

An interview with: Professor Geoff Smith

By Stephen McGrail

Professor Geoff Smith is Emeritus Professor in Applied Physics at the University of Technology Sydney (UTS). His work over the past four decades has spanned solar energy, material science and new materials technologies (e.g. new advanced solar control windows), and, over the past decade or so, green nanotechnology (e.g. the optical physics of nanoscale structures and their potential applications in improving energy efficiency). Professor Smith also works on the Urban Micro Climates research project as part of the CRC for Low Carbon Living, which “aims to identify cost-effective strategies for mitigation of urban heat islands in Australian cities, initially focusing on Adelaide, Sydney and Melbourne”.

It's now 2040 and we're living in a radically low carbon and resilient city in Australia. What does it look and feel like?

Geoff Smith (GS): What we're aiming for is that the feel will be somewhat cooler despite global warming. Assuming the average temperature goes up a bit and nighttimes are somewhat warmer we have reengineered things to manage that a lot better. The way we build our buildings and roofs and parks and gardens and all that stuff, will to some extent not be that different but there will be important differences based on technology, materials technology, aesthetics and thermal performance. If things go the way we planned, it will be a much more pleasant place to live than what we have now but we have made some radical changes. There will still be a need for air conditioning, but it will be very efficient if we can get the environment, the outer skins of buildings and particularly the roofs and surrounds properly laid out. Urban planning has a big role to play, but some of the layouts are kind of locked-in place already. The year 2040 is not that far away in the sense of you can't go tearing down cities they're locked in place. They expand on the periphery and restructure a bit in the interior, but people certainly aren't in a hurry to pull down the larger scale structures in 20 years. A lot of the buildings are still going to be there so you have to look at retrofitting significantly.



Photo by Joanne Saad

If you imagine you're flying over the city, e.g. over Sydney, you've got the view from above, how would the view of the city changed? What would it ideally now look like?

GS: There'll be much more solar energy coming back, i.e. reflected upwards. If you look down on the city you see three major projections: roofs, and to some extent facades; the green stuff, the trees, gardens, parks, grass and so on; and you see roads and pavement. Hopefully roofs will all have “cool roofs” by then, which stops heat getting in the building by reflecting more sun and also has feedback effects like reducing air conditioning load and making ventilated air a lot cooler. But whether the look will be that much different is the interesting one, because some technologies enable us to retain colours and other features and still get a lot better albedo. I expect there'll be a proliferation of whiter roofs, those technologies will become essential. If you have highly solar reflective roofs with high emittance, that's the initial cool roof, not the one's I'm now working on, plus a few trees and grass, the air and the general feel in that area will be more comfortable, and air conditioning loads will go down much more than people expect. If the thermal comfort inside is not better, air conditioners pump out heat and heat the air and it cycles back. By then we've hopefully also moved away from black bitumen. But it just depends on the global warming and the urban heat effect, how

bad it gets, and how much we can modify it in time. That's a big effort, because we're talking about a lot of projection, cities cover a lot of area.

Is there anything else that strikes you as being different about the city now versus cities in 2015?

GS: The way we move around will have changed, I don't know whether it's going to be EVs or hybrids more and so on, or smaller cars and maybe special “banks” of cars. If it's hot then cars themselves have to stay cooler by being lighter, solar reflective colours maybe, with a solar panel to drive the electronic wizardry. There will be other radical changes too. Technology will play a role, with the ability to control things like shading and blinds, a lot of our work is on complex glazing now, the whole facade.

So there'll be much more advanced building systems?

GS: Yes, and part of that is how we do ventilation. A key weakness of Australian buildings, in particular homes, is air tightness and control of air flow. There are times in Australian homes because of where they're located that you want them to ventilate strongly, other times you want to ventilate a bit and other times you want to seal them up. In the wintertime, we're worse. The cold side of the equation is important for energy use, because we use more energy in Australia in wintertime than in summer – the peak loads are in summer now, but total energy use is greater in winter. A key reason is that most of our buildings, especially older ones, leak like a sieve – the air exchange rates are too high.

Were you also suggesting earlier that in 2040, in a city like Sydney, energy use for example for cooling could actually come down significantly, even though the climate is warmer?

GS: Oh yes, even despite global warming, if we set about these things the right way and we have correct planning requirements and other things both indoors and the outdoors can be far more comfortable and with less energy use. I don't like to use this jargon, but it's win-win-win.

What changes are required to achieve that?

GS: The right roofs, right facades, better design of our roads. Shading plays a role too. The reason I like high albedo surfaces – and they've got to be aesthetically pleasing as well and low

glare – is because it pumps heat straight back into space, it never heats anything. The ultra cool roofs I'm working on do that in the extreme, and any heat that comes from anywhere else they also pump out. The albedo is close to 100 per cent, which is possible through the design of the materials.

Let's pretend that all the desired potential changes you've just outlined have happened: How do you think we might have got to such a future?

GS: Well, we upped the albedo of all the surfaces that face upwards – traditional roofs get 50, 60, 70 degrees above ambient in the day, and consequently the air around about gets warmer too and just like the air above black roads – and added greenery. Some roofs will look the same, because you can have coloured cool roofs that are higher albedo, but the best will be white. Especially with residential, we also looked at the total heat storage load we're imposing because, for example, if you have lighter materials and moderately good cooling capability for radiation you can dump heat far more quickly.

What also has to occur between 2015 and 2040 in order to enable these changes?

GS: There's a whole hierarchy of things, starting with research and development, fundamental science and materials and optics and solar technology. We've got a role to play here but it's an international effort. We need companies to be tuned in to what's going on. We have to educate professionals – there's still a lack of understanding about the best way to go. We need stronger building codes. Local councils have to play a better role. With all these things there are political problems because you don't want less regulation. However, I think the biggest motivations are financial and quality of life for people if they experience the benefits. It's happening in the big buildings space; greener buildings are making a premium. We've got a long way to go on the home front. The big building companies have to play their role in that as well, because there's a bit of "stick" but I think we need more "carrot".

So a mixture of demand-driven change, such as due to these quality of life benefits, and stronger roles for urban planning and regulations drive the change?

GS: Yes, building codes at the top level, and then councils – councils have two major roles, maybe several. One is planning requirements, which is partly state, partly local. Two is the checking on this – someone has to audit that the codes are

met. Then there is energy efficiency, like the scheme that ACT has. Should a house have an energy rating when it's sold? Just like pest inspections, it should become de rigeur. Councils have another role to play outside, the pavements, the roads and the amount of tree planting, parks, and maintenance of such things. Urban planning issues, layouts of new suburbs, all that sort of stuff has to better take account of these issues. Personally I'd like to ban all black pavements and black roof tiles – unless they're coated with infrared reflectors – and grey for that matter, it's become a fad! It's stupid, the air conditioning load in those homes goes through the roof, unless they fill the roof cavity with insulation. There's all sorts of things that can be done, and we just have to help people to gradually get used to it – they worry things will look different, but so what? If life's better, who cares? It's a case of getting used to different things. One of the biggest problems is just peoples' natural conservatism and not only the public, bureaucrats too, everyone's innately conservative. They like what they're familiar with and business of course more so, building product makers and so on.

Do any other key barriers need to be overcome?

GS: Just the availability of products and awareness. I don't think people are aware of what can be achieved. How can you make them aware? The other barriers are the incentives. There are issues of software and things like that – some has its problems, but they are available to the average person, or to councils. It's also not just about this piece of technology or that building, it's about the whole package including urban layout. So a challenge is that you've now got to think of the whole system, the layout of buildings, multiple buildings, what goes between them and on top, roof albedo. In other words, you need an accounting procedure, which says if we do this, everyone benefits in a precinct. I'm not sure what the barrier is, it's just how do you get change to happen, which comes back to consumers.

Just quickly the final aspect we haven't talked about, that you might like to comment on, is the energy production side, or do you want to leave that?

GS: I do have some issues with some of the so-called renewable or green technologies if they get to dominate. In the city context they can be done to a certain limit but for instance absorption cycle chillers generate a lot of heat. Many people think it's marvellous if we have tri gen systems sitting in the

city buildings, with mini building power stations and so on. A little bit of that's okay, but if the whole city became full of these mini power stations... there's some down here in Sydney, they just pump out the heat – their waste heat goes out in Darling Harbour or the air or somewhere outside. Well one or two of those is okay, but if everyone started doing it, there will be environmental impacts and humidity impacts. That's the other thing – they generate a lot of moisture. Solar is a different matter, we're not talking about solar. But a lot of the small gas power is currently coming in the big buildings.

All right, thank you Geoff, that's probably a good place to leave it.

