Particulate Pollution in Ireland from Solid Fuel Burning

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Outline

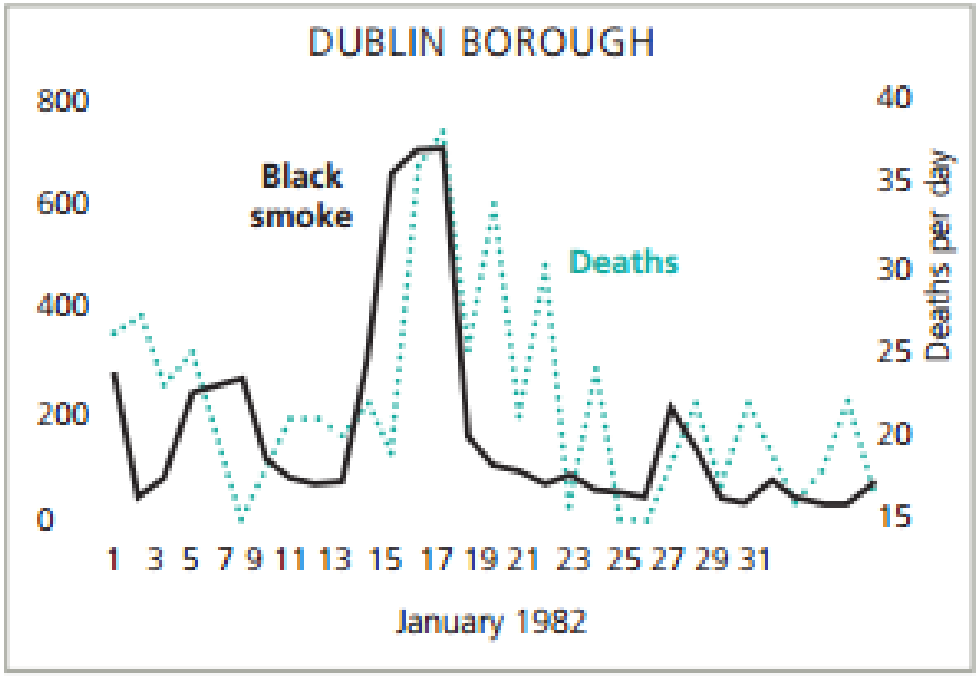
- Smog and the Smoky Coal Ban
- From Black Smoke to Particulate Matter (PM)
- Sources of PM
- Identifying and Quantifying Sources of PM
  - Cork City
  - Killarney
- Summary and Perspectives

Dublin Smog 1982

Mortality in a General Hospital and Urban Air Pollution

Ian Kelly and Luke Clancy,

Irish Medical Journal, 1984, 77, 322-4



- Cold weather, temperature inversion, low wind speeds
- Very high levels of black smoke and sulphur dioxide
- Number of deaths per day doubled during the smog event and remained high for days afterwards

The New York Times

Dublin Journal; Fair Is City but Foul Is Air When Smog Creeps In

By SHEILA RULE, Special to the New York Times
Published: January 18, 1989

The smog creeps menacingly through doors and windows here. It attacks throats and lungs. It sometimes invades Dublin to such a degree that night appears to fall by midday.

Ballyfermot, Thursday 24 November 1988, 4pm

Tony Gavin

Dublin city centre, Friday 25 November 1988, 2pm

Ban on Smoky Coal in Dublin

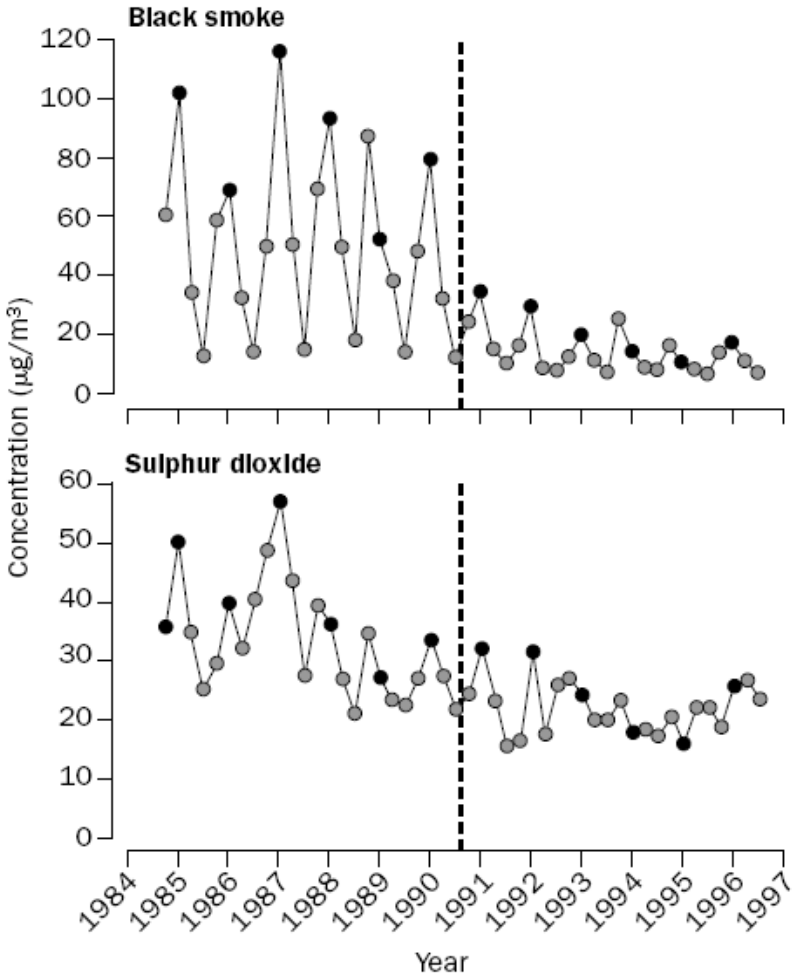


Figure 1: **Seasonal mean black smoke (upper) and sulphur dioxide (lower) concentrations, September 1984–96**
Vertical line shows date sale of coal was banned in Dublin County Borough. Black circles represent winter data.

1st September 1990

70% reduction in black smoke

34% reduction in sulphur dioxide

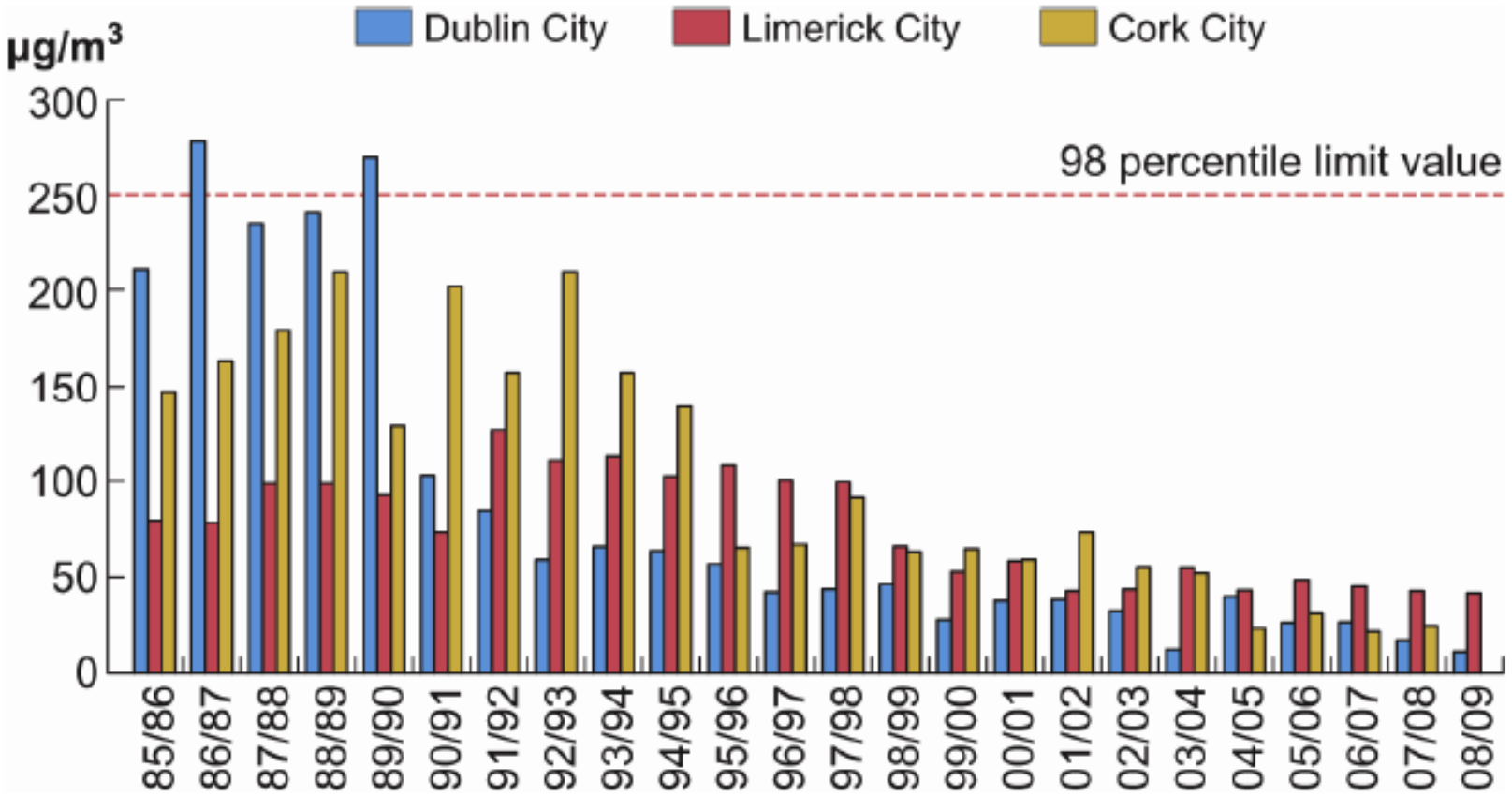
On average per year:
116 fewer respiratory deaths
243 fewer cardiovascular deaths

Clancy et al., Lancet 2002

Extension of Smoky Coal Ban

1990	Dublin
1995	Cork City
1998	Arklow, Drogheda, Dundalk, Limerick City, Wexford Town

Trends for Black Smoke



- Significant reductions after ban

Dublin 1990 Cork 1995 Limerick 1998

Extension of Smoky Coal Ban

1990	Dublin
1995	Cork City
1996	Arklow, Drogheda, Dundalk, Limerick City, Wexford Town
2000	Celbridge, Galway City, Leixlip, Naas, Waterford City
2003	Bray, Kilkenny, Sligo, Tralee
2011	Athlone, Carlow, Clonmel, Ennis
2013	Greystones, Letterkenny, Mullingar, Navan, Newbridge, Portlaoise

Significant reductions in Black Smoke observed in all cities and towns after the ban (up to 2000)

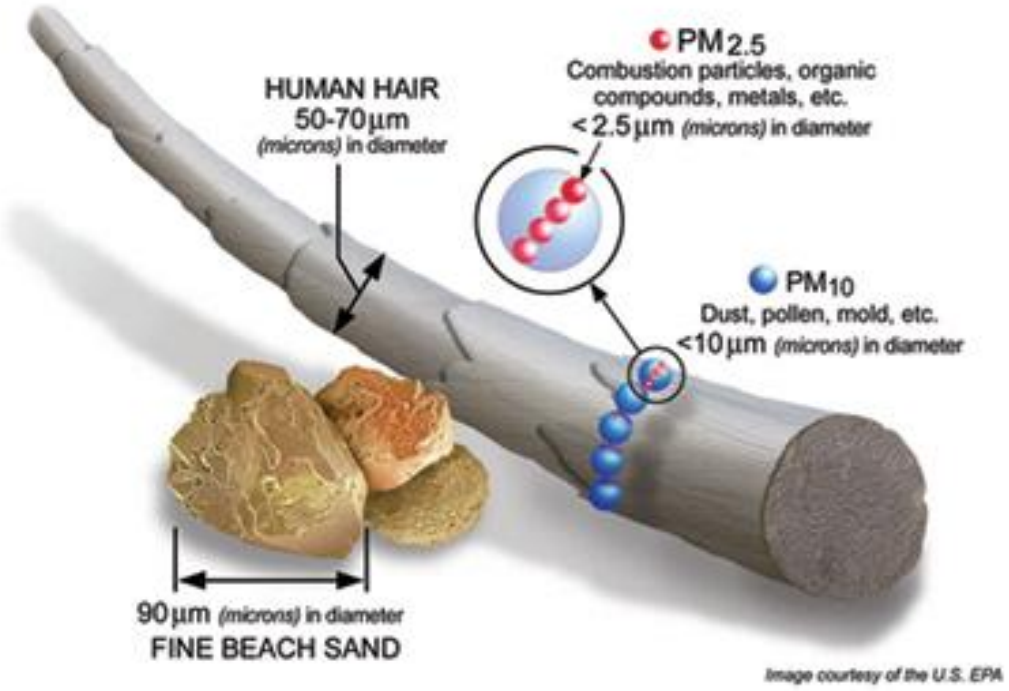
(Goodman et al, *J. Air & Waste Manage. Assoc. 2009,* **59**:207–213)

From Black Smoke to Particulate Matter

In 2005 Black Smoke standards were replaced by PM limit values in European Air Quality Directive (1999/30/EC)

PM_{10} Particulate Matter with diameter less than 10 microns

$PM_{2.5}$ Particulate Matter with diameter less than 2.5 microns



PM Size is Linked to Health Risk

PM_{10} enters upper respiratory system

$PM_{2.5}$ can penetrate deep into the lungs

There is a greater health risk associated with exposure to smaller particles

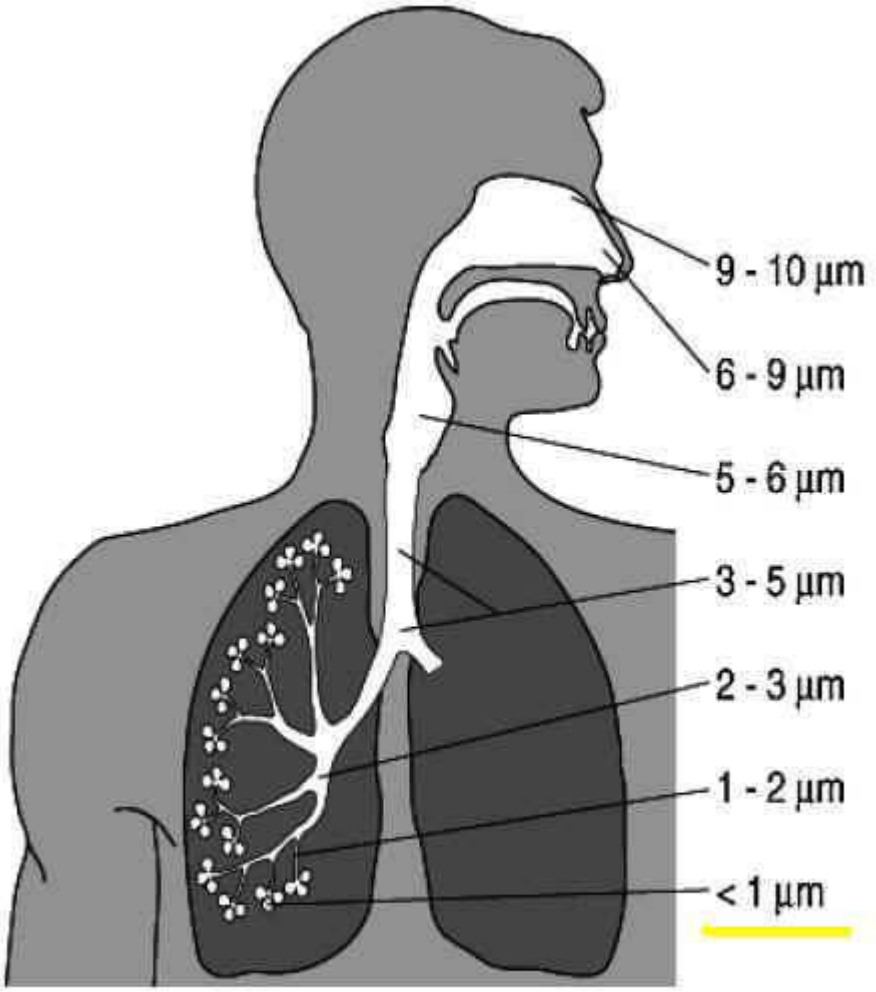


Figure 2 Particle deposition in respiratory system

Well Documented Health Effects of PM

Short term (hours, days) exposure

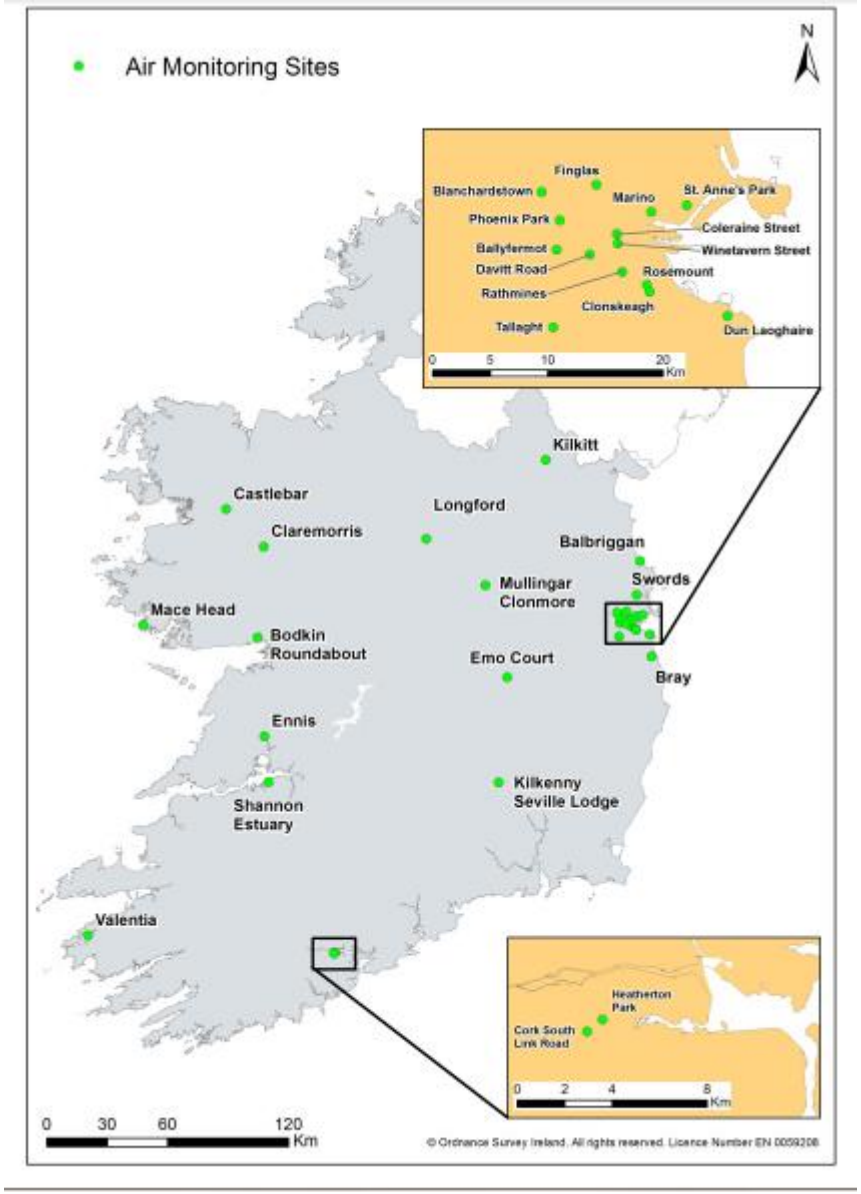
- respiratory and cardiovascular morbidity, such as aggravation of asthma, respiratory symptoms

Long term (months, years) exposure

- mortality from cardiovascular and respiratory diseases and from lung cancer

PM_{10} and $PM_{2.5}$ are classified as air pollutants and limits on their concentration form part of EU legislation on air quality

PM Monitoring Sites in Ireland

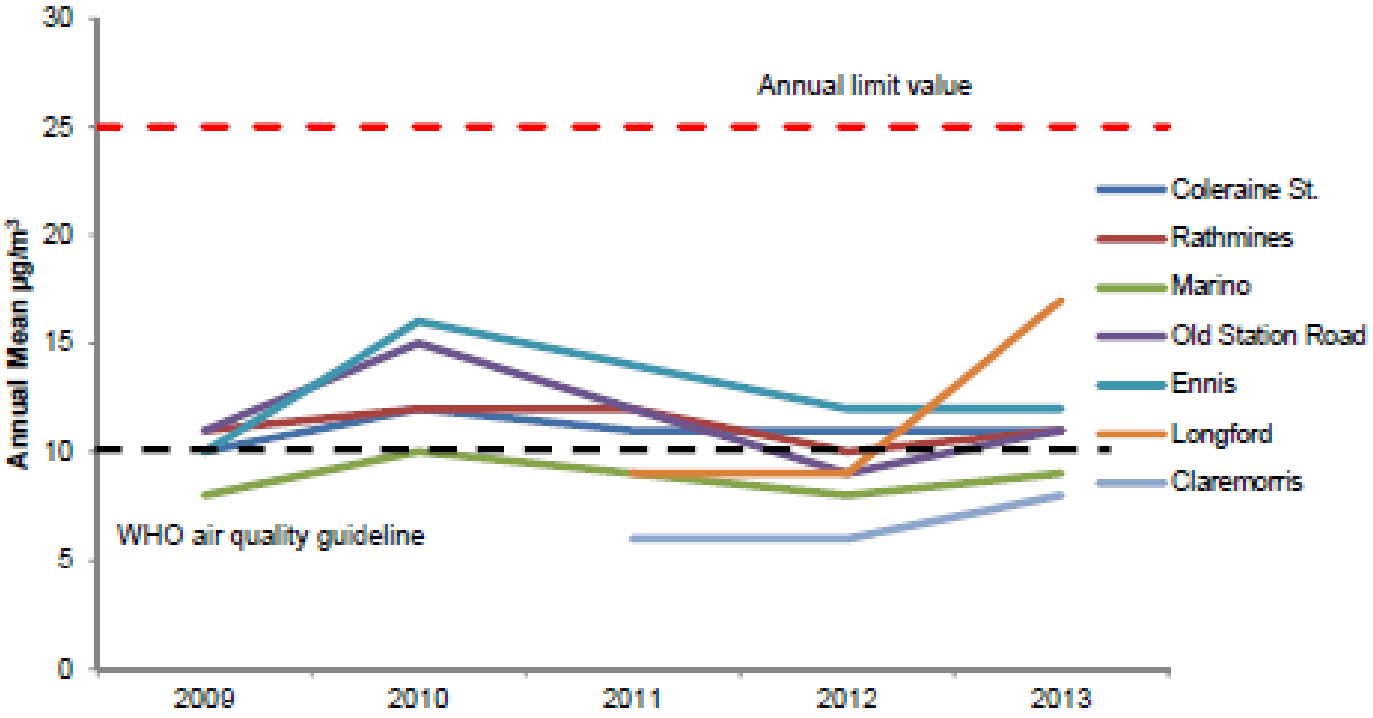


EPA Air Quality Report 2013

PM monitored at many locations

Daily average values for concentration ($\mu g/m^3$)

EPA Air Quality Report 2013



- Air Quality in Ireland is generally good
- $PM_{2.5}$ levels are below EU annual limit value <u>BUT</u> above WHO Clear Air Quality Guidelines

WHO Report for Europe 2013

Exposure to $PM_{2.5}$ reduces the average life expectancy in Europe by 9 months

There is no evidence of a safe level of exposure to PM

Clear evidence of health benefits if PM levels are reduced

Reducing PM levels

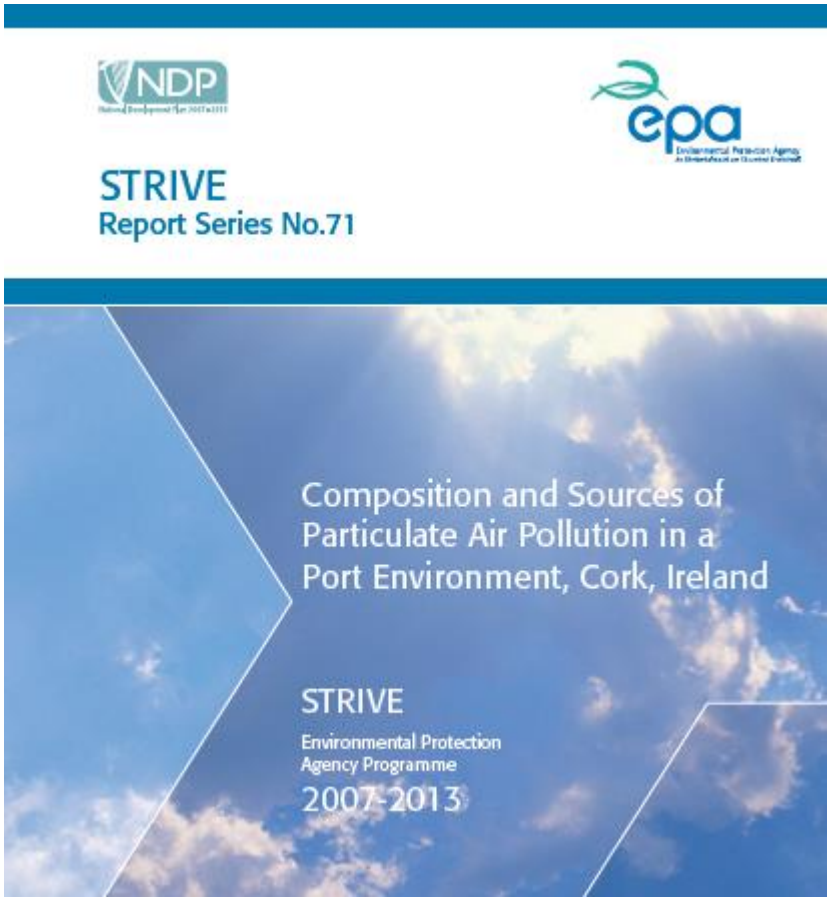
We need to know AND quantify the sources

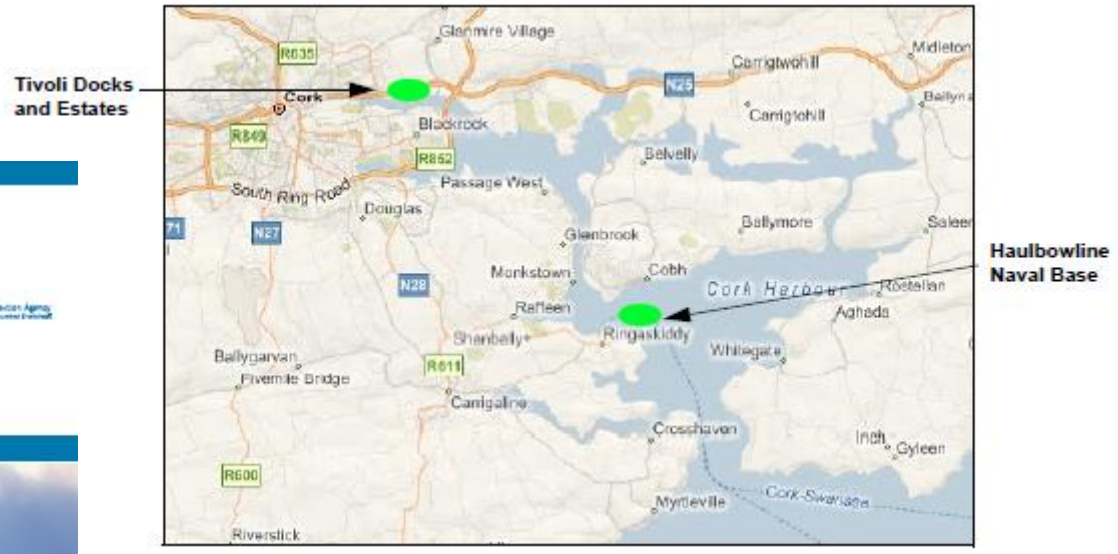
- How much PM is from traffic?
- How much PM is from solid fuel burning?
- How much PM is from other sources?
- How do the emissions from these sources vary during the day and by season?

Detailed measurements of the PM are required

- Size, concentration and chemical composition at a HIGH-TIME resolution
- Source Apportionment Modelling

Case Study: Cork Harbour

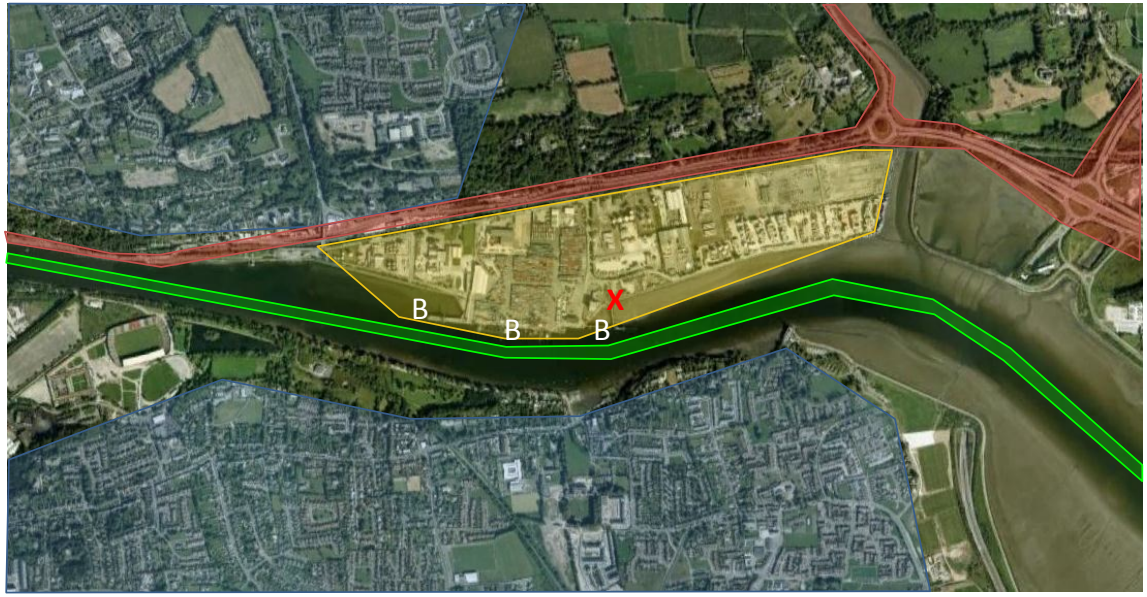


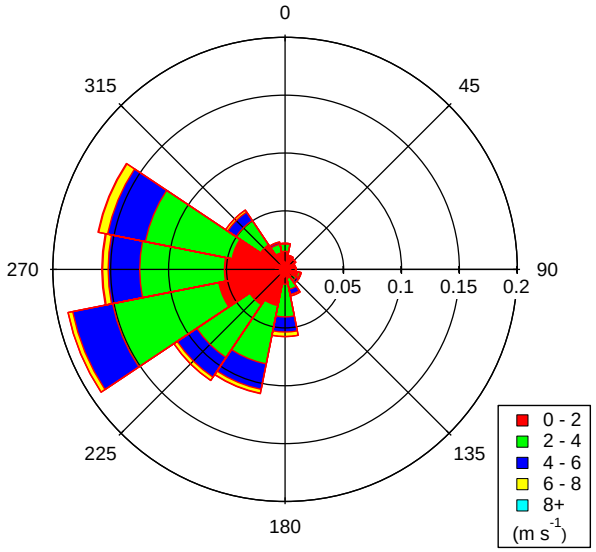


- Long-term (1 year) monitoring campaigns
- Intensive (1 month) measurement campaigns

Intensive Measurement Campaign

Tivoli Docks August 2008 and February 2009





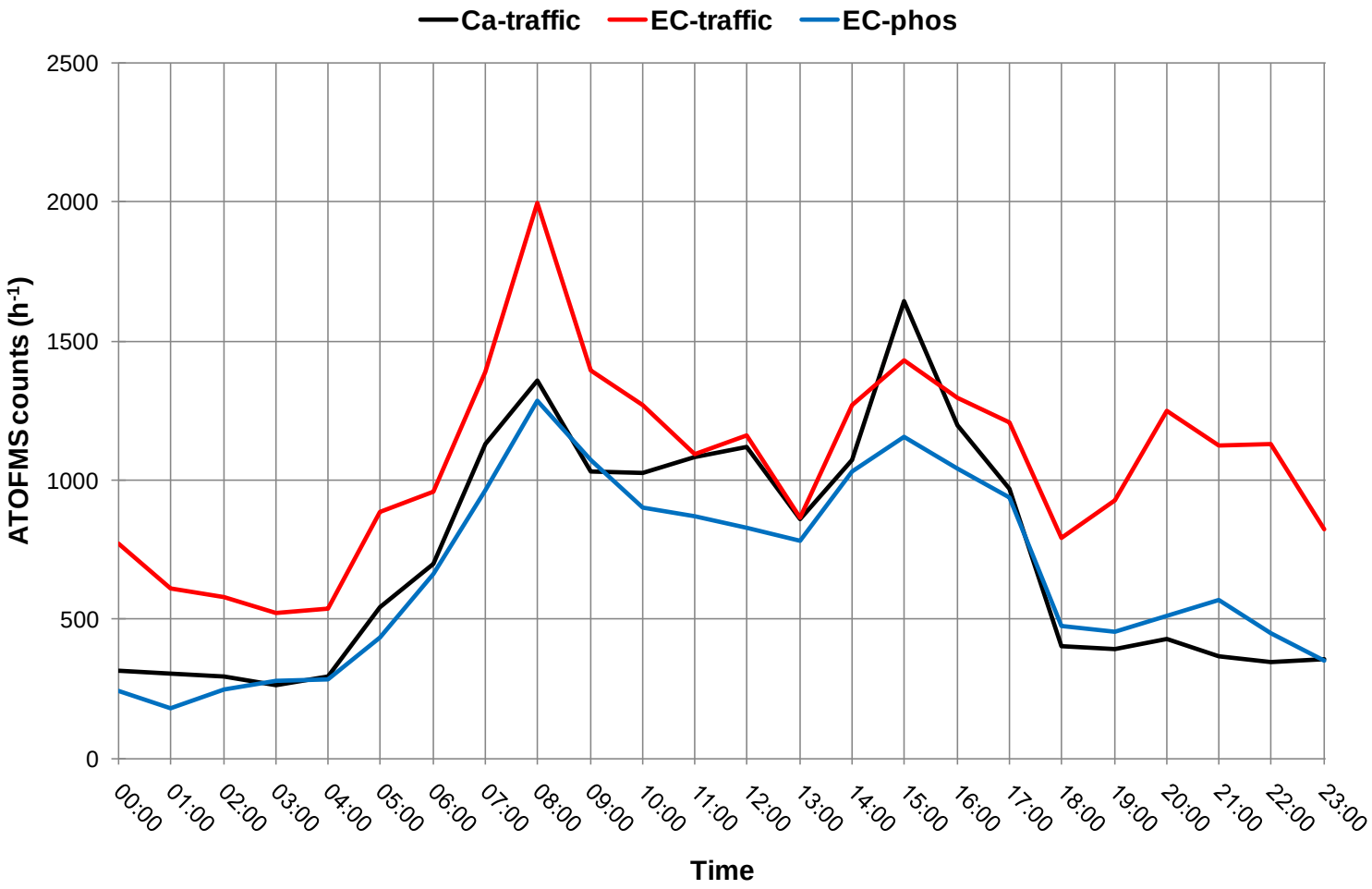
Healy et al., Atmospheric Chemistry and Physics 2010

Intensive Measurement Campaign

Tivoli Docks August 2008 and February 2009

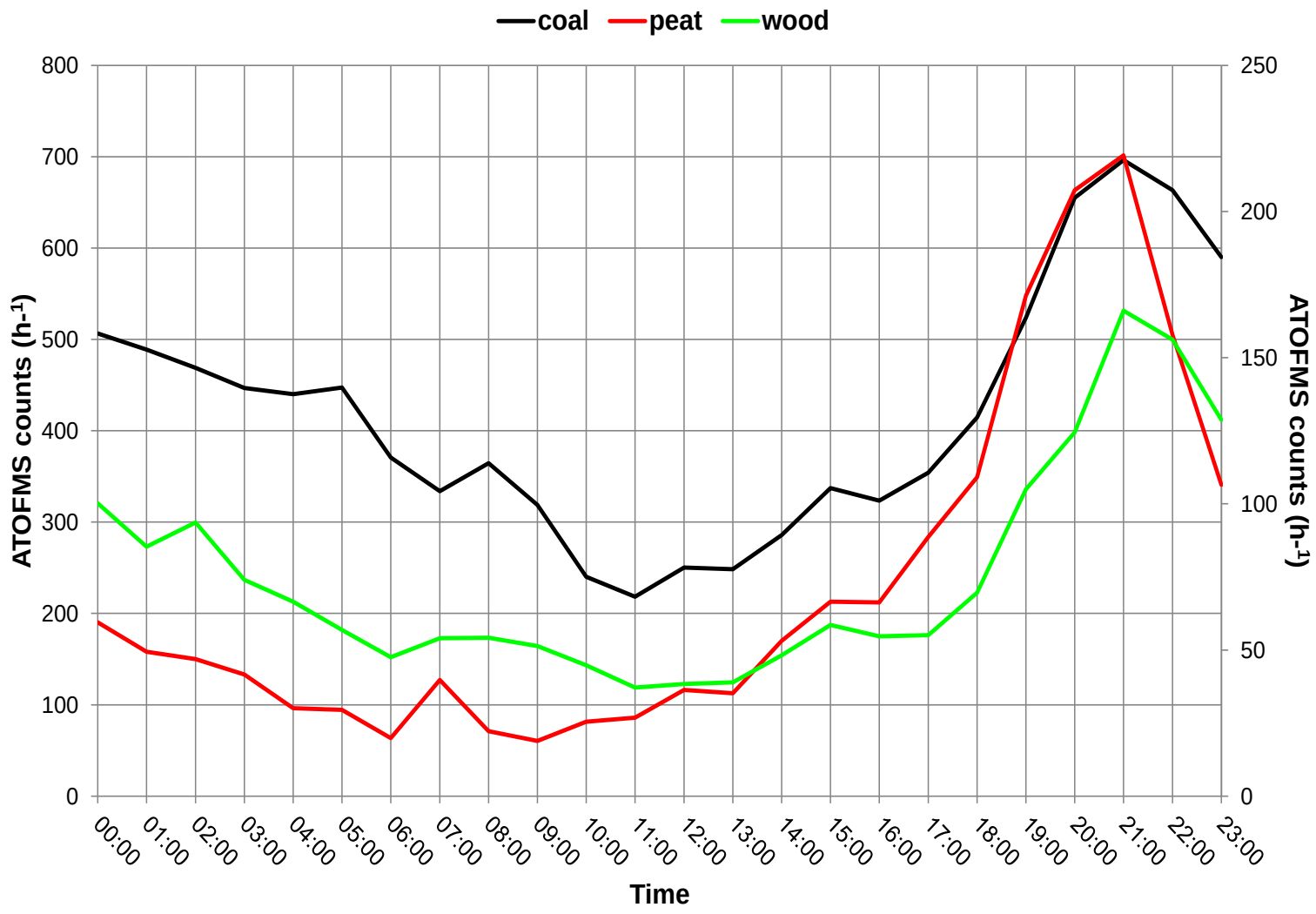
A range of state-of-the-art instruments deployed for *On-line* monitoring of particle mass, size, number and chemical composition in *real-time*

Sources in Cork Harbour: Vehicular Traffic



Healy et al., Atmospheric Chemistry and Physics 2010

Sources in Cork Harbour: Solid Fuel Combustion



Healy et al., Atmospheric Chemistry and Physics 2010

Source Apportionment of PM

- State-of-the-art analytical techniques used to apportion PM mass

	PM2.5 average ($\mu g/m^3$)	Solid Fuel Burning %	Traffic %	Other Local Sources %	Regional Sources %
August 2008	9.7	5	23	24	26
February 2009	16.2	50	19	21	10

Dall'Osto et al., Atmospheric Chemistry and Physics, 2013

Kourtchev et al., Science of the Total Environment, 2011

Healy et al., Atmospheric Chemistry and Physics, 2010

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epa
Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Source Apportionment of Particulate Matter in Urban and Rural Residential Areas of Ireland (SAPPHIRE)

1 April 2014 – 31 March 2016

http://www.ucc.ie/en/crac/research/sapphire/

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SAPPHIRE Objectives

- To quantify the major sources of $PM_{2.5}$ (especially solid fuel burning) in small towns

- To provide policy makers with relevant scientific information to support development of effective strategies for reducing particulate pollution

Monitoring Location: Killarney

- A small rural town with no natural gas, outside of the smoky coal ban, indicating high solid fuel usage
- Site is located on the grounds of the Community Hospital, nearby to a residential area

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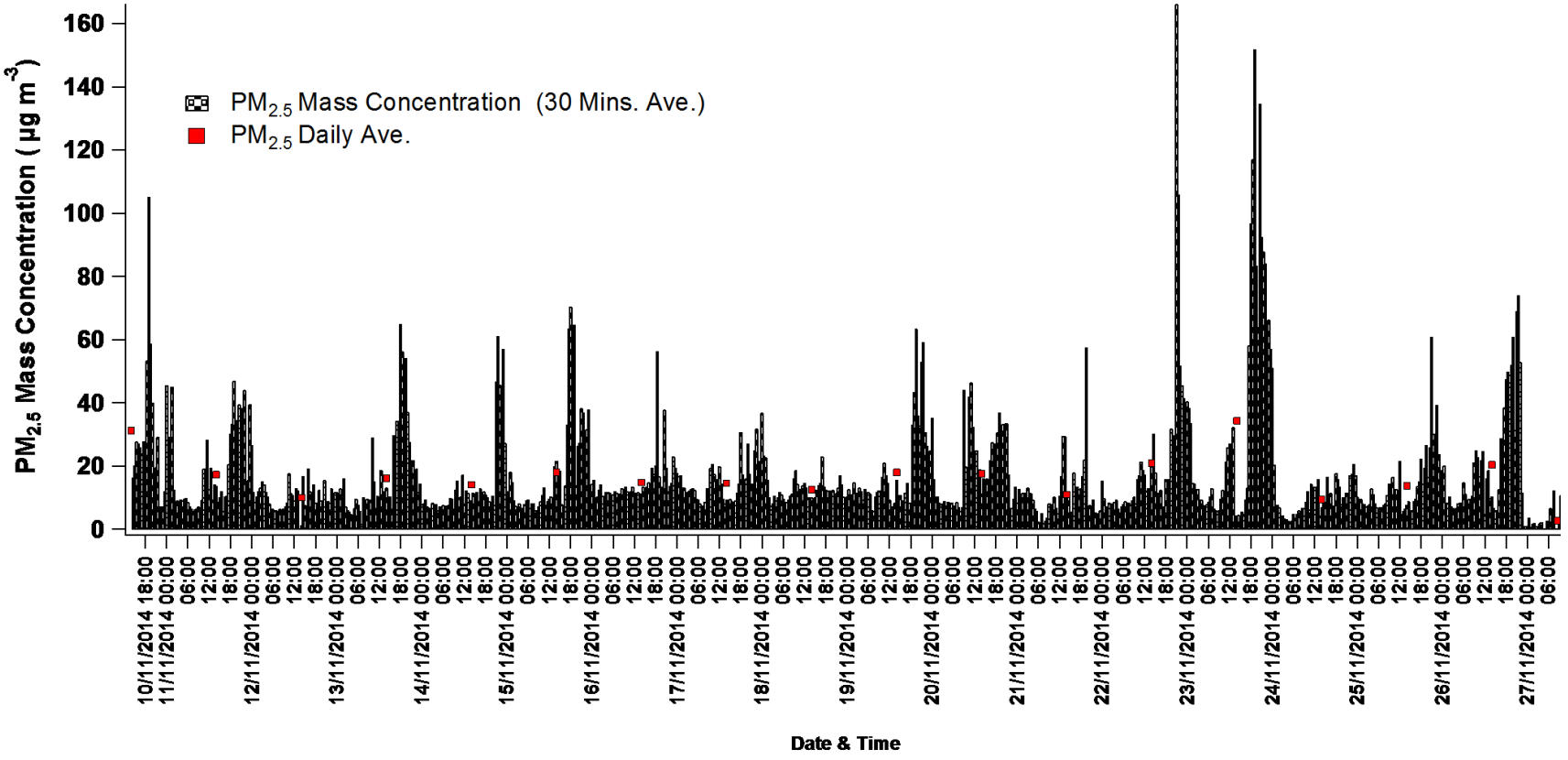
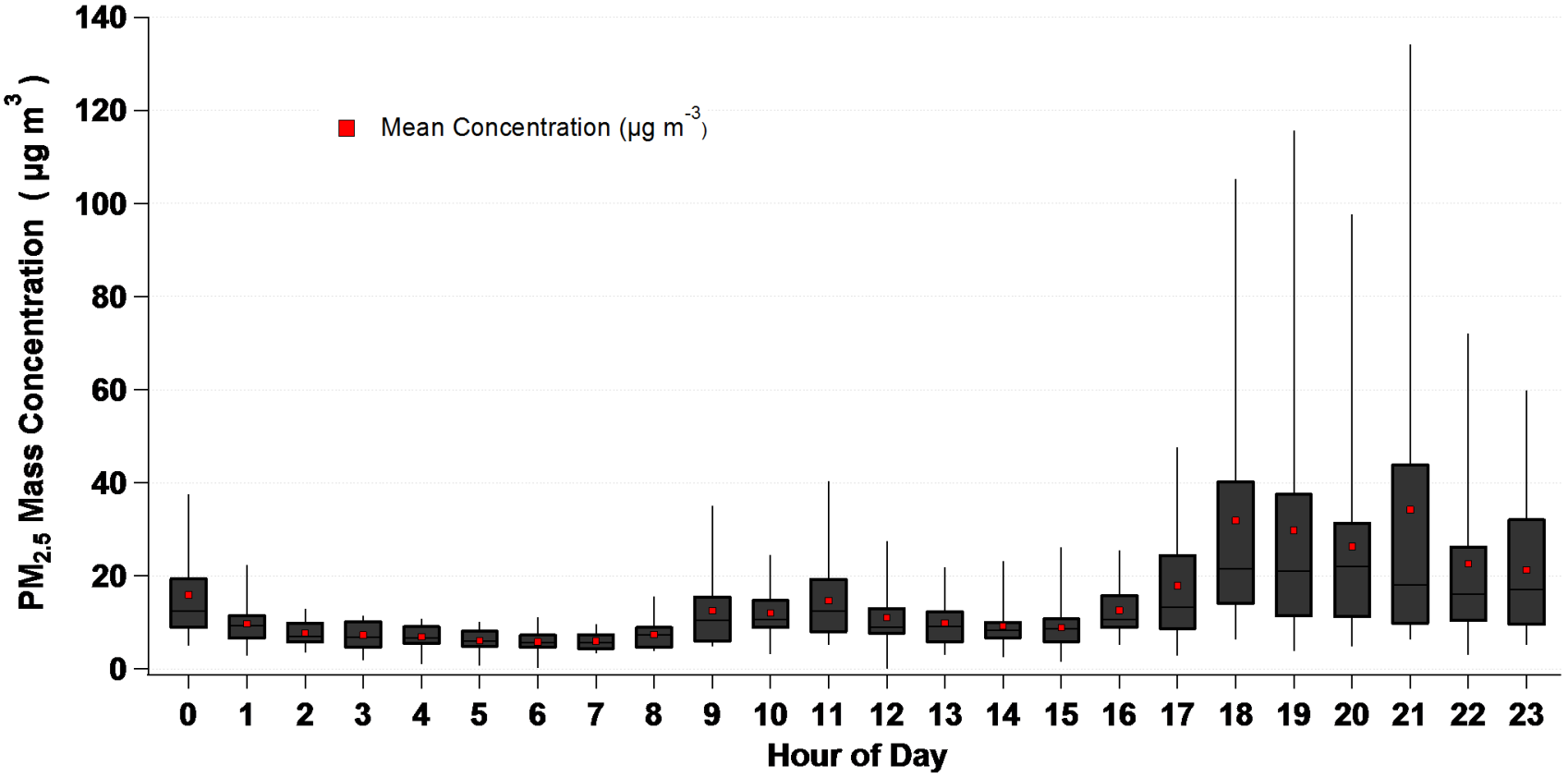
Killarney: $PM_{2.5}$ Trend



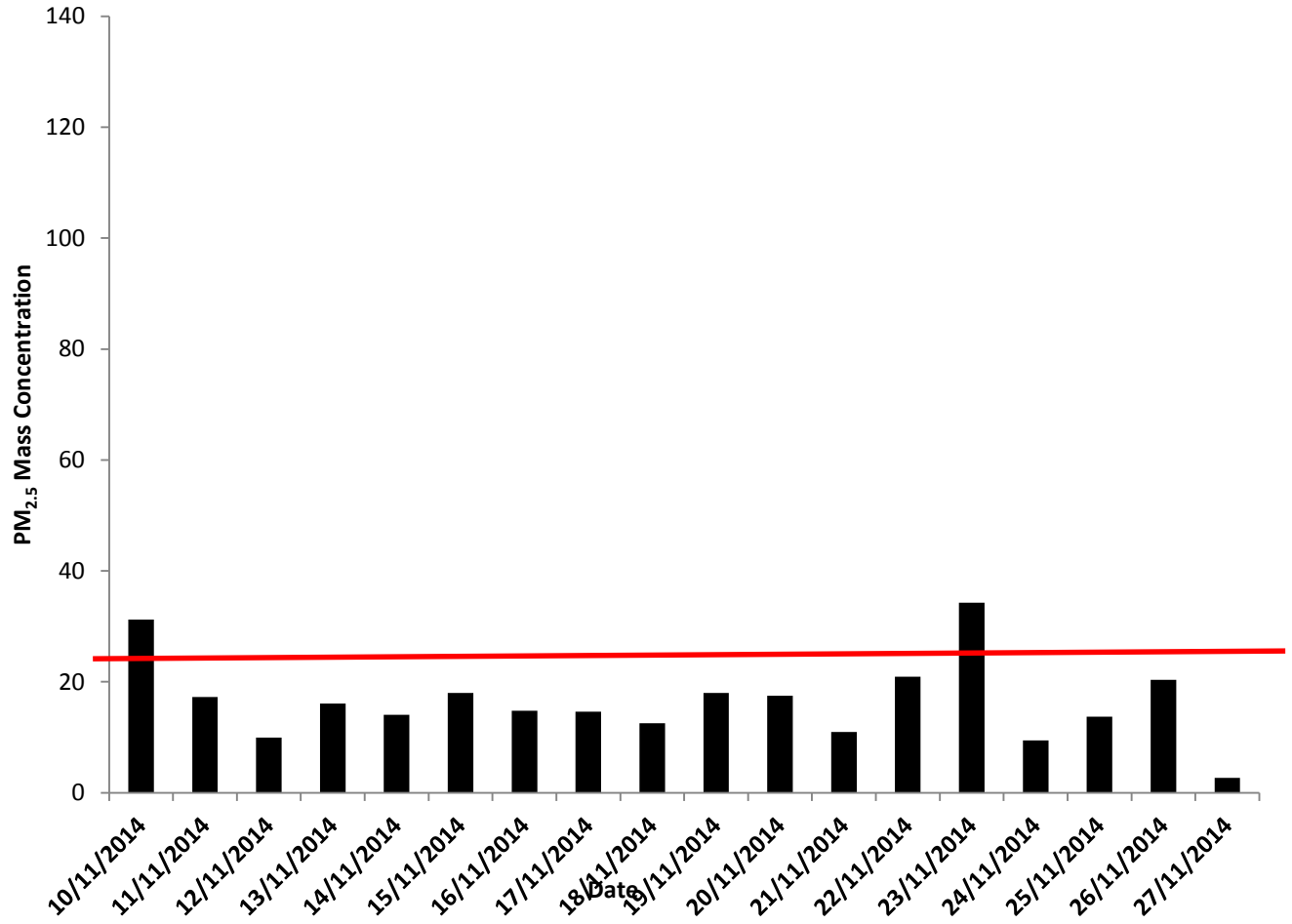
- Very large increase during evening and night, consistent with solid fuel burning

24 hours of $PM_{2.5}$ in Killarney



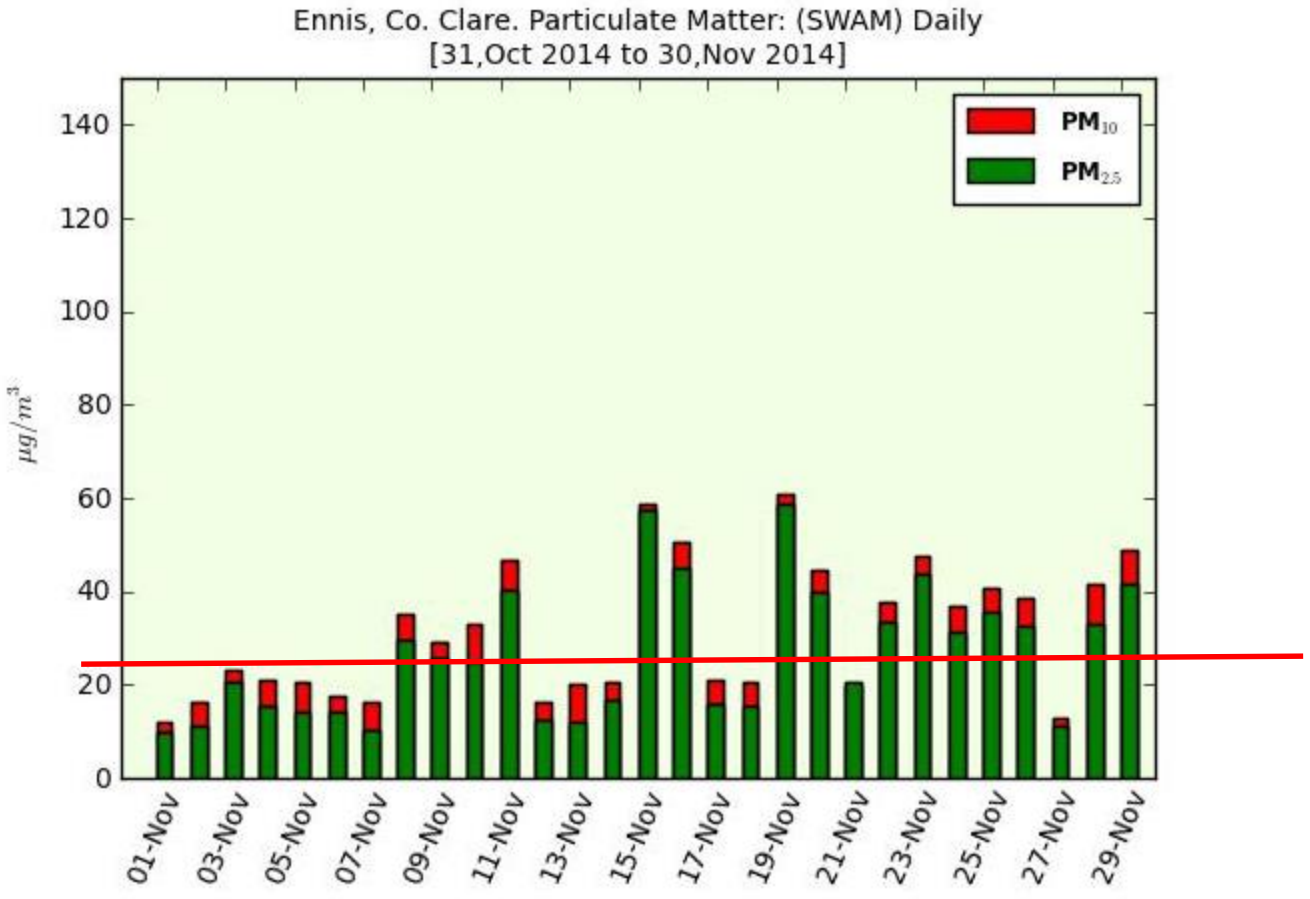
- Hourly averages for monitoring period
- 6-8 hours of elevated $PM_{2.5}$

Killarney: Daily Average $PM_{2.5}$



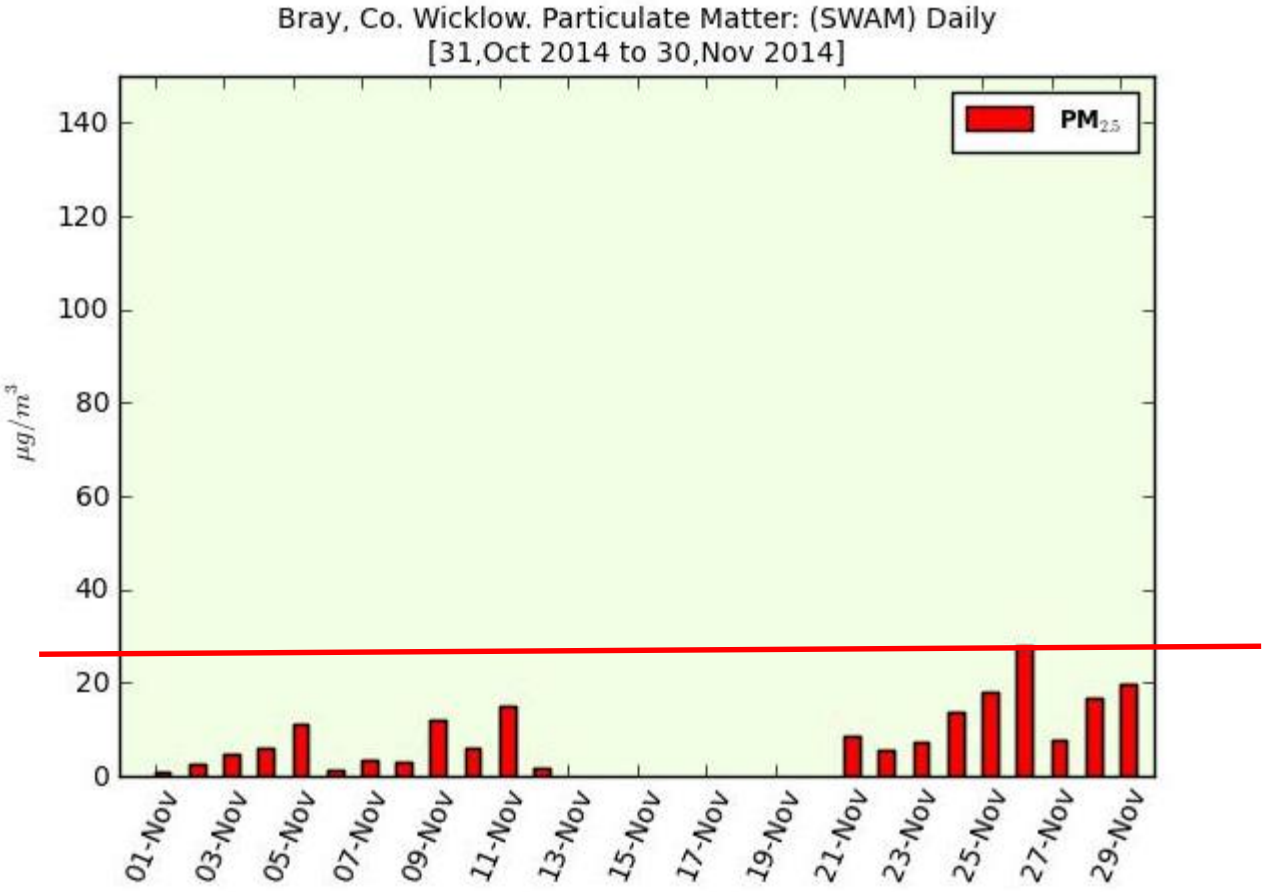
- Two days where the DAILY average mass of $PM_{2.5}$ exceeded the Annual Limit value of 25 $\mu g/m^3$

Particulate Matter Measured at Ennis



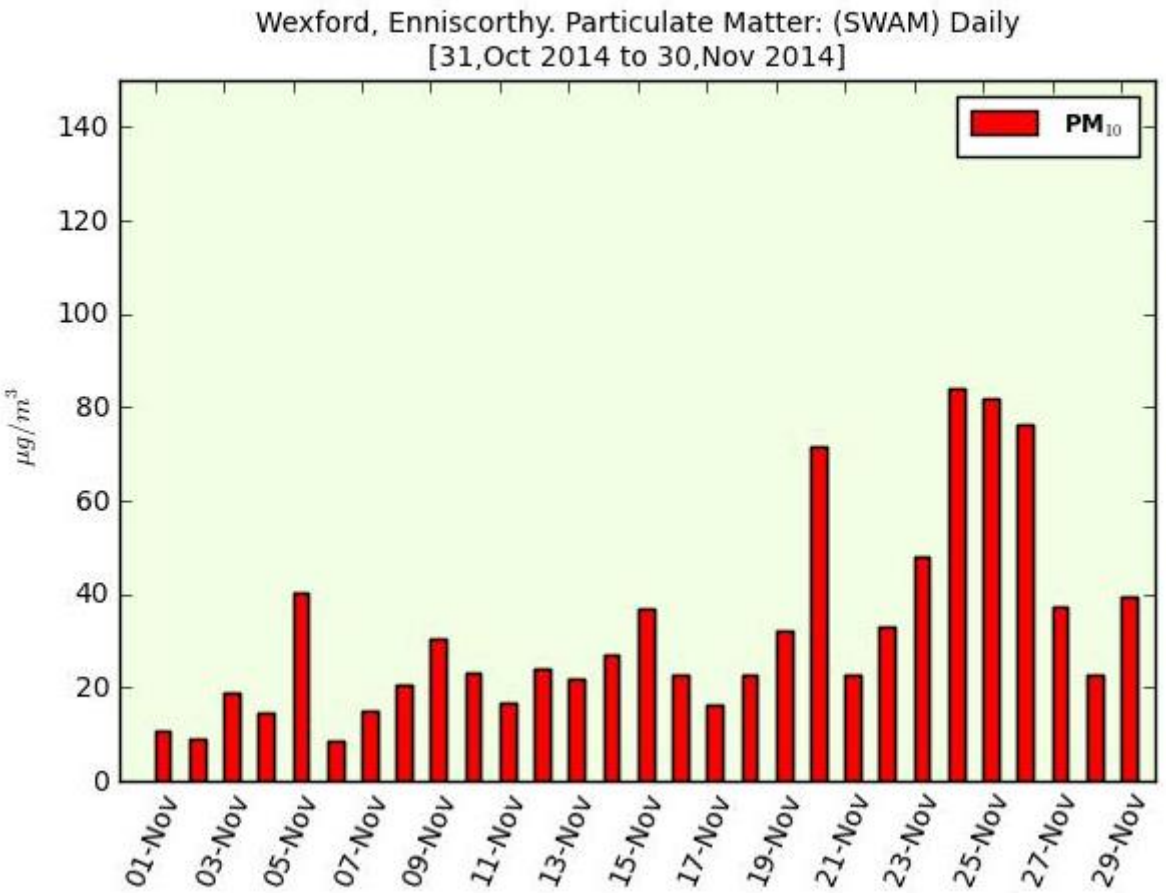
- More than 12 days where the DAILY average mass of $PM_{2.5}$ exceeded the Annual Limit value of 25 $\mu g/m^3$

Particulate Matter Measured at Bray



- No days where the DAILY average mass of $PM_{2.5}$ exceeded the Annual Limit value of 25 $\mu g/m^3$

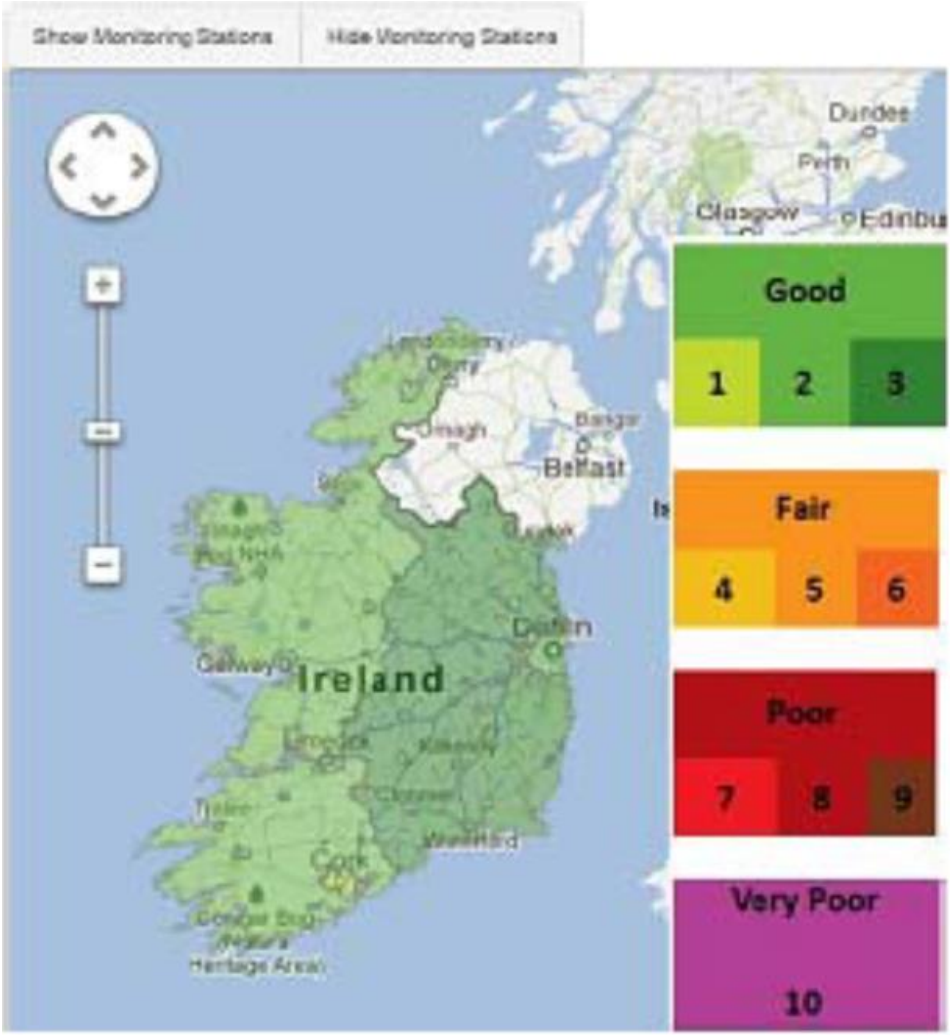
Particulate Matter levels at Enniscorthy



- High levels of PM_{10}
- We will start monitoring $PM_{2.5}$ in January 2015

Summary and Perspectives

- Air quality in Ireland is generally good



EPA Air Quality Report 2013

Air Quality Index For Health

www.airquality.epa.ie

@EPAAir Quality

Summary and Perspectives

- Air quality in Ireland is generally good
- Smoky Coal ban has reduced pollution levels in many towns and cities
- BUT particulate pollution remains a problem in several areas, especially in small towns during winter months
- At least 50% of wintertime $PM_{2.5}$ in Cork city is attributed to solid fuel burning
- Similar source apportionment studies for small towns are in progress

A Hot Topic!

thejournal.ie
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BUSINESS ETC THE SCORE THE DAI

Phil Hogan: I want smoky coal to be banned within the next 3 years

Smoky coal is already banned in 27 towns and cities around the country, but now the Minister for the Environment says he wants to see it nationwide.

MINISTER FOR THE Environment Phil Hogan has said he wants to see a ban on smoky coal throughout the country within the next 3 years.

Image: Sasko Lazarov/Photocall Ireland

Smoky coal was banned in seven more towns around the country – Greystones, Letterkenny, Mullingar, Navan, Newbridge, Portlaoise and Wicklow – on 1 May, bringing to 27 the total number of towns and cities which have already banned the fuel.

The government has brought in a number of measures to discourage people from using fossil fuels, including a carbon tax on solid fuels which began last Wednesday.

Phil Hogan pointed to research which found that the smoky coal ban resulted in up to 350 fewer deaths every winter since being introduced in Dublin in 1990. The ban was in response to severe episodes of winter smog which resulted from the widespread use of smoky coal.

"The health benefits in areas where the ban is already in place are well documented and an all-Ireland ban is the next phase I anticipate in this area," he said. "The burning of solid fuel for residential heating makes a disproportionate contribution to air pollution".

> The ban has clearly been effective in reducing air pollution with proven benefits for human health and our environment and has led to improved quality of life in cities and towns where the ban applies.

> I am convinced of the health benefits from an all Ireland ban on smoky coal and these benefits should be extended to all citizens through such a ban.

He made the comments as he announced a major new study which will measure air pollution caused by people burning solid fuel – such as coal and peat briquettes – in their homes.

The study, which is a joint piece of research between Northern Ireland and the Republic, will look at possible policy options to reduce pollution from solid fuel as well as the potential environmental and human health benefits.

"North-South cooperation in this area provides an opportunity to further improve air quality for the citizens of this island both North and South," Phil Hogan said.

Read: Bad news for fossil fuels: cost of coal and briquettes to rise today >

http://www.thejournal.ie/smoky-coal-ban-ireland-pollution-phil-hogan-897056-May2013/

Summary and Perspectives

- YES…from a health and environment perspective it makes sense to support a nationwide ban on smoky coal
- But, how well will it work, particularly in areas where gas is not available?
- Peat and Wood also produce similar amounts of $PM_{2.5}$
- A ban on smoky coal may not be sufficient
- Other strategies should also be investigated…

e.g. Switch to cleaner burning technologies (stoves etc.)

It is not just WHAT fuel we burn, but HOW we burn it

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