Distributed Generation Connection Guide: Contents

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Distributed Generation Connection Guide: Information Sheets

The following pages contain a number of information sheets. These bring information that is contained throughout the Guide into a single page. The information sheets include:

- Decision Tree for the Distributed Generation Connection Guide—to help you to identify whether this is the right Guide for you.
- Capacity cut off points—a diagram illustrating the impacts that the generation capacity of your generating equipment has on the requirements and opportunities for your project.
- Provision of Information: DNO websites—a summary of the information you can expect to find on DNO websites.
- Legislative and Regulatory Document Hierarchy—an illustration of document hierarchy, and list of key documents.

You will find the Guide introduction and contents after these information sheets.

Decision Tree for the Distributed Generation Connection Guide

There are a number of Distributed Generation Connection Guides, each with a corresponding 'Summary' guide. The purpose of the summary guides is to act as a quick check, providing only the most useful information in a condensed format. This flowchart guides you to the most relevant Connection Guide for the Distributed Generation you are planning to install. The Guides can be found on the Distribution Generation section of the ENA website.

Size of your generating unit within any single premises

Does your Power Generating Module (PGM) (or the aggregation of modules if there are more than one) have a capacity of 16A per phase or less, and is it connected at low voltage? In other words:

- Three phase—generation capacity of 11.04kW or smaller and connected at 400V
- Single Phase—generation capacity of 3.68kW or smaller and connected at 230V

Yes → **Number of premises**

In how many premises are you planning to install Micro-generators:

- within 500m of each other; or
- with the same postcode (ignoring the final two letters)?

1 → Guide for EREC G98 projects for Single Premises

More than 1 → Guide for EREC G98 projects on Multiple Premises

No → **Size**

Does your Power Generating Module have a registered capacity of less than 1 MW ?

No → Guide for EREC G99 Types B to D Power Generating Modules

Yes → Does your Power Generating Module have a connection point below 110 kV ?

No → Guide for EREC G99 Types B to D Power Generating Modules

Yes → Guide for EREC G99 Type A Power Generating Modules

Projects can no longer connect under EREC G83 and EREC G59.

Simplest process → Most complex process

Examples of Distributed Generation that is 16 A per phase or less

PV system: If you are installing solar panels on the roof of your home (or another similar building), it is likely that your project will be less than 16 A per phase, particularly if your array is about 30 m^2 or less; or about 18 panels or fewer.

Wind: Many small wind turbines are also less than 16 A per phase. For example:

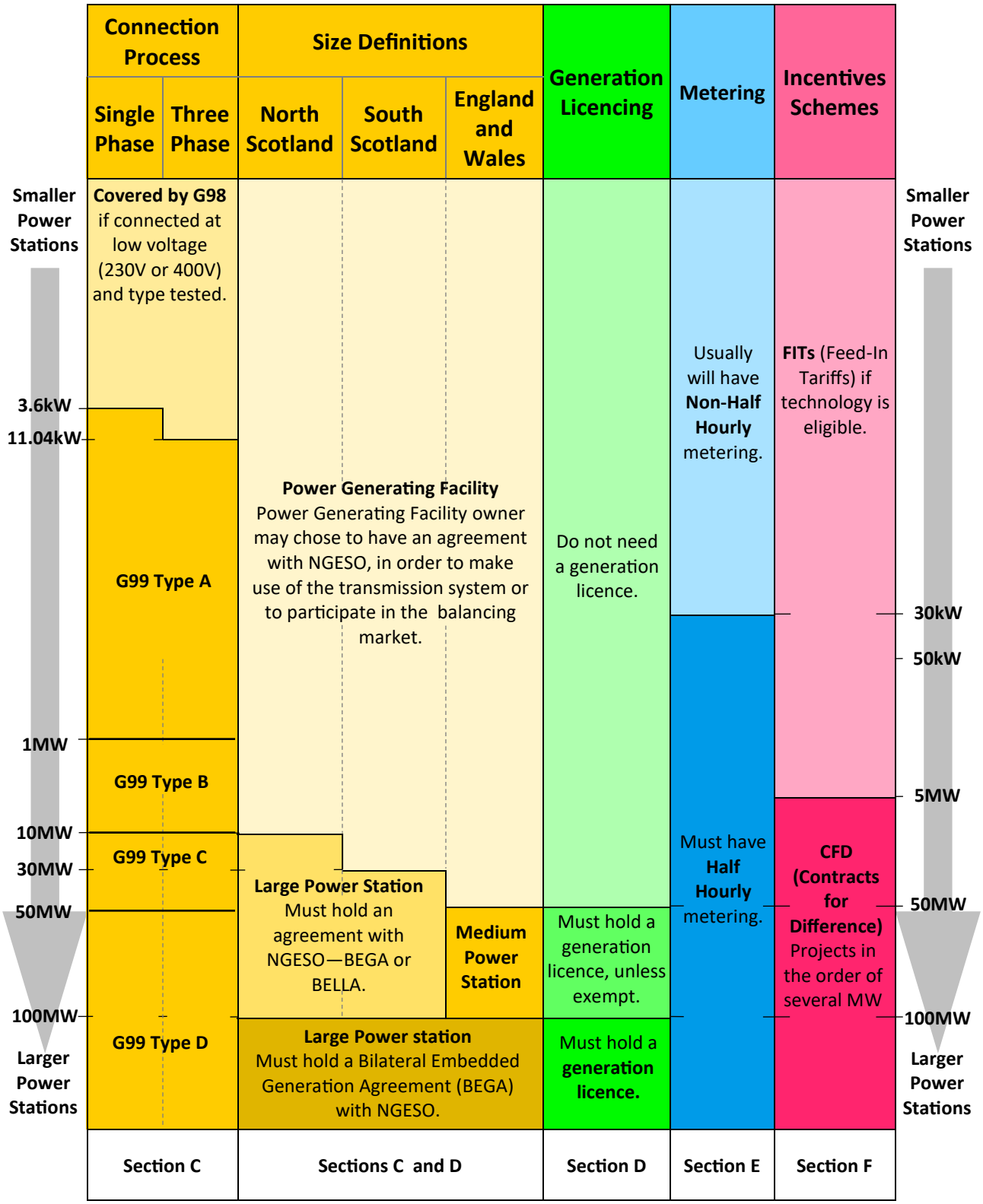
- **QR5 turbine**: Rated 6.5 kW with a rotating section of 5 m height
- **Bergey wind turbine**: Rated 10.0 kW with a diameter of 7 m

Combined Heat and Power (CHP): A micro-CHP plant rated 6 kW (3-phase) (the size of a big dishwasher 0.8 x 1 x 1 m) could have a thermal output of 18 kW.

Connection Process: Capacity Cut Off Points

The tasks that you have to undertake to get connected vary with the capacity of the generating plant. In general, the bigger the generator, the more complex the connection requirements.

The table below illustrates some of the impacts that the capacity of your generating units have on the connection process and requirements on you.



Provision of Information: DNO Websites

There is a great deal of published information available from your DNO that can be helpful for your project planning. Some of the most useful sources are summarised here, and links to the DNO websites are in the table below.

Long Term Development Statement (LTDS)
Covers the development plans for the network, and other information useful for prospective developers. An introductory chapter is generally available on the DNO's website and DNOs will give access to the full document on request. These documents are updated every six months, and published annually.

Connection Charging Documents
Statements and methodologies will be given for both connection charges and Use of System (UoS) charges. This information may be included in a single document, or in several, and are updated regularly. These are available on DNO websites.

Standards of Performance
Ofgem has set minimum performance standards for connections, both during and after their construction. If your DNO fails to meet these standards, you may be entitled to receive payment. Ofgem has guidance documents about these Standards on their website: www.ofgem.gov.uk/licences-codes-and-standards/standards/quality-service-guaranteed-standards

Distributed Generation "Work Plan"
The Incentive for Customer Engagement (ICE) exists to encourage DNOs to engage with and respond to the needs of major connections customers (which includes generation customers), and includes a requirement on DNOs to set out plans on what improvements they plan to make in the next regulatory year, consisting of two parts. Part 1 covers plans for improvements for the forthcoming year; and Part 2 reviews the progress in the previous year. Check your DNOs Distributed Generation web pages.

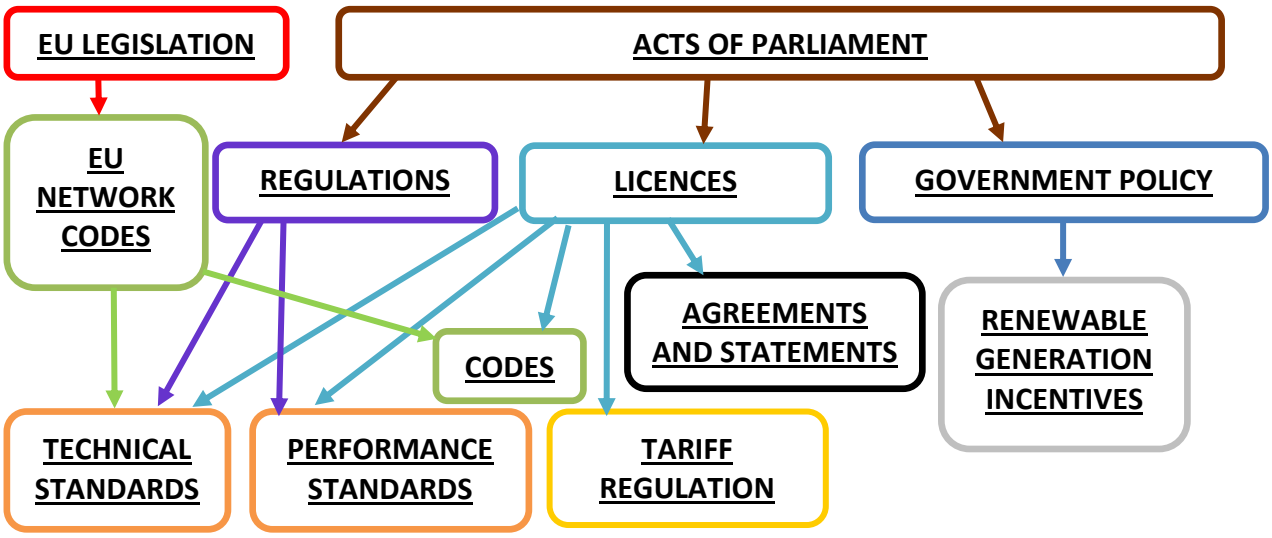
Other Supporting Information Provided by DNOs
In recent years, there have been improvements to the information that DNOs provide, including:

- web portals and decision support tools/application hotline;
- capacity "heat maps", indicating areas that can more readily facilitate connections;
- holding events such as "open surgeries" for Distributed Generation customers; and
- more details provided on outages (planned and historic).

Region	DNO	Website
North Scotland, Southern England	SSE Power Distribution	www.ssepd.co.uk
South Scotland, Cheshire, Merseyside and North Wales	SP Energy Networks	www.spenergynetworks.com
North East England and Yorkshire	Northern Powergrid	www.northernpowergrid.com
North West	Electricity North West	www.enwl.co.uk
East Midlands, West Midlands, Southern Wales, South West England	Western Power Distribution	www.westernpower.co.uk
Eastern England, South East England, London	UK Power Networks	www.ukpowernetworks.co.uk

Legislative and Regulatory Documents Hierarchy

The following diagram shows the legislative and regulatory documents in the power sector. These are grouped by category, and where possible the relationship between documents is illustrated. The documents have been colour coded by document category. The most relevant examples of each documents are included in the boxes below.



KEY:

→ Indicates where a document feeds into or influences another.

Document Category:

- Acts
- Regulations
- Licences
- Policy
- EU Legislation
- Agreements / Statements
- Code
- Standards
- Tariff regulation
- Renewable Energy Programmes

ACTS OF PARLIAMENT:

- Electricity Act 1989
- Utilities Act 2000
- Energy Act 2004 (BETTA go-live direction)
- Energy Act 2008 (FITs etc.)
- Energy Act 2013 (CfD etc.)

REGULATIONS:

- Electricity Safety, Quality and Continuity Regulations 2002
- The Electricity (Standards of Performance) Regulations 2015

LICENCES:

- Generation
- Transmission
- Distribution
- Supply

EU LEGISLATION:

- EC No 714/2009

CODES

- Balancing and Settlement Code
- Connection and Use of System Code
- Distribution Code
- Grid Code
- System operator – Transmission owner Code (STC)

AGREEMENTS AND STATEMENTS

- Connection Agreements
- Charging Statements
- The Distribution Connection and Use of System Agreement
- Master Registration Agreement

GOVERNMENT POLICY:

- The Clean Growth Strategy 2017
- Upgrading our Energy Systems: Smart Systems and Flexibility Plan 2017 (also 2018 update)

TECHNICAL STANDARDS

- Engineering Recommendations
- Security and Quality of Supply Standard (SQSS)

PERFORMANCE STANDARDS:

- Guaranteed standards and DG standards

EU NETWORK CODES

- Requirements for Generators
- Demand Connection Code
- System Operation Guidelines (SOGL)

RENEWABLE GENERATION:

- FITs and CfD

TARIFF REGULATION:

- Ofgem Price Controls

PERFORMANCE STANDARDS

- Guaranteed standards and DG Standards

Distributed Generation Connection Guide: An Introduction

Who is this Guide for?

This Guide is intended to help you, as a developer or the prospective owner of Distributed Generation, to connect your generating unit to a distribution network in Great Britain. It may also be useful for installers or manufacturers of distributed generation equipment.

The types of generation that most frequently connect to the distribution networks include:

- renewable energy projects;
- waste to energy projects;
- energy storage devices (e.g. batteries); and
- on-site generation and Combined Heat and Power (CHP) projects.

What is the aim of the Guide?

The main aim of the Guide is to provide a 'route map' of the processes for getting a generation project connected to the distribution network. The Guide provides an overview of the connection process, as well as more details on the application stage.

The connection process involves discussions and agreements between you and your Distribution Network Operator (DNO). This process is more likely to be successful if you and the DNO can communicate effectively and understand each other's concerns. So, in addition to its main aim of providing a 'route map' of the connection process, the Guide has a number of other aims:

- to provide background information about the GB power sector and the role Distributed Generation has to play;
- to describe the main factors affecting connection costs and ongoing charges;
- to highlight your options relating to your connection works, identify different contracts relating to your connection and discuss some day-to-day operational issues; and
- to describe two key financial incentives for Distributed Generation: Feed-in Tariffs (FITs) and Contracts for Difference (CFD).

What is not covered in the Guide?

In addition to arranging a connection to the network, you will also have other issues to address in order to get your project up and running. These include:

- Designing, installing and operating the generation installation
- Buying and selling electricity (beyond FITs and CFDs)
- Planning the project
- Financing the project
- Resolving local planning issues

These issues are outside the scope of this Guide, but you will need to about these in parallel with the connection process.

Note that this document covers the process for connecting generation to the distribution networks in Great Britain. Northern Ireland has different connection arrangements, for example different versions of Engineering Recommendations G98 and G99 are in use. For more information, refer to the Northern Ireland Electricity website: www.nie.co.uk

Distributed Generation Connection Guide: An Introduction

The format of the Guide

This Guide has been written and formatted with you, the reader, in mind. In particular we think this Guide will be useful for customers with generation, installers and developers. We have tried to make this Guide as clear and easy to read as we can, bearing in mind that some of the issues discussed are technical and complex. In particular:

- Terms which may be unfamiliar are defined or explained in boxes around the main text.
- Key points and summaries are highlighted.
- Text is **emboldened** for emphasis.
- Where necessary the Guide distinguishes between the arrangements that apply in Scotland and those which apply in England and Wales. This is indicated with a Scottish flag.
- At the end of most chapters there is a pointer on where to find more information.

Though this Guide is intended for the general public and should not require the reader to be technical or familiar with the energy industry, please be aware that the topics covered here are technical and complex. It is therefore necessary to refer to such concepts as voltage and power. Where possible, terms that may be unfamiliar have been explained.

Governance of the Guide

This Guide is a Distribution Code Review Panel (DCRP) document. The DCRP will update the Guide using similar processes it has for updating other distribution related documents.

There are many areas of regulation and legislation relating to Distributed Generation which are evolving and a number of issues are under consultation. The Guide has tried to capture the most up to date position at the time of writing. However, for the most up to date information you should refer to key documents and organisation websites. Please see the reference section for more information.

Governance of related Codes and documents

Many of the codes and other documents described in this guide are governed in such a way that any interested and materially affected party can propose a change to the codes and documents. This includes the Connection and Use of System charging arrangements (for both distribution and transmission) and the Distribution and Grid Codes. There are also groups with Distributed Generation community and DNO representation where issues can be raised and discussed which may lead to changes being proposed.

The overarching group to discuss commercial and procedural issues associated with connection is the ENA DER (Distributed Energy Resource) Connections Steering Group. Any issues you have for the Group should be raised through trade associations who are represented. Please note that practices between DNOs may be different; for example where the connection requirements are location specific or the connection risks and the network characteristics are different.

Distributed Generation Connection Guide: Is this the right Guide for my project?

The process of connecting Distributed Generation to the electricity distribution network varies depending on the size of the generation to be connected, and the specific technology to be used. In general, the larger the generation capacity, the more complex the process.

The Engineering Recommendations that cover the connection of Distributed Generation to the electrical distribution network are: EREC G98 (for smaller generation capacities) and EREC G99 (for all other projects). These are described further in the information boxes on the following pages.

A number of a Guides have been developed:

- EREC G98 compliant units in a single premises;
- EREC G98 compliant units in multiple premises within a close geographic region;
- A guide for EREC G99 Type A Power Generating Module
- A guide for EREC G99 Type B-D Power Generating Modules; and

A "summary" version of each Guide, containing the minimum, essential information from each chapter, is also available—refer to the ENA website.

The table on the next page includes a quick check for finding the right Guide for you. Read the information boxes for further explanations of terms that may be unfamiliar to you. Where you are installing multiple asynchronous or inverter connected generating units, the application process (ie EREC G98 or G99) is based on the total installed capacity of the generating units. Where you are installing synchronous Power Generating Modules, the application process (ie EREC G98 or G99) is based on the capacity of each generating unit. If you are adding new generating units to an existing installation, refer to guidance on page 27.

Important note: Generation projects can no longer connect under EREC G83 and G59. Generation will only be allowed to connect under EREC G98 and G99, with an exception for certain generators. For more information on this transition, refer to "Recent Changes to Regulations" page—just before Chapter A.

Distributed Generation Connection Guide: Is this the right Guide for my project?

<table>
<tr><th>Guide</th><th colspan="2">Criteria</th></tr>
<tr><td>A guide for connecting Distributed Generation that falls under EREC G98 in a single premises</td><td>Installation of one or more Distributed Generation units at a single premises.</td><td rowspan="2">Distributed Generation is compliant with EREC G98 if:
• It meets the size definition of Micro-generator;
• It is installed in accordance with EREC G98. Your installer should be familiar with these requirements; and
• It has been tested and approved according to the relevant Type Testing Annex in EREC G98.</td></tr>
<tr><td>A guide for connecting Distributed Generation that falls under EREC G98 in multiple premises</td><td>Installation of Distributed Generating units at more than one premises within a close geographic region.</td></tr>
<tr><td>A guide for connecting Type A Power Generating Modules under EREC G99</td><td colspan="2">This Guide is written for installations where:
• The registered capacity is >16 A/phase and above, but less than 1 MW; and
• The connection point is below 110 kV (in practice in GB this is at 66 kV or below).</td></tr>
<tr><td>A guide for connecting Type B—D Power Generating Modules under EREC G99</td><td colspan="2">This Guide is written for installations where the registered capacity is at or above 1 MW, or for any generation connected at or above 110 kV (in practice in GB this is at 132 kV or above).</td></tr>
</table>

Distributed Generation Connection Guide: Is this the right Guide for my project?

Engineering Recommendation G98

EREC G98 is called "Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks". It sets out the requirements you must meet before your Micro-generator can be connected to the network. The capacity threshold refers to the **aggregate generating capacity installed in a single premises**. EREC G98 is available on the Distribution Code website.

The document is aimed at the manufacturers and installers of your Micro-generator.

Engineering Recommendation G99

EREC G99 is called "Requirements for the connection of generation equipment in parallel with public distribution networks". The purpose of the document is to provide guidance to you and to DNOs on all aspects of the connection process. It contains a glossary of items and diagrams of Power Generating Module types and categorisation, which you may find helpful. EREC G99 is available on the Distribution Code website.

Micro-generator

A Micro-generator is defined in EREC G98 as "A source of electrical energy and all associated interface equipment able to be connected to an electric circuit in a Low Voltage electrical installation and designed to operate in parallel with a public Low Voltage Distribution Network with nominal currents up to and including 16A per phase. For the avoidance of doubt this includes electricity storage devices". 16 A per phase corresponds to **3.68 kW on a single-phase supply and 11.04 kW on a three-phase supply,** and refers to the **aggregate Micro-generator capacity installed in a single premises.**

Close Geographic Region

Typically, a Close Geographic Region is one which is fed by the same part of the distribution network, from a single feeder or distribution transformer. Your DNO will be able to advise you as to whether your Micro-generators are within a close geographic region. A general rule of thumb is that if your Micro-generators are within 500 meters of each other, or if the post codes are the same at least up until the last two letters, then they are likely to be within a close geographic region.

Distributed Generation Connection Guide: Is this the right Guide for my project?

Inverters

An inverter is an electrical device that converts Direct Current (DC) to Alternating Current (AC). This is required when you want to connect a generating unit with a DC output (eg. a Photovoltaic array) to the distribution network, which operates at AC.

The term Micro Inverter is used to describe small scale inverters which are connected to (multiple) small generating units, such as individual PV panels. This is often done so that if one panel is impaired for any reason, then the output of the others is not affected.

Type tested equipment

Type tested equipment is defined in EREC G98 and G99 as "A product which has been tested to ensure that the design meets the relevant requirements of this EREC G98/G99, and for which the Manufacturer has declared that all similar products supplied will be constructed to the same standards and will have the same performance". Examples of products which could be type tested include generating units, inverters and the interface protection. Using type tested equipment simplifies the connection and commissioning process.

EREC G98 and G99 annexes contain methodologies for testing equipment against a set of test conditions to demonstrate compliance. The manufacturer produces a Type Test or Compliance Verification Report to demonstrate compliance. Where the whole Micro-generator or Power Generating Module is type tested (rather than just a part), it is Fully Type Tested. All Micro-generators connecting under EREC G98 must be Fully Type Tested. The Fully Type Tested concept also applies in EREC G99.

The ENA hosts an online Type Test Verification Report Register. This contains certificate and test documentation for generation products and enables product identification and information sharing. The product manufacturer is responsible for uploading and maintaining data and documentation relating to their products. You can access the register at: http://www.ena-eng.org/gen-ttr/

Equipment Certification

The ENA are working with potential Equipment Certificate providers and manufacturers to investigate formal G98 and G99 equipment certification. This will be progressed throughout 2019.

Distributed Generation Connection Guide: Is this the right Guide for my project?

Emerging Technology

EREC G98 and G99 have a relaxed set of requirements for generation that is classified as an Emerging Technology. This is because the Requirements for Generators (RfG) allows for this. The Emerging Technology status only applies to Type A generation, which has a generating capacity of 0.8 kW to 1 MW and is connected at less than 110 kV (in practice in Great Britain that is 66 kV or below). The Emerging Technologies are:

- 'Baxi Ecogen' generators (the specific products are the Baxi Ecogen 24/1.0, Baxi Ecogen 24/1.0 LPG and Baxi Ecogen System)
- KD Navien stirling engine m-CHP (Hybrigen SE) (the specific products are the 'NCM-1130HH – 1 KWel' and the 'NCM-2030HH – 2 kWel')
- Pellematic Smart_e
- Dachs Stirling SE Erdgas and Dachs Stilring SE Flussiggas

RfG Types A to D

The European Requirements for Generators (RfG) Code has introduced the classification of Power Generating Modules by Types. There are four types, A to D, and they relate to the registered capacity and connection voltage of the Power Generating Module. In Great Britain, the Types are:

Type A: From 0.8 kW to < 1 MW and connected at < 110 kV

Type B: From 1 MW to < 10 MW and connected at < 110 kV

Type C: From 10 MW to < 50 MW and connected at < 110 kV

Type D: ≥ 50 MW or connected at ≥ 110 kV

Note that in different European countries, the capacity and voltage thresholds may differ.

The technical requirements in RfG are less onerous on the smaller Power Generating Modules, and increase cumulatively for the larger Power Generating Modules, ie a Type B Power Generating Module must meet the requirements for Type A and Type B. Some requirements are common across all European countries. However, some requirements have country-specific parameters, which have been set by national network operators. That means that some of the parameters in Great Britain are different in Northern Ireland, and other European countries.

Apart from pumped-storage, electricity storage devices are excluded from RfG requirements—so if electricity storage devices are part of your installation and are connected via separate inverters from other generation, their capacity does not count for determining RfG Type classification.

Recent Changes to Regulations

Requirements for Generators

The European Third Energy Package was adopted in July 2009, and has been law since March 2011. The Third Energy Package refers to a suite of legislation for both Electricity and Gas. It has three key objectives:

1. Enhancing sustainability and helping the European Union meet its decarbonisation obligations;
2. Ensuring security of supply in light of a changing generation mix; and
3. Creating a single European Market for Electricity.

The Third Energy Package requires the development of European Network Codes. The Network Codes cover three areas: grid connection codes; market codes and system operation codes. One of the Codes is called Requirements for Generators (RfG). This sets out requirements which new generators will need to meet.

The RfG, which became a binding EU regulation in May 2016, is available on the EUR-Lex website.

A joint Distribution Code Review Panel (DCRP) and Grid Code Review Panel (GCRP) workgroup was charged with implementing the Requirements for Generators in GB. This included setting parameters that the RfG leaves to national interpretation. The workgroup proposed changes to the Grid Code, Distribution Code and supporting Engineering Recommendations. The revised documents were consulted upon with stakeholders by the GCRP and the DCRP.

This work resulted in the publication of Engineering Recommendations G98 and G99, as well as revisions to the Distribution Code and Grid Code. These new EREC documents apply to generation that is connecting to the distribution network. The old EREC G83 and EREC G59 should no longer be used after the 27th April 2019.

Drivers for the Requirements for Generators

The EU Network Codes aim to harmonise technical and market rules to help to minimise barriers to energy trading. They also aim to prevent wide-scale technical events, and to help to recover the system if there is such an event in the future. There has been a huge increase in the amount of generation connected to distribution networks – in Great Britain and across Europe. It has been recognised that Distributed Generation can and needs to do more to provide support to the power system, so that generation supports system frequency, remains connected if possible and rides through faults – rather than tripping off, and potentially exacerbating any problems.

The Requirements for Generators contains technical requirements, which have been incorporated into EREC G98 and G99, so that generating units can provide such system support. For example, there are requirements for:

- All Type B, C and D Power Generating Modules to stay connected to the distribution network when there is a fault on the transmission system;
- Type B, C and D inverter connected Power Generating Modules (eg solar PV, battery storage, wind turbines) to provide support in the event of a network fault, using a technique called Fast Fault Current Injection (the design of synchronous machines means they inherently provide support during faults);
- All Power Generating Modules to provide support in the event of a high frequency event (Limited Frequency Sensitive Mode – Overfrequency); and
- Type C and D Power Generating Modules to provide support for low frequency events (Limited Frequency Sensitive Mode – Underfrequency).

Recent Changes to Regulations

These requirements have been introduced so that generation of all sizes can help to provide system support.

The new rules applies to all generation, not just Distributed Generation.

Key Terms for EREC G98 and G99

In the process of drafting EREC G98 and G99, the opportunity was taken to align with European terms used (eg from the Requirements for Generators document) and to consolidate terms previously used in GB documents. This means some new terms have been introduced, which are used widely in the documents. The key terms are summarised on this page, and some are explained further in break out boxes throughout the document or in the main text. Terms that are particularly relevant for EREC G98 are indicated with a *.

Fully Type Tested*	The whole Micro-generator / Power Generating Module is type tested, rather than just part of the Micro-generator / Power Generating Module.
Micro-generator*	A source of electrical energy and all associated interface equipment connected at Low Voltage to the distribution network, with nominal currents up to and including 16 A per phase.
Micro-generating Plant*	An electrical installation with one or more Micro-generators with nominal currents in sum not exceeding 16 A per phase.
Generating Unit	Any apparatus that produces electricity.
Power Generating Module (PGM)	Either a Synchronous Power Generating Module (SPGM) or a Power Park Module (PPM) - see below.
Synchronous Power Generating Module (SPGM)	An indivisible set of Generating Units—ie one or more units which cannot operate independently of each other—which generate electrical energy in synchronism.
Power Park Module (PPM)	Generating Units that are connected to the network either through power electronics (eg solar PV or electricity storage devices connected through an inverter) or asynchronously (eg some wind turbines are induction or asynchronous generation). They have a single Connection Point to the distribution network.
Power Generating Facility (PGF)	One or more Power Generating Modules connected to at one or more Connection Points. This is a Power Station in EREC G59.
Registered Capacity	The normal full load capacity of a Power Generating Module less the MW consumed when producing the same (ie auxiliary load). For Power Generating Modules connected via an Inverter, the Inverter rating is the Power Generating Module's rating.
Type A / B / C / D	Classifications of Power Generating Modules by size and connection voltage, to determine technical and compliance requirements.

A: A Guide to the UK Power Sector

In this section:

- An overview of the commercial structure of the power sector
- An introduction to the UK power sector and how it is changing
- A discussion about the various types of organisations that you may come across while developing your Distributed Generation project
- A discussion on Network Innovation projects
- Guidance on where to find more information

Tip: Read the information boxes for definitions or explanations of terms that may be new or unfamiliar.

Introduction

Understanding a little about the UK power sector may be useful when discussing your Distributed Generation project. This section aims to give some background explanation about the UK power sector and how it is changing to meet the challenges of protecting the environment and changing Government policy.

There are many organisations involved in the UK power sector, which are introduced in this section.

Apart from the physical structure of the power sector, there is also a commercial structure, which is discussed in this section.

The Commercial Structure of the Power Sector

The commercial structure of the electricity industry in Great Britain provides a competitive market in electricity retailing. This enables customers to contract with any one of a number of competing electricity suppliers. The sale of energy is also a competitive market. Note, your Feed-In Tariff level is an indication of the minimum you can expect to be paid for the electricity you generate.

Generators sell the electricity that they generate in the wholesale market or directly to suppliers. Suppliers sell the electricity they purchase to customers. The majority of trading occurs in advance of the time of use.

The wholesale market is governed by British Electricity Trading Transmission Arrangements (BETTA), which was introduced in 2005.

If you install Distributed Generation you can use the electricity you produce on site to reduce the amount of electricity that you need to buy thus lowering your electricity bills.

You can also sell electricity to customers, suppliers or, depending on the size of the generation, on the wholesale market. You can read more about power trade options in Section F. Selling Electricity.

The Physical Infrastructure of the Power Sector

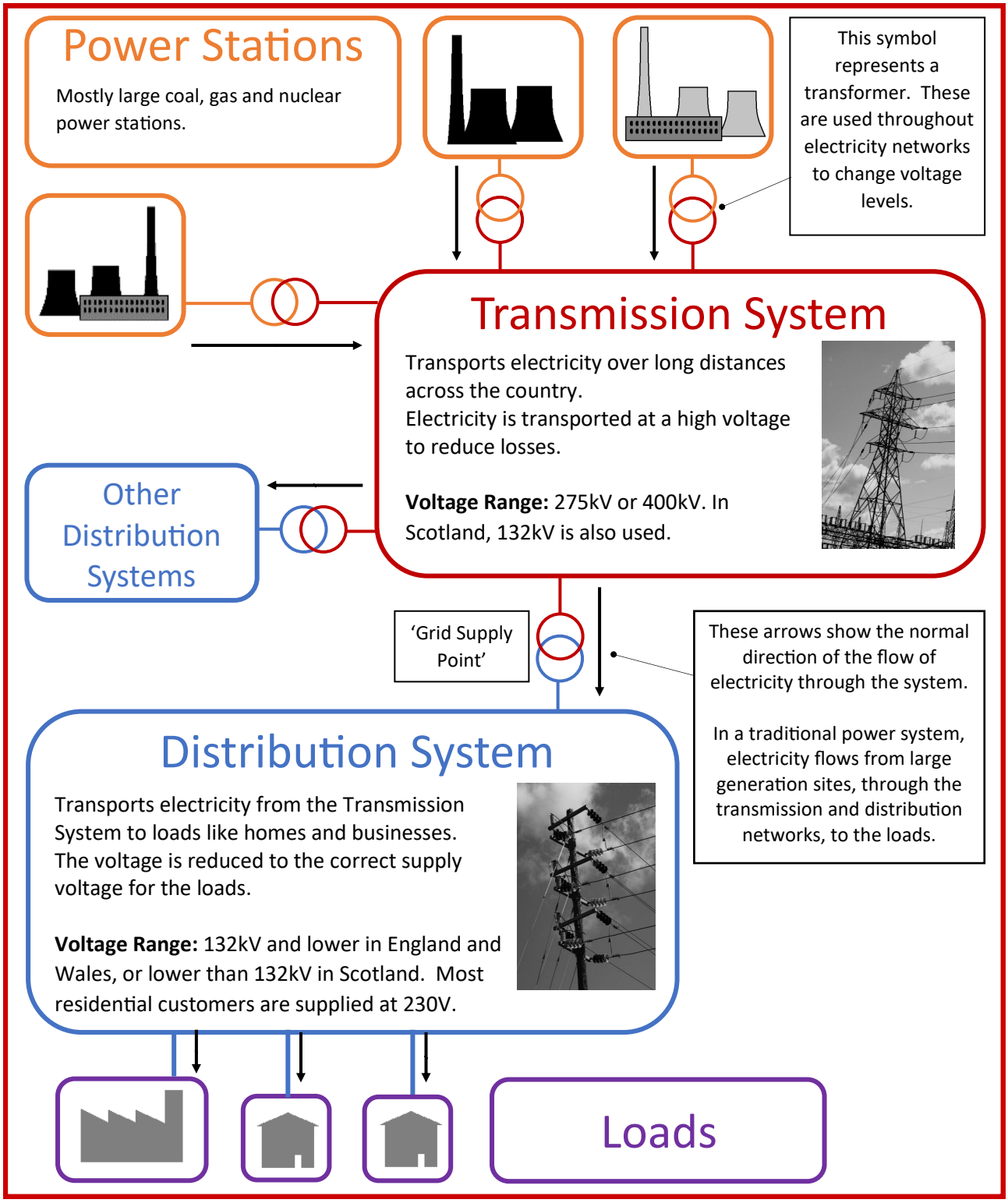
Traditional electricity system

The diagram below illustrates the infrastructure of the traditional power sector.

Large power stations feed into the transmission system, and the electricity is then transported to the distribution system.

The distribution system carries the electricity to loads, such as homes and businesses.

The transmission and distribution systems are also called transmission and distribution networks. Both terms are used in this Guide.



The Physical Infrastructure of the Power Sector

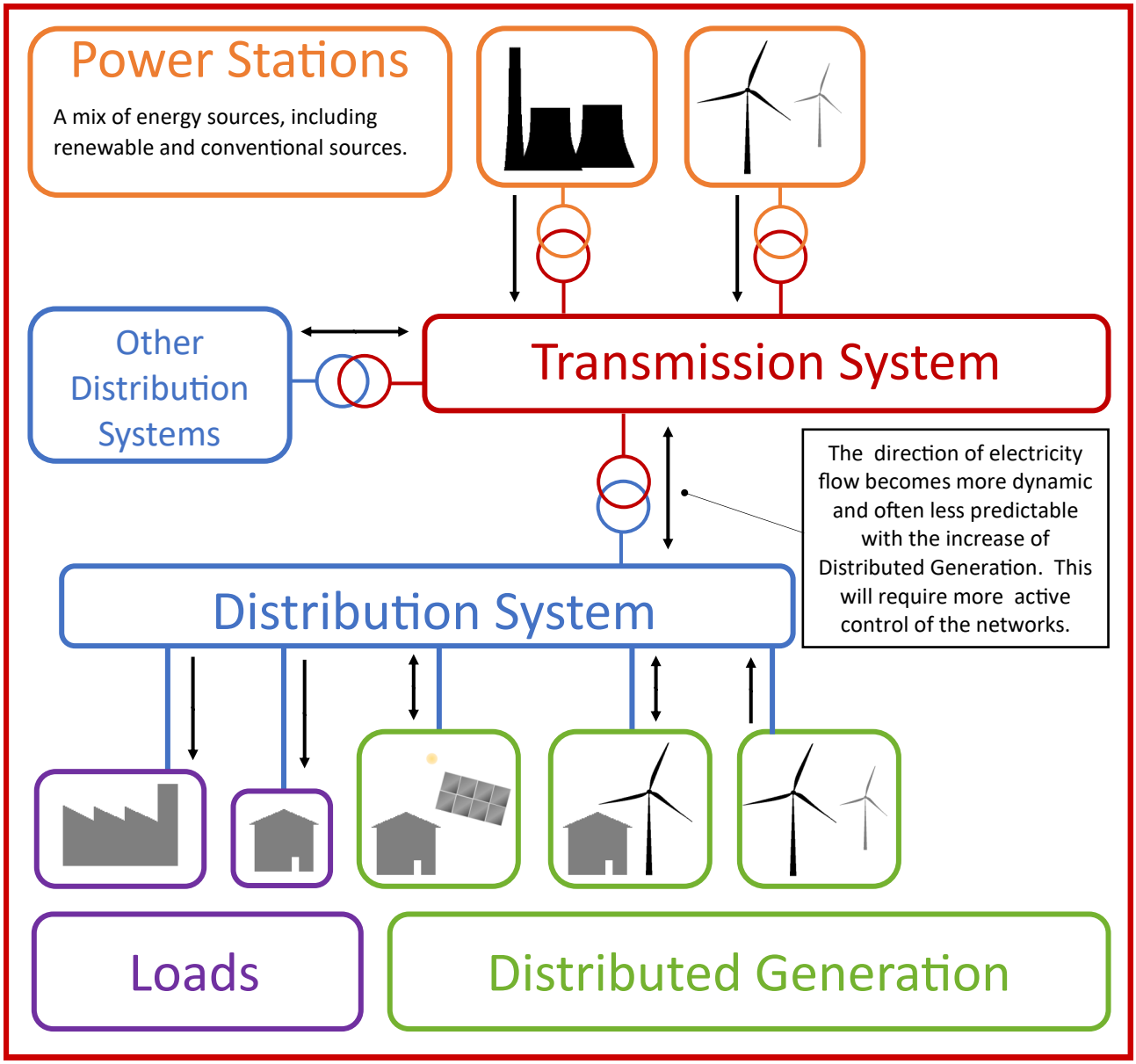
Changing electricity system

In addition to the large power stations connected to the transmission system, an increasing number of small power stations are being developed, often connected to distribution networks. Generation connected to the distribution network is called Distributed Generation. The diagram below illustrates this changing electricity system.

Distributed Generation can result in electricity flows in both directions; from the distribution network to customers, and from customers with Distributed Generation back into the distribution network. The system is no longer a "waterfall" system, with electricity flowing from the large power stations in one direction towards customers. Instead, electricity flows are more unpredictable.

Distributed Generation (DG or 'Embedded Generation')

A generation project is classed as Distributed Generation if it operates while electrically connected to the distribution network. Energy generated from Distributed Generation may be used onsite, or some or all of it may be exported to the distribution network.



Key Organisations

The transmission and distribution systems are owned and operated by regulated monopoly businesses. Transmission and distribution businesses recover the costs of operating and maintaining their systems by levying Use of System charges on electricity traded using their network.

Distribution Network Operator (DNO)

A DNO owns, operates and maintains public electricity distribution networks in one or more regions in the UK. They must hold a Distribution Network Operator Licence. Under the terms of their licence, each DNO is allowed to distribute electricity both inside and outside its legacy geographic area.

There are six DNOs in Great Britain. The regions where they operate are shown on the map below.

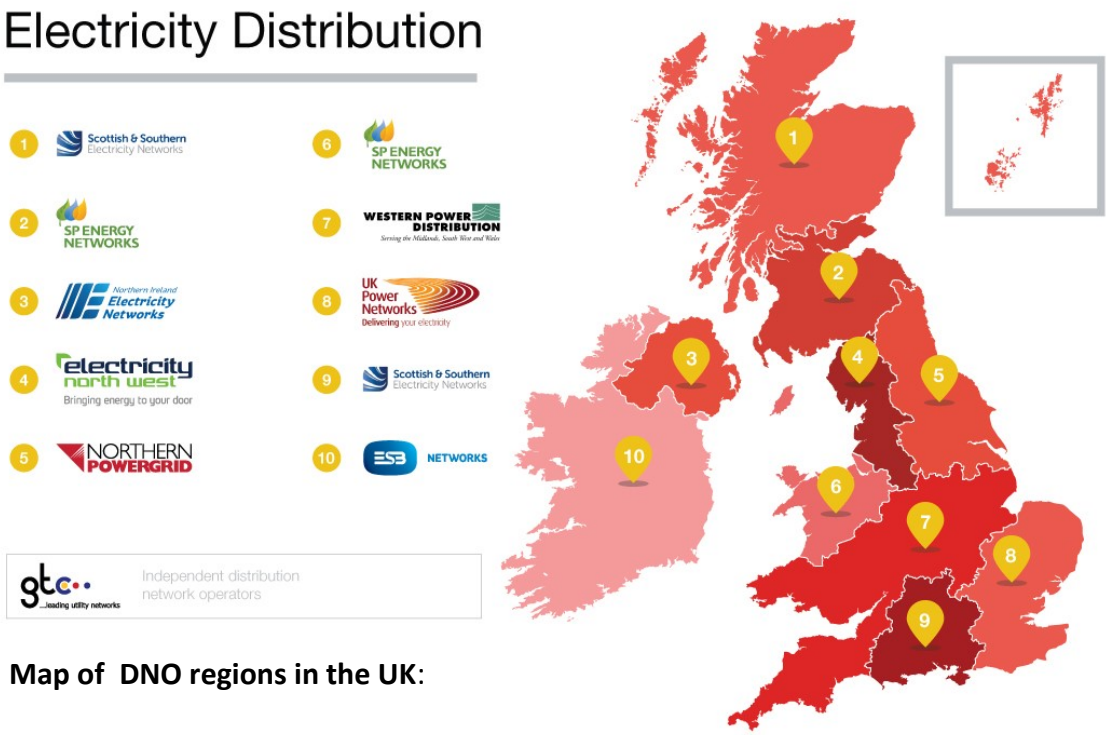
To facilitate competition in supply, each DNO is required to allow any licensed supplier to use its distribution network to transfer electricity from the transmission system (and from Distributed Generation) to customers. DNOs charge suppliers for using the distribution system.

DNOs can form part of a group that undertakes other areas of business as well, eg. electricity supply. However, these businesses have to be kept separate, and you, as a developer, will have to interface with the network operator business.

Independent Distribution Network Operators (IDNOs)

An IDNO designs, builds, owns and operates a distribution network, which is an extension of an existing DNO network. They typically build network for new developments such as business parks and residential areas. IDNOs differ from DNOs in that:

- they do not have service areas (they are not tied to a geographical location);
- they are regulated like DNOs, though have fewer licence conditions to meet.



Map of DNO regions in the UK:

For DNO website details, please see the membership area of the ENA website.

Key Organisations

If you are connecting your Distributed Generation to an IDNO's network, the process is almost identical to that if you are connecting to a DNO. There are a few exceptions to this, which are discussed in Section C of this Guide.

Transmission Owner (TO)

A TO owns and maintains the high voltage transmission system, known as the National Electricity Transmission System, referred to in this Guide as the transmission system. Transmission Owners are responsible for making sure that transmission services are available to the System Operator (see explanation later in this section). The Transmission Owners are as follows:

- **National Grid Electricity Transmission (NGET)** in England and Wales
- **SP Energy Networks (SP Transmission plc)** in southern Scotland
- **Scottish and Southern Electricity Networks (Scottish Hydro Electric Transmission plc)** in northern Scotland (Scottish Hydro Electric Transmission Ltd, or SHETL)

Private Networks

Private networks are similar to IDNO networks in that they are extensions of the DNO network which are not owned by the DNO itself. The owners of private networks are distinct from an IDNO because they do not need to be licenced and are unregulated.

For example, private networks can be owned by hospitals, airports, industrial sites, etc. This Guide is not intended to address connections to private networks. If you are connected to a private network, you should discuss your plans with the network owner as soon as possible.

Suppliers

Supply is the retail of electricity. Suppliers buy electricity in bulk from generators, and then sell to consumers. They are responsible for providing bills and customer services, and arranging metering and meter reading. Electricity supply is a competitive market so you can choose and change your electricity supplier.

Aggregators

Aggregators specialise in co-ordinating demand and generation (including storage) to provide demand response and other market services. The Network Operators and Suppliers may buy demand response and other grid balancing services from aggregators.

Energy Service Company (ESCO)

A Government paper defines ESCOs as "a company that provides a customer with energy solutions" rather than simply being an electricity or gas supplier. ESCOs can enter into long-term contracts to provide information, installation, finance, operation and maintenance. There are various models the ESCO can take. ESCOs can work on a performance contract, where they guarantee energy savings and make charges based on the extent to which these savings are achieved. This model is typically used by commercial and industrial customers. ESCOs can also work for communities, servicing a group of customers in the same local area.

ESCOs may develop into a household model, to provide energy efficiency savings and small scale generation for home owners, rather than just supplying electricity.

Generators

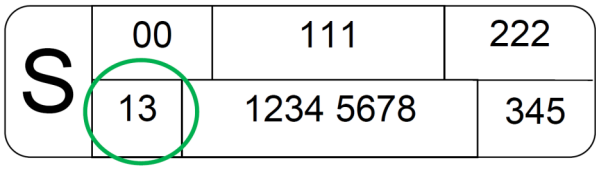
Generators own, operate and maintain Power Generating Facilities which generate electricity from various energy sources, eg. coal, gas, hydro and nuclear. Newer generation technologies include wind, solar, tidal and wave. See the end of this section for links to more information on generating technologies.

Key Organisations

To identify your DNO or IDNO:

If you already have a meter at your site, find the first two digits of your **MPAN** (Meter Point Administration Number), which is shown on your electricity bill, and may be shown on your meter. This corresponds to your DNO or IDNO, see table below.

Example MPAN, with first two digits indicated



If you do not have a meter at your site, you can contact the DNO whose geographic area you believe you are in and they will be able to confirm. See the map on page 14.

First 2 MPAN digits	Service Area	Distribution Business
10	Eastern England	UK Power Networks– Eastern England
11	East Midlands	Western Power Distribution (WPD) – East Midlands
12	London	UK Power Networks (UKPN) – London Power Networks (LPN)
13	Cheshire, Merseyside and North Wales	SP Energy Networks – Cheshire, Merseyside and North Wales
14	West Midlands	Western Power Distribution (WPD) –West Midlands
15	North Eastern England	Northern Powergrid (NPG)
16	North Western England	Electricity North West (ENW)
17	Northern Scotland	SSE Power Distribution – Scottish Hydro Electric Power Distribution
18	Southern Scotland	SP Energy Networks
19	South Eastern England	UK Power Networks (UKPN) – South Eastern Power Networks (SPN)
20	Southern England	SSE Power Distribution – Southern Electric Power Distribution
21	Southern Wales	Western Power Distribution (WPD) – South Wales
22	South Western England	Western Power Distribution (WPD) – South West
23	Yorkshire	Northern Powergrid (NPG)
24	No area—IDNO	GTC (Independent Power Networks)
25	No area—IDNO	ESP Electricity Limited
26	No area—IDNO	Energetics Electricity Limited
27	No area—IDNO	GTC (The Electricity Network Company)
29	No area—IDNO	Harlaxton Energy Networks Limited
30	No area—IDNO	Leep Electricity Network Limited
31	No area—IDNO	UK Power Distribution Limited
32	No area—IDNO	Energy Assets Networks Limited
33	No area—IDNO	G2 Energy IDNO Limited
34	No area—IDNO	Murphy Power Distribution Limited
35	No area—IDNO	Fulcrum Electricity Assets Limited
36	No area—IDNO	Vattenfall Network Limited
Tbc.	No area—IDNO	Utility Assets Limited

Key Organisations

System Operator (SO)

Electricity cannot be stored at a large scale and so demand has to be balanced with generation on a second by second basis by the System Operator. The SO makes requests of generators to increase or decrease output from their units, or may ask some large customers to control their demand. NGESO is the System Operator in Great Britain. Following a government consultation on greater separation between the System Operator role performed by National Grid and the rest of the National Grid group, National Grid has established a new, legally separate company to carry out the Electricity System Operator function within the National Grid Group, which is called the National Grid Electricity System Operator (NGESO). This separation took place on 1st April 2019.

Balancing Settlement Code company

Elexon is the company that manages the balancing and settlement of electricity trading. They do this by identifying where generators have not generated the amount of electricity they are contracted to produce, and suppliers' customers have not consumed the amount of electricity that was expected. Out of balance parties are charged based on the additional cost to balance supply and demand (often by buying or selling electricity at short notice).

The Balancing and Settlement Code (BSC) governs the operation of this balancing mechanism.

Regulator

The Office of Gas and Electricity Markets (Ofgem) is responsible for:

- regulating prices and performance in the monopoly elements of the electricity supply industry;
- resolving disputes between different parties when necessary; and
- granting licences for the following activities in the power sector:
  - Generation
  - Transmission (and interconnection, a transmission link with another country)
  - Distribution
  - Supply

Generation licence requirements for Distributed Generation are discussed in Section D. The Connection Application: Generation Licensing.

European organisations

The regulatory arrangements that apply across continental Europe are implemented by National Regulator Authorities (NRA) in each member state of the European Union; Ofgem is the National Regulatory Authority for Great Britain. The regulations are required to comply with policy criteria determined by the European Parliament and implemented through European Directives and Regulations. To assist with this process in relation to electricity networks, a number of bodies have been set up that represent regulators and transmission system operators. National Energy Regulators work with the Agency for the Cooperation of Energy Regulators (ACER) and the Council of European Energy Regulators (CEER) on policy developments in different areas of electricity market liberalisation.

ENTSO-E, the European Network of Transmission System Operators for Electricity, is a membership body for Transmission System Operators (TSO). ENTSO-E promotes cooperation across Europe's TSOs. One of ENTSO-E's roles is drafting the European Network Codes, which includes the Requirements for Generators (RfG).

The UK's membership in these agencies post-Brexit will be subject to negotiations.

Network Innovation and Industry Developments

Innovation Funding

New challenges and applications in energy networks have motivated many projects that aim to develop innovative tools and products to improve the way networks operate and customers are connected.

Ofgem has a number of mechanisms that the DNOs and other organisations can use to fund electricity network innovation. The two main mechanisms for network companies are called the Network Innovation Allowance (NIA) and Network Innovation Competition (NIC), which apply to both electricity and gas distribution and transmission.

- NIA is an allowance each network company receives to fund smaller scale innovation projects which have the potential to deliver benefits to network customers.
- NIC is an annual competition, where network companies compete for funding for development and demonstration of network innovations such as new technologies or novel operating and commercial arrangements.

Learning from these projects is shared amongst all DNOs and TOs for the benefit of the power sector as a whole. Incorporation of the learning into business as usual practices is laid out in the business plans of the individual network companies.

For more information, and details about individual projects, refer to the Smarter Networks Portal, hosted by the Energy Networks Association:

http://www.smarternetworks.org/

Electricity Network Innovation Strategy

Following a review of the NIA and NIC, Ofgem proposed a number of changes to the innovation funding schemes. One of these was the requirement on network companies to collaboratively produce an industry wide innovation strategy. The Electricity Network Innovation Strategy sets out a jointly agreed roadmap which demonstrates how innovation can accommodate future whole-system requirements and lead to benefits. The document was first published on 29th March 2018 and will be reviewed every 2 years at a minimum. Further information is available on the ENA website.

Transmission and Distribution Interfaces

There has been a significant increase in the amount of connected Distributed Generation in the last few years. This has meant that the DNOs, TOs and the SO have to change the way they work together, to maintain an economic and secure network. In order to address these challenges, the Transmission Distribution Interface (TDI) Steering Group was established by ENA and its members. Network companies recognise the need for distribution and transmission companies to work together more closely in order to consider how they can tackle the whole system impact of Distributed Generation and other technologies such as storage.

In January 2017 the Open Networks Project was launched by the Steering Group. The aim of the Open Networks Project is to transform the way electricity networks operate and provide the first step towards creating a smart grid.

Full details of the work done so far can be found in the Open Networks Project 2018 report. Network companies have consulted on their future structure in a world where they become system operators. The 2018 report contains some case study examples of changes that the network companies are implementing. The work is continuing in 2019.

Network Innovation and Industry Development

New technologies

Active Network Management (ANM) schemes, which have been trialled in innovation projects, are now being included as part of Business As Usual Connection Offers. ANM uses control systems to manage Distributed Generation in constrained areas. Note that ANM connections may only be available in selected parts of the network.

Export limiting devices are also coming into use. These devices allow a limit to be set above which the generation will not export. This may allow generation to have a constrained connection, to reduce the need for reinforcement. If you want to explore the use of these devices, seek guidance from your DNO. ENA has published Engineering Recommendation (EREC) G100, which provides technical guidance on the connection of Customer Export Limiting Schemes that operate in parallel with the distribution systems of licensed DNOs. This is available on:

http://www.energynetworks.org/electricity/engineering/distributed-generation/engineering-recommendation-g100.html

Energy storage is becoming increasingly prevalent in distribution networks. For more information on network connected storage (eg. batteries), refer to Chapter C: Getting Connected—Energy Storage.

Where to Find More Information

There are some very good guides to the UK power sector available in the public domain. In particular, if you want to read more on this subject, you may wish to read the following:

- A Guide: Sale of Power Opportunities for Distributed Generators; DTI (Department for Trade and Industry);
- Guidance Note – The Electricity Trading Arrangements: A beginner's guide; Elexon

  www.elexon.co.uk/knowledgebase/about-the-bsc/

A good source of information on the organisations we have introduced are their own websites:

- Energy Networks Association —the industry body for UK energy transmission and distribution licence holders and operators: www.energynetworks.org
- A list of IDNOs can be found on the Ofgem website:

  www.ofgem.gov.uk/Networks/ElecDist/Policy/IDNOs/Pages/IDNOs.aspx
- Ofgem—The Regulator: www.ofgem.gov.uk
- National Grid —The Great Britain Electricity System Operator, and Transmission Owner in England and Wales: www.nationalgrid.com/uk/Electricity/
- Elexon—The Balancing and Settlement Code Company: www.elexon.co.uk

For more information on ESCOs, the following document is a useful reference:

- Making ESCOs Work: Guidance and Advice on Setting Up and Delivering an ESCO; London Energy Partnership, which is on the London Energy Partnership website: www.lep.org.uk

The following website gives more information on generation technologies:

- Energy Saving Trust: www.energysavingtrust.org.uk/Generate-your-own-energy

The GB Distribution Code, Annex 1 and Annex 2 documents and the associated GB Distribution Code User Guide can be found in the link below:

- DCode: http://www.dcode.org.uk/the-gb-distribution-code/

The GB Grid Code and the associated Guide can be found in the link below:

- GCode: http://www2.nationalgrid.com/UK/Industry-information/Electricity-codes/Grid-Code/

Information about licence exceptions and private networks can be found:

- UK legislation: http://www.legislation.gov.uk/uksi/2001/3270/contents/made

B: The Role of Distributed Generation

In this section:

- An introduction to the role of Distributed Generation
- A discussion on the drivers for Distributed Generation
- Some of the benefits and impacts of Distributed Generation
- References to some documents where you can find out more on these issues

Introduction

As explained in Section A of this Guide, the electricity industry is undergoing changes with increasing amounts of Distributed Generation being connected to the system. There are a number of drivers behind this:

- Environmental issues;
- New Government Policy;
- Security of supply; and
- Technological innovation.

In this section, these drivers are discussed in more detail. We will also introduce some of the benefits and challenges of Distributed Generation.

We refer to some useful documents and reports for further reading on this topic.

What is Driving Distributed Generation?

Environmental concerns

Globally there has been increasing concern over greenhouse gas emissions and the impact that they may be having on the environment.

Most of the electricity in the UK has traditionally been generated by power stations fuelled by fossil fuels, for example coal, gas and oil. The burning of these fuels makes a significant contribution to emissions.

There is therefore a drive to change the mix of generation technologies we have, to include more low-carbon options.

Technological innovation

Technology is developing all the time, and due to drivers such as environmental concerns and government policy, there are more generating technologies available now than there were when the national grid was being developed. For example, wind, wave, solar and biomass generation.

Although the connection and integration of these newer generating technologies may pose challenges, innovative technical solutions are being sought to overcome these challenges. These are discussed on page 18.

Government policy

The Department for Business, Energy and Industrial Strategy (BEIS) oversees energy policy and climate change mitigation policy. The UK energy supply is one of BEIS's key policy areas. BEIS is developing policy to ensure that in the UK energy supplies are secure, low carbon, and fuelled from a diverse mix of energy supplies. However, BEIS also has to ensure that energy prices are maintained at affordable levels. Relevant pieces of legislation include:

- Climate Change Act 2008
- Energy Act 2008
- Energy Bill

What is Driving Distributed Generation?

The Climate Change Act sets out legally binding targets for emissions reductions. As such, policy has been developed, which introduces initiatives such as:

- Climate Change Agreement (Climate Change Levy)
- Zero Carbon Homes

As well as legislation from the UK Government, the EU also introduces relevant legislation and initiatives, such as the EU Emissions Trading System and the European Third Package, which is driving a set of new European Network Codes.

Security of Supply

The UK increasingly relies on importing fuel, in the form of gas, coal and oil. This introduces a great deal of uncertainty as the cost and reliability of supply is outside of UK control. It is therefore an advantage to have a diverse mix of energy sources, which would make the UK less vulnerable to a restriction in fuel availability or rise in price.

It is also known that fossil fuels will eventually run out as they are being used much faster than they are being created. As they become more scarce, the prices will rise as the markets become more competitive. Therefore to ensure the security of the energy supply into the future, alternative sources are being encouraged.

Benefits of Distributed Generation

There are a number of benefits that increased Distributed Generation has for the UK and its electricity system. These include:

- **Increased energy mix** —Distributed Generation is often a renewable source of energy, such as solar, wind or biomass, or uses the energy in a more efficient way as with Combined Heat and Power (CHP) projects. Therefore increased Distributed Generation results in a lower carbon mix of energy sources in the electricity system.
- If Distributed Generation is connected close to the point of use, there is a **reduced need for the distribution and transmission infrastructure**. In some cases, this can delay the need for reinforcement, although the TO and the DNO also need to ensure that the network provides adequate security of supply for its users.
- Where there is a balance between Distributed Generation and local demand the **transmission and distribution losses are reduced**, when compared with the alternative of the centralised power stations and bulk transmission of electricity.
- The introduction of local generation in businesses and communities can lead to **greater awareness of energy issues**.

There are a variety of commercial benefits to having Distributed Generation, which include:

- **Self Consumption**, where you use the electricity that you generate to avoid importing from the grid, therefore lowering your electricity bills.
- **Selling electricity** that you generate, including gaining Feed In Tariff (FIT) payments and Contracts for Difference (CFD). This is discussed further in Section F: Selling Electricity.
- Climate Change **Levy Exemption Certificates (LECs)** are issued to generators of renewable energy and good quality Combined Heat and Power (CHP). These can be sold to the supplier

Benefits of Distributed Generation

along with the energy generated. Companies can use LECs to avoid paying the Climate Change Levy tax.

- **Embedded benefits** of the generating unit being connected to the distribution rather than the transmission network, eg. charge avoidance of Transmission Network Use of System charges and Balancing Services Use of System charges.
- Generators whose equipment has a capacity greater than 3 MW (and/or the ability to deliver in excess of +/- 15 MVAr of reactive power) can enter into agreements with NGESO to provide **Ancillary Services**, for which they will be paid.
- Generation that is not receiving low carbon support (eg. Feed-in Tariffs, Renewables Obligation) and does not have a long-term contract to provide Short Term Operating Reserves (STOR) to National Grid Electricity Transmission could be eligible to enter the **Capacity Market**, and receive payments for delivering energy at times of system stress.
- **EU Emissions Trading System (ETS)** - applies to approximately 10,000 energy intensive users in the UK such as metal industry, paper factories and refineries. These large energy users have been allocated green-house gas allowances for their operations. At the end of each year, they must ensure they have enough allowances to cover their emissions: they can buy additional allowances or sell any surplus allowances generated from reducing their emissions.

Impacts of Distributed Generation

As well as introducing benefits, the increased penetration of Distributed Generation in UK distribution networks also poses challenges. These will depend on a variety of factors, such as the generation technology, the voltage level the Distributed Generation is connected to, the size of the generating unit(s), the level of export to the distribution system, and on the type of network (eg. urban or rural).

Some examples of the challenges posed to distribution networks by Distributed Generation include:

- Distributed Generation changes the current flows and shape of the load cycle where they are connected. This could cause:
  - **Thermal ratings to be exceeded**.
  - **System voltage to rise** beyond the acceptable limits.
  - **Reverse power flows**, ie power flows in the opposite direction to which the system has been designed.
- Distributed Generation can contribute to **fault level**, which can raise the fault level above the rating of network equipment.
- There are a number of **power quality** limits that can be affected by Distributed Generation, including:
  - **Contributions to harmonics**, particularly if a significant number of invertor controllers are present.
  - **Voltage unbalance** which affects power quality, if there are lots of single-phase generating units.
  - **Voltage fluctuation or flicker,** if the output of the Distributed Generation changes rapidly.

Note: The technical terms used above are defined in the glossary.

Where to Find More Information

The amount of generation connected to distribution networks has increased significantly since 2010. Today there is over 27,000 MW of Distributed Generation in the UK. The benefits and challenges of Distributed Generation are complex, and the industry's understanding of them is evolving as experience increases. For more information on current initiatives in distribution networks, the following documents are useful:

- The Electricity Networks Innovation Strategy; Energy Networks Association; 2018
- The Open Networks project; Energy Networks Association

The following documents are useful if you want more information on Government policy:

- The Clean Growth Strategy; BEIS; 2017
- Upgrading our energy system: smart systems and flexibility plan; BEIS; 2017

For the most up to date information on relevant Government policy, refer to the BEIS website:

https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy

For more information on Embedded Benefits, the following document is useful:

- Embedded Generation and Embedded Benefits; Elexon; March 2019

C. An Overview of Getting Connected

In this section:

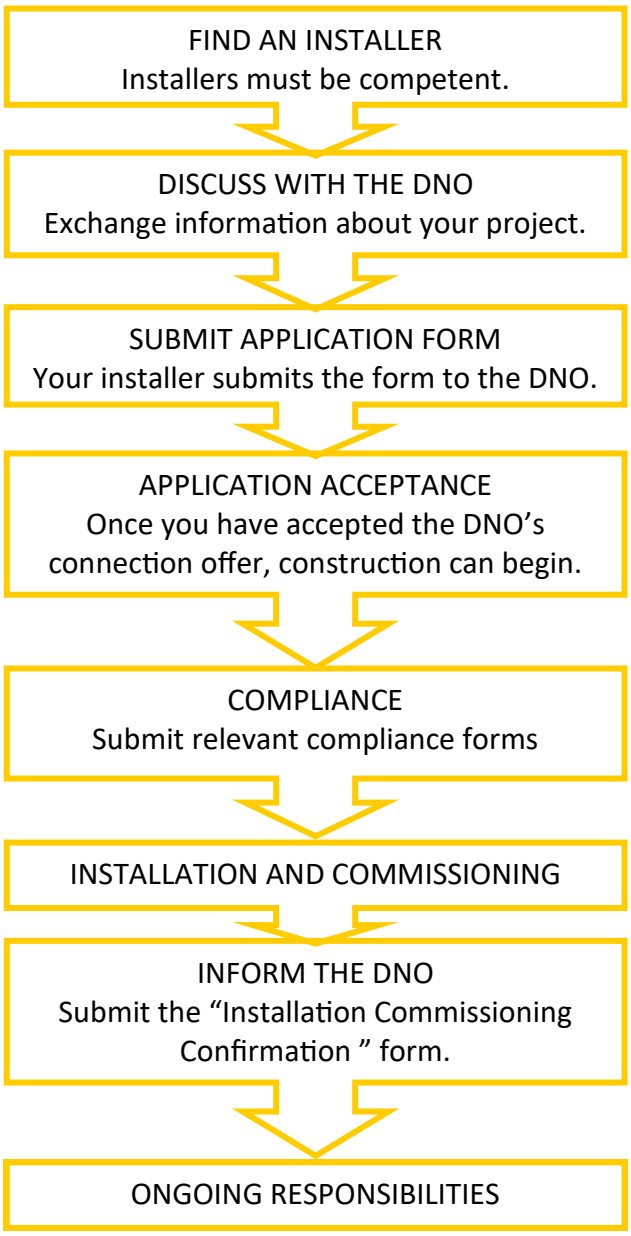
- The main tasks in the process of connecting Type A Power Generating Modules under EREC G99
- An explanation of the terms Power Park Modules and Synchronous Power Generating Modules
- Guidance on adding new generation to an existing installation
- The provision of information and customer service standards
- A discussion on connecting to an IDNO network
- Guidance on where to find more information

Introduction

This Guide describes the process for connecting Type A Power Generating Modules under EREC G99.

Under EREC G99, the technical and compliance requirements are less onerous for Type A Power Generating Modules, compared with Types B to D. A Type A Power Generating Module has a capacity between 0.8 kW and 1 MW, and is connected below 110 kV. However, this G99 Guide only applies to Type A Power Generating Modules > 16 A per phase. If you are installing a Power Generating Module that is ≤ 16 A per phase, you should refer to the G98 Guide.

The diagram opposite shows the key steps in the connection process. These tasks are based on the requirements set out in EREC G99.



Note that this document covers the process for connecting generation to the distribution networks in Great Britain. Northern Ireland has different connection arrangements, for example different versions of Engineering Recommendations G98 and G99 are in use. See www.nie.co.uk

Types of Power Generating Module

Power Park Modules and Synchronous Power Generating Modules

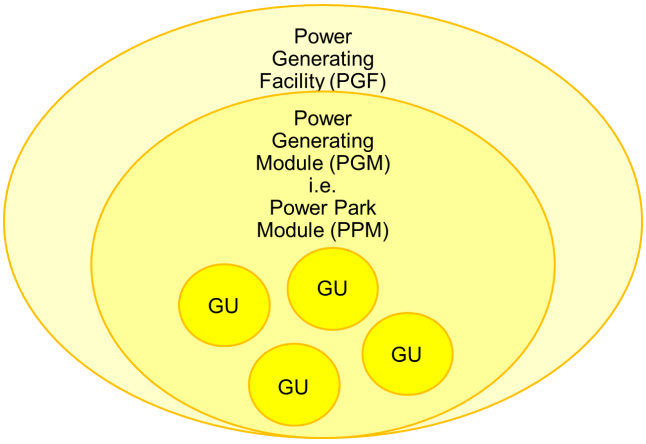
Power Generating Modules are classified in EREC G99 as Power Park Modules (PPM) or Synchronous Power Generating Modules (SPGM). Both comprise one or more generating units, which is any apparatus that produces electricity.

Power Park Modules (PPM) are connected to the network either through power electronics (eg. solar PV or electricity storage devices connected through an inverter) or asynchronously (eg. some wind turbines are induction or asynchronous generation). They have a single Connection Point to the distribution network.

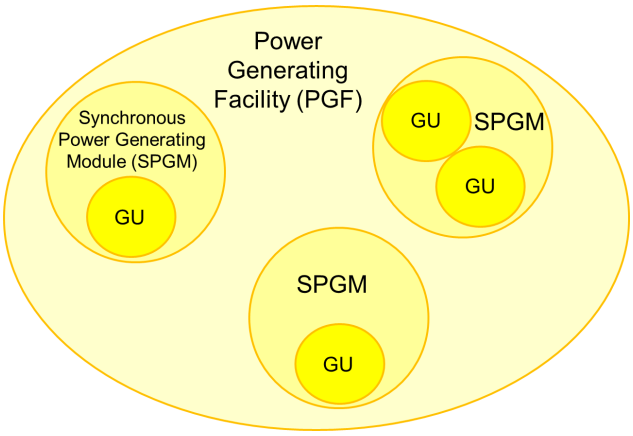
Synchronous Power Generating Modules (SPGM) are defined in EREC G99 as "an indivisible set of Generating Units (ie one or more units which cannot operate independently of each other) which can generate electrical energy such that the frequency of the generated voltage, the generator speed and the frequency of network voltage are in a constant ratio and thus in synchronism." Where the generating units cannot run independently from each other – eg. if they have a common shaft – they form a Synchronous Power Generating Module.

In terms of classifying your Power Generating Module as Type A to D – for a Power Park Module, this is based on **the total capacity of all generating units** in the Power Generating Facility (all behind a single Connection Point). For Synchronous Power Generating Modules, this is based on the capacity of **each** Synchronous Power Generating Module, even if there are multiple modules in a Power Generating Facility. This is illustrated in the diagrams.

Power Park Module - the classification of Type A to D is based on the capacity of the Power Generating Module (PGM), which is the total capacity of all generating units (GU) in the Power Park Module (PPM):



Synchronous Power Generating Module – the classification of Type A to D is based on the capacity of **each** Power Generating Module (PGM) in the Power Generating Facility (PFG):



Where generating units are connected via inverters, the inverter rating is deemed to be the generating unit rating. Note that where electricity storage devices are connected via separate inverters from other generating units, their capacity does not contribute to the aggregate capacity for Type A to D classification, as storage is excluded from RfG requirements.

Types of Power Generating Module

For example: A Power Generating Facility comprises three 400 kW Synchronous Power Generating Modules (SPGM). Although the capacity of the Power Generating Facility is 1.2 MW, the threshold for requirements is based on the capacity of each Synchronous Power Generating Module. As each is 400 kW, each SPGM must meet the Type A requirements in EREC G99.

Another Power Generating Facility comprises three 400 kW generating units (eg. wind turbines), which form a Power Park Module (PPM). The capacity of the Power Park Module is the total capacity of all of the generating units, ie 1.2 MW. The Power Park Module must meet the Type B requirements in EREC G99. There are further illustrations of examples in Section 4 of EREC G99.

New and Existing Generation

Power Park Modules

If you are adding new (ie connected under EREC G99) generating units to an existing (ie connected under EREC G59) Power Park Module installation, the new generating units will be treated as a separate Power Park Module. Only the capacity of the new generating units should be taken into account when determining the Type A to D category of the new Power Park Module (even though all units are behind a single Connection Point).

However, this is not the case if you are adding new generating units to an existing Power Park Module installation, where the existing Power Park Module was also installed under EREC G99. In this case, the total capacity of all generating units in the Power Park Module will determine the Type category.

This is the same irrespective of the technology – eg. if there are wind turbines and solar panels behind the same Connection Point, it is the total capacity of all units that determines the compliance requirements—unless there are electricity storage devices connected via separate inverters. Electricity storage devices are excluded from RfG, and their capacity does not count towards Type classification.

Synchronous Power Generating Modules

If you are adding new (ie connected under EREC G99) Synchronous Power Generating Modules (SPGM) to an existing (ie connected under EREC G59) installation, the compliance requirements for the new SPGMs are determined by the capacity of each new SPGM.

All Power Generating Modules

In all cases, if as a result of adding generation to an existing installation the total capacity of all Power Generating Modules (existing and new) exceeds the threshold for Embedded Medium or Large as defined in the Grid Code, then the Power Generating Facility will need to comply with relevant parts of the Grid Code.

There are further examples in EREC G99.

The Connection Point and Interface Protection

If you are installing new Power Generating Modules at an existing site (where the existing Power Generating Modules were connected under EREC G59), and where the interface protection is located at the connection point, you will need to consider the design of the connection including the location of the interface protection to ensure that all the generation on the site meets with all applicable requirements.

Getting Connected—Main Tasks

Finding an Installer

The first task is to find a competent installer. There are companies who design, install and commission domestic and other smaller generation. They can fully certify and sign off installations.

For installations up to 50 kW, certified generation products and installers can be found on the following website:

www.microgenerationcertification.org

The Microgeneration Certification Scheme is operated by the Department for Business, Energy and Industrial Strategy (BEIS).

Discussions with the DNO

You must discuss your plans with the DNO before starting work. You should do this as soon as possible in your planning, as the DNO's response may have a big impact on how you plan your project. You may discuss the feasibility of your connection, and if there will be any charges for connection (charges are discussed further in Section E: Costs and Charges).

All DNOs provide information to support generation developers, such as capacity heat maps, on their websites. These can be an important source of information. In addition, there may be dedicated generation 'surgeries' or 'drop in' sessions to discuss your project with the DNO.

Alternative Connections

Each DNO's current approach to offering alternative connection offers, such as Active Network Management, may be found on their website, noted in any connection offer or determined by discussion with the DNO.

Make contact with the DNO

Extra information can be obtained by making early contact with the DNO to discuss your project. This may be within dedicated generation 'surgeries' or 'drop in' sessions arranged by the DNO. Discussions might include:

- How close your proposed generation site is to the existing network;
- Whether there are any other planned Distributed Generation projects in the same area; and
- Whether there is any "spare" capacity in the network.

Feasibility studies (Optional)

At this stage, you could have feasibility studies carried out to assess possible connection layouts and indicative costs. These studies can be conducted by the DNO or an external contractor, for a fee. If you do opt for feasibility studies, they should take into account the standard of security required in the connection between your generating equipment and the DNO's network.

Decide who will construct the connection

A key decision you have to take is whether to:

- appoint an Independent Connections Provider (ICP) to do the Contestable work and the DNO to do the Non-contestable work; or
- appoint the DNO to carry out all of the work required to provide the connection.

Using an ICP to install the contestable work allows the work to be competitively bid for, meaning that it could bring some cost advantages. At the same time, using an ICP results in an additional relationship between the DNO and ICP which will need to be managed. If you are considering contracting an ICP to undertake the Contestable work, you may wish to invite quotations from a number of ICPs, as well as the DNO for comparison.

Submitting an application form

Once you have planned the project and exchanged information about your plans with the DNO, it is time to submit an application

form. If your Power Generating Module is less than 50 kW three-phase or 17 kW single-phase, then you can use a simplified application form. The format of the simplified application form is given in Annex A.1 of EREC G99, which is available from the Energy Network Association's website. G99 is also available via the DCode website. Your installer should submit the application form on your behalf. For larger schemes, you should use the standard application form, which is generally available on DNOs' websites.

You should do your best to provide as much of the information required in the application form as possible, to ensure your quote is as accurate as it can be. If you have difficulty filling out this form, you can discuss this with your DNO or engage an adviser such as an engineering consultant to assist you.

Application Acceptance

When you submit your application form you need to include technical details of the equipment. The DNO needs this information to assess the impact that your generating equipment may have on the network.

Once the DNO has conducted these assessments, they will produce a connection offer. This will specify the conditions for your connection, and inform you of any connection charge that you may be asked to pay (charges are discussed further in Section E: Costs and Charges). You should ensure that you fully understand this offer before accepting it. You should discuss questions with your DNO if you are unsure.

Connection offers are time limited. Your DNO will inform you how long the offer is valid for. If a Connection Offer has expired, there is no guarantee that the same offer will be made again, particularly if your development is in an area where there are many Distributed Generation projects.

Once accepted, Connection Offers may be withdrawn if the DNO feels that your plant is not progressing at a reasonable rate. This is to prevent spare capacity being 'reserved' for projects that in practice are not actually being built. A best practice guide to progression milestones was published in November 2016 which your DNO may use to track the progress of your project. You may be asked to provide regular updates about the progress of your project. This will enable the DNOs to proactively manage the queue on behalf of generation customers.

Enter into agreements with the DNO

You need to enter into a number of agreements with the DNO before your generating unit(s) can start operating, such as:

- A Connection Agreement
- An Adoption Agreement (only if you are using an ICP for your project)
- An agreement covering the arrangements for operating the interface between the distribution network and your generating equipment. This may be contained in a Schedule to the Connection Agreement, or in a separate agreement such as a

Contestable and non-contestable work

There are certain tasks that DNOs do themselves, so that they can maintain co-ordination and control of their networks. These tasks are called Non-contestable work, as they are not open to competition. Conversely, when work is open to competition it is called Contestable work. Contestable work can be conducted by Independent Connections Providers (ICPs). Often, tasks that involve reinforcing existing equipment are non-contestable. Tasks which include the installation of new infrastructure or extensions to the network tend to be contestable.

Site Responsibility Schedule or Joint Operational Agreement

Some of these agreements will be in place before construction begins.

Compliance

Power Generating Modules can:

- Be Fully Type Tested, or
- Comprise some Type Tested equipment, and/or use manufacturers' information (see break out box) to demonstrate compliance, and/or also require additional site testing.

If your Power Generating Module is:

- Fully Type Tested, and
- registered with the Energy Networks Association Type Test Verification Report Register

then your application should include the Manufacturer's reference number (the Product ID). In all other cases, you need to provide the DNO with a Compliance Verification Report. The format of these reports is given in Annex A.2 of EREC G99. There are different forms for Synchronous Power Generating Modules and Power Park Modules.

These forms are completed by the manufacturer of your Power Generating Module. However, you (or your installer on your behalf) should obtain these and submit them to the DNO as part of the connection process.

Installation and Commissioning

You should maintain close contact with the DNO throughout construction. This is so that you are aware of the timeline of any reinforcement works that they need to do, and you can plan your project with this in mind.

Commissioning can only take place once the construction is complete. EREC G99 details the commissioning tests that you or your installer needs to perform. For generating units covered by EREC G99, it is your obligation to undertake appropriate commissioning tests, which the DNO may choose to witness.

For a Fully Type Tested Power Generating Module connected at LV, your DNO will not normally need to witness the commissioning testing. However, your DNO may choose to do so. If this is the case, they will state this in their Connection Offer.

If your commissioning tests are being witnessed by the DNO, you or your installer should discuss the scope of the testing with the DNO from an early stage, and must submit the scope, time and date of the testing at least 15 days before commissioning takes place.

Fair and Effective Management of DNO Connection Queues: Treatment of Changes to Connection Requests:

The ENA Distributed Energy Resources (DER) Connections Steering Group published a consultation in response to Ofgem's strategy to create more efficient ways to connect to the distribution network. It specifically addresses concerns that when small changes are made to connection requests, they are treated as new requests and moved to the back of the queue. This can impact project timescales, costs and the network capacity available. The purpose of this consultation document is to bring further clarity about the concept of 'allowable change'. The proposals aim to provide DNOs with a clear and consistent approach when considering change requests to a current project. DNOs are aiming to publish their position during 2018. More information is available here.

Getting Connected—Main Tasks

Informing the DNO

You should notify the DNO **at least 28 days before** commissioning the Power Generating Module, and provide them with information on the installation and the full results of the commissioning tests. This information is captured in two forms, both of which are available in EREC G99 and on the ENA website:

- The Installation Document (Form A.3)
- Site Compliance and Commissioning Test Form (Form A.2-4), where required, eg. if the interface protection is not Type Tested and needs to be tested onsite.

If your commissioning is being witnessed by the DNO, then these forms can be filled out and handed to the DNO representative witnessing.

The forms include a declaration that the installer must sign. This states that the installation complies with EREC G99.

Note: DNOs may have their own versions of these forms on their websites—a web search should help you locate the forms you need, or try contacting your DNO.

Put commercial arrangements in place

If you have made arrangements with a supplier to buy electricity that you export, it is your responsibility to keep them informed of the proposed commissioning programme. In particular they should know the date you expect imports and exports across the connection to start.

Ongoing responsibilities

Although the focus of this Guide is to inform you about the process of connecting your generation to the distribution network, you should be aware that once it is connected you have some responsibilities. This includes:

- Keeping your generation equipment maintained by someone who is competent to do so;
- Performing periodic tests that are required by the DNO. They will discuss these with you;
- Informing the DNO if there are changes to the installation that affect the generating characteristics;
- Complying with Health and Safety requirements;
- Inform the DNO if something happens that affects the compliance of your Power Generating Module with EREC G99; and
- When you are decommissioning your generating unit(s), you need to send the DNO certain information. This is detailed in EREC G99 Annex D.1.

Annex D.3 in EREC G99 is called "Main Statutory and other Obligations" and summarises the main obligations on generators.

EREC G99 exceptions

If you are installing a generating unit under EREC G99 then the requirements apply in full in most circumstances. However, if your Power Generating Module is one of the following, some parts of the technical requirements in EREC G99 do not apply:

- Classified as an Emerging Technology (see Emerging Technology box on page 7)
- An electricity storage device
- Operating in infrequent short term parallel operation mode (ie operates in parallel with the distribution network no more than 5 minutes in any month, and no more frequently than once per week)

The full details of the requirements that do not apply are in EREC G99.

Getting Connected—Main Tasks

Changes to your Power Generating Module

If you need to replace a component of your Power Generating Module, or its protection system or interface protection, you must notify the DNO before making changes. You and the DNO will need to reach agreement on the significance of the change. If it is considered a small change, you will only need to confirm the compliance of the affected component with EREC G99.

However, if it is a significant change (eg you increase the capacity of your Power Generating Module), you will need to agree with the DNO the approach to be taken with the replacement equipment and in many cases submit a new Standard Application Form for the new equipment.

If you have an installation that was connected under EREC G59 and you replace a major component you should notify the DNO if the change alters the operating characteristics of the generating unit. If you replace all or part of the interface protection you should notify the DNO as they will need confirmation that the new protection complies with EREC G59 and may want to witness the commissioning of the new protection.

If you replace a generating unit or Power Generating Module that has been installed under EREC G59 you will need to discuss with the DNO whether the new equipment needs to comply with EREC G59 or be upgraded to be fully compliant with EREC G99.

For the addition of new Power Generating Modules, see page 27.

EREC G99 was introduced in May 2018. It is based on EREC G59, which was revised to take account of a European Network Code called Requirement for Generators. Generation connecting to the distribution network must connect under EREC G98 or G99.

Manufacturers' Information

Manufacturers' information is a term used in EREC G99. Along with Type Testing and onsite tests, it is another way of demonstrating compliance of a Power Generating Module with EREC G99 by providing information. The information is supplied by the manufacturer to the customer, who should send it to the DNO. The suitability of the information is agreed between the generator and the DNO.

Once the DNO is satisfied that the manufacturers' information they have received accurately represents the performance of the generating unit, it may be assigned a reference ID. If your generating unit already has manufacturers' information available and a reference ID, you can use this reference ID in your compliance forms.

Customer Service and Provision of Information

There are a number of drivers for DNOs to provide a good level of service to customers.

Price Control Proposals (RIIO-ED1)

Ofgem administers a price control regime which allows DNOs to earn a fair rate of return while limiting costs passed on to customers. The current price control period is called RIIO-ED1, which runs until 2023. The RIIO-ED1 proposals include a number of mechanisms to incentivise DNOs to provide a good service to Distributed Generation customers, including:

- A new Time to Connect Incentive for minor connections customers (less than 70kW and connected at LV);
- An Incentive on Connections Engagement (ICE) - to encourage DNOs to engage with and respond to the needs of major connections customers (which includes generation customers), and includes a requirement on DNOs to set out plans on what improvements they plan to make in the next regulatory year, consisting of;
  - Part 1: Plans for improvements for the forthcoming year; and
  - Part 2: Reviews the progress in the previous year.

  ICE workplans can be found on individuals DNO websites
- The Broad Measure of Customer Satisfaction (BMCS) surveys.

As part of the Incentive on Connections Engagement (ICE), DNOs publish annual ICE plans for stakeholder engagement.

Guaranteed Standards of Performance

The guaranteed standards of Performance are set out in Standard Licence Condition 15A. They include, for example, maximum timescales in which DNOs must provide you with a quotation (Connection Offer). Ofgem has guidance documents about these Standards on their website.

Distributed Energy Resources (DER) Forum

The DER Forums, hosted by the ENA on behalf of DNOs, are events that are used to explore issues and concerns around Distributed Generation connections, including barriers to Distributed Generation and process issues. They are open to anyone, and are attended by DNOs and developers. Details can be found on the ENA Events website.

Improvements made to DNO Services

In recent years, there have been a number of improvements to DNO services as a response to these drivers and feedback, including:

- Increased internal resources;
- Improved provision of information, including more detailed breakdown of costs, web portals, decision support tools/application hotline, and capacity "heat maps", indicating areas that can more readily facilitate connections;
- Holding stakeholder and customer events; and
- Exploring the possibility for discussions prior to formal application ("connection optioneering"). This process is being carried out in different ways by different DNOs. Refer to your DNO for more information.

DNOs have promised to bring about continued improvements, including:

- Shortening connection timescales;
- Enhancing the publicly available network capacity information, eg. contracted capacity reports;
- Publishing case studies; and
- Enhancing the connection application and the wayleaves/consents processes.

DNOs publish Distributed Generation 'Work Plans' that outline progress against improvement initiatives. Check your DNO's Distributed Generation web pages.

Getting Connected — Energy Storage

Storage devices for electrical energy are becoming more prevalent, and can be used as part of Distributed Generation schemes to allow generated electricity to be stored within the premises rather than exported to the distribution network.

DNOs treat storage as demand when its importing from the distribution network and generation when its exporting to the distribution network, and need to be aware of storage because of the potential impact on their networks. Therefore, storage devices need to meet the relevant connection requirements (EREC G98 or G99). Some of the technical requirements in EREC G99 do not apply to storage – these are detailed in EREC G99 Annex A.4. If you are planning to use storage in conjunction with PV (or other technologies) to offset consumption, the total connected generation is likely to be above 16A / phase and EREC G99 applies. However, DNOs have implemented a fast track application process, for domestic scale storage. This involves submitting the G99 Form A1-2 : Application for connection of Fully Type Tested Integrated Micro Generation and Storage installations and reduces the connection time from 45 days to 10 days or less. If the storage is intended to be operated in island mode (during a power outage) the fast track process is not applicable and the standard EREC G99 process applies.

Getting Connected — Vehicle to Grid

Vehicle to Grid (V2G) is in its infancy and trials are being undertaken to further understand and demonstrate its benefits. The electric vehicle will be considered as both a demand and a generator by DNOs. The generator application will depend on the power export capacity of the V2G and what generation or storage devices are already connected at the designated charging point.

Where the total of all generation, fixed storage and the power export capacity of the V2G is < 50 kW 3-phase or 17 kW single-phase, the G99 simplified application Form A1-1 can be used.

Where the total of all generation, fixed storage and the power export capacity of the V2G is > 50 kW 3-phase, the connection application should be made using the Standard Application Form. It is likely that V2G will be > 16 A/phase and therefore G98 is not applicable and G99 should be used.

Getting Connected — IDNO's Networks

The process for connecting your Distributed Generation to an IDNO's network follows EREC G99, and is therefore similar to connecting to a DNO's network. IDNOs are licensed entities and are bound by some of the same licence conditions as DNOs, including certain performance standards such as timescales for responding to requests for quotes. The majority of what is included in this guide applies to both DNO and IDNO connections.

However, there are a few key differences for a Distributed Generation connection to an IDNO network:

- **Provision of Information:** IDNOs have a reduced set of licence conditions compared with DNOs, and they are not obliged to provide the same documents for customers. IDNOs are not required to produce Long Term Development Statements nor Connection Charging methodologies and statements.
- **Interaction between the IDNO and the DNO:** When an IDNO receives an application for connection for Distributed Generation, they need to get approval from the DNO before they can offer to connect you. If your generation project would cause certain network parameters to exceed defined limits, such as voltage or export to the DNO network, the IDNO and DNO will explore options for accommodating your project. This discussion will take place between the IDNO and the DNO, and will not involve you directly. However, the IDNO may then discuss different options with you for the most appropriate generation project to be connected.
- **Formal Agreements:** IDNOs will not necessarily insist on the same set of formal agreements that the DNOs will. Agreements such as the connection and adoption agreements may not be required.

To determine whether you are connected to a DNO or IDNO network, refer to the guidance on page 16.

Where to Find More Information

If you want to find out more, these documents are particularly relevant:

- Engineering Recommendation G99, Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019. This can be downloaded free of charge via the DCode as well as ENA website.
- Engineering Recommendation G59, relating to the connection of generating units to the distribution systems of licensed Distribution Network Operators. This is not applicable to generation connecting after the 27th April 2019.
- Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002, Section 22: Statutory Instrument Number 2665, available free of charge.
- Ofgem's information about how to get an electricity connection for a new building or site.

Some DNOs have produced their own guidance notes for generation connections - check your DNO's website.

Other useful documents and links

- Independent Connections Providers (ICPs): see the Lloyds Register website information on the National Electricity Registration Scheme (NERS)
- Metering Codes of Practice
- The IET Wiring Regulations (British Standard 7671) are available to buy on the IET website
- Ofgem's information about how to get an electricity connection for a new building or site

Where to Find More Information

Health and Safety considerations

Safety is very important in the design of generation connections. Some of the safety requirements for Distributed Generation connections are set out in EREC G99. This document references the Regulation that informs these requirements, the Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002, and also lists the relevant British Standards.

You can find out more about Health and Safety aspects of Distributed Generation connections on the following websites:

- The Electrical Safety Council (ESC): www.esc.org.uk
- The Energy Networks Association—Safety, health and environment: www.energynetworks.org/electricity/she/overview.html

Supply Issues

Your DNO is obligated to maintain the power quality on their network within a set of defined limits. These include maintaining voltage at the required levels. This is so that customer equipment is not damaged. If you have a voltage complaint you should contact your DNO. Your DNO should respond to your complaint within 5 working days, or visit within 7 working days. If work is required to correct the issue, the DNO should complete this within 6 months.

Dealing with disputes

If you are not satisfied with a particular aspect of service during the process of connecting your generation, your first port of call should be the party with whom the issue lies, eg. the DNO, supplier, etc. DNOs have their complaints process set out on their website. If you still cannot resolve the issue you can contact the Energy Ombudsman:

www.ombudsman-services.org/energy.html

If you are still unable to resolve the matter, as a last resort it can be referred to Ofgem.

D. The Connection Application: Connection Application Process

In this section :

- How to apply to your DNO to install Power Generating Modules
- Details of the connection offer that the DNO will produce for your connection
- How to notify the DNO that your Power Generating Modules have been installed and commissioned in accordance with EREC G99

Introduction

This section of the Guide describes the application process for the connection of your Power Generating Modules to the distribution network. This includes the application for connection form, and the connection offer from the DNO.

This section also explains the forms that your installer will need to provide to the DNO, including:

- compliance forms, and
- notifications once the units are commissioned.

This section is written for installations where the Power Generation Module to be installed is categorised as being Type A in EREC G99, and where the output is greater than 16A per phase. If this does not apply to your installation, please refer to the section at the beginning of this guide entitled "Distributed Generation Connection Guide: Is this the right Guide for my project?".

There is more information on the connection application process in the Guide for EREC G99 Type B – D Power Generating Modules, including:

- Wayleaves for new connections;
- Interactive connection applications; and
- The Statement of Works process and recent developments in this area.

These are unlikely to be relevant for connecting Type A Power Generating Modules, but if these do impact your project, refer to the EREC G99 Types B to D Guide for more detailed information on these topics.

The Standard Application Form

For Power Generating Modules with capacity less than 50 kW 3-phase or 17 kW single phase there is a simplified connection application form in Annex A.1 of EREC G99, which is available from the ENA website. This form is simpler than the form required for larger Power Generating Modules. It requires information about the site, any existing generation on the site, and some simple details of the equipment you are intending to install.

For larger Power Generating Modules there is a standard application form, which is available on the ENA website and generally on DNO websites.

The Standard Application From

The standard application form contains a comprehensive list of data requirements to assist the DNO with carrying out system studies to assess your connection. You should do your best to provide as much of this information as possible as part of your connection application to ensure your quote is as accurate as it can be. If you have difficulty with filling out this form, you can discuss this with your DNO or an adviser such as an engineering consultant to assist you.

You or your installer should submit the application form to the DNO before any generation equipment is installed, as the DNO needs to assess the possible impact of your generating equipment on the distribution network.

The standard application form is used as an iterative document, developed as the connection and commission process develops. It is used to record information about your generating units that needs to be provided to the DNO before commissioning, to comply with the requirements set out in the Distribution Code DDRC.

When the application has been submitted to the DNO, they will assess the impact of the generation on their network. Where necessary, they will carry out design work, eg. for network reinforcement. This will be detailed in your Connection Offer.

The Connection Offer

The Connection Offer that you will receive from your DNO should contain a number of key pieces of information. These include:

- details of the equipment and works needed to connect your generating units to the distribution network;
- information about any works needed to extend or reinforce the DNO's network as a result of connecting your generating unit to the system;
- any technical and commercial terms which will apply for the DNO to construct the connection and provide Use of System services to the developer;
- Any other useful information such as whether the DNO will need to witness commissioning of your units.

The offer will also contain details of the costs for the DNO to undertake any work. Further information about these costs is given in Section E: Costs and Charges.

You will have a defined period specified in your Connection Offer within which to accept the offer. This will typically be in the range 30-90 days. Make sure you are aware how long your acceptance period is, as this can vary across DNOs. There is no guarantee that once a connection offer is lapsed that a similar offer can be made again.

Connection Offers may also be withdrawn if the DNO feels that your plant is not progressing at a reasonable rate. This may be measured by progress against milestones set out in your Connection Offer. This is to prevent spare capacity being 'reserved' for projects that in practice are not actually being built. Your DNO may specify reasonable milestones to be met to prove the progress of your project.

It is possible that there will be other Distributed Generation in development in the same area of the network. If this is the case, your application may affect, or be affected by, another connection application. In this case

The Connection Offer

all the relevant applications are referred to as "interactive". The DNO will tell you in writing if your connection application is interactive with one or more others. The Connection Offer will also specify that it is interactive with other applications.

Interactive connection applications are considered on the basis of 'first come first served'. The DNO uses the date and time that your Connection Application was made to put your Connection Offer in priority order compared to other applicants. For more information on interactive applications, see the EREC G99 Types B to D Guide.

Connection Conditions

The DNO may include certain conditions or restrictions in order for the connection to be put in place. Your Connection Offer will include details of these, and if you need to know more information then you can discuss this with your DNO. You will have to agree to these conditions in order to accept the Connection Offer.

Flexible Connection Offers

The DNO will decide if a connection is viable by considering the worst case scenario for the network. If the connection of your generation would cause equipment ratings or statutory limits to be exceeded, then the DNO would not allow the connection without addressing the issues identified. The DNO may decide that the best thing to do is to reinforce the existing network so that it can cope with new power flows. However, this could be prohibitively expensive for your project.

In these cases, or where the customer has requested, the DNO may offer a connection with certain restrictions, such as setting a maximum level for export, or restricting generation export under certain network conditions. This could involve entering into a specific commercial arrangement.

Even with a standard Connection Agreement, in rare operational scenarios it may be necessary for the DNO to curtail the operation of a generator in order to, for example, maintain safety or power quality.

If NGESO is involved in your project (eg. if your DNO has requested a Statement of Works for any transmission system works required), then they can impose conditions on your connection. Your DNO must ensure that NGESO conditions are met before they allow connection.

Reactive Power Import / Export

The apparent power at any point on the network is the product of the voltage and current at that point. The apparent power is made up of two components, the real power and the reactive power. It is likely that real power is the electrical power you are more familiar with. It is measured in Watts (W), and is the useful power that we import into our houses to run our electrical goods. However, there also needs to be a balance of reactive power on the network. It is the DNO's responsibility ensure that the distribution network can cater for both real and reactive power.

Your generating unit will be capable of controlling the amount of reactive power that it absorbs or produces, and it is possible that the DNO may request that you operate in a certain way. It may be possible to mitigate negative effects that your generator might have on the network (eg. rise in system voltage) by controlling the amount of reactive power you produce or absorb. This may allow you to connect a higher capacity generator. You can discuss this option with your DNO.

Compliance Forms

If your Power Generating Module is Fully Type Tested and registered with the Energy Networks Association (ENA) online Type Test Verification Report Register, it will have a manufacturer's reference number (or Product ID on the ENA website). This means that the Power Generating Module meets the requirements of EREC G99, and the manufacturer has submitted information to the ENA that demonstrates this. You should include the reference number on your application form, and do not need to submit anything further to demonstrate compliance.

Otherwise, your Power Generating Module may comprise a mixture of type tested components, components where the compliance is demonstrated using manufacturers' information, and components that will need to be tested on site. In this case you (or your installer) need to submit information to indicate how you are intending to demonstrate compliance with EREC G99.

This is done by submitting a Compliance Verification Report for each Power Generating Module. The format of this report is given in Appendix A.2 of EREC G99. There are several options (Forms A.2-1, A.2-2, A.2-3), depending on the size of your Power Generating Module, and the type (synchronous, asynchronous, inverter connected). These forms should be submitted prior to arranging commissioning.

In some cases (eg. where interface protection is not Type Tested) you will need to demonstrate elements of compliance on site. You can do this at the time of commissioning (see below). In this case, there is a Form A.2-4 in EREC G99 called "Site Compliance and Commissioning test requirements for Type A Power Generating Modules", which sets out the format of recording the relevant test results. Where the DNO witnesses commissioning, this can be submitted to the DNO on the day. Otherwise, this should be submitted to the DNO within 28 days.

The Installation Document

Commissioning should take place once the installation and connection is complete (or in the case of a phased installation, when the phase is complete). The tests and checks required for commissioning are described in section 15 of EREC G99.

The results of the commissioning should be recorded on the Installation Document, which is included in Annex A.3 in EREC G99, available on the ENA website.

You or your installer should fill out this form, and sign the declaration at the bottom. The information required includes:

- details about the site where you are connecting your Power Generating Module, including metering information;
- contact details for the installer/owner of the generating unit;
- technical information about the Power Generating Module itself, including the generating capacity, type test reference and technology type;
- details of the installer of the Power Generating Module, including the party's accreditation and qualifications;
- supporting information, eg. circuit diagrams;
- a signed declaration as to the compliance of the Power Generating Module with the requirements of EREC G99; and

The Installation Document

- a signed declaration as to the compliance with the site compliance and commissioning tests, if applicable (Form A2.-4).

There are two parts to the Installation Document:

- Part 1 is required for the Power Generating Facility; and
- Part 2 is required for each Power Generating Module.

The Installation Document must be submitted within 28 days of the date of commissioning (including the commissioning day itself). If the DNO witnesses the installation, then the form can be filled in on the day and handed to the DNO representative.

Other Requirements

The declaration that your installer (or you) signs on the Installation Document requires them to confirm that they've installed your Power Generating Modules in accordance with EREC G99. It's important that you use an installer who is familiar with the requirements of these standards. If you appoint a competent installer (see Section C: An Overview of Getting Connected), they should know about these standards and make sure that your installation meets with all the relevant standards.

E. Cost and Charges: Overview of Charges

In this section:

- An introduction to connection costs
- The basis of DNO connection charges for infrastructure
- Other elements of connection charges and where to find indicative costs and examples
- Generation Distribution Use of System charges and metering arrangements

Tip: Read the boxes for definitions or explanations of terms that may be new or unfamiliar.

Introduction

There are two categories of charges made by the DNO:

- **Connection charge**: this is a one-off charge made by the DNO, which primarily covers the cost of work and equipment associated with connecting your generating project to the distribution network. This includes a portion of reinforcement costs.
- **Use of System charges**: these are ongoing charges, which primarily cover operation and maintenance costs and include an element to cover the costs of ongoing network development including general reinforcement.

DNOs are obliged to publish documents describing the basis of their connection charges and their charging methodology. They also present the different elements of connection charges, and indicative costs for works and equipment of significant cost. This will help you to understand the charges they quote you. This information is contained in the DNOs Statement of Methodology and Charges for Connection to the electricity distribution system. All DNOs' statements follow the same format, and are available on their websites. This document contains:

- The DNO's connection charging methodology (ie how they calculate their charges);
- The DNO's connection charging statement (ie what the charges are);
- An indication of the costs of providing a connection quotation / budget estimate; and
- Other relevant information for connecting customers.

The basis and elements of connection charges, as well as indicative costs and examples are discussed in this section.

Use of System charges are levied by the DNO on the supplier, so as a generator you will not be charged these directly. However, this section is included for your information, as Use of System charges may appear as an item on your bill.

Connection Charges—Infrastructure

The connection provides an electrical path between your generation installation and the DNO's network. Any work required to establish this connection will result in some initial costs, which will be charged to you upfront as part of the connection charge.

The work required to provide this path can be broken down into two categories:

1. **New infrastructure** (or extension) must be installed to provide an extension of the existing network. This is from the point of connection on the existing network up to the new point of supply.
2. Some **reinforcement** of the existing network infrastructure may be required to accommodate your planned generation capacity.

These are illustrated in the figure below and the point of connection is defined in the Glossary.

Reinforcement work is usually required to increase the electrical capacity of those parts of the network which form part of the electrical path from the generating equipment to the network. However, some reinforcement work does not fit this description, for example:

- It may be necessary to install switchgear at a substation some distance from your project site. This could be due to the increase in fault level caused by the connection of your generator, or to create a new protection zone.
- Equipment such as reactors or static VAR compensators may be needed for times when the voltage may rise, eg. when your generating equipment is exporting at times of light demand.

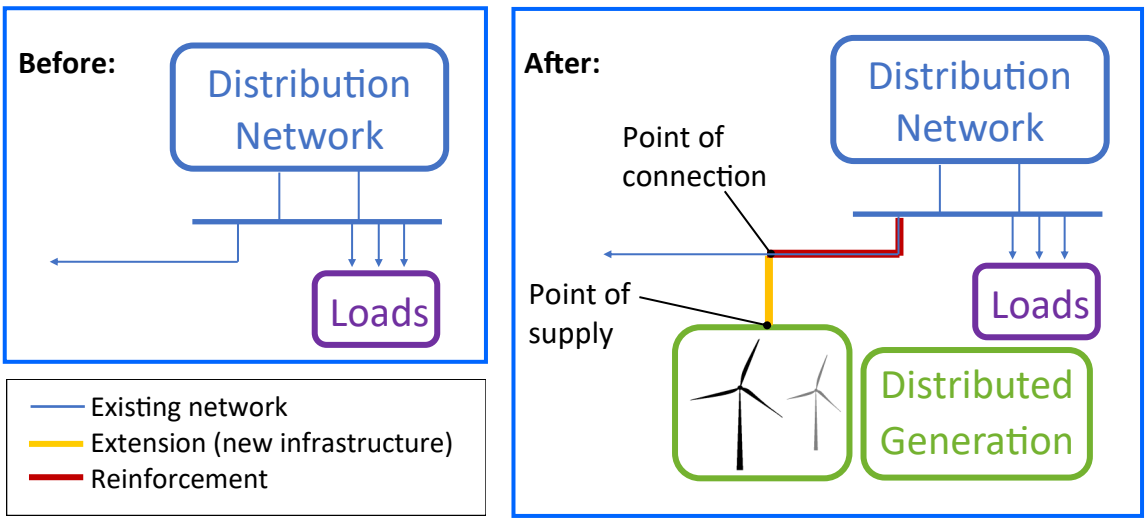
The asset costs that are included in the connection charge include:

- Any extension to the network
- A **portion** of reinforcement costs

DNOs are obliged to publish a document describing the basis of their connection charges and their charging methodology. You can refer to this document to see what portion of reinforcement costs you will be charged for. These are available on DNO websites.

In some cases, Distributed Generation may have an effect on the transmission network. In this case your DNO may need to request a Statement of Works from NGESO. Refer to the G99 Types B—D Guide for more information.

Extension and reinforcement



Connection Charges—Other Elements

Elements of charges

As well as charges for the reinforcement, there are other elements that are covered in the connection charge. These can include the following:

- System / feasibility / fault level studies
- Provision of Wayleaves
- Additional meetings with the DNO or site visits
- Administration

Note that not all DNOs apply charges for all of these items, and that not all of these items will be relevant for your project.

Indicative costs and examples

Equipment costs and charges for services vary across DNOs; it could therefore be misleading to list indicative costs in this Guide. If you want to get an idea for indicative costs, the best place to look is the **DNO's Statement of methodology and charges for connection**. You can find this on the DNO's website.

Aside from giving indicative costs for connection charges, these documents typically contain other useful information, including guidance on the connection process and examples of various connections and their associated cost breakdown. It is updated annually.

The connection charging methodology is governed by the Distribution Connection and Use of System Agreement (DCUSA) and is subject to open governance so any party materially affected by it can propose a change to it. The process for doing this is laid out within the DCUSA itself. See the DCUSA website for more information: www.dcusa.co.uk

The Distribution Charging Methodologies Forum exists to enable parties to discuss ideas for improving the methodology possibly prior to submitting a formal change proposal.

Estimating costs and getting a quotation

As mentioned, you can obtain indicative costs for works and equipment from DNO documents. To obtain a more accurate picture of the connection costs for your project, you can:

- Ask the DNO for a budget estimate
- Obtain an estimate of connection costs from a specialist engineering consultant

You should exercise care in interpreting budget estimates. DNOs use reasonable endeavours to identify remote reinforcement costs associated with the proposed connection at this stage. However, it is possible that not all of the reinforcement costs will be included at this time.

Connection Offer expenses (Assessment and Design fees)

Following a recent government consultation, BEIS is now allowing DNOs to charge Connection Offer expenses (also known as Assessment and Design fees), regardless of whether or not the subsequent Connection Offer is accepted. Connection Offer expenses are a charge by the DNO for the cost of producing Connection Offers, and cover activities such as network modelling, connection design and site surveys. These changes came into force in April 2018. For further information on the recent consultation, refer to the BEIS website. Note that DNOs are applying these charges differently. For example, some are only applying them to projects with certain connection voltages. Refer to your DNO website for details on how they are applying the charges.

Connection Charges—Other Elements

Payment of connection charges

Connection charges are paid either:

- in full at the time that the connection offer is accepted; or
- in staged or phased payments, as per a payment schedule.

Staged payments are typically used for generation projects which are greater than a certain size, eg. in project value or duration. The staged payments cover committed expenditure by the DNO.

If your connection does not proceed, it is possible that some of the connection charge will be refundable depending on if the DNO has performed the work. You should inform your DNO as soon as possible if you decide not to go ahead with your project.

Charging Futures Forum: The Charging Futures Forum is a programme that co-ordinates significant reform of electricity network access and electricity network charging arrangements. Ofgem is the chair of the programme, and members include generators, network operators, large customers, industry bodies and universities. The programme includes holding a quarterly forum and teams called Task Forces, which review specific issues in detail. For more information see the Charging Futures Forum website.

What is a budget estimate?

You may read about **budget** or **indicative estimates** and **formal quotations**. The differences between these two terms are summarised in the following table.

Budget or Indicative estimate	Formal quotation
Requested in the early stage of a project, and generally only for larger capital projects	Requested when electrical requirements have been finalised
The DNO doesn't require much information from you	The DNO requires a lot of information from you
Based on a desktop study—the DNO is unlikely to carry out detailed designs or studies	Based on detailed design work, and may require other input such as site surveys
To give an **indication** of costs, and is therefore subject to change	Provides formal contract offer
Not open for acceptance	Open to acceptance, subject to conditions
DNO may charge	DNO may now charge (see Assessment & Design fees)

Assuming that you ask the DNO to undertake all of the work involved in your connection, the timescale for the DNO to provide a budget estimate is 10 working days.

Use of System Charges

Use of System (UoS) charges cover operation, repair and maintenance of network assets, and also any reinforcement to the network that might be necessary that is not covered by the connection charge.

All generators with equipment connected at LV and HV are subject to UoS charges under the Common Distribution Charging Methodology (CDCM). Generators with equipment connected at EHV are subject to UoS charges under the EHV Distribution Charing Methodology (EDCM).

These charges can be negative for generation (ie credits). Please see the table below for definitions of the terms LV, HV and EHV.

DNOs are obliged to publish documents about their UoS charges. These cover their UoS charging methodology and a statement of what the chares are for both generation and demand customers. You can find these on DNOs' websites.

You can find out more about the Common Distribution Charging Methodology (CDCM) and EHV Distribution Charging Methodology (EDCM) from DNOs' websites, Charging Arrangements section on Ofgem website, and Charging Methodology section on the Energy Networks Association website.

Definitions of LV, HV and EHV

Term	Voltage level
LV (Low Voltage)	In general: less than 1 kV. In practise, this means 400/230 V
HV (High Voltage)	In general: 1 kV—22 kV. In practice, this means 6.6, 11 or 20 kV.
EHV (Extra High Voltage)	In general this covers connection to the distribution network at or above 22 kV. In practice this means 33 or 66 kV, (or 132 kV in England and Wales only). Some DNOs may define this slightly differently. See the definition of EHV for your local DNO.

Ofgem Targeted Charging Review

Ofgem has been reviewing certain elements of Transmission and Distribution Use of System charges, in a Targeted Charging Review (TCR) Significant Code Review (SCR). This is because they have concerns that the current framework for charging may result in inefficient use of the networks and unfair outcomes for consumers. The review was launched in August 2017. Ofgem held a consultation which closed on the 4th February 2019. They asked various stakeholders to provide feedback on an impact assessment study which considered the options for Use of System charges. They are currently reviewing the responses from the stakeholders and are expected to make a final decision in June 2019. See Ofgem's website for the latest information.

Metering Requirements, Parties and Charges

Metering requirements

You may require separate meters for measuring your import and export. There are two categories of meter:

- Half Hourly (HH)
- Non-Half Hourly (NHH)

They are described in the box on the next page.

The type of meter will affect:

- the meter charges you pay; and
- what category of UoS charges apply.

Section L of the Balancing and Settlement Code (BSC) dictates the type of meter you will require. If you are classed as a 'Small Scale Third Party Generating Plant' (currently defined as less than 30kW capacity), you can choose to have a NHH meter. Otherwise, you have to have a HH meter, if metering export.

HH meters can provide metering data for each half hour period, and so can be useful for understanding your electricity import or export at different times of the day. However, they have significant costs associated with them.

Parties involved

NHH meters are the responsibility of the supplier. They will appoint the following Supplier Agents:

- Meter Operator: installs and maintains the meter
- Data Collector: retrieves the data recorded by the meter and calculates your actual or estimated volume of energy consumption
- Data Aggregator: sums up volumes of energy consumed for each supplier and sends the information to a central system for balancing and settlement

You can choose to contact your supplier about the provision of meters, or contract directly with a Meter Operator. If you use HH metering, it is your responsibility to appoint a Meter Operator. You will have to enter into a Meter Operator contract with a meter supplier. The contracts normally last for five years, and the Meter Operator will:

- Provide, install and maintain your meter; and
- Collect data from your meter via a communications link such as a telephone line he provision of meters is open to competition. Details of Meter Operators and their contact details can be found on the Association of Meter Operators website:

www.meteroperators.org.uk

There are Codes of Practice which detail technical requirements for Metering Systems. These can be found on Elexon's website.

Charges

The cost of Meter Operator agreements and the costs associated with the communication to collect data from your meter can be in the order of several hundred pounds a year. You should consider obtaining quotations from a number of Meter Operators.

Note: in practice suppliers may pay the owner of some smaller Distributed Generation a fixed amount (eg. £/year) instead of installing meters and making payments based on units exported. This is something you can discuss with your supplier.

Metering Requirements, Parties and Charges

Half Hourly (HH) meters and Non-Half Hourly (NHH) meters

Meters record the flow of electricity. There are two main categories of meters; Half Hourly (HH) and Non-Half Hourly (NHH). HH meters are for larger customers; if your generation peak power is greater than 30 kW you have to use a HH meter, if metering export.

NHH meters record total energy passing through the meter, but do not record the times the energy is transferred. Typically the recorded data would be collected a few times a year, eg. every quarter. In contrast, HH meters measure and record energy passing through the meter for each half hour period. The data they record is typically collected remotely every day, for example by a telephone line.

Data from meters is used to determine charges and rewards. For example, to calculate:

- Imbalance charges for balancing and settlement
- Distribution or Transmission UoS charges
- Renewables Obligations Certificate rewards

F: Selling Electricity- Feed-in Tariffs (FITs)

In this section:

- An introduction to the Feed-in Tariff Incentive
- Eligibility and Accreditation
- Deployment caps and how they work
- Guidance on where to find more information

Tip: Read the information boxes for definitions or explanations of terms that may be new or unfamiliar.

Introduction

Feed-in Tariffs (FITs) are a financial incentive to support distributed and small-scale renewable energy generation, up to 5 MW.

FITs are available for the following generation technologies:

- Anaerobic digestion
- Hydro
- Solar PV
- Wind

A number of domestic Combined Heat and Power (CHP) units are also supported through FITs under a Micro CHP pilot scheme. The Micro CHP pilot will support up to 30,000 installations with an electrical capacity no greater than 2 kW.

This section will detail the structure of the tariffs and will explain how to get accredited with FITs.

Important Point: the FIT scheme for generators closed on the 31st March 2019. From the 1st April 2019 onwards, network applications for generators will not be eligible to obtain a FIT from their energy supplier.
Applications that were submitted before the 31st March 2019 will have a deadline (depending upon technology and ownership) to install the distributed generation. The period of installation is as follows:

- Wind projects must be installed within 12 months
- Hydro projects must be installed within 24 months
- Anaerobic digestion (AD) must be installed within 12 months
- Solar projects must be installed within 6 months

If the generation projects are FIT accredited by a community then a 6-month extension will be granted to the above timescales. Please refer to https://www.ofgem.gov.uk/system/files/docs/2018/12/cs_guidance_version_4.pdf for more information and the definition of a community.

Tariff Structure

There are three sources of financial benefit from a Generation project receiving FITs:

- **Generation tariff (FITs):** A fixed price for each unit of electricity generated.
- **Export tariff:** A guaranteed price for each unit of electricity exported to the grid.
- **Import reduction:** reducing your import from the grid by using your own electricity.

Tariffs are adjusted annually for inflation. The generation tariffs are published by Ofgem, and you can access them on their webpage:

www.ofgem.gov.uk/environmental-programmes/feed-tariff-fit-scheme/tariff-tables

The tariff level that you will receive will be the most recent tariff level on the eligibility date of the installation. You will continue to receive this same tariff throughout the eligible lifetime of the project, which for most technologies is 20 years.

FITs for PV generation

The FITs for PV are structured in a slightly different way. PV installations are subject to the following criteria:

- Energy efficiency requirements—the building to which the solar PV is attached should achieve an Energy Performance Certificate (EPC) rating of level D or above for installations up to and including 250 kW; and

- Multi-installation tariffs—applies to any solar PV installation where the recipient of the FIT already receives FIT payments from 25 or more other PV installations.

The impact of these criteria on the tariff level received is summarised in Ofgem's tariff tables. Refer to the BEIS or Ofgem websites for the most up to date information.

Export Tariff

The export tariff is a guaranteed price for the export of your generated electricity, and is the same for all installations which are eligible for FITs. At the time of writing, the export tariff is set at 5.24p/kWh, but this is subject to regular reviews. Refer to the BEIS or Ofgem websites for the most up to date information.

Metering Requirements

You will need to measure three electrical flows to get the most out of the FIT scheme; import (this is your usual electricity meter), generation and export. For your generation financial stream, each of your generating units must be measured separately.

For your export payments, you may choose to measure your export to the grid via a meter (often called an export meter). However, the Government is allowing an interim measure of estimating export, subject to conditions. For example, the Energy Savings Trust website states that domestic FIT installations are likely to have an estimated export level of 50% of electricity generated.

Your electricity supplier is a good first port of call to discuss metering arrangements.

Eligibility and Accreditation

Renewable Energy generators under 5 MW are eligible for Feed-in Tariffs. Renewable Energy generators supplying off-grid or private networks are also covered by the FITs scheme. They receive generation tariffs and the benefit of avoiding the costs of generating electricity by other means e.g. Diesel.

Accreditation steps:

There are two routes to accreditation. For wind or solar PV generation up to and including 50 kW, and for micro CHP, the accreditation process is as follows ("MCS-FIT"):

1. Install your generating unit—**you must use a Microgeneration Certification Scheme (MCS) installer** (see below);
2. Your installer will register you on a central accreditation system;
3. You will receive a certificate confirming you are eligible for FITs;
4. Register for a FIT with your supplier, and provide them with your FIT compliance certificate so that they can verify your eligibility;
5. Indicate to your supplier if you are opting for the guaranteed export tariff or if you prefer to sell your electricity using a Power Purchase Agreement (a legal contract between you and your electricity supplier);
6. Your supplier will then be responsible for the level of payment you will receive for the electricity generated and exported, for which you may be required to provide meter readings.

See Ofgem's website on MCS-FIT accreditation: www.ofgem.gov.uk/environmental-programmes/feed-tariff-fit-scheme/applying-feed-tariff/mcs-fit

For anaerobic digestion and hydro generators and for solar PV and wind generation over 50 kW, the following "ROO-FIT" process applies (see information box on page 53):

1. Install your generating unit;
2. Apply for accreditation through Ofgem's Renewable and CHP register (see ROO-FIT box on page 53);
3. Successful applicants will be awarded an accreditation number;
4. Register for a FIT with your supplier, and provide them with your accreditation number so that they can verify your eligibility.

Steps 5 and 6 are as above.

While Ofgem is responsible for establishing and maintaining the central FITs register, suppliers manage the registration process—they will be your point of contact.

Microgeneration Certification Scheme (MCS)

The MCS is currently the only formalised industry standard in the UK based on European and international standards for microgeneration projects. MCS is a BS EN ISO/IEC 17065:2012 Certification scheme covering Renewable Energy products (wind and PV up to 50 kW (electrical), solar thermal, biomass and heat pumps up to 45 kW (thermal), Micro CHP and hydropower) and Renewable Energy installation companies.

MCS checks for the products' performance and quality and for the installation methods and quality. MCS will increase your confidence in the Renewable Energy technology you are buying and in the company installing it. The MCS is linked with FITs accreditation for Renewable Energy generation ≤ 50 kW electrical capacity.

For more information please refer to the MCS website: www.microgenerationcertification.org

Deployment Caps

Deployment caps were introduced to the FIT scheme in February 2016. A deployment cap is defined as a limit on the capacity that can receive a particular FIT tariff, in a particular tariff period.

Once a deployment cap has been reached, no further installations are eligible to receive the tariff rate applicable for that band, in that tariff period. All the remaining tariff periods will degress by a further 10% (in addition to the default degression). Ofgem will publish a report once the deployment cap has been reached. Indicative queues for each ROO-FIT and Standalone deployment cap can be found on the Ofgem website.

The deployment caps queue is based on the date and time you submit your FIT application to Ofgem. A place in the queue does not guarantee eligibility for a particular tariff or eligibility for support under FITs, as it will depend on the volume of applications ahead of you.

Two examples are given below:

1. A tariff period opens on 1 April 2016 at 00:00:00 and closes on 30 June 2016 at 23:59:59. A standalone PV installation submits an application to Ofgem on 1 June 2016 at 12:20:35. The deployment cap for this technology and tariff band has not been reached and there is sufficient capacity available to accommodate this installation. The tariff rate for this installation is the tariff rate that applies to the tariff period that the application was submitted in.

2. A tariff period opens on 1 April 2016 at 00:00:00 and closes on 30 June 2016 at 23:59:59. A standalone PV installation applies and exceeds the relevant cap for that tariff period on 1 June 2016 at 12:20:35. The tariff rate for that tariff period is applicable to installations with an application date and time from 1 April 2016 at 00:00:00 to 1 June 2016 at 12:20:34. Applications received on or after 1 June at 12:20:35 are queued for entry into the next available tariff period. The tariff rate applicable for applications submitted after the cap is exceeded will be the tariff rate associated with the next tariff period, with capacity available to accommodate the capacity of the installation. The next tariff period opens on 1 July 2016 at 00:00:00 and there is sufficient capacity to accommodate the capacity of the installation. The installation receives the tariff rate available in that tariff period.

Eligibility and Accreditation

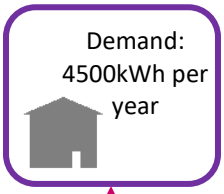
ROO-FIT accreditation arrangements:
Anaerobic Digestion and hydro installations of any size are accredited by the Renewables Obligation (RO) Order Feed-in Tariff ("ROO-FIT") process, rather than the MCS accreditation process ("MCS-FIT"). Wind and solar installations greater than 50 kW are also accredited in this way. The ROO-FIT accreditation process is run by Ofgem (rather than the generation installer / supplier), via Ofgem's Renewable and CHP register. There is more information about it on Ofgem's website:
www.ofgem.gov.uk/environmental-programmes/feed-tariff-fit-scheme/applying-feed-tariff/roo-fit

Micro CHP Pilot: The Micro CHP pilot will support up to 30,000 installations with a review to start when the 12,000th installation has occurred. To qualify the CHP unit must have an electrical capacity no greater than 2 kW.

Community Energy Schemes: The Feed-in Tariffs (Amendment) Order 2015 has introduced an exemption to the definition of the term "site" in the FIT legislation, which is effective from April 2015. The amendment allows two projects to share one grid connection and receive separate tariffs based on their individual generating capacity, provided that at least one project is owned by a community organisation. Both parties sharing the grid connection will be required to seek support under the FITs scheme. In order to enable Ofgem to treat the individually owned sections as separate eligible installations each will be required to register as separate FIT generators and to meter their generation separately.

FIT Example
The **example** tariff levels are:
Import tariff: 10p/kWh,
Generation tariff: 8.19p/kWh

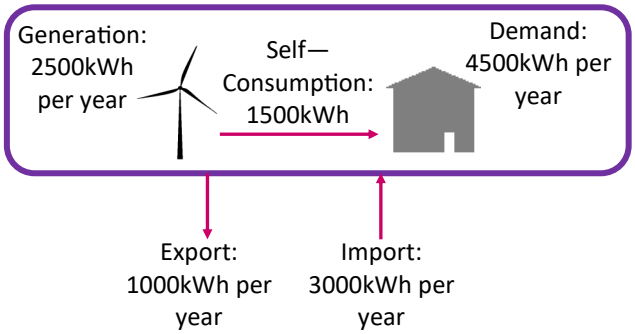
Before Installation



Import: 4500kWh per year

Cost of Import per year:
4500kWh x 10p/kWh = **£450**

After Installation of Distributed Generation



Income per year:	Cost of Import per year:
Generation: 2500kWh x 8.19p/kWh = £204.75 Export: 1000kWh x 5.24p/kWh = £52.40 This is a **total income of £257.15**	3000kWh x 10p/kWh = £300 This is a **saving of £150** due to avoided import.

Total net benefit: £257.15 + £150 = **£407.15 per year**

Where to Find More Information

For more guidance and the most up-to-date information on Feed-in Tariffs, please see the following organisations' websites:

- Energy Saving Trust — Initial port of call for information
www.energysavingtrust.org.uk/Generate-your-own-energy/Financial-incentives/Feed-In-Tariffs-scheme-FITs

- Carbon Trust — Initial port of call for information for businesses:
www.carbontrust.com

- Department for Business, Energy and Industrial Strategy (BEIS) — Policy setting
https://www.gov.uk/feed-in-tariffs

- Ofgem—FIT administrator
www.ofgem.gov.uk/Sustainability/Environment/fits/Pages/fits.aspx

Note that your electricity supplier is your point of contact for the FIT scheme.

F: Selling Electricity- Contracts For Difference

In this section:

- An introduction to renewable electricity incentives
- Contracts for Difference
- The Renewables Obligation closure
- Guidance on where to find more information

Tip: Read the information boxes for definitions or explanations of terms that may be new or unfamiliar.

Introduction

This section of the Guide focuses on Feed in Tariffs with Contracts For Difference (CFD). This is the main financial incentive mechanism for larger schemes of low carbon generation. It has recently replaced the Renewables Obligation (RO), which closed to new applications in March 2017. The RO closure does not affect generation that was already accredited before the relevant closure date.

This section introduces the CFD mechanism, and explains how you, as a generator, can benefit. Key elements of the CFD scheme are introduced. The application process for a CFD is much more complex than for the FIT scheme. You are referred to relevant websites and documents for more information.

There are various other power trading options for Distributed Generation, including:

- Selling your electricity on the wholesale market or to an electricity supplier
- Levy Exemption Certificates (LECs)
- Embedded benefits
- Ancillary services
- EU Emissions Trading System (ETS)

These have been discussed briefly in Section B. The Role of Distributed Generation: Benefits of Distributed Generation, which also points to further reading on these topics. Beyond that, they are outside of the scope of this Guide.

Contracts for Difference (CFD)

Introduction

A Contract for Difference is a bilateral contract between a generator and the Low Carbon Contracts Company (LCCC, the CFD counterparty), which is government owned. A generator with a CFD is paid the difference between the "strike price" and the "reference price". The strike price is an agreed price for electricity reflecting the cost of investing in low carbon generation. The reference price is a measure of the GB market price for electricity.

CFDs require generators to sell electricity into the market as usual. But to reduce their exposure to market prices, the CFD provides a variable "top up" payment. When the strike price is higher than the reference (market) price, the generator receives a payment. At times when the market price exceeds the strike price, the generator is required to pay back the difference, thus protecting consumers from over-payment.

Parties involved

A number of parties are involved in the CFD mechanism. They include, with examples of their roles:

- Government: writes the policy, specifies the eligibility criteria and sets the budgets and rounds.
- Low Carbon Contracts Company (LCCC): signs the CFD and forecasts CFD payments.
- National Grid (Electricity Market Reform (EMR) Delivery Body): runs the system for users to register, submit and manage applications; assesses the eligibility of applicants; and runs the CFD allocation process.
- EMR Settlement Ltd (Settlement Services Provider): collects metering data, calculates payments and manages the settlement of payments between generators and suppliers.
- Ofgem: regulates National Grid as the EMR Delivery Body and determines disputes.

Eligibility

There are a number of eligibility criteria for the CFD, including:

- Meet qualification requirements, eg. evidence of planning permission, counter signed connection offers, generation type;
- Not considered an excluded applicant eg. in receipt of another subsidy; and
- Provision of other information / data, eg. incorporation information (details of different parties involved).

CFD Allocation

CFDs are awarded in rounds. During a round, if the specified budget for CFDs is not exceeded, all qualifying applicants will be awarded CFDs. If the budget is exceeded, the Delivery Body will run an auction to allocate CFDs.

Rounds 1 and 2 took place in 2015 and 2017 respectively, and CFDs have been allocated. In Round 1 there were 27 successful applicants, with project installed capacities ranging from 6 to 714 MW, and strike prices ranging from £50 to £119.89 (in 2012 prices). In Round 2 there were 11 successful applicants, with project installed capacities ranging from 50 kW to 1,386 MW, and strike prices ranging from £40 to £74.75 (in 2012 prices). Round 3 is due to take place in 2019.

National Grid publishes a Contract for Difference Interactive Guidance document which provides details on the CFD process. Also see BEIS and the EMR Delivery Body websites for the latest information.

Renewables Obligation

The Renewables Obligation (RO) closed to all new generating capacity on 31 March 2017. This was previously the main incentive mechanism for larger renewable generation. The closure does not affect capacity accredited before the relevant closure date, which will continue to receive full 20 year support until the end of the scheme in 2037.

There are a number of grace periods, which allow generators to gain accreditation under the RO in certain circumstances after 31 March 2017. The availability of grace periods differs across England and Wales, Scotland and Northern Ireland .

The grace periods are available on Ofgem's website.

Operators that are successful in their grace period application will have the opportunity to apply for accreditation under the RO after the 31 March 2017.

For more information on the closure of the RO, refer to Ofgem's website.

Where to Find More Information

For Contracts for Difference (CFD) refer to the BEIS website:

https://www.gov.uk/government/collections/electricity-market-reform-contracts-for-difference

National Grid as the Delivery Body for CFDs has a website:

https://www.emrdeliverybody.com/cfd/home.aspx

The Ofgem website has details on the Renewables Obligation closure:

https://www.ofgem.gov.uk/environmental-programmes/ro/about-ro/ro-closure

Glossary of Terms

Adoption Agreement: An agreement between a developer of Distributed Generation and a Distribution Network Operator (DNO) and / or an Independent Connections Provider (ICP) concerning the transfer into DNO ownership of infrastructure supplied and installed by an Independent Connections Provider (ICP).

Aggregator: An organisation which specialise in co-ordinating demand and generation (including storage) to provide demand response and other market services. Network Operators and Suppliers may buy demand response and other grid balancing services from aggregators.

Ancillary Services: Services such as the provision of reactive power support and black start capability by a Generator to NGESO as part of an Ancillary Services Agreement with NGESO.

Apparent Power: The apparent power (measured in Volt-Amps or VA) at any point on the network is the product of the voltage and current at that point. The apparent power is made up of two components, the real power and the reactive power.

Auxiliary equipment: Any apparatus not directly a part of the boiler equipment or Generating Unit, but required for the boiler equipment or Generating Unit's functional operation.

Balancing and Settlement Code (BSC): The Code which determines the rules governing the Balancing Mechanism and settlement process for electricity trading in Great Britain. A BSC Panel has been charged with overseeing the management, modification and implementation of the BSC rules, as specified in Section B of the BSC. The Balancing and Settlement Code Company (ELEXON) supports the BSC Panel.

Balancing Mechanism: NGESO has a licence obligation to manage the Transmission System and, and needs to have an arrangement in place for the scenario where more energy is generated than consumed, or vice versa. Unchecked, this would result in system frequency falling or rising to an unacceptable degree. The balancing mechanism provides a means by which NGESO can buy or sell additional energy close to real-time to maintain energy balance, and also to deal with other operational constraints of the Transmission System.

Capacity: See Registered Capacity.

Capacity Market: A market that aims to ensure security of electricity supply by providing a payment for reliable sources of capacity.

Connection Agreement: An agreement setting covering the conditions under which your generating equipment is allowed to be physically connected to the DNO network and remain connected and energised while the network is operating normally.

Contestable: That part of the connection works which is open to competition.

Contracts for Difference (CFD): A bilateral contract between a generator and the Low Carbon Contracts Company (LCCC, the CFD counterparty).

Climate Change Levy (CCL): Part of a range of taxation measures designed to help the UK meet its legally binding commitment to reduce greenhouse gas emissions. This levy / tax is chargeable on the industrial and commercial supply of taxable commodities for lighting, heating and power by consumers in the following sectors of business: industry, commerce, agriculture, public administration and other services.

Connection and Use of System Code (CUSC): Contractual framework for connection to and use of the National Electricity Transmission System.

Declared Net Capacity (DNC): Unless the energy source for your generating unit is wind, solar, wave or tidal, then the declared net capacity is equal to the maximum power available for export on a continuous basis minus any power imported by the station from the network to run its own site. For wind, solar, wave and tidal, the declared net capacity is this value multiplied by a constant as follows: wind, 0.43; solar, 0.17; wave or tidal, 0.33.

Glossary of Terms

Distribution Code: The code required to be prepared by a DNO pursuant to condition 21 (Distribution Code) of a Distribution Licence and approved by the Authority (The Gas and Electricity Markets Authority - Ofgem) as revised from time to time with the approval of, or by the direction of, the Authority.

Distributed Generation (DG): A generating unit which is connected to a distribution network rather than to the transmission system. Distributed Generation is generally smaller than generating units connected to the transmission system as the maximum operating voltage of distribution networks is 132 kV in England and Wales and 33 kV in Scotland.

Distribution Network: The distribution network is the system that comprises the equipment between the transmission system and the customer's service switch. In England and Wales the distribution networks are the lines with a voltage less than or equal to 132 kV. In Scotland the distribution network is composed of lines with an operating voltage of less than 132 kV.

Distribution Network Operator (DNO): A holder of a Distribution Licence, the DNO owns, operates and maintains a Distribution network and is responsible for confirming requirements for the connection of Distributed Generation to that network.

Embedded Generation: Another term used for Distributed Generation. See above.

Embedded Benefits: If a generating unit is considered to be 'embedded' in the distribution network, it will be viewed as reducing the demand for power from the transmission system and the resulting losses. Suppliers can see their charges for use of the distribution system reduced as a result. Generators can, in some instances, negotiate to be paid a percentage of this benefit.

Energy Service Company (ESCO): A Government paper defines ESCOs as "a company that provides a customer with energy solutions" rather than simply being an electricity or gas supplier.

EU Emissions Trading System (ETS): Formerly referred to as the EU Emissions Trading Scheme, the EU Emissions Trading System (EU ETS) is one of the key policies introduced by the European Union to help meet its greenhouse gas emissions reduction target. It is a Europe-wide cap and trade scheme that started in 2005. The EU ETS covers electricity generation and the main energy-intensive industries.

Exemption Order (Generation License): Certain generating units that are not obliged to hold a generation licence under the terms of Statutory Instrument 2001 No. 3270, The Electricity (Class Exemptions from the Requirement for a Licence) Order 2001.

Extra High Voltage (EHV): This term is not defined in the Distribution Code, which only defines High Voltage (HV) and Low Voltage (LV). In general EHV refers to a voltage above 22kV. In practice this means 33 or 66kV, or 132 kV (England and Wales only). Refer to your DNO's definition.

Extension: It is sometimes necessary to extend the DNO's distribution network in order to provide a connection for a new user (demand or generation customer).

Fault Level: Prospective current that would flow into a short circuit at a stated point in the system.

Fully Type Tested: The whole Power Generating Module is type tested, rather than just part of the Power Generating Module.

Generation Licence: A licence granted or to be granted under section 6(1)(a) of the Act - Statutory Instrument 2008 No. 2376. This licence is obtained from Ofgem.

Generator: A person who generates electricity under licence or exemption under the Electricity Act 1989.

Grid Code: The code which the GB System Operator (NGESO) is required to prepare under its Transmission Licence and have approved by the Authority (Ofgem) as from time to time revised with the approval of, or by the direction of, the Authority.

Glossary of Terms

Grid Supply Point (GSP): Any point at which electricity is delivered from the national electricity transmission system to the DNO's Distribution system.

Harmonics: A component of a periodic wave with a frequency that is a multiple of the frequency of the original wave.

High Voltage (HV): A voltage exceeding 1000 V AC or 1500 V DC between conductors, or 600 V AC or 900 V DC between conductors and earth. In general DNOs consider that HV are voltages in the range of 1 kV to 22 kV.

Independent Connections Provider (ICP): Companies that have been thoroughly assessed and granted the necessary accreditation to provide new connections in competition with the DNOs.

Independent Distribution Network Operator (IDNO): A holder of a distribution licence, an IDNO designs, builds, owns and operates a distribution network, which is an extension to existing DNO network. They typically build network for new developments such as business parks, retail and residential areas and leisure facilities.

Interface Protection: The electrical protection required to ensure that the generation is disconnected for any event that could impair the integrity or degrade the safety of the Distribution Network.

Large Power Station: A power station which is connected to a system in:

- National Grid's Transmission Area with a Registered Capacity of 100 MW or more;
- SP Transmission plc's Transmission Area with a Registered Capacity of 30MW or more; or
- Scottish Hydro Electric Transmission plc's Transmission Area with a Registered Capacity of 10MW or more.

Levy Exemption Certificates (LECs): These exemptions favour energy efficient technologies or sustainable power units; good quality Combined Heat and Power (CHP) and renewable electricity could be granted, under certain conditions, Levy Exemption Certificates (LECs) for each kWh of electricity generated and the LECs could be used to obtain Climate Change Levy (CCL) Exemption, and therefore avoid paying the CCL tax applied on energy supplied to industrial and business users. Directly related to the Climate Change Levy (CCL) as some supplies are excluded or exempt from the levy while others have a reduced or half-rate.

Low Voltage (LV): A voltage normally exceeding 50 V AC between conductors and earth or 120 V DC between conductors but not exceeding 1000 V AC or 1500 V DC between conductors or 600 V AC or 900 V DC between conductors and earth.

Medium Power Station: A Power Generating Facility with a registered capacity of 50 MW or more but less than 100 MW in England and Wales (by definition, there are no medium power stations in Scotland). In EREC G99 this is known as an Embedded Medium Power Station.

Micro-generator: A source of electrical energy and all associated interface equipment able to be connected to an electric circuit in a Low Voltage electrical installation and designed to operate in parallel with a public Low Voltage Distribution Network with nominal currents up to and including 16 A per phase.

National Electricity Transmission System Operator (NETSO): Operates the electricity transmission system in England, Wales and Scotland (see System Operator).

National Grid Electricity Transmission (NGET): Owns the electricity transmission network in England and Wales. NGET is a member of the National Grid group of companies.

National Grid Electricity System Operator (NGESO): Operates the transmission system in England, Wales and Scotland (takes the role of the NETSO). NGESO is a member of the National Grid group of companies.

Glossary of Terms

Ofgem: The Office of Gas and Electricity Markets.

Point of Connection: The interface at which the Power Generating Module or Generator's Installation is connected to a Distribution Network, as identified in the Connection Agreement.

Point of Supply: The point at which the Distribution Network is to be connected into the customer site.

Protection Settings: The provisions for detecting abnormal conditions in a System and initiating fault clearance or actuating signals or indications.

Power Exchange: Market and clearing services for the UK Wholesale Power Market are provided by EPEX SPOT (part of the APX Group) and Nord Pool Spot AS (NPS), which operates under the name N2EX. N2, the UK market offering, will initially be a marketplace for Physical UK Power contracts and launch a platform for financial futures contracts further into 2009: a physical market and a futures market. From the outset N2 will operate as a physical power exchange providing platforms for the trading of UK Power contracts. This can be divided into three product areas: the Spot Market, the Prompt Market and the Day Ahead Auction Market (DAM).

Power Generating Facility (PGF): One or more Power Generating Modules connected to at one or more Connection Points. This is a Power Station in EREC G59.

Power Generating Module: Either a Synchronous Power Generating Module or a Power Park Module.

A **Synchronous Power Generating Module** is an indivisible set of Generating Units (i.e. one or more units which cannot operate independently of each other) which can generate electrical energy such that the frequency of the generated voltage, the generator speed and the frequency of network voltage are in a constant ratio and thus in Synchronism.

A **Power Park Module** is one or more Generating Units (including storage devices) generating electricity, which is either asynchronously connected to the network or connected through power electronics, and has a single connection point to a Distribution Network.

Power Generating Facility: One or more Power Generating Modules connected to a Network at one or more Connection Points. This is also known as a Power Station in some regulatory documents.

Reactive Power: Reactive power (measured in Volt-Ampere reactive, or VAr) is a component of apparent power (see apparent power definition above).

Real Power: Real power (measured in Watts, or W) is a component of apparent power (see apparent power definition above). It is likely that real power is the electrical power you are more familiar with. It is the useful power that we import into our houses to run our electrical goods.

Registered Capacity: The normal full load capacity of a generation set as declared by the generator less the MW consumed when producing the same. For a customer with own generation this will relate to the level of output they expect to export to the DNO's Distribution System.

Registered Data: Data referred to in the schedules to the Distribution Data Registration Code.

Reinforcement: Reinforcement work is usually required to increase the electrical capacity of those parts of the network which are affected by the introduction of new generation or demand. Other work might include upgrading the switchgear at a substation some distance from the proposed generation project, due to the increase in fault level caused by the connection of generating equipment.

Renewable Obligation Certificates (ROCs): A green certificate issued to an accredited generator for eligible renewable energy generated within the UK and supplied to customers within the UK by a licensed electricity supplier. ROCs are issued for each MWh of eligible renewable output generated, the amount of ROCs received depend on the technology of the generating station.

Glossary of Terms

Retail Price Index (RPI): General purpose measure of inflation used in the UK.

Reverse Power Flows: Power flows in the opposite direction to those associated with the consumption of electricity by users.

Site Responsibility Schedule: Also called a **Joint Operational Agreement.** A schedule defining the ownership, operation and maintenance responsibility of equipment and Apparatus at the Point of Supply of the DNO.

Supplier (Electricity Supplier): Electricity suppliers purchase electricity (on the market or in contracts) and sell electricity to customers (commercial, industrial and domestic).

Transmission Network (System): A system of electricity lines and equipment owned by the holder of a Transmission Licence and operated by the GB SO, which interconnects Power Stations and substations. In England and Wales the transmission system is the equipment principally rated above 132 kV while in Scotland they are those principally at or above 132 kV.

System Operator (SO): The operator of the transmission networks, the System Operator balances supply with demand on a minute by minute basis.

System Voltage: The voltage at which an electrical network is operated.

Thermal Rating: The current-carrying capacity of a cable, an overhead line or any other item of electrical infrastructure, which is determined by the heating effect arising from electrical losses.

Type Tested Equipment: Equipment that has been tested in accordance to ensure that it meets the requirements of EREC G98 or G99. Using type tested equipment simplifies the connection and commissioning process.

Use of System (UoS): The use of a transmission or distribution system by a generator, supplier, customer or an interconnected party for the purposes of transporting electricity.

Voltage Flicker: Voltage flicker is a deviation in system voltage, where power is not completely lost. Flicker may be defined as the sensation experienced by the human eye when illumination levels change as a result of the change in voltage.

Voltage Fluctuation: Fluctuations in the supply voltage that can be caused by a fluctuating load, and which in turn cause flicker.

Voltage Unbalance: Occurs where there exists a difference in voltage magnitude between phases and/or a shift in the phase separation from 120° (for a three-phase system).

References

Standards and other documents:

Balancing and Settlement Code (BSC) is available free of charge on Elexon's website

Connection and Use of System Code (CUSC) is available free of charge on National Grid's website

Distribution Code of Great Britain—available free of charge on the Distribution Code website

Engineering Recommendation G59, relating to the connection of generating equipment to the distribution systems of licensed Distribution Network Operators. This is not applicable to generation connecting after the 27th April 2019.

Engineering Recommendation G81 is called "Framework for design and planning, materials specification, installation and records low voltage housing development installations and associated new HV/LV distribution substations". It can be found free of charge on the Energy Network Association's website

Engineering Recommendation G98: Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks on or after 27 April 2019— available to download on the DCode website or ENA.

Engineering Recommendation G99: Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019— available to download on the DCode website or ENA.

Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002, Section 22: Statutory Instrument Number 2665, available free of charge

Grid Code of Great Britain — available free of charge on National Grid's website

IET Wiring Regulations (British Standard 7671) are available to buy on the IET website

Metering Codes of Practice

Requirements for Generators is available free of charge on the EUR-Lex website.

Requirements for micro-generating plants to be connected in parallel with public low-voltage distribution networks (BS EN 50438) is available to buy on the BSI website

Statutory Instrument 2001 No. 3270, The Electricity (Class Exemptions from the Requirement for a Licence) Order 2001

Statutory Instrument 2008 No. 2376, The Electricity (Applications for Licences, Modifications of an Area and Extensions and Restrictions of Licences) Regulations 2008

References

Useful websites:

Agency for the Cooperation of Energy Regulators (ACER)	www.acer.europa.eu
Association of Meter Operators	www.meteroperators.org.uk
British Hydropower Association	www.british-hydro.org
Renewable UK	http://www.renewableuk.com/
Carbon Trust	www.carbontrust.com
The Council of European Energy Regulators (CEER)	www.ceer.eu
The Association for Decentralised Energy (combined heat and power)	www.theade.co.uk
Department for Business, Energy & Industrial Strategy	https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy
Distribution Connection and Use of System Agreement (DCUSA) website	www.dcusa.co.uk
Electricity Networks Strategy Group	https://www.gov.uk/government/groups/electricity-networks-strategy-group
Elexon	www.elexon.co.uk
Energy Networks Association	www.energynetworks.org
Energy Saving Trust	www.energysavingtrust.org.uk/Generate-your-own-energy
Energy UK	www.energy-uk.org.uk
ENTSO-E	www.entsoe.eu
Lloyds Register	www.lr.org/sectors/utilities/schemes/ners.aspx
Microgeneration Certification Scheme	www.microgenerationcertification.org
National Grid	www.nationalgrid.com/uk/Electricity/
Ofgem	www.ofgem.gov.uk
Renewable Energy Association	www.r-e-a.net

References

Relevant reports and guides:

Electricity Trading Arrangements: A Beginner's Guide; Elexon

Embedded Generation and Embedded Benefits; Elexon; November 2013

The Electricity Networks Innovation Strategy; Energy Networks Association; 2018

The Open Networks project; Energy Networks Association

The Clean Growth Strategy; BEIS; 2017

Upgrading our energy system: smart systems and flexibility plan; BEIS; 2017

Revisions

Version Number	Date	Details of Changes
1.0	July 2019	The guides have had an annual update and minor revisions have been made. Changes include: • General Updates • Inclusion of V2G • Update of the FIT's