A TOOL TO ANALYSE THE REGULATORY INCENTIVES ON A DISTRIBUTION NETWORK OPERATOR AT A PROJECT LEVEL

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ABSTRACT

Although distribution network operators face economic regulation that operates at the level of the whole network business, commercial performance is a consequence of decisions taken about and impacts of a portfolio of individual projects. A new spreadsheet tool has been developed to investigate the links between individual projects and the complex regulatory package for the network operator as a whole, based on the regulatory system in Great Britain. Applying the model to one typical microgeneration scenario demonstrates that the regulatory system does not financially incentivise DNOs to actively encourage microgeneration connections.

INTRODUCTION

The economic regulation of the regional electricity distribution networks in Great Britain is based on a system of price and revenue caps, plus various performance incentive schemes. This regulation takes place at the level of the whole distribution business.

However the network performance, income and expenditure of a whole distribution network business are consequences of a portfolio of past and current network projects, together with the actions and requests of network users. Decision making by the network operator either occurs on the level of an individual project or at the level of policies applied to projects. A need can therefore be identified for analysis of the complex regulatory package that links the impact on the business as a whole with the project level.

This generic problem has been investigated in the context of distribution network regulation in Great Britain. The energy regulator, Ofgem, has set a framework for the economic regulation of the fourteen Distribution Network Operators (DNOs) for five years from 1st April 2005 to 31st March 2010. Distribution Price Control Review 4 (DPCR4) determines the allowed income of the DNO during this period. Ofgem's documents for DPCR4 [1, 2] describe the effects of network performance, income and expenditure on the permitted or regulated income of the whole DNO.

A spreadsheet model has been created in Excel to investigate the issue. All business-specific information in the model refers to the United Utilities network. However the inputs to the model may be easily altered to any other of Great Britain's regional distribution networks.

A number of potential applications for the model have been noted. Firstly the model can be applied to specific projects or changes of network use in order to investigate their regulatory impact, particularly if there are several detailed options amongst which the DNO can choose. Secondly the model may be applied to hypothetical trade-offs as an input to policy development by the DNO, policies which might then influence the implementation of specific projects. Thirdly the model may be used to gain greater understanding of the interplay of incentives in the regulatory system and their net impact on the DNO.

THE REGULATORY SYSTEM

DPCR4 is described in detail in Ofgem's final proposals [1] and covers economic regulation of four types of regulated DNO activities.

1. Distribution network services (the main price control)
2. Distributed generation
3. 'Excluded services'
4. Metering – asset provision and operation

All items except metering are considered in the model, since price controls for meter operation and for new and replacement meter assets cease from April 2007 [1].

For distribution network services in the main price control and for distributed generation, the allowed revenue is defined by formulae in the special licence conditions issued to each DNO [2]. The level of income is an allowance fixed by the regulator, but there are a number of specific income-varying incentives based on items such as capital expenditure against forecast, units of electricity distributed, number of connected customers, customer interruptions, network losses and new distributed generation connected. Expenditure is not explicitly controlled, but the DNO must comply with its licence obligations and may spend in order to target the various incentive schemes. In contrast total income from the small number of 'excluded services' [2] - such as system studies, revenue protection schemes, relocating cables and connection charges for sole-use assets – is unrestricted, but the conduct and prices of these services are overseen by the regulator. The majority of DNO income and expenditure relate to distribution network services to serve demand. Each network operator then recovers its allowed revenue by charging demand customers (via suppliers). Remaining income principally comes from charging generator customers and project developers for new or reinforced connections.

The treatment of income and expenditure under the regulatory accounting system of DPCR4 is additional to and different from the statutory accounting system applicable to all companies. However it is in the regulatory accounting system that allowed revenue is determined, so the most accurate indication of the financial impact on a DNO will come from taking a regulatory accounts perspective. Thus a model has been developed of the pre-tax financial impact on a DNO in regulatory accounting terms of any project occurring during the DPCR4 period.

FEATURES OF THE MODEL

The model calculates the financial effect in terms of the net present value (NPV) in 2005/06 of the *change* in cash flows resulting from any network project during the financial years 2005/06 to 2009/10. For example any project that alters units distributed is considered in terms of the variation to the expected units distributed from the network.

All of the project information is entered in the sheet 'Project inputs'. An example of the range of input information is shown in Figure 1 overleaf. It should be noted that in any case where the field is left blank, the economic impact on the DNO is assumed to be zero. This input information is then copied across to separate worksheets to analyse the following income and expenditure effects.

- Expenditure in the main price control eg capital and operational expenditure (capex and opex) indirect costs and excluded services, and conversion from the statutory to regulatory accounting framework
- Any difference between the DNO's cost of capital and Ofgem's assumed cost of capital
- Base revenue - changes to units distributed and connected customers.
- Losses incentive – either due to a direct change in losses or indirectly by increasing or decreasing supply to a site with a loss adjustment factor (LAF) that is different from the regulator's target.
- Quality of Service incentives on Individual Customer Interruptions (ICIs) and Individual Customer Minutes Lost (ICMLs)
- Innovation Funding Incentive (IFI)
- Distributed Generation (DG) incentive – related to the treatment of capital and operational expenditure, incentives and allowances.

It is assumed that all costs and benefits occur as predicted by the DPCR4 framework, but that the targets/ benefits of all incentive schemes are reset after this. The output sheet shows the NPV result for each feature of the regulatory system as well as the overall NPV result. The scope and timescale of the effects included in the model are key parts of the model assumptions, but may be varied.

There are various financial effects that have not so far been considered in the model since they are considered unusual or hard to influence eg telephone response incentives. Other effects relate to the whole DNO portfolio eg the caps on aggregate revenue exposed to the quality of service incentives. So far however no rigorous test has been applied to determine which effects should be included in the model. Indeed for different project types the likelihood and size of each effect will vary significantly. Thus it may be reasonable to add further effects in future developments of the model. The model does not at present consider how DNO behaviour within one price control will affect the terms of a subsequent price control eg how operational expenditure in DPCR4 will affect the opex allowance made in the next price control period.

Investment appraisal by net present value (NPV)

The NPV method discounts future cash flows so that they can be assessed in current terms ie at their present value. This is a popular investment appraisal technique because it is relatively easy to calculate, considers the time value of money and can be adapted to the cost of capital used by the business. Furthermore it is based on cash flows rather than profits which are subject to accounting standards [3]. When comparing two project options over the same timeframe, a profit-maximizing DNO will favour the project with the highest NPV.

The model calculates the NPV in 2005/06 of the cash flows associated with a network project. All costs must be entered in the spreadsheet in 2005/06 prices. If the project is considered over 5 years of the price control from 2005/06 to 2009/10, then at a discount rate r the formula used to discount income streams a, b, c, d and e in the five years is,

$$NPV = a + \frac{b}{1+r} + \frac{c}{(1+r)^2} + \frac{d}{(1+r)^3} + \frac{e}{(1+r)^4} \tag{1}$$

The discount rate used is 6.9% as default, since this is Ofgem's assumed pre-tax cost of capital for DPCR4 [1]. However both Ofgem's assumption and the DNO's actual cost of capital are model variables and may be reset for each five-year period.

Figure 1. Example input page in regulatory incentives model.

PROJECT INPUT SHEET

Scenario Name | Version

Expenditure	*Expenditure negative, income positive*	2005/06	2006/07	2007/08	2008/09	2009/10	
	Direct OPEX						
	Non-operational CAPEX spend						
	Direct CAPEX						
	Fault cost						
	Indirect						
	Pensions						
	Excluded services (NTR)						
	Excluded services (Other)						
	Total statutory spend	0	0	0	0	0	£
	Total regulatory spend	0	0	0	0	0	£

Base revenue adjustment		2005/06 - extra change	2006/07 - extra change	2007/08 - extra change	2008/09 - extra change	2009/10 - extra change	
	Units for year LV1						GWh
	Units for year LV2						GWh
	Units for year LV3						GWh
	Units for year HV						GWh
	Units for year EHV						GWh
	Connected customers at 30 Sep						

CI and CML	**IN-YEAR CHANGES ONLY**	2005/06	2006/07	2007/08	2008/09	2009/10
	Planned ICI					
	Planned ICML					
	Unplanned ICI					
	Unplanned ICML					
	Other networks ICML					
	ON-GOING CHANGE					
	Planned ICI					
	Planned ICML					
	Unplanned ICI					
	Unplanned ICML					
	Other networks ICML					

Losses Is new measure DG? no **Leave as 1.000 -->** 1.000 LAF for generation

LAFs for demand	2005/06	2006/07	2007/08	2008/09	2009/10
Project LAF LV1	1.0568	1.0568	1.0568	1.0568	1.0568
Project LAF LV2	1.0568	1.0568	1.0568	1.0568	1.0568
Project LAF LV3	1.0568	1.0568	1.0568	1.0568	1.0568
Project LAF HV	1.0568	1.0568	1.0568	1.0568	1.0568
Project LAF EHV	1.0568	1.0568	1.0568	1.0568	1.0568

1.0568 as default gives no impact on losses

MWh change	Direct effect not due to changing units distributed		Indirect effect due to changing units distributed	
0			On-going	
2005/06			0.00	MWh
2006/07			0.00	MWh
2007/08			0.00	MWh
2008/09			0.00	MWh
2009/10			0.00	MWh

Innovation Funding Incentive (IFI)							
	Additional IFIEt						£

Distributed Generation (DG)							
	DG capex						£
	kW incentivised						kW
	Sole-use capex						£
	Generator's proportion of these reinforcement costs - CAF						%
	Annual additional O&M costs						£
	Voltage level	LV - not SSEG	LV - not SSEG	LV - not SSEG	LV - not SSEG	LV - not SSEG	
	Firm connection						
	Network unavailable per year - permitted						hrs
	Network unavailable > 1hour - per year - planned						hrs
	Network unavailable > 1hour - per year - unplanned						hrs

Cost of Capital		DPCR4	2010/11-2014/15	2015/16-2019/20	2020/21-2024/25	2025/26-2029/30	
	Ofgem's expected cost of capital	6.9	6.9	6.9	6.9	6.9	%
	DNO's assumed cost of capital used as discount rate	6.9	6.9	6.9	6.9	6.9	%

An example - domestic microgeneration

Consider the case of a small scale embedded generating unit (SSEG) installed at a single domestic property in accordance with engineering recommendation G83/1 [4]. It is assumed that the commissioning is notified to the DNO at the beginning of financial year 2006/07. A 1kW peak electrical output microgenerator such as a small CHP unit or small building-mounted wind turbine might conceivably generate of the order of 2 MWh per year, depending on the heat load of the building or the wind conditions of the site.

This is a not 'project' in the sense of a scheme of work instigated by the DNO, but as the connection of a small generator has impacts on the allowed income and likely expenditure of the DNO, it may be analysed by the incentives model.

In a simple example of the application of the model, the following assumptions are made

a) The generator is installed at a property charged on a single-rate tariff.
b) 75% of the generated electricity is used on site and 25% exported, so units distributed to the property are reduced by 1.5MWh per year from 2006/07 onwards.
c) There is no net change to network losses eg if any reduction in losses occurs by reducing power flows to serve demand, then these are compensated by an increase in losses when the generator increases power flows by exporting from the site.
d) There is no net change to quality of supply.
e) There is one-off 'indirect' expenditure in 2006/07 of £25 in 2005/06 prices, associated with entering information about the generator on network records.
f) There is no ongoing addition or reduction to capital or operational expenditure.

Thus the three remaining financial effects on the DNO, given in NPV terms in 2005/06 are

1. +£24 from the DG incentive of £2.50/kW/yr, recovered in the year of commissioning and subsequent years, due to 1 kW of capacity added in 2006/07. DNOs would generally recover this money from the portfolio of other generators connected to the network rather than charged to the individual microgenerator.
2. -£16 as the regulatory impact on the DNO of the £25 expenditure (ie 67.41% of spend, plus a discount factor from 2006/07 to 2005/06)
3. -£30 loss of revenue from the reduction in units distributed, considered over the lifetime of the price control ie up to 2009/10.

The net pre-tax financial impact on the DNO in NPV terms of the microgeneration connection, subject to the assumptions of the model, is thus a loss of £22. This suggests that, at least in the scenario considered, the regulatory system does not incentivise DNOs to actively encourage microgeneration connections. The realism of the scenario and the sensitivity to different assumptions can then be explored using the model to understand the issue in more depth. For example what would be the impact if the amount of generation and the reduction in units distributed were different, or if the demand reduction occurred amongst customers on a multi-rate instead of unrestricted tariff?

CONCLUSIONS

Development of the model remains a work in progress with further testing required. Consideration also needs to be given to the validity of a pre-tax analysis and of how DNO behaviour in DPCR4 may impact the financial settlement in the next price control. It is anticipated that the next stage of the model will be applied to examine the impact of environmentally desirable changes to the energy system on DNO income in the current regulatory system. The specific cases proposed are community-scale combined-heat-and-power (CHP) plants and demand reduction / reduced demand growth.

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