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Submission on problem definition

Topic 4: The future impact of emerging technologies in the energy sector (Rev A)

My submission relates to demand side management.

Background

In 1959 I was involved in managing the load control for the Auckland Electric Power Board. During a peak load day we could hold the load at 144 MW from 7 AM until 9 PM with a small dip around lunchtime. All the other power boards in the country did the same thing so the whole New Zealand load was held steady over much the same period.

Peak load control had been popular in New Zealand for many years. Probably the first was instituted by Lloyd Mandeno in Tauranga around 1925 when he developed insulated electric water heaters and decreed that there must be a switch over the stove that directed power to the water heater or stove but not both. As a result no water heaters were on during the evening cooking peak.

By 1959 most power boards were using ripple control while others used pilot wires and time switches. Power Boards were able to invest large amounts of money in ripple control because electricity was charged to them at £5 per kW of peak demand with no charge for units used[1]. The Power Boards charged for units used so they could increase their profits – or more correctly, reduce the cost to their consumers – with peak demand management.

This situation continued until the advent of the electricity reforms when, for some reason that I have never understood, lines companies were forced to pass through Transpower charges. As a direct result most of them stopped expanding their ripple control systems and, in the case of Vector at least, they let the existing system run down and did not install ripple injection equipment in new substations. As a result they incurred additional expenditure on reinforcing their system[2]. It seems that, because of the way the regulations work, they can make money from overbuilding their system, but not from managing peak demand.

[1] It was correctly assessed that, because the system was all hydro, generating electricity cost virtually nothing but providing for peak demands required large additional expenditure on power stations transmission lines and distribution systems.

[2] A few years before they had run a test in conjunction with Transpower to see what happened if they left all the hot water on over a peak demand period. They gave up early into the peak demand period as there was a risk of seriously overloading the system.

The conclusion from this is that, before the electricity reforms, the system was optimised to make the best use of ripple control and benefit consumers.The reforms removed the motivation to optimise the system in the interests of the consumers.

The problem

Now, judging from the shape of the curve on EM6live, Vector seldom – if ever – use ripple control for managing peak demands. This means they have spent millions of dollars in reinforcing the system to meet unrestricted peak demand and they will have increased the demand on the Transpower system by at least 200 MW more than needed. It is interesting to note that the 400 kV line to Auckland increases transmission capacity by just 200 MW! It is possible to conclude that if Vector had acted in its consumers' interests and continued with ripple control, Transpower – and the consumers – would have saved something like $900 million for this alone.

The main problem as I see it is not so much with accommodating emerging technologies is the fact that the electricity "reforms" have killed off technologies that were – and still could be – a huge benefit to the consumer.

Nevertheless, there are some emerging technologies which could bring even more benefit. I have recently proposed an alternative to ripple control in the form of a smart water heater thermostat that is sensitive to frequency over say, +/-0.05 Hz from 50 Hz. The device would incorporate a triac or similar that would regulate the power into the heater in proportion to the frequency deviation. If the frequency dropped to 49.95 Hz, the load would automatically reduce by hundreds of MW. If the frequency went high and the heater was switched off it would switch it on to absorb the surplus energy. It would switch off if the water heater temperature rose to, say, 10° above normal. In practice, this would never happen.

In effect, the water heating load would take over frequency management and the multimillion dollar costs of managing frequency and spinning reserve[3] would be dramatically reduced. Because it acted very quickly it would also reduce the chance of an under frequency load shedding incident. Under frequency load shedding has very high costs for the economy.

The device would also have a Wi-Fi connection so that Transpower, the lines companies, the retailer and the consumer could, if they wished, control the water heater to limit peak demands, to avoid high-priced periods and to manage transmission constraints.

Technically, there are no problems in mass-producing this device: installation simply means disconnecting the existing thermostat, pulling it out, and replacing it with the new device.

Everybody I have talked to in the industry agrees that there is little chance that this device would see the light of day even though they all agree that it would bring huge benefits to the

[3] "Spinning reserve" is generating plant that is kept rotating at low load me to pick up load rapidly if the wind drops suddenly or if there a major problem with the transmission line or a power station.

consumer and the whole power system from cost reductions related to demand, frequency management, managing price spikes and constraints.

The fragmented nature of the industry means that something that benefits almost every aspect of the industry has a value that no single entity can capture. Although it is claimed that the market could do this, if it were possible, we would have seen it happen with ripple control already. As it has not happened with ripple control – which, in many cases, already has frequency sensitive elements – there is no reason to assume that the improved technology of my proposal would suddenly make it all happen.

The solution

Instead of concentrating on the individual components of the industry and the belief that the existing market is "efficient" we need to look at the whole system from the consumer's point of view and consider technologies like ripple control and the smart thermostat that would, quite clearly, benefit the consumer. It would then be necessary to work out why it is not happening, and take whatever action is needed to remove the regulatory problems so that it can happen.

As I've already pointed out, the main regulatory problem is that lines companies are not allowed to make money out of managing their consumers' load. If they were allowed to profit from this, then it is possible that they would take the lead in promoting the devices and managing them. It would then be possible for the retailers to control individual consumer's load so that they were able to reduce the retailers demand when prices were high and they were purchasing on the spot market. It is also possible that some retailers might even manage their consumers loads to minimise the consumers' power costs.

Consumers who purchase electricity on the spot market could also manage their own demand by logging into a website (e.g. nodewatch@incremental.co.nz) that monitors spot prices and sends them a message when they exceed a set price. They could even go further and use the message to trigger the sending of a Wi-Fi signal to the thermostat.

Obviously my proposal will bring large benefits to the consumer. It will also bring smaller benefits to the system operator, Transpower, the lines companies and the retailers. But there is no way that all these organisations could ever get together under the present regime and encourage the consumers to install smart thermostats. I suspect that if they did, it would be called "collusion".

Another option is for the powers that be to simply decree that these smart thermostats should be installed in all storage water heaters on the basis that the national benefit is great and they will reduce consumers' costs and increase reliability of supply. Doing this is, in fact, less Draconian than the present requirement that many/most domestic consumers be on a feeder scheduled for under frequency load shedding. It could simply be a requirement of the conditions of supply that, when the consumer has a load that can be controlled without the consumer noticing then the system has the right to control it. The same requirement could easily be extended to other similar loads like commercial refrigeration and, for short periods, air conditioning.

Specific questions

246.1.1 What do you think are the prospects for change in electricity systems in New Zealand from these developments? How imminent and material is this change in New Zealand?

>I think the prospects for change are poor. The industry objectives do not always encourage it to act in the best interests of the consumer.

246.1.2 What changes (if any) have you implemented (or seen) in anticipation or in response to these developments in New Zealand?

> I have not seen any changes even though I have been lobbying for something like 20 years. In spite of my lobbying, I have been totally unable to persuade the Electricity Authority that the fact that lines companies cannot make money from managing their consumers load is a real problem that only the Electricity Authority and the Commerce Commission can fix.

246.1.3 Given the current level of uncertainty, how does the value of waiting to get more certainty compare with the risks of maintaining the status quo?

> It is been obvious for the last 20 years that ripple control benefits the consumer. The sooner something is done the better.

246.1.4 Are there any no-regret measures we could take now?

> Yes. Let the lines companies make money from managing the demand of their consumers. Consider a regulation that would allow the system operator – and others in the industry – to regulate loads when it can be done without affecting the consumer.

246.2 How this topic translates to specific issues for electricity(and where relevant gas) lines businesses, including on our understanding of the issues that flow from the potential increasing deployment of emerging technologies;

> Existing technologies – implemented and not yet implemented – are all that is needed to reap huge benefits for the consumer and the power system.

246.3 Any other experience(domestic or international) you think would be relevant in addressing any issues relevant to this topic. We ask that submitters are specific on what aspects of the experience they find relevant to the NZ context;

> As I said, New Zealand was once a world leader in peak demand management. What we need to do is get back to that situation. Most of the emerging technologies overseas are driven by subsidies based on a blind belief that man-made carbon dioxide causes dangerous global warming. To give but one example, I have yet to find a serious economic analysis that finds any economic benefit in so-called smart metering. Smart metering is being installed overseas either

because of the stimulus money from the US government or, in the European Union, from government regulation[4].

246.4 The problem definition(s) There are a number of issues that may result from increasing deployment of emerging technologies, which we have attempted to describe in this chapter. However, it is not yet clear how this results in specific problems as they relate to Part 4 regulations and the IMs.

> Emerging technologies such as wind, solar, and micro-grids all load large extra costs on the consumers without conferring any benefit because they increase the cost of managing the system and make it less reliable. In most cases, poor consumers finish up funding those rich enough to install wind farms and solar cells and reap the subsidies.

246.5 Potential solutions. While the focus at this stage is on problem definition,we welcome any potential solutions to the specific problems identified. Solution suggestions should be expressed in terms of how they promote the long-term benefit of consumers.

> I trust I have done this above. The benefit to consumers would be hundreds of millions of dollars.

Sincerely yours,

[4] http://www.bryanleyland.co.nz/power-industry-stuff.html