DGHost Brochure

EPECentre
ELECTRIC POWER ENGINEERING CENTRE

Distributed Generation connected on Low Voltage Networks

The connection of Distributed Generation (DG) units, such as solar PV systems, to an electricity distribution network can cause parts of the network to become congested. This congestion is typically the result of voltage rise along feeders or the overloading of equipment in the network. Consequently, when considering DG applications, Electricity Distribution Businesses (EDBs) must be able to determine the maximum amount of DG that can be installed at each ICP in a network, without adversely affecting its operation or breaching network requirements. This amount is defined as the hosting capacity of the network.

DG hosting capacity can be determined by full power-flow simulations of a network, or by approximate methods, such as those used in the DGHost Service. The *EEA Guideline for the Connection of Small-Scale Inverter Based Distributed Generation* *(draft)* specifies appropriate connection requirements for DG applications according to network-specific hosting capacity thresholds. This categorises DG applications into a three-tier *traffic light system* based on the hosting capacity, as shown in Figure 1. Each category reflects the likely impact of the DG exporting into the LV network, and thus if it can be approved for connection.

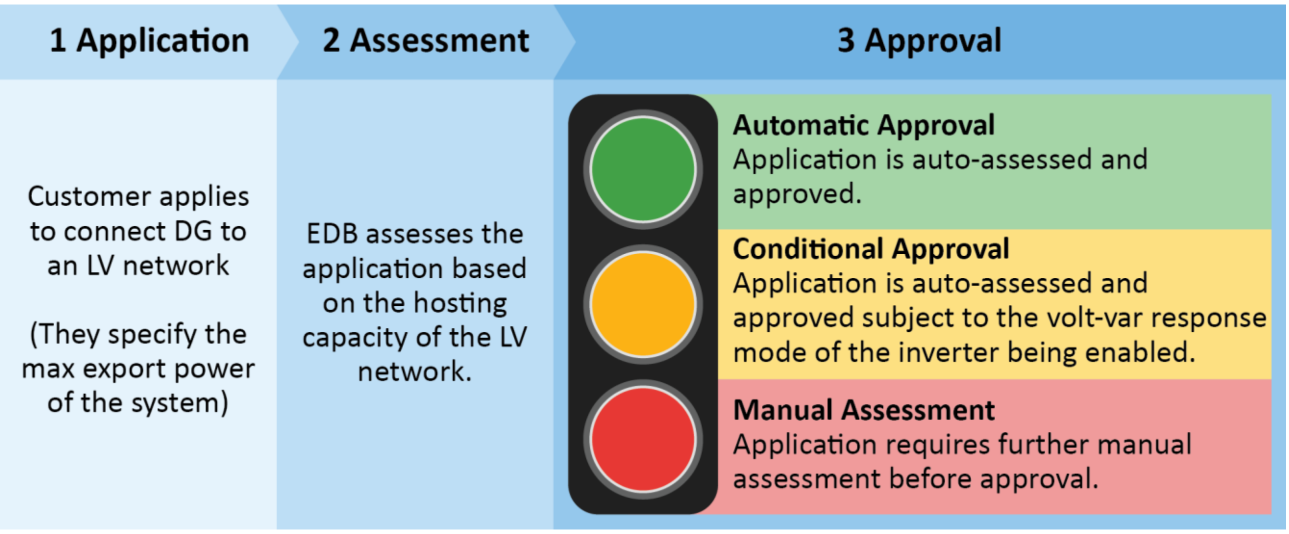

Figure 1: Three tier traffic light system for assessing DG applications using hosting capacity.

DG hosting capacity can also help EDBs to meet Electricity Industry Participation Code (EIPC) requirements to inform their customers about which parts of their network are congested, or are expected to become congested in the near future.

What is the DGHost Service?

The DGHost service, developed from GREEN Grid research by the EPECentre, is a commercial service designed to allow third parties the opportunity to determine approximate hosting capacities for their low voltage networks. It requires a minimal number of input parameters, thereby making the determination of hosting capacity straightforward.

Initial work to understand the impact of PV in LV networks focused on full network simulation studies. However, following feedback from Electricity Distribution Businesses (EDBs) concerning the difficulty of obtaining the network data required for such studies, an approximation method was developed. This method implements an optimised k-Nearest Neighbours algorithm to find the most statistically "similar" networks, to the network of interest, from a reference database. The reference database was generated from over twenty million full power-flow simulations of over twenty thousand LV networks. This approximation method, referred to as DGHost, is described in more detail in the paper available at this link.

Input Requirements

Inputs will be submitted by the user in an Excel spreadsheet using a template provided by the EPECentre. Three basic network parameters, in addition to the **Network ID** (identification number or code), are required to specify each LV network:

- **Transformer rating** of the distribution transformer supplying the LV network.
- The total **Number of Installation Control Points (ICPs)** physically supplied by all feeders connected to the LV terminal of the distribution transformer.
- **Maximum feeder impedance** which is the magnitude of the impedance for the path, from transformer to ICP, with the highest impedance on the LV network.

Additionally, two special case network types can be specified:

- **Single Phase Network**: Specifies if the network is three-phase or single-phase (i.e. if the LV network is supplied by a single-phase transformer).
- **Reduced Neutral Conductor Sizing network**: Specifies if the network contains neutral conductors which are undersized relative to the main phase conductors.

The user can optionally specify up to **four DG penetration levels**, corresponding to the percentage of ICPs with DG installed in the LV network, or alternatively can use the default values.

DGHost Service Results

Full results will be provided in an Excel spreadsheet, with three worksheets for three different levels of volt-var response. An example of one worksheet is given in Table 1. DG hosting capacity for each LV network will be given for:

- A **maximum of four DG penetration levels.**
- At each DG penetration level, two outputs will be produced for the DG hosting capacity of the LV network:
  - a **Conservative** hosting capacity, given by the lower quartile value (25th percentile **P(25)** value)
  - a **Median** hosting capacity, (50th percentile **P(50)** value)
- **Three different levels of volt-var response** of the DG inverters:
  - 0% or no volt-var response,
  - 30% volt-var response,
  - 60% volt-var response.

Table 1: Example DGHost Results worksheet for volt-var (0%)

Note that values below are provided as an example only, and do not represent the results of real networks.

	Hosting Capacity Penetration Level 1	Conservative	Median	Hosting Capacity Penetration Level 2	Conservative	Median	Hosting Capacity Penetration Level 3	Conservative	Median	Hosting Capacity Penetration level 4	Conservative	Median
Network ID	**Penetration Level [%]**	**P25 [W]**	**P50 [W]**	**Penetration Level [%]**	**P25 [W]**	**P50 [W]**	**Penetration Level [%]**	**P25 [W]**	**P50 [W]**	**Penetration Level [%]**	**P25 [W]**	**P50 [W]**
Example 1	25	5800	6200	50	3800	4000	75	3300	3600	100	3000	3000
Example 2	28	2000	2300	42	1100	1300	71	900	1000	100	1000	1000
Example 3	25	4400	4700	50	3000	3100	75	2200	2400	100	2000	2000
Example 4	50	7000	7100	100	3600	3600	NA	NA	NA	NA	NA	NA

Next Steps

If you are interested in using the DGHost Service, contact us at dghost@epecentre.ac.nz to receive a more detailed technical specification and a proposal with our commercial conditions.

About the EPECentre and the GREEN Grid project

New Zealand's Centre of Excellence in Electric Power Engineering was launched at the Electricity Engineers' Association Conference on Friday 21 June 2002. The EPECentre is hosted within the College of Engineering at the University of Canterbury. The EPECentre is leading the GREEN Grid programme to ensure that New Zealanders have access to reliable, safe, and affordable renewable energy. The GREEN Grid project is a 6-year research project, funded by MBIE, Transpower and the EEA.