

Australian Standard[®]

Smart grid vocabulary



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 - Australian Energy Market Operator
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 - Consumer Electronics Suppliers Association
 - Consumers Federation of Australia
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 - Department of Resources, Energy and Tourism
 - E-OZ Energy Skills Australia
 - Energy Networks Association
 - Energy Retailers Association of Australia
 - Federal Chamber of Automotive Industries
 - International Copper Association Australia
 - Smart Grid Australia
-

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PREFACE

This Standard was prepared by Standards Australia Committee EL-062, Smart grids.

The objective of this Standard is to establish a common terminology for use in the electricity supply, electrical equipment, communications, appliance, consumer, government and other sectors involved smart grids in Australia.

The need for this Standard was identified in the *Australian Standards for Smart Grids—Standards Roadmap* (June 2012).

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STANDARDS AUSTRALIA

Australian Standard
Smart grid vocabulary

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard describes key concepts, and lists terms and definitions relating to smart electricity grids, in the Australian context. The definitions have been sourced, in order of priority, from published Australian regulations or Standards, from International Electrotechnical Commission (IEC) Standards and documents, and then other documents. This Standard is intended to be referenced by other Australian Standards relating to the construction, operation and assessment of smart grids.

Section 2 of this Standard describes key concepts and attributes of smart grids.

Section 3 contains definitions describing the relationships between energy suppliers, energy users and other entities involved in the operation of smart grids. These are called transactional and operational terms. Many of these relationships are also present in conventional grids, but require clarification in the smart grid context, or need to be included for completeness (e.g. because they have an accepted definition in the *National Electricity Rules* or to contrast with the use of the same term in a smart grid context).

Section 4 contains definitions related to the technology of the smart grid, or the relationships between its physical elements and communications systems. These are called technical terms.

Section 5 contains general terms that have specific meanings in the context of this Standard (e.g. 'person').

The Bibliography lists Standards and other documents found to be of particular value in the preparation of this Standard, but not explicitly referenced in the text.

Figure 1 illustrates the notional relationships between the concepts and technologies defined in Sections 3 and 4 of this Standard.

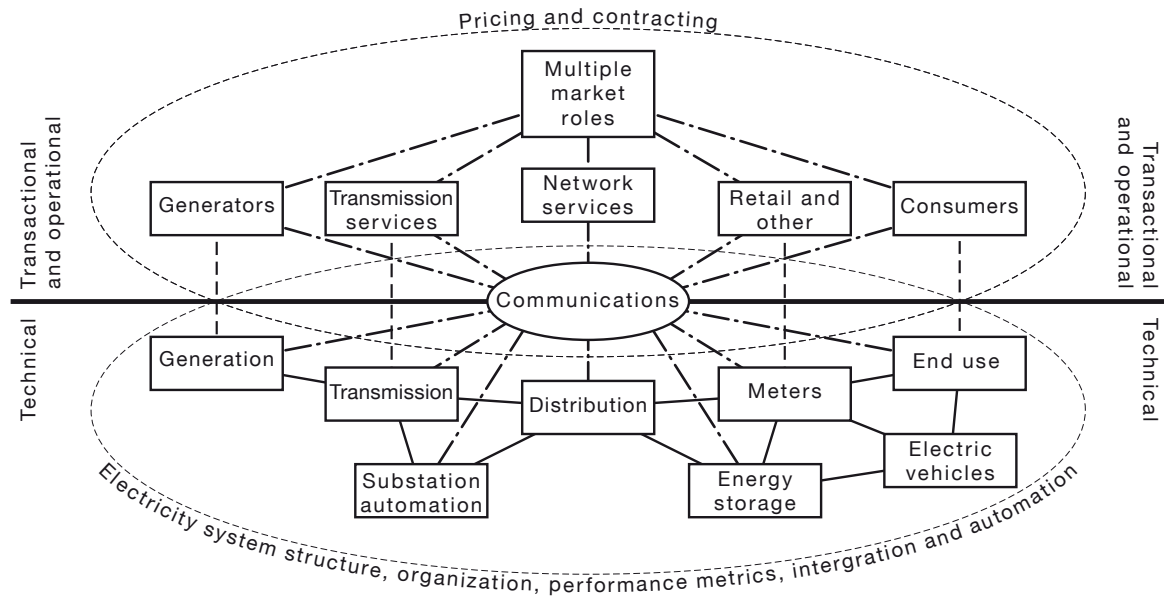


FIGURE 1 RELATIONSHIPS BETWEEN THE ELEMENTS OF SMART GRIDS

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

4755 Framework for demand response capabilities and supporting technologies for electrical products

AS ISO

8713 Electric road vehicles—Terminology

AS/NZS

3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

4755 Demand response capabilities and supporting technologies for electrical products (series)

4777 Grid connection of energy systems via inverters

IEC

61850 Communication networks and systems for power utility automation (series)

61851 Electric vehicle conductive charging system

61851-1 Part 1: General requirements

AEMC Australian Energy Market Commission

National Electricity Rules

<http://www.aemc.gov.au/Electricity/National-Electricity-Rules/Current-Rules.html>

National Energy Retail Rules

<http://www.aemc.gov.au/retail/national-energy-retail-rules/current-rules.html>

SECTION 2 KEY CONCEPTS RELATING TO SMART GRIDS

2.1 SMART GRID

Smart grid* is defined as ‘an electricity system incorporating electricity and communications networks, that can intelligently integrate the actions of parties connected to it’.

This definition describes a smart grid in terms of its most distinctive capability (the ‘what’). The intended objectives of making a conventional grid more smart are to more efficiently deliver safe, sustainable, economic, secure and reliable electricity supplies and to meet changing consumer expectations (the ‘why’). Most of this Standard describes the concepts, arrangements and technologies which can make a grid more smart (the ‘how’).

Smart grid is a comparative descriptor. There is no absolute level of capability or set of attributes which marks the transition of a specific electricity network from conventional to smart. Grids may become more smart over time as they acquire more of the transactional, operational and technical features defined in this Standard.

In general, a smart grid is distinguished from a conventional grid by the deployment of enhanced information and communications systems, in order to manage equipment in a way that achieves outcomes remotely, automatically, more rapidly and more precisely.

2.2 ADVANCED MANAGEMENT OF ENERGY FLOWS

Electricity grids in Australia (and elsewhere) have evolved over more than a century. The implicit assumption of grid planners and managers has been that electricity will be generated at a few locations and distributed to many energy users, and that the behaviour of both generators and users can be predicted with a reasonable degree of confidence over time scales of hours, days and years. The implicit assumption in smart grids is that energy may be generated and used anywhere on the grid, the behaviour of both generators and users is much more variable and less predictable, and that both will continuously react to the other.

One contributor to greater variability is the rising share of generation from renewable and distributed energy sources. Consumers can rapidly change from net importers to net exporters and vice versa, due to on-site generation and automated modification of equipment operation, as they respond to changes in dynamic energy price and other factors. Similarly, they can instantly switch from being energy consumers to sellers of load reductions or load increments.

The smart grid differs from the conventional grid in its ability to manage rapid changes in the magnitude and direction of energy flows in near real time, reducing network losses and congestion, and hence optimizing utilization of energy and network assets.

The means to do this include—

- (a) energy supply and demand forecasting;
- (b) deployment of automated sensors, switching devices and controls;
- (c) continuous monitoring and analysis of the condition of the grid;
- (d) supply response—monitoring, management and modification of generation, including renewable and distributed generators;

* The term is sometimes capitalized and/or combined into a single word, e.g. SmartGrid. In this Standard the words are separated and in lower case. The term is used in the plural (‘smart grids’) rather than the singular (‘the smart grid’) to indicate that there are many possible configurations and degrees of capability.

- (e) demand response—monitoring, management and modification of loads to facilitate either load reduction or load increase;
- (f) automated network reconfiguration to distribute load over a larger number of supply resources (e.g. dynamic feeder switching); and
- (g) energy storage, both centralized and distributed.

A smart grid relies on innovative technologies and operating systems to manage energy flows, and also relies on flexible and dynamic institutional arrangements.

2.3 CONSUMER SIDE ENERGY MANAGEMENT

Energy users require access to energy services, at high levels of security and at reasonable cost, under arrangements they can easily understand. They need to purchase both energy and a stock of physical equipment (e.g. buildings and appliances) to obtain the required services. Individual consumers value energy services differently, and the preferences and priorities of each consumer will change over time (possibly over the course of a single day).

In conventional grids there is little differentiation in the price charged for energy, little information about the cost, environmental impact or quality of energy services, and only limited guidance for consumers who wish to optimize the value of their energy services.

Smart grids utilize technologies and contracting arrangements that enable consumers to be more active market participants allowing them to better manage their use of energy services, both in the short term (by changing how they use their existing appliances and equipment) and the longer term (by more informed selection of new equipment). The means to do this include—

- (a) better indication of the total quantity of energy used and the share of that energy used by different energy services;
- (b) clearer indication of the costs of using and supplying energy at various times;
- (c) assistance with automated demand response, for those consumers who wish to manage their exposure to high-energy-price periods or take advantage of opportunities to sell energy or load response;
- (d) facilitating choice of generation sources to realize environmental and/or social benefits;
- (e) enabling greater consumer control, autonomy and convenience; and
- (f) satisfactory safeguards for vulnerable consumers.

2.4 INTEGRATION AND SECURITY OF COMMUNICATIONS

Smart grids rely on rapid and accurate exchange of information between human agents (e.g. grid managers, energy users) and the many technical agents that comprise the grid (e.g. generation plant, transformers, switchgear, overhead and underground lines, meters, end use equipment and controllers).

Integrated communications enable these agents to exchange information with each other through the use of agreed protocols and interoperability standards. However, integration may also increase the vulnerability of the system to accidental error or deliberate, unauthorized intrusions and manipulations.

Security encompasses measures to ensure the privacy, integrity, and availability of the electronic information communication systems and the control systems necessary for the management, operation, and protection of the smart grid's energy, information technology, and telecommunications infrastructures.

2.5 DATA AVAILABILITY AND VISIBILITY

The efficient operation of smart grids relies on the ability of the agents to make continuous decisions, based on accurate real-time information about the condition of the grid as a whole, as well as the parts they own or have a legal entitlement or obligation to manage. The existence of key devices and information flows needs to be made known to those agents who require access to it, and critical information about changes in the condition of the grid needs to be made available, in a form that supports rapid decision-making.

Raw data from infield sensors acquired by metering, data acquisition (e.g. SCADA) devices and other systems need to be processed before presentation to system managers and other participants, and before initiating automated grid responses.

2.6 FLEXIBLE COMMERCIAL CONTRACTS

Smart grids enable forms of exchange between parties that could not exist in conventional grids. For example, smart meters or other technologies enable new forms of pricing and service provision and allow consumers to realize the value of a broad range of actions.

Such arrangements may require new forms of contracting between parties, beyond the traditional agreements for the supply and purchase of energy. Individuals and businesses may have several roles in the market, either sequentially (e.g. depending on the direction of energy flow) or even simultaneously.

Flexible contracting arrangements also involve new ways to share risk, and in some cases could increase risk for some parties. The potential for some consumers to become worse off should be managed through safeguards such as those in electricity retail regulations (e.g. the National Energy Customer Framework^{*}), consumer protection regulations and broader social policy.

2.7 DISTRIBUTION AUTOMATION

Distribution automation optimizes the performance of feeders, transformers and other components of networked distribution systems, and integrates them with transmission systems and consumer operations. As smart meters and demand response develop, and as distributed energy resources including plug-in electric vehicles are deployed, the automation of distribution systems becomes important to the efficient and reliable operation of the grid.

2.8 ADVANCES IN TRANSMISSION SYSTEMS

The key to achieving smarter transmission is advanced management of energy flows. The enabling technologies discussed in Clause 2.1 are generally applicable to both transmission and distribution systems. A number of other enabling technologies are primarily found in transmission systems.

These include:

- (a) Increased use of power electronic controllers (e.g. including flexible a.c. transmission systems and high voltage direct current links for delivery of enhanced control of active and reactive power).
- (b) Increased use of phasor measurement units (PMUs) for wide area measurements.
- (c) Increased use of near real-time dynamic line rating technologies.
- (d) The use of demand side response for transmission line congestion management.

^{*} National Energy Customer Framework <http://www.aer.gov.au/retail-markets>

SECTION 3 TRANSACTIONAL AND OPERATIONAL TERMS

3.1 ELECTRICITY MARKET PARTICIPANTS

Electric power system manager; or Independent system operator A person responsible for the long term planning and/or day-to-day management of an electricity grid.

Supply management The planning, implementation, and monitoring of strategies to manage supply to meet demand in the medium or longer term.

Generator A person who engages in the activity of owning, controlling or operating a generating system that is connected to, or who otherwise supplies electricity to, a transmission or distribution system and who is registered with the appropriate regulatory authority.

Self-generator A person who engages in the activity of owning, controlling or operating a generating system that is connected to a transmission or distribution system, and who is not registered with the appropriate regulatory authority.

NOTE: Non-registered generators generally operate generating units of less than 5 MW output.

Transmission network service provider (TNSP) A person who engages in the activity of owning, controlling or operating an electricity transmission system.

Distributor; or Distribution network service provider (DNSP) A person who engages in the activity of owning, controlling or operating an electricity distribution system.

Retailer A person authorized to sell energy to consumers.

Energy services company (ESCO) A person who designs, supplies or manages the means to convert delivered (or self-generated) energy to energy services, but without supplying the energy itself.

Agents with multiple market roles

Gentailer A person with commercial interests in both electricity generation and retailing.

Gentrader A person with rights to trade the output of a generator.

Aggregator (small generation) A person who intends to supply, or supplies, electricity from one or more small generating units that are connected to a transmission or distribution systems and is registered with the appropriate regulator.

Aggregator A person who contracts with a number of other participants (e.g. energy consumers) in order to combine the value of smaller loads or actions such as demand response or ancillary services.

<i>Prosumer</i>	An electricity consumer who also has the means to export electricity to the grid, through either energy storage and/or self-generation.
<i>Multi-utility</i>	A person who supplies, or is capable of supplying, a range of services beyond energy and/or energy services (e.g. water, telecommunications).

3.2 PRICING AND CONTRACTING

Transactive energy system	An integrated approach to balancing generation, consumption and flow of electric power by the use of two-way flows of information, localised decision-making and dynamic market-based constructs.
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Contracts and supply arrangements

<i>Energy pricing</i>	An arrangement in which the amount charged is based on energy use.
<i>Capacity pricing; or Load pricing</i>	An arrangement in which the amount charged is based on power or peak demand.
<i>Power factor-based pricing</i>	An arrangement in which the amount charged is based on reactive power or power factor.
<i>Hybrid pricing</i>	A form of pricing in which energy costs, capacity costs and/or network charges are not differentiated in the amounts charged to consumers.
<i>Supply charge; or Standing charge</i>	A charge that is based on the right to access the grid as a consumer, and which – once established – does not vary with load or energy usage. Supply charges may be levied according to the capacity of a connection.

Energy pricing

<i>Conventional pricing</i>	An arrangement in which charges are based on the energy used between meter readings, without otherwise taking into account the time of use. All energy may be charged at the same rate per kWh, or in blocks (e.g. one price for the first X kWh per charging period a different price for the next Y kWh and so on).
<i>Cost-reflective pricing</i>	An arrangement in which the price of energy varies with location and/or time of energy consumption.
<i>Time-of-use (TOU) pricing; or Flexible pricing</i>	An arrangement in which prices vary according to the time of day, the week or the season when energy is used.
<i>Off-peak pricing</i>	An arrangement in which prices are based on time limitations on the availability of electricity (e.g. off-peak water heating).