IN AUSTRALIA, AS ELSEWHERE, there is an urgent need for electricity supply and distribution utilities to solve the problem that the projected increased peak demand will soon exceed capacity to supply. An illustration of the gravity of the situation is that wholesale price spikes are often more than 100 times the average price. The situation is so critical in South Australia that the state’s local utility (ETSA Utilities) has put out an appeal to the public for ideas. Why has the situation come to need such seemingly desperate moves?

The electricity industry, unlike most other suppliers, must meet demand immediately and without the freedom to control demand using flexible prices and the ability to stockpile product. To these difficulties is added an almost total lack of real-time communication with the customer.

In my view, the Australian deregulated market in power is missing this vital component, which is essential to any form of market—effective supplier-customer communication. This communication gives the ability to influence demand and keep it at manageable levels.

**Increase Supply or Reduce Demand?**

Stepping back, solutions to the looming power crisis fall into one of two categories: methods to increase the capacity to supply the peak or methods to reduce the level of the peak.

Increasing the network’s capacity (more generation, transmission, and distribution assets) is generally a long-term project that is expensive and also inefficient since the extra capacity remains unused outside of peak times.

The more attractive option is to reduce peak demand. This can be accomplished with mechanisms to smooth the demand curve by lowering the demand curve with electricity usage efficiency improvements.

Efficiency improvements have great potential. Apart from an overall reduction in demand, some efficiency improvements also result in lowering the ratio of peak to average demand. For example, better home insulation causes thermostatically controlled air conditioners to come on progressively rather than at the same time when the outside temperature rises past comfort levels. Efficiency improvements could be encouraged by the utilities through the use of advice and product advertising and promotions, that is, more customer communication.

Smoothing the demand curve is undoubtedly the best short-term option for implementation by the utilities. The following unrefined method, euphemistically referred to in utility circles as “demand management,” is already used. If the peak is projected to exceed capacity to supply, then selected, less essential parts of the distribution network are preemptively cut off (load shedding). This avoids damage to the network but has a huge cost in customer dissatisfaction and potential health and safety risks (e.g., home-patient oxygen concentrators). The problem with this demand management, and the reason it can only be used in emergencies, is that the break is forced upon the customer.

An improved method, also currently used, is agreed noncontinuous supply contracts; load control for residential hot water is the most common example in Australia. Hot water contracts only help the supplier manage the peak demand to a very limited extent because the absolute peak demand is increasingly due to air conditioning use during very hot periods. Hot water load control is of no use in these situations because these loads are generally off in the daytime. Other noncontinuous supply contract customers have negotiated a lower price in exchange for accepting prewarned interruptions. The number of industries for which interruptions are of little consequence is very limited. Generally, industry is extremely sensitive to power cuts and their loads are relatively constant. This indicates they are poor candidates for load shedding schemes; they don’t cause the needle peaks, and providing sufficient incentive for them to shut down during the peaks would be very expensive. So, conventional agreed noncontinuous supply contracts are a partial answer at best.

**A Proposed Solution**

What is needed is to target those customers causing the needle peaks and to encourage them to voluntarily spread the load.

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One can imagine that the most important customers to target in Australia would be domestic customers at home during the day. They are well synchronized in their usage patterns by the weather and by domestic habits (which leads to the peak demand problem), and they have discretionary control over most of their loads.

The question to consider is what is the most efficient way (in terms of low cost to supplier and maintenance of customer satisfaction) to encourage these people to switch off at the critical time. Encouragement and persuasion dictates some form of communication. Tempting them to switch off at specific times requires real-time communication. Direct real-time communication between the supplier and customer and displaying the current price is the most efficient way (in terms of low cost to supplier and maintenance of customer satisfaction) to encourage customers as tolerably unobtrusive, routine, and advantageous to him or her.

In a hypothetical, ideal scenario, the customer might have in the office or kitchen a display box that beeps and tells them the network’s load is approaching its maximum. The display would inform the customer that his or her load is currently high and the utility is offering 10 kWh free usage worth AU$1.20 if their load remains under 4 kW for the next half hour. In this case, our hypothetical customer has preprogrammed the box to only alert her when offers exceed a value of AU$1. The beep reminds her that this is an offer she might consider worthwhile. She has just put the dishwasher on and realizes it could wait until the evening. Her response is immediate: without a second thought, she switches the dishwasher off and goes over to the air conditioner to readjust the thermostat—just to be sure she earns the offered reward.

The above communication with an individually addressable device in the kitchen is currently a technophile fantasy; the technology exists, but the utilities won’t pay for it or for the convenient, in-home installation. It is perfect from the customer’s point of view, but they won’t pay for it either because the savings to them is too small to warrant any expenditure on equipment. However, this dream illustrates the essential features of a workable scheme.

The customer’s attention must be grabbed at the critical time. Preferably, only customers with a high or at least significant load should be contacted and only those customers likely to respond immediately to the particular level of incentive offered.

✔ The customer should be involved, rather than the utility, taking control of equipment. The customer can decide which loads are less critical at the time, and manual control has no associated control device cost. It is acceptable to load control hot water because it makes little difference to the service the customer sees, but the same does not apply to most other domestic uses of electricity.

✔ There must be a mechanism for verifying that the customer took action and reduced load by the required amount for the required time period. This is to ensure that only the appropriate customers—those that took action—are rewarded.

### Possible Implementation Details

For any scheme to satisfy the above requirements, some form of load current monitoring at the meter is required to identify target customers and to verify compliance. Also, some form of communication with the human customer is required to make the offer.

Can such a scheme be implemented with currently available, economically viable technology, and would its ongoing cost be low? I believe, in Australia, the answer to both questions is “yes.”

Consider a scheme with two elements: 1) an automated telephone system linked into metering and billing databases for communication with the customer and 2) one of two load monitoring options, automatic meter reading (AMR) devices or replacement short interval meters.

The phone system would be used to call the target customers at the appropriate time and to make the offers. The customers would be selected according to their load (either measured or predicted) and according to their incentive threshold (which has been previously determined by questionnaire). A computer-generated voice would be
used with personalized messages. An example is: “Hello [insert names on bill]. This is your electricity supply utility calling, we are currently experiencing particularly high demand and would like to make you the following offer...Please reduce your load immediately if you wish to accept our offer.”

The choice of technology for the second element of the system, load monitoring, is very much dependent on the local conditions. In Australia, most meters are still the simplest mechanical disc type; they are generally very old and due for replacement. A replacement program could deploy very cheap meters incorporating AMR modules such as Hunt Technology’s turtle (other viable upstream communications systems also exist).

An alternative to reading the meter in real time is to have the meter store the variation of load with time. This rules out the definitive identification of high-load (target) customers at the critical needle peak time, but likely target customers could be identified from past data retrieved from the meters. The determination of whether or not a target customer actually reduced his load after accepting an offer can still be made if the resolution of the interval data recorded by the meter is sufficient. This option, the use of interval meters, is attractive because at least one Australian state government has already stated its intention to mandate the installation of interval metering for residential customers (by 2013).

In analyzing the overall cost of the scheme, it should be remembered that the devices only need be installed in the proportion of customer premises necessary to ensure sufficient load shedding capability, perhaps as low as 20% of homes. With this scheme, not only will the fewest customers have been inconvenienced by having to reduce their load, but those customers will have done so by choice. When these customers see “peak reduction rebate of 10 kWh ($1.20 credit) with thanks” noted on their bills, they may even have more positive feelings toward the utility than if the event had never taken place.

In conclusion, demand can be managed effectively only through increased and improved interaction with the customer. Enabling systems don’t need to be expensive, and they will lead to substantial savings for retailers (due to reduced peak wholesale price) and for network providers (due to delaying the requirement for new assets). More importantly, for the community, it will avert the impending power crisis.