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HEALTH & WELLBEING 360

Are we ready for voluntary domestic burning regulations?

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Background

ROHIT CHAKRABORTY

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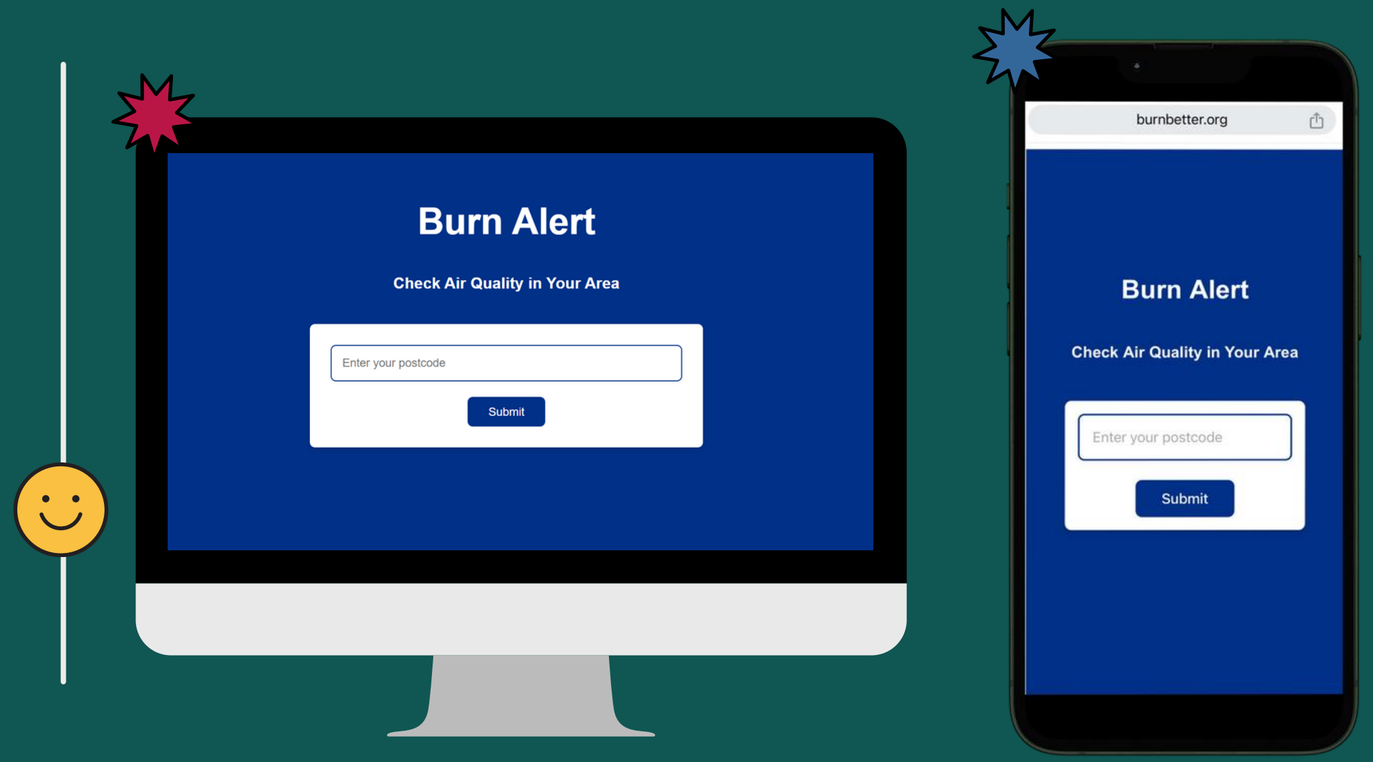
ENVIRONMENTAL PUBLIC HEALTH SCIENTIST, UKHSA

- Completed PhD (2018-2022) at University of Sheffield, specializing in air pollution monitoring and modeling in cities with low-cost sensors.
- Worked as Air Quality Scientist at AirRated, London, post-PhD.
- Joined UKHSA in October 2023 for Air Quality Public Health team working on air quality monitoring research.
- Visiting Research Scholar, University of Leeds (2025)

Introduction

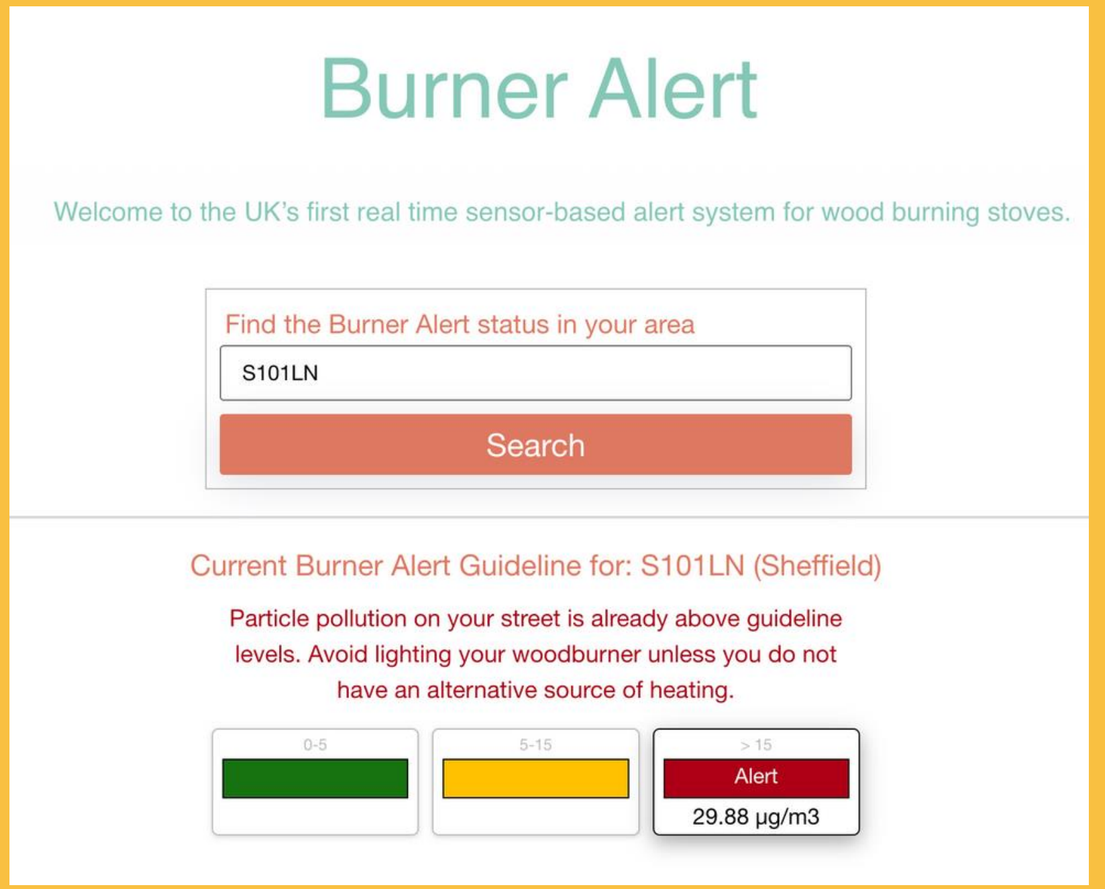
Burn Alert: A Pilot Study

What is ‘Burn Alert’?
It is a system that combined a bespoke high-density outdoor monitoring network with postcode-level PM2.5 data and behaviourally informed SMS and/or email push messages



Empirically, this is the first burn alert trial to combine a bespoke, high-density official sensor network with real-time, postcode-level PM2.5 data, and to use this to send street-specific ‘push’ messages to burners via SMS and email.

This study evaluates a city-wide air quality alert system trialed in Swansea as a voluntary supplement to statutory controls.



2021

Wood burners triple harmful indoor air pollution.
Chakraborty

2022

Wood burning stoves, participatory sensing, and 'cold, stark data'
Heydon, J., Chakraborty, R.
https://doi.org/10.1007/s43545-022-00525-2

2023

Burner Alert v1 Sheffield
v2 National

Could 'no burn days' work in the UK? ⟶

Preliminary Findings

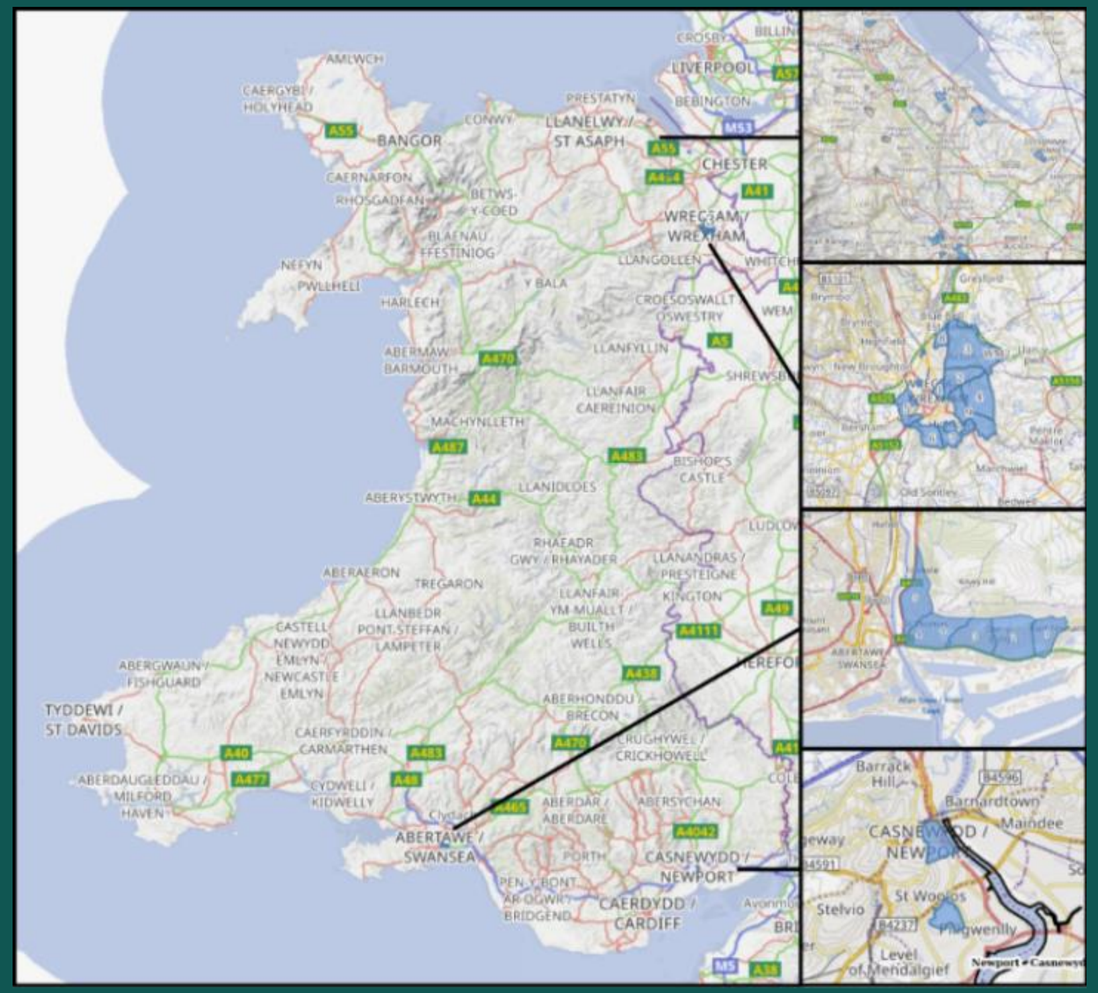
92% (n=46) received an alert.

74% (n=34) avoided lighting their stove at least once

33% (n=11) of these also lit t92% (n=46) received an alert, used their stoves for a shorter duration (1.8 hours reduction pp).

Over two weeks, the Burner Alert prevented 65 stove uses and 178 hours of burn time (conservative figure).

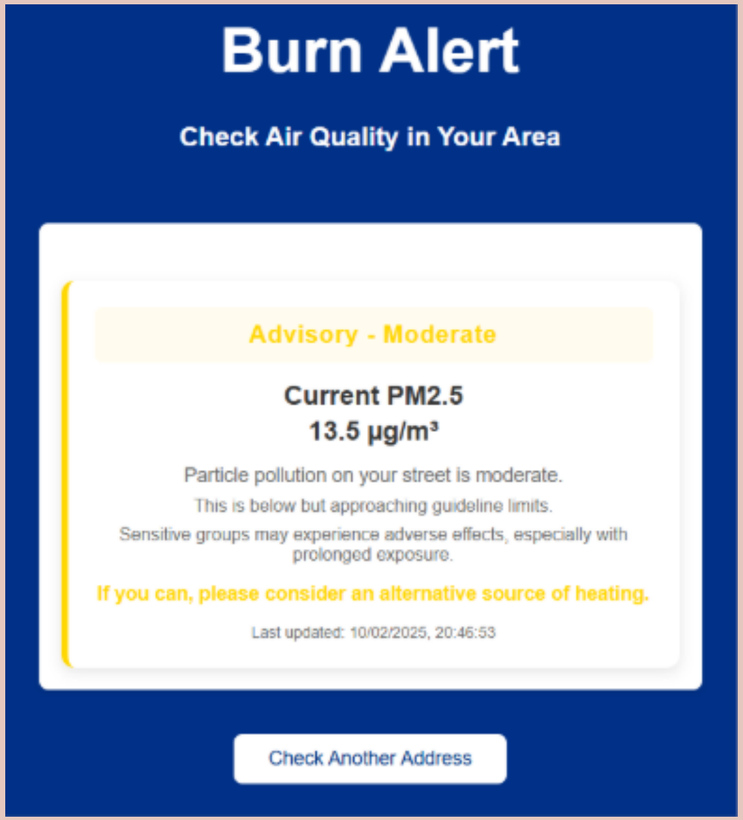
Swansea Pilot Study



*SCAs in blue

Problem

- Over one-third of Wales' PM2.5 from domestic burning
- Only 4 Smoke Control Areas in Wales
- Weak enforcement due to resource limits
- Low AQ Literacy
- Even 'authorised' stoves emit 300x more PM2.5 than gas boilers



System Design

- **Data source:** Swansea City Council's expanded monitoring network (reference-grade stations, Zephyr units, BettAir sensors).

- **Reporting frequency:** 15–60-minute intervals, transmitted hourly to an AWS cloud server.

- **Data processing:** Automated validation (range, consistency, outlier handling) and aggregation to hourly means in **PostgreSQL**.

- **Spatial modelling:** Hyperlocal **$PM_{2.5}$ fields** generated on a 25 m grid (10 m where sensors were closer)

- **Exposure mapping:** Participant postcodes linked to nearest grid-cell estimate.

- **Alert generation:** Triggered when **evening $PM_{2.5}$ thresholds** exceeded.

- **Alert delivery:** Automated **email/SMS** messages via the UK Government alert service, sent in **Welsh or English** based on participant preference at 6pm.

Alert Thresholds and FEMA Messaging

The burn alert was accompanied by an animation outlining the system rationale, guidance on how to use it, and information on the dense local sensor network underpinning the alerts

Alert Level	Alert Colour / Text	Threshold	Fact	Evaluation	Motivation	Action
Burn Alert	Extremely High	>30 ug/ m^3	Particle pollution on your street is extremely high (ug/m3).	This is well above guideline limits.	Exposure to higher levels of air pollution can be harmful to you and your family's health.	Please avoid lighting your stove, unless you do not have an alternative source of heating.
	Very High	> 20 ug/m^3	Particle pollution on your street is very high (ug/m3).			
Advisory	High	15– 20 ug/m^3	Particle pollution on your street is high (ug/m3).	This is above guideline limits.	Exposure to higher levels of air pollution can be harmful to you and your family's health.	Please consider not lighting your stove and using an alternative source of heating. Please monitor the burn alert website as conditions may worsen.
	Moderate	10- 15 ug/m^3	Particle pollution on your street is moderate (ug/m3).	This is below but approaching guideline limits.	Sensitive groups may experience adverse effects, especially with prolonged exposure.	Particle pollution levels can change as stoves are lit. If you can, please consider an alternative source of heating.
No Alert	Fair	0– 10 ug/m^3	Particle pollution on your street is low (ug/m3).	This is well below guideline limits.	Exposure at this level involves minimal health risks.	Particle pollution levels can change as stoves are lit.

Research Methodology

1 Pre-Intervention Survey

📝 Baseline characteristics & burning behaviours (n = 49)

Air quality literacy (AQ literacy) & perspectives

Structured questionnaire before alert exposure

2 Post-Intervention Survey

📊 Conducted after 4 weeks of Burn Alert use

Compared pre/post responses & user experiences

Included:

12 AQ literacy items (from SAQLS)

10-item System Usability Scale (SUS) (Hyzy et al., 2022)

3 Follow-Up Interviews

💬 Online qualitative interviews (n = 14)

Explored behaviour change, perceptions & usability feedback

🎯 Outcome: Combined quantitative and qualitative evidence on stove user behaviour and AQ literacy improvement

Results

Burn Alert led to significant behaviour change and literacy gains.

🔥 85% (n=41/49) avoided burning ≥ once after alerts.
⏱️ 606 total hours of burning prevented → ~3.7 hrs/week per household.
🔻 37.7% reduction in weekly burn time (from 9.8 → 6.1 hrs).

📘 AQ literacy:
Pre: 7.9/20 → Post: 8.6/20
+0.65 mean increase, $t(40)=2.04$, $p<.05$.

Engagement gradient:
High (n=24): 75.5% of hours avoided
Moderate (n=11): 18.4%
Low/None (n=14): 6.1%

“Whenever the message came through, it sparked interest! The burn alert was just an encouragement to make a better decision each day that it went off. — P10

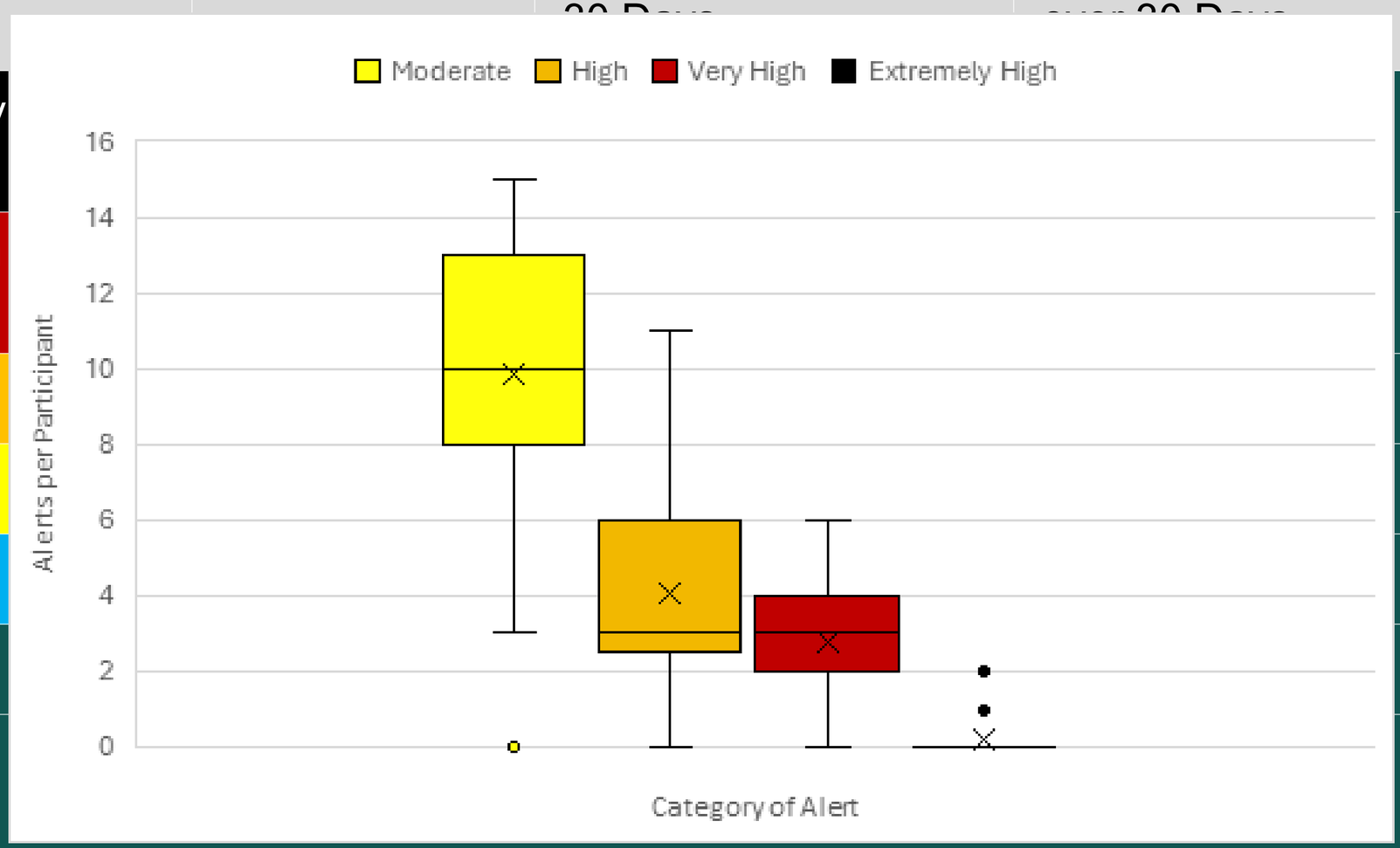
IBM-WASH Analysis of Intervention Engagement

Factor	Example / Quote
💷 **Economic**	“I’ve just spent a few thousand installing this burner… not going to stop burning completely.” – *P20, High*
🧠 **Psychosocial**	“I didn’t want to add to my neighbours’ burden.” – *P7, High*
🖥️ **Technological**	“If I followed the alerts, I’d never use my log burner.” – *P26, Low/No*
🌍 **Information**	“We installed it thinking it was low carbon.” – *P46, High*

Although the IBM-WASH helped to sensitise analysis to these different dimensions, participant accounts clustered more specifically around cross-cutting themes emphasising relationships between levels and factors.

Distribution of Alerts

Alert Level	Alert Colour / Text	Threshold	Mean No. Issued over 30 Days	Total No. (%) Issued over 30 Days
Burn Alert	Extremely			
	Very High			
Advisory	High			
	Moderate			
No Alert	Fair			
Total	/			



Why People Keep Burning?

Aesthetics

- 🔥 **73%** burned to **heat the home**

- ❤️ **39%** chose **aesthetic appeal** as their **main reason**
•Many combined warmth + affordability (39% selected both)

“It’s cosy, looks nice, and saves on bills.” – *Participant summary*

“Even if energy costs drop, I’d still light it for the atmosphere.” – *P7, High*

- 💷 **50%** to **save on energy costs**

💰 Cost & Flexibility Divide

Financial necessity strongest among Low/No engagers

“Every time I get my gas bill, I think I’m going to start using my burner more.” – P25,

High engagers could afford to avoid burning:

“We’re fortunate – can pay our bills, use heating instead.” – P16

“I wouldn’t have frozen to death if I didn’t use it.” – P9

🌲 Fuel Access & Sunk Costs

“My friend’s got a forest – he delivers me a pile every year.” – *P41*
“With all that wood outside, it’s almost like free heating.” – *P1*
•**55%** accessed **free or cheap wood** locally.
•**Sunk-cost effect:** Installation seen as investment to recoup.
“I’ve spent a few thousand on the burner – not stopping now.” – *P20*

Conclusion

Voluntary burn alerts work — but impact depends on who engages

⚡ ~40% reduction in burning among users;
3.5 hrs avoided per alert.
📈 Significant rise in AQ literacy and high usability ratings.
💬 “Concise, factual, health-focused alerts encouraged better decisions.”

Evidence supports value of actionable, localised messaging for behaviour change.

⚖️ Uneven Engagement
Compliance shaped by contextual, psychosocial, and technological factors:Energy costs, health vulnerabilities, “authorised” appliance labels.

Alert timing & frequency also key.
High engagers benefit most, but population uptake remains low (49/3000).
💭 Wider Implications
Burning is a normalised behaviour — seen as warmth, comfort, and cost-saving.
Voluntary measures face indifference, not hostility, limiting reach. Similar to Clean Air Zone debates: issues of fairness, trust, and autonomy can overshadow health benefits.

Thank you

Funded by Welsh Government Local Air Quality Management Fund

Voluntary Regulation at the Limits of Statutory Control: An IBM-WASH Evaluation of a City-Wide Air Quality Alert System

James Heydon (University of Nottingham) · Menna Price, Ian Walker, Paul Lewis, Kori Sunter (Swansea University) · Caitlin Bunce (University of Nottingham) · Rohit Chakraborty (UKHSA)