

Episode 8

Retrofitting a Victorian House to Passivhaus Standard – Part 1

The show notes: www.houseplanninghelp.com/8

Ben: I'm here with Tom Pakenham from Green Tomato Energy. Hi.

Tom: Hi there

Ben: And we're here with you today because – this is something quite close to my heart as well because I love all the old buildings – you've retrofitted a Victorian property, haven't you.

Tom: That's right. We've retrofitted our Victorian terraced home to Passivhaus standard.

Ben: Before we get into some detail there, I think actually your company on the whole and the wider group is very interesting. So how did you decide to set up Green Tomato Group?

Tom: So I was concerned about the way that we treat the planet and thought that it was probably worth doing something about that and decided that the best way of doing something about that was created businesses that would offer people, goods and services to reduce their environmental impact but also to improve their lives.

Ben: And has that been something that has grown quite quickly? Have you found your market readily?

Tom: So the first Green Tomato business was called Green Tomato Cars which was a minicab company which we ran

on low emission principles, we use low emission principles and had a bunch of other environmental approaches which made it as environmentally friendly as possible. That was taking an existing business sector and making it as environmentally friendly as possible so we didn't have to create a whole new market. As a result it was very popular, a very simple product. Essentially the offer to the customer was exactly the same product as normal, if not a bit better, same price, if not a bit cheaper, and it just so happened that it was also kinder to the environment. It was pretty compelling. People were very excited about it and it grew extremely quickly. So that was the first business.

Then we launched something called the Green Tomato Kit, which is a green starter pack for the home. It contained a variety of energy, waste and water saving devices that people could install in their homes quite easily. It would reduce their environmental impact immediately. It would begin their understanding of their impact and also save them a little bit of money in the process. That was reasonably successful. It was popular amongst housing associations and businesses who wanted to help their employees be more environmentally responsible, but it was a bit more tricky to shift large quantities of them. Partly because I think in this sector people are very used to being given low energy products, environmentally friendly products for free and so they weren't really prepared to pay for something, they just assumed it was something they should have been given for free. Partly because possible the product itself was not quite as good as it could have been and therefore didn't have that style cache that people often buy on the basis of. So we still sell the Green Tomato Kit, primarily to social housing providers for their tenants to begin their kind of green journey.

And Green Tomato Energy was the third company, is the third company in the Green Tomato group. We exist to help people reduce their environmental impact through

their homes, we offer consultancy services for low energy building. We offer services to SMEs and to social housing organisations in terms of designing low energy buildings, advising on carbon emissions and increasingly we are building the ability to deliver the works to people. We would go to their homes, say this is what you could do, this is how much it would cost, would you like to do it, if so we can do it for you. So that's the bigger goal and we think that's what people really need. Sometimes there's a danger for people that they get advice but then it's very difficult for them to actually follow through on that advice, and we see that increasingly in the space so we're hoping to address that.

Ben: So when you came to retrofitting your property, it wasn't really a choice between renovation or new build? It was, you wanted to show this is what you can do right now?

Tom: So, my wife and I, we're both Londoners. We have grown up in this part of West London all our lives. We didn't want to move away from the area. Our lives are here, our families are here but the opportunity for new build in this part of town is pretty much zero so we were always tied into having to do something to an existing building. Most of the buildings here are Victorian terraced houses. There are some exceptions to that as a result of World War II and other things, but the vast majority of homes are from the late 19th, early 20th century and so we were forced into retrofitting rather than doing a new build. Also we love the buildings and we wanted to show the world, I guess, because there's a lot of rubbish out there being talked, we wanted to show the world that you can have a super low energy home which is sympathetic to the culture heritage and is also very attractive to look at. Typically people think, a lot of people that is, think of low energy homes as some kind of bomb shelter, nuclear bunker, very unattractive, very angular, boring buildings. As it happens quite a lot of buildings are of that more modern style but it doesn't have to be the case. The point of low energy building is one of principles of physics rather than some

aesthetic rules that someone in Switzerland or Austria has deemed to be absolutely necessary. So that was the purpose and also we wanted to live in a beautiful building and a comfortable home and that's why we decided to do what we did.

Ben: I know that any retrofitting for energy purposes is quite difficult, but why did you choose the Passivhaus standard?

Tom: I was slowly introduced to the Passivhaus standard over the course of a year and a half. We knew we always wanted to build a low energy home but we hadn't at the beginning decided that it had to be a Passivhaus, but as I looked into it more and more and became better acquainted with the options that were out there, the Passivhaus standard became more and more attractive. Primarily because it's actually quite flexible in terms of its application. It's a standard rather than a prescriptive method of building so it allowed us to take an existing building of the geometry that it was and work out a way of making it perform to Passivhaus standard, which is interesting from an engineering point of view. I think that excited our team as well – it was a bit of a challenge. Also, the most important thing that I think people should realise about Passivhaus is it's been around for quite a while now. Therefore there are a lot of Passivhauses, not so much in the UK, although a growing number, that have been tested over many decades or at least a few decades. Therefore we have really good data to show that the Passivhaus method does actually work and you can trust it. That shouldn't come as a surprise to anyone as it was devised by a physicist who specifically set about doing it in order to show that you can apply the rules of physics and you will achieve the same result again and again and again, as long as you build it correctly. But it was very convincing for that reason and we thought if we build it correctly according to the design it will work, so we can have confidence in that.

Ben: Where is the starting point? So you have your house, what do you do next?

Tom: You find an architect and then someone who understands energy engineering. Those two people have to work together to come up with a really robust and complete a design as possible. You should spend time with your design team to make sure what they're designing will work within your budget and within how you want to live in the property. So it's a combination of, it's a bit of time and a bit of planning. We did a fair amount of planning. We lived in this house for 6 months before we started the work so we got to know it a little bit, we had time to think it through and understand how we would live here, which I think is pretty helpful. A lot of people who are going to do a project like this will already have lived in the property for a while. It's good to get to know the building but don't rush the planning stage because you'll suffer at a later stage if you do. Then I would say start to build a relationship with whoever it is that's going to do the actual building works because that will turn out to be a major challenge is finding a builder who is technically competent but more importantly than that understands what you're trying to achieve and is preparation to buy into the project. Typically the attention to detail, the technical requirements of a building like this, particularly in a retrofit are such that the building team, right from the head builder through to the most junior builder on the team, really need to understand the basic outlining principles of what you're doing technically i.e. unbroken insulating, closing thermal bridges, making sure that the building is airtight etcetera, etcetera. If they don't understand that and don't buy into it as an objective that they believe in and want to achieve, then you will start to fail on the details and when you start to fail on the detail, then the whole project can come into jeopardy. That's the next stage to basically make sure that your whole team is on side and pulling in the right direction. Then obviously work out how much it's going to cost, make sure you've got enough money plus a bit extra, particularly for an old

building where you start taking plaster off the walls and really investigating the guts of a building like this, any building built in the 19th century and you find some quite interesting structural surprises which will cost extra money and will need to be addressed during the course of the build.

Ben: So going back to the tradespeople that you were using. I can already tell you've got a great amount of knowledge on this. Did you have that knowledge when you started?

Tom: I've been working in what you would call the environmental space for some years by the time we started this project so some of the fundamental principles of what one is trying to achieve in that sense were quite deep rooted in me mentally. I think in many ways that's the most important foundation for embarking on any project that is attempting to be low impact. But technically too, I had some experience with solar thermal systems, I'm not bad at a bit of DIY, so I wasn't scared of building works and getting my hands dirty so I think that was helpful. But no, a lot of it was learning as we went along, hearing what the team had to say. Part of the reason for doing the project was to learn, for me and for other members of the team and I think as long as you approach the project with an open mind and the understanding that something might change and you might need to learn things as you go along, then you'll be fine.

Ben: Yes, I often hear that about how knowing as much as possible can help you, but I was just wondering from the point of view of hiring people, how you know that they are actually going to do a good job, particularly when for you this was almost a pioneering project.

Tom: Well it was a pioneering project. Well this along with a house in Kensington was the first of its kind, which is a full Passivhaus retrofit, in the UK. As a result no one had done it before and some of the things had not been done by anyone in the UK or not in this form exactly. So there

was definitely a pioneering element to it and actually we made a mistake. Unfortunately our architect, who's a very competent architect on many levels, it didn't quite work out in the longer run with him. His skill set wasn't quite right to what we needed so he did the initial work and then we took over a lot of the more detailed design work within the Green Tomato Energy team from then onwards. You might get it wrong, you might always get things wrong. This is the thing. Accepting that you're going to get things wrong but trying your hardest not to and then when you do, making the right decision as to how to bring them back on track is the right way to approach it rather than necessarily expecting to get it right and then being surprised when you don't.

Ben: I live in a period property myself and I suppose something that's in my mind at the moment is that, if I tackled this, because it's a big project, what if I ruin the building in the process? I don't even know why I'm thinking that, but there's no back button or rewind.

Tom: Well, there is a rewind. It's just expensive! [Ben laughs.] We love this house. We love living here. It's an incredibly comfortable place to live. It's a beautiful property. It's very quiet. It has almost a unique feel to it, like many passive houses do. It's a really unusual place to live. It's entirely different from living in a typical British, Victorian house, just the comfort levels and the sensation level in here is. So the outcome has been fantastic. So far there doesn't appear to be any structural issues and certainly there is no reason to think that there will be. Obviously we've paid quite a lot of attention to that side of things, but it is quite dramatic a transformation and so as a result if you're nervous... you will be nervous about it and it is a in 'risk'. In life you choose what your risk reward profile, what you're happy with on that side of things, so people won't be. There'll say this is too much, I'm too scared, I don't want to do it and if it goes wrong that would be a disaster. This is not magic. You don't have to close your eyes and jump into a dark well or something. This is something that

can be designed. The way that a building is built and its structural behaviour and its energy behaviour and how insulating something or cutting off thermal bridges will impact on brickwork or joists or whatever part of the structure of the building, it's something that you can work out and design accordingly. So we didn't just blindly build this building hoping that it would work. A lot of thought went into it and a lot of learning came out of that, and a lot of learning continues to come out of how the building's performing and looking at it and the structure is fine. When I talk about taking a risk it's more psychological than real. The fact is if you've got a sensible design team, this is not a problem, this is not an issue so long as you do the work. You don't want a cowboy builder to what in 200mm of phenolic insulation on your wall without thinking about what the impact of that will be. That's a really bad idea and that's why Green Tomato Energy or part of the reason why Green Tomato energy exists is to help people get it right and it's important that they realise that.

Ben: What are the key changes? It's funny being in this building. I'm imagining it hasn't changed that much if you'd come in before anything had happened and then afterwards... perhaps a lick of paint. But what has changed as we look at it?

Tom: Part of the frustration for people who come here to do tours of the house is that there's not that much to see and that's kind of the idea! Most of the interventions that we carried out are hidden behind the walls, behind the plasterboard, behind the paint, under the floors, in the ceiling, wherever it might be. So the differences are not that obvious. To summarise what you have to do to create a Passivhaus, it's the same whether it's a new build or an existing building retrofit, is you have to super insulate it, which we've done here. There's 180mm of insulation on the external walls, on the internal face of the external walls. There's 50mm on the party walls. We have installed

triple glazed windows which look like sash windows from the outside but they are not.

Ben: I'm just thinking, that in itself for a Victorian property, there must be a huge market about to open up here, but how did you do it being the first person?

Tom: Well, that is a whole other story and rather a controversial one but the answer in brief is that they had to be made specially for the building and our hope was that we would then go into business of building and selling triple glazed windows, which hasn't materialised for all sorts of reasons which I think are best not talked about on this podcast. [Tom laughs.] Well, they're just complicated, commercial really. Anyway that may change and hopefully somebody will create them because I agree with you that may well be a good market going forward. Certainly we've seen double glazed sash windows becoming very popular. There are some complications around triple glazed sash windows, which we can go into. The most notable one being they can't really be, except with quite expensive glazing units, they can't really be sliding sash units they've got to be... these ones, for example, are more like a European style window so the top frame is fixed and the bottom pane opens on a tilt or turn mechanism so you can open it like a door or tilt it inwards. So they're not actually sash windows. Part of the reason for that is that if you have a sliding sash, they become much heavier with triple glazed units in them so your sash weights need to be bigger and you need bigger sash boxes and it all becomes really quite complicated. Plus, if you have a sliding sash window, it's very difficult to create a good seal to make the window airtight. So you could have triple glazed panes of glass but lots of heat loss through uncontrolled ventilation around the windows so you slightly undermine the purpose of having triple glazed windows in the first place. That's part of the reason why windows being as popular as they are. One of the things about triple glazed windows that people don't realise and perhaps anyone listening to this will hear from the

quietness in the background is that they are very good sound insulation. There's really very little noise in the house. It's much more peaceful than a typical house and that again adds to the sense of stillness when you live here, which is great from a kind of Zen point of view.

Ben: I'm just having a listen to that. Yes, you're right.

Tom: So, sorry you asked about...

Ben: We covered the windows. We mentioned insulation. What about ventilation system? I can't even see a vent or is that a vent up there?

Tom: Look there on the floor.

Ben: Ah, underneath. I wasn't going to look there.

Tom: So there's vents either in the floor or the ceiling. It depends on how the ductwork is running. So the house is more or less airtight, which means that if you pressurise... if the house is unpressurised you don't get draughts coming in and out of the house. You test air tightness by pressurising the house using something called a blower door and then you see how quickly the air escapes and where it escapes from and then you try and plug the holes. So, in order for a house to be Passivhaus, it has to have fewer than 0.6 air changes per hour when the inside of the house is pressurised to 50 Pascals. So you couldn't take the house into space but it basically means that we don't lose a lot of heat through draughts coming in and out through windows and floorboards. Of course, you do need to ventilate for a few reasons. One for air quality so you can breathe, good fresh air, and also to control moisture because obviously you don't want lots of moisture building up and mould forming around the house and condensation on the windows and that kind of thing. We have a big couple of fans in the basement. They're actually about 70 watts. One fan sucks air into the house and distributes it into the living area and another fan

sucks air out of the bathrooms and kitchens, and takes it and dumps it outside the house. That means the air is constantly circulating, fresh air is constantly coming into the house replacing the old air and as a result you get a really nice balanced sense of fresh air in the house. It comes through a couple of filters, which take out pollen and dust so the air quality is typically higher than you would experience in a normal house. If you have a look at the surrounds of say a sash window or a window, you'll often see – especially in the city – black markings around it where the air's coming in. That shows the pollution coming in and the air leakage coming into the house so you don't obviously have that here. And every 2½ hours 100% of the air is changed so it's completely fresh and yeah, it works really nicely.

Tom: Does all this make sense financially or is it further down the line that it's going to make a lot more sense financially? Or when is the pay-off?

Ben: The payback, if you were to take your savings versus the capital cost, in this case the payback is in the region of 35 years, straight-line payback on this particular investment. That assumes no capital uplift in the cost of the house. I don't know if we put this house on the market whether it would attract a higher price than a normal price. We don't know the answer to that question. It might well do because obviously the buyer would be saving a lot on their energy bills. Obviously that straight-line payback depends on energy prices, so as energy prices rise that payback gets shorter and shorter and shorter.

People do think a lot about payback in this sense. I would encourage people to realise the comfort and incidental benefits of living in a low energy house other than just the financial side of it. It's not necessarily the only thing to think about. You know, when you install a kitchen you do so because it's going to be nice kitchen and you're going to enjoy living and using the kitchen. Well, when you build a low energy house, it's going to be a nicer house and

you're going to enjoy living in there and I can't remember the last time anyone, other than a property developer, worked out the payback time on a kitchen. So I think it's a bit of a red herring, really, which is unhelpful for the low energy community.

Ben: Also, when you came to get your various permissions for this, was that quite a simple process?

Tom: It's standard planning process. We had to jump through a few hoops because of the windows and because of the solar panels, but the solar panels wouldn't now be a problem because since we built this house there's been what you might call a solar revolution in the UK and planners are much more used to having solar panels in conservation areas. So I don't think that would be nearly as much of an issue as it was for us. The windows were problematic but other than that it was just normal. Most of the work is inside the building so there's not that much to worry about from a planning point of view. The building regs guy, building control was interested in the structural stuff and the ventilation but once we explained how it would work they were pretty relaxed.

Ben: And I know that you did a great video of this whole process as it went on and we're going to link to that in the show notes for this episode, but is it... [Ben laughs.] I don't know how to say this. Is it something that might scare people how much you strip back the building?

Tom: I think it would scare people, yes. Absolutely. I don't think there's any two ways about it but some people will be doing huge works to their properties anyway. You've got to be pretty keen to achieve a property like this if you're going to do just for the sake of doing it. I think the thing to remember is people renovate their houses on a fairly regular basis, when they buy a new house for example, move houses or whatever it might be. So that's the time to do works like this when you're doing works anyway. If you do it on a stand alone basis, then it obviously

becomes more expensive because you're doing all of the works around the energy works and also more disruptive. In terms of stripping a house back to the brick, yeah we didn't plan to do that but as we started exposing more and more of the property we discovered more and more woodworm and more and more wood rot and brickwork that needed redoing, we had to put in some steels to support the central column in the house, stuff that we hadn't anticipated doing. So eventually we ended up taking out a lot more out of the property than we thought we would.

Ben: Is there anything that you would have done differently?

Tom: There's some details, but not really, no. I think we would possibly have given another month's worth of planning. On the flip side we were keen to get on with it and move back into the house. No, I think it was... If you do something differently then you'll have a different problem. So, no, just approach it with an open mind and be prepared for challenges.

Ben: And finally, for anyone listening who owns a period property and is starting to think down these lines, do you have any tips? Maybe three tips of things that might help them.

Tom: Yeah. I think the first tip is to spend more time planning it than you think you need and then add a bit on top of that, because I can't overstate how much easier it is to do a building like this when it's properly thought through and properly designed.

The second thing is to have a really good team. Make sure all of your team from the designer, the architect, the structural engineer, energy engineer, the builder, they really understand what you're trying to achieve and buy into it so they're not just doing a job but they share your objective, particularly the builder. Make sure that goes right through the building team.

Thirdly, just like in any building project, make sure you've got enough money to finish because it is quite radical to do something of this scale and the last thing you want is to be caught halfway through and unable to finish in a completely gutted house.

Ben: Tom, thank you very much.

Tom: Thank you.