Is Mandating “Smart Meters” Smart?

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“Smart meters", which allow electric power users to respond to wholesale spot prices, are expected to transform the electric power industry. Consumers will reduce their consumption during peak hours, thus reducing installed capacity requirement and emissions of CO_2 and other pollutants. Electric power retailers will capture significant operational savings. Distribution Network Operators will be able to control in real time their entire network, thus improving its performance and reducing their costs.

The potential value of the demand management benefits is significant. For example, Faruqui et al. (2009), estimate the annual potential value for all of Europe of reduced capacity cost at € 4.8 billions, and the value from reduced electricity consumption at € 600 millions. Similarly, the Department of Energy and Climate Change (DECC) estimates the Present Value for Britain of energy savings benefits at £ 4 400 millions, carbon savings at £ 1 100 millions, and peak load shifting at £ 800 millions. As a result, full deployment of "smart meters" is underway in many European countries and US states.

The policy discussion of smart meters appears to be framed as a “one-or-zero” problem: should we install meters for all users or for none? This is surprising. As all economic problems, it should be cast as an “optimal share of deployment problem”: which consumer groups should be equipped with smart meters? To answer that question, one should compare the marginal value of equipping a class of consumers against its marginal cost. A

key ingredient in the analysis is the marginal value of demand response, i.e., the marginal surplus generated by one customer becoming price responsive. This is precisely what this article estimates.

Specifically, I determine the marginal value of the most efficient form of demand response, Real Time Pricing (RTP) of electricity. Under RTP, customers face and react to wholesale spot prices, thus consumption of electric power is perfectly aligned with its opportunity cost.

The first result is that, under reasonable conditions on the shape of demand, the marginal value of RTP is decreasing as the fraction of customers on RTP increases: switching the first percentile of customers to RTP generates more benefits for society than switching the 20^{th} percentile, which in turns generates more benefits than switching the 60^{th} percentile.

The second result is an estimate of the marginal value of switching one customer to RTP. I calibrate a simple yet realistic specification of demand on data from the French power market. I then estimate that, for the 20 millions residential customers whose peak demand is lower than 6 kVA, the net surplus from switching to RTP varies between 1 €/year and 4 €/year depending on assumption on elasticity of demand.

This analysis main finding is that the value of RTP lies overwhelmingly with large customers. I believe this result, mostly driven by the differential in size between large industrial and small residential users, will prove robust as other specifications are tested on data from other countries, even though the exact values will vary.

This result has three main policy implications. First, it is essential that large customers face real-time prices, as is the case in most restructured power markets. Ensuring this captures most of the benefits of demand response.

Second, the case for complete rollout of smart meters is weakened. This analysis does not constitute a full-blown marginal cost benefit analysis, as it does not include all costs and

benefits of "smart meters". When properly accounting for all these, the benefits may exceed the costs. However, it appears that a large share of the energy management benefits can be obtained with a much more limited smart meters rollout. This suggests a partial rollout should be at least examined.

Third, the economic case for exposing all residential customers to RTP appears weak. Policy makers have always been hesitant to do so, concerned that customers find the exposure to volatility of spot prices unbearable. The analysis presented here suggest that the economic benefit is small, less than € 4 per customer per year. Thus a voluntary approach may be preferred.

Finally, the analysis has a commercial implication. Given the small value of price responsiveness compared the cost of convincing clients to adopt it, developing a profitable residential energy management offer will prove challenging.