

Environmental Audit Committee

Oral evidence: Outdoor and indoor air quality targets, HC 1411

Wednesday 5 July 2023

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[Watch the meeting](#)

Members present: Philip Dunne (Chair); Duncan Baker; Barry Gardiner; Clive Lewis; Caroline Lucas; Cherilyn Mackrory; Dr Matthew Offord; Cat Smith.

Levelling Up, Housing and Communities Committee Member present: Ian Byrne.

Questions 78 - 166

Witnesses

I: Professor Sir Chris Whitty KCB, Chief Medical Officer for England.

II: Professor Nicola Carslaw, Professor in Indoor Air Chemistry, University of York, Larissa Lockwood, Director for Clean Air, Global Action Plan, and Dr Tom Woolley, Architect and Environmental Consultant, Rachel Bevan Architects.

Written evidence from witnesses:

[Prof Nicola Carslaw \(Professor of indoor air chemistry at University of York\), Professor Nicholas Pleace \(Professor at University of York\), and Dr Sarah West \(Director of Stockholm Environment Institute - York at University of York\)](#)

[Global Action Plan](#)

[Dr Tom Woolley, Architect and Environmental Consultant, Rachel Bevan Architects](#)

Examination of witness

Witness: Professor Sir Chris Whitty KCB.

Q78 Chair: Good afternoon, and welcome to the Environmental Audit Committee. We have two panels of experts for our inquiry into outdoor and indoor air quality. To kick us off, we are very pleased to welcome Professor Sir Chris Whitty, who is the Chief Medical Officer for England, having had many other responsibilities in the Department of Health, including when I was Minister there. I shall just put on the record that we know each other from that time.

Chris, you produce an annual report in your current role. You chose to focus the report last year on air pollution. Why was that your topic for the report last year?

Professor Whitty: Thank you. The reason for doing air pollution was that, of all the environmental impacts on health, air pollution is both the largest—I think that is widely accepted—and one where a lot of progress has been made but there is substantial opportunity to go further. It seemed a sensible one to lay out to the public that there are some things that we could do to improve the situation, given that it has such a big impact on quite a lot of different diseases.

Q79 Chair: Could you characterise for us how it is that we know that it has such a big impact, compared to other things? The UK Health Security Agency provides a range of deaths in England attributed to different causes. How do we know that air pollution, which is quite hard to identify—well, is it hard to identify and how accurate do you think those estimates are?

Professor Whitty: There are two bits of it that are easy to identify. It is putting the two together that is the harder bit. It is relatively easy to identify the people who have had different diseases, including fatalities, and it is relatively easy to identify where there is air pollution. There are good ways of measuring that, and there are several different pollutants we might want to come back to. What you then need to work out is how much of the disease is caused by the air pollution. These are classical epidemiological studies, where you see an association and you try to work out if there are other things that could explain it, so you do not assume that, just because there is high air pollution and high disease, they are causal.

This is looked at by a variety of mechanisms. They all land in roughly the same place, and there are also biological studies, toxicological studies that demonstrate that air pollutants have effects on cells and other living tissues. If you put those together, we are confident of the effect. The size of the effect has reasonably wide confidence intervals, but we are sure it is a relatively substantial effect.

Q80 Chair: We had evidence earlier from one of our academic panels that air quality challenges give rise to problems in the brain and foetal



development beyond the more obvious respiratory conditions. Do you have confidence that such estimates are valid from a scientific and medical point of view?

Professor Whitty: With the caveat I have given, that the exact figures should not be too heavily relied on. In terms of giving a ranging shot, I think that they give good estimates. One of the things that I think would surprise people is that the biggest size of the effect appears to be in cardiovascular disease, particularly in heart disease and stroke. There is increasing evidence of impacts on dementia over a lifetime, in addition to ones that I think are more obvious, such as lung cancer and asthma, where I think the association is easier to explain.

Q81 **Chair:** How do you account for that?

Professor Whitty: The current assumption is that this is probably because the air pollutants lead to inflammation, and it is the increase in generalised inflammation that leads to an increase in cardiovascular disease, stroke and heart disease. The association we are reasonably solid about. The cause for it I think is a bit more disputed, but that is the leading hypothesis.

Q82 **Chair:** Where would you recommend to Government and this Committee that we should focus our attention in relation to the different kinds of pollutants that cause air quality issues?

Professor Whitty: It is worth putting a little bit of historical background to this because it explains why this is a solvable problem. There have been several very major air pollutants that we have substantially reduced, for example, sulphur dioxide. If I had been giving evidence to a Committee 30 or 40 years ago that was a very major part. That has gone down to 5% of the level it was in the 1970s. Lead from petrol used to be a huge problem in developing brains, causing significant brain damage in children. That has now gone away. There are a lot of things we have improved.

Indoor is a bit more complicated, but in outdoor air pollution we are concerned about two things: particulate matter—and particularly the smaller particulate matter—what is called PM2.5, which is about the size of it, and also the nitrogen oxides. Principally, although not entirely, they come from transport in terms of the ones that affect people. Those are the pollutants. There are others and there are contributing ones, such as ammonia from agriculture. I know you have had witnesses talking about that, but they largely have their effect through creating what is called secondary particulate matter, where they combine with other chemicals and cause particulate matter.

The second question is geographical. The most important thing with air pollution is clearly when it happens where people live. This is an important difference from our worry about carbon dioxide and other greenhouse gases, where it does not matter where they are. They all have an effect that is equally bad for the long-term prospects of the



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world. In terms of air pollution, the most important thing is where people live, work or play. Air pollution in towns, air pollution near schools are the ones we should concern ourselves most with. That tends to be where the highest air pollution levels are.

- Q83 **Chair:** We have devices that will record at the consumer level and provide alerts for things such as carbon monoxide and radon. When people move house, they get their radon checked. Are there other specific pollutants that you think we should focus on at a consumer level, as opposed to an economy-wide level?

Professor Whitty: At an outdoor air pollution level I think particulate matter and NO_x are the key ones. If you get on top of them a lot of others would follow. Indoor is more complicated. With indoor spaces there is a combination of chemicals that are only produced indoors—volatile organic chemicals, for example, are emitted indoors—and then there are issues around ventilation, which are complicated particularly in winter when people want to keep their windows shut.

- Q84 **Chair:** As a Committee, we have done a lot of work looking at energy efficiency in homes. One of the leading ways of achieving that, which is being encouraged by Government, is to look at making our homes more airtight, rather than less, to save energy. Is what you have just said in conflict with the building intent to produce much more airtight places to live?

Professor Whitty: I would say it is an intention with, rather than in conflict with, because I think there are engineering solutions that can help with this. I would separate within indoor spaces public spaces, which are things such as the House of Commons, supermarkets, libraries, hospitals, and private spaces. I think we would all accept that Government have a greater responsibility probably in a public space, which everybody shares. It is a shared Commons. Most of those buildings—and the House of Commons is an exception—mainly now have mechanical ventilation.

It is possible to significantly reduce air loss, while maintaining ventilation, by a variety of engineering mechanisms. What has tended to happen is that the engineering expertise on ventilation and the engineering expertise on keeping houses warm have operated in isolated siloes. What we now need to do, if we want to tackle both air quality and heat—because both are important for health and for multiple reasons—is to bring those two together, to say, “This is an engineering challenge. It is a solvable engineering challenge. How can you help us to do that?”

- Q85 **Chair:** That is a good suggestion. Is that something that falls within the remit of the Chief Medical Officer?

Professor Whitty: It is, and I am talking to the Royal Colleges and the Academy of Engineers and others about this. They completely agree with us. They do believe there are engineering solutions.



There are also old-fashioned things people can do—for example, if they have sash windows, opening the very top and the very bottom, and that produces the maximum ventilation with the minimum heat loss. The Victorians were very good at this. The way that this building is ventilated by natural ventilation is also quite good at maintaining heat while still circulating air. There are things we can do going back to engineering from the 19th century, in addition to things looking forward to the rest of the century.

Q86 Chair: I think many of us would take issue with you as to the ability of this building to retain heat at the right time and to retain cool at the right time.

Looking forward to a world in which we are improving air quality, what aspects of improved air quality would be beneficial to public health and to the NHS?

Professor Whitty: Starting off with outdoor air quality—because there the answer is easier—there are a group of things that we can do in terms of transport and traffic, both for vehicles on the road, trains, in ports and airports particularly in local areas. There are a group of things that we can do in terms of siting of areas of air pollution to ensure that they are sited as far away from human habitation as possible.

There are some important things we can do in terms of heating and one I would pull out in particular—because we need to work out what the right social balance is—is woodburning, which has increased over the last decade. That is now contributing quite a significant proportion of our particulate matter, particularly in winter. There are some things that we need to concentrate on. For all of these, though, not just saying that this is a problem. For all of them there are things we can do to improve them without constraining people's choices too greatly.

Q87 Chair: How would you compare the problems posed by air quality with the other big public health challenges of smoking and obesity?

Professor Whitty: They should not be seen as in competition with one another. Trying to get smoking down to zero is an absolute aim of public health for many reasons. It has an extraordinary contribution to diseases: cancers, cardiovascular diseases, and others across the pitch. Obesity is the literally growing problem that we face that is going to cause very significant health problems. It is already doing so and will cause more over time. It is very heavily linked to deprivation, which we need to address. I do not want to see these as in competition. I would see these as three very major things we need to address.

Q88 Chair: You have just used the word “deprivation”. Do you see health inequalities playing a big part in where we work to try to address air quality issues? Is it closely linked? If you live on the edge of a busy road, are you going to have a much bigger problem than if you do not?



Professor Whitty: There are three ways in which they interact, and it is an extremely important issue. First, on balance, there tends to be more air pollution in areas of deprivation. That is not absolutely true, and some of the wealthiest areas also have quite a lot of poor air quality. Therefore, it is not an absolute correlation in comparison to some other areas but that is overall true.

The second is that many of the solutions that are available for air pollution are either more difficult to do in areas of deprivation or inequality or cost a lot more, which of course means that in families who are already struggling it is quite problematic, so something that might be relatively straightforward to do for someone who is relatively wealthy is not straightforward.

The third thing is people already have pre-existing health conditions at a much higher rate in many areas of deprivation and then the air pollution builds on top of that. There are three different things we need to keep in mind when we are looking at this.

Q89 **Dr Matthew Offord:** I will briefly start by thanking you for your services, Chief Medical Officer. Your efforts are much appreciated.

What is your estimation of the public's perception of the dangers faced by air pollution and poor air quality?

Professor Whitty: It is quite striking that reducing air pollution—judging it, for example, by which newspapers periodically campaign on it—is not a left-right issue. It is an across-the-board issue. People do care about air pollution quite widely, but there are several bits of air pollution that people probably don't understand or appreciate the scale of. People completely underestimate the impact of indoor air pollution. They worry about outdoor, which other people can be doing to them, but think less about indoor. For example, if they have children who have asthma or other conditions, that is something that people are unaware of.

Several things that people probably do not realise are highly polluting—and I use the example of wood burners—many people use a wood burner thinking it is a natural thing and, in a sense, see that as a positive contribution. Whereas, in purely air pollution terms, it definitely is not, although that varies very much by stove design, which we might want to come back to.

Q90 **Dr Matthew Offord:** In your experience would you say that health practitioners are aware of the risks of air pollution and poor air quality?

Professor Whitty: I think they are aware of them as a generic issue. I think what many health practitioners struggle with is they have a child or an adult in front of them with a health condition: what useful advice can they give? It is the responsibility of people like me to work with the Royal Colleges and others—medicine, in my case, nursing in the case of others—to say, "In fact, there are many things that people can do". The



principal aim should be for all of us to get air pollution down everywhere. That is by far the best answer.

There are also things we can do within the current situation by varying routes, times and reducing some of the risks of indoor air pollution that people just don't think about like, for example, air fresheners. The name implies that they are cleaning the air. In fact, the reverse is true. There are things people can do that will practically help them to reduce their risk. This is most useful when we are dealing with people who have a pre-existing health condition or vulnerability.

- Q91 **Dr Matthew Offord:** If you had the ability to run a public health campaign about air pollution, how would you describe it? What would you say were the potential dangers?

Professor Whitty: The ones that I would start with are the ones that I think are major and underappreciated. Therefore, I would start with cardiovascular disease, strokes, heart attacks and possibly dementia because people don't see the links. Due to some excellent campaigning—which I would like to pay a huge tribute to—the link to asthma has been accepted by the general public quite widely, but lots of people who don't have any asthma in their family, and don't have asthma themselves, may well think that this problem isn't a problem for them, and forget that major or very dangerous conditions, chronic obstructive airway disease, for example, can be associated if they have a lifetime exposure. It is extending the range of conditions that we know are caused by air pollution that are in the public debate.

- Q92 **Caroline Lucas:** I want to ask some questions about transport. In the first instance, I have a very general question. What contribution do transport emissions make to the public health burden of air pollution in the UK?

Professor Whitty: In urban areas—so this is talking about where people live rather than if you just spread it thinly across the country—they have a very significant contribution and, in particular, in areas of deprivation more widely.

Within that, the biggest relative contribution is in nitrogen oxides, NO_x, which we have really the capacity now to significantly reduce. It has already gone down a very long way due to steady improvements in engineering. However, motor vehicles, whether private or large trucks, lorries and buses, still produce quite significant NO_x. If we were to move over to electrification of the fleet, we would essentially eliminate those down to zero, but we would still have particulate matter.

Particles from transport also come from road surface, brakes and tyres. Electrification does not solve that problem at a stroke. It does reduce brake problems to quite a high degree because most electric cars do use regenerative braking, which is a mechanism that does not produce friction and, therefore, it doesn't lead to particles. Initially, in fact, because of battery size, electric cars would probably be slightly heavier.



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If anything, issues of tyres and road wear may slightly go up over that period and we will need to deal with that.

I don't think we have thought about how to reduce air pollution from tyres previously, because it has been such a small proportion. Now that we are getting rid of many of the tailpipe or all of the tailpipe emissions, I think we need to start looking at these quite seriously.

Q93 Caroline Lucas: I think the pollution from motor vehicles is relatively well known, but I was quite surprised to read about some of the pollution from trains and, in particular, from stations. Can you say a bit about the nature of the health risk from short-term exposure to pollutants, for example in a concentrated area of a station, and what can we do in terms of redesigning or when we come to build new stations to try to reduce that risk?

Professor Whitty: Chair, with your permission, if I can do a quick plug for, in my view, my good report on air pollution. For those who are interested, that covers all of these issues in quite a lot of detail and there is a section on trains.

The point that I make in that report is that there are some bits of train travel that are going to take a long time to sort out. The full electrification of the train system is desirable for multiple reasons—and air pollution is one of them—but the important bit is what happens when trains are going through built-up areas. The most built-up area of all of course, where there is a high concentration of trains, is in stations. I am talking about the overground fleet, and I might come back to the underground if that would be useful.

We know from studies in the busy railway stations—Birmingham New Street, for example—that the air quality is substantially lower than it is virtually anywhere else in the city. That is because you have diesel trains continually running while stationary in stations. In my view, in the long run, we should fix this by better engineering of the trains, using trains that can use dual power in the first instance, so have battery power when they are in cities and then maybe use diesel in between. That is an entirely feasible technical solution.

In the short run, I think that having trains running diesel engines in stations where large numbers of people congregate—and particularly the workers in those stations who are there the whole time—seems to me wholly unnecessary and is something that we could sort out very quickly by changing over to power produced for these trains while they are in the station from electricity. There are some immediate and medium-term fixes in terms of dual power and the long-term fix of the full electrification of the fleet, which seem to me well overdue.

Q94 Caroline Lucas: I have looked at your report but have not read every page, so can you remind me if you talk about the impact on workers? Have any studies been done about their exposure? Many rail workers work in those stations for 20 or 30 years.



Professor Whitty: I am not aware of studies specifically on that, but there may be some I am not aware of. I think it would be extraordinary, given how much higher the levels of pollution are. A relatively recent study in Birmingham New Street, for example, PM2.5 had 42 micrograms per cubic metre. If you think about what the WHO maximum recommended, that is substantially above that. Workers are going to be exposed to that the whole time.

This seems to me to be something where those who work in the railways would want to work with us to solve this problem, which is a problem for the public and is also a particular problem for those who work in these environments.

Q95 **Caroline Lucas:** In terms of active travel, what role do you think that plays in reducing air pollution? I know some people have had big conversations about whether people are more at risk from air pollution when they are walking or cycling. Is there an answer to that question too?

Professor Whitty: The first thing to say is that active travel is incredibly good for health, period. Whatever its other benefits—and this is walking, cycling, whatever mechanism people use—it is very good for people's cardiovascular and mental, physical, musculoskeletal health. It is an all-round good thing, to make that clear.

It used to be, when we had really bad air pollution in the 1960s and 1970s, that the risks of active transport from air pollution might significantly undermine the other health benefits. That is no longer true. Even in the most polluted parts of our cities, if you are going in for active transport you are still improving your health compared to if you sat on a bus or sat behind the wheel of a car. It is a very important thing to do for people's health in general. Also, fairly obviously, the more we move people from transport into active transport the less air pollution there will be, particularly if we move from cars or one or two people per vehicle on to active transport. That is going to reduce the air pollution, so you get a win that way around.

It is important that people feel safe, and that includes safety from air pollution when they go in for active transport. One of the main reasons that people don't take up cycling in particular, walking to a lesser degree and in slightly an older age, is that they feel that the infrastructure is not safe for them. It is important that we design infrastructure for active transport and that will help with air pollution. Air pollution should not be a reason that people worry about this.

Q96 **Caroline Lucas:** I remember we used to be told that if you strap your child in the back of the car, thinking that you are protecting them from air pollution better than if you walked them down the street, that the amount of pollution inside vehicles is very significant.



Professor Whitty: A lot of it will be to do with the period of time that they are there. If it is a three-hour walk and a one-minute car journey, clearly the car journey is probably going to have less pollution. If somebody is sitting in a traffic jam while others walk merrily by, the benefit is the other way. In general, people in cars have higher levels of pollution than people outside them in that particular part of the town.

Q97 **Caroline Lucas:** Do policymakers have a good understanding of the health impact of measures to reduce emissions from transport? Is health a sufficiently important component in terms of those policy debates?

Professor Whitty: I think most people who are policymakers and senior politicians do understand this link, maybe not in as much detail as this Committee, but I don't think that case needs to be made. Where I think people worry is they think this is an intractable problem. I think that they underestimate both how much progress has been made—if you compare where we are to where we were in the 1970s, it is massively better in almost every sector—but also how much further we could go with realistic solutions, rather than ones that are almost utopian in their approach. We could go a long way with existing technology properly applied.

Q98 **Clive Lewis:** Dr Whitty, can I quickly ask you to explain what particulate matter is—and then I will ask the question in your answer, if that is okay—so that everyone understands what it is? Do particulates emitted from combustion have a disproportionately negative impact on people's health?

Professor Whitty: A particle is literally a physical thing. It can be anything from something you can see right down to something that you would need an electron microscope to physically see. There are a very wide range of them. The smaller ones are probably more problematic for air pollution, because they penetrate the body more easily. The very smallest ones may well cross the blood-brain barrier and a variety of other issues. Size counterintuitively means it can be worse if it is smaller. That is probably in part to do with how far they can get into the system and in part because it is about surface area. If it is causing inflammation, the bigger the surface area on average the more inflammation it is likely to cause.

You asked about the particles from combustion. It is likely that different particles have different amounts of irritation to the system and different amounts of damage. In my view, the science that we have at the moment does not give us a strong enough feel for how big that difference is. Is it likely that something that is jagged and, let's say, has rubber around it is more likely to cause a problem than something that is smooth and does not? Probably yes, but we don't have strong enough science that I can say to you that that is categorically the case. Therefore, the material they are made of probably is important.

A lot of the particulate matter that comes from human activity is currently from combustion of different types. We have talked about



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transport and heating. Those are probably the biggest ones, but industry, cooking and a variety of other issues do as well. A lot of those will be combustion-related directly or indirectly, but not all.

Q99 **Clive Lewis:** I realise I just called you doctor, and you are a professor, so I do apologise.

Professor Whitty: I answer to almost everything.

Q100 **Clive Lewis:** You have a thick skin, but none the less I apologise. Having listened to that, what is the best way to quantify the impact of particulate matter on human health? What is the best metric that science has at the moment?

Professor Whitty: Ultimately, I go back to the Chair's very first question. I think the most important thing is to start off with people who have become ill, and then work out in what proportion of those people it is due to air pollution. What we are all worried about in this particular discussion is around people becoming ill before their time.

Q101 **Clive Lewis:** Moving on to solid fuel burning, what do we know about the impact of that, especially in terms of indoor burning?

Professor Whitty: We know that we have now reached the point where about 17% of our particulate matter is from woodburning, slightly more if you add in other solid fuels. That is substantial. That has increased, both in proportionate terms by about 35% and in absolute terms over the last decade. We know that this is an issue that is significant and getting more significant in absolute and relative terms.

Within that, there is a very wide range of different forms of heating from open fires, which have the highest rates of particulate matter produced, through to older stoves that are slightly better in terms of their impact. There are these new, DEFRA-approved eco stoves that take it down by maybe eight times if they are used with dry wood. Wet wood is a lot worse than dry wood. I can give you numbers if you want, but they are substantially worse. The next down from there is oil-fired heating, and right at the bottom is gas and then electricity, which has zero emissions.

The point I am making about them—and the reason I am making this point fairly strongly—is that it is important that we enforce regulations that already exist. The Clean Air Acts were brought in for a reason and they are about large amounts of particulate matter being produced by combustion where people live. It is also important that we very strongly encourage people who wish to use a wood burner, where that is already allowed, to use one of the new designs with dry wood. They are much less polluting than the designs we had 15 or 20 years ago. It is important that we make that differentiation.

Q102 **Clive Lewis:** Would you personally install a DEFRA-approved wood burner in your home?



Professor Whitty: There would be two situations. In a situation where people don't have access to the gas network or are a long way from oil supplies, absolutely. There are a lot of people in rural areas who are reliant on woodburning as a form of heating, and it is entirely appropriate just as straight heating. I would encourage them to move to a DEFRA-approved one and to use dry wood.

There are also people who put them in for aesthetic reasons, which is reasonable enough, but I would encourage them to use them when it really matters to them for aesthetic reasons and not to use it as a principal means of heating where that is not relevant to them, when they could easily use a much less polluting one. It is essentially allowing people the choice for the thing they want, but not getting around the fact that this is a relatively polluting way of heating a house, if it is not that you are sitting in front of dancing flames and enjoying an evening with your family or with friends.

Q103 **Clive Lewis:** I am going to use that one. My wife and I are arguing a great deal about this. I don't think that we should have one, for health reasons, and she does for aesthetic purposes. I don't know if you have resolved the argument, but I will show this to her none the less.

Professor Whitty: I have no intention of standing between you and your wife.

Q104 **Clive Lewis:** Probably a good idea. To conclude on that, does solid fuel burning have a greater negative impact overall on indoor air quality or at the location of burning or overall outdoor air quality? One of the things that I am aware of is that where I live in London I see now an increasing number of the little spinner valves at the top, which probably implies that someone has a wood burner. What is the impact on the local community of that?

Professor Whitty: As with all these things they are cumulative. That is the reason why enforcing existing regulations where people are highly concentrated is important. There are parts of London now—to take it as an example—and the same would be true in many other conurbations, where the density of people using this is leading in winter to substantial amounts of external air pollution. There is a density question and there is also an enforcement of better stove quality.

You talked about outdoor and indoor. Outdoor of course is the one that we most care about, because that is something where one person pollutes, and many other people downwind get the pollution, so this is a societal issue. For the indoor, a lot of it is to do with how well people use it. If people are not used to using them, you can go into people's houses who are not used to using stoves, and they smell like a kipper factory. There is smoke everywhere. Others who have the hang of it can get most of the smoke up the chimney and, therefore, it does not lead to very substantial amounts in the house.



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Chair: I should have welcomed Ian Byrne, from the Levelling Up, Housing and Communities Select Committee, who is guesting with us today. Ian, your turn to ask some questions.

- Q105 **Ian Byrne:** Thanks, Chair and thanks, Professor Whitty, for everything that you are doing on this issue. I want to touch on the indoor air quality element. How does the public health impact of poor indoor air quality compare to that of poor outdoor air quality?

Professor Whitty: If you had gone back 20 years ago, we would have said that outdoor air quality was substantially bigger than indoor. Largely because we have improved on outdoor air quality, a lot of this is now a much higher proportion of the issue. It is a lot more variable. For example, if people are living in poorly ventilated, mouldy houses with carbon dioxide, carbon monoxide and a variety of other things in high amounts, there can be quite a substantial risk. We have had some very tragic recent cases where that link was very clear. It does depend on ventilation and the amount that is produced inside the house. There is a lot of variability between one house and another, some for reasons we understand, such as ventilation, and some for reasons that are rather less clear.

- Q106 **Ian Byrne:** Moving on to that, since Covid-19 we have seen an explosion of working from home. Has there been any observable change in the incidence of people affected by exposure to this indoor pollution that you are talking about?

Professor Whitty: I don't think that we yet have any data that are meaningful in this area. Of course, people are still spending roughly the same amount of time indoors, so it is going to very much depend on whether the air quality in their home is better or worse than the air quality in their workplace.

- Q107 **Ian Byrne:** It is up to 80%, isn't it?

Professor Whitty: It is over 80% of an adult's time is probably spent indoors on average. It varies a bit by time of year and a variety of other things; children are slightly less. If you are working from home, you are still working indoors, and it might be that their workplace is better ventilated and has lower air pollution, or it might be that it is higher. That will depend on a lot of different factors, so I don't think it is easy to make a blanket either one or the other is better.

- Q108 **Ian Byrne:** What additional policy interventions to mitigate risk from poor indoor air quality might be required in addition to interventions to tackle outdoor air quality?

Professor Whitty: First, with outdoor you would be able to give a very clear answer to what we should do next, and then the question is if we are prepared to pay the bill. In indoor air quality there are quite a lot of things we don't fully know. For example, there are quite a lot of products we use indoors or have indoors, flame retardants, things from paints, a variety of other things—



Ian Byrne: Air fresheners?

Professor Whitty: —and air fresheners, and we don't know the impact of these. Almost certainly with quite a lot of them with a bit of tweaking of the manufacturing of them we could reduce the amount of air pollutants they produce directly or indirectly, because often one thing combines with another and has what is called a secondary particulate matter.

Secondly, as we discussed earlier in the Committee, we must look very seriously about trying to maintain heat in winter at the same time as maximising ventilation or, if necessary, filtration. That is easier in big public buildings that have mechanical ventilation sometimes than it is in the UK housing stock, which is often relatively old, as you know. Retrofitting can be a lot harder.

There are a bunch of things that are not straightforward in indoor compared to outdoor, but it is a big area that we must tackle now.

Q109 **Ian Byrne:** Do the World Health Organisation guidelines for ambient air quality apply to indoor settings as well as outdoor?

Professor Whitty: They are aimed at outdoor settings at the moment. What you would find indoors is huge variation in indoor settings. Even one house near a next-door house that looks almost identical could have very different areas. The WHO guidelines are not aimed at dealing with this level of variation.

Q110 **Ian Byrne:** Are they taking it seriously enough? Is it getting looked at equal to the outdoor air quality?

Professor Whitty: What the WHO guidelines have rightly demonstrated is that the thresholds that were previously thought to be adequate we now think, if you can go lower than that on particulate matter and NO_x and probably these other chemicals, that health will improve significantly. I think we now need to start looking at this seriously in an indoor context as well as in an outdoor context.

Q111 **Ian Byrne:** What is the likely health impact of non-methane volatile organic compounds such as those emitted from the cleaning products, as you touched on, at concentrations that people are typically exposed to indoors? Has there been enough work done on this yet?

Professor Whitty: I don't think there has and, therefore, I am not able to give you a good answer. We need more work on it, but I am confident the answer is that they will be less good than not having them at all. How bad that effect is and, therefore, whether it is worth making the changes needed to reduce it significantly is not yet clear. The likelihood is yes, but compared to particulate matter and sulphur dioxide and NO_x, which we talked about earlier, where I think the data are solid now, here I think the data are much less clear.



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Q112 **Ian Byrne:** Is the scientific understanding of the sources of indoor air pollutants, and the risks posed by indoor air quality, currently sufficient to allow further action on indoor quality? If not, what do we need to do?

Professor Whitty: It is perfectly sufficient for us to want to do more action on particulate matters, on heating, as we talked about, and on ventilation. I think the evidence there is clear. On some of these other chemicals I am confident there will be things that we can do, but I don't feel we are yet at the point that we can say with confidence, "This is what we should do and here technically is what is possible. Is the cost worth it?" I don't think we have reached the point where we are confident on that.

One of the key things I said in my report to the research community is that this is now a big priority. We really must get on top of what is going on, what will make a difference and which ones probably don't.

Q113 **Ian Byrne:** A good answer. I am lucky enough to have Alder Hey Children's Hospital in my constituency. We have some fantastic doctors, such as Professor Ian Sinha, and at the moment they have research going on working with the RSL, the Register of Social Landlords, and air pollution within them and how they can improve what you touched on before. How can the Government support research, to better understand the sources of and risk from indoor air pollution and the policy interventions that are likely to be most effective in tackling this?

Professor Whitty: Two of the largest funders of research, not just in the UK but in Europe, the National Institute for Health Research, NIHR—which at one point I had the privilege of running—and the Medical Research Council, have both said that this is an area they want to take very seriously. I know that some of the research charities are also very interested in this area. Of course, science is also international. Much of the evidence we get will also come from other nations that are scientifically active.

Q114 **Chair:** Following that up, you touched in your evidence today on things such as air fresheners polluting the air, rather than improving the air quality. Are there other products that you have in your sights? Would you encourage the Committee to recommend some labelling measures to raise public awareness where there are some things that damage the atmosphere that they don't appreciate?

Professor Whitty: I am always a bit cautious about jumping the gun on this. To go back to the last set of questions, I think the data are not strong enough. However, a time will come where we will be able to fix it. Let's say there is a particular propellant that is the problem. We will change the propellant—as we did, for example, to reduce the risks on ozone from freezers—or alternatively say to people, "Look, particularly if you have very high risk children or elderly people in the house, these are products you probably should not use". I think to get ahead of the evidence is always a mistake. You can get yourself into knots.



Q115 **Chair:** In relation to policy agenda across Government, as a Committee we can roam across Government and very often what we do impacts on more than one Government Department. Your report covers a lot of areas. We have been talking about transport and schools, education and lots of other Departments that have some relevance there. Has your report prompted any cross-Government working to try to pull together people with responsibility in different Departments to try to address some of these issues?

Professor Whitty: Without telling tales out of school, I would say that some Departments have welcomed it and I have had very useful conversations. I will pull out the Department for Transport, for example. For others their enthusiasm is delayed, but I am sure it will come.

Q116 **Barry Gardiner:** If I may have a brief follow up. You said it is always dangerous to proceed ahead of the evidence, but we also operate in public health on the basis of the precautionary principle. When comparing these two, there would appear to be a tension at least. How would you reconcile it in this area?

Professor Whitty: I would have no problem saying to people, "If you have an asthmatic child, I recommend you don't use an air freshener" but I think for Parliament to say something that is rather different. You ask what the Committee should do. The Committee is part of the legislature of the country. One must be very careful not to get ahead of where the evidence is. On your point, I would not say to everyone not to use air fresheners, but I would say, "If your child has been in ICU three times this year do everything you can to minimise the risk. Here are some sensible things".

In the report we have laid out a section to allow doctors, nurses and others who are recommending saying, "Here are some common-sense things, candles, joss sticks, a variety of things that if you have a very high-risk person, not across the board, these could help to reduce your risk". Hopefully that meets the point you are making.

Q117 **Chair:** That concludes our questions for you. Thank you very much for joining us, Professor Sir Chris Whitty. We will conclude this panel.

Examination of witnesses

Witnesses: Professor Nicola Carslaw, Larissa Lockwood and Dr Tom Woolley.

[This evidence was taken by video conference]

Q118 **Chair:** Welcome to the second panel of the day for our inquiry into air quality. We are focusing on indoor air quality for this panel. I would like to welcome first, online, Professor Nicola Carslaw, who is the Professor of Indoor Air Quality at the University of York. Can you say hello to us?



Professor Carslaw: Hello.

Q119 **Chair:** Good. You can hear us, and we can hear you. That is excellent. We are also joined in the room by Larissa Lockwood, who is the Director of Clean Air at Global Action Plan. Welcome, Larissa. Could you tell us what Global Action Plan is?

Larissa Lockwood: We are an environmental charity working to mobilise action on the systems that harm us and our planet, so clean air is one of our big areas of work. We work with schools, healthcare organisations, community organisations, individuals, to help them to do something about air pollution but also to identify the systemic changes that we need.

Q120 **Chair:** We are also joined by Dr Tom Woolley, who is an architect and environmental consultant at Rachel Bevan Architects. Could you explain your interest in this topic?

Dr Woolley: One role is that I am chair of the Clean Air Steering Committee, which has an overview of various projects on both external and internal air quality, which are being funded through various Government and other research bodies. It is also something that I have been working on as a green campaigner, in a way, within the architecture world for several years. I am very much looking forward to coming back to some of the things that Chris Whitty brought up.

Q121 **Chair:** Are you working mostly in the public realm or in the private realm?

Dr Woolley: I do a lot of consultancy work, which is within the public sector. These days it seems to be cries for help from people who have mould and damp in their houses that are not being dealt with. Also, we design and build healthy homes that don't have any of the problems that you have just heard about. I can tell you how we do that if you want.

Q122 **Chair:** Thank you. I am going to start with Nicola. Nicola, I did not ask you to introduce yourself. I did it for you, but in answering my question perhaps you could explain your role within the university. The question is: what do you see are the primary problems to be addressed in air quality in people's homes?

Professor Carslaw: I have been working in the field of air quality since the early 1990s. I started off as an atmospheric chemist, very much interested in air quality outdoors, and then probably around 20 years or so ago I started to get interested in indoor air quality before anyone even thought about it, really. I just became more fascinated. I am a chemist, so what I try to do is understand the chemical pathways that lead to the formation of pollutants indoors, so particularly thinking about some of these volatiles that Chris Whitty mentioned earlier.

My main focus is to try to understand the sources of pollution indoors, how they interact with each other, and the pathways to formation of



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harmful pollutants. It is very much a chemical mechanism-based approach.

In terms of the important issues, there are several things. I think somebody on the Committee has already mentioned that indoor air quality is still not on people's radar. One of the things that is important is more education. There is a lot that people can do to remove sources of pollution indoors if they know about them, but at the moment, as has already been alluded to, people don't tend to think about them.

There is a lot to be said about moderation as well. Some of the issues that arise from indoor air pollution are linked to perhaps excessive use of things. We did a study in York where we looked at six identical houses in the same street. We measured VOCs within those six houses and we found that despite the fact the build was the same, the outdoor air pollution was the same, because they were in the same street, the indoor air pollution levels were very different and that linked to people's behaviour in those homes. There was one home, in particular, where there was a dog and the owners would follow the dog around when it had been outside with an air freshener, spraying after it. Also, in the same home, someone liked to have 20 scented candles around their bath every evening. We could see that in the measured levels of pollution. That is another aspect.

The final one is ventilation. Again, this has already been alluded to, but just the importance of opening windows, just like people used to do. This has become far more important as our homes have become more airtight. Obviously, there is a tension if you live on a busy road and that makes it a bit more nuanced. However, it is getting people to be aware of all of their sources of pollution, and indoor air pollution is definitely not on people's radar.

Q123 Chair: With that study, was there any noticeable difference in socioeconomic conditions of the households?

Professor Carslaw: We did not look at that. It was more we wanted identical houses, identical outdoor conditions. We only had six houses. Having said that, we are doing a much bigger study at the moment in Bradford. I don't know if the Committee is aware of the Born in Bradford cohort. It is quite a famous health cohort, and this is following children who were born 15 or 16 years ago, so there is lots of information about their health. We know that within this cohort there are high levels of deprivation, high levels of ethnicity.

What we are going to be doing as part of the INGENIOUS project, which is ongoing, is going into 300 of these homes measuring indoor air pollution. At the same time, we are asking the people in the houses to keep activity diaries so that we can understand what they are doing. That sounds a bit like "Big Brother", but just in terms of understanding how they are cooking and cleaning, how many times they are opening windows. I think that for the first time we will be able to link indoor air



pollution, human behaviour and health. That is going to be a nice way into that understanding what we need and with a community that is seldom heard, with high levels of deprivation and ethnicity.

Q124 **Chair:** That sounds very interesting. When are you likely to produce that?

Professor Carslaw: It is a four-year project. We are halfway through. We have done about 90 of the houses. As I said, we have 300 and with 80 of those homes we are going to go back in about a year's time with some designed interventions to try to improve things. The other thing I feel quite strongly about is it is one thing going into someone's home and saying, "You have an air pollution problem", but then what you don't want to do is just leave them with that. We are providing feedback for the residents, to tell them about what we found, but we also want to go back in with some interventions we have designed to try to help and obviously to try to find solutions to the problems.

Q125 **Chair:** I am sure the successor Committee to this—as we will be into the next Parliament by the time you report—will be interested to look at the conclusions from your work. Thank you.

Larissa, could you give me your top line on the primary sources of indoor pollution that you have identified?

Larissa Lockwood: We have been working on home heating and cooking, because so many of the causes of air pollution in the home also contribute to climate change and you can tackle both at the same time. Through our work, we did a project with NAQTS and measured both indoor and outdoor air quality at the same time in a number of homes. We found that, on average, indoor air pollution was about 3.5 times higher indoors than outdoors, with some dramatic peaks. When people were cooking, levels of air pollution indoors were about 500 times the level outside. That was a big source. We have been doing work on gas cooking, and also when people use their log burner.

Q126 **Chair:** Is that all gas? Were you only looking at gas cookers?

Larissa Lockwood: We were only looking at gas cookers and looking at domestic burning, so when people are using their log burners you get those peaks. As Professor Whitty alluded to, the emissions then get trapped in the home. These peaks that are 500 times higher than outdoor air pollution then hang around in the home. They take hours to dissipate, which is why these levels build up. We have been focused on those areas.

It is worrying, because we spend so much of our time indoors. I think there is a real need for people to understand that these are sources of air pollution and the health harms associated with them. Because there is a lot of particulate matter, pollution from domestic burning. There is a lot of NO₂ pollution from gas cookers and what some of the solutions can be. We work on public awareness and engagement campaigns to help give



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people the information, and people are at very different stages of understanding.

At the moment, our research shows that very few people understand that solid fuel burners are a source of air pollution, let alone that that pollution is bad for their health. Interestingly, people with a solid fuel burner are less likely to be concerned about the health impacts of that burner. There is a real need to let people know what the problem is, and then what they can do about it.

We also know that the demographic of people using wood burners is predominantly in urban areas, the higher socioeconomic groups. We have been working with Kantar on some research that shows that the majority of that group are using it for aesthetic purposes. It is a lifestyle choice, rather than a primary heating choice. It is a different story in rural areas, but in urban areas this has become a lifestyle choice for many, and wood burners and log burners are on the rise. I think there is estimated to be a 2% to 3% increase each year.

We need to stem that flow, turn off the tap, make them less glamorous, less of a lifestyle choice, so working with mass media, with home design programmes to deglamourize it. Also, I think health labelling of products would be helpful as well, so people when they go to choose a log burner know of the health harms that are associated with it, so they can make an informed choice. I have neighbours who have put them in and then found out about the health harms and have now stopped using them. That is quite an expensive mistake to make. People need that information up front as well as working through what can then be done to eventually phase them out.

Q127 Chair: Do you recognise what Chris Whitty said about the eco standard being much less polluting?

Larissa Lockwood: They are much less polluting, but if you look at the diagram in his report it is quite beautiful in terms of showing the number of emissions from different types of heating source. If you look at the comparison to gas boilers, gas boilers are so much cleaner, electric heating even cleaner. Therefore, we have to move towards decarbonising home heating and cooking, so looking at electric sources of heating in the home and also electric sources of cooking.

Q128 Chair: Tom, can you give us an overview? Perhaps you can explain this to me. Other members of the Committee may understand this, but I was labouring under the impression that stoves are generally vented through a chimney to the atmosphere and that they were airtight. Therefore, I had not appreciated the extent of indoor air pollution from woodburning stoves.

Dr Woolley: I hope we don't get too distracted on to stoves. We live in a house where we cook with gas, and we heat the house entirely with woodburning stoves. We don't think we have an air quality problem. That



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is because these things can be managed and controlled. What I want to leave you with today, if I can, is the idea that there are serious pollutants in buildings that people cannot control, because they are in the fabric of the building. The buildings are made with materials that are increasingly emitting chemicals. Those chemicals have only been used in buildings in the last 30 years. It is a very recent problem. They are increasing all the time, and it is a very serious and worrying problem and it has very serious effects on people's health.

Related to that is the fact that we can build buildings without using those chemicals. When we do that, we use what we call breathable materials. That is not a very technical term; the correct term is vapour permeable. We can make healthy buildings that are free of chemicals and are also using hygroscopic materials that make it virtually impossible for mould growth. Earlier there was talk about airtight buildings and that is happening increasingly. We have new buildings that are airtight and retrofitted buildings, making them more airtight. We can mitigate that problem by using vapour permeable materials. In fact, the company that we mainly use to supply the materials to do these buildings is in your constituency, Chair. Therefore, these companies are around and they do a very good job, but they are very marginal because people are not aware of the serious problem of chemicals.

When you look at the international literature on indoor air quality, the main focus is on chemical emissions from the chemicals used in building materials. All the other issues that we have heard about today are also important, but they can be controlled through human behaviour. People, when they buy a house and move into it, don't realise the level of chemical pollution that is already in there, in the fabric, that they cannot change. That is my main focus.

Q129 Chair: I must talk to you afterwards about my constituency company, but can you illustrate for us the kinds of products that have chemicals that you are concerned about? Presumably this is primarily insulation material.

Dr Woolley: Yes. It is such a massive problem, and I am probably the last person to ask about this, because I am completely obsessed with it at the moment. I have produced a list. For instance, I brought along my last book. I am working on volume two of this now. I have 18 pages of chemicals in building materials. We are talking about insulation materials, flame-retardants, PFAs, the for ever chemical, and so on. There are a wide range of these chemicals. To be quite honest, we don't know why they are used. The Environmental Audit Committee looked into flame retardants, but I think the main focus was on furniture.

The flame retardants used in building materials, which are highly toxic, carcinogenic, endocrine-disrupting chemicals, have serious health effects and often don't do the job they are supposed to do anyway. I can talk all day about all the materials and half the time—as an architect, I am not a chemist—I cannot even pronounce the names of many of them. I have to



read from my texts to explain those. There is a vast range of VOCs, SVOCs, formaldehyde and, as I said, PFAs and so on. There is a wide range of chemicals. We need to stop them. They need to be controlled. It is not in the building regulations.

Q130 Chair: This takes me on to my next question. Do you or do others have the data—to go back to the point that Sir Chris made about evidence-based policymaking—and is the data robust about what kinds of chemicals cause which kinds of problems? Is it widely recognised that this is the cause?

Dr Woolley: No, it is not widely recognised. That is the problem. When you read my evidence, you will see that I am quite critical of both of the NICE review and the DEFRA review on indoor air quality because it largely—if you excuse the pun—brushes the problem under the carpet. They have largely ignored the problem of emissions from chemicals, but the evidence is there in the international literature without a doubt. There is plenty of evidence there.

Q131 Chair: Perhaps I can turn to our professor of indoor air quality to talk about data and evidence. In addition to the study you mentioned in Bradford, are you looking at individual chemicals, to pick up Tom's point?

Professor Carslaw: No. The issue that with outdoors now, we have been monitoring for many years and we have a good feel for long-term trends. The indoor air quality studies that have happened tend to be snapshots. Someone will go into a building. Quite often, they are focused on human activities, like cooking and cleaning. You might make measurements—*[Interruption.]*

Q132 Chair: We have lost you. Frozen. While we try to bring Nicola back, Larissa, can you shed light on this issue of evidence to try to improve policymaking in indoor air quality?

Larissa Lockwood: Yes. We have been working with an organisation called CLASP recently to look at the impact gas cooking has on health. The UK has one of the highest rates in Europe of homes that cook with gas; I think 36 million homes have a gas cooker at the moment. Gas cookers are one of the main sources of indoor air pollution, which means that potentially 36 million households live in homes, and spend a lot of time in homes, with levels of air pollution that violate even the UK outdoor regulations let alone the WHO guidelines.

Through that work, we have discovered that children living in a home with gas cooking have a 42% increased risk of current asthma, and that over 500,000 children in the UK suffered asthma symptoms in the last year due to cooking on gas. It seems that this has a material impact on people's health and especially on children's health.

This needs more serious attention. The Government are looking at phasing out gas boilers. I think that 2035 is the target date for that. Gas cookers are not mentioned at all. That seems to me a fairly easy win. If



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you are trying to reduce the amount of gas used in the home, look at the gas cookers as well.

Of course, you can do various things. For new builds, it is easier to stipulate no new gas cookers and you must cook on electric instead. Induction is a sound alternative these days rather than the more old-fashioned and less responsive electric hobs. There are good alternatives now. We need to work out that pathway to get rid of all gas in the home including gas cookers.

I wonder if doing it from an air quality perspective makes people move on it a bit quicker. We do quarterly polling looking at the public's attitudes and behaviours towards air pollution. People reported being much more willing and feeling more able to replace a gas cooker with an electric cooker than they would a gas boiler with a heat pump. It seems like it would be an obvious and perhaps easier next step to help decarbonise the home and reduce some of these serious levels of air pollution that gas cooking causes inside.

Q133 Chair: Thank you. I will stop you there because we will come on to heating and cooking specifically in a moment. Nicola, you froze in midsentence. Perhaps, if you can remember what your sentence was, you could conclude what you were saying about data. Then I have another couple of questions for you before we move on.

Professor Carslaw: I was just making the point that we need more longer-term measurements, so that we can understand the difference between longer-term exposures to some of the chemicals that Tom was talking about versus short-term exposures to very high concentrations of several hundred micrograms per metre cubed when you cook, for instance. If you fry meat, you can make particulate pollution levels maybe 30 or 40 times higher than Oxford Street. It is trying to weigh up which of those types of exposures is worse for health.

Q134 Chair: To work that out, we need systems of measurement. Do you have a view as to whether personal monitors versus static monitors in buildings are feasible and are reliable?

Professor Carslaw: It is tricky. Personal monitors are tricky. It is hard to do lots of people at the same time.

We are building a new facility at York—a bit of a plug—but here we are building, basically, a semidetached house. One side will be representative of typical British build standards. One side will be a passive house. We can do the same experiments in both sides and then we will have an integrated laboratory in the middle where we can sample air from both buildings. We will be out to do some of these studies that look at the impact of air tightness but also, maybe more importantly, monitor the concentrations of things that are off-gassing from the building materials from the start of the building's life and have a longer-term record of what happens in a home as you move into it.



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Chair: Interesting. Thank you. Barry Gardiner.

Q135 **Barry Gardiner:** Professor Carslaw, can I ask you about our schools? We know that children are growing. They have higher respiration rates. They spend a large amount of time outdoors, but indoors they are physiologically more sensitive. Are air pollutant levels in typical school buildings safe?

Professor Carslaw: Chris Whitty was asked something similar about this earlier. It is hard to generalise. There is no reason to think that being inside a school would be particularly dangerous; it depends where that school is. If that school is located next to a busy road, that will probably be the highest exposure source.

The problem comes when you have overcrowding. We saw that with Covid. Some of the school estate is very old and not ventilated well. Both Larissa and I work on a programme called TAPAS, where we look at air quality in schools. We know from talking to some of these schools that they are unable to open windows anymore. Over the years, they have been painted over. There is an element of the school estate perhaps needing to be upgraded. A lot of this goes back to ventilation, again, and making sure that schools are adequately ventilated.

Q136 **Barry Gardiner:** Let's turn to landlords, Ms Lockwood. Should they be required to provide tenants with information on indoor air quality in the buildings that they are renting out?

Larissa Lockwood: Everybody needs information about air pollution. We know from our polling that levels of public concern about air pollution are high. We also know that levels of public understanding about the sources of air pollution, the health harms of air pollution and what they can individually do to protect their own health are low. We need an overarching public health campaign and, as part of that, certainly, why shouldn't landlords give tenants information about how they can use the building to have as clean an air as possible. Landlords have a duty as well to reduce the sources of air pollution in that home.

Q137 **Barry Gardiner:** You say there is a duty but I presume you mean it is a moral duty rather than a legal one?

Larissa Lockwood: Yes, absolutely, to have cleaner sources of heating, to have cleaner sources of cooking, to consider the building fabric.

Q138 **Barry Gardiner:** Dr Woolley, you told us about the work that you have been doing as an architect but, almost as an aside, how it has led you to look at this area. What can be done to improve indoor air quality in existing buildings? You spoke about new build and you spoke about the changes that have come in over the past 30 years but, in existing buildings, how can we improve that air quality?

Dr Woolley: We can improve buildings by using the right materials. For instance, if you fill a building up with plastic, non-breathable, airtight



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materials, you will get damp and mould. It is very straightforward. It happens. Many of the retrofit measures that are currently used cause that problem.

This is widespread. I have done interviews on local radio stations the length and breadth of the land, because people had been getting in touch and saying, "We have mould in our house", and it was caused by retrofit measures. We can use materials that don't cause those problems. Unfortunately, they are not normally used at the moment. The materials that are mainly used are chemical materials.

We have not touched on another issue that is relevant to what you are saying and that is about ventilation—

Barry Gardiner: I was coming on to that, yes.

Dr Woolley: —because one thing about gas cooking is whether you have a good extract ventilation system. Now local authorities, housing associations and landlords install these nice, shiny things over cookers that just recirculate the air. They don't extract at all. In fact, I did not realise this was happening until I came across it in a local authority scheme where they were putting these in and the tenants were terribly pleased—"Now our air will be extracted"—until I said, "Where is the extract pipe taking it outside?" "Well, isn't there one?" I cannot believe that that has been done and they are spending a lot of money on it. Sometimes these things can be dealt with quite simply. If you have good quality ventilation in a building it can certainly reduce the problem.

I want to come back to source control. At the end of the day, you need to use the right materials and you need to look at the fabric. That will need a massive change in current thinking and practice. It is a huge problem because we are using all the wrong materials. People believe in these wonder chemical, flammable, toxic materials. They think they are good. It is scary.

I discovered only recently the levels of flame retardants that they use in airtightness membranes. Those flame retardants are quite volatile and then will off-gas into the indoor air. However, we don't have the data on this. As Professor Carslaw was saying, we need to do a lot more research.

Q139 **Barry Gardiner:** In each of those applications, if I can put it like that—schools and tenanted buildings and existing buildings and workplaces—we want to improve but that means setting standards. Should there be air quality standards limiting indoor air pollution concentrations in all public buildings and other shared spaces, like schools? Should that be a recommendation that this Committee makes as a result of its inquiry?

Dr Woolley: In the building regulations at the moment, you build a house and you then have to test for its airtightness. People come along with a whole lot of kit and they put up a fan and they blow air into the building. It is quite an expensive process, but they don't check the



ventilation. There is no requirement under the building regulations to assess whether the ventilation works or not. They certainly don't assess the indoor air quality. There is a lot of talk about sensors and so on. I am afraid I am a bit cynical about these sensors, although you can get some information about what are called total volatile organic compounds, but you don't actually find out what is really being emitted.

We can do indoor air quality testing. It costs about £300 or £400. A sample of the air in the building goes off to a laboratory and you get a whole list of chemicals that are emitting within the building. That should be a requirement for buildings. We should have to do that. In my view, it is far more important than testing the airtightness.

Q140 Barry Gardiner: In terms of regulation, when people look at new build—and predominantly you are talking about new build here rather than older buildings—should it be part of the building inspection regime that they look at the ventilation? Also, earlier you talked about the combination of ventilation and filtration to make sure that you capture the heat so that you tackle climate change as well as indoor pollutants.

Dr Woolley: Absolutely. You seem to know quite a bit about this. That is exactly the case. That is needed but, at the moment, it is not on the agenda. This Committee can refer to the Building Regulations Advisory Committee, BRAC, and say, "You are not doing enough on this". It is aware of the issues. There have been reports and studies particularly on the failures of ventilation, important work done by Ian Mawditt for the Government, but it has not been followed up.

It is not easy and you are right that this is new build. We have to do this for retrofit as well. It is not an overnight change, but we are not even moving towards it. We need to have the data that shows the levels of flame retardants, for instance, that are present in buildings.

Q141 Barry Gardiner: Piecing together from what all of you have said, we don't yet have the data sufficient to set the standards that we need to retrofit to. We know what we can do for new build but to tackle the much greater problem—retrofitting our building stock—we need a sustained programme of data capture and standard setting. Is that fair?

Dr Woolley: The Clean Air Programme—and I am chair of the steering committee for that—has only just got hold of the issue of indoor air quality and the data collection at the very end, just as the money is about to run out. You have heard about three or four of the projects today. The WellHome Project that Imperial is doing in west London will yield some data on this, but the money has run out and we don't know whether there will be any further funding for more research on this in the future.

Q142 Barry Gardiner: Would you wish this Committee to make that recommendation?



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Dr Woolley: Definitely. People will not accept what I suggest unless you have the evidence to back it up.

Professor Carslaw: We need more longer-term monitoring. A sensible place to start would be in schools because we care about children and they have immature immune systems. To me, that would be a logical place to start long-term monitoring and to think about introducing regulations.

For some of the pollutants, we already know. We have WHO guidelines, as Professor Whitty alluded earlier, so we know what levels of PM_{2.5} we should be exposed to and what levels of NO₂ are safe. That is the same if we are exposed to them indoors or outdoors. We know quite a lot about some of the pollutants. Schools would be a sensible place to start. We cannot do everything, but schools would make sense given the vulnerability of the children.

Larissa Lockwood: To echo that, the World Health Organisation guidelines apply to both outdoor and indoor settings, apart from some occupational areas. That is worth bearing in mind. There is work—

Q143 **Barry Gardiner:** What monitoring is done of them indoors?

Larissa Lockwood: Systematically, very little. The British Standards Institution has a new code of practice that aligns with the WHO limits. That looks at health and wellbeing and indoor environmental quality in buildings, so work is being done in this area.

Q144 **Barry Gardiner:** Who is responsible for that monitoring and what enforcement measures are within their power?

Larissa Lockwood: Nobody at the moment.

Q145 **Duncan Baker:** I will talk about the questions of ventilation. We know poor ventilation, increased humidity and suchlike all leads to poor air quality and many issues that stem from that. How important is effective ventilation for improving indoor air quality? What are the most effective types of ventilation for improving indoor air quality?

Dr Woolley: You have to have good ventilation, but ventilation does not get rid of the problem. Say you have a building with serious off-gassing of chemicals in that building that come from the materials. If you increase the ventilation, you can probably improve the air quality so that it appears to be better. However, if you turn that ventilation off, they are still there. The chemicals are still lurking in the building. Ventilation is essential.

Purge ventilation is incredibly important. There was an amazing study done of different countries in Europe—at the Poles and other places—in which 70% or 80% of people open their windows in the morning, however cold it is. We are at the bottom of the list. British people don't



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open their windows and don't purge ventilate their houses. Simple things can be done, which are partly to do with the behavioural aspects of this.

Ventilation is only part of it. The essential way to deal, for instance, with mould is to use hygroscopic materials, which can regulate the humidity. In most houses, relative humidity is around 75% to 80%, which is the level at which mould growth can develop. We can make houses now using hygroscopic materials where the relative humidity stays at 50%.

A study done by Professor Griffiths at Ulster University monitored one of the houses that we built for a year. That showed that the relative humidity stays the same.

Q146 **Duncan Baker:** What is the cost implication of that?

Dr Woolley: It is cheaper. This is not expensive or luxury. It is simple and easy to do. We put hygroscopic materials into buildings in relatively small quantities. That will be enough to mitigate the problem and reduce relative humidity. Whacking up the ventilation unfortunately does not necessarily change the relative humidity. The relative humidity is related to the building materials. The more plastic the impermeable materials that you have in your building, the more the water will run down the walls and the mould will get established.

Larissa Lockwood: I will defer to colleagues on the ventilation question, but I will echo the point that ventilation is important. But we have to focus on source reduction, getting rid of the pollutants at source: the heating, the cooking, the paints, varnishes, building materials, personal care products and cleaning products. There is so much that we are bringing into our homes and using that creates this chemical mixture. Yes, you can ventilate and put it out the window, but essentially you move the problem elsewhere. We have to focus on source reduction. I will defer to Nicola. She is the expert on ventilation.

Q147 **Duncan Baker:** Yes. Professor Carslaw, would you like to echo those thoughts?

Professor Carslaw: Yes. We have not mentioned that outdoor air pollution often stops people ventilating their homes. The other obvious thing to do here is to get traffic off the roads. Improving our air quality outdoors makes it easier for people to ventilate. Then maybe you will get people opening windows like the Poles do. It used to be a lot more common in the UK as well that people would open their windows.

Q148 **Duncan Baker:** Getting traffic off the roads is probably easier said than done. Are air cleaners and filters effective at improving indoor air quality?

Professor Carslaw: I have a real bugbear with air cleaners because they are completely unregulated. The Government could help here. At the moment, there is nothing to stop anybody building something that they call an air cleaner or, even worse, an air purifier and marketing it. The general public looking at these things have absolutely no idea if they are



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effective or not. Quite often, these things would be marketed as removing 99% of Covid or other viruses but some of them through that operation will produce chemical pollutants, including ozone.

I work with manufacturers of air cleaners. We have some attached to our TAPAS network that I mentioned earlier. The responsible ones are frustrated by the lack of regulation. They would like to see regulation because they believe in their products that they have tested properly. This is an easy win situation. Those people who have to ventilate their buildings because they live on a busy road, for instance, have to be sure that an air cleaner that they buy has been through some sort of standards testing, which they are not at the moment.

Q149 Duncan Baker: If you don't use an air cleaner, what is more effective? If you call for regulation and if you say that you have a particular bugbear with air cleaners, what is a more effective way of improving that indoor air quality?

Professor Carslaw: You could use air cleaners. They need testing. Some technologies like HEPA filters, for instance, work basically on physically removing pollutants via filtration that are fine as long as you maintain the filters and change the filters when they get clogged up. There are lots of technologies we know make ozone or nitrogen oxides through their operation.

A standard testing procedure needs to be set up for these things before they go to market in the UK. The responsible manufacturers—because we don't want to stop innovation and some of these air cleaners are absolutely fine, but a lot are not.

Q150 Duncan Baker: Thank you. On to something that is close to everyone's heart in the EAC: energy efficiency of our homes. We have run numerous inquiries and touched on this issue many times over the last few years.

There appears to be something of a trade-off between improving the energy efficiency of your home and then indoor air quality, particularly when we look at the thorny issue of retrofitting our leaky older housing stock. Dr Woolley, can you comment on that issue particularly?

Dr Woolley: It is simple: stop wrapping everything in plastic. That is the simple solution. The plastic comes with a lot of toxic chemicals. It stops the building breathing. Old buildings might be leaky and not very efficient but they probably were a lot healthier, apart maybe from the lead paint and the windows. We can create buildings that are vapour permeable using hygroscopic materials that allow the building to breathe and then can control moisture. That is the best way.

The other interesting thing about some of the materials that we use to do that is that they also contain thermal mass. A lot of the materials that are currently advocated to make buildings more energy efficient are lightweight. That means that buildings overheat. In fact, this has become



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a massive problem now. The Government are very much aware of this. A lot of research is going on about what on earth we do about it.

The simple solution is to use more thermal mass in the building. If you use an insulation material that has thermal mass as well, that will help to mitigate that problem as well and will make the building more efficient.

At the moment, energy efficiency is measured using the standard assessment procedure, which does not consider specific heat capacity. I am sorry to get technical about this, but specific heat capacity is not part of the building regulations and yet it is essential to understand how buildings work physically.

A whole load of work needs to be done on building physics. If you look around the UK, there is not a single department of building physics in any university as such anymore. You have to go to Belgium and other places to find experts on these sorts of subjects. We don't teach people the right skills. We don't give them the right information. We promote a form of energy efficiency that causes serious problems and often leads to what journalist Kate de Selincourt called the retrofit disaster problem, which is a serious worry.

Q151 Duncan Baker: Larissa, how will you marry those two issues together?

Larissa Lockwood: I look at it from the perspective of carbon efficiency and air quality and source reduction. Woodburning is pretty much a disaster for climate change. Even the Committee on Climate Change has recommended that the Government should not support woodburning stoves as part of the climate policy and that they should be phased out, due to not just the air quality impacts but inefficient heat generation and suboptimal use of finite bioenergy resources.

Q152 Duncan Baker: There was a quite alarming statistic by Professor Chris Whitty in the first session.

Larissa Lockwood: Yes. If we look at climate change versus air quality, we need to tackle both in the home at the same time by decarbonising heating and cooking sources. It would reduce or phase out the use of domestic burning in urban areas and transitioning away from gas to cleaner energy sources, like electric heating and cooking in the home, and, therefore, will get those air quality benefits.

Duncan Baker: A final say to Professor Carslaw on this.

Professor Carslaw: We are trying to do this with the new facility at York that I mentioned. We will be able to answer these sorts of questions because one side of the house will be a passive house standard, which should be well thermally regulated, and the other side will be more like a standard UK build.

These are some of the questions we can start to address: what is the payoff between energy efficiency and air quality? Is there a win-win



situation here? Can we work on the energy efficiency while maintaining the indoor air quality? They need to be considered together.

Chair: Thank you, Duncan. Most unusually, Barry Gardiner will have a second bite of the cherry.

Q153 **Barry Gardiner:** Thank you, Chair. VOCs—I hate acronyms. Professor Carslaw, for the benefit of any member of the public who is watching this, how can somebody sit in a building and do nothing but the building could in some way poison them at the same time? What is a VOC?

Professor Carslaw: It stands for volatile organic compound. They are typically chemical species that contain carbon, hydrogen, sometimes oxygen and sometimes other things.

The ones that we tend to focus on indoors are the ones that are fragrant. If you use a shower gel or perfume or aftershave, the characteristic smell that you get with that product will come from the volatiles, which is why they are called volatile. They off-gas to give you that fragrance.

The problem does not come with the volatile organic compounds themselves, often, although formaldehyde is an exception. Some volatile organic compounds are carcinogenic and are emitted directly. Formaldehyde is in various building products. Often the problem comes through the chemistry. We know that these VOCs will react with oxidants in the air, like ozone, that come in through windows, and those reactions lead to the formation of these fine particles that Chris Whitty was talking about.

At the moment we have no idea—and Chris Whitty alluded to this as well—which sort of particles are worse for your health, but we know that activities like cleaning and using these fragranced compounds, like scented candles indoors and air fresheners, can lead to quite high concentrations of particles forming. Often the secondary reactions drive the adverse health effects.

Q154 **Barry Gardiner:** Formaldehyde, in particular, would come from plywood, wallpaper paste and stuff like that, which all of us use or have in our homes. You particularly highlighted that one. The trouble is that our scientific understanding and our regulation of volatile and semi-volatile organic compounds does not keep pace with new product development. At least the Royal College of Physicians seemed to tell us that. Would you agree with that? Should there be some way in which those who create new VOCs are obliged to respond in some way to that problem?

Professor Carslaw: Yes, I agree. It is not just about VOCs, either. It is about the mixtures of VOCs. In some of the work we have done at York, we have been looking at playing around with the mixtures. Imagine you have a cleaning product and you could tinker around with the VOCs to look at what chemistry goes on afterwards. You can find that you can make more or less particles depending on that mixture. However, the



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information we don't have at the university is why those products are in the cleaning formulations to start with.

There is a lot of cloak and dagger around the ingredients in cleaning products and other things we use in our homes. Quite often they are hidden by a word like "perfume", which could actually be 30 to 50 different VOCs. More information needs to be on labelling, giving consumers more choice.

It is worth mentioning this explosion of so-called green or natural cleaners. We have been looking at these at York as well and comparing them with more traditional cleaners. There are as many, if not more, VOCs in the green products compared to the traditional ones. People seem to have this feeling that if something is natural it must be good for you, but it does not matter if you get the smell of a lemon from the lemon itself or from a synthetic version of that VOC. It has the same health effects. It has the same reactivity.

It is about labelling and talking to manufacturers about responsibility. I have even seen some cleaning products online advertised as "chemical free", which is clearly ridiculous because water is a chemical. Some responsibility is needed with how we label these things and how we give the consumers the information they need.

Q155 Barry Gardiner: Would labelling products that lead to those exposures be effective enough to inform the public? I am thinking in particular not just of products like air fresheners and cleaning products, which are retail products that someone buys, but then the wholesale products that are embodied within the structure itself. It seems to me that labelling may not be as effective there as it would be in individual scented candles, for example.

Professor Carslaw: Yes, that is a good point. I cannot help but think there must be a way. We did it with paint. Paint used to be very high emission. When I was a little girl, I remember my dad was painting and it was terrible. We had to leave the house for several days. Now paint emissions have got much lower. I am not entirely sure but I think that came about through the European REACH regulation. Things have definitely improved. Paints will now be labelled as low VOC. Tom might know more about this.

Q156 Barry Gardiner: You say that but a recent survey found that redecorating has been associated with an increase in concentrations of VOCs, which increase the risk of infants under one year of age being diagnosed with wheeze and acute inflammation of their airways. Many parents will redecorate the room in readiness for a new baby and then put it into that toxic environment. We should take the whole issue around redecoration much more seriously from an infant health perspective.



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Professor Carslaw: Yes, I guess so. I wonder if it is to do with—again, Tom might know more about this—some of the antifungals and other things that they put in paint these days.

Dr Woolley: You took the words out of my mouth. They put fungicides into so many materials now because of the problems with mould, but the fungicides themselves are pesticide and are toxic.

It is important that REACH has been mentioned. One of the most boring things I do in my life is to read health and safety datasheets—

Q157 **Barry Gardiner:** Sorry, again, for the acronym watch, but is that the registration, evaluation, authorisation and restriction of chemicals regulations?

Dr Woolley: Yes. Also, to give you another acronym, there is the COSHH sheets. Manufacturers are required to publish these COSHH sheets. You will find now that there is no information on them. They say, "Nothing known", or, "Complies with the REACH directive or whatever". You cannot find the chemicals that you used to.

I have discovered that the same companies will publish health and safety datasheets in Canada and Australia, which are the old-fashioned ones that still list the chemicals. In the UK, they don't do that anymore. They leave the information out.

I have a meeting coming up with someone in the Health and Safety Executive whose job is to work on the REACH directive. It is another area of complexity in all of this because, if you have ever tried to find out information from REACH, for instance, which operates out of some bunker in Gothenburg in Sweden and you have to know the reference number exactly to find the product, and the companies change the formulation all the time and submit new information to REACH, which means you cannot track the products. There is a lack of transparency in all of this and it is quite hard work to get the information.

Q158 **Barry Gardiner:** That is fascinating. How could it be better regulated, given that we in the UK are no longer part of the EU REACH directive?

Dr Woolley: We still do it. Because companies in the UK want to trade in Europe they have to comply with those regulations anyway.

Until I meet this person from the Health and Safety Executive, I am not sure whether they have enough funding to do this work. I will let you know when I have spoken to them.

Chair: Thank you. As you are clearly a student of companies based in my constituency, Tom, I should probably also mention that adjacent to my constituency near where I live is a natural paint company, which has no chemicals in its product. It is doing well as a result. Thank you. Ian Levy.

Q159 **Ian Levy:** Thank you, Chair. I would like to declare two points of



interest. The first is that we have a family farm and we supply logs to the log-burning industry and people's homes. The other one is to Clive. My wife and I bought a log burner and it is great and I recommend it. We went for a DEFRA-approved log burner.

Clive Lewis: However, you had hair the other week, so I wonder if—

Ian Levy: I burned it off, yes. Thank you. Tom, what is the impact of solid fuel burning on indoor air quality?

Dr Woolley: You have heard quite a bit about that already today. In some circumstances, it has a serious effect. A lack of regulation and confusion seems to surround it, for instance.

Let's have another acronym: HETAS. I had a massive argument recently with a building control official who told me that HETAS was a Government body. I said, "No, it is not a Government body. It is a private trade organisation". I have nothing against HETAS. It is an earnest group of people who are trying to improve regulation in this area.

This issue came up when I had an interesting disagreement with a colleague at Imperial University—I will not say who—about this. He is particularly passionate about this issue. I waded into this to discover that it is a bit of a jungle and a bit of a mess. A lot of work needs to be done. There is definitely some information and it is a problem in some places. Some people install the wrong kinds of stoves and so on.

On the other hand, we monitor the particulates in our own house, where we have two woodburning stoves. We use dry wood that comes from our own woodland. You will be familiar with that. That is not a serious problem in our own particular house, but we are in a rural area. It is quite different if you have people opening up old fireplaces in west Belfast, burning plastic and all sorts of rubbish just to keep themselves warm because they cannot afford the heating. That will not be good for people. It is a complex issue and a bit too much emotion and propaganda flies around about this at the moment. We could do with taking a step back and reviewing this a bit more carefully.

Q160 **Ian Levy:** Larissa, are you of the same opinion?

Larissa Lockwood: Not entirely, no.

Ian Levy: I did not think you would. That is why I thought I would go there.

Larissa Lockwood: We had the first meeting for 10 years of the academic and policy and NGO community around domestic burning last week, facilitated by the UK Clean Air Champions, one of whom came to give evidence here a couple of weeks ago. This issue has not been addressed and it is a growing source of particulate matter pollution and a growing concern, especially in urban areas where most people live because it has become an increasing trend.



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Interesting research done in Nottingham across a number of homes across the city showed that those with a woodburning stove had three times more PM2.5 pollution than those without. That echoes some of the research that we have done previously with monitors. Obviously, Tom, you burn very cleanly. It does depend on what an individual is doing in the home. Then it also contributes to the outdoor air pollution. It is both an indoor and an outdoor air pollutant.

Q161 Ian Levy: Is that down to what people burn?

Larissa Lockwood: Not just that, but the fact you are burning something. As the nice diagram in Chris Whitty's report shows, any woodburning stove is more polluting than electric heating or gas heating.

The PM2.5 pollution that woodburning stoves and solid fuel stoves create is one of the most harmful pollutants to health. It is linked to respiratory cardiac health conditions and cancer. The more you are exposed to, the more likely you are to die from pulmonary disease or lung cancer.

This is not talked about. It is a raging trend and we are not having an informed conversation about it. People need the facts. We do the market research. People don't understand that they are a source of air pollution, nor how to manage that, nor what the health implications could be, so they are not making an informed choice.

People don't want to be told not to burn at the moment. Through our market research, people say, "Give us the information. We will make our own informed choices". Some of those who know will burn less, as some of our pilots have shown.

Q162 Ian Levy: If we can stay on that theme, could you touch on the impact of going from cooking with gas to cooking with electricity and what benefits there would be of that? Can you expand on that?

Larissa Lockwood: Yes. Gas cooking is the largest contributor to nitrogen dioxide air pollution in the home, so essentially getting rid of that as a source of air pollution. Some 36 million homes in the UK have a gas cooker and it exacerbates asthma symptoms, especially in this research that has been looking at children. Potentially, if you take gas cookers away, 500,000 fewer children could suffer asthma symptoms, which to me seems quite significant.

Of course, there will be other pollutants generated through cooking. The act of cooking itself creates pollution, and that is why ventilation is important. Definitely, indoor levels of nitrogen dioxide where gas cookers are present can be two to five times higher than outdoors. By taking that source away and switching to electric, you will reduce exposure to NO₂ significantly.

Q163 Ian Levy: We have covered quite a lot in that but, Nicola, what would encourage a shift from gas to cooking with electricity? What would encourage the public to make that move?



Professor Carslaw: Knowing that it is a thing. Lots of research out there now shows that cooking with gas produces higher levels of pollutants than cooking with electricity, like Larissa said. You would immediately get a reduction in NO_x and a reduction in particulates as well.

Some of the work we have done has looked at levels of particulates that have formed from cooking. Frying meat can generate enormous quantities of particles, as in 300 micrograms per metre cubed. If you set that in the context of the WHO limit of five, you can see that that is a very high concentration.

There is also the link to the fossil fuel argument here. We could do lots of things here that would help with climate and help with health. We should all eat less meat anyway. This is real nanny state stuff, but if you really want to reduce particulate matter emissions indoors, fry less meat and cook with electricity or induction. Having cooker hoods venting to the outdoors is pretty fundamental but, like Tom, I have been amazed to find that some cooker hoods vent back into the kitchen. It is a combination of education and also regulations around how we ventilate our kitchens.

Dr Woolley: Carbon monoxide—we have not mentioned that—is absolutely critical. I need to mention it as well because I am chairman of the parliamentary forum on carbon monoxide. They would be a bit annoyed with me if I did not bring it up. Carbon monoxide is still a big problem in the UK. Not only are there deaths from carbon monoxide, but they are beginning to realise that at a lower level it can have quite serious effects on both health and mental capacity. Clearly, with the sorts of things we are talking about, carbon monoxide would be less of a problem. If you have a stove installed, you have to have a carbon monoxide detector with it because there is a clear association. It is quite important not to forget the carbon monoxide issue.

Q164 **Ian Levy:** I have one more question, if I may, before I finish. We went through an official authorised fitter to fit and supply the stove. Does everybody have to do that at present or are people fitting these stoves—

Dr Woolley: There are rogues out there.

Ian Levy: That is the point I am trying to get at, yes.

Dr Woolley: It is not well enough regulated at the moment, in my view, despite the fact that people are doing something. It is not well enough regulated. As Larissa said, a lot of information is collected now but we need to bring it together and assess it calmly and look at the best way to deal with it in the future.

Q165 **Chair:** Can I pick up two points? Nobody has mentioned burning the toast. I imagine burning the toast isn't great but it is quite hard to regulate against that, at least among members of my family.

Professor Carslaw: That experiment has been done, yes.



Larissa Lockwood: That experiment has been done. We have seen that go through. It was up to 500 units on toast burning.

Q166 **Chair:** Thank you. I am pleased you mentioned carbon monoxide. It came up in our discussion with Professor Whitty earlier. In my constituency I had a death from carbon monoxide poisoning on a campsite a few years ago and have taken an interest in it ever since.

We have an increasing prevalence of carbon monoxide monitors in particular for rental properties, hotels and so on. At the moment, the monitor is binary. It activates at a certain level to protect lives but not necessarily to protect from harmful levels for health. Do you suggest that we could reduce the scale and thereby provide an alert when levels are higher but not life-threatening?

Dr Woolley: I am still learning about this, but a couple of campaign groups are critical of the current regulations and methods of measuring carbon monoxide. More work definitely needs to be done in this area. You are right that it is slightly crude. Never having had a carbon monoxide detector go off in a building that I have been in, I still need to learn more about that. We need to look at the science of that.

Of course, a lot of people still don't know what carbon monoxide detectors are. "Yes, we have one", they say, but no, that is a smoke detector. They don't even know that there is a difference between that and a heat detector, for instance. There are issues about the way that is dealt with within the building regulations, which I feel are not satisfactory at the moment.

Chair: Good. Thank you very much indeed. Sorry, Nicola, did you have your hand up?

Professor Carslaw: Yes. You can get in touch with the CO Research Trust or CORT, which looks at carbon monoxide. I believe it is starting to do work looking at health effects at lower levels, around a part per million, which is lower than we have considered to be harmful before.

Chair: Excellent. Thank you. We will certainly do that. I conclude by thanking Professor Nicola Carslaw from York, Larissa Lockwood in the room and Dr Tom Woolley also in the room for joining us today. I thank Kerry Stewart for providing an excellent brief for us and Ian Byrne for joining us from another Committee.