

Irish Heart Foundation submission on the Clean Air Strategy 2022

Introduction

There is simply no safe level of exposure to air pollution for human healthⁱ. For years, the true extent of harm inflicted has been largely unknown or underestimated. That is, until relatively recently however, as more and more evidence reveal the catastrophic affect polluted air has on nearly every organ in our bodiesⁱⁱ.

This risk is underlined by WHO's recent update of its Global Air Quality Guidelines (AQGs) which showed that even low concentrations of pollutants damages human health, and that almost the entire global population (99%) breathes air that exceeds these limits, threatening their healthⁱⁱⁱ.

The Irish Heart Foundation welcomes this public consultation on the draft Clean Air Strategy as it offers a chance for every citizen and stakeholder to call on the government to act upon the evidence and introduce the necessary transformative measures that will bring about clean air for all.

Every individual residing on this island has a right to breathe clean air as it is essential for quality of life. However, air pollution undermines this by debilitating all forms of life and has been deemed the largest environmental risk to public health by both the WHO^{iv} and the European Environmental Agency (EEA)^v.

While Ireland's air quality can be considered generally good due to our lack of heavy industry and large cities, there are deeply concerning localised issues in our cities, towns, and villages. According to the EEA, air pollution claims 1,410 lives annually, 1,300 of which are due to fine particulate matter (PM2.5)^{vi}.

While the strategic priorities set out in the public consultation are promising, the key goal for the Clean Air Strategy must be the protection and preservation of life from the dangers of air pollution. In particular, the health of those most vulnerable to unclean air, such as those living with chronic illnesses, the elderly, children, pregnant women, and their foetus.

We believe this Clean Air Strategy presents an opportunity for the government to set Ireland as a global leader in delivering clean air to the benefit of public and planetary health. In this

submission, we will put forward recommendations that we believe will meet that ambition to best help protect the public from the dangers of air pollution.

Updated WHO guidelines

As stated earlier, there is simply no safe level of exposure to air pollution for human health and this was underscored in September of last year when the WHO tightened its global air quality guidelines (AQGs). These new levels indicate the safety threshold necessary to protect public health worldwide^{vii}. Since its last update of the AQGs in 2005, there has been a marked increase of evidence showing the truly devastating impact of air pollution on health.

For decades, the genuine damage of polluted air on health was severely underestimated. Now however, the scientific evidence is overwhelming and points to only one conclusion. Even at low concentrations, air pollution inflicts enormous harm to nearly every organ of our body.

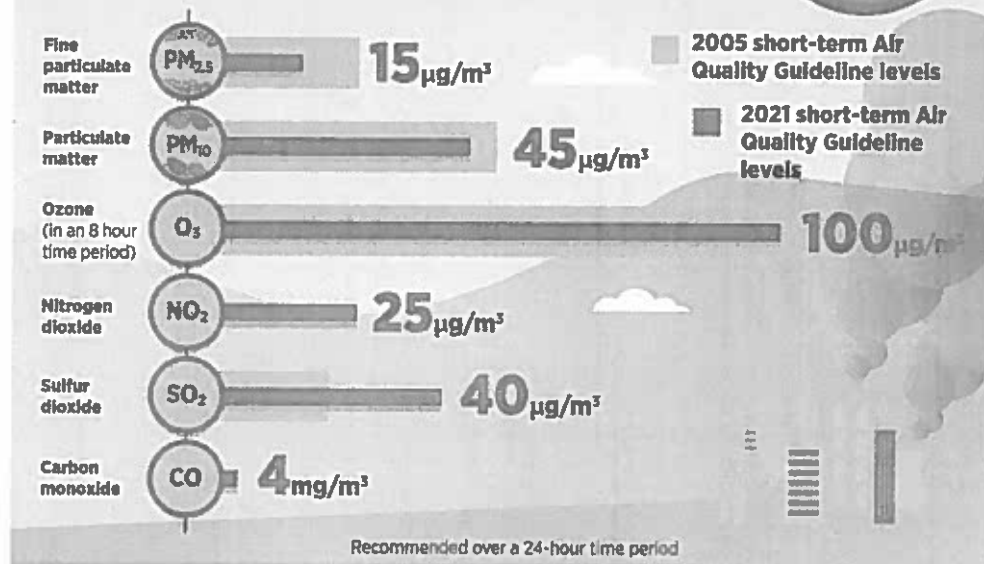
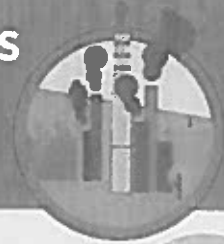
For that reason, the WHO significantly reduced its standards for the six pollutants: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide (NO₂), sulphur dioxide, and carbon monoxide. As seen below, for both long-term and short-term air pollution exposure, the WHO has tightened its limit for safe levels of exposure^{ix}.

Despite the WHO setting stricter targets, Ireland continues to abide by the EU air quality standards which permit higher levels of air pollution even though the scientific evidence indicates that these levels, deemed "safe" by the EU, are harmful. In fact, for small particulate pollution (PM10 and PM2.5), the WHO has found that there are health impacts even at tiny concentrations – indeed, it states that no threshold has been identified below which no damage to health is observed^x.

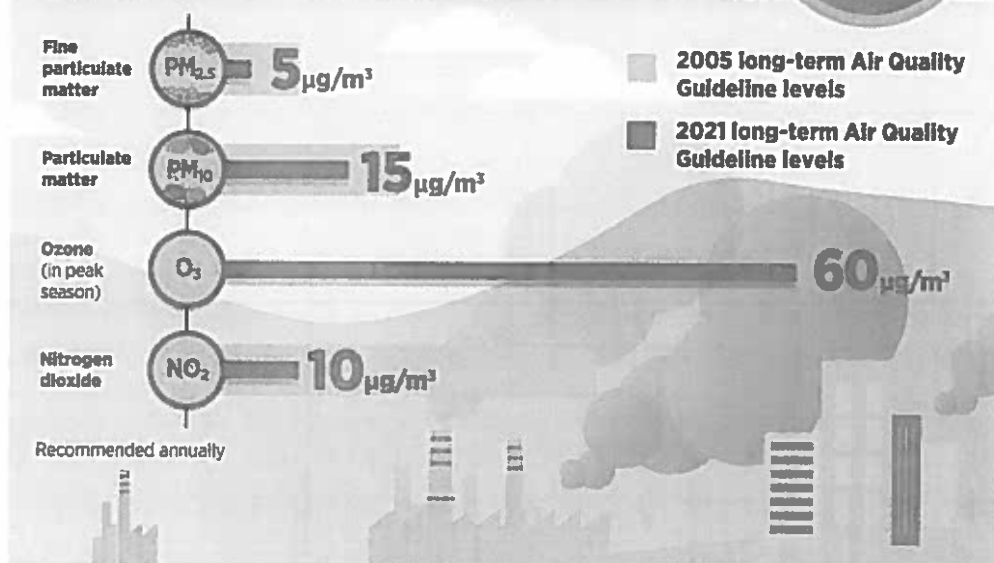
Although the EU is currently revising its air quality standards through the European Green Deal and its Zero Pollution Action Plan, which includes the commitment to align the current EU Air Quality Standards closer with WHO guidelines, this may be several years away to the detriment of human and planetary health.

It is the position of the Irish Heart Foundation that the Irish government must be much more ambitious and adopt the WHO AQGs as legally binding measures without delay.

NEW WHO AIR QUALITY GUIDELINES SET CLEAR GOALS TO HELP IMPROVE AIR QUALITY FOR ALL



WHO AIR QUALITY GUIDELINE LEVELS ARE LOWER THAN 15 YEARS AGO



Health impact of air pollution

Air pollution is now considered to be the world's largest environmental health threat, accounting for 7 million deaths globally every year^{xi}. Here in Ireland, it accounts for 1,410 premature deaths annually through stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma.

As the national heart and stroke charity, our greatest concern is of the cardiovascular impact of air pollution. According to the WHO, ischaemic heart disease and stroke accounts for 80% of all outdoor air pollution-caused deaths and 60% of all indoor air pollution-caused deaths^{xii}.

The most health-harming air pollutant identified is particulate matter (PM10 and specifically PM2.5), which are so small that 500 particles could sit side by side in the width of a human hair^{xiii}. It is particularly dangerous because not only can it get into our respiratory systems while carrying cancer-causing chemicals, it can also enter our arteries causing damage that clogs up the arteries causing stroke or heart disease. The smallest PM can circulate in our blood stream and reach our brains.

PM2.5 within the blood vessels restricts movement, resulting in higher blood pressure which increases the risk of heart attack and stroke^{xiv}. Exposure to PM2.5 over a few hours to weeks can trigger cardiovascular disease related mortality and nonfatal events; longer-term exposure increases the risk for cardiovascular mortality to an even greater extent^{xv}.

Research has found that air pollution in winter months due to higher levels of PM_{2.5} from solid fuel burning of coal, peat, and wood, was associated with increased hospitalisations for all strokes in Dublin^{xvi}, while a further study suggested that even slight changes in the level of air quality in Dublin can impact the number of hospital admissions for individuals with heart failure, as well as asthma and chronic obstructive airways disease^{xvii}.

Moreover, research from the British Heart Foundation identified that PM_{2.5} can exacerbate existing heart conditions, with exposure to elevated levels of PM_{2.5} increasing the risk of a heart attack or stroke in vulnerable groups such as the elderly within 24 hours^{xviii}.

Worrying, recently published research has discovered microplastic pollution lodged deep in the lungs of living people for the first time due to breathing in polluted air. As a governments highest concern is safeguarding its citizens, the clean air strategy must put the protection of public health as its utmost priority.

Consultation Questions

Please find below our responses to the specific questions set out in the public consultation.

1. Do you agree with the five strategic priorities outlined in the draft strategy?

The five strategic priorities contain many positive actions that are welcome. Yet, we believe there can be improvements and below, we will set out where each strategic priority can be enhanced. To begin with, it is disappointing that the actions set out within the priorities make no mention of health as this should be the overarching objective. Accordingly, it is imperative that public health & wellbeing is incorporated into the strategic priorities.

Strategic priority one - Ensure continuous improvements in air quality across the country. Above all, priority one mentioned above must be amended to include 'for the benefit of public health'. Specifically, the action 'Reduce the number of premature deaths and years lost to air pollution' must be added to the associated list of key actions.

According to the EEA, air pollution is attributable to 1,410 premature deaths in Ireland every year and 17, 560 years of life lost (YLL)^{xix}. As such, the clean air strategy must be actioned to target reducing these figures and ultimately eliminating any premature deaths or years lost to polluted air. Therefore, measures that can save lives from premature death due to polluted air must be fast-tracked to protect public health as part of this measure.

Research shows that 1,300 of the 1,410 annual premature deaths are due to PM2.5. The dominant source of this pollutant is residential home heating (55%) followed by vehicle emissions (14%). For the benefit of public health, the clean air strategy must prioritise the transition away from solid fuels (smoky coal, smokeless coal, peat briquettes, sod turf, and both dry and wet wood) towards sustainable forms of home heating (electric, heat pumps, etc), expediate the National Retrofitting plan targeting those most at risk of energy poverty and accelerate the societal shift from private vehicle use to active travel and transport^{xx}.

The best means of achieving a reduction in years and lives lost to air pollution is urgently adopting the updated WHO AQGs. Currently priority one only actions to take the new limits into consideration which is simply inadequate. As stated clearly by the WHO, small particulate pollution (PM10 and PM2.5) has health impacts even at very low concentrations – indeed no threshold has been identified below which no damage to health has been observed. Therefore, it is imperative that Ireland adopts and meets the WHO AQGs as quickly as possible^{xxi}.

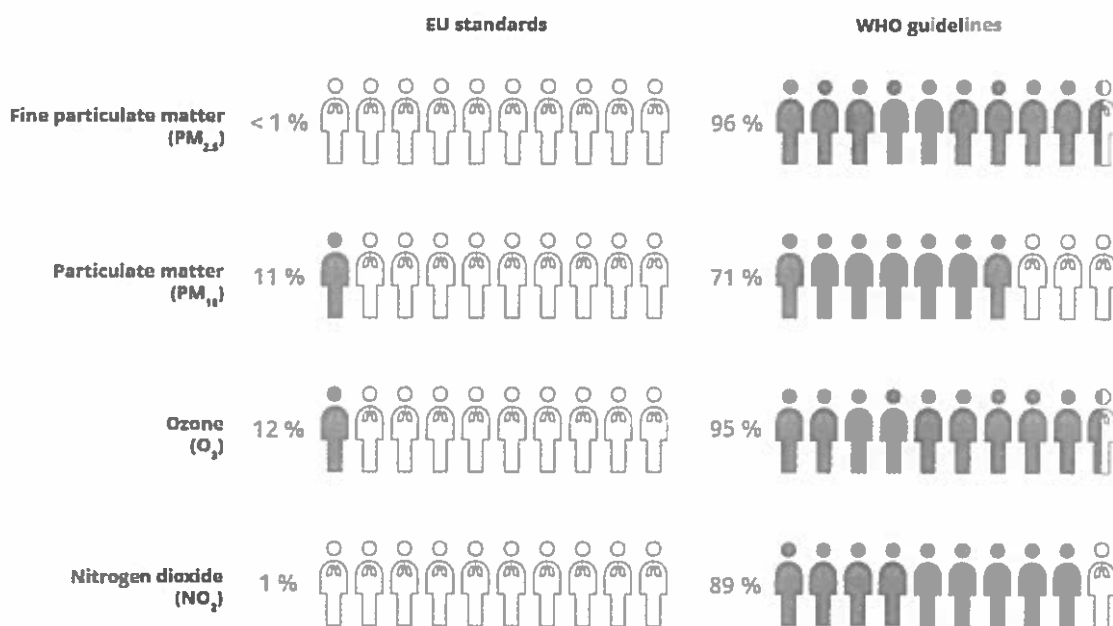
Underlining the health benefit of clean air, the WHO has estimated that adhering to the updated 2021 guidelines would cut the number of deaths globally related to PM2.5 by

almost 80%, compared with a 48% reduction under the 2005 limit^{xxii}. It could be assumed that Ireland could achieve a close-to similar reduction in premature deaths from air pollution if we met the new guidelines.

Ireland currently abides by the EU air quality limits which are much more lenient than the WHO. And although the EU is revising its standards through the European Green Deal and the Zero Pollution Action plan, which include the commitment to align the current EU limits closer with the WHO guidelines, this may take several years meaning thousands of additional lives lost prematurely to air pollution^{xxiii}.

According to the EEA, 96% of the urban population in the EU are exposed to concentrations of PM2.5, the most health-harming pollutant, above these limits^{xxiv}. With 63% of the population in Ireland living in urban areas^{xxv} and the share forecast to grow in the coming decades, we simply cannot allow the vast majority of the public to suffer from the health effects of air pollution.

Figure 1. Share of the EU urban population exposed to air pollutant concentrations above EU standards and WHO guidelines in 2020



Source^{xxvi}.

The high levels of disease and premature deaths caused by polluted air can only be reduced and ultimately eliminated if the government adopts the WHO updated limits as legally binding targets. While this may result in Ireland regularly breaching the stricter WHO limits, it would deliver several benefits, including forcing successive governments to act for better air quality, raise public awareness of both the dangers of polluted air but also the massive health benefits of clean air, and help motivate the public for the societal change required.

In that regard, priority one of the Clean Air Strategy must be amended to include an action that commits Ireland to legally adopting the WHO AQGs without delay.

Strategic priority three – Increase the evidence base

The EPA must be commended for its work in recent years in expanding its network of national monitoring stations and participating in the EU LIFE Emerald project. This will help develop the agency's range of capabilities while improving public awareness of air quality through its three-day air quality forecasts and other measures.

This priority omits two key areas of work that require further research and evidence. Firstly, better all-island data on air quality which the EPA can attain by greater co-operation with its counterpart in Northern Ireland. And secondly, improved evidence on the health impact of air pollution at a national and localised level. Strategic priority three should be amended to meet this.

There was a noticeable lack of the protection and promotion of valuable green spaces mentioned throughout the strategy. Faced with concurrent climate and biodiversity crises, high-quality green spaces can offer multiple co-benefits. We recommend that further research should investigate which green spaces would be the most effective relating to air quality and overall planetary health.

Strategic priority four - Enhance regulation and enforcement

The newly incoming solid fuel regulations will effectively ban the burning of smoky coal and wet wood nationally, whilst regulating the extraction of sod turf. As these fuels emit high level of PM when burned, the regulations will bring about enormous health benefits. Although welcome, this will leave several solid fuel types on the market for residential home heating that discharge dangerously high level of PM when burned.

For instance, in 2020 the EPA examined the emission factors of different solid fuels used in residential settings. It noted that all the solid fuels it tested, including fuels categorised as "smokeless" under Irish law, were found to generate very substantial levels of PM when tested over a complete combustion cycle^{xxvii}.

As outlined below, smokeless coal, peat briquettes, and dry wood (both soft and hard) continue to emit high levels of PM. Hence, within priority four of the clean air strategy, the phasing out of these remaining solid fuels must be actioned.

	PM EFs (g GJ ⁻¹)						
	Peat sod	Peat briquettes	Coal: bituminous	Coal: smokeless	Wood: soft	Wood: hard	Wood: wet
Max.	467	333	168	141	79	67	255
Min.	149	51	69	90	18	25	68
PM EF	296	135	115	112	46	38	152
Median	313	120	115	113	44	35	118
PM 95% CI (±)	37 (12.5%)	34 (25.3%)	24 (20.9%)	13 (11.7%)	16 (35.3%)	9 (25.1%)	115 (78.1%)
EMEP (SP)	500 (240–800) ^a				760 (360–1520) ^b		
					200 (100–400) ^c		

However, the Irish Heart Foundation acknowledges the serious issue of energy poverty that affects a significant number of households in Ireland. While ESRI research shows that the proportion of households in or at risk of energy poverty has reduced from 28% in 2015 to 17.5% in 2020^{xxviii}, this is still stubbornly high, and every effort must be made to not risk exacerbating this as a higher proportion of homes with the lowest energy ratings rely on coal, smokeless fuel, peat, wood, and solid multi-fuels.

In that regard, we welcome the references to alleviate energy poverty through measures such as the National Retrofit Plan, made throughout this strategy. In addressing the climate crisis and improving air quality, we must prioritise the protection of those most vulnerable from energy poverty with targeted support so that they can heat their homes in a clean, healthy, and sustainable manner.

Yet, the incoming solid fuel regulations will be futile if there is a lack of resourced enforcement policing the standards. The draft strategy notes the extremely low level of enforcements recorded by the EPA in its 2020 report, so it is welcome that the department will work with local authorities to ensure rigid application and prosecution of the regulations. It cannot be stressed enough that this can only be achieved if the authorities are supported by ample resources and funding.

2. Do you feel there are additional strategic priorities which should be included?

As air pollution does not respect international boundaries, it is a public health concern for everyone living on the island of Ireland regardless of jurisdiction. As such, the clean air strategy must include an additional strategic priority to address all-island air quality.

According to data compiled by the British Heart Foundation Northern Ireland, 1,800 deaths are attributed to air pollution each year on the island of Ireland. Moreover, on the whole island, 900 heart and circulatory disease deaths are attributed to the most dangerous kind

of air pollution, particulate matter. Most alarming though is that over the next decade, heart and circulatory disease deaths on the island of Ireland attributed to particulate matter air pollution could reach up to 12,000.

Evidently, a sixth strategic priority must be added to acknowledge and set actions for greater north-south government co-operation to reduce air pollution. Within this, improved north-south collaboration to increase monitoring and sharing of data on particulate matter and the relative health impacts arising from pollutants from different sources must be acted upon. This would provide a more precise all-island picture of the impact of air quality on health and the measures that will lead to the largest improvement.

To facilitate this, we ask that an action is incorporated that tasks the future work programme of the North-South Ministerial Conference (NSMC) Transport and Environment sector to prioritise tackling air pollution across the island for the benefit of public health. We want to see an intergovernmental commitment to integrate air pollution into all decision-making and to situate health and the environment as mutually reinforcing priorities.

Furthermore, we would welcome the commissioning of a new report from the NSMC with a widening of scope from the 2016 report on all-island air quality to include the investigation of pollution produced from transport and the measures that can be taken to reduce this, a key recommendation in the 2016 report.

We would particularly appreciate greater north-south collaboration to increase the monitoring and sharing of data on fine particulate matter and the relative health impacts of pollutants from different sources. This should build on priority three – Increase the evidence base – to provide a more accurate picture of the impact of air quality on health on an all-island basis and the collective measures from both jurisdictions that will bring about the largest improvement.

It was encouraging to see the National Economic and Social Council, a government backed think-tank, identifying climate change and biodiversity loss as a “clear and urgent platform” that requires pressing ambitious action across the entire island of Ireland. As air pollution is a key driver of global warming and biodiversity loss, the government must take heed of this recommendation and prioritise all-island action^{xxix}.

Finally, an all-island strategic priority within the clean air strategy must include an action to pursue a joint north-south ban on the domestic burning of the worst solid fuels including bituminous coal, peat, and wet wood and regulation that commits to the phasing out the remaining solid fuels from the market.

However, in recognition of the considerable level of energy poverty in both the Republic and Northern Ireland, any commitment to reducing the use of solid fuel island-wide must include a commitment to provide the necessary support for households at risk of energy poverty to transition to less polluting domestic heating and the prioritisation of such homes for renovation under a joint all-island retrofitting scheme.

3. How can pollutant emissions data be better used to inform actions at local and national levels?

The quantity and quality of real-time localised air quality data continues to improve as the EPA expands its network of monitoring stations across the country. To better utilise this accurate data at a local level, the EPA must be resourced to provide each local authority and their respective elected county councillors with a monthly and annual regional air quality report of their jurisdictions, highlighting air pollution black spots and measures that should be implemented to address such localised issues.

The Climate Action and Low Carbon Development Bill 2020 mandated that every local authority develop a climate action plan. To build on this, each local authority should be required to benchmark its respective plan against their annual air quality reports provided by the EPA so that measures for improvement can be identified and actioned.

On a national level, the new carbon budgets will set limits on greenhouse gas emissions to cover three sequential five-year periods. Overall, the economy-wide carbon budgets will be divided into sectoral emissions ceilings and the range of emissions reductions these sectors must meet^{xxx}.

To further this and better utilise data at a national level, each sectoral department within the government should be provided with monthly and annual updates of its sectoral emissions. This should detail the types and quantity of pollutants being emitted, the potential health implications, and the required measures to reduce such emissions.

4. What do you feel are the most important current and emerging air quality issues in Ireland that require further research?

As evidenced throughout this report and by the WHO's recent update of its AQGs, we have grossly underestimated the health risk of air pollution for decades. Although the body of evidence has improved in recent years, most of the research conducted analyses the impact

at a global or EU level. To remedy that, Ireland would greatly benefit from further research into the health impact of air pollution at a national and localised level.

Moreover, it would be valuable to have additional in-depth research on the health impact of air pollution on specific population groups in Ireland such as those living with chronic diseases, the elderly, pregnant women, and outdoor workers, amongst others, and measures that would reduce their exposure to polluted air.

Although the updated solid fuel regulations will effectively remove some of the worst solid fuels from the marketplace, dry wood and smokeless coal will continue to be available for residential heating. Given that these two fuel types emit high levels of PM_{2.5}, to the detriment of human health, further research is needed into levels of wood and smokeless coal burning at a national and local level.

For example, government data from the UK showed that wood burning in homes there produces more small particle pollution than all road traffic in the UK^{xxxi}. From 2010 to 2020, wood burning rose by a third in the UK and staggeringly it all comes from 8% of homes, even though 95% of which have other sources of heating. This may be the case also for Ireland and thus merits further research.

At a local level, particularly in our major urban cities and towns, it would be useful to conduct additional research into the levels of NO₂ and the measures to reduce this pollutant, such as restricting road to cars to facilitate higher numbers walking and cycling. The clean air strategy should support each local authority to conduct research of this kind for all the urban areas in their jurisdiction.

Ireland has a significantly high level of ammonia (NH₃) due to our large agriculture industry which accounts for over 99% of all ammonia emissions within the State. According to the clean air strategy, ammonia can react with other pollutants in the air to form secondary particulate matter. A number of European studies have shown that in some areas, at particular times of the year, more than 50% of particulate matter is a result of reactions in the atmosphere involving ammonia. Similar research on an Irish level, which has not been conducted yet, should be commissioned.

Finally, to mitigate the health risk of air pollution, greater research is required into the measures that could be implemented at a national and localised level to reduce levels of polluted air for the benefit of public health. As there is no safe level of exposure to air pollution for human health, there must be stronger emphasis and resources provided to mitigation rather than adaptation. The human body can simply not adapt to dirty air.

5. How can we better increase awareness of the health impact of air pollution?

Healthcare professionals such as nurses and doctors, can play a vital role in improving awareness of the health impacts of air pollution. Highly respected in society, both patients and the public at large listen and act upon their advice. For example, ahead of COP 26 in Glasgow, an open letter signed by 600 organisations representing 46 million nurses, doctors and health workers worldwide was delivered to every delegate warning them that the climate crisis is the single biggest health threat facing humanity and calls on world leaders to deliver on climate action^{xxxii}.

To increase awareness, healthcare professionals here in Ireland must be given the tools, training, and resources to incorporate environmental health into their patient facing practice. As strategic priority two commits to ensuring the integration of clean air considerations into policy developments across government, the department of health, in conjunction with the HSE, and the department of education, must be directed to integrate environmental health into the medical training of all healthcare professionals.

While there currently exists optional courses and study days that healthcare professionals can engage in, there is no official mandatory training for staff on environmental health which is a severe omission. To remedy this, the undergraduate curriculum for all types of medical staff, along with the further General Practitioner training course, must be updated to include environmental health training which would allow all healthcare providers in turn educate and raise awareness to their patients.

The announcement by the EPA last year that it has initiated a three-year project to improve the level of air quality information to the public and policy makers, as part of the EU's LIFE EMERALD programme, is a welcome move that will improve public awareness. Within this, it will develop an operation 3-day ambient air quality forecast and provide near real-time mapping of the main air pollutants throughout the country and in major cities and towns^{xxxiii}.

Plans such as the EPA providing Met Eireann air quality information to build into its weather forecast bulletins will help deliver increased public awareness on the matter^{xxxiv}. Certain demographics, such as the elderly who are at higher risk to polluted air, still rely heavily on traditional forms of media such as TV and radio for their news and weather forecasts. Incorporating air quality forecasts would be particularly beneficial as these bulletins could warn of times of higher levels of air pollution in the area and advise on ways to mitigate it, such as staying indoors or avoiding busy roads.

6. What issues might a national clean air awareness campaign encompass and how could its impact be measured

The overarching theme that should be emphasised in any awareness campaign is the multitude of immediate health benefits that can be gained from improving air quality, and the physical and mental health benefits that come from the actions that reduce air pollution such as walking and cycling. Just as stop smoking national campaigns focus on the individual health benefits, so should this.

However, the dangers that polluted air has on health, particularly for those most vulnerable (elderly, infants, etc) must be highlighted and not ignored. The science is overwhelming clear and must be communicated to the public. While this may be alleged as scaremongering, we simply cannot keep the public oblivious to the harm caused by air pollution, and the sources of it, such as burning solid fuels within one's home, has on our health.

The national campaign should also include regional specific plans that raise awareness of issues affecting certain localities. For example, research conducted by the EPA showed that three rural Irish towns had considerably higher levels of PM2.5 than large cities with the dominant source being the residential burning of peat, followed by wood and coal.

To raise public awareness of this issue and promote the measures to address it, advertisements could be placed in local newspapers, on billboards within towns, and on popular regional radio stations. Moreover, local councillors and TDs should be updated on a monthly and annual basis of their jurisdictions air quality, the health impact that their constituents are experiencing, and the measures that could be implemented to alleviate it.

Although a significant proportion of homes in Ireland still rely on the burning of solid fuels for home heating, many of these do not rely on these forms as their primary source of heating. Often wealthier households that have cleaner, more sustainable forms of central heating, light wood fires or use sod turf in the winter for customary or traditional reasons.

This practice of lighting a fire for second-heating purposes should be cautioned and advised against through the national awareness campaign. Whether it is an open fire or closed stove burner, the public are generally unaware of the level of harmful PM emissions that are discharged directly into their own homes.

Despite the tradition of lighting fireplaces in the winter or burning sod turf, the science is clear of the health dangers from exposure to open fireplaces and wood-burning. Worryingly, often it is the elderly who most accustomed to such practices and they are most at risk, with

open fire being linked with dementia^{xxxv}. While frightening, this must be communicated to the public to counter such practices^{xxxvi/xxxvii}.

7. What particular metrics or benchmarks do you think should be considered in tracking the progress of a Clean Air Strategy

The metric most applicable to track the progress of the Clean Air Strategy is the benchmarking of air quality in Ireland to the WHO's AQGs. Adopting the AQGs as legally binding targets and regularly measuring the level of pollutants in Ireland against these thresholds would act as a simple, yet effective, tool to track the strategy's progress.

Moreover, the following benchmarks should also be included in the strategy to track progress; reducing the number of premature lives lost to air pollution, particularly PM2.5 which accounts for the greatest loss of life; reducing the number of years lost to air pollution; reducing the number of hospitalizations attributable to air pollution; and lowering and ultimately eliminating air pollution blackspots in towns, villages, and urban areas.

Finally, progress of the strategy can be easily benchmarked by tracking the reduction in all types of pollutants, especially PM10, PM2.5, and NO2 given their health harming consequences.

8. Are there any other comments you have in relation to the draft national Clean Air Strategy?

Conclusion

The Irish Heart Foundation is cognisant that delivering clean healthy air within the WHO standards would require a whole-of-society transformation. Nevertheless, with almost the entire global population breathing air that threatens their life, the measures to attain this goal are evidently warranted. Not only will it deliver improved physical and mental health benefits for every member of our society, but it will also assist in the fight against the climate crisis.

In that regard, the foundation re-iterates its call for the government to give clean air the priority it deserves and adopt the WHO AQGs as legally binding targets without delay. The

mounting level of alarming evidence demonstrating the catastrophic health and planetary health consequences of air pollution merits a radical response which this clean air strategy can deliver.

Ends

For further information, please contact [REDACTED] Irish Heart Foundation 01-634 6948;
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References

- ⁱ Ambient (outdoor) air pollution. (2021) WHO. Available at: [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)
- ⁱⁱ Carrington, Damian. (2019) Revealed: air pollution may be damaging 'every organ in the body'. The Guardian. Available here: <https://www.theguardian.com/environment/ng-interactive/2019/may/17/air-pollution-may-be-damaging-every-organ-and-cell-in-the-body-finds-global-review#:~:text=Air%20pollution%20may%20be%20damaging%20every%20organ%20and%20virtually%20every%20brittle%20bones%20and%20damaged%20skin.>
- ⁱⁱⁱ Billions of people still breathe unhealthy air: new WHO data. (2022) WHO. Available here: <https://www.who.int/news/item/04-04-2022-billions-of-people-still-breathe-unhealthy-air-new-who-data>
- ^{iv} Air pollution and health. UNECE. [Online]. Available here: <https://unece.org/air-pollution-and-health#:~:text=Air%20pollution%20is%20now%20considered,pulmonary%20illnesses%20and%20heart%20disease.>
- ^v Air pollution is the biggest environmental health risk in Europe. Europe Environment Agency. [Online].
- ^{vi} Air Quality in Europe – 2020 report. (2020). EEA. [Online]. Available here: <https://www.eea.europa.eu/publications/air-quality-in-europe-2020-report>
- ^{vii} New WHO Global Air Quality Guidelines aim to save millions of lives from air pollution. (2021) WHO. Available here: <https://www.who.int/news/item/22-09-2021-new-who-global-air-quality-guidelines-aim-to-save-millions-of-lives-from-air-pollution>
- ^{viii} WHO Global Air Quality Guidelines 2021. (2021) WHO. Available here: <https://ec.europa.eu/environment/air/quality/documents/20210923%20-%20AAQ%20Revision%20-%20Stakeholder%20Meeting%20-%20WHO%20AQ%20Guidelines.pdf>
- ^{ix} Barisione, Matteo. (2021). The new WHO Global Air Quality Guidelines: we must tackle air pollution now! European public health alliance. Available here: <https://epha.org/the-new-who-global-air-quality-guidelines-we-must-tackle-air-pollution-now/>
- ^x Ambient (outdoor) air pollution. (2021) WHO. Available at: [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)
- ^{xi} Air pollution and health. United Nations Economic Commission for Europe (UNECE). Available here: <https://unece.org/air-pollution-and-health>
- ^{xii} 7 million premature deaths annually linked to air pollution. (2014). WHO. [Online]. Available here: <https://www.who.int/mediacentre/news/releases/2014/air-pollution/en/>
- ^{xiii} Sodeau, John and Wenger, John. (2017). Invisible pollution can be just as deadly. Irish Examiner. [Online]. Available here: <https://www.irishexaminer.com/business/arid-20463119.html>
- ^{xiv} What is air pollution? British Heart Foundation. [Online].

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- ^{xv} Brook RD, Rajagopalan S, Pope CA, Brook JR, Bhatnagar A, Diez-Roux AV, Holguin F, Hong Y, Luepker RV, Mittleman MA, et al. Particulate matter air pollution and cardiovascular disease: an update to the scientific statement from the American Heart Association. *Circulation*. 2010; 121:2331–2378.
- ^{xvi} Byrne CP, Bennett KE, Hickey A, Kavanagh P, Broderick B, O'Mahony M, Williams DJ. Short-Term Air Pollution as a Risk for Stroke Admission: A Time-Series Analysis. *Cerebrovasc Dis*. 2020;49(4):404-411. doi: 10.1159/000510080. Epub 2020 Aug 10. PMID: 32777785.
<https://pubmed.ncbi.nlm.nih.gov/32777785/>
- ^{xvii} Quinyne KI, Sheridan A, Kenny P, O'Dwyer M. Air Quality and Its Association with Cardiovascular and Respiratory Hospital Admissions in Ireland. *Ir Med J*. 2020 Jun 11;113(6):92. PMID: 32816427.
<https://imi.ie/air-quality-and-its-association-with-cardiovascular-and-respiratory-hospital-admissions-in-ireland/>
- ^{xviii} Miller et al. (2013). "Diesel exhaust particulate increases the size and complexity of lesions in atherosclerotic mice" in *Particle and Fibre Toxicology* 10: 6
- ^{xix} Air quality in Europe – 2020 report. (2020) European Environmental Agency. Available here: <https://www.eea.europa.eu/publications/air-quality-in-europe-2020-report>
- ^{xx} Ireland's Air pollutant emissions. (2020) EPA. Available here: <https://www.epa.ie/publications/monitoring--assessment/air/EPA-Air-Pollutant-Emissions-website.pdf>
- ^{xxi} Ambient (outdoor) air pollution. (2021) WHO. Available at: [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)
- ^{xxii} Carrington, Damian. (2021). WHO slashes guideline limits on air pollution from fossil fuels. *The Guardian*. Available here: [https://www.theguardian.com/environment/2021/sep/22/who-cuts-guideline-limits-on-air-pollution-from-fossil-fuels#:~:text=The%20WHO%20has%20reduced%20the,metre%20\(%C2%85g%2Fm3\)](https://www.theguardian.com/environment/2021/sep/22/who-cuts-guideline-limits-on-air-pollution-from-fossil-fuels#:~:text=The%20WHO%20has%20reduced%20the,metre%20(%C2%85g%2Fm3))
- ^{xxiii} Barisione, Matteo. (2021). The new WHO Global Air Quality Guidelines: we must tackle air pollution now! European public health alliance. Available here: <https://epha.org/the-new-who-global-air-quality-guidelines-we-must-tackle-air-pollution-now/>
- ^{xxiv} Europe's air quality status 2022. (2022) European Environment Agency. Available here: <https://www.eea.europa.eu/publications/status-of-air-quality-in-Europe-2022/europes-air-quality-status-2022>
- ^{xxv} Census of population 2016 – profile 2 population distribution and movements. (2016) CSO. Available here: <https://www.cso.ie/en/releasesandpublications/ep/p-cp2tc/cp2pdm/>
- ^{xxvi} Europe's air quality status 2022. (2022) European Environment Agency. Available here: <https://www.eea.europa.eu/publications/status-of-air-quality-in-Europe-2022/europes-air-quality-status-2022>
- ^{xxvii} Smith W.J. and Quinn C. (2020). Emission factors from Domestic-scale Solid fuel Appliances. EPA. Available here: http://www.epa.ie/researchandeducation/research/researchpublications/researchreports/Research_Report_3_24.pdf
- ^{xxviii} Parliamentary Question [14215/21] 24.03.2021. Available here: <https://www.oireachtas.ie/en/debates/question/2021-03-24/221/>
- ^{xxix} McGee, Harry. (2022) Think-tank's all-Ireland report sees climate change and biodiversity loss as action areas. Available here: <https://www.irishtimes.com/news/politics/think-tank-s-all-ireland-report-sees-climate-change-and-biodiversity-loss-as-action-areas-1.4851205>
- ^{xxx} Minister Ryan welcomes the first carbon budgets from the Climate Change Advisory Council as a significant milestone in Ireland's efforts to tackle climate change. (2021) Merrion Street. Available here: <https://merrionstreet.ie/en/news-room/news/minister-ryan-welcomes-the-first-carbon-budgets-from-the-climate-change-advisory-council-as-a-significant-milestone-in-irelands-efforts-to-tackle-climate-change.171839.shortcut.html>
- ^{xxxi} Carrington, Damian. (2022). Wood burners emit more particle pollution than traffic, UK data shows. Available here: <https://www.theguardian.com/environment/2022/feb/15/wood-burners-emit-more-particle-pollution-than-traffic-uk-data-shows>
- ^{xxxii} Letter from 46 Million Health Workers Calling for Global Climate Action Delivered to COP26 & COP27 Presidencies. (2021). The Global Climate and Health Alliance. Available here: <https://climateandhealthalliance.org/press-releases/letter-delivered-to-world-leaders-from-46-million-health-workers-calling-for-global-climate-action/>
- ^{xxxiii} LIFE EMERALD – Improving our understanding of Ireland's air quality. (2021). Available here: <https://www.epa.ie/news-releases/news-releases-2021/life-emerald--improving-our-understanding-of-irelands-air-quality.php#:~:text=LIFE%20EMERALD%20E2%80%93%20Improving%20Our%20Understanding%20of%20Ireland's%20Air%20Quality,->

Date%20released%3A%20April&text=EPA%20has%20started%20a%203,European%20Commission%20LIFE%20funding%20programme.

^{xxxiv} Murray, Daniel. (2020). Weather forecast may include air quality data. Sunday Business Post. Available here: <https://www.businesspost.ie/sectors/weather-forecast-may-include-air-quality-data-0c5881ce>

^{xxxv} Keep the home fires burning? Don't even think about it! (2020). The Guardian. Available here: <https://www.theguardian.com/lifeandstyle/2020/nov/11/keep-the-home-fires-burning-dont-even-think-about-it>

^{xxxvi} Cullen, Paul. (2021). Sitting in front of open fire as harmful to lungs as rush-hour traffic fumes. Irish Times. Available here: [https://www.irishtimes.com/news/health/sitting-in-front-of-open-fire-as-harmful-to-lungs-as-rush-hour-traffic-fumes-](https://www.irishtimes.com/news/health/sitting-in-front-of-open-fire-as-harmful-to-lungs-as-rush-hour-traffic-fumes-1.4497427#:~:text=It%20can%20trigger%20asthma%2C%20skin,dementia%2C%20according%20to%20various%20studies.)

[1.4497427#:~:text=It%20can%20trigger%20asthma%2C%20skin,dementia%2C%20according%20to%20various%20studies.](https://www.irishtimes.com/news/health/sitting-in-front-of-open-fire-as-harmful-to-lungs-as-rush-hour-traffic-fumes-1.4497427#:~:text=It%20can%20trigger%20asthma%2C%20skin,dementia%2C%20according%20to%20various%20studies.)

^{xxxvii} Lovely but dangerous, wood fires bring health risks. (2019). American Heart Association. Available here: <https://www.heart.org/en/news/2019/12/13/lovely-but-dangerous-wood-fires-bring-health-risks>