A Practical Guide to Distributed Generation Frameworks

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1 DG Regulatory Process Flow

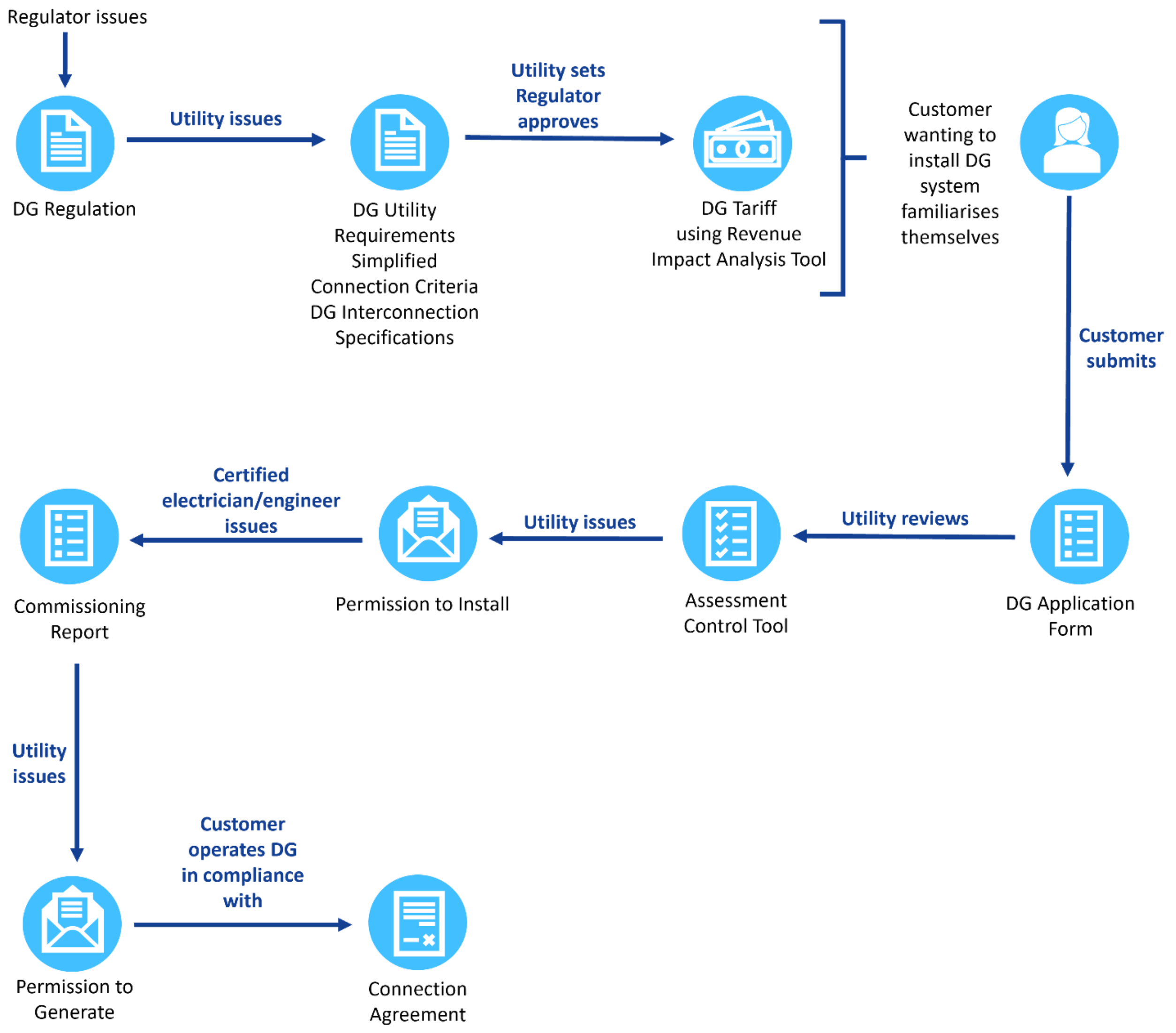

Figure 1. Process flow depicting DG Regulatory templates/tool and steps at which they become relevant

2 Glossary

Customer means and includes any individual, company, organisation or any other legal entity using electricity from a distributed generation system connected to the Network, which may or may not also feed power into the Network. A customer may also be the installer of the DG system. For simplicity, this guide may use the terms Customer and Installer interchangeably. Different jurisdictions may also use the term 'Prosumers'.

Distributed Generation means any small to medium scale generation (typically upto 1MW but in some countries may be up to 5MW) that takes place near the point of consumption on the consumers side of the electricity meter, and which is connected to the main distribution grid i.e. the Network via low- or medium voltage network, often from a source such as solar PV.

Network means the network of power lines and substations that make up the national distribution grid for delivering electricity to consumers.

Regulator means the electricity regulatory authority of any country responsible for overseeing and managing the power sector, including setting of DG rules, regulations and principles.

Utility means any entity licensed in accordance with a national electricity legislation, typically an electricity act, to operate and maintain the Network of one or more licensed areas of the country. In the context of this guide, the Utility primarily refers to any licensed agency responsible for the distribution of electricity and management and operation of distribution assets.

3 Introduction

Distributed Generation is revolutionising energy access in Africa, especially for the commercial and industrial sector. According to Ember Energy in only one year from June 2024, the import of solar panels to Africa has seen an increase of 60%, reaching 1.5GW, most of which has been driven by DG as opposed to utility scale solar.[1] While this growth has opened up numerous avenues for residential and commercial customers for reducing costs, access clean and reliable energy and drive economic growth, it also brings with it several regulatory challenges.

Unregulated growth of DG can not only cause disruptions and damage to grid networks and equipment, it can also negatively impact Utility's revenue base. On the other hand, safe integration of DG systems to the network can not only bridge the energy access and reliability gap but also provide an opportunity to the network operators to smartly employ these systems to balance electricity supply and operations. Several critical policy and procedural steps must be taken to create an enabling environment for DG.

The purpose of this document is to provide a practical guide on the key building blocks that need to be established to ensure regulated and safe growth of DG from a regulatory, technical and economic perspective to ensure safe, compliant and financially sustainable integration of DG to existing grid networks. This guide also highlights the templates and tools that can support regulators and utilities in establishing institutional and operational processes and capacities. Additionally, the guide elaborates roles and responsibilities of the regulator, utility and customer with respect to each building block.

4 The Trifecta of Regulatory Building Blocks

Before delving into the regulatory building blocks, it should be noted that the national electricity legislation, which is typically in the form of an Electricity Act, must provide for small scale generation systems and allow these to be operated without the requirement of licensing. Many national legislations allow for systems up to 500KWp or 1MWp to be installed and operated with a simplified requirement of registration with the Regulator and/or Utility. For instance, Uganda's Electricity Act, 1999 provides that a generation system with a capacity up to 500KW may be registered with the national Regulator, and any system exceeding 500KW may only be set up and operated after procuring a generation license from the Regulator.

If however the national legislation does not provide for such an exemption or places a stringent requirement of licensing on all generation and supply system irrespective of their size and capacity, it is highly recommended that such provisions be reviewed and amended to be more in line with the

[1] Ember Energy, 2025, Ember - The first evidence of a take-off in solar in Africa

evolving realities of the power sector and allow for small scale generation systems be they grid tied as in the case of DG or off-grid like mini-grids or standalones.

In this guide, we approach DG frameworks as a trifecta of regulatory building blocks as highlighted in figure X below.

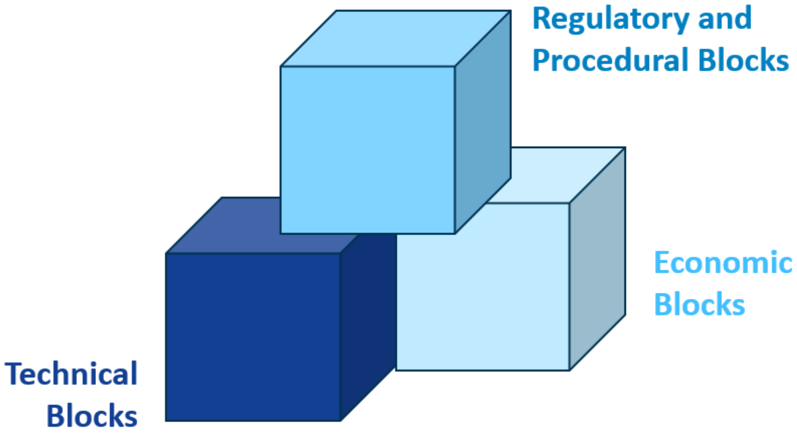

Figure 2. DG Regulatory Building Blocks

The **regulatory and procedural block** focuses on the establishment of broad regulatory frameworks in alignment with the national policy and electricity legislation in force in the country. It goes into further details of the processes to be instituted by the Utility to ensure due receipt and processing of applications for approval and registration of DG by Customers.

The **economic block** focuses on establishing a tariff framework that ensures financial sustainability for Utilities and the power sector as a whole by balancing the Utility's revenue requirements and a fair and attractive business case for the Customer.

The **technical block** focuses on establishing the specifications for generation sizes that may be installed without negatively impacting the Network as well as power quality and safety standards at the point of connection.

4.1 Regulatory and procedural blocks

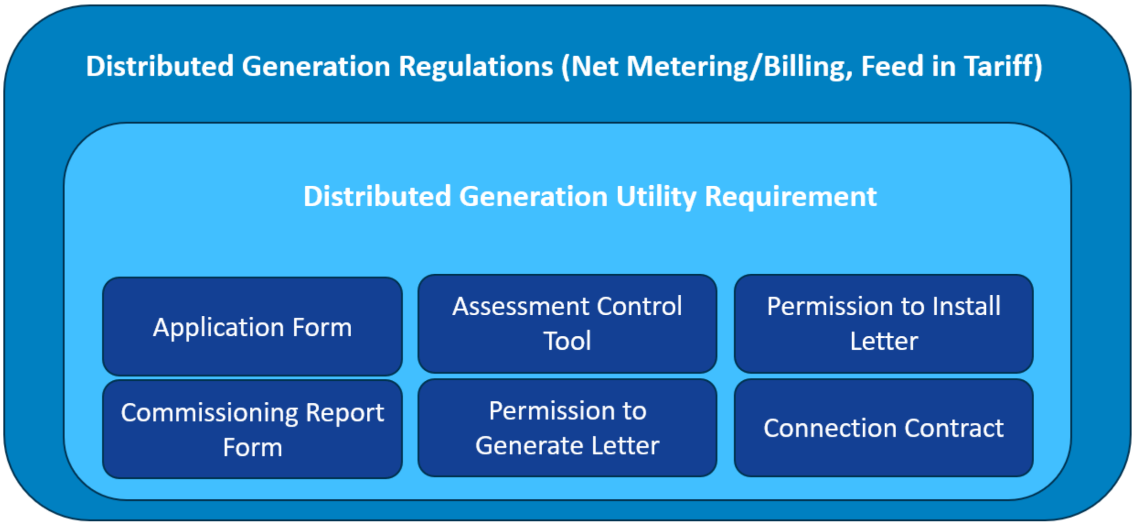

Figure 3. Breakdown of Regulatory and Procedural Block

This section focuses on the various regulations, processes, checklists and agreements that the Regulator and Utility must establish. One of the key regulatory blocks is a DG regulation. This can take the form of a Net Metering Regulation, Net Billing Regulation, Feed In Tariff Regulation, or a combination of two or all. Feed In Tariff Regulations provide an incentive mechanism to small scale power producers to generate power and feed it into the Network at predetermined "feed in" tariffs. This approach is typically more expensive but can prove to be a good incentive for investors to invest more in the DG sector. However, as the growth of DG in Africa is organic and driven by a number of benefits already discussed in the introduction above, such an incentive mechanism may be misplaced, and a Net Metering/Billing Regulation would be more appropriate.

Note: Feed in tariffs may also be applied to incentive slightly larger but below utility scale generation projects. For example, under Uganda's Global Energy Transfer Feed In Tariff (GET FIT) Program, the focus was in incentivising renewable energy projects ranging between 1 and 20MW.

It is therefore important for any DG regulation to specify the generation size and capacity which it applies to.

A **Net Metering/Billing Regulation** should provide which technologies are eligible for connection and the generation capacity limit in alignment with its parent legislation, for instance 500kW in Uganda, 5MW in Zimbabwe, and 1MW in Kenya. The Regulation should set out the Utility's mandate with respect to receipt and permitting of DG applications from customers and its responsibility to provide non-discriminatory access to the Network provided all the necessary technical and procedural conditions are met. The Regulation should also indicate the technical codes and standards that must be complied with for instance a Grid Code, and/or an Interconnection Standard, and set out the broad principles for determination of the DG export tariff.

It should be noted that application processes for approval and registration of DG systems, technical standards and export tariffs for the same should not be defined in great detail in the Net Metering/Billing Regulation, but rather in rules and guidelines issued by the Utility thereunder. This is because amending a Regulation may be a lengthy and difficult process and in a fast-evolving sector like DG, frequent regulatory adjustments may be needed which can be better achieved through rules and guidelines.

A customisable template for Net Metering/Billing Regulations can be found here.

DG Utility Requirements should be issued by the Utility in line with the Regulator's mandate under the Net Metering/Billing Regulation to provide Customers guidance on the application process for a DG system and any conditions it must comply with. The Requirements specify DG systems that fall under its purview, for instance grid tied solar PV systems and hybrid grid tied solar PV systems and the assessment requirements for such systems, for instance, a system with a generator output of less than 100kVA need only be in compliance with a Simplified Connection Criteria (See section 4.3 below), while one with a generator output above 100kVA must also pass a grid impact study. The Requirements must also specify applicable technical standards like interconnection specifications, simplified connection criteria, grid codes, quality of supply standards etc., and the type of equipment testing and certification required.

Additionally, the Requirements provide the steps for submitting and approval of an application form along with its format, relevant documents to be submitted with it like circuit diagram, certification for inverter, permissions from any other authorities etc., any application charges to paid. The Requirements also lay out how export tariffs for different categories of Customers (residential, commercial and industrial) shall be determined.

A customisable template for DG Utility Requirements can be accessed here. Several ancillary tools and documents as detailed below can further support the Utility's receipt, assessment, and approval processes for DG applications.

An **Application Form** should be issued as an annex to the DG Utility Requirements for Customers to apply for permission to connect DG systems. The form should collect the necessary information to enable the Utility to assess whether the DG can proceed to installation or not. Submission of an application form by the Customer includes acceptance of the terms and conditions of the DG Connection Agreement (see below). A customisable template can be accessed here.

An **Assessment Control Tool** can support the Utility in assessing applications submitted by Customers and run checks at face value whether the application violates any conditions or requirements, whether it provides complete information, and then take further action with respect to approving, rejecting or seeking additional information. A customisable template can be accessed here.

Permission to Install is typically a letter that a Utility must issue to the Customer once it has approved the DG based on information in the Application submitted by the customer. On receipt of such a letter the Customer can proceed to installing the DG system. A customisable template can be accessed here.

A **Commissioning Report** is usually required by the Utility for all DG systems. This report or certification is based on tests carried out by a competent electrician or engineer registered with a professional body. who can certify that the installation is safe and compliant. Commissioning is carried out after the Customer receives a permit to install the DG system. A customisable template can be accessed here.

Permission to Generate is issued in the form of a letter by the Utility to the Customer once the DG has been installed and the Commissioning Report has been submitted and approved. A customisable template can be accessed here.

A **DG Connection Contract** consists of the terms and conditions that the Customer agrees to be bound by upon submitting an application as per the DG Utility Requirements. These terms and conditions of connection may be periodically updated and published by the Utility through their website or any other channels. A template for such an agreement issued by the Utility can be found here.

Responsibility of Actors. A Net Metering/Billing Regulation is issued by the Regulator and implemented by the Utility through issuance of further requirements and guidelines, and a Customer must comply with both.

4.2 Economic blocks

In many countries, electricity tariffs are bundled in a way that a single volumetric charge is used to recover all the costs of the Utility for supplying electricity to its customers which includes not only variable costs but also fixed costs like repair and maintenance, staff salaries and wages, capital charges and others. As Customers shift to DG for self-generation/consumption, Utilities are able to recover less of its costs with such a bundled tariff. This can create lead to an untenable situation referred to as the ‘Utility Death Spiral’, where the Utility may raise energy charges causing more Customers to opt for DG which offers a cheaper solution, further decreasing the Utility’s revenue base which may ultimately lead to financial bankruptcy.

For Utilities to be able to sustainably operate and Customers to be charged fairly for electricity supply and use, it is important to unbundle electricity tariffs into representative tariff components of fixed, and variable charges. In this guide the focus is on tariffs charged to DG Customers. Components of such a tariff include - **Fixed Charge** that may include a one-time connection charge and flat monthly service charges for Utility’s supply, **Energy Charge** which is a variable use-based charge for importing electricity from the Utility, and an **Export Tariff** for exporting self-generated power to the Network as may be agreed with the Utility.

These **Fixed Charges and Energy Charges** should be high enough to cover the Utility's costs for electricity supply, meet growing demand for electricity while providing quality service. At the same time the aforementioned charges should be low enough to allow for economic growth, protect low-income households who depend on cross subsidised lifeline tariffs and prevent excessive Utility profits. Fixed Charges and Energy Charges should be determined through a cost of supply (COS) study. COS studies are generally country specific. For a basic introduction to COS studies please refer here.

Export Tariffs or credits should be set in a way that they are high enough to attract investments in the DG sector and incentivise feeding power back to the Network but also low enough to protect the Utility's revenue base. Of the several approaches that can be used to determine an export tariff, the avoided cost method that accounts for all the key avoided costs due to lower consumption and demand that the power system no longer has to incur, is the most common. Introduction to a simplified avoided cost calculation method can be accessed here. Once an export tariff is determined using this method, a revenue impact study should be conducted to determine the potential impact of the export credit on Utility's revenue. A revenue impact analysis tool for DG can be accessed here.

4.3 Technical blocks

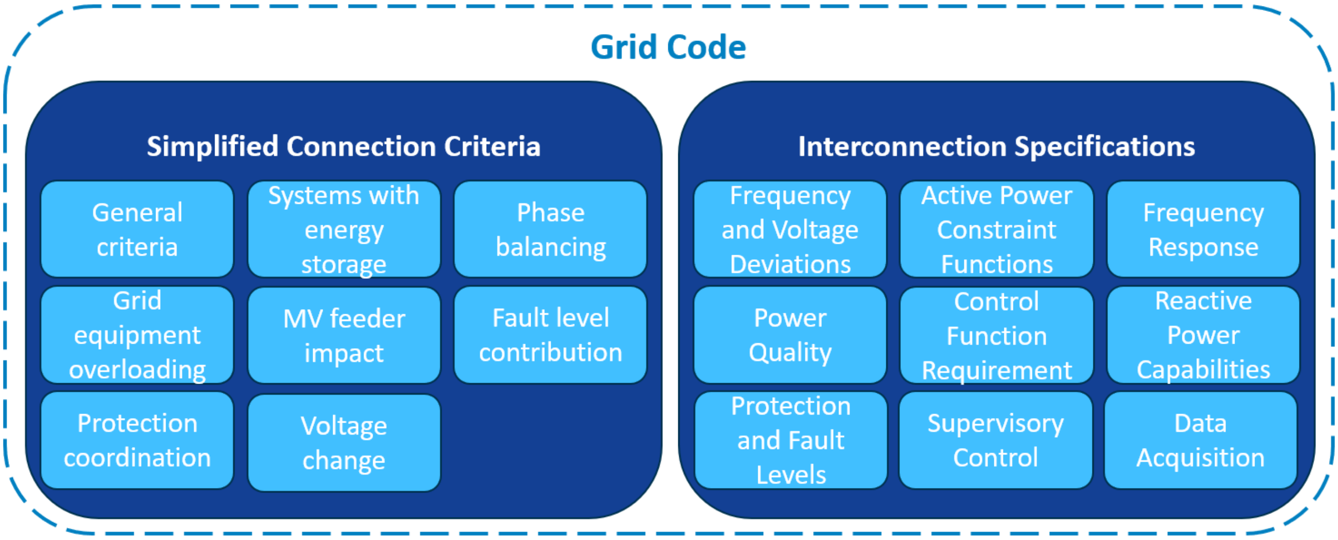

Figure 4. Breakdown of DG technical blocks

Traditionally, Networks have been built to transfer power from transmission points to load points. However, with the introduction of DG where power is generated locally i.e. close to the load, issues like reverse power flows can arise where power may be transferred from the distribution grid to the transmission grid. This can cause various technical challenges during periods of high DG feed in and low demand including over voltages, overloading of network equipment, and protection issues like correct detection and clearance of short circuits.[2]

Utilities and Regulators must therefore update planning and operations practices for distribution grids to handle high penetration of DG and introduce technical requirements and power quality standards to curtail the negative impacts of DG on the Network.

In this Guide, the focus is on the latter which can be regulated through introduction of a Simplified Connection Criteria and Interconnection Standards, which facilitate the processing and approval of low voltage (LV) connected DG systems that fall within the criteria laid out thereunder without the requirement of detailed network or grid impact studies. These standards fall within the purview of the Grid Codes, however may be separately iterated to allow for ease of implementation and/or amendments. Lesotho for instance has integrated these criteria and standards within its Grid Codes while Eswatini has issued them as separate albeit interfacing regulatory codes.

Simplified Connection Criteria sets out the screening criteria with respect to several parameters including the Nameplate Power Rating (NPR) threshold for DG systems, the Maximum Charging Current (MCC) limit for systems equipped with energy storage, phase balancing, cumulative Maximum Export Capacity (MEC) of all LV/MV connected DGs to avoid grid equipment overloading and reverse power flows, voltage change limits, etc. These thresholds and limits should be determined based on each country's power system characteristics and the regulatory thresholds provided for by Net Metering/Billing Regulations and the DG Utility Requirements (see legal and procedural block above). To illustrate, the NPR threshold applicable in Lesotho is 100 kVA while in Eswatini it is 350 kVA. On the other hand, in both countries the MCC for systems equipped with energy storage systems is limited to a value equivalent to 25% of the customer's Utility Installed Capacity.

In cases where the limits set by the Simplified Connection Criteria are exceeded the Utility would request the Customer to modify the DG system to fall within the specified parameters, and/or specify conditions under which the application for connecting DG may be approved or request detailed network studies before assessing the application.

As Simplified Connection Criteria is dependent on the specifics of each country's power system, a template for the same has not been developed. However, a more detailed guide on the various parameters to be covered by it and how to determine them can be referred to here.

Distributed Generation Interconnection Specifications, specify the minimum technical and design grid connection requirements for DG systems connected to or seeking connection to the LV or MV Network. This includes setting out standards for frequency and voltage deviations during normal and abnormal operating conditions, disturbance ride through capability, frequency response in case of

[2] GET.transform, 2023, GET.transform-Brief_Good-Practices-in-RE-DG.pdf

Network imbalances, power factor operation, power quality in terms of allowable harmonics distortions, flicker and voltage fluctuation, islanding detection function and other specifications. The limits and ranges can differ between countries. For instance, in Eswatini DGs must be capable of operating within the voltage range of -15% to +10% around the nominal voltage at the connection point, while in Namibia the application voltage range is -10% to +10%.

Interconnection Specifications also provide for forecasting, supervisory control and data acquisition to allow for communication between the Utility operating the Network and the DG system. Compliance with these specifications can be established through authorised certifications and/or testing, with equipment certification being the preferred method allowing for standardisation. Utilities can publish lists of approved certified equipment for Customers to refer to. A detailed guide on the various aspects to be specified by an Interconnection Specification can be accessed here.

Responsibility of Actors. Typically, the Utility would be responsible for setting out the Simplified Connection Criteria and the Interconnection Specifications and publishing it and the Customer would be responsible to ensure that any DG system they seek to connect to the Network adheres to them. The requirements of these documents can feed into the Assessment Control Document (see above in Section 3.1) to allow quicker checks by the Utility.

5 Further Resources

GET.transform, 2023, GET.transform-Brief_Good-Practices-in-RE-DG.pdf

GET.transform, 2026, Distributed Generation in Africa » GET.transform

GET.transform, 2025, Scaling Distributed Generation in Mozambique » GET.transform

GET.transform, 2022, Grid-Connected Distributed Generation in Africa » GET.transform

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