

Grid Architecture Component Class Specification

Component Class Designation: Load

Summary Overview

Load is the set of end user devices and systems that consume real power from an electric grid. Load may be considered in terms of individual devices, or in aggregated form, as seen by a grid. Load is where demand originates, and so loads individually and in aggregate are the sources of the essential signals that drive grid operation. Figure 1 illustrates demand flowing from Consumer net load to the grid, and supply flowing from sources and storage back to Consumers to achieve balance.

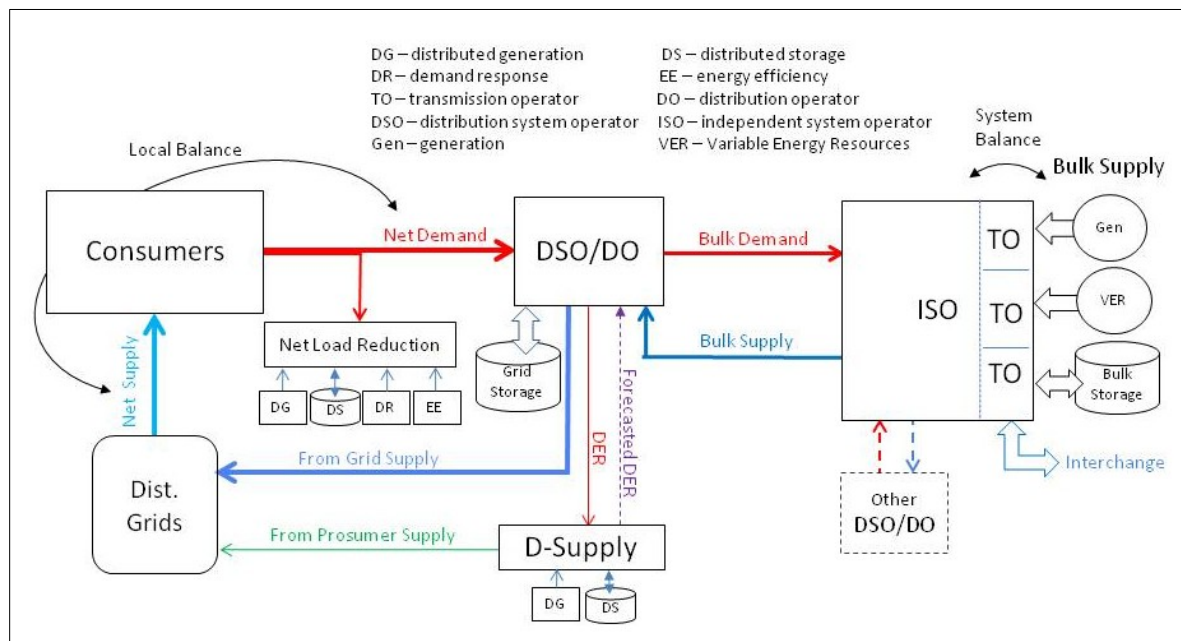


Figure 1 Demand Flow from Loads to the Grid

Definitions

Sensitive load – loads which depend strongly on power supply for particular purposes because of the impact on personal well being or the community as a whole. Commercial and industrial businesses such as hospitals, utilities, public venues with large gatherings of people and heavy industry with environmental concerns are examples of such commercially sensitive loads.

Adjustable load – loads for which demand can be altered from the value it would have under autonomous operation. The load may be continually adjustable such as with variable speed drives for motors, fans and pumps, or it may be duty-cycle adjustable, such as with heating/cooling systems controlled by thermostats.

Sheddable load – loads whose demand may be modified by shutting them off completely.

Net load – the apparent demand seen by the grid from a load that has behind-the-meter resources to supplement the grid; net load can be more volatile than actual load if the local resource has high volatility (e.g. rooftop solar PV).

Component Class Description

Purpose and function

Loads exist in diverse forms that have diverse behaviors. See Figure 2 for a breakdown of electricity usage in the US.

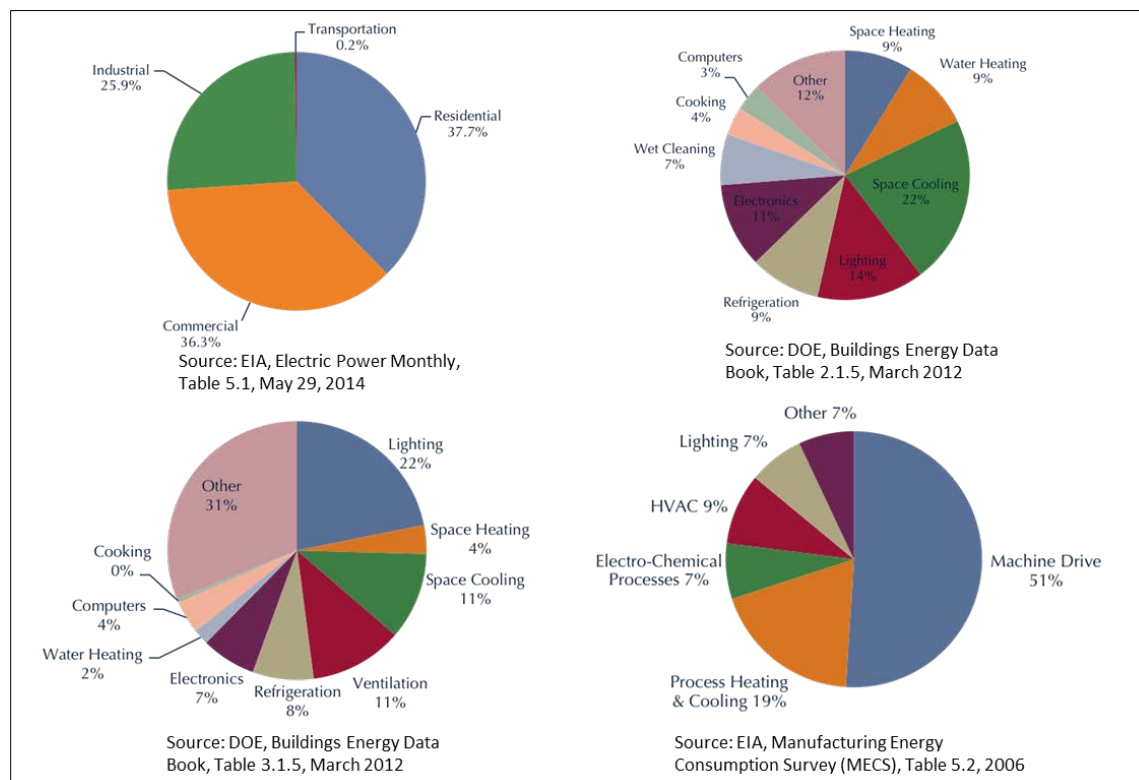


Figure 2 Electricity Usage in the US

Most loads operate autonomously with respect to the grid, according to the needs of users without regard to grid conditions (other than abnormal events). Some loads are capable of being responsive to grid conditions or may even provide services to the grid (regulation, congestion relief, aggregate load profile adjustment, etc.). The presence of behind-the-meter generation or storage can modify the apparent demand from a load to a net load. Depending on the nature of the generation, this may increase that apparent volatility of the load and can introduce other problems related to abnormal grid events. Figure 3 provides a classification of load types, and relationship to net load reduction. Note that net load reduction has a time scale property and can be deterministic or stochastic on short or long time scales.

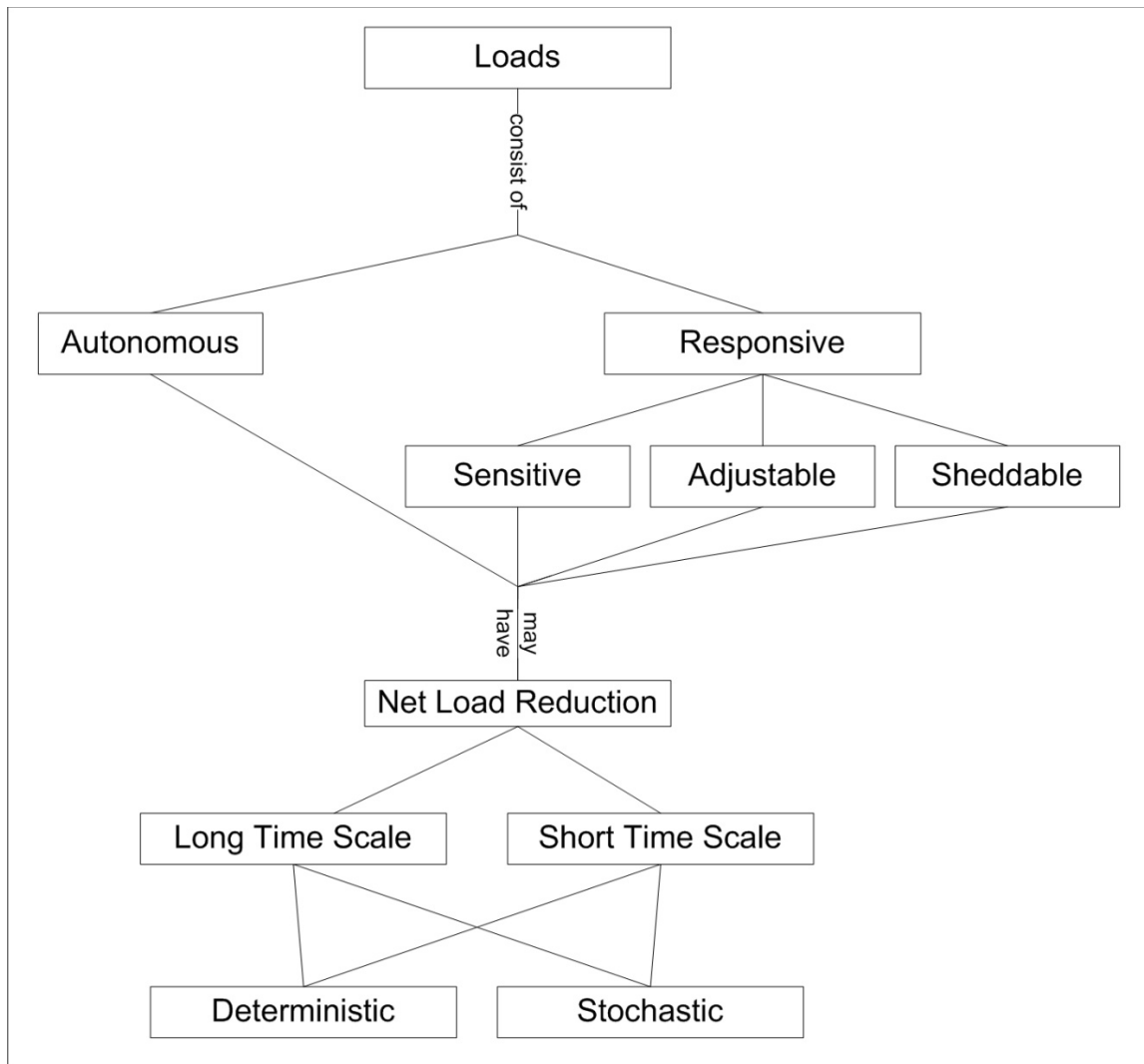


Figure 3 Load Taxonomy and Load Reduction Property

Some loads may be capable of providing services to electric grids. These services can include

Key externally visible properties

Demand – electric power being drawn by a load; usually expressed in kilowatts or Megawatts.

Load diversity – randomization of duty-cycle many controlled loads such that aggregated load is less than the sum of such loads if all were to be on simultaneously. Diversity can be lost temporarily after a power outage.

Load volatility – temporal fluctuation of demand from a load; aggregate load volatility (at the substation level) is generally well understood and is normally well-behaved (predictable) due in part to load diversity but the introduction of a stochastic behind-the-meter load reduction capability can significantly increase volatility.

Interface descriptions

Power connection – electric service connection; may be single-phase or three-phase. For loads with distributed generation, the power connection may include a power electronic inverter.

Meter- generally considered the demark between the utility and the load, the meter registers usage and may provide other data; meters have one of more interfaces, including a human-machine interface for manual reading and possibly an electronic interface for automated reading of meter data.

Grid/market services communication interface – for loads capable of response to grid signals or market participation, or for loads that can provide services to grids, an electronic communication interface supports the necessary information exchange. This is separate from the meter and may operate over a different communication network than the meter.

Table of relevant standards

Standard Name	Description	Version/Date

List of Attached Documents <list Visio drawing packages, Xcel spreadsheets, etc.; add rows as needed>

	Description	Version/Date
GMLC 1.2.1 Loads class diagrams v.01.vsd	Diagrams for the Load Component Class definition	V 0.1 26-Jun-16

Version History

Action	Date	Description	Author(s)
created	22-Jun-16	initial draft	jd taft