

SYSTEMS REFERENCE DELIVERABLE

**Distributed energy resource aggregation business -
Part 1: System architecture and service scenarios**

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IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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Distributed energy resource aggregation business - Part 1: System architecture and service scenarios

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The text of this Systems Reference Deliverable is based on the following documents:

Draft	Report on voting
SyCSmartEnergy/330/DTS	SyCSmartEnergy/335/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Systems Reference Deliverable is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 63443 series, published under the general title *Distributed energy resource aggregation business*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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1 Scope

This part of IEC SRD 63443 covers the terms and definitions, system architecture, and service scenarios of distributed energy resource aggregation business (ERAB), whose definition is to restrain or elevate the power generation of distributed energy resources (DERs) and power demands of controllable loads (CLs) at customer premises in accordance with the performance measurement by the metering device at the point of common coupling (PCC), allowing real-time data access from customer premises and the request of the transmission service operator (TSO), distribution system operator (DSO), electricity supplier, and energy exchange, as illustrated in Figure 1.

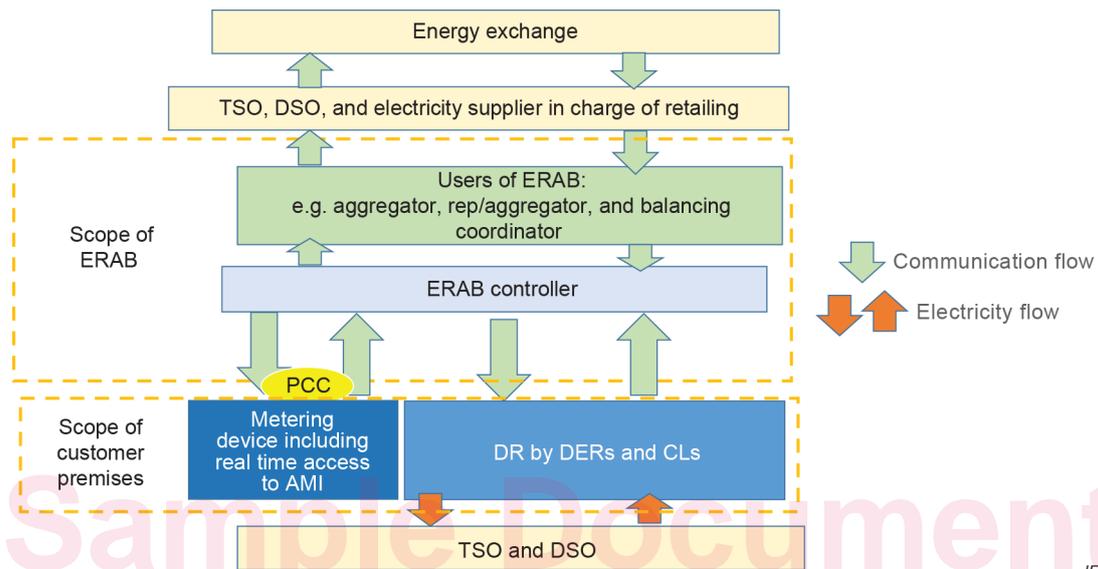


Figure 1 – Position of ERAB system

In conventional power systems, the balance between supply and demand is adjusted by the transmission service operator (TSO) and distribution system operator (DSO) controlling the power generation facilities on the supplier side, enforcing the same amounts of demand and supply at the same time on TSO and DSO. However, the widespread use of DERs and CLs with network access has enabled them to be configured as virtual systems on the demand-side. In addition, real-time data access to a metering device allows measurement of the performance of aggregating these devices using trustworthiness data. Similar to the drastic changes in the electricity system, the ERAB provides a new service scenario that contributes to the balance of supply and demand within the electricity system.

The ERAB coordinates the requests and reports from/to ERAB participants, such as the TSO, DSO, and electricity supplier, and manages the remote control of the DERs and CLs executed through the ERAB controller that provides site-specific DER management. The ERAB provides two types of services: "demand restraint" and "demand increase." The former model removes tight supply and demand by effectively shaving or shifting the peak demand. The latter model contributes to the effective use of energy by shifting the demand against the excessive power supply owing to the expansion of the introduction of renewable energy, as well as to the improvement of energy autonomy by aggregating the DERs and CLs with a power storage function.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

aggregator

party that contracts with several other network users to combine the effects of smaller loads or distributed energy resources for actions, such as demand response or ancillary services

[SOURCE: IEC 60050-617:2017, 617-02-18]

3.2

advanced metering infrastructure

AMI

a system that uses a smart electric meter or other energy gateway to enable continuous two-way communication between utilities and HAN-based devices

[SOURCE: IEC TR 63097:2017, 5.9.5.4]

3.3

balancing coordinator

party contractually responsible for the observed differences between the electricity supplied and electricity consumed within a defined area

[SOURCE: IEC 60050-617:2009, 617-02-13]

3.4

baseline

kW value expected in the absence of a control mandate

3.5

controllable load

load of particular consumers which, under contract, is reduced for a limited period of time at the request of the distribution supply undertaking

[SOURCE: IEC 60050-603:1986, 603-04-42, modified – The requirement has been removed in the definition.]

3.6

distributed energy resources

generators (with their auxiliaries, protection, and connection equipment), including loads with a generating mode (such as electrical energy storage systems), connected to a low-voltage or medium-voltage network

[SOURCE: IEC 60050-617:2017, 617-04-20]

3.7
demand response
DR

action resulting from management of the electricity demand in response to supply conditions

[SOURCE: IEC 60050-617:2011, 617-04-16]

3.8
delivery point

interface point between an electric power system and a user of electric energy

Note 1 to entry: The user can be the end user or an organization for the distribution of electric energy to the end users.

[SOURCE: IEC 60050-601:1985, 601-02-33]

3.9
distribution system operator
DSO

party operating a distribution system

[SOURCE: IEC 60050-617:2009, 617-02-10]

3.10
distributed energy resource aggregation business
ERAB

party that restrains or elevates power generation of DERs and demands of CLs by a set of customer premises in accordance with the performance measurement by the metering data, allowing a user to access customer premises and requests by the transmission service operator (TSO), distribution system operator (DSO), electricity supplier, and energy exchange

3.11
energy exchange

marketplace for buying and selling electric power and electric energy to be delivered during a given time interval, with transparent and non-discriminatory pricing conditions for all authorized participants and legal independence from the buying and selling business entities

[SOURCE: IEC 60050-217:2009, 617-03-01]

3.12
electricity supplier

party having a contract to supply electric power and energy to a customer

[SOURCE: IEC 60050-617:2009, 617-02-08]

3.13
final customer

party purchasing electric power for a given interval and energy for its own use

[SOURCE: IEC 60050-617:2009, 617-02-04]

3.14
gate close
GC

deadline for submission of supply and demand plans from electricity supplier to TSO/DSO

3.15

metering point

point in an electric power system, where the flow of energy and, when applicable, the flow of electric power is metered

[SOURCE: IEC 60050-617:2009, 617-04-06]

3.16

point of common coupling

PCC

point in an electric power system, electrically nearest to a particular load, at which other loads are, or can be, connected

Note 1 to entry: These loads can be devices, equipment, systems, or distinct network users' installations.

[SOURCE: IEC 60050-161:1990, 161-07-15, modified – The words "of a power supply network" have been replaced with "in an electric power system" and "may" with "can" in the definition; the word "customer" has been replaced with "network users" in Note 1 to entry; Note 2 to entry has been deleted.]

3.17

prosumer

network user that consumes and produces electrical energy

[SOURCE: IEC 60050-617:2017, 617-02-16]

3.18

REP/aggregator

aggregator that sends DR service menu to ERAB system according to a DR bidding contract from TSO/DSO or electricity supplier

Note 1 to entry: See IEC SRD 62913-2-3:2019 A.1.3.

3.19

smart metering

technology for recording usage from metering devices and providing communication and/or control paths extending from electric power utility to current-using equipment

[SOURCE: IEC 60050-617:2011, 617-04-14]

3.20

supply contract

contract in which an energy supplier provides a consumer, including a prosumer, with electricity by balancing supply and demand before the GC

3.21

transmission system operator

TSO

party operating a transmission system

[SOURCE: IEC 60050-617:2009, 617-02-11]

3.22

virtual power plant

group of distributed energy resources which combine to function as a dispatchable unit

Note 1 to entry: A virtual power plant can be used to participate in the electricity market or aggregate ancillary services.

[SOURCE: IEC 60050-617:2017, 617-04-27]

4 System component

4.1 General

The decentralised generation of electrical power, as well as the spread of energy storage and controllable loads, the management of distributed energy resources (DERs), and controllable loads (CLs) at the customer premises near the final customer offer economic and ecological benefits. In addition, information on metering data from advanced metering infrastructure (AMI) provides a customer with a method to measure the value of aggregating these resources at the customer premises.

Distributed energy resource aggregation business (ERAB) is a system architecture and service scenario that restrains or elevates the power generation of DERs and demands of CLs by a set of customer premises in accordance with the performance measurement by metering data at the point of common coupling (PCC), allowing real-time access from customer premises and requests by transmission service operators (TSO), distribution system operators (DSO), electricity suppliers, and energy exchange. The ERAB is configured by the ERAB server that manages upward communications such as the TSO, DSO, and electricity supplier and ERAB controller that manages downward communications such as a metering device, DERs, and CLs.

ERAB was mapped onto the smart grid architecture model (SGAM) in IEC TR 63097:2017, as shown in Figure 2. ERAB servers were placed in the enterprise zone, configuring the ERAB controller at the field zone with real-time data access to a metering device at the PCC. The DER and CL at the field zone are operated by the ERAB controller.

Annex A shows use cases of distributed energy resource aggregation business for information.

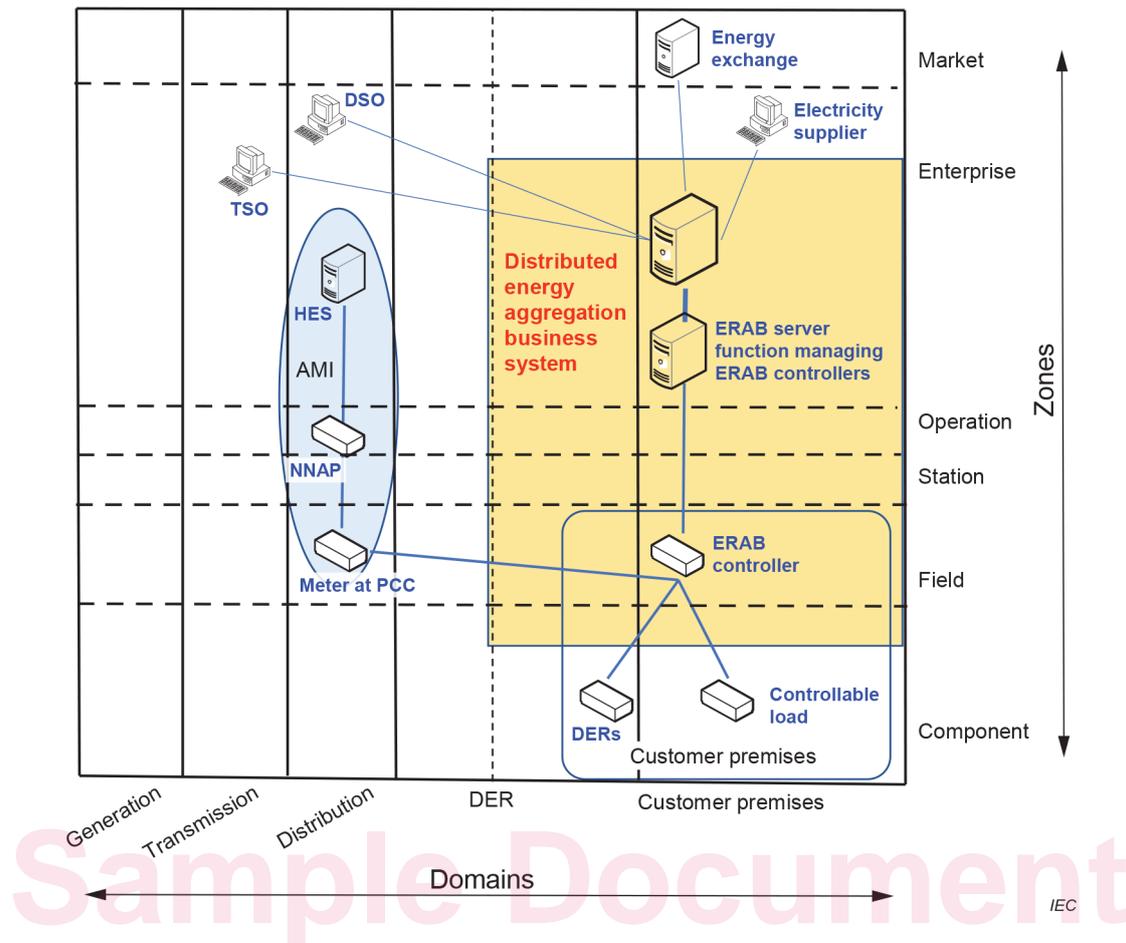


Figure 2 – Outlook of ERAB on SGAM plane in IEC TR 63097:2017

4.2 ERAB system

In alignment with the hierarchical approach in SRD 62913-2-3:2019, ERAB is described in five levels across multiple domains, as illustrated by the five-level hierarchical system architecture shown in Figure 3.

- Level 1: DERs and CLs are at the bottom level and are described as customer premises. They are operated autonomously in normal time but are incorporated behind the PCC, in which a metering device allows real-time data access when ERAB is in process. The remote operation signal is delivered by the ERAB Controller at level 2.
- Level 2: The ERAB controller is at a higher level in which the operation of the DERs and CLs and the metering data at the PCC are managed. The controller has been recognised as a logical function in the field zone in SGAM, so that it appears in commercial and industrial sites, such as households and buildings.
- Level 3: The ERAB server requests and commands the DERs and CLs through the ERAB controller that performs specific actions, such as turning on/off and increasing/restraining the output. The signal managed by the ERAB server, for example, DR, is in accordance with the commands by the user of ERAB such as, TSO, DSO, electricity supplier, and energy exchange.
- Level 4: The utility operational grid management in DSO/TSO applies to utility applications that are required to determine what commands should be issued to the ERAB servers.
- Level 5: Market operations involve a large-energy environment. For example, a balancing power market is a bid/offer transaction energy market between ERAB and TSO/DSO.

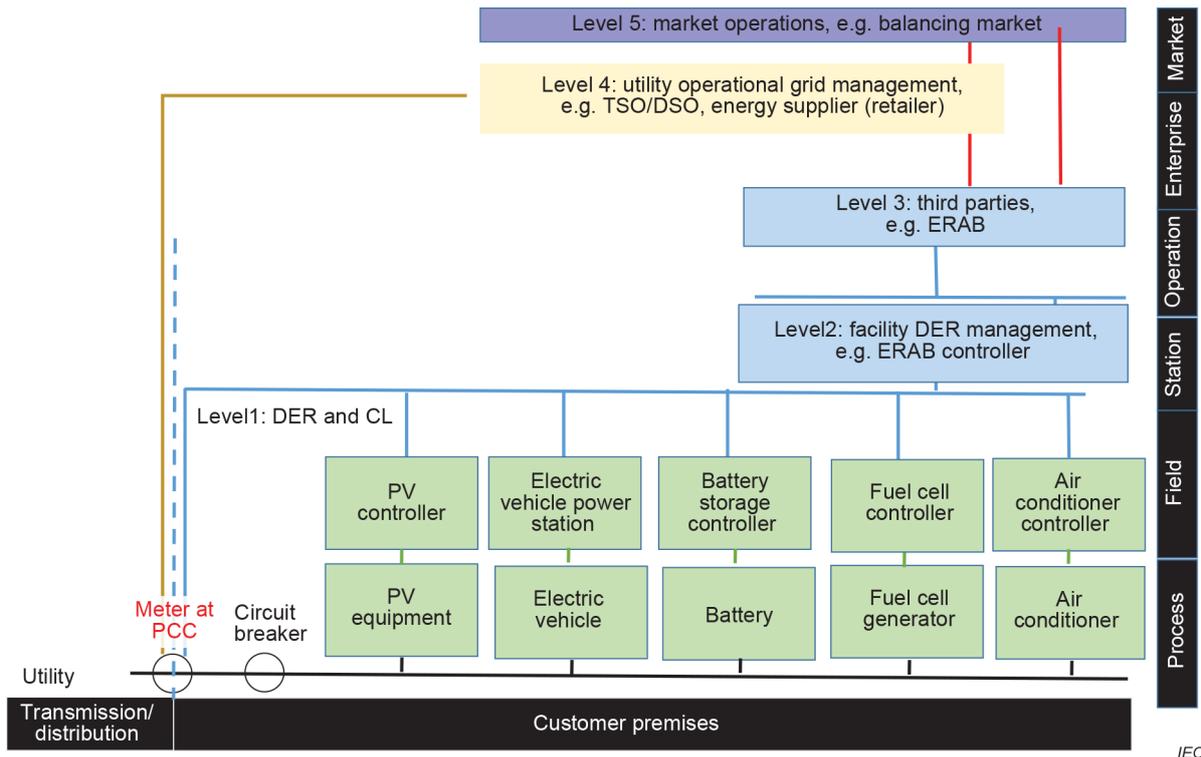


Figure 3 – ERAB on the five-level architecture in IEC SRD 62913-2-3:2019

4.3 ERAB controller

The ERAB controller collects data from the metering device at the PCC, controls various DERs and CLs, and communicates with them. The controller provides the following key functions:

- data ingestion, cleaning, filtering, positioning, and early analytics before being sent to a cloud or remote data centre;
- security as a network gateway acts as a buffer between a WAN and devices on customer premises;
- provision of real-time configuration, control, management, and tracking.

4.4 Distributed energy resource

Distributed energy resource (DER) is a generator (with its auxiliaries, protection, and connection equipment), including loads with a generating mode (such as electrical energy storage systems) connected to a low-voltage or medium-voltage network.

4.5 Controllable load

Controllable load (CL) is the load of particular consumers that shall be reduced for a limited period of time under contract at the request of the distribution supply undertaking. The controllable loads in ERAB include air conditioning, lighting, and other loads. The controllable loads exchange information with an aggregator through ERAB, uploading their status and responding to a control signal such as DR.

4.6 Metering device

A smart metering device is essential for the ERAB. The data accuracy collected at the metering device ensures the performance of the ERAB, which manages the DR orders from the TSO, DSO, and electricity supplier. To trade electricity in the ERAB, a metering device measures the active power at the PCC. Its data interval, for example, every 1 min and 30 min, is in accordance with the service menu between ERAB and its users. The real-time data access between the ERAB controller and metering device at the PCC is mapped on the five-layered architecture in IEC SRD 62913-2-3:2019, as shown by Figure 3.

5 Evaluation of the value of ERAB

5.1 Evaluation pattern of ERAB

To evaluate the value created in the ERAB, it is necessary to define the evaluation procedures shown by the measurement items (location, interval), criteria (kW and kWh), and time. This procedure is implemented using the data accessible to a metering device at the PCC. Table 1 illustrates the necessary evaluation items for ERAB as well as the reward/penalty mechanism.

Table 1 – Evaluation patterns of ERAB

Item			Abstract
Evaluation	Measurement item	Location	Measurement location to evaluate the amount of balancing power generation with DR
		Frequency	Measurement interval to evaluate the amount of balancing power generation with DR
	Criteria	Response quality shown in kW	Evaluation of capability of balancing power generation value (kW) according to the command value.
		Quantity of controlling power shown in kWh	Evaluation of capability of balancing power generation value (kW)
	Time	Timing	Time subject to response evaluation and controlled amount evaluation.
Rewards/Penalty			Reward to be paid in response to the amount of electricity provided (kWh) and a pre-shared kW target. Also, a penalty for failing to meet the DR contract requirements

5.2 Measurement point of ERAB value

5.2.1 General

In general, there are two measurement points for evaluating the amount of supply under control: point of common coupling (PCC) and DER point measurement. ERAB applies PCC measurements while also considering DER point measurements for future adaptation.

5.2.2 PCC point measurement

As shown in Figure 4, the point of common coupling (PCC) is a point in an electric power system, electrically nearest to a particular load, at which other loads are, or can be, connected. The PCC measurement is applicable for the trade of adjusting power at the energy exchange as well as the ERAB. The necessary metering data available at PCC is shown in Table 2 for general purpose, Table 3 for low-voltage customers, and Table 4 for high-voltage customers.

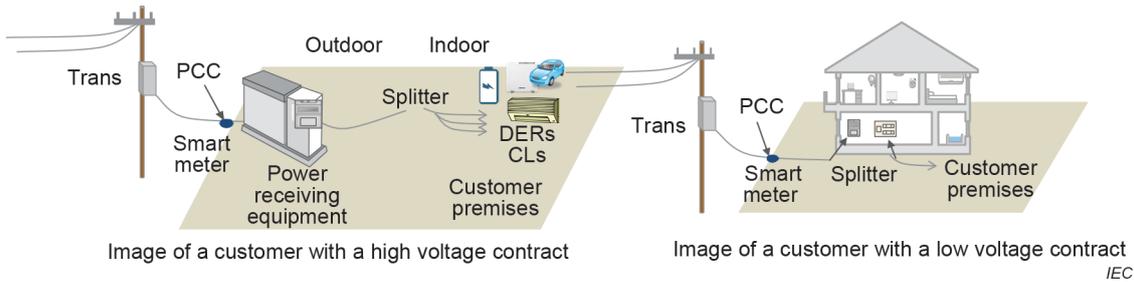


Figure 4 – Measurement at PCC

Table 2 – Available data item from a metering device at PCC

Data item	Access role
Installation location	⊙
Standard version information	⊙
Fault status	⊙
Manufacturer code	⊙
Production (serial) no.	○
Current time setting	⊙
Current date setting	⊙
Status change announcement property map	⊙
Key ⊙ high necessity in ERAB ○ optional – not supported ● installation prohibited	

Table 3 – Available data item from a metering device at PCC (for a low voltage customer)

Data item	Access role
Operation status	⊙
Data exchange point number at PCC	⊙
One-minute measured cumulative amount of electric energy (normal and reverse directions)	⊙
Coefficient	○
Number of effective digits for cumulative amount of electric energy	⊙
Measured cumulative amount of electric energy (normal direction)	⊙
Unit for cumulative amounts of electric energy (normal and reverse directions)	⊙
Historical data of measured cumulative amounts of electric energy 1 (normal direction)	⊙
Measured cumulative amounts of electric energy (reverse direction)	○
Historical data of measured cumulative amounts of electric energy 1 (reverse direction)	○
Day for which the historical data of measured cumulative amounts of electric energy is to be retrieved 1	⊙
Measured instantaneous electric power	⊙
Measured instantaneous currents	⊙