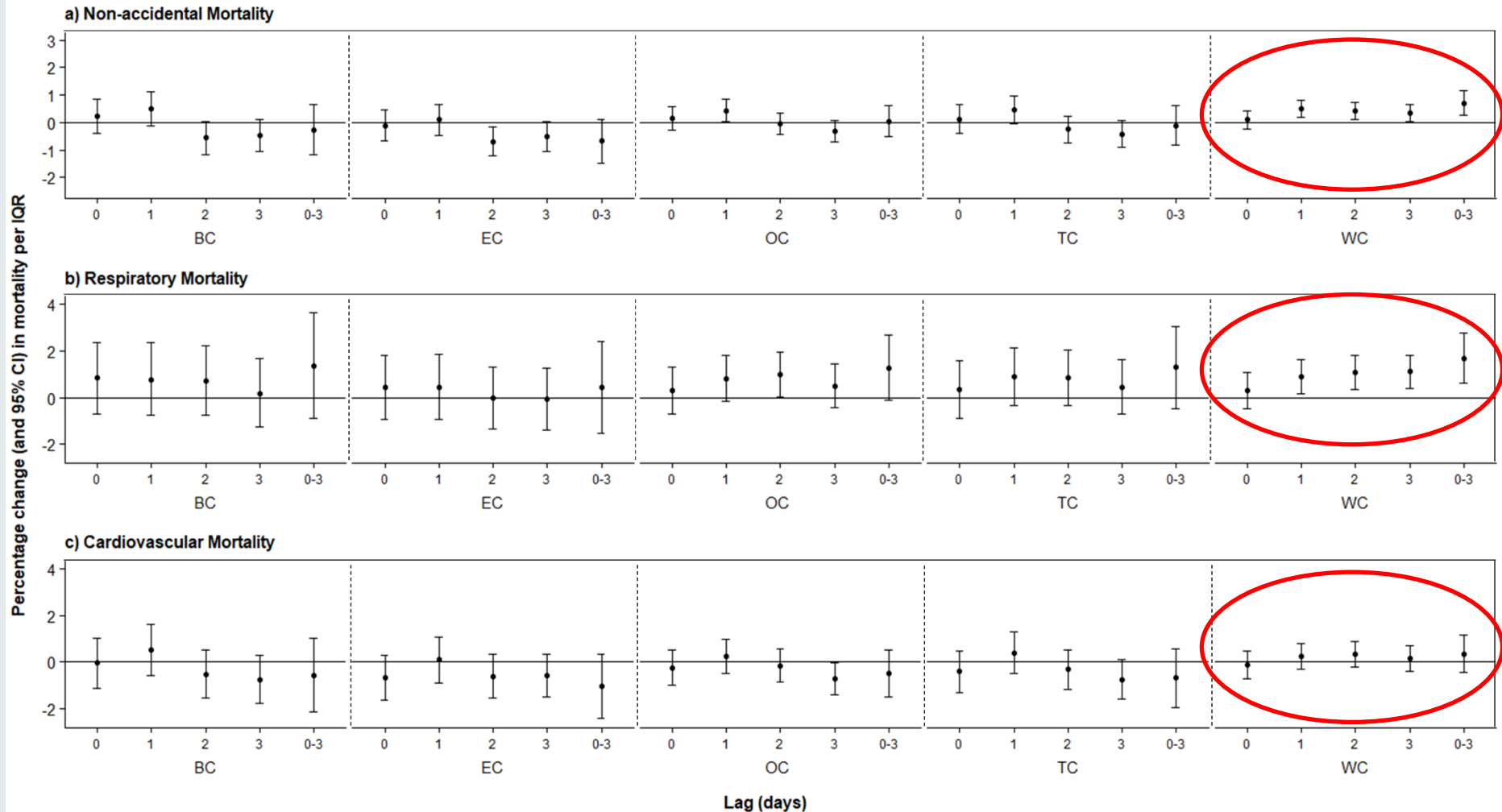
²NiHR HPRU in Environmental Exposures and Health, Imperial College, London, UK

³MRC Centre for Environment and Health, Imperial College, London, UK

⁴Medical School, National and Kapodistrian University of Athens, Athens, Greece

⁵Anna's Affiliation

⁶Instituto de Salud Global de Barcelona (ISGlobal), Barcelona, Spain



Home solid fuel use is a social issue and not a technical one



A hearth is at the heart of a home.

People struggle to believe that burning a *natural* product and their tiny fire can have a big impact.

In 1950s 18 percent of UK coal was used to heat homes. This created 60 percent of wintertime particle pollution.

Today 8% of homes product 27% of our primary PM2.5.

#3

Solutions - what's been tried and what works...

Scheme	Success?
Clean Air Act – smoke control areas #4	75% ↓ PM due to smokeless coal in 1950s London Relied on simple supply chain Widely ignored today – 27% open fires in SCAs, 56% in London.
Smokey coal bans #5	75% ↓ PM London 1950s 70% ↓ PM Dublin 1990 Not widely used fuel Now in England
Wet wood standard	Not tired before Sold wet wood is only 20% of total wood burned
Stove standards – Defra approved, Ecodesign, Clearskies, Nordic Swan #6	More emissions in real-world vs test – can be 3-16x greater! Turnover is slow ~60% > 10 years old England, 90% in London. Will be overtaken by 2-3% in wood burning homes. Having invested, stove users use their appliance 1.9 x more than those with open fires.

Solutions - what's been tried and what works...

Scheme	Success?
Subsidies for new stoves	Eg Libby Montana almost all stoves upgraded ↓ winter PM by 27%. <u>Less wheeze in children.</u> Similar results from Rhone Valley.
Subsidies to replace stoves and fireplaces with other heating	Eg Launceston, Aus – wood burning homes dropped from 66% to 30%, PM ↓ 40%, <u>death rates ↓ by 11% vs places with no scheme</u>
Burn bans – banning wood burning on polluted days.	Eg across the US, esp western states. Requires publicity and enforcement PM ↓ 20-30% raises public awareness of wood burning harm too. <u>Reductions in hosp admissions in CA</u>
Behavioural change campaigns (not just telling people the law!)	Several councils requested no bonfires or no burning in lockdown. Best campaign is / was run by Environment Canterbury (South Island. NZ)

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@drgaryfuller

www.imperial.ac.uk/people/g.fuller

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Wood (and solid fuel) burning in the UK- a new challenge from an old problem

 Clean Air
Programme

www.ukcleanair.org

