Energiavirasto

Selected regulation methods supporting demand flexibility in electricity distribution network operations

Reliance Restricted

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Selected regulation methods supporting demand flexibility in electricity distribution network operations

05 April 2018

In accordance with our engagement agreement dated 19 December 2017 (the ”Engagement Agreement), Ernst & Young Oy (”EY”) is pleased to present the following report (the ”Report”) outlining the key considerations resulting from the benchmarking study of regulation methods supporting demand flexibility in electricity distribution network operations in Australia, Germany, New Zealand, UK and US.

A version of this report will also be translated to Finnish.

Purpose of our report and restrictions on its use

This report was prepared on the specific instructions of the directors of Energiavirasto (the “Client”) solely for the purpose of the benchmarking exercise and should not be used or relied upon for any other purpose. This report and its contents may not be quoted, referred to or shown to any other parties except as provided in the Engagement Agreement. As the Request for Proposal (“RFP”) forms part of the Engagement Agreement it is permissible for Energiavirasto to publish this report of the website.

We accept no responsibility or liability to any person other than to the Client, or to such party to whom we have agreed in writing to accept a duty of care in respect of this report, and accordingly if such other persons choose to rely upon any of the contents of this report they do so at their own risk.

Nature and scope of the services

The nature and scope of the services, including the basis and limitations, are detailed in the Engagement Agreement.

Whilst each part of our report addresses different aspects of the work we have agreed to perform, the entire report should be read for a full understanding of our findings and advice.

Should you wish further information or discussion regarding items raised in this draft report, please contact Lili Kirikal at the usual contact numbers.

Yours faithfully,

Mikko Äijälä

Ernst & Young Oy

Dashboard

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Executive summary

1 Executive summary

Benchmark countries

Of the 5 countries investigated, Australia was considered to have implemented the most relevant demand flexibility mechanisms

- The following five countries were investigated:
  - Australia (4 mechanisms)
  - New Zealand (2 mechanisms)
  - Germany (not applicable)
  - United Kingdom (2 mechanisms)
  - United States (New York and Rhode Island states) (only demonstration projects)
- Please refer to below to see that the shortlisted mechanisms considered most relevant to Finland are from Australia

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Shortlisted Mechanisms

Of the 8 mechanisms identified in the expert sessions, 4 were shortlisted during the workshop

The following mechanisms were investigated during the expert sessions and the ones highlighted in bold were shortlisted and considered the most relevant

- **Australia: Regulatory test and new facilities test (totex)**
- United Kingdom: RIIO (totex)
- Australia: Power of Choice (demand response)
- **Australia: Network control services contract (demand response)**
- **Australia: Demand management incentive scheme (demand response)**
- New Zealand: Demand management response program and interruptible load (demand response)
- New Zealand: Case by case approval (battery storage)
- **United Kingdom: Changing definition of battery (battery storage)**

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1 Executive summary

Considerations

As a result of the workshop in collaboration with Energiavirasto the regulatory investment & new facilities investment test and / or the demand management incentive scheme were considered the most relevant.

- Whilst, to date:
  - the regulatory test & new facilities investment test has not resulted in significant employment of demand response by DSOs as a substitute for capex, and
  - the demand management incentive & innovation allowance does not encourage the DSO to support demand response beyond the amount covered by the incentive payments,
- they would be simple (relative to the other mechanisms) to implement and by pairing these incentives with rigorous monitoring by Energiavirasto and advances in cost effective demand response technology, we would likely observe a greater adoption flexible demand response solutions.
- The EU will most likely address the future definition of batteries

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2

Background

Project background, benchmark countries and roadmap

2 Background

The sector is undergoing major transformation. DSOs need external support to tackle the complex issues impacting the industry, and position themselves as a ‘utility of the future’

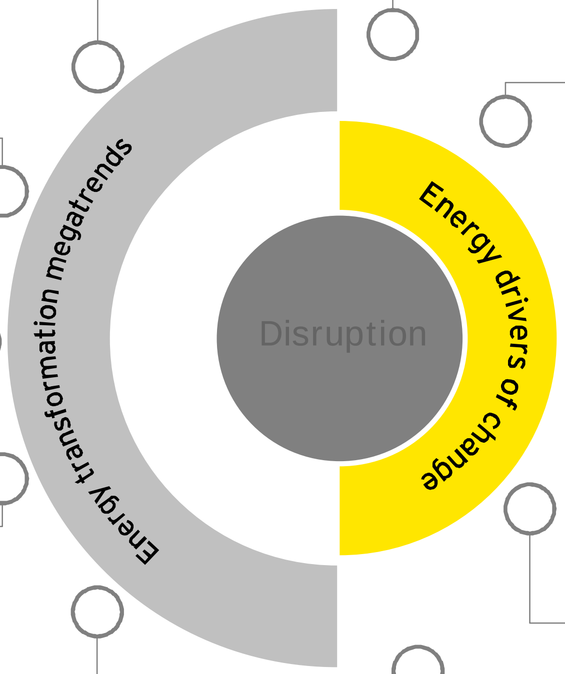
Global climate framework
Supply and demand-side energy efficiencies and the development of energy supply from renewable and other low-carbon sources

Resource transformation
Natural resource constraints–whether in availability or infrastructure–challenge established modes of consumption

Innovation
Technology, market design and climate resilience-led innovation

Rapid urbanization
The need to accelerate the deployment of distributed energy and micro-grids

Demographic changes
The accessibility and affordability of energy supply across the population



Government and regulatory change
Energy market reforms and regulatory incentives to invest in renewables in response to climate change concerns

Grid modernization
Reliability of energy infrastructure, the ability to meet current and future demand, falling cost of battery storage, and innovation in smart grids and microgrids

Smart technology
Technology disrupts the operational and competitive landscape. Smart technology introduces cybersecurity and new IT challenges

Changing customer expectations & digital channels
Customers want the choice of how and when to interact with their utility

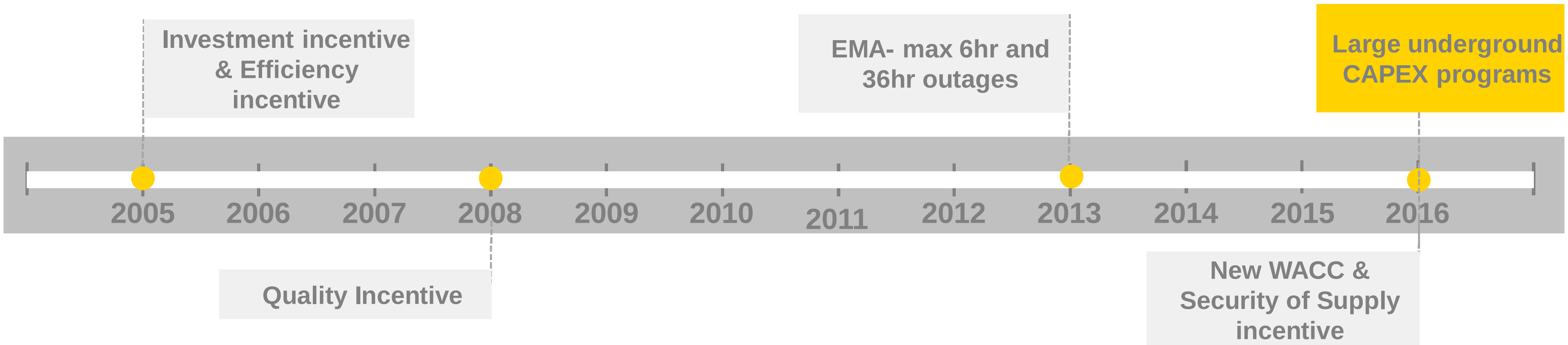
New ‘non- traditional’ entrants
Electricity becomes a service, Internet of Things, proliferation of multi-service players, and new entrants from other sectors

Changing generation mix
Uptick in distributed sources of energy – solar and wind with storage

2 Background

Introduction of various regulation incentives since 2005 and EMA amendments have resulted in DSOs favoring capital investments and accelerating underground cabling projects

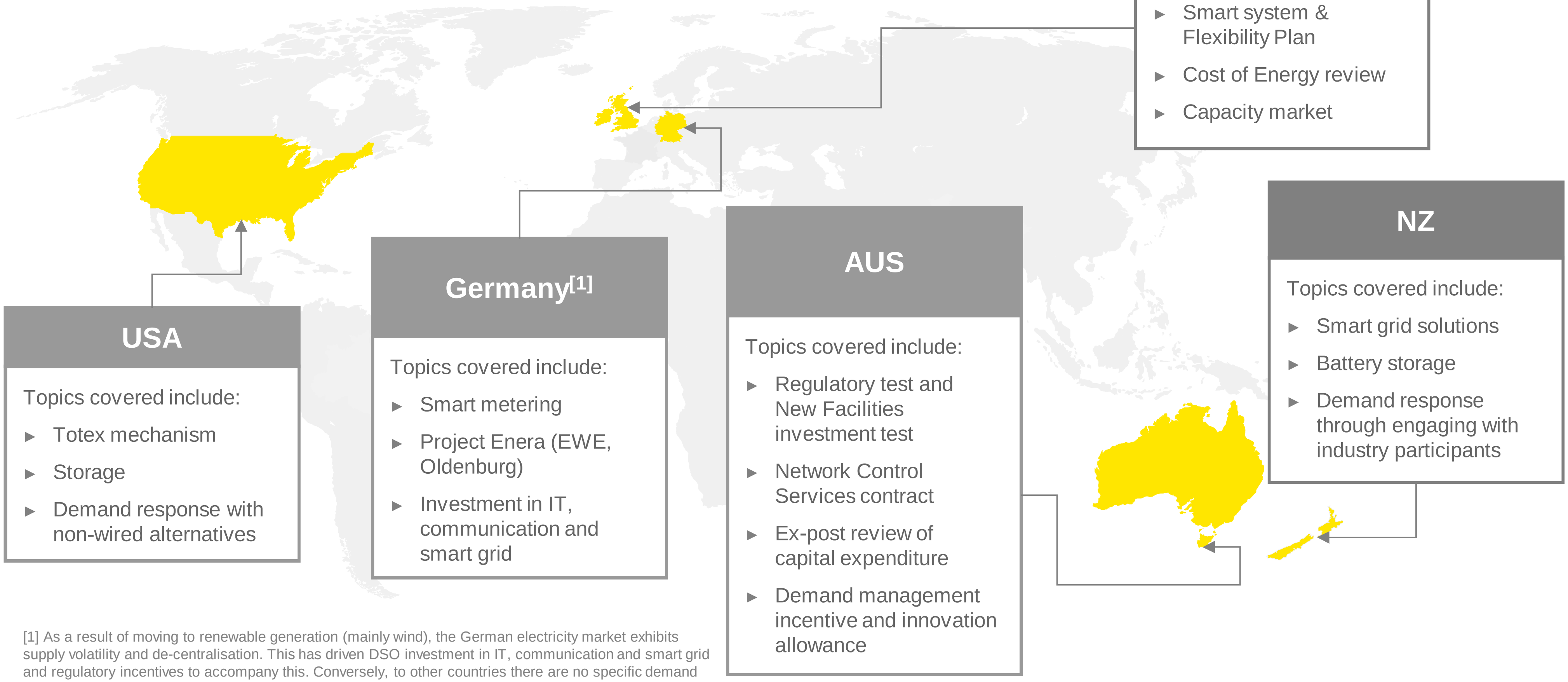
- Finnish regulation is currently favourable to investments through the following mechanisms:
  - periodic revaluation of RAB paired with nominal WACC, which was revised to a higher level than previously in 2016
  - security of supply incentive compensating the DSO for tree clearing and early retirement of overhead lines if they are replaced with underground cables
  - efficiency and quality incentive both penalising the DSO for outages in large storms.
  - the 2013 Energy Market Act ("EMA") amendment further sets high targets for maximum allowed outages by 2029.
- The above factors have motivated or forced the DSOs to:
  - invest in underground cabling.
  - undertake more extensive tree clearings and widen the paths of the overhead lines.
  - bring the overhead lines next to roads.
- We understand that the latter two options are often not perceived economical or practical by the DSOs due to the following:
  - Tree clearing from wide paths are expensive and often not even possible due to landowners' resistance
  - Bringing the overhead lines next to roads shall still not eliminate the risk of trees falling from one side of the road.
- As a result, the DSOs are currently not necessarily motivated to choose the most optimal solutions for customers from social perspective because any increase in RAB due to underground cabling gives them additional economic value via investment incentive, WACC, and opex reductions (efficiency and quality incentives).
- Consequently, the Smart Grids working group within the Ministry of Employment and Industry have proposed exploring whether the regulation of DSOs could be changed so as to motivate socially most reasonable investments.
- For this purpose, regulations including totex principles, demand response and innovative grid methods, which could serve as alternatives to underground cabling and tree clearing have been investigated



2 Background

Demand flexibility solutions were investigated in five countries; Australia, Germany, New Zealand, United Kingdom and United States (NY and RI states)

In the original request for proposal (”RFP”), Energiavirasto, at a minimum, were looking to investigate demand flexibility in the United Kingdom, Australia and at least one additional country. In collaboration with Energiavirasto we proposed Germany, New Zealand and the United States to be investigated in addition because of the demand flexibility activities these countries were undertaking. The demand flexibility examples and resulting outcomes reached are therefore limited to these countries and do not consider potentially more appropriate examples in other countries.



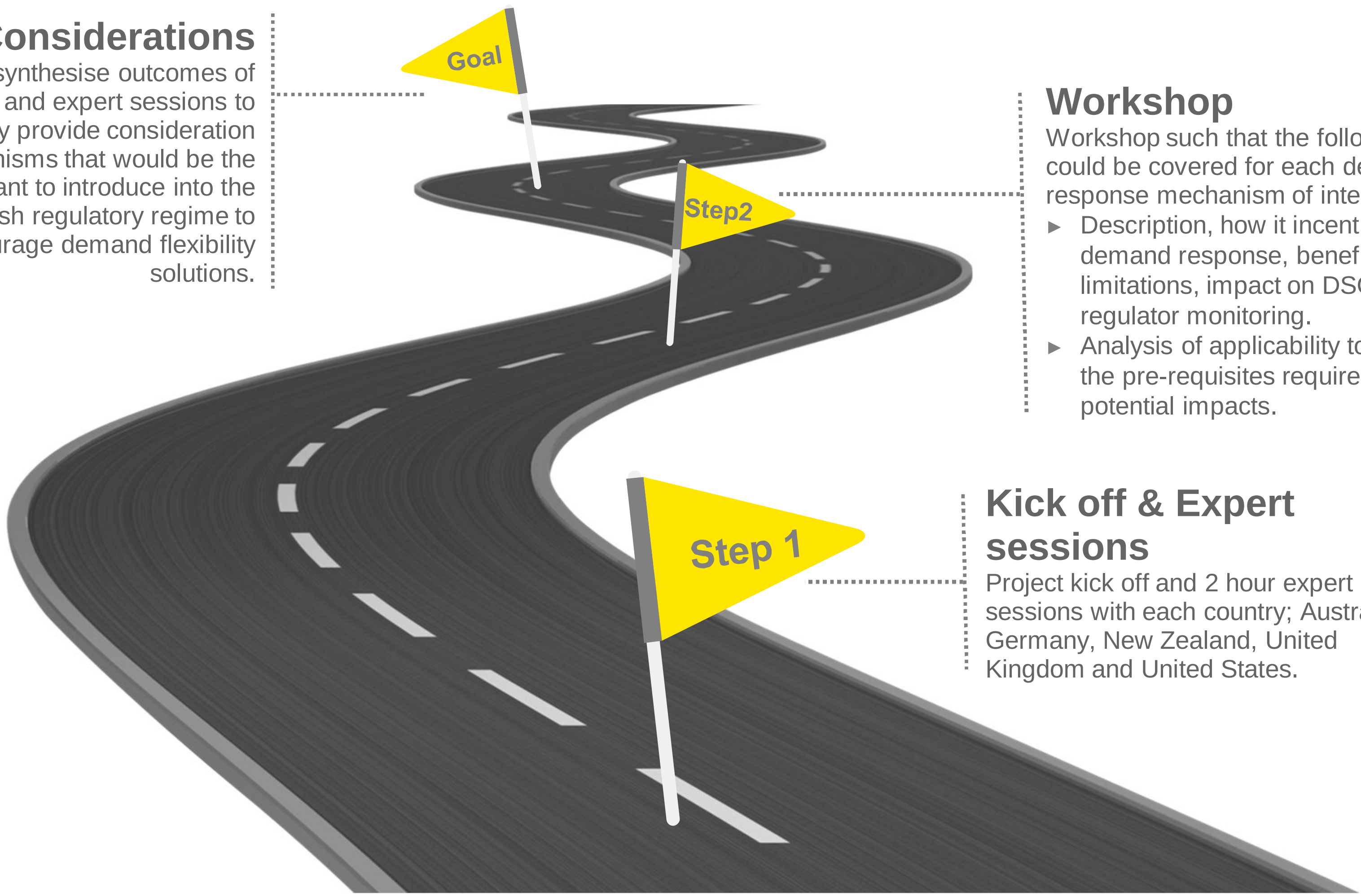
[1] As a result of moving to renewable generation (mainly wind), the German electricity market exhibits supply volatility and de-centralisation. This has driven DSO investment in IT, communication and smart grid and regulatory incentives to accompany this. Conversely, to other countries there are no specific demand response mechanisms in the regulation. Therefore Germany has been excluded from the analysis that follows.

2 Background

The purpose of the project is to assess demand flexibility mechanisms in the benchmark countries and determine their applicability to the Finnish regulatory regime

Considerations

Analyse and synthesise outcomes of the workshop and expert sessions to collaboratively provide consideration on the mechanisms that would be the most relevant to introduce into the Finnish regulatory regime to encourage demand flexibility solutions.



Workshop

Workshop such that the following could be covered for each demand response mechanism of interest:

- Description, how it incentivises demand response, benefits & limitations, impact on DSO and regulator monitoring.
- Analysis of applicability to Finland, the pre-requisites required and potential impacts.

Kick off & Expert sessions

Project kick off and 2 hour expert sessions with each country; Australia, Germany, New Zealand, United Kingdom and United States.

3

Regulation overview

From benchmark countries; Australia, New Zealand, Germany, United Kingdom and United States

3 Regulation overview
Australia

1 Australia

Market overview

Australia consists of 7 states; Western Australia, Northern Territory, Queensland, South Australia, New South Wales, Victoria and Tasmania. Electricity transmission and distribution is regulated under a separate Act in Western Australia compared to the other states:

- Eastern and Southern Australia (National Electricity Market)
  - 13 regulated DSOs
  - Structural separation between network and upstream/downstream activities (unbundling)
  - Contestable wholesale and retail sectors, although there are concerns over the effectiveness of competition due to high levels of market concentration and vertical integration between generators and retailers. While most retail markets across the NEM have more than 19 retailers operating, the 'big three' vertically integrated gentailers, AGL, Origin and Energy Australia, hold large retail market shares in most regions and control in excess of 60% of generation capacity in NSW, South Australia and Victoria and over 70% of retail electricity customers
  - Building block approach to regulation of natural monopoly DSOs
  - National Electricity Law enacted in the South Australian Parliament and adopted in other states through an applied legislation approach
  - National Electricity Rules determined by the Australian Energy Markets Commission (an independent body) with network regulation administered by the Australian Energy Regulator
- Western Australia
  - 1 regulated DSO (plus 1 readying for the introduction of an access regime)
  - Structural separation between network and upstream/downstream activities (Unbundling)
  - Contestable wholesale sector, although dominated by State owned generator/retailer
  - Retail sector not contestable for customers <50 MWh per annum
  - Building block approach to regulation of natural monopoly DSOs
  - State based legislation and codes
  - Regulation by the Western Australian Economic Regulation Authority

Regulation

- The current approach to the regulation of electricity distribution assets in Australia can be summarised as follows:
  - The DSO conducts a forecast of future expenditure requirements over an access arrangement period of usually five years
  - The network business then proposes a network investment plan and a required level of revenue (including a rate-of-return) to service/fund the plan - opex and tax are recovered at forward looking, efficient cost
  - After a process of regulatory assessment, and possible appeal to administrative law tribunals, a final determination is made as to the efficient level of investment and the tariffs that the network can charge over the period of the access arrangement
  - Incentive mechanisms are put in place to allow the DSO and consumers to share cost savings achieved over the regulatory control period
  - In Western Australia, regulatory assessment is not only ex ante, it is also ex post, which means the regulator can remove capex from the RAB that it assesses to have been inefficient or imprudent after the fact. This is not the approach taken in the National Electricity Market

Market overview

- There are 29 Electricity DSOs in New Zealand. 12 of these DSOs are consumer owned (meaning all control and equity return rights are held by one or more community trusts or customer co-operatives) and are not subject to price-quality regulation. The remaining 17 DSOs are subject to price-quality regulation as below.
- The New Zealand electricity market uses mainly renewable energy sources such as hydropower, geothermal power and increasingly wind energy, with 80% of energy for electricity generation coming from renewable sources.
- DSOs: Distributors provide and maintain the power lines used to transfer electricity from the national transmission grid to homes and businesses across New Zealand. They transport electricity to a customer at a particular level of quality and reliability. Electricity distribution companies are connected to the national grid and most sell their services to electricity retailers.
- Electricity Retailers: Electricity retailers in New Zealand provide a ‘bundled’ service for most consumers by buying electricity at wholesale (spot and contract) prices from the generating companies, and transmission or distribution services from lines companies. The retailers' charges to the end-users include the cost of the electricity supplied as well as charges for transmission and distribution. Some large consumers contract separately with retailers and lines companies for energy and network services.

Regulation

- Suppliers of electricity distribution services (non consumer owned) are regulated by the Commerce Commission under Commerce Act 1986. They have been subject to default/customised price-quality regulation and information disclosure since 2009.
- Price-quality regulation is designed to ensure that DSOs have similar incentives and pressures to suppliers operating in competitive markets to innovate, invest and improve their efficiency. A 'default path' applies to all regulated suppliers for a regulatory period between four and five years. The main components of a default price quality path (“DPP”) are:
  - the maximum prices/revenues that are allowed at the start of the regulatory period
  - the annual rate at which all DSOs maximum allowed prices can increase (i.e. rate of change)
  - the minimum service quality standards that must be met.
- Individual DSOs have the opportunity during the regulatory period to apply to the Commission for an alternative or 'customised' price-quality path (“CPP”) to better meet the particular circumstances of the individual DSO. The rules and processes for customised price-quality path proposals, are set out in the input methodology (“IM”) determination applying to DSOs.
- The maximum allowable revenue under a CPP is based on standard building blocks formulae which determines revenue from the DSOs RAB, WACC, operating expenditure, depreciation and tax.
- The regulatory rules include an incentive regimes which allows the DSO to retain a share of underspend based on deferred operating and capital expenditure from previous regulatory periods. This seeks to incentivise DSOs to explore and adopt options that lower its capital and operating including exploring demand side initiatives.

- The electricity sector in Great Britain ("GB") are broadly made up of generation, networks, energy suppliers and customers. The sector is overseen and governed by Government and regulators.
- Energy companies in the unbundled GB energy sector are privately owned, but subject to government policy, and regulations formed and implemented by the regulator for gas and electricity markets, Ofgem.
- Electricity generators and suppliers must comply with the licence conditions set by Ofgem[1]. Electricity networks must also comply with their relevant licence conditions, but additionally are subject to economic regulation, referred to as RIIO (described in the following pages).

Government and regulator

- The Department for Business, Energy & Industrial Strategy ("BEIS"), on behalf of the UK Government, is responsible for ensuring that the country has secure energy supplies that are reliable, affordable and clean.
- Ofgem is the independent economic regulator for energy wholesale markets, networks, and retail markets.

Electricity networks

- There are 3 separately owned, but interconnected, electricity transmission networks covering the whole of GB. The 2 electricity transmission networks operating in Scotland are owned by Scottish & Southern Electricity ("SSE") and Scottish Power, and the electricity transmission network in England and Wales is operated by National Grid.
- There is a single System Operator for electricity, owned and operated by National Grid, which balances all 3 electricity transmission networks.
- There are fourteen electricity distribution network operators (DNOs), owned by 6 different companies, as set out in the following table.

DNOs operating in GB

DNO group	Individual DNO
Electricity North West	▶ Electricity North West Limited (ENW)
Northern Powergrid ("NPg")	▶ Northern Powergrid (Northeast) Limited ▶ Northern Powergrid (Yorkshire) plc
Scottish and Southern Energy ("SSEN")	▶ Scottish Hydro Electric Power Distribution plc ▶ Southern Electric Power Distribution plc
ScottishPower Energy Networks ("SPEN")	▶ SP Distribution Ltd ▶ SP Manweb plc
UK Power Networks ("UKPN")	▶ London Power Networks plc ▶ South Eastern Power Networks plc ▶ Eastern Power Networks plc
Western Power Distribution ("WPD")	▶ Western Power Distribution (East Midlands) plc ▶ Western Power Distribution (West Midlands) plc ▶ Western Power Distribution (South West) plc ▶ Western Power Distribution (South Wales) plc

- Under RIIO, Ofgem sets the allowed cost of equity for the DNOs. Under the current price control, the DNOs within the WPD group were set an allowed cost of equity of 6.4%, while the other DNOs were given 6%. WPD received a higher allowed cost of equity for the submission of their robust business plan.
- DNOs can earn higher returns than the allowed cost of equity and debt through incentives; the key incentive under RIIO is discussed later in this report.

[1] https://www.ofgem.gov.uk/licences-codes-and-standards/licences/licence-conditions

3 Regulation overview

United Kingdom: Overview of the regulator's approach

Electricity suppliers and customers

- Electricity suppliers are responsible for buying electricity, from generators or traders, to sell to their customers, and also contract with network companies for the physical delivery of energy to their customers. Energy suppliers also meter their customers' usage in order to bill them.
- Energy suppliers in GB have been mandated to roll-out smart meters to all homes and small businesses which agree to the installation by the end of 2020.

Regulatory background

- Economic regulation of the energy industry is based on the RIIO system of price controls, establishing a system of price controls which is reviewed periodically.
- The process involves companies setting out proposals in their business plans for the forthcoming price control period.
- The price controls determine the amount that DNOs can charge their customers, their agreed regulated capital value ("RCV") and the returns that they are allowed to make on these regulated assets ("reg WACC").
- The regulatory economic framework for companies operating in the gas and electricity markets in GB is a pre-specified output led framework. This is illustrated adjacent.

Overview of Ofgem's regulatory framework for DNOs

Outputs led framework

- DNOs are incentivised to deliver outputs in the following six primary output categories (in addition to long term sustainability objectives):
  1. Customer satisfaction
  2. Reliability and availability
  3. Conditions for connection
  4. Environmental impact
  5. Social obligations
  6. Safety

Price control

- RIIO provides an ex ante price control framework for determining DNO revenues. The current price control for DNOs (RIIO-ED1) runs from April 2015 to March 2023.
- The building blocks of this price control are determined ahead of the start date through public consultation and are finalised with the publication of the Final Determination. For RIIO-ED1 this was published on 28 November 2014.
- A key input to the RIIO framework is the Regulated Asset Value ("RAV").

Revenue adjustment within period

- The allowed revenue, which is set ahead of the regulatory period, can be adjusted upwards or downwards within the price control period according to:
  - DNO performance against the output categories
  - Sharing of DNO under- or over-spending against expenditure allowed at the price control review ("efficiency incentives").
  - Uncertainty mechanisms to adjust revenues in line with changes to pre-set exogenous factors, including volume drivers, revenue triggers, specific reopeners, and pass-through costs.

Charging arrangements

- DNOs recover their allowed revenues in Distribution Use-Of-System ("DUoS") charges on users of the distribution network.
- All DNOs are required to use two common distribution charging methodologies to set their DUoS charges:
  - The Common Distribution Charging Methodology ("CDCM")
  - The Extra-High Voltage Distribution Charging Methodology ("EDCM")

Determination of revenues in the RIIO-ED1 framework

- Committed revenues are split into different categories under the RIIO framework:

1 Baseline revenue allowance

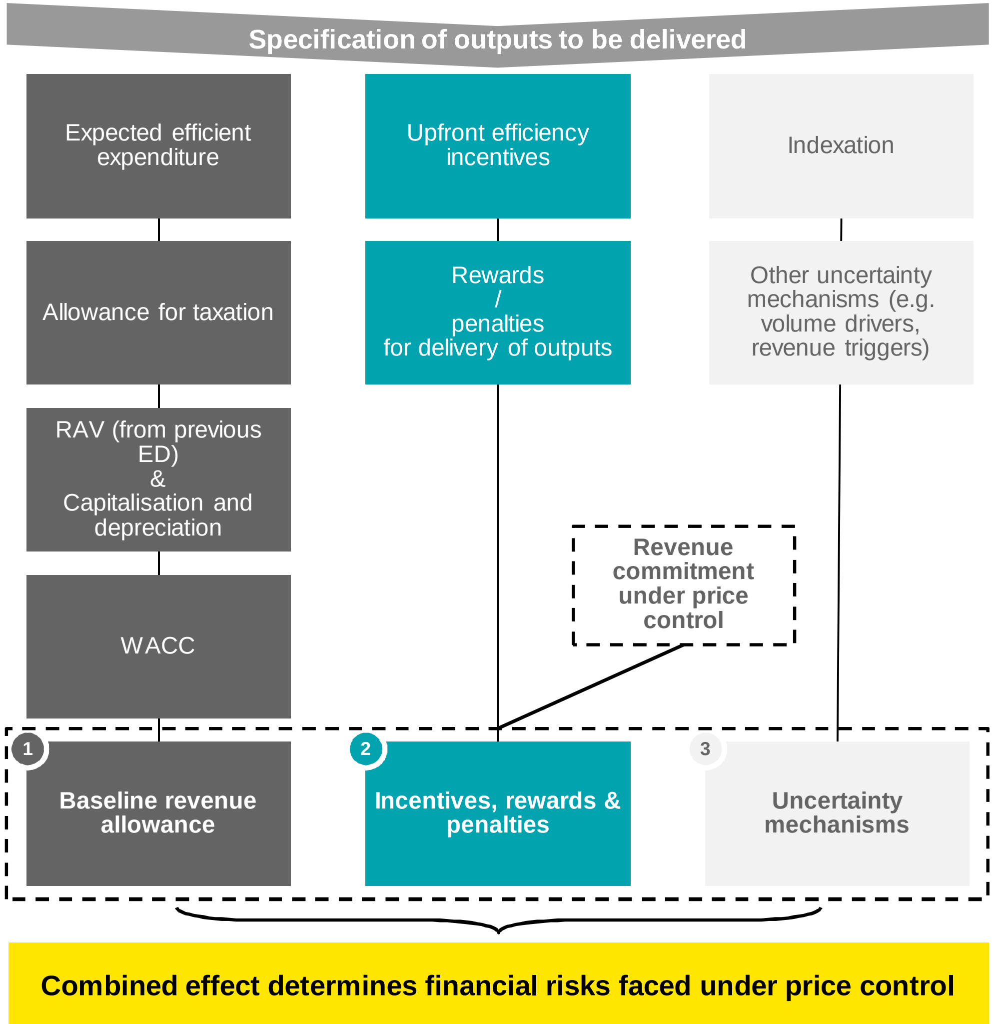
- Ofgem determines the baseline revenue allowance based on the regulated asset value carried forward from the previous control period, as well as expected efficient expenditure.
- Ofgem makes allowances to these costs for taxation and updates its estimates for the appropriate level of WACC.

2 Incentives, rewards & penalties

- Rules to adjust revenues in light of the DNO's performance.
- Ofgem determines the outputs expected of the DNO alongside the profile of rewards and penalties for over/underperforming relative to the outputs.
- These incentives are not necessarily symmetrical, with the profile of incentives differing between outputs.
- The company's performance against the incentives leads to changes in the baseline revenue allowance.

3 Uncertainty mechanisms

- In addition to changes in the baseline revenue for the DNO's performance on outputs, there are additional mechanisms for revising the allowed revenue for other factors.
- These include indexation for inflation and the cost of debt in line.
- There are also uncertainty mechanisms that allow Ofgem to adjust revenue in light of changed circumstances, for instance changes in the volume of energy carried through the network.

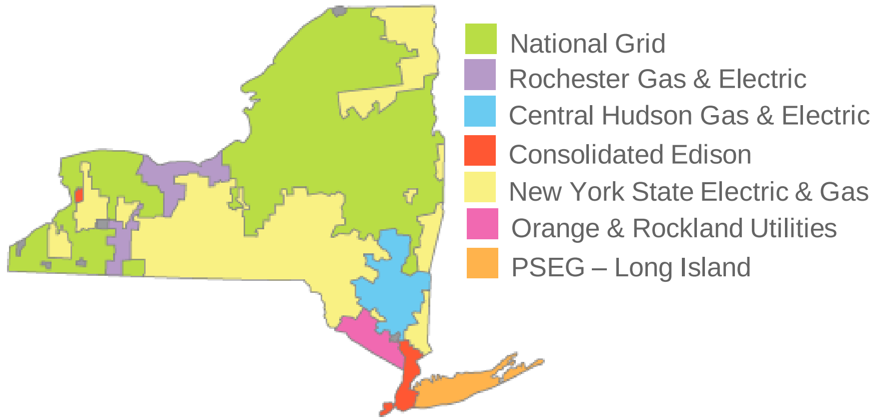


Market overview

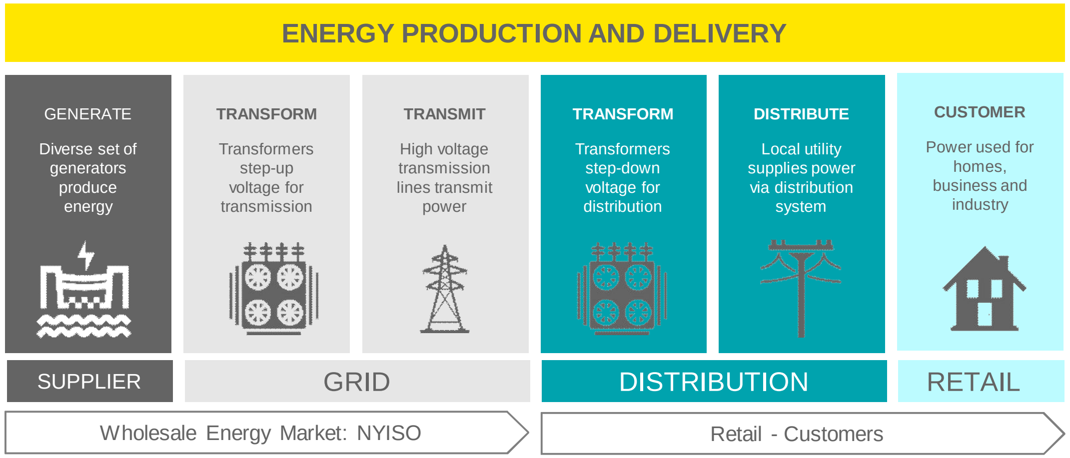
Energy retailers

Energy service companies ("ESCOs") (energy retailers), provide electricity and natural gas to residential and business customers, which is then delivered through utilities like Con Edison or National Grid. New York opened up the energy market to ESCOs in the early 2000s in an effort to give New Yorkers more options in how they get their energy and, hopefully, to drive down prices by introducing competition. Overall, the ESCO market is thriving, with some 200 companies providing electricity and gas across the state. Some 20% of residential energy customers buy from ESCOs (ESCOs may not sell to low income customers). A much higher rate of commercial and industrial customers also use ESCOs, and largely benefit from the market to fit their different energy needs. In the event an ESCO does not follow-through on its promises to provide energy services, the incumbent utility provides default service.

New York State Investor Owned Utilities and Service Territories

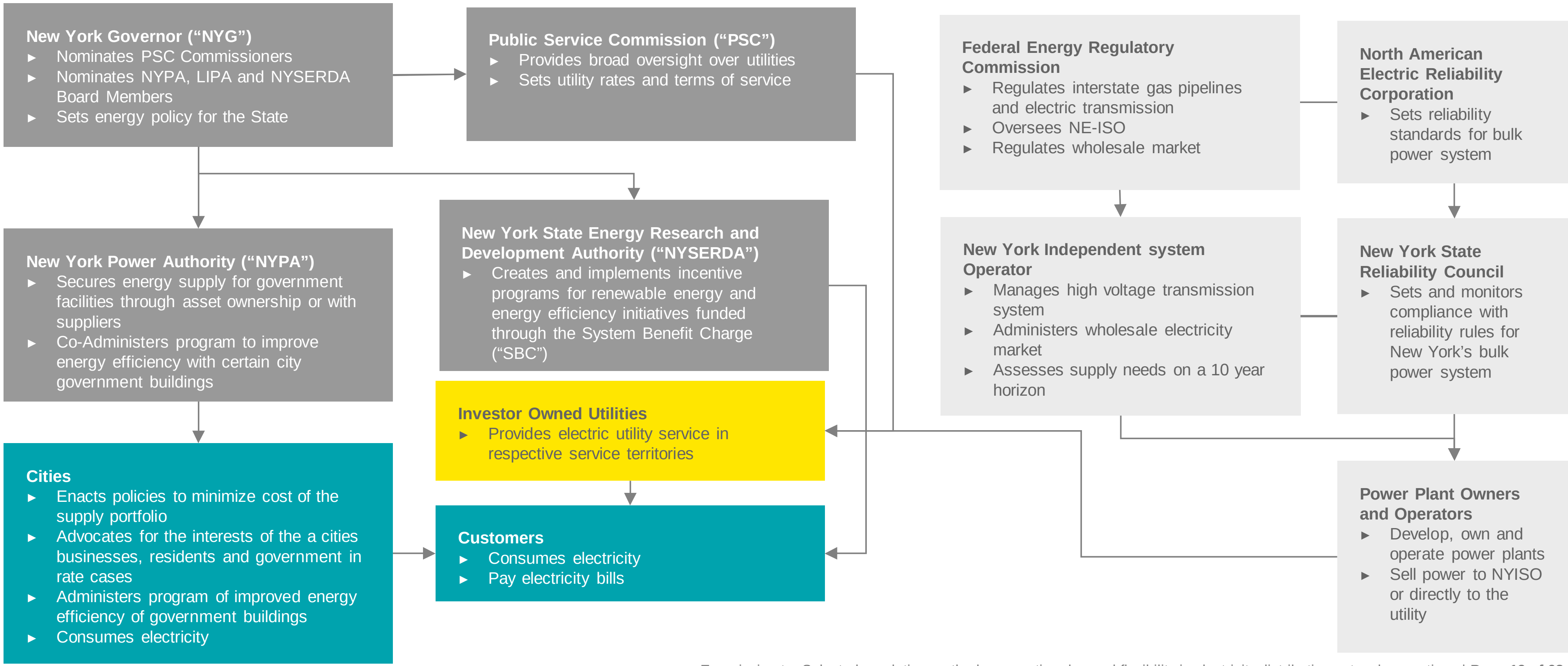


Market operations



Regulation

While the Public Service Commission (PSC), in rate cases decided in recent years, has authorized electric and gas ROEs that are lower than the nationwide industry averages, for the most part, these decisions were based on multi-year settlements that incorporated increasing rate bases over the term of the plans, revenue decoupling mechanisms and deferral accounting for increases in such items as net plant, pension expense, and labour costs. Additionally, other factors in the rate-setting process, including the incorporation of fully forecasted test periods improve the utilities' opportunity to earn the authorized ROE. Regarding industry restructuring, the electric utilities, for the most part, divested their generation assets, and the companies are protected from commodity price risk, given their use of automatic mechanisms that allow timely recovery of power procurement costs from provider-of-last-resort customers. The PSC has embarked upon an investigation, "Reforming the Energy Vision", or REV, addressing how the current regulatory paradigm is to be modified to enable electric utilities to coordinate and manage distributed energy resources. This is detailed in Appendix A.

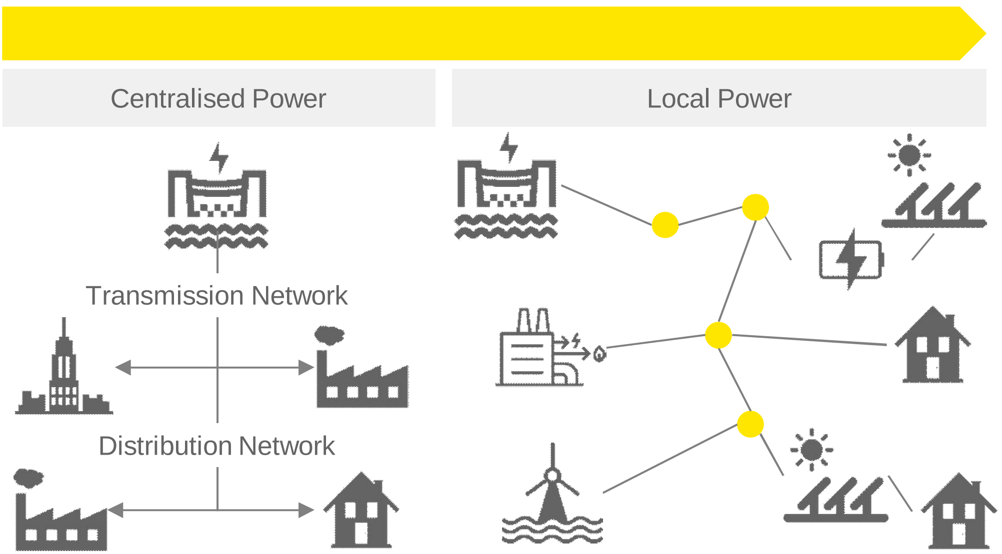


Market overview

Energy retailers

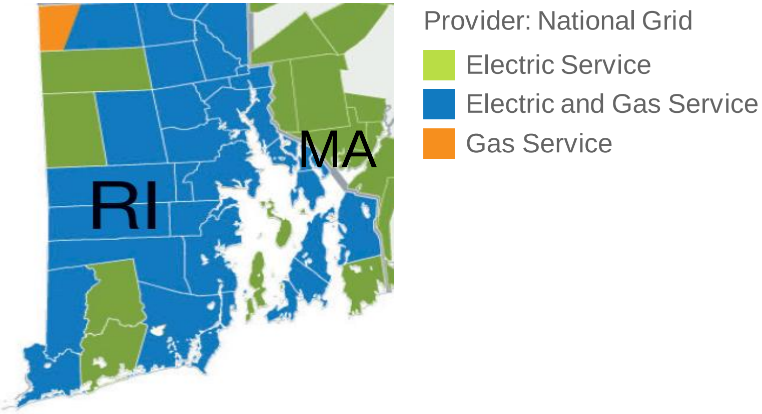
ESCOs, provide electricity and natural gas to residential and business customers, which is then delivered through the National Grid. Rhode Island was one of the first states to open up the energy market to ESCOs in 1996 in an effort to give Rhode Islanders more options in how they get their energy and, hopefully, to drive down prices by introducing competition. Suppliers are often able to offer lower rates because they're able to buy electricity more frequently than the utility, and they can better estimate the amount to purchase because they have fewer customers than the much larger utility. A much higher rate of commercial and industrial customers also use ESCOs, and largely benefit from the market to fit their different energy needs. In the event an ESCO does not follow-through on its promises to provide energy services, then National Grid provides default service.

Market operations



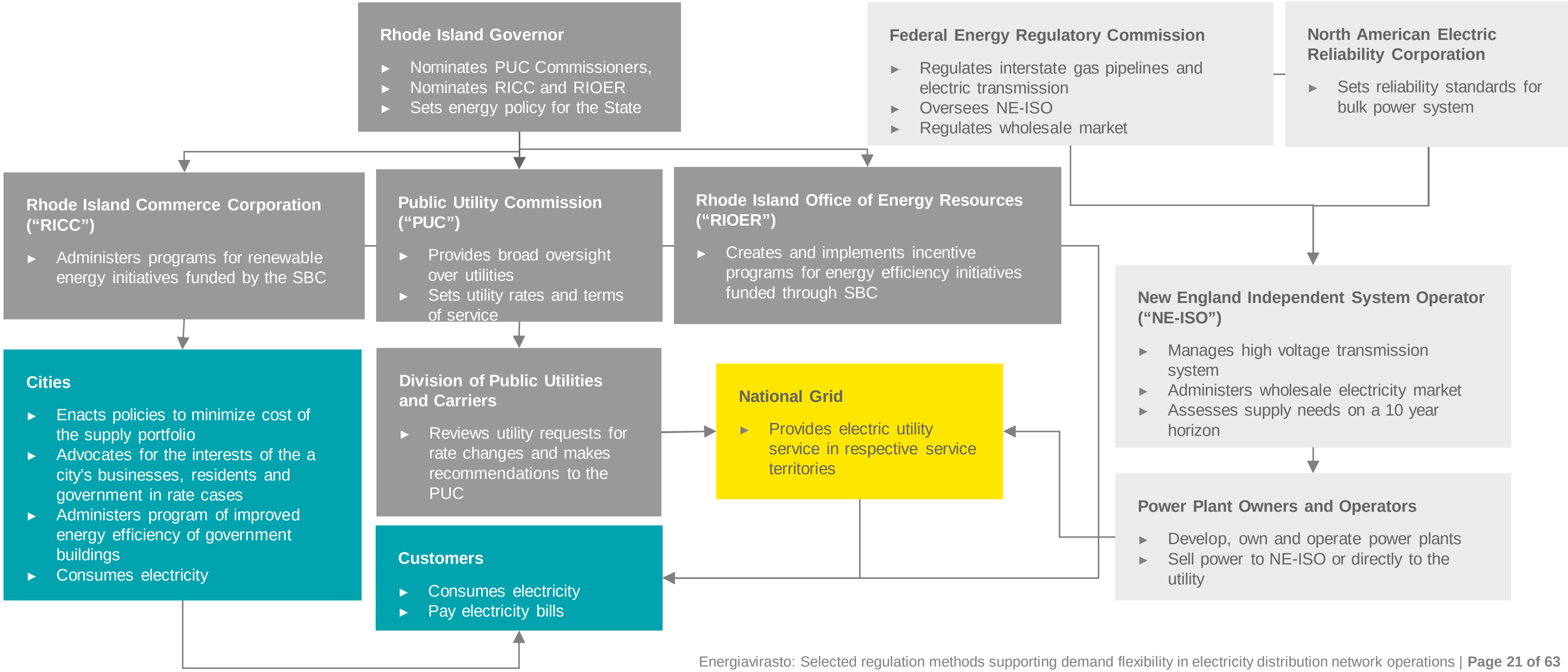
Renewable sources, local CHP, house with solar panel, solar PV with storage etc

Rhode Island State Investor Owned Utilities and Service Territories



Regulation

The RIPUC has authorized returns on equity that have been below the industry averages when established. The PUC utilizes a forward-looking test year and an average rate base in its rate proceedings. Regarding electric industry restructuring, the state's only electric distribution utility, Narragansett Electric (National Grid), has retained the provider-of-last-resort responsibility for power supply, but is insulated from market-price fluctuations. The PUC has authorized Narragansett to implement full decoupling mechanisms for its electric and gas operations, following a legislative directive. The law also allows for annual rate adjustments outside a base rate case to reflect incremental capital investment for electric and gas operations, as well as expenses associated with safety and reliability. An earnings sharing mechanism is in place for Narragansett's electric and gas operations that provides for graduated earnings sharing above the benchmark returns to be shared with customers. In addition, pension adjustment mechanisms are in place for Narragansett's electric and gas operations that reconcile actual pension and other post-employment benefits expense to those reflected in base rates. The PUC has approved a gas adjustment clause that reflects a variety of costs, including system balancing, low-income assistance, demand-side management and environmental response..



4

Mechanisms

From benchmark countries; Australia, New Zealand, United Kingdom and United States

Totex: Regulatory test and new facilities investment test

Description

- Tests that the regulator applies to assess the prudency and efficiency of proposed expenditure, or in the case of Western Australia, past expenditure
- The regulatory test applies to major augmentations (transmission capex > AUD 36.7m, distribution capex > AUD 12.2m), and requires the DSO to demonstrate that the investment "…maximises the net benefit after considering **alternative options**"[1] (emphasis added)
  - Alternative options are defined as "… alternatives to part or all of the major augmentation, including **demand-side management** and generation solutions (such as distributed generation), either instead of or in combination with network augmentation"[1] (emphasis added)
- The new facilities investment test applies to all network expenditure and requires the DSO to justify investment on the basis that:
  - The DSO is efficiently minimising costs, plus
  - The project will generate incremental revenue to recover its costs, it net benefit justifies the cost, or it is requires to meet reliability standards
- The regulator can remove capex from the RAB that it assesses to have been inefficient or imprudent on an ex-post basis

Incentive

- These tests are structured as penalties rather than incentives because they do not provide additional reward to the DSO for outperformance. The incentive on the DSO is to avoid a write down (i.e. capex not being rolled into the RAB). So the DSO would seek to avoid a penalty in the form of an uncompensated cost where the investment is deemed imprudent or inefficient by the ERA.
- These tests try to overcome the bias towards capex solutions caused by DSOs enjoying a rate of return for network solutions, but no rate-of-return for non-network solutions (such as demand response)
- The regulatory test explicitly requires the DSO to consider efficient, demand-side management solutions
- In practical terms, the new facilities investment test requires:
  - Options development and analysis, including consideration of a wide range of options - the more exhaustive and diverse the options considered (e.g. demand response options), the more likely the regulator will be satisfied that the recommended option is the optimal option
  - Project selection, including justification of the project in terms of the options analysis

Funding

- Ultimately, regulatory costs are recovered from end use customers

Benefits and limitations

- Encourages the DSO to develop expenditure governance frameworks with the regulator in mind
- No clarity for operators whether an investment will be included in RAB
- "Stick" rather than "carrot" approach

DSO impact

- Governance frameworks need to be robust for determining investment
- Investment documentation must be thorough and in compliance with DSOs governance frameworks
- A number of options to deliver a project need to be considered

Customer impact

- Lower prices to the extent that inefficient or imprudent expenditure is not rolled into the RAB

Monitoring

- Sample of projects are assessed for compliance by the regulator on both an ex-ante and ex-post basis as part of the DSO regulatory submission

[1] Western Australia, Electricity Networks Access Code 2004

4 Mechanisms

Totex: Regulatory test and new facilities investment test (1/8)

1 Australia

Totex: Regulatory test and new facilities investment test (cont.)

Examples

- The approach has resulted in demand response opex options being 'considered'
- However, it is difficult to find evidence that demand response options have been chosen over network solutions
- In practice the approach has improved DSO expenditure governance practices for capex, but has not resulted in significant employment of demand response by DSOs as a substitute for capex
- The lack of network expenditure on DSO solutions suggests that the application of a regulatory test may not have overcome the underlying incentive for the network to choose a capex solution over an opex solution. One possible explanation for this may relate to the level of regulatory effort required to enforce network investment via these mechanisms.
- If the DSO considers an efficient demand response option, but does not choose it over a less efficient capex solution, then the regulator would need to enter into a technical argument with the DSO. It may be difficult for the regulator to prosecute in front of an administrative tribunal unless there is a clear error found (e.g. an error in discounted cash flow modelling that resulted in the wrong option being chosen).

[1] Western Australia, Electricity Networks Access Code 2004

RIIO Totex Incentive Mechanism (TIM)

Description

- Under RIIO, the regulator sets allowed expenditure in relation to Totex, which is the sum of capex and opex. The concept of Totex was introduced to reduce prescription in the price control, and create a level playing field between capex and opex solutions.
- Related to Totex is an incentive, the Totex Incentive Mechanism ("TIM"), whereby the DNO can keep a proportion of any underspend compared to allowed expenditure, which is based on Totex (and vice versa). TIM was introduced as RIIO is an ex-ante price control, and is used to drive efficient expenditure.
- The proportion that of under/overspend that DNOs must share with their customers is referred to as the sharing factor, and is as follows:

DNO sharing rates

DNO group	Sharing Factor
Electricity North West	41.89%
Northern Powergrid	44.16%
Scottish and Southern Energy	43.53%
ScottishPower Energy Networks	46.5%
UK Power Networks	46.72%
Western Power Distribution	30%

- The sharing factor was determined at the beginning of RIIO, and determined by how ambitious the business plan was; the more ambitious the plan, the lower the sharing rate, i.e. the more of the underspend the DNO can keep, or the more of the overspend the DNO has to incur

Incentive

- Network companies do not have an explicit incentive to use demand response. However, as TIM incentivises DNOs to adopt least cost solutions, DNOs will be attracted to demand response solutions where they are expected to be cheaper than alternative options

Funding

- TIM is part of RIIO, and therefore is funded by all end-consumers who are connected to the DNO's network as part of the charging regime. The DNO charges its customers, i.e. energy suppliers, who in turn charge end-consumers via their electricity retail bills.

Benefits and limitations

- Benefits include:
  - DNOs are incentivised to identify and implement the least cost solution; the regulator does not presume to know the optimal solution, or prescribe DNOs activities in detail;
  - Market orientated i.e. opportunities for a range of providers, and technologies/ solutions to be adopted due to less prescriptive regulation, and focus on least cost;
  - DNOs should be indifferent between capex and opex;
  - Any underspend compared to allowed expenditure is shared with the customer (in the form of a reduction in tariff two years after the fact)
- Limitations include:
  - Potentially all DNOs can over perform; and
  - Limited number of direct links between any underspend and delivery against outputs; underspend assumed to be due to efficiencies (although DNOs met their outputs in almost in all instances in the first two years of RIIO

RIIO Totex Incentive Mechanism (TIM) (cont.)

DNO impact

- DNOs are incentivised to chose the most cost effective solutions, to deliver their outputs under RIIO, which may be demand response is some instances

Customer impact

- During the first two years of RIIO-ED1, the majority of consumers have benefited from DNOs underspending compared to their allowed expenditure, as set out in the table below, and therefore will benefit through the TIM. Any over- or underspend will be shared with the DNO's customers in accordance with the sharing factors set out on the previous slide.

		2015-16 and 2016-17 (£m)		
DNO group	**Individual DNO**	**Allowance**	**Actual**	**Difference[1]**
ENW	▸ Electricity North West	500	461	-40
NPg	▸ Northern Powergrid (Northeast)	393	381	-12
	▸ Northern Powergrid (Yorkshire)	507	475	-32
SSEN	▸ Scottish Hydro Electric Power Distribution	349	327	-21
	▸ Southern Electric Power Distribution	670	596	-74
SPEN	▸ SP Distribution	443	408	-35
	▸ SP Manweb	520	500	-19
UKPN	▸ London Power Networks	530	400	-131
	▸ South Eastern Power Networks	506	382	-124
	▸ Eastern Power Networks	733	597	-135
WPD	▸ Western Power Distribution (East Midlands)	565	638	73
	▸ Western Power Distribution (West Midlands)	610	630	20
	▸ Western Power Distribution (South West)	320	295	-24
	▸ Western Power Distribution (South Wales)	466	488	23
TOTAL		7111	6580	-531

Monitoring

- Regulator approves the allowed expenditure ahead of each price control period
- DNOs need to report on their expenditure each year.
- Regular reporting and monitoring is a significant undertaking for the DNO and regulator respectively.

Examples

- ENW (one of the DNOs) introduced Customer Load Active System Services ("CLASS") in 2014[2], a low-cost solution which uses voltage control to manage electricity consumption at peak times. The solution competes with other balancing services, and does not interfere with the operation of the wholesale electricity market.
- ENW ran a 12-month trial where new voltage controllers were installed at 60 substations serving 485,000 people. Detailed research carried out during the trial showed that customers didn't notice any change in their electricity supply.
- Following a six month extension to the original CLASS project which demonstrated how the technology could be deployed commercially, ENW are now rolling out the CLASS project into our business as usual processes.
- ENW's approach can be used to help balance electricity supply and demand for and brings a number of other advantages, such as avoiding or deferring the cost and disruption of expanding GB's network of overhead lines, underground cables and substations. As a result, ENW estimate that by installing 'voltage controllers' in their substations they could save their customers in the around £100 million over the next 25 year as the benefits are shared.

[1] Differences are subject to rounding
[2] https://www.enwl.co.uk/innovation/class/

Demand response: Power of Choice (smart meters)

Description

- A reform to roll out smart meters on a competitive basis, which should assist consumers to engage in demand response
- Newly created market participants called 'metering coordinators' have been given responsibility for provision of contestable metering
- The metering coordinators' customers will be retailers and DSOs (e.g. for instantaneous data such as network voltage)
- Minimum meter specifications include:
  - remote disconnection
  - remote reconnection
  - remote on-demand meter read
  - remote scheduled meter read
  - metering installation inquiry service
  - advance meter reconfiguration
- Some DSOs are likely to participate as metering coordinators, but they will need to ring-fence this part of their business off from the main network business unit. Another alternative would be to divest this part of their ownership of existing meter, although a recent example suggests the trend may be the former
- Where the customer's existing meter is at the end of its life, fails, or can't perform required functions it will be replaced with a smart meter. Alternatively, Retailers may run meter replacement campaigns requesting customers to change their meter

Incentive

- Ability to put in place time of use and/or critical peak pricing tariffs to incentive demand response

Funding

- The retailer pays for the services provided by the metering coordinator and recovers the cost from end use customers. Metering coordinators can also sell services to DSOs e.g. real time network data

Benefits and limitations

- Market operator and DSO may obtain information on demand side participation from registered participants
- Metering reform was supported by improved business to business communications procedures

DSO impact

- Provides greater visibility of customer usage such that flexible tariff structures can be developed
- Defers investment through shifting peak load
- If DSOs participate, metering data provision procedures must be developed by the market operator
- Retailers and distributors must ring-fence any metering coordinator business they own from their core business

Customer impact

- There will be an initial upfront cost to end use customers to install the advance meter
- Over the long term, more efficient pricing and demand response should benefit all customers through downward pressure on network investment requirements

Monitoring

- As this is a competitive sector, the regulator's main role is to ensure ring-fencing provisions are complied with

4 Mechanisms

Demand response: Power of Choice (smart meters)

(3/8)

1 **Australia**

Demand response: Power of Choice (smart meters) (cont.)

Examples

- the ActiveStream metering business was sold by the largest gentailer AGL to a DSO and another large gentailer Origin Energy is looking to sell the Acumen metering business
- It seems that the metering coordinator businesses will be a large volume game, and that there will be significant market consolidation
- It will take some time before the metering roll out progresses to a point where a judgement can be made on its effectiveness in supporting demand response

4 Mechanisms

Demand response: Network control services contract (4/8)

1 Australia

Demand response: Network control services contract

Please include the following:

Description

- This is a contract between a DSO and a generator or load to provides an opex solution to a network control issue
- Network control service contracts are a way of deferring or avoiding network investment

Incentive

- It provides a mechanism rather than an incentive for demand response

Funding

- Ultimately, end use consumers pay through an increase in regulated tariffs

Benefits and limitations

- The process lacks transparency
- In the case when government owned DSOs are contributing to significant government debt issues, network control service contracts can reduce the risk of credit rating downgrades

DSO impact

- Network problems are made available
- DSO only receives AUD 1 of regulated revenue for every AUD 1 of opex it spends on a network control service contract (i.e. it receives a return of but does not receive return on investment), whereas for a network investment it gets more than AUD 1 of regulated revenue for every AUD 1 of opex it spends.
- Whilst the network control services contract does not financially incentivise DSOs, it facilitates connecting opex solutions providers with the DSOs

Customer impact

- Potentially lower prices than would otherwise be the case, assuming efficient network control contracts are entered into by the DSO

Monitoring

- No monitoring required

Examples

- There is no publically available evidence that these contracts have been entered into by DSOs for demand response

1 Australia

Demand response: Demand management incentive and innovation allowance

Description

- These are two incentive mechanisms that have recently been introduced to the NEM that do not apply to Western Australia (i.e. only apply to Eastern and Southern Australia)
- Demand management incentive allows networks to increase revenue
- The demand management incentive is up to 50% of the expected costs of committed, efficient demand management projects (up to a cap equal to the net benefit realised or 1% of allowable revenue, whichever is less)
- The innovation allowance is a demand response research and development fund equal to AUD $200k (CPI adjusted) + 0.075% of the DSOs allowable revenue which provides the DSO with an annual, ex-ante allowance in the form of additional revenue.

Incentive

- Allows opex to earn a return on investment (as well as a return of investment)
- Removes the bias towards capex solutions (which generally do not involve demand side management)
- Encourages innovation towards accommodating demand response solutions into network investment plans
- It is difficult to assess how the mechanisms have encouraged cost effective demand response as they have only recently been introduced

Funding

- Ultimately, the end use customer pays for the incentive schemes
- In theory, all else being equal, prices would be higher than would otherwise be the case if the DSO could be forced (rather than incentivised) to choose the least cost option by a regulator – however this is assuming such regulation is costlessly enforceable, which is unlikely to be the case in practice

Benefits and limitations

- Only applies when DSO submit a regulatory proposal
- Does not encourage DSO to support demand response beyond the amount covered by the incentive payments

DSO impact

- DSOs are now considering demand response options in their planning
- Potential for DSO to earn higher revenues through the schemes than would otherwise be the case

Customer impact

- Only recently implemented and therefore true impacts unclear

Monitoring

- Allowable revenue associated with the incentives are awarded as part of the regulatory determination

Examples

- Only recently implemented and therefore unable to provide examples

Demand response: Demand management response program and interruptible load

Description

- Transpower NZ Limited – a state-owned enterprise responsible for electricity transmission has an incentive based demand response programme that targets specific areas throughout New Zealand, and also encourages new sectors including agri-business, campus-style organisations and residential consumers using battery-based technology to participate.
- Transpower currently does hold direct contracts with its customers. Once the contracts are agreed the load disconnection is primarily controlled by the customer.
- Through its demand response programme, Transpower is able to manage peak demand by contracting consumers to manage their energy use, in return for a payment. Once accepted into the programme, participants can earn a recurring availability payment for committing to the programme, as well as a payment for reducing load during specific demand response events.
- Electricity consumers in New Zealand have to sign up to participate in Transpower's demand response programme. Once electricity consumer's choose to participate they will receive a signal from Transpower that announces a demand response event. The signal specifies a time period and a price point. Typically, participants use their standby generator to provide the power they need for the time of the demand response event, instead of consuming power from the national grid.
- Interruptible Load is another incentive based demand response programme in New Zealand which automatically reduces capacity across dozens of sites to adjust for the small number of major fluctuations in the balance between electricity generation and demand
- Interruptible Load is provided by industrial and commercial end-users. Usually these end-users will provide their interruptible load via an aggregator (in NZ's case – EnerNOC NZ Inc.) who is contracted by Transpower to offer interruptible load into the reserves market. In return, the end-users receive payments for their Interruptible Load.

Incentive

- Availability payment as well as payment for reducing load during specific event.

Funding

- Ultimately, regulatory costs are recovered from end use customers

Benefits and limitations

- Any reduction in peak demand can result in reduced grid and generation investment. Less transmission and generation infrastructure means lower electricity costs for end consumers. Also consumers who enrol in the demand response programme will receive payment for participation

DSO impact

- The regulatory rules include incentive regimes which allows the DSO to retain a share of underspend based on deferred operating and capital expenditure from previous regulatory periods. This seeks to incentivise DSOs to explore and adopt options that lower its capital and operating costs including exploring demand side initiatives.

Customer impact

- As at December 2015, Transpower stated that its demand response programme demonstrated an increasing consumer (mainly commercial/industrial consumers) interest in managing electricity usage and being involved in programmes that are providing beneficial returns. Respondents offering between 2 kW to 6.5 MW were accepted. In total, 26 proposals were received, reaching across the whole of New Zealand. Applicants included hospitals (public and private), supermarkets, battery users, solar cells, renewable generation, and standby diesel generation

Demand response: Demand management response program and interruptible load (cont.)

Monitoring

- New Zealand's Electricity Authority has regulatory oversight of the retail and wholesale markets, and transmission contracts. The Electricity Authority is currently investigating demand response principles in the New Zealand electricity sector.

Examples

Timaru District Council – Waste Water Treatment Plant

- Timaru District Council participates in the Transpower's Demand Response program. They get paid to run their own power generator on a frequent basis in the period when the National Grid requires power. Timaru District Council always have people on site, monitoring the plant making it very easy to manage.
- "Participating in the program has helped us understand and investigate how we could also use our generator to smooth the peaks in our own energy use, not just contribute to the National Grid's demand profile. Our electricity tariff is based on our maximum demand, so if we can smooth those high demand peaks it could save us money overall. Because we're in the Demand Response Program, we're actually using the generator more often, which means we are really familiar with the process now and that knowledge is shared across the team. It's a good thing." – Grant Hall, Drainage and Water Manager for Timaru District Council.

New World Kawerau Supermarket

- Kawerau New World Supermarket was part of the Demand Response program from late 2014, and was able to take advantage of Transpower's Demand Response smartphone app to participate in its Demand Response Program.
- The owner and operator of the supermarket, Wade Brown, opens the Demand Response App on his iPhone to assess the details of the event, he then enters in the amount he is willing to switch on the supermarket's standby generator for, and if he gets accepted to participate then a notification comes through on the App. Through the App he logs the event on his Outlook calendar with a reminder to switch the generator on.
- Once the event is complete, he turns the generator off and the mains power comes back on. Afterwards, a notification appears on his phone that the event has ended, and then a payment comes through for the agreed payment at the end of the month. The mobile App displays all the past events, power amounts and prices.
- "As a business owner, driving down costs without reducing service or quality is a constant challenge. As part of my building warrant of fitness and disaster recovery planning, as an internal process in the store we are required to run the generator once a month. To me it was a 'no brainer' – if they've got to be on anyway, why not be a part of the demand response scheme and be paid for running the generators?" – Wade Brown, Owner and Operator of Kawerau New World Supermarket.

Case Study: Juken New Zealand Limited (JNL)

- JNL is a participant in the Interruptible Load program, they have two sites enrolled in the Fast Instantaneous Reserves Market (FIR). Where load from their dryers are removed within one second of the frequency drop and maintained for 60 seconds before resuming normal operations.
- JNL also has one site enrolled in the Sustained Instantaneous Reserves (SIR), where some equipment is quickly removed but kept offline for up to 30 minutes. This includes their kiln fans and chippers, which are able to be powered down for a longer period without impacting production.
- Nominating specific loads for different reserves enables JNL to benefit from the different participation opportunities available in the program, and a good understanding of their business and operational flexibility ensures that neither deliverables nor equipment are negatively impacted

4 Mechanisms
Battery storage: Case by case approval (7/8)

2 New Zealand

Battery storage: Case by case approval

Description

- The Commerce Commission has taken an initial view that battery storage could form part of a regulated service as it provides functions similar to that of traditional “poles and wire” service.
- There is no limit of number or size of batteries allowed at this point. DSO’s can own the battery storage which they can potentially factor into their RAB calculation as below.
- The regulatory treatment of a battery depends on the extent to which it will be used for regulated or unregulated services, and the overlap in the costs related to each. If it is used for both, the DSO must apply the cost allocation IM to allocate the capital costs of the battery. This will ultimately determine the extent of the capital expenditure associated with the battery that can be entered into the RAB, which in turn will drive the calculation of the maximum allowable revenue.
- Where there is a relatively small degree of shared costs between the regulated and unregulated services provided by the battery, the DSO may use the Avoidable Cost Allocation Methodology (“ACAM”) which assigns all shared costs to the regulated services (i.e. adds them to the RAB). To assess whether this is permissible, the Commerce Commission uses ‘materiality thresholds’ to assess whether cost allocation outcomes would be moved materially closer to those in a workably competitive market, by the use of a methodology that splits costs between regulated and unregulated services. If these thresholds are not met, ACAM may be used. If they are met, the Accounting-Based Allocation Approach (“ABAA”) must be sed. This assigns costs to services based on relationships of causation.

Incentive

- Battery technology may incentivise DSOs to invest in non-traditional network infrastructure in order to postpone or remove the need for traditional network upgrades.

Funding

- Battery storage would be funded by the DSO, with the intention of including it in its RAB, which would increase its maximum allowable revenue commensurately. The percentage of the battery that enters the RAB is determined by the cost allocation methodology.
- The current regulatory treatment of storage is not distinct to that of any other asset proposed for the RAB.

Benefits and limitations

- If approval process is cumbersome, DSO’s may avoid the need for traditional network upgrade
- May cause stranded assets
- Allocating proportion of battery to regulated service can be difficult
- Allows batteries to be used if they have a positive cost benefit ratio relative to traditional investment DSO impact

DSO impact

- Consideration of battery solutions however, the current regulatory treatment of storage is not distinct to that of any other asset proposed for the RAB.

Customer impact

- Potentially lower prices than would otherwise be the case, assuming batteries are used to reduce / defer traditional network upgrades

Monitoring

- Each proposal requires review if contained in regulatory proposal

4 Mechanisms
Battery storage: Case by case approval (7/8)

2 New Zealand

Battery storage: Case by case approval

Examples

- Wellington Electricity has determined that a 1 MW/2MWh battery, reducing the peak load on a major substation, would defer the need for additional capital expenditure of approximately $3m by five years.
- Mercury Energy, a Generation and Retail business, is researching the integration of a 1 MW/2MWh battery technology with New Zealand's electricity system. This involves a Tesla Powerpack 2 large-scale battery which will be installed, connected to the grid, and ready to trade in the wholesale market in August 2018.

Battery storage: Cost of Energy review (changing definition of battery)

Description

- Large scale, grid-connected battery storage can currently earn revenue through arbitrage of electricity prices, through the Capacity Market , or by offering flexibility and balancing services (i.e. to control frequency and voltage) to the Transmission System Operator ("SO")
- The government's and regulator's focus is on removing barriers to the deployment of batteries, such as clarifying the definition of batteries
- Currently battery owners and operators have to comply with the licence condition for generators, but there is not a set definition for batteries within the licence.

Consultation

- The first action Ofgem took on this mater was to open a consultation in October 2017:
  - including the definition of electricity storage in the electricity generation licence;
  - clarifying, based on GBs review of the electricity generation licence, GBs expectations for storage with respect to compliance with the standard conditions; and
  - consulting on introducing a new licence condition into the generation licence applicable to electricity storage providers. The condition requires the licensee to ensure that they do not have self-consumption as the primary function when operating its storage facility.
- Ofgem's aim is for the modified licence to provide regulatory certainty to battery owners and developers, and ensure that a level playing field exists so that storage can compete fairly with other sources of flexibility, to encourage deployment.
- The licence changes are also supposed to address the issues batteries face with regards to final consumption levies under network charging.

DNO impact

- DNOs cannot currently own or operate battery storage, however they can bilaterally contract with battery owners for the provision of network services
- This situation is expected to remain, even as regulation of battery storage develops

Next Steps

- The consultation has closed, and Ofgem's decision is pending[1]

[1] https://www.ofgem.gov.uk/publications-and-updates/clarifying-regulatory-framework-electricity-storage-licensing

5

Market mechanisms, demonstration projects and case studies

From benchmark countries; Australia, New Zealand, United Kingdom and United States

Demand response: Capacity market (CM)

Description

- The Capacity Market ("CM") is a descending clock, pay-as-clear auction that is open to all capacity providers, including demand response
- A target capacity is set, and all capacity that is awarded a contract receives a steady, predictable revenue stream (a Capacity Payment) on which providers can base their future investments
- In return for Capacity Payments, providers must deliver energy at times of system stress, or face penalties

Incentive

- The CM is not specifically focused on demand response, but it is one of the main mechanisms to encourage demand response

Funding

- The Capacity Payments are funded by end consumers throughout GB. Electricity suppliers are charged via the Supplier Obligation, who in turn charge end-consumers via their electricity retail bills.

Benefits and limitations

- The benefits are that the Capacity Market is held regularly
- Initially, the CM had transitional arrangements whereby there were demand response specific auctions.
- The enduring CM regime is technology neutral, hence the limitation for demand response it must compete with generation technologies

DNO impact

- The CM is run by the government, regulator, and delivery body, and is not specifically aimed at DNOs

Customer impact

- The CM imposes an additional cost on consumers electricity retail bills.
- The most recent CM auction, for delivery in 2021/22, cleared at GBP 8.40 per kW per year (2016/17 prices).

Monitoring

- There is no explicit monitoring of DR in relation to the CM, but CM reports cover any demand response that wins capacity awards

Examples

- In the most recent CM auction, for delivery in 2021/22, 1.2GW of demand response was award a capacity agreement, accounting for 2.39% of "capacity" that was successful in the auction[1] The following companies (a mix of established utilities and specialist aggregators) won capacity agreements for demand response in the most recent CM auction[1]
  - British Gas Trading Ltd.
  - Distributed Energy Customer Solutions Ltd.
  - DONG Energy Power Sales UK
  - EDF Energy Customers Plc
  - E.ON UK Plc
  - Endeco Technologies Ltd
  - EnerNOC UK Ltd
  - Flextricity Ltd
  - GB Gas Holdings Ltd
  - Kiwi Power Ltd
  - Npower Ltd
  - Origami Energy Ltd
  - Smartest Energy Ltd
  - Scottish Power Energy Retail Ltd
  - SSE Energy Supply
  - UK Power Reserve Ltd
  - Veolia

[1] https://www.emrdeliverybody.com/Capacity%20Markets%20Document%20Library/Final%20T-4%20Results%20(Delivery%20Year%2021-22)%2020.02.2018.pdf

Case study: Battery storage - Western Power case studies

1 Australia

Battery storage: Western Power case study

Please include the following:

Description

- Western Power is the major DSO in Western Australia
- The DSO has lobbied for rule changes that will allow it to install stand alone power systems in lieu of network investment for high-cost, low reliability fringe of grid customers (e.g. on long rural feeders)
- An alternative approach that Western Power has taken has been to maintain a low-reliability network connection at the fringe of grid, and to develop a microgrid at the end of that low reliability connection
- The recently announced Kalbarri microgrid provides a case study for this approach
- A large battery system will be supported by an operations and maintenance contract services by Energy Made Clean and Lendlease that will install and operate a key component of the microgrid
- The battery will be designed and managed by Western Power with support by, Energy Made Clean and Lendlease
- Western Power has sought that such investment should be rolled into the RAB and intends to roll the battery capex into the RAB

Incentive

- The investment is being subjected to the new facilities investment test, and so will be assessed by the regulator as being least cost or otherwise will not be included in the RAB
- A robust options analysis was conducted, resulting in the microgrid being chosen as the efficient solution

Funding

- Provided the battery is only used for network support services (i.e. it is not used for arbitrage in the wholesale market) Western Power may be able to argue that its capex should be rolled into the RAB. In this case the cost will be recovered through network charges

Benefits and limitations

- Provides a low cost solution well suited to a fringe of grid application
- An opex solution would likely result in lower tariffs (e.g. network control service contract)

DSO impact

- Improved reliability provides the DSO with incentive payments
- The DSO receives a return-on and a return-of investment

Customer impact

- Improved reliability for customers in the area
- ‘Socialised’ cost recovery from broader customer base through increased network tariffs

Monitoring

- Reliability performance monitored by the regulator
- Project subjected to the new facilities investment test

4 United States (New York)

Reforming the Energy Vision

New York's Reforming the Energy Vision ("REV") seeks to incentivize utilities to move their role beyond that of simply providing electric services to becoming a capital-efficient platform that integrates distributed resources in one area to benefit both local customers and all energy customers. New York energy policy makers and regulators envision that utilities will procure more demand response, energy efficiency and clean energy, and they will do all these things as a "business" rather than a "matter of compliance". The New York PSC is working with the state's Investor Owned Utilities on demonstration projects that encompass energy efficiency, distributed generation, energy storage, community solar and customer analytics. These demonstration projects test business models rather than technologies, with the most successful to be rolled out across the state.

For details on each demonstration project, please refer to appendix A

6

Considerations

Based on the benchmark countries and the workshop, the most relevant mechanisms to the Finnish regulatory regime were identified in collaboration with Energiavirasto

6 Considerations

2 benchmark mechanisms from Australia were considered to be the most relevant to the Finnish electricity regulation regime: regulatory investment & new facilitates investment test and the demand management scheme

Workshop

On Tuesday 27 February 2018 we held a workshop with the Energiavirasto team and Tatu Pahkala from TEM, the purpose of which was to identify relevant mechanisms to introduce into the Finnish electricity regulatory regime based on the benchmark countries. We achieved this by providing an overview of each mechanism as outlined in the previous section and then undertaking the following exercises either individually or in smaller groups.

- Creating a shortlist of relevant mechanisms from the benchmark countries
- Determining the potential pre-requisites for customer, DSO, regulator and other to implement the shortlisted mechanisms
- Determining the potential impact on customer, DSO, regulator and other of each of the shortlisted mechanisms

Please refer to Appendix B and C for the detailed results from the workshop.

Considerations

The recent rate of change at which technology is developing and the transition to more renewable energy sources has resulted in the regulation lagging for incentivising the adoption of for example smart grid, smart metering and battery technologies. Therefore, no one country had a the perfect answer or set of incentives to achieve demand flexibility. Instead, the benchmark countries demonstrated the implementation of piecemeal initiatives to either test or incentivise demand flexibility.

In collaboration with Energaivirasto, a total of 4 mechanisms were identified as being potentially relevant to the Finnish market. In addition, a number information on the Western Power case study in Australia and numerous demonstration projects in the US and Germany were also of particular interest:

- Mechanisms:
  - Australia: Regulatory test and new facilities investment test
  - Australia: Network services contract
  - Australia: Demand management incentive and innovation allowance
  - UK: Changing definition of batteries
- Demonstration projects and case studies:
  - Demonstration project in USA: Various (please refer to Appendix A for more details)
  - Demonstration project in Germany: Company EWE in Oldenburg, Enera Project
  - Case study in Australia: Western Power Battery installation

We would like to note that within the RIIO model introduced in the UK, efficient investment in totex (rather than capex and opex separately) is incentivised and is viewed by many countries as the gold standard of regulation with a focus on outcomes rather inputs. This model however, would be a significant and complex change to the current regulatory regime in Finland. Therefore, a more gradual transition to incentivising totex is recommended as demonstrated in Australia.

As a result of the workshop in collaboration with Energiavirasto the **regulatory test & new facilities investment test** and / or the **demand management incentive & innovation allowance** were considered the most relevant. Whilst, to date:

- the regulatory investment & new facilities investment test has not resulted in significant employment of demand response by DSOs as a substitute for capex, and
- the demand management incentive scheme does not encourage the DSO to support demand response beyond the amount covered by the incentive payments,

they would be simple (relative to the other mechanisms) to implement and by pairing these incentives with rigorous monitoring by Energiavirasto and advances in cost effective demand response technology, we would likely observe a greater adoption flexible demand response solutions. In addition, the EU will most likely address the future definition of batteries.

Please refer to page 41 and 42 for details of the pre-requisites and impact of the recommended mechanisms as developed in the workshop and subsequent research.

6 Considerations

Pre-requisites of 2 shortlisted mechanisms from Australia

	Regulatory test & new facilities investment test	Demand management incentive scheme
Customer	Not applicable	Not applicable
DSO	► Governance frameworks need to be developed and robust for determining investment ► Investment documentation must be thorough and in compliance with DSOs governance frameworks ► A number of options to deliver a project need to be considered	► Need to understand the technology available and economic analysis of demand management solutions ► Better interaction with other players (customers, aggregators)
Regulator	► Resources and training ► Defining the cost benefit analysis required:	► How to measure benefit ► How to define demand efficient demand management projects and the associated cost ► Design of mechanism
Other	Legislation ► Legal changes required for ex-ante approvals of investment needs	Not applicable

6 Considerations

Impact of 2 shortlisted mechanisms from Australia

	Regulatory test & new facilities investment test	Demand management incentive scheme
Customer	► Lower prices to the extent that inefficient or imprudent expenditure is not rolled into the RAB ► Potential to participate in the investments	► Only recently implemented and therefore true impacts are unclear however the in the long-term slower increase in tariff could be observed due to more opex based solutions being favoured
DSO	► Governance frameworks need to be robust for determining investment resulting in more resources required for the DSO ► Investment documentation must be thorough and in compliance with DSOs governance frameworks ► A number of options to deliver a project need to be considered	► DSOs would need to develop regulatory proposal and submit to regulator ► DSOs would consider demand response options in their planning ► Potential for DSO to earn higher revenues through the schemes than would otherwise be the case ► DSO may not support demand response beyond the amount covered by the incentive payments in the regulatory proposal
Regulator	► Greater number of resources required for assessing a sample of projects for compliance on both an ex-ante and ex-post basis as part of the DSO regulatory submission	► Greater number of resources required for assessing the regulatory proposal
Other	► Could potentially create a new market	Not applicable

7

Appendices

7 Appendices
Appendix A: Reforming the Energy Vision (1/8)

Reforming the Energy Vision

REV seeks to incentivize utilities to move their role beyond that of simply providing electric services to becoming a capital-efficient platform that integrates distributed resources in one area to benefit both local customers and all energy customers. New York energy policy makers and regulators envision that utilities will procure more demand response, energy efficiency and clean energy, and they will do all these things as a "business" rather than a "matter of compliance". The New York PSC is working with the state's Investor Owned Utilities on demonstration projects that encompass energy efficiency, distributed generation, energy storage, community solar and customer analytics. These demonstration projects test business models rather than technologies, with the most successful to be rolled out across the state.

CenHub Marketplace

Description

- Central Hudson partners with a tech company to build an online portal for energy products and services to provide customers with personalized recommendations and offer an enhanced data analytics package for customers who want greater insight into their energy use. REV objectives addressed include: Enhanced Customer Knowledge and Tools for Effective Total Energy Bill Management; Market Animation

Expected Benefit

- Creation of a home energy advisory platform providing insight into energy usage for all residential customers
- Introduction of new channels and cross promotion for customers to participate in energy and cost savings programs
- Increased awareness and customer choice associated with program enrolment and the purchase of products and services
- Customer convenience
- Lower 3rd party customer acquisition and transaction costs
- Evaluation of potential new revenue streams

Outcomes

- Expected cost of this program is just over USD 10m over an 8 year period. Program began in 2016, so far no measurable outcomes are known

Residential Customer Marketplace

Description

- Orange & Rockland partners with a tech company to build an online engagement platform that leverages customer data and analytics to help customers find energy products and services that meet their needs. REV objectives addressed include: Enhanced Customer Knowledge and Tools for Effective Total Energy Bill Management; Market Animation

Expected Benefit

- Provide customers with high quality products and services that promote EE and demand reduction;
- Facilitate the use of customer owned DER products and services while allowing O&R to obtain effective management of the grid and defer investment in traditional utility infrastructure;
- Reduce carbon emissions through reduced customer energy usage, contributing towards overall emission reduction in the State of New York;
- Establish an animated and active market for energy products and services within the O&R service territory;
- Develop a new model for EE and DER delivery that leverages information-based tools, enhanced by targeted incentives, to drive tailored customer experience; Elucidate the effective roles utilities can assume in building customer motivation and streamlining customer action;
- Test transaction, fee, and advertising based models and potentially expand the testing into financing, integration to supply management, and other ways to monetize the asset value beyond only rate-base; and

Reforming the Energy Vision Expected Benefit (cont.)

- Potentially demonstrate the benefits of integrating future offerings that may use smart metering, demand response, time of use rates, and other aspects of the customer experience

Outcomes

- No project budget is noted in the implementation plan.
- The beginning of 2016 was the launch of the “My ORU Store” offering a selection of Wi-Fi Thermostats, since then the Company has expanded to other offerings.
- June 2017 marked the beginning of a unique collaboration with O&R and Suez Water NY (Suez) designed to help customers save water and energy while lowering their utility bills. Mutual customers are now offered additional instant rebates on a number of products available.
- Since the official site launch, there have been increased customer engagement with the online portal. The team surveyed hundreds of engaged customers willing to share feedback and provide suggestions for future enhancements.

Building Efficiency Marketplace

Description

- Consolidated Edison partners with a tech company to build a clean energy project origination, bidding, and technical support platform for small commercial customers. The platform will analyse interval meter data to identify high potential projects that can be put out to bid on the platform, with technical support and financing options facilitated by Con Edison. REV objectives addressed include: Enhanced Customer Knowledge and Tools for Effective Total Energy Bill Management; Market Animation

Expected Benefit

- Leveraging lessons learned in data analytics from the BQDM project, like Con Edison found substantial increases in market activity. In this Project, Con Edison will augment its capabilities developed in BQDM in several ways, including:
  - Providing customer access to virtual energy assessments through an engagement portal, giving building owners a new way to access and interact with their building analysis and identify savings opportunities
  - Streamlining the implementation process for energy efficiency projects by offering customers project development tools, fee-based consulting support, and bid management functionality
  - Supporting market partner objectives by providing new fee-based tools and resources that will give them access to more projects and potential customers
  - Testing and refining new monetization strategies that will serve to inform future rate design and the development of a future DSP

Outcomes

- Financial filings are confidential
- Initial engagements with the Energy Insights Marketplace have provided new levels of insight into customer behaviour as well as Market Partner activity. Never before has the Company been able to encounter this level of perspective. Before any conclusions can be drawn about the success of interacting with customers and Market Partners, through the Energy Insights Marketplace, the Project team needs to gather more project level feedback.

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Appendix A: Reforming the Energy Vision (3/8)

Reforming the Energy Vision Flexible Interconnect Capacity Solution

Flexible Interconnect Capacity Solution

Description

- Iberdrola partners with a tech company to offer a new, less costly, and faster way for customers and third parties to connect large distributed generation projects to the grid by providing an “infrastructure as a service” alternative to traditional interconnection, managing the distributed resource on an ongoing basis to avoid the need for new hard infrastructure. REV objectives addressed include: Market Animation; System Wide Efficiency; System Efficiency, Reliability, and Resiliency

Expected Benefit

- Align the interests of utilities, DER developers, and customers to work together to identify the best interconnection solution given the specific facts and circumstances.
- Accelerate and expand the benefits of DER development to NYSEG and RG&E customers.
- Allow NYSEG and RG&E to leverage the distribution network to support a "platform-as-a-service" business model that generates new revenue streams for the Companies.
- Maximize the utilization of existing network infrastructure, while in parallel increasing visibility of the network.
- Support the achievement of certain core REV policy goals, including an increase in DER interconnections.

Outcomes

- According to latest filed update with the PSC in Q2 2017, further evaluation of additional FICS candidate projects was completed. In addition, servers, panels, and firewall for DER #1 were installed and configured at the AVANGRID control center.
- Also, an updated interconnection analysis and cost estimate for DER #2 was reviewed with the developer.
- Finally, execution on NYSERDA PON 3397 project with CYME, Smarter Grid Solutions (SGS), and Clean Power Research was begun.
- Plans for 3Q 2107 include:
  - Progress substation and point of interconnection design for DER #1
  - Progress development on joint SGS-CYME-Clean Power Research NYSERDA PON 3397project
  - Complete analysis on additional potential FICS projects
  - Complete an analysis incorporating ANM with both energy storage and DER

CONnectED Homes Platform

Description

- Consolidated Edison partners with tech companies to build a marketing platform targeting residential customers with relevant messaging from DER providers on the bill, over email, and through an online marketplace. REV objectives addressed include: Enhanced Customer Knowledge and Tools for Effective Total Energy Bill Management; Market Animation

Expected Benefit

- An expanded market for DERs through increased market integration and partnerships between Con Edison and a broad network of DER providers;
- Increased alignment between Con Edison’s market incentives and the energy management needs of its customer base;
- Improved knowledge about strategies for acquiring customers for DER providers, which can help lower the costs to acquire customers for these products and services;

Appendix A: Reforming the Energy Vision (4/8)

Reforming the Energy Vision Expected Benefit

Expected Benefit (cont.)

- More engaged customers that have the tools to better understand their energy use and take actions to use energy more efficiently;
- Improved customer access to personalized information about available energy services and products; and
- An evaluation of alternative rate designs that can provide greater overall system efficiency and enable customers to better manage their bills.

Outcome

- USD 16m budgeted for this demonstration project. No update available as information is filed confidentially with PSC.
- The Project launched in Q2 2016 to approximately 275,000 customers in Con Edison's Brooklyn and Westchester territories. Customers have access to detailed energy insights online and have received targeted offers in their Home Energy Reports and High Usage Alerts for solar panels, Wi-Fi thermostats, Sealed home services, and the Con Edison Marketplace, as eligible.
- In early 2017, the Project successfully upgraded to the second version of the Con Edison Marketplace (Marketplace 2.0), the second version of the printed Home Energy Reports (HER 2.0), and launched the second round of targeted offerings for sealed home services, Wi-Fi thermostats, and Marketplace.
- In Q2 2017, the Project team developed new modules for the SunPower and Sealed campaigns creative, expanded marketing efforts and added two new revenue streams on the Marketplace: third-party advertising and cost-per-click referrals.

Brooklyn Queens Demand Management Project

Description

- BQDM Program, is designed to address a forecasted overload condition of the electric sub-transmission feeders serving the Brownsville No. 1 and 2 substations using a combination of traditional utility-side solutions and non-traditional customer-side and utility-side solutions. The impacted area, the BQDM Area, comprises locations served by the Brownsville 1 and 2 sub-stations in Brooklyn and Queens and includes the three electrically independent networks of Ridgewood, Richmond Hill and Crown Heights. In its petition, the Company forecasted that, unless the anticipated load growth in these BQDM Area is alleviated, by 2018 the sub-transmission feeders serving the area will be overloaded by 69 megawatts ("MW") above the system's current capabilities for approximately 40 to 48 hours during the summer months.

Expected Benefit

- Offset USD$1billion in infrastructure investment
- Less peak power procured at higher prices on market
- Lower carbon emissions
- Challenge to devise the calculation method to compensate utility.

Outcomes

- Spent approximately USD 50 million of a USD 200 million budget.
- Expected to have 52 MW of demand reductions and 17 MW of distributed resource investments by summer of 2018
- BQDM project extension approved by NYPSC

Community Energy Coordination

Description

- Iberdrola partners with a consulting firm to aggregate local demand for clean energy technologies, target outreach to areas where DERs can provide the greatest system benefits, and orchestrate a bulk purchase from third party providers on behalf of customers to lower costs and increase benefits. REV objectives addressed include: Enhanced Customer Knowledge and Tools for Effective Total Energy Bill Management; Market Animation

Reforming the Energy Vision Outcomes

Community Energy Coordination (cont.)

Expected Benefit

- The CEC project will test the benefit of NYSEG taking on new roles within the distributed energy resources value chain. The first role is for NYSEG to coordinate input and facilitate planning among various community stakeholders; the second is for NYSEG to act as a sales agent for DER, and the third role is for NYSEG to be the market coordinator for DER.

Outcomes

- Through the CEC project NYSEG expended approximately USD 485k in outreach activities and is marketing three different DER's; residential solar, community shared solar, and energy efficiency services, directly to its customers. Customers are encouraged to go to an online services marketplace, called NYSEG YES Home Solutions, where they are able to gather information and connect with participating energy efficiency and community shared solar service providers, and receive competitive quotes from residential solar service providers.

Resiliency Demonstration in Potsdam

Description

- National Grid partners with local customers and DER providers to fund a microgrid through a new tariff design, testing demand for a premium resiliency service. Also includes new metering, billing, and financial services for DER providers. REV objectives addressed include: System Reliability and Resiliency

Expected Benefit

- National Grid is undertaking this REV demonstration project to develop and test four new utility services, in support of the Potsdam microgrid project, that may be required for the further deployment of hybrid utility microgrids in New York. The project provides required coordination and aggregation, with novel rate recovery, to enable a financially sustainable multi-customer microgrid business model. The four services are:
  - Tiered recovery for new storm-hardened, underground wires
  - Central procurement for DER
  - Microgrid control and operations
  - Billing and financial transaction services
- Preliminary budget on this demonstration project was USD 1.1m and had to be scaled back as demand needs were higher than expected.
- Based on the scaled-down version, the Project team will continue to work on the business and governance model to present a clear and compelling case that the benefits to the community, stakeholders, and utility outweigh associated costs and risks. Most of the structure of the already developed model can easily be altered as the microgrid scope is condensed. The financial analysis model currently being developed will be the basis of the value proposition developed by the Project team in Q3 2017. Key to the value proposition will be National Grid's Preliminary Pricing Proposal, currently on hold until the scope and size of the microgrid is finalized. Expected completion of this deliverable has shifted into the fall of 2017.

Demand Reduction Demonstration Project in Clifton Park

Description

- National Grid partners with various clean energy providers to offer customers various programs and pricing signals to manage usage to reduce energy bills and demand during peak times

Expected Benefit

- National Grid believes that it is possible to create more responsive relationships with customers by leveraging critical infrastructure, customer outreach and engagement, deep energy insights and actionable information, as well as price signals and DER products and services, which incentivize customers to reduce peak electric load and overall electric and gas energy use.

Reforming the Energy Vision Outcomes

Demand Reduction Demonstration Project in Clifton Park (cont.)

Outcomes

- Budgeted cost for this demonstration project is USD $27m
- Company is in Year 2 of 3 for the project. Currently deploying VVO software and hardware. Deployment of VVO software and devices will enhance the efficiency of the electric distribution system through the installation of software and devices that better regulate the voltage of the distribution system.

Fruit Belt Neighbourhood Solar

Description

- National Grid aims to help low-to moderate-income customers access clean energy while reducing arrears through a neighbourhood solar project in an economically distressed area, and test how solar can be paired with communications technologies to deliver benefits to the overall electricity system. REV objectives addressed include: Enhanced Customer Knowledge and Tools for Effective Total Energy Bill Management; Market Animation; System Wide Efficiency

Expected Benefit

- The Demonstration model of “in front of the meter” solar and utility ownership removes existing barriers for low/moderate income residential customers to participate in the solar market today. To take advantage of most solar market offers, customers need to have good credit standing and income levels that allow receipt of tax credits, leaving LMI neighbourhoods like the Fruit Belt underserved by the market. This Demonstration will unlock the benefits of solar, and additionally connect customers to energy efficiency, at no-cost to participants, clearing traditional financing obstacles.

Outcomes

- Installation of 31 residential PV systems; 7 connected to the distribution grid
- 31 other PV system are under construction
- 1 PV system installed at a church and ready for connection
- Baseline power use model for 2 project area feeders is in draft form
- 2 Fruit Belt Neighbourhood residents were hired and under the workforce development plan to install PV systems
- Agreement between NYSERDA and National Grid for the provision of energy efficiency services in the project area.
- Solar PV systems will be installed and connected at an additional twenty-five (25) residences, one (1) church, and two (2) community non-profit-owned buildings.
- Looking to having 500kW installed. The Project area was found to have fewer qualified roofs than what was originally expected, as the initial estimate was calculated prior to the City of Buffalo enacting a solar panel set-back requirement and prior to National Grid partner Solar City conducting a ground truth survey of all housing stock in the Project area. Budgeted at USD $2.4m.

Energy Marketplace

Description

- Iberdrola partners with a tech company to launch an online marketplace for customers to buy energy products and services. REV objectives addressed include: Market Animation

Expected Benefit

- Customer engagement through use of tools and information to better understand and manage their energy usage;
- Market animation to connect distributed energy resources (DER) providers with potential customers;
- Support of Energy Efficiency, Distribution Level Demand Response (DLDR) and Non-Wires Alternatives (NWA) where synergies are discovered.

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Appendix A: Reforming the Energy Vision (7/8)

Reforming the Energy Vision Outcomes

Energy Marketplace (cont.)

Outcomes

- A staged launch of the RG&E YES Store was implemented during Q3 2016 first targeting employees, followed by 10% of eligible customers, and then a full launch to all RG&E residential and small commercial customers.
  - Seasonal sales on thermostats and lighting (Earth Day, Summer)
  - Continued to experiment with and analyse email frequency and engagement
  - Introduced new LED lighting and connected home products
  - Continued collaboration with other programs - Demand Response (DR), Community Energy Coordination (CEC), Energy Smart Community (ESC)
  - Hosted online survey to gather customer feedback

Distributed Generation Interconnection

Description

- National Grid aims to accelerate the pace and scale of interconnecting distributed generation systems above 50kW through upfront investment by the Company along with alternative cost allocation methodology.

Expected Benefit

- Determine if DG developers will respond to shorter construction timelines and known costs
- Determine if upfront investment cost recovery is a feasible mechanism for DG applicants and the Company
- Identify methods for effectively marketing capacity to DG developers seeking to interconnect with Company's system.

Outcomes

- Preliminary filing made to NYPSC
- No update on project status

BNMC DSP Engagement Tool

Description

- National Grid aims to use the Buffalo Niagara Medical Campus as a test-bed for DSP functionalities, coordinating and optimizing DERs throughout the campus

Expected Benefit

- Within the BNMC, a demonstration project will test the ability and customer willingness to manage the BNMC's portfolio of DER assets based on BNMC's priorities with respect to reliability, cost, and sustainability within a simplified DSP framework. This test aims to understand how DERs can be optimized to maximize economic value (savings, avoided spend, and revenue) and reliability. The management platform will manage DER assets through forecasts of load and generation to create a dynamic, forward-looking dispatch schedule that meets the BNMC's requirements. Lessons learned from this demonstration project will allow National Grid to determine the types of scalable solutions to connect customer-to-grid assets to functional market mechanisms that do not currently exist (e.g., ancillary services, capacity, demand response, etc.)

Outcomes

- Budgeted cost for this demonstration project is approximately USD $4.8m.
- The project is currently in "field testing" stage, thus not material outcomes are known at this point.

Commercial Battery Storage

Description

- Con Edison aims to address energy storage technologies and associated new business models which increasingly have the potential to support cost-effective solutions for distribution-level grid needs

Reforming the Energy Vision Storage on Demand

Commercial Battery Storage (cont.)

Expected Benefit

- Enable a broader array of customers and customer types to derive value from energy storage by compensating participating customers in a clear, simple way, while not affecting their current electric bills;
- Align transmission and distribution ("T&D") support needs with energy storage dispatch from FTM customer-sited energy storage;
- Minimize the cost to the Company of deploying energy storage by enabling larger project sizes and offsetting total project costs through 1) lower customer acquisition costs and 2) secondary value streams from the battery;
- Increase available market size by engaging a larger customer pool and allowing for large scale deployment of energy storage resources, where they are needed, by removing behind the meter ("BTM") limitations on project siting
- Better align the interests of the Company, ratepayers, and third-party service providers by creating a dispatch agreement that allows the Company priority access to the battery during times of peak load on the grid, and allows for wholesale market participation for revenue generation during all other times.

Outcomes

- Initial budget is USD $12m
- No update on project status

Storage on demand

Description

- Con Edison proposes to test a technology solution and business model that provides the opportunity for two parties to utilize transportable batteries at a higher rate by sharing deployment of the batteries for different purposes at different times through the year.

Expected Benefit

- Enhance Con Edison's ability to better manage capacity constraints on its distribution system through transportable batteries that can meet a variety of needs;
- Provide empirical data to support future integration of grid-scale energy storage in New York Independent System Operator ("NYISO") markets;
- Benefit the distribution system by clipping peak demands and lowering energy distribution costs; and
- Offset transportable battery solution costs with revenues earned from wholesale market participation.

Outcomes

- Initial budget is USD $10m
- No update on project status

Smart Home Rate

Description

- Con Edison and O&R propose combining smart home capabilities with the Companies deployment of Advanced Metering Infrastructure to demonstrate a new pricing framework for residential customers.

Expected Benefit

- The SHR demonstration project will also provide important insights to the Companies as they continue to develop the functions of the DSP. Lessons learned from the SHR demonstration project will inform efforts to develop rate structures that can work alongside Non-Wires Alternative projects, utility demand response programs, and Value of Distributed Energy Resources tariffs to engage customers in managing their electricity use and generation in ways that support the grid.

Outcomes

- Preliminary filing made to NYPSC
- No update on project status

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Appendix B: Assessment and selection of benchmark mechanisms

Regulatory test & new facilities investment test	Totex (RIIO)	Power of Choice	Network control services contract
▸ It would be applicable it CBA is outsourced (P)	▸ Will it benefit the customer? (?)	▸ Full roll out of smart meters (O)	▸ Transparency (?)
▸ Needs to be paired with incentive (P)	▸ With some conditions e.g. benefit sharing (P)	▸ No need (O)	▸ By DSOs? (?/P)
▸ This could be a good way to incentivise network companies to find efficient solutions (P)	▸ It seems quite challenging to evaluate the economical effects. In theory appears good though (?)	▸ Could provide market-based incentives to demand response if meters were more visual and informative (?)	▸ Demand response is market based function. DSO could receive benefit (P)
▸ Seems a good way to incentivise DSOs (P)	▸ Difficult to benchmark but similar to opex benchmark (P)	▸ Finland already has first generation smart meters (O)	▸ Market based solution (P)
▸ (-) Is an ex-post review ▸ (+) puts pressure on DSO to actually consider options (?)	▸ (-) Demand response measures not mandatory to consider ▸ (+) incentivises deferring capex (P)	▸ How to move to competitive model? ▸ Needed?, priority?, benefits? (?)	▸ Easy to implement (P)
▸ Easy to add new incentive (P)	▸ After large investments (capex) (?)	▸ Currently smart meters in place, but is one size fits all best option for all (?)	▸ Alternatives to capex based solutions (P)
▸ Allowing new technologies and alternatives to DSOs (P)	▸ DSO may use opex based solutions (P)	▸ (?)	
✓	✗	✗	✓

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Appendix B: Assessment and selection of benchmark mechanisms

Demand management incentive scheme	Ripple control *(not provided in summary of report)*	Demand management response program & Interruptible load	Capacity market
▸ Pair with investment test (P)	▸ Network in charge (back to the 60's) (O)	▸ Network engages customers directly, effect on market? (?)	▸ Hopefully not needed (O)
▸ How to define efficient demand management projects? (?)	▸ Efficient (?)	▸ Partially in place in Finland already (?)	▸ Cross Nordic topic (O)
▸ Carrot rather than stick ▸ Will the consumer see benefits (P)	▸ Needs to be paired with other mechanisms (P)	▸ But not by DSO (?/P)	▸ Answer to a difficult problem (O)
▸ Could be part of the investment test / approval (P)	▸ It would be good to get all demand response in operation but not sure how this really works (?)	▸ Consumers get an actual payment for participating (P)	▸ Not part of network regulation (O)
▸ (-) later stage solutions would need a stick approach ▸ (+) applicable to new solutions at early stage (?)	▸ (-) Would require investments into appliances at home ▸ (+) forces demand response when needed (?)	▸ Consumers can have benefits if the participate (P)	▸ Limited applicability on the whole energy consumption /production (O)
▸ If beneficial in total (P)	▸ How do consumers get the benefit? (?)	▸ Yes but probably not DSOs directly (?)	▸ Not for DNOs (O)
	▸ Good idea but people won't necessarily approve (?)		▸ Not DNO business (O)
✓	✗	✗	✗

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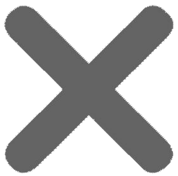
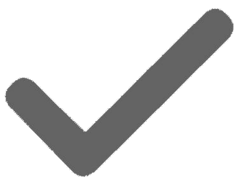
Appendix B: Assessment and selection of benchmark mechanisms

Case by case approval	Changing definition of batteries (enabling third party providers)
▶ Allows a DSO to own storage if it is the most cost effective solution (P)	▶ Pair with incentive (P)
▶ Battery not in RAB (O)	▶ We follow CEP (P)
▶ Applicable on large scale batteries (P)	▶ Definition of battery needs to be clarified (P)
▶ DSOs would not be able to operate it in all markets (O)	▶ Definition should be clear, EU will regulate the issue soon (P)
▶ Possible some part of network won't find service providers (P)	▶ New devise / system needs definition (P)
▶ Batteries could be utilises for many purposes. DSO investment always exception (P)	▶ What is the end result if end ownership is not allowed (?)
▶ Limited possibilities due to market effect (P)	





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Appendix C: Pre-requisites and impact of selected benchmark mechanisms

Regulatory test & new facilities investment test

	Pre- requisites *Regulatory & new facilities investment test*	Rating	Impact *Regulatory & new facilities investment test*	Rating
Customer	n.a	4	▸ Might participate in the investments ▸ Could lower distribution costs	4
DSO	▸ Longer terms plans needed at a detailed level ▸ Network planning needs to be evaluated to a new level	3	▸ More work ▸ Delayed investments ▸ Less revenue	(2)
Regulator	▸ Resources ▸ CBA: ▸ NRA sets rules ▸ Outsources resources should be able to be used ▸ Need to be ensured that the customer benefits	1	▸ More work	3
Other	Legislation ▸ Legal changes needed - ex-ante approvals of investment needs more powers to NRA	3	▸ Could create a new market	4

Overall Rating

20

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Appendix C: Pre-requisites and impact of selected benchmark mechanisms

Network control services contract

	Pre- requisites *Networks control services contract*	Rating	Impact *Networks control services contract*	Rating
Customer	n.a	4	▸ Could participate ▸ Could lower distribution cost	3
DSO	▸ Change in mind set ▸ Incentive to pass through cost	2	▸ Some more work ▸ Could lower revenue	(1)
Regulator	▸ Monitoring resources needed ▸ Some changes to regulatory methodology	2	▸ More work	1
Other	▸ Service provider market needed for regulation ▸ Legal changes needed to protect the customers	3	n.a	3

Overall Rating

17

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Appendix C: Pre-requisites and impact of selected benchmark mechanisms

Demand management incentive scheme

	Pre- requisites *Demand management incentive scheme*	Rating	**Impact** *Demand management incentive scheme*	Rating
Customer	▸ Awareness ▸ Motivation ▸ Money	4	▸ Immediate money ▸ Long-term slower increase in tariff	4
DSO	▸ Know-how ▸ Technology, economic (CBA) ▸ Better interaction with other players (customers, aggregators)	3	▸ Carrot ▸ Better reputation and customer relations	3
Regulator	▸ How to measure benefit (CBA) ▸ How to define demand management activity / cost ▸ How to design the mechanism	2	▸ Resource including know-how	(3)
Other	n.a	5	▸ n.a	0

Overall Rating

18

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Appendix C: Pre-requisites and impact of selected benchmark mechanisms

Changing definition of batteries (enabling third party providers)

	Pre- requisites *Changing definition of batteries (enabling third party providers)*	Score	**Impact** *Changing definition of batteries (enabling third party providers)*	Score
Customer	n.a	5	▸ Reliable supply ▸ Lower tariff	5
DSO	▸ Know-how ▸ Technology, legal (regulatory), economic (market) ▸ Pilot ▸ Incentive innovation over traditional network innovation	1	▸ Carrot ▸ Less risk (short term innovation) ▸ Outage payments decrease	4

Regulator	▸ If allowed:
	  ▸ Unit price and allocation mechanism
	▸ If not allowed:
	  ▸ Cost of service
	▸ Conditions for exceptions
		2	▸ Resources including time and know-how	(3)

Other	Legislation ▸ No definition yet but will be (currently regarded as generation but in the future will be regarded as storage) ▸ DSO's can't own storage but exceptions are not clear (if not market based)	3	▸ Temporary resource	(1)

Overall Rating

16

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Appendix C: Pre-requisites and impact of selected benchmark mechanisms

Rating scale

The following scale was used to rate the pre-requisite of each of the selected benchmark mechanisms

0 – Difficult to implement in terms of budget and resource)

5 – Pre-requisite already in place

The following scale was used to rate the impact of each of the selected mechanisms

(5) – Extremely negative impact

0 – No impact

5 – Extremely positive impact

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Appendix D: Definitions and abbreviations (1/3)

ABAA	Accounting-Based Allocation Approach (NZ regulation)
ACAM	Avoidable Cost Allocation Methodology (NZ regulation)
AUD	Australia dollars
Aus	Australia
BEIS	The Department for Business, Energy & Industrial Strategy (UK regulation)
BQDM	Brooklyn Queens Management Project
Capex	Capital expenditure
CDCM	The Common Distribution Charging Methodology (UK regulation)
CLASS	Customer Load Active System Services (UK regulation, DNO initiative)
CM	Capacity Market (UK)
CPP	Customised price quality path (NZ regulation)
DER	Distributed energy resources – distributed generation, also distributed energy, on-site generation or district / decentralised energy is electrical generation and storage performed by a variety of small, grid connected devise
DNO	Distribution network operator
DPP	Default price quality path (NZ regulation)
DSO	Distribution system operator
DSP	Distribution system provider
DUoS	Distribution Use-Of-System
EDCM	The Extra-High Voltage Distribution Charging Methodology (UK regulation)
EE	Energy efficiency
EMA	Energy Market Act
ESCOs	Energy service companies
EWE	Energy company operating mainly in the north of Germany
GB	Great Brittan

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Appendix D: Definitions and abbreviations (1/3)

GBP	Great British Pound
Gentailer	A generator that is also a retailer (i.e. vertically integrated upstream and downstream of the network)
IM	Input methodology (NZ regulation)
NE-ISO	New England Independent System Operator (Us regulation)
NEM	National Electricity market (Aus)
NPg	Northern Powergrid (UK DNO group)
NY	New York (state in United States of America)
NYPA	New York Power Authority (US regulation)
NYSEG	New York State Electric & Gas
NYSERDA	New York State Energy Research and Development Authority (US regulation)
NZ	New Zealand
NZD	New Zealand dollars
O&R	Orange and Rockland Utilities
Ofgem	Office of Gas and Electricity Markets (UK regulation)
Opex	Operating expenditure
PSC	Public Service Commission (US regulation)
PUC	Rhode Island Office of Energy Resources (US regulation)
RAB	Regulated Asset Base
RAV	Regulated asset value
Remote scheduled	Meter read scheduled for a specific date/time
RCV	Regulated capital value
REV	Reforming the Energy Vision (US)
RG&E	Rochester Gas & Electric
RI	Rhode Island (state in United States of America)

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Appendix D: Definitions and abbreviations

RICC	Rhode Island Commerce Corporation (US regulation)
RIIO	Revenue equals incentives plus innovation and outputs
RIIO-ED1	Price control period from April 2015 to March 2023
RIOER	Rhode Island Office of Energy Resources (US regulation)
ROE	Return on Equity
SBC	System benefit charge
SO	Transmission system operator
SPEN	Scottish Power Energy Networks (UK DNO group)
SSE	Scottish & Southern Electricity (UK DSO)
SSEN	Scottish and Southern Energy (UK DNO group)
TIM	Total incentive mechanism (UK regulation)
Totex	Total expenditure
UK	United Kingdom
UKPN	UK Power Networks (UK DNO group)
US	United States of America
USD	United States dollars
WACC	Weighted Average Cost of Capital
WPD	Western Power Distribution (UK DNO group)