Examination Library Document Reference I9

North Norfolk Power Study

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Prepared for: North Norfolk District Council

Date: 29 March 2019

Reference: P3735

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Document History

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Contents

1. Executive summary

North Norfolk District Council is developing a new Local Plan for development across North Norfolk, including development of up to 11,000 new homes and 50.5 hectares of employment land between 2016 and 2036. In order to deliver this growth it is important to consider how new growth can be supplied with energy, Egnida were commissioned to review current energy infrastructure and identify areas where there may be constraints on energy supplies now and in the future. This study is intended to provide evidence in order for the emerging North Norfolk Local Plan to support development and the spatial distribution of growth.

Existing demand for electricity and gas has been reviewed to create a baseline of energy demand across North Norfolk. Plans for development, both commercial and domestic, were also reviewed and the likely additional peak power demand was forecast, based on benchmarks and forthcoming changes to government policy.

Projected energy demands for new development sites have been considered in conjunction with substation load data from UK Power Networks in order to understand the likely impact of this new development and how it can be delivered. The results of the analysis are illustrated in Figure 1. The areas of planned development are shown in relation to the local substation, which is also colour coded in a traffic light system according to the available capacity. The substations in green have no capacity issues, while those in red have under 5 MW of spare capacity and will struggle to serve major additional development without further reinforcement.

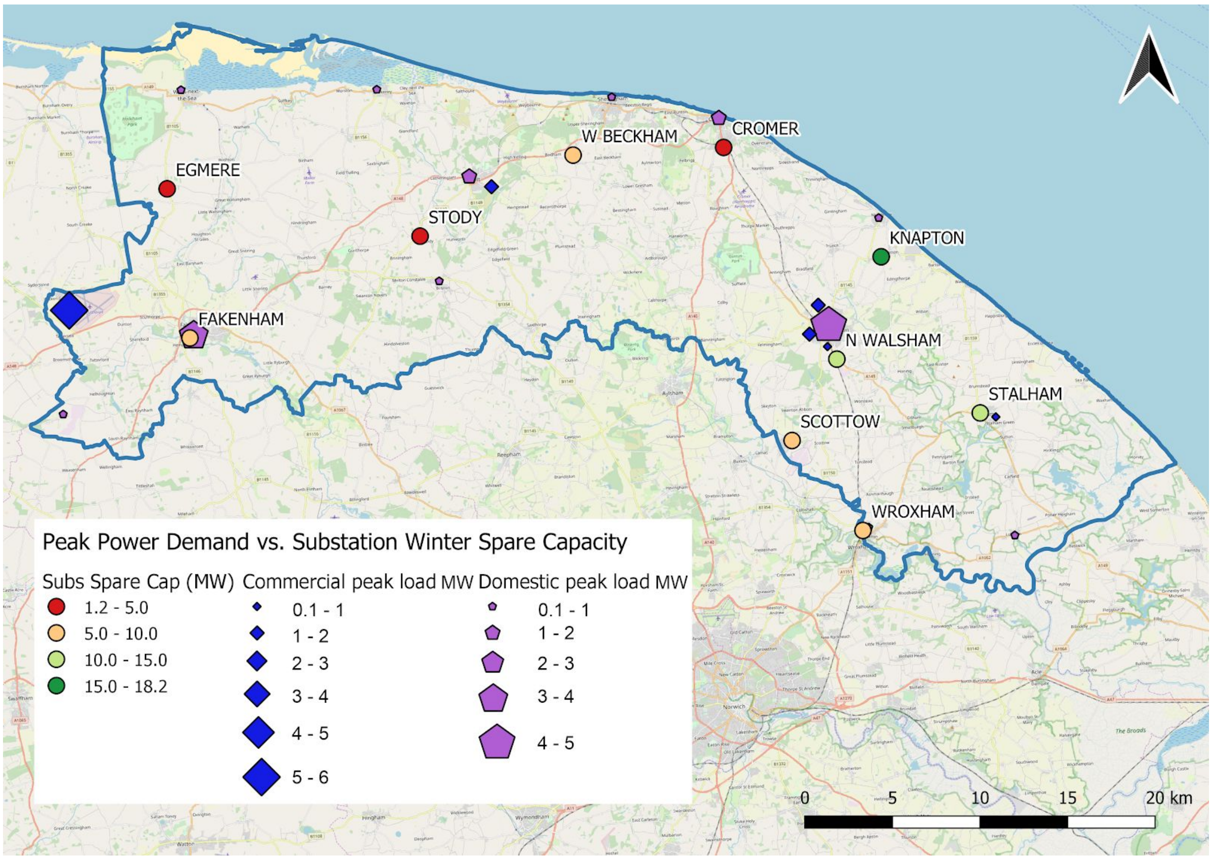

Figure 1: Development site demand mapped against winter spare capacity

From Figure 1 it can be seen that the areas with the highest additional loads from new development are around Fakenham and North Walsham in particular, and whilst these are not the sites with the lowest levels of capacity, the scale of planned development is still substantial when set against this spare capacity. Table 1 shows the Primary substations (33/11kV) with planned development against locally available capacity.

In the 2019 Spring Statement the chancellor announced the complete phase out of fossil fuel heating systems in new housing by 2025. This will likely lead to the greater uptake of heat pumps, potentially increasing peak electrical demands from new housing by up to 25% further compounding constraints..

Table 1: Winter spare capacity and peak loading for each 33/11kV substation

Substation (33/11kV)	Total Electrical Energy Demand (GWh)	Current Electrical Winter Spare Capacity (MW)	Future peak power demand of all development sites	Spare capacity after planned development
Fakenham Primary	278	8.20	9.20	-1.00
Cromer Primary	26	1.20	1.67	-0.47

Egmere Primary	3	1.35	0.20	1.15
Stody Primary	76	3.16	1.94	1.22
North Walsham Primary	143	10.80	7.60	3.20
West Beckham Primary	11	5.13	0.74	4.39
Wroxham Primary	4	5.13	0.35	4.78
Scottow Primary	0	9.78	0	9.78
Stalham Primary	23	12.89	0.82	12.07
Knapton Primary	3	18.2	0.19	18.01

From this it can be seen that, around Fakenham and Cromer, future demand exceeds the available capacity at the substation. The development sites affected due to this are shown in Table 2 below. While this analysis does not suggest constraints on development at North Walsham, discussions with UK Power Networks have indicated that additional development here is subject to capacity issues on the local 33kV network where available capacity is limited. This would potentially constrain some of the large scale development surrounding North Walsham.

Table 2: Development sites associated with constrained development areas

Substation	Affected development sites
Fakenham Primary	West Raynham Housing - Fakenham Tattersett Business Park
Cromer Primary	Housing - Cromer

Recommended approaches for grid constraints

The traditional solution to grid constraints is to upgrade the local network connection at the substation and in the local infrastructure. However, the capital costs to do this would be between £2.5 million and £10 million, depending on the scale of the development. It is also likely to take several years before the work can be undertaken. There are ways to avoid or reduce the costs of improved network connection. Each site will be different, dependent on what activity will be undertaken on the site and the local vicinity. However, the following list of alternative approaches should be considered for all sites affected by grid constraints:

- Semi-islanded approaches utilising on-site generation and smart energy management solutions can enable development in constrained areas. Semi-islanded development

sites including high levels of on-site, renewable or low carbon generation and batteries can be designed such that local benefits can be maximised while also having a positive effect on local electricity networks.
- Work with the DNO to offer demand side response services, where on-site generation could be turned up or load reduced in response to network signals, can help balance supply and demand more locally and assist system operators to deal with local constraint issues, at times of network stress.
- Investment in infrastructure on these sites could be delivered through an Energy Services Company model, which can then provide a steady revenue stream for those involved.

Next steps

Next steps to progress this study are:
- Undertake more detailed feasibility studies considering identified sites, in particular Tatterset Business Park, in order to model potential semi-islanded approach in greater detail
- Explore potential for local authority involvement in an Energy Services Company to deliver local infrastructure investment. North Norfolk should liaise with Norfolk Council and Greater Norwich on work being undertaken in this area
- For sites in areas that are particularly constrained ensure alternative approaches to energy infrastructure are considered
- Review energy-related planning policy measures within the local plan with particular focus on energy efficiency

2. Introduction

This study is an appraisal of North Norfolk's electricity grid looking at the limitations and restrictions within the area. An assessment of the current demands on the electricity network will ensure a robust representation of the area to understand constraints and suggest suitable steps forward.

The study analyses projected future additional commercial and domestic demand as set out in the local plan and identifies potential bottlenecks of future commercial and domestic developments. It also then considers suitable mitigation measures for North Norfolk Council to undertake to facilitate development.

North Norfolk's emerging Local Plan is being developed to ensure that there is positive planning for the development and infrastructure that communities need, and to set out the strategic priorities for North Norfolk to 2036. The draft Local Plan sets out significant growth plans and identifies the need for between 10,500 and 11,000 new dwellings to 2036 with the local plan to identify new development sites for approximately 4,500 dwellings. It also identifies up to 50.5 hectares of proposed employment land. The new Local Plan is anticipated to be finalised in late 2020.

Egnida has undertaken a complementary study commissioned by the Greater Norwich authorities (Norwich City Council, Broadland District Council, South Norfolk Council) reviewing energy infrastructure study of Greater Norwich. North Norfolk District Council is adjacent to the Greater Norwich area and its power supplies are intrinsically linked to the neighbouring authorities' areas.The projected future growth in energy demand in Greater Norwich will have an effect on North Norfolk and this has been considered as part of this study.

3. Electricity network constraints

Figure 2 shows the electricity network within the study area. The black mapped network indicates a 132kV network with the neon green representing the 33kV network. The red dotted line represents the National Grid operated 400kV network that supplies the 132kV network.

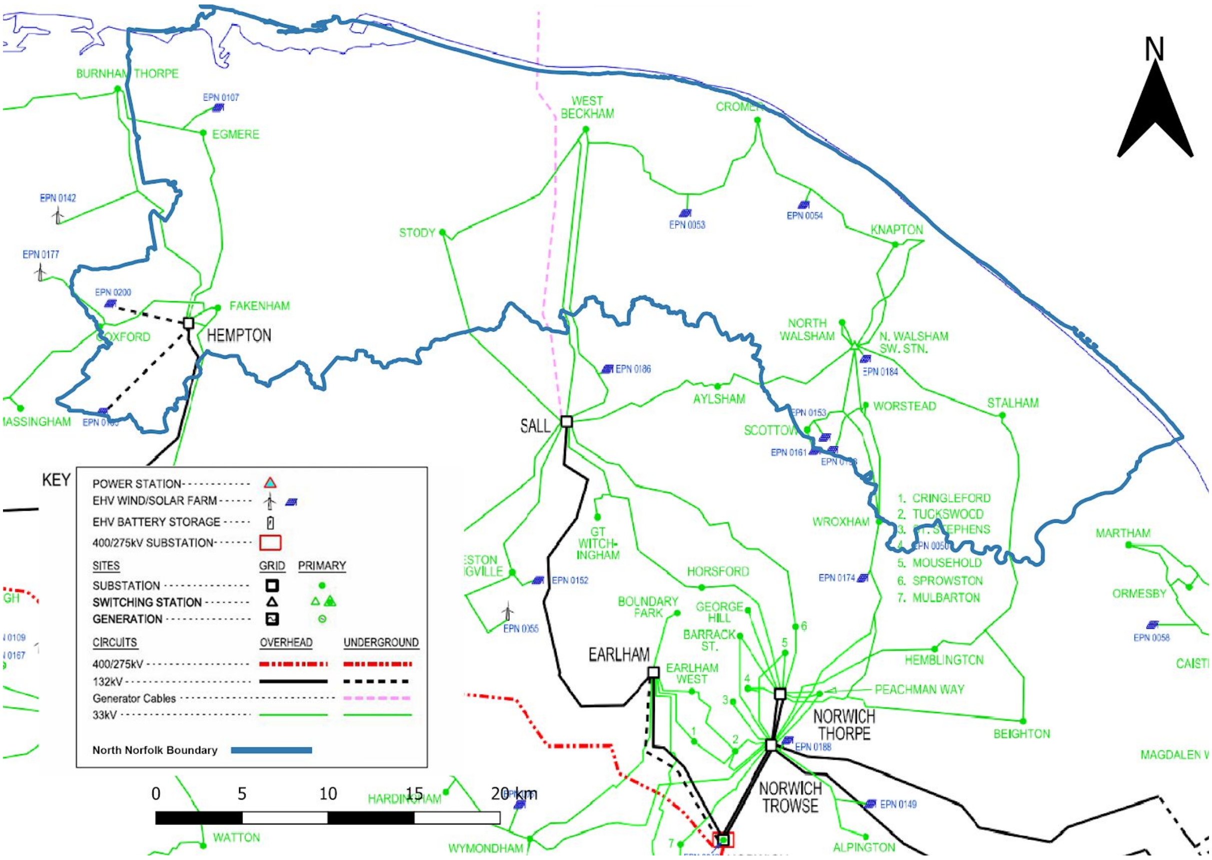

Figure 2: Electricity network in and around the study area showing the 400, 275, 132 and 33kV network (UKPN LTDS 2018)

From this it can be seen that the bulk of North Norfolk is supplied from the Sall, Thorpe and Trowse 132kV substations fed from Norwich main, while the west of the district is supplied from Hempton. This 132/33kV substation is supplied from the Grid Supply Point (GSP) at Walpole, west of King's Lynn. Voltages at 132kV and below are operated by the local Distribution Network Operator, UK Power Networks (UKPN). Each of the 132/33kV substations shown in black supplies a number of further Primary substations within North Norfolk, connected by the 33kV network shown in green. The network below 33kV is not shown on this map, this is where the majority of loads are connected, some directly at 11kV, with most connected to the low voltage network at 415/240V.

3.1. 33kV network constraints analysis

Electricity network data from the 2018 UK Power Networks (UKPN) Long Term Development Statement (LTDS) were analysed for the winter season when the peak power demands on the network are highest.

Modelling has been undertaken to assess the impact of future commercial and domestic development sites on the electricity grid. By mapping the substations in the area that supply power at 33kV we can identify the locations most affected by constraints in the area.

3.1.1. Winter peak loading

The Figure 3 shows the percentage of capacity used at each substation during the winter season, considering peak power winter demand for the area connected to the substation against the maximum rated capacity of the transformers within the substation. This is represented using a traffic light system where green indicates low utilisation and red represents high utilisation. From this we can see that the majority of substations have significant proportions of unused capacity, with most peak loads below 75%. The exception to this is Cromer, where peak loads utilise 91% of available firm capacity. This data is also represented in Table 3 below.

Figure 3: Winter capacity utilisation of 33kV substations in the North Norfolk area

Table 3: 33kV substation loadings

Substation (33kV)	Peak winter load (MW)	Firm capacity (MW)	Winter peak loading
Egmere	3.4	4.8	71.9%
Fakenham	14.8	23.0	64.3%
Stody	9.3	12.5	74.7%
West Beckham	11.4	16.5	69.0%
Cromer	13.3	14.6	91.4%
Knapton	10.5	28.7	36.6%
North Walsham	11.1	21.9	50.7%
Scottow	2.7	12.5	21.8%
Stalham	10.1	23.0	43.9%
Wroxham	7.5	12.5	60.0%

More important than utilisation when considering the potential connection of new demand is how much physical capacity is available at each site at times of peak demand. Figure 4 below represents the substation spare capacity in megawatts. Egmere, Cromer and Stody show the least spare capacity with 1.4, 1.2 and 3.2 MW respectively. North Walsham and Stalham have the most capacity with 10.8 and 12.9 MW respectively.

Figure 4: Winter Spare Capacity of 33kV substations in the North Norfolk area

3.1.2. Reserved capacity

These figures show only connected capacity, however alongside this the DNO has also made connection offers to customers that have not yet connected to the network. Any party can request and accept a quotation for a particular site which will reserve capacity for a finite period. Beyond this it is possible to enter into a 'Reservation of Capacity' agreement, although this will incur ongoing charges.

This means that even in areas where there appears to be some spare capacity new development may not be able to proceed if some of that spare capacity has been reserved for other uses. In those development sites that are more advanced towards implementation developers involved in these sites may have partially secured some of this capacity for delivery of these sites, so consideration of reserved capacity as 'utilised' and unavailable for development can be misleading, but it provides guidance as to where the areas of most constraint are.

3.2. 132kV analysis

Issues upstream from the substations mapped in Figure 3 and Figure 4 can impose an additional constraint on development. These upstream 132/33kV substations are mapped in Figure 5 below using a similar traffic light representation to show the winter capacity utilisation of these.

Figure 5: 132kV Winter Capacity Utilisation

The 132kV substations supply the 33kV so it is important to understand the demand on this network. While only one 132/33kV substation, Hempton, is within the North Norfolk area, constraints on those outside of this area can also have a significant effect where they supply the 33kV network within North Norfolk. Table 4 shows the loads on these substations.

Table 4: 132kV substation winter peak loads and capacity utilisation

Substation	Peak Winter Load (MW)	Firm Capacity (MW)	Winter peak loading
Hempton	31.9	56.2	56.8%
Sall	90.5	109.7	82.5%

Earlham	53.6	109.7	48.9%
Thorpe	88.8	109.7	81.0%
Trowse	105.3	109.7	96.00%

Thorpe and Trowse run interconnected at 33kV level, so additional load on one is shared with the other, however both experience particularly high levels of demand. They are also affected by the other areas connected to these substations within Greater Norwich. Planned development as part of the emerging Greater Norwich Local Plan will likely add over 40 MW of peak demand to Thorpe and Trowse substations, leading to reinforcement being required of these irrespective of the scale of development in Greater Norwich.

The timescales for UKPN to carry out reinforcement of these are uncertain however and therefore lack of available capacity on these substations is likely to cause a constraint to development in North Norfolk. This is explored in more detail in section 5.1.1.

4. Energy and power demand

To better understand North Norfolk's energy structure, the local electrical energy and power demands have been analysed.

4.1. Existing electricity demand

The electricity consumption is modelled by Middle Layer Super Output Area (MSOA), this is a commonly used geographical unit used to represent small areas and the data is published by the government's Department for Business, Energy & Industrial Strategy (BEIS). Figure 6 gives an indication of the electricity consumption within the study area. These figures are combined domestic and commercial demands. The highest consumption is in the north east and south west of the study area, with the areas around Fakenham and Knapton representing the lowest demand.

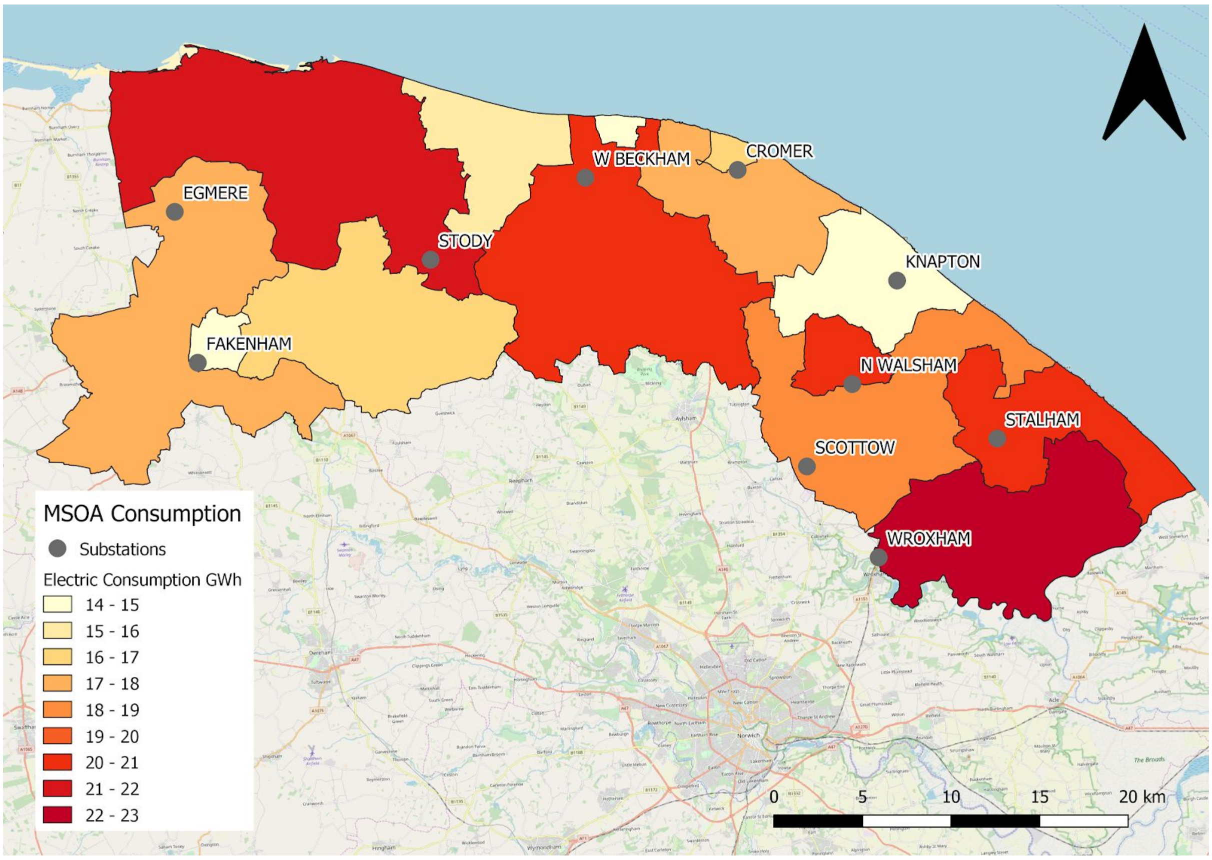

Figure 6: Electrical consumption by MSOA in North Norfolk

4.2. Projected demand for future development sites

For the commercial sites, the demand has been modelled using energy benchmarks that rely on data such as site occupancy based on building use/classification. Load profiles for different types of commercial demand have been applied for these to understand the peak power demand. Thus, a complete picture showing total demand and peak power requirements of each of these sites has been created. It is important to note however, many of the development sites are at an early stage of planning, these figures should be viewed as estimates only.

Domestic property electricity demand can vary and are dependent on a number of factors. For this modelling the After Diversity Maximum Demand (ADMD) figures for peak domestic power were utilised. ADMD is an important tool used in the design of electricity distribution networks where electricity demand is aggregated over a group of domestic properties. Network peak demand is considered around 4-8pm when most people return from work. However considering each property, demand can vary greatly and this can prove difficult to model the ADMD aggregates demand over a large number of domestic properties and considers the variance in instantaneous load in each property. This reduces overall peak load for a given area and gives a more reliable figure. Peak power demand for new housing is modelled using an ADMD figure of 2kW per house.

Table 5: Development sites with associated peak power and electrical energy demands

Development Sites	Total dwellings to be built	Employment land (ha)	Peak Power Demand (MW)	Energy Demand (GWh)
West Raynham	100+	-	0.20	3.1
Housing - North Walsham	2,378	-	4.76	73.7
Housing - Fakenham	1,763	-	3.53	54.7
Housing - Cromer	836	-	1.67	25.9
Housing - Wells	101	-	0.20	3.1
Housing - Sheringham	370	-	0.74	11.5
Housing - Holt	741	-	1.48	23.0
Housing - Stalham	203	-	0.41	6.3
Housing - Hoveton	131	-	0.26	4.1
Housing - Briston & Melton Constable	193	-	0.39	6.0
Housing - Mundesley	96	-	0.19	3.0

Housing - Ludham	44	-	0.09	1.4
Housing - Blakeney	35	-	0.07	1.1
Housing - Small villages	676	-	1.35	21.0
Housing - Remaining settlements	377	-	0.75	11.7
Housing - Windfall development	2,295	-	4.59	71.1
Land at Heath Farm	-	6	1.22	46.4
Land at Norwich Road & Nursery Drive	350	2	0.41	15.5
Land off Cornish Way	-	5	1.02	38.7
North Walsham Western Extension	1,800	7	1.42	54.1
Land North of Yarmouth Road, East of Broadbeach Gardens	80	2	0.41	15.5
Tattersett Business Park	-	29	5.79	220.3

Table 5 is a summary of the electrical power and energy demand of the development sites within the study area. Some of the biggest projects include Tattersett Business Park with 29 hectares of employment land. Housing sites in North Walsham and Fakenham are larger housing developments with 2,378 and 1,763 dwellings respectively. North Walsham Extension is another large housing site with a further 1,800 homes. Windfall development sites account for a potential additional 2,295 homes, however these are likely to be more spread out across a range of potential sites rather than be a source of concentrated peak demand.

4.2.1. Changes to future electrical demand

ADMD figures are based on traditional approach to energy supply to houses, including a gas connection to each property. In the 2019 Spring Statement the chancellor announced the complete phase out of fossil fuel heating systems in new housing by 2025. This will likely lead to the greater uptake of heat pumps.

Electric Vehicles (EVs)
With current market share of EVs increasing rapidly and the government's commitment to stopping all fossil fueled vehicle sales post 2040 there will be a key growth in electricity demand. This will have implications on the infrastructure. The addition of EVs will require smart charging and incentivising households not to charge at peak times. This can also mean vehicles are used to provide electricity at peak times to the grid and reduce demand.

Scenario	Description	ADMD Per Home (kW) Diversified	ADMD Per Home (kW)
0	Gas Fired Heating With A Conventional House	0.75	2.0
1a	30% Deployment Of HP	0.80	2.0
1b	60% Deployment Of HP	1	2.5
1c	Full Deployment Of HP	1	2.5
2a	30% Deployment Of Total Electrification In Smart Grid Scenario	1	2.5
2b	60% Deployment Of Total Electrification In Smart Grid Scenario	1.5	3.0
2c	Full Deployment Of Total Electrification In Smart Grid Scenario	2	5.0
3a + 2c	Full Deployment Of Total Electrification In Smart Grid Scenario + 30% Deployment Of EV's At On Peak Fast Charge	3	7.0
3b + 2c	Full Deployment Of Total Electrification In Smart Grid Scenario + 60% Deployment Of EV's At On Peak Fast Charge	3.5	9.0
3c + 2c	Full Deployment Of Total Electrification In Smart Grid Scenario + Full Deployment Of EV's At On Peak Fast Charge	4.5	11.5

Figure 7: Modelled ADMD figures under different scenarios from Strathclyde University's Wire Resilience Impact Scenario Calculator (WRISC)[1]

Figure 7 shows the difference in modelled ADMD under different uptake scenarios of low carbon technologies, including heat pumps and electric vehicles. This shows the substantial additional demands that can be imposed by high penetration of low carbon technologies and the need to incorporate an appropriate plan for some of these issues when considering new developments.

It can be seen that new homes utilising heat pumps would expect to have a 25% higher ADMD figure compared to homes utilising gas heating.

[1] http://www.esru.strath.ac.uk/EandE/Web_sites/13-14/WRISC/index.html

4.3. Demand and constraint analysis

The future development sites were used to model constraints on the electricity grid. Figure 8 above shows the forecast peak power demand from the proposed large-scale developments alongside the winter spare capacity at each substation.

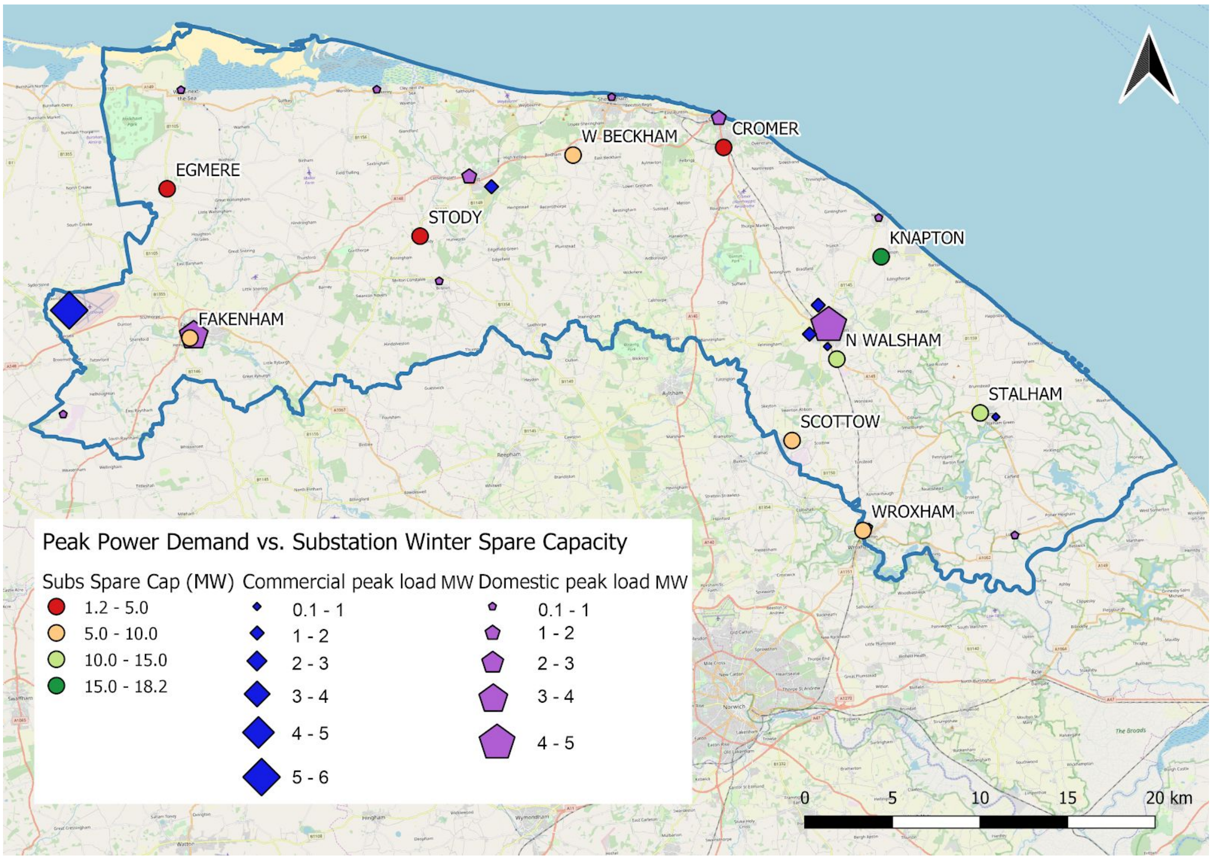

Figure 8: Development site demand mapped against winter spare capacity

Table 6 shows these figures in further detail, showing total demand from future development sites connected to each substation within the study area, and the impact this will have on capacity.

Table 6: Development site demand on substations

Substation	Current Electrical Winter Spare Capacity (MW)	Future peak power demand of all development sites	Spare capacity after planned development
Fakenham Primary	8.20	9.20	-1.00
Cromer Primary	1.20	1.67	-0.47
Egmere Primary	1.35	0.20	1.15

Stody Primary	3.16	1.94	1.22
North Walsham Primary	10.80	7.60	3.20
West Beckham Primary	5.13	0.74	4.39
Wroxham Primary	5.13	0.35	4.78
Scottow Primary	9.78	0	9.78
Stalham Primary	12.89	0.82	12.07
Knapton Primary	18.2	0.19	18.01

This data shows:

- **Fakenham** and **Cromer** in their current state are **not suitable for the planned future development**.
- **Egmere** and **Stody** will be running at **close to their maximum capacity**.
- **North Walsham**, **West Beckham** and **Wroxham** have **enough capacity for planned developments**.
- **Scottow**, **Stalham** and **Knapton** have **sufficient spare capacity** and there is only low impact from planned developments.

While this analysis does not suggest constraints on development at North Walsham, discussions with UK Power Networks have indicated that additional development here is subject to capacity issues on the local 33kV network where available capacity is limited. This would potentially constrain some of the large scale development surrounding North Walsham.

No demand is forecast connected to Scottow substation from development within North Norfolk, however there will be some additional load from developments within Broadland district.

Cromer requires an upgrade to the 11kV switchgear and transformers have already been changed in 1994. Changing this switchgear will increase capacity further but capacity is also dependent on the capacity of the 33kV network.

Egmere only has a single transformer and capacity is limited by the ability to supply the connected demand from alternative substations in the event of outages. Some additional capacity here may be able to be released by reinforcing the interconnecting 11kV network.

5. Constraint mitigation measures

Fakenham and Cromer are the most constrained substations where developers must either invest in costly network reinforcements, which could delay development, or find ways to control the demand in the area. The specific sites that will need some sort of intervention are detailed in Table 7 below.

Table 7: Constrained substations with associated development sites

Substation	Affected development sites
Fakenham Primary	West Raynham Housing - Fakenham Tattersett Business Park
Cromer Primary	Housing - Cromer

5.1. Reinforcement

There are a number of methods to mitigate the effect of grid constraints. This section explores plans for reinforcement.

5.1.1. Conventional reinforcement

There are no development proposals for 2018/19 outlined in the 2018 Long Term Development Statement that will increase capacity within the study area. Beyond this there are potential longer term upgrades within UKPN's business plan for asset reinforcement and replacement at higher voltages.

UKPN business-as-usual reinforcement
As highlighted above, one major potential barrier to new development is available capacity at 132kV, in particular Thorpe and Trowse. These two substations run interconnected at 33kV, with any additional demand on the 33kV network divided between the two. The levels of new demand committed is higher than available capacity on these substations, however the timescales for the development of some of this demand is uncertain.

Reinforcement work at this voltage level is included within the DNO's business plan submission to OfGEM for forthcoming regulatory periods when their assessment is that the load is likely to 'naturally' grow to an extent to require the works within that period. However, the work will only be undertaken once the load has materialised, as OfGEM does not encourage DNO's to invest 'ahead of need' as they see that as not utilising the funds received from the customers in the most efficient manner.

Future reinforcement at Thorpe / Trowse was included within UKPN's 'RIIO-ED1' business plan (Apr 2015 – Mar 2023) submission to OfGEM, however the load has grown more slowly than anticipated so UKPN may not undertake the works within that period. However, even where reinforcement is included within the strategic plan, if UKPN receive an application that 'triggers' the work before it has been fully authorised, then the applicant is still likely to have to pay at least a proportion of the costs in line with their Common Connection Charging Methodology Statement. This means that despite reinforcement being planned by UKPN, constraints at 132kV level can still present a barrier to new development. Reinforcement costs for new substation and transformer assets are outlined in Appendix I.

5.1.2. Alternatives to conventional reinforcement

UKPN standard reinforcement proposals are based on the use of conventional network assets such as transformers, overhead lines and underground cables. UKPN is incorporating flexibility services that achieve net load reduction as an alternative to network reinforcement. Flexibility is the ability to change generation and demand in order to support UKPN in its role of developing and operating the distribution network.

Flexibility services are a means to reduce or shift peak demand using smart systems (technology and processes). This can be achieved by importing less or exporting more power to the distribution network . Services like these can be procured by network operators by offering generators or loads financial incentives to respond to signals to react to the needs of the grid.

UKPN has proposed in its Flexibility Roadmap of 2018 to adopt a 'flexibility first' approach to delivering additional network capacity. This will help drive down costs and the adoption of renewable technology by enhancing the competition. This 'flexibility first' approach will help to reduce the cost of adding additional renewable technology in comparison to the more traditional approach of network reinforcement.

The core applications for flexibility on the distribution network as described in the roadmap are:

- deferral of network reinforcement
- managing planned maintenance,
- and managing unplanned interruptions.

"UK Power Networks is committing £12m in funding across 28 locations in the South East and East of England to kick-start a new market for energy generators and other energy resources to sell flexibility services to network operators and lower costs to customers."[2]

After consultation, UKPN has identified numerous locations across its service area where flexibility would benefit the grid across its three licence areas. Previous tender procurement exercise is currently being held to meet flexibility needs from 19/20 and 20/21.

5.2. Smart control and demand side management

There are a number of mitigation solutions that full under the category of demand side management:

- Smart Grid
    - Monitoring and control systems.
    - Constraint management tools to monitor and control loads across the grid. E.g power aggregators who help system operators to reduce electricity consumption at peak times.
    - Helping utilities avoid the cost of distribution network reinforcement.
- Capacity swapping – facilitating the swapping to excess capacity at certain times of year between large energy users to negate the need for grid expansion.
- Time of Use Tariffs: designed to incentivise customers (domestic and commercial) to use more energy at off-peak times, in order to balance demand. The benefits are twofold: demand is managed and customers can lower their bills.
- Complementary tenancies – balancing predicated heat and electricity demand of businesses/organisations
- Large-scale on-site generation to reduce import requirements

Semi-islanded approach
Under normal operating conditions 'behind the meter' embedded generation and storage reduces the power drawn from the distribution network. This can be made up of technologies such as:

- on-site solar PV,
- heat pumps,
- combined heat and power systems,
- diesel generators or;
- battery storage.

It is important to account for non-standard operating conditions, where due to maintenance, economics, or weather conditions; the site can resume taking some, or all of its power, from

[2] "12m funding announced for Flexibility services in South East and East ...." https://www.ukpowernetworks.co.uk/internet/en/news-and-press/press-releases/12m-funding-announced-for-Flexibility-services-in-South-East-and-East-of-England.html. Accessed 26 Mar. 2019.

its grid connection. The unpredictable nature of this phenomenon would not reduce the peak system requirements needed to be supplied by the network, unless a level of guarantee around the maximum peak demands to site were maintained with sufficient on-site reliability to meet the required proportion of demand.

The deployment of semi-islanded site including high levels of generation does not have to be an additional burden on the local distribution network, systems can be designed such that local benefits can be maximised while also having a positive effect on local networks. For example, through engagement with the DNO to offer demand side response services, where on-site generation could be turned up or load reduced in response to network signals. This can help balance supply and demand more locally to minimise required input from higher level networks. These services can also be procured to assist system operators when dealing with local constraint issues, so at times of network stress, on-site generation could be increased.

For example, if operating a Combined Heat and Power plant on site, electricity production could be maximised during peak times to reduce network stress, while additional associated heat produced stored in a thermal store and used to supply local heat demands at a later time. Battery storage could also assist with this, storing electricity to be used at peak times. Any generated electricity would be exported to the grid and not just used to offset on-site demand

Regulatory considerations
The sale of electricity typically requires an electricity supply licence which can be costly and difficult to obtain. The regulatory costs incurred from complying with the industry codes and securing a supply licence are not scalable and often require significant up-front investment and ongoing resourcing which, for small entrants, adds major overheads. However, for small-scale generation schemes, there is an exemption which allows for the supply of up to 5MW of self-generated electricity to local consumers, of which no more than 2.5MW may be to domestic premises. The scale of any scheme developed including on-site generation would need to be within these limits. Behind the meter generation and storage do not have to comply with these limits, however would only be able to supply a single business with a single meter point.

There are no requirements to hold a licence for the supply of heat, however, operators must comply with the Heat Network (Metering and Billing) Regulations 2014, amended 2015, which place obligations on heat suppliers to fit heat meters and ensure billing is fair, transparent and based on actual consumption. Suppliers selling heat to the domestic or micro-business market are also encouraged to sign up with the Heat Trust[3] which provides an independent ombudsman service to customers and operators of district heat networks.

Impact on network charging
Where a fully-dimensioned grid connection is maintained by a site that utilises on-site generation with consumption behind the meter, the site avoids contributing to many of the

[3] http://www.heattrust.org/

funding mechanisms on which upkeep of the electricity network depends. Many of these costs are charged on a per kWh basis, so reducing energy import through on-site generation reduces network costs payable, despite retaining the ability to impose similar peak demands on the network to other customers through their grid connection. This is an area Ofgem are concerned about as if more engaged consumers are able to avoid paying network costs, a greater proportion of costs will fall on vulnerable consumers less able to shift their consumption or self-generate. Network charging is under review with alternative proposals being put forward as part of Ofgem's Targeted Charging Review.

5.3. Tattersett Business Park - Case study

As previously mentioned one of the proposed development sites that will be severely constrained is Tattersett Business Park . Figure 9 represents the site location with the two nearest substations with their winter capacity.

Figure 9: Development sites in the Fakenham area

Tattersett Business is a 28.5 hectare development site with building types B1, B2, B8 and suis generis (unique) building classification . As previously mentioned the Tattersett Business Park has a peak load of 5.79MW and the two nearest substations Fakenham and Egmere have a spare capacity of 1.35MW and 8.22MW respectively. This means it is unsuitable to connect at Egmere and if connected at Fakenham will only leave a 2.43MW spare capacity. Considering the Housing development in Fakenham which has a peak power demand of 3.53MW leaving the area severely constrained.

Further investigation should be undertaken considering the most appropriate measures to mitigate local constraints including the options set out in section 5.2.

5.4. Areas suitable for further development

There are areas identified within the study which show potential for additional development sites. The data shows us that there is potential capacity on some parts of the 33kV network but further upstream on the 132kV network there may still be some constraints as previously identified. As discussed in section 5.1.1, reinforcing these upstream assets is included as part of UKPN's business plan, however due to the timescales involved and their requirement to see clear need for new capacity before investing in the network, the timescales may not align with those preferred by the council or developers.

Areas that are potentially suitable locations for additional development from a grid capacity perspective are:

- Knapton and surrounding areas
- Stalham and surrounding areas
- Scottow and surrounding areas

These sites were chosen due to their spare winter capacity and due to their lack of development in the area making them ideal to connect additional demand. While there may be electricity capacity in these identified locations, this will not be the sole determinant of where growth goes, so where development is delivered in other areas a plan needs to be in place to overcome constraints.

6. Conclusions

The total development sites that are identified as being potentially partially constrained are:

- Fakenham
  - Tatterset Business Park
  - Housing - Fakenham
- North Walsham
  - North Walsham Western Extension
  - Land at Norwich Road & Nursery Drive
  - Land off Cornish Drive
  - Housing - North Walsham
- Cromer
  - Housing - Cromer
- Stody
  - Land at Heath Farm
  - Housing - Holt

These represent about a third of planned development, which are at significant risk, without some sort of intervention.

DNOs set clear recommendations and requirements before they can upgrade infrastructure for developers. Timescales for reinforcement by DNOs may not align with those required by developers. Additionally, regulatory obligations of DNOs to avoid unnecessary investment requires clear evidence that a reinforcement is required before it will be carried out.

Policy could be reviewed by DNOs whereby costs can be paid in increments or after developments are connected, based on robust data that ensures that new assets can be fully utilised. Thus ensuring that developments can go ahead according to time frames as well as assurance to DNOs that investment in the asset will be worth while.

Alternative approaches include:

- Semi-islanded networks with on-site generation and smart energy control. These on-site generation types should include high levels of low carbon and renewable technology. Where possible battery storage should be utilised for peak-shaving. This can help reduce peak power loads on the system, particularly in winter.

- Engagement with UKPN to facilitate Demand Side Response Services where power generating assets (such as on-site generation suggested in the previous point) can respond to signals from the network. By being able to increase or reduce the load system operators can benefit from less constraints on the grid by balancing supply and demand. UKPN has proposed in its Flexibility Roadmap of 2018 to adopt a ‘flexibility first’ approach to delivering additional network capacity, in order to drive lower costs and increased renewable energy on the network through more competition.

North Norfolk Council should engage with the local DNO, UKPN, to investigate the possibility of flexibility services with North Norfolk. Given the high level of local distributed generation and a range of commercial loads the study area may have potential to provide flexibility services to the network.

North Norfolk should also consider undertaking further feasibility to investigate the suitability of a semi-islanded development approach at Tatterset Business Park. This study would weigh up the possible solutions and give a balanced approach on how the development sites could be delivered technically and economically.

Planning policy

Planning policy can play an important role when it comes to energy. New homes that are delivered using heat pumps as a primary heating source rather than gas or oil boilers will have higher peak electrical demands to accomodate on the network. The 2019 Spring Statement commitment on no fossil fuel heating in new homes will have an impact on this, as discussed in section 4.2. In areas with electricity network constraints this can prove challenging, particularly when considered alongside the likely growth in uptake of electric vehicles and likely increase in peak loads associated with this. A fabric first approach to maximise energy efficiency should be taken in order to minimise the effect on the local network.

Tools such as the UK Green Building Council sustainability resource[4] can help provide guidance on appropriate energy policy to put in place. The Greater Norwich Infrastructure Study delivered in parallel to this report also included greater focus on potential planning policy measures, these should be reviewed for appropriateness for North Norfolk.

Next steps

Next steps to progress this study are:

- Undertake more detailed feasibility studies considering identified sites, in particular Tatterset Business Park, in order to model potential semi-islanded approach in greater detail
- Explore potential for local authority involvement in an Energy Services Company to deliver local infrastructure investment. North Norfolk should liaise with Norfolk Council and Greater Norwich on work being undertaken in this area

[4] https://www.ukgbc.org/wp-content/uploads/2018/07/Driving-sustainability-in-new-homes-UKGBC-resource-July-2018-v4.pdf

- For sites in areas that are particularly constrained ensure alternative approaches to energy infrastructure are considered
- Review energy-related planning policy measures within the local plan with particular focus on energy efficiency

7. Appendix I: UKPN reinforcement costs

New connections to the network are charged for the assets they require that are fully utilised by them , such as a new substation on the site of a new development. Developers must also pay for any reinforcement required further upstream if it is required. As detailed further on, these charges can be quite significant. For this reason it is best to avoid these costs where possible.

UKPN's charges and the rules that are followed when determining costs are set out in their Common Connection Charging Methodology Statement (CCCMS).

Additional reinforcement upstream in the network is typically charged using a Cost Apportionment Factor (CAF) where the new asset owner pays for the percentage of the network reinforcement that they will be utilising.

The Electricity (Connection Charges) Regulations 2002 mean when a customer has paid in full for distribution system assets, they are entitled to any future payment should that asset be utilised by someone else. Customers who connect to those assets within 5 years will be subject to a connection charge which is a proportion of their total use of the asset which is paid back as a rebate to the original customer who invested in those assets.Any customers who paid a proportional amount for their required capacity are not entitled to rebates if another customer does connect in the future.

Costs that DNOs incur are paid for by the consumer by electricity bills, so DNOs have a responsibility to get value for money for their investments. This has a downside of restricting their ability to invest in assets as there needs to be guaranteed utilisation to prevent the asset being 'stranded'
Specific prices may vary depending on different factors and an accurate price can only be obtained from contacting UKPN directly.

Table 8: New substation transformer costs, UKPN Connections Charging Statement 2018

Area	Item	Min	Max	Average
EHV/HV Primary substation	New indoor single transformer substation	£2.5m	£5m	£3.75m
	New indoor double transformer substation	£3.5m	£6.5m	£5m
	New outdoor single transformer substation	£3.5m	£6m	£4.75m

	New outdoor double transformer substation	£4m	£6m	£5m
	Add an additional transformer at existing indoor substation	£1.5m	£2.5m	£2m
	Add an additional transformer at existing outdoor substation	£1m	£3m	£2m
132kV/EHV substation	New indoor single transformer substation	£4.5m	£7.5m	£6m
	New indoor double transformer substation	£6m	£10m	£8m
	New outdoor single transformer substation	£6m	£9.5m	£7.75m
	New outdoor double transformer substation	£8m	£13m	£10.5m
	Add an additional transformer at existing indoor substation	£4m	£6m	£5m
	Add an additional transformer at existing outdoor substation	£3m	£6m	£4.5m

Upgrading the network becomes progressively higher as the voltage increases. A typical 33/11kV substation costs costs between £2.5 and £6m, a new 132/33kV costs between £4.5 to £10m depending on the specification.

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