Who is going to do all this?

A contribution to the Electricity Brain Trust at https://groups.google.com/g/electricity-brain-trust

Stephen Littlechild[1]

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As one of the "few aging economists" originally said to be on this circulation list, I am unfamiliar with many of the electricity technologies discussed in this Brain Trust and therefore hesitant to comment. But since this forum seems to be the biggest game in town at the moment, it would seem a shame not to throw a chip on the table.

The contributions to date have been mostly about how tariffs ought to be set for various exciting new technologies. As I read each of the marvellous contributions I think "Fantastic, Yes, that sounds sensible".

But I begin to note various differences of view. And gradually I begin to think "Hang on, are these proposals all mutually compatible? Who is going to decide which of these many technical solutions is most appropriate and most likely to work, and how? Who is going to calculate and set these efficient, cost-reflective prices, or decide the trade-off between fair and efficient prices, or work out the appropriate income transfers to the poor? And who is going to be responsible for implementing all these desirable improvements, and how?"

Of course, the consultants among us will immediately put up their hands and say "We will". But what kinds of institutional arrangements are most conducive to asking their views in the first place, and then taking notice of them, and finding which kinds of solutions work best in practice, and which are most appealing to customers? There are basically two options: regulation and the competitive market.

In the attached contribution (warning 8 manuscript pages) I advance the following arguments, using Time of Use pricing (TOU) as the simplest example of a much wider set of innovative tariffs and products that we envisage might be developed.

- The reluctance of regulators to approve TOA and other innovative products is not exceptional, it is the norm. It ain't going to get better. Regulation is like that.
- In competitive retail markets, that regulatory barrier does not exist: anyone can offer whatever products they think will appeal to customers. Competing retailers have not offered many such products hitherto because these products are not yet sufficiently attractive to customers. But the competitive market offers a better prospect than regulation of discovering products that are both reflect cost and are appealing to customers.

[1] Emeritus Professor, University of Birmingham; Fellow, Cambridge Judge Business School; Associate Researcher, Energy Policy Research Group, University of Cambridge; former Director General of Electricity Supply (DGES) and head of the Office of Electricity Regulation (OFFER) (1989-98).

- So are time and effort best spent pressing regulators for more TOU and other such products now?
- Innovation is of the essence in today's and tomorrow's electricity sector, but is absent from the static welfare economics underlying TOU pricing.
- In contrast, Alfred Kahn emphasises that competition is important both in bringing about the welfare optimum and in promoting greater efficiency and innovation. The Austrian school of economics makes innovation central to its concept of competition as a rivalrous discovery process.
- This suggests that finding ways to increase competition could facilitate TOU and other innovative products. Three examples are given from recent weeks in the UK.
- The final section asks whether there are opportunities for regulatory changes to enable more competition and/or innovation in the electricity sector – for example, in particular US states, localities, cooperatives and municipalities. It also asks whether negotiated settlements have been or could be used to coordinate support for particular projects.
- Finally, it poses a challenge: can participants on this list come to a hypothetical agreement (without commitment) on any particular project in any particular state? If so, it would be very helpful to know what kinds of projects can command such broad support. If not, it strengthens the case for trying to increase the competitive opportunities available.

I am indebted to Tim Brennan for summarising the main part of the above argument as follows: If one wants to discover the methods of pricing that best balance efficient allocation of generation and other resources, and consumer willingness to tolerate and manage price volatility, experience in electricity regulation and in general says that markets are going to get there better and faster than regulators. So let's find ways to give markets more of a chance.

1. We need more innovative pricing schemes

Ahmad has done us a splendid service by documenting (here and elsewhere) more than a hundred applications of many different variants of TOU and real time pricing (RTP) in the US electricity sector. There is no doubt that - with appropriate research, information, design, promotion and regulatory pressure or support - a variety of different schemes can be attractive to at least some customers. In order to meet the many challenges ahead, we need to learn more about how well these different schemes work, how customers respond, what are the practical problems, the costs and benefits, and so on. It would therefore be desirable to facilitate more such schemes, to help us deal with the ever more complicated electricity world that we are entering.

There seem two main obstacles to this at present: regulators and customers.

2. Pricing in competitive markets and regulated industries

First, again extensively and ruefully documented by Ahmad, is the apparent reluctance of politicians and regulators, faced with various kinds of opposition, to move in the TOU direction.

He earlier cited the widespread use of TOU pricing in airline pricing, hotel room pricing, rental car pricing, vacation packages, movies, operas and sporting events. These are competitive markets where individual companies found that they could attract additional custom by cutting prices at certain times, often when they had spare capacity, and that the market would bear price increases at other times, often when their capacity was tight. No one instructed or authorised them to do this. Some competitors followed, or did something else different, some carried on as usual.

Some customers no doubt liked particular instances, others didn't (many uber riders reportedly hate surge pricing), yet others didn't care. In general they were not asked their views, certainly not their permission. Market participants did not debate whether the resulting price differentials were efficient or fair. The pattern gradually evolved and is constantly evolving further over time, as market participants discover and adopt what works for both customers and themselves, and abandon what doesn't.

In contrast, other TOU prices (freeway tolls, bridges, parking, road congestion charging) have been mandated by government or regulators, typically after long political debate involving economists as advisers. These latter applications are characterised by their limited and cumbersome nature as well as by political constraints on their introduction and modification.

This is not only in the US. Road congestion charging in London was the same: recommended by a Government committee of economists and road engineers in 1964 and not adopted until 40 years later. After nearly 20 years it remains virtually unchanged. The Transport Secretary did once propose a national scheme in which every vehicle would be fitted with a satellite receiver that would calculate charges, with prices ranging from 2p per mile on uncongested roads to £1.34 per mile on the most congested roads at peak times. (Sound familiar?) The scheme was dropped by Prime Minister Tony Blair after an online petition against these proposals gained over 1.8 million signatures.

Or consider the UK nationalised industries. Long run marginal cost pricing was formally adopted as Government policy in 1967. In the early 1970s I attended a succession of meetings between the Treasury and the various government departments that "sponsored" the nationalised industries. Without exception all the departments declared their strong support for marginal cost pricing in general, and in all other industries except their own, where it was inappropriate at this time for a variety of reasons. A 1976 inquiry by the National Economic Development Office (NEDO) "found that in no cases were prices based on marginal costs". (Though electricity presumably came closest.)

All this is not accidental. There is now an extensive theoretical and empirically tested economic literature (public choice, theory of economic regulation etc) whose clear lesson is that this is life. This is how regulation works. The regulators resisting TOU and other such schemes are not unusually incompetent, unintelligent, uninformed, negligent or nervous individuals. They are normal people doing their job in the way that most other people would do it.

This is not to deny that there are some bold and far-sighted regulators who will take distinctive action. Nor to suggest that regulatory decisions cannot be modified by careful and informed arguments and evidence, or that nothing can be done. I don't say that it's not worth trying, I don't say that nothing will happen. Rather, if anything that is not run-of-the-mill happens, it will be later and less than proponents might hope, and once in place it is unlikely to evolve much further.

3. What do customers want?

The second main obstacle is customers. Ahmad is right that a variety of TOU and similar schemes have been attractive to some customers. And a competitive retail market allows them to be offered to customers without the need to get regulatory consent. But Bruce is right that such schemes and customers are not in the majority. Indeed they seem very much in the minority in those states or countries where there is an unconstrained competitive retail market (eg Texas, UK, Australia, NZ) where customers can choose from a wide range of products without a regulated default tariff, and there is nothing to stop TOU products.

In the UK residential market, there is a TOU product reflecting a specific earlier policy. In 1978 the nationalised electricity industry developed night storage (underfloor) heating, which was installed in new apartment buildings, and to accompany this it developed special two-rate Economy 7 meters, with tariffs offering 7 hours of cheaper night-time electricity. This all happened automatically: these customers didn't have to do anything. Customers in such buildings are essentially locked in to such meters, although today's competitive suppliers do indeed offer corresponding TOU products. However, the proportion of residential customers with such meters has been steadily declining over the last few decades, to around 13% today.

Incidentally, I learned recently from a large supplier that two rate tariffs, no more complex than the Economy 7 tariffs, are available in the market for medium-sized companies. "But anything more complex than that and the brokers struggle to compare prices between suppliers – remember this market is heavily intermediated. We tried a more complex ToU tariff which had different rates between seasons (very important) and time of day and week a while ago, but it fell flat because the brokers were not interested". It seems likely that residential customers too would find it difficult to compare complex tariffs, at least initially.

In Australia, as Bruce has previously explained, TOU products are often used (or required to be used) by residential solar developers. In addition, a small handful of suppliers in most competitive markets have offered free energy at weekends, or at specified off-peak times. One or two suppliers in each competitive market offer real time pricing (RTP). There is a particular growth of TOU and RTP products and other arrangements associated with Electric Vehicles.

So, as of today, adding up all these variants, TOU and RTP products and customers are very much in the minority in fully competitive markets. Ahmad instances over half a million customers on some kind of time-varying rate in ERCOT. But there are over 26 million customers in ERCOT, so that's about 2%. Elsewhere Ahmad estimates under 4% of customers

are on any kind of time-related product across the whole of the US, and forecasts less than 15% by 2025.

However, the situation will gradually change, the demand for EVs and related tariffs will continue to grow, and devices will be developed to facilitate customer understanding and participation. Most importantly, the competitive market does not present a regulatory barrier to those who want to offer TOU or more sophisticated tariffs. Anyone who wants to offer them can do so, it is not necessary to get the support of other parties or of the regulator.

4. Limited prospects via regulation

So, what is the best way to make progress? Is it to continue to encourage regulators to use the powers that they have over utilities, limited though they may be, to insist on some variant of TOU or on further trials? Despite the evident difficulties in persuading the regulators and some of the interested parties?

That is one route, and to that end Ahmad elsewhere suggests "five steps for utilities to cross the chasm between pilots and deployment" viz introduce a variety of customer-friendly cost-reflective rates, learn how customers think, educate customers, use enabling technologies and behavioural messaging, and use phasing plus bill protection. These all seem plausible measures and I would not want to argue against them.

I also accept that the situation is constantly evolving: e.g. growing pressure to achieve net zero, greater spread of smart meters, increasing ability to store and use big data, the development and spread of smart devices. So there is indeed a case for persevering.

But at the same time I note again i) the evident very limited interest at present of most (not all) customers and retailers in competitive markets where there is no restriction on the types of products that can be offered, and also ii) the differences even within this Brain Trust about the magnitude and even direction of some of the relevant costs and benefits, and iii) the strongly antagonistic positions that often seem to be taken in regulatory proceedings. All these raise the question whether political capital and economic resources are best spent in pressing regulators for TOU and similar products today, or whether some other route might have more prospect of success.

5. Welfare economics and innovation

I have a fondness for TOU because I devoted much of my thesis to it and then another decade of my life. But I confess to a reservation about the static economic theory underlying it.
The subtitle of Ralph Turvey's book on Optimal Pricing and Investment in Electricity Supply is "an essay in applied welfare economics". This is the neoclassical paradigm that all economists have been taught, and that appears in textbooks. Basically, it is a static model, with given products and costs and technologies, given customers and customer preferences, and no innovation. The question is how best (most efficiently) to allocate the available resources. The

answer, in simple terms, is price equals marginal cost, of which TOU is a special case. Of course, the appropriate definition and calculation of marginal cost, and the tradeoffs that might have to be made in implementation, are very subtle issues, to which Turvey and others have devoted much valuable thought, and which have surfaced repeatedly in the present discussion.

Looking at the situation from a 2020 perspective, it is arguable that this was an eminently sensible approach last century. We understand the thinking behind Hopkinson's tariff in 1892 and he would have understood Boiteux in the 1940s, Turvey in 1968 and Fred Kahn in 1970, and if he had joined us a hundred years later in 1992 he would not have had much trouble in understanding our TOU discussions. Last century, with technology moreorless given for the planning horizon, say a decade at a time, and innovation something that other people did in a separate laboratory, a static welfare economic analysis made sense, and provided useful insights.

But what would Hopkinson and the others make of the electricity sector as it is beginning to emerge today, with prosumers and prosumagers and solar and battery storage and distributed resources? With not just a different set of technologies but with every prospect of ever-changing technologies, where the preferences of customers themselves are evolving too? Is a static model of efficient pricing sufficient in such a world? Do LRMC and LRAC even mean anything in a world where technology and costs are ever-changing conjectures?

Economists used to consider innovation. For example, the index to Pigou, Economics of Welfare 1962, notes numerous passages on inventions, including "public operation unfavourable to". But static welfare economics has little to say about it. With a bit of handwaving, the general notion is that prices reflecting marginal costs will provide incentives in the right direction. But innovation is not in the model. This seems a bit reminiscent of the late 1960s Tom Lehrer song: "Once the rockets go up, who cares where they come down? That's not my department, says Werner von Braun."

6. Listen to Fred Kahn

What does Fred Kahn, the nearest thing to a deity in our world, have to say about innovation? Vol 1 - Principles – has nothing to say: the term does not appear in the index (though the word just creeps onto p. 177). This again reflects the constraints of conventional static welfare economics.

But Kahn Vol 2 – Institutional Issues – is a different matter. It has six indexed references to "innovation, prerequisites of". Right at the beginning, the Introduction refers to the importance of "product or service innovation" as a means to achieve the rules for efficient pricing discussed in Vol 1. It says "the optimum rate of innovation requires a balance of pressures of competition" and of protections against competition.

Kahn refers to "the virtue of freedom of entry and competition as a device for innovation – for encouraging the development of new and different services and for assuring the optimal

development and exploitation of new technology" (p 149). Subsequent illustrations are generally in the context of telecoms, where the message is clear. "Most important of all is the likelihood that opening the market to a large number of other, technologically progressive companies, by offering them the opportunity of competing on equal terms for Bell company custom, would contribute powerfully to innovation. The result could well be even more rapid reduction in cost and proliferation of new services than has been accomplished thus far." (p 303)

7. There are other economic models

Thus, the static welfare economics rules for efficient pricing are not the whole of the story about pricing. Nor indeed about competition. An alternative or complementary approach that (I suspect) economists often have to discover for themselves is the Austrian (Schumpeter-Hayek-Kirzner) concept of competition as a rivalrous discovery process taking place over time. Here, changing knowledge, preferences and technologies are of the essence of the process.

The difference was epitomised to me in a conversation I had, sometime before 1998, with the (non-economist) CEO of an electricity company that was preparing to compete in the residential retail markets of the other companies. I can't remember precisely what I said (perhaps something about whether price would now reflect cost, maybe even marginal cost??) but he replied: "We don't look at it that way [now]. We ask what price differential (below the incumbent's price) will be necessary to persuade customers to switch supplier to us. Then we ask how we can design a product that we can deliver at that price."

This is a fundamental change of perspective. Static welfare economics and much regulation go from Product to Price to Customer. Competitive markets go from Customer to Price to Product. I interpret Kahn Vol 2 as arguing for some of that approach in order to achieve Kahn Vol 1.

8. Enhancing competition

This leads me to the view that a more productive approach to innovative pricing, or at least a complementary one, would be to try to increase the opportunities for competition in the electricity sector. The states that continue to insist on setting a monopoly tariff or a default tariff have thereby prevented or distorted competition, and created the regulatory decision-making problem – constraints on action and innovation - that is at the heart of the present concern.

Although fully competitive retail markets have not hitherto adopted much TOU pricing, this seems, as noted, to reflect how customers presently feel. In the medium term, such markets seem the better bet for discovering and implementing workable schemes that are attractive to customers. Moreover, where competition at both wholesale and retail levels is taken as given and observed in action, there is a natural tendency to look for further ways to extend competition as far as possible in other respects e.g. by allowing, inviting or encouraging aggregators, energy storage providers and other new parties, and by incentivising transmission,

distribution and system operators to help create the conditions for extending competition, not least in ways that could relate favourably to TOU. To that end, for example, Ofgem is considering whether the conventional concepts of generator, retailer, network operator are still fit for purpose, or whether something much more fluid would facilitate a more competitive, innovative and efficient system.

Consider three examples of how competitive residential retailers are contributing to the innovation and discovery process in the UK. (These are from what just happened to be reported in a daily energy bulletin in the last couple of weeks.)

- 21 August 2020: Innovative and fast-growing new entrant energy retailer Octopus Energy has for some time had a half-hourly real time product Agile Octopus. It is now partnering with battery company Powervault to trial a scheme whereby residential customers charge batteries at off-peak hours and go off-grid during peak hours. It offers £500 off the battery and a credit of £10 per month off the energy bill, all of which is said to "generally save between £270 to £580 a year compared to an average UK household's energy bill" [about £1000 a year]. https://octopus.energy/blog/agile-powervault-trial/

- 24 August 2020: Kaluza, the "intelligent energy platform" of new entrant energy retailer Ovo, goes live with flexibility service to Western Power Distribution network operator, adding EV smart charging and Vehicle to Grid optimisation to its existing battery charging and discharging service. https://www.kaluza.com/kaluza-optimises-electric-vehicle-charging-v2g-and-sonnen-batteries-in-uks-first-combined-grid-flexibility-service/

- 3 September 2020: National Grid announces that new retail supplier Social Energy "has won the first ever fully domestic [residential] contract to supply week-ahead Firm Frequency Response (FFR), following the results of a recent trial weekly auction. …The green energy supplier will use 80 per cent of its fleet of battery-powered customers [residential] to provide 4MW of FFR capacity to the ESO [Electricity System Operator]." https://www.nationalgrideso.com/news/new-contract-sees-domestic-solar-panels-and-batteries-helping-balance-grid

I don't know anything more about these schemes, but they seem to me typical of the constant flow of innovative ideas involving competing retail suppliers that are actually getting put into practice in the UK. In due course we shall learn whether or not they work, which we would not otherwise know, and they will no doubt expand or be abandoned accordingly. It would be useful to know whether similar innovations are happening in other contexts.

9. Opportunities in the US context?

This leads me to wonder what possibilities might be available for increasing the opportunities for innovative electricity products, including but not limited to TOU. The following options are couched in a US context but there would be parallels in other countries.

i) Is there scope to modify the statutory monopolies of utilities in non-competitive states so that others who want to offer TOU or other products are able to do so? (I believe Nevada nearly got there last year.) And is there scope to remove or restrict the scope of the default tariffs in the dozen or so states that have retail competition, so that utilities and others can set whatever products they consider might be appropriate or of interest to at least some customers, and competition from retailers is not distorted by the default tariff obligation? And if adoption of some product throughout the whole utility area would be too problematic, is there scope for experiments in particular local areas or for subsets of customers?
ii) Is there scope to provide or extend incentives to network and system operators to encourage retailers and others to compete to provide necessary services, including variants of TOU pricing?
iii) Is there scope to encourage the many US cooperatives and municipal utilities to explore TOU pricing and other product innovations, and to allow participation by retailers or other parties, and how might this best be facilitated?
iv) Is the recent growth of Community Choice Aggregation an appropriate vehicle for facilitating TOU and new developments generally? (Municipal aggregation was helpful in Ohio and Illinois but there it required a community vote in favour, whereas in California it is possible for a government authority (city council or county board of supervisors) simply to declare itself a CCA. I am also conscious that a number of UK local governments entered the retail market to offer better prices than the large incumbent suppliers. They have all made losses and gradually withdrawn from the business. The last and largest two, Nottingham and Bristol, sold their customer bases in recent days, each having recorded a loss of over £20m, which presumably falls on the local taxpayers.)

10. Negotiated settlements?

In all this, is there any scope for negotiated settlements (briefly mentioned by Ahmad), or has that already been explored and largely abandoned? Settlement seems to me one of the significant achievements of US regulation, and I wish I had known about it earlier in my career. It is much easier for a regulator to accept a proposal that all parties support, or at least don't oppose, than to push through a measure that is controversial and resisted, whatever its merits. (I have recently argued that UK water and energy regulators should use the settlement approach to reform the UK network price control process that over time has gradually gone badly wrong. https://www.eprg.group.cam.ac.uk/wp-content/uploads/2020/06/S.-Littlechild_Submission-to-CMA_June2020.pdf)

I understand that TOU proposals often offer significant discounts to low income customers or seniors, so there may have been an attempt at settlement, but even so there is often resistance

to TOU options. Is there no set of terms related to TOU or other innovatory products that can gain all-round support?

This actually suggests a challenge: is there anything that members of this Brain Trust can agree on (or not object to)? Consider a reasonably concrete situation in various different US states. Is there any TOU tariff or other proposal that anyone can put together in any state, even if only for a short trial in a limited area, that would command the support (or non-opposition) of all the interested parties in that state?

Why not try it? Of course I agree that participants here cannot commit their principals or clients. So it's all on a "hypothetical without commitment would be prepared to enter discussions around such a proposed tariff" basis.

Let's see what groups form and what sorts of proposals they are or are not prepared to consider. If parties do manage to agree a basis for a hypothetical settlement, then that is crucial information that should guide future proposals. But if even a hypothetical settlement can't be reached, it suggests that extending competition may be a quicker and more realistic way to make progress. It also raises the question whether some more radical change in the nature of US electricity regulation is necessary in order to get more innovation and customer orientation in electricity product design?