

## **Smart Metering Subgroup TOR (iii), part 3 - Demand diversity**

### **Background:**

Demand diversity is the term used to describe the degree of non-coincidence of electricity consumption behaviour amongst different users connected to the electricity network. Not all customers connected to the network will use electricity at the same rate at the same time and because of this the peak network demand on the network assumed when planning and building infrastructure is smaller than the sum of the individual customers' peak demands. By how much the assumed peak network demand can be reduced from the sum of individual peak demands is the percentage diversity factor applied.

Such diversity factors are used by the DNO when assessing new connection requests, particularly for residential or groups of residential customers connecting to existing network infrastructure. For a new connection design, DNO engineers must determine a) the amount of additional peak demand capacity that the network must be able to provide once the new customer is connected and b) whether or not that capacity is available on the network – or how best to provide it through reinforcement or alternative connection points.

Diversity calculations thus generally affect only the new loads not those already on the existing system as the measured maximum demands on the existing system already inherently include diversity. However, the application of diversity factors to new loads may consider the diversity that exists between the new load and the existing system load; for example new housing with an early evening peak in an existing network dominated by industrial load with a day time peak.

### **Application of diversity factors:**

A new customer's requested peak demand is taken into account when determining their authorised supply capacity, but a percentage diversity factor may then be applied to their peak demand to produce an after diversity maximum demand (ADMD) where there are already significant volumes of existing customers.

Typically commercial developers request a specific peak demand determined by their consultants and unless there is a clear difference between their load and the existing local load, diversity is not applied.

House builders tend to ask for connections to a number of properties of a certain size and type (e.g. two bedroom electrically heated flats with PV on 50% of properties or four bedroom gas heated houses without PV). The choice of supply capacity and diversity between the properties is then left to the DNO to decide, unless otherwise agreed with the customer.

Historically, most DNOs offer a default authorised supply capacity of, for example, 80A (18.4kW at 230V) for a single domestic dwelling but expect the dwelling's individual peak to be somewhat lower than that, perhaps in the range of 12 to 15kVA depending on the property type. This allows proper design of the service cable to the dwelling; the service is of course not subject to diversity between properties because it services only one property.

In designing the LV mains and substations that supply those services the ADMD value is used. The ADMD represents the network capacity per customer required in order to connect a number of residential customers.

Most DNOs have a generalised ADMD value that is applied for a particular dwelling type; a typical value would be 1.8kW ADMD for a gas-heated 4 bedroom home. This assessment is most important for larger multi-residential premise developments where, for example a ten-premise development of such properties might have an aggregate authorised supply capacity of 150kVA, but using ADMD figures can generally be assumed to add only around 30kVA to the substation maximum loading, 15kVA for the first dwelling and 1.8kVA per property for the remainder<sup>1</sup>.

Importantly, once customers are connected to the network, demand diversity is taken to be inherent to the observed peak demand on the network and diversity calculations are not used to assess or allocate the capacity remaining on the network.

#### *Innovation project research and low carbon transition:*

With new, more advanced data sets on residential demand patterns from smart meters, such as those obtained on the Low Carbon London and Customer Led Network Revolution projects, diversity assumptions can be more accurately defined, based on household size, customer demographics, and using up to date customer usage patterns. These diversity figures benefit from a greater sample size than most previous studies on diversity. The data sets also allow for a much more detailed understanding of the relationship between population size and demand diversity. The greater the population, the greater the diversity will be between consumers' individual demand patterns, so diversity factors that vary with the number of customers connected to the network, derived from real-world data sets, are another key means of increasing accuracy in network capacity provision.

Over time it may be possible to expand and refine the data sets from the innovation projects following the national rollout of smart meters and these updates may become important as load patterns change with the penetration of LCTs. We also note that LV network design is driven by other considerations as well as the thermal capacity assessed through ADMD figures.

Widespread use of categorised, up to date demand assumptions will provide more efficient access to the network for new connection customers (e.g. reduced time and cost of connection<sup>2</sup>) and will protect the future performance of the network by more accurately provisioning network capacity. More accurate and targeted diversity assessments will also provide an improved understanding of base residential load patterns on top of which new demand types can be introduced into capacity

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<sup>1</sup> It is worth noting that for new networks, transformer and cable sizes will be determined by other factors such as available equipment sizes, voltage drop, loop impedance, power quality considerations and especially losses. The latter in particular will generally result in larger LV cable and HV/LV transformer sizes than required to serve the after diversity capacity requirements of the properties served.

<sup>2</sup> The SMSG noted that for some new connections a portion of the reinforcement costs for connection are apportioned to DUoS customers as well as the new connection customer, as per the approved connections charging methodology. In these cases, a new smart meter-derived ADMD assumptions may change the connection design in a way that affects the amount of reinforcement cost charged to DUoS customers as well as to the new connection customer. However the quantity and scale of these benefits or impacts are not currently considered to be significant.

assessments, such as those driven by low carbon technologies like electric vehicles, heat pumps, and PV. This could be particularly relevant in large scale forecasting models that require diversified load profiles to estimate system load growth.

Changes to ADMD assumptions however do not 'release' latent capacity on the network, as the true diversity of demand amongst existing network customers is directly observed in the network peak demands measured at substation level.

The relevant LCL reports are as follows:

	REPORT	DESCRIPTION
16	<b>C1</b> <a href="#">Use of smart meter information for network planning and operation</a>	Presents the analysis of domestic customer's profiles as well as the voltage assessment from the engineering instrumentation zones
21	<b>D1</b> <a href="#">Development of new network design and operation practices</a>	Outlines the key changes and considerations required for implementing the LCL findings into planning and network operation processes.
27	<b><a href="#">SUMMARY REPORT</a></b>	

#### Use of diversity factors in the future

Enhanced demand diversity assessments, are one of the ways in which SM data can be used to help enable the delivery of consumer benefits for new connections. At present, we do not consider there to be any substantive barriers/enablers to improving and applying diversity assessments following the national rollout of smart meters.