WESTERN POWER DISTRIBUTION

INNOVATION

NEXT GENERATION NETWORKS

Comparison of price incentive models for locally matched electricity networks.

Appendix B: Understanding the current market for Network Replicating Private Wires (NRPW)

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Executive summary

This study took both a qualitative and quantitative approach to understanding the existing market and potential growth for private wires that connect distributed generation directly to a demand customer adjacent or close to the generation site

To establish a likely number of these Network Replicating Private Wires (NRPW) we first carried out interviews with ten industry experts. We then looked at WPD's export and import customers in the South West license area to establish whether NRPW's could be identified from the data. Combining the findings of these two stages, we looked to identify individual projects in the dataset and from that estimate the number and capacity of NRPW's likely to be in the South West.

We found that given the commercial benefits of private wires, installing a private wire to a local demand customer will be one of the options that distributed generation developers will explore. However, few exist in practice. This is due to the contractual complexities and investment risk involved.

The interviews carried out in this study suggested there is a very low percentage of distributed generation sites that have NRPW. And our analysis of the South West region's distributed generation supported that Network Replicating Private Wires (NRPW) are likely to make up a small subset of these instances of private wires.

As subsidies for renewables have decreased, the economic rationale for installing a private wire has increased, particularly for those installed on the same site or 'behind-the-meter'.

But for private wires that link two different sites, complexities with the arrangements remain. Therefore, stakeholders expect private wires that replicate network assets to experience only modest growth.

In this study, we have made an estimate that two percent of large generation and demand sites (those that generate and import above 100 kW) have NRPW. This may grow to around five per cent. However, as the examples are quite low in numbers, these estimates have a high degree of uncertainty.

Section 1: Market analysis – industry views

The study first needed to understand the existing private wire market before developing models for networks that might meet that need and demand. To do this we sought industry views on private wires, the size of the market, drivers and constraints to future growth.

Methodology:

A list of twenty-five distributed generation industry stakeholders with a likely interest in private wires was identified from Regen's contact database. These were investors, developers and lawyers predominantly in renewable generation (solar and wind) but also with experience in storage and other technologies.

These stakeholders were contacted via email and short telephone interviews were arranged with responders or those referred to by original stakeholders. Those not responding were chased once via email or telephone. Interviews were held with self-selected stakeholders with an interest or knowledge about private wires or virtual private wires.

- Interviews conducted with ten industry participants between August and September 2017
- They were asked about their experience with private wires in the current market
- They were asked about the drivers for any projects and the market conditions.
- They were also asked about how the market might develop in the future and what those barriers and drivers are expected to be.

Key findings from industry analysis:

Existing market for NRPW

- Most private wires are 'behind the meter' or same-site wires that connect generation to demand within a commercial site.
- These sites are not within the scope of this study which is to identify sites where there are duplicated network assets.
- The private wire market as defined in this project (e.g. replicating distribution assets across two locations) is currently small. The study definition is 'Network Replicating Private Wire' (NRPW)
- Interviewees felt that these NRPW would be in the very low percentages of distributed generation
- One interviewee estimated that around two percent of large generation and demand sites projects will have a NRPW (by which we mean those with greater than 100kW capacity)
- This current low percentage can be explained by the fact that previously the subsidy regime for renewables offered enough income to make the project viable just exporting to the grid as opposed to NRPW which are complex with significant counterparty risk.
- For solar PV the benefits to the demand customer may be reduced because the generation profile means it only displaces imported energy in low-cost periods.
- Existing NRPW are likely to have been built with support from both renewables subsidies and the PPA income from the demand customer which is likely to be above the market price.

Potential for market growth:

- NRPW that link directly to external sources of demand are expected to grow in both new distributed generation sites
- However, the interviewees were not aware of a distributed renewable generation project that had been built only with a private wire PPA although felt that some would be being explored.
- It may be that retrofitting a private wire, which is mainly of benefit to the demand customer, is currently more likely rather than using the PPA to build a new asset.
- The main driver for this is to offset low wholesale electricity prices for generators and high grid prices for electricity for demand customers.
- Expected growth is modest and the numbers of NPPW built are to stay in the low percentages.
- One interviewee estimated that NRPW may grow to around 5 percent of large generation and demand sites.

Examples of Network Replicating Private Wires

The following are examples of NRPW that were mentioned during the interviews and found in searches and would be of interest to this study.

- Honda Swindon and the 10.4 MW Sevor solar plant in South Marston in Swindon developed by Eneco. http://projects.eneco.com/sevor-farm-solar/eneco-uk/
- UPN Paper Mill Shotton and a 72 MW Solar Array, the UK's largest solar park at Shotwick, Cheshire. https://www.cleanenergynews.co.uk/news/solar/upm-shotton-to-meet-energy-demand-with-uks-largest-private-wire-solar-park
- Restormel South West Water near Lostwithiel with the Polmaugan Solar Farm 4.5 MW Solar Array. http://www.foresightgroup.eu/news/foresight-solar-investment-cornwall-takes-innovative-community-approach-to-renewable-energy/
- London Gateway Port receives power directly from the 800 MW Coryton gas-fired power station. http://s341013790.websitehome.co.uk/
- A 100kW community-owned solar array with a private wire to South West Water's Nanstallon Sewage Treatment Works. http://www.wren.uk.com/news/100-community-energy-powers-sewage-treatment-works
- 5 MW Kernow Solar Park near Newquay in Cornwall supplies power both to Newquay Airport and to the grid. http://www.bbc.co.uk/news/uk-england-cornwall-19504345
- Belfast Airport receives power from 4.84 MW Solar Farm developed by Lightsource https://www.cleanenergynews.co.uk/news/solar/belfast-international-airport-to-reduce-grid-energy-demand-through-4237

The examples show that the sizes of the projects can vary from 100 kW to 72 MW capacity. There are three sized at around 5 MW, two supplying airports.

One key variable is whether generation is sized for the demand customer or the generation plant is oversized and the generator uses the connection capacity of the customer to access the market. The latter would have a PPA with two prices, one paid by the customer and one for exported electricity.

In other models, the generator has two connections, one private wire and one network connection. This would be the case with Coryton Power Station and The Kernow Solar Park.

Using this and other examples we can generalise that NRPW examples tend to involve:

- Supplying high investment grade counterparty with an interest in green credentials
- Demand site is a high energy user with long term commitment to a single large industrial site with appropriate demand profile for the generation.

Findings on the future market for private wires

The interviewees felt that future growth of private wires will be driven by:

a. **Obtaining a higher price for electricity.** A private wire agreement can in principle provide a much higher price for electricity for generators than the current wholesale price and avoid network and policy charges. This can help make an investment case for new projects.
b. **Compensation for subsidy loss.** The reduction in subsidy for renewables means developers are looking for alternative income to compensate and to allow new renewable generation to be built. One option is a private wire.
c. **Consumer green credentials.** Consumers are increasingly looking to purchase renewable generation due to environmental requirements of supply chains and corporates e.g. RE100. These requirements are growing.
d. **Long-term price certainty.** Private wires can, for some demand sites, provide lower energy prices and long-term certainty on those prices for between 15-25 years. This is of value to large consumers that have a long-term investment in one location and looking to offset likely future increases in energy costs.
e. **A solution to network constraints.** The conversations indicated that private wires often provided a solution to network issues such as high connection costs in a location or capacity constraints for consumer. These constraints are expected to grow and increase demand for private wire.

All these drivers are relevant to both behind-the-meter private wires as well as NRPW. Bullets b. and c. are only relevant to renewable generation.

Interviewees felt that future growth of NRPW is limited by:

f. **Investment risk of consumer.** It is a higher investment risk to hold a PPA with consumer rather than to export to the grid. Most feel that the key limiting factor for NRPW is investment grade of consumer able to take on a 15-25 year contract.
g. **Number of feasible sites.** High energy users tend to be in or close to built-up areas and so there is limited land nearby to develop for generation assets. This impacts mainly renewables and solar PV in particular. There may be further potential from non-renewable sources, CHP etc. that require less land.
h. **Contract complexity.** The complexities of negotiating the contracts and adhering to supply/distribution rules and exemptions.
i. **Competing options.** Many developers and corporates also explore sleeved PPA agreements Though prices are low at present and none have provided sufficient prices to build a new renewable asset without subsidy. On-site battery storage could also provide demand sites an alternative way to manage their energy usage and demand with more flexibility than generation assets.
j. **Upfront cost.** The upfront costs of private wire installations.

To note that these constraints are relevant mainly to NRPW, less so to behind-the-meter options.

Section 2: Market analysis - data

The second part of the market analysis was to try and identify the size of the private wire market by interrogating distributed connections data from the South West region. This, along with the industry interviews would establish an estimated number of projects in the region.

WPD provided connections data for all installed generation capacity on the database within their South West distribution area (2302 sites). The information included kW import capacity, export capacity and installed generation capacity.

Looking at the values and relationships between those data sets we attempted to distinguish the different types of generation and those likely to have private wires.

Based on a process of elimination, 184 of the 2302 sites, with a total of 133 MW installed capacity, have some of the attributes to be NRPW, or at least none of attributes which means we can be quite confident they are not NRPW – i.e. they are large capacity (greater than 100kW installed generation and import capacity), are not generation-only or behind the meter-only.

Data methodology

Step 1. Isolate half-hourly metered sites. We narrowed down the initial 2302 sites to those with an installed capacity of 100kW or over in both installed generation capacity and import capacity. This aimed to isolate those with half hourly meters who are significant users or generators and therefore of interest to this study. This left 456 projects, 20 percent of those provided.

The rest of the analysis described below was undertaken using this selection of sites above 100 kW generation and demand which we are referring to as 'large generator and demand sites'. We used various assumptions to narrow down the number of sites within those 456 that may have a NRPW.

Step 2. Remove generation-only sites. To remove further generation sites from the large generator and demand sites, we assumed that those with small import capacity versus installed capacity were generation sites only. There were 87 of these sites or 19 percent. These made up 65 percent of the installed generation capacity, suggesting that they tended to be the larger sites.

Step 3. Remove behind-the-meter only. The interviews indicated that having the option to export all or nearly all capacity to the grid through the consumers grid connection was important for risk mitigation where the generation site is not owned by the consumer. This is less important for consumer owned sites. Therefore, we removed those with no reported export capacity. There were 95 sites, so 21 percent of sites with no reported export capacity.

The remaining 274 sites or 60 percent could be private wires, although they may be either behind-the-meter or NRPW.

Step 4. Remove likely to be behind-the-meter private wire. To narrow down further we removed sites where the export capacity was below 75% of the installed capacity. As those with a private wire of interest to the study would require any excess generation to be exported to the grid up to or near to the full capacity of the generation asset. This removed a further 90 sites as likely to be behind-the-meter private wires.

The final 184 sites or 40% of the large generator and demand sites have some of the attributes to be NRPW. It is impossible to distinguish these from the same-site separately owned generation or some behind-the-meter systems.

Though the largest number of sites, this category only had a total of 133 MW of installed capacity, or 9.4 percent of the capacity. This suggests these are likely to be smaller systems.

The remaining sites by installed generation capacity and types of generation is in the table below. Photovoltaic dominated in the smaller sites with 105 sites or 78% of those under 500kW.

Row Labels	No of projects	Capacity	% Total Capacity
Hydro	5	977	0.7%
Landfill Gas, Sewage Gas, Bio	4	1,610	1.2%
Medium CHP (>5MW,<50M	1	11,250	8.5%
Mini CHP (<1MW)	8	3,541	2.7%
Mixed	13	18,152	13.6%
Onshore Wind	8	9,355	7.0%
Other Generation	24	25,577	19.2%
Photovoltaic	115	30,928	23.2%
Small CHP (>1MW, <5MW)	4	11,600	8.7%
Storage (Battery)	1	15,400	11.6%
Waste Incineration (not CHP	1	4,715	3.5%
Grand Total	**184**	**133,105**	**100.0%**

Estimating the number of NRPW

To estimate the actual number of NRPW we assumed a percentage based on industry conversations. We then undertook analysis of some of the possible NRPW sites to see if NRPW could be identified and how many are evident. This helped us establish whether the estimate was likely to be in the correct order of magnitude.

We recognise that this approach is only able to deliver a very broad estimate of numbers and the margin of error will be large.

1. **Assumption on percentage of sites.**

Few interview participants were able or willing to put a number on the percentage of distributed energy projects having a NRPW, but all agreed they were in the very low percentages. One mentioned that having one was like 'finding a unicorn'.

We made a further assumption that NRPW sites are more likely to feature in the largest generators and consumers. This is because private wires involved large upfront capital investment as well as significant contract costs, and therefore would be most economical in larger sites. We are aware of a community project that delivers 100kW to a large demand customer and believe this is likely to be the smallest scale that would be feasible.

Based on this we have estimated that they could account for around 2 percent of large generation and demand sites. These assumptions allow us to estimate that there would be NRPW in 2 percent of the selected 456 projects. This suggests there would currently be approximately nine projects with duplicated distribution assets in the South West Area.

There was also some agreement that further NRPW could be built up to around 5 percent. This means that there may be around 20-30 sites in the future.

2. **Verifying the numbers with NRPW within the selected projects.**

We would expect most of these nine projects to be within this NRPW sub-set of 184 projects that we found in the data set to have some attributes of a NRPW.

To identify some sites to investigate further, we made another assumption that the majority of NRPW would be renewable generation as it is less likely to be suitable to be co-located on the demand site. PV may not be able to fit on a demand customer's site or wind turbines may need to be situated away from buildings for onshore wind. Other distributed technologies like CHP, gas and diesel require much smaller amounts of land or buildings and so are likely to be placed in the same site as their demand customer.

The NRPW with Portland Docks and gas fired station is an example of where gas generation is not co-located. However, situations when NRPW are the best option for non-renewable generation will be limited.

Using internet searches, we investigated the 10-highest capacity renewable sites on the NRPW possible list.

Out of the top 10 renewable sites we found:

- Two have NRPW

- The remaining eight are on-site systems exporting excess to grid.

We believe this corroborates that our estimate of the number of NRPW in the South West (9) is likely to be in the correct order of magnitude.

Conclusions about 'Network Replicating Private Wires'

Existing market for NRPW

The private wire market as defined in this project 'Network Replicating Private Wire' (NRPW) is currently very small. We estimate that it could account for perhaps nine projects in the South West licence area or two per cent of existing large generation and demand sites (those generating and importing over 100 kW). In the South West, these sites would have likely total capacity of 22.5 MW.

Although the prices achieved through a private wire can be attractive for generator and customer, they are limited by complexities including legal issues with arranging the PPA, investment risk of the demand customer and by the number of feasible sites.

Future market for NRPW

Despite complexities, numbers of NRPW are expected to rise. However, none of our interviewees knew of any renewable generation sites that had been built with a NRPW and PPA without subsidy. The greater potential may be in retrofitting existing sites to mitigate the low market price for electricity.

This study estimates perhaps NRPW would grow from two per cent to around five per cent of large generator and demand sites or 25 projects in the South West.

Types and size of NRPW

There are a number of models of NRPW and a key variable is the generation size relative to the demand. There are examples between 100 kW and 72 MW with three at 5 MW. Some are sized for the demand customer, some are oversized and export to the grid through the demand customer connection. Some will have both a private wire and a grid connection. The examples we found suggest that generally a NRPW involves:

- Supplying high investment grade counterparty with an interest in green credentials
- Demand site would be high energy user with long term commitment to a single large industrial site with appropriate demand profile for the generation.

Importance to Network Operators

Though NRPW are rare, the typical size and profile of generation and demand within a NRPW arrangement is likely to be significant within a sub-station or supply area.

The interviews indicate that most, if not all, of NRPW will want the capability to export to the grid often to the full capacity of the generation asset. Therefore, in the majority of cases, the generation will be visible to the DNO.

DNOs have seen a rise in interest in private wire arrangements, particularly to fund the development of renewable generation. The findings from this study suggest that despite interest, the commercial difficulties in arranging private wires will mean that growth will be modest and there will be more demand for them than are built.

However, it remains important for the DNO to understand customers motivations and needs and how the interest in private wires and local connections to distributed generation can be done without the duplication of assets.