

London Assembly Environment Committee – Thursday 20 September 2018

Transcript of Item 7 - Embodied Carbon in Buildings

Caroline Russell AM (Chair): That now brings us to today's first item for discussion on the progress made on embodied carbon. Our guests are Simon Sturgis, who is the Founder of Sturgis Carbon Profiling; Anne-Marie Robinson, who is a Senior Policy and Programmes Officer at the Greater London Authority (GLA); Rhian Williams, who is a Senior Strategic Planner at the GLA; Julie Godefroy, who is Head of Sustainability Development at the Chartered Institute of Building Services Engineers (CIBSE); Robbie Epsom, who is a Sustainability Consultant from WSP; and Jane Wakiwaka, who is the Sustainability Manager for The Crown Estate. Welcome to everyone.

I am going to start things off by asking a very simple question. What is embodied carbon and why is it significant? This is incredibly interesting, but I gather that we need to work hard to make sure that people understand the interest in embodied carbon. Perhaps I could start with Simon.

Simon Sturgis (Founder, Sturgis Carbon Profiling): All right. Embodied carbon is the emissions associated with the building of buildings, in essence, and maintaining them. It covers the carbon impacts or the carbon emissions associated with sourcing materials, transporting those materials to manufacturing plants, manufacturing them into products, transporting them to fabrication plants, transporting them to sites and then building buildings. It is all those emissions associated with getting to a point where the building is now complete. Also, it includes the emissions associated with repair, maintenance and so on and, ultimately, it includes the emissions associated with demolition, deconstruction and disposal of buildings. It is all basically material-related emissions as opposed to what we describe as operational emissions, which is the day-to-day energy use.

Caroline Russell AM (Chair): Thank you. I know more about transport than housebuilding, but the sector is being asked to reduce emissions by how much in order to meet the Government's commitment to the Paris Agreement?

Simon Sturgis (Founder, Sturgis Carbon Profiling): Overall, as a country, we have to reduce [our carbon footprint] by 80% between 1990 and 2050. At the moment, if you look at any diagrams on this, the focus for the built environment tends to be on the day-to-day energy use that buildings use. I am sure Julie [Godefroy] will come in on this if I am getting this wrong, but it really covers that. Also, in terms of meeting our obligations and that 80% reduction, it also covers industry and, as you say, transport and it includes waste and so on.

A lot of the aspects that are to do with running an economy, if you like, go into producing the materials. Therefore, although the emissions are out there in the sense that they are being covered in other areas, it is really to do with demand and it is to do with incentivising demand, if you like. When people are building buildings, they need to be, in my view, incentivised and encouraged to demand or require lower carbon emissions. It might be choosing low-carbon materials. It might be choosing longer-life and more durable materials, for example, if you are building houses. It will cover all of those aspects. It is looking to really improve.

Another important point here is to do with cost. Typically, choosing lower-carbon materials is synonymous - and I am not saying always but typically - with reducing costs of construction.

Caroline Russell AM (Chair): With reducing and so there is an incentive for --

Simon Sturgis (Founder, Sturgis Carbon Profiling): There is an incentive, but against that you have entrenched views and all sorts of other things and so, really, there needs to be incentives. We will come to it I am sure, but the latest draft of the London Plan is including whole-life carbon. Should I mention --

Caroline Russell AM (Chair): We will be coming on to the London Plan later in the meeting. Thank you. Is there anyone else, particularly our three guests at this end of the row, who would like to say anything else on just that introductory question of what embodied carbon is and why it is significant?

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): If I could just add, it is true that the United Kingdom's (UK) carbon policies have tended to focus on operational carbon in the headlines. However, what I would like to point out is that there are many policies and regulations and incentives that are not labelled as directly carbon-related but which are. For example, there are policies to reduce waste, a lot of carbon emission directives coming from the European Union (EU) transmitted in the UK on industrial emissions. They are meant to incentivise more efficient manufacture of products, etc. It is just a caveat.

That also leads me to say that there is the embodied carbon of the material itself and then, very importantly, how it ends up in the building, and so it is also the process of getting there, not only the material. I know it sounds pedantic, but there is, for example, so much waste that you might choose low-carbon material and actually end up with a high-carbon building because --

Caroline Russell AM (Chair): You have wasted it, you mean, during the construction process?

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Yes.

Caroline Russell AM (Chair): Thank you. Robbie, did you want to add?

Robbie Epsom (Sustainability Consultant, WSP): I suppose I could add to that as well. An important point to make with embodied carbon is that it is about where you draw the boundary or I guess the scope. What Simon described is the embodied carbon for a building and so, in that sense, you think of the building as the product and so your life cycles stretch across the building itself. A lot of us look at embodied carbon at a product level as well and so you could be looking at a tonne of steel or a tonne of concrete.

That is quite an important point to make because it very much changes the conversation. If you are dealing with a tonne of steel, you tend to be talking to the manufacturers about how they make their steel and you are looking at the operational carbon that goes into making that tonne, which then ultimately becomes part of the procurement process for the building. That is quite important because, when you are talking about buildings, you are dealing with the designers and the developers and the conversation is slightly different. When you are talking about products, you are dealing with manufacturers. Also, there are different opportunities in terms of what you can do. With a building, there is a lot you can do around embodied carbon but, equally, it does fall on the people who manufacture the original goods that you are getting to be able to have that impact. It is also important to make because it creates that dialogue between those two parties.

Caroline Russell AM (Chair): Thank you. Jane, did you want to add anything?

Jane Wakiwaka (Sustainability Manager, The Crown Estate): The panellists have covered it very well, but in terms of the significance, if you are looking at the whole-life carbon of the building, embodied carbon probably embodies up to 30% to 50% of that building life cycle. The importance is to look at it on a holistic level.

Caroline Russell AM (Chair): Thank you. Do we know which stages of the building life cycle are the most carbon-heavy?

Simon Sturgis (Founder, Sturgis Carbon Profiling): It varies depending on the building type but, clearly, the construction phase up to the point of completion is probably the major bit. Building the building is a major carbon cost. Also, the important point is that once you have built the building, you should know what it is made of and, therefore, you should be able to assess fairly accurately the carbon cost of having made that building. From that point onwards during the life of the building, you have day-to-day energy use, but you also have repair and maintenance. Both of those are not as accurate to predict because things change and so on, but it is fair to say - and it is certainly something we have looked at quite carefully - that with new buildings the material costs over the life of the building, as Jane has said, tend to be in excess of about 50% of the total picture. It is quite a complex series of interconnecting things that happen there, but it is not an insignificant part. That is what I am really saying. Whatever percentage you finally settle on, it is a major part of it.

The issue has been that over the years the effectiveness of things like the Building Research Establishment Environmental Assessment Method (BREEAM), Part L [of Schedule 1 to the Building Regulations 2010] and other regulations and standards has been to bring down the operational energy use to the point where now embodied has become, if you like, the elephant in the room.

Caroline Russell AM (Chair): Do you think embodied carbon is the elephant in the room in terms of the carbon impact of construction?

Simon Sturgis (Founder, Sturgis Carbon Profiling): Yes. It is something that could be readily addressed by people building buildings, developers of housing or offices or whatever. Also, the other point is that the emissions are being saved now rather than potential savings over the life of the building. If you are looking at embodied up to the practical completion of construction of the building, those are savings you can achieve now. Of course, every tonne of carbon that goes into the atmosphere, the sooner you save it, the better, if you see what I am saying.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): If I could add to that, I would certainly agree that it is not an insignificant part. It does really vary with the building type in terms of both the end use and the construction type, simplistically, between residential and high-end, cooled, ventilated offices. Again simplistically, there will be big differences between a Victorian house that has been there for over 100 years and a high-rise building which may not be that flow-efficient, etc. Sometimes 50% is used as an estimate, but on some building types I have also seen figures of 15% or 20%.

One of the complications at the moment is that there is not that much data on that many building types for the industry to be able to give accurate benchmarks and estimates. We need to be a little careful about the figures that are available at the moment. There is not that much data.

Caroline Russell AM (Chair): Is there work going on anywhere to get better data?

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): The GLA. The draft London Plan will be a great start and the Royal Institution of Chartered Surveyors (RICS) methodology that I am sure we will come to.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Yes. With the RICS methodology, which I was co-author of, one of the key problems, as Julie has correctly pointed out, was that although there were people working to the same British Standard, EN 15978, people were interpreting in all sorts of ways, and so, of course, that discredited the whole idea of embodied carbon. However, it is fair to say that since this has been produced, it has given a common methodology for people to refer to. From that, it has meant that also it happens to overlap with BREEAM 2018, not 100% but pretty closely, and so there is alignment.

Also, we are finding that increasingly the industry is taking account of this. For example, I have been going around the Royal Institute of British Architects (RIBA) Stirling Prize finance and most of those have taken in an embodied whole-life carbon assessment, whether crude or not. At the top of the industry, people are looking at those things. It will filter down.

Caroline Russell AM (Chair): Thank you. You described embodied carbon as “the elephant in the room” when it comes to carbon emissions from construction. Are there stages where there are some quick wins where it would be easier to bring down the embodied carbon? Are some stages of the construction process easier than others to get those savings?

Simon Sturgis (Founder, Sturgis Carbon Profiling): The obvious first wins are things like structure. That is a big component and so structure and services are typically a good ones to work on. The interesting thing about things like services and the external walling and the cladding of a building is that whilst they may have relatively small carbon cost to make -- if you are putting in, say, boilers or a central plant of any sort, the carbon cost of those is a certain amount, which is not necessarily huge at the outset, but because you replace these things on a regular basis through the life of a building, they add up. In aggregate they build up and they can be more than, say, something like the structure, which at day one was the biggest single item. If you are starting off, yes, you want to work on the structure, but you also want to think about the life cycle of the building. You want to think about the life of the build.

For example, buildings that are naturally ventilated, first of all, do not have a capital carbon cost apart from a financial carbon cost of the plant in the same way that a regularly air-conditioned building would be, but they also have replacement costs as well in carbon terms.

Robbie Epsom (Sustainability Consultant, WSP): Can I make a really quick point?

Caroline Russell AM (Chair): Yes, Robbie, please.

Robbie Epsom (Sustainability Consultant, WSP): Just going back to your last question on the elephant in the room of embodied carbon, an important point to make is that embodied carbon’s relationship with operational carbon, which is another key thing, fluctuates and a big part of that is the decarbonisation of the grid. As embodied carbon improves and we look at things like modular design and a lot of the circular economy actions that you hear bandied about, there will be an improvement in embodied carbon versus operational – i.e. operational will be the worst maybe of the two - but then, as the grid decarbonises, embodied again becomes the issue. It is probably fair to say - I do not know if the rest of the panel agrees - that we are definitely trending with the grid decarbonising like it is to embodied being a much more significant part of the life cycle.

The other point is that you asked about any action that was being taken on embodied carbon. Sweden is looking at being carbon or climate-neutral by 2045. WSP has been working with them to develop their roadmap for the construction sector. There are people taking positive actions at country level and so there is no reason why we could not do that. That takes into account a lot of the easy, low-hanging fruit that Simon just mentioned.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): I do not know if there are easier steps, but there are certainly measures that are 'no regrets' that a lot of project teams could focus on. In particular, I am thinking about construction waste. That is not necessarily that easy because it does rely sometimes on supply chain and contractor arrangements, but there definitely would be benefits in costs and a host of environmental issues, not only carbon.

There are other measures that benefit both embodied and operational carbon; for example, passive design strategies that allow the building to use less energy but also reduce or even take plant out, and so you have saved embodied carbon as well. Really, once project teams start thinking about it, there are lots of opportunities there that are really interesting and avoid what can be very difficult sometimes, which is to weigh one measure against another. For example, should I have more insulation or not? What is better in terms of embodied and operational carbon? 'Win-win' or 'no regrets' or some catchy title would be good to focus on.

Caroline Russell AM (Chair): Great. Does anyone else want to come in that?

Simon Sturgis (Founder, Sturgis Carbon Profiling): Just considering a microcosm example, if you put insulation into a building, you improve the operational day-to-day use. The more insulation you put in, the better it gets. However, the interesting thing is that the current regulations do not distinguish between the different sorts of insulation you might be putting in. You might be putting insulation in which has quite a high carbon cost to make, whereas really what you should be incentivising is not only putting in insulation but putting in something that is a low-carbon cost. As we all know, there is no free lunch and so putting in insulation costs carbon as well as saving carbon. It is really getting the optimisation between those two things, as was said a bit earlier. The relationship between embodied and operational carbon wants to be optimised so that they both work in the best possible way.

Caroline Russell AM (Chair): Presumably, you are going to get the best results if you are looking at that whole life cycle at the design stage.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Absolutely.

Caroline Russell AM (Chair): What are the barriers to that happening at the design stage at the moment?

Simon Sturgis (Founder, Sturgis Carbon Profiling): Education and information. I am trying to think of a third one, but basically that sort of thing. It is to do the information and I suppose regulation, probably.

Caroline Russell AM (Chair): Yes. Thank you.

Unmesh Desai AM: I have a question. Before I ask the two questions that I have, I just want to clarify the two sets of figures that have been given to us. Forgive my ignorance, but this is a rather technical area and I am subbing for another Member of this Committee.

You mentioned a figure, Ms Wakiwaka, of 50% and, Julie [Godefroy], you mentioned 15% to 20%. Can you just clarify the context in which you quoted those figures?

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): I have seen, basically, a range of studies on the proportion that embodied carbon represents in a whole building carbon context.

Unmesh Desai AM: Fine. Within a building?

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Yes.

Unmesh Desai AM: Fine. And your 50% was what?

Jane Wakiwaka (Sustainability Manager, The Crown Estate): My statistic was basically saying - and it does reflect what Julie said - that it could be up to 50%, and so it does vary significantly.

Unmesh Desai AM: That was my understanding but I just wanted to be sure and not look silly. In terms of London-wide, what percentage of London's carbon emissions is represented by embodied carbon?

Robbie Epsom (Sustainability Consultant, WSP): That is a very difficult question to answer because, although I do not believe infrastructure is the topic of today's meeting on embodied carbon, infrastructure is very different from buildings. If you take something like the Tideway with pumps running for a 120-year design life, embodied carbon gets quite significantly skewed for a product like that versus a two-bedroom flat with a combi boiler and some light-emitting diode (LED) lights. It is a very difficult question to answer. With every situation, it is going to be down to - even just looking at buildings - whether it is a warehouse, a flat, a multi-tenancy or multi-occupancy office block, old or new. To come up with a single figure would be too difficult. That is my opinion, though.

Simon Sturgis (Founder, Sturgis Carbon Profiling): If I could add to that, there are two things. One is that in the RICS professional statement on whole-life carbon, there are some diagrams that give some proportions of that for new buildings. They make allowances for operational energy use, both regulated and unregulated, which I know is an area that is often underestimated. For new buildings it is one thing, but of course, if you are asking about London as a whole, most energy used by London buildings will be buildings that exist as opposed to being built and, therefore, the overall amount of embodied emissions in London as a whole would be restricted to new buildings. That means that it would be a relatively small percentage because, if we are talking about saving energy across the entire housing, for example, that is going to be all those existing houses and so it is all going to be about operational energy and what you do with existing buildings, which is on the agenda. That is a very important area. In terms of new buildings, that is really where the embodied savings come in.

Unmesh Desai AM: Just to put this formally to you, Mr Sturgis, you already touched upon this but, again, a very general question: how much of a barrier is embodied carbon to the Mayor achieving a zero-carbon city by the 2050 target?

Simon Sturgis (Founder, Sturgis Carbon Profiling): Yes, that is a very big question. It raises the issue of whether it is possible to get a truly zero-carbon building because, if you are building a building, it has emissions whether you like it or not. Therefore, to get it to zero is problematic, clearly, unless you are offsetting. To get to zero carbon or carbon neutrality by, say, 2050 is going to be a big ask. Certainly, if we are, building new buildings, it is a very difficult question. It is a big question, as somebody else said.

Robbie Epsom (Sustainability Consultant, WSP): It is a question of payback periods. If we just put carbon to one side and think of it in terms of its capital costs, if you invest in some solar photovoltaics (PV) on

your house it costs you X amount, how many years do you have to wait before you have benefited from that original investment? It is the same with carbon. If you build a new building, how many years is it going to take before the embodied carbon gets paid off by the savings in the operational? There will be a point when it does start to become carbon-zero, I guess, once it is net positive, if that is the right term, but it would require some type of offsetting. A great future would be maybe having buildings that are like mini energy-generating facilities which are constantly offsetting to the grid, but it would take something like that because, just like Simon said, there is a capital burden to building a new structure.

Caroline Russell AM (Chair): Rhian or Anne-Marie, did you want to just comment on the question about meeting the Mayor's target?

Anne-Marie Robinson (Senior Policy & Programmes Officer, Greater London Authority): A big part of this is being able to capture the data on these types of emissions. We are looking to be able to capture what we call the 'scope 3' emissions for London. This is not just the embodied emissions from buildings and transport, but also those associated with the products and services that Londoners consume from the food and drinks industry and that kind of thing. There is work going on around this bigger picture, but the issue is that there is a lot of data lacking at the moment which we are trying to build information on so that we can at least track those emissions, which the Mayor has less influence over compared to more direct emissions. We still agree that it is important to at least monitor them so that we can make sure that they are remaining stable and that we are doing what we can to reduce them.

Caroline Russell AM (Chair): Thank you. We are going to move on now and Navin is going to take up looking at the product stage and the recycling aspects of the end-of-life stage of buildings. After that, we will be looking at the construction stage and demolition and waste disposal aspects.

Navin Shah AM: Thank you, Chair. Already, Simon, you have talked about the building process, the structural elements and what part they play in the external cladding, the envelope you mentioned, the building regulations and BREEAM, what that contributes and so on. Julie has talked about building types and so on. I am homing in on questions on both building products as well as building form. I have specific questions.

The opening question is: how can London reduce the carbon embodied in its building materials? Do you want to start, Simon?

Simon Sturgis (Founder, Sturgis Carbon Profiling): There are various things that could be done. One way to deal with this would be to set a per-metre carbon cost for different building types. Let us say it is housing and you are saying that to build a reasonably low-carbon house in terms of construction is 800 kilograms of carbon dioxide (CO₂) per square metre. What you could do is incentivise people to reduce below that, in which case they get a credit against the Section 106 [of the Town and Country Planning Act 1990], say. Where you set it would have to be decided and discussed, but that would set an overall thing.

Otherwise, it is a question of shifting. It is a balance because, on the one hand, you want low-carbon materials, but on the other hand you do not want short life, in my view, because you are investing in buildings. You do not want them to last no time at all. Therefore, it is a question of the designer balancing out these things.

There are certain things to do with choice of materials. Clearly, timber is good, but it is only good if it is treated and handled in the correct way. Brick will take a lot of energy to make, but then it will last you 2,000 years if you want it to. It is about incentivising the process and encouraging people to get the overall pot, if you like, down because that in itself will then reduce the individual components, i.e. the bits and pieces that go to make a building. In the simplest way, it is rather like setting a U-value [Thermal Transmittance] or

something. You set a level and you get credits, as I say, below that. You might have to compensate financially by increasing the cost if you do not reach the threshold. In other words, you are effectively taxing the lack of meeting the embodied carbon level.

Otherwise, it is to do with education and encouraging people on where to look for better materials. A very simple example is something like aluminium on the outside of a building. If you anodise it, which is the shiny finish, you need to have virgin aluminium because you have to have consistency of the aluminium colour to make anodising work. If on the other hand you use powder coating, which is basically a paint, then you can use recycled content in your aluminium, which in turn will bring down the carbon cost, improve circularity and recycling and so on. At the moment, for many architects - and I am an architect - the choice is one about colour and maybe cost but it is not about carbon, yet. For those sorts of things, people do not understand the implications and so it is education. Architects, building designers and design teams need to really understand in the fullest possible sense their materials.

Navin Shah AM: Do you think they do within the architecture or construction industry?

Simon Sturgis (Founder, Sturgis Carbon Profiling): No, not enough. It applies to things like ethical and responsible sourcing. It is the same basic issue. Architects and engineers and so on need to know much more about the materials that we specify.

Navin Shah AM: I am an architect and certainly I would admit that that was never on the agenda pretty much, let alone at the top of the agenda. Whatever we say, glass, aluminium, steel, they are going to be there for all forms of buildings, I reckon. It is a question of how we can make them more carbon-efficient in a sense. This is something which has been lacking in training and the whole workings of how professionals take on board building specifications as well as forms as such.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Your question is exactly about better building because inherent in it is to do with longer life, more durable construction and more durable materials and not, to be cynical slightly, taking the photographs at the end of the project and moving on to the next one. You need to at design stage really know about the life of your building.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): I absolutely agree about the importance of education and raising awareness of the importance of the issue and of measures that can be done about it. However, right now we are not at the stage where there could be a target set for many reasons that we have mentioned earlier; for example, all the different building types, building end-uses, project circumstances, etc. Particularly if that target was linked to a tax, I could foresee a lot of issues, pushback, loopholes, etc. Raising awareness, absolutely.

There are also existing mechanisms that teams could use much more; for example, systematically asking for information from their supply chain or using Environmental Product Declarations (EPDs).

Another difficulty with setting a target is that actually there is very little information, particularly in building services, and very often cost is used as a proxy. You could see how difficult it would be to set a target.

An intermediate way may be that, for example, project teams could be required to calculate and to disclose the information and that, particularly in the microcosm of London, is quite powerful. Even without a set target, the leading consultants and the leading developers check each other's work and gradually improve the industry but without at the moment the uncertainties of a target.

Simon Sturgis (Founder, Sturgis Carbon Profiling): I would disagree. There is sufficient data to set a target, but in fact the actual target is not so important because it is about generating a trajectory for behaviour. The level of a target is probably less important than the existence of a target. If the target is not that demanding, it means that people get benefit against Section 106 too early. If you make it really quite demanding, it will nevertheless generate a situation where people will drive towards it. If it is quite demanding, that is fine because it means that people still have to work towards it, but at the same time, as I say, it is about behaviour.

There is a point about encouraging education, if I can put it like that, if you use it as a vehicle to change behaviour. Of course, these things can be moved. BREEAM ratings, for example, get moved along and all of these things evolve, but even setting a fairly basic target or series of targets to start with would be a good thing to, as I say, change behaviour.

Navin Shah AM: To everyone, could the building regulations, for example, which set the building standards and such and the code of practice, actually be more specific to require building products to be more carbon efficient for that matter? I do accept incentives, as you might call it, rather than targets. You mentioned Section 106 or it could be a Community Infrastructure Levy as well, which can generate leads better quality in this sense. However, surely there may be some room for building regulations to take that on board in greater detail and other provisions so that we get more carbon-efficient buildings.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Yes. At this point in time, interestingly, the latest version of the London Plan just by asking for whole-life carbon and embodied carbon is already creating an incentive for people to engage and that is a great start, in my view.

Navin Shah AM: Simon, you mentioned timber, you mentioned bricks and you mentioned aluminium in whatever form. What other carbon-efficient materials are there and how can they substitute for more carbon-intensive materials? Julie, do you want to come in first, or Robbie?

Robbie Epsom (Sustainability Consultant, WSP): Yes, I have just one really quick point. I am a process engineer and so products is a big part of what we do. Embodied carbon spans all sectors. A pen has embodied carbon in it, a glass, a construction product. Some of the best action in terms of a reduction in embodied carbon is in the construction sector.

The interesting thing is that most of it is market-driven by things like BREEAM and Leadership in Energy and Environmental Design (LEED) Version 4. It is not just about selecting efficient materials. Sometimes it is just about working with the manufacturers, going back to the point I said earlier, to make existing products more efficient. A big part of that is doing things like EPDs. They are, more and more, being asked for and are being used in a lot of things which we work with, tools, software. High Speed 2 (HS2) uses them to assess that infrastructure project. It is incredible what can be done compared to business-as-usual when you actually work with these companies to start thinking about how they can make their products more efficient.

It is about quite a few different things. It is about working with the existing materials and their manufacturers to make things more efficient. It is about working with the designers - going back to the education piece - to ensure better construction processes but also new innovative products are selected. This is a key thing for WSP. We are very keen, whilst measurements are really important, on the practical action side of things. What do we do to improve this once we know that it is a problem?

One thing we have done is to publish a set of ten recommendations on the circular economy and practical ideas and actions for what could be done to reduce embodied carbon and other embodied environmental

impacts. Circular economies, for instance, are great because they are all about things like modular design, reuse, design for demolition and all these sorts of things.

Some of the key things we have put forward go back to exactly what several other panel members have mentioned, which is that these sorts of principles need to be embedded into architecture, engineering, design and all these degrees so that when they get out there and they start designing buildings and putting in processes to make tonnes of steel or concrete or whatever it might be, the next generation of designers are doing this with all these best-practice principles in mind. They do exist. I have seen some incredible improvements. It is just about getting it to be business-as-usual.

Another big one, just to pull out a few examples, is the waste regulations. Construction waste and excavated material is still defined as waste. If we could define it as a resource, it would become a product that could serve other projects across London.

We have ten great practical recommendations under the banner of the circular economy, but there is a lot that can be done. EPDs seem like quite a good vehicle for helping to communicate that and catalyse the market.

Simon Sturgis (Founder, Sturgis Carbon Profiling): I could add to two things that might be useful, which are two things the RIBA is doing or has done. The first one is this document I did for the RIBA, *Embodied and Whole Life Carbon Assessment for Architects*. Whereas this is a heavy technical thingy, this is understood by architects, including me, and so it is written as a primer.

One of the important things in here is that it also refers to the project stages and what should be done each project stage. Following on from that - I am Chair of RIBA's Sustainable Futures Group - the plan of work, which is what everybody uses as their point of reference for the stages of a construction project, is having a new sustainability overlay produced which is in the process of being finalised. In fact, there is a session next week for consultation and there will be further consultations. The idea there is that these sorts of issues we are talking about today will be embedded in the plan of work. Architects and indeed the design teams will have a direct understandable point of reference on what they should be doing at each stage of a project in reference to embodied carbon and whole-life carbon.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): In response to your question about materials, certainly in the context of policy, I would be wary about mentioning too much specific materials because policy should focus on outcomes and then project teams can evaluate the best response to it. Carbon is an important issue, but there are all sorts of others; air quality, for example, etc. To take your example of bricks, the brick itself is not the only issue. It all depends on the mortar you are going to use with it, how much energy goes into making it, whether or not it is recyclable, etc. Therefore, I would be a little careful. There are examples in energy policy where that has happened in the past and a simple policy that had good intentions drove negative outcomes because suddenly project teams did not think about what was best for the project and ticked a policy box.

Similarly, just to make you aware of educational publications, CIBSE has produced guidance for building services engineers and has focused on products and materials, as well as - as we have mentioned before - supply chain arrangements, procurement, etc. They are coming. I agree that it is not high up on the agenda, but the amount of information is growing.

Navin Shah AM: Julie, whilst you are in full flow, can I move on to the next question, if you want to respond to that initially? How can buildings be designed to use less material? You have talked about skyscrapers and high-rise buildings and the scale and so on. I understand that if you have compact buildings, they can be more carbon-efficient. Is there something there which needs to be promoted?

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): This is a big area of debate and I am sure others will want to talk about it. My understanding - and we held a debate on this in the context of the London Plan consultation a few months ago - is that it really is one area where there is not that much data yet. On skyscrapers, this is not my area of expertise, but my understanding is that first there is a certain height at which the usable floor area is not that much anymore. Compact buildings also typically are heavily serviced and that comes with operational carbon and a lot of plants --

Navin Shah AM: Not for residential buildings, I would have thought?

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Some residential towers now are heavily serviced. They have mechanical ventilation --

Navin Shah AM: Sorry, I meant low- to medium-rise, rather than high-rise.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Sorry. Yes.

Navin Shah AM: You said that generally all buildings, if they are high-rise, tend to have more space taken up by structural elements, services, etc, except that what I was saying was that surely that is not true for low-rise or medium-rise residential buildings where M&D services are not much to say of anyway.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Yes, typically, but these are more general principles. I am not aware of comprehensive data on this. Maybe someone else is.

Robbie Epsom (Sustainability Consultant, WSP): It is, as I am sure you know, one of the key principles of Publicly Available Specification (PAS) 2080 is to build less. In infrastructure projects particularly, there are a lot of opportunities for the designers to think about ways to build less. Can we make a path narrower? Do we really need to put a utility bridge there? All of those give the opportunity to reduce embodied carbon by avoiding something that would have been otherwise built.

I suppose it is not the only way. A good example is one of the products I have worked with in the past, the concrete cable troughs that run parallel to railway tracks. With that, the size and shape of the product remained exactly the same, but they built it from a recycled polymer and that then meant it was much lighter. They had savings in the actual material itself and also in the actual logistics of getting the product there and installing it onsite. It could almost be lifted by a person rather than by equipment, which meant reduced plant as well. That all contributed to a reduction in embodied carbon of the building.

There are lots of ways to think about it. PAS 2080 has some great principles, as does the RICS guidance.

Navin Shah AM: Is there a need for better guidance within the building industry to this approach?

Robbie Epsom (Sustainability Consultant, WSP): Personally, I would love to see some more guidance because, going back to Simon's point on setting targets, it is about making progress. If we all have something we can work from - defined baseline materials, embodied carbon factors for doing the calculations and the measurements - so that we are all on the same page, even if it is not a perfect method, we will have a comparable result that we can all use for decision-making. We are already seeing EPDs being used as decision

processes in procurement and it seems like a great platform to build on. RICS, I believe, mentions EPDs as the base as well.

Simon Sturgis (Founder, Sturgis Carbon Profiling): To add to your question on how to reduce materials in buildings, one way might be to ask how to reduce the use of virgin material. If you are using recycled content, there is no point in using recycled material for the sake of it. It has to be more efficient than using something new, and by 'efficient' I mean environmentally efficient as well as financially efficient. One way to do that is to reduce the incidence of new material in buildings.

The other way, which is a difficult one because there is no benefit to the person building the building, is to encourage the ability of the building to be recycled later. That means that it is capable of being dismantled in an easy and efficient way and the components can be recycled. This is a circular economy, if you like. It also means avoiding things like composite materials. Julie was talking about construction with brickwork and that is absolutely right. If you use, for example, soft mortar that can be taken off the bricks, it is easier to reuse the brick than it is if you have cement mortar, in which case the brick has only one future life and that is as rubble under a motorway. It is a complex three-dimensional issue.

The idea of the circular economy, which is becoming more and more important, was raised earlier. In the RICS document there is Module D, which is about the benefits post the end of life and is encouraging building designers to create scenarios where a building is capable of being reused in its proponents and not precluding that. That will become increasingly important.

Navin Shah AM: Thank you.

Caroline Russell AM (Chair): Navin, just before you move on to the next question, I just wondered if we could bring Jane in here. Jane, you are involved in refurbishing buildings, I assume, if you are involved in sustainability with The Crown Estate. I just wondered if you had anything to add on these questions about how we can reduce the carbon emissions of the materials being used in buildings if you are involved in refurbishment.

Jane Wakiwaka (Sustainability Manager, The Crown Estate): Yes, that is fine. We do a combination of both refurbishments and redevelopments and we can very much talk about our experience in a central London context. I would echo a lot of what the panellists have said in that collaboration is absolutely key.

The way that we have done it from our experience is we have our Development Sustainability Principles, which is a corporate strategy document that applies to all of our developments. That essentially sets out the process. It is something that we have to look at on a case-by-case basis. What is appropriate for the particular scheme that we are looking at? It is establishing that process to make sure that embodied carbon is considered as part of a number of factors. There are different things that you can do throughout the design and construction process which can help to reduce both the volume of building materials and embodied carbon. If we are looking at the design stages, it is designing out waste principles and then, into the construction phase, looking at opportunities to collaborate with our supply chain to reduce it. We have some good examples on some of our schemes whereby applying that process and approach we have been able to reduce embodied carbon.

Navin Shah AM: What levels of recycled materials do you reckon you use in your projects?

Jane Wakiwaka (Sustainability Manager, The Crown Estate): As I said, it is assessed on a case-by-case basis. What we do have is our Development Sustainability Principles, which set out recommendations on using EPDs and recycled content, but we are not prescriptive in terms of specific building materials because it has to be looked at on whatever is appropriate for that development.

Navin Shah AM: Sure. My last question in this cluster of questions is about the role of the Mayor as well as boroughs. How can the Mayor best tackle embodied carbon in the London Plan? What is the role of the boroughs and how best can the Mayor support boroughs towards forwarding this agenda? The London Plan and the Mayor's role, please.

Rhian Williams (Senior Strategic Planner, Greater London Authority): We recognised that it was something that we needed to tackle in the London Plan and so the main policies that deal with it are Policy S12 on greenhouse gas reduction and also Policy S17 on the circular economy.

As previous speakers have said, we recognise that we have tackled operational emissions quite well to date and it is becoming more important to deal with the embodied emissions because that is becoming proportionately more significant. We have made this important first step to bring in the principle of asking referable developments - the larger developments that the Mayor sees - to start assessing their embodied emission so that we can make a first step in gathering data about this. That may lead on in the future when we have better data on this to setting benchmarks and setting targets, but it is a really positive first step.

I have taken on board comments during the consultation from people around the table and things like the RICS guidance that was published quite recently in coming up with a positive way that developments in London can start to tackle this. Getting the principle in the London Plan is the first step and, once we have that through, our focus is on the London Plan and the upcoming Examination-In-Public (EIP). Then we will start looking at developing guidance that can support developers and planners both at the level of scheme we are talking about in the Plan specifically, referable scale developments, but also something that can filter down to smaller schemes and the applications that the boroughs might see.

At the moment, it is not a new principle, but everyone has talked about possibly the lack of data. It is quite a new area. How do we set the boundaries of what we are measuring? Boroughs probably do not have a lot of resource to start dealing with this issue at the moment and so it is important to start with the big things and with the developers and consultants who are maybe a few steps ahead and start setting the agenda, start making designers, architects and developers bring this forward in their thinking and bring it into the design stage with a view to it filtering down to smaller schemes.

Navin Shah AM: Do you think much is being done to forward the agenda through other policies as well as mere strategies? There is a lot of overlap when you look at the policies within planning, regeneration and various other aspects. That is where we can have a much stronger impact on getting the carbon-friendly developments.

Rhian Williams (Senior Strategic Planner, Greater London Authority): Yes. It does fit well with other policies, like you said, on reducing waste and improving recycling. People maybe were not thinking about it from a carbon angle, but this just brings that as another part we are thinking. It sits quite nicely with some of the other things that are happening.

Simon Sturgis (Founder, Sturgis Carbon Profiling): I know that Camden has quite a punchy bit on embodied and whole-life carbon already in its policy, which was rewritten in June [2018], I think. Haringey is also moving quite rapidly in that direction and trying to become much more holistic and is very pro the idea, for example, of embodied carbon, as I say, becoming another way of offsetting against part L, you know, 'lean, clean and green'. There is already a will out there.

Navin Shah AM: Do you think the Mayor can play a bigger role and a better role through the London Plan, which is being looked at, and soon, as has been mentioned, we have an EIP on that? Are there other policies,

etc, that come to your mind immediately or something that you would want the inspectors to look at to better address these policies in the new London Plan?

Simon Sturgis (Founder, Sturgis Carbon Profiling): I suppose it is always a question of wanting more, is it not? As has been said, it is for referable schemes. Being idealistic, it would be nice if it was for all schemes, but I can see that things need to be taken a step at a time. I can see the data does need to be collected and I know that RICS has bought the Waste and Resources Action Programme (WRAP) database and is going to be collecting data, although it claims funding issues but that is another whole world. No, apart from always wanting more, actually, where things are going now is good.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): It is a very small point to add. It is not more, but we could get much more out of the policy if there was guidance to boroughs so that the assessments which are going to be asked for in the draft Plan are not only done at the application stage but also revised at completion of the building. These assessments are full of assumptions. Through no fault of design teams, there is just in some cases very little that is known at the application stage. Not only would the GLA have much better information, but also project teams would start to see the impact of their supply chain decisions. A classic example is whether your granite comes from China or not. That would be really powerful and it is just a small tweak in the guidance.

Simon Sturgis (Founder, Sturgis Carbon Profiling): I fully agree with that.

Robbie Epsom (Sustainability Consultant, WSP): I think that as we are on the product stage, I suppose, and so focusing on products, the first point is that there are a lot of standards out there already. There is an International Organization for Standardization standard for product carbon footprints and, ultimately, a building is the sum or aggregation of multiple products. Therefore, there is a lot of stuff which we could already build on.

What is lacking, particularly in I guess the UK - we are great at corporate level for having frameworks and methodologies for assessing carbon and at a business level - is not a consistent framework for calculating and reporting carbon at a product level. RICS has made good progress with that, but what I would like to see is the Department for Business, Energy and Industrial Strategy (BEIS) and Department for Environment, Food and Rural Affairs (Defra) encouraged to update the Government conversion factors with the embodied carbon factors that we are all using, like we very successfully do for transport and for electricity, to have a go-to where we are all comparing like with like and can start to use it as a tool for decision-making.

The other thing is to look at things like BREEAM and LEED and the huge successes they have had for infrastructure. They have been market-driven drivers that have been very successful in getting manufacturers and developers to start thinking about low embodied carbon products and procurement. We literally get panicked phone calls at WSP from manufacturers of construction products saying, "I have been told that if I do not get an EPD sorted and start looking at the embodied carbon in my product, it is not going to be included in the procurement list for this infrastructure project". It has been a great catalyst for change and there is no reason why we could not take those same principles to the built environment for buildings.

Nicky Gavron AM: Robbie, are you saying that the RICS guidance is not good enough on products?

Robbie Epsom (Sustainability Consultant, WSP): The RICS guidance is great. It has been a long time and it has been long overdue. Correct me if I am wrong, Simon, but we have not got to the stage where there are consistent emission factors that we are all working from.

Simon Sturgis (Founder, Sturgis Carbon Profiling): No, that is true.

Nicky Gavron AM: Is that the case, Simon?

Simon Sturgis (Founder, Sturgis Carbon Profiling): Yes, that is a fair point. It is improving very rapidly, as has been said. The instance of EPDs and also the gathering of data is improving that aspect of things relatively quickly.

The key thing is that what the RICS document does is it gives you a hierarchy of references. You start off with the best and then you get the second-best and so on. The use of EPDs in accordance -- there is a standard out there to which they should all be referring, 15804, which is a sister standard to the standard on which this is based. There is an element of joined-up thinking there, for sure, and it is a question of maturity and gathering data.

Nicky Gavron AM: I am actually very disappointed. I have argued for embodied carbon, particularly around materials, to be included in our zero-carbon target. I am understanding that that is going to be only about operational emissions and not about any of the non-regulated ones. Correct? Do I have it right?

I wondered. How many years do we have to wait before we can actually include embodied carbon as part of our carbon target?

Simon Sturgis (Founder, Sturgis Carbon Profiling): I would be keen to include it now, but it is really a question of -- and I was suggesting that there was a target level if you were building a building. We would have to have different targets for different types of building, but if we had a target level for a building type - say housing or non-high-rise housing - then, even if that target is not perfect, at least it means that people have to think about all the embodied carbon aspects of all the materials that collectively meet a target level. That is the way around this, I suspect.

In other words, you create an overall incentive to reduce the embodied carbon cost because that allows the designer and the client to choose a combination of low-carbon things at the outset or long-life things, which may not be necessarily that low in carbon. Like a brick is not inherently a low-carbon product because it takes a lot of energy to make a brick, but it lasts forever. It is not as simple as, "This is a low-carbon product. That is a high-carbon product". It is the context in which it is used which is also very important, how it is assembled and also the life over which it is expected to live and what happens at the end of it.

As we were saying about bricks, if you use a soft mortar, you can take it off and you can reuse the brick. That aids the embodied carbon life cycle, if you like, of the brick. If you use cement mortar, then it glues itself to all the other bricks and it can only be used at a much lower level, i.e. hard-pour in foundations or something.

There are various bits and pieces that go up to making this. My view is that in order to incentivise an overall reduction, you need the regulation and things like the London Plan identifying the fact that you need to record this information and you need to undertake the study and so that is a start; but then it is a question of setting levels ideally to bring it down and put overall pressure on the combination of materials that make a building.

Nicky Gavron AM: This is quite a lot of stuff to absorb. Are you saying that we could be doing it now? Are you saying that we have to get this data and refine it a bit before we can bring in some target?

Simon Sturgis (Founder, Sturgis Carbon Profiling): Personally - and I know people will disagree with me - I think there is no harm in starting something now and evolving it. If we look back to the first iteration of BREEAM, it was a pretty crude instrument, but it has got more and more sophisticated over the years. We

have to make a start. I would be in favour of making a start now with whatever is available and maturing it over the next however many years, but it would be good to get the ball rolling.

Nicky Gavron AM: I wonder if there is a response from the GLA officers on this or from Julie Godefroy?

Robbie Epsom (Sustainability Consultant, WSP): Can I add very briefly to my previous point? I may have come across incorrectly. There is a lot of great work going on in embodied carbon for buildings. The issue is that there are emission factors out there, often through things like EPDs that we can all use. They are typically produced by industry. You might have a large cement manufacturing company or a steel manufacturer that will produce an EPD for a tonne of its product or a metre cubed of its product. We then tend to use that data to then calculate the impact of HS2, for example, when we are looking at trying to help reduce the embodied carbon through the various design cycles.

What I was trying to say was that there is a lot of data out there and so there might be 20 or 30 different EPDs for concrete, and what would be great is to agree the baseline that we are working from and the emission factors that we are all using so that we can all talk about a corporation's electricity consumption from an emissions point of view and we can compare like with like because we are all working from the same dataset. With embodied carbon, there is not yet unanimous agreement as to which factors we should all be using so that we can compare like with like.

That was just really to get a bit of a steer. I am not sure where the opportunity would be to do that, but that would really help to catalyse the market. There is a bit of action already happening there with BREEAM and LEED driving the market, but it is still not like-for-like.

Nicky Gavron AM: Do we need this like-for-like, Simon?

Simon Sturgis (Founder, Sturgis Carbon Profiling): We do, ultimately, but I suppose the approach I am suggesting is one where we just aggregate it so that we are saying that there is a level whatever combination of materials that you are choosing --

Nicky Gavron AM: I get it, yes. I get that, yes.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Whatever the combination is, you create a level and you say, "That combination has to be below that level if you want to get a credit on your [Section] 106".

Nicky Gavron AM: There could be weighting for different things.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Yes.

Nicky Gavron AM: I am sure there is a time factor here. I wondered what Rhian thought about this.

Rhian Williams (Senior Strategic Planner, Greater London Authority): We have made a really significant step towards this, bringing it up the agenda, but there are very established ways of dealing with and calculating the operational emissions. At the moment, we want this to be something complementary that sits alongside it. We want to bring industry and everyone else with us as we start to get this data and start to learn about it and the established benchmarks and understand what good is. Then that is something we can start to set targets against in the future, but --

Nicky Gavron AM: Then what? When will these targets be set?

Rhian Williams (Senior Strategic Planner, Greater London Authority): When we next review the London Plan.

Nicky Gavron AM: That is another 10 years, is it not?

Rhian Williams (Senior Strategic Planner, Greater London Authority): I do not think it will be 10 years.

Nicky Gavron AM: I want us to take this away and think if we cannot do a bit better.

Rhian Williams (Senior Strategic Planner, Greater London Authority): We are in a position at the moment where we have the draft London Plan. We have made the minor suggested changes, which have to be minor, and we have taken on board to a very significant extent the comments of people around the table. It has been quite well received so far. We can take this as a really positive thing that we have in the Plan at the moment. However, I understand your frustration that it does not perhaps go as far as you would like.

Nicky Gavron AM: Not having embodied carbon targets sets back a whole range of things which are being explored in this meeting, but anyway. All right. I am going on to --

Caroline Russell AM (Chair): Nicky, before you move on, in terms of wrapping up on the section we have just been dealing with, I just wanted to ask. This is national but it is relevant. I understand there are sustainability standards, the Scheme Development Standards, which must be met by affordable housing providers in order that they get grant funding from the Homes and Communities Agency. This standard includes sustainability grading of materials using the Building Research Establishment's (BRE) Green Guide system, which is based on life cycle assessments.

Do you think it should be applied to private-sector housing? We have heard people saying we need some incentives and so, if it applies in the public sector for housing, should it also apply to the private sector? Julie, you are smiling.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): In London and in many boroughs, there are such requirements. It is very useful also outside of London where local authorities sometimes are less well-resourced and less well-equipped to check the implementation of their policies. They are useful. Whether the BRE's Green Guide is the best tool is outside of today's meeting. There are EPDs and the BRE increasingly refers to EPDs.

What is useful also with these tools is that they do not only look at carbon. There are all these other environmental issues we have mentioned to be looked at in the selection of materials and processes, etc, and we should not forget this.

Caroline Russell AM (Chair): OK. Simon?

Simon Sturgis (Founder, Sturgis Carbon Profiling): The BRE is abandoning the Green Guide in favour of the new Mat 01 in BREEAM 2018.

Caroline Russell AM (Chair): All right, but the principle of applying these standards to private-sector as well as to public-sector housing?

Simon Sturgis (Founder, Sturgis Carbon Profiling): Yes. Why not?

Robbie Epsom (Sustainability Consultant, WSP): The funny thing is that the private sector just gets on and does a lot of this without any legislation, the reason often being - going back to a lot of what the panel said earlier - is cost. These are often win-win situations. It is almost incredible that they do not happen by default. They are saving money. They get great reputational benefits from doing it. It gives them positive public relations (PR). They can get a LEED excellent building. A lot is happening there, but the answer for me would be, yes, I would love to see everyone doing it.

Simon Sturgis (Founder, Sturgis Carbon Profiling): If I could add one more thing, in my experience the private housing sector is not that interested in embodied and life-cycle carbon for the very good reason that they do not have a great deal of interest until after the building has been finished because they will flog them off. That is a mistake because the whole point about the life cycle aspect is that you are producing a better, longer-term, more durable product. By taking a whole-life view and enforcing that, you would encourage - or enforce or whatever you want to call it - a better product. As has been said, this is not necessarily meaning additional cost because low-embodied carbon tends to mean lower cost.

Nicky Gavron AM: Just with your indulgence, Chair, having listened to this last debate, there could be something we could recommend. I accept that we are on embodied carbon in products and buildings and so on, but what we are talking about is looking at the data, getting consensus and bringing everyone on side. Maybe even we could suggest it as amendment to the Plan but it is up to the Mayor to do that, but maybe we could set a date for a target rather than waiting until there is a complete review or replacement of the London Plan in eight or ten years' time, maybe like in four years' time or something, just to set a target by which all this sorting out and consensus building and data refining can be done. Anyway, it is a suggestion.

My question is about construction and demolition, as the Chair said, and I want to start by asking - and I will open it and see who wants to come in on it - in what ways and how the construction and demolition industry can improve on its record on reducing carbon emissions. How could it improve? Does anyone want to come in?

Simon Sturgis (Founder, Sturgis Carbon Profiling): Firstly, I would say that quite often we found that some of the bigger contractors are already quite positive about this line of thinking because it means improving the efficiency of the way they produce things and also, as I say, for example, if they are producing things in a more efficient way, they can reduce costs and reduce deliveries and so on.

In terms of construction, you really need a better understanding by designers of what they are specifying in all aspects. We were talking a little bit earlier about the nature of the materials, the choices, the way you choose to select materials. You need to really understand not just the colour and the shape and so on and the cost, but the carbon cost of that, the ethical sourcing aspects and the healthy materials. All of these things go together. At the moment, they are not covered. They are not of great interest to most building designers. I am probably doing down a lot of people but, nevertheless, by and large architects specifying products are interested in the visual performance, the structural performance and so on, but that needs to broaden and that needs to filter back down and up through the supply chain. It needs better linkage between the supply chain and the architects.

Quite often what happens with design and build, which is a favourite way of constructing at the moment, seems to be that the architect may design things to a certain point and then the contractor takes over the detailed design and that then leads through procurement and so on. Therefore, there is not that interconnectivity. When you are designing a building, you really need to, at the earliest possible stage, engage with the supply chain and the construction processes so that you understand the implications of what you are doing in the fullest possible sense. That is not necessarily happening in the best way possible at the moment.

As far as deconstruction goes, the issues around deconstruction need to be considered at design stage. The ability for a building to be easily taken apart, shall we say, also aids of course maintenance and enables a circular economy and reuse. It is, again, thinking holistically about the life of a material right from its sourcing. I was using an example of aluminium, which, if it is anodising, it has to be all virgin material and, if it is powder coating, it can be recycled material. If it is anodising, for consistency you need virgin material. If it is powder-coated, then you can have recycled content, which means the colour of the aluminium does not really matter and you are just painting the whole lot. It is those sorts of things that need to be better understood. It is not just aluminium; it is all sorts of products, materials, processes, where they come from, what they are made of and so on. Really, you have to bring it back to it to the design team - the architects, the engineers - to understand what the products they are specifying are made of, but they can best do that by a better connection with the supply chain.

Nicky Gavron AM: All right. It is much more joined-up between them. You said connectivity --

Simon Sturgis (Founder, Sturgis Carbon Profiling): Yes. With the demolition, it is --

Nicky Gavron AM: Disassembling.

Simon Sturgis (Founder, Sturgis Carbon Profiling): -- understanding at the design stage how to take your building to bits. I was talking to a developer only literally two days ago who was describing how they are building a building from the top. You build the core and then you hang everything off it. I said, "How do you take that building down?" I happen to know that there are a couple of buildings in the City that were really problematic to demolish because they were of an upside-down construction. She said, "We just never considered that". People do not build buildings to think about how they come apart. That is important and needs to be thought about, particularly in our increasingly resource-concerned world that we live in.

I do not know how many people know this, but two of the Ministry of Defence's prime strategic threats to the UK are climate change and resource depletion. If the Ministry of Defence is on it, we should all be on it, probably.

Nicky Gavron AM: That is interesting, but then you were saying that speculative builders or contractors are not likely to think so much about the disassembly. That might be 30 or 50 years away.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Yes, but that comes back to incentivisation with a bit of arm-twisting.

Nicky Gavron AM: Exactly. Can I bring other people? Does anyone else want to comment on this? You might want to talk about other aspects, too, like the transport side of it or the energy or plant side of it.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Local sourcing reduces -- again, an example from somebody I know is that they normally would have brought the cladding for their building - this was a building up in York - from Europe because that is where you buy fancy cladding. However, they have discovered because they decided to go with local sourcing that there was somebody not that far away who could do just as good a job but, because they were not one of the big names, they just would get overlooked. Local sourcing has social benefits, embodied carbon benefits and so on.

These things all link together, which is really interesting. The Social Value Act comes in as well in terms of reuse of materials and so on.

Nicky Gavron AM: Thank you, Simon.

Robbie Epsom (Sustainability Consultant, WSP): If I can jump in, I did have something to say. One of the big problems is ownership structure. Jumping on to the circular economy topic again, one of our recommendations at the WSP is about looking at modular design. That is the design for demolition and making sure buildings can be taken apart. The challenge there - and one of the topics on the agenda - was barriers to adoption. That is the complex structure in which buildings are owned. You have a designer and a developer who builds it. It then gets handed over to someone else who might have paid for it. You have a facilities manager. You have multioccupancy and different tenants.

Like with the Automotive Industry, there is a movement towards leasing, and this is one of the key principles of the circular economy. When you have that, the person who owns the materials has ownership of that embodied carbon and the other impacts and sees that through the whole life cycle. Therefore, at the end of its life or maintenance, whatever it might be, they are able to monitor that and adapt it and ensure that good green principles are being applied. With buildings, if we started to move towards that structure which we are seeing in other sectors, there would be someone who would be able to see that building through the whole life cycle. You would not just design it and then the person walks away and it is someone else's problem. It would be able to be moved the whole way through.

We are seeing this in London already. Companies like WeWork and various other equivalents are buying up entire estates and they do everything. They have opportunities to trial and pilot things that are circular economy and low-carbon and, if it works, to roll it out across their entire estate.

Ownership structure is a key thing and it is having someone who is responsible from the construction stage right the way through to the end of life. At the moment, that is one of the big barriers.

Nicky Gavron AM: That was very interesting. I was going to ask a later question about barriers but that is interesting. Also, not just the barrier, but one of the solutions is the leasing model.

Robbie Epsom (Sustainability Consultant, WSP): It is. It is happening in every industry: mobile phones, cars. The great thing there is that, as a consumer, I do not want to own the materials that are in my vehicle or my washing machine or whatever it might be. They are complex materials that I do not know how to dispose of at the end of its life and, equally, I do not know how to maintain or fix. Them keeping control of that means that as these things adapt, as better practice comes in, as we start to embed these principles into degrees and training, they can adapt in real time. The principles apply very well to buildings and infrastructure.

Caroline Russell AM (Chair): Sorry, could I just come in here? Jane, you are from The Crown Estate, which owns property. I am just wondering in relation to the ownership structures points that were just being made whether you have anything to contribute about whether that ownership makes it easier to think about these long-term issues around embodied carbon.

Jane Wakiwaka (Sustainability Manager, The Crown Estate): As I mentioned before, we do have our Development Sustainability Principles and that means that we can set quite clear targets and requirements. We do consider embodied carbon as part of a number of other decision factors when we are looking at a development.

In terms of the comment around ownership structures, what I would say - and this might be something to consider - is that the construction industry is quite complex and fragmented and you are talking about very long supply chains. When you have that quite fragmented supply chain, that is one of the challenges that we have, in addition to the fact that is still an emerging area for the construction sector compared with other areas like operational carbon. The challenge/opportunity is how to harness all of the different parts of that supply

chain and ensure that they are collaborating together so that you can actually deliver meaningful carbon reductions.

Caroline Russell AM (Chair): Thank you. Sorry, Nicky, to interrupt.

Nicky Gavron AM: Does anyone else want to come in on this?

Simon Sturgis (Founder, Sturgis Carbon Profiling): I could just throw something in on procurement, if that would be helpful.

Nicky Gavron AM: Yes.

Simon Sturgis (Founder, Sturgis Carbon Profiling): What is also being experimented with, with a circular economic and low-carbon emphasis, is different modes of procurement. For example, at the moment, the traditional procurement route would be to buy light fittings and specify the fittings you want and they would get produced and you would tender them and the people supplying them have an incentive to produce the cheapest fitting that will last at least a year before maintenance kicks in, if you see where I am going with that. However, of course, if you just buy lights -- it has happened in various places and Schiphol Airport is an often-quoted example - and if you say you want a certain light level at the desk level and you go out to the industry and you say, "That is what we want. We want a light for 20 years", or whatever it is, then the industry is incentivised, instead of producing a fitting that will last a year because that is the cheapest way they can make it to sell it, to produce a longer-lasting fitting because it will then mean less maintenance and less trouble for them. It is the same concept as Uber or Deliveroo or any of these things. You buy a service rather than an object. That also comes back to ownership and things like that because of course the light fitting is not owned by you, the building owner; it is owned by the person supplying the light and, if it fails, they replace it or fix it or whatever.

There are new models of things coming forward of improving things like procurement and so on in this whole process of construction, but of course for that to bleed down into more regular building is probably more complicated, I should think.

Nicky Gavron AM: Do others want to come in on this? Do if you want to. I just want to ask Robbie. You mentioned offsite construction. The Planning Committee has looked at this and done a report and made a lot of recommendations on this. I am just interested in how people around the table think that it helps reduce carbon emissions.

Robbie Epsom (Sustainability Consultant, WSP): This is the modular constructions.

Nicky Gavron AM: It is modular, offsite -- it has so many names, does it not? The Mayor's name for it, which is a good one, is 'precision manufactured housing'.

Robbie Epsom (Sustainability Consultant, WSP): I am going a bit off-piste here with an example or analogy. It is a Henry Ford type of example, I guess. If you are going to mass-produce something, there is always, from a process engineering point of view, more opportunity for efficiencies. With modular construction, what you are looking at is you are mass-producing the parts that will ultimately go into the building and, therefore, you can look at small tweaks which overall make a large difference. It has been very effective. Germany is one of the examples that is normally used where modular building has been a very effective way of doing it.

Also - going back to the point Simon made - it allows it to be deconstructed at the end of its life. If you can reuse something, each time you reuse it you are effectively halving the embodied carbon because it is being used again and it is no longer a virgin material. It is a very good way of doing it, but I have not personally done a full life-cycle assessment of it and so I could not comment on exactly which life-cycle stage the benefits come from.

Nicky Gavron AM: Jane, is modular construction used in your outfit?

Jane Wakiwaka (Sustainability Manager, The Crown Estate): Prefabrication?

Nicky Gavron AM: Factory-built homes or whatever.

Jane Wakiwaka (Sustainability Manager, The Crown Estate): We can talk from our experience, which is focused on commercial offices and retail, predominantly, as opposed to large-scale residential developments, but within some of our developments in central London we have examples of where we used prefabrication for some of our schemes. For our schemes, we are in an area that has heritage considerations and we do have to factor in what is appropriate for each of those schemes. There are benefits that we recognise that prefabrication provides, whether it is around less waste onsite and offsite --

Nicky Gavron AM: Sorry. Less waste onsite and offsite?

Jane Wakiwaka (Sustainability Manager, The Crown Estate): Onsite and offsite due to the efficiencies in manufacturing and also less transport going to and from the site as well. It is looking at how that ties in with some of the heritage things that we take into consideration. Perhaps it just needs to be looked at in terms of how appropriately it can be applied depending on the type of development that we are doing. Large-scale residential would be a good example of where, Robbie, your example would tie in. The large-scale residential type schemes which we do not do as part of our work in central London would be a good example perhaps where prefabrication would work on a very large scale.

Robbie Epsom (Sustainability Consultant, WSP): It is a really good point on the minimisation of waste because, if you predesign modular parts, you minimise things like offcuts and various other oversized parts onsite, which is another contributor to embodied carbon.

One of the other topics in this session was the construction itself, all the plant equipment, the logistics, everything that happens onsite. With modular construction, there are huge efficiencies in getting the materials to site because you can design transport mechanisms that reflect the modular parts that are moving. Also, if you look at what is going on in China, they are building skyscrapers in weeks using modular construction as opposed to years in the UK, which greatly reduces the amount of onsite plant activity during construction. It is huge of economies of scale efficiencies to be gained, but that does not mean it is the only solution.

Nicky Gavron AM: Your point about plant is interesting, too, because you do not have the plant onsite, do you?

Robbie Epsom (Sustainability Consultant, WSP): I mean the construction equipment for the actual --

Nicky Gavron AM: Yes, which is all very --

Robbie Epsom (Sustainability Consultant, WSP): It is offsite, yes.

Nicky Gavron AM: -- energy intensive.

Robbie Epsom (Sustainability Consultant, WSP): Yes, and this is an assumption but I would assume it would be moving to more electric than gas if it is onsite, which would also take advantage of the decarbonisation.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): There are potential air quality benefits there, too.

Nicky Gavron AM: Sorry. Is that one of the ways you could improve?

Robbie Epsom (Sustainability Consultant, WSP): If you are looking at a product level, if you are manufacturing something in a facility, you could start to move your factory to be more dependent on electricity than gas and other fossil fuels. That would allow that product to reduce its embodied carbon because it is taking advantage of the decarbonisation of the grid itself.

Nicky Gavron AM: Simon, do you want to come in here?

Simon Sturgis (Founder, Sturgis Carbon Profiling): I would absolutely endorse what has been said. The construction industry is a difficult industry and it works to very low margins and so on and is actually probably quite inefficient. One of the things about modular construction is that it raises the level of efficiency because, of course, you are bringing various trades together under one roof. The incidence of things like snagging, failure and errors in construction are clearly reduced in offsite construction, which has direct benefits in terms of involving carbon not just at the point of construction but over the life of the building. Inherent construction defects - unless they are design defects - are definitely going to be reduced.

Nicky Gavron AM: I do not know if anyone has anything to say on this: are there any examples of emerging technologies that will be really helpful in relation to this topic?

Simon Sturgis (Founder, Sturgis Carbon Profiling): There are areas at the moment that are interesting but not yet developed and fully carbon efficient. One of those is three-dimensional (3D) printing. People like Arup have produced 'knuckles', where the structural members come in, which are 3D printed in metal. There are other examples with ceramic and so on. There is also the use of robotics in construction so that very complex shapes can be produced very easily and efficiently. Every sheet of glass in this building would have been pre-programmed and designed and it is an evolution of that, taking that further and further. Therefore, there is evolution.

For example, if you look at the demand for housing in this country and the available workforce, there are not enough people to build all the buildings that are required, particularly housing. Therefore, things like offsite robotics, etc, will increase. However, what is odd is that at the moment are examples such as Legal & General (L&G) has produced a factory in the north that was supposed to be online by now and there have been problems there, and Laing O'Rourke has a factory near Ebbsfleet. However, for some reason these have not really picked up steam yet, hopefully they will do. It is not an instant panacea. There are issues people are trying to deal with to roll these things out more effectively.

Even if you do offsite construction, you quite often have to wrap them up with the skin on the outside, you have to put the cladding - the brickwork or whatever it is - on separately.

Nicky Gavron AM: Digitalisation generally - Building Information Management (BIM) - there is a whole area of data, is that not going to make construction much more efficient?

Simon Sturgis (Founder, Sturgis Carbon Profiling): It should do, yes, absolutely.

Nicky Gavron AM: The way design and digitalisation meets manufacturing.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): That was going to be my next point, that it is not so much about the technology but also the information available, which has been recommended in all sorts of areas including the latest Hackitt [Dame Judith Hackitt] review [*The Independent Review of Building Regulations and Fire Safety*]. It is having information in the building about what is there, how it is supposed to be maintained so that it is durable, how it is supposed to be dismantled, who can reuse it in the future; BIM, etc - whichever way we want to call it - is certainly one exciting area.

Interestingly a lot of the feedback that CIBSE received from members was that maybe it is something the GLA could act as a repository for. Therefore, in new buildings you would have a database of who has what, to create a network that things like WRAP used to have - or used to say it would have and obviously it is not there anymore - to have the start of a mini circular economy in London to not see materials as waste anymore but as a resource.

Nicky Gavron AM: It will be interesting - if you think that is an initiative the GLA should take up - if you fleshed it out a bit and sent it in.

We are talking about technologies; is there anything else people want to raise?

Robbie Epsom (Sustainability Consultant, WSP): I have another one on technology. You mentioned BIM, there is a lot of work to create product passports for construction products. Taking things like EPDs that were mentioned earlier, which is effectively all the material and other environmental impacts against a tonne of concrete or steel, and putting that alongside BIM - as we are starting to see happen - means it can then be built into the modelling of the actual building at the design stage and we can look at not only the operational but also the embodied carbon. That is starting to work really well. I am on the International Advisory Board for the EPD system. One of things we are pushing there is digitalisation of this environmental data, so it is accessible to designers in real time.

The other thing, which I am glad I get to mention, is Blockchain. Blockchain is becoming a fantastic tool.

Nicky Gavron AM: What is Blockchain?

Robbie Epsom (Sustainability Consultant, WSP): At its heart, it is a digital ledger, like you would use for finance purposes to keep track of a financial ledger as it moves through a chain. The applications are becoming really broad. I know it is starting to be trialled in the construction industry alongside things like BIM data. It is basically making sure that if I have a whole lot of environmental and material data associated with a product, as it moves through my supply chain when I am building my project I know that data is accurate, has not been tampered with and any accreditations it comes with are fully traceable. It is effectively building trust into the procurement process and sitting that alongside the data. It is quite 'future ready' but is something I know the Government is looking at it. It has a committee on Blockchain.

Caroline Russell AM (Chair): Construction materials are about messy stuff and cement. The idea you can get more trust about the sourcing - with something as technical as a Blockchain process - of physical, messy stuff on the ground that is handled by people who do not necessarily even use computers very much in their everyday work, is that technology really able to come in and provide that assurance?

Robbie Epsom (Sustainability Consultant, WSP): It is a very good question. One of the really exciting things about it is that once it is in the Blockchain, that data is able to travel uncorrupted because of the complex process that it uses, therefore that bit is un-hackable. However, like you say, it is getting that into a digitised asset. That is key for us, if we are looking at a building we want to know that environmental data and all the other data is definitely what was there at the beginning of the value chain. There is a whole niche market where people will start to be looking at how you get real-world assets - timber, concrete, whatever it might be - into these digital ledgers. A good example is the Kimberley Process for diamonds where they are able to asset tag a physical asset, ie the diamond, with a unique tag that says whether it is conflict free and various other things. The electronic mode is using that same real-world digital asset technology and moving it into something like a Blockchain. It is working quite well in quite a few industries. I know forestry is looking at it for timber: if you are sourcing Forest Stewardship Council (FSC) timber, how do you know there has not been volume fraud in the supply chain? It is things like that.

Leonie Cooper AM (Deputy Chair): Food also.

Robbie Epsom (Sustainability Consultant, WSP): Yes, with Walmart, it was.

Leonie Cooper AM (Deputy Chair): If you do not want genetically modified food and if you want to certify it as genetic modification (GM) free. Yes, there is some really interesting use of Blockchain around food as well.

Nicky Gavron AM: When you think of the construction industry, construction and demolition, what are the barriers to smoothing the way forward? The Mayor wants to reduce waste. Do I have this right: he wants to reduce it so that we have only 10% left? Is that correct, Officer, we want to reduce the amount of construction and the demolition waste?

Scrutiny Manager: A figure of 95% recycling by 2020.

Nicky Gavron AM: That is a very close target. We are now at about 54%, is that right? Something like that. What are the barriers to us doing better? You mentioned ownership.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Knowledge and education are the key thing. It is a question of what creates the circumstances to improve knowledge and education in something like this. That may be regulation or certainly some form of incentivisation but awareness needs to grow. It is growing quite quickly at the moment. As I mentioned to you, I was with the Stirling Prize judges this week, as I was last year, advising on sustainability. There was not a single person this year who did not really think about embodied and whole-life carbon, did not address it or had not covered it in some way. Last year it was very different, and certainly in 2014 it was only about one of the six finalists. If you take those as the cream of the profession, supposedly, there is a rapid take-up of knowledge and information. That needs to spread right through the whole industry, which obviously takes time.

The tools are probably there now to enable people to progress with confidence. EPDs are growing rapidly. Software is being developed by all sorts of people. The ability and methodologies to do these assessments and calculations are out there. As has been said already, it is the gathering of data and the information to verify things that needs to mature and grow.

It comes back to our earlier discussion: how do we get people to take this up? Do we have to jump in and say that we are going to have a requirement of some sort that then means people have to start responding?

Nicky Gavron AM: What would the requirement be?

Simon Sturgis (Founder, Sturgis Carbon Profiling): For example, in the latest iteration of BREEAM matter 1 is now requiring a lifecycle assessment of embodied carbon at Investment Appraisal Board stage 2. They are requiring an assessment to be done, which is a good start. However, if you are not interested in doing a BREEAM rating then you will not take that into account or if you are not that interested in getting that many points, you just want to get a 'very good' or an 'adequate'.

Nicky Gavron AM: We are back really to the previous discussion. Anyone jump in, are there other ways we can support the industry? How can we 'hothouse' this along?

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): We have covered that before but the current policy wording is a very good start. It asks for assessment and calculation. This could be disclosed. It would build skills among the industry. It is an incentive. The biggest barrier that I see at the moment is the lack of incentive. Why would people look at it? Planners do not ask for it, building regulations do not ask for it and many clients do not ask for it.

I know you are very keen to have something happen now but with a policy like that, in a cycle of planning applications of two or three years, you can really develop a lot of capacity in the industry. The points we have mentioned before about looking at how, for example, an assessment varies from the early planning stage to the completion stage would open the eyes of many people about the importance of the supply chain arrangements, of procurement and of procedures on site.

Nicky Gavron AM: We are now talking about construction demolition. Of course, there is a lot of embodied carbon involved but you are saying just the process of bringing everyone together, getting more data and so on, is going to help?

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Yes. There would be a lot more awareness. We very briefly mentioned other policies that go along the same way, incidentally. All the attention on air quality - to move away from diesel generation and diesel equipment onsite - will make a massive difference to carbon, let alone local air quality and we have covered waste at length already. Yes, there are some policies that are not labelled carbon.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Julie's point about an assessment at the end of the project is really important because otherwise what will happen is you will get some glowing embodied carbon assessment at stage two, three or whatever it is - the pre-construction stage - but if it goes out to design and build or whatever happens that will all be lost. If you are talking about the construction stage and the demolition stage, building on what Julie said, you need to ensure that whatever brilliant things were assessed at stages two and three are delivered through the construction process and are reviewed at completion.

Nicky Gavron AM: Thank you for that. Can I then ask our GLA officers, how are the London Plan, the Environment Strategy and so on providing the right drivers?

Rhian Williams (Senior Strategic Planner, Greater London Authority): What we have in the London Plan sets out the broad principle. When we get on to the details of what an assessment is and when you do it, these kinds of things, we will have to look at producing guidance and working with --

Nicky Gavron AM: Sorry to just jump in, but the point made by Julie and reinforced by Simon was about assessments at the end, when the project has been built. That is really important for zero carbon reduction targets. Most people do now know how to read the energy assessment and then they do not know how to monitor it. Is that something we can put in?

Rhian Williams (Senior Strategic Planner, Greater London Authority): Potentially. We need to look at all the options for guidance. I cannot give you an answer as to what we would or would not put in there at the moment because we need to have a lot more discussions and do more research.

Caroline Russell AM (Chair): That is something you can come back to the Committee on?

Rhian Williams (Senior Strategic Planner, Greater London Authority): Yes. Once we have the London Plan examination and we know we have the policy principles there, we absolutely need to be looking at all the guidance that supports the plan and specifically what form our guidance might take. I know we have existing pieces of guidance in various formats. We need to have a look at that and what sits together.

Caroline Russell AM (Chair): Nicky, I am going to call a halt now to you and bring in Leonie who is going to be looking at demolition, rebuild or retrofit and how you make those kinds of decisions. Leonie, over to you.

Leonie Cooper AM (Deputy Chair): Just before we move on to that, I was interested when Robbie was talking about some international work that has been done on this. If we are looking to make changes and to come up with useful guidance, pulling in what has been done internationally is really important because there is literally no point in us reinventing the proverbial wheel, whether that is a Blockchain wheel, an old cart wheel or any other kind of wheel for that matter.

Obviously, over the years we have gone through phases where we have decided there are buildings we cannot stand anymore; back-to-backs around Glasgow so we knocked all of those down and stuck up other buildings that since then we have now decided we also do not like very much, and we demolished the whole of Holly Street. Usually the decision-making process that is followed seems to be more about the amount of carbon that is being emitted as a result of what people are doing in the buildings because they are leaky old buildings and are very inefficient. The usual decision seems to be between, "Can we stick something all over it to make it more efficient or should we just knock it down?" Are any of you aware whether in that decision-making process the embodied carbon in the actual building has been considered as part of the matrix that has allowed us to make those decisions? I am going to ask Julie to start with that.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): I am only aware of a very few examples. Personally, as a consultant, I happened to be in Camden. It was many years ago, unfortunately before there was widely available guidance. It was on a couple of very controversial projects where asking for an embodied carbon comparison was the planners' attempt to find a reason not to knock down the building, to be quite blunt. Because there was no established methodology it was extremely difficult to do a thorough assessment with confidence. We could basically get an assessment to say what we wanted. This is from many years ago.

Leonie Cooper AM (Deputy Chair): A long time ago, in a country far, far away called Camden, once upon a time we did it a couple of times but we did not really have any kind of methodology. Have we moved on since then? I can see Simon is waving.

Simon Sturgis (Founder, Sturgis Carbon Profiling): We have done a fair amount of work with Grosvenor on by and large Victorian buildings, some Edwardian and some Georgian. We have done a lot of retrofits to varying standards; clearly, at a minimum, they obviously comply with whatever is required. We have done some EnerPHit, which is the Passive House version for refurbishing. We have also done new builds of the same sort of typology - to put it bluntly, building fake Victorian buildings - to either passive house standard or, indeed, to a high level.

I accept what I am about to say is limited to what we have done and more work would need to be done on this, but the benefit of the overall whole-life cost – looking over 80 or 90 years – of refurbishing a building of the type I have described to a high standard, and getting it to be more energy efficient is, in overall terms, better than knocking it down and building a brand new building to the same performance standards. That is for the very good reason that you have the embodied cost you are not having to spend. It seems intuitively sensible but has to be examined more clearly, as I said, but certainly the indications we have had is that it is definitely better to refurbish. However, if the quality of the original building is diabolical then all bets are off. If you have a reasonable quality – and, frankly, Victorian buildings are not bad, if they have been going for 150 years they probably have another 100 years in them – it is definitely better. It comes back to my point about reusing recycled content. After all, you are just re-using the whole building.

Leonie Cooper AM (Deputy Chair): It was really interesting where Simon had just got to, essentially saying that if you take in the whole lifetime – I think you were saying, to paraphrase – and taking the embodied carbon into consideration, as well as the operational carbon that people produce whilst using the building, usually it would probably in most circumstances be better to go for refurbishment rather than demolition. That is what Simon was saying fairly clearly. We have produced some fairly ghastly buildings – let us be frank – where all bets are off and those ones are worthy of demolition because they are probably impossible to live in, in any case, for people and cannot be made decent in terms of heating, dampness and all the rest of it.

Would anyone disagree generally with the overall thrust of what Simon has said, that in most cases refurbishment is better in terms of overall carbon? Does anyone want to arm wrestle Simon on that point? Not literally!

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): There is really not enough data. I would like to think so, particularly when we are talking about the heritage estate.

Leonie Cooper AM (Deputy Chair): That also then speaks to Simon's other point, which is we need to do more in terms of starting to gather the data so we are in a much stronger position to answer that kind of question. Is that something where the GLA can really start to help push everything forward so WSP and other companies which work in that space are all working from a level-playing field and everyone knows they need to do more in this area? Can I pose that to both Rhian and/or Anne-Marie?

Anne-Marie Robinson (Senior Policy & Programmes Officer, Greater London Authority): The new London Plan policy will apply to major refurbishments as well in terms of the requirement for a whole lifecycle assessment. We do not see too many of them. They happen more at the non-referable level so we are not going to gather a huge amount of data through that process.

Leonie Cooper AM (Deputy Chair): I know the Mayor has introduced his Good Practice Guidance and is balloting residents who live on estates about whether they would like them to be demolished or not. Is it time for us to have a good practice guidance on full lifecycle assessment of buildings before you even get to the point of thinking about balloting the residents, is that where we should be in terms of carbon if the Mayor is to achieve the goal? I bent his ear before he was even elected about making London a zero-carbon city so it is something I feel very passionately about and I know Caroline does as well. Is that not something we should be requiring people to do?

Rhian Williams (Senior Strategic Planner, Greater London Authority): It is a reasonable consideration. The difficulty with those large sites, when you are talking about large-scale estate regeneration schemes, is that there is a whole host of different considerations going on there. Where density is upping dramatically it

will depend on the state of the buildings and on a whole host of things. It is something that is well worth considering as part of that multitude of things.

Leonie Cooper AM (Deputy Chair): The point that worries me is that it is not even being considered as one of a multiplicity of issues at the moment. I can see Julie is nodding. For example, I have a very large estate - some of which is architecturally fantastic - in Roehampton. There are a number of beautiful slab blocks that appear to float above the ground modelled on Le Corbusier, so on and so forth. There are also a number of other buildings that are pretty horrible and not very nice to live in. There is a need to increase density but people are saying, "Do we need to do a full demolition of all of these different parts and rebuild everything, or could we do it, for example, by building floors on top of what is already there?" That would probably then reduce the overall carbon in a way that the demolition will not. Is that something that has been brought into consideration?

Rhian Williams (Senior Strategic Planner, Greater London Authority): On sites like that the new policy would start to apply. The steps we have taken in the new London Plan will start to get that brought into the agenda. It is going to be very site specific. We have listed buildings and all sorts of other consideration on those specific sites. If you want to build on top, how much can you get away with and what is the existing structure. It is going to be quite site specific.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Leaving aside embodied carbon for a minute, I understand directly from working with the GLA that the policy on operational carbon is meant to apply to major developments, whether it is a new build or a substantial retrofit. However, in practice it is very inconsistently applied in retrofit. Obviously, it is more complicated in retrofit but many, many projects literally strip down the building to the floors and the /structure so there is really little justification for not meeting the operational carbon policy. I am not sure it is clear at the borough level that the policy applies. There are big opportunities for making much more out of these major retrofits in operational carbon terms. I know it is an aside but it is a recurring problem that we have seen for many, many years. The policy is interpreted as new build only.

Leonie Cooper AM (Deputy Chair): I know retrofit is not your major business, Robbie, at WSP but I am sure you have views on this because I know you have a number of people who work in the sustainability team globally.

Robbie Epsom (Sustainability Consultant, WSP): Totalling almost 6,000 now, it is growing quickly. We do a lot of whole lifecycle assessments for buildings and also for infrastructure. There is a lot of activity in that space. Probably our biggest project there at the moment is HS2. We are working with them to try to show a 30% reduction between scheme design and detail design, which is very much looking at embodied carbon of the construction. We do similar things for buildings driven by LEED version 4 and BREEAM. That, again, is typical for new builds because they want to get that certification and also because if they are building from scratch there are often a lot of market drivers beyond the framework industry guidance that are already out there.

With regard to retrofitting, I did a bit of research before this and a good example is the United Nations (UN). They did a retrospective study where they demolished their building and replaced it with a similar sized one that was much more efficient. They found it had a payback of between 35 to 70 years before those new operational efficiencies outweighed the capital carbon cost. It does very much look - especially with the grid decarbonising - like it is heading towards that trend of embodied carbon being the big thing and retrofitting being better.

However, London is a very complicated city with lots of varying infrastructure with different time periods, builds, warehouses and various other things. What I would like to see is something - even if it is just for a limited amount of time - that if a building or structure is going to be demolished it triggers an assessment of demolished versus the proposed retrofit, just to see what that is going to look like. Retrofit is quite a broad subject, I do not know where you draw the line. If you keep the façade of a building and build almost a new building behind, is that a retrofit or is that a demolish? It is to look at what is proposed. I am sure there are cases where retrofits could be done very inefficiently, using quite poor materials and designed quite badly. For a year or two years to see what it looks like for London's specific housing stock would be really interesting, but I feel it is leaning towards that retrofit is always better where possible.

Leonie Cooper AM (Deputy Chair): I am going to bring in Jane because I know you have been working a lot on the Crown Estate on this whole point of how you make that decision and how have you done that assessment of what the payback period is. You have probably gone more towards retrofit rather than demolish for very obvious reasons.

Jane Wakiwaka (Sustainability Manager, The Crown Estate): We have quite an extensive sustainability programme that is aimed at reducing overall carbon emissions, which comprises new developments but also refurbishments as well as retrofits. As a long-term landowner and owning quite an extensive part of the West End, we have been doing an extensive amount of work in terms of the refurbishments to make sure the existing buildings we have are performing as efficiently as possible. We have a programme in place that looks at that.

When we are looking at refurbishments and/or developments we have to consider a range of different factors, of which embodied carbon is one. We do have an example where we decided to do a refurbishment of a building and decided to retain the building services for that particular building - from a cost point of view as much as embodied carbon - where it was felt that building would be able to run efficiently and at the same time it would be able to operate in that same way for another ten years. Therefore, we decided to make that decision to not change the building services but we have done other things to make sure the building continues to perform efficiently. We have examples of where we are ensuring it is integrated as part of that decision-making process.

Leonie Cooper AM (Deputy Chair): That would be quite interesting. I do not know whether you have anything you will be able to share with us about how you have made those decisions. I am interested in the UN example as well. That is quite a range of time, is it not, paid back at 35 years or 70 years?

Robbie Epsom (Sustainability Consultant, WSP): I have not looked into it in detail but I would imagine it might be something to do with the decarbonisation assumptions for the grid that they looked at. That is just my theory.

Leonie Cooper AM (Deputy Chair): If you have anything you can share with us that will be really interesting. Sorry, Simon, you wanted to come in?

Simon Sturgis (Founder, Sturgis Carbon Profiling): I am just going to really endorse what Robbie was saying. I completely agree that that should be a starting point, assessing what you can reuse, the structural frame or whatever there is, particularly in London where the height constraints are really not that problematic. I know economics may drive it but I still think with a carbon perspective it would be a good thing to do.

Leonie Cooper AM (Deputy Chair): Do you think anyone has done any kind of estimate of how much of London should be left as it is, retrofitted or completely replaced? That is not the kind of assessment anyone has done. You were saying London is very complicated and difficult.

Simon Sturgis (Founder, Sturgis Carbon Profiling): Probably not since BREEAM.

Robbie Epsom (Sustainability Consultant, WSP): Building on Simon's point, a very key circular economy principle is collaboration. We have seen examples where it has happened almost by accident and major projects in London have collaborated and materials, on a large scale, have been reused. There is a side piece to this of making sure we redefine construction waste as resource unless it is hazardous. One of the key things is making sure these projects, from buildings to major things like Tideway and HS2, are talking to other. Why cannot one building's excavated material become another's infill? Why cannot the materials in a building that are going to be demolished, if it is safe to do so, be used to build another? We could get a collaboration network in London with all these designers, developers and building owners talking to each other and sharing best practice as well of where things worked. People love a good success story, particularly if it saves money.

Leonie Cooper AM (Deputy Chair): Interestingly enough - as part of one of the reports we were just referring to, which Grace Loseby [Former Assistant Scrutiny Manager for the Environment Committee] was very helpful with - we conducted a visit to a company that deals with construction and demolition waste, repackages it all and reuses just about everything. Some of it gets used here and some of it gets sent abroad. The amount of material was quite astonishing. Almost nothing was wasted from the building sites. On the other hand, they did also point out that on building sites in this country an awful lot of things are wasted because we are unbelievably careless, whereas if you went to Japanese building sites the number of pellets or the number of broken pieces of plasterboard would be almost zero because people are incredibly careful in the construction process. It was instructive talking to them about that point, but a lot of it may well be being used. For information, that company was called Powerday.

Are we in a position where you think that because of the decarbonisation of the grid we can end up with buildings that can be so efficient over the whole of their lifecycle that they can be completely zero emission? Obviously, there are some that might even be net zero or, if they are completely covered in terms of a new build, contributing back to the grid.

Simon Sturgis (Founder, Sturgis Carbon Profiling): I was looking at a study done by a group of Norwegians, really aimed at circular economy thinking, which was to do with decarbonisation of the grid. It was for all materials, not just building materials but it certainly applies to building materials. What they were looking at was if you were to produce materials - whether it is for buildings, food, or whatever it was - from zero-carbon energy you would still have significant carbon emissions. The reason for this is because of the way a lot of products are produced, even if you have zero-carbon energy feeding into making them it is just the process of extracting things and turning them into materials. If you have a budget to the end of the century for gigatonnes of carbon allowable from materials to stay within two degrees, it is 300 gigatonnes to the end of the century. It is to the extent that, even with zero-carbon energy, the materials would use up 600 gigatonnes. Therefore, materials remain a problem, even with manufacturing being very efficient and zero carbon. That then leads us straight into reuse, recovery, recycling and all the rest of it to bring that down.

Leonie Cooper AM (Deputy Chair): Interesting, thank you.

Caroline Russell AM (Chair): Thank you. New build is zero rated for value added tax (VAT) and refurbishment obviously pays VAT at 20%. Do you think this is a big factor in the way people make their decisions about whether to refurbish or demolish and start from scratch?

Simon Sturgis (Founder, Sturgis Carbon Profiling): Yes.

Caroline Russell AM (Chair): That goes beyond what the Mayor can do; it is a national thing.

Simon Sturgis (Founder, Sturgis Carbon Profiling): If it is listed, then another issue kicks in.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): That is a recurring industry issue. Also, it depends on who the people who decide are. If we look at homeowners or individual homes, it is very different. There are a lot of studies that show even if there were long-term energy savings etc there are many other factors of why people do not retrofit; hassle, mistrust in builders, etc.

Caroline Russell AM (Chair): Cutting the cost by a fifth might well encourage people to make those investments into retrofitting their homes to make them more energy efficient.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Possibly. Certainly for individual homeowners, which are a little bit outside the remit of this policy, it seems we have to address other things to do with behaviour, comfort and maybe showing the co-benefits. We do not necessarily behave financially rationally, there are all sorts of other reasons. Yes, in terms of the wider industry it seems --

Caroline Russell AM (Chair): An issue.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Yes.

Caroline Russell AM (Chair): Thank you. I am going wrap up now. I wonder if each of you would like to make any suggestions on how the Mayor could best tackle embodied carbon in the London Plan and his other policies, is there something you think the Mayor could be doing to tackle this issue? Simon, can I start with you?

Simon Sturgis (Founder, Sturgis Carbon Profiling): We have probably covered most of the issues, to be quite honest.

Caroline Russell AM (Chair): If you were going to be asked for one thing we have covered during the meeting, what would you ask the Mayor to do?

Simon Sturgis (Founder, Sturgis Carbon Profiling): I would reassess at the end of the project.

Caroline Russell AM (Chair): Great, thank you. Jane?

Jane Wakiwaka (Sustainability Manager, The Crown Estate): It is a good question. In our opinion we welcome the revisions that were made in the London Plan. Perhaps, aside from policy, the GLA might have a role in convening different parts of the supply chain to better understand embodied carbon.

Caroline Russell AM (Chair): Thank you. Robbie, one thing that would be good, or two?

Robbie Epsom (Sustainability Consultant, WSP): I wrote down a couple of things. The requirement for the retrofit assessment triggered by demolition is a good point because I do not think it is clear how far retrofits go sometimes, so that would be really useful. Also some leadership from London in terms of best practice, collaboration and guidance to help us all see what the best practice is. That is something we are really passionate about at WSP so we are happy to keep helping in the journey.

Caroline Russell AM (Chair): Thank you. Julie?

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Someone has stolen my answers.

Caroline Russell AM (Chair): Re-emphasise.

Julie Godefroy (Head of Sustainability Development, Chartered Institute of Building Services Engineers): Disclosure of information. It could be anonymous, but showing what is out there, good and bad examples; public information.

Caroline Russell AM (Chair): Rhian and Anne-Marie, is there anything you have taken out of all the brilliant evidence we have heard this afternoon that you are going to take away?

Rhian Williams (Senior Strategic Planner, Greater London Authority): The whole thing has been really useful for us to hear. I know we have had previous discussions, certainly with Simon, before and engagement with other groups but continuing to have these kinds of discussions will be useful when we are developing the guidance so I am looking to keep up contact with you.

Anne-Marie Robinson (Senior Policy & Programmes Officer, Greater London Authority): The issue around what gets agreed at planning and making sure that happens in practice is something we definitely want to move towards. That is why we have new monitoring requirements in the new London Plan. Looking at whether the whole lifecycle assessment can become part of that is something we can take away.

Caroline Russell AM (Chair): Thank you, all of you, for your time and your thoughtful contributions. It has been a really interesting session.