Mathematical & Computer Modelling

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Guy Donald
Distribution Policy
OFGEM

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Dear Guy,

Distribution use of system charges:

Way forward on higher voltage generation charging

OFGEM paper 134/11 October 2011

Please find attached a response to the above consultation. As you will be aware the proposed methodologies have been developed over several years, becoming increasingly complex in an effort to deal with the many problems raised when faced with actual implementation. The economic model on which the methodologies are based can be seen as inadequate and inappropriate for determining charges for discrete embedded generation. I haven't dealt with this in detail in the response but essentially either the charges are so weakened that they are ineffective or they are large enough to be of major concern to generators and are likely to be challenged.

Option 2 which drops the locational part of the generation charges seems to offer an adequate solution and should enable the Distribution Charging project to be implemented by April 2013.

If you should require further detail, please don't hesitate to get in touch with me.

Yours faithfully,

Robin Hodgkins

Distribution use of system charges: way forward on higher voltage generation charging: OFGEM paper 134/11

October 2011

Response by Mathematical & Computer Modelling

Summary

Part 1 of this paper reviews the issues raised by OFGEM's consultation paper 134/11. Part 2 provides responses to the specific questions raised by OFGEM.

A review of the methodologies for setting charge rates for EDCM generation discloses a number of issues in terms of the rationale for both the LRIC and FCP methodologies and in terms of their outputs. The aim of introducing new methodologies is to change customer behaviour to yield economic benefits. On the whole, because of severe capping, LRIC is unlikely to significantly affect customer investment decisions or customer behaviour, although some customers are likely to feel they are being unfairly treated and may challenge the arbitrary basis by which charges are set. In some cases the FCP methodology could lead to high enough charges to affect customer behaviour. Of likely concern is the setting of high charges for existing customers making full use of available network capacity. Causing such customers to reduce or cease generation would in general result in a reduction of economic benefit and possible (successful) legal challenges from affected customers.

The concerns expressed by generators over volatility and lack of long term predictability have not yet been addressed. The paper sets out a number of conditions which need to be addressed if the scheme as proposed by the distribution companies in their proposals of April 2011 were to be introduced.

However, it is concluded that the simplest and safest way forward is to drop the locational charges for generation (Option 2). Locational signals are already provided by the connection charges and by the proposed generation benefit. The complexity of further refining the proposed model introduces further arbitrary assumptions which reduce the credence of the methodology. Instead Generation Side Management Schemes should be introduced to resolve issues in particular cases and a framework for these needs to be agreed with generators before implementation of a new methodology.

Part 1

The rationale for charging distributed generation

The overall aim is to encourage generation to locate at sites which minimise the need for network reinforcement and offset predicted growth in demand that might otherwise require reinforcement. The latter aim is met by the introduction of generation benefits determined from the demand charging models. In general the distribution network has been built to supply power to demand customers. Therefore the presence of distributed generation serves to offset the need to supply generation from the transmission system. No distribution charges are levied on generation supplied from the transmission system since it is in effect simply the reverse of demand. This doesn't have to be the case since the supply of electricity could be seen as a transaction by the supplier between the generator and the demand customer and it would be for the supplier to pay distribution charges and recover them from the generator and the demand customer. However, this doesn't offer an easy way out since the definition of the path, other than in a radial network, is not uniquely defined, witness the issue of attributing losses on the transmission network.

Accepting the historical approach and starting from the standpoint that power generated on the transmission system does not pay distribution charges, then distributed generation should only pay for the additional costs arising from being sited locally (and should of course receive the benefits arising from any reduction in costs). When deep connection charges were levied then the generator paid up front for these costs and it was reasonable that charges should only be levied for any O&M not covered up front and billing costs etc. With the introduction of shallower connection charges only a portion of the charges were paid up front with the remainder being recovered as uniform charge on all generators as a £/kVA connected, i.e. it was no longer site specific. This was a deliberate attempt to encourage generation which was being deterred by substantial connection charges at many sites. One argument for the change was that it was for the distribution company to make the network fit for purpose.

Implementation issues

The desire to introduce locational forward looking charges according to their effect in bringing forward or delaying future reinforcement raises a number of major issues when applied to generation since there is no forecast of where new generation is likely to be sited. A proportion of new generation is likely to be small scale (photovoltaics etc) at LV and HV and will be seen at EHV as a decrease in demand, as will energy saving measures. As such, it may imply that some reinforcement is needed. However, the assessment of whether reinforcement is required is based on the coincidence of minimum demand and maximum generation. These may only overlap for short periods, if at all, and in general this problem should be manageable with Generation Side Management agreements rather than expensive reinforcement.

The greatest part of new generation on the distribution system is likely to arise from the introduction of further medium size generators such as wind farms. These are very likely to be sited in areas where the local demand is low. The aim of locational charging is to encourage developers to choose sites where reinforcement is not required. However the proposed charging methodologies impose charges which penalise that existing generation which make full use of the available capacity,

the grounds being that any additional generation would require network reinforcement. Once reinforcement has been carried out, then the network would no longer require reinforcement so charges would then reduce and the new generator would not pay fully for the cost incurred. So the signals imposed by deep connection charges have been weakened and replaced by a charge which may serve only to discourage existing generation.

However, post 2005 generators will have only paid shallowish connection charges and remainder is notionally recovered within the generation revenue target, along with the DNO generation incentive payments.

LRIC and FCP results

There are fundamental differences in the assumptions of the two methodologies and comparative site by site results have not been published. However, some comparisons can be made in terms of the range and magnitude of the proposed charge rates. Note that the total recovered is set by the generation revenue target although the split between that recovered by the EDCM and CDCM may vary. One factor is that the proposed locational charges for both LRIC and FCP are in effect capped. The worst case is where a single generator causes the asset(s) maximum capacity or rating to be reached at the time of minimum demand. Here the years to reinforcement (LRIC) or the headroom (FCP) is zero and there are no contributions to the cost of reinforcement by other customers. LRIC severely caps the reinforcement charge by introducing a recovery factor which limits it to:

LRIC maximum charge rate = a A/G £/kW p.a.

where a is the annuity factor, A (£) is the cost of the reinforcement and G (MW) is the maximum generation. This rate is approximately 20% of the maximum charge rate without capping.

The equivalent FCP formula when the headroom is zero, is:

FCP charge = P_V A/ (10G + P_V 10G_{New}/2) £/kW p.a.

where P_V is the probability factor of new generators being sited within the Network Group at voltage V and G_{New} is the expected amount of new generation locating in that Network Group within the next 10 years. The worst case is when G_{New} is small and P_V is large. The implication of P_V being greater than unity is that the introduction of a test size generator at all existing substation locations at a particular voltage level would be insufficient to accommodate the expected amount of new generation over the next 10 years[1]. Therefore the maximum FCP reinforcement charge rate becomes:

FCP maximum charge rate = 0.1 A/G £/kW p.a.

In practise this is not likely to be reached since whenever P_V is large it is likely that G_{New} will also be large. The FCP maximum rate is approximately double that of LRIC since the LRIC annuity rate is based on a 40 year period whilst FCP only charges for reinforcements expected within the next 10 years and recovers the cost over the shorter period.

[1] It would seem desirable to insert within the definition of P_V that this is limited to a maximum value of unity.

In general neither of these rates would appear to be excessive and are equivalent to the rates that would be levelled on demand customers. However, when the cost of reinforcement is high, as could be the case if a long circuit would need reinforcement, then the actual charges could reach a high level. The charge rates issued by the DNOs in their submission of April 2011[2] show a maximum rate of approximately £25/kW p.a. (see table below) and the 90th.percentile of those with a positive charge of about £4.6/kW p.a. The maximum figure corresponds to about 0.5p/kWh for a generator with a load factor of 50%. This would be a significant rate, especially for intermittent generators which could have a substantially smaller load factor. When the aim is to modify customers' behaviour this level of charge would appear to be reasonable provided it can be justified.

Also shown is the largest generator benefit applicable to an eligible generator for each kWh produced in the super red time band. The final column coverts this into a £/kW p.a. rate assuming 100% generation throughout the super red time band.

It is noticeable that the FCP charge rates are generally higher than for LRIC. Only one LRIC charge rate (£16.17/kW p.a.) appears in the highest 35 rates, the second highest LRIC rate being £4.31/kW p.a. The table summarises the data but note that the averages quoted are not weighted for capacity as the capacity of individual generators are not given. All data relates to generators with a non-zero export capacity charge.

Company		Charge>0	£/kW p.a. Max. Charge	£/kW p.a. Mean Charge	p/kWh Max.Benefit	£/kW p.a. Benefit
NEDL	LRIC	5	2.26	1.66	1.26	3.78
YEDL	LRIC	2	16.17	9.45	1.35	4.05
CNE	FCP	33	2.88	1.66	3.73	9.59
CNW	FCP	15	5.91	1.33	10.39	26.72
ENW	LRIC	33	2.99	1.02	3.69	6.33
SPD	FCP	41	7.88	2.33	7.63	19.62
SPM	FCP	17	24.82	7.81	6.34	16.30
SEPD	FCP	28	2.19	1.29	3.77	11.31
SHEPD	FCP	133	11.10	2.47	0.51	4.32
EPN	LRIC	9	4.31	2.20	5.29	13.60
LPN	LRIC	1	1.50	1.50	2.46	9.62
SPN	LRIC	6	5.11	1.14	8.95	23.01
WPDWales	LRIC	36	3.80	1.48	13.01	26.95
WPDWest	LRIC	32	3.52	1.57	18.11	30.01
	FCP	267	24.82	2.50	10.39	26.72
	LRIC	124	16.17	1.55	18.11	30.01
All		**391**	**24.82**	**2.20**	**18.11**	**30.01**

Effect of charges

In general it appears that the level of the LRIC generation charges are unlikely to modify the behaviour of an existing generator although it could encourage generators to contract for a

[2] 'Appendix 1A, revision of 12 April.xls'.

somewhat reduced capacity if their existing capacity is rarely attained. However, DNOs may be able to take account of this in other ways. The LRIC outlier needs validation.

The question arises as to whether the differences in charge rates are capable of providing a sufficient incentive to influence the choice of location to intending generators? This poses a very complex problem for an intending generator. A high charge rate indicates that in order to accommodate a sizeable amount of new generation, then network reinforcement is likely to be required; in such a case there may be a significant connection charge. This could be offset by a much lower charge rate once the reinforcement has taken place. So customers would in principle either seek sites where there was more than ample spare capacity so that even with additional generation the charges would be low, or sites where the rate would be low due to reinforcement necessarily being carried out to accommodate the new generation. However, in economic terms there is benefit in utilising any site where the required capacity exists as it makes better use of existing assets.

The LRIC charge rates would seem in general only marginal in influencing the choice of site. It is noticeable that for eligible generation considerably larger incentives are often available via the generation benefit derived from reducing the need for demand led reinforcement.

A major issue is that customers are not provided with the information to carry out these assessments. It is of vital importance that customers are able to understand the basis, not only of their own charges, but also, if alternative or new sites are to be considered, of all feasible sites. No information is provided for sites other than those with existing generation. No predictions can be made by the customer about future charge rates. Both charge rates and generation benefits will change should new generation be introduced and these are outside the control of the customer. Thus should charge levels be sufficient to influence the actions of the customer, then the fears expressed by customers regarding future volatility would appear to be justified.

The fact that FCP and LRIC can apparently give significantly different charge rates is an indication to the customer that the underlying economic theory is insubstantial and both methodologies introduce arbitrary assumptions. If the charge rates are substantial then this could signal unwarranted differences between different distribution areas. The severe capping of LRIC results in fairly insignificant locational signals. FCP gives generally more substantial locational signals in accordance with the original intention, but can then penalise existing generation.

It has been suggested that most new generation pays little or no connection charges for reinforcement of shared assets. This would appear to indicate that the shallowish connection charges provide a major deterrent to new generation locating at sites where network reinforcement would be required. Neither data analysis nor customer studies appear to have been carried out.

Other major factors

As has been pointed out previously, it has been assumed that the P2/6 rules apply to generation. This was adopted as a compromise as some DNOs apply P2/6 and others do not. In general there is no economic basis for applying P2/6 to generation. There may some cases (nuclear, large hydro

schemes) where alternative supply routes are vital, but it would appear to be an unwarranted cost of investment to reinforce the network to provide P2/6 security levels for many smaller generators. Of course, this is probably not in fact provided, in which case any attempt to charge on that basis should be prohibited. Removing this condition, except where warranted, could substantially affect the need for reinforcement and hence the locational charges. No study of this has been issued.

Another factor, not included in the development of either the LRIC or the FCP methodologies, is the effect of price elasticity. If the elasticity is zero or very small, then there will be no significant change in customer behaviour and no point in introducing the charging methodology. On the other hand if the customer responds to price signals then this needs to be incorporated in the economic model. In particular, the cost of accommodating customer requirements (which should determine the level of charges) is the minimum of the cost of reinforcing the network and the cost of changing customer behaviour. Furthermore, the customer behaviour only needs to be changed in periods when network capacity is insufficient. It would seem that most, if not all, such cases could be met by GSM agreements. Such agreements are desirable whenever they reduce network costs and work most effectively where they offset charges which customers are keen to avoid.

As stated by OFGEM, a major reason for this consultation has been the responses of generators to the consultation of April 2011. It is imperative that generators believe that the charges are fair and set on a sound basis. The aims will not be met unless generators have confidence in the system. This requires longer term stability of prices and the ability for generators and their advisors to assess charge rates for themselves. Neither of these conditions is currently met.

Conclusions

The underlying economic theory on which both LRIC and FCP have been based cannot be substantiated for generation when most generation takes place by new sizeable generators rather than steady growth of existing and small incoming customers. In contrast to the demand model, the location of new generation is unknown. In particular:

It penalises existing generation sized to make most use of existing capacity.

It discourages new generation which might make use of the remaining spare capacity.

The reinforcement charge rate does not affect any new generation which would actually require network reinforcement, since the charge rate sinks once reinforcement takes place. The only deterrent is the connection charges which are already in place.

Customers are unable to understand the basis of the charges since information on the network is not published in sufficient detail for independent calculations to be carried out.

Customers are unable to determine charges for alternative sites.

Customers are unable to predict future charges which are affected by new entrants.

It assumes an unwarranted level of reinforcement by assuming P2/6 security which is not generally applicable to generation.

It fails to consider explicitly the alternative of GSM agreements.

The level and distribution of the LRIC generation reinforcement charges are in general unlikely to cause any significant change in customer behaviour. Any outliers need investigating. A non-locational uniform charging would seem to be far simpler, cheaper, and less likely to be subject to challenge.

Some of the FCP reinforcement charges are such that they could cause changes in customer behaviour. The response would not necessarily lead to any overall economic benefit and could cause a loss if the viability of existing customers were to be threatened. Large customers would be prepared to challenge such charges (as has already been evident in response to previous consultations).

Therefore, before introducing charges derived from FCP, it would be necessary to:

Ensure that P2/6 security is only applied where it is necessary.

Ensure the model is fully transparent and complete data is available.

Clarify the use of GSM agreements.

Carry out an individual validation of all substantial charge rates.

Recommendations

It is recommended that the locational aspects of the generation reinforcement charges are omitted (Option 2). The locational signals are then provided by the connection charges and the generation benefits.

Further work needs to be undertaken in conjunction with generators to agree a framework for GSM agreements.

Part 2

Responses to questions posed by OFGEM

Question 2.1: Option 1 – Do you think that charges more or less appropriately reflect costs imposed by DG, following the removal of (some or all) pre-2005 DG?

It is reasonable that the generation charges should recover the cost of generation reinforcement not recovered in the connection charges. There is an argument for some of the generation incentive to be recovered from demand customers, since an overall aim is to encourage new generation and discourage enhanced demand. However, the average generation charge needs to be at a level where GSM agreements can offer a worthwhile incentive to generators to limit export when network capacity is reached. It would be helpful to understand the substantial differences in the changes for distribution areas between the current revenue recovery and that when pre-2005 EDCM DG is excluded (6% increase overall, SHEPD 900% increase, WPD 50% reduction).

Question 2.2: Option 2 – Do you think it is appropriate to include a generation-led reinforcement (locational) charge? What are the advantages and disadvantages of removing such a charge?

No. The locational charges as proposed can be seen as largely arbitrary, can penalise existing customers and may result in loss of economic benefit. They lead to volatility and are unpredictable where long term investment decisions are required.

Question 2.3: Option 2 – This option may result in increased charges for generators currently in demand-dominated areas of the network, compared to those predicted under the EDCM. However, this could be matched by a decrease in potential volatility. What are your views on this potential trade off?

There is no substantial benefit in new generation siting in demand-dominated areas unless it reduces the need to reinforce the network. This is rewarded through the generation benefits.

Question 2.4: Option 3 – Do you think that the EDCM should continue to calculate charges as if all generators continue to be charged? What is the reasoning behind your response?

This depends on the decision on future charging of pre-2005 generators. It would seem desirable to avoid substantial changes if pre-2005 generation were to be added.

Question 2.5: Option 4 – Is it appropriate for EDCM generators to recover their share (based on their capacity relative to CDCM) of the DG incentive revenue (i.e. 80 % of generation-led reinforcement costs plus £1/kW incentive revenue)? If not, how should this incentive revenue be recovered?

See Q2.1

Question 2.6: Option 5 – Do you think it is better to revisit the methodology more fundamentally?

No. Option 2 offers an adequate solution which is an improvement over the present system in that it includes generation benefits. There appears to be no prospect of an acceptable alternative methodology being developed (and implemented) within the present Price Control period.

Question 2.7: Option 5 – What cost signals do you think generators have the ability to respond to?

Generators respond to connection charges and have expressed the view that even the shallowish connection charges can be a deterrent. Most generation should be able to reduce or cease export in response to signals that the network is overloaded. It is important that GSM agreements are

generally introduced and should be obligatory for all new generation. To impose them later could prove difficult. ShouldP2/6 security be required, then this should be paid for at connection time.

Question 2.8: Do you have any other suggested modifications to the proposed methodology?

Not at present. However, a detailed examination of the basis of actual charge rates could throw up anomalies. Option 2 would minimise this.

Question 2.9: Which of the options (if any, or including a combination) do you think would enable the EDCM for DG charging to fulfil the Relevant Objectives set out in the licence after the removal of exempt generators? Why?

Option 2 would seem to offer worthwhile improvements over the existing method by introducing generation benefits. It avoids controversial locational charges which could be deemed arbitrary and could well require the introduction of further modifications should some generators challenge their charges.

Question 2.10: What is the most appropriate way of redistributing the unrecovered revenue from exempted generators to other users of the network?

If exempted generators have already paid through connection charges, then this should not be considered as unrecovered revenue, but simply as part of the overall revenue to be recovered from all customers including CDCM.

Question 3.1: Do you think EDCM charges for non-exempted generators should apply from 1 April 2013? Why?

Yes. This would appear to give adequate time if based on Option 2.

Question 3.2: Do you agree that the boundary change for generators should be deferred to coincide with the implementation of EDCM generator charging? Why?

Yes. It would be very confusing for generators to have to face two changes in a short period when they are looking for long term financial arrangements.

Question 3.3: Do you have any comments on the suggested timetable for the reconsideration and subsequent approval of EDCM charges for DG?

No.