HOUSE PLANNING HELP

Episode 82

Do I Need Solar Photovoltaic (PV)?

The show notes: www.houseplanninghelp.com/82

Intro: We're speaking to David Winterton today from Sydney-based Ecological Design. They are a consultancy firm and they do a lot of great work. But when I got talking to David I learnt some really interesting things about solar PV and that's why I thought he'd be the perfect person to teach us some basics. The other aspect is Australia is all about the sun!

I started by asking David how he developed an interest in sustainability.

David: I have travelled a lot around the world and in reflection there's this deeper sense of connection and I think that sustainability offers that. I've seen some incredible indigenous communities that have worked within their natural environments to create really beautiful places to live. At the end of the day I also want to live in these bustling, culturally inviting, invigorating cities. It's about better places to live so I guess that's a driving force for me. And it's also the association, the friendship, and the communities that you actually develop in working in this field that has always restored my faith I guess in humanity! [David laughs.]

Ben: Well that's a good start! We're going to be talking solar today, so let's start with just the very simple stuff. For example what is . . . Is it solar power? What definition are we defining? I don't even know that question!

David: Well I guess today we're going to very much focus on solar PV. We'll talk more about grid connect. In Australia we've got around about a million people living off-grid, which is interesting. That's something which in many ways Australia has pioneered and we're certainly seeing that in other places around the world and that's coming through in other kind of building classifications or building, I guess you could say trends, construction trends around the world.

Ben: Is that because of the geography here?

David: Absolutely. We've got a unique situation in Australia. You know we've got double the solar resource of say Germany, in general, but then when you actually look at areas to the north of Australia you've got areas that have you know equivalent solar resources to the Sahara Desert. So we've got incredible solar resources in Australia.

On the other side of that we've got electricity prices that can be 2 or 3 times what they are in the USA, so we've got this massive grid that has also been over-invested in, where we've looked at much higher electricity prices for consumers.

Ben: What is the driver to going for solar energy in the first place?

David: I think we've moved into the second section of the market now. We've got around about 1.3 million homes in Australia with solar PV. There would be many more with solar hot water, so when you're looking at states, a place like South Australia where in a lot of suburbs you've got over 20% of that community with solar PV, there's been a range of drivers. At the moment I'd say it's mostly economically driven. And I also refer, there's a study in the States which I think is interesting. They've found the driver for people getting solar was the fact that someone else had solar nearby.

Ben: [Ben laughs.] That's brilliant!

David: So very simply you know, if Bill's got one I'm going to go and talk to him about it and that breaks down the barriers. I guess when I say it's more economically driven, previously people bought solar PV systems because the early adopters, a lot of those people wanted to do that in a way they were doing a good thing. They were shifting the way that they were consuming resources.

Now what we have seen is in fact the size of solar PV systems, which used to be the average was around about 1.5, this is going back about 5 years ago, to today where it's about 2 to 3 times that. Partly that's been decreasing PV panel prices as well and also the way they're being sold. So there's been a shift in the size of those systems and you can say that's certainly an economic driver today. And again with electricity prices we've seen those go up in areas by more than 50% in a lot of areas across Australia in the last 3 years.

Ben: We always like the starting point to be about minimising everything so that you don't need much energy in the first place, but we're assuming you've got to that point at the moment. Can I just get a clarification? If I'm saying solar panels is that right? Why are you saying solar PV?

David: Okay. Solar PV. When people hear solar panel they might think oh that's a solar panel for hot water because it's a panel. You'll have a flat panel for hot water systems. Solar PV is simply photovoltaic. So it's a way of understanding that's what PV is. Sorry to slip into that lingo but that's a quick differentiation between those things. And just, it can get a little confusing.

There are panels that do incorporate both of those things, and there's also solar PV that also will incorporate . . . In Australia there's a product that's being developed at the moment that is actually a roofing material that will also provide for a degree of air heating and cooling by actually having a profile that will allow air to move underneath the panels. Even more confusing there's now solar PV that's built into solar air-conditioners. [David laughs.]

Ben: Okay, let's not even go there! A nice, not really simple question, but just how does it work? We're using the sun, we know that, but what happens next? How do we turn this into energy?

David: The fundamental thing to understand about solar PV is it's actually static. You know you put it on the roof and it doesn't move. You can have tracking systems but the very notion is that everything else that generates electricity is something that spins around. So that doesn't matter if it's a wind turbine, a coal fired power station, a nuclear power station, hydro, all of these things are about spinning things around.

With PV what you've got is you've got the sun coming in and it's actually creating an electrical current in between the different wafers of silicone. And from there there's a DC output that's actually coming out of those panels and then that's converted into an AC to be provided, and that's through the different types of inverters and also in the way your panels are strung together. So yeah, I guess that's the fundamental thing to understand about PV is it doesn't move. It's a solid state form of electrical generation.

Ben: And you've made it sound, actually, simple which I like. But are we talking about these materials being quite difficult to get hold of and assemble or is this why the prices have just gone right down for solar PV?

David: Look, with the massive investment in what we've seen in China, in materials, particularly in what they bought out of Germany and now they're producing . . . I think China installed roughly 400 times the amount of solar that Australia did last year. 5 or 6 times the amount

that Germany did, just to give you a sense of what those figures are.

You've got two things going on in solar. You've had some of these disruptive changes in technology but what you've also seen is incremental shifts in the way that the silicone is being produced there's been ongoing efficiencies.

So first of all you've bought the plant and equipment, maybe that was bought five years ago. Now that it's paid for itself and at the same time there's improvements in manufacturing processes, means that solar is pretty much on a downward price curve. There's a price curve for solar that's been running for over 30 years now. It's almost contrary to every other market that's out there, that we actually know that we're going to see a reduction in price.

Now it's really important to say in Australia that reduction in price is on panels. It's not on labour. There's components of the installation of the system that will increase over time, but solar PV in itself, so we talk about it as dollars per watt. Previously, you know if we're looking back say five, six years ago you had systems going in with the PV price that would have been more like $6-8 per watt. There was actually a rebate scheme in Australia that made those things cheaper. But today what we've got is we've got prices that are down between $1 and $2 a watt, up to about $3 a watt but that's for the Rolls Royce of solar panel.

So we've got this range of round about $1-$3 a watt. If you look at a pioneer in our field, who actually lives about a kilometre away from where we're sitting here, Michael Mobbs, when he put his panels in they were like $10-$12 a watt from memory. So we're talking about an order of magnitude of 10 times reduction in price. There's no sense that silicone is going to run out or aluminium is going to run out. They're not dependent on any particular rare earth mineral.

And there's also the capacity in Europe to recycle these systems. They've got a long life, things are guaranteed. Generally now the best, the leading warranties are for 25 years at 80% production, so most other companies are at least matching that with 10 or 15 year warranties. So these things are going to be in our building fabric, in our communities for a very long time, so making an investment in the stuff, you do want to get it right.

Ben: What wears out? You've mentioned there are very few moving parts, but what is it that goes then?

David: The thing that tends to go are the inverters. What we've seen, and we'll see this increasingly in the next couple of years, is the quality of panels and the quality of inverters coming into Australia. A lot of people bought on price and simply buying on price is not something that either the ATA or Ecological Design would recommend. There's certainly been problems in inverters. Some of those have been Chinese made. It's just been the lack of quality rather than where they were actually produced which is the issue. So inverters, you might be looking at things with 10 year lives, and certainly we've seen inverters fail in less than 5 years.

Ben: What is an inverter?

David: Ah, so the inverter is the box that sits on the wall. And this is what they were before. Before they were a box that sat on the wall. They would take that DC that was coming out of the panels and they would turn it into AC. They were before your metre box so any energy that you used in the house you would be drawing out from the inverter. Any extra energy that you didn't need in the house would then go out into the grid.

Now before that was pretty much a static box. It sat there, there'd be an LCD screen, you could go out and you could have a look how much have I generated today and what am I doing.

Now what we're seeing is a lot more social integration in the way that those things operate. For instance, now a lot of them will run off a screen, an in-home monitor. Some of those can be hooked up simply to say a tablet, say a simple Galaxy tablet, and that will give you a lot more information. This means if you know how much energy you're using you can choose to use energy or not to use energy during those times.

I was at a conference last year and SMA talked about the fact that they might look at some Facebook integration. It's kind of like *look at how much energy I'm producing, I've got this much!* So you can see this shift in perception. Solar PV has come from engineers. It's not like you go into an Apple store and buy your system. It's put up on the roof, the box goes on the wall and what we're looking at now as we shift in the type of market, where we're moving into a market where people want to know more and want to be able to optimise their systems and so that you can get more value. And that design side of PV hopefully we'll see more, more integrated design to actually get better outcomes for people.

Simply buying on price, people have bought on price or just bought on size before, yeah, you wouldn't do that with a car so I don't see why you would do that with a PV system. And it's going to last a lot longer than a car! [David laughs.] So you might want to get it right!

Ben: Let's talk about the relationship with the sun, because that's our key source of energy. So it's never going to be 100% pointing at the sun. Does it need to be? How does that drop off or change?

David: It's interesting, and it brings up some of those questions around the level of efficiency of panels. Like where I live where we're sitting today, I have got about 8m² of available roof space that has about 80% efficiency. Like it's shaded 20% of the time. Now that was impossible, or it was financially it wasn't a good idea to put solar PV on there 5 years ago. Whereas now the energy density of the panels means that you can get a lot more power into a smaller panel, makes it possible for me to fit 1.5kw into that 8m².

So one thing is just the energy density of the panels and the actual roof space that you have. So in any house you want to create north facing and west facing, or north-west facing or north-east facing, this is in Australia's example, roof spaces where you can actually get a yield.

Now interestingly our yields previously have been based on just getting the highest yield out of these systems. And in fact what we want to do is look at our energy consumption and match that yield. So what you can do is alter how the panels are on the roof space, so you might actually look at west facing panels and people go *why would I put a panel on to the west?* Well if you're actually facing straight west that's only a 12% reduction from north. So in Australia our relationship to this, and this will change to some degree with latitude and obviously depending the further north you are and the closer to the equator.

All of this comes back to understanding your latitude and understanding you know what your relative tilt angles should be. This stuff is all very well known. Every, you know every, any Google search will bring it up for your area.

The important thing is there has been this focus on just getting as much solar production as possible, whereas in fact in Australia you might find okay we wake up at 7am, we come home at 5pm at night, well actually having an east-west array where I've got two strings of panels. So you need a more complex inverter, so it needs to have the ability to actually deal with two inputs to come into it,

will actually deal with this so you get a peak in production, probably about 10am and 4pm which is a little bit different to if you had panels facing north, where what you would get every day is you get a peak production right during the middle of the day. And if you're not there during the middle of the day then that doesn't actually match your energy requirements.

In Australia we're paid very little for exporting electricity so we're paid, if you're lucky, about one fifth of what we would get by replacing our energy use. So you want to look at your local regulations, understand where the potential is. Is the potential feeding into the grid? Is the potential in replacing your own energy usage and what's the sort of principle in between?

You talked about the fact that the sun doesn't shine all the time and this move towards off-grid, you know I think it's the Pareto principle, the 80/20. For the amount of work to get 80% of production, to try and get that extra 20% out of solar can sometimes cost at least 100% more. So it's really worth considering, even if that means scaling up to a battery system.

In Australia we have 'time of use' metering and what that can mean is during the energy usage peak at night, our energy prices can go up, and this I think will shock some people overseas, will go up over 45 cents a kilowatt-hour (kWh) at the time when you're cooking at home. So if you put in a small energy storage system to get you through this peak, so that might only be 3 - 5 kWh, then you don't depend on using the very expensive energy during this short period of time.

So it's very much that design and being able to get those things to work in harmony and also to look at what's going to happen in the future. I think Australia has some really good lessons for the rest of the world. We've had a pushback against feed-in tariffs. If you're not in an area with solar friendly regulation or solar friendly retailers I can honestly say in the experience of Australia I'd imagine that would happen.

Australia is very interesting in its amount of energy resources and it's no secret to say that the three areas in Australia that have the most progressive energy supply have the lowest amount of coal being mined out of the ground! [David laughs.] So you know we look at Tasmania, fantastic hydro resources, fantastic wind resources, that island we've seen a company that 40 years ago kick-started the environmental movement today by flooding lakes

which you know none of us even feel great about today, is actually a really progressive energy company.

In South Australia we've had days recently where in fact they've generated their daytime energy supply purely through wind and solar, which is amazing. They're up above 30% of their energy supply is in renewables. That gives you a sense of what Australia is capable of. If you compare that to New South Wales we're down below 10%. So they're quite different and so state, federal and local regulations will obviously have an impact on what kind of work that you do. But to a degree in Australia you can follow the money to understand what's happening in our networks.

Ben: You mentioned storage a few moments ago and I think I've heard this in the past, that actually batteries are an issue. So is that why you were saying just a small amount of storage and are we talking batteries?

David: Yes, certainly batteries. Batteries really is the only way to go at a household level. There's a few, yeah, there's other things you could potentially do. I mean storing energy as heat is another way because any extra energy that you produce you could dump into a hot water system. That's not as important in Australia as in colder climates. The energy systems that we're seeing in Australia are, when it comes to battery storage, up above $1000 a kWh so that's expensive.

Ben: Can you give us just an idea of, you talked about kilowatt-hours (kWh) a couple of times, how many kilowatt-hours are we likely to be using in electrical energy?

David: They talk about the average house in Australia using 20 kWh a day. The average house is pretty meaningless. The house that we're sitting in today that runs a heat pump, we're running on somewhere between 6-8 kWh a day. That's with between 2 and 3 people living in it. You would expect an efficient, well designed, but not overly scrupulous household, you know like when they're not overly absolutely focussed on these things, to be in the region of 10 kWh a day.

So that average is skewed by these much higher energy users and obviously solar hot water in Australia or using a heat pump can make a massive difference in that when 40% of your energy requirements might be coming solely through hot water. So when I talk about a 1 kWh battery system, 1 kWh is going to run your average you know, an efficient fridge pretty much for a day. Not on

a 40 degree day in Australia, it'll be struggling a little bit! [David laughs.] Probably give you like 12 hours, perhaps 12-18 hours!

So these smaller battery systems and that capacity for these things to be modular and that's what we're seeing to a degree in the solar PV market. Now interestingly in New South Wales where we are, we've had a feed-in tariff of 60 cents a kWh. Some of the people I know, my neighbours two doors up, they've been getting 66 cents a kWh. Now in the next 18 months we'll actually see them fall off that contract. So they've been on these contracts for six years. They haven't had to deal with paying the increased cost of electricity, partly due to a very small proportion of that, you know when you're sort of 2-5% range has been due to these schemes. It has been part of it you can't ignore that but they've been insulated against these rises in pricing. Suddenly we're going to have tens of thousands of people in Australia with solar PV in their roofs that have gone from maybe not even having a bill to having bills that are hundreds of dollars. So there's going to be a really interesting shift.

If you look at the solar market in Australia, ten years ago we had in the hundreds, I think it is, it might have been a thousand solar PV systems in residences. If you look at it today we've got over a million. To think of a similar trajectory that might be possible with battery storage and I'll just refer to that Pareto principle, I don't think people, I don't see the reason to go completely off-grid. I see a reason to really reduce your reliance on the grid and that reliance on the grid could actually mean that you would even get smaller voltages supplied to your house and you can buffer that through your batteries and your inverter and your charge controller to do those kinds of things.

There's definitely some interesting things, hopefully more innovative. I'm trying to think of the right word for what we call our gentailers (generator-retailers), will actually take on, our electricity generators and retailers. It's not because they're gentlemanly at all!

Ben: I'm running out of time here. There are lots of other avenues that I could explore but let's just do a couple of simple ones. For example, are there any pitfalls? Are there any ways we can be scammed, this can go wrong, how do we make sure that when we're doing this it's all going to go well?

David: Certainly in Australia with the Clean Energy Council and the regulation around that, you would have to make a lot of bad decisions now. People have been scammed. It's the low quality that you've really got to look out for.

And there's future proofing. We talked about battery storage, now if you can't actually Google the inverter that you're getting and look at its capacity to feed into some kind of battery storage or into a charge controller to provide a battery storage option, I wouldn't even consider it as a product today. I'd simply just scrub that off the list. It's not worth doing.

Understanding your shading, absolutely shading can be an issue if you've got any shading with a drop in voltage that can affect the production of all of your panels. PV is quite different to solar hot water. If you've got 10% shading on a solar hot water panel you've got 10% less heat. Now that's not what happens to PV. What will happen along all of your panels is one panel gets shaded, is you'll see a drop in voltage because it will actually revert to the lowest voltage. Shading is really important. Understanding how your panels will be affected by shading. Micro-inverters are a way to actually get around that and the design of that system to work in with what your local regulations are so that you get the most out of it. Just because a system is 3kW or 4kW it might be much better to have a smaller system that's designed with different orientation that meets your energy needs so you might be able to design it in such a way that you actually get a lot more bang for your buck.

And the other thing is energy efficiency. There's always energy efficiency to be found in a house at some level. And focussing on that first, the great thing is . . . It's funny I've thought that you should go energy efficiency, energy efficiency, energy efficiency, solar. And I've sort of explained solar as being the icing on the cake and some people put solar on a house without even considering there was cake in the first place! [David and Ben laugh.] So it can make it more difficult.

The thing is through having solar you will then have generally more access to that information. So that compatibility to have an in-home monitor, that compatibility to store energy into the future, that compatibility to think about how you might charge an electric car. Start asking some of those questions about where you're going to be living in five years time.

Stay away from things that say you can actually upgrade an inverter. There's people that have said: "I'll get a 3kW inverter and that can be upgraded to 5kW in the future." That's not how inverters work! [David laughs.] Stay away from those people and really read through it!

There is absolutely no reason why any solar installer can't give you a production graph of how much energy you will produce. All of the information is available through software packages and will give you some really detailed information that you can then overlay with your energy consumption.

So that gives you a really good match to think about where you're going. And it also means that you might take some of your other energy needs, so that could be producing hot water, running a dishwasher, running a washing machine and actually doing them during those times.

So yeah, think holistically around those things, talk to your neighbours! [David laughs.] It's always a great thing to do, particularly neighbours with solar PV and get a sense of how that can also work within your community because what we're looking at with solar is actually a real shift in the way that we're thinking about the way that we use energy.

Ben: Finally, is there anything that we've missed out? I know there will be loads more intricacies but just any key things or have we fairly much given a good overview?

David: I think we could chat for a while! [David laughs.] In the next two years we're seeing a shift in energy markets at the moment. The declining oil prices around the world and some of the other energy geo-politics that are going on are massive. I think that stuff can be a little overwhelming.

There's a place within energy markets I think for community energy to really play a strong part and I guess that's what I was reflecting on at the end of that last question. So even if you mightn't be able to put solar PV on your home, actually understanding community energy initiatives in your area and the future that that will mean for your communities is so important because we've been done over. In New South Wales the decisions that have been made on our energy system have not been in the interests of the community and it would be very hard for any politician to say that they've done the right thing. So it's really important to understand the governance and the capacity for changing those things to actually get those things to work. So yeah, involve yourself. At the end of the day these are political decisions that we're making and I think in many ways they're really good politics. Understand your product, understand where it's coming from, and the sun is always going to shine! [David laughs.]

Ben: For a few million years or whatever! David, thank you very much.

David: Let's hope a few billion! Thank you! [David laughs.]