

## **Comments from United Utilities on Bath University Benefit Analysis Work**

### **1 General**

This is a valuable piece of work. While the exact quantification of the results is open to debate, we support the overall view that economic charging should lead to more efficient use of distribution networks. Although there is significant scope for further work in the areas of, for instance, reference networks, customer price elasticity and also the effect of connection charges, we believe that this would only improve understanding of the magnitude of the end result rather than change the direction of the outcome.

We are also of the view that the process has succeeded in its secondary objective of highlighting some of the issues that arise when designing particular economic charging methodologies. The issues raised concur with our own understanding, gained also through working with a local university along similar lines, and we have some comments on the detail of the models studied, borne out of this experience.

A general observation at this stage is that our goal should be to develop a consistent theoretical framework, applied across all voltages, within which to establish our prices. However, within each stage of the process there must also be a checkpoint to consider any practical implementation constraints. These can often only be evaluated once some analysis has been done, and we would not therefore support the closing off of options without an assessment of the implications. (This would apply, among other issues, to the potential treatment of connection related costs).

In this context, it should also be appreciated that each cost driver, and each practical constraint, may carry a different weight within different distribution areas. Although we understand the value to be gained from consistency of presentation between different DNOs' tariffs, this does not mean that they should necessarily be based on identical pricing methodologies.

### **2 Cost Drivers**

We agree that the mechanism for attribution of network costs should be based on forward looking costs and have found it interesting to consider the different approaches suggested by University of Manchester and University of Bath. These attach different weight to the differentiation of drivers of asset requirements between the time of use (and the interaction of uses at any time), the geographical location and extent of assets, the degree of 'spare capacity' within existing assets and the distinction between active and reactive power. The more variables that are added to the mix the more complex the model becomes. With complexity comes the possibility (likelihood even) of spurious accuracy in any modelling. We therefore see great merit in a review of the significance of including specific drivers.

For now, it is probably sufficient to acknowledge the value that we would expect to see in understanding the nature of incremental costs relating to changes in both generation and demand at distinct geographical locations. How much of this is worth reflecting into prices to suppliers and generators can only be decided after the analysis has been done.

### **3 Locational messages**

A fundamental benefit of economic pricing of the distribution system is to influence the siting decisions of demand and generation such that they tend to locate together and thus save on network investment. We believe that location is one of the main economic decisions that can be affected by price structures and levels. This implies that any cost models should be able to identify the extent of geographical variation in costs, leaving the option of reflecting significant differences in prices, whether through the use of system charge or connection charge as appropriate. It also implies equity of the marginal cost message between demand and generation (at the same voltage level).

We believe that these requirements mean that the cost attribution model needs to be sufficiently disaggregated geographically to take account of load flows (in terms of capacity demands) on individual network assets. It follows that cost attribution should be based on an asset-based network load flow model.

It is possible to address separately the “technical” features of the network model, relating to the cost attribution process, and the methodology for deriving the “forward looking investment cost” of the individual assets within the model.

### **4 Technical Issues**

#### **4.1 Cost Attribution Principles**

The principle underlying the ICRP network model is that customer capacity requirements drive network reinforcement, and that the forward-looking cost of this reinforcement is driven by:

- The required capacity of the reinforced assets, and
- The length of the reinforced asset

LRIC introduces a further parameter, being the extent of utilisation of the existing network capacity.

The basis of the existing ICRP approaches is that the appropriate (annuitised) branch costs to take into the model are based on (Capacity x Distance). It may be noted here that “Capacity” could relate to the asset rating, which would define a fixed cost for each asset, or alternatively be varied within the attribution model according to circuit loading.

University of Bath identifies a price-stability issue with ICRP models, characterised by long radial circuits being associated with high prices, simply due to their length, and that prices will therefore “flip” as the load flow changes direction, from “demand dominated” to “generator dominated” or vice versa. Our experience suggests that this issue can be addressed within an ICRP model however, by modification to the attribution methodology; it is therefore not a problem with ICRP in itself as a cost basis, rather its application within the attribution model.

## **4.2 DC or AC Models**

The key feature of the DC model is that it provides a linear output. This allows the principle of superposition to be applied, so that branch flows arising from injections at individual nodes can be considered individually and then added together to calculate the combined effect. This is an essential feature for the attribution of costs arising from a combination of peak branch flows that are associated with differing sets of initial conditions.

In contrast, the output from an AC model is non linear and is therefore dependent on the initial conditions assumed. In particular, it is not true to say that the effect of combining two inputs is equal to the sum of the individual effects. This leads to problems of how to attribute total costs to individual nodes.

Therefore, although AC models have a theoretical attraction, we believe that the dependence of the AC model solution on the initial conditions and the volatility of reactive flows could both have pronounced effect on the instability of prices, and that this issue would require further study before pursuing an AC solution.

## **4.3 Treatment of System Security and Non-simultaneous Peak Flows**

We note that the University of Bath's models use the simple expedient of incorporating a system security factor; in this case effectively halving the capacity of individual network components. However this approach can be challenged, particularly in the case of meshed networks or where the HV system provides security for the EHV. A more rigorous approach is to rerun model many times to test all contingencies. This has the benefit of identifying the peak flow on each individual asset, whenever it might occur (a particular issue where a network section is dominated by generation).

The possibility of individual network components having peak demands at differing times can be addressed by anticipating a Time of Year (and Day) tariff, and running the model twice, thus capturing two possible extremes of flows on the network:

- Peak "Winter" – Maximum demand/Minimum generation
- Peak "Summer" – Minimum demand/Maximum generation

This approach could be extended to accommodate a night-time peak, say, by splitting the year into further time slots.

It is for further consideration as to whether these issues are sufficiently significant to warrant this more sophisticated treatment in practical models.

## **5 Cost Issues**

### **5.1 ICRP**

As noted above, we believe that the price-stability issue identified by University of Bath in the ICRP model relates in fact to the attribution methodology rather than the underlying choice of cost base. We have a few comments on the choice of the "right" costs to apply to the incremental assets.

Most approaches try to establish Modern Equivalent Asset (MEA) values, but there are a variety of ways of doing this. Some have suggested using cost projections from the last price control review or the unit costs within that process. It is an interesting question whether to use only the costs of 'load related investment' divided by the extent of load growth or to also allow for replacement investment as well. Our current view is that it is unit costs consistent with network extensions or enhancements that should be used, but we can see the danger of discounting the effects of technological progress in the future. We are also concerned that some parties are looking only at capex, whereas the true incremental costs will also include the future stream of operating expenses triggered by the new investment. The bundle of costs that should be attributed on the basis of the network usage model should therefore include all costs that are triggered by incremental investment, including both direct and indirect opex as well as capex.

## 5.2 LRIC

The key issue introduced by the LRIC approach is the extent to which the spare capacity of existing assets is taken into account when deriving locational prices. We have already indicated that the ICRP model can be modified to take account of actual peak power flows (rather than asset ratings), but a further step would be to include both power flow and rating in the model. The issues to consider are firstly how important utilisation is as a driver, and secondly whether including this parameter introduces any unwanted effects, for example excessive price instability.

Arguably the issue of existing network utilisation is more important on a distribution, as opposed to a transmission, network. The extent of under-utilisation can be significant on the remote parts of the network, related to the “lumpiness” associated with distribution investment, and the requirement on these networks to be more extensive in terms of geographical penetration. In urban areas, conversely, it is not uncommon for there to be a choice of point of connection to the distribution network, with the available capacity on existing assets being a key driver of that choice.

It is appropriate at this stage to also mention reinforcement costs that do not link directly to the capacity and distance drivers e.g. switchgear replacement for fault level. Similarly to circuit utilisation issues, the potential exists for significant, relatively localised, costs to arise because of the particular network conditions that exist at a proposed point of connection.

At one end of the charging spectrum, the concept of full deep charging is to charge purely on the basis of (the lack of) existing available capacity. The inherent instability in prices that result leads to clear inefficiencies: free riding, periods of boom and bust etc. However, it is possible to envisage some form of hybrid approach that takes some account of existing network alongside the pure long-term forward-looking costs.

In theory, the LRIC model proposed by University of Bath, based on the increment in NPV reinforcement costs caused by a nodal injection, can address both the circuit utilisation issue and also the potential for fault-level related costs. Our concern, however, is that the more that “deep” costs are brought into the model the greater the potential for price instability.

The issue of price instability is important in the context of providing a long-term pricing signal, and the effect needs to be thoroughly tested during the development of practical models. In particular, a useful test of any model is to consider in detail how prices change as nodes get near to balance i.e. the issue of price “flipping”. Ideally, consideration of circuit utilisation would address this issue, by ensuring that prices increase as circuits become more heavily loaded, and fall as they become more “balanced”, eventually to zero and then change sign as the node changes from “demand dominated” to “generation dominated”. As indicated earlier, we believe that this issue can be addressed within both LRIC and ICRP models.

## **6 HV/LV Networks**

We note that the study did not consider economic charging models at lower distribution voltage levels, where the costs of implementation may be significant. We also note however that connection charges could be used to convey a locational message, and we would therefore recommend that the assessment of models should embrace the treatment of connection costs so as to inform future debate.

## **7 Further Work**

In order to develop comprehensive pricing models there are significant areas of work that need to follow on from the choice of cost attribution methodology, notably to:

- Establish the customer groups across which to attribute costs;
- Develop yardstick costs for each customer group;
- Calculate tariff components from the matrix of costs; and
- Reconcile expected revenues to the limits implied by price controls.

The last element has implications for cost modeling, which needs to pick up more than the costs associated with network usage. Price control allowances are unlikely to exactly match forward estimates of incremental costs against any category of expenditure, and it is the 'total cost' that needs to be reconciled to allowed revenue.

## **8 Conclusion**

The University of Bath study is useful in drawing out some of the issues surrounding cost attribution methodologies. The University of Bath notes that it was not the purpose of the study to form a view as to the most appropriate form of charging model that might be adopted, and we would further suggest that it might be possible for a network operator to extract and combine aspects from more than one model in order to provide the most appropriate solution for their particular circumstances.