Stephen Browning – Future Energy – submission to IEEE Smart Cities

We need an Integrated solution to get the best result as regards Fuel Burn, Emissions and cost with adequate capacity, security and stability of Energy supply to customers. We also need to maintain diversity of Fuel sourcing.

Low Carbon Gas (LCG) can be produced from a variety of fuel sources, including Trash and incorporating a low cost/low energy sequestration process.

Better use of Gas by proper Integration of Distributed Energy Resources (Demand and Generation) and more efficient combined production of Electricity and Heat is needed...
This also provides flexibility to buffer variable renewables.
The 'Big + Little' Picture

- Resurrect the British Gas Lurgi (BGL) Gasifier and HiCom Methanator mechanism. Eats Coal, Biomass, Trash and produces Synthetic Natural Gas (SNG) - Methane and High pressure Carbon Dioxide. The Carbon Dioxide can be easily sequestrated by a unique mechanism . It can be further processed with Hydrogen (say from electrolysis using excess Electricity or Biogas) for more Methane.
The original BGL-HiCom development was a full production system. BGL is in use in Chemical industries today. Johnson Matthey hold the patents for HiCom. For Transport, Compressed Natural Gas in large vehicles is an option. Also, the Gasifier output can be (and has been) used to produce Liquid fuels (Methanol).

- Gas storage and flexibility is awesome - the GB Gas National Transmission System Linepack (Gas in pipes) alone is 3.5TWh and can release and recover up to 10% during a day. GB Explicit storage has reduced but is still @14TWh. By my original analysis Gas can handle Power movements from @150GW to @250GW and back during a day. Even higher rates of Gas Power movement (50GW to 300GW) have been presented recently.

- Use the Gas better - Combined Heating Power and Cooling (CHPC) with Thermal Storage and enhanced machine design (more below) to give extra flexibility. Large premises plant room systems up to District Power and Heating.

- At domestic level (with small commercial where adjacent) Set up Energy Hub units (up to 500kVA) at Distribution substation level. Heating Flow and Return Water. Target difficult to heat areas, especially with bad Air Exchange rates in 'leaky' dwellings where increasing insulation is not effective against the overall heat loss.

- Individual and linked systems at large Domestic, Commercial and Industrial premises.

Stephen Browning – Future Energy – submission to IEEE Smart Cities

- Both Internal Combustion CHPC and CCGTs provide Inertia, although that from IC Engines may be low unless extra flywheels can be fitted. IC CHPC can be very efficient (Power and Heat provision) at Full and Part load.

We set up the units thus….
ICEngine-Clutch-Flywheel-Alternator/Motor-Fluidrive-MechanicalHeatPump.
And a Thermal Store and Absorption Chiller
Mode 1 – High Price Grid Electricity. IC Engine Generating with Heat Recovery Delivery, also for Storage and Chilling as required.
Mode 2 – Low Price Grid Electricity. Motored Heat Pump, IC Engine shut down.
Mode 3 – High or Low Grid Electricity Price, High Heat Requirement. IC Engine and Heat Pump running.
Mode 4 – Synchronous Compensation. IC Engine and Heat Pump Shut down. Flywheel and Alternator Spinning (Synchronised).
In all 4 modes we can provide Inertial Damping, Response (if IC Engine or Heat Pump running), Reaction and Reserve (Fast start IC if not running).
The on course the machines can be instructed in Dispatch, Timing (Sync-Desync) and Commitment Timescales.
Also, with the Alternator Synchronised we can of course provide MVAr Export and Import to stabilise Local and Grid Voltages.

- All these systems need to be managed in a hierarchical Communications mechanism from Premises to Microgrid to Distribution Voltage Level to Transmission Supply Point to Electricity System Operator. To ensure integrity of Electricity Delivery at all levels (Matching, Security, Stability) as everything affects everything else simultaneously

- Aggregation of data (metering, offers of Generation and Demand) upwards.

- Dissemination of data and requests (Timed and 'Situation' based Pricing, Dispatch/Scheduling/Commitment requests – Reserve Arming, Voltage control requests, etc) downwards. Effectively 'Bartering' at each level upwards

- This also enables the 'shift' of non Time Critical Appliance demands to the best times. With serious application 'behind the meter' of the Internet of Things

- It provides the flexibility to 'buffer' more extensive penetration of Variable Renewable Generation with prediction errors.

- For an overview of this 'Smart' Enterprise and the new interface to the 'flxible' retail Customer please see FPS 20 and FPS 21 linked at www.eleceffic.com.

- We are effectively using Gas and Heat Storage to provide Electricity storage.

- This all needs a Standard Framework/protocol interface but with Flexible data content (Industry and Customers will be learning how to interact). This also improves visibility of generation, accuracy of SO Matching and of SO and DSO stability and security management. Uncertainty breeds excess cost (and fuel burn and emissions and risk) due to inefficient operation.

- The associated IT systems need Machine AI to prepare and run the models needed.

- The biggest logistical change to operation since 1933 in GB when the Grid was commissioned.