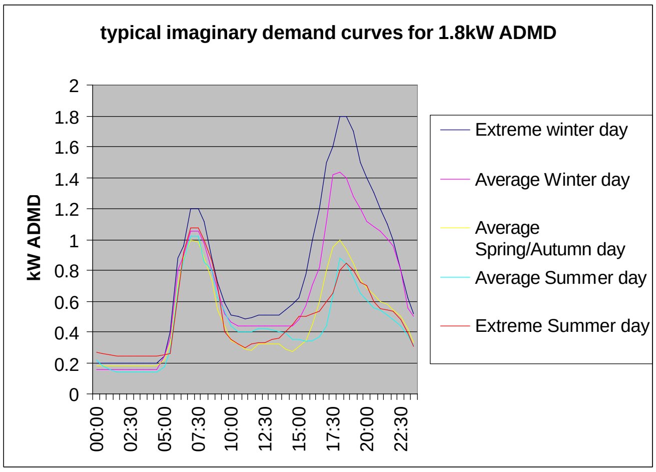
Thames Valley Vision LCNF Project - Appendix 16.1

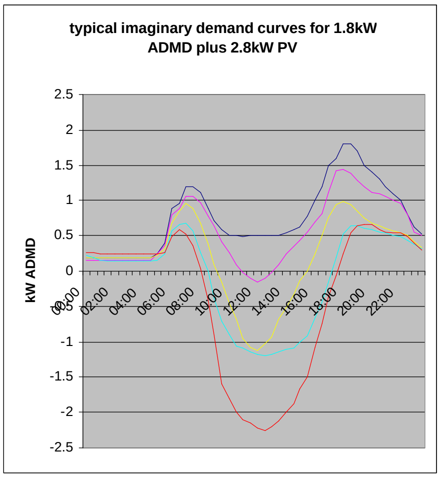
1. Effect of low carbon technologies on the load factors of LV networks

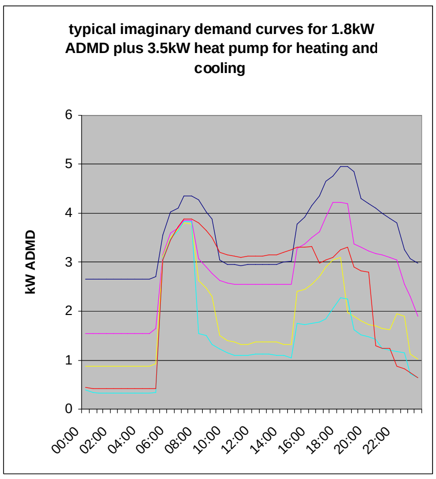
The load factor of existing LV networks varies depending on the behaviour of customers. It has over the years increased from the traditional values due to the number of appliances left on 24 hours per day and those which are used for many hours per day such as computers which can be left on for 8 hours or more.

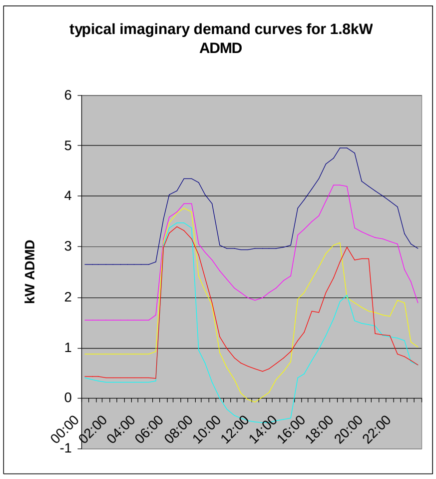
One deliverable of the TVV project will be to establish accurate load factors for our LV networks and 11kV/433v transformers in the Bracknell area. Rough estimates based on HV feeder data and existing LV demand indicators suggest that the actual load factors are in the range 0.2 to 0.4 however the transformer utilisation factors are much lower than this in the range 0.1 to 0.25.

Taking a typical LV network load factor of 0.3 today the effect of low carbon technologies could be to reduce the load factor to 0.1 if only PV systems are installed. An increase to 0.4 could be seen if electric heat pumps are installed for both heating and cooling purposes. A balanced mix of heat pumps and PV might result in a load factor of around 0.35. Both PV and heat pumps will increase the peak load on the system and PV will in addition cause high voltage problems which will need to be addressed in a new way.









2. Effect of low carbon technologies on the load factors of LV networks, comments on EV battery charging.

Adding EV charging to the mix is difficult as unlike PV and heat pumps dealt with Appendix 1 it is not easy to estimate when the charging is required. A typical small EV car might have an energy consumption of 0.25kW per mile and a typical daily journey of 60 miles. This requires 15kWh of charging per day. All this charging could be done without increasing the peak load on the network and would hence further improve the LV networks load factor if a 3kW charger was used midnight to 5am. If on the other hand 12kW quick chargers were available and people used these on returning home, peak loads could increase by 6 times and the load factor drop below 0.1. This is clearly an unacceptable situation from a DNO's point of view, and probably from a supplier's point of view as well. Thought needs to put into ensuring that suitable tariffs are available to encourage sensible use of battery charging at off peak rates with a disincentive to charging at peak periods.

Something along the following lines might be sensible say the basic rate of energy is 16p per kWh and the car does 4 miles per kWh 60 miles per day, 300 miles per week and 15000 miles per year.

00:00 to 06:00 basic rate times 0.5	2p per mile	£300 per year
6:00 to 7:00 basic rate	4p per mile	
7:00 to 9:00 basic rate times 2	8p per mile	
9:00 to 16:00 basic rate	4p per mile	
16:00 to 17:00 basic rate times 2	8p per mile	
17:00 to 18:30 basic rate times 3	12p per mile	£1800 per year
18:30 to 20:00 basic rate times 2	8p per mile	
20:00 to 22:30 basic rate times 1.5	6p per mile	
22:30 to 00:00 basic rate	4p per mile	

If you turn up at 17:00 and have an urgent need to charge to go out for an evening journey then you can do and would pay the additional £6 for the privilege of doing so rather than waiting till after midnight.

The good news is that at the moment all the potential commercial offerings of EVs due to launch during 2011 appear to have only 3kW home chargers designed for use overnight with a boost button available should a customer need to charge up the battery sooner.

The Mini E has a 7kW home charger but this is only a trial vehicle and considerable modifications to the house wiring were required to accommodate a charger of this size.

One EV the Nissan Leaf has a 50kw charger available but this will not be installed for home use but perhaps at a service station allowing a car to re charge while you stop off for a meal allowing occasional longer journeys.

3. Potential none reinforcement strategies to cope with voltage issues on LV networks

Both additional load and generation have the potential to cause voltage problems on the LV networks as low carbon technologies are adopted. As noted above with good time management EVs should be acceptable on the network to quite high densities without causing problems. PV on the other hand could quickly cause high voltage problems. The conventional way of dealing with this has been to reinforce the network to keep voltage rise to no more than 1.2%.

Alternatives which can be used to give extra headroom to allow the connection of PV are.

Alter the tap on the local transformer. This can give an extra 2.5% effectively 3.7% in total. A large number of LV networks are suitable for this option.

Alter the target voltage of the AVC scheme at the primary sub station. This could reduce voltages by up to 3% at the time of peak PV output. Note that at this time loads are less than the winter peaks so that the overall network can accept this reduction. Using the 3% voltage reduction available on the load shedding scheme could be used on many networks. However this might be too much on some networks and an alternative scheme might be required. This will give 3% or in some cases a smaller value could be coupled with the 2.5% on a local transformer to give 4.5% extra headroom total 5.7%. This approaches the design 7% drop for LV networks. Due to the very good power factors of the inverters used with PV systems, voltage rise in distribution transformers feeding back to the HV network is very low and in most cases can be ignored.

This will allow DNO's to accept the large number of PV systems expected to be connected under the Feed In Tariff without resorting to expensive reinforcement of the LV networks except in areas with very high installation rates.

4. Notes on the uptake of heat pump systems for heating and cooling

There is at present little evidence of any uptake of these in the Bracknell area. Most of the area involved in the trials has gas available and this is currently cheaper than using heat pumps. There are two large new developments going on but these both have 100% gas heating.

However in the rural areas of Wiltshire and Oxfordshire where there are no gas mains present the take up of heat pumps is as high as 80% with there being a mix of ground source and air source heat pumps. A second market area where they are taking off is small scale developments of flats where there are difficulties in installing gas heating. Air source heat pumps are taking approximately 50% of the market where gas has been excluded due to the difficulties in installation with the rest using direct acting heating which is still cheaper to install than a heat pump.

Heat pumps are available with Direct on Line starting or with Electronic Soft Start Technology. In most cases DOL is not acceptable and ESST is acceptable. To date most installations are in new properties and the type of starting can be discussed and agreed at the time the quote is issued. If people start to install these as retrofits for gas fired heating systems in the future there may be issues with voltage flicker on start up if DOL starting its used. Some method of getting the customer, or installer to ask before installation, as is required with micro-generation installations above 16A per phase, would be very useful in preventing problems like this. Note that most domestic heat pumps are in the range 2.5kW to 4.5kW and all have starting currents above 16A per phase when DOL starting is used.

The Modelling and Planning Work Pack does include elements specifically to look at the modelling of different technologies to assess voltage flicker and harmonics.

It is important to note that heat pumps while being lower carbon in winter for heating give customers the option of cooling in summer which is a new load and will use additional carbon resources until such time as the electricity network is de-carbonised. As summer peak loads rise on the system, its capacity will fall compared to winter peak loads as the ambient temperature of the air in summer is much higher. This will transfer many networks from being winter constrained as they are at present to summer constrained, though the absolute loads in summer will not be as high as in winter. So unlike PV and EV charging, heat pumps will have both positive and negative effects on the amount of carbon dioxide production.