

Environmental Audit Committee

Oral evidence: [Heatwaves: Adapting to Climate Change](#), HC 826

Tuesday 15 May 2018

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[Watch the meeting](#)

Members present: Mary Creagh (Chair); Colin Clark; Zac Goldsmith; Mr Robert Goodwill; Caroline Lucas; Kerry McCarthy; Anna McMorrin; John Mc Nally; Alex Sobel.

Questions 125-241

Witnesses

[I](#): Dr Anastasia Mylona, Research Manager, Chartered Institution of Building Services Engineers, Cassie Sutherland, Policy and Programmes Manager for Climate Change Adaptation, Greater London Authority, Emma Fryer, Associate Director, techUK, and Sam Longman, Policy Manager for Environment (City Planning), Transport for London.

[II](#): Aaron Burton, Director of Policy and Innovation, Waterwise, Alex Plant, Regulation Director, Anglian Water, and Paul Hickey, Deputy Director for Water Resources, Environment Agency.

Written evidence from witnesses:

- [Chartered Institution of Building Services Engineers](#)
- [Greater London Authority](#)
- [techUK](#)
- [Transport for London](#)
- [Waterwise](#)
- [Anglian Water](#)
- [Environment Agency](#)

Examination of witnesses

Witnesses: Dr Anastasia Mylona, Cassie Sutherland, Emma Fryer and Sam Longman.

Q125 **Chair:** I call the Committee to order and open our third public hearing on “Heatwaves: Adapting to Climate Change”. For the purposes of *Hansard*, I ask our guests to introduce themselves, starting with Dr Mylona.

Dr Anastasia Mylona: Hi, I’m Anastasia Mylona. I am the business manager at CIBSE, the Chartered Institution of Building Services Engineers.

Cassie Sutherland: Hi, I’m Cassie Sutherland. I work at the Greater London Authority, where I am the policy and programme manager for climate change adaptation.

Emma Fryer: I’m Emma Fryer. I work for techUK, the digital technology trade association for the UK. I look after data centres, where I am the associate director for the programme.

Sam Longman: I’m Sam Longman. I am the policy manager for environment at Transport for London.

Q126 **Chair:** Thank you all very much for coming. We have a wide range of issues to cover. You are all representing different but particular things that we are interested in. I will start with an overarching question. We have heard that building regs in this country do not really protect occupants against the health risks posed by overheating. How could mitigation of those risks be incorporated into building regulations?

Dr Anastasia Mylona: I think it is the responsibility of the building regulations or the regulatory framework to address health issues, including overheating. There are various ways to incorporate overheating measures into building regs and the policy framework. The current way that the regulations are laid out is not ideal, because overheating is such a dynamic phenomenon, with implications for air quality and energy use. A more holistic approach would be a better way to regulate how buildings could perform in the future. That is an approach that could be integrated for new builds, but we have to also consider existing buildings, which at the moment are not covered by building regulations unless they are undergoing thorough refurbishment.

Emma Fryer: I work for, essentially, an industrial sector, so I would be reluctant to see new regulations, because we are looking at technical real estate where the process is industrial. The process is computing, and the by-product of computing is heat, so our operators deal with heat as part of their business process in very competent ways. It would be difficult to target everything with the same brush. While I certainly would not object to regulation per se, it would need to be appropriately targeted.



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There are very strong incentives for heat management in data centres—cost incentives, reputational drivers—as part of the business risk management process. People are not working eight hours in the data halls, which is the environment where we get excess heat. They would generally manage that remotely from a comms room, pressing buttons with things on screens. Therefore we would not anticipate that people would need to be in those environments for very long. At the moment, that is handled as part of corporate risk management. I have not had any reports of people suffering from heatstroke or issues with heat management. There are other technical solutions.

Also, the sector that I am in is essentially a clustering of a number of different sectors, such as comms, buildings, data, engineering and cooling. Each of those sectors is separately regulated. For comms, there is comms regulation for data in the GDPR. For generators, we have four different kinds of regulation. We are very heavily regulated in all the different aspects that make up the data centre, so I would be reluctant to see something that was not adequately targeted, but I would not oppose regulation per se.

Dr Anastasia Mylona: When I am talking about regulations, I mean at the design stage, when data centres are actually under planning, so that they have the right measures and the right mitigation options. If there is a heatwave or a really hot event, they can respond to it.

Q127 Chair: What about modular homes? The Government are talking about modular construction. There are 15,000 modular homes built in the UK each year by China National Building Material. These are prefabricated, factory-built houses, many of them in London. We have people living in sea containers in London; I do not imagine that they are very energy efficient. I have prefabricated housing in my constituency that was thrown up after world war two and was meant to be pulled down after five years, but it is still there 60 years later. Those houses are not attached to the gas grid, they have huge heating bills and tin roofs, and they are boiling in summer and freezing in winter. Is the dash to build housing causing problems? What is London doing, Ms Sutherland?

Cassie Sutherland: In the existing London plan we have policies in place for managing heat risk, and any new developments go through and follow the cooling hierarchy, which looks to minimise the overheating risk of buildings and incorporates some additional guidance and modelling that CIBSE has produced, which looks at dynamic thermal monitoring rather than steady state modelling, so it starts to take into account how people live in those buildings and what risks they will be introduced to. We also look at how buildings will affect the urban heat island effect of London, which I am sure we will come on to in a moment, taking into account the materials and the construction methods that are used.

In terms of existing buildings, the Mayor runs a series of programmes under the Energy for Londoners brand around retrofitting existing homes, targeting fuel-poor homes but also retrofitting homes and non-domestic buildings. These schemes do not just look at improving the energy



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efficiency in order to heat the buildings better in the winter, but look at minimising any risk of unintended consequences like overheating. They have within their technical guidance examples built in and assessments that the installers have to do to mitigate any of that risk.

Q128 Chair: There is a new draft national planning policy framework. Do you think that adequately accounts for the risk of overheating, as it stands in draft?

Cassie Sutherland: From the GLA's perspective, we would like to see stronger references to mitigating overheating in the NPPF, and taking the approach that we are actually taking in the London plan—the existing one and the draft new London plan—that looks at minimising internal heat gain and then looks at minimising the impact of new development on the urban heat island effect. We think the cooling hierarchy in the London plan at the moment is one option or framework that could be used as an example of including that kind of more targeted focus on overheating.

Dr Anastasia Mylona: It is an improvement in the new draft that there is mention of overheating risk as a risk, but the rest of the framework will need to address the issue by giving an aesthetic approach, what solution exist, how to measure it, and what would be good advice for the local authorities to follow as well.

Q129 Chair: Okay. It sounds like London is “on it”, but I think other local authorities are dealing with other types of risk. In Yorkshire, we are looking at flooding risk very heavily, but less at overheating.

Dr Mylona, would you recommend that the guidance you have produced for the Zero Carbon Hub, which—sadly—is now closed, should be implemented into building regulations at that micro level? We have talked about the macro level of the plan; what about the micro level of building regulations?

Dr Anastasia Mylona: I would say yes, but with a couple of caveats. The good thing is that we have now a standard that is based on our knowledge of how to test a building for comfort. Our knowledge is still not very good in terms of the health effects of overheating for people who have pre-existing health conditions. For me, that is a gap. To my knowledge, there is not such a standard or such advice available, other than Public Health England advice.

The other caveat would be that again the building regulations will have to look at overheating within the context of other deliverables and other tests—air quality, for example, within part F, and energy efficiency. We need that holistic approach, where the building is designed and tested for whole year round performance, rather than for specific issues that are looked at separately.

Q130 Chair: You mentioned part F. Part L also deals with insulation, openings and permeability. Those are the obvious places to put it, aren't they?

Dr Anastasia Mylona: Yes. I have had this discussion for the last 12 years with CLG and what came across was the idea that somehow



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overheating could come into conflict with the conservation of energy that part L is dedicated to. That is why they are currently looking at minimising solar gains—that is the term that they are using instead of overheating within part L.

There was a period—I think it was the 2006 regulations that actually introduced a test, but that was then removed in the 2010 revision.

Q131 **Chair:** What was the test in 2006?

Dr Anastasia Mylona: The test introduced dynamic thermo-modelling into the design of buildings. You could then look at the hourly summertime performance and how many hours above a certain threshold—I think it was 28°—the indoor temperature would reach. If it reached that temperature for more than 1% of occupied hours, the building was deemed to be overheated. It is a simplistic approach, but it is much more thorough than having nothing or than what we have at the moment.

Q132 **Chair:** Why was it removed in 2010?

Dr Anastasia Mylona: I don't know. I suspect it was because it created conflicts with the energy agenda. That is the only thing I can think of.

Chair: Okay. We can pursue that separately. Thank you.

Q133 **Caroline Lucas:** Generally, what types of buildings are at the greatest risk of overheating and what are the consequences of that?

Dr Anastasia Mylona: I would say that the buildings most at risk are domestic properties, because traditionally they do not have mechanical cooling methods of ventilation. Commercial buildings tend to have more mechanical services, so they have the ability to mechanically cool the space if it reaches a certain temperature.

At greatest risk are single-aspect flats, flats with communal corridors with uninsulated hot water pipes going through them, and properties that rely on natural ventilation, so people need to open windows, but they are in very highly polluted, high-noise areas, so actually people cannot open the windows. They have no other means of cooling the space, which means that temperatures increase.

There are also buildings with very high internal gains, such as schools and hospitals. Those that are mechanically cooled can deal with that, but those that are not are at high risk. There is also top-floor flats, usually because of the heat traveling upward.

Q134 **Caroline Lucas:** Are there any barriers to surveying the overheating risk in existing buildings—trying to get in to discover which buildings are overheating? Are any buildings particularly hard to survey? For example, we heard that some buildings might have some of this ICT equipment in them, but if they are in a public sector or private building, how do you get access to them so that you can go and poke around and see what is going on?



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Dr Anastasia Mylona: It is an issue. Some buildings—especially commercial buildings—have building management systems in place, so they can get information from the temperature sensors and actually give that kind of advice to building managers. Most buildings do not have those kind of systems, and definitely the domestic sector does not have the capacity. There is no consistent way we could immediately implement to start monitoring the temperatures. The lack of a consistent way of monitoring indoor temperatures and how they respond to outdoor temperatures is partly one of the problems in collecting evidence to show that overheating is actually a problem.

Q135 Caroline Lucas: Is there a recommendation that follows from that observation, in terms of what we could do about that?

Dr Anastasia Mylona: My recommendation would be for developers, clients, building owners and councils, which can access council housing, to put in temperature sensors so that they could collect that kind of information. It could then be analysed, and we could see a broader picture of the problem.

Emma Fryer: In the ICT estate for data centres, we would define an older facility as something above 10 years old, so we are in a slightly different age range from most other buildings. That is because the newer facilities will have access to better technology and new technology such as adiabatic or evaporative cooling—that kind of thing. The facilities that would be more at risk are not the large, commercial ones that are bound by reputation or service level agreements with their customers; they have got access and investment to introduce the best controls. It is the ones that are below the radar, which I think you referred to—perhaps smaller server rooms within smaller organisations or local authorities. They do not have to report outages, or report whether there has been a problem, to their customers; they are not obliged in the same way. The energy users are transparent—so they are not accountable in the same way. Obviously, they are accountable to their own organisation, but not externally accountable.

All I can say is that what we imagine is a spectrum of performance across that. The important one is what are those IT functions supporting? Are they in effect supporting the storage of shoe sizes of people in Wolverhampton from 1972? If so, it is not such a big issue. If they are supporting air traffic control or traffic lights in London or something more critical, that is an issue.

Q136 Caroline Lucas: What is the worst-case scenario, in that latter example?

Emma Fryer: I am being a little facetious—sorry. Usually, if it is something supporting a mission-critical activity, it will have some other form of back-up. There will be redundancy within the system, so the facility might be mirrored—there will be other forms of redundancy. I would be very surprised to see something really critical going down from a small server in a small organisation, to be honest.

Caroline Lucas: Good.



Sam Longman: Building on that, in transport, one of the things that concerns us is the interdependencies. Obviously, we are very concerned with people experiencing heat and what we can do to manage that within buildings, stations, trains and the like. One of the problems we see with transport is fluctuations in heat, so that when we get the first hot day, electronic equipment goes down, but what is the knock-on impact of that? Do you end up with signal failures, or people being trapped in tunnels, for example, and overheating as a result? When we talk about heatwaves, it is really important that we do consider the interdependencies and do not just worry about people's personal experience of the direct heat, but the knock-on impacts of things starting to fail, as Emma has alluded to.

Q137 **Mr Goodwill:** Dr Mylona talked about people who could not open their windows because of levels of pollution, but the other reason why people do not open their windows is noise. Are we doing enough in, for example, the flight path of airports such as Heathrow, to ensure that we have higher standards of air conditioning or other design within the building, so that where people cannot open their windows, they have a better environment in their properties?

Dr Anastasia Mylona: I guess this is a case-by-case issue. If a property is on an flight path, that needs to be taken into consideration. The risk is much higher for the domestic sector, because it mostly relies on natural ventilation to cool properties when it is hot. It is not just noise from aeroplanes but also in city centres—city environments. Perhaps there are areas where, in the past, we did not think about building properties, but because demand is high we will now have to build in those areas. That means that there should be a way that we can test whether those properties are in danger of overheating and, if we still want to build there, we need to introduce measures of cooling in order to protect the occupants.

Q138 **Caroline Lucas:** Dr Mylona was talking about the importance of monitoring overheating. Is overheating monitored in existing buildings—for example, tube stations, data centres or, indeed, the properties that the rest of you are involved with? If so, what are the procedures for monitoring overheating, specifically?

Cassie Sutherland: I will join this with the point that I was going to make before, which is another type of building that may be likely to overheat. I was going to reflect on Dr Rajat Gupta's study from Oxford Brookes on air overheating risk in care homes. That was an interesting study that looked at care homes, which often focus on keeping residents warm, rather than cooling. That has led to some overheating. It was quite a small sample size, but he looked at a few care homes and found that, although modelling showed that they were not at risk of overheating, by going in and monitoring, they were overheating. That shows the importance of monitoring as well—bringing that back. I will let my other colleagues talk about the different systems, but from our perspective at the GLA, looking across, the monitoring is patchy. We have quite a lot of modelling, but for on-the-ground monitoring to test how that is working in practice, we would struggle to get a rich dataset. It is richer in some areas



than others, but across the whole, and particularly in the health sector, we are struggling to get hold of rich data.

Emma Fryer: I will talk about data centres. Part of the definition of a data centre is about environmental management. To be a data centre, it has to have environmental management in place. That is a mixture of monitoring and modelling. Computer room air conditioning units—what we call CRAC units, because we love to make everything into acronyms—will do advanced monitoring, look at what is going on and control the temperature. We also do things that vary from thermal imaging to computational fluid dynamics to model what is going on within the data centre.

We deal with hotspots, because what tends to happen is that in one area you have a higher density of IT equipment, and that could create a hotspot. There are ways of dealing with that. First, you have to identify them—you can model them or you can monitor them—but there are very basic ways of dealing with them. Sometimes you put blades extending out, which expand the area from which the heat can radiate. Sometimes you do this thing called hot aisle and cold aisle containment, which is really just plastic sheeting that directs the air—it is incredibly basic stuff—so that the cold air is going into the front of the servers in the racks, and the hot air is being directed away where it can be recirculated and cooled. At the other end are very state-of-the-art computational methods and a thing called data centre infrastructure management. If you went to a data centre conference, probably a quarter to a third of the agenda would be made up of people showing you new developments in cooling technologies, so it is quite a complex subject.

Sam Longman: In the tube network, we have extensive monitoring in place. It starts months ahead of the various seasons. We have a look-ahead in our network command centre, where they look at the forthcoming seasons to see if there will be any problems. Also on a daily basis—in fact on an hourly basis—they look at the weather reports. A morning call goes across all the senior officers in Transport for London to look at what problems might be coming. We have a 5-4-3-2-1 plan where everyone knows their roles five days ahead of the event, four days ahead of the event, three days ahead of the event and so on. Things are done to ready for that, such as messaging—putting posters up—and audio messaging to make sure that people are hydrated. Across the network, thermometers are measuring the temperature all the time continually. We have teams of energy cooling and heating engineers who know the network very well, so they know where we have problem areas and where we have hotspots. We have a whole programme of actively trying to manage the temperatures within the tube network in particular.

Q139 **Caroline Lucas:** What flexibilities do you have beyond telling people to drink more water and get off the tube if they are feeling queasy?

Sam Longman: To be honest, a lot of it is automated anyway, so any active cooling that we have will automatically kick in. It is not like, say there is a heatwave coming, so we ship in loads of fans or whatever. When

we are designing the network, particularly when we are doing upgrades, we look at climate change anyway and we have a whole detailed design standard for how we manage the temperatures and try to stay within a safe envelope. It is more about the messaging and what our response is if problems occur.

What is interesting about the tube network, particularly the deep tube, is that it is very well insulated from outside temperatures, so the temperature is actually quite stable. The big challenge we have is people turning up already hot and flustered and then getting on the tube. Particularly if they have underlying problems, say they are hungover or pregnant, then they might experience problems due to heat. Safety is our No. 1 priority, and we do not really see a correlation between temperature in the atmosphere and an increase in illness on the trains. When we have looked at it previously, our peaks tend to be around Christmas time, for reasons that you may be able to imagine yourself.

The other interesting thing is that we look at the whole system, so at the health outcomes that we can achieve in London through the transport network. There is a balance between upgrading the network and adding more capacity, which can generate more heat, so we look at how we can make the trains as efficient as possible. With unlimited funding, you could, in theory, make the tube network very comfortable and cool, but is that funding better spent on other things, on promoting active travel and public transport, getting people active and the health outcomes you get as a result of that? It is this balancing act that we are doing the whole time.

Q140 Chair: So it is internal dehydration rather than external.

Sam Longman: Yes. As I say, there are no real instances of perfectly healthy people falling ill due to heatstroke. Our messaging used to be "Stay cool", but now it has changed to "Stay hydrated", because that is the most important thing—that you keep drinking water.

Q141 Chair: What about your staff? Are they allowed to wear shorts and so on?

Sam Longman: They are allowed to have a uniform that is appropriate for the conditions that they are working in. Our concern about safety is not just about passengers; it is also about staff. There are internal procedures, when people are working in hot environments, about taking breaks, staying hydrated, looking out for each other and so on.

Q142 Chair: Going back to data centres, we had a data centre in Leeds that flooded. It was under the river, and we heard about it being flooded. It was a bank's data centre. So I'm sure they have lots of fans, but there are lots of different risks. Do you have to tell anybody where ICT infrastructure is located? We heard that the climate change risk assessment people could not work out where this stuff was. We do not, as policy makers, have a picture of where this stuff is; do you have a picture of where it is?

Emma Fryer: A pretty good picture, yes.

Q143 Chair: Would you like to share that with policy makers—on a discreet



basis?

Emma Fryer: It depends—I'll do the "It depends" thing. The commercial sector, the people who are data centre operators and provide data centre services to third parties, are very easy to locate, certainly within the particular area; and actually, 70% of that market is concentrated around the M25 and within London, so that's your big block—

Q144 **Chair:** In the hottest part of the country.

Emma Fryer: Indeed, but also where there is the greatest connectivity and the greatest customer demand, and there are reasons for the way that has grown up. They may not necessarily look logical in retrospect, but they are pretty logical.

Then there is what we call the enterprise market. Enterprise really means "in-house". Those are the people who are using the data centre to support their own corporate activity, their own corporate IT function. We have absolutely no idea where a lot of those are, because those companies do not wish to tell us that. If you were a bank and your main disaster recovery site was a data centre in Nuneaton, I don't think you would want to tell people it was there, because that would be a problem for your own resilience. The fact is that the first line of resilience is to have it not absolutely clear where a lot of these major facilities are.

I can understand why the climate change committee is anxious about knowing where they are, but in a sense there is a balance to be struck in relation to revealing the locations of all these sites. And I don't think GCHQ is very keen to reveal its exact location!

Chair: That is helpful; thank you.

Q145 **John Mc Nally:** Good morning, panel. This has been very interesting so far. It is good to know that a lot of action is going on and taking place on a very practical level. May I move you on to the subject of adapting existing buildings and infrastructure? This question is probably for you, Dr Mylona. Is the use of mechanical cooling inevitable to reduce overheating in buildings, and how can we reduce the dependence on high-emission solutions?

Dr Anastasia Mylona: If we continue building the way we are at the moment, cooling will be inevitable, not just because of the techniques, the materials and the ways we are building and designing our buildings, but because there does not seem to be any mitigation of climate change and there is intense urbanisation. If you put all this together, it is inevitable that we reach a point where mechanical cooling or some sort of cooling will need to be implemented to keep people healthy and happy, in their homes especially, because mechanical cooling is common practice in other, commercial buildings—offices, for example.

Q146 **John Mc Nally:** I have noticed in my own constituency air cooling units being put in—or put outside new houses, on new developments. That is a thing I have never witnessed before, especially in my area.



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Dr Anastasia Mylona: Yes, exactly. It should not be a problem in the British climate to have mechanical cooling. Because of this silo approach to energy efficiency, we put a lot of effort into sealing our buildings so that we don't spend a lot of energy during the winter, but we don't look at the implications of that during the summer.

Also, we want to make more of the space that we have, so we compress the space and make buildings and flats smaller. We try to make the most of the floor area that we have, so we have single-aspect flats. All of those techniques and practices are creating a problem that shouldn't be there, and it is going to get worse because of urbanisation—we are putting more people and buildings into the urban environment—and because climate change continues to increase temperatures.

Emma Fryer: I have a slightly happier story than that, but only because we are dealing in this case with machinery, not people. The data centre sector is moving in the other direction, away from mechanical cooling and towards what we call free air cooling. The reason why we have been able to do that is because standards for the manufacture of IT hardware, which are governed by an organisation called ASHRAE, have changed.

The servers that do the computer processing are now designed so that they can operate in wider envelopes of temperature and humidity, called ASHRAE envelopes. That means that if you adhere to, say, an ASHRAE level 2, your computer will work reliably in quite high degrees of humidity and temperature, and the manufacturers will underwrite their guarantees to that.

That means that you can then run a data centre at a higher temperature and humidity, which is actually very useful if you then want to adopt free air cooling, where you actually just circulate air—you don't have to use mechanical chillers. I think I included in my written submission a map that shows where we can now use free air cooling. It is right down to southern Europe now. I would imagine that, even with much higher average temperatures and some heatwaves, we will continue to be able to use increased amounts of free air cooling.

There are obviously limits. You cannot have people working in data centres at 40°C. Other parts of the facility will start to fail, so you can't push it forever. However, we are reducing the amount of mechanical cooling in the sector.

Sam Longman: I am pleased that you raised emissions associated with this. It is incredibly important, and is something that we are very passionate about at TfL when we think about the whole system. There definitely is a relationship between mechanical cooling and the increase in emissions. At Transport for London, we have a cooling hierarchy. First, we try to recycle any wasted energy, through, say, regenerative braking, instead of letting that escape as heat. We try to make the whole system as efficient as possible, such as by introducing coasting instead of active braking. We try to recover wasted heat. We have an example in Bunhill where we try to export waste heat into a heat network.



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It is incredibly important, particularly with some of the challenges we have now with the Mayor's targets around carbon, for example. We are aiming for the tube network to be zero carbon by 2030 and for the whole of London to be zero carbon by 2050. Of course, transport will need to be zero emission as a result of that. We need to look at the whole system, as well as air quality. We have cooling on all our double deck buses, and they have things like white roofs and insulation to try to manage the—

John Mc Nally: I think some of them were made in my own area, in Falkirk.

Sam Longman: Yes. You could put, say, even more active air conditioning and chemical cooling on the buses, but that would end up making the engines work harder, which will add to air pollution, and we have an air pollution problem at the moment that we are also trying to manage. It is so important that we don't consider these things in isolation. It is about maximising all those benefits where you can and striking the right balance.

Q147 **John Mc Nally:** It is a bit of a conundrum. I can understand that.

Cassie Sutherland: Sam mentioned the Mayor's target for a zero-carbon London by 2050. Of course, that is important when we are considering building our new buildings and developments, and also air retrofitting. In terms of new developments and looking at the cooling hierarchy, the last resort is mechanical cooling.

We are looking for developers to demonstrate a series of things before they actually consider active mechanical cooling, such as first having to minimise internal heat generation. That is stuff like waste heat coming from pipes, as Anastasia talked about before, such as from any hot water pipes through the common areas. There is also reducing the amount of heat actually entering the building, which requires careful shading, looking at louvres and particular glazing, but also the shading from trees and vegetation outside, which is important. That is part of that holistic approach as well.

There is also the use of thermal mass and high ceilings to help to manage the heat within a building. Increasing that amount of thermal mass can help to absorb some of the excess heat. If ventilation is required, we are looking at passive ventilation, such as opening windows where possible and other design methods that can be used, such as shallow floor plates and dual aspect units. Then there is mechanical ventilation, before we get to active cooling, looking at some of the free air methods—which Emma was just talking about—about free cooling. For example, when the outside air temperature is lower, using that to draw the warmer air out of the building. Using those low-tech, if you like, cooling methods, before you start to get to active cooling. Developers need to demonstrate all of that for the new developments in London before there is a consideration of any active cooling. That is partly reflective of the fact that there will be emissions associated with that, and that it will produce waste heat, which will then likely be dumped into the environment as well.



Q148 John Mc Nally: You have probably addressed my next question fairly well. How could we nudge the public to greater awareness of the efficacy, to encourage people to introduce these measures, to take more responsibility for themselves and their own immediate environment? How do you think we could do that and get that message out there that they all need to take that responsibility?

Cassie Sutherland: Part of it is through that good design. Therefore people are buying or renting buildings that are well designed. There is a need to raise awareness about the risks and impacts of higher temperatures, and the fact that we are likely to have more heatwaves occurring. What we see as heatwaves now will start to become normal temperatures in years to come. There is some provision of information on how people can manage their own homes. For example, keeping their blinds down during the day when they are out at work will cool their home during the day and it will be cooler when they get home—it won't have heated up. The same goes for work places. Those are simple things, but I don't think there is great awareness of this.

Q149 John Mc Nally: That goes back to my question. How do we make the public more aware of possibilities, such as products that are perhaps available? I am not aware of them. You have told me quite a lot already, but how do we get that message out there?

Dr Anastasia Mylona: For new designs, the responsibility lies with the designers to implement those measures, because with a lot of them, it is very difficult to implement after the building has been completed. For existing ones, it is very important to get that knowledge out there when people are refurbishing their homes or buildings. That is a great opportunity to say, "Since you are investing money on your building, perhaps you should consider also putting shutters and shading, or changing your glass type." Any refurbishment schemes that the Government might launch, for example the Green Deal, are a great opportunity to tell people to consider overheating.

Sam Longman: I just want to build on that. One of the things that is good to think about is how you frame your messaging. With a lot of environmental stuff it can come across like we are making people's lives difficult. We are taking things away. They have to walk more, not use their cars and have shutters. It can be a bit miserable. But I think that you can frame a lot of this stuff in a very positive vision for the future—how it will be better for individuals and will be healthier. For example, more greening in the city, more walking and cycling, and less energy being expelled through heat and mechanical moving, etc. Those things can have a lot of very real health outcomes for people. If you can sell that positive vision about trying to make a better, more sustainable city, not just because we care about the planet, but because it will be better for everyone living in it, then you are more likely to get people to take action, in our experience.

Q150 John Mc Nally: It seems that this is a unique moment in time regarding all the plastics, which everybody is aware of. You have this impartial observer sitting on your shoulder and I think everybody is gaining



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awareness of their own particular situation. Earlier you mentioned databanks and so on. I am aware that we have had them in southern Europe, but we would quite like to see them a bit further north. I think it was Facebook that moved a data centre into the Swedish Arctic. Is that correct?

Emma Fryer: Luleå.

Q151 **John Mc Nally:** Would that be a possible solution to part of the problem?

Emma Fryer: It is a frequent suggestion. It depends—sorry that I keep saying that it depends—on the type of function it would do. If you are a large cloud hyperscale provider—such as a Facebook, a Google, an Amazon or a Microsoft—you will be seeking the lowest possible energy costs. You will have a highly commoditised activity, which is hugely efficient, and that is because the thing that you are selling is not particularly time sensitive. If you are providing a data centre service for, say, financial services or a range of other businesses, they require what is called ultra-low latency, or relatively low latency, which just means a quick flash-to-bang between the message going out and the message coming back. If you are buying shoes or wanting to upload a video of yourself teaching your dog to tap dance, it does not really matter whether that takes two seconds, 12 seconds or 2 milliseconds, but if it was an algorithm on the trading floor, that would really matter. It depends a bit on what you are doing. The UK is not a destination of choice for those big hyperscale operators, and that is why they are there.

Q152 **Chair:** Can we go back to TfL? With all your brilliance in planning, how come you managed to design a bus that overheated—the new Routemaster? What happened there? What went wrong?

Sam Longman: In terms of the battery technology?

Chair: Just people boiling up on the top deck with no windows.

Sam Longman: We have now put in opening windows. There is a difference between perceived overheating, where people are not able to open the window and feel cooler because of the breeze, as opposed to the actual temperature. It was a new design of a bus for London and there are always improvements to be made. We have since put in opening windows for that bus.

Q153 **Chair:** What are the lessons from that, then?

Sam Longman: We are learning lessons all the time and improving our technical understanding of how to make people feel comfortable, how to keep them safe and how to be as energy efficient as possible while keeping our transport services as cool as possible.

Q154 **Chair:** You said that there was a perception of overheating because you could not open the windows. Was there actual overheating? What were the temperatures on that top deck?

Sam Longman: I do not know the details of the specific instances that have happened, but what I do know from speaking to colleagues is that

with air conditioning, as you will be aware, if you open all your windows you are effectively air conditioning the world as opposed to inside the bus. Certainly, people feel a lot better by having that option to open the windows themselves and get the breeze, which does have a cooling effect.

Q155 **Chair:** So it is a behavioural thing, as much as anything.

Sam Longman: I think so, yes.

Q156 **Colin Clark:** Moving on to local planning, do we need local or national policy to address overheating in buildings and cities?

Dr Anastasia Mylona: We need both. The national policy will set the targets and the strategic vision, and the local authorities will have the local understanding of the vulnerabilities, the risks for buildings and the population, and then they can be in charge of the delivery of those strategic targets. It is very important that we have awareness and policy at both levels.

Cassie Sutherland: I have talked a bit about the policy that is already included in the London plan and that has been proposed for the new London plan. That approach is very important for London: we are doing this twin track by looking at minimising internal heat gain and the impact that will have on people's health, and looking to not exacerbate the urban heat island effect across the city as a whole as increased urbanisation of the city happens, as Anastasia mentioned. Having an eye on both things and looking to address them through new developments, particularly in areas that are likely to undergo major development or major regeneration, offers an opportunity to build in some of those mitigations at that point. From our perspective, that local, although strategic, policy within the London plan is very important, and that will then go down to borough local plans as well.

Q157 **Colin Clark:** Would it be reasonable to say that budget cuts to local planning authorities are affecting their ability to make towns and cities more resilient to heatwaves? From what you are saying, you have quite advanced plans on that anyway.

Cassie Sutherland: From our perspective, those plans are being adopted. We have been promoting thermal modelling—overheating modelling—that CIBSE have done recently. We are starting to see developers come to us more and more and be very keen to put that modelling in place. Whereas at first that was maybe more of a challenge—it was new and people were just getting used to it—now we are starting to see that become the norm, which is really positive.

Q158 **Colin Clark:** Will it become part of the sales pitch of developers?

Cassie Sutherland: It could be. I don't know, actually. Maybe it has already.

Colin Clark: Are people environmentally aware enough that they—



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Cassie Sutherland: I think we are certainly starting to see sustainable buildings in particular being used more in that way. I see certain developers use that as a selling point. Whether they are particularly using the dynamic overheating thermal modelling, I am not sure yet, but maybe they will do.

Q159 **Colin Clark:** Other than the placement of buildings, what planning decisions increase the risk of overheating, in both suburban and rural areas and in digital infrastructure?

Emma Fryer: I cannot think of any at the moment. We deal mainly with generator emissions in planning requirements, so it is very much the other end of the thing. Possibly it would only be in terms of how close together buildings were allowed to be spaced, but it is outside of my area of experience.

Q160 **Colin Clark:** So maybe in housing.

Cassie Sutherland: It is important to look at the whole use of a development. For example, some of the opportunity is in London, where there is going to be large-scale development. They are looking at the mixed uses that are going to be there, whether that's a mixture of low-rise and higher-rise buildings, domestic versus non-domestic, and schools and hospitals and those kinds of services as well. And there is also utilising well-designed public realm in that case, ensuring that green infrastructure is built into that public realm and/or cool pavements, cool roofs and green roofs, so that you have an impact—or, in fact, you do not have an impact—on the overheating effect by the development of the area. It is important to look at that strategic scale as well as the individual building-level scale.

Dr Anastasia Mylona: I absolutely agree with Cassie about the fact that when we are designing a new development we have to look at it holistically—the public areas as well as the buildings. I do not think there is anything within the planning policies that restricts the treatment of overheating, but I think it is the lack of any advice that gets it ignored.

Q161 **Colin Clark:** So all this is coming from the temperature going up in the UK. What is needed to ensure that planning policies and procedures to prevent overheating can be adopted in UK towns and cities? I am obviously from the north of Scotland, like my good colleague John McNally, and we build lots of green areas in developments. This has been an experience in Europe for a long time. What lessons can we learn? Most of this must have already been done in other cities, so can we not just adopt what they have done in other cities and make sure we do that? As you get as far north as the north-east of Scotland, it is not quite so hot, by the way.

Cassie Sutherland: London is part of the C40 network, which is large cities across the world working together to tackle climate change. There are really good lessons we can learn from other cities. Melbourne, for example, has a quite established managing overheating risk plan and strategy, and a lot of that is through greening the city. The greening



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changes the albedo effect, so you are reducing the overheating effect that way, but it is also providing some localised cooling through the evaporative effect of the plants and so on. They now have quite a large number of green roofs and we have seen the green roofs policy in London be very successful as well—we have started to see many more of those roofs being installed in recent years. And then there are the core roofs, having painted white roofs, for example, and so on. So some of those measures have been very effective in other cities. Melbourne is the one that sticks in my mind as where it is very well done, but there are a number of others. I completely agree that there are many things we can learn from other cities' experience in these issues.

Sam Longman: Although we are brilliant at designing things and planning—you are correct—there is a real opportunity with adaptation. I am very passionate about it because I work on air quality, CO₂ and biodiversity—all the things I have talked about. The reason I am so passionate about adaptation is that I think there is a real opportunity to do things better, and measuring our performance is the key thing I want to be able to do. On an individual service or piece of infrastructure, I have given the impression, which is correct, that a lot of extensive work goes on, but how are we doing overall as a city and how is transport doing overall in terms of being resilient to future climates?

Now, as a result of the new mayoral strategy, there is a lot of work going on to try to do better in terms of quantifying. We have been inspired by, for example, Network Rail, who have done a lot of work on this, triggered, admittedly, as a result of flooding, but it applies to adaptation generally. They have a public performance measure, and they can see during adverse weather that that public performance measure, which has several different inputs, drops by about 6%. That starts to give you some kind of benchmark of performance. If you can start to shave that off and get it to 5% or 4%, you can hopefully drive business decisions. That is what I really want to do, to enable the TfL board and decision makers to be better informed about the implications of their decisions, because money is finite. We have lots of things we need to do and you are able to make a case for some things very robustly in monetised forms but, if I am honest with you, in terms of adaptation becoming more resilient, there is a lot of opportunity to do more work, to get more evidence. If you are providing this additional greening structure, if you are providing this energy efficiency thing or if you are calling this—or whatever—you will have this monetised benefit and you will be able to compare it with other things that might be on the table, for example. There is a lot of work that is going on. In our evidence, we pointed to some papers that went to our safety, sustainability and human resources panel, which talked about all this work, and we'll gladly share more of that with you.

Q162 **Colin Clark:** On industrial buildings, have we moved on from what they were in the past? I used to have factories that were built in the 1970s and they were terrible for overheating. We simply painted the roof silver and it made a massive difference. Has commercial property policy really changed?



Emma Fryer: I can only speak for data sectors, and in old facilities—I think it's about 15 years old—we'd call that legacy, with retrofitting issues. We tend to retrofit quite frequently, because the asset life of IT equipment is much shorter than much other infrastructure asset life, and that gives us the opportunity to keep one step ahead. So, even with the chiller units, you might get an old facility that is getting on and the chiller units are getting on. It's full, which is also a problem, and therefore you need to replace stuff, but you can do that because the life of a chiller is maybe 10 to 15 years. There is a natural refresh cycle for all the different components.

One thing I will add on planning is that I totally agree with my colleagues here about the need for a more holistic way of looking at sites, because one of the issues that we have, which isn't strictly to do with overheating but it is to do with heat rejection, is that there are often planning requests for us to make available our waste heat, which is not simple. There are a number of barriers, because it's very low-grade heat, but we have done that. In one well-known instance, we did that. We provided it to edge of site, as required—or the operator did—and then the local authority forgot to tell the developer, who came and found that there was a heat source coming into the site. So that was never made use of, which is a great shame.

We have found that connected thinking, and perhaps some less institutional amnesia perhaps from time to time, would help, so I would agree with the points that have been made.

Q163 **Colin Clark:** It needs to connect up to big greenhouses, and grow tomatoes and peppers.

Emma Fryer: It is done in places.

Q164 **Colin Clark:** It is—it's done hugely in Kent.

How does the London cooling hierarchy deliver low-carbon solutions to reduce overheating, and what demonstrable impact have these measures had on reducing overheating?

Cassie Sutherland: I think we have two cooling hierarchies, which is somewhat confusing: the cooling hierarchy in the London plan and a transport cooling hierarchy. We will go away and work on our names for a bit. I think you're talking about the one for development, in the London plan.

I talked through this briefly, but it's this process so that then you're getting to any active or air conditioning basically last, so developers have to have consideration of all of the other ways in which they can minimise internal gains and heat first. They look first at making sure they don't have big pipes that are emitting loads of waste heat within the communal areas, reducing the internal gains through shading—that can be through vegetation and trees or through louvres and shutters—and then moving towards passive ventilation and then mechanical ventilation, before you would get to a stage of having active cooling.



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We have found that to be effective. During any pre-application stage, developers demonstrate to us how they are following that hierarchy, and that is then reviewed by officials at City Hall. Questions are asked if we think the developer could go further, in terms of maximising the passive measures and options first, before getting to active cooling. In order to meet our carbon reduction targets, it is important we don't suddenly have lots of active cooling within the city. And there are options. Using low-grade waste heat is also a way of powering cooling.

That's something that we look at through our decentralised energy programmes. We've actually mapped across the city different secondary heat sources: either heat from data centres or heat from the tube. I think Sam mentioned before that that's being extracted up in Islington and being used to heat homes and leisure centres nearby. So we're actually starting to capture some of that waste heat, which then has a localised cooling effect, but also that heat could then be used to power cooling mechanisms as well.

We are kind of looking across that whole system for buildings as well and actually looking at it as a system rather than just, "Okay, do we want to put an air conditioning unit in here?"

Sam Longman: Essentially, they are the same. If there is unwanted heat, that is energy that is being wasted, so it's about getting the system as energy efficient as possible, whether that is by just having an efficient system in the first place or reusing that energy. Or, if there is waste heat, how can you reuse it several times without linking to heat networks? Your last port of call is putting in mechanical engineering to try and actively cool it, because it has the associated energy and emissions with it.

Q165 **Zac Goldsmith:** Cassie Sutherland, the draft London environment strategy outlines how the GLA will evidence the impacts of the urban heat island. Have you found a link between the amount of urban green space and the urban heat island effect? Is there a direct correlation?

Cassie Sutherland: There is evidence to show that the urban heat island is more pronounced in more densely developed parts of the city. In large open spaces we can definitely see a reduction, based on the maps we have of the urban heat island. While we think that yes, that is linked to green space, there is also something about the quality of the green space. More highly vegetated areas are going to have a more significant impact on the heat island in that respect. We recently published a natural capital account for London that looked at putting an economic value on London's parks, and at the economic cooling effect of our parks as well. That impact came out at something like £590 million. It was quantified on the benefit to health and therefore looked at the knock-on effects on health services and reductions made there.

Q166 **Zac Goldsmith:** You talk about the quality of green space. If you had a network of playing fields—just turf—is there a measureable cooling impact from that kind of terrain, as well as from woodland terrain, as you have just described?



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Cassie Sutherland: Yes, there is a measurable impact. I don't know the direct difference between those two.

Q167 **Zac Goldsmith:** Would it be less pronounced?

Cassie Sutherland: Probably, but it would still be more effective than a heavily urbanised area or somewhere that was full of hard and dark surfaces that therefore were going to absorb more heat and release that at night time, which is the main impact of the heat island.

Q168 **Zac Goldsmith:** Have urban heat islands become more intense over the years of erosion and loss of green spaces in London?

Cassie Sutherland: There has not been a huge decline in green space in London. There has been a change in quality in some of those cases. There is a difference of about 10 degrees between the centre and the outer parts of London. That overall difference has not changed hugely; it has existed for quite a while. We are not seeing huge increases in that, although it is likely that the centre will stay as an urban heat island, because it is becoming more densely populated. The area may be larger, but that is different from the temperature differential being any larger between the centre and the outskirts.

Q169 **Zac Goldsmith:** Presumably, the green walls and green roofs that we occasionally see would have the same cooling effect?

Cassie Sutherland: Yes—certainly we have found that there is a cooling effect of green roofs and green walls. In 2016 we did a survey and there are now over 700 green roofs in the central activity zone in London—so covering quite a small area.

Q170 **Zac Goldsmith:** Over what period of time?

Cassie Sutherland: Mainly since 2008, when urban green policy was first introduced to the London plan—but there may be some that were there before that.

Q171 **Zac Goldsmith:** Are there any planning regulations that made that hard, which prohibit or prevent the building of green walls and green roofs? Are there any obstacles?

Cassie Sutherland: Green roofs particularly have been pretty successful. We have seen a lot of them being adopted. We have not encountered too many barriers at the moment. I am sure there are limitations on retrofitting them in certain conservation areas, but in terms of our new developments, we are finding that they are promoted and delivered not only through the London plan, but through borough local plans as well. They are being quite effectively delivered there.

Q172 **Zac Goldsmith:** Finally, do you believe there should be more targets—or targets, full stop—to increase green spaces across cities in the UK? I suppose your focus is on London.

Cassie Sutherland: We have one.

Q173 **Zac Goldsmith:** What is the target?

Cassie Sutherland: It is for more than 50% of London to be green by 2050.

Q174 **Zac Goldsmith:** When was that target brought in—is that the latest London plan?

Cassie Sutherland: It is in the London environment strategy.

Q175 **Chair:** Can I follow up on that? The current green space in London is 47%. Is there going to be an increase of 1% every decade? What is the actual plan for that, the underpinning theory?

Cassie Sutherland: We have not set out a timeline for that increase to happen, because we see the major opportunities to increase green space in London as being through new development and large-scale developments such as the opportunity areas and the strategic areas of development and regeneration within the city. Some of those have quite a long lead time into them, but we are putting a few mechanisms in place to try to make that happen.

In the new London plan we propose a policy called the urban greening factor, which we allow developers to quantify, and give them a guide for how much green space they should incorporate into their buildings. That would be through greening the built environment—through green roofs and green walls and so on—and actually making those spaces work for us and deliver multiple benefits, like biodiversity, cooling air, water management through drainage and surface water management as well. There is not a staged approach for that increase, although the opportunity areas and other developments offer the greatest chance for us to make that change.

Chair: Sam, did you want to come in?

Sam Longman: All I was going to mention, which I think is obvious, is the importance of shade and shelter. It is not just about the actual cooling effect in the urban heat island. There is a direct correlation between having shade and shelter and encouraging walking and cycling, which is incredibly important. Street trees are a good example of that.

Q176 **Chair:** And is there a plan for street trees, or is that done at borough level?

Cassie Sutherland: I was just going to link into TfL's healthy streets approach, which Sam can probably talk a bit more about. That is the other opportunity we see to green the public realm and the streets and road networks of London. That could be through providing shade and shelter through trees or through other vegetation.

Sam Longman: We have targets in the Mayor's transport strategy to increase the number of street trees. As Cassie was talking about, the healthy streets approach is really starting to inform everything we are doing. If you are not aware, the idea is that there are 10 indicators of



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what makes a healthy street—it is quiet, there are things to see and do, there is shade and shelter, and clean air.

The important thing about that is that is not a menu of what to do to a street but about how people feel and how they experience a street. We do surveys to see how people experience a street, using these indicators, and we see if we can improve that over time. Again, it goes back to what I was saying about it creating a positive vision. People can see that these changes are about making their lives better. Certainly, having shade and shelter is a key part of that and of helping to green the streets.

Q177 Chair: In terms of the trees that you are putting in, what is their pollen effect? Anyone cycling down the embankment has a load of lime tree and plane tree pollen in their faces. It has been absolutely incredible in the last couple of days. Sorry to put in a personal pitch, but anyone who uses the embankment deals with those massive trees. You are talking about increasing the trees, but boroughs have made mistakes in the past with trees that fruit and then the fruit falls off and people slip on them. Do you have a menu of trees that are low impact?

Sam Longman: I can't respond directly to that. I wish I could, because it is a good point.

Q178 Chair: Can you write to us with a tree menu, please?

Cassie Sutherland: I'm writing it down.

Sam Longman: It is a really important point. One thing we are looking at, which is slightly related to this, is what species of tree is most suitable for a future climate. We don't want to put in a load of trees now that will not be so suitable in a hotter climate, so we are doing some work now looking at that.

Chair: Olive trees aren't so good for shade.

Sam Longman: We will take pollen into account.

Chair: And that's part of the air pollution piece as well.

Q179 Mr Goodwill: We have already heard from Mr Longman about the effect that temperature has on TfL's customers, staff and infrastructure. To what extent and how often is your infrastructure disrupted by overheating, and to what extent is that a problem for you at the moment?

Sam Longman: This goes back to the work I talked about that we kicked off in the last year or so to really start to quantify the total impact. There is loads that we can do. With the amount of data we collect and the different assets and services we can look at, there is an endless menu of things that we can investigate. We are trying to work out from experience, through workshops we hold with asset managers and other infrastructure and transport providers and boroughs, where the problem areas are, so we can target them.

Some specific work we have done recently looked at the tube network. We have extensive data about delays and about the causes of delays and failures. We have mapped historical weather records to see if there is any correlation between temperature and delays and failures. In fact, for some lines there is. The Central line is a good example: if it gets too hot, the delays go up, and if it gets too cold the delays go up.

Q180 Mr Goodwill: Is that the signalling systems failing? What is it specifically?

Sam Longman: We need to now take that work, which looks at different timeframes and assets—the rolling stock is a particular problem and tends to be what fails—and dig into it to understand in a bit more detail what is going wrong. We then need to look at opportunities to make improvements to our systems or the technology that we use, so that we can improve that performance and become more resilient.

This goes back to what was highlighted about the importance of taking a more quantified approach, so we have this strategic understanding of where our problems are and can start to drive investment, but it is also about taking an adaptive pathway approach. You may be aware of the Thames 2100 plan, where people asked, “What if the sea level rises by a metre, 2 metres or whatever?” We want to do a similar thing with transport, so we can start to inform business planning decisions. As you are fully aware, it is much cheaper to build the adaptation in from the outset, as opposed to trying to retrofit later, but with a limited budget, we need to understand when we need to start making those investments. As I say, there is a lot of opportunity and there is work actively going on there, but I don’t have a specific answer for you in the sense of being able to say, “This is the amount of failure we see as a result of heatwaves.”

Q181 Mr Goodwill: I think my next question follows on directly from that. Obviously, we already have problems with current levels of temperature and incidence of heatwaves. In your 2015 adaptation report, you used a medium emissions scenario to quantify climate risks. Are London transport services adequately prepared for the risks of overheating from even higher emissions heating scenarios?

Sam Longman: UKCP18 will be coming out this year, and I think we are going to start to focus more on the higher scenarios. Given the way climate change is starting to play out, using the medium scenario is not taking enough account of the risks, so I think we do need to start planning for the higher scenario. When we are doing big infrastructure projects, there will be sensitivity testing that looks at the whole range of scenarios, but this is a good thing to highlight.

Q182 Mr Goodwill: You have been talking about high temperatures that cause people to be ill. A lot of customers of the London underground and the buses would quite like to feel comfortable as well.

Sam Longman: Yes, exactly.

Mr Goodwill: Are adaptation measures such as air conditioning essential to protect public health and improve comfort on infrastructure such as the

underground, and does that respect the London cooling hierarchy?

Sam Longman: Yes, I think it is important that we take climate change into account as we manage and upgrade the network. I go back to what I said earlier: there is a limited amount of funding, and we need to consider all the health outcomes that we can get from it. One of the things we are balancing at the moment is this: we are adding more services and upgrading the network, and that creates more energy and releases more heat. It is a question of trying to make sure the temperatures do not go any higher and stay within the design standards, as well as of taking those opportunities whereby we can actively cool existing parts of the network.

Parts of the network are incredibly old, which makes it challenging. With new infrastructure such as Crossrail, it is a lot easier, because you are designing something at first hand; we will have a much better experience in terms of heat there. It is a balancing act the whole time. What we need to do, and what we are doing, is to take a much more strategic approach to looking at what the sum total is of the risks over time and how we can measure our performance at a London-wide, strategic level, as well as the case-by-case infrastructure upgrades and projects that we are doing and making sure they take account of climate change.

Q183 Mr Goodwill: You have explained very sensibly how, if you start opening windows and doors, you cannot air condition the whole of the atmosphere. In fact, when we first got a tractor with air conditioning on our farm, we had a big problem with a guy who wouldn't keep the window shut, and it kept breaking down. I can remember that on some underground lines, there were doors that had to be activated by the passengers. Have you looked at whether, at times, if you have air conditioning in the train, you might not need to open all the doors? At some of the stations, the doors stay open for a long time, with the heat coming in. Is that a short-term measure you might look at?

Sam Longman: I don't know whether we have looked at that specifically, but what I would say, having spoken to our engineers and looked at the design standards myself—they are a bit too technical for me, I have to admit—is that it is clear that extensive modelling is undertaken to understand how best to manage the heat. Of course, if you have mechanical cooling on the trains themselves, the heat is being expelled into the tunnels, which is where we experience most of the heat and why we are so concerned if a train ends up stopping in the tunnel. Regardless of heatwaves and climate change, the temperature starts to go up as a result of all those bodies, all those people, in there. We do things like take account of maintenance, so when people are modelling station stuff, they take into account what the capacity is for closing escalators and the whole airflow around the station and what happens when you make various changes. I cannot answer the specific question, but from my experience of talking to colleagues and looking at those standards, I get the impression that extensive work goes on to try to minimise those risks on an engineering and scientific basis.

Q184 Mr Goodwill: Thank you.



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Emma Fryer, in periods of hot weather, many organisations give their staff the option of working from home. Does this put extra pressure on our digital infrastructure, and should the resilience of public transport therefore be improved to ensure that economic productivity is not lost in the event of a heatwave?

Emma Fryer: It certainly would not put undue stress on the digital infrastructure. There is plenty of capacity in our core digital network, so I think the answer is that there is a lot of capacity and lots of redundancy. Our digital infrastructure is actually a number of multiple interconnecting systems.

Q185 **Mr Goodwill:** Some people who live in areas with very slow internet might argue that working from home is not as productive.

Emma Fryer: It is what we call the contention ratio—when there are too many people sharing the thin pipe; I am not a broadband expert—and we are then talking about the access network. I work from home in North Yorkshire, so I am a remote worker. I do that all the time. I think there may be issues in some areas of the access network. I know in parts of Yorkshire there are still issues with broadband coverage.

In terms of the broader core infrastructure and how much capacity there is, there is a lot of capacity in that. One of the things that we tend to find—say there have been floods or a lot of heavy snow and people could not get into work—is that the issue then is sometimes what your arrangements are with your IT provider. You may have only a certain number of formal access points into the corporate network or business network. You can always come in via other means. You can use webmail and other things. There are lots of different ways of doing it. Connectivity speeds could be an issue, but in terms of the broader capacity of the network, there is a lot of redundancy built into it.

Q186 **Mr Goodwill:** There are probably other issues that employers sometimes get worried about in terms of working from home, other than just the speed of the internet.

Emma Fryer: You might be using your own air conditioning, which would add power to the system. In fact, there was a very interesting case—it isn't a climate change-related issue—when the volcano went up in Iceland and there were no flights for a number of days. The amount of virtual conferencing and home working went up enormously and did not affect productivity. A lot of people retained those systems afterwards.

Q187 **Chair:** Sorry, I just want to go back to the tube and the tunnels. You said that you are worried about the number of bodies being in there and heating up. How fast does a tunnel or a tube train heat up? Is it 1°C per hour per body?

Sam Longman: I cannot answer that specific question. Of course it would be due to a range of factors, I imagine.

Q188 **Chair:** Could you ask around in your organisation how quickly things heat up, because we have had serious customer incidents in tunnels, and



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people need to know.

Sam Longman: What I can say from speaking to colleagues—it goes back to this 5-4-3-2-1 planning I was talking about—is that our network managers know the network very well, and they know where the problem areas are. For all locations, they have an emergency plan. For trains, there is a plan that is in place that will take account of the heating factors as a result of that train being stuck. It will depend a lot on where on the network we are talking about. I can try to get something a bit more specific about our approach to that.

Q189 **Chair:** And another part of our evidence has been that suicides increase in a heatwave. We wondered if you could go back and ask whether that is something that you can map on the network—if you can make a correlation between heat and increases in deaths on the railway. That would be very interesting for us and brand-new evidence that has not been seen before.

Sam Longman: Yes.

Q190 **Chair:** Thank you very much. We have overrun by about 15 minutes, but that is testament to your interesting answers and brilliant coverage of the topic. Thank you all very much.

Examination of witnesses

Witnesses: Aaron Burton, Alex Plant and Paul Hickey.

Q191 **Chair:** We are on our third public hearing on “Heatwaves: Adapting to Climate Change”. May I ask our second panel of witnesses to introduce yourselves, please?

Aaron Burton: Good morning. My name is Aaron Burton, and I am director of policy and innovation at Waterwise. Waterwise is an independent, not-for-profit organisation established in response to the 2005 drought. We are supported mainly by water companies, working to deliver our mission that water is used wisely every day, everywhere.

Alex Plant: Good morning. I am Alex Plant. I work for Anglian Water, the regional water company for the East of England, where I am regulation director.

Paul Hickey: I am Paul Hickey, head of water resources at the Environment Agency.

Q192 **Chair:** Great. You are all very welcome. We have been learning a lot about water in this inquiry and we have learned about hydrological drought and meteorological drought. We are trying to work out whether government policy has taken into account hydrological drought, which we have been told is a future threat for the UK. What analysis have you done of the future of hydrological drought?



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Paul Hickey: There has been a lot of work in this area, by ourselves and the water industry and more recently the National Infrastructure Commission. We have been looking at future scenarios in terms of climate change. That is just one of the pressures on water resources. The others are population growth and the needs of the environment and how we might need to reduce abstraction to protect the environment. That shows that there is an increasing risk of drought without intervention—something in the region of about 1% per year for a serious drought.

Q193 **Chair:** 1% of what?

Paul Hickey: A 1% risk—of severe drought that is.

Q194 **Chair:** By that, you mean hydrological drought, which is when the temperatures dry up the ground, rather than meteorological drought, which is when the rain does not fall over a long time, or both?

Paul Hickey: What I would say is that firstly there is no single definition of drought and each drought is different. We look at drought through impact, rather than whether it is due to rainfall or is hydrological. We classify drought by the impact it is having, either on the public water supply, the environment or agriculture. A severe drought is one that has a big impact in terms of the public water supply—there would be quite severe use restrictions at that point.

Q195 **Chair:** Okay. So a 1% risk of that happening in any year.

Paul Hickey: Yes.

Q196 **Chair:** What are your projections? Is that risk set to increase?

Paul Hickey: Yes. As we set out in our evidence, purely from climate change, that risk is set to increase between 4% and 7% in the next—

Q197 **Chair:** That is a huge increase in risk. To 4% or by 4%?

Paul Hickey: Sorry—to clarify: the reduction in public water supply due to climate change is between 4% and 7%, depending on the part of the country we are looking at. So climate change generally has more of an impact in areas with hard geology, because they are essentially more responsive to changes in rainfall, which is the predominant thing we are looking at with climate change.

Q198 **Chair:** What is the risk of drought going to increase by? Do you have a figure?

Paul Hickey: Again, it depends on the severity of the drought that we are looking at. I can send you some of the evidence that we have done on that to give you precise figures.

Q199 **Chair:** That would be helpful, thank you. Can you explain how drought affects public water supply? Perhaps turning to you, Mr Plant.

Alex Plant: In a period of extended drought, you have a number of impacts. First, you have a diminution in the amount of water coming into supply. Secondly, you can have an increase in the demand for water as

you get those drier conditions coming through. So you have both impacts happening at once, which is one of the issues we set out in our research around water resources—the long-term planning framework that Paul also referred to—and is reflected in the National Infrastructure Commission’s recent publication, “Preparing for a drier future”, which points out some of those risks. That is why what we are putting forward in our own water resource long-term planning is something that looks at a twin-track approach to try to reduce demand and improve leakage, and also, in some areas, increase supply so we have more storage and more ability to move water from wetter to drier parts of the region and the country.

Q200 Chair: How is your company doing on leakage reduction?

Alex Plant: We are the industry-leading company on leakage reduction, so we have the best performance on leakage.

Q201 Chair: Why is that?

Alex Plant: I suppose in part it is because we are the driest part of the country—we have lower rainfall than any other part of the country—so we have a greater need to ensure that we do all we can to reduce leakage. We are also one of the fastest-growing parts of the country, so the growth impacts on us mean that it is imperative that we recognise and try to do all we can to drive down leakage.

I should say that although we are the leading company, it does not mean we are resting on our laurels. The plans we have are to continue to drive leakage further down, so that we are doing the very best we can with what is an increasingly scarce resource, particularly in our region. The whole philosophy of the company is “Love Every Drop”, which tries to communicate the value and scarcity of water, and leakage is obviously one key element of trying to ensure that we make the most of that valuable and scarce resource.

Q202 Chair: Waterwise, we have heard that the risk of drought is set to increase substantially. Do you have any figures or planning on that, and what do you see as your role in helping people?

Aaron Burton: Referring back to Water UK’s long-term planning framework report, it suggests that water companies, even those that do not have a current deficit, might be resilient to the worst historic drought on record, but face up to a 12% chance of seeing a drought event with standpipes in place for two to three months over the 25-year planning period.

Q203 Chair: Pause that, because your planning framework said that “a dry climate could treble the risk of experiencing a severe drought in the East of England.” That is trebling. What is the 12% figure? Could you explain that again?

Aaron Burton: There is a 12% chance of seeing a drought event with standpipes for all companies.

Chair: Across the whole country.

Aaron Burton: Across the country.

Chair: So that is the global risk.

Aaron Burton: That is a really important point to make. That report sets out that it is not just the east of England; it is across the entirety of England and Wales that there is a potential risk.

Chair: Over a 25-year period.

Aaron Burton: That report goes out much longer than 25 years, but water companies plan on a 25-year period.

Q204 **Mr Goodwill:** Obviously, most people find out there is a drought because of the hosepipe ban. At what point is a hosepipe ban brought in? Is that before it is an official drought or when there is a drought announced? How can we judge when there is a drought by when there is a hosepipe ban, or is that completely unrelated?

Aaron Burton: Water companies have to produce drought plans that they submit to the Environment Agency. My colleagues might like to speak on that. Certainly it gets into temporary use bans, which were implemented for the first time in the 2012 drought, and then looking into drought permits. One point is that there could be better integration between drought planning and water resources planning. Some companies are taking that forward at the moment.

I did some work looking at the 2012 drought. From the customer perspective, they would have liked to have known a little bit earlier before temporary use bans came in, and it is the same for businesses. That is one of the recommendations that came out of that drought, but we haven't necessarily implemented it. There is no single place for customers to get an understanding of the water resources situation at the moment.

Paul Hickey: In the national framework we have for drought management, we classify various phases of drought, going from normal to prolonged dry weather to drought, and then to severe drought and recovery. As you move into those phases, that triggers different measures to mitigate the impact of the drought.

We think it is really important that things like temporary use restrictions—hosepipe bans, as was—are implemented very soon in that, because one of the first things that is impacted is the environment and sectors such as agriculture. By limiting non-essential use, you help to both conserve the resources and mitigate the impact on agriculture and the environment.

Alex Plant: One issue that is really important here is that, although we are talking a bit about when it gets bad—when you start to need hosepipe bans or more extreme restrictions—the messaging into customers and businesses needs to always be around making the best use of water and trying only to use what is needed. To my mind, it is not enough to only



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respond when the crisis happens. It is really important that we have, and improve, the level of understanding of the importance of trying to make the best use of water and reduce water use in normal times, so that you build up your resilience such that, when you hit those prolonged periods of dry weather, you have more in the tank, if you like, to cope with the crisis.

Q205 Kerry McCarthy: I have a few questions about soil and the retention of water, which are partly based on evidence that we have already been given. Where does the responsibility lie for retaining moisture in the soil, and what more could be done to prevent soil from drying out during a heatwave? We have heard that soil actually plays quite a significant role in reducing temperatures during heatwaves.

Paul Hickey: The Environment Agency has quite narrow responsibilities for soil management. We provide advice and guidance to land managers during the course of other interactions. We manage some specific regimes to do with material recycling for land—sewage sludge, for example—which bring some benefits, in terms of organic inputs into soil. We also have an instant response function to protect against both damage to soil and, when soil is badly managed, how soil can run off and impact on rivers.

There is a whole range of things you can do to improve soil moisture, such as, as I say, putting in more organic material, be that through ploughing the residuals of crops or green manure. There are also things that you can do to prevent the loss of soil, such as avoiding compaction. Those measures are important for protecting the soil's moisture retention ability.

Alex Plant: As a water company, we monitor soil moisture deficit using the data that we get from the Environment Agency and the Met Office. During a heatwave you will obviously see that soil moisture deficit increase, and it is something that we need to monitor because we need to know how much more rainfall is needed to replenish it back to the levels it was at before. It goes back to why leakage reduction is so important. In that scenario, you are improving the background position by every megalitre a day you can save off your leakage.

It also goes to the point that a lot of these issues around drought are not the responsibility of any one organisation. Water companies have a responsibility, the Government have responsibility, and we work with bodies like Waterwise. We have looked at our water resources challenge through something that we formed called Water Resources East, which brings in a number of organisations that need to take action together such that we can mitigate the risk of drought. That goes to agriculture, industry, individual customers, local authorities, Government bodies and water companies. I think that is the sort of approach that needs to be developed if we are to really tackle these issues effectively.

Q206 Kerry McCarthy: Do you think the groundwater abstraction regime needs to be reformed? If so, would that cause problems for you, in terms of supply?

Alex Plant: No. I think there is room for reform in that area. We did some work a few years ago looking at how Australia has dealt with the extended

drought. There are lots of interesting things in that study, and if the Committee is interested we can send you through the report we did at the time. The two things that came out that were the most interesting for me were, first, the very significant additional level of water storage that Australia has compared with the UK. It is massively more in terms of the level of storage available, because they are familiar with dealing with much drier circumstances.

The other thing is that Australia has introduced a change to the way in which abstraction licensing and abstraction trading work, so they have a water share system, which allows for abstraction licences to be traded between the different people. What that does is that when you hit a period of extreme water scarcity, you see relatively quick and easy shifts in how water is being used, and it goes to the areas of most need. We thought that was an interesting experience to reflect on, and I think we would see benefit in there being another look at abstraction reform in the UK context.

Paul Hickey: Just to build on what Alex said, at the end of last year we and DEFRA published an abstraction plan. It is a strategy about how we are modernising the abstraction regime, be that for surface or for ground waters. It has three pillars. One is about restoring catchments to sustainability and using our full powers to do that. The second is looking at how we can evolve our current regime to increase access to water and protect the environment, and we have four priority catchments. We are looking at how we can do the sorts of things that Alex is talking about, in terms of optimising abstraction trading between users.

The third thing is modernising the service. We are bringing abstraction, which is currently a paper-based licensing system, into the digital age. I think that will be one of the transformational pieces, because through the system we are developing people will be able not only to carry out the regulatory functions of abstraction but to see water availability in real time, or near real time. That will make us able to have a far more dynamic approach to water management. So there is a quite a lot going on in terms of policy development and regulatory change for our abstraction regime, for both ground and surface waters.

Q207 **Kerry McCarthy:** Is that at the proposal stage?

Paul Hickey: No, the plan I mentioned was published last year. With the IT system I mentioned, elements are already online. It is done in a modular system, so you can view your abstraction licences online on gov.uk. It is being implemented, and we have to report to Parliament on progress next year.

Q208 **Kerry McCarthy:** Good. One thing that was said to us was that soil was an obvious omission from the climate change risk assessment. Is that something you would agree with?

Paul Hickey: The proper management of soil is a feature of the national adaptation plan, both because we need healthy soils for good water management and wider ecosystem benefits and because healthy soils are



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a big carbon store. One of the particular things in the adaptation plan looks at how peatlands are important in terms of carbon storage—how peatland habitats have around half the carbon capture of all the soils in the country. Proper soil management is strongly referenced in the adaptation plan.

Q209 **Kerry McCarthy:** That is in the adaptation plan, yes. I think this was about the climate change risk assessment.

Paul Hickey: The adaptation plan is like the response to the risk assessment, isn't it?

Q210 **Kerry McCarthy:** I think you have answered the next question. If I can just ask Alex: do you think that water companies ought to have more responsibility for soil management? I appreciate that you are in a difficult position, in that the problems with the soil drying up are not necessarily caused by you, but you are the one who has to find the water, in the end.

Alex Plant: Yes—I would not say that it is obviously a thing that you could naturally make water companies directly responsible for, but I suppose it goes back to my earlier point that the answer to these sorts of issues needs to be collaborative. I think that water companies have a role to play in working with stakeholders in their region to get to the right sustainable solutions, which would include thinking about how you retain soil moisture deficit.

Certainly, in our region, we have a lot of the peaty soils that Paul referred to, which are so important as a carbon sink; we are also the bread basket of the UK in terms of agricultural production. Ensuring that we work with agriculture—it is mostly arable, by the way—so that we can retain the conditions that allow for the growing of crops and the continued maintenance of food supplies is obviously an important aspect of what we do. I suppose it is like a shared, not a sole, responsibility.

Q211 **Chair:** Just to follow up on that, I heard that Yorkshire Water was the second or third largest landowner in Yorkshire. Is the same true for you, in East Anglia?

Alex Plant: Not as big—I don't know the details of Yorkshire's land holdings, but I believe they have a bigger set of land ownership than we do. Clearly, we do own significant amounts of land—

Q212 **Chair:** So what would you be—the fourth or fifth largest land owner?

Alex Plant: I don't know; I would have to find out.

Q213 **Chair:** In terms of managing your soils, do you have a programme?

Alex Plant: Certainly in terms of our own management of our own areas, absolutely; it is something we are looking at now. We have just completed a first natural capital account for the whole region, with the University of East Anglia. That doesn't just look at our assets; it tries to look at the totality of assets in the region. It includes soil but would bring in other elements, such as biodiversity, water quality and so forth. The aim is that we use that natural capital baseline to assess how decisions we make in

the future add to or subtract from that natural capital baseline position. That would be where we would bring in issues such as our management of our own estate.

We have certainly done a lot around things such as developing combined heat and power solutions, so we essentially create our own energy where we possibly can—we are not drawing from the grid. That is not quite a soil example, but a similar example of how we try to make the most of the land assets that we hold. We have also done things such as develop wetland solutions, for example; there are a couple of quite important schemes in Norfolk where we are looking at using wetlands as a means of dealing with the final polishing of water before it goes back into the environment. We have been dealing with our water recycling activities. I would like to see us having more of those sorts of schemes, which are natural capital-enhancing—and, by the way, lower cost. First, it makes sense in a kind of circular economy sense, but, coming back to the subject of this enquiry, the more we can deliver those sorts of natural capital solutions, the more benefits there are through green environments providing something of a mitigation when we hit heatwave-type scenarios.

Paul Hickey: While the northern companies have ownership of the catchments around their reservoirs—I think that is what you are alluding to—and Anglian does not have that, one of the things we think is really positive in the sector is that all companies are engaging in catchment management outside their own land holdings, in order to work with agriculture and other sectors to protect catchments. That started with quite a focus on diffuse water pollution—protecting more water quality that goes into the supply. One of the things that is really encouraging, which we have started to look at more widely, is water source protection, which includes focus on soil.

Q214 **Chair:** We have just done an enquiry on nitrates, so we have had chapter and verse on that.

Paul Hickey: Sorry—so you know about that.

Chair: No, that's fine. Thank you very much.

Q215 **Anna McMorris:** Turning to water efficiency in households, in 2013 the national adaptation programme set an action point for water companies to address water inefficiency in homes by continuing to deliver water efficiency campaigns. That was five years ago; what has been done since?

Alex Plant: Do you want me to answer that for Anglian?

Anna McMorris: Yes, as an example—

Alex Plant: You might want a broader sectoral position. We have continued and, in fact, upped the level of work we do around the public awareness campaigns. We have programmes such as Drop 20 that try to encourage households to find a way that they can drop their usage by 20 megalitres per day, and use water wisely—messages around that. All of



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that aims to reduce water wastage and encourage more water-wise behaviour.

It is particularly interesting in our area, because there has been a long campaign from us around the importance of "loving every drop". You see a greater level of understanding within our customer base than may be true in wetter parts of the UK.

One of the things we have done in recent times is through an initiative we have in and around Newmarket, which we call our shop window; it is like an innovation showcase around a given town. We have done a lot of work with customers in that area to try to move to much lower levels of water usage. As part of that, we have been trialling the use of smart metering, so that we can demonstrate to people what it is that they are using on a near real-time basis. Then we run campaigns, competitions and different sorts of behavioural incentives that we are starting to see some real benefits from, with people making quite significant reductions in their water usage.

I think that as we move into the next price review, the roll-out of smart meters across our region will be a key aspect of what we put forward to Ofwat in our plan, because we see that the benefit of moving towards smart metering actually starts to get you into some of those really interesting and more fruitful behaviour change programmes that we are seeing through the experiments I have just talked about.

Q216 Anna McMorris: Just before we move on from that, have you been able to measure water efficiencies?

Alex Plant: Yes. There has been a general reduction over time in the level of consumption that we have continued to see, and part of that comes from just moving from unmeasured to metered households. By the end of this price review period, we will be at around 93% of our properties being metered. That is quite a high level in comparison with other companies.

With some of the experiments I have talked about in Newmarket, I am a bit wary of claiming them as being absolutely definitive, because they are quite small-scale at the moment. Nevertheless, we are seeing really quite significant reductions; you are looking at about 25% reductions in consumption in some of the examples we have done. The reason we are wary is that there are only a few people in the sample and it is a relatively short time period that we have run it over, so we don't yet know whether it is a short-term reaction to the stimulus and then people return to more traditional levels of consumption, or whether it can stick. That is what we want to try and do more of.

Aaron Burton: Perhaps I can provide a bit of a wider sectoral perspective. Waterwise has been involved with many water companies individually in their programmes but also with an initiative called SaveWater South East, which was taking a regional approach to communication. Water companies in the south-east were involved in that.



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A few examples include Thames Water, which has been running something innovative called Greenredeem, which involves incentives at an individual household level. Thames Water is trialling it in 3,000 homes in Reading and it has a 27% uptake rate, which is quite good. It will be interesting to see the outcomes of that. If an individual household saves water, they will get access to vouchers for something they might like, for example coffee or movie tickets.

Southern Water is trialling that at a community level in Hampshire and it has achieved a 5% to 7% reduction in consumption, where it has said to the community, "We'll provide an investment into your community if you make this water saving." Another innovative area is with Scottish Water, where it is joining up water efficiency and energy efficiency programmes that are going into households. There has been progress along those lines. As well as companies implementing metering programmes, they are often including behaviour change and retrofit of homes as well. That is a key way of getting water efficiency out there. We think that in future, there need to be more joined-up, national-level communication and campaigns.

The NAP talks about businesses and campaigns for business. With retail separation, businesses can now choose their water company in England. That has led to some issues in terms of resilience around, for example, "Who's a key contact? Who's a contact during phase 4 events—drought, for example?" Some research that Waterwise undertook showed that there is real variation in the water efficiency services now being offered to businesses and that less than half are offering simple services, like leak detection for example. We are starting a leadership group chaired by the CEO of Business Stream in the next month, to have a conversation and address that, but it is something that has become a bit of an issue over that time period.

Q217 Anna McMorris: So there is an issue there, basically, because of that competition?

Aaron Burton: Yes. The idea was, from the experience in Scotland, that water efficiency would come in as a service and that would help them sell their services. However, while it happens for some of the larger customers, it does not for the SMEs, which is a large business group.

Paul Hickey: The water companies, as you may know, recently submitted their draft water resource management plans to cope with the needs of their customers over the next 25-year period. At the heart of that is a twin-track approach, looking at what they need to do to develop new supplies but also do more with the supplies they have through demand management. We are providing representations back to DEFRA on our technical opinion of those plans, and as part of that, where we think some companies are not being ambitious enough, we do put challenge in. We expect that to flow through from DEFRA in terms of challenge to those companies that have not set the bar high enough to do more.

Q218 Anna McMorris: And you are working with Natural Resources Wales on that as well?

Paul Hickey: We review the plans in England. Natural Resources Wales do the plans—

Q219 **Anna McMorris:** To report to Welsh Ministers.

Paul Hickey: Yes. But we do technically join up, so there is coherence between the two, because obviously some companies are in both.

Q220 **Anna McMorris:** It is one of those cross-border issues.

Paul Hickey: Yes, and water resources flow across both countries.

Q221 **Chair:** Which companies have more to do?

Paul Hickey: I am not sure if our representations are in the public domain at the moment, but the very progressive companies we see are ones in the east and south-east, primarily because that is where we see the most need.

Q222 **Anna McMorris:** We are just talking about England here.

Paul Hickey: And we are challenging different companies for different facets of demand management. So some can do more on leakage and some could do more to engage their customers to reduce water use. It is quite a mosaic there.

Alex Plant: I have a general observation, looking at the current system around water resource management plans, which each company has to bring forward, and the scrutiny process that Paul just described. To my mind, we ought to go a bit further on the work we have done through the regional grouping I mentioned around Water Resources East in trying to ensure that, as we evolve the policy, there really is join-up across the individual water companies so that when you add up the sum of all the individual water resource plans, they make sense in a long-term, region-wide strategy. At the moment, that is a voluntary thing. We have tried to inculcate that through the work we have done in Water Resources East, but there is nothing other than the scrutiny that Paul described to stop a water company ignoring the regional position and just doing their own thing.

For me, the question is: can we do more around recognising the interrelationship between different water companies, and indeed other players—the role of energy, for example, in water usage is massively important, as well as agriculture—such that we start to evolve something that is a bit more integrated as an approach to long-term water resource management?

Paul Hickey: If I may respond to that, we applaud the work of Water Resources East, which takes a cross-sector view, looking not just at the needs of public water supply but at the long-term needs of agriculture and other sectors, and is developing an integrated water strategy for the region. We are in the process of looking at the framework for water resource plans for the future—Water Resources 24. We believe that the regional governance that Alex has talked about is really helpful,



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particularly in the south-east, where the sector is most fragmented , but also critical is looking at work across sectors. If we are going to put interventions in, they should serve not just public water supply but other sectors as well.

The other thing we think will help drive that is a national framework so the different regional entities or groups—they will be different, given the different needs of the geography they serve—can join up. That need is again reflected in the NIC report. I would support what Alex said about the future direction of water resource management.

Q223 Mr Goodwill: As I understand it, the majority of the costs water companies face are based on their infrastructure—reservoirs, water treatment, pipes and sewage treatment works. If we can persuade everyone to reduce their water consumption by 25%, would bills have to go up to compensate for that?

Alex Plant: A quick point: not everyone knows that the majority of costs for a water company are on the waste water side. Recycling the sewage is where the bulk cost is; it is normally around 60/40 for a water and sewage company.

Going to the question about whether we can deliver demand reduction, when we looked at our water resources management plan, and indeed in our business plans, we very much had a twin-track approach, which is driving down demand and reducing leakage, and putting in place additional supply—having more ability to move water between areas. We do not have a national grid in water; it is partial. Some of what we are proposing would be to improve interconnectivity within the region and to other regions, but also to have more storage, as I said before.

On the cost involved in supply side and demand side, sometimes the demand-side solutions are more expensive. We have tended to take the view that you should try to drive down demand first before you reach for a supply-side solution. But the costs are not necessarily low. Thinking about rolling out smart metering, as I talked about earlier, that is not a cheap thing to do. There is quite a significant cost in moving the demand-management side down.

To go back to the question asked right at the beginning, because we are the leading company on leakage, we are trying to drive that even further down, and it gets harder, because the low-hanging fruit has already been taken. As we move forward to much lower levels of leakage, we are having to do more to invest in detection and leak repair because the easy bits have been done. It becomes more expensive as you get to that lower end of the spectrum on leakage reduction. A 25% reduction in usage comes with a bill, I'm afraid, as does the supply side.

Q224 Mr Goodwill: If I have my own septic tank, I get billed for the water I use but I do not get billed for the waste water.

Alex Plant: That is right, yes.



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Q225 Mr Goodwill: A lot of people are looking at having a brown water system, so they capture the water off their roofs and use that to flush their toilet. How will you catch those people through the billing system? At the moment, because they are not being metered or billed for their water coming in, they are not being billed for their waste water going out. Are these people free riding the sewage treatment system?

Alex Plant: I don't know. It is a good question.

Mr Goodwill: It occurred to me when I was looking at a brown water system.

Alex Plant: Part of this goes back to the general premise that we should try to get to a position whereby everyone is metered. Whether you get there through compulsory metering or continuing to—

Q226 Mr Goodwill: But you won't be metering the brown water off my roof.

Alex Plant: Not off your roof, no.

Q227 Mr Goodwill: That flushes my toilets but then goes into your sewers.

Alex Plant: It then still goes into our sewers so there is still a cost to us in dealing with it. I do not know is the answer. I would have to come back to you on how such a situation works. It is a part of the company activities that I have not explored sufficiently, clearly.

Aaron Burton: Can I add something on the previous question about the economics of water efficiency? In terms of bills, there is a revenue correction mechanism that Ofwat uses, so that if water companies make savings through water efficiency, that does not affect the pricing and it counts for profits in that formula, too. There used to be an issue with capex bias—water companies would prefer to build things than to undertake demand management, for example. Now, they use totex, which is evening that out a bit, although there are still some cultural issues and some companies are further ahead than others.

A different approach to the economics of the issue is taken in the NIC report that has recently been published. It suggests that because water companies plan to have hosepipe bans and get down to that level of restrictions, that often means that water efficiency options are less economic. But the reality of the situation is that we are likely to invest before we get to rota cuts. If you take into account the cost of those new desalination and new measures, water efficiency becomes a lot more cost effective. That report really adds something to the economic discussion.

Paul Hickey: On the point about billing, the companies can bill for waste water services only, if it is just connected to the sewer system but is not receiving the water supply. Customers can receive a benefit if they disconnect their service water and reduce the pressure on the sewer system.

Chair: Thank you, that is helpful.



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Q228 Mr Goodwill: If you have septic tank, you are not using the sewer, but there will be people with their own brown water or even with boreholes, where the water is still going into the sewer.

Paul Hickey: If they are positively connected to the public sewer system, they can be billed separately for waste water services only.

Q229 Alex Sobel: The National Infrastructure Commission has found that 20% of mains water is lost every day, due to leakage. Do you support the commission's proposal for the Government to set an objective for the water industry to halve leakage by 2050? That is still a very long target—32 years away.

Paul Hickey: The motive for setting that target and giving a long timescale is to prompt very new thinking—not incremental thinking but, “If you approached this from a very different point of view, how would you get there?” We absolutely agree that that aspiration and intent is positive, because, as has come out through our evidence, to meet the long-term needs of the nation we need equal ambition on demand management as on the focus on new supplies.

Alex Plant: Very much so. We spent a lot of time giving evidence to the NIC before they concluded their work on the “Preparing for a drier future” report. Certainly our own plans are to build on our already low, compared with the rest of the industry, leakage position, to reduce it by a further 23% by 2025. We are already pushing to the sorts of levels of reduction that are consistent with the challenge set out in the NIC report.

In general I think it is absolutely the right thing for the NIC to be calling out, including the economic point that Aaron made earlier. Essentially the key thing for me in this is it says, “If you don’t do anything, it is going to cost you £40 billion. If you do, it is going to cost you £20 billion.” Well, it seems an obvious solution as to what we should go for. But it is always this combination: to remember it is about leakage, yes, but it is also about demand management and it is about supply. You need all three of those things to be coming together to address the challenges we face in the UK and particularly in the south and east of England, where water scarcity is the most acute. You are right that it is true everywhere, but it is particularly acute in the south and east.

Aaron Burton: At Waterwise, we also really support the aspiration to reduce leakage and think that it is achievable. There are also wider recommendations around metering and enabling all water companies to meter—not just in areas of water stress, which we think is really important. Also, there is a large focus on leakage. Ofwat’s final price review methodology for water companies suggests that they should be looking for a 15% reduction in leakage, for example, in the current round of planning, and they are adopting that, but we have not seen something similar for per capita consumption. I think that is set out in the Government’s 25-year plan—that they will look at setting a national target—but the timing is kind of now in terms of water resources planning.

Q230 Alex Sobel: Do you think it can be achieved more quickly than in 32



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years?

Alex Plant: My one hesitation is around the fact that, as I mentioned earlier, it gets harder as you get lower; but if we are ambitious enough to challenge ourselves to get down 23% by 2025 and continue that sort of trajectory, we should be able to beat the target that is in the NIC report.

Q231 **Alex Sobel:** Since the Government dropped the code for sustainable homes, water efficiency in building regulations has become less of an issue. How could water efficiency be built into building regulations for new homes? What would this mean in practical terms for households, and are there any good examples of water-neutral homes in the UK?

Alex Plant: Certainly we have, as Water Resources East and as Anglian Water, made representations on the desirability of looking at building regulations for new homes, particularly in water-scarce areas. You referred to the code for sustainable homes, where there was a sort of ratchet up towards new homes that were more efficient in all regards, but including in relation to water efficiency. We certainly think it is regrettable that the position we are now in is such that it is actually much harder to see that consistent application of those sorts of rules, even in more water-scarce areas; so while we work with our local authorities to encourage the application of those lower targets, we would prefer if there were a clearer national position within the building regulations that made that more ambitious target on water efficiency the standard for new homes in water-scarce areas, rather than optional. That would be our policy preference in relation to the development of planning policy and building regulations in particular. Are there good examples of new homes that are built with high water efficiency standards? Yes, absolutely. We have some in our region and there are others across the country. It can be done. I just think it needs a bit of a push.

The one thing I would say is, although we would like there to be policy change that would help to drive this, we have also looked at trying to encourage it ourselves. As I said earlier, we are one of the fastest-growing parts of the country and we have quite a lot of large new town-type developments as well where it is a bit easier, if you are building a lot of houses, to deliver really water-efficient solutions than if you are just building a few. We are offering discounts of up to £722 per property for developers in our region who install water-efficient technology in their development—things such as rainwater harvesting and water-efficient showers—that allows a reduction from a current new build average of 125 litres per person per day down to 100 litres per person per day. We are directly taking action on what we can do through incentivisation, but would like there to be a change in the policy position that underpinned that sort of approach.

Q232 **Chair:** Is that a reduction in the amount that you charge developers to connect the house to the network?

Alex Plant: Yes, exactly. It is the charge that we—

Chair: What would it normally be—is it £1,000 or £2,000?

Alex Plant: I can't remember.

Chair: If you could write to us, that would be helpful.

Alex Plant: I will write to you. At that level, it is significant enough, we think, to be an incentive, but I will write to you on the precise numbers.

Chair: And how many homes have had more efficient things as a result of your incentive. That would be helpful.

Q233 **Alex Sobel:** To go back to that point, do you think that reintroducing the code for sustainable homes, or something like it, would improve issues around water and water-saving measures in building a new home?

Alex Plant: Not necessarily the code as was, I suppose, but certainly if there is an opportunity, as I believe there is, to review the building regulations, there is an obvious chance to try to insert some of these more stringent requirements on new homes. It seems an obvious thing to do in areas of water scarcity. It does not solve the problem, because most of the building stock we have, and will have for the next 100 years, is already built, but we might as well be making the most we can of new developments and trying to drive to more water-efficient solutions in those homes.

Aaron Burton: If I could come in on the incentives, the Anglian approach is really interesting, but Severn Trent Water and Southern Water are also trialling that at the moment. They have not really had much engagement from developers, so that has been one of the issues.

In terms of the code for sustainable homes, because the previous approach had so many levels, it was bound to be a bit complicated and convoluted to use. However, we definitely think that all new homes should be built for 110 litres per person per day, which is currently an option, instead of 125 litres.

Another element we are looking at through our water efficiency strategy for the UK is we are undertaking an independent review of water efficiency labelling. That is used in the US and Australia as an easy option that can link products to building regulations to improve water efficiency of new homes, but also in terms of retrofitting, you can incentivise households to buy water-efficient appliances and devices, and change the market so only water-efficient appliances are available. That could make a real significant impact on PCC.

Q234 **Alex Sobel:** On a more macro level, the NPPF states that, "Local planning authorities should adopt proactive strategies to mitigate and adapt to climate change, taking full account of flood risk, coastal change and water supply and demand considerations." Do you feel that the proposals for water efficiency from the NPPF go far enough to address water efficiency?

Alex Plant: I came early to hear the first session that you had this morning. One of the things that struck me in the conversation around



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London was the value that is inherent in the fact that you have a London plan, which allows you to essentially take a regional view at the London level, which allows you to take some of those higher-level positions and principles into account, and the boroughs then, as I understand it, ensure that their own policies link with the overall London plan.

For issues like the ones you have just described—flood risk, the coast and water supply—the ability to understand that at a bigger than local authority level is just obviously useful, so the absence of a strategic planning level seems to me to be making it more difficult for us to get to the right sort of answers on the kind of issues you have talked about. I think we would certainly be positive about any moves that reintroduced that strategic planning tier. We are working, in our region, with the non-statutory spatial planning framework, which some of our local authorities and combined authorities are trying to bring forward on a non-statutory basis, but more strategic planning would be helpful, compared with where we are now.

Q235 John Mc Nally: To go back to the first panel just for a minute, the Greater London Authority has noted that production of green structures, such as green walls and roofs, to reduce the urban heat island effect would require significant irrigation, so do you support the increase in green infrastructure in cities, and how would it affect the water supply?

Paul Hickey: I think green infrastructure is a very positive thing, for a whole host of reasons. You have mentioned the heat island effect, but it is positive just in terms of quality of life, so we are very supportive of it. Is there a conflict with the public water supply? I suppose that will come about if, at a time of drought, we are restricting non-essential use. The heat island effect mitigation from green infrastructure happens best when the vegetation is in a good state. That can be mitigated by using drought-tolerant species. The other thing that some local authorities are looking at is things like trees, which are much more drought resistant because they are more deep-rooted. So the potential conflict can be mitigated by the way you implement the green infrastructure—the nature of it.

Alex Plant: From a water company point of view, we absolutely would be supportive of those sorts of approaches. We have just put forward our first long-term surface water management strategy. That involves a number of things. We are going to disconnect about 1 million downpipes and replace them with rainwater harvesting systems—rain gardens, water butts and those sorts of approaches—and do significant planting. We are going to plant a million trees, shrubs and hedges to enhance the green infrastructure position, as well as working with schools to retrofit SUDS in their own systems and get them to understand the benefit of those sorts of approaches.

Perhaps going back to the question about whether the NPPF is going far enough, I think the push towards SUDS could be stronger. In general terms, we think that would give you a more sustainable overall environment; we see that as generally beneficial for the overall question of water management, rather than negative.



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Aaron Burton: It is an interesting question, because there is a potential issue with irrigated green infrastructure like green walls. No one has really looked at that at the strategic level, so there is a piece of research that needs to be done there. Best practice approaches should look at blue-green infrastructure—using rainwater, storm water and grey water on the green infrastructure—so that you are getting multiple benefits: managing storm water and water quality as well as water resources. That is what Waterwise is really pushing, in terms of integrated water management. A lot of work is being undertaken by water companies on the sustainable drainage side of things. Water efficiency tends to sit in a water resources silo, but actually there are quite a lot of links between the two, so across the sector we need to join up a lot more.

Q236 **John Mc Nally:** Who should take responsibility for the maintenance of SUDS after developments are built, and how should they be involved in the planning process? I have heard this, as the chair of the flood prevention group, many times over the last two and a half or three years: nobody seems to know who has taken responsibility. I know that in Scotland Scottish Water has not only a statutory responsibility to maintain SUDS but a statutory right to be included in the planning process, so how did that work?

Paul Hickey: That is cited as a disincentive for implementing SUDS: the developers want to be able to get other people to adopt the structures. One thing is to ensure that they are built to an adoptable standard. Some companies have moved early on this. I believe Anglian is one of those, and it has put out its own documentation about the standards for adoption, with a willingness to adopt such structures. We are working with the trade group Water UK to roll that out more generally across the sector, because a very clear adoption is an important part of enabling of SUDS.

John Mc Nally: Chair, may I go back to question 10?

Q237 **Chair:** I want to get to the bottom of SUDS first. It has been brought in in Northern Ireland and Scotland, so clearly it is not a problem there. What is different in those two countries from England and Wales, which are arguably the areas that need SUDS more than Scotland and Northern Ireland, both of which certainly have ample rainfall?

Paul Hickey: One of the barriers that has been cited is someone to adopt and look after them in the long term. An obvious candidate to do that is the water company. Historically, there has been some reluctance in the sector to adopt non-pipe systems—

Chair: But they are being adopted in Scotland and Northern Ireland, aren't they?

Paul Hickey: I was going to say, some companies have already changed their position and are adopting SUDS, putting out clear technical guidance to developers to say, "If you want your SUDS structure to be adopted, we want it to be built to this standard." As I mentioned in my earlier answer, there is work more generally in the sector to bring all the other companies to the same place.



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Q238 **Chair:** So some English water companies do adopt SUDS—if they are built to an appropriate standard—and some don't.

Paul Hickey: Yes.

Alex Plant: As Paul was saying, we do, so we have moved in that direction, but the point about ensuring that SUDS is built to the right standards—that it is adoptable—is really important. Otherwise, you would potentially be incentivising—

Chair: Bodging it and scarpering. We've all come across that, and we all have housing association houses where the drainage is a nightmare.

Anna McMorris: Wales is introducing SUDS now, this year—they have just consulted on it. It is going into legislation this month.

Chair: So England is the last adopter. John, you wanted to go back to question 10.

Q239 **John Mc Nally:** This might sound a bit flippant but is quite a serious issue when you get down to the nitty-gritty of people and behavioural change. I think it was in 2016 that Anglian Water—I almost said Anglican water, which would be holy water, wouldn't it—and Southampton University, I think, presented to the hair-and-beauty industry technology that they were introducing to showers. They presented particularly to the hairdressing industry because of the volume of water that goes down the drain and so on. They were introducing a traffic signal hose—red, amber and green—which they were going to roll out to give people a warning about how long they had been in the shower, basically. They were trying to get it rolled out to hairdressing as well, which uses a huge volume of water. Do you have any personal knowledge of that—not that I want to know how long you take in the shower, but I wondered if you knew if that had been rolled out. To me it was an absolutely superb idea, getting people involved in how they look after their water system, or a great nudge towards that.

Aaron Burton: I am not aware of that exact trial, but Waterwise has been involved in an EU research project trialling a smart shower monitor. I have one in my shower at home, and it gives me an A to F rating every day above my shower—as you might imagine, I work for Waterwise so it is at the A end of the spectrum. It also tells you the amount of water used, and it can give that information back to your mobile phone, so if you have a smart meter you can also get the wider water use in the home. We trialled it in St Alban's in the UK and in Alicante in Spain, and the results coming out are about a 20% reduction in water and energy use—because of that feedback in the shower. PUB, the utility in Singapore, is rolling out about 10,000 of them at the moment, which is good to see. As far as I am aware, Anglian is looking to trial it or something similar in its innovation shop window in Newmarket. This next level of technology can make a real difference.

Q240 **John Mc Nally:** May I get copied in to that information?

Alex Plant: Come to Newmarket.



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Aaron Burton: We are trialling some in Scotland actually, through Scottish Water—I forgot about that. Actually, it is more innovative in Scotland because the water company is installing them as part of energy efficiency programmes—it is a really cost-effective way of getting water efficiency into homes.

Q241 **Chair:** Certainly beats an egg timer, which is what Thames Water gave me. It falls off the wall every time I have a shower. Paul, you wanted to finish off.

Paul Hickey: Just to link back to the previous questioning about leakage, one of the things that we see as really important is that, if we are trying to influence how consumers behave and step up in terms of being water-efficient themselves, they absolutely have to see that the company is addressing its own leakage. That is why we are so supportive of an ambitious target, because that change of behaviour is disincentivised if people see lots of water being wasted by the incumbent water company.

Chair: On that positive psychological point, we shall close the meeting.