Episode 63

Smart Energy and Data

The show notes: www.houseplanninghelp.com/63

Intro:	Data is what we're talking about today. When I go to various different talks they will often reflect on data that has been collected, whether it's from moisture sensors or CO_2 sensors so I did wonder whether it's something that I should be doing on my project, making sure that there is something useful coming out of it in terms of data. That probably means planning upfront so I just wanted to find out all about that. Recently I saw a talk on smart energy so I thought we'd tie this all together and see how we go with it.
	Doug King has a lot of experience in construction, particularly high performance buildings - which is what we like - and he's someone that I've been wanting to talk to for a while.
	I started by asking him for a little bit of background on his work.
Doug:	I started out as a physicist. I fell into the profession of building services engineering, out of curiosity, and then I spent the last 20 years thinking about how building services systems work together with building fabric, with the technology to control them and finally how human beings relate to all of that as a system in order to try and understand the key issues about optimisation, how to get these things working together properly rather than the building services systems fighting against the building fabric and the users not understanding what the hell is going on.
Ben	Today we're going to be looking at smart energy and data. Is there a distinction between the two, actually, in that one is about collecting data that could be useful to move forward, to progress and then there's smart energy that is more about feedback in the existing house?
Doug:	Yes, there is. Obviously data on its own isn't terribly useful. Data comprises of lots and lots of structured collections of numbers or even unstructured collections of numbers and other information. Turning that into something, which is useful is the purpose of smart.
	Now I don't think you get much smarter than people and actually when it comes to interpreting data and figuring out how to make things work well, people are the best control system I know. But

there is a big move in terms of the technology sector to develop smart systems for buildings which automate the interpretation of the data and start to make decisions based upon it on models that have been developed of typical scenarios, typical behaviours, the idea being that presumably a smart system will be able to anticipate your needs and control your home without you getting involved.

Ben: Is this aimed at us, is this aimed at the companies supplying us, selling gadgets? Is this just an all round win win win?

Doug: At the moment it's clearly evident that the smart control sector is being driven by the technology suppliers. There are advantages, there are some advantages, but I'm not sure whether the advantages at the moment being offered outweigh the long-term disadvantages when we take into account how people, you and me, behave when we're confronted with a new piece of technology as we learn to love it and eventually as we get bored with it. There's a very distinct cycle of understanding and engagement with technology which is beginning to be revealed which suggests that there may be more long-term problems with smart technology than there are short-term gains.

Ben: I'm someone who loves to embrace simplicity but I am aware sometimes you have to go through this complexity before you come out at the other side. So what's the relationship here between data and simplicity?

Doug: Data can be as complex, I think, as we want to make it. That doesn't necessarily mean that it's good or useful. We have a habit of collecting an enormous amount of data because data collecting and data gathering has been driven by academic study, when we need to have rigorous correlation of data sets revealing different aspects of human behaviour and building operation. That doesn't necessarily mean you need all of that data to be able to make sensible and smart decisions about how to use your house, when to turn things on or off, depending on whether your PVs are generating or not, is a simple decision driven by a simple interpretation of the data that's available. You don't need a lot of complexity to achieve that.

I do believe that the more data that we try and gather and interpret, and the more layers of complexity that we lay onto it the further and further we get away from something that is intuitive and simple to control, which is what we really want.

Ben: So looking at this from a self-builder's point of view, I want to build my house, and I'm interested in data in terms of really helping the building industry. I'm not talking about installing a Nest - a Google Nest, because they bought that recently – in the house, just in terms of I would like to use some sensors to collect data. Is that helpful for academic study or am I just doing it because I like . . . again, it's an extension of gadgets?

Doug: I think if we're doing it ourselves we're probably just doing it because we're interested. The rigour with which we have to collect data for academic study is generally beyond the cost that we would normally be prepared to pay when we were going to do it for ourselves. If we are studying a building for academic purposes we want to be able to link power draw from the electricity meter, the gas meter to whether or not the boiler's firing up at a particular point in time, whether the occupants are in residence, what the temperatures are in different spaces, even whether people are opening and closing windows. So there's an awful lot of data points to collect to be able to interpret something that would be generically useful about the behaviour of people and that building. That's way beyond the expense that most of us are prepared to accept.

At the moment the University of Ulster are developing a small-scale system, collecting about half a dozen variables and that's coming in at about £1,500 - £2,000 per home as a device for academic study. Not many of us are prepared to pay that so we've got to be sensible about what can we do with the data that's already available to us. It won't be long before smart meters are installed almost universally. In the meantime if we want to collect useful data we can go out and buy a £30 or £40 home energy monitor which clips onto the existing electricity meter and provides us with a display which is a little bit more useful than the simple meter reading, the dial that goes round on the electricity meter.

Even without any of those gadgets we can still collect useful data about building performance by reading the meter more frequently. Most of us don't bother to read the meter at all. We simply leave it to the utility companies to come round once every three months and read it if they can be bothered or estimate our bill if they can't. If we were interested, if we wanted to start to reveal issues about how our homes perform and how we use energy you could for instance read your electricity meter at the same time, once every day, and do that for a period of time. Now what that gives us is a series of intervals of energy consumption. If we plot them on a graph it would more or less reveal an upward rising line. There's going to be some variation because on different days you do different things or there's

need for more or less lighting but if you were then to plot a trend line through those upwardly-rising points you would reveal the typical energy consumption day by day.

Now that's going to start off as a straight line but over a period of time that line might start to rise which indicates that typically you're using more energy per day than you were before, so you can look at that and start to question why. Is it winter? Are we using the lights more? Have we bought a new gadget? Have we changed the way that we're living and working? And so, even simple data can be turned into useful information if we're prepared to put in a little bit of time and effort to interrogate it. To be honest, I think that level of understanding is just as beneficial as any smart system that's going to try and anticipate those changes and make decisions on how to run your house based on an aggregate model of how lots of people run their houses.

Ben: As I see it, over the next few years it's coming to come down to a much more complicated equation. Each of us has a footprint on this planet and we're going to have to come to grips with what that footprint is and those amongst us who want to make a serious impact are going to have to try and plot the downward trend of that. It could be in various different ways, but it's not just the house I'm talking about here because obviously you could have the world's most energy-efficient house and then go and fly around the world a few times and probably you've done just as bad. So with that in mind, there has to be some stronger grip on more than just energy or anything like that.

Doug: If we want to understand our footprint in context then we need to understand how our behaviour, how our energy consumption, relates to the average, whether we're above the average or below the average. If we're all targetting being below the average then of course over time the average comes down and we still strive to be below the average and we all get into this virtuously spiral of decreasing energy consumption.

In order to do that we have to have an understanding of what is average, what is typical and that's quite hard to come by at the moment. There are many different databases which are being operated to collect energy performance data for commercial buildings and there are not nearly so many available for housing. At the moment the only one that I'm aware of that homeowners can actually contribute their own data to would be the one that is run by the AECB but you have to be an AECB member to be able to contribute.

Ben: Is this the Low Energy Buildings Database?

Doug: Yes, yes. I don't know much about it but I think that it's grown out of work that was funded by TSB (the Technology Strategy Board) through the Retrofit for the Future project and for the building energy performance monitoring projects, compiling that initial chunk of data which consists of a descriptive about the building, so we know what it's made of, how it's made, how big it is and then performance data with regard to energy consumption and some other issues.

            Now as these databases build we can start to benchmark across sectors. In the commercial sectors we can do that, we can identify typical energy consumption for schools, for offices, for hospitals and things like that. For housing it's very much more difficult because housing isn't standard, housing is very very much unique to the homeowners, but we can start to get useful information out of those data sets that say on average we could expect a UK home to consume something around about this much, depending on the weather, depending on other social circumstances. Then you've got an idea of where you sit by looking at your energy consumption against that benchmark we can start to say, well, on the whole we're doing well or we're not doing so well and we need to address it.

Ben: And in that scenario - I hope that we will go this way - what then do we do with the average person and encouraging them to go below? There will those that will take the initiative. Can we ever enforce this? Will we get to a situation where naturally the energy isn't available? [Doug laughs, with concern!]

Doug: This is the big imponderable question about climate change and society. I oscillate from being hugely optimistic to hugely pessimistic depending on the month. To be honest we cannot legislate to force people to consume less energy. At the moment our current government is pursuing the energy sector over prices, even though our prices are actually very reasonable in real terms, considering what we need to do in terms of decarbonisation and infrastructure renewal. And the government is pursuing the energy sector because it's seen as cheap political capital. By bashing the energy companies that can secure, hopefully, more votes for the next election.

            Pricing energy hits those in fuel poverty first and hardest, and whether the human being's psyche is actually geared up to taking

on board the messages about climate change is questionable. There's a big issue around the psychology of people and whether they will invest in activities or actions which only give rise to delayed gratification rather than immediate gratification that suggests that altruistic action on climate change is very difficult to achieve, in the same way that actually it's very difficult to get you and I to invest in our pensions because the consequences of not doing something now are so far remote that they don't appear important.

Ben: But in Australia they take off an amount for the pension! [Ben laughs.]

Doug: Yes, and the pension reforms in the UK are aiming to do the same sort of thing. With energy, we've reached a point in society where energy is the universal enabler for our lifestyles and to start to restrict that brings with it very much greater consequences than simply the conservation of energy.

            What we need to do, what we need to understand is how to do what we do now using less energy, not simply embargoing energy consumption.

Ben: I think you answered that very well. Let's move back to, I mentioned Nest earlier in this episode and Nest I don't fully understand it myself, have you any insight into this?

Doug: Not much. I've read the brochures and the marketing stuff. So supposedly Nest is a smart thermostat which learns your preferred temperature over a period of time, it learns the temperatures you prefer at different times of day and then repeats that pattern. It has some presence detectors in it so that it can recognise when you are not in the house or maybe just not in that room, we're not sure about that and if you're not present then it turns the heating off.

            So it's taking a model of human behaviour, which is fairly simple - if you're not at home the heating doesn't need to be on, if you are at home the heating does need to be on. On top of that it builds a contextual model based on your behaviour, your own behaviour over a period of a few days while the system learns what you like. So if you habitually turn the temperature up in the morning when you get up it will learn that behaviour over a few repetitions. If you then typically turn the thermostat down again during the middle of the day it will learn that. And it will continue to repeat that ad infinitum.

Now if your behaviour pattern doesn't change, that could lead to delivering you the expected level of comfort with reduced energy consumption. It will certainly save you energy by switching off the heating when you go out if you habitually forget to do so yourself.

My question with these systems is - the model is quite simple - what happens when your lifestyle changes? That could be a simple change, a change of the seasons from winter to summer. Actually, even though the comfort science tells us that we're all supposed to be comfortable in a fixed range summer and winter you find that people will adjust their heating temperatures quite significantly between the winter and the summer compensating for the outside air temperature, for the feeling of it being warmer and sunnier, and that's just a simple change in the behavioural pattern.

If you want your Nest thermostat to actually follow changes in your behaviour then you're going to have to reprogram it on a regular basis. Otherwise it will simply repeat the program that it has learned and if that's out of sync with your lifestyle requirements it won't give you the benefits. More than that, it might even lead to dissatisfaction because it's delivering temperatures that you're uncomfortable with.

So, none of these smart systems is actually fit-and-forget smart, you have to engage with it continuously to re-teach it the new models of behaviour that you want it to replicate. If we don't do that then I suspect we would become dissatisfied with these systems quite quickly and I do wonder about how long people will be prepared to continue their engagement with the technology because there is a distinct pattern of loss of interest in new gadgets when it comes to energy and comfort in homes.

Ben: I'm interested that you mentioned heating first of all because I saw a talk at the AECB conference on the topic of whether it would get bored, a gadget like this, in a Passivhaus with just a stable temperature! [Ben laughs.]

Some of the other aspects that they talked about in this seminar were that there could be some other elements that might be able to help us in the future. Let's just take our scenario that we have some renewable energy and we want to use that at some times or is it cheaper from the grid or export to the grid? It could work out the best times for you, say for example, to switch on the washing machine, because if it were cheaper in the night to get your energy when there's not this peak load.

So could there be a benefit of that or is it becoming more big brother at that stage? Perhaps there are downsides there, too.

Doug: There's certainly potential for smart systems to indicate how you can use energy more efficiently and this is one of the underpinning ideas for the smart meter rollout. Smart meters, let's be clear, are primarily to save the expense of the utility company having to employ people to come and read your meter on a regular basis. The smart meter takes that manual activity and turns it into automated communications but now the communication is established there are spin-off benefits that are available. And if the smart meter roll-out addresses some of these additional benefits and not just the basic metering technology then yes it's perfectly possible for the utility company to generate a signal back to your smart meter to indicate what tariff you're going to be charged for consuming electricity or gas at that time of day. A little box of logic can then do some calculations and suggest whether or not you might want to be turning your devices on or off.

Ultimately you could plug a PV generation meter into a device of a similar thing and start to get contextual information, which is useful. I don't think that's going to exist within the smart meter package and I don't think that's going to exist within the standard PV metering packages. It would be a third party offering that you would have to pay for to assemble that data and to give you some kind of useful indication, but even with a simple PV meter these days you get a big friendly tick on the display telling you when you're generating enough electricity for it to be worth turning your washing machine on or other power-hungry devices. So even at a relatively simple level you can still get what we would call a smart interpretation of the data to give you an indication that something is actually useful.

The big brother scenario is of course that as we continue to ramp up our demand for energy and fail to invest in infrastructure renewal that there will come a time when it becomes necessary for the power companies to switch you off in order to avoid the big peaks. Now the latest revisions to the energy legislation, the Contracts for Difference establishes a means for energy companies to pay people to either meet a shortfall or to switch off in response to an under capacity situation and theoretically that could of course be extended to homes.

I think the Daily Mirror was writing about, 12 months ago, about the energy companies taking control of your fridge, being able to switch it off remotely at times of high power demand. There's a choice to

be made amongst consumers, whether that is an unacceptable intrusion or whether for a small payment from the energy company you'd be willing to have your fridge switched off for 15 minutes in every hour, which isn't going to make any difference at all to the food in the fridge. How these things are perceived, I think, is very much a question of how they are handled at a political level. If the power companies and the politicians and the academics engage and we openly discuss the benefits and the concerns about data privacy, about loss of control and all of these other issues then we could move smoothly into a situation where demand management in homes is viable. If we don't do that, then actually what will happen is that the general public - you and I - will get very outraged about the imposition of control upon us and we will get ourselves into a very difficult situation with regard to smart metering and all of the advantages that it could bring.

Ben: Because I like to think that A) you're opting into this so as all of us have done with technology, with an iPhone that can monitor us wherever we go and all the different sorts of data that comes from that. So it's the same, gadget lovers will inevitably have all of these things that they'll install into their houses. Beyond that though it's a good control mechanism and I would like to think personally I've got nothing to hide and I wonder in the future whether more of us might lead more open lives because of the internet. It seems to be promoting transparency and all these things.

           So there's an element of me which is concerned obviously about that but the other side is saying: "Well, if I'm not doing anything wrong . . . "

Doug: Well absolutely, but this is a transactional thing. We have accepted smart phones and the sacrifice of personal data about all sorts of things because of the convenience and the advantage they can offer us, because of the payback. So when it comes to smart metering and demand side management it has to be absolutely clear to the consumer that the benefit that they derive from these technologies is greater than their perceived loss, in loss of control and loss of privacy, potentially which is what they'd be concerned about.

           So we have to be very clever and we have to be clear, and we have to design systems that will deliver significant advantages, tangible advantages that people can then measure against the intrusion. That's the only way we're going to take this forwards.

The way that people respond, again, the way that people will respond depends entirely on their initial circumstances. The technology-lovers will leap in feet first. There will be a general swell of eventual followers as there has been with many other technology developments but there will always be laggards. The question is how do we ensure that the technology is providing sufficient advantages to bring the laggards on board as well.

Ben: Well, perhaps you've answered my next question a little bit. How do you see all of this playing out?

Doug: Do you want my unwashed, unvarnished [Doug laughs] view of how things might play out?

Ben: Go on! Let's have it.

Doug: I don't hold a lot of hope for widespread acceptance of smart meters. Smart meters are being rolled out, it seems to me, to compensate for the lack of central government investment in energy infrastructure for the last two decades. We're facing a situation where energy security is becoming a very real concern in the next decade. We're not going to be able to deliver enough renewable energy to meet the shortfall. We're not even going to be able to build enough new conventional power stations to meet the potential shortfall. So demand management goes a long way to being able to keep the lights on at times of high demand.

That seems to me the principle purpose of rolling out smart metering, to enable demand management and to enable better balancing of the grid and the infrastructure.

The attention has not been given to the benefits that are going to be derived by homeowners from the installation of smart meters.

A lot has been hung on the suggestion that a home energy monitor coupled to a smart meter will provide the intelligence for homeowners to save money. Initially that may well be true and a lot of the pilot studies that have been carried out using home energy monitors do indicate that homes with monitors have managed to achieve savings of anything up to about 15% in their energy. However, all of those pilot studies have been relatively short term and we've now built a national energy policy around an expectation. It concerns me that a few years ago a research group at the technical university in Delft revisited Dutch households that had taken part in a home energy monitor pilot study and what they found was quite disturbing. In every group, regardless of how

engaged the households had become with their energy monitor in the initial pilot study, every group showed the same rate of lapse back to original behaviour 15 months after the end of the pilot study. At the end of the pilot study 50% of the participants didn't even see the value in keeping the home energy monitor which they were offered for free. They returned it back to the energy companies. The worst performing group in the initial trial period had achieved savings of maybe 3-5% but 15 months later they were then consuming more energy than they had been at the beginning of the pilot study. The best performing group, those who actually engaged with the home energy monitor on a daily basis and took action in response to that they reported around about a 15% reduction in energy consumption during the pilot study but 15 months later almost half of that gain had gone as they lapsed back towards prior behaviour.

So there's a clear indication there that new technology is interesting and we play with it but we then get bored and unless we address the underlying behaviours and the underlying causes of energy consumption then simply giving people information is not going to lead to a long-term behavioural change.

Ben: Doug, thank you very much.

Doug: You're very welcome.