Energy Independence for Southampton

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It is not possible or desirable for Southampton to be truly autonomous in its energy supply. It is inevitable that system security can only be guaranteed with a base of connections to the national grid, augmented by locally sourced and supplied energy. Southampton at the present time relies almost exclusively on power from the national grid and transformed downwards in voltage by the regional DNO (Distributed Network Operator), in this instance Scottish and Southern Energy Networks (SSEN).

The estimates circulated by the recent report on Southampton's energy demand by the University of Southampton's researchers show that, looking at present and likely future demand for power from energy-intensive users in Southampton, combined with likely demands on power across the city as low-carbon electrification of heating and road transport expands in the next decade, power requirements will far exceed anything Southampton itself could produce for local power consumption. Energy independence for the city therefore means that Southampton has, for the next few decades, a secure and adequate supply of power coming from the national grid into the city, and in addition, the best use of indigenous power sources so that this security is enhanced and guaranteed for the future.

Currently, Southampton faces two negatives in this respect: firstly, the present configuration of power cabling coming into the city form the national grid system does not provide adequate power for the reasonable future requirements of both the city's industry and domestic energy users. Secondly, the city has negligible sources of self-generated power available to it, and in any event, what is established (e.g. solar panels on roofs in Southampton) is not organised in such a way that power can be captured for the city's use and instead contributes an unmetered addition to the power going into the high level transmission network.

The purpose of this report, therefore, is to address both issues: what to do about the power deficit that Southampton presently has, and what to do to establish and advance the best possible use of the resources in the city to develop home grown power to add to the security of the system for the future.

Part one: an energy deficit in Southampton and how to resolve it.

1. **<u>The problem: the University of Southampton report</u>**

The August 2024 University of Southampton paper, 'Southampton City Electricity Demand' by Professor Bakr Bahaj and colleagues highlighted that, by 2026 Southampton will effectively 'run out' of power – that the primary substation capacity will be exceeded by the increasing demand for four primary energy intensive users in the city, and power requirement will approximately double above that level by 2035. Power demand overall in the city is likely to be higher than that, since the analysis majored on key energy intensive power users in the city, rather than the overall requirement for the city arising for electric vehicle use and the electrification of heating.

The report also shows that the power demand is not concentrated equally among primary substations in the city. These substations, in Maybush, Bassett, Central Bridge and Western Esplanade are shown to have various levels of overloading coming their way. Three substations, Maybush, Bassett and Central Bridge, are shown to have sufficient capacity to cope with the demands of their supply areas over the next decade, albeit Maybush (supplying the General Hospital) coming uncomfortably close to its capacity limit by 2035. Western Esplanade is, however, likely to become grievously overloaded very shortly. To be entirely accurate, the Western Esplanade area consists of two plants on adjacent sites: firstly, a Bulk Supply Point, from which much of the ports supply is issued, and a primary substation which supplies other users in the city centre.

A strategy for overcoming these identified deficits across substations should therefore concentrate primarily on alleviating the potentially disastrous shortfall in capacity at the Western Esplanade substation and BSP, whilst taking measures developing homegrown power to alleviate the strain on the other substations in the city.

2. **<u>Addressing the problem: substation overloads and new cabling</u>.**

The key starting point, therefore, must be to resolve the crisis at the Western Esplanade substation and Bulk Supply Point to secure the port and other city centre users to ensure a stable and adequate power supply.

Southampton is fortunate in having ample supply of power within a short distance of the city's boundary. The national grid's high voltage (440kv) cabling runs close to the city and is accessed and transformed down to other levels of power (132kv, 33kv and 11kv) from the Nursling high voltage substation. The Nursling substation is 8.8 km from the Western Esplanade substation and BSP, and it is eminently feasible and not hugely expensive to lay a further 132kv cable from the Nursling substation to the Western Esplanade, albeit with some works to increase the receiving capacity of the BSP and Western Esplanade substation. This would resolve the overloading concern at the substation and secure its ability to serve the city centre for several decades.

It is often suggested that re-cabling densely populated areas is very difficult and expensive because of the disruption and disturbance from trenching and works of at least six metres wide. However, Southampton is again fortunate in its particular geography: that is, that most of the length of a new cable into the city centre need not go through densely populated urban land at all. It can be laid from the Nursling substation along the route of the railway as it abuts the (unpopulated) saltmarshes in the Test estuary, and then in the estuary itself once it reaches Totton. The cable can then emerge at dock gate 4 and travel via a short land trench to the substation location behind the Toys ‘R’ Us site on Western Esplanade. Cables of this level of power cost between £500,000 and £1 million per kilometre to install: the total cost of installing the cable and works to the substation would probably turn out at about £5 million.

No feasibility work has been undertaken on a possible estuarine route for a new power cable, and it may be that the combination of difficulty to service, conflict with large vessels in the port area and of ‘re-entry’ from the dock to the Western Esplanade would present insuperable difficulties. An alternative would be to route the cable through the saltmarshes and alongside the railway track (which appears to be an area through which there is an existing cable wayleave), and then into and along the peripheral areas of the port’s estate, which is mostly land set aside for car parking, container stacking or unoccupied scrub. This would have the advantage of utilising virtually no built-up areas other than the edge of the port’s estate, and being in the hands, mostly of one landowner rather than a patchwork of hereditaments.

3. **Stumbling block: new cabling not in the Distributed Network Operators plans.**

New cabling and system enhancements in the UK are contained within successive ‘RIIO’ programmes – a system where both the high voltage grids and the DNOs submit plans at the beginning of each RIIO investment period, which are then set by Ofgem against, among other things, the effect the recovery of the investment cost will have on customer bills. We are currently in the middle of the second RIIO period running from 2023-2027, known at DNO level as ‘ED2’. The main problem with this timetable, however, is that the Distributed Network Operator, Scottish and Southern Electricity Networks (SSEN) does not have a capacity increase for Central Southampton in its established and agreed plans for the ED2 period 2023-2027. There are however extensive plans and commitment within the ED2 period to uprate Southampton’s existing supply system, in the form of aged fluid filled cable replacement (Woodmill Lane) transformer upgrades, the reconstruction of Southampton Central Bridge substation to ensure resilience against flooding, the uprating of the capability of the City Centre Bulk Supply Point and the reinforcement of part of the network in the city through cable replacement. These measures will greatly enhance the resilience of Southampton's system and bring aged equipment up to date but will not in themselves solve the capacity problem in the city centre. However, in the next ED period (ED3) from 2028 to 2033, SSEN commits itself to tackle the issue of capacity in the form of the completion of the BSP and, fairly early in the period (by 2030, to install two new 132 cable circuits from the Nursling substation to the Western Esplanade substation).

In a communication with me, SSEN sets out the work programme thus:

'As part of the ED2 workbank, SSEN is undertaking a phased programme of reinforcement works to strengthen the electricity network between Nursling and Southampton Main (next to Western Esplanade) substations.

The first step, commencing in late 2025, is the transformer upgrade at the existing Southampton BSP to unlock additional capacity. This is followed by the construction of a new 33kV indoor switchroom from mid-2026, designed to enhance operational resilience.

The final phase, starting in mid-2027, involves the construction of a new Bulk Supply Point and installation of two new 132kV cable circuits from Nursling, which will provide a significant uplift in network strength and flexibility.

This programme is based on the current scope handed to the Large Capital Delivery (LCD) team and has been developed in close collaboration with colleagues from Distribution System Operations (DSO), Asset Management, and Connections.

Taken overall, the work programme, as SSEN stated in a recent press release represents a £55 million investment which 'supports greater economic growth and decarbonisation in Southampton'.

What is not clear from recent communications and the press releases is which elements of the programme are confirmed, 'in the bag' and proceeding according to what has been agreed for SSENs work in the period of ED2, and what is more speculative and may have been submitted for approval and action within the ED3 period.

What the programme does look like upon closer inspection is a programme of work split between the two periods: ie a modernising and reinforcement programme in ED2 that is timely but not in the right place, and a projected programme that is in the right place but is not timely. In that if it does go ahead, it will be perhaps 2030 or so before it can be said that Southampton will have resolved its capacity problems in the longer term: five years at least after the University of Southampton report points out that the city centre substation will be overloaded beyond repair.

It is not entirely clear whether elements of the re-cabling programme are in place now, or whether they are all subject to the review process now underway for ED3. This is important because DNOs, essentially proposals that a DNO makes for the next period (ED3 from 2028 to 3033) are not certain and finalised: they will usually consist of a programme of works submitted by the DNO that will be examined by Ofgem and then mediated against the effect that such proposals have on the element the DNO can recover through levying its proportion of electricity bills for the period.

It is already known that SSEN has neither submitted nor has been authorised by Ofgem to pursue any substantive additional capacity work in Southampton in the present RIIO/ ED2 period. There is, however, a provision within the RIIO process, called a 'reopener' whereby, if a case is made for additional works because of emergency, the work can be retrospectively included in the RIIO settlement. In this instance this might involve making a case that capacity upgrading should take place within the period of ED2 and not after it – perhaps bringing the work forward by three to four years, and importantly establishing it as a certainty within the ED2 period, and not as a possibility in the period subsequent.

The first priority, therefore, is to put a case to SSEN that the establishment of a further high-powered cable into Southampton is now an emergency, and that the network should pursue it with Ofgem through a Riio ED2 'reopener'.

Further discussion and clarification with SSEN recently suggest that this now is what SSEN propose to do: that is to bring the installation of two 132kv cables into the current ED2 period through including them in a 'reopener' application to Ofgem. This would of course be dependent on the completion of Bulk Supply Point uprating. This is a very encouraging development, but we are still yet to see this process in action, and there is still the possible point that Ofgem will refuse to sanction the 'reopener' application.

Continuing close dialogue with SSEN to ensure that the 'reopener' is successfully lodged will be necessary, together with possible consideration of a direct case from Southampton to Ofgem that the 'reopener' case is vital for Southampton's future energy security.

4. Getting round the DNO's investment problems: an alternative approach.

The present position of SSEN concerning new cabling to the city centre is reasonably encouraging, albeit far further away in execution than we might like, and there is the question still to be resolved of the priority SSEN might place upon capacity upgrades in their submissions for ED3. There is also a consideration to be had of the stance Ofgem might take on submitted plans. If the worst comes to the worst, and we cannot firm up plans for progress through SSEN's good offices, there is a possible alternative way forward to consider.

The relatively short distance that the cable would be required to travel makes it a possible candidate for a development by an Independent Distributed Network Operator (IDNO).

IDNOs are licenced and regulated by Ofgem in the same way as the main distribution networks but mainly to perform a function at the end of network connections. Typically, the IDNO will assume responsibility for the laying and connection of cabling for developments such as new housing estates. They will lay the cabling as an investment and will receive income from the result through carriage charges from the substation to the estate subsequently. So-called 'last mile' provision is now substantially established in the UK and is now responsible for grid cabling and connection for most new estate-sized housing developments. This is undertaken by several independent grid operators and essentially, they contract to establish a connection and run it as an initial investment expense.

IDNOs have markedly increased their range of cable laying activity in recent years, and several now have 132kv cables in their portfolios. Currently, an IDNO is involved in laying a 57-mile cable in Wales with Ofgem approval.

It would be possible for the city's council, or a Southampton consortium to act as the client for a commissioned IDNO cable laying project, which could take place entirely outside either the RIIO or the reopener process. In principle, the capital for the project would be raised by the IDNO agreeing to lay the cable, although there may be a question of some joint capital raising because of the large scale (in IDNO terms) of the proposal.

A problem that would likely arise in this instance, however, is that, as it stands, a cable would be laid by an independent operator connecting to two points controlled by the statutory DNO, making it very difficult to operate a complete carriage charging regime through the IDNO. It would be necessary to purchase or lease the Western Esplanade substation for SSEN to deliver a complete 'mini network' for the IDNO to control and operate. Whether this could be financed through the 'last mile' operation itself or might need to be separately negotiated with the network operator is unclear at present, as is the likely added cost of the purchase and strengthening of the substation to make it all happen.

It would be prudent, in addition to an approach to SSEN, to investigate how an alternative IDNO project could work, and pursue some preliminary soundings with possibly interested companies.

Part two: Establishing and capturing locally produced power.

1.Enhancing cabling and connectivity in the city: Grid mesh arrangement.

Before any locally produced power can be captured effectively in the city, it will be necessary to have a means to channel and distribute local power locally, either by private wire arrangements or by a grid mesh An important part of both would be a new feed into the city, and the harvesting and retaining of city power provided from local installations (see also below) would be the establishment of a local grid mesh. This is a premise already being undertaken by the city's energy manager in conjunction with Energy Southwest and Regen. This seems to be progressing in conjunction with plans to extend rooftop solar in the city, particularly through extended installations on city council-owned buildings (e.g., schools.) It is not clear what this ambition consists of in practice.

The 'energy mesh' arrangement at present falls foul of site development regulations: but Elexon has recently progressed a code amendment (c441) for 'complex sites' which would enable this to happen. I have been trying to find out what progress is now being made with the establishment of a code amendment, we may have to approach Elexon to find out.

A method of storing likely variable local power is important and can be achieved through the substantial establishment of batteries in and around the city. It is not clear to me how much benefit could be obtained by installing load shifting measures through batteries (i.e. storing power overnight when demand is low and releasing it - hopefully through local grid mesh arrangements) although this could be considerable in circumstances where large 'slugs' of power are needed intermittently such as shore to ship power for visiting vessels and cruise ships in the port. There are already in existence container-based battery installations able to do this – e.g. the Chinese/American company Maxxbox supplies portable containerised batteries able to supply shore to ship power, a principle which could be extended to other intensive power users such as the General hospital.

Xenobe batteries supplies large installed (50mw) batteries for high energy users such as electric bus charging at bus stations and several have been installed as we've seen in Guildford.

Pivot power received the go-ahead to install a 50mw battery storage system at the Nursling substation in 2019. It is not clear what happened to this, and whether if it is up and running (there are contradictory indications in various posts on the project since then). If it exists or will exist in completed form at Nursling, it could be used to help enhance the resilience of the Southampton system, or similar battery storage companies could be invited to establish sites closer to the city centre (Western

Esplanade or the central bridge substation). The port is apparently investigating whether a 50mw battery system could be installed on port land, which if established and connected to private wires channelling power retained locally, could have a substantial effect on the management and development of power needs in the city centre over and above what might arrive in the form of additional capacity at substations.

Supporting the installation of several large battery sites in the city could have a real effect on mitigating the need to strengthen further, particularly in those areas coming close to capacity, although I am not clear to what extent. Modelling the real effect of such installations on overall loads on the existing system could be important. Local battery installation would certainly assist with the resilience of substations that are likely to run close to their margins but not overloaded, at this time.

2. **Indigenous power sources in Southampton.**

There is then the question, alongside these measures that strengthen or diversify grid connections to the city, of whether the establishment or extension of a number of primary energy producing sources could effectively secure 'energy independence' for Southampton, provided the product of such primary sources could be captured for the city and not nationally dispersed.

There are several possibilities in Southampton: projects ranging from the near-achievable on present resources, to fairly wild speculative schemes that may or may not work and are likely to be very costly.

The leading realistically achievable opportunities to do this are:

1. **Establish a city-wide solar roof programme with an aggregating company retailing collective output**. The beginnings of this potential programme are being investigated by the city already but may lack ambition or aggregation opportunities. An ambitious programme would include city council owned buildings, higher education establishments, Southampton General Hospital, commercial premises in the city, the development of solar roofs on city carparks and so on. Utilita, a national retail energy provider, based in Chandlers Ford, are looking to diversify and have established a solar installation division, and could be a dedicated partner to the city in this endeavour. City institutions such as the University of Southampton and Southampton Solent University are keen on this development.

An important consideration for this possible programme is the role Great British Energy, and its community programme, which might assist development (see note at end).

2. **Establish some local onshore wind in the city.** Recent legislative changes have re-established onshore wind in England as a permissible and viable proposition and subject to planning with no greater obstacles than other capital projects. Onshore wind is now eligible for support under CfD allocation rounds. An installation of perhaps three medium sized turbines on the best windy location in the city, the tip of the eastern docks, would in principle now be fairly straightforward: permission would be granted by the landowner ABP; planning would and could be expediated through the city planning arrangements and a developer such as RES (with an onshore track record) could come in with high confidence that the project could succeed and be fundable through an allocation round bid. It is worth noting that because of Government imperatives on a low carbon energy economy, allocation rounds will now be far better financed, and most bidders will receive assistance. AR6 was funded with almost £1.5 bn for CfDs, and AR7 is likely to have an even higher level of 'pot' funding in the future.

3. **Refurbish and uprate the city's geothermal energy plant, and link existing CHP plants across the city.** The geothermal plant, which has been operational since 1984 supplies (mostly) heat to a number of institutions across the city via an 18km heat main. However, the original bore through which heat is obtained (at about 71°c) was never designed for commercial production and is too small and shallow: the bore goes down to about 1800m - a further few hundred meters would yield water at nearer 100°c). The district heating company, Equans UK, which pursued a very conservative course in its management of the plant has been taken over by Shroeder Greencoat, along with 11 other heat systems across the UK. The company is ambitious for the future of their new acquisitions and have relatively deep pockets for investment. A good investment into the Southampton plant would be the reboring of the well on Western Esplanade (together with a modern return pipe) so that a larger and deeper source was obtained. Water in greater quantity and at a higher temperature would mean that a substantial electricity producing facility could be introduced to the scheme without compromising heat distribution. I understand that the new owners of the plant are actively considering a rebore, although it is not clear yet whether the city council is either in support of this or is willing to engage in active partnership in any further development.

Separately, work has been undertaken on the possibility of joining the various CHP plants and networks in the city (the university, hospital and city centre) to create a mutually supporting 'heat loop' across the city. Achieving this would be advantageous for all heat networks and would allow for the development of more connections with reliable backups. It would be possible to obtain assistance for this development through new heat network finance now becoming available.

A more ambitious but also possibly fundable development of the heat and power network would be to establish a cross Solent heat pipe to capture the abundant and currently unused waste heat from the Marchwood incinerator. An under Solent pipeline, which would cost between £1-2 million to complete would travel a relatively short distance and would incur very little heat loss in the process. This could be very practical in the event of a CHP system link: making the system very reliable and completely independent from gas inputs.

4. **Install a hydropower plant at Woodmill on the edge of the tidal part of the River Itchen.** Some plans for this were drawn up about fifteen years ago but have never been progressed. Matters have changed in recent years because the bund that holds the flow in above tidal level through the mill pool has deteriorated and requires replacing. Stewardship of the bund itself has now (recently) been transferred to Southampton City Council from the Environment Agency. Grants are likely to be forthcoming for the replacement of the bund wall, and it would therefore be relatively cost effective to install one or more turbines alongside the restoration process. The Woodmill site has, however, been recently sold to Southern Water, but this should not detract from the wisdom of carrying out, in conjunction with them, a combined environmental strengthening and hydropower project. Whilst the power output of such a scheme would be modest it could represent a useful addition to power independence and may well be eligible for further funding support through the community arm of the recently established Great British Energy (see below), A model of how this might be done successfully already exists in the form of the Oxford Community Hydro scheme which might be worth a visit.

5. **A tidal low/barrage on the River Itchen estuary.** A far more ambitious hydro installation could be achieved in the form of a mini barrage on the tidal Itchen roughly sited in parallel with the Itchen Bridge (or perhaps more fancifully suspended from the railway bridge further upstream). A barrage of the lower Itchen could be 'sold' and at least part financed by flood protection measures for the estuary to guarantee and extend the limited measures undertaken in St Denys.

All these projects can produce reliable power from within the city with the means to distribute it locally. The projects may in some instances, be entirely fundable by commercial investment (onshore wind for example), and others with a combination of private sector investment and public sector support. In this context, it is important to note that the landscape for such projects has fundamentally changed in recent months with the establishment of a national body that can both supply funding and advisory support for local energy projects: indeed, some local authority areas in the country such as the Greater London authority, have already assessed locally viable projects and notified GB Energy of their existence. It is worth therefore considering what progress has been made with the establishment of GB Energy, what it might do to support local and community projects, and how Southampton can access its provisions.

A note on Great British energy.

GBE has now been established by Act of Parliament. According to its founding document:

‘It will be a publicly owned energy company, designed to drive clean energy deployment, boost energy independence, create jobs and ensure UK taxpayers, billpayers and communities reap the benefits of clean, secure, home-grown energy. Setting up Great British Energy is one of government’s first steps for change and we will do this in a way that means it will have both an early impact and long-term success.

Through its five functions, Great British Energy will speed up the deployment of mature and new technologies, as well as local energy projects, to support the government’s aim of decarbonising our electricity system by 2030 whilst also ensuring we can meet future demand as we further decarbonise the economy.’

One of the five functions set out in the founding document concerns local and community energy which the founding document describes thus:

Local Power Plan

Local power generation is an essential part of the energy mix, ensuring communities own and benefit from clean power projects, and reducing pressures on the transmission grid. Great British Energy will provide support to deliver the Local Power Plan, putting local authorities and communities at the heart of restructuring our energy economy. The plan will give them a stake in the transition to net zero as owners and important stakeholders in local clean power projects.

Through partnering with and providing funding and support to Local and Combined Authorities and Community Energy Groups, the Local Power Plan will roll out small and medium-scale renewable energy projects, using established technologies, to develop up to 8 GW of cheaper, cleaner power. This will include shared ownership projects in partnership with private developers. This will support a more decentralised and resilient energy system, with more local generation and ownership.

The Local Power Plan will help crowd in investment while ensuring benefits flow directly back into local communities. This increased investment will create thousands of skilled, clean energy jobs across the country and change communities for the better.

To support local and combined authorities, and community energy groups in accessing funding, the Local Power Plan will also provide commercial, technical and project-planning assistance, increasing their capability and capacity to build a pipeline of successful projects in their local areas. The Local Power Plan will ensure there is coherence with other existing public sector advisory functions, funding and finance organisations operating in the local energy space, such as the UK Infrastructure Bank.

A national and community component for partnership investments in its constitution. Something like £1.3 billion of its £8 billion founding capitalisation has been allocated to go towards community and local energy initiatives. One stipulation of this investment is that it should go to community owned projects (which will encompass a fairly wide range of local authority and community owned ventures). Some, or all of the schemes proposed here would qualify for substantial support from GB Energy if they are set up in the right way. We should urgently investigate how this might be achieved in Southampton.