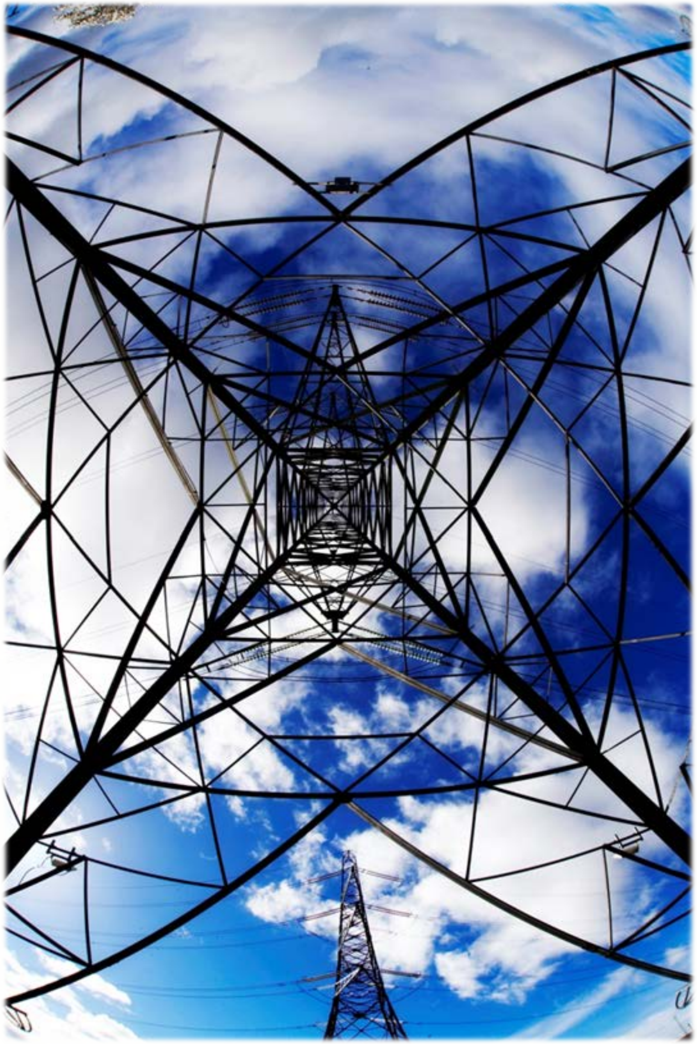

The Impacts of Distributed Energy Resources on Future Network Utility Tariff Structures

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The Impacts of DERs

Introduction

Flexibility, DERs and the impact on network costs

- Growth of Distributed Energy Resources (DERs) will change the way that users and utilites operate
  - Distributed Generation (DG), Energy Storage (ES) and Demand Side Response (DSR)
- Will allow distribution networks to be operated with greater **flexibility**
- This will alter the fundamentals of costs, and could skew cost allocation
- This paper proposes explores these issues and sets out a framework for considering future tariff structures

Distribution Costs

Investment and operational timescales

- Useful to distinguish between behaviour of the utility and its customers over **investment** (long term) and **operational** (short term) timescales
- In many countries, DNOs currently make very few active decisions over operational timescales
  - Mechanisms which provide signals to users over operational timescales (e.g. For flexibility actions) can be very simplistic
- Instead, network is *passively* designed over investment timescales to meet worst case decisions
  - Network asset costs and cost reflect charging structures are therefore often driven by peak demand conditions
- In the future, distribution utilities may do more active management of the users on their network, and could incur short term operating costs (e.g. for operation of local congestion management markets/services)

Distribution Costs

Recovery of residual revenue

- In regulated networks, common for tariffs to be set independently of price control allowances.
- Price controls effectively set a cap on allowed revenue, based on anticipated costs.
- Part of this cost is variable – it may increase or decrease depending on customer behaviour.
- However, a larger proportion is essentially ‘fixed’
  - Direct and indirect operating costs, age related asset replacement, taxes, sunk costs etc
  - Typically <10% of revenue relates to marginal cost based expenditure
- Fixed/sunk cost recovery often referred to as **residual revenue**

Distribution Expenditure

A GB example - Western Power Distribution between 2015-2023

Category	Funded through Use of System Tariffs	Funded through Connection Charges	Total	Proportion
Shallow Connections		£542.1m	£542.1m	5.6%
Deep Reinforcement	£598.5m	£37.5m	£636.0	6.5%
Non-load network investment	£2,275.6m		£2,275.6m	23.3%
Direct Operating Costs	£1,224.9m		£1,224.9m	12.5%
Indirect Operating Costs	£4,154.9m		£4,154.9m	42.6%
Network Rates	£929.9m		£929.9m	9.5%
Total	£9,183.8m	£579.6m	£9763.4	100%

Use of System Charges

Forward looking cost signals and revenue recovery

- Use of system charges often set based on forward looking pricing principles e.g. Long Run Marginal Cost (LRMC)
  - Consider future investment by the utility
  - Provides signals to customers about impact of their decisions over investment timescales
- Usually a gap between LRMC tariffs and allow revenues, due to ‘fixed’ and sunk costs.
  - The utility’s average cost is greater than it’s marginal cost
- Utilities alter tariffs to ensure correct revenue recovery:
  - Tariffs can be **‘scaled’** to ensure that allowed revenue is recovered
  - Alternatively, **‘residual’** tariffs can be applied to all users.
  - Simpler tariff structures focus on cost recovery only, with no LRMC cost allocation

The Impact of DERs

DERs distort recovery of residual revenue

- Existing tariff structure can allow flexible users (e.g. Users with DERs) to avoid contribution to the network's fixed and sunk costs
  - E.g. Reducing consumption throughout the year with micro-generation
  - Time-shifting demand using energy storage
- These users still benefit from the existence of the network, but do not pay for it

1. Could prompt a '**utility death spiral'**
2. **Shifts the burden of cost recovery** to users who do not or cannot invest in DERs – often poorer users
3. May **over-incentivise flexibility** and deployment of DERs without actually encouraging desired behaviour from these users

The Case for Reform

Summary of the problem

- Uptake of DERs expected to increase and systems will become more flexible
  - Tariffs can help to encourage DERs and flexibility where this brings benefits to the system
  - Tariffs need to create a fair/sustainable basis for cost allocation

- A flexible user may be able to easily avoid consuming power during peak conditions (e.g. with a battery)
  - This may significantly reduce their network charges
- However, they still derive value from their firm network access
  - The 'option' to use the network has some value
- Should not be able to completely avoid paying for the existence of the network

International Precedent

Some examples from different countries

- Introduction of demand charges throughout the USA
  - Some revenue recovered based on peak kW consumption during certain period, as well through kWh tariffs
- Changes in cost allocation between users in South Queensland
  - Users with PV paying far less than users without
- Distortive effects of ‘Triad avoidance’ in GB energy and capacity markets
  - ‘Embedded’ generators derive value by not paying residual transmission costs. This may have suppressed the clearing price of recent capacity auctions.

Future Tariff Structures

Building Blocks

Options for Signals and Cost Recovery

	Signals	Cost Recovery
Investment Timeframe	‘Opt-in’ (LRMC) Tariffs *Or* Contracted Tariffs *Or* Access/Connection Markets	Fixed Tariffs *Or* Use Based Tariffs *Or* Ramsey Pricing Tariffs
Operational Timeframe	‘Opt-in’ (Time of Use) Tariffs *Or* Contracted Tariffs *Or* Wholesale Markets	Fixed Tariffs *Or* Use Based Tariffs *Or* Ramsey Pricing Tariffs

Building Blocks

Signals over investment and operational timescales

Opt-in Tariffs	Passive tariffs set by a utility (probably based on modelled costs and benefits). No commitment from users.
Contracted Tariffs	Similar to 'Opt-in' tarifs but users would contractually commit to certain flexible operating modes.
Markets	Utility and consumers actively providing signals to each other for certain types of behaviour. Wholesale or ancillary service markets over operational timescales. Access markets over investment timescales.

Building Blocks

Cost recovery over investment and operational timescales

Fixed Tariffs	Could be appropriate for some types of consumers (e.g. Domestic) with less data and disengaged customers.
Use-Based Tariffs	Relative usage of the network – e.g. MWh consumption or contracted MW capacities
Ramsey Pricing Tariffs	Costs allocated to users inversely to their expected price elasticity. Theoretically the most economically efficient way to recover taxes/monopoly costs.

Tariff Packages

The status quo in GB

	Signals		Cost Recovery	
Investment Timeframe	‘Opt-in’ (LRMC) Tariffs		Fixed Tariffs	Use Based Tariffs
Operational Timeframe	‘Opt-in’ (Time of Use) Tariffs	Wholesale Markets		

Tariff Packages

Incremental changes to the status quo

	Signals		Cost Recovery	
Investment Timeframe	‘Opt-in’ (LRMC) Tariffs		Fixed Tariffs	Use Based Tariffs
Operational Timeframe	‘Opt-in’ (Time of Use) Tariffs	Wholesale Markets	Fixed Tariffs	Use Based Tariffs

Tariff Packages

A market/efficiency based package

	Signals	Cost Recovery
Investment Timeframe	Access/Connection Markets	Ramsey Pricing Tariffs
Operational Timeframe	Wholesale Markets	Ramsey Pricing Tariffs

Tariff Packages

A 'discount structure' package

	Signals		Cost Recovery	
Investment Timeframe	Contracted Tariffs		Fixed Tariffs	Use Based Tariffs
Operational Timeframe	Contracted Tariffs	Wholesale Markets	Fixed Tariffs	Use Based Tariffs