

**REPORT ON PROCEEDINGS BEFORE**

**PORTFOLIO COMMITTEE NO. 2 - HEALTH**

**HEALTH IMPACTS OF EXPOSURE TO POOR LEVELS OF AIR  
QUALITY RESULTING FROM BUSHFIRES AND DROUGHT**

**Virtual hearing via videoconference on Friday 12 June 2020**

**The Committee met at 10:00.**

**UNCORRECTED**

**PRESENT**

The Hon. Greg Donnelly (Chair)  
Ms Cate Faehrmann  
The Hon. Wes Fang  
The Hon. Emma Hurst (Deputy Chair)  
The Hon. Natasha Maclaren-Jones  
The Hon. Taylor Martin  
The Hon. Walt Secord

**GUY MARKS**, Chief Investigator and Head, Centre for Air pollution, energy and health Research, affirmed and examined

**SUZANNE HOLLINS**, Head of Research, Nuclear Science and Technology and Landmark Infrastructure, Australia Nuclear Science and Technology Organisation, affirmed and examined

**DAVID COHEN**, Distinguished Research Scientist, Nuclear Science and Technology and Landmark Infrastructure, Australia Nuclear Science and Technology Organisation, affirmed and examined

**The CHAIR:** I invite opening statements from the respective organisations. Can I just confirm that with respect to submissions made to the inquiry from the Centre for Air pollution, energy and health Research [CAR] your submission has been received and is No. 34 to this inquiry, and thank you for that, and with respect to the Australia Nuclear Science and Technology Organisation [ANSTO], your submission has been received and it stands as submission No. 33 to the inquiry, and thank you for that. For our witnesses to appreciate: all Committee members have copies of your submissions and have had now an opportunity to read them. So in making your opening statements you do not need to refer in detail to the content but rather perhaps set up a discussion for us which we can follow up with some questions regarding the terms of reference. If we start first with Professor Marks. Would you like to make an opening statement?

**Professor MARKS:** Yes, thank you, and thank you again for inviting me to present to you. I am sure you do not need me to say to you that these catastrophic bushfires that occurred in December and January were at the time a unique event but, sadly, as many people have not recognised, were probably a harbinger of our future. From a public health perspective, we like to think about layers of response and intervention from a prevention perspective. It is clear that much of the capacity to prevent these layers outside the domain of health are starting with, of course, action on global warming and climate change, which is the underlying cause, and proceeding through layers of prevention related to preventing the fires themselves and adequately controlling the fires, but ending with efforts to mitigate the effects of the bushfire smoke, and that comes more readily into the health space.

This was the first time really that we have had such a large population of people in our big cities that were exposed to such prolonged and high levels of smoke exposure, and for many people this was a new experience to realise that what is in some ways a natural occurrence—bushfire smoke—might have adverse health effects. Many people have thought of smoke as being a relatively benign phenomenon and the idea that this might have adverse health effects was not obvious to people. What it highlighted for us who were dealing with the health effects and trying to advise people about how to mitigate them, was how little we actually know about the short-term and long-term adverse effects of this smoke exposure and about the effectiveness of various strategies for protecting human health. Much of what we have presented to you in our submission is the little we do know and the need for further knowledge about how to mitigate this problem.

**The CHAIR:** Thank you very much, Professor Marks. Either Dr Hollins or Professor Cohen, would you like to make an opening statement?

**Dr HOLLINS:** Yes, I have a short opening statement on behalf of ANSTO.

**The CHAIR:** Please proceed.

**Dr HOLLINS:** Thank you to the Chair and Committee members for having us here today. We are grateful for the opportunity to support the New South Wales Government in its undertaking of this important inquiry. I am the head of research at ANSTO and my colleague David Cohen is responsible for leading the air quality research that we undertake at ANSTO. We, along with approximately 1,000 other scientists, engineers, technicians and nuclear medicine manufacturers, are ordinarily based at Lucas Heights campus in southern Sydney. Over 30 years ANSTO has played a leading role in measuring and characterising foreign particles in the air from a range of locations across Australia and, in fact, the world.

In New South Wales, ANSTO has around 12 air monitoring locations, from Newcastle down to Wollongong, including in the Sydney metro area, and our highly sensitive particle accelerators at ANSTO Centre for Accelerator Science analyse samples of air from these monitoring stations to determine the fingerprints of that air pollution. This analysis of those fingerprints tells us the source and origin of this air pollution with great accuracy. The measurements taken can detect more than 20 different elements including those found in bushfire smoke and wind-blown soils. This data has been used by our partners to guide environmental protection measures and to support health studies. In particular this analysis enables a greater understanding of the impact of bushfire smoke, which can inform decisions in response to and in preparation for future bushfire seasons. ANSTO is looking forward to assisting the Committee in this inquiry and enhancing its partnership with the New South Wales Government in air pollution studies. Thank you.

**The CHAIR:** Thank you, Dr Hollins, that was very good. That has set it up nicely for us. We will move to questioning now. The way we like to do it, if it is agreeable, is we have representatives on this Committee from Opposition, Government and crossbench and we share the questions around as we move through the next 35 to 40 minutes or so. We will get things underway. Would someone like to kick-off?

**The Hon. WALT SECORD:** My first question is to Dr Hollins. You made reference to these 12 air monitoring locations. How would you describe them? Are they sophisticated? What kind of monitoring stations are they?

**Dr HOLLINS:** I am going to hand that over to David Cohen because he actually runs these monitoring stations. I think he is better-positioned to answer.

**Professor COHEN:** Thank you. Our stations are actually fairly sophisticated; they have been running for quite a while. They are based on a cyclone system which was developed in collaboration with the US EPA in North America, where they had 70-odd such systems in national parks throughout North America. Their interest is visibility because if you go to one of these processes and seek a view then they set it up there. So we use their technology; it is called the improved technology, and we took that back in the nineties from them, the cyclone systems. They are full approved by the US EPA and what they do is they have a pump and a pump pulls air through the cyclone system, which circulates the air and the finer particles, the PM 2.5, 2½ micron diameter or less, the ones that you breathe deep into the lungs are the ones that are selected by these cyclone systems on a filter paper. We then take that filter paper and we put it in the accelerators at ANSTO and, using nuclear techniques, in a few minutes we can non-destructively analyse very small, 300 microgram samples, the 20 or 30 different elements. So they are a fairly sophisticated system.

**The Hon. WALT SECORD:** So they are not real, on-time—you have to go there. Is it correct that you have to take the paper or the filter out?

**Dr HOLLINS:** It looks like David has dropped out so I will answer that. Yes, they are not real-time systems. I guess you could say they are complementary to the real-time systems set up by the EPA in various sites including some co-located with our sites. So those EPA sites just tell you about the total mass of the particulates that are in the air. We take the sample back to ANSTO and we are analysing not so much the mass of what is in there but the constituents, the make-up of it. So we use that data and various modelling techniques and climate modelling to then apportion to say this particulate matter is made up of different sources—that could include bushfire smoke, it could include soils, it could include sea salt, it could include wood fire burning et cetera—but it is not real-time.

**The Hon. WALT SECORD:** Okay.

**Professor COHEN:** Sorry about that. That is twice my internet seems to have dropped off or something has happened.

**The CHAIR:** No, that is fine.

**The Hon. WALT SECORD:** Dr Hollins has answered my question. I would like to go to Professor Marks. In your submission—I cannot find the page number—in the section where you refer to the effectiveness of government plans for improving air quality and you talk about the messaging "not sufficiently nuanced". What did you mean by that?

**Professor MARKS:** I think the issue around the messaging is that we need to investigate better ways of informing the community about what is going on during the bushfires. Part of our problem was there was a lot of uncertainty in what messages we wished to convey, and this really comes back to what I said in my introduction that this was a first-ever event such as this and so we were trying to extrapolate from short-term exposures that had happened with previous bushfires, and much of the advice was difficult to translate to very long periods of time. For example, we were giving people advice like stay indoors and do not exercise. That might make sense when the bushfires are operating and the smoke is around for one day, but it is very difficult to sustain that when it is going for three months. So I think that is what we were referring to in that part of the submission, the fact that we really need better quality of evidence about what advice to give and then be consistent.

The other issue was there was some inconsistency around the country around the nature of advice that was given. That was before we had a National Cabinet and perhaps we needed one for this event as well. There were certainly differences between the States and jurisdictions in what advice was being given. So it comes back to knowledge and then translating that knowledge into messaging.

**The Hon. WALT SECORD:** Are you aware that previous evidence said that there were major differences or discrepancies between advice and categories between the ACT and New South Wales?

**Professor MARKS:** That was sort of what I was alluding to just then, that there were certainly differences and also between some of the States, but it is obviously much more obvious when it is a difference between the ACT and New South Wales.

**The Hon. WALT SECORD:** Do you think that that had an effect on the health of individuals who lived in the area?

**Professor MARKS:** I think it reduced people's confidence in the advice that they were given because obviously if they are getting different advice from different experts it is hard to have confidence. The actual impact on health would be difficult to quantify.

**The CHAIR:** Either the Hon. Emma Hurst or Ms Cate Faehrmann?

**The Hon. EMMA HURST:** Thank you. I have just got a question for Professor Marks. You mention in your submission that there is a need for further studies to investigate the effects of bushfires which last longer than several days. Is that a specific gap in the current research?

**Professor MARKS:** As I mentioned, this was the first time anything like this had occurred, so we are really in uncharted territories. So it is a gap and there is a need to try and investigate what the impacts of this most recent fire event were. The research designs that are necessary to do that investigation are not simple, but there are a number of different models of research design that might be relevant—some of them epidemiological, studying populations, examining what happened in the population—but some of them more basic research; experimental studies, for example, where we need to consider long-term exposures to smoke, which are novel in this country. I have to say they are not novel on a global scale, and many people in countries in our region—for example, in Indonesia, in the Philippines and Malaysia—are exposed to very prolonged fire smoke from agricultural burning, and that has been going on for a long time.

**Professor COHEN:** Can I pass a comment on that?

**The CHAIR:** Yes, please.

**Professor COHEN:** I think it brings up the need we came across back in the nineties when we started sampling for long-term sampling, and we have been doing that at ANSTO for decades around New South Wales. We have got data now going back to the 1990s. It comes down basically to cost for us. We can only sample twice a week; we do a Sunday, which is the weekend, and we do a Wednesday, which is mid-week, to look for the differences between weekends and whatever. For long-term sampling, as Professor Marks says, where you need to be, you do not miss these events, and the advantage of the foreign particles that we talk about is that they hang around for days and weeks—in fact, the bushfires took three weeks to go around the globe and come back again; they were there for a long time. So long-term sampling is important.

**The Hon. EMMA HURST:** Professor Cohen, just to follow on from that, what do you think the Government should be doing to support the research and technology development in this space and even more broadly as well?

**Professor COHEN:** I guess it all gets down to what you are prepared to fund, again. We have concentrated on the urban areas because that is where people live; that is where you will see health effects, where people live. So we have got long-term data going back 20, 25 years on fine particles—not just the mass but the composition of that mass. We can get up to seven, eight, nine different factors that make up the mass and we have been doing that in Wollongong, Sydney and Newcastle and the Hunter Valley area for decades. If you really wanted to do a bushfire zone combined with urban areas—and you saw bushfires out in the rural areas but the impact was in the Sydney Basin—my suggestion would be that in the New South Wales context we probably need to look at some of the more rural areas like Armidale and Wagga Wagga and the South Coast and North Coast areas and monitor those as well to try and keep track. We should not just concentrate on where the large numbers of people have been, because there are people outside these areas that are also affected.

**The CHAIR:** Does Ms Cate Faehrmann have any questions?

**Ms CATE FAEHRMANN:** Yes, thank you, Chair. I have a question in relation to basically the data that ANSTO is collecting on the various elements of the PM 2.5 that you have spoken about. The New South Wales Government gets that as well. Is that correct? What happens with that data? Is that data then made public in any form, that you understand, from the Government's perspective?

**Professor COHEN:** It is entirely out in the public domain. You can go onto our website and get data from half a dozen or more sites going back 20 years. We do it in the form of graphs, and there is also a nice little Google map where you can click on the sites that you have and when you click on a site in Liverpool or up in the Hunter Valley you can see there whether there are secondary sulphates or what the mass levels are going back 20

years. We make that data available to the public. We also work with schools on citizen and livestock projects as well. But also we work with Professor Marks and our people as well and the CSIRO and also the NSW EPA and the Office of Environment and Heritage, and our data is exchanged with them.

For example, we have just recently put together an instrument that measures black carbon, which is a key component of bushfires, obviously. But it turns out that there are two types of black carbon: there is black carbon from diesel vehicles that is generated at very high temperatures, which is small, spherical particles; and there is black carbon from wood fires at lower temperatures, which is a larger and fluffier-type thing. We have developed a multi-wavelength instrument, which is similar to our thermometers but it is much cheaper and can be used quite widely. We sell that to over 40 countries now around the world, and this distinguishes, as I say, between diesel and smoke. These are important things in health aspects as well because black carbon comes in fine fractions.

**Ms CATE FAEHRMANN:** You said in your submission that you have sold that to various countries, but the New South Wales Government in terms of using that, for example, to measure the difference in black carbon from smoke and black carbon from vehicle exhausts—ANSTO has that, but in terms of public policy and the Government having that here in New South Wales, is that the case?

**Professor COHEN:** They have these real-time aethalometers that work on a similar principle; they pull air into a box and they use the seven different wavelengths to scatter off the particles in the box and measure that directly. That is a real-time measurement that they get. They can get that measurement in real time and, as we said before, our measurements are not done in real-time, they are done on filters that are analysed. But the advantage and why we work with the EPA as a complement to that data is we tell them what is in the mass; they measure the mass in real-time, but we tell them what is in the mass. That is not a real-time measurement; it is one of the drawbacks of the system. If we could get a nice sensor that would give us a real-time measurement that would be really good.

**Ms CATE FAEHRMANN:** I have just got a question about the Clean Air Strategy for both organisations. Have you been consulted on the Government's latest iteration of the Clean Air Strategy, which is yet to be released—we understand it was not and now it is, so hopefully it still will be at some point? Have you been consulted on the Clean Air Strategy in terms of both organisations and, if you were, can you remember when that was?

**Professor COHEN:** We are regularly consulted. I work quite closely with Matt Reilly in the NSW EPA. He is director of Climate and Atmospheric Science. I am also a member and an honorary fellow of the Clean Air Society. These places generally distribute these sorts of documents to us for comment and we have commented both directly through the NSW EPA [inaudible]. So we are aware of this and we do have input into it.

**Ms CATE FAEHRMANN:** Professor Marks?

**Professor MARKS:** Likewise, we work quite closely with what is now called DPIE, it used to be the air quality branch of DPIE. I actually do not know that we have made a specific submission on that strategy but we communicate with them and meet regularly with them and share data with them on a regular basis.

**The CHAIR:** Would any of the Government members like to ask a question of any of the witnesses?

**The Hon. NATASHA MACLAREN-JONES:** Yes, Chair. I have just got a question in relation to having a better understanding of the fine particles. You talked about black carbon and, obviously, bushfire and dust and other things. How does that relate to you being able to use your research to better target health and deliver health care?

**Professor COHEN:** That is probably Professor Marks' area.

**Professor MARKS:** Fine particles that can enter the lower respiratory tract are important for health. Much of what we know about the adverse health effects of fine particles comes from the particles that Professor Cohen was referring to, mainly from combustion and fossil fuels—in other words, urban ambient air pollution, which is from traffic and from power stations and in other industrial processes. The fine particles that are coming from bushfire smoke are obviously a different source. What we know so far is that they have relatively similar adverse health effects, but most of the data we have is from traffic-related and industry-related air pollution. We need more data actually about the adverse health effects of the fire smoke-related fine particles.

This recent episode was, I think, really a wake-up call for many people to recognise that smoke actually has adverse health effects. I think most people had never really thought about smoke—a relatively naturally occurring source of pollution—as having adverse health effects and they think of the anthropogenic- or industry- and traffic-related air pollution as being the cause of adverse health effects. But it seems likely that smoke also is having adverse health effects similar to those from other fine particles. But the answer to your question is that we do not know for certain.

**The Hon. NATASHA MACLAREN-JONES:** Does that also mean that it is hard to determine now when it comes to protective wear, whether it is masks, that there is no difference as to the types of fine particles at the moment or is it that we have to get more research to then be able to say we need to have tailored types of equipment?

**Professor MARKS:** I think the safest assumption is that the particles from smoke have adverse health effects like all other particles. So all of our modelling so far has been on the assumption that we can extrapolate from what we know about other ambient particles to the effects of smoke, and that relates both to the adverse health effects and strategies for mitigating. But there is need for further work on both of those things, both on understanding the health effects and understanding the effectiveness of strategies for mitigating those effects.

**Professor COHEN:** Can I comment on that too, maybe?

**The CHAIR:** Please proceed, yes.

**Professor COHEN:** Our work over many decades—we put out with CSIRO three major reports which are available publicly. One was on the Hunter Valley. One was on the upper Hunter. One was the lower Hunter and one was the Sydney Basin region, covering 15 years. If you go into fine particles, which we concentrated on, there are three main sources that contribute to this. There is the smoke, and surprisingly the smoke is not necessarily just from bushfires or controlled burning. It is also from domestic heating for a three-month period in the Sydney Basin. In fact, somewhere between 60 and 80 per cent of the fine particle concentrations in the wintertime can be due to this domestic heating and combustion for heating. The second one is diesel vehicles. Buses, lorries and people who drive diesel vehicles put out fine particles. The third one is power station emissions for electricity generation. They are the three key sources, if you come down to it.

The interesting thing about the smoke one is that you can see that the domestic wood heating covers a three-month period in the wintertime. But interspersed with that are these spikes that last a few days, sometimes. As it did in the last bushfires in December—October right through to January, really—it can last for several months. But if you go back over a 20-year history, you have these cycles with the domestic heating lasting three months, and then you have these spikes on the cycles with the smoke that last a few days to a couple of weeks. You can pick these out by doing these daily [inaudible] that we do here at ANSTO and analysing for them. When we use our nuclear techniques we can tell the difference between the diesel vehicles and the bushfire smoke. We can partition that out of the mass. When you are dealing with 300 micrograms, that is 300 millionths of a gram of material that the average person will breathe in a day.

**The Hon. WES FANG:** I was just going to ask for a bit of an expansion on that, just to talk about whether cumulative effects have played a part. For example, we talked about car and truck and bus particles in a city aspect, but what we saw during the bushfires was probably more of a higher concentration. Does that higher concentration over a short period or a lower concentration over a longer period make any difference to when we have cumulative effects? Is one worse than the other? I guess that is where I am going with that. If you could provide an explanation, that would be fantastic.

**Professor MARKS:** I think that is a good question, but a difficult question to answer. It is likely from a physiological perspective, if you like, that there are both. Both are relevant. Short-term adverse effects of very high exposures are relevant and in some cases the consequences of that are fairly transient. Many of the consequences of that are fairly transient and so people recover quickly from those exposures. Whether there are persistent adverse effects of those very high levels of exposure remains to be seen. You may have heard about this from my colleague, Fay Johnston, who spoke to you earlier—the evidence from the events in Victoria at the coal mine fire at Hazelwood.

They were able to demonstrate, by following up people in Morwell two and a half years later, a number of longer-term adverse effects from relatively short-term exposure to high levels of particulates. That of course was not bushfire smoke. That was coal smoke. But nevertheless it was smoke—fine particles. It is certainly possible and there is some evidence to suggest that there can be persistent effects from these short-term exposures. But most of the data that we have from the study of ambient air pollution of course is about people who are exposed on a daily basis to varying levels of ambient particulate air pollution, mainly from traffic and other industry sources, as David was describing. That is long term exposure. The answer is that it is very difficult to disentangle these effects, but some study has been done that suggests that there are both long-term and short-term consequences. I cannot give a very clear answer, but I hope that helps.

**The CHAIR:** That has been helpful.

**The Hon. WES FANG:** I was curious to know the effects because obviously people that live in the city—their exposure to diesel particles, et cetera, is much less concentrated but over a much longer period of time. Whereas for those of us that live in rural areas we have this bushfire smoke for a short period but we have the

benefit of much cleaner, clearer air. I was just curious as to that difference and how you viewed it. Thank you very much.

**Professor COHEN:** I think the whole thing emphasises the need here to understand the composition of the mass. For instance, in Liverpool in the Sydney region there are seven or eight things that take the mass. Typically you get 4 per cent soil, 14 per cent industry, 24 per cent secondary sulphates, 30 per cent smoke, 17 per cent cars and automobiles and 4 per cent nitrates. They are a mixture of various sources. The interesting part about it is that we have found—with the bushfires everybody said, "Oh, it's smoke." In actual fact there is a lot of fine soil, which can also be a health issue with silicosis and other things like that, which is also uplifted by the high winds and the high temperatures of fires.

You can get very large variations in the composition of the smoke mixed with the soil on various days. For instance, at Liverpool on one of the highest smoke days we had 5 per cent black carbon, 2 per cent soil and 42 per cent organics. Whereas at Mascot we had 22 per cent black carbon, 10 per cent soil and 4 per cent organics. So you get these factors of two and three variation. As Professor Marks said, we do not understand which of these components may or may not have a health effect. Or is it just the particles themselves? There are a lot of unknowns in there.

**The Hon. WALT SECORD:** My question is to Professor Marks. In your submission you say that some authorities recommended wearing face masks and members of the public did resort to using face masks, but you said your organisation, CAR, does not recommend the use of face masks. Can you elaborate on that, please?

**Professor MARKS:** There is in fact investigation going on now. One of my colleagues is starting a research study on whether or not wearing face masks has any beneficial effect for protecting against smoke. The problem is that N95 or P2 face masks, to filter out fine particles, need to be tight-fitting and probably need to be replaced regularly because they only last for—as they get moist they lose their effectiveness. The likelihood that you can protect yourself from fine particles by a well-applied face mask for a long period of time is not that likely. It is not that likely that it will confer good protection against the adverse effects of particles. But it is a question that can be answered. Our view—and this also still needs to be investigated further—was that people are more likely to be protected by staying in an indoor environment with the windows closed, but of course that is also not that feasible for very long periods of time. It was a very difficult period in which to protect people for this very long period of time.

**The Hon. WALT SECORD:** Are there masks available that provide protection?

**Professor MARKS:** In theory a well-fitting N95 mask would provide protection, but it is just not feasible to wear it for the periods of time that would be necessary to confer that protection. They are meant to be worn for short periods of time. It is very interesting; we have had two crises this year in which masks have played a potentially significant role. In this latter crisis the role of them is not only in protecting the individual from inhaling things but, actually more importantly, preventing them from expelling things into the environment. But with the bushfire smoke that is of course irrelevant. It is only about protecting the wearer from what is in the environment. The effectiveness of them for that over a long period of time is dubious but able to be tested, and a study is underway at the moment to see whether or not they do confer protection, particularly for people who are susceptible—who have underlying lung disease, for example.

**The CHAIR:** Earlier today we had evidence from Associate Professor Fay Johnston, who I believe you know. We had a discussion—or at least some exchange—over the issue of expanding the number of monitoring stations or monitoring devices, to be better able to collect information and rapidly assess information and then provide that detail out to the community in the context of a bushfire emergency. Obviously, to use the colloquial, you get what you pay for. In terms of this monitoring equipment it can be highly sophisticated, but then it can scale down to relatively cheap equipment and at the lowest end—which no-one is recommending—questionable quality equipment. Looking at the issue of expanding the monitoring sites and the types of equipment used on those sites to produce information that can be then communicated to the population at large, I would welcome your thoughts about what we should be thinking about in that respect. That is an open question to all of the witnesses.

**Professor MARKS:** I might let Professor Cohen go first on that.

**Professor COHEN:** I will take that one. I think there are two aspects to the monitoring side. The NSW EPA does an excellent job with the sampling that it has currently got. It spends a lot of money and it has got a lot of sampling sites. It has got a lot of highly sophisticated equipment in large numbers of areas around the State. It gives out real-time data and that gives the public an assurance that what it is breathing, in terms of the mass, is either good, bad or hazardous. It puts out this air quality index, working on the 25 micrograms per cubic metre

maximum 24-hour average. I think that is good and that is probably best addressed by the NSW EPA, as to where they should put these and how they would best serve the public.

The other aspect to it—where I think we fall down a little bit and could really help the people looking at managing air pollution and the health people—is to understand what is in the mass, like I told you before. That is very hard to be real-time, unless we can get some sensors that you can put out there, en masse, that are very cheap. It costs about \$20,000 to put one of our cyclone units out there to get six to eight components of the mass. That is an annual cost. That is why we have now got six, eight, 10, a dozen of them out there doing this. That has to be funded and the NSW EPA, or what used to be the Office of Environment and Heritage, is funding those. It is funding them in key areas like Newcastle and Kooragang Island and things like that. They pick these hotspots to do it. You have got to have a two-pronged approach where you have this thing that runs all the time and measures the mass and gives people this instant—in 20 minutes or half an hour, you go on the web and you see what you get.

The question is, "Okay. We have measured the mass. It is 100 micrograms per cubic metres. It is four times what it should be for health reasons. But what is it?" We need to know what it is. Principally the classic example that you have probably heard of—up in the Hunter Valley we had a lot of trouble with coal trains and dust from coal trains. People are going on about how this dust was affecting their health. With the CSIRO we ran a two-year study and we measured everything that was in the air at the time. We got six or eight components. Do you know what we found that it was? It was smoke from domestic burning. The actual stuff from the coal trains was coarse particles, not fine particles, and did not necessarily have the health hazards that the fine particles do. That was a real lesson in understanding what is actually in the air and which ones might be related to health. I think these two aspects are very important—to have the instantaneous turnaround, but also to understand what the composition is and what we are working with. That will help the health people.

**Dr HOLLINS:** Can I add into that, though? I think there is another component there. Professor Cohen is right in pointing out that there is an opportunity to scale up some of this data collection. But I think the other opportunity is in that collaborative model—that we actually take a more coordinated and collaborative approach to dealing with that. For ANSTO one of our key roles is actually collecting that data and analysing it, but we are not the experts in understanding the health effects. So we are really, really keen to be collaborating in the long term with more scientists and researchers like Professor Marks and some of his team, but more broadly to make sure that the data that we are providing—that we actually are collecting right now—is better-utilised in forming health research and policy decisions, et cetera. That is another suggestion, I think, and an opportunity. It is not just about collecting more data, but also ensuring a much more collaborative model, to ensure that we are getting more out of that data.

**The CHAIR:** That is very useful.

**Professor MARKS:** I support that. Can I just add something quickly to that? I think in the first part of what Professor Cohen was talking about—about measuring the actual distribution and time course of particles in the air—there has been a lot of technological development has enabled this to happen much better over the last two years than it used to be. One of my colleagues from CAR, who is based at Queensland University of Technology in Brisbane—Lidia Morawska and her team have developed a sensor which is rather quaintly called KOALA. I forget what it stands for, but it does not stand for the little furry animal. KOALA is a sensor device that is enabled with communications technology.

It is relatively cheap, and there are a number of other low-cost sensors that are now able to be deployed quite widely and give us much more nuanced spatial and temporal resolution on the distribution of particles. This together with data science and mapping technology—including information from satellites—is enabling us to get a much better picture of what the distribution of air pollution is over space and time, in real time, than we used to have. I think we need to invest further in this technology and make use of it, both for informing the general community, and for informing government agencies and other stakeholders in this process. There is much better capacity now to have knowledge about the quality of the air that we are breathing.

**The CHAIR:** That is very helpful, Professor. Ms Hurst, did you have any questions that you would like to follow up with?

**The Hon. EMMA HURST:** No, I am fine. Thank you, Chair.

**The CHAIR:** Thank you. Ms Faehrmann, did you have one final one? You had your hand up there.

**Ms CATE FAEHRMANN:** It is okay, Chair. We are over time. It is fine. I can put some on notice, if need be.

**The CHAIR:** Okay. On behalf of the committee, I thank our three witnesses. That has been very detailed and very rich evidence that we have received this morning. It perfectly complements what you provided in your submissions. We are very grateful for that. There may well be some supplementary questions arising from our members of the Committee reading *Hansard*. If you would be agreeable, our Committee secretariat will liaise with you in regard to those supplementary questions. We provide a 21-day turnaround time. That material coming back will further inform the inquiry by becoming evidence as well. Once again, we know you are very busy. We thank you very much for your time and we are most grateful for you participating. Thank you.

**Professor MARKS:** Thank you.

**Dr HOLLINS:** Thank you.

**Professor COHEN:** Thank you.

**(The witnesses withdrew.)**

**(Short adjournment)**