Peak and off-peak electricity distribution charges

24 November 2017, Franck Latrémolière, Reckon LLP

1. Setting different charges for peak-time and off-peak use of electricity distribution systems is common enough. But are the methods used to set these differentials reputable?

2. The answer, obviously, is that it depends. It would be very ambitious to try to classify all the methods that have been used; so I am not going to do that.

3. Instead I use just a few examples which I happen to know something about:

   (a) The TURPE, which is the system used to set most electricity network use of system charges in France.

   (b) The CDCM (common distribution charging methodology), which is the system used to set electricity distribution use of system charges in England, Wales and Scotland. This actually provides two examples because the CDCM changes significantly for charges after 1 April 2018, with the implementation of a modification known as DCP 228.

French TURPE

4. Under the TURPE, the allocation of network capacity costs to unit rates is done in three steps:

   (a) First the costs of network capacity are allocated to each hour within the year.

   (b) Then within each hour the costs are shared between the units distributed within that hour.

   (c) Then a statistical technique is used to convert different prices in each hour into something more manageable like a five-rate seasonal time of day tariff.

5. Once costs are allocated to hours, sharing them between users is uncontroversial. The main properties of the TURPE therefore derive from the method used for the first step of the allocation.

6. The TURPE decision document expressly rejects something it calls marginal costs, because that would recover all the money from peak-time users. Instead the method used is labelled as incremental costs, and works as follows in respect of each network level:

   (a) The hours in the year are sorted in order of increasing load.

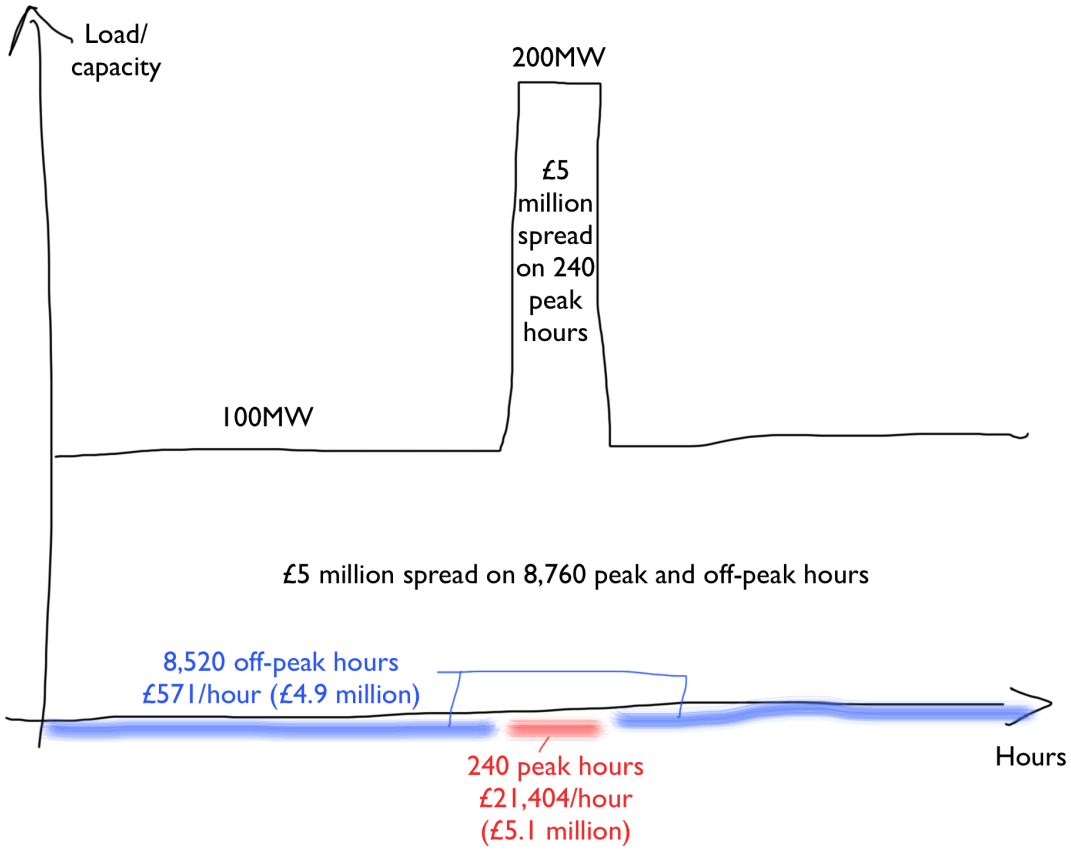
   (b) For the first hour to be taken out of that list, which is the hour with the lowest load, the cost of the capacity needed to meet that load is shared across all the hours in the year.

(c) Then, for each subsequent hour in the sorted list, the annual cost of the additional capacity needed to meet the additional load in that hour is shared with all the remaining hours in the list.

(d) The last hour in the list, being the hour with the highest load, bears the full annual cost of the last little tranche of network capacity.

7. A simple example might help. Let's say that, for a section of network, load is 100MW for 8,520 off-peak hours in the year, and 200MW for 240 peak hours, and that network capacity costs £50/kW/year. The total annual cost of £10 million is split into two £5 million increments, one shared between all 8,760 annual hours giving £571 an hour, and one shared between 240 peak hours giving an extra £20,833 for each peak hour, making a total of £21,404. The unit rates are therefore 0.571p/kWh off-peak and 10.702p/kWh at peak time. Figure 1 illustrates these calculations.

Figure 1 TURPE allocation of capacity costs to hours



8. At first sight, and bearing in mind my earlier advice to privatise costs and socialise benefits,[1] this sounds good. Each hour is paying for the total cost of the capacity that it uses, scaled down by the number of other hours that each tranche within this capacity is being shared with. That way of scaling down is a sound way of sharing the network benefit that arises from the fact that the same network infrastructure provides distribution capacity at different times.

[1] http://dcmf.co.uk/hector-2017-11-19.html

9. Of course, a sound method of socialising benefits would provide no protection against an unsound method of privatising costs.

10. Given that the method was based on slicing the year into individual hours, one cross-check that seems useful is to confirm that the end results are providing a good split of network benefits between users that have realistic all-year load profiles.

11. Let's take someone consuming 100kW at all times. That person is using 100kW of network capacity, worth £5,000 a year.

12. So what share of network benefit does TURPE give them? For the off-peak hours, 100kW represents 0.1 per cent of the total load so a 100kW flat load picks up a charge of £0.571 an hour, totalling £4,865. For the peak hours, it's 0.05 per cent of £21,404 times 240 hours, which comes to a further £2,568. So under TURPE the flat load is paying £7,433 a year, for capacity worth only £5,000. Something has gone wrong.

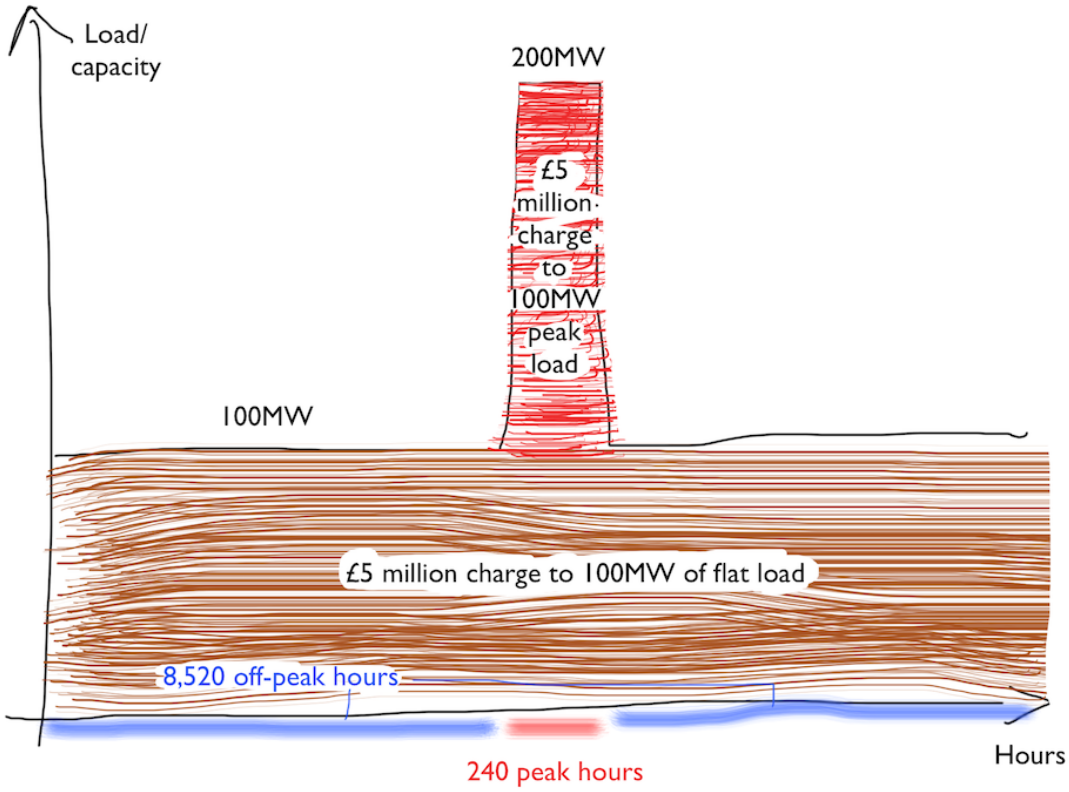
13. The reason for the error is that the product that the distribution system really provides is network capacity, which is available at all times, and not the transport of electricity at particular times.

14. There is nothing wrong with charging for a capacity service on a consumption basis, provided that the charges are constructed in a way that does not attempt to double charge customers for the underlying capacity. Thus, a 100kW flat load customer who only uses 100kW of capacity should not pay more than the cost of 100kW of capacity. TURPE violates that constraint.

15. A better cost-allocation method can be constructed by analysing the consequences of a rule against multiple charging for the same capacity. After the flat load constraint, the next constraint would come from a hypothetical customer who takes a flat load in every hour except the lowest-load hour, and so on. Figure 2 illustrates this decomposition of total demand in the same simple case as figure 1.

16. The resulting allocation is simpler than TURPE: the £10 million total gets split into two £5 million pots, one recovered from 100MW of flat load and the other recovered from 100MW of peak-time-only load.

Figure 2 Sensible allocation of capacity costs to hypothetical customers



17. Under TURPE, the analysis of demand as a collection of individual loads in individual hours led to a lot of network benefits to be shared back. This alternative way of packaging demand, because it implies more intelligent customer behaviour, does not: the total network capacity required is equal to the sum of the capacity used by each user group.

18. Translated into unit rates, at first sight this approach would mean charging zero at all times except in the peak hour where the unit rate could be very high in cases where the maximum load is reached in a single hour (or half hour, or quarter hour). But of course all the analysis above only holds for a single transformer or circuit. In reality, costs need to be calculated and allocated in respect of broad sections of networks containing many assets, which peak at different times. Using the distribution of peaking times in the analysis will ensure that the total cost of a network level is spread over hundreds or thousands of hours in a year.

19. The apparent network benefits that were being shared in TURPE were an artefact of an assumption of inefficient packaging of demand, which led to multiple charging of flat loads for the same capacity. The sharing of the false network benefits across all users mitigated that multiple charging somewhat, but not enough to prevent flat loads from incurring excessive charges.

20. As a result of these defects, the TURPE unit rates might put the distributor in breach of the prohibition on abuse of a dominant position, in two ways.

21. There is exploitative abuse because the distributor is using the dominant position arising from its incumbency/concession status to charges prices to flat loads that amount to double-charging for the cost of the relevant capacity, which it could not have done if there had been normal and sufficiently effective competition for the provision of network capacity.

22. There is discriminatory abuse because an all-year flat load and a part-year flat load which are both active at peak time are being charged materially different prices even though they use the same network capacity.

British CDCM before DCP 228

23. The CDCM before DCP 228 operates on the basis of things it calls peaking probabilities, which are really peaking frequencies: the proportion of assets at each network level which have their peak within each time band. This is consistent with the idea advocated above of allocating the cost of each asset to its peaking time, and then recognising that there will be a distribution of peaking times and therefore a spreading of costs.

24. There are some incredibly weird and complicated adjustments to peaking probabilities which take place within the Multi sheet of the CDCM spreadsheet model. Whilst these adjustments bring a degree of opacity and some real defects to the methodology, and make forecasting of tariffs harder than it should be, I do not think that they lead to a lot of systematic distortion between peak and off-peak unit rates.

25. The CDCM includes, alongside estimates of network capacity costs, an element of residual revenue or revenue matching which is often positive and large. A major reason for that is that the main cost analysis excludes the majority of costs of repairs and renewals, particularly for low-voltage local distribution infrastructure.

26. In the pre-DCP 228 CDCM, the missing money is instead recovered through an uplift to the costs of the highest voltage level of the network, allocated between unit rates in the same way as these costs (except where doing so would lead to negative prices). This means that the missing charges are levied primarily on peak-time units.

27. The effect of this approach is that peak-time units get overcharged, as they pay for costs which should have been covered primarily from fixed and capacity charges. The magnitude of the error varies a lot between the 14 distribution areas.

28. That misallocation of costs, bad though it might be, does not create a distortion between flat and peaky loads like TURPE does. With the pre-DCP 228 CDCM, people might be charged too much for top-level network capacity, but the overcharge is not discriminatory between different load profiles.

British CDCM after DCP 228

29. DCP 228 changes the CDCM by replacing the residual charge/credit on peak-time consumption with a residual charge/credit applied uniformly to units distributed (except where doing so would lead to negative prices).

30. This flat charge creates a discrepancy similar to TURPE. Like TURPE, it introduces material discrimination in charges between flat loads and less flat loads that use the same amount of network capacity. Thus, DCP 228 is a change for the worse.

31. Ofgem approved DCP 228 on the grounds that the pre-DCP 228 process of charging peak-time units for the missing money "introduces a distortion to the differences between the unit rates" and that DCP 228 "removes much of this distortion".[2]

32. So here is the nub. I care about discrimination identified by comparing a flat load with a less flat load that uses the same services from the distribution network. I want to apply the same £/year distribution charges to a factory that works 24 hours a day and a factory that works business hours only, if all relevant parts of the distribution system are sized by reference to loads during business hours only.

33. In its DCP 228 decision, Ofgem cared about distortions between the charge for a unit of electricity taken at peak time and the charge for a unit taken off peak. This means that Ofgem was not comparing a 24-hour factory with a business-hours factory: instead it was comparing a 6 am to 3 pm office with an 11 am to 8 pm office, and wanted to make sure that the higher distribution charges levied on those who prefer a lie-in did not exceed the costs attributable to consumption during the evening peak.

34. It did not matter to Ofgem that they were allowing discrimination against the factory that would be creating economic growth by moving to 24-hour operation using spare electricity distribution capacity. It did matter to Ofgem to ensure that the incentive against having a lie-in was not too strong. By their priorities you shall know them.

By the way

35. A unit rate calculation methodology that looked similar to TURPE was discussed in the context of the recent CDCM review: I think that it is option 2B in the final report.[3]

36. The difference was that costs were split between distribution units in different time bands in one step (instead of being split between hours first). But the principle, effect and defects are the same as with TURPE: in particular, that method would double-charge flat loads for network capacity. It looks like British electricity distributors can be as wrong as the French, sometimes.

Shameless plug

37. Go to dcmf.co.uk/models to explore further how this works in practice in the CDCM. The spreadsheet model generator at dcmf.co.uk/models is useful because it can give you a wide variety of charging models populated with any of the input data published by distributors since 2010.

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[2] https://www.ofgem.gov.uk/publications-and-updates/distribution-connection-and-use-system-agreement-dcp228-revenue-matching-cdcm

[3] http://www.energynetworks.org/electricity/regulation/distribution-charging/distribution-charging-working-groups.html