Tackling Tariff Design

Making distribution network costs work for consumers

citizens advice

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Introduction

Introduction to networks

Distribution networks are the pipes and wires that take gas and electricity from the central energy network[1] directly into consumers' homes. They are an essential service, playing a crucial role in ensuring that lights stay on and homes stays warm.

Key Numbers

- **7:** the number of electricity distribution networks.
- **£24bn:** total amount of allowed revenue for electricity distribution companies, over 8 years.
- **8:** the number of gas distribution networks.
- **£17.2bn**: total amount of allowed revenue for gas distribution companies, over 8 years.

Operating and maintaining the distribution networks form a significant part of consumers' bills. The average consumer spends £310 on network costs a year, around a quarter of their total bill[2]. It is the second largest component of consumers' bill, after the wholesale cost of the energy itself.

Network companies are regulated in a different way to consumers' suppliers. Energy suppliers are expected to compete with each other to drive down price. As there is only one set of pipes and wires, most network activities are monopolies and competition in the services they provide is very limited.

Ofgem, the energy regulator, therefore sets a price control for each electricity distribution network operator and gas distribution network company, which determines the total amount of money that network companies can recover from consumers through their energy bill from their supplier.

However, there are a number of different ways in which network companies could recover this revenue. They could recover it as a fixed charge to all consumers or entirely as a unit charge depending on consumers' energy consumption; or they could vary the charge according to the time that consumers are using energy. How these costs are recovered is a matter of **distribution tariff design.**

Distribution costs are currently recovered from customers through a simple tariff which includes a fixed charge per day and a unit charge per kilowatt hour of consumption. The standing charge is relatively small, varying between £1 and £2.50 per month, depending on the network. The majority of distribution costs are

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[1] This is called the transmission system, which takes energy from its source of generation (in electricity's case) or supply (in gas's case) and transfers it to the distribution system.
[2] Ofgem Supply Market Indicator (http://tinyurl.com/j8xfoqy) and Ofgem Understanding Energy Bills (http://tinyurl.com/jg65339).

recovered through a unit charge, varying between 1.7 and 3.1 pence per kilowatt hour.

Citizens Advice's role

Citizens Advice are the statutory advocate for energy consumers. We represent the interests of all consumers at the highest levels of energy policy making.

There is a real risk of consumers losing out in the regulation of network monopolies. For example, when Ofgem sets price controls, there is a huge amount of money on the line and industry heavily invests in these negotiations to achieve more favourable deals for them. These debates are highly technical, time-consuming and seemingly small decisions can change consumers' bills by hundreds of millions of pounds overall. Because these networks are monopolies, there is little competitive pressure to force costs down.

Consumers therefore need a strong voice to represent them. We play two roles in debates over networks, as we do in other regulated markets:

1. **We represent consumers at the negotiating table.** Our consumer advocates understand the technical details, but their only interest is standing up for consumers. We make sure the consumer voice is heard.
2. **We bring complex discussions out into the open.** We write and commission reports — like this one — that translate the technical details of these discussions for a wider audience, making sure that the results are available for all.

Our goal is always to deliver **fairness for vulnerable consumers** and **minimise all consumers' energy bills.** Through our expertise as consumer champions, we also help shape networks' services, ensuring that they **meet consumers' needs.**

About this research

This research focuses on making sure that networks' revenue is fairly recovered from consumers, with a particular eye to the needs of vulnerable consumers. To this end, we commissioned **The Brattle Group,** an economics consultancy, to model the impacts of different tariff options on different types of consumer, using data from tens of thousands of real consumers. This report summarises the findings of this research and provides our perspectives on the results.

We wanted our research to provide us with a comprehensive overview of the issues surrounding distribution tariff design for gas and electricity networks. To this end, we asked the Brattle Group to undertake the following activities:

- Summarise the current debate about electricity and gas distribution tariffs in Great Britain and identify key concerns with current arrangements;
- Identify drivers for change, such as the smart meter rollout and distributed generation;

- Review British and relevant international literature and experience on electricity distribution tariff design;
- Undertake a series of interviews with key industry and regulatory stakeholders;
- Model the impacts of different tariff designs on consumers' bills and behaviour.

What's driving change?

The design of electricity and gas distribution tariffs has been stable in recent years. However, electricity distribution tariffs are likely to be revisited in the future, because of the potential for technological change in how our electricity is supplied and delivered. Stakeholders confirmed that electricity distribution tariff design is on the cusp of becoming an important issue. While the same level of technological change is not expected for gas distribution networks, it is likely that gas distribution tariffs will be revisited as well, to make them more cost reflective (discussed in subsequent sections). Our research identifies several change drivers, of which the most relevant are **distributed generation**, **the smart meter rollout** and **intermittent generation.**

Distributed generation

Rooftop solar panels are likely to be the largest source of distributed generation and their uptake is the most significant global driver of electricity tariff reform. The growth in rooftop solar panels is driven partly by declining costs (the UK solar industry reduced costs by 70 per cent between 2010 and 2015) and partly by the government's strategy to reduce carbon emissions.

Currently, unit charges for distribution costs are recovered based on *net* usage: the amount of energy they consume minus the energy the produce.

Distributed generation is a way of generating electricity directly in consumers' homes. This energy can be consumed by a household and/or exported to the distribution network.

In the UK, consumers are rewarded for 'feeding in' electricity to the network. This happens through **'feed in' tariffs.**

Installing solar panels reduces consumers' net usage and therefore reduces their distribution bill. However, unless these consumers are generating enough energy, and have the means to store that energy for usage when the sun is not shining, they will still rely on electricity from the distribution system to some extent. For this reason, utility companies often argue that rooftop solar panels do not necessarily reduce the costs of providing the distribution system to these consumers. These consumers are therefore potentially being under-charged. Because there is a fixed amount of revenue that must be recovered from consumers to deliver the distribution system, this cost is imposed on the remaining consumers — potentially including low-income consumers, as discussed below.

Smart meter rollout

These meters can record consumers' real electricity usage on a half-hourly basis and their gas usage on a daily basis. As well as enabling much more accurate billing, smart meters will enable innovative new tariff options in electricity, which are described below. In this context, some hope that electricity smart meters will facilitate ‘demand-side response’, where consumers are encouraged to vary their electricity consumption in order to better manage peak demands on the system. This may help reduce the costs of managing the distribution system and assist in integrating sources of generation that only produce electricity at certain times.

We do not expect smart meters to enable sophisticated, new tariffs in the consumer gas market. This is partly because gas smart meters will collect data only on a daily basis so will not enable peak demand and time of use tariffs described below, as these rely on gathering up-to-date energy usage data on a much more frequent basis. It is also because there is less need to manage peak usage in the gas market.

The target for completing the rollout of smart meters to domestic households in Great Britain is 2020.

Intermittent generation

The UK is trying to reduce its carbon emissions, partly by increasing the use of renewable electricity generation. Renewables like wind and solar only produce energy at certain times. One way to deal with this challenge is to encourage consumers to shift energy consumption to particular times, through the ‘demand-side response’ outlined above. New tariff structures could play a part in promoting demand-side response.

Alternative tariff designs

A core principle of tariff design is that tariffs should be cost reflective — they should seek to recover from consumers the actual cost of providing the service. The reason for this is twofold. Firstly, charging the actual cost of providing a service should encourage people to use it efficiently. If they were subsidised or penalised instead, this might result in inefficiency, by either encouraging overconsumption or discouraging people from using a service they need. Secondly, the costs of the distribution network need to be recouped from someone. So if one network user does not pay the true cost of the service that is provided to them, someone else will have to pay for that shortfall.

However, it is not necessarily clear-cut what charging the actual cost of the distribution system means and a case can be made that several of the following tariff designs are cost reflective. Equally, what is cost reflective for the electricity network may not be cost reflective for the gas network. The way in which consumers respond to how cost reflective a service is may vary: it could be that consumers' usage of the distribution system is less responsive to price than of other goods. If this is true, the benefits of more cost-reflective tariffs may be reduced.

Tariff reformers must also carefully consider how changes could impact vulnerable consumers. Different options may have positive and negative impacts on vulnerable consumers. Any negative consequences for vulnerable consumers must be mitigated when reforming distribution tariffs.

Finally, consumers are charged for distribution costs indirectly, through their energy supplier, which passes on the revenue to the distribution company. Our stakeholder interviews and review of the UK landscape suggests that currently suppliers pass these costs directly on to consumers. However, this could change if tariffs are reformed.

It is worth reiterating that under all of these options, **the total amount of revenue recovered from consumers as a whole remains the same.** Each option only affects only affects the distribution of **who pays** and **how much they pay.**

Our research suggests four principal alternative tariff designs. Of these, peak demand and time-of-use tariffs both require half-hourly usage data from smart meters, which will only be available for electricity smart meters. As managing peak demand is less critical for gas distribution networks, these are unlikely to be useful tariff options in the gas context. Higher standing charges and rising block tariffs are feasible tariff options for both electricity and gas distribution networks.

Peak demand tariff

In a peak demand tariff, the distribution costs are based on a demand charge. Peak demand is the time at which a consumer is using the most energy at once. A peak demand charge is calculated by looking at the consumer's demand over a particular time period — typically the monthly billing cycle — and charging the consumer based on their peak demand during that period.

Peak demand tariffs might be more cost reflective because the long-run costs of electricity networks are driven by the need to invest in network and generation assets to meet peak demand. Reducing peak demand would reduce the need for these capital investments. Consumers might also have the opportunity to reduce their bills by changing their consumption pattern - for example, by reducing the number of appliances they use at the same time.

However, consumers may not understand how they can change their behaviour to reduce their peak demand. Educational messages such as 'be careful about how many appliances you use at once' may not be acted on and some consumers may find it difficult to change their behaviour. Therefore the desired behaviour changes might not be achieved for some consumer groups.

Time of use tariff

There are reasonably predictable peaks in when we use the energy system. Under a time of use tariff, consumers are charged a higher unit charge at peak times and a lower charge at all other times.

Time of use tariffs are different to peak demand tariffs. Unlike a peak demand tariff, time of use tariffs do not base costs on individual consumers' peak demand over time. Rather, time of use tariffs set peak times for the entire energy system and charge all consumers more for using electricity during that period.

The underlying rationale for time of use tariffs *is* similar to peak demand tariffs — they might better reflect costs because investments in the network are driven by the need to manage peak demand. Consumers also have the opportunity to reduce their bills by changing when they use electricity - for example, by setting their washing machine on overnight.

Again, consumers might not understand time of use tariffs and therefore not change their behaviour. However, time of use tariffs have been piloted in Great Britain and there is some evidence that consumers do, on average, change their behaviour.

Higher standing charge

As discussed above, most distribution costs are recovered from consumers through a unit charge. The standing charge for the distribution tariff is therefore currently quite modest — between £12 and £30 per year, depending on consumers' network. One option for tariff reform is therefore increasing the standing charge. The unit charge would then be reduced in proportion, ensuring that the same amount of revenue is collected.

An argument for increasing the standing charge and decreasing the unit charge is that much of the cost of providing the distribution system — the pipes and the wires — is fixed. The cost of providing them is the same no matter how much energy you use. Therefore, recovering the majority of costs for the system through a unit charge that is based on how much energy you use may not reflect costs adequately. Higher standing charges would also provide stability and predictability to consumer bills.

However, higher standing charges do not provide the same signal to consumers to reduce peak demand, so may not reflect the costs of managing the network at that time. They also do not provide consumers with an opportunity to reduce their bills by changing their behaviour.

Rising block tariffs

Rising block tariffs charge consumers a price that increases as their consumption increases over the course of each billing period. Often, they are designed to charge a lower price for a minimal amount of consumption that is necessary for basic services like lighting and refrigeration, and then a higher charge afterwards.

Rising block tariffs are uncommon for distribution tariffs, because the cost of providing and running the distribution network is not necessarily related to consumption over the course of a billing period.

These tariffs may encourage reduced consumption, as consumers try to avoid the higher price for a higher rate of consumption. However, they will not help in managing peak demand for electricity, as they do not signal to consumers that they should reduce their consumption at particular times (unlike time of use tariffs).

A global perspective

Other countries are already dealing with some of the issues that are posed by technological change:

- In **Ontario,** the regional government has decided to respond to the challenges posed by intermittent generation and managing peak capacity by mandating time of use tariffs for all consumers, while **California** plan a similar time of use rollout;
- In **Victoria,** in contrast, the regional government is only allowing time of use tariffs on a voluntary, opt-in basis;
- In **California,** utilities had rising block rates with an increasingly complex rate structure, which led to consumers installing solar power only to avoid the highest priced tiers;

- In **Arizona,** where rooftop solar has taken off dramatically, regulators have proposed a ‘grid access charge’ for all solar consumers, which is being contested by the solar power industry.

Impacts on consumers' bills

Our research used data from more than 11,000 consumers who had participated in either the Low Carbon London or Customer Led Network Revolution 'smart grid' trials[3], which provided half-hourly meter reads over the course of a year. The Brattle Group classified these consumers into five pre-defined categories:

1) **Affluent Achievers:** the most financially successful people in the UK;
2) **Rising Prosperity:** younger, well educated, prosperous; many have substantial incomes but have not yet converted these into substantial savings/investments;
3) **Comfortable Communities:** 'middle of the road' Britain; all life stages represented; most are comfortably off with few major financial worries;
4) **Financially Stretched:** Incomes well below average; many getting by with modest lifestyles;
5) **Urban Adversity:** the most deprived areas of large and small towns and cities across the UK.

Our research modelled the impacts that different tariff options had on each of these consumer groups in the current energy system. An important caveat to this modelling is that it shows the **average** impact on each group. Within each group, there will be winners and losers from any reform of distribution tariffs. For example, it is often suggested that lower income consumers also consume smaller amounts of energy. Our data suggests that this is true, but only on average - there are lower income consumers who consume a very large amount of electricity (possibly, for example, consumers with electric space heating). It is important to bear this in mind when considering potential tariff reforms.

Evidence suggests that consumers change their behaviour in response to each of these tariffs options. Our modeling incorporated the findings of 40 pilot studies into how consumers respond to price changes, which determined the level of behaviour change we expected for the tariff options.

While our research principally focused on distribution tariff design, its conclusions apply with similar force to redesigning a consumer's bill entirely. It should therefore be of wider interest in looking at how different tariff options affect different groups.

Impacts on vulnerable customers

Our data only allows us to judge the impacts on lower income consumers (the Financially Stretched and Urban Adversity groups above), rather than vulnerable consumers in general.

[3] Low Carbon London: http://tinyurl.com/q7ser4s; Customer Led Network Revolution: http://tinyurl.com/za84zs7.

Time of use, peak demand and block rate tariffs all reduce the distribution bill of the average consumer in the 'Financially Stretched' and 'Urban Adversity' groups, when consumer behaviour change is taken into account. However, there is a large variation within these groups: block rate tariffs, for example, will increase bills for those in urban adversity for the 90th percentile while reducing bills by in excess of 20 percent at the 10th percentile.

In contrast, the average consumer in urban adversity will experience a 10 per cent increase in their bill under an increased standing charge.

In the current energy system, when behavioural changes are taken into account, we expect higher standing charges to have a negative impact on the bills of the average low income consumer, while time of use, peak demand and block rate tariffs would have positive impacts.

Impacts on bill volatility

As well as overall cost, consumers are also concerned with bill volatility: other things being equal, they will want to pay a predictable price for their energy each month. Our research therefore also measured what percentage of consumers would experience reduced volatility in bills.

A higher standing charge leads to lower volatility for all consumers. A peak demand tariff leads to lower volatility for about three quarters of high income consumers and half of low income consumers, while time of use decreases bill volatility for around half of consumers, with fairly even impacts across income levels. Rising block tariffs, meanwhile, increase bill volatility for a large majority of consumers.

Impacts on rural and urban consumers

Our data allowed some investigation of any differential impact on rural and urban consumers. Increased standing charges led to slightly lower bills in London and slightly higher bills in other urban and in rural areas, while the inverse was true for rising block tariffs. However, on the whole, these impacts were minimal.

Impact of distributed generation on tariffs

The previous models set out the impacts of different tariffs, on the assumption that the energy system stays largely the same. However, in electricity distribution, this may not be so. Rooftop solar and other forms of distributed generation may significantly affect who pays for the distribution system under current tariff designs. As suggested above, under the current distribution tariff design, as the number of distributed generation consumers increases, their contribution towards the cost of the distribution system decreases. The overall cost of the distribution system remains the same, however, so all other consumers' costs decrease.

To understand the impacts of distributed generation on our different tariff options, our research also used a stylised model, which suggested how increased distributed generation adoption might change distribution costs for the average consumer who had not purchased distributed generation.

Under each of the tariff options, there is some shift in who pays for the distribution system, with consumers with distributed generation paying less and consumers without paying more. However, the the higher standing charge and the demand charge minimise this cost shift, reducing the impact on consumers without distributed generation. Time of use, rising block and existing distribution tariffs all lead to substantial increases in costs facing consumers without distributed generation.

Recent data from DECC suggests there is a strong correlation between income and adoption of rooftop PV. Therefore, it is likely that low-income consumers will face increasingly large cost burdens as the take up of distributed generation increases.

Reflections and recommendations

This research poses complex questions and there is no simple resolution to the problems it raises. However, we have identified six reflections and recommendations that we believe will be very important to the future of when considering tariff reform.

1. Technological change is crucial to understanding the impacts of different tariff options on different groups of consumers. Electricity distribution tariff reform should be led by technological change and its potential impact on consumers.

The electricity system is in flux. We are in the midst of potentially profound technological change, which may fundamentally alter how we use the distribution system. Crucial to tariff reform will be whether distributed generation is widely adopted, as this substantially impacts which consumers face the cost of the distribution system.

Our research does not suggest one perfect solution. All solutions involve trade-offs and substantial further research would be needed before committing to a particular tariff reform. However, peak demand tariffs may warrant particular attention when considering future reform of electricity distribution tariffs. There is a positive case that peak demand tariffs would be more cost-reflective than the current tariff model, as well as — unlike the higher standing charge — minimising the cost burden facing low-income consumers. Peak demand tariffs may also be more **resilient** — our model suggests that peak demand tariffs are one of the most successful options in ensuring that the cost of the electricity distribution system are not unfairly placed upon one group of consumers in a world of high distributed generation adoption.

However, peak demand tariffs do not come without constraints — they may be more difficult for consumers to understand than other tariff options. They also depend on the successful roll-out of smart meters being achieved before distributed generation reaches a level that requires immediate tariff reform.

2. Gas distribution tariff reform has fewer technological drivers, so there may be a case for considering gas distribution separately.

The gas distribution system likely faces fewer technological disruptions in coming years that would require tariff reform in and of themselves. Options such as peak demand and time of use tariffs will not be possible on a nationwide scale, because gas smart meters will not collect half hourly data.

Tariff reform in the gas distribution system should therefore be driven by making the distribution tariff design more cost reflective of the existing gas distribution system and by ensuring that the interests of vulnerable consumers are addressed. This creates a policy dilemma. Higher demand charges increase the cost reflectivity of the gas distribution tariff but negatively impacts the average low income consumer; while the inverse is true for rising block tariff. Any tariff reforms in this area must take this dilemma seriously and ensure that reforms work in the interest of low income consumers.

3. For most consumers, well-designed tariff reforms will not lead to significant bill changes. For a minority of consumers at the extreme end of the distribution, there will be significant bill changes.

The average bill change for each consumer bill under any tariff option is relatively small. However, within each consumer group we identified, there is a minority of consumers who will face much more significant impacts.

To ensure that these impacts are addressed, significant primary research is required to test the assumptions underlying any tariff reform. This requires further modelling beyond what we have undertaken here, to quantify bill impacts on consumer sub-groups — particularly for low-income consumers. Considerable research of consumers' understanding of the new tariffs through market research and empirical analysis is also necessary.

4. Tariff design reform is an important task that requires careful planning and thought. An effective and considered transition plan will be essential.

Our research suggested several ways in which successful tariff reform can be achieved. First, tariff reform must be a collaborative process. Ofgem will need to undertake a thorough open dialogue with stakeholders to ensure that design issues are considered from every angle. We believe this should begin now: while the technological drivers may take time to come onstream, industry, the regulator and consumer groups could benefit from agreeing clear protocols and plans for tariff redesign.

Second, the new tariff should be phased in gradually, to give consumers the time to adapt to the new pricing structure. Alongside this, a consumer education plan will be needed, to ensure that consumers are aware of changes in tariff design and can realise the benefits from certain tariff options (for example, by understanding how they could reduce their bill through shifting their energy usage to low peak periods under time of use tariffs).

Third, even if the tariff design provides on average better outcomes for vulnerable and low-income consumers, there will still be consumers within these groups that will be worse off as a result of the reforms. A clear plan for supporting these consumers needs to be in place and consideration should be given to protecting these consumers if the impact on their bill is likely to be significant.

Finally, serious consideration should be given to making the transition to a new distribution tariff **voluntary** and **opt-in** for a significant trial period. In particular, consumers who have purchased distributed generation under the existing tariff structure should be given this option.

5. Suppliers currently choose how they pass through distribution charges directly to the consumer. This could change and understanding this will be an important part of tariff redesign.

Under new distribution tariff structures, this may not necessarily be the case; especially if suppliers are experimenting with their own innovative whole-bill tariffs, made possible by the smart meter rollout.

Suppliers will need to be closely involved in distribution tariff redesign and the consequences of them passing costs through to consumers in a different way must be understood. Discussion of time-of-use tariffs for network charges needs to go hand in hand with the discussion of their use in relation to commodity charges, as the peaks in both are likely to coincide.

Where possible, we favour a consistent approach to cost pass-through from suppliers, to ensure that consistent messages can be used in consumer education programmes about tariff reform.

6. This research suggests wider implications for tariff design beyond distribution charges.

Our research has primarily focussed on the redesign of the distribution tariff. While considerations regarding cost-reflectivity relate to the distribution system only, the bill impacts analysis we have undertaken should apply to consumers' energy bill as a whole.

We expect that the results will be useful in informing how innovative tariffs – in particular, time of use and peak demand tariffs – made possible by smart meters will affect consumers and how they might respond to them.