DEPARTMENT OF ELECTRONIC & ELECTRICAL ENGINEERING

Prof. Keith Bell BEng (Hons), PhD, FHEA, MIET, CEng
Dept. of Electronic and Electrical Engineering
University of Strathclyde
Royal College Building
204 George Street
Glasgow G1 1XW
Tel. 0141 548 4651 (direct)
keith.bell@strath.ac.uk

Catherine Williams,
Head of Commercial Regulation –
Electricity Transmission
Ofgem
107 West Regent Street
Glasgow
G2 2QZ

May 27, 2014

Dear Catherine,

Re. Project TransmiT: Further consultation on proposals to change the electricity transmission charging methodology

If transmission charging is intended to reflect the transmission infrastructure costs consequential to use of the system by generation and demand, it should reflect, at least to some extent, the transmission capacity that would be built to accommodate that generation and demand, i.e. the drivers of additional transmission.

In some parts of the system, transmission reinforcement is driven by the need to secure imports of power, the critical condition generally being peak demand. In other parts of the system, transmission reinforcement is driven by exports of power with a trade-off being made between transmission infrastructure cost and the cost of re-dispatch of power, i.e. cost of constraints. To be accurate, the latter should be assessed for conditions that can be reasonably foreseen to arise in the course of a typical year of operation. However, as has been noted by Ofgem in its consultation on Project TransmiT of April 27, the NETS Security and Quality of Supply Standard (SQSS) does include a concept of 'economy driven' reinforcements determined by rules that act as a proxy for a balancing off of the annual cost of constraints with the cost of reinforcements.

One of the features that the GB electricity supply industry desires for the transmission charging methodology is that it is simple. In general terms, a methodology that accurately models the transmission design process and the drivers for additional transmission cannot be expected to be simple. Moreover, very sophisticated models can be highly sensitive to input parameters and are prone to giving highly variable results whereas the industry also prefers a methodology that gives quite stable and predictable results.

The CUSC Amendment Panel has considered a number of options that might allow the transmission charging methodology to remain relatively simple while approximating the energy transfers that, for an exporting case, would drive either transmission reinforcement or re-dispatch of generation. As an experienced power system modeller and analyst who has conducted or advised on the development of a number of software tools for computation of power system behaviour, it is my judgement that it is impossible for a model and the software to implement it to be both simple and, for a large and complex system like the GB transmission system, highly accurate. A compromise must be made. That being so, the key questions that should be answered in respect of any change to the charging methodology are, in my judgment, as follows:

1. does the proposed revised methodology remain sufficiently simple, at least by comparison with the present methodology?

2. does the proposed revised methodology better meet the principles of transmission charging and the purposes of the CUSC than the present methodology?

In my view, the answer to both of these questions is 'yes'.

While my judgement is that the proposed revised methodology better meets the principles of transmission charging and the purposes of the CUSC than the present methodology does, it is important for significant changes to be backed up by evidence of their benefits. Given the size of the industry, the burden of regulatory processes and the difficulty of defining and implementing a control, there is no opportunity to test the proposals by means of a 'real world' experiment. One must then depend on modelling to test the effect of the proposed changes.

There have been various iterations of analysis by Baringa in respect of the possible impact of the proposed changes to the transmission charging methodology. The most recent suggests an overall benefit arising from the proposed changes. However, it is apparently relatively small. It therefore remains important to think through the implications of the changes and test them by means of a 'thought experiment'. An attempt to do so is presented below.

In general, in respect of any industry code change, one may expect there to be 'winners' and 'losers'. In respect of the proposed transmission charging methodology change and given that the main demand centres are predominantly in the south, in simple terms one may expect the winners to be:

- wind (that inherently has a relatively low capacity factor) in the north;
- marginal plant (other generation with a low capacity factor) in the north;
- marginal plant everywhere.

In simple terms, the losers might be:

- base load plant (generation with a high capacity factor) in the south;
- base load plant everywhere.

To 'win' or to 'lose' is only relative and the extent of gains or losses in any of the above categories will vary. However, it is also important to note that it is not actually a zero-sum game. In other words, the sum of the gains is not equal to the sum of the losses. This is because the total sum recovered by the transmission licensees for transmission infrastructure may be expected to change, and this will change, among other things, because of the changed location, over time, of different types of generation, partly as a consequence of changes to the transmission charging methodology.

When assessing the overall impact of the proposed charging methodology change on the total cost of electrical energy, one may ask, relative to the current charging methodology:

1. does the change cause a bigger increase in the cost of generation than decrease in the cost of transmission? Or,
2. does the change cause a smaller decrease in the cost of generation than increase in the cost of transmission?

(If competition is effective, reductions in the cost of generation should pass through to consumers in respect of both energy and capacity.)

If the answer to either 1 or 2 immediately above is yes, the change is a bad one. Otherwise, the change is a good one.

To help answer the questions, some particular issues may be considered.

a) Under the proposed change, would more generation connect in the north than under status quo? If this extra generation leads to an increased sum of constraint costs and infrastructure costs, this looks like an undesirable outcome (though if constraints income accrues to generation that stakeholders really want to be built and it somehow reduces what needs to be paid to it by other means, the effect, at least to some extent, is softened). Similarly, would the proposed change lead to less generation in the south? If this reveals an insufficiency of transmission import capability in the south, either southern generation must be paid to remain or become available or there should be an enhancement to transmission infrastructure in the south.
b) The proposed methodology change reduces transmission charges in the north relative to the status quo for low capacity factor plant. A generator's decision to build such generation in the north means that the profits associated with that generator will be bigger than under status quo. This suggests private benefit but not necessarily societal benefit. If that larger private income can be offset by reduced additional financial support via other mechanisms, e.g. low carbon contracts for difference, then consumers share in the benefits.
c) The proposed change increases transmission charges to base load generators in the south for which, as a consequence, costs increase. If these generators are to remain open and profits maintained, there must be increased revenue from energy, from capacity or from both. In other words, in respect of these generators, the total cost of generation will increase. However, if, either as a consequence of there being more renewable generation or because of the increased costs, this southern, base load generation becomes more marginal, its capacity factor will reduce and the increase in transmission charges will not be as high as would otherwise have been the case or perhaps the increase in charges would be eliminated completely.
d) In view of the approximations inherent in either the current or the proposed charging methodology, actual constraint costs and transmission infrastructure costs associated with each location are unlikely to be the same as those signalled by the charging methodology. How does the charging methodology err? If the methodology under-estimates the impact that generation in the north has on the total cost of transmission, more generation will connect in the north than should 'really' be the case. If it over-estimates the impact, then less generation will connect in the north than should 'really' be the case.
e) From the perspective of the transmission charges levied on a generator under the proposed change, to build generation in the north, of any type and any capacity factor, is still more expensive than to build similar generation in the south. Suppose that the methodology imposes a charge in the north that, because of the inherent approximations, is higher than it should be. If a generation developer goes ahead and builds in the north anyway, in spite of the higher charge, then it may be robustly concluded that it is the 'right' place to build the generation. Our concern then might be to make the 'excess' costs the generator faces as low as possible. If the methodology is still erring on the side of, in effect, *signalling* more transmission than is actually built, can we be confident that the transmission charging change is good for consumers?

It may be accepted that the signals given by the transmission charging methodology are not perfect, primarily as a consequence of the compromise between accuracy and simplicity. The methodology might suggest (through the difference in zonal tariffs) a lower impact on the total cost of transmission than is really the case. For example, more generation might be attracted to the north than, in theory, should be. In the short term, constraint costs would be higher than they should be and, as a response to that, more transmission infrastructure would be built than should be. The latter will reduce the total cost of constraints but, because transmission reinforcement does not (and should not) totally eliminate constraint costs, both constraint costs and transmission infrastructure costs would be higher than they should be.

Instead of the above, the methodology might suggest a higher impact on total cost of transmission than would really be the case. This might act as a deterrent to investment in generation in the north. If generation still connects in the north, the extra cost of transmission infrastructure would be more than adequately recovered from generators in the north (and, as consequence of the inaccuracy of the charging methodology, generators in the south would pay less than they should). The excess signal would nonetheless be expected to lead to higher overall cost of generation than would ideally be the case (because at least some of the generation would be in the 'wrong' place) but lower cost of transmission.

To summarise, the following outcomes are possible in respect of a change to the transmission charging methodology and errors within it:

i. The methodology under-estimates the effect of generation in the north on the total cost of transmission (constraints plus infrastructure). (Less money is recovered from generation in the north than should be; the balance is recovered from generation in the south which pays more than, in an ideal world, it should).
ii. The methodology over-estimates the effect of generation in the north on the total cost of transmission. (The cost of transmission infrastructure is over-recovered from generation in the north; generation in the south would pay less than, in an ideal world, it should).

The issue is not really whether the proposed charging methodology change gives the 'right' signals but whether the change gives *better* signals than the current methodology. As already noted, the proposed charging methodology change will make the cost of using the transmission system lower for low capacity factor generation in the north than under status quo. This may be expected to increase the attractiveness of investment in the north and, according to the Baringa analysis, reduce the cost of wind energy. If, in spite of being lower, the methodology still over-estimates the effect of low capacity factor generation in the north, i.e. charges are higher than they should be relative to the impact on the actual cost of transmission, we can be confident that the change is better than the present methodology even though it is not perfect. (Similarly, by over-estimating the effect of generation in the north, the impact of the change on generation in the south would be lower than it 'should be'). Furthermore, because the locational signals are stronger than they 'should be', the total cost of transmission ought to be lower than it 'should be'. However, the cost of low capacity factor generation will be reduced relative to the status quo.

Given that wind generation, in particular, does not substantially and reliably contribute to meeting the peak demand but does significantly reduce dependency on fossil fuelled plant during higher wind periods, it does not seem reasonable that transmission charging should be based solely on power flows at time of peak demand with all generation contributing equally as is the case in the status quo. Furthermore, in respect of 'economy driven' transmission capacity, it does not seem reasonable to assume that both low and high marginal cost generation are assumed to use transmission simultaneously at *all* times. Given the way the two different drivers for transmission – 'security' and 'economy' – are represented along with 'sharing factors', the proposed methodology does, in principle, seem to be better than the present one. In respect of how the signal given by the methodology might err, two relevant observations might be these: the 'sharing factors' are generally conservative; and the ICRP approach does not recognise 'headroom' transmission capacity or its 'lumpiness'. It effectively assumes that every additional MW of power flow resulting from additional generation or demand at any location requires a change in transmission capacity. In general terms, this represents an over-estimation of the impact on the cost of transmission compared with what would often be the case. As consequence and using the logic from the 'thought experiment' above, I believe it may be concluded that the proposed new methodology, while arguably not perfect, is better than the present one.

Yours sincerely,

Prof Keith Bell