Future System Operators Regulatory Environment- Dr B Murray 4/1/2024

I would like to make comment on your proposal regarding the future role of the system operator. My background was as the System Control Development Manager, a senior manager at the national control centre where I led on the development of the control function facilities exploiting new technology. This paved the way for unifying system control into one national centre based on a new IT infrastructure that I was responsible for developing.

My perception of the current situation is that the power sector faces a major change with no apparent overall leadership direction. The impression now appears that anyone can connect to the grid and supply and buy energy without restriction. A massive increase in wind power is planned that is both less predictable and not synchronous, at the same time the capacity of conventional generation is being depleted making system frequency control increasingly difficult. The depletion of synchronising energy makes the system more susceptible to any disturbances. The system demand is expected to rapidly increase with the take up of EVs with charging requirements that are not coordinated. At the same time weather patterns are changing and becoming more extreme and less predictable.

I believe there is a strong case for establishing a more coordinated approach to using energy that will minimise costs and disturbances. This will be most effectively realised through exploiting the developing IT based communication infrastructure and engaging with end users to support and enable their involvement. The basic concept is to manage the demand side to match the less predictable energy supply patterns. The role of National control would be to make available the data streams of the predicted generation and demand streams to enable end users to respond to minimise their costs. Some canny end users are already controlling their demand to minimise costs. The technology is available but most end users will need a more simplified user interface. Octopus energy have already engaged in experimental tariffs to reward consumers who reduce demand at peak times. Other suppliers may follow suit but the overall direction needs to be coordinated centrally and this can only be enabled with the input of the National Control centre. It would also need to be location specific taking account of any local network constraints and wind and solar generation patterns. I believe national control is the only location that has the facilities and capability to implement the role of overall demand and generation control. The development of the process and facilities needs to start now as the renewable generation and EV demand continue to grow and Ofgem has a role to support the FSO in facilitating coordinated demand control.

I have undertaken a series of national UK power system studies to indicate the feasibility of the proposed approach. In particular it illustrates matching a future tranche of EV charging to the prevailing wind output based on recorded wind data. It shows there was sufficient wind to always charge your car provided charging points are widely available. The charging periods would be automatically linked to the prevailing wind generation. This has the important advantage of stabilising the demand on conventional generation avoiding frequent load changes. A requirement is the establishment of widely available charging points at work and home. The incentive for the end user is the lower costs of charging energy. The role of National Control would be to provide the data stream of expected wind/solar generation that would also take account of physical location and expected EV demand in an area. The role is analogous to the normal role of matching generation to meet demand but in reverse. The requirement is to establish an IT data stream from the FSO to enable end user participation.

Proposed Process

A process needs to be established to facilitate end user participation in managing their demand in the short term to take advantage of periods when there are high levels of renewable generation available and prices are low. This will include:

(1) Future wind and solar generation output profile is predicted by the FSO on a zonal basis in the medium and short term with input from the met office.
(2) Area Boards maintain records of controllable demand including connected EVs and heating and hot water systems that have agreed to participate in remote control.
(3) Area boards advise the FSO of consumer demand available on the day to participate in remote control taking account of any current network constraints.
(4) The FSO advises on the expected wind and solar generation that may be made available in each area board taking account of any HV network constraints.
(5) Consumer demand switching is directed by the area boards in accordance with the outturn wind and solar generation to affect a balance taking account of constraints.

The indefinite nature of the process will need to be managed in real time by regulating conventional generation but it is expected that this can be minimised as the process develops. There may be a case for storing energy on a short-term basis to manage errors in prediction. There is also the option to regulate export energy particularly at times of low demand. It is considered that a centrally coordinated approach, involving end users, is essential to manage the intermittency of wind and solar generation and enable its full exploitation at least cost.

A key component of this proposal is the availability of connection points for EVs. Having a charging point at home will be an option for many people and would facilitate overnight charging when conventional electricity demand is low. With the increasing proportion of staff working from home several days a week this will be less of a problem in future. There is also the option for charging facilities to be made available at places of work. In the home there will also need to be the option for appliances like heating and washing machines to take advantage of periods of high wind capacity and low electricity rates. Plugs with remote switching capability are currently available to support this process. Car charging will become less of a problem when users gain experience of the required frequency of charging.

Table 1 includes figures of a recent survey of the annual mileage of UK vehicles. It shows that for all car/taxis the total annual mileage is 278 billion miles a year. Based on a Tesla EV with a capacity 80kwh and a gross energy use of 0.4328 kwh/mile the energy use for 278 billion miles = 121 billion kWh/year or 121TWh/year. This is a good match for the expected annual output of the planned wind generation during the next decade of 131TWh/yr.

Table 1 UK annual traffic mileage

Vehicle	Car/taxi	Light commercial	Heavy goods	Motorcycles	Buses	all
Billion m/yr	278	53.5	17.4	3.0	2.4	356.5
Vehicles k	31,619	4,097	416	1,304	123	38,157
Miles/car/yr	8,800					

Assuming 10 million cars are converted to EVs by 2030 each with a capacity of 50kWh then based on the estimated average usage/day of 10 kWh (25 miles) the recharge requirement would be **100GWh/day** i.e. 4GWh continuously. This compares with the average continuous wind energy output expected by 2030 of **260GWh/day** (10.8GW/hr).

While the wind output is variable from day to day in the UK it is rarely consistently low and exceeds the car average charge estimate of 100GWh/day in this assessment other than a few periods of two to three days. The situation will improve with more off shore wind and **compares favourably to a requirement of 100GWh/day for 10m cars in this initial assessment.** Conventional batteries could also be used to support the process.

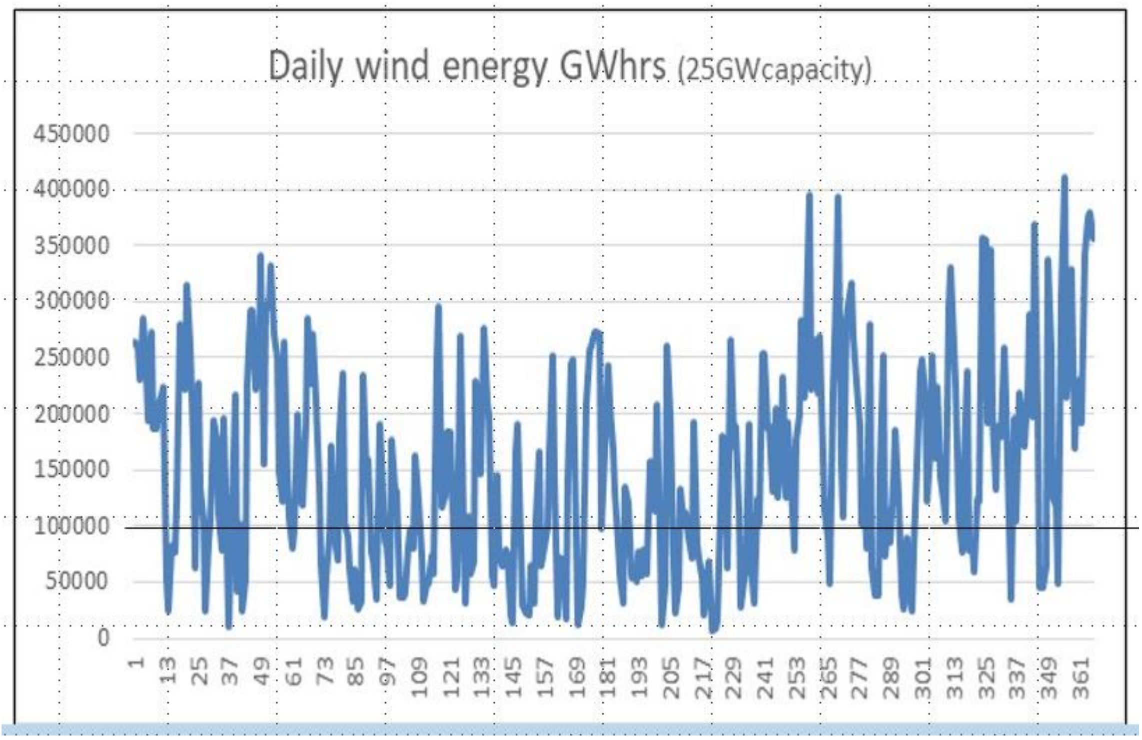

Figure 1 Historic UK wind energy profile

With 15GW of average wind output expected by 2050 there is capacity to meet the charge requirements of all car transport based on EVs equivalent to 13.8GW continuously. A key requirement will be the provision of charging points both at home and the workplace as well as fast charging points at garages.