Int1: Thank you so much for attending today. This is the first in a series of meetings that we are holding over the next year to hopefully engage with people in clinical practice community spheres and public policy about this project, that we've got some funding for from the Welcome Trust to run. J and I work together. So what we're doing today, just a brief introduction because there aren't that many others, a little bit of a recap on the project so that we're all on the same page. R, I haven't had an opportunity to talk to you explicitly about the project, but M and I have had a chat about it when I went to visit Grimsby and Cleethorpes; but it was a little while ago, so just a bit of a recap about what the project is actually about. I've been working with this fantastic group that do web development and design, and they are UK based; they're actually an NGO called Common Knowledge. We are working collaboratively with them to develop and design some material which we will be delivering through a web and mobile phone application, and part of that is in fulfilment of this Welcome Trust bid. So we will be introducing some of the content that they have developed with us, and we'll be looking for a little bit of feedback and evaluation, and then we'll have a chat about future meetings. I doubt this will go for two hours, and there are a few points where we will have some breaks, so you won't be just sitting here listening to me. I have a couple of surveys throughout this. It's something I've not done before, but it's really cool, you can put surveys into meetings, and then you can see peoples’ responses in real time and have a chat about it; so a few little interactive bits and pieces as well. Something that we will do before most meetings is a little pre survey just to get a sense of people's interests before we go into the meetings. And when people do this in advance, it's really helpful because it helps me tailor what we're doing in the sessions. So in our very small group, can we please introduce ourselves, all I would like is name, institution, the community that you represent, and this is an interesting one, but I consider that everybody that is involved in this project is a lived experience expert of some form or another, that might be an expert in understanding the people that you work with. It might be a lived experience expert from the perspective of the challenges that you encounter in your workplace, relating with others, delivering on various work objectives, it could be anything like that. And then, this is a bit silly, but I just want to see what people actually think about when they think about methane, methane is a big part of this project and understanding health outcomes. Obviously, my name is H, and I'm at the university of Lincoln and I work with J, and I was a senior lecturer in geography. I'm just about to move into a new institute that we have here, the Institute for Rural and Coastal Health, which is very exciting, and is headed by Prof Mark Gussy who is also based here. I would consider that the community that I represent is not just academia, from the perspective of how we communicate with others, but certainly my lived experience with mental health and with mental health in community, and I've been living in Lincoln since 2018, and there are quite a few different social groups that I interact with, that I see the different ways in which mental health presents, and the various solutions that communities have to addressing mental health within their communities. And for some reason, when I think methane, I cannot get it out of my head, it's just a really bright orange. And I know that's probably got nothing to do with what I've seen, I just see bright orange. The colour bright orange. I even asked our design team – Can you put some orange in the slide templates that you are making for us! It was such a powerful impression that I had. Probably comes out of really crappy sci-fi movies or something, but that was just the impression that it gives me. So I'll just go around in the order that I see on Teams, if you could just introduce yourselves, that would be great. I will start with J, my colleague?

Int2: I am J. I am a post doctorate work associate at the university of Lincoln in the Community and Health Research Unit. I am currently working with H on this project. In the past, I've worked on community projects; primarily primary care research projects and public health; which is the reason why I am working with H on this interesting project. I can't wait to see how it progresses; it is looking good for now.

Int1: Thank you J, and what do you think of what do you think of methane, what comes to mind?

Res2: I think about air pollution, and the impact on the climate; that's the interesting aspect, there is air pollution all over the place, and if it is one of the pollutants, then it can lead and contribute with other pollutants, like nitrous oxide, ammonia oxide, and so on. It can cause respiratory problems. It can cause mental health problems. And respiratory problems like COPD. I think we have a host of these happening around so much pollution. I think this project is going to hit right on these things, and that's what makes it very interesting.

Int1: Thank you. R?

Res1: Hi, I’m RT, I am a public health programme manager for NE Lincs council. This is the third week that I have been in post with NE Lincs council. So I am still trying to get to grips with local authority. Up until now, my career has been completely in the NHS. I have spent 20 years, particularly in primary care, the primary care trusts as they were then, but mainly GP practices. My data experience area I suppose is primary care, and how it interacts with the other health sectors. So local authority is brand new to me and I'm still trying to work out. What do I think of when I think of methane? I think of cows! And cow flatulence! I'm sure you've probably heard of that before. I just get the vision in my head of an intense dairy farm with all these cows’ bottoms producing the methane; that's what I think of!

Int1: That's more rational than just a bright orange! So I'm impressed. Thank you for coming along when you have been in post for such a short amount of time; that's fantastic. M?

Res2: Hi everybody, I am M. I work a place called Centre4 which is in Grimsby. It is a community hub, a former school where we rent rooms, deliver services, events, we have a farm at the back, all sorts of things a bit beyond what you would not normally expect from a community hub. We are a registered charity, part of the voluntary sector. The areas that I particularly work in is the health and well-being team; and particularly one of the biggest contracts that I work on is on behalf of the ICB which is social prescribing, and within that, we have an eligibility criteria, which is based on health conditions. And two of those are directly connected to this area which is asthma and COPD. There is a lot of talk currently in NE Lincolnshire about respiratory problems, and I think very few if any, talk about methane which is quite interesting following the conversation that I had with H a few months ago. So yes, that interests me from that perspective. What comes to my mind when I think of methane is totally different, when I spoke to H actually, but if I try to cut you out of my mind, I might have got the chemistry slightly wrong about this, but I think if the gas given off by rotten material, I'm not sure if that is quite true. But my daughter used to be manager of a waste site a few years ago, they used to recycle the gas that came off all of those materials to be used to power the whole village where she lived, as a replacement to British Gas type stuff. Forgive my knowledge on these materials and substances, I'm not completely sure if I have got it. Rightly or wrongly, that is what pops into my head when I think about methane.

Int1: I think you have got it right. Methane is a byproduct of waste processing; that's so interesting. I just think it's interesting because where do we start, part of our project is about delivering this application, but a huge component of that is education, and I think sometimes it's really hard as an educator, for someone that has been lecturing for 12 years now or something, it can be quite difficult if you don't understand people's baselines of knowledge to then think - How do I teach? I think about the general public, we are obviously not general public, but it is one of the sorts of ideas that comes to mind when people think about things like atmospheric chemistry. It's such an obstructive thing for me anyway, and certainly since I started in this project, I had no idea of the kind of role that methane played, just that it stinks and stuff like that. I find it super interesting to see what other people think. Because to me, when I started, I was like - Is it an orange gas? It is not an orange gas. So both of you have had a much more science based understanding then I came with entering this project. Just to recap what the project is actually about, I'm going to go through some of the material that we submitted to the Welcome Trust as part of our proposal, but actually there’s only specific focuses that we're working on in the stakeholder meetings. This is a Welcome Trust funded project. And it's interesting because whilst we put forward a proposal for what we wanted to do, Welcome actually gave a very specific brief for what they wanted which was to develop a dashboard to understand the impact of methane on health. So that was given to us as the focus of the project, rather than us saying - We are really interested in methane. And we sort of went from there to understand what the interest was. The application, the web and mobile phone application that we are developing is just a prototype really, we're prototyping if we can co-develop and co-design the application with people like yourselves, and in that time, we will also develop the actual functional app and trial it with people. So there will be a point that we share a QR code and say - Who do you think might benefit from using this? Share it and say that it is a free application. So everything that we're working on together is about - How do we design and develop something that we think will be accessible understandable and useful for people. And at some point we will actually go and trial that and see how it goes. Then we will go back to Welcome and say - Look actually, hopefully this has some benefits for people in their health, and if so, where do we go from here. And we will be looking for future funding to keep it as an operational application. We're working across multiple regions, not just in the UK. So obviously Grimsby/Cleethorpes sort of area, as well as Lincolnshire. And we are considering variations on the impact of people's health inland where I am now, all the way to the coast, from the various different industrial activities that occur in those spaces. We are also working in Ghana, and J and myself, and other colleagues, are going to Ghana next year to meet some of the stakeholders that we're working with. But there are very different health challenges in somewhere like Ghana compared to somewhere in the UK; one of those is around data access and availability when it comes to doing some of the modelling that we are doing. So even in the first couple of months, this has been a super interesting process for me to be involved in. We're also really keen on multi sector collaborations. So fantastic that even with a small group today, we have representation from a community hub as well as public policy, that is very exciting for me. This project as we envisage it is a first step towards not just improving awareness and education about methane, but also access to services. So part of what we are embedding into the application, and we will ask you to feed into, is that it's all very well to educate people about health impacts but where do they go from there? If they actually want to do something about their own health protection, are there services, M, in Grimsby and Cleethorpes that they might be able to access that they might not know about? Can we put links to those services in our application? Maybe R, there is a County Council project or online resource that you think that actually the general public should know about. There might be something in our application that we can embed a link in to try and promote that information. So it's about understanding and education, but also improving access, and providing opportunities to support researchers as well. We're looking at what we're doing might have some benefits on the research community in Ghana. The project has a couple of different components. We are very ambitiously using machine learning to predict ozone levels. I say ambitiously because ordinarily the Met Office in the UK uses a three-dimensional climate model to do that, which is expensive, high maintenance, requires lots of professional input and skills. If we want to work across somewhere like Ghana, the Ghana meteorological agency doesn't do the same modelling to produce zone outputs, so I wanted to see if there are other data sources that we can use to actually predict ozone levels for health protection in a way that is a little less tech heavy regions in the world that might not have that capacity. A big part of what we're doing and talking to you guys about is developing a web app for health protection. So ideally what we want to be able to do is forecast ozone concentrations in the air using all sorts for the readings that we have of chemical composition in the atmosphere, and then feed that into an application where people can receive alerts for their health protection. We are trialling that in the UK and Ghana, and we are particularly interested in asking people to self-report through this app about their health outcomes so we can investigate links between ozone and methane and health outcomes like respiratory conditions and mental health. So there is a lot of different components of the projects. Some around using machine learning, specifically deep learning, and some around thinking about the data and the best possible data that we can be using across the different regions that we're working with. So in Lincoln share we are working with the ICB, and when I went and met M, I didn't know that NE Lincolnshire ICB was actually integrated with Yorkshire and the Humber, so that was very new to me, and I went – Gosh, I have spent six years working towards being able to work with data from Lincolnshire’s ICB, probably I'm going to have to take another six years to understand the ICB structure and layout of NE Lincolnshire. So they are two other components. But the components that we're focusing on at the moment is the user functions in this application, and how we can improve the visibility of climate change impacts. So we wanted to design an application. What function does it need to have to help people understand the impact of climate change might have on their health? There are four main functions of the application that we are developing, and from here on in in the presentation, actually the images that I'm using, for example that map that you can see, these are all parts of the design and development output that we have been co-designing with Common Knowledge. So throughout, please have a think about what that looks like, whether it makes sense visually. We have a little follow up survey, that I will send out to you later today or tomorrow that is specifically about some of these images. So we are sort of trialling with you guys what these images look like. I would encourage you to think about the people that you feel you represent, whether that is in public health and your experience R outside the role that you are specifically in now say, or M with these community groups that you are talking about, and the eligibility criteria with asthma and COPD. Who are these people and with the images and the text that we're using, do they actually make sense? We're trying to make sure that we're not being classic academics and doing what we do best which is confusing everyone when we think we are being clear. We're trying to make sure that this prototype is accessible. The four main functions: there is an alert function that people can opt in for. So for example, you might get a message on your mobile phone that tells you that there are high ozone concentrations in the region near you. There is an ‘Explore and Learn’ function, which is sort of related to that map that you can see, which is about people being able to play around with a very simple data interface to be able to see what health rates look like in their area, the relationship between environmental indicators and health in their area. And it will be pretty simple: like click on the button and the map changes and you can see stuff. There are also some inbuilt educational modules in there. That is on ‘Our Data’ section which I suppose is a bit more advanced which gives people the option to learn where the data comes from. It's probably not necessary for everybody, but we know we have some really active community members say in Lincolnshire, who really want to know about air pollution, and they want to see the data and they want to know where it comes from. So this is an opportunity for us to link them to that, the same with health data. Then there is a ‘My Profile’ section. So this is an application like anything else, like a health or exercise app, you set up a profile about yourself. This is the cute map that the group that we're working with has developed for us so far. They're thinking that this might be what the actual application looks like so that you can click on different sections to access different content like ‘Explore and Learn’. And this is just the first look what that meant but look like. This is very similar what we went to the Welcome Trust with. I'm not a machine learning expert here, we developed code that took the atmospheric chemistry for things like UV radiation, under the atmospheric chemicals like nitrous oxide and methane, and actually predicted for all those units of measurement for different things in the atmosphere, what the ozone might look like, and produced little alerts. And methane was one of those inputs, the methane levels in an area and how that interacts with other chemistry and produces an alert. Ideally what we would like in the application is for people to be able to say – Click on an area and get a little box up that tells them about the conditions in their area, and then can select a pollutant, and map that pollutant with the scale that tells them whether there is more or less at that pollutant in different areas. That's what I mean about having quite a simple interface, you can go - Oh I'm interested in ozone, cool, I will click on that, that's what the numbers look like in this area on average or something. The ‘Alert Me’ and ‘My Profile’ functions are sort of related, so I thought I might show you a little bit of that together. This is just some prototype images that Common Knowledge have put together for us, what a health profile development might look like. So what information you might put in. And part of that ’Alert Me’ function is that later in the day, just say you've had an alert saying – Based on your health profile, if there's a very high ozone concentration and I was an asthmatic, what I want to know so I could make a choice to say exercise indoors or exercise outdoors that day. So I might get alert that says - Have you considered exercising indoors today? And then there will be a prompt later in the day, for people to self-report their symptoms. This is all anonymised, so we don't know who these people are, but what we do know is what kind of alert they received. So what was the ozone area like in that day, and what did they report? This is just a bit of a prototype, but it's based on some national standards how you actually report respiratory symptoms, and we're developing similar based again on the data metrics for say mental health conditions. This is something to think about with accessibility because this is a very quantitative approach, I'm looking to develop more symbolic and image based approaches for doing this like emotion wheels or health wheels that people can click on pictures as well. So ideally, you would register a user profile, sets so you can opt in, push buttons on the phone, you don't have to have them, but that's an option for ozone in your area. You can receive then the prompts to self-report. And there is an advanced option here. If you imagine that you had a parent with a child who has really severe asthma, the alert system that we have will be based on I think WHO standards for concentrations, But can you imagine if you had a child who is very susceptible, or say an elderly parent that you are monitoring, should the window be open or closed? They might actually have a respiratory response at much lower concentrations compared to what The WHO says is dangerous. There is an advanced option where you can bespoke requests for different concentrations, and that might be something that you observe over long time use. The idea might be that you report, and then at some point, you might get a certain number of reports over days. You would actually get an option to look at the graph where you compare self-reported health against the air quality that has been. So what we're hoping is that it gives some agency to people to say - Do you know what actually, over a period of a month, Nan’s health response were quite severe even with low concentrations of ozone, so I'm going to shift the parameters for when I'd like to receive an update about ozone concentrations, so I can support Nan a bit better and shut the window. This is just a little mock up of that might look like on the phone, a little image coming up there. So that's probably quite a lot of information for now, before we move on, I would encourage you to have a little bit of a think about the material presented, if you have any questions or anything is unclear. But also to consider the people in your life that you might represent, who might actually use an application like this? Can you think of any red flags or unintended consequences of this app? So what we have here, what can you see on the screen?

Res1: 2 blue hexagons.

Int1: 2 blue hexagons. I'm not sure why that is. I will put in the chat a QR code. If on your phone you scan that QR code, you should be able to have pop up on your phone a brief survey. I appreciate you trialling this with me because I was hoping it would come up on the screen. I don't know if what you type will come up on the screen, it is meant to but it might not. But if you don't mind comment just have a go at responding to that. So let me know when you are done, and if it works and if I get responses. I think it's just a single question.

Res1: I have submitted one, I don't know if you can see it?

Int1: I will have a look. It doesn't come up on the screen, that's good for me to know. I can see your responses outside of that. If you don't mind me sharing those, they are really useful. So we have – ‘Over analysed, uneducated conclusion.’ ‘People may unintentionally stay indoors more than previously impacting on physical and mental well-being.’ They are both such interesting and valid points. Certainly, the uneducated interpretations potentially having a negative impact when people deciding to stay indoors more. Considering those, any ideas from yourselves and how to circumnavigate those issues? Not that I'm expecting us to solve all the world's problems?

Res2: The thing that went through my mind, from my perspective, on the screen there is loads of really interesting information that I would absolutely love, but I think the general people, almost more simplified, they don't need that much information, they just need – ‘Is it a good day or a bad day’ type of thing.

Int1: So you just mean rather than the sort of detailed breakdown of chemical composition, and that sort of thing?

Res2: Yes, it feels like that is more of a professional’s view.

Res1: I completely agree with what you are saying. I was thinking more of a traffic light system, so – Green, that's a good day and no problems. Amber, maybe you want to have a think - do you want to go out. Red day, this day might be problematic for you and maybe don't go out unless you have to. With the slides before, the map thing was really good, but for me I didn't know where anything was. Maybe if you picked out some landmark type things so you could actually see where things were. I'm not from that area so I don't know what that map was really. So trying to find me on that map, if I was a patient or a client or whatever, I wouldn't have a clue.

Res2: I'm not trying to think all things bad, but as a follow up to that, it is fairly standard when you click on a map nowadays that it shows where you are as a norm; presumably you will get the location settings and stuff like that, won’t you?

Int1: That's great, that's really useful. It's really an interesting process working with the design company. We are going backwards and forwards with this iterative process, and we’re really happy to make changes and get feedback from people, that's what this is about, thank you. What about the other issue then of potentially encouraging people to stay indoors, and then have negative consequences of that?

Res1: I think that's why an explicit kind of simplistic alert kind of thing would help that. Because if it's too complicated, and your average Joe in the street might not know what it meant for them, so they might be more risk averse – Gosh, I best not go out today. When actually, the added risk was actually not that high for them. Then be more specific perhaps with what your advice would be for them. Are you advising them not to go out, or not to do heavy exercise outside. And if you do say that, then what does that mean to somebody? Try not to get stressed, do you know what I mean, it has to be really simple, otherwise people won't understand it and they won't use it. What do you think, M?

Res2: I agree with all of those things. I was just thinking from maybe a different angle. Looking at the feedback that people are going to enter at the end of the day, that if it's tracking of people's behaviours, then there could be some kind of feedback of what is your reaction this week, that might highlight that maybe they could have been less cautious, because as a health condition thing, it needs to be promoting the value of being outside as well, don't you? I haven't explained anything that is an answer to that, but there is something that is along the lines of people understanding that being over cautious is going to be detrimental as well.

Int1: I think they are all valid points, thank you. I like that suggestion to be very specific about the recommendation. So it's not saying – Don’t go outside. It might actually be saying - If you're going outside, be mindful of very heavy exercise, go for a walk, maybe just don't go for a 10K run if you are an asthmatic. Again, I think some of the recommendations that are standardised by WHO, even I've seen some UK wide ones, I'm not sure they are that nuanced, let's say. Even if we are going with a standardised, that might be room for more nuance today's standard recommendations to ensure that we are not actually having a harm impact.

Res1: Another thing I thought I've actually, why was the Grimsby and Cleethorpes area, and Ghana, why were they picked specifically?

Int1: There are a number of reasons. The comparative analysis between the UK and Ghana was for a wider research agenda about decolonizing data science, and seeking to find ways to do what we want to do in places that have more of a challenge with data scarcity, and a lot of lower to middle income regions, you don't have anywhere as near as much public available data as we have in the UK. So can we produce an ozone forecast for those areas? Can we link that to health records and try to understand? Are we able to do that in other places? The choice of Ghana, and Lincolnshire/NE Lincolnshire, is interesting because these are both areas they have coastlines and in land. So they are coastal. And they also have very different sources of methane. If you look at Grimsby and Cleethorpes, Amy took me up to Immingham around the oil refineries, and actually when we look at satellite imagery maps, we can see that the Grimsby coastline have some of the highest methane emissions in the UK actually. Even though the UK is heavily regulated, you are not going to get the same sort of massive leaks and flares as you see in places like America, but you do get variation in sources as well. And then with Lincolnshire, you have the rurality, so from Lincolnshire to the coastline is just rural, and actually you can get really high levels of air pollution in rural areas as well. So we're looking across urban, industrial and coastal spaces. And then in Ghana, you have completely different sources of methane again. One of the highest outputs of methane in Ghana is actually what M was talking about, which is the waste processing. They have different environmental regulations again. So it's a bit of comparative analysis about the geographies of where methane comes from, as well as different types of communities as well that might be impacted, does that answer question?

Res1: It does. That's what flagged it up in my head because a potential negative outcome of this, I think you might have to be very careful when introducing it to people and trying to explain, because what I could potentially see happening is that somebody is getting alerts - Another red day, those bloody factories, let's go and picket them, they are polluting our air! Unless it is explained specifically that this oil refinery is not responsible for all the methane and the ozone on this particular day, do you know what I mean? It would maybe concern me that the message could get misconstrued, a kind of a blame culture type of thing.

Int1: I wonder if there's an opportunity. In the next little bit, I'm showing you the educational content, I wonder if there's an opportunity in there to answer that concern directly, to try and make it explicit that actually something like ozone is about how chemicals mix in the atmosphere, and there are lots of different sources. Some of those sources are cows in agricultural areas. Some of those sources are industrial activity. Some of them are also just urban activity. Because as you will learn in a moment, for ozone to be created it's not just about pollutants that come from industry, it's things like mixing pollutants that come from cars. It requires more than one element coming from a factory; that's one part of it. But the methane alone doesn't produce ozone. So maybe there's something in that that could be in an educational module. So maybe some emphasis that it requires all of these things, not just – Bob, at the refinery, it's all his fault. So the modules that we are developing with Common Knowledge, it was actually a mate of mine that suggested the Perfect Storm as a name for it, because it is about those different components coming together. It has to be certain conditions to produce ozone, it's not just that the factory pumps out x, and the ozone is produced. What we'll do with the Perfect Storm is that I will talk you through the actual evidence base. Keep in mind that the depth of information that I'm giving you isn't necessarily going to be related to the public. This is just more for our understanding. And then I will show you the content that Common Knowledge have developed. And then there is a little evaluative component to this. This also a module we're working towards called Ozone and Health, which is about respiratory and mental health, again evidence based for what we think is likely to be related. So with my chemist hat on, this is how I understand how ozone is produced. From a very basic understanding, sunlight UV, plus CH4 which is our methane, plus non methane other organic compounds in the atmosphere, plus nitrous oxide's produce ozone. So the important components of that are UV, nitrous oxide's as a separate driver, and then volatile organic compounds so they are reactive in the atmosphere, and some of those are methane, and some of them are non-methane but they are also reactive in the atmosphere. We know that ozone, and this is an important one for those unintended consequences, people misinterpreting things, we know that ozone occurs naturally in the stratosphere which is our upper atmosphere, and this makes the earth habitable. So people get confused often about the ozone that we breathe, and the ozone that naturally occurs that protects the earth. So when we talk about global warming and the hole in the ozone layer, we're talking about the upper stratosphere where ozone occurs naturally. When we talk about ground level ozone, we're talking about the air that we breathe, and that's in the lower atmosphere called the troposphere, and this is one of the key drivers of global warming and also has health impacts. So in the lower atmosphere, ozone doesn't actually have a natural source. In the upper atmosphere, that layer around the earth is completely natural, but the lower in the troposphere that we breathe, there is no natural source of ozone, it comes from interactions from emissions of human activity as well as meteorological conditions. So it's a bit of an interesting one, because it's not as simple as saying climate change is producing more ozone. Climate change is increasing temperature, and higher temperatures is one of the precursors to ozone. And ozone then has a warming effect on the earth which increases temperature, so it's a more complicated feedback loop than just saying that climate change causes ozone, and ozone causes global warming. Ozone in the troposphere that we breathe, is created when hydrocarbons interact with nitrous oxides and sunlight, can we talk about nitrous oxide's, NOx component of the equation, these are emitted when fuel is burned. This is equally problematic for things like car emissions as it is for commercial industrial, as well as residential emissions. So that emphasis on that there are lots of sources of emissions, it's not just the guys burning in Immingham, it's all of it. And the sources of methane and non-methane volatile organic compounds include things like vegetation breaking down, so wetlands, the natural breakdown of vegetation, permafrost causes quite a lot of methane. Waste processing like I mentioned in Ghana. Fuel production and combustion like your oil refineries. Meeting itself is pretty important, this is beyond the amount of information that we're putting into educational, modules but methane is important because it stays in our troposphere, the air that we breathe, a lot longer than other pollutants. It stays in the troposphere for up to 12 years. So those other non-volatile organic compounds that also produce ozone, they tend to stay in the atmosphere from one day to a month, put the main thing that we are pumping out and emitting in various ways, stays in the atmosphere much longer time, which means that it becomes a chemical compound that drives ozone for a lot longer than other compounds. To complicate things really, and the reason why you haven't heard about me thing, because it's not as reactive as other organic compounds. So it's sort of been overlooked to a large degree but it is more abundant because it has the longer lifespan, and it kind of builds up over time. It's also a huge driver of climate change, so the warming part of methane is 80 times greater. So per molecule of methane, has a 80 times greater impact than CO2. There is less of it than CO2, but it has a higher impact. There is more of it than other hydrocarbons, but it has a lesser impact. So it's more abundant than some, more powerful than others, so it's the in between chemical is very important, but doesn't fall into the category as being as abundant as CO2. When we do we find readings in the atmosphere, it reflects an accumulation of build up, not just the reading today because that's the reading today. Is that 12 year build up. I mentioned that positive feedback loop before the ozone in the air that we breathe does actually have a compounding effect on global warming. And we know that the warming is doing things like melting time of frost. We know that permafrost contains a ton of methane. So ozone causes warming, the permafrost releases more methane higher temperatures, which drives further ozone productions. So this is why it's that whole chain that is quite concerning, that's why we're interested in helping people understand about that. Obviously, we don't want people going and picketing individual oil refineries, but we do want a more educated public about where these things come from. So that's more information then we will give to the general public, but what we've done is taken all that information, and thought what are they really core bits the people should know or understand. I can already tell R what some of your ideas might be on the actual content, I'm thinking oil refineries, but as we go through, again think about unintended consequences, evaluation, understanding, visibility. I wonder also about having a purely visual schematic to show the interaction between different components, but right now what we've got is some text in there as well. So how understandable is that text. So thinking about the people that you represent, how well would they understand the content that we are about to show . We have gone into a lot more detail but are we capturing enough in the content that we've got to try to communicate the core bits of that. Are there any red flags? So we're calling this the perfect storm <shows schematics and diagrams> So that is what we have developed so far. Can you scan this QR code again please. Any concerns you have all ideas for further discussions? For your playlist for your playlist. Let’s start with R?

Res1: I think it is good, you might think it's silly, but I don't think that Joe public will understand the different types of ozone as you already mentioned. I've just wondered if it's conceivable that you could call it B-Zone, something else completely just for this purpose, so that people don't get confused. I don't know how practical that would be, call it something other than ozone, call it a different word to try to prevent those confusions. I would say that the use of the chemical symbols and stuff, again I don't think Joe public will get it all. They won't know the difference between O2 and O3. My final point is that I would say that an image tells a 1000 words, I would suggest more pictures and less words, that would be my view.

Int1: I actually thought G-Ozone, or GO, or something like that because it's ground ozone, but we can have to think about that. Ditching the chemical symbols maybe. Highlight the idea of having more images as well, that's really useful feedback, thank you. Over to you M?

Res2: I do think it's quite complex. I do rate myself as fairly clever, and I don't fully understand it. I think I have a broad enough grasp of what I need. What went through my mind, I'm not really sure have relevant it is to sufferers. Would they need to be interested in why it is or what it is? Because that sort of implicates wanting to do something about it, unless you crave that deeper understanding of things just for the sake of it. It's about learning to live with the atmosphere that we've got, which is not going to be changed by any of those knowledge areas at all. That was my thought - Do people really need to know all of those things. I'm sure you need to have it somewhere, but in terms of the masses, it is uncontrollable: all those different things that people are suffering on a day-to-day basis. Again, going back to the traffic light thing, is today a good day or not, this as much as they are interested about the whole thing, and the more knowledge that they've got, the more scared they can get, and come up with theories about ice and industry and all the other stuff. For me, I would dumb it down as much as possible, and then go back to it and dumb it down again. So in other words, on the point of the refineries, we could tell people the things that cause it, and refineries are one of those things, but that's probably it for me, because all of this is going to be in the atmosphere regardless of how much people know about it. It could just scare the life out of you. I'm already working out how many chunks of ice have to melt, how many more cows have to be born, population growth and all of that stuff, you could scare yourself up to death, couldn't you? It is really good for me, I'm interested, I'm not sure if people that I know would be.

Int1: That's really interesting, thank you. That's giving me a lot to think about and is entirely the purpose of these sessions. Do people want to know, and do they find it that interesting? I think it's fairly hit and miss, talking to community representatives, some people seem really enthusiastic and they really want to know what's going on in the world that makes them feel a certain way, that makes them cough on certain days or whatever, other people couldn't care less. So I suppose our view on it is that it is an option to understand. It's not something that you might necessarily revisit in the application, but I do take your point about dumbing it down considerably, and possibly, I don't know what you think about this idea, but the idea was there to be a separate educational module that looks at your health outcomes associated with ozone. But I wonder about structuring some of this content in the context of - Ozone has an impact on health and this is where it comes from. And learn about the health outcomes associated with it at the end, rather than just have it be environmental, bringing some of that narrative into it, like learning where the ozone in the air that you breathe comes from. Then people have the option of learning that. If it was linked a bit more explicitly to your health and why it matters? Why care about ozone? And it might be more accessible?

Res1: I think it's really interesting by the way, I'm loving this, I'm just thinking about my dad for example who is in his 80s, with severe COPD, would he want to know? Probably not. Would he understand what his ozone is? No, he wouldn't. If you got an alert saying - Air quality is poor today. That would mean a lot more to him than the ozone is bad. We are technically talking about air quality aren't we, just with specific focus on the methane and the ozone bit. I would think having a button somewhere, a little thing you can click on, that says if you want to know more about the science, a link to an in depth thing, and then a less dumbed down version, and then a button saying if you want to know even more about the science, and then you can have as much detail, so people have the choice as to how scientist they want to get.

Res2: I agree, the fact that you have two things called ozone is really unfortunate, I think.

Int1: Blame the atmospheric chemist for that one! I don't understand, it's beyond me. It is unfortunate. I really like that idea of having a quite simple visual schematic, that is a more illustrated design rather than anything else, just something really basic, and if they want to find out more, being something that then gives people the opportunity to be a ‘sciency’ as they want, but still have something very basic. So I think we need to think about is stripping it back a little bit, taking chemical equations out of it. I'm thinking what does the average person actually need to know? So I suppose part of what we have committed to doing is developing something that is partly educational, but within the objective, what does that objective need to look like. It is very possible that we have overthought what people need to know as academics because we are interested in this stuff. So that's really useful. We will take on board all of that. I'll explain what we're doing in the last session. We don't have any visual content yet, for the educational material around ozone and health. What we have is an evidence base that we have collected in a scoping review links of ozone and respiratory/mental health, and what we would you like me to consider is what bits of this you think are their most important. I'm sat here thinking – Gosh, why didn't we do this to start with with the evidence base around ozone and ask for feedback about what you think is important. But this is a great opportunity to do this with ozone and health. So it's a bit of content. I had an ambitious idea, that was to draw something that you think what's it like the impact of air pollution on lungs. But actually, some people are more comfortable doing that than others, but really what I'd like is what do you think should be visualised, what should be in the application’s educational module. You've identified that there is way too much detail in the last content that we presented, so for all the evidence I'm about to go through, what should be in there that is meaningful? Keep in mind what you think should be the information that is communicated, if there's anything that comes to mind that should be more visible than text based, would be a really useful information piece for us. We're starting then with ozone and respiratory health, it's a pretty straightforward message in the literature. I haven't done a proper systematic literature review yet, but that's probably something that we will do, I did a more scoping review where I just jumped into the literature, and looked at highly cited papers, most recent literature, the type of findings that seem to be the most consistent over time, as opposed to rogue reasoning that seems to have died off. We know that the WHO estimates are more than 7 million deaths per year from air pollution, this is worldwide, but some of those are directly attributed to 03 specifically, as opposed to other types of air pollution. We know parts per million particular matter, that is also really important, but there does seem to be an independent evidence base specifically for ozone, and this can occur during warm periods across Europe. So to aggregate 2015 to 2017, more than 100,000 deaths seem to be associated with ozone. This loss of life seems to be around cardiovascular and respiratory illness specifically and includes both long and short term exposures. So your shorter term exposures, and your longer term exposures can decrease lung function, and is particularly noticeable for children. When we talk about the impact of 03, we talk about the peak daily, so it's not just the fluctuate in small amounts of the day, but the daily peak that seems to have the impact. It's also in warmer months. And associated again with cardiopulmonary and respiratory conditions and symptoms. There are no surprises there with the warmer months because we know that UV is one of the factors that actually causes the ozone to occur. So with respiratory it is pretty straightforward and pretty well understood. The mental health research is a little less clear, so again it's for our benefit, when you see that little symbol ug/m3 we're talking micrograms per cubic metre. What I've looked at is a series of review studies, so studies that go away and do the hard work for us, synthesise all the other research for us. This one from 2018 locked at 31 studies. The reason I'm going into this amount of detail is because there is considerable variation in the findings of different studies. So when it comes to respiratory, it's all pretty consistent in what the findings suggest. When it comes to mental health, it's actually a lot less clear. This is maybe worse than the unintended consequences of research, because there is no simple message that you can communicate about mental health. It is more complicated, there are more unknowns, probably we need to think more carefully about what we communicate and how we communicate it. These studies that were found in 2018 vary in quality, so there's a lot of quality assessment that we do when we do big reviews have lots of literature, and what we're finding is considerable variation in the quality of these studies. For that reason, some of the findings appear to be more possible, or more

likely. So the more possible, the more high quality studies seem to suggest that there is an independent link between ozone and cognitive function, so decreasing cognitive function. And then there are studies that link to suicide, depression and emergency department admissions for panic attacks. There are two cohort studies looking at association between depression, including increased risk of reporting symptoms per 10ppb O3 exposure, association with ambient concentration, so ambient concentration and suicide mortality in Belgium, and they found there was a link between ozone exposure and suicide mortality in all seasons except winter, and this was the case control showing differences in ozone for days with two suicides in Belgium. This is why I've got this ug/m3 air here, the higher concentration days appeared to be associated with higher suicide mortality. The reason that I'm plugging these studies in particular is what on earth does increasing risk of reporting symptoms per 10 parts per billion ozone exposure even mean? There's no threshold given, is it just any amount of ozone increases mental health risk, surely there is a threshold? Surely there are very high concentrations that have an impact. These are the studies showing that higher concentrations… my mind is racing with stuff like - OK this is one study, but is there a threshold beyond which people with depressive disorder are more at risk? And to be completely honest, I find some of this stuff pretty confusing and potentially quite dangerous. It could have all sorts of negative impacts if it's not properly understood. What I say is that a lot of this research is by mental health clinicians who don't necessarily understand what 10 parts per million ozone exposure means. Or to put that into context of people's daily exposure, what does that mean? The other thing to consider here is the direct versus the indirect pathways. Why on earth does ozone exposure have an impact on the brain or on mental health? We know it's some pollutants like particular matter, PM5, PM10, that sort of thing, there may very well be an impact on the brain’s nervous central system, apparently very small particular matter does have an impact on cerebral white matter, and is associated with alterations in certain brain regions and process is linked to psychopathology. So things like changes in neurotransmitters in the brain. Again, I'm not suggesting this is the level of detail that we need to go into with the general public, it's just their own understanding that this is where the evidence base seems to be at. It seems to be at that there are some impacts associated with particulate matter that may have a direct biological impact on people's brains, and some of those might be linked to psychopathology. But when it comes to stuff like ozone, ozone is a gas, ozone is not particular matter, it's not very small particles, it's a gas, so does that have a direct impact on the brain or are there indirect pathways? And the fact is that we have no idea. There is very little research on why there seems to be a link between ozone and mental health. But I have spoke to some really interesting nurses in the past few months as I was doing my meet and greets and get to know you with everyone, and it was a nurse from the ICB in Lincolnshire, he said to me - What about the links with respiratory systems and mental health flare ups? Since we have somebody who is very extreme asthma, and ozone flares up their asthma, there are panic attacks associated with breathing. So maybe it's an indirect link, but it's not like PM10 having an effect on the brain directly. And they said to me that one of the objectives of the NHS is to try and reduce the over reliance on the blue inhaler. I didn't know anything about Salbutamol, so being an academic, I went and spent two days reading everything I could get my hands on the effects of overuse of salbutamol, and it turns out that over reliance on that blue inhaler, there are two types of inhaler, when you take in the morning that is preventative and is steroid based, put the salbutamol is the one that you take if you are about to have an asthma attack. It immediately increases your metabolism and blood flow to the lungs; it helps oxygen get to you quicker. It has a cardiovascular effect of increasing blood vessel capacity, and it increases your heart rate massively. Overuse can cause tremors, heart palpitations, and stomach acid because it has such a rapid effect on metabolism, that it's almost like going for a long run and you build up ascitic acid, and it has an effect on your stomach. So there are all these effects that may well be more likely be related to panic then the actual ozone itself. Which I never would have thought of, had this asthma nurse not mentioned it to me. There's just no information on these direct and indirect links. So really, we are just reading the literature but that's all we know. Some of the interesting points that came out of this was that if you look at the traffic lights that WHO provides for ozone levels, the red zone is above 100 ug/m3. Very few studies that I've seen on the psychological impacts of ozone suggest that actually the amount that might be associated with suicide outcomes was around 80. So that's just one study that's not necessarily truth or untruth, but the question is, if ozone does have an effect on mental health are they red traffic light concentrations the same for mental health as they are for respiratory health, or are they lower? Could it be related to her severe your asthma is or respiratory condition, and therefore maybe it varies? Is there a safe concentration? Is there an orange concentration, is there a red concentration? Maybe the thresholds are lower for mental health we don't really know because it's such a new area of research. Are there actual biological links or are the drivers and pathways more indirect, and we know there is absolutely more research needed in this area. I have initially thought that we draw pictures like these students that I met, but I thought you'd be interested to see them. This is my favourite at the bottom- How the bad things get out. The kid was saying you have to share the bad things get. It is at the bottom with this little car, and the bad things have sad faces, and they're getting out and that's what causes the problem, the sad face bad things from the car. I thought that was fantastic. But actually a more useful approach this would be, what are the things that you think, has chosen thinking about how the bad things get out is really important to understand, what is it from that evidence base that would be a useful message to people about respiratory and mental health?

Res1: If I'm being completely honest, I would be concerned that the mental health aspect is unproven, tenuous at best at this current stage, and will take away some of the stuff you would get if you just pointed out the respiratory, which are well known and proven and evidenced. In terms of detail, it would have to be way dumbed down for Joe Public, and again a traffic light feedback system - How do you feel today? Smiley face, middle face, sad face. Maybe a text box to comment why. Might be useful in collecting data to add resonance to whether mental health is affected by ozone levels.

Res2: I do kind of agree, obviously the evidence base is key, if we're not sure, it's difficult to put it across in that perspective. I was thinking of a different angle on that, I'm not sure where you would get this from, but I know there's an evidence base that links SMI’s with COPD, asthma and I think diabetes. I think there's something like 40%. Whether or not the mental health is caused by the air or the fact that the person is struggling with the symptoms of the respiratory thing, I don't really know, but one way or another it does go together for sure. If something is affecting someone’s respiratory, then there's going to be a chance that it impacts on mental health as well.

Int1: Do you think it would valuable, putting aside the direct pathway - air pollution to mental health, do you think it would be a useful message in a simple pictorial way to communicate that impacts on breathing can make people sad, or impacts on breathing can leave you feeling low? Even that link that you have mentioned, do you think it's a useful communication in the sense that it is validating, this is a common experience, that having these respiratory effects can make you feel unhappy, or is even that not necessary do you think? Could there be a benefit in validating that this could be lived experience, can make you feel bad, or is that maybe not a necessary message?

Res2: I couldn't give you a 100% yes or no to that, but what I do think is that the consequences of one thing in a person's life, can be relevant to what might be causing that. If you take the equation if somebody has a debt problem, there's a good chance they may have a mental health problem as well, if you can deal with the debt then the mental health issue would be less, and i think that, if I'm honest, respiratory illness, we could be talking about a lot of things, but I suppose the point I'm making is that anything that has an adverse effect on your health is going to affect your mental health as well.

Int1: Do you think this it is of value if that is mentioned in the narrative? If we're talking about ozone and you're health, and the indirect effects of struggling with health has negative well-being effects, this can also affect people's well-being? I've mentioned these educational modules that we're going to embed help seeking prompts, like - Find out about health services near you, if this is something you are struggling with. Do you think there would be a benefit to mentioning mental health in that wider health narrative in the way that we could then say - We connect you to ask my groups. We can also link you to well-being groups for people who struggle with this. So rather than deep diving with evidence base and all that sort of stuff, more just a recognition that struggling with respiratory conditions can impact your well-being. Here are some options for how to address your well-being; do you think that sort of thing might be useful?

Res2: Yes, that's the kind of thing that I was mentioning. It's tricky isn't it to say that the ozone might have a direct impact on mental health, if we're not certain that that is the case, or we don't have the evidence to back it up.

Res1: It could be impossible but if you could find some way of getting the feedback, you are almost lending your own weight to the research, to say that if someone says – Yes, I have got an unhappy face, and I don't feel good today mentally. Then they can comment when you say - Why is that? – I have been up all night coughing. Then you know that their mental health state is directly related to the respiratory problem. Which again, is directly contributable to the ozone peak, or whatever it was on that particular day.

Int1: That is exactly what we're planning on doing, is having a self reporting mechanism, where we can actually prompt people to independently report about their respiratory and their well-being, and then look at relations between. You can imagine in an ideal world, if thousands of people use this app, and we went – Isn’t this interesting, on some days with high ozone people have respiratory problems and mental health problems, and some days when they don't have respiratory problems, but they have mental health problems, you might be like – Yes, we can look at direct and indirect links. I think in reality, I would be seriously surprised if he didn't come out seeing a link between respiratory and mental health; certainly, we can work on that evidence base, and one of the stakeholder meetings that we're going to have like this is around what those smiley faces and sad faces should look like. Because that's another huge thing. We're holding workshops like this with Ghana as well because there are going to be cultural differences, all sorts of things in there. That makes me think that the incorporation of mental health should only be as a periphery message around respiratory health, and a more peripheral, briefer mention of struggling with your respiratory health can also impact your well-being. That sort of a message rather than anything more in depth, anything that confuses that message. And allowing people to report to self report their well-being as well as their respiratory health. Does that summarise your recommendations at this point?

Res2: I like the sound of that.

Res1: Yes.

Int1: The next steps that we're going to have after these initial meetings, I will send out a brief survey to you this week to get some ideas. For the NE Lincolnshire region, if you think about well-being and respiratory, probably come to mind around community resources. It could be groups – If you are using this app to help support an elderly member of your family, or a child with asthma, there might be more specific groups that people can get links to. Alternately, there could be public health resources that often people don't know about because they don't jump online and research these things. So anything we can embed into the application and find out more, would be cool. Also, we are really keen to incorporate stakeholders like community based stakeholders with lived experience working with others who might find an app like this useful. If there's anyone you could think of. What we can do is compensate anyone who is a community stakeholder, we can give Amazon vouchers for their time. We will hold an in person meeting next year at some point. We can compensate people for travel and time, directly financially, but given these meetings are online, our option from the university perspective is vouchers. We're hoping if people might be able to identify community members or lived experience experts who work with others who might be interested in attending something like this to feed into. This will become so important as the process goes on with the development of the app, and what self reporting looks like, what the climate and health module looks like and all of that. If there's anyone that comes to mind, please feel free to get in touch with me, we can invite them to the next meeting, that would be fantastic. Also, in the follow up survey, to get a little bit more information and feedback. What we will do in the meetings, we are paying for a transcription service, it is all anonymised, but just what everybody said. You can have that as a record for yourselves. For future meetings, a similar process to what we're going through today, for the design of the actual material. There are a few things that we're looking at. Visual self-assessment tools. So you guys have said about traffic light faces, and tracking how you are feeling today feedback. For people who are interested in the more advanced kind of components, the app being able to graph against what the air pollution is been with your happy/sad faces, can see generally what your health seems to be like. And a few nurses say to me – Do you know what, there are patients out there who would love to collate for themselves an evidence base that they can take to a doctor and say – I have been keeping record of this, I know I'm having these experiences. I said - Is that really necessary? And they said that loads of people talk about not always getting the validation that they want from their GP, and the usefulness of something that tracks in the system. So that might be something that we present and try and work on, and be accessible, and not ridiculously complicated. A simple graphical image. Mapping the data, so that the map that we looked at in trying to make that accessible and not too complicated. Finally, when we actually have the app, sharing and distributing to be able to see if we can encourage some people to try it and see if it actually works. With these sorts of prototypes, there is a lot of potential for it to be useful to people, but at the same time, we can sit around and discuss what we think unintended consequences might be, but through prototyping it is really the only way, asking people to trial is really the only way that we can establish whether or not we were right about that. There could be things that we have missed. And when we prototype it as an actual functional app, there should be some feedback mechanisms in there for people, and they will know it is a prototype. They will know that it's prototype, not a finished product – We are asking you for your help to see if this works, this is a prototype. We only have a year to do this which is crazy when I think about how much work has gone into just developing content for a single meeting, but keeping to the timeline, we're probably every few months, we will have a meeting like this, and try and align it with some of that content being ready for you guys to see. Then we're hoping towards the end of the project when we have some outcomes, promote of this engagement that we can actually present, that we can definitely do some in person sessions. I'm hoping we can come and do one of those in northeast Lincolnshire, and then have another one in Lincolnshire that we can also invite everyone in northeast Lincolnshire to come to, and support travel time and all of that. So to make that happen, we realise we have to plan pretty early, we mentioned this follow-up survey in that I might just try and get a sense of how realistic that is for the May/June period. I'm hoping to capture before everybody goes on holiday in 2025. It is a little way away, but hopefully if we plan early enough, we will find time for people. That would be really cool just to resent to everybody what we've done and what we've achieved as a wider group. Just before we wrap up, any final comments come my questions or concerns? <Discusses future meetings form>Anything you've been thinking about but haven't had a chance to raise?

Res1: Just in terms of future meetings, I think Fridays are a day to avoid because lots of people work part time, generally Friday’s is a day that is blocked.

Res2: There's nothing else for me. I think I would say that this is fascinating stuff to be honest. We have at least 200 people who are diagnosed with asthma will COPD on just one of our programmes. I would like to invite maybe one of those two to a meeting at some point, but I think I'm pleased that this isn't the one because when we get to that stage, I think they will be more engaged looking at the app. But it's really important stuff, and it's really important for me to understand all this background stuff completely, it's really good.

Int1: Fantastic, I'm so glad. I agree it is super important for all of us to understand, even if it's not the depth of knowledge that we communicate to other people. So having you guys along to have some insight is really fantastic. I appreciate your time, thank you so much. That's everything I have for now. Thanks so much. We will sort out the transcription for this, and we will send up follow up survey to gauge times and dates for next meetings. That has been invaluable. You always try to anticipate where you're going to learn for the stakeholder participation, but you can't, there are always brand new ideas, and it's such a valuable process so I really appreciate your time.

Res1: You are very welcome.

Int1: See you next time.

Interview Ends