

Human or octopus: what's your market preference?

Consider the octopus – although you may never eat those chewy little suckers again.

Only 600 million years or so ago, the story goes, the evolutionary tree branched in two directions. While ours, the vertebrates, developed a single brain and central nervous system, invertebrate mollusks like octopi went in a different direction.

Octopi have two-thirds of their neurons in ladder- or lattice-like formations in their arms rather than in their head. Each tentacle is a bit like a brain that can control motion and taste and smell independent of the central brain. Individual tentacles can keep these functions even when cut off from the main body. They can talk to each other and feel pain.

Human limbs, you may have noticed, don't function well on their own, and we have a fair bit of trouble keeping things going overall when the head is separated from the body. That's the price we pay for a root-like central nervous system controlled by a single brain.

What does this have to do with me, you may ask?

The electricity system we have now evolved over the last century, rather faster than either octopi or humans, to operate on a centralised, one-way model. But now we are in the process of redesigning it in a much shorter timeframe to move energy in both directions.

Till recently, we have been winging it, accommodating bidirectional flows caused by the export of excess distributed energy resources (DER) with few issues. But with Australia's world leading uptake of rooftop solar, those days are coming to an end. You can't have negative grid demand in the middle of sunny days — which is what South Australia is now facing — without some pain.

There are relatively cheap and simple solutions to the current problems, from tariff reform to transformer upgrades. But with DER forecast by AEMO to amount to nearly half of all energy generation within two decades, there are deeper structural issues that must also be faced sooner or later.

In a one way system, power (in both senses) and control flow from the top down, or from the centre to the periphery. The market operator is in charge of the whole shebang, and we consumers are passive recipients of someone else's electrons, whether dirty or clean.

Now that we all have the opportunity to generate, store and trade energy, this is changing. But the power structure, reflected in the architecture of the grid, remains largely the same. It sometimes seems as if prosumers are pushing energy rather than shit uphill, and are treated as pesky threats to the security of the overall system.

This is what you get when the energy system is still operated like a human being rather than an octopus.

There are alternatives. What if DER were at the top of the tree rather than the bottom, the centre rather than the periphery of the system? What would the grid look like if DER were regarded as the solution rather than the problem? What if we thought more from the tentacles than the head?

Fortunately, smarter minds than mine have been thinking about this for a while – especially in the US. They have come up with a model known (awkwardly) as a “decentralized, layered-decomposition optimization structure”, but which I prefer to call the democratic grid.

Essentially, each layer of the system – DER, distribution and transmission – takes care of its own needs as much as possible, and only interacts with the layer above to the extent necessary to cover capacity shortfalls or system security issues. It is a complete reversal of the traditional power structure.

The road network is another good analogy. The Department of Main Roads, which operates the freeways, doesn't need to know what's going on in every suburban or country road, only what is happening on the freeway on and off ramps. And the local council, which maintains the rest of the road system, doesn't need to know what's going on in every garage and driveway. They should be able to largely predict the future on the basis of past patterns of behaviour, the weather forecast, and changing trends within and external to the system – but also have enough room to move in the case of unknowns.

It is an appealing vision, but we are a long way from being able to make it happen right now. There are significant technical issues to be faced before DER can talk to each other and be traded in the distribution system while speaking the same language and without causing problems for the market operator. (It would help if our so-called smart meters were not so dumb, especially outside Victoria, but that's another story...)

We need to get cracking though. The Energy Security Board is smack in the middle of a very short process (Post 2025 Market Design) that will largely determine the structure of Australia's electricity grid for the next generation.

Worst case scenario, all household solar and battery energy will need to be scheduled and bid their price and quantity into the existing wholesale market every five minutes – a complex and expensive nightmare.

Best case, we will redesign the market so that you can trade your excess energy and demand response (load shedding or shifting) via your choice of market platforms, without remote interference, whether actively or passively (via an aggregator) and without causing system security issues. A many-tentacled splendour.

Peer to peer, VPPs, vehicle to home and grid, community batteries and solar gardens: the possibilities are many, but they will be stuck in the slow lane unless there is fundamental reform of the grid architecture.

Either way, the first step is to follow the old medical maxim: Do No Harm. Don't do anything in the short term that would narrow our options for the future. Innovation in the DER space is happening fast, and we should not impose a structure to solve today's problems if it limits tomorrow's possibilities.

At the same time as avoiding harm, we need to develop a vision of the future we want — democracy, autocracy or a hybrid of the two — and the steps needed to get from here to there.

Top down or bottom-up? Human or octopus? Let the ESB know what you think by 19 October.

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