Electricity Balancing SCR - Response to initial consultation

I write as a member of the public who has some background knowledge of the UK electricity supply network, and seek that legislation does not prohibit small scale renewable generators and households from contributing to the security and stability of electricity supply.

Your report looks as though it were written by economists and commodities traders, so I will attempt to explain terms used in this submission and apologise to electrical engineers who can skip those sections explaining terms which they already know much more than I do about. I will aim to state what I can see from local measurement, and state what information I or my computer would need to make optimal demand and supply decisions.

One of the first principles of a truly free and open market which allows participants to make optimal decisions is publication of a price and a price forecast. That can be done, for example as at www.aemo.com.au

I have not found a UK spot price, and nor have I found a UK utility company who have in place a supply agreement for one household on a single phase which makes the spot price applicable to me and effective in guiding electricity decisions which I make. All utility companies appear to offer are various complications based on a flat rate throughout the day, which gives me no preference to correctly set demand managed appliances or controllable renewable battery generators. A solution of the 1970‘s was to meter daytime electricity separately to nighttime electricity which was much cheaper. Now that a competent internet computer is available, one can envisage a local calculation of by-the-second power metering in units of kJ multiplied by an automatically supplied and authenticated chart of p/kWh from which the by-the-second local spot price was calculated, and integrating kJ/second over each half-hour period, to result in a price in pennies per half-hour period computed.

All that the utility companies want to know is how many pennies of electricity did my house use that month, so there is no reason to send them any more than a short message saying that, plus authenticity codes so that they know that I had not tampered with the spot price data. I would need such a meter to make a copy of the local spot price and forecast which can be sent to other devices which I am developing. If it is not economic to meter my house in such detail, then read-only internet access to a file on my nearest internet enabled street transformer could work.

Suboptimal Decisions as a result of time independent pricing

My house is a net generator in most weeks of the year. That is mainly from an always-on silicon photovoltaic array and inverter, and is assisted by a few extra solar photovoltaics which I have connected in. Household usage of appliances is ordinary for a 3 bedroom house with typically 3 occupants. It has not escaped my notice that of the 70 to 80% of electricity which is generated and immediately exported, we get an unmetered deemed export rate of 3p for 25% of the electricity generation shown on the photovoltaic generation meter. That is about 1p per kWh of exported electricity. It is not in my interests to export electricity at 1p / kWh and at other times buy electricity at 13p/kWh. Therefore all of the investment of a rational self-interested household should be aimed at decreasing imports of expensive electricity, possibly by decreasing unmetered exports.

At the time of writing, I am thinking about how to configure my household electricity market participation to be closer to the UK optimal than would be for local bill reduction alone. That is, I am largely ignoring present day pricing structures and thinking about what we would need to set the household to contribute to optimal operation of the electricity network rather than selfish bill minimisation.

With a flat rate all day for the cost of imported electricity, I pay less if I can time household loads to be on while the solar panels are generating. I expressed this as an instruction which my mother tends to follow; “if it looks like its turning into a lovely sunny day for the washing line, that’s a good time to start the washing machine”. I also preferentially use the vacuum cleaner, the oven, the lawnmower, and larger computers in the daytime. From the point of view of national supply, that is probably much worse than doing those late at night, but the billing structure guides the rational household towards what is best for their bill, and that is to preferentially select a time for my loads which is within the daytime and makes use of my generating surplus.

Request To Legislators

In the energy bill of 2012, please do not prohibit a bilateral agreement between myself and another energy market participant which may be complex, difficult to understand, may contain jargon and vocabulary not known to an average citizen, and might not set a single simple price of electricity in p/kWh. My reason for preferring to work with a variable spot price rather than a fixed price is that the former might reward optimal decisions, whilst a fixed price would not.

National Status

Without any internet connection nor information brought in from outside, the national electricity frequency is observable to any appliance connected to the national grid. The frequency was recorded at home with inexpensive electronic components to interface the mains electricity voltage to the audio input of a PC. Open source software and simple code were used to collate recordings and make a chart, which is available to interested parties who email me.

I was able to observe the deviation from the nominal 50 Hz of UK mains, which by 1930's methods was sufficient to regulate governor valves at numerous power stations. An example of a governor for a single steam engine connected to a single mill, using the technology of the

1840's, can be seen on several of the steam engines at the Science museum in Kensington, London. If the machine is spinning too fast, a steam valve is closed until the machine slows to its setpoint. If the machine is spinning too slowly, the steam valve opens until speed has increased to its setpoint. This relies on the boilerman stoking a furnace sufficiently to ensure that steam power is available for next time the governor indicates that more steam is required. Efficiency requires that the boilerman knows a forecast of power demand so that he does not stoke the boiler with more coal than is going to be needed.

With no internet subscriptions nor any other outside information, I have sufficient observables to provide a small contribution towards national grid frequency regulation. That is, I could set the second photovoltaic generator at this site to make mains electricity only at times when the national grid frequency indicates that more power is required.

National Status Indication being less useful than Regional Status

There will be times when the reason for the national grid running slower than 49.9Hz is located far from my generator. An imbalance between supply and demand might occur as far away as Scotland. Take for example an imbalance in the Merseyside region caused by a demand spike during the adverts break for Coronation Street. Power station controllers will have forecast that one and stoked up their power stations ready for it, but their forecast will be imperfect. For a Merseyside power station to open a valve should be more useful than for me to activate an on-demand generator, because I am so far from those loads that 20% transmission loss can be expected. On another day at another time, the same dip in national grid frequency below 49.9Hz could occur due to an imbalance closer to home. For example, if my local power station at Aberthaw had stoked up with a shipload of damp lignite, they might have less steam than required to keep up with forecast and contractually agreed supply. At such times, it would be most useful if microgenerators like myself respond to local demand spikes, because we are closer to Cardiff loads than the LNG fired power station at Milford Haven, who might have been the next best placed to respond.

In order to distinguish between the Merseyside example and the local example, my control computer would need information which is too locally specific and commercially confidential to be published nationwide, which is the local demand and supply forecasts in as fine a detail as the power stations use. That might be 600 point charts spanning the next hour for this postcode only, or some other format to be decided by the local power station. I would adapt and possibly interpolate whatever they could make available.

Street Status being more useful than Household Status

From inexpensive electronic components at the meter cupboard of the house, I am able to detect in real time the waveform of net current in or out of the house. Wiring the current and voltage waveforms to ordinary stereo cable, the PC recording these waveforms can monitor net power in or out of the household, and can also test for the harmonics and waveform quality. By comparison to the ideal sinewave which would be drawn by a resistive load such as a kettle, the household current waveform often indicates that consumer appliances containing a bridge rectifier have made the waveform quite ugly. For my own bill reduction, I would like to build circuits to generate a custom waveform which fills in spikes in household consumption to draw a more sinelike ideal waveform.

It is likely (though unproven) that doing so would improve the load waveform quality of my phase of my street. Since commercially calibrated test equipment for harmonic content is expensive, I do not have any of that nor expect every household to want it. There might though be a suitable unit in a nearby street distribution transformer. Ideal for me would be ability to have read-only internet access to look at the waveforms of net current and voltage on my phase for the street. I could then add a line of code to my custom waveform generator so that it operates only while doing so both cuts my household bills and lessens the undesirable harmonic loads of my street.

For me to locally provide harmonic correction services could be competitive to anything which the power stations can provide. If every bridge rectifier in the Cardiff area draws two spikes of current per 20ms cycle, those would be audible as mild shuddering in the turbine hall of the power station, so there may be dedicated extra coils or other apparatus to interface from the sinewave current which the generators provide to the particular waveforms which households use. Another possibility is that the distributed capacitance and inductance of national grid cables and transformers provides this interface, with energy storage within the cables for 2 to 8 ms decreasing the harmonic content of demand presented to the power station. If so, the cost in kWh of ideal sinewaves generated to supply the kWh of nonideal loads may be somewhat higher than the cost to me of providing nonideal waveforms from a solar battery generator. I cannot tell because the price of harmonic correction services is not visible to me.

Weather and renewable generation forecasts

In addition to the registered sinewave generating silicon solar photovoltaics at the house, I have additional photovoltaic panels for test and development purposes. Those maintain charge in a pair of used automotive lead acid batteries and while the batteries are full may supply “overflow” to a small grid tied inverter which also generates sinewave current. The usefulness to me of a good weather forecast is that it answers the question of how much should I run down my batteries tonight to obtain the most valuable output over the next few days. If the forecast for tomorrow is sunny, then I should select the most valuable periods in the spot price forecast aiming to be generating about 1kWh, since that is how much the photovoltaics which recharge the battery can be expected to gather. If the forecast for tomorrow is dismal then I might only expect 0.2kWh, but I might run down the batteries by more if the spot price went high enough for that to be worth my while.

It is possible for me to write a program to count the number of yellow, white, and black pixels in each half hour period of the www.bbc.co.uk/weather forecast for my postcode in each half hour period over the next 24 hours. I would prefer to obtain a solar forecast from a reputable source such as the met office or ecotricity, as those could be useful to any other renewable microgenerators. Distributing a program to look at a graphical by-postcode forecasts would make a lot of computers busy by comparison. The postcode forecast still needs to be multiplied by a site specific orientation chart (calculations from latitude, longitude, photovoltaic pitch and heading angles, and obstructions specific to the particular site), so I would prefer chart data of forecast light vs time at my postcode than anything more customised to my particular site.

Summary of Information Requested

I am a householder with a few solar photovoltaic panels and a kWh of battery storage writing about the information requirements to make best use of those from the point of view of national electricity supply, rather than selfish bill reduction. With sufficient information, it might be possible to set automatic equipment to work towards both goals.

Since it will take more than 30 years for this site to generate 100MWh, I do not ask to be considered in the commodities trading offices which rank bids from major power stations and dispatch generating orders. In any case, I would not expect a household to have multiple firewalls to protect confidentiality of price information nor the redundant systems required to avoid onerous fines for not delivering a generating contract. What I seek is more exposure to the spot price and forecast of it than a consumer household would normally want, so that what I generate is in the correct direction to assist stability and security of supply.

An indicative spot price forecast, near to the median of the bids from the power stations, and suitable to be distributed as freely as the spot price at www.aemo.com.au is requested.

Essential

Spot Price (£/MWh) as would apply to me
Spot Price Forecast (next 24 hours in 30 minute intervals)

Desirable

Local frequency regulation services pricing
Local waveform or harmonic correction services pricing
Local solar generator's weather forecast
A history of actual spot price so that I may try out some retrospective calculations.

Any questions or information may be sent to the author by email:
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