AUCTIONING 'LOSS REDUCTIONS' IN THE ELECTRICITY MARKETS

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ABSTRACT

In this paper the author outlines a radical approach to treatment of electrical losses in the electricity market.

A saving in losses produced by use of more efficient but marginally more expensive plant could be seen as the equivalent of the installation of a mixture of base and peaking generation plant. However it would have no running or fuel costs, and typically last for 40 -60 years with little maintenance.

If the losses saved were treated in the settlement system as the equivalent of a generator then the output of this 'equivalent generator' could be auctioned off by the Distribution Network Operator(DNO) in the open market for it's full economic value.

The result would be optimal investment in losses reduction by network operators, funded by market participants.

BACKGROUND:

Electricity losses on networks are an intrinsic part of the operation of Transmission and Distribution systems, and can account for up to 15% of the units generated., with Distribution losses in the UK running at 6.5% (20TWh) and costing up to £600m per annum.

The 'optimal' level of losses on a network depends on the nature of the network and the cost of generation – some networks may have optimal loss levels of say 4%, others would have optimal levels of over 10%. The real answer is that '*the optimal level of losses is that which results in the marginal cost of reducing losses being less than/equal to the long term marginal cost of supplying these losses from generation.'*

Whilst it is easy to state the principle it is much more complicated to actually calculate the appropriate target level, as most of the factors involved are themselves very difficult to assess e.g. what is the marginal long term cost of generation over the next 25 years?

However despite the difficulty in calculating the optimal target it is in societies interest that losses are reduced toward the optimal target.

In the days of vertically integrated utilities this was much easier as the one DNO optimised the overall long term marginal cost of the electricity unit, making the necessary tradeoffs between investment in Generation, Transmission and Distribution. However with the introduction of competition, generation has been separated from the 'wires' business so that any investment in the 'wires' business are in a framework set by the Regulator.

The reason a Regulator is used is that 'wires' businesses are natural monopolies where economies of scale are critical, so that lowest price can be achieved through Regulation, rather than through competition amongst DNO groups that have no economies of scale.

Effectively the Regulator represents the customer and sets rules which encourages the 'wires' DNO to operate in a manner which is both in the best interests of the DNO and of the customer.

From the Regulators viewpoint incentivising the DNO to make the appropriate level of investment in losses is very difficult, as it not only requires estimation of long term marginal costs from generation but also the cost/benefit of specific networks investments on losses.

REGULATORY INCENTIVES:

UK Approach:

The UK led the way on the introduction of Regulation and Competition in Europe and the strategies adopted were copied by many other Regulators around the world.

The general approach used was to set a target level for losses and then assess the DNO's performance against the target. The actual losses are shared between suppliers/generators in the market according to their volume, and are not a cost to the 'wires' business.

The main drawback with this approach is that the entity controlling the losses (i.e. the DNO) does not benefit from the full economic gains produced by a reduction in losses, only from their performance against Regulatory targets.

This means that society as a whole is disadvantaged as the monetary award set in the Regulatory target is always only a small portion of the gain to society from decreased losses.

Thus the DNO will look at an investment strategy for the development of the network, assess a 'normal' loss option and a 'low' loss option and then compare the marginal cost of each against the benefit allowed in the regulatory target.

This will not bring about an optimal reduction in losses for society as it will be limited to the level set by the Regulator, which may or may not be correct, and also by the utilities view on the attractiveness of the losses investment.

French Approach:

A more economically sophisticated approach has been adopted in France where the Regulator requires EdF to purchase the losses incurred, and funds the allowed level of losses in DUoS.

The benefit of this approach is that the optimal level of network investment required to reduce losses is now within the control of the entity whose networks incur the losses, and the required investment in the overall network, including losses, is optimised.

The regulator's role is then simply to reduce the overall cost of DUoS to the customer by requiring a cut of X% in overall DUoS over the regulatory period. In this case however DUoS includes the cost of losses, which are now a cost to the 'wires' business and are not attributed to the Suppliers/Generators.

However it also means that the utility must buy on the market the residue of losses which remain, and as losses may account to, say, 8% of units sold, this now means that the 'wires' business is a significant player in the market. It also means that the 'wires' business is exposed to trading risk and must develop skills in this area.

REVIEW OF REGULATOR'S OPTIONS:

Between the UK approach where the Regulator puts up a small amount of money as an incentive to reduce losses and the French approach where the losses are paid for through DUoS, there is a very wide divergence.

From the Regulator's viewpoint the criteria which must be fulfilled by a satisfactory framework are that:

(a) the incentive is sufficient to drive the behaviour required

(b) that the benefit to the utility is proportional to the effort required and does not deliver windfall gains

(c) that the results achieved are those that are desired i.e. no dysfunctional behaviour.

It is clear that much of the problem with losses incentives stems from the fact that it is difficult to evaluate the real cost of losses and hence assess their economically optimal level.

In situations where the utility capitalises the cost of losses over (say) 25 years and adds these capitalised costs to the purchase cost of the transformers bought so that the least cost option on a life cycle basis is chosen, debate abounds over the correct capitalisation rate and the cost of long run marginal cost of the electricity unit to be used.

An alternative approach which would let the market decide these questions would give a more economically correct answer.

AUCTIONING LOSSES – A RADICAL APPROACH

Utilities in making investment decisions can choose between options which meets the technical criteria such as capacity and voltage drop etc. and have low losses, or ones which also meet these criteria but have higher losses.

A simple example would be the decision to purchase MV/LV transformers with high or low loss levels.

The marginal cost between a low loss and a high loss transformer may be small as a percentage of the overall purchase price, but the gain received for this extra cost may not be compensated by the Regulator under current incentive schemes. Accordingly, this investment may not be made, although from societies point of view it would be beneficial.

However if the actual savings in losses from the use of such transformers were calculated, then this would correspond to an equivalent amount of generation plant and fuel saved, as well as a reduction in emissions.

Can the savings in losses be calculated for such instances? The answer is 'Yes' – they can be calculated to a level which is approximately correct and this is all that is required.

Once an approximate level of losses saved has been estimated (and this can be made more or less precise according to the effort made) then by applying a suitable 'Safety factor' proportional to the estimate's reliability, an assured minimum value of losses saved can be calculated.

Such estimates are already accepted and done at a macro level in calculating Loss Load Factors for generation. Other areas in which estimates are used and accepted for significant amounts include the cost of unmetered loads such as public lighting.

The losses calculated for the transformer group will vary according to the typical load they feed, their initial loading and will vary on an hour by hour day by day basis. In the case of MV/LV pad mounted transformers they are mainly used to feed housing loads, and are sized to meet the peak load ab initio i.e. the trafo is connected to it's ultimate load of ,say, 200 houses on day one and if load growth occurs it will be on a geographical basis, with extra houses, which will be fed from a new transformer.

So this means that the losses saved can even be forecast/calculated on a day to day basis according to how the system load for the domestic load profile varies.

In effect the losses saved are the equivalent of the output of a small generator, except that this generator has no running or operational costs and requires no fuel.

If the Regulator agrees with Market participants that this 'virtual generator' can partake in the settlement system then no special IT requirements are necessary – it is just input as another generator.

More correctly, it would be input as two generators –one generator, called the Iron Losses Generator would be priced at base load as it's output is always on and constant, and the second, the 'Copper Losses Generator' would be priced as 'peaking plant' as it increases it's output in response to load, and is greatest at highest load.

The output of such 'virtual generators' would be very valuable and attractive to Suppliers, as the zero fuel costs mean that they provide a valuable hedge against volatile fuel prices, and as the output of the generator increases with the square of the load would be particularly beneficial at time of system peaks.

Having established the characteristics of such 'virtual generators' the next step would be to auction their output over (say) a 5 year period. This would be done in a simple public auction process at which Suppliers or Generators could bid.

The benefit of this last step is that the marginal investment in lower loss transformers as now covered by the monies received from the auction, so that the utility is immediately recompensed for their extra investment. In fact as the utilities marginal expenditure is really only on extra kgs of Iron and Copper, and as the benefits are in kWh saved, then the monies received from the auction are likely to be many times greater than the original investment.
Essentially, the auction is allowing market forces to forecast the price of electricity over the next 5 years and discount this at the appropriate interest rate! By using 5 years the risk for the buyers is reduced and the income derived from the investment by the utilities will more closely track the real value of the losses saved i.e. there will be no major windfall gains or losses for Suppliers/Generators.

The optimal amount of investment in losses by the utility can be assessed by the auction returns – if these are higher than the marginal investment cost then further investment in losses is still economically sound. As the auction product is essentially a financial instrument it can subsequently traded in the market, so that the market price at any time can then act as an up to date estimate of the value of losses.

From the above it would seem that such an approach is even better for the utility and would allow the utility to recoup the full market value of the losses saved, and as the 'wires' utility is the only source of such investments, it would be a perfect business to be in.

Of course this is why there is a Regulator! The Regulator looks at the excess return earned in the auction and, having allocated some to the utility as an incentive, uses the remainder to reduce DUoS.

This means that whilst the utility will earn a good, safe return, it will not earn any super-normal profits.

This sounds as if it is a 'win/win' for all participants, so who loses out? Obviously fuel suppliers – essentially energy which would have been wasted has now been saved, with less fuel being consumed as a result.

The benefits of such an economically transparent system would be that :

(a) the market would determine the optimal investment in loss reduction, not the regulator or the utility

(b) supplier/generators would be able to buy 'generation capacity' which had no fuel costs and thus helped hedge their fuel exposure, and, by definition at a price below which they would have been able to generate these units themselves

(c) the 'losses equivalent generator' has the attraction of following the system load curve 365 days a year an increasing output at times of peak (due to I^2R)

(d) the siting of the 'virtual generation' is geographically spread and is proportional to the load in the area

(e) Overall system losses would decrease which would be of benefit to all customers and even those generators who did not bid at the auction

(f) Utilities would be incentivised to do extra work to decrease losses and as a by product would have low loss plant which was more reliable (lower temperature operation).

(g) Environmental costs such as CO2, NOX, SOX are implicitly catered for insofar as these costs are included in electricity unit costs

(h) Customers would save on DUoS and on Generation costs.

FURTHER AREAS FOR LOSSES SAVINGS:

In the above section a situation has been considered where the marginal extra cost of low loss plant has been funded by the market.

Currently, losses incentives in any jurisdiction would never justify network investments to minimise losses only. However with this new approach this may no longer be the case.

Consider a situation where a heavily loaded network is within all planning standards- capacity is adequate, voltage is within limits and security of supply criteria are met. However as a rough estimate the optimal loading on these circuits to minimise losses might be 30%, whereas their actual loading could be 50 – 60% +.

Splitting such circuits would dramatically reduce losses, and in fact such reinforcement could well be what is planned in 10 years time.

So measuring the load and losses on such circuits and then carrying out the investment (with half hourly metering being installed on circuit outlets) would give an accurate model of losses saved. Again this could be auctioned for the 10 year period.

ARE THERE RISKS?

The main risk would be the impact of a serious discrepancy between the losses expected to be saved and those which actually were, but the impact of this risk actually quite minor.

The losses estimated can be over or under estimated. This 'error' can only persist for 5 years at which time a new auction takes place, so that there is a time limit on the impact of such errors.

If under estimated then the auction results will be less than anticipated and the 'wires' business will receive a lower return. More losses will actually be saved than expected and so overall losses will reduce and the benefit will accrue to Suppliers in general, and, in an efficient market, will also pass to customers.

If overestimated then the 'Wires' business will receive extra money, although the auction buyers will just receive the amount of losses bought i.e. auction participants will neither gain nor lose. The extra losses not saved by the 'virtual generator' will then end up allocated to all participants in the market. This is what happens with residual losses anyway, except that the residual losses will be less than what would have been the case if no auction had occurred. Furthermore, most of the excess gained in the auction by the 'wires' business will automatically pass back to customers via a reduction in DUoS.

However underestimation can be easily avoided by a conservative estimate of losses saved in the first place.

SCOPE FOR APPLICATION:

The scope for application will be limited by the amount of network refurbishment and new works being carried out by the utility, as in the past loss reduction projects on their own will normally not have a high enough return to justify their introduction.

However, this also means that there could be a wealth of projects which have not previously been investigated, and which under more favourable terms would now be justified.

The introduction of the methodology is simple and low cost. No IT changes need to be made to the settlement system as the 'virtual generator' simply plugs in as a normal generator (if bought by a Generator) or is netted off the demand (if bought by a Supply company).

The greatest time delay would be in setting up term contracts for the purchase of low loss equipment.

Overall the scheme could be operational within a year!

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