

a return to the local energy economy

capturing the value of decentralisation

executive summary

Grid-based electricity has driven the industrial, commercial and technological revolutions of the twentieth century. However, twenty-first century concerns about geopolitical instability, fossil fuel depletion and climate change all suggest that we cannot continue to take our national electricity supply for granted. A seismic shift in the assumptions we make about energy provision is imminent, and in order to protect our future we need to take action, not in ten or twenty years time, but now.

Expert opinion is divided as to whether or not the planned additional UK capacity to be built over the next five years will be sufficient to meet demand, as older power stations are taken off the grid. Current measures to reduce consumption, driven by carbon and cost-cutting agendas, may help to nudge down demand and so avoid power shortages, but the

risk remains high. If the grid cannot cope, domestic users and essential services will take precedence over private and public sector organisations. Large energy users that want to guarantee their energy resilience from 2015 onwards will need to provide themselves with alternative sources of supply.

In the decentralised energy economy, low-carbon generation technologies are deployed for common benefit across broad energy communities with a diversity of users and interests.

This paper demonstrates how these sources can, in part, be delivered through locally based decentralised generation schemes. It looks specifically at ways in which organisations can benefit themselves and their surrounding communities by developing decentralised energy strategies

based on bespoke local energy infrastructures. This is not just a knee-jerk reaction to a potential threat: it is key to long-term economic and environmental sustainability.

In the decentralised energy economy, low-carbon technologies are deployed for common or mutual benefit across more than one type of property and different users with diverse interests. There may be a variety of generation inputs as well as the opportunity to sell surplus electricity back to the grid. In the short term, this will enable organisations to meet obligations and earn incentives through carbon reduction. In the longer term, there will be benefits of energy security and resilience required to meet the challenge of a national grid under increasing pressure. The economic models for decentralised energy provision are increasingly attractive, with new approaches being applied and validated across every sector.

the future of the grid

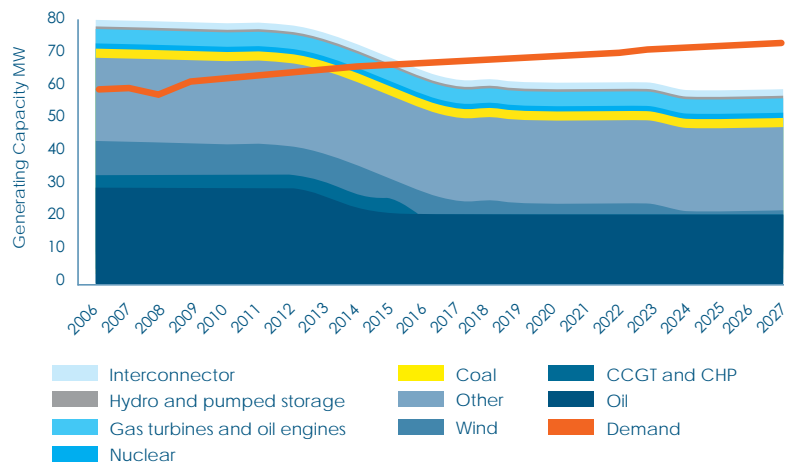
Grid electricity has been the hero of 20th century economic power. The development and commercialisation of AC power transmission from the 1880s led the way to exponential industrial and technological growth, made possible by seemingly endless, cheap supplies of electricity from national grid systems. The grid was good: it enabled the economies of scale for base load, and cheap imports to meet peak demand.

There are many reasons why, today, the grid seems altogether less heroic. The knock-on effect of fluctuating oil and gas prices has made electricity a generally more expensive commodity, with little forward cost certainty. The climate change movement has highlighted the vast carbon dioxide output of fossil-fuelled power stations, the heat squandered through cooling towers, and the amount of electricity lost over long-distance transmission. As the Decentralised Energy Knowledge Base says, "the developed world is currently dominated by a centralised electricity generating system, which is the embodiment of technological inertia, performing little better today than it did in the 1970s".¹

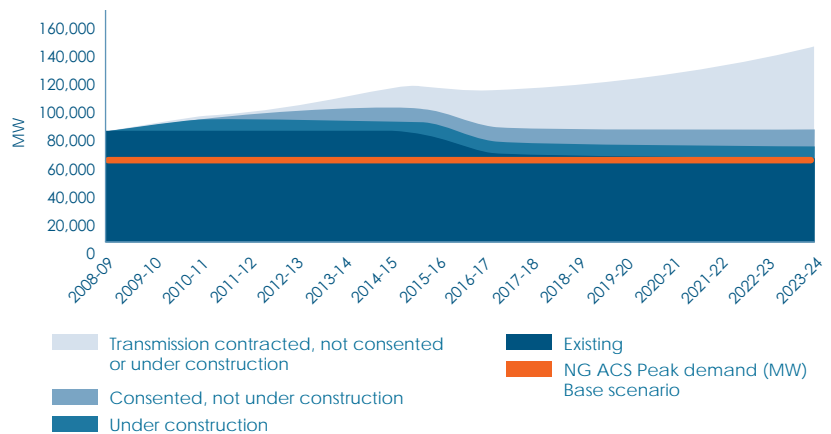
Fossil fuels are an increasingly risky basis for the long-term provision of energy, as supplies diminish and exploration extends to more difficult, hazardous and uneconomic reservoirs. The disaster in the Gulf of Mexico jolted even the energy-profligate US into some realisation of this. The only large-scale alternative to fossil fuels for electricity generation is nuclear, which will always remain a disputed option, whatever a national government's policy might be. In the UK, nuclear power remains a significant element of the strategy to replace our ageing estate, along with cleaner, more efficient conventional power stations.

Figure 1: two alternative supply and demand scenarios

Scenario A



Scenario B



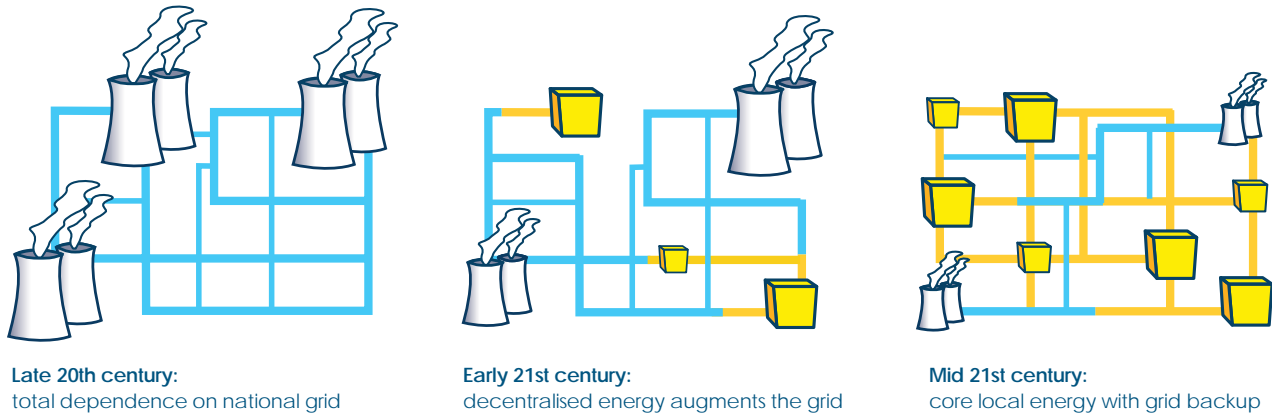
It seems increasingly unlikely, however, that the building programme will be sufficiently advanced to meet the deadline of 2015, when five of our 14 coal-fired stations must close to hit European environmental targets.

so will the lights go out?

It depends who you believe. Energy business analysts Douglas-Westwood, in their UK Power Generation Expenditure Forecast 2010-2030,² (Figure 1, A) claim that the closure of current nuclear and coal power stations is set to create a power shortfall as early as 2017. The Energy Market Assessment published jointly

by HM Treasury and DECC in March 2010, and based on data from DECC's Energy Markets Outlook December 2009,³ (Figure 1, B) suggests that existing capacity will still just about cover peak demand by 2017. Thus, the report argues, supplies will be sufficient, provided that at least some of the capacity under construction, consented or contracted comes on stream. Against this, Ofgem's Project Discovery report (February 2010)⁴ said that energy companies may need stronger incentives before committing the £200bn needed to develop enough new capacity by 2020.

Figure 2: decentralised energy: reducing dependency on the grid



The overall view would have to be that the current and planned building programme may not be sufficient to bridge the gap, and that vulnerability to imports could also contribute to a situation where power shortages occur. Under these circumstances, domestic users and essential services are likely to be protected, but private and public sector organisations may find themselves on rota, or losing supplies at times of peak demand. Large energy users would therefore be wise to assume that traditional national supply infrastructures may not be able to meet all their needs in the medium to long term. Resilience, meaning the capability to absorb possible disturbances to energy provision, will be achieved partly by reductions in demand, but mostly by alternative sources of supply. One such source will be local energy provision based on decentralised energy infrastructures.

Private and public sector organisations will need to achieve longer term resilience partly by reducing demand, but mostly by securing alternative sources of supply. One such source will be local energy, generated by decentralised infrastructures.

what is decentralised energy?

There are many definitions of 'decentralised energy' or, as it is also known, 'distributed energy' or 'embedded generation'. The Business Taskforce on Sustainable Consumption and Production,⁵ convened by DEFRA and the DTI, suggests that it encompasses "the wide range of technologies that do not rely on the high-voltage electricity transmission network or the gas grid". The Taskforce includes all plants that are connected to a distribution (local, low voltage) network rather than the transmission (national, high voltage) network, and supply electricity to a building, a complex or portfolio of buildings, or a community. Decentralised energy installations might include, for example, a combined heat and power plant serving a commercial building; a waste-to-energy system using household refuse or industrial waste as fuel; a gasification plant burning sustainable biomass; or a small-scale wind turbine installation.

Decentralised energy is progressive and exciting because it will allow organisations and communities to thrive in the future by taking greater control of their own energy provision - creating economic as well as environmental sustainability.

Ultimately, one can envisage a situation where the main sources of energy can become local, with grid supplies reserved for contingencies (see Figure 2). Despite this, the UK's use of decentralised generation currently lags behind both Europe and North America. The government has, however, now provided strong incentives for growth through the Feed in Tariff (April 2010) and the Renewable Heat Incentive (April 2011).

Decentralised energy encompasses a wide range of generation technologies that supply electricity to an organisation or community through a low-voltage, local distribution network, rather than the high-voltage national transmission system - enabling them to take control of their own energy provision.

The decentralised energy economy is driven by innovative infrastructure that uses established and emerging technologies to maximum advantage. Most low-carbon technologies, in fact, have been in existence for years: wind power, solar heating, heat pumps, thermal treatment of waste, biomass boilers. Improved product development means that they are

now able to deliver much higher levels of efficiency and economy. Different technologies and approaches are often sponsored and promoted by different stakeholders, making it difficult to determine the best way forward. The main contribution of specialist engineers, therefore, is to evaluate the specific site, organisation and community opportunity, and to select, combine and customise the most appropriate technologies to meet the need.

communities and energy centres

In order to appreciate the full potential of decentralised energy it is important to understand the idea of an energy community. This is not necessarily a community in the social or cultural sense (although it may be): the concept applies to any group of buildings and their occupants that can benefit from a shared local energy source. In the simplest terms, for example, a local authority housing estate in Gloucestershire forms a natural energy community, which is now being served by an advanced ground source heat pump system that will deliver warmer homes, cheaper bills and lower carbon output. On a much larger scale, a district heating scheme in Scotland, based on a biomass-fueled CHP plant, will cover around 1500 existing and new homes and other commercial properties in its first phase alone. Most universities are already energy communities, with energy centres serving academic, administrative, social and accommodation buildings across the campus.

The decentralised generation technology does not necessarily have to be onsite. By combining the energy requirements of three schools in Derbyshire, and thus forming a consuming community, it was possible

how decentralised energy works in practice

Decentralised energy schemes can range from renewable generation for a single building to a large energy centre serving an organisation and its surrounding community. Here are a few examples.

NHS energy efficiency for 15 years

A major London hospital required a low-carbon energy centre to be developed at minimum financial risk to the NHS Trust. The centre delivers guaranteed savings of £15m over 15 years - the equivalent of 822 kidney transplants - and exports surplus energy to the local community.

Offsetting wind energy for schools

Funding for new school buildings depends on meeting carbon reduction targets. A small-scale wind farm generates 300,000KWh pa, offsetting enough grid supplies to meet the energy needs of three schools. This saves enough carbon to offset 750 average school runs.

Biomass energy for a retail store

A biomass fuelled onsite energy centre will supply a new supermarket, saving £1m in costs, 90% of grid electricity and 85% of gas, with no capital investment. Surplus energy worth £1m will be exported to nearly 100 homes. Similar energy centres can be rolled out across the estate.

Renewable energy for new build

A prestigious new office building in a historic town centre required 10% renewable energy generation to meet planning guidelines. The bespoke ground source heat pump system fulfilled the requirement and the installed system has exceeded predicted energy efficiencies.

to create enough energy demand for a viable small-scale wind farm on an advantageous site in the south west of England. The electricity generated by this installation offsets the grid supplies used by the schools, enabling them to meet low-carbon energy targets under the Building Schools for the Future programme.

The greatest advantage comes, however, when the infrastructure is centred on an efficient, low-carbon energy centre providing secure, predictably-priced energy to a private or public sector organisation, with surplus heat or electricity going to the local community. The model is equally effective, whether the core user is an office, manufacturing or retail enterprise, a government department, a hospital or a community college. One major London NHS trust is already developing a scheme of this kind, which will generate revenue for the hospital while reducing heating costs for social housing tenants and carbon emissions for the local authority.

the economics of decentralised energy

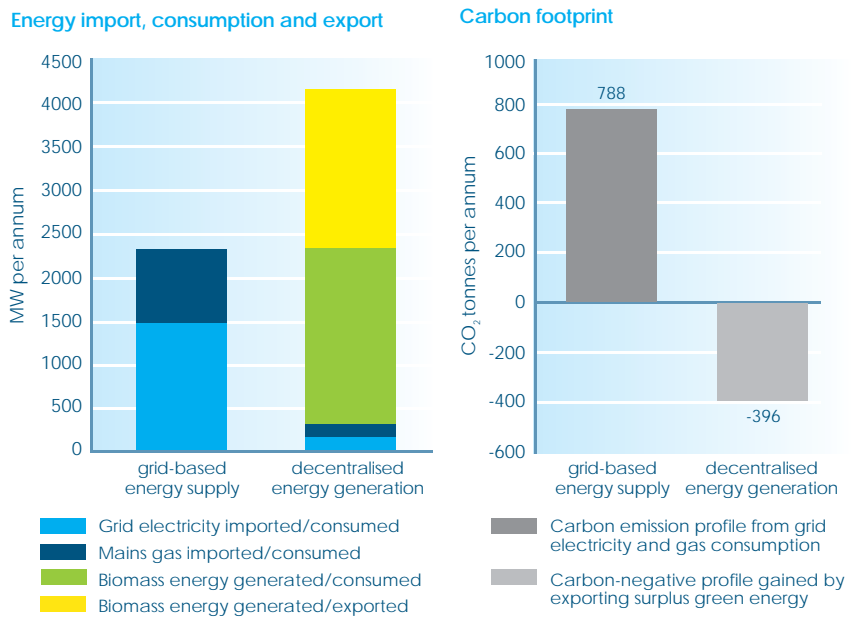
Energy provision is traditionally based on two separate transactions: buying electricity or gas from national utility companies; and procuring the equipment, systems and appliances that convert the energy and deliver it to the building, as heat, cooling, light or power. In addition, many organisations are now involved in a third transaction - the acquisition of their own on-site, low-carbon generation equipment. What most energy users actually want, however, is a single commodity: defined energy output that is sufficient and flexible enough to meet their needs, with guaranteed cost savings and availability over a sustained period. Decentralised energy enables

this, because the infrastructure is developed to meet the precise requirements of the core organisation and its associated community, in the most efficient way, using the most appropriate economic model.

Availability-based contracts, for example, are attractive because they transfer the risks of owning and operating energy infrastructure from the user to the provider. The user pays only for the output created and actually used, while the provider develops and supports the assets throughout their lifetime. For organisations that do wish to invest in their own assets, performance-based contracts guarantee that the plant and equipment will achieve predetermined outputs in terms of cost, carbon savings or other measures. The provider will normally recoup the capital cost through a unitary charge, with efficiency savings often being used to offset part or all of it.

Models of this type are demonstrated through, for example, a partnership to develop a biomass-powered energy centre for a new supermarket store. Under an energy services contract, the retailer will purchase the store's energy requirements from the energy centre provider, and will sell surplus heat to the local community (see Figure 3). In another case, a joint venture has been established to develop an energy centre processing waste wood, with the electricity and heat generated being sold to a local manufacturing plant under a ten-year agreement. Such

Figure 3: comparative energy scenarios for a 2000m² store



negotiated contracts move away from the old short-term approach of minimising expenditure at the point of procurement, through tariff deals and lowest-cost contracting. In the new decentralised energy economy, the emphasis shifts to achieving planning and budgeting certainty over the full contract term: best value, rather than lowest price.

conclusion

It is well recognised that we need to make a significant transition in the way we deploy core energy resources, to safeguard supplies for the future as well as to protect the planet. Decentralisation creates the opportunity to break the mould, establish new, sustainable ways of generating and consuming energy, and share the benefits. The technologies exist, and are proven in action in thousands of installations across the UK.

Although many communities are making their own progress towards local energy sustainability and resilience, the participation of larger organisations will accelerate the process, by creating a critical mass of demand that justifies the investment in decentralised infrastructure. Those organisations that contribute most to the solutions, by developing schemes that can be shared with local communities for mutual benefit, will find themselves best positioned to thrive in the future.

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