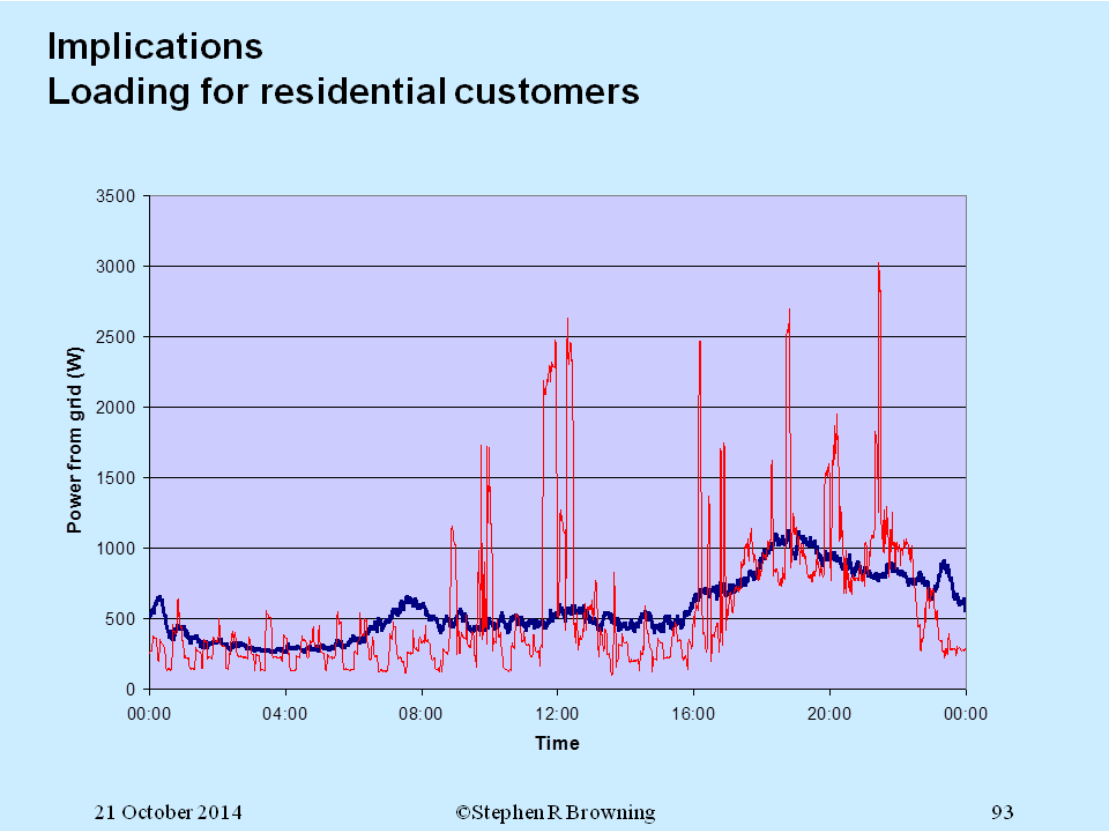
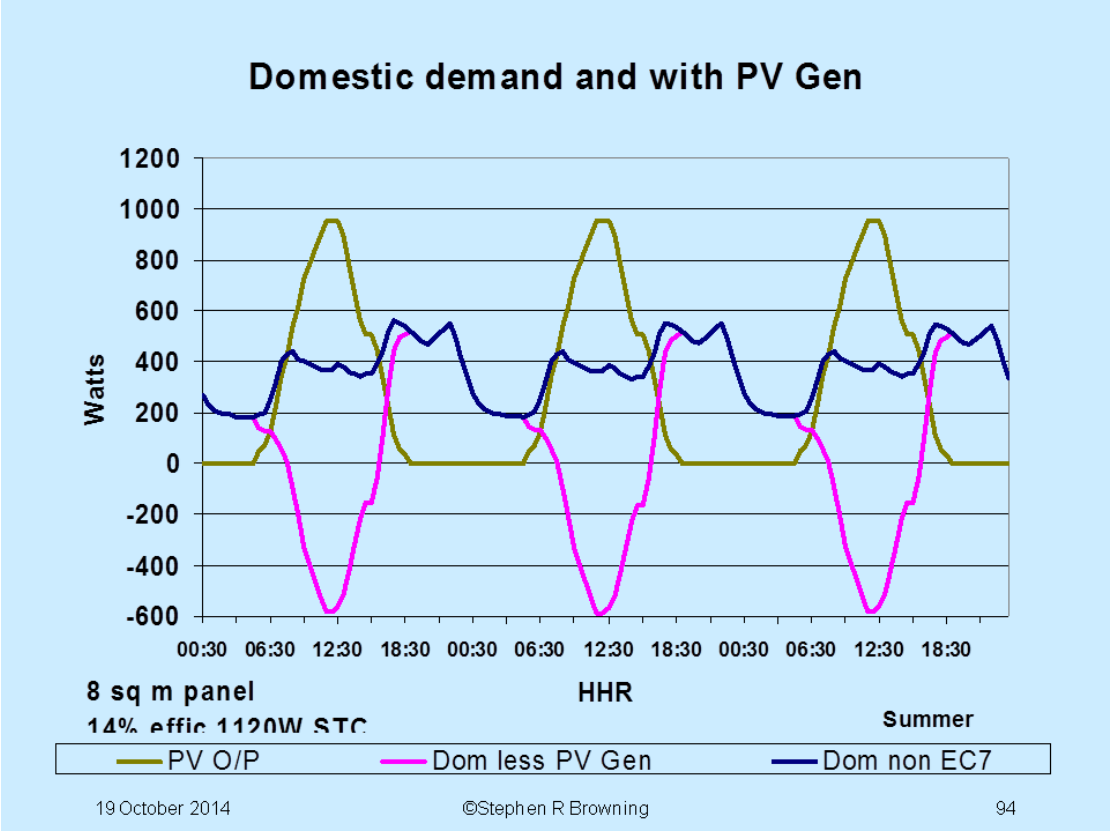
The Power profiles for different DER sectors, with and without generation, need to be considered carefully.



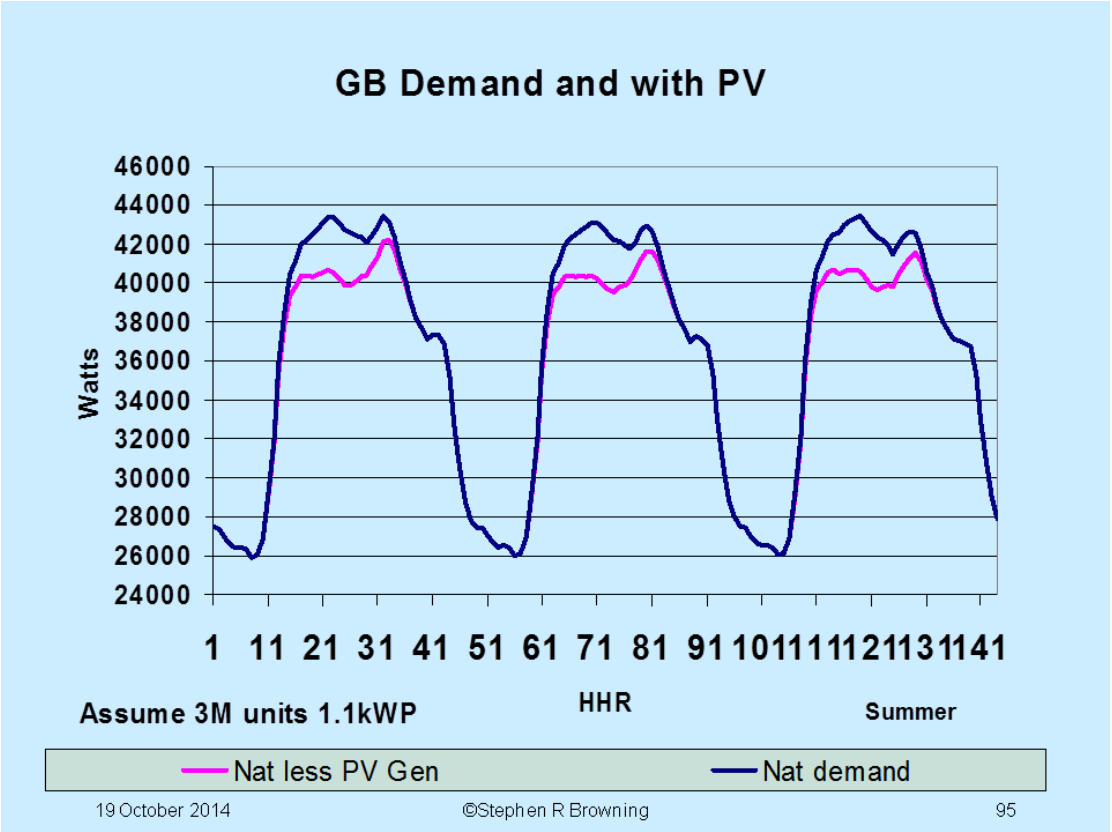
As we mentioned earlier, domestic premises' level of electrical demand is highly erratic. The relative level of short term variability could increase in modern high efficiency houses, even though the overall energy consumption will decrease. To this could be added generation of an 'erratic' nature such as wind (turbulence at low height) and PV under changing light conditions (fast moving broken cloud).

PV under a clear sky or constant cloud level will give a smoother, but variable profile, rising to a peak then dropping again as the sun traverses. CHP will give periods of constant output depending on the outside temperature and thermal cycling requirement. However, in more efficient homes CHP will not be needed; CHP schemes on some pilot, low energy domestic developments can be seriously underutilised. Lower heating requirements, a move to instantaneous electric water heating (new high erratic demand) and heat pumps obviate the need for fossil fired systems. Against this, note that heat pumps may not be viable in high density developments!

On working days, PV tends to operate before the peak demand and thermal (rather than synoptic) wind can drop when darkness falls. As we noted before and above, demand in high efficiency dwellings will be dominated by lighting, entertainment, cooking and water heating while occupied; thus the weekday peak demand always occurs in the evening.

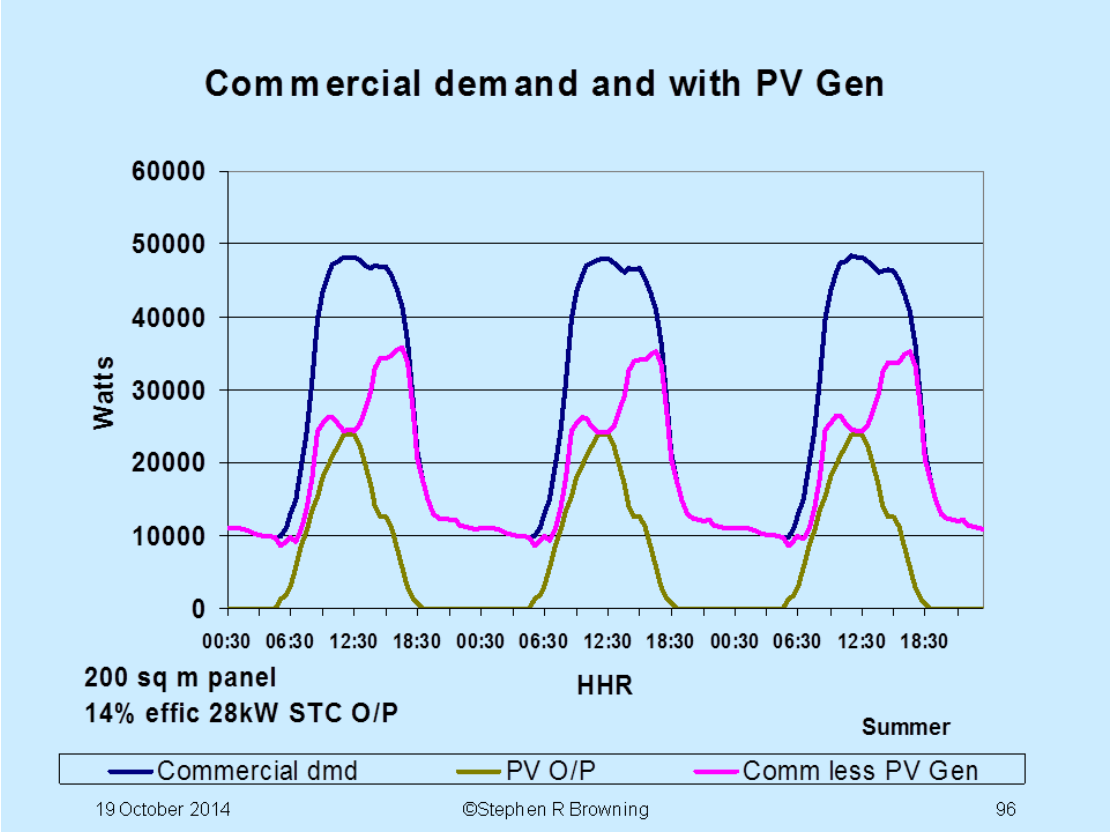


3m panels operating on a bright day in Great Britain (GB) will actually shift the peak time to the evening.

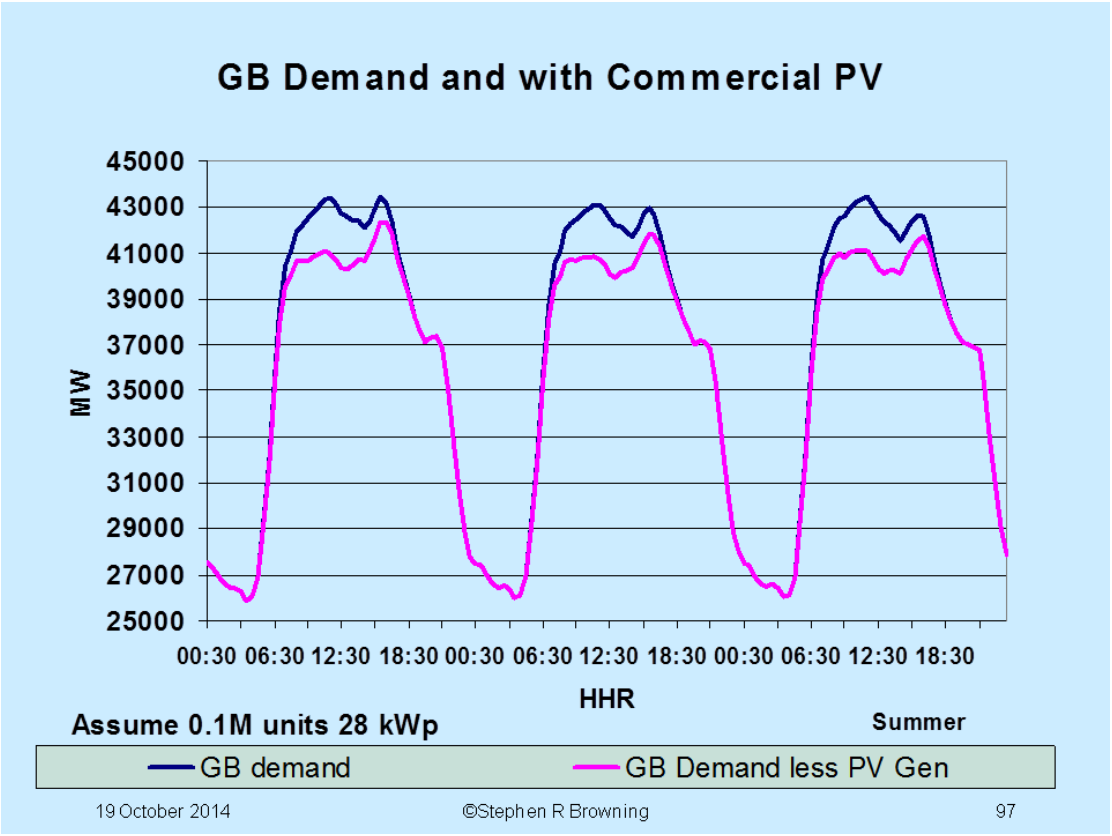


Commercial premises have a steadier load during the working day period, comprising lighting, water heating, cooling and office equipment plus some (relatively) minor cooking load. Again, application of renewable generation is subject to the same observations as above; wind will be erratic but PV output will synergise with the highest demand level. Commercial space (especially high rise) in dense urban areas will again not be suitable for heat pump installations and natural cooling, due to lack of open ground and density of occupation. Thus, CHP for both heating and to drive cooling may be appropriate, as illustrated in the previous article (13).

For electricity generation alone, PV is also being increasingly installed on modern commercial buildings. The resulting profile for the premises can look as follows.



When scaled up on a GB basis, again the peak gets shifted to the evening



Industrial demand is highly 'bespoke' and driven by the requirements of the individual production processes. It is usually more controllable within time periods and notice limits. Some large demand can be interruptible at short notice while other processes can have their schedules adjusted with some notice, but are 'uninterruptible' when in progress. Where heat and electricity are used by processes, fossil-fired CHP has been found be efficient and cost reducing. Renewables will make some reduction.

We need to consider what level of control is appropriate at premises level. As we said before Demand falls into one of three types:

Time critical

Non time critical

Unnecessary!

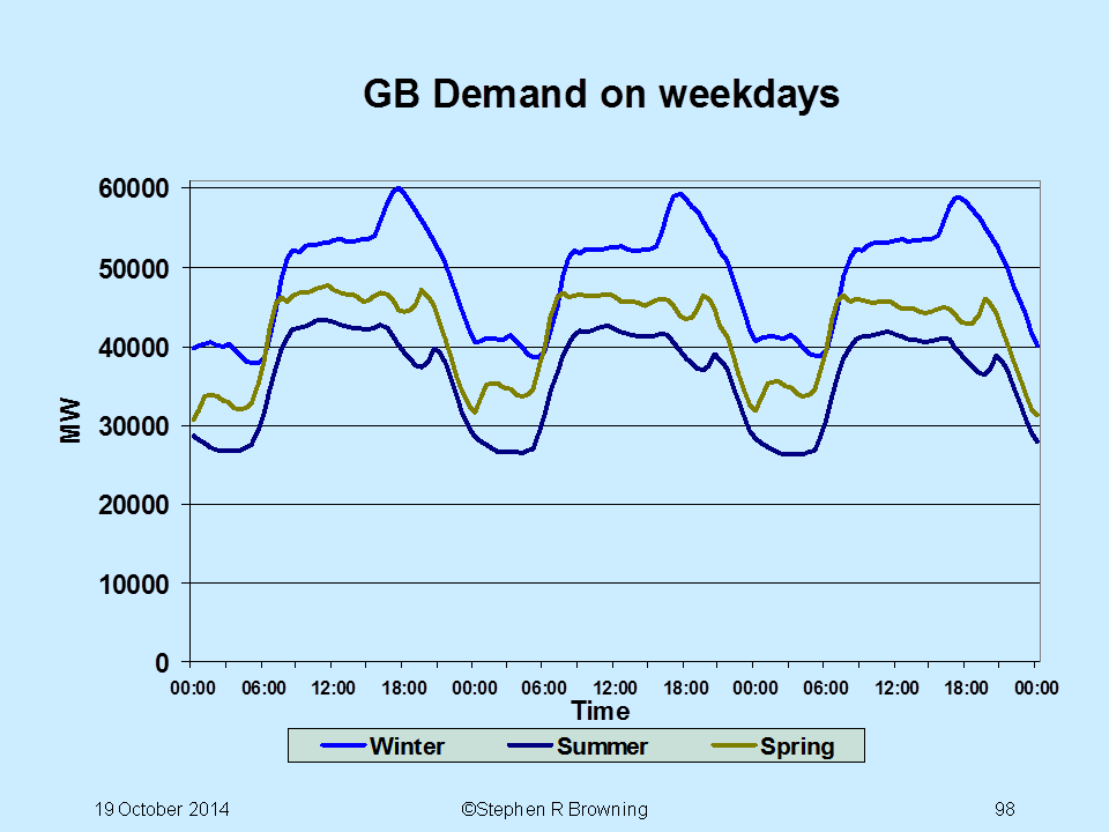
The latter of these three is obviously being tackled vigorously as public awareness of energy costs rises. Use of power efficient light bulbs and recognition of the fact that empty rooms and inanimate objects are not frightened of the dark (turn lights off in unoccupied areas) is being recognised; a change from the acceptance of 'passive energy waste' we have grown up with.

Manual actions are relatively time consuming and tend to be forgotten after a while. What we must remember is that each customer group is primarily concerned with

Making Widgets (Industrial)
Making Money (commercial) and
Getting on with life (Domestic)

Thus automatic monitoring and management is the key to ensuring efficient premises energy management.

Tackling the non-time critical demand is more complex to handle; remember that predictability is vital - power, time and location. There are considerable gains to be made by smoothing and reducing the peak demands on - fossil fired generation. However, poorly controlled load movement can give rise to worse demand shapes as was experienced in the early days of fixed time off-peak domestic electrical heating. The remnants of this can still be seen as an artificial trough around midnight on the Great Britain (GB) Spring demand profile below. There are also examples of 'bad shaping' in the previous article (13) on intelligent buildings.



As we have already said, careful, ramped application of dynamic electricity prices (export and import) by time and group (supplier, geographical and/or sector) can influence premises Import/Export by changes to Demand, Generation and Storage. This should be able to effect compensation for unpredictable renewable plant output and produce a more efficient load profile for the remaining fossil plant which needs to run, rather than simple timer or advance time block pricing methods. Having said this it is important to recognise that forecasts of prices by time are important for effective control of customer DER resources.

However, any level of 'change' to the demand (and distributed generation/storage) profile gives rise to issues of predictability for the market and system/distribution operator. We will explore this in more detail later.