**Regular viewers of the channel will know that I’m a bit of a fan of a concept known as ‘lateral thinking’, having spent many a Saturday morning as a kid in the early eighties watching grainy programmes on TV presented by a guy called Edward de Bono, who went on to write best-selling books on the subject.**

**I mention this because every now and then during the course of my research work, I come across a concept that exemplifies the principles that Mr de Bono espoused, and the technology I’m focussing on today is a perfect example. To the casual observer it may look like nothing more than an interesting metallic structure on top of a tall building. But to Ibis Power, who are the company that installed it, it’s a fully integrated multi-faceted system called Powernest, that provides several complimentary services and benefits to the building below, all of which can vastly reduce energy costs and potentially act as a hub for a localised community electricity grid network.**

**So, I thought I’d better get in touch with Ibis Power to find out a bit more about how their installation works and why it could play a vital role in the green energy transition.**

**Hello, and welcome to Just Have a Think**

**Finding ways to harness the power of wind from the top of tall buildings is a challenge that appears to be engaging the minds of developers all over the world at the moment. You may, for example, have seen the recent video I made about a US company called Aeromine, who are testing a prototype wind generation unit on the roof of a building in Detroit, Michigan.**

**To find out what makes this new Powernest concept stand out from the crowd, I caught up with its inventor via Zoom recently.**

**He’s called Dr Alexander Suma, and unlike many other designers, he didn’t start out by thinking ‘how can I make a wind turbine work on top of a tall roof? He engaged a much more lateral thought process, along the lines of ‘how can I squeeze every ounce of available resource from an otherwise virtually unused flat surface at high level?”**

**Back in twenty-o-nine, while training to become an architect and civil engineer, Alexander was sitting in a classroom learning about sustainable construction, and like all good creative people, he was doodling in his notebook while he was listening to the speaker. By the end of the lecture, he’d sketched out a blueprint for an integrated rooftop wind and solar installation that, in his mind, would also need to be beautiful and architecturally sympathetic. So that’s all fine and lovely and everything, but it also has to work in the real world, doesn’t it? And that’s where a lot of conceptual ideas like this tend to fall by the wayside. But when Alexander started looking into the concept in more detail, he found that wind has a very high energy density and tends to flow faster the higher you go. He also learnt that allowing air to flow rapidly beneath an installation of solar panels has a significant beneficial impact on their performance. Both those physical attributes play a pivotal role in the design of the Powernest system. But the lateral thinking doesn’t stop there, as we’ll see a bit later in the video.**

**Dr Suma founded Ibis Power back in 2012 to develop the Powernest concept to full commercialisation, and by 2016, with the help of a one point seven million Euro grant from the European Commission, the company had a full-scale prototype that could be used for testing and validation. That’s really a key milestone in the journey of any new startup because it allows potential investors to properly scrutinise the proposition to see if it can generate a decent return on their money.**

**A year later Ibis received some seed investment and won permission to install the prototype unit on top of a ten-storey residential building in the Dutch city of Utrecht, resulting in some glowing testimonials from the people who lived in the block below. There were no vibrations and no noise coming from the installation, and of course the energy bills of the residents were significantly reduced. So, you know, everyone’s a winner!**

**But that was just a single unit. Alexander’s vision of a crowning architectural structure, blending seamlessly into a building, would take a few more years to come into being.**

**The first full roof installation, with three turbines and 144 solar panels, was successfully installed in 2021 as a fully integrated component of a new apartment block construction in Rotterdam.**

**Then, just one year later, the second project, twice the size of the first, came into being on the red building that we saw at the start of the video. This one’s located in Eindhoven, and it consists of four wind turbines and 296 solar panels.**

**One of the key insights that Alexander’s architectural training revealed was the fact that most tall modern buildings, at least here in Europe anyway, have common dimensions for their main structure - typically either 5.4 or 7.2 metres. So, each Powernest module is fabricated to be exactly 7.2 metres in length and width.**

**And as any fan of dear old Henry Ford will tell you, standardisation allows for mass production, which drives economy of scale and keeps the price for the end user to a minimum. There will of course be some variations on building dimensions from time to time, so the company also produces a range of simple steel fillets that take up any gaps and maintain the architectural integrity of any new installation.**

**The second key insight is the fact that most tall buildings also have the same lining in their façade, which means Ibis can use their standardised modules to facilitate extremely fast and safe attachment to the rooftop.**

**So, now we’re getting to the business end of the project, and we can consider those other lateral thinking innovations that I mentioned earlier.**

**The first and perhaps most obvious step in designing any new installation is to assess which direction the main wind flow comes from and orientate your turbine modules to get the maximum benefit from that air flow. But, perhaps counterintuitively, in the Powernest design that does NOT mean placing the turbines on the edge of the roof that is the closest to that air flow.**

**To understand that slightly confusing logic, let’s just have a quick look at how air flows around a tall structure, using a computer-generated model based on the 70-metre-tall Eindhoven building.**

**Urban environments like this have lower wind speeds and a lot of turbulence. Air is forced upwards as it hits a tall building and then it tries to come into balance with the high-level prevailing wind up here, at what’s known as the shear line. As a result, you get one big mess of turbulent wind flow directly above the roof.**

**Meanwhile, down here at street level there are high pressure zones in front and low pressure zones behind the building causing wind nuisance to pedestrians. It’s the reason why you sometimes get a very unwelcome blast of wind in your face when you walk around the corner in a city environment.**

**The Powernest system has very carefully designed louvres at three different heights, each of which is shaped to direct the wind towards low pressure zones that accelerate the air flow across the roof of the building, effectively sucking air towards the exit side.**

**And here’s how that design changes the air flow in the computer-generated fluid dynamics model. It’s quite a dramatic difference, isn’t it?**

**Not only is there a huge reduction in the turbulent air above the building, but the wind nuisance at the base of the building is also significantly reduced. And if we zoom in on the roof itself, you can see that the air flow velocity is indeed increased as it moves across the Powernest structure. And that’s why the turbines are placed a certain distance from the roof edge, where the air is flowing at its fastest speed. Each turbine drives an electrical generator with a maximum capacity of 3kW, which it reaches at a wind speed of 12 metres per second. The acceleration effect that we’ve just looked at means it's quite common for the installation to achieve wind speeds of around 11 or 12 metres per second, which translates into an operational generation capacity of two pint five to three kilowatts per unit, although wind flows are not steady most of the time so there will be variation there.**

**The second innovation is to mount the solar panels at the top of the structure, some 4.8 metres above the roof, and to give that structure an overhang of one metre out from the roof edge on all four sides. The weight of the whole installation equates to between a hundred and twenty and a hundred and forty and 140 kilograms per square metre, which is the equivalent of having twelve to fourteen centimetres of water on a roof and well within acceptable operational parameters.**

**The benefits of configuring the system in this way are threefold. Firstly, it leaves the roof surface empty so that any essential equipment can be housed there as normal. Secondly, the overhang means the Powernest system can effectively utilise more than 100% of the surface area of the roof it sits on, and thirdly it means that the carefully directed air flow across the roof can continuously cool the underside of the solar panels.**

**As we’ve discovered in previous videos on this channel, solar PV doesn’t work so well when it gets hot, which is ironic, given that it derives all of its power from direct sunlight. By drawing that excess heat away from the underside, the Powernest structure squeezes between 10 and 15% more power out of each panel. Which is a significant improvement.**

**The next piece of smart thinking is to use bifacial solar panels and to make all the internal cladding white, to maximise light reflections onto the bottom surface of each panel. Believe it or not, that single simple step of logic results in another 20 to 30% efficiency in solar power generation.**

**And as a final sort of ‘cherry on the icing on the cake’, so to speak, all future Powernest systems will include a specially strengthened structural rail integrated into the roof edge of the overhanging louvre frame, supported by the triangular structure beneath it. The rail will house the cabling for the building’s façade maintenance cradle. That allows full access for cleaning every window on every side of the building. And, when it’s not in use, the cradle will park itself neatly up on the rooftop underneath the Powernest. It’s yet another piece of lateral thinking by the system’s designer that will do away with the need for a roof mounted crane. And in the space where that crane would normally sit, there’ll be enough room for an extra 48 solar PV panels.**

**According to Dr Suma, when you put all those innovations together you end up with a system that achieves double the power generation of an equivalent PV installation mounted on a similar raised structure and between 6 and 10 times more than a system of panels mounted directly to the roof surface. And in terms of levelised cost of electricity, which I know you folks are always keen to hear about, the Powernest system comes out at between 8 and 12 cents per kilowatt hour, depending on the location, based on a 25-year operating lifetime.**

**A key goal for Ibis Power in the medium term is to include a battery energy storage system underneath future Powernest installations so that they can be seamlessly integrated into the community power generation projects that’ll be popping up in urban environments all over the world as part of our rapid transition away from centralised, fossil fuel driven energy providers, and towards a more distributed smart grid model. The Eindhoven installation, for example, provides 85% of that tower’s electricity, and Alexander Suma believes very strongly that the residents should be allowed to become the owners of their own energy facility.**

**Legislation didn’t allow that on this project but that will certainly change over time.**

**Ibis are now discussing projects from as far south as Portugal and Spain all the way up to the countries of Scandinavia. And of course, there are high-rise buildings in sunny and windy locations over in North America and all across the globe.**

**So, the future looks extremely bright and extremely busy for this ambitious startup. The next two projects are due for completion in the Netherlands in the first half of 2023, and another three are slated for installation before the end of the year.**

**So, what do you think? Do you like the architectural design of the Powernest system? Could you envisage something like this on a building near you in the coming years? And what do think about these new community energy projects? Are they genuinely the way forward or do you think they may turn out to be an unattainable pipe dream?**

**As always, let me know your thoughts in the comments section below.**

**That’s it for this week though. A huge thank you, as always to the fantastic team of channel supporters over at Patreon who enable me to keep these videos free of ads and sponsorship messages and who also provide an invaluable source of information and feedback to keep me on the straight and narrow. That’s something you can get involved with too for about the price of a coffee each month. As a Patreon supporter you’ll get yourself exclusive early access to every new video that I produce, so that you can point out all my mistakes before I post the final version on YouTube. You’ll also get regular exclusive extra content from me AND you’ll be able to directly influence the video topics we chose via monthly content polls.**

**And of course, if you found this video useful and informative, then you can really help the channel by clicking the ‘subscribe all’ option in YouTube’s drop down menu, so that you get notified whenever a new video comes out.**

**As always, thanks very much for watching, have a great week, and remember to Just Have a Think.**

**See you next week**