# IEC SRD 62913-2-3

Edition 1.0 2019-05

# SYSTEMS REFERENCE DELIVERABLE

colour inside

## Generic smart grid requirements – Part 2-3: Resources connected to the grid domains

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IEC SRD 62913-2-3:2019-05(en)

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

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

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## Generic smart grid requirements – Part 2-3: Resources connected to the grid domains

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 29.020; 29.240; 33.200

ISBN 978-2-8322-6882-7

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CONTENTS

FOREWORD ..... 6
INTRODUCTION ..... 8
1 Scope ..... 9
2 Normative references ..... 9
3 Terms, definitions and abbreviated terms ..... 10
3.1 Terms and definitions ..... 10
3.2 Abbreviated terms ..... 15
4 Distributed energy resources ..... 16
4.1 Purpose and scope ..... 16
4.1.1 Purpose: business analysis of DERs ..... 16
4.1.2 Scope: DERs as sources of generation ..... 16
4.2 Business analysis of DER systems ..... 17
4.2.1 Benefits and challenges of grid-connected DER systems ..... 17
4.2.2 Stakeholders involved in the DER domain ..... 20
4.2.3 Traffic light concept for DERs ..... 20
4.2.4 Business drivers and objectives of DER stakeholders ..... 21
4.2.5 DER grid services ..... 23
4.2.6 Regional differences ..... 29
4.2.7 List of business roles and business Use Cases of the domain ..... 29
4.2.8 List of system Use Cases and system roles ..... 33
5 Smart home/commercial/industrial/DR-customer energy management ..... 41
5.1 Purpose and scope ..... 41
5.1.1 Clause objective ..... 41
5.1.2 General context ..... 41
5.2 Business analysis ..... 42
5.2.1 General overview ..... 42
5.2.2 List of business roles and business Use Cases of the domain ..... 43
5.2.3 List of system Use Cases and system roles ..... 48
5.3 Smart home requirements for the smart grid ..... 55
5.3.1 Smart grid requirements extracted from smart home Use Cases ..... 55
5.3.2 Other requirements ..... 72
6 Energy storage ..... 72
6.1 Purpose and scope ..... 72
6.1.1 Clause objective ..... 72
6.1.2 General context ..... 72
6.2 Business analysis ..... 74
6.2.1 General overview ..... 74
6.2.2 EES grid services ..... 74
6.2.3 List of business Use Cases and business roles of the domain ..... 78
6.2.4 List of system Use Cases and system roles ..... 80
6.3 EES smart grid requirements ..... 82
6.3.1 Smart grid requirements extracted from EES Use Cases ..... 82
6.3.2 Other requirements ..... 82
Annex A (informative) Links with other TCs and gathered materials ..... 84
A.1 Distributed energy resources ..... 84
A.1.1 Identified TCs ..... 84

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A.1.2 Gathered materials ..... 84
A.1.3 Description of the five-level hierarchical diagram ..... 85
A.2 Smart home/commercial/industrial/DR-customer energy management ..... 87
A.2.1 Identified TCs ..... 87
A.2.2 Gathered materials ..... 87
A.2.3 Liaisons from other TCs contributing to the smart grid requirements of the domain ..... 96
A.3 Energy storage ..... 97
A.3.1 Identified TCs ..... 97
A.3.2 Gathered materials ..... 97
A.3.3 Liaisons from other TCs contributing to the smart grid requirements of the domain ..... 100
Annex B (informative) Use Cases ..... 101
B.1 Distributed energy resources ..... 101
B.2 Smart home/commercial/industrial/DR-customer energy management ..... 109
B.2.1 Business Use Cases ..... 109
B.2.2 System Use Cases ..... 175
B.3 Energy storage ..... 376
B.3.1 Business Use Cases ..... 376
Bibliography ..... 392

Figure 1 – Example of a hierarchical DER system five-level architecture ..... 19
Figure 2 – DER primary stakeholders ..... 20
Figure 3 – Traffic light concept ..... 21
Figure 4 – Business policies, business objectives, business processes, and system use cases ..... 22
Figure 5 – Role highlights of the smart home domain ..... 44
Figure 6 – General architecture for the smart home ..... 54
Figure 7 – General architecture for the smart building ..... 55
Figure 8 – EES domains, services and roles ..... 75
Figure A.1 – Reference architecture diagram for smart metering communications ..... 94
Figure A.2 – EU M/490 – Flexibility Functional Architecture (CEN-CENELEC-ETSI) ..... 94
Figure A.3 – France – COSEI architectures ..... 95
Figure A.4 – Correspondence table between hardware components and functional components (system roles) ..... 96
Figure B.1 – Level 1 DER systems with autonomous functions at facility and DSO sites ..... 101

Table 1 – Content of IEC SRD 62913-2-3:2019 ..... 9
Table 3 – Matrix of stakeholders versus their primary business purposes ..... 22
Table 4 – Types of DER services ..... 24
Table 5 – Business roles ..... 30
Table 6 – Business Use Cases ..... 31
Table 7 – Identified system Use Cases of the domain ..... 33
Table 8 – System roles of the domain ..... 38
Table 9 – Business roles of the domain ..... 43
Table 10 – Identified smart home business Use Cases of the domain ..... 45

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Table 11 – Identified smart building business Use Cases of the domain ..... 46
Table 12 – Identified system Use Cases of the domain ..... 48
Table 13 – System roles of the domain ..... 53
Table 14 – Business requirements ..... 55
Table 15 – Identified EES services ..... 74
Table 16 – Business roles of the domain ..... 78
Table 17 – Identified business Use Cases of the domain ..... 79
Table 18 – Identified system Use Cases of the domain ..... 81
Table 19 – Requirements extracted from EES Use Cases ..... 82
Table A.1 – Existing User Stories ..... 84
Table A.2 – Existing Use Cases ..... 85
Table A.3 – IEC documents on smart home/commercial/industrial/ DR-customer energy management ..... 87
Table A.4 – Existing User Stories ..... 88
Table A.5 – Existing Use Cases ..... 89
Table A.6 – Links between TC 57/WG 21 User Stories and SyC SE Use Cases ..... 90
Table A.7 – Existing User Stories ..... 93
Table A.8 – International Standards on energy storage ..... 97
Table A.9 – Regional and/or organizational standards on energy storage ..... 98
Table A.10 – Existing Use Cases on energy storage ..... 99
Table A.11 – Existing Use Cases on energy storage ..... 100
Table B.1 – DER Use Cases ..... 102
Table B.2 – Adapt the smart home behaviour to the resident/client's preferences ..... 109
Table B.3 – Enable the interoperability between the smart home and the smart grid ..... 118
Table B.4 – Provide enriched smart home data to relevant parties in order to make the resident/client more active ..... 126
Table B.5 – Manage the flexibility on electricity demand and generation within a smart home from market signals ..... 134
Table B.6 – Adapt the smart building behaviour to the energy manager/client's preferences ..... 142
Table B.7 – Provide enriched smart building data to relevant parties in order to make the energy manager/client more active ..... 151
Table B.8 – Manage the flexibility on electricity demand and generation within a smart building from market signals ..... 160
Table B.9 – Manage the flexibility in electricity demand and generation within a smart home from emergency signals ..... 168
Table B.10 – Manage the flexibility of the smart home on electricity demand and generation from price incentives ..... 175
Table B.11 – Manage the flexibility of the smart home on electricity demand and generation from DR requests ..... 205
Table B.12 – Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests ..... 233
Table B.13 – Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals) ..... 247
Table B.14 – Provide a third party with enriched smart home electricity data ..... 261
Table B.15 – Provide alarms related to the smart home electricity behaviour to the client or resident ..... 278

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Table B.16 – Manage the flexibility in electricity demand and generation within a smart home from emergency signals ..... 287
Table B.17 – Manage the flexibility of the smart building on electricity demand and generation from price incentives ..... 296
Table B.18 – Manage the flexibility of the smart building on electricity demand and generation from DR requests ..... 306
Table B.19 – Manage opt-outs of the smart building to automatic responses related to price incentives or DR requests ..... 316
Table B.20 – Customize automatic responses of the smart building (price incentives, DR requests, or emergency signals) ..... 329
Table B.21 – Provide a third party with enriched smart building electricity data ..... 344
Table B.22 – Provide alarms related to the smart building electricity behaviour to the client or energy manager ..... 360
Table B.23 – Optimize the smart building behaviour regarding internal and external information received ..... 369
Table B.24 – Contribute to the efficient integration of intermittent renewable energies in the electric power system ..... 377
Table B.25 – Help the grid user or the grid operator improve the quality of supply ..... 385

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# GENERIC SMART GRID REQUIREMENTS –

# Part 2-3: Resources connected to the grid domains

## FOREWORD

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IEC SRD 62913-2-3, which is a Systems Reference Deliverable, has been prepared by IEC systems committee Smart Energy.

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

| Draft SRD | Report on voting |
|---|---|
| SyCSmartEnergy/89/DTS | SyCSmartEnergy/98/RVDTS |

Full information on the voting for the approval of this Systems Reference Deliverable can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC SRD 62913 series, published under the general title *Generic smart grid requirements*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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# INTRODUCTION

The IEC SRD 62913 series has been broken down into domains so as to provide a neutral term for document management purposes. Under the general title *Generic smart grid requirements*, the IEC SRD 62913 series consists of the following parts:

– *Part 1: Specific application of the Use Case methodology for defining generic smart grid requirements according to the IEC systems approach*;

– Part 2 is composed of 5 subparts which refer to the clusters that group several domains:

- *Part 2-1: Grid related domains* – these include transmission grid management, distribution grid management, microgrids and smart substation automation;
- *Part 2-2: Market related domain*;
- *Part 2-3: Resources connected to the grid domains* – these include bulk generation, distributed energy resources, smart home/commercial/industrial/DR-customer energy management, and energy storage;
- *Part 2-4: Electric transportation related domain*;

IEC SRD 62913 refers to 'clusters' of domains for its different parts so as to provide a neutral term for document management purposes simply because it is necessary to split in several documents the broad scope of smart energy.

The purpose of this document is to define the generic smart grid requirements of resources connected to the grid domains, i.e. distributed energy resources, smart home/commercial/industrial/DR-customer energy management, energy storage, and bulk generation domains, based on the methods and tools developed in IEC SRD 62913-1.

The document for each domain is composed as follows.

- Purpose and scope.
- The business analysis: to address domain's strategic goals and principles regarding its smart grid environment. It also lists business Use Cases and system Use Cases identified, their associated business roles and system roles (actors) and the simplified role model highlighting main interactions between actors.
- Generic smart grid requirements: extracted from Use Cases described in Annex B.
- Annex A lists links between domains, technical committees and gathered materials (existing standardization documents, user stories, Use Cases and functional architectures).
- Annex B includes a complete description of Use Cases per domain based on IEC 62559-2.
- Bibliography.

This document is based on the inputs from domain experts as well as existing materials in a smart grid environment.

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# GENERIC SMART GRID REQUIREMENTS –

# Part 2-3: Resources connected to the grid domains

## 1 Scope

This part of IEC SRD 62913 initiates and illustrates the IEC's systems approach based on Use Cases and involving the identification of generic smart grid requirements for further standardization work for resources connected to the electric power systems – i.e. distributed energy resources, smart home/commercial/industrial/DR-customer energy management, energy storage, and bulk generation domains – based on the methods and tools developed in IEC SRD 62913-1.

This document captures possible "common and repeated usage" of a smart grid system, under the format of "Uses Cases" with a view to feeding further standardization activities. Use Cases can be described in different ways and can represent competing alternatives. From there, this document derives the common requirements to be considered by these further standardization activities in term of interfaces between actors interacting with the given system.

To this end, Use Case implementations are given for information purposes only. The interface requirements to be considered for later standardization activities are summarized (typically information pieces, communication services and specific non-functional requirements: performance level, security specification, etc.).

This analysis is based on the business input from domain experts as well as existing material on grid management in a smart grid environment when relevant. Table 1 highlights the domains and business Use Cases described in this document.

Electric vehicles are on one hand considered as a DER and normally should fit in IEC SRD 62913-2-3; but on the other hand, and for historical reasons, they are separated into two documents and covered in the IEC SRD 62913-2-4 electric transportation domain.

The document will be updated as new editions are published. Table 1 highlights the business areas covered in this document.

**Table 1 – Content of IEC SRD 62913-2-3:2019**

| Domain | Content | Scope described |
|---|---|---|
| Distributed energy resources | Identified with 41 business Use Cases and 36 system Use Cases | Operation and monitoring of a DER |
| Smart home/commercial/industrial/ DR-customer energy management | Described with 8 business Use Cases and 14 system Use Cases | Smart home, smart building, multi-building complexes |
| Energy storage | Described with 2 business Use Cases | EES services for grid users and system operators |
| Bulk generation | n/a | n/a |

## 2 Normative references

There are no normative references in this document.

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# 3 Terms, definitions and abbreviated terms

## 3.1 Terms and definitions

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

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

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

**3.1.1**
**ancillary services**
services necessary for the operation of an electric power system provided by the system operator and/or by power system users

Note 1 to entry: System ancillary services may include the participation in frequency regulation, reactive power regulation, active power reservation, etc.

[SOURCE: IEC 60050-617:2009, 617-03-09]

**3.1.2**
**automated control**
aggregate of operations aimed at sustaining or/and improving the functioning of a controlled object without direct human participation and in accordance with a prescribed control objective

EXAMPLE Automatic response to signals such as dynamic peak period notifications, price period changes or flexibility requests.

Note 1 to entry: The automated control is configured and tuned by the client/resident and the client/resident can override it if needed.

**3.1.3**
**capacity firming**
method that uses storage to control the ramp rate (MW/min), smooth and mitigate rapid output changes from renewable generation due to different natural parameters such as wind speed variability affecting wind generation or shading of solar generation due to clouds

Note 1 to entry: It is important because these rapid output changes must be offset by other "dispatchable" generation.

[SOURCE: DOE Global energy storage database, Glossary]

**3.1.4**
**congestion**
<electric power system> situation in a transmission or distribution network requiring, in parts of an electric power system, a limitation of load flow

[SOURCE: IEC 60050-617:2009, 617-03-04]

**3.1.5**
**congestion mitigation**
set of one or more actions set up to avoid grid congestions by means such as by increasing the transfer capacity of the grid, by curtailing demand connected to the grid or by curtailing generation units

Note 1 to entry: Congestion in transmission and distribution grids refers to a situation in which the demand for power transfer exceeds the transfer capability of a grid.

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**3.1.6**
**dispatchable generation source**
source of electricity that can be dispatched at the request of power grid operators or of the plant owner

Note 1 to entry: That is, generating plants that can be turned on or off, or can adjust their power output according to an order.

**3.1.7**
**flexible load**
load of consumers (in kW) which can be reduced or increased for a limited period of time at the request of an external actor according to contractual arrangements

Note 1 to entry: The control is automatic and based on technology or devices operated remotely due to the volume of consumers participating – such as residential consumers.

Note 2 to entry: The control may target specific appliances, such as space-heaters for instance.

**3.1.8**
**distributed energy resource**
**DER**
distributed set of one or more energy service resources, including generators, energy storage, controllable load and ancillary services

**3.1.9**
**dynamic peak period**
**DPP**
superseding calendar which replaces the initial price schedule during a short period of time when facing a peak demand

**3.1.10**
**electric power system**
**EPS**
network of electrical components deployed to supply and transfer electric power to a load

Note 1 to entry: The EPS may include generation units.

**3.1.11**
**electrical energy storage**
**EES**
process which consists in using various forms of energy such as mechanical, chemical, electrochemical, electrical, or thermal energy to store energy that will later be converted to electricity

Note 1 to entry: This domain report covers any type of EES which can charge electricity to and discharge electricity from any source.

**3.1.12**
**electrical energy storage management**
collection of methods used to manage EES with software, hardware, and services associated with the intelligent monitoring, management, and control of EES, for the specific purposes such as the enhancement of a system's efficiency, cost reduction or optimization of energy utilization to meet EES users' needs

**3.1.13**
**electrical connection point**
**ECP**
point of electrical connection between the DER source or sink of energy and any EPS

Note 1 to entry: Each DER unit has an ECP connecting it to its local power system; groups of DER units have an ECP where they interconnect to the power system at a specific site or plant; a group of DER units plus local loads have an ECP where they are interconnected to the utility power system.

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Note 2 to entry: For those ECPs between a utility EPS and a plant or site EPS, this point is identical to the point of common coupling (PCC) in IEEE Std 1547, *Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces*.

**3.1.14**
**electricity data**
electricity-related data, either generation or consumption, coming from the electricity meter or from electrical devices

**3.1.15**
**energy meter**
instrument intended to measure electrical energy by integrating power with respect to time

[SOURCE: IEC 60050-313:2001, 313-01-35]

**3.1.16**
**energy shifting**
principle of shifting the timing of energy use by, for example, charging electricity during off-peak time and by discharging it during peak hours to reduce the cost to purchase electricity

**3.1.17**
**flexibility**
modification of electricity injection and/or extraction, on an individual or aggregated level, in reaction to an external signal in order to provide a service within the energy system

Note 1 to entry: Definition based on EURELECTRIC, Active Distribution System Management. A key tool for the smooth integration of Distributed Generation, 2013]

**3.1.18**
**frequency regulation**
ability of a balancing authority to help the interconnection maintain scheduled frequency

Note 1 to entry: This assistance can include both turbine governor response and automatic generation control.

**3.1.19**
**grid stabilization**
process requisite to stabilize power transmission and distribution networks with the operation of power plants

Note 1 to entry: Grid stabilization can be achieved, for example, by stabilizing the frequency of electric power produced on an island and by stabilizing voltage at the end of a long transmission line.

**3.1.20**
**historian**
software service which accumulates time-stamped data, events and alarms in a database which can be queried or used for further actions

**3.1.21**
**home area network**
**HAN**
in-house local area network which interconnects domestic equipment and can be used for energy management purposes

[SOURCE: CEN/CLC/ETSI TR 50572:2011]

Note 1 to entry: There can be multiple HANs inside a customer's premises.

**3.1.22**
**islanding**
process whereby a power system is split into two or more islands

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[SOURCE: IEC 60050-603:1986, 603-04-31]

Note 1 to entry: Islanding is either a deliberate emergency measure, or the result of automatic protection or control action, or the result of human error.

Note 2 to entry: In this document, islanding refers to a measure to avoid load shedding in an area by immediately supplying power to the area from EES, and temporarily form an islanding status after the power supply from grids fails due to, for instance, a contingency.

**3.1.23**
**load following**
adjusting the output of power generation plants to meet the electricity demands which vary in a particular period

**3.1.24**
**manual control**
mode that allows clients or residents to directly control their consumptions depending on information provided by the energy market player(s) they have contracted with

Note 1 to entry: Sometimes this manual control mode is the only one available when technology or the electrical devices are not able to respond automatically to dynamic peak period notifications, price period changes or flexible requests.

**3.1.25**
**operating reserves**
all resources, generation or consumption, available to the system operator within a short interval of time to provide for frequency regulation or balancing purposes

Note 1 to entry: Operating reserves consist of spinning reserve, the increasing power output of generators that are already connected to the power grids, and non-spinning reserve, the extra generating capacity that is not currently connected to the system but can be brought online after a short delay.

[SOURCE: ENTSO-E: System operation guideline]

**3.1.26**
**peak shaving**
process needed to reduce peak demand by storing energy when demand is low and releasing energy when demand is high to level out electricity load throughout the day

**3.1.27**
**price-based management**
management method based on the fact that in order to modulate clients' consumptions during a day, a week or a peak period, the electricity supplier can offer temporarily higher electricity prices in order to tempt clients to erase or postpone the use of some of their electric devices

Note 1 to entry: Price-based control therefore combines variable electricity prices and the sending of price incentives to clients for them to be able to control manually or automatically the use of their electric devices.

**3.1.28**
**quality of service**
collective effect of service performance which determines the degree of satisfaction of a user of the service

Note 1 to entry: The quality of service is characterized by the combined aspects of service support performance, service operability performance, severability performance, service integrity and other factors specific to each service.

[SOURCE: IEC 60050-191:1990/AMD1:1999, 191-19-01]

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**3.1.29**
**remote customer information**
**RCI**
data and signals communicated toward the smart home through the internal smart metering gateway

Note 1 to entry: This data can be tariff signals, flexibility requests or technical data.

**3.1.30**
**security**
<of an electric power system> ability of an electric power system to operate in such a way that credible events do not give rise to loss of load, stresses of system components beyond their ratings, bus voltages or system frequency outside tolerances, instability, voltage collapse, or cascading

[SOURCE: IEC 60050-191:1999, 191-21-03]

Note 1 to entry: In the context of smart grid the term 'security' may be too vague. In this document, it may be replaced by 'operational reliability' or 'operational security' to reflect the real practices of, for example, NERC or ENTSO-E.

**3.1.31**
**self-consumption**
act of consuming energy which is produced by a power generation system installed at the consumption site

**3.1.32**
**smart home**
house or apartment equipped with a communicating (electricity, telecoms) and structured home area network (HAN)

Note 1 to entry: Clients or residents are able to remotely control and/or programme home electrical devices by activating or enabling and/or disabling internal controls and/or external events (excluding emergency signals). Then, smart home devices can adapt their operations without any resident intervention.

**3.1.33**
**smart home flexibility**
ability of a smart home to adjust up or down its consumption or generation depending on signals in order to modify the load curve

**3.1.34**
**smart site**
site equipped with a communicating (electricity, telecoms) and structured home area network (HAN)

Note 1 to entry: Clients, residents or operations staff are able to remotely control and/or programme home electrical devices by activating or enabling and/or disabling internal controls and/or external events (excluding emergency signals). Then, smart home devices can adapt their operations without any resident intervention.

**3.1.35**
**traffic light concept**
concept which describes the relation between the use of flexibilities on the grid side (red phase) and the market side (green phase) and the interrelation between both (yellow phase), and which evaluates the grid status (red, yellow, green) and provides the information towards the relevant market roles

**3.1.36**
**virtual power plant**
collection of small and very small decentralized generation units that is monitored and controlled by a super-ordinated energy management system

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[SOURCE: IEC smart grid Standardization Roadmap, 2010]

**3.1.37**
**virtual resource**
set of one or more energy service resources, including generators, energy storage, controllable load, and ancillary services

**3.1.38**
**voltage support**
ability to cope with the effects on grid voltage profiles when, for example, heavy power flows occur, to allow more installed photovoltaic capacity, while meeting the power quality requirements without grid reinforcement and power curtailment

**3.1.39**
**wide area network**
**WAN**
network that provides communication services to a geographic area larger than a single urban area

Note 1 to entry: Typically a wide area network covers a single country.

[SOURCE: IEC 60050-732:2010, 732-01-07]

### 3.2 Abbreviated terms

| | |
|---|---|
| AMI | advanced metering infrastructure |
| CHP | combined heat and power |
| EES | electric energy storage |
| EHV | extremely high voltage |
| EPS | electric power system |
| ESP | electric services provider |
| ESR | electric services retailer |
| EV | electric vehicle |
| DER | distributed energy resource |
| DMS | distribution management system |
| DR | demand-response |
| DSO | distribution system operator |
| FDEMS | facility DER energy management system |
| FCR | frequency control reserve |
| FRR | frequency restoration reserve |
| HAN | home area network |
| HV | high voltage |
| HVDC | high voltage direct current |
| ICT | information and communication technologies |
| ISO | independent system operator |
| LAN | local area network |
| LV | low voltage |
| MV | medium voltage |
| PV | photovoltaic systems |
| RR | restoration reserve |

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RTO regional transmission organizations
SCADA supervisory control and data acquisition system
SGAM smart grid architecture model
TSO transmission system operator
WAN wide area network

# 4 Distributed energy resources

## 4.1 Purpose and scope

### 4.1.1 Purpose: business analysis of DERs

The purpose of Clause 4 is to address a business analysis of distributed energy resources (DERs), and further describe the requirements of the domain in smart grid through the Use Case approach defined in IEC SRD 62913-1.

This analysis is based on the inputs from domain experts as well as existing materials in a smart grid environment. It is understood that different countries and regions in the world may have different regulatory and market structures for DERs, and these differences can even be within countries. Therefore the use cases contained in this document may or may not apply to all regions. However, DER regulations and markets are rapidly evolving so that even if certain use cases are not currently applicable to a particular region, this may change in the near future. Therefore, no attempt has been made to correlate specific use cases with specific regions.

### 4.1.2 Scope: DERs as sources of generation

DERs can be defined as a distributed set of one or more energy service resources, including generators, energy storage and controllable load, that are connected at the medium or low voltage levels (distribution power system). Some DERs are considered as sources of renewable energy, while others are fossil fuel based, or a combination of different types. They may provide energy as well as ancillary services.

Some typical types of DER include:

- battery based energy storage systems;
- biomass plants;
- combined heat and power (CHPs);
- cold storage and heat accumulation;
- electric vehicles (EVs) and their chargers: electric vehicle service elements (EVSE);
- fuel cells;
- gas turbines;
- geothermic power plants;
- hydro plants;
- photovoltaic systems (PV) and PV plants;
- pumped water storage systems;
- PV plus battery storage;
- tidal energy;
- wind turbines and wind power plants;
- wood chip boilers.

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Because the scope of Clause 4 only includes generation, only the generation capabilities of DERs are discussed. DER generation can be defined as "the production of electric energy by multiple sources which are connected to the power distribution system". The terms commonly used for DER generation include on-site generation, distributed resources (DR), embedded generation, dispersed generation (DG), or dispersed power (DP).

All aspects of energy storage and batteries are out of the scope of Clause 4, as they are covered in the energy storage domain, although it is understood that both electric vehicles (EV) and electric energy storage (EES) can also sometimes provide distributed generation.

Installation rules are out of the scope of this document, as they are covered in the HV/LV installation domains in IEC SRD 62913-2-1.

DERs are a type of resource connected to the grid. Their main purposes are to provide a source of active power and energy-related services – depending on legal and/or regulatory framework. In many cases, DERs are not connected directly to the grid but are part of prosumers' or consumers' installations, thus providing services "behind the meter" as well as to the utility grid. However, some DERs are connected within plants which have the express purpose of providing energy and ancillary services to the grid.

The DERs domain is strongly related to the following domains.

- Transmission grid management: DERs may provide (or even be required to provide in some systems) ancillary services to system operators to contribute to system security (reactive power and voltage control, load following, etc.).
- Distribution grid management: DERs connection to the grid and operations shall respect specific (legal and/or regulatory) technical requirements, so they do not undermine the reliability of the grid and quality of supply, ensured by grid operators.
- Metering management: DERs will use meters and metering services to measure and optimize use of the exported energy or associated services (certification).
- Market: DERs may (or are required to) participate in electricity markets, by trading the energy produced and/or energy-related services.

## 4.2 Business analysis of DER systems

### 4.2.1 Benefits and challenges of grid-connected DER systems

#### 4.2.1.1 General

DER systems are providing many benefits as well as many challenges to the electric energy domain. Many countries and regions are promoting the development and support of DERs in general, and renewable energy sources in particular, with the goals of achieving a transition towards a free-carbon economy and guaranteeing a competitive energy market, while continuing to ensure the security and efficiency of supply. There is an expectation that renewable energy will eventually be able to provide 60 % to 80 % of all electric generation around the world, with a large portion of that renewable energy coming from distribution-connected DER systems and DER power plants.

#### 4.2.1.2 Impacts of DERs on the grid

However, the increased penetration of DERs onto the grid, with the connection of many small-scale and even larger-scale power generation sources to low and medium voltage networks, is leading to new operational challenges for grid management. In particular, system and grid operators will need to assess DER interconnection requirements, to monitor the variable and uncertain renewable output of these large numbers of DERs, and to initiate control actions either through market-based requests or direct commands.

In the future, more and more DER systems will be connected to the distribution network and will affect the operation of the grid both positively and negatively. Distribution operations have

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to embrace DER systems, manage their negative impacts, and take advantage of their capabilities to improve safety, reliability, and efficiency.

#### 4.2.1.3 Regulations related to DERs

Interconnection of new DER systems typically is regulated by country, state, regional, or other regulatory body. In the USA, IEEE Std 1547 is often used as the basis for those regulations, while other countries develop their own interconnection regulations. In Europe, these regulations are defined in the ENTSO-E network code for "requirements for grid connection applicable to all generators" (RfG). In all of these regulations, DSOs are required to assess the impact of new DER systems and require them to provide certain functions such as anti-islanding, voltage ride-through, frequency ride-through and possibly other functions.

The conditions to which electricity produced by DERs can be traded on electricity markets also vary according to the different regulatory and/or legal frameworks. In some countries, renewable energy power purchase obligation mechanisms (feed-in tariffs) have been implemented in order to guarantee a competitive price for renewable energies and encourage investments in renewable energy sources.

In Europe, by law, the responsibility of the safety of the network as well as the stability of frequency is under the responsibility of TSOs. DSOs do not have the mission of maintaining the stability of frequency of their grid themselves: in the European interconnected network, the frequency cannot be different between TSOs and DSOs.

#### 4.2.1.4 Benefits of DERs

DERs can also provide both energy and ancillary services to the electric power system that benefit power grid operation, consumers, and society.

- DERs are able to help TSOs and DSOs improve the reliability and efficiency of the grid and maintain power quality through their smart converters and through management by facility DER energy management systems.
- DERs can provide consumers with less expensive energy over time even if they are not involved in retail energy markets.
- The integration of DERs involves the optimization of their contribution to the electric power system – through their participation in electricity markets and market mechanisms (balancing, capacity, ancillary services, …).

Society benefits from the increased use of renewable resources and the consequent decrease in the production of greenhouse warming gases. According to the IEC smart grid standardization roadmap, "the generation of these types of energy near to the consumers offers economic and ecological benefits."

#### 4.2.1.5 Architecture of DER systems

DER systems are expected to be managed through a hierarchy of stakeholders and systems. An example of a five-level hierarchy is shown in Figure 1. The diagram is described in A.1.3.

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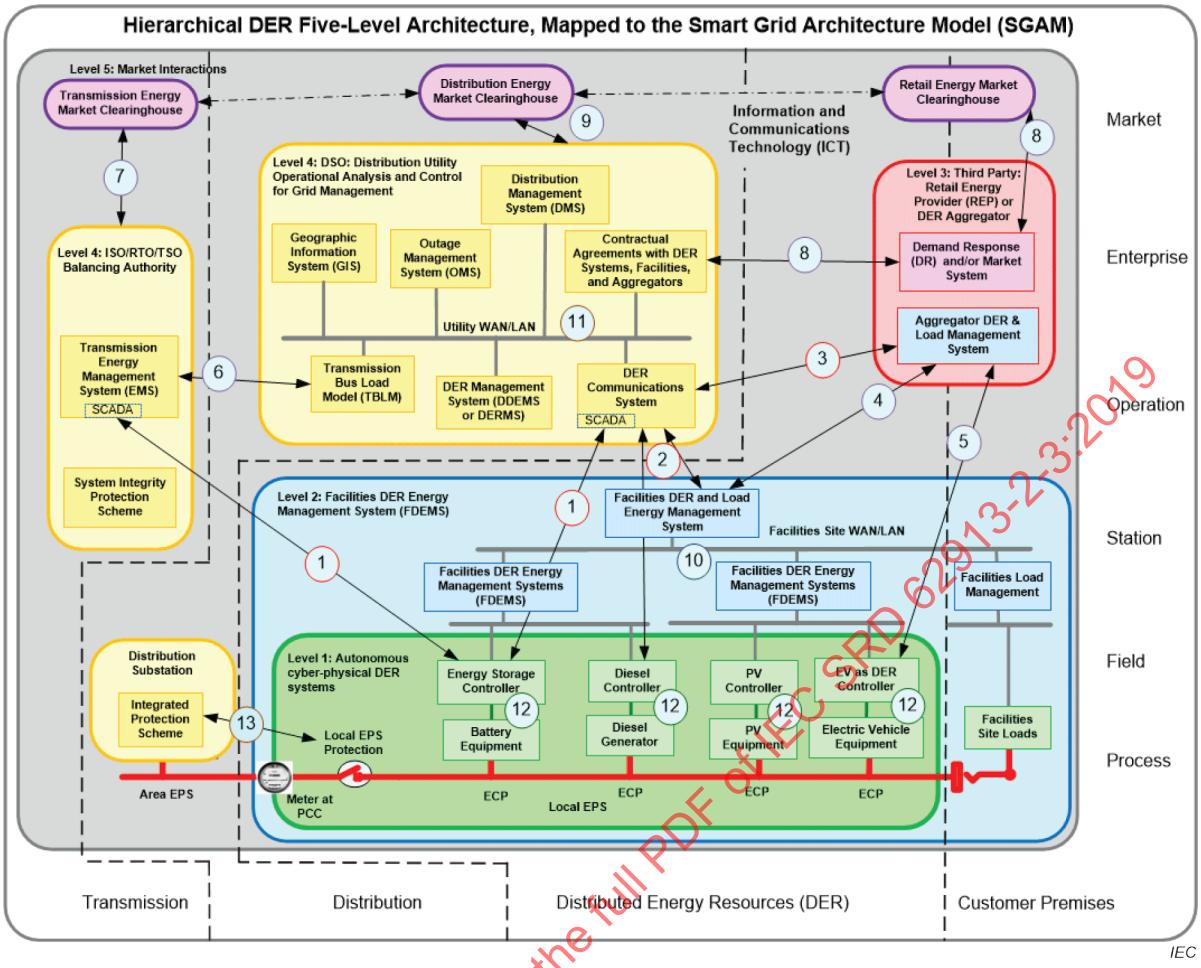


NOTE An explanation of this figure is given in A.1.3.

**Figure 1 – Example of a hierarchical DER system five-level architecture**

Most DER systems can or must operate autonomously in order to respond rapidly to changing power system conditions and meet power system safety, reliability, and efficiency criteria. At the local level, DER systems must manage their own generation and storage activities autonomously, based on local conditions, pre-established settings, and DER owner preferences. However, communications with utilities, facility energy management systems, and/or retail energy providers can support additional functions and provide updated functional parameters, so that the DRs can participate more effectively in the management of the area EPS. But direct control by utilities is not feasible for the thousands if not millions of DER systems connected to the distribution system, so a hierarchical approach is necessary for utilities to interact with most of these widely dispersed DER systems.

In some situations, depending on regional options and regulations, utilities may request or require DER systems to be located at critical electrically important points, while utility assessments of new DER implementations may determine which DER functions could be preferred or even mandatory for providing grid support. For any DER systems to be active participants in grid operations, their operations must be coordinated with other DER systems and with distribution grid equipment such as load tap changers, capacitor banks, and voltage regulators.

Many commercial and industrial customer sites would likely include facility DER energy management systems (FDEMSs) that could modify DER autonomous settings and issue direct commands. The area EPS operators could interact with these FDEMSs occasionally to update settings or broadcast pricing signals and/or emergency commands. In addition, the distribution-level area EPS operators could provide some of the DER benefits to regional transmission organizations (RTOs) and/or independent system operators (ISOs) for reliability

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and market purposes. In some regions, retail energy providers (REPs) or other energy service providers (ESPs) would be responsible for managing groups of DER systems.

### 4.2.2 Stakeholders involved in the DER domain

DER systems involve many different stakeholders, each of which has different business cases. Some of the DER Use Cases benefit just one stakeholder, but in most situations, many of the DER Use Cases can benefit multiple stakeholders often through tariff agreements or market pricing that balance the compensations across these stakeholders. Some of the primary stakeholders are shown in Figure 2.

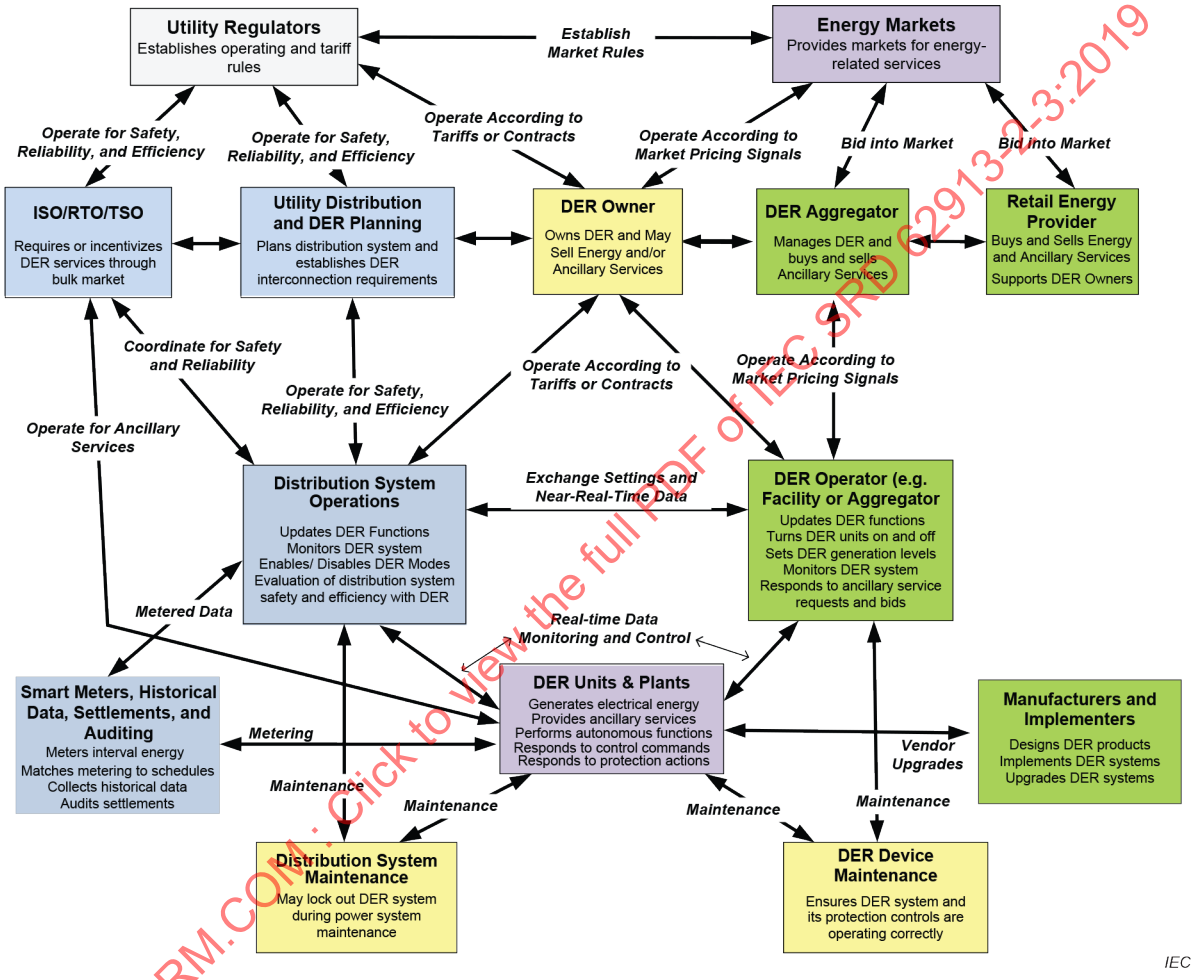


**Figure 2 – DER primary stakeholders**

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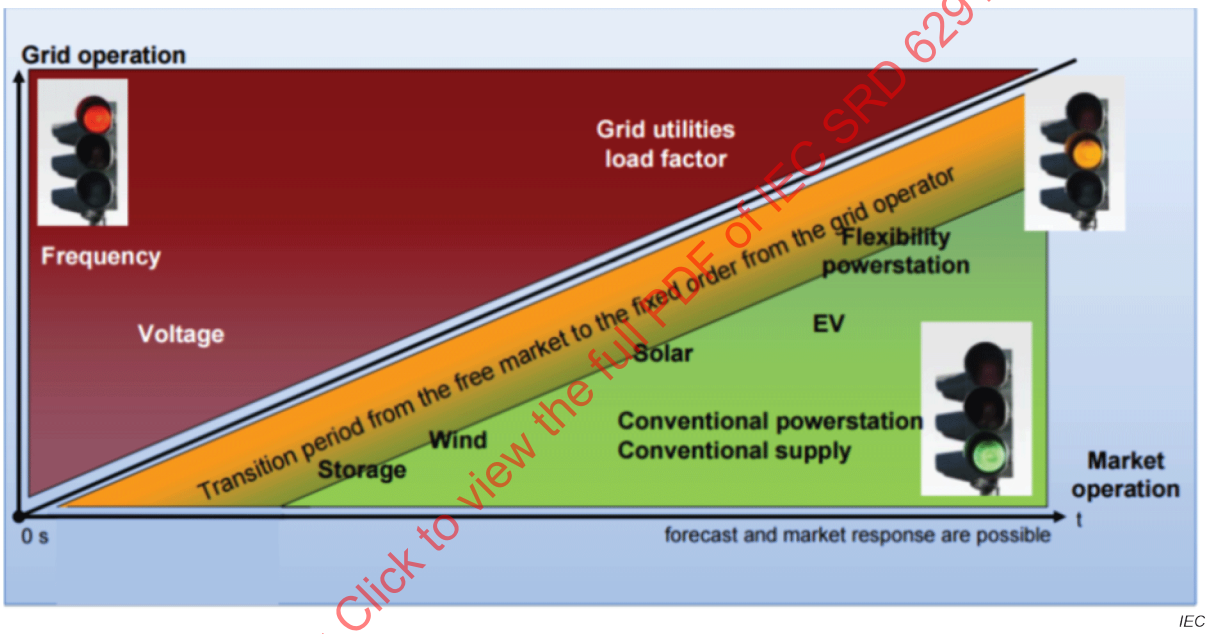
The list of primary stakeholders should also include the following:

- consumers;
- market-based third parties, such as flexibility aggregators;
- system maintenance personnel;
- society.

### 4.2.3 Traffic light concept for DERs

The traffic light concept for DERs identifies when markets should operate as the primary grid management force and when system operators must take over grid management in order to maintain grid safety and reliability (see Figure 3).

- The green state defines the region where the 'smart market' competitively operates freely; the system operator may or may not interact with the market at this point. This should be seen as the 'normal operating state'.
- The yellow state indicates the state where the system operator actively engages with the market in order to keep the system from becoming unstable; it is therefore a temporary state preventing the grid from entering the red state. This could be by executing pre-agreed contracts or by stepping in to procure in real time at market prices. This does not mean that the customer has to accept any situation where a third party decides when they can use what is in their home or business premises. Instead intelligent solutions and economic incentives should be provided to allow the customer to decide and accept some limits.
- In the red state, the system operator can override contracts existing in the market, execute dedicated emergency actions through flexibility operators, or execute direct controls over generation or demand in order to re-stabilize the system as far as a contract or regulation/legislation allows. However, actions in this state must be specific and well defined and be temporary in nature.




SOURCE: SG-CG/M490/Methodology & New Applications, Annex B.

**Figure 3 – Traffic light concept**

In the green and yellow states, DER owner/operators may respond to market signals, such as price incentives or demand response requests, according to established contracts between the DER owner and market actors. They would in this case have the possibility to opt out.

In the red state, DER operators may receive emergency signals from the system operator and would in this case have to prioritize electrical usages in order to temporarily reduce their consumption/generation – they would not have the possibility to opt out in this case.

### 4.2.4 Business drivers and objectives of DER stakeholders

#### 4.2.4.1 General

As illustrated in Figure 4, DER stakeholders are driven by economic requirements, and are constrained by regulatory and environmental policies. In some cases, mission statements are used to outline the key interests of the stakeholders.

Business objectives, reflected in business cases, identify the key purposes that must be met in order to follow the policies and resulting constraints. From these business cases, more

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detailed business use cases can be developed that reflect the business processes. Finally, system use cases can be developed to identify specific requirements and functionalities.

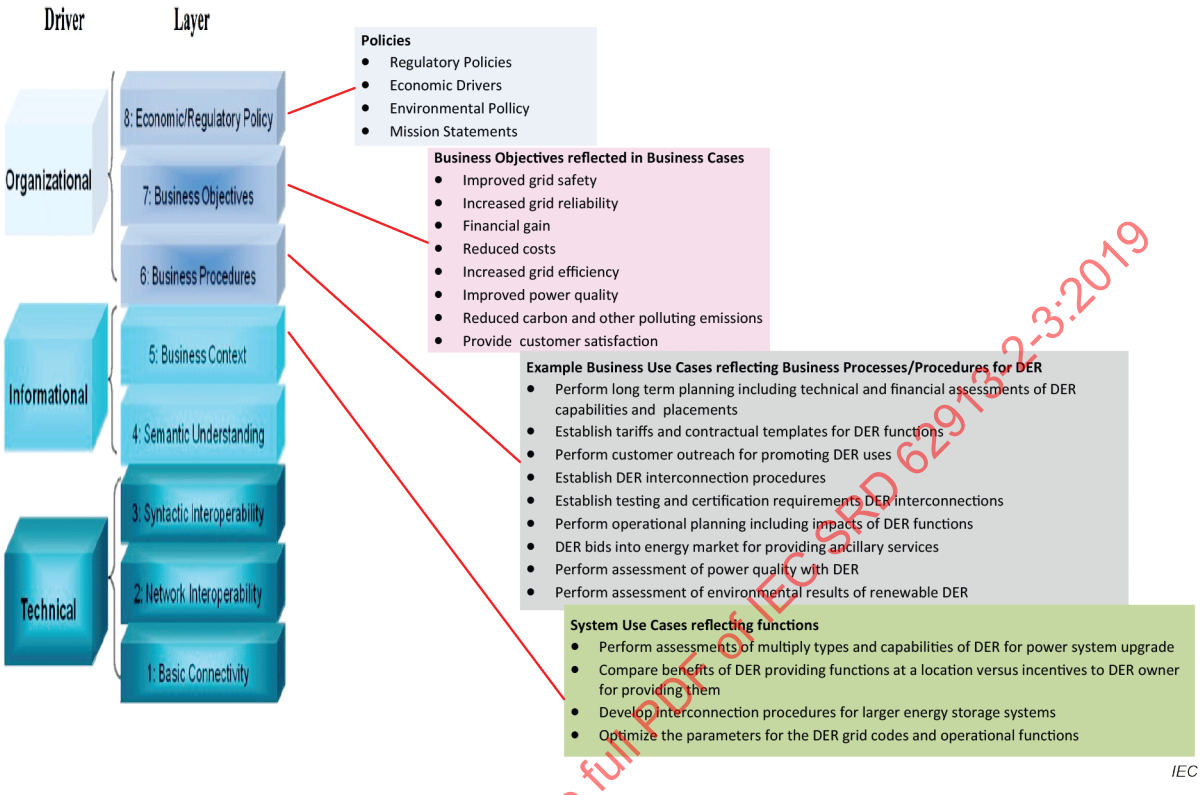


**Figure 4 – Business policies, business objectives, business processes, and system use cases**

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#### 4.2.4.2 Business objectives

For DERs, the primary business objectives of the stakeholders include:

- financial gain;
- reduced energy costs;
- improved grid safety;
- increased grid reliability;
- increased grid efficiency;
- improved power quality;
- reduced carbon or other pollutant emissions.

The matrix of stakeholders versus their primary business purposes is shown in Table 2.

**Table 2 – Matrix of stakeholders versus their primary business purposes**

| Stakeholders | Improved grid safety | Increased grid reliability | Financial gain | Reduced energy costs | Increased grid efficiency | Improved power quality | Reduced emissions |
|---|---|---|---|---|---|---|---|
| DER owner | | X (microgrid) | X | X | | X | |

| Stakeholders | Improved grid safety | Increased grid reliability | Financial gain | Reduced energy costs | Increased grid efficiency | Improved power quality | Reduced emissions |
|---|---|---|---|---|---|---|---|
| DER operator including facility operators or third party operators | | | | X | | X | |
| Transmission system operator | X | X | | X | X | X | X |
| Distribution system operator | X | X | | X | X | X | X (if incenti-vized) |
| Market-based third parties, such as flexibility aggregators | | | X | | | | X (if incenti-vized) |
| DER manufacturers | | | X | | | | |
| DER implementers | | | X | | | | |
| Metering, settlements, and auditing parties | | | | | | | |
| Distribution system maintenance personnel | X | | | | | | |
| DER maintenance personnel | X | | | | | | |
| Consumers | | X | | X | | X | |
| Society | X | | | X | | | X |

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Although Table 2 indicates the types of business objectives that different stakeholders may have, the methods for achieving these business objectives can involve many of the different DER capabilities at different levels in the hierarchy of DER system management. There is no one-to-one correspondence, but rather a mixture and a balancing of purposes. For instance, the DER owner may be looking for reduced energy costs while the DSO is looking for improved reliability – these may need to be balanced against each other with appropriate incentives if, say, the increased use of DER by an owner may cause voltage power quality problems.

### 4.2.5 DER grid services

#### 4.2.5.1 Overview of DER grid services

DERs are able to provide many services to the grid. Some of these services are (or are becoming) mandatory in some jurisdictions, and are termed "grid codes". These grid codes are focused on improving grid safety, grid reliability, and grid power quality, although some may have additional purposes. Other DER services are focused more on providing financial, reliability, and/or power quality benefits to their owners. Table 3 outlines the types of grid services that DERs may provide.

**Table 3 – Types of DER services**

| DER services | Business objective |
|---|---|
| **DER grid codes mandated by regulations** | |
| Disconnect / connect function | Improved grid safety |
| Cease to energize / return to service function | Improved grid safety and reliability |
| High/low voltage ride-through (fault ride-through) mode | Improved grid reliability |
| High/low frequency ride-through mode | Improved grid reliability |
| Dynamic reactive current support mode | Improved grid reliability |
| Frequency watt mode (frequency sensitivity mode) | Improved grid reliability |
| Volt-watt mode | Improved grid reliability<br>Improved power quality |
| Fixed (constant) power factor mode | Improved grid reliability |
| Fixed (constant) reactive power mode | Improved grid reliability |
| Volt-var mode | Improved grid reliability<br>Improved power quality |
| Watt-var mode | Improved grid reliability<br>Improved power quality |
| Watt-PF mode | Improved grid reliability<br>Improved power quality |
| Active power limiting mode | Improved grid reliability |
| Active power setting mode | Improved grid reliability<br>Improved power quality |
| Low frequency-watt emergency mode for demand side management (fast load shedding) | Improved grid reliability |
| Low voltage-watt emergency mode for demand side management | Improved grid reliability |
| Monitoring key status, alarm, and measurement values: in real-time (seconds), in near-real-time (minutes), as revenue metering, and as forecasts for next minutes, hours, and/or days<br>Provide forecast information on weather, planned maintenance, changes in capacities, etc. | Improved grid reliability<br>Improved power quality<br>Reduced energy costs<br>Increased energy efficiency<br>Reduced pollution emissions<br>Metering and billing |
| Scheduling of power settings and modes | Improved grid reliability<br>Improved power quality<br>Reduced energy costs<br>Increased energy efficiency<br>Reduced pollution emissions |
| **DER grid services for DER owner benefit** | |
| Peak power limiting mode | Reduced energy costs |
| Load following mode | Reduced energy costs |
| Coordinated charge/discharge management mode | Reduced energy costs |
| Generation following mode | Financial gain |
| Active power smoothing mode | Financial gain |
| Frequency-watt primary frequency mode | Financial gain |
| Automatic generation control (AGC) mode | Financial gain |
| Frequency-watt smoothing mode | Financial gain |

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| DER services | Business objective |
|---|---|
| Power factor limiting (correcting) mode | Financial gain |
| Tertiary frequency (operating or spinning reserve) | Financial gain |
| Microgrid separation control (intentional islanding) | Improved reliability |
| Provide black start capability | Financial gain |
| Provide backup power | Improved reliability |
| Historical Information | Improved reliability, efficiency, power quality<br>Reduced emissions<br>Metering and billing |
| **DER grid services provided by system operators** | |
| Maintain DER nameplate database in DER database and management systems (DERMS) | Improved reliability and safety |
| Update DER capabilities database | Improved reliability and safety |
| Perform short term load and generation forecasting | Improved reliability and safety |
| Perform state estimation of transmission and distribution grids | Improved reliability and safety |
| Perform power flow analysis of grids | Improved reliability and safety |
| Perform contingency analysis of grids | Improved reliability and safety |
| Evaluate possible ameliorations to contingencies | Improved reliability and safety |
| Determine settings for groups and individual DERs to reflect near-term requirements | Improved reliability and safety |
| Issue schedules and/or commands to DERs to comply with near-term requirements | Improved reliability and safety |
| Determine day ahead and next hour electricity prices | Improved reliability and safety |
| Provide to DERs the electricity prices, including energy, ancillary services, locational, etc. | Improved reliability and safety |
| Monitor the grid in real-time | Improved reliability and safety |
| Issue any emergency updates to DER settings | Improved reliability and safety |

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#### 4.2.5.2 DER functions providing grid services

DER systems are capable of providing many functions that support power system operations and contribute to grid benefits. Many of these inverter-based functions are described in IEC TR 61850-90-7 and are being updated in the second edition of IEC 61850-7-420[1].

Certain of these DER functions are crucial for grids that have high penetrations of DER systems. The implementation of these critical DER functions can avoid power systems outages and the possible need to retrofit DER systems during the course of their useful life or their contractual period, as unfortunately occurred in Europe. Some of those critical DER functions have already been implemented in Europe, are included in many DER products, are mandatory in California, and are expected to become mandatory for grid operations in North America.

Most DER systems can or must operate autonomously in order to respond rapidly to changing power system conditions and meet power system safety, reliability, and efficiency criteria. At the local level, DER systems must manage their own generation activities autonomously, based on local conditions, pre-established settings, and DER owner preferences. However, communications with utilities, facility energy management systems, and/or market-based retail energy providers can support additional functions and provide updated functional parameters,

[1] Under preparation. Stage at the time of publication: IEC CD 61850-7-420:2018.

so that the DRs can participate more effectively in the management of the area EPS. On the other hand, direct control by utilities is not feasible for the thousands if not millions of DER systems connected to the distribution system, so a hierarchical approach is necessary for utilities to interact with most of these widely dispersed DER systems through facility energy management systems and through retail energy providers/aggregators.

In some situations, utilities may request or require DER systems to be located at critical electrically important points, while utility assessments of new DER implementations may determine which DER functions could be preferred or even mandatory for providing grid support. For any DER systems to be active participants in grid operations, their operations must be coordinated with other DER systems and with distribution grid equipment such as load tap changers, capacitor banks, and voltage regulators.

Many commercial and industrial customer sites would likely include facility DER energy management systems (FDEMSs) that could modify DER autonomous settings and issue direct commands. The area EPS operators could interact with these FDEMSs occasionally to update settings or broadcast pricing signals and/or emergency commands. In addition, the distribution-level area EPS operators could provide some of the DER benefits to regional transmission organizations (RTOs) and/or independent system operators (ISOs) for reliability and market purposes. In some regions, aggregators or other energy service providers (ESPs) would be responsible for managing groups of DER systems.

#### 4.2.5.3 Balancing and frequency services

##### 4.2.5.3.1 Balancing purpose

Balancing authorities are responsible for ensuring that generation and load balance each other at all times. The primary measure of whether they are balanced is the frequency of the power system. This frequency must stay within a "normal" range of its nominal value (50 Hz or 60 Hz) and must avoid any lengthy (a few minutes) excursions outside of this normal range as well any very high or low (exceeding nominal by more than 2 Hz to 3 Hz) excursions.

##### 4.2.5.3.2 Frequency ride-through

As more DERs connect to the grid, it is increasingly important that they are capable of autonomously "riding-through" short frequency anomalies, and do not trip off unless the frequency exceeds its normal range for long times and/or spikes or sags steeply for shorter periods of time. DER systems can ride-through such situations, including ceasing to energize without tripping off, and recovering within a short time after the frequency returns within its normal range.

During a ride-through event, DERs may also attempt to counteract the frequency anomaly by increasing power output if the frequency has decreased, or by decreasing power output if the frequency has increased. This DER function is called frequency-watt, frequency-sensitivity, or frequency droop.

In addition, loads could be shed, either locally or on a larger area if commanded by the system operator.

##### 4.2.5.3.3 Frequency regulation

One of the primary responsibilities of balancing authority is to maintain the power quality of electricity supply. By constantly matching power generation to demand in a power system, the grid frequency can be maintained within ranges as regulated by authorities. Grid-integrated DERs can be used for frequency regulation. This can be handled through enabling DERs to change their power output to counter frequency changes even while the frequency is within its normal range. Alternatively, the balancing authority can directly issue commands for more or less energy from DERs. In this latter case, DERs are typically aggregated into multi-megawatt groups, either in the form of DER power plants or through an aggregator who is managing dispersed DERs as a group.

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#### 4.2.5.3.4 Operating reserves

Operation of electricity grids always needs a certain amount of power capacity which can be available in a short time after power generation plants become unavailable due to unplanned maintenance or troubles. Reserve power can be in the form of either generation or demand reduction to be able to deal with power demand being greater than forecast demand and/or plant unavailability. DER can be one of the sources for the operating reserves.

There are generally three types of operating reserves as follows:

- Spinning (operational) reserve (synchronized) – Spinning reserves are the fastest acting contingency reserve. Generators providing spinning reserves are synchronized to the grid (the turbine is "spinning" but not generating power), allowing the reserve to be provided very quickly. Energy storage systems are particularly suited to provide such operational reserve since their main purpose is not necessarily generation, but rather ancillary services. Since they can be continuously connected to the grid even if charging, they can respond very quickly to a request from the balancing authority.
- Non-spinning reserve (non-synchronized) – Non-spinning reserves are extra generating capacity that is not currently connected to the power system but can be brought online after a short delay.
- Supplemental reserves – Supplemental reserves, on the other hand, are not required to be synchronized to the grid and are a backup capacity for spinning and non-spinning reserves.

#### 4.2.5.3.5 Black start capabilities

Many facilities with critical loads use DERs to provide power in case of power grid outages. These DERs are typically uninterruptible power supply systems which combine batteries for instantaneous power with diesel generators for longer duration power outages.

Black start capabilities are necessary to restore power to grids after a wide-area outage where the bulk power supply from the grid is not available. Diesel generators or hydroelectric power plants that are capable of supplying load beyond their own facilities may become designated as black start resources.

DER systems, particularly if they are part of microgrids, can be another source of black start capabilities, and help system operators during a catastrophic failure of grids by restoring their power.

### 4.2.5.4 Power grid voltage infrastructure services

#### 4.2.5.4.1 Voltage ride-through

Both transmission systems and distribution systems may experience voltage anomalies. Just as for frequency anomalies, it is critical that DERs do not trip off for short duration voltage sags and spikes, but are able to "ride-through" these events. Whenever DERs sense the voltage is beyond the voltage limits, they can cease to energize without tripping off, and recover within a short time after the voltage returns within its normal range.

During a ride-through event, DERs may also attempt to counteract the voltage anomaly by increasing power output if the voltage has decreased, or by decreasing power output if the voltage has increased. This DER function is called the volt-watt function.

In addition, loads could be shed either locally or on a larger area if commanded by the system operator.

#### 4.2.5.4.2 Voltage support

System operators are required to maintain the voltage of both the transmission and distribution systems within specified ranges. To do this, the operators manage active and

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reactive power to maintain normal voltage levels, typically with utility-owned equipment. However, DERs can also be used as voltage support resources within the grid through being set at a fixed power factor, by providing autonomous volt-var support or through responding to direct requests from the system operators for specific levels of active or reactive power.

Variations of these autonomous functions include the watt-power-factor function and the watt-reactive power function. In addition, DERs can provide autonomous volt-watt support if the volt-var function is producing excessive reactive power. DERs may also respond to power limiting commands in order to reduce local voltage levels.

#### 4.2.5.5 Energy management services

##### 4.2.5.5.1 Energy shifting

The true and market cost of energy can vary significantly during the hour, the day, the week, and the season. For some DER owners, the cost to purchase electricity from the wholesale electricity markets can be reduced by increasing their DER generation (or decreasing load) during high cost times. In particular, energy storage systems can increase their power output to compensate for loads. Utilities also use energy storage systems, including pumped hydro and battery storage units within substations. The primary purpose of these energy storage systems is to shift energy from peak times to lower cost times. These energy storage systems are then recharged during off-peak times.

As with all of the energy management services, energy shifting may provide a large benefit to utilities by allowing them to defer construction, such as avoiding the need to build additional substations, upgrade transformers, and increase the carrying capacity of wires.

##### 4.2.5.5.2 Peak shaving

Peak shaving is similar in concept to energy shifting, except that it is focused on the time of a customer's demand peak, which may or may not coincide with the cost of energy at that time. For instance, the utility tariffs may not include time-of-use (a very common practice for residential customers). Therefore, there is no incentive for these customers to shift energy. However, some tariffs for larger customers include demand charges, which provide an incentive to minimize demand at specific times of day, thus "shave the demand peak", particularly if their energy bills vary according to their highest power demand. This service may be profitable if the peak demand is predictable and of relatively short duration.

As with energy shifting, peak shaving not only allows time shift of energy but also works to reduce the necessity of installing additional facilities. DER can be used to reduce the need to construct power generation plants, mainly oil-fired thermal power, which produce a large amount of carbon dioxide, to meet weekday peak demands.

##### 4.2.5.5.3 Load and/or generation following

Load following involves an entity matching (or following a percentage of) the generation and loads by ramping up or down of generation to follow load changes throughout a day. For local loads, DER can be used effectively to carry out this load following function.

DERs can also provide generation following services. For instance, if a solar power plant produces fluctuating power due to clouds, energy storage systems can follow the dips in generation and provide compensating energy during those dips.

Combinations of solar and storage systems are becoming increasingly popular even for residential and commercial customers. In these systems, the storage systems can compensate for any solar dips due to clouds and thus provide maximum export of any excess power during the day, or conversely, provide more power during the early morning and later afternoon as the sun is rising and setting.

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#### 4.2.5.6 Customer energy management services

##### 4.2.5.6.1 Improve grid power quality

Power quality at customer sites can be improved by compensating for electrical anomalies and disturbances such as voltage sag, unstable voltage, frequency variations, and sub-synchronous resonance. DER may be used for such power quality support. In particular, for islanded grids (either natural islands or artificial microgrids), DER responses to power quality issues become even more important since the power system inertia is relatively low. Some types of DER systems, such as biomass DER and hydro DER or even diesel generators, could become important resources to mitigate the instability caused by the variability of renewable DER systems.

##### 4.2.5.6.2 Islanding or microgrids

Electricity supply can be maintained within a local island or microgrid even if there is a total loss of power from a power grid due to wide area outage. This service can be delivered with DERs which can continuously supply electricity to customer loads within an islanded grid.

System operators could minimize the influences of wide-area power outages by warning customers with pre-established islanding capability of the likelihood of an outage. In addition, microgrid energy management systems could detect anomalous situations and initiate the creation of an island.

### 4.2.6 Regional differences

Different regulatory jurisdictions are expected to require different grid services, while DER owners will also have very different purposes for their DERs. For this reason, flexibility is crucial. In some cases this flexibility will just reflect different values in a function (e.g. 10 % vs. 5 %) while in other cases the same function may be used for different purposes (e.g. emergency frequency-watt vs. frequency-watt smoothing).

Tariffs, individual contracts, and market structures in different regions will also differentiate how different grid services may be performed and validated. For instance, if smart meters are not available or capable of capturing and/or measuring DER actions, then separate systems must be used to verify if the DERs are performing the indicated grid services. These systems may be managed by utilities, by flexibility market entities, or by multiple third parties such as aggregators.

### 4.2.7 List of business roles and business Use Cases of the domain

The primary policies that drive the business objectives are:

- regulatory for power grid safety and reliability, and for utility tariffs;
- economic for tariffs, contracts, and market structures for providing energy and ancillary services.

The business Use Cases shown in Table 4 are associated with one or several of the business objectives of the domain, which include:

- sell energy to an aggregator/to the market/to a customer;
- provide ancillary services to system or grid operators;
- provide flexibility in managing energy production through contractual arrangements;
- operate and maintain the DER in a cost-efficient way.

These business Use Cases include the business roles that have been identified so far. This list is not exhaustive.

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**Table 4 – Business roles**

| Business roles | Definition |
|---|---|
| **Energy generation roles** | |
| DER owner | Responsible party for overall market and financial decisions and contracts related to DER including microgrid design and operations |
| DER operator | Responsible party for operational aspects of the facilities and their DER systems including real-time microgrid operations |
| Flexibility aggregator | A party which aggregates flexibilities for its customers.<br>May activate flexibility sites.<br>Equivalent to retail energy provider (REP) in this document. |
| DER equipment manufacturer | Entity that produces, tests, sells, and implements DER systems |
| Producer | Party generating electric energy.<br>Additional information: This is a type of grid user.<br>[SOURCE: IEC 60050-617:2009, 617-02-01] |
| Prosumer | Party both generating and consuming electric energy |
| Decentralized electricity producer | Electricity producer with generator(s) connected to the distribution grid. Production can be dispatchable and/or non-dispatchable.<br>This is a type of producer. |
| Power plant operator | Responsible party for operational aspects of a power plant |
| Power plant owner | Responsible party for market and financial decisions and contracts related to a power plant |
| **Utility roles** | |
| Microgrid operator | Responsible party for operational aspects of a microgrid |
| Microgrid owner | Responsible party for market and financial decisions and contracts related to a microgrid |
| Retail energy provider (REP) | Third party managing DER systems based on market information |
| System operator | A party that operates one or more grids. This term is used when it is not necessary to specify whether distribution or transmission system operator is meant. |
| Distribution system operator (DSO) | Entity responsible for the planning, operation, maintenance, and the development in given areas of the electricity distribution network (LV, MV, and potentially HV), the quality of electricity supply (power delivery, voltage, etc.) and for customer access to energy supply retail market through his or her system under regulated conditions.<br>Equivalent to MV/LV system operators. |
| Transmission system operator (TSO) | Entity responsible for the planning, operation, maintenance, and the development in given areas of the electricity transmission network (HV), the quality of electricity supply (frequency and voltage), and access to the bulk market system for DER systems capable of participating<br>Equivalent to HV system operators.<br>According to Article 2.4 of the Electricity Directive 2009/72/EC (Directive): "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity". Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.<br>[SOURCE: EU Commission Task Force for smart grids, EG3] |
| Balancing authority | Entity responsible for balancing generation and load, using frequency management to achieve this responsibility |
| **Customer roles** | |
| Client/customer (of electricity supplier) | A party connected to the grid that contracts for the ability to consume electricity at a metering point. |

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| Business roles | Definition |
|---|---|
| Consumer | A party connected to the grid that contracts for the ability to consume electricity at a metering point. |
| Grid user | A party connected to the grid and consuming and/or producing electricity. Grid users include consumers, producers, and prosumers.<br>Equivalent to Party Connected to the Grid. |
| **Market services roles** | |
| Service provider or energy service provider | Entity providing electricity-related services (such as energy efficiency or communication services). |
| Bulk power market or transmission market | Entity providing a market for buying and selling energy and ancillary services to the bulk power system |
| Distribution market | Entity providing a market for buying and selling energy and ancillary services to the distribution power system<br>In general, this entity does not exist as a "market", but many energy service providers may provide related capabilities. |
| Demand response market | Entity providing energy prices to consumers and prosumers so that they may change their energy demand based on those prices. |
| **Third party roles** | |
| Meter operator | A party responsible for installing, maintaining, testing, certifying and decommissioning physical meters in compliance with the regulated conditions for contract between ESP and their customers.<br>[SOURCE: ENTSO-E, EFET, and ebIX, 2010] |
| Metering point administrator | A party responsible for registering the parties linked to the metering points in a metering grid area. The metering point administrator is also responsible for maintaining the Metering Point technical specifications and is responsible for creating and terminating metering points.<br>[SOURCE: ENTSO-E, EFET, and ebIX, 2014] |
| Telecommunications operator | Entity that offers telecommunications services. |
| Electricity installer | Entity that installs and maintains smart electric systems for industrial, commercial and residential purposes. |
| Equipment manufacturer | Entity that produces and sells electrical devices and electricity management devices. |

Table 5 outlines the high level business objectives which lead to business cases of the DER domain and examples of their associated business Use Cases to achieve those objectives. The first business objective is primarily regulatory, while the remaining business objectives include a mixture of regulatory and economic purposes.

**Table 5 – Business Use Cases**

| Business cases | Index of the business Use cases | Identified business Use Cases |
|---|---|---|
| **Improved grid safety and reliability through regulations** | | |
| Regulators and system operators establish DER interconnection requirements including mandatory grid code functions | UC62913-2-3-B001 | • Develop overall regulatory interconnection requirements for different types, sizes, and capabilities of DER systems, including functional requirements, communication requirements, and performance requirements. |
| | UC62913-2-3-B002 | • Define regional or utility-specific DER interconnection requirements within the overall regulatory requirements. |
| | UC62913-2-3-B003 | • Establish timeframes for DER compliance with new regulations |
| System operators establish DER | UC62913-2-3-B004 | • Define operational settings for different DER sizes, locations, and capabilities |

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| Business cases | Index of the business Use cases | Identified business Use Cases |
|---|---|---|
| operational requirements for grid safety and reliability | UC62913-2-3-B005 | – Develop communication systems for interacting with DER systems as necessary for grid safety and reliability |
| DER owners/operators operate the DER per the grid codes for grid safety and reliability | UC62913-2-3-B006 | • Implement all mandatory DER grid codes and the necessary communications for interacting between the utility and the DER, its owner, and/or its operator. |
| | UC62913-2-3-B007 | • Deliver the grid services as and when mandated. |
| **Financial gain, reduced energy costs, increased grid efficiency through tariffs and contracts** | | |
| Regulators and system operators provide tariffs and/or contracts for energy and ancillary services | UC62913-2-3-B008 | • Develop tariffs for all types of energy and ancillary services from different types, locations, and capabilities of DER systems |
| | UC62913-2-3-B009 | • Outline contract requirements for specific types of energy and ancillary services from different types, locations, and capabilities of DER systems |
| DER owner sells energy to the grid based on energy tariffs | UC62913-2-3-B010 | – Invest in DERs to use and to sell excess energy based on the appropriate tariff |
| | UC62913-2-3-B011 | • Optimize the operation of DERs from a technical and economic perspective |
| Aggregator manages DER systems in order to sell energy to the grid based on contracts | UC62913-2-3-B012 | • Develop DER systems for sale or for installation by "renting a roof". |
| | UC62913-2-3-B013 | • Install DERs at customer sites for the purpose of selling excess energy based on a tariff or contract with the system operator |
| | UC62913-2-3-B014 | – Optimize the operation of DERs from a technical and economic perspective |
| **Financial gain, increased grid reliability, increased grid efficiency through market operations** | | |
| Regulators establish market structures | UC62913-2-3-B015 | • Develop market structures based on input from stakeholders and taking into account power system regulatory requirements |
| | UC62913-2-3-B016 | – Oversee market interactions and revise rules when necessary for fairness |
| Balancing authority manages frequency support services | UC62913-2-3-B017 | • Receive energy offers from DER owner/operators |
| | UC62913-2-3-B018 | • Analyse energy offers to determine ranking and amount for different time periods |
| | UC62913-2-3-B019 | – Notify DER owner/operators of energy offer results when appropriate |
| | UC62913-2-3-B020 | – Receive offers for frequency support services from DER owner/operators |
| | UC62913-2-3-B021 | • Analyse frequency support offers to determine ranking and type for different time periods |
| | UC62913-2-3-B022 | – Notify DER owner/operators of frequency support results when appropriate |
| | UC62913-2-3-B023 | • Issue frequency support commands to DERs based on the market results |
| System operator receives offers from DER owners and aggregators for providing voltage support services | UC62913-2-3-B024 | • Receive voltage support offers from DER owner/operators |
| | UC62913-2-3-B025 | • Analyse voltage support offers to determine ranking and amount for different time periods |
| | UC62913-2-3-B026 | – Notify DER owner/operators of voltage support offer results when appropriate |
| | UC62913-2-3-B027 | – Issue voltage support commands to DERs based on the market results |
| Distribution system operator receives offers from DER owners and aggregators for | UC62913-2-3-B028 | • Receive power quality support offers from DER owner/operators |
| | UC62913-2-3-B029 | • Analyse power quality support offers to determine ranking and amount for different time periods |

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| Business cases | Index of the business Use cases | Identified business Use Cases |
|---|---|---|
| providing additional power quality support services | UC62913-2-3-B030 | • Notify DER owner/operators of power quality support offer results when appropriate |
| | UC62913-2-3-B031 | – Issue power quality support commands to DERs based on the market results |
| **Financial gain, reduced energy costs through demand response** | | |
| DER owners/operators receive pricing information for energy and respond by changing DERs and loads | UC62913-2-3-B032 | • Receive demand response pricing information |
| | UC62913-2-3-B033 | • Respond to demand response pricing information |
| DER owners/ operators receive pricing information for ancillary services and respond appropriately | UC62913-2-3-B034 | – Receive demand response pricing information |
| | UC62913-2-3-B035 | – Respond to demand response pricing information |
| **Improved grid safety, increased grid efficiency through maintenance** | | |
| DER owners/ operators maintain the DERs to provide optimal availability and capabilities | UC62913-2-3-B036 | • Optimize the operation of a distributed energy resource from a technical and economic perspective |
| | UC62913-2-3-B037 | • Monitor the DER unit, provide data to third parties, and carry out urgent maintenance operations (including incidents management) |
| | UC62913-2-3-B038 | • Carry out renewal programmes of a DER |
| **Increased grid reliability, increased grid efficiency through long term planning** | | |
| System operator establishes long term planning procedures which include incentivizing different types of DER to be located in optimal places on the grid | UC62913-2-3-B039 | • Develop long term energy and ancillary service requirements |
| | UC62913-2-3-B040 | • Request estimates and commitments from third parties for locating DER |
| | UC62913-2-3-B041 | • Determine which requirements may be met by DER and which require expansion or other changes to the grid |

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### 4.2.8 List of system Use Cases and system roles

Table 6 lists the system Use Cases which have been identified so far to enable the business Use Cases described above to operate. The list is non exhaustive and will be updated as new editions of IEC SRD 62913-2-3 are published.

**Table 6 – Identified system Use Cases of the domain**

| Index of the system Use Cases | Identified system Use Cases | |
|---|---|---|
| **Grid code modes** | | |
| UC62913-2-3-S001 | Disconnect/connect function<br><br>Disconnect or connect the DER from the grid at its ECP | The disconnect command initiates the galvanic separation (usually via switches or breakers) of the DER at its ECP or at the PCC. There may be a time delay between receiving the command and the actual disconnect.<br><br>The connect command initiates or allows the reconnection of the DER at its ECP or at the PCC. A permission to reconnect may also be issued. |

| Index of the system Use Cases | Identified system Use Cases | |
|---|---|---|
| UC62913-2-3-S002 | Cease to energize and return to service<br>The DER ceases all active power output<br>Allow active power output at the PCC | "Cease to energize" is a different function from disconnect/connect. The (draft) definition is: "The DER shall not export active power during steady-state or transient conditions. Reactive power exchange (absorb or supply) shall be less than a percentage set of nameplate DER rating and shall exclusively result from passive devices.". There may be a time delay between receiving the command and the actual cease to energize.<br>"Return to service" allows current flow at the PCC. A permission to return to service may also be issued. |
| UC62913-2-3-S003 | High/low voltage ride-through mode<br>The DER rides through temporary fluctuations in voltage | The DER follows the utility-specified voltage ride-through parameters to avoid tripping off unnecessarily. The function would block tripping within the fault ride-through zones.<br>Although normally enabled by default, this ride-through mode may be updated, enabled, and disabled. |
| UC62913-2-3-S004 | High/low frequency ride-through mode<br>The DER rides through temporary fluctuations in frequency | The DER follows the utility-specified frequency ride-through parameters to avoid tripping off unnecessarily. The function would block tripping within the fault ride-through zones. Although normally enabled by default, this ride-through mode may be updated, enabled, and disabled. |
| UC62913-2-3-S005 | Dynamic reactive current support mode<br>The DER reacts against rapid voltage changes (spikes and sags) to provide dynamic system stabilization | The DER provides dynamic reactive current support in response to voltage spikes and sags, similar to acting as inertia against rapid changes. This mode may be focused on emergency situations or may be used during normal operations.<br>When the dynamic reactive current support mode is enabled, the DER monitors the voltage at the Referenced ECP and responds based on the parameters. |
| UC62913-2-3-S006 | Frequency-watt mode<br>The DER responds to large frequency excursions during abnormal events at a Referenced ECP by changing its production or consumption rate | The DER is provided with frequency-watt curves that define the changes in its watt output based on frequencies around the nominal frequency during abnormal events.<br>When the emergency frequency-watt mode is enabled, the DER monitors the frequency and adjusts its production or consumption rate to follow the specified emergency frequency-watt curve parameters. |
| UC62913-2-3-S007 | Volt-watt mode<br>The DER responds to changes in the voltage at the Referenced ECP by changing its production or consumption rate | The DER is provided with voltage-watt curves that define the changes in its watt output based on voltage deviations from nominal, as a means for countering those voltage deviations.<br>When the volt-watt mode is enabled, the DER receives the voltage measurement from a meter (or other source) at the Referenced ECP. The DER adjusts its production or consumption rate to follow the specified volt-watt curve parameters. |
| UC62913-2-3-S008 | Fixed (constant) power factor mode<br>The DER power factor is set to a fixed value. | The DER power factor is set to the specified power factor. A leading power factor is positive and a lagging power factor is negative, as defined by the IEEE or IEC sign conventions. |
| UC62913-2-3-S009 | Fixed (constant) reactive power mode<br>The DER is requested to provide a fixed amount of reactive power | The DER is requested to provide a fixed amount of reactive power |
| UC62913-2-3-S010 | Volt-var control mode<br>The DER responds to changes in voltage at the Referenced ECP by supplying or absorbing vars in order to maintain the desired voltage level | The DER is provided with voltage-var curves that define the vars for voltage levels.<br>When the volt-var mode is enabled, the DER receives the voltage measurements from a meter (or other source) at the Referenced ECP. The DER responds by supplying or absorbing vars according to the specified volt-var curve in order to maintain the desired voltage level. |

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| Index of the system Use Cases | Identified system Use Cases | |
|---|---|---|
| UC62913-2-3-S011 | Watt-var mode<br>The DER responds to changes in power at the Referenced ECP by changing its vars | The DER is provided with watt-var curves that define the changes in its vars based changes of power.<br>When the watt-var mode is enabled, the DER modifies its vars setting in response to the power level at the Referenced ECP. |
| UC62913-2-3-S012 | Watt-PF mode<br>The DER responds to changes in power at the Referenced ECP by changing its power factor | The DER is provided with watt-PF curves that define the changes in its power factor based changes of power.<br>When the watt-PF mode is enabled, the DER modifies its PF setting in response to the power level at the Referenced ECP. |
| UC62913-2-3-S013 | Set active power mode<br>Set the DER to generate or consume energy as a percentage of maximum capability | The DER is set to a percentage of maximum generation or consumption rate. A positive value indicates generation, negative means consumption. |
| UC62913-2-3-S014 | Limit active power production or consumption mode<br>Limits the production and/or consumption level of the DER based on the Referenced ECP | The production and/or consumption of the DER is limited at the Referenced ECP, indicated as absolute watts values. Separate parameters are provided for production or consumption limits to permit these to be different. |
| UC62913-2-3-S015 | Low frequency-watt emergency mode for demand side management (fast load shedding) | Enable automatic "low frequency" disconnection of a specified proportion of their demand (in stages) in a given time frame. |
| UC62913-2-3-S016 | Low voltage-watt emergency mode for demand side management | Provide capabilities to enable automatic or manual load tap changer blocking and automatic "low voltage" disconnection. |
| UC62913-2-3-S017 | Monitoring function<br>The DER provides nameplate, configuration, status, measurements, and other requested data | The DER provides status, measurements, alarms, logs, and other data as authorized and requested by users. Examples include connect status, updated capacities, real and reactive power output/consumption, state of charge, voltage, and other measurements. Also of interest are forecast status and expected measurements. |
| UC62913-2-3-S018 | Scheduling of power settings and modes<br>The DER follows the highest priority schedules | The DER follows the schedule which consists of a time offset (specified as a number of seconds) from the start of the schedule and is associated with:<br>• a power system setting<br>• the enabling/disabling of a function<br>• a price signal |
| **Non-grid code modes** | | |
| UC62913-2-3-S019 | Peak power limiting mode<br>The DER limits the load at the Referenced ECP after it exceeds a threshold target power level | The active power output of the DER limits the load at the Referenced ECP if it starts to exceed a target power level, thus limiting import power. The production output is a percentage of the excess load over the target power level. The target power level is specified in absolute watts. |

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| Index of the system Use Cases | Identified system Use Cases | |
|---|---|---|
| UC62913-2-3-S020 | Load following mode<br>The DER counteracts the load by a percentage at the Referenced ECP, after it starts to exceed a threshold target power level | The active power output of the DER follows and counteracts the load at the Referenced ECP if it starts to exceed a target power level, thus resulting in a flat power profile. The production output is a percentage of the excess load over the target power level. The target power level is specified in absolute watts. |
| UC62913-2-3-S021 | Generation following mode<br>The consumption and/or production of the DER counteracts generation power at the Referenced ECP. | The consumption and/or production of the DER follows and counteracts the generation measured at the Referenced ECP if it starts to exceed a target power level. The consumption and/or production output is a percentage of the excess generation watts over the target power level. The target power level is specified in absolute watts. |
| UC62913-2-3-S022 | Active power smoothing mode<br>The DER produces or absorbs active power in order to smooth the changes in the power level at the Referenced ECP.<br>Rate of change of power | The DER follows the specified smoothing gradient which is a signed quantity that establishes the ratio of smoothing active power to the real-time delta-watts of the load or generation at the Referenced ECP.<br>When the power smoothing mode is enabled, the DER receives the watt measurements from a meter (or other source) at the Referenced ECP. New data points are provided multiple times per second. |
| UC62913-2-3-S023 | Frequency-watt primary control mode | The DER provides primary frequency control |
| UC62913-2-3-S024 | Automatic generation control (AGC) mode<br>The DER responds to raise and lower power level requests to provide frequency regulation support | When AGC mode is enabled, the DER responds to signals to increase or decrease the rate of consumption or production every 4 to 10 seconds, with the purpose of managing frequency. |
| UC62913-2-3-S025 | Coordinated charge/discharge management mode<br>The DER determines when and how fast to charge or discharge so long as it meets its target state of charge level obligation by the specified time | The DER is provided with a target state of charge and a time by which that SOC is to be reached. This allows the DER to determine when to charge or discharge based on price.<br>The DER takes into account not only the duration at maximum consumption/production rate, but also other factors, such as that at high SOC the maximum consumption rate may not be able to be sustained, and vice versa, at low SOC, the maximum discharge rate may not be able to be sustained |
| UC62913-2-3-S026 | Frequency-watt smoothing mode<br>The DER responds to changes in frequency at the Referenced ECP by changing its consumption or production rate based on frequency deviations from nominal, as a means for countering those frequency deviations | The DER is provided with frequency-watt curves that define the changes in its watt output based on frequency deviations from nominal, as a means for countering those frequency deviations and smoothing the frequency.<br>When the frequency-watt mode is enabled, the DER monitors the frequency and adjusts its production or consumption rate to follow the specified frequency-watt curve parameters. New data points are provided multiple times per second. |

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| Index of the system Use Cases | Identified system Use Cases | |
|---|---|---|
| UC62913-2-3-S027 | Power factor limiting (correcting) mode<br>The DER supplies or absorbs vars to hold the power factor at the Referenced ECP within the PF limit | When the PF limiting (correcting) mode is enabled, the DER is provided with the target PF. The DER supplies or absorbs vars in order to maintain the PF at the Referenced ECP within the limits of the target PF. |
| UC62913-2-3-S028 | Historical information | Detailed measurement and performance data which may be valuable to record in an operational historian |
| **Non-functional capabilities** | | |
| UC62913-2-3-S029 | Establish ramp rates | In addition to the default ramp rate, the DER may support multiple ramp rates that reflect different conditions. |
| UC62913-2-3-S030 | Soft-start return to service | Use ramp rate and/or random time within window when reconnecting |
| UC62913-2-3-S031 | Delta power control function<br>Decrease active power output to ensure there remains spinning reserve amount that was bid into the market | Decrease active power output to ensure there remains spinning reserve amount that was bid into the market |
| UC62913-2-3-S032 | Power rate control<br>The power is limited by the maximum ramp rate. | Another is ramp time, when the active power should be at the required power level by the end of the ramp time. It may reach the required power level earlier, but not later. |
| UC62913-2-3-S033 | Operating reserve (spinning reserve)<br>The DER provides operating reserve | The DER can provide reserve power available within about 10 minutes |
| **Capabilities not yet defined** | | |
| UC62913-2-3-S034 | Microgrid separation control (intentional islanding) | Process for normal separation, emergency separation, and reconnection of microgrids. These microgrids could be individual facilities or could be multiple facilities using area EPS grid equipment between these facilities. |
| UC62913-2-3-S035 | Provide black start capability | Ability to start without grid power, and the ability to add significant load in segmented groups |
| UC62913-2-3-S036 | Provide backup power | Ability to provide power to local loads when not connected to the grid |

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According to the IEC smart grid standardization roadmap, "a successful operation of a virtual power plant requires the following technical equipment:

- an energy management system that monitors, plans and optimizes the operation of the decentralized power units;
- a forecasting system for loads that is able to calculate very short-term forecasts (1 hour) and short-term forecasts (up to 7 days);
- a forecasting system for the generation of renewable energy units. This forecast must be able to use weather forecasts in order to predict the generation of wind power plants and photovoltaics;
- an energy data management system which collects and keeps the data that is required for optimization and forecasts, e.g. profiles of generation and loads as well as contractual data for customer supply;
- a powerful front end for the communication of the energy management system with the decentralized power units."

Table 7 lists the system roles that have been identified so far. This list is not exhaustive and will be updated as the system Use Cases are drafted.

**Table 7 – System roles of the domain**

| System roles | | Definition |
|---|---|---|
| **Level 0 Electric power system** | | |
| Electric power system (EPS) (high level) | | Facilities that deliver electric power to a load |
| | Local EPS | An EPS contained entirely within a single premises or group of premises |
| | Area EPS | An EPS that serves local EPSs |
| | Microgrid EPS | A local EPS that can operate as an island and is operated as a virtual resource to the area EPS |
| | DC EPS | A local EPS that operates direct current |
| Electrical point of connection (ECP) | | Point of electrical connection between the DER source or sink of energy and any EPS<br>Each DER unit has an ECP connecting it to its local power system; groups of DER units have an ECP where they interconnect to the power system at a specific site or plant; a group of DER units plus local loads have an ECP where they are interconnected to the utility power system.<br>NOTE For those ECPs between a utility EPS and a plant or site EPS, this point is identical to the point of common coupling (PCC) in IEEE Std 1547. |
| | Point of common coupling (PCC) | The point where a local EPS is connected to an area EPS. |
| | PCC switch | Switch plus its controller at the point of common coupling (PCC) between the local EPS and the area EPS |
| | EPS switch | Switch plus its controller within an EPS |
| Synchronizing equipment | | Equipment that synchronizes the frequency between two EPSs |
| Weather system | | Meteorological service providing weather system that can affect DER capabilities |
| **Level 1 DER** | | |
| Virtual resource (high level) | | A set of one or more energy service resources, including generators, energy storage, controllable load, and ancillary services |
| Distributed energy resource (DER) (high level) | | A distributed set of one or more energy service resources, including generators, energy storage, controllable load, and ancillary services |
| | Renewable DER | DER system whose prime mover energy comes from renewable sources, including water, solar, wind, and biofuels |
| | Combined heat and power (CHP) | DER system whose primary purpose is creation of heat but can also provide electrical energy from the heat creation capability. In some circumstances, electrical energy is the primary purpose with heat as a secondary purpose |
| | Photovoltaic system (PV) | |
| | Fuel cell | |
| | Wind turbine | |
| | Hydro plant | |
| | Gas turbine | |
| | Biomass plant | |
| | Wood chip boiler | |

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| System roles | | Definition |
|---|---|---|
| | Battery energy storage | |
| | Pumped water storage | |
| DER unit (high level) | | Prime mover and converter to and/or from electrical energy, including generators, energy storage, and controllable load |
| DER controller (high level) | | Controller of DER unit |
| DER system (high level) | | Combined DER controller and DER unit, including generators, energy storage, and controllable load |
| | Regulating DER system | DER system responsible for frequency and/or voltage regulation. The regulating DER system could be a generator, an energy storage system, or controllable load. |
| | Non-regulating DER system | DER system not participating in frequency or voltage regulation. |
| DER storage unit (high level) | | DER unit that includes energy storage that can be converted to electrical energy |
| DER generating unit (high level) | | DER unit that includes generation of electrical energy |
| DER controllable load (high level) | | DER that consists primarily of a load that is allowed to be modified based on operating conditions, tariffs, contracts, or other criteria |
| | Non-controllable load | Load that is not allowed to be modified |
| | Critical load | Loads within a local EPS having the highest priority of service. These loads are served at the expense of all other loads. |
| | Non-critical load | Loads within a local EPS having the lowest priority of service. These loads may be left unserved in favour of critical loads. |
| Time synchronization source | | Source of an accurate time signal |
| DER protection function | | Safety-related function to prevent harm to personnel, the DER system, and/or other electrical equipment |
| DER log | | Log of significant events and alarms for use in market settlements, operational analysis, and other audit purposes |
| DER meter | | Meter that records the energy produced within specified time periods, energy used within specified time periods for DER charging of storage, and demand curves of DER generation and storage over time |
| **Level 2 FDEMS** | | |
| DER management system (DER-MS) (high level) | | System that manages the settings and dispatch of DER systems |
| Facility DER EMS (FDEMS) | | System that manages the settings and dispatch of DER systems within a facility. This facility could be a residence, a building, a commercial site, an industrial site, or any other high level location. |
| | Microgrid DER EMS (MDEMS) | System that manages the settings and dispatch of DER systems within a microgrid, and that can cause the microgrid to become an island and to reconnect with the area EPS. |
| | Power plant DER EMS (PDEMS) | System that manages the settings and dispatch of DER systems within a power plant |
| | Building DER EMS (BDEMS) | System that manages the settings and dispatch of DER systems within a building |
| | Virtual power plant (VPP) DER EMS (VDEMS) | System that manages the settings and dispatch of DER systems that are enrolled in a virtual power plant |

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| System roles | | Definition |
|---|---|---|
| | Meter data management system (MDMS) | |
| Energy services interface (ESI) | | |
| Facility local area network (Facility LAN) | | |
| **Level 3 Aggregators** | | |
| Aggregator | | See definition in Table 5 |
| | Aggregator DER management system (ADEMS) | |
| | Retail DER energy management system (RDEMS) | System that manages the settings and dispatch of DER systems that have been contracted to be operated by REPs and/or aggregators |
| **Level 4 DSO and TSO** | | |
| Transmission system operator (TSO) | | See definition in Table 5 |
| | TDEMS or TSO EMS | TDEMS is part of the TSO EMS that manages large DER systems or large aggregations of smaller DER systems |
| Distribution system operator (DSO) | | See definition in Table 5 |
| | DSO planner | Planner |
| | DSO DER EMS (DDEMS) | |
| Distribution management system (DMS) | | High level term for all applications used for distribution management. |
| | Distribution operations model and analysis (DOMA) | Topological model of distribution system, including the location and profile characteristics of all distribution equipment and DER systems (individually and/or in aggregate). This model is derived from the geographic model in the GIS, the facilities information (often included in the GIS and/or an asset management database), and the DER profiles (derived from the CIS and DER characteristics database) |
| | Distribution system power flow (DSPF) | Application that determines the power flows of the distribution system, using the DOMA model |
| | Transmission bus load model (TBLM) | |
| Geographic information system (GIS) | | Geographic model of the distribution system, including the location and characteristics of all distribution equipment and DER systems (individually and/or in aggregate) |
| Customer information system (CIS) | | System with customer information, including personal information, billing information, customer profile information, etc. |
| Outage management system (OMS) | | |
| Distribution SCADA system (DSCADA) | | |
| **Level 5 Market** | | |
| Transmission energy market (high level) | | |
| | Wholesale energy market | |
| | Balancing authority (market) | |

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| System roles | | Definition |
|---|---|---|
| | Transmission market operator | |
| Retail market (high level) | | |
| | Demand response (DR) system | System providing demand response pricing information for different energy products during different time frames |
| Demand response (DR) pricing schedule | | Schedule provided by REPs, DSOs, TSO, and others to indicate contractual and/or forecast prices for energy and ancillary services during specific time periods |
| **Level 6 Communications** | | |
| Wide area network (WAN) | | |
| | Public network | |
| | Advanced metering infrastructure (AMI) | |
| | Cellular system | |
| | Public Internet | |
| | Communication nodes | |
| Cyber security | | |
| | Password and certificate management | |
| | Firewalls | |
| | Key management systems | |
| | Role-based access control systems | |

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# 5 Smart home/commercial/industrial/DR-customer energy management

## 5.1 Purpose and scope

### 5.1.1 Clause objective

The intention of Clause 5 is to present a business analysis of the smart home / commercial / industrial and DR-customer energy management domain, and more specifically to describe the smart grid requirements of the domain using the Use Case approach as defined in IEC SRD 62913-1.

In this document, the technical possibilities of smart homes, smart building, multi-building complexes and other customer energy management devices and their behaviour are considered. The Use Cases further detail the communication between actors by describing the signals and data models. It also helps determine if existing or proposed architectures are compatible with the smart grid requirements which have been defined.

### 5.1.2 General context

According to the evolution of the smart grid, the following main points are identified.

- The role of the consumer
  - The consumer is slowly turning into a "prosumer," a term which denotes a person who both produces and consumes energy. More and more consumers are installing their own renewable energy products to lower energy costs, increase use of renewable sources, and/or increase energy efficiency. Depending upon regulations and business opportunities within different regions, these prosumers are cogenerating heat and

power with their own solar panels or micro CHPs, selling energy back to the grid, or simply reducing their use of grid-supplied energy. This trend is set to continue, as government bodies continue to provide incentives to domestic users to become "prosumers" as part of their increased energy efficiency policies.

  - The consumer is empowered and wants to take advantage of the new possibilities in terms of internal optimization according to his or her priorities and choices (comfort, industrial processes, sustainable consumption, ...) and make use of his or her flexibility on the market taking into account external signals (prices, demand response).
  - Considering the possible complexity of the home management, some consumers are delegating this task to authorized third parties.

- The evolution of the technology of smart homes
  - Smart homes are becoming "active" and able to participate in the grid and market business processes to satisfy the consumer's needs.
  - Commercial and industrial smart buildings are becoming more easily monitored and controlled than residential ones. For the smart home, simple architectures are critical to meet the many diverse situations in the world.

## 5.2 Business analysis

### 5.2.1 General overview

Information and communication technologies (ICT) offer new opportunities to customers to manage their electricity consumption. They are able to take a more active part in the electric power system (EPS), with the development of demand response (DR), communication devices connected to their electrical equipment, and communicating electrical equipment. According to IEC TR 62746-2:2015, demand response is: "a concept describing an incentivizing of customers by costs, ecological information or others in order to initiate a change in their consumption or feed-in pattern".

This trend is impacting all types of consumers, including residential, industrial, and tertiary ones. With the development of smart homes, residential customers have the opportunity to optimize their energy consumption/generation according to their needs, and potentially to support the activities of different stakeholders of the electric power system by responding to various signals.

A smart home is a house or an apartment equipped with a communicating and structured home area network (HAN). Residents who live in smart homes are able to remotely control or programme home electrical devices by activating/enabling and/or disabling internal controls and/or external events (excluding emergency signals).

Residents can thus better manage their energy consumption/generation and set the behaviour of the smart home to respond to external events, according to their preferences (economic optimization, comfort, environmental concerns). This customization could be done in a manual or automatic mode, depending on the configuration of the smart home. In automatic mode, when receiving a signal from the smart grid, smart home devices can adapt their operations without any further resident intervention. Residents/clients can always "keep control", except in emergency situations. Residents/clients may also decide to partially or totally delegate the customization to external roles, such as energy service providers, whom they have contracted with. These parties could for instance elaborate and propose to the residents/clients load schedules based on the analysis of the smart home data. Smart grid technologies including smart metering systems empower residents/clients to be aware of their consumption habits, energy costs and behaviour.

Furthermore, smart homes offer residents/clients the opportunity to become more active in the functioning of the grid and electricity markets. They can respond to signals designed to manage the electrical flexibility of the smart home depending on the state of the network (for instance, responding to emergency conditions when the power system "traffic light" shows "red" conditions).

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### 5.2.2 List of business roles and business Use Cases of the domain

The business Use Cases listed are a result of the business analysis carried out previously – the list is not exhaustive, and it is likely to grow as new Use Cases come to light.

The Use Cases are associated with one or several of the business objectives of the domain, which include:

- configure the smart site (smart home or smart building) to enable interoperability with the smart grid;
- optimize the smart site (smart home or smart building) behaviour;
- manage the flexibility of the smart site (smart home or smart building);
- customer preferences to minimize customer costs and/or maximize customer convenience;
- regulatory requirements to ensure safety and reliability of the power system;
- societal to minimize the ecological impact of customer use of energy.

Table 8 lists the business roles that have been identified so far. This list is not exhaustive.

**Table 8 – Business roles of the domain**

| Business roles | Definition |
|---|---|
| After-sales service operator | Entity that offers after-sales services at home. |
| Automation operator | Entity managing home devices (electrical devices, electricity management devices, WAN-IAN interface). |
| Building resident | A party that is a resident of the building and that may customize some of the uses or equipment according to the rights that the energy manager has given to him or her. |
| Client/customer (of electricity supplier) | A party connected to the grid that contracts for the ability to consume electricity at a metering point. |
| Consumer resident | Electricity end user residing in a smart home with capability of electricity flexibility and possible capability of energy storage. |
| Electricity feed-in administrator | A party which remunerates its clients for the electricity fed in the smart grid by the smart home or smart building. |
| Electricity installer | Entity that installs and maintains smart electric systems for industrial, commercial and domestic purposes. |
| Electricity supplier/retailer | Entity whose activity is the wholesale purchase of electricity and the subsequent direct resale to client through a contract. The supplier may also deliver energy-related services such as providing flexibility through electricity price modulation e.g. time-of-use, critical peak prices). |
| Energy manager | A party in charge of the energy management of the smart building. |
| Equipment manufacturer | Entity that produces and sells electrical devices and electricity management devices. |
| Facility manager | A party in charge of supervising the equipment of the smart building. |
| Flexibility operator (FO) | A party which technically operates flexibilities for its customers. |
| Grid operator | A party that operates one or more electrical grids.<br>[SOURCE: ENTSO-E, EFET, and ebIX, 2014] |

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| Business roles | Definition |
|---|---|
| Metering system operator | A party responsible for:<br>• operations of the metering system, including communication with the Metering Points;<br>• meter reading and quality control of the reading – taking the role of Metered Data Collector defined by ENTSO-E, EFET, and ebIX in their role model.<br>May also be referred to as AMI system operator. |
| Producer client | A party connected to the grid at a metering point that generates and sells electricity through a contract. |
| Producer resident | Smart home resident producing electricity. |
| Resident | Electricity end user residing in a smart home who can be a consumer resident, a producer resident or both, with capability of electricity flexibility and possible capability of energy storage. |
| Service provider | Entity providing electricity-related services (such as energy efficiency or communication services). |
| Service operator | Entity connected to a service provider information system and to the home automation operator one. This entity operates services on behalf of a service provider. This entity can also collect and aggregate the smart home data before sending them to a service provider. |
| Telecommunications operator | Entity that offers telecommunications services. |

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Figure 5 is an extract from the role overview regarding the smart home. This diagram is not exhaustive but only highlights some of the relations between the roles involved in the domain.

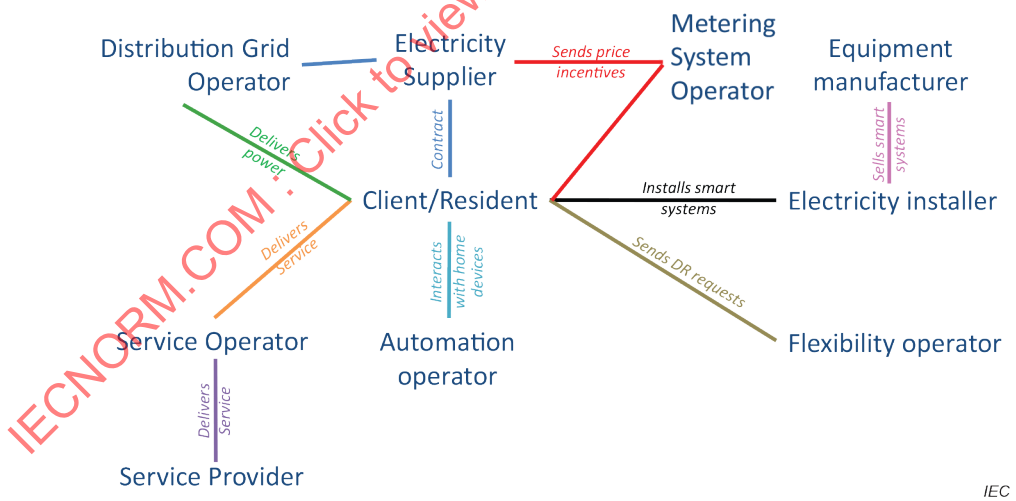


**Figure 5 – Role highlights of the smart home domain**

Table 9 lists and provides a brief description of the smart home business Use Cases that have been identified so far (they do not cover the entire domain business Use Cases).

**Table 9 – Identified smart home business Use Cases of the domain**

| Index of the business Use Cases | Identified business Use Cases | Brief description | System Use Case required to enable/execute the business Use Case | Level of maturity |
|---|---|---|---|---|
| UC62913-2-3-B042 | Adapt the smart home behaviour to the resident/client's preferences | The business Use Case describes how the resident/client customizes the management of his or her appliance(s) namely during dynamic peak periods and the monitoring of events, according to his or her preferences (decision between comfort and economic optimization). The resident/client may choose to respond to events in manual mode or automatic mode, and may in this second case delegate the customization to an authorized third party. | Customize automatic responses (price signals, DR requests, emergency signals) | Already implemented |
| UC62913-2-3-B043 | Enable the interoperability between the smart home and the smart grid | The business Use Case describes how the client configures his or her smart home to receive smart grid signals (market or emergency signals). The configuration may include the installation of smart home devices | Configure the smart home in order to enable the interoperability with the smart grid | Adjustments in progress |
| UC62913-2-3-B044 | Manage flexibility on electricity demand and generation within the smart home from market signals | The business Use Case describes how the resident/client responds to market signals (price incentives or DR requests) and adapts the behaviour of the smart home. | • Manage the flexibility of the smart home on electricity demand and generation from price incentives<br>• Manage the flexibility of the smart home on electricity demand and generation from DR requests<br>• Manage opt-outs to automatic responses (only price signals and DR requests, emergency excluded) including manual actions | • Already implemented<br>• Adjustments in progress<br>• Already implemented |
| UC62913-2-3-B045 | Manage flexibility on electricity demand and generation within the smart home from emergency signals | | • Manage the flexibility of the smart home on electricity demand and generation from emergency signals | • Adjustments in progress |
| UC62913-2-3-B046 | Provide enriched smart home data to relevant parties in order to make the resident/client more active | The business Use Case describes how the resident/client or an authorized third party receives electricity data regarding the electricity behaviour of the smart home. The occurrence of events is monitored and the resident/client is warned if an event occurs. | • Provide alarms related to the smart home electricity behaviour to the client or resident<br>• Provide a third party with enriched smart home electricity data | Already implemented |

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| Index of the business Use Cases | Identified business Use Cases | Brief description | System Use Case required to enable/execute the business Use Case | Level of maturity |
|---|---|---|---|---|
| UC62913-2-3-B047 | Assess the value of the flexibility of the smart home | | • Process metering data to invoice electricity supply of the smart home<br>• Process data related to the smart home behaviour to aggregate (forecasting, real-time), assess the value of and certify flexibilities<br>• Process metering data to remunerate electricity feed in by the smart home | • Already implemented<br>• Adjustments in progress |

Regarding the smart building, similar business Use Cases have been identified (see Table 10). This first list may be amended with the detailed description of the smart building BUC.

**Table 10 – Identified smart building business Use Cases of the domain**

| Index of the business Use Case | Identified business Use Case | Brief description | System Use Cases required to enable/execute the business Use Cases | Level of maturity |
|---|---|---|---|---|
| UC62913-2-3-B048 | Adapt the smart building behaviour to the energy manager /client preferences | The business Use Case describes how the client/smart building energy manager customizes the energy management of the smart building namely during dynamic peak periods and the monitoring of events, according to his or her preferences (decision based on economic optimization). He or she may delegate the customization to an authorized third party. | • Customize automatic responses of the smart building (price signals, DR requests, emergency signals)<br>• Optimize the smart building behaviour regarding internal and external information received | Adjustments in progress |
| UC62913-2-3-B049 | Enable the interoperability between the smart building and the smart grid | | • Configure the smart building in order to enable the interoperability with the smart grid | Adjustments in progress |

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| Index of the business Use Case | Identified business Use Case | Brief description | System Use Cases required to enable/execute the business Use Cases | Level of maturity |
|---|---|---|---|---|
| UC62913-2-3-B050 | Manage flexibility on electricity demand and generation within the smart building from market signals | The business Use Case describes how the client/smart building energy manager responds to market signals (price incentives or DR requests) and adapts the behaviour of the smart building. | • Manage the flexibility of the smart building on electricity demand and generation from price incentives<br>• Manage the flexibility of the smart building on electricity demand and generation from DR requests (Level of maturity: Incomplete due to uncertainty)<br>• Manage opt-outs to automatic responses (only price signals and DR requests, emergency excluded) of the smart building including manual actions (Level of maturity: Already implemented) | Adjustments in progress |
| UC62913-2-3-B051 | Manage flexibility on electricity demand and generation within the smart building from emergency signals | | • Manage the flexibility of the smart building on electricity demand and generation from emergency signals | Adjustments in progress |
| UC62913-2-3-B052 | Provide enriched smart building data to relevant parties in order to make the energy manager/ client more active | The business Use Case describes how the client/smart building energy manager or an authorized third party receives electricity data regarding the electricity behaviour of the smart building. The occurrence of events is monitored and the client/smart building energy manager is warned if an event occurs. | • Provide alarms related to the smart building electricity behaviour to the client or resident<br>• Provide a third party with enriched smart building electricity data | Adjustments in progress |
| UC62913-2-3-B053 | Assess the value of the flexibility of the smart building | | • Process metering data to invoice electricity supply (Level of maturity: Already implemented<br>• Process data related to the smart building behaviour to aggregate (forecasting, real-time), assess the value of and certify flexibilities<br>• Process metering data to remunerate electricity feed in by the smart building | Adjustments in progress |

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### 5.2.3 List of system Use Cases and system roles

#### 5.2.3.1 System Use Cases and system roles of the domain

Table 11 describes the system Use Cases which have been identified so far to enable the business Use Cases described above to operate. The list is non exhaustive and will be updated as new editions of IEC SRD 62913-2-2 are published.

**Table 11 – Identified system Use Cases of the domain**

| Index of the system Use Cases | Identified system Use Cases | Brief description |
|---|---|---|
| UC62913-2-3-S037 | Configure the smart building in order to enable the interoperability with the smart grid | The smart building is configured in order to enable the communications:<br>– externally with the smart grid through the smart grid connection point;<br>– internally between the system roles.<br>The smart building is configured as required in order to operate the flexibility management and the ancillary services.<br>This business process takes into account the first configuration of the smart building and the following upgrades. |
| UC62913-2-3-S038 | Configure the smart home in order to enable the interoperability with the smart grid | The smart home is configured in order to enable the communications:<br>– externally with the smart grid through the smart grid connection point;<br>– internally between the system roles.<br>The smart home is configured as required in order to operate the flexibility management and the ancillary services.<br>This business process takes into account the first configuration of the smart home and the following upgrades. |
| UC62913-2-3-S039 | Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals) | A resident/client customizes the management of his or her appliance(s) namely during dynamic peak periods.<br>A resident/client also customizes the monitoring of events.<br>Described function<br>• First function: Customize the automatic responses of the smart home<br>– Depending on the smart home capabilities and the resident/client needs, the customization may be defined and applied to different scopes: the whole smart home, one or several areas (rooms), one or several uses, one or several appliances.<br>– Depending on the smart home capabilities, the customization may be defined and applied to different timescales:<br>i. price period,<br>ii. standard day,<br>iii. standard week,<br>iv. standard season,<br>v. use/appliance consumption time slot.<br>• Second function: Customize warnings (events to be tracked) and specify the related emission channel<br>– The event to be tracked is exceeding an electricity data threshold in the smart home (such as a threshold of consumption in kWh).<br>• Third function: Notify that the new customization has been taken into account<br>• Fourth function: Read the customization |

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| Index of the system Use Cases | Identified system Use Cases | Brief description |
|---|---|---|
| UC62913-2-3-S040 | Customize automatic responses of the smart building (price signals, DR requests, or emergency signals) | A client/smart building energy manager customizes the management of his or her equipment(s) namely during dynamic peak periods.<br>He or she also customizes the monitoring of events.<br>Described function<br>• First function: Customize the automatic responses of the smart building<br>– Depending on the smart home capabilities and the client/energy manager needs, the customization may be defined and applied to different scopes: the whole smart building, one or several areas (rooms), one or several uses, one or several equipment.<br>– Depending on the smart building capabilities, the customization may be defined and applied to different timescales:<br>i. price period;<br>ii. standard day;<br>iii. standard week;<br>iv. standard season;<br>v. use/equipment or appliance consumption time slot.<br>• Second function: Customize warnings (events to be tracked) and specify the related emission channel<br>– The event to be tracked is exceeding an electricity data threshold in the smart building (such as a threshold of consumption in kWh).<br>• Third function: Notify that the new customization has been taken into account<br>• Fourth function: Read the customization |
| UC62913-2-3-S041 | Manage the flexibility of the smart home on electricity demand and generation from DR requests | The smart home receives a DR request notification or a DR request via the EMG or via the external smart metering gateway.<br>When a DR request notification is sent, the smart home can define a load management strategy, inform the clients/residents if necessary and execute new instructions if any.<br>When a DR request is sent, the smart home can adapt the load management strategy, inform the clients/residents if necessary and execute new instructions if any.<br>Price incentives, resident/client customizations and possible opt-outs are taken into account so as to define or adapt the load management strategy.<br>3 steps:<br>• Before a DR request: anticipate if need be<br>• During a DR request: shut off or automatically adapt loads within the customer's smart home<br>• After a DR request: switch back on loads if need be |
| UC62913-2-3-S042 | Manage the flexibility of the smart home on electricity demand and generation from emergency signals | Manage the electrical flexibility of a smart home depending on emergency signals received from external SMG.<br>3 steps:<br>• On a pre-emergency period (if possible to detect): anticipate if need be<br>• During an emergency period: shut off or automatically reduce loads within the smart home<br>• After an emergency period: switch back on loads if need be |

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| Index of the system Use Cases | Identified system Use Cases | Brief description |
|---|---|---|
| UC62913-2-3-S043 | Manage the flexibility of the smart home on electricity demand and generation from price incentives | The smart home receives a price incentive via the external smart metering gateway. This price incentive can be a dynamic peak period notification, a notification regarding price levels for the next day, a dynamic peak period start, a dynamic peak period stop, a change in supplier index or a change in the position of the physical dry contact.<br><br>Depending on the price incentive, the smart home can define or adapt a load management strategy, inform the clients/residents if necessary and execute new instructions if any.<br><br>Resident customizations and possible opt-outs are taken into account so as to define or adapt the load management strategy.<br><br>4 steps:<br>• Before a peak and depending on the price levels of the next day: anticipate if need be<br>• During a peak: shut off or automatically reduce loads within the customer's smart home<br>• After a peak: switch back on loads if need be<br>• After a change in supplier index: choose and execute a load management strategy<br><br>Load management strategies take resident/client customizations as well as opt-outs into account. |
| UC62913-2-3-S044 | Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests | After receiving a notification or during the execution of an automatic response that results from a price incentive or a DR request, the client/ resident opts-out of a planned or occurring automatic response.<br><br>In other words, the smart home will not apply a strategy that takes into account price incentives or DR requests or will apply a new strategy that matches the resident/client instructions. Opt-out, entirely or to a given level, i.e.:<br>• either not to take into account price incentives (related to a DPP for example);<br>• or to apply an instruction that the resident/client wants (only for a DPP for example). |
| UC62913-2-3-S045 | Manage the flexibility of the smart building on electricity demand and generation from price incentives | The smart building receives a price incentive via the external smart metering gateway. This price incentive can be a dynamic peak period notification, a notification regarding price levels for the next day, a dynamic peak period start, a dynamic peak period stop, a change in supplier index.<br><br>Depending on the price incentive, the smart building can define or adapt a load management strategy, inform the clients/smart building energy manager if necessary and execute new instructions if any.<br><br>Customizations and possible opt-outs are taken into account so as to define or adapt the load management strategy.<br><br>4 steps:<br>• Before a peak and depending on the price levels of the next day: anticipate if need be<br>• During a peak: shut off or automatically reduce loads within the customer's smart home<br>• After a peak: switch back on loads if need be<br>• After a change in supplier index: choose and execute a load management strategy |

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| Index of the system Use Cases | Identified system Use Cases | Brief description |
|---|---|---|
| UC62913-2-3-S046 | Manage opt-outs of the smart building to automatic responses related to price incentives or DR requests | After receiving a notification or during the execution of an automatic response that results from a price incentive or a DR request, the client/energy manager opts-out of a planned or occurring automatic response.<br>In other words, the smart building will not apply a strategy that takes into account price incentives or DR requests or will apply a new strategy that matches the client/energy manager instructions. Opt-out, entirely or to a given level, i.e.:<br>• either not to take into account price incentives (related to a DPP for example);<br>• or to apply an instruction that the client/energy manager wants (only for a DPP for example). |
| UC62913-2-3-S047 | Manage the flexibility of the smart building on electricity demand and generation from DR requests | The smart building receives a DR request notification or a DR request via the EMG or via the external smart metering gateway.<br>When a DR request notification is sent, the smart building can define a load management strategy, inform the clients/energy manager if necessary and execute new instructions if any.<br>When a DR request is sent, the smart building can adapt the load management strategy, inform the clients/energy manager if necessary and execute new instructions if any.<br>Price incentives, customizations and possible opt-outs are taken into account so as to define or adapt the load management strategy.<br>3 steps:<br>• Before a DR request: anticipate if need be<br>• During a DR request: shut off or automatically adapt loads<br>• After a DR request: switch back on loads if need be |
| UC62913-2-3-S048 | Manage the flexibility of the smart building on electricity demand and generation from emergency signals | Manage the electrical flexibility of the smart building depending on emergency signals received from external EMG<br>3 steps:<br>• On a pre-emergency period (if possible to detect): anticipate if need be<br>• During an emergency period: shut off or automatically reduce loads within the smart building<br>• After an emergency period: switch back on loads if need be) |
| UC62913-2-3-S049 | Optimize the smart building behaviour regarding internal and external information received | External data received by the smart building and local data of the smart building are automatically taken in account to adapt the electricity behaviour of the smart building |
| UC62913-2-3-S050 | Process data related to the smart home behaviour to aggregate (forecasting, real-time), assess the value of and certify flexibilities | The system Use Case describes how the smart home data needed to aggregate (forecasting, real-time), assess the value of flexibilities and certify flexibilities are collected, processed and transmitted |
| UC62913-2-3-S051 | Process metering data to invoice electricity supply of the smart home | The system Use Case describes how the metering data needed to invoice electricity supply are collected, possibly processed and transmitted in order to invoice electricity supply |

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| Index of the system Use Cases | Identified system Use Cases | Brief description |
|---|---|---|
| UC62913-2-3-S052 | Process metering data to invoice electricity supply (Level of maturity: Already implemented | The system Use Case describes how the metering data needed to invoice electricity supply are collected, possibly processed and transmitted in order to invoice electricity supply |
| UC62913-2-3-S053 | Process data related to the smart building behaviour to aggregate (forecasting, real-time), assess the value of and certify flexibilities | The system Use Case describes how the smart building data needed to aggregate (forecasting, real-time), assess the value of flexibilities and certify flexibilities are collected, processed and transmitted |
| UC62913-2-3-S054 | Process metering data to remunerate electricity feed in by the smart home | The system Use Case describes how the metering data needed to remunerate electricity feed-in is collected and transmitted in order to remunerate electricity feed-in |
| UC62913-2-3-S055 | Process metering data to remunerate electricity feed in by the smart building | The system Use Case describes how the metering data needed to remunerate electricity feed-in is collected and transmitted in order to remunerate electricity feed-in |
| UC62913-2-3-S056 | Provide a third party with enriched smart home electricity data | Energy data regarding the electricity behaviour of the smart home are made available externally or locally to a physical person (client, resident) via a UI or to an automated system that uses these data.<br>• First function: Make the smart home's energy data locally available<br>• Second function: Make the smart home's energy data externally available<br>• Third function: Enhance the smart home's energy data |
| UC62913-2-3-S057 | Provide a third party with enriched smart building electricity data | Energy data regarding the electricity behaviour of the smart building are made available externally or locally to a physical person (client, energy manager) via a UI or to an automated system that uses these data.<br>• First function: Make the smart building's energy data locally available<br>• Second function: Make the smart building's energy data externally available<br>• Third function: Enhance the smart building's energy data |
| UC62913-2-3-S058 | Provide alarms related to the smart home electricity behaviour to the client or resident | The occurrence of events is monitored and the resident/client is warned if an event occurs.<br>2 steps:<br>• Monitor the occurrence of (the) event(s)<br>• Warn if an event occurs |
| UC62913-2-3-S059 | Provide alarms related to the smart building electricity behaviour to the client or resident | The occurrence of events is monitored and the client/energy manager is warned if an event occurs.<br>2 steps:<br>• Monitor the occurrence of (the) event(s)<br>• Warn if an event occurs |

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Table 12 describes the system roles which have been identified so far to enable the system Use Cases described above to operate. The list is non exhaustive and will be updated as new editions of IEC 62913-2-3 are issued.

**Table 12 – System roles of the domain**

| System role | Definition |
|---|---|
| Smart metering | Combination of the following meter-related functions from the smart metering reference architecture:<br>• metrology functions including the conventional meter display (register or index);<br>• one or more additional functions. These may also make use of the display;<br>• meter communication functions.<br>[SOURCE: CEN/CLC/ETSI TR 50572:2011] |
| Internal smart metering gateway (internal SMG) | Communications functions between the smart metering and the smart home. |
| External smart metering gateway (external SMG) | Communications functions between the smart grid area and the smart metering. |
| Energy management gateway (EMG) | Communication functions between the WAN and the HAN. |
| Customer energy management system (CEMS) | System enabling the definition of coordinated energy management strategies of one or several related DEMS depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, resident/client customization and potential resident/client opt-outs.<br>This system includes a processing ability notably in order to take resident/client customization and electricity data enhancement into account. |
| Device energy management system (DEMS) | System adapting the operations of a given electrical device depending on the incoming orders, resident customization and potential opt-outs that may be manually done locally. |
| User interface (UI) | User interface (UI) can be connected to the smart home HAN or to the WAN. If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. |
| Smart grid connection point (SGCP) | Borderline between the area of grid and markets towards customer role (e.g. households, building, industry).<br>[SOURCE: CEN/CLC/ETSI TR 50572:2011] |
| Building energy management system (BEMS) | System enabling the definition of coordinated energy management strategies of one or several related DEMS in a smart building depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, energy manager and building resident customization and potential opt-outs.<br>This system includes a processing ability notably in order to take Building Manager customization and electricity data enhancement into account. |
| Context information (CI) | Function giving local context information. |
| Smart home | Smart home is an actor grouping, composed at least of the following system roles:<br>• the smart home is connected to grid through the SGCP composed of at least smart meter, external SMG and internal SMG;<br>• one DEM;<br>• one UI.<br>Optionally the SGCP can be enriched by an EMG.<br>The smart home can be enriched by one or multiple DEMs, CEMs and UIs. |
| Smart meter | Meter with additional functionalities, one of which is data communication.<br>[SOURCE: M/441 smart metering-Coordination Group, 2011] |

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| System role | Definition |
|---|---|
| SM-MC | Gateway enabling two-way communication between the smart meter (SM) and the metering channel (MC). |
| SM-HAN gateway | Gateway enabling the smart meter (SM) to transmit data toward the smart home HAN. |
| WAN-HAN interface | Gateway. |
| DCA (directly connected appliance) | Appliances connected to the HAN that can receive orders directly from the smart meter through SM-HAN gateway (air conditioners, heaters, etc.). |
| ICA (indirectly connected appliance) | Smart appliances connected to the HAN that can receive orders from a customer energy management system (connected home devices with embedded "intelligent" capabilities such as clothes washer, heat pump, refrigerators, etc.). |
| BA (binary appliance) | Appliances and connected home devices that can receive two state orders, etc. |

#### 5.2.3.2 Role model

Figure 6 illustrates the general architecture of a smart home, while Figure 7 illustrates the general architecture of a smart building.

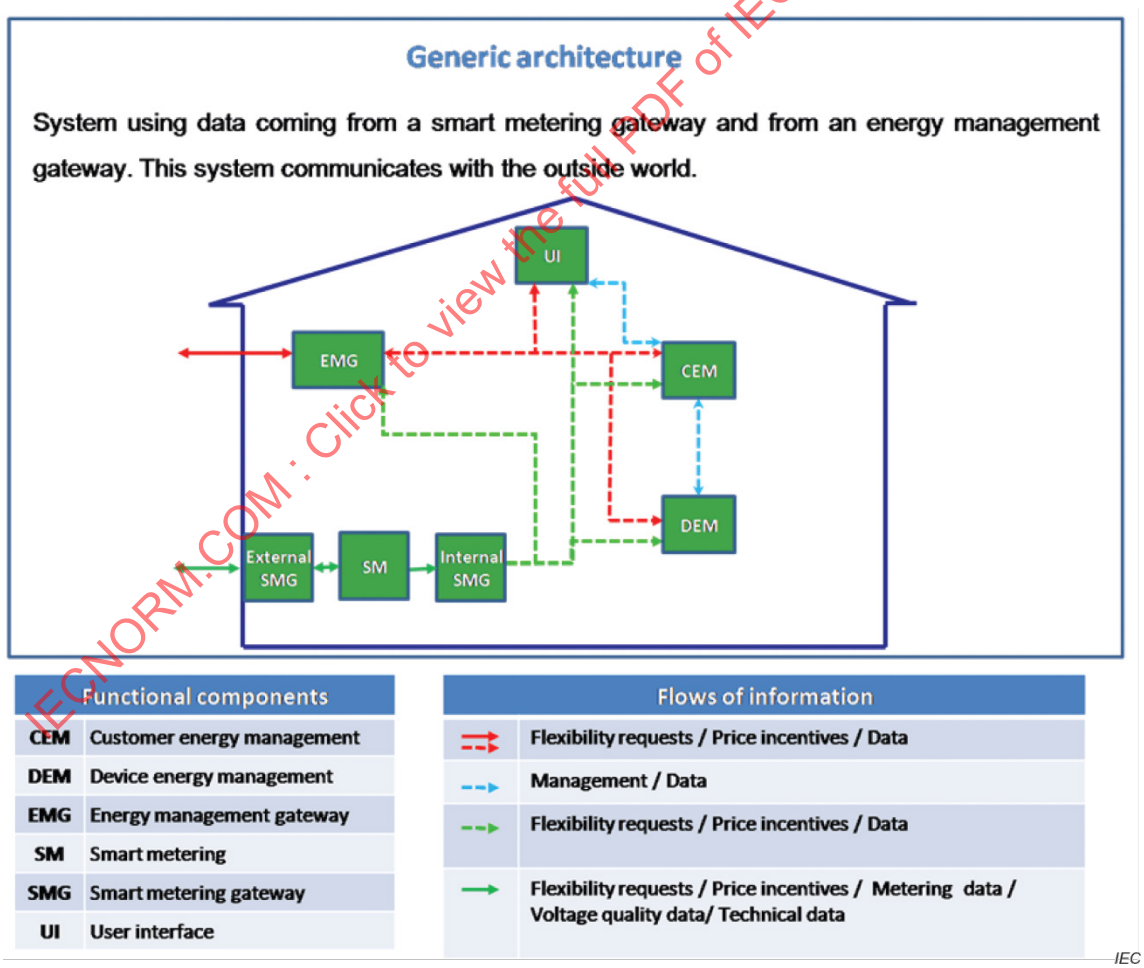


**Figure 6 – General architecture for the smart home**

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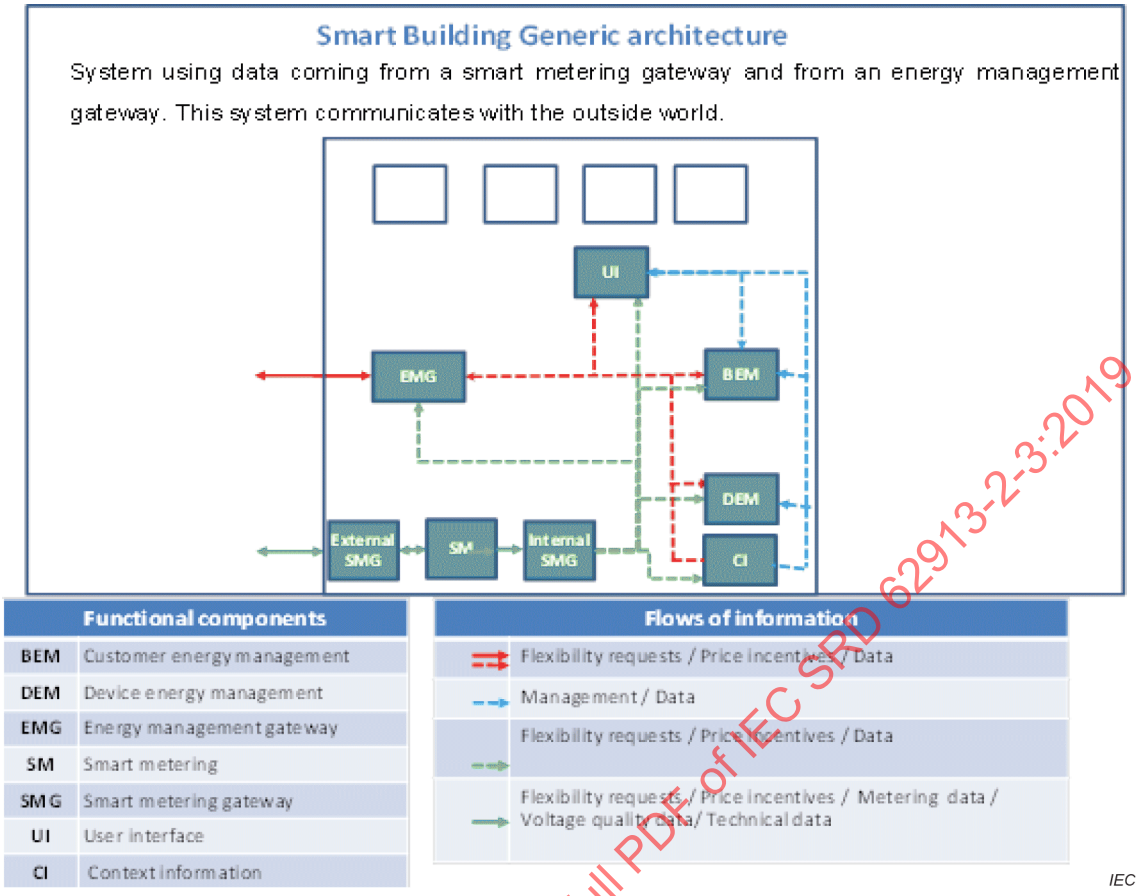


**Figure 7 – General architecture for the smart building**

## 5.3 Smart home requirements for the smart grid

### 5.3.1 Smart grid requirements extracted from smart home Use Cases

The smart home/commercial/industrial/DR-customer energy management requirements in 5.3 have been extracted from the following Use Cases described in Annex B according to the IEC 62559-2 Use Case template.

- Manage flexibility on electricity demand and generation within the smart home from market signals (see Table B.4).
- Manage the flexibility of the smart home on electricity demand and generation from DR requests (see Table B.9).

These smart home/commercial/industrial/DR-customer energy management Use Cases are associated to the business case Manage the flexibility of the smart home.

The IEC core standards shall support the needs and requirements listed in Table 13.

**Table 13 – Business requirements**

| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-001 | Smart home is configured in order to enable the interoperability with the smart grid and receive smart grid signals (market signals or emergency signals) | Table B.2<br>Table B.5<br>Table B.9 |
| R62913-2-3-002 | The resident/client is given a way to initially configure the smart home | Table B.2 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-003 | The resident/client is given a way modify the configuration of the smart home | Table B.2 |
| R62913-2-3-004 | Smart home offers energy consumption adaption mechanisms following the reception of market signals (price incentives or DR requests) received through the smart grid connection point | Table B.5<br>Table B.10<br>Table B.11 |
| R62913-2-3-005 | Price incentives are sent by the electricity supplier with whom the client has contracted an electricity plan | Table B.5<br>Table B.10<br>Table B.8<br>Table B.17 |
| R62913-2-3-006 | It is possible to have an anticipation capability within the smart home | Table B.5<br>Table B.10 scenario 3<br>Table B.10 scenario 6<br>Table B.10 scenario 7<br>Table B.11 scenario 1<br>Table B.11 scenario 3<br>Table B.11 scenario 4<br>Table B.9<br>Table B.16 |
| R62913-2-3-007 | If the smart home has the capability to establish an anticipation strategy, the smart home offers mechanisms to optimize the energy bill through anticipation of a dynamic peak period and price levels sent by the electricity supplier through the grid | Table B.5<br>Table B.10 scenario 3<br>Table B.10 scenario 6<br>Table B.10 scenario 7 |
| R62913-2-3-008 | If it has the capability to establish an anticipation strategy, the smart home anticipates electricity consumption by adapting loads before a peak and depending on the price levels of the next day | Table B.5<br>Table B.10 scenario 3<br>Table B.10 scenario 6<br>Table B.10 scenario 7 |
| R62913-2-3-009 | After the reception of price incentives or DR requests or flexibility notifications or customization modification or opt outs, the smart home defines and carries out load management strategy to take into account Price incentives, DR requests, flexibility notifications as well as resident's customization and possible opt-outs. | Table B.5<br>Table B.10<br>Table B.11<br>Table B.12<br>Table B.13 |
| R62913-2-3-010 | Price incentives, DR requests, flexibility notifications received by the smart home as well as resident's customization and possible opt-outs are taken into account to adapt the load management strategy of the smart home. | Table B.5<br>Table B.10<br>Table B.11<br>Table B.12<br>Table B.13 |
| R62913-2-3-011 | Smart home is able to switch off or automatically adapt loads during a peak period | Table B.5<br>Table B.10 |
| R62913-2-3-012 | mart home is able to switch back on loads if needed after a peak period | Table B.5<br>Table B.10 |
| R62913-2-3-013 | DR request and flexibility notification is sent by the flexibility operator with whom the client has subscribed a contract | Table B.5<br>Table B.11<br>Table B.8<br>Table B.18 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-014 | If it has the capability to establish an anticipation strategy, the smart home is able to anticipate electricity consumption by adapting loads after the reception of a coming flexibility notification | Table B.5<br>Table B.11 scenario 1<br>Table B.11 scenario 3<br>Table B.11 scenario 4 |
| R62913-2-3-015 | Smart home is able to switch off or automatically adapt loads during a DR request period | Table B.5<br>Table B.11 |
| R62913-2-3-016 | Smart home defines and carries out a load management strategy by switching back on loads if needed at the end of the DR request period | Table B.5<br>Table B.11 |
| R62913-2-3-017 | Smart home gives its resident the capability to opt-out of a planned automatic response after receiving a notification | Table B.5<br>Table B.10 scenario 6<br>Table B.11 scenario 4<br>Table B.12 scenario 1 |
| R62913-2-3-018 | Smart home gives its resident the capability to opt-out of an occurring automatic response during the execution of the automatic response that results from a price incentive or a DR request | Table B.5<br>Table B.10 scenario 4<br>Table B.11 scenario 5<br>Table B.12 scenario 1 |
| R62913-2-3-019 | Smart home gives its resident the capability to opt-out over different scopes (the whole smart home, one or several areas, one or several uses, one or several appliances) | Table B.5<br>Table B.10 scenario 4<br>Table B.10 scenario 6<br>Table B.11 scenario 4<br>Table B.11 scenario 5<br>Table B.12 scenario 1 |
| R62913-2-3-020 | Smart home gives its resident the capability to opt-out totally from the demand | Table B.5<br>Table B.10 scenario 4<br>Table B.10 scenario 6<br>Table B.11 scenario 4<br>Table B.11 scenario 5<br>Table B.12 scenario 1 |
| R62913-2-3-021 | Smart home gives its resident the capability to opt-out from the demand at a given level | Table B.5<br>Table B.10 scenario 4<br>Table B.10 scenario 6<br>Table B.11 scenario 4<br>Table B.11 scenario 5<br>Table B.12 scenario 1 |
| R62913-2-3-022 | The resident/client is given a way to check the current or planned status of his or her appliances | Table B.12 scenario 1 |
| R62913-2-3-023 | The resident/client is given a way to opt out as many times as he or she wants | Table B.12 scenario 1 |
| R62913-2-3-024 | The resident/client of the smart home is given a way to opt-out via a UI connected to the CEM | Table B.12 scenario 1 |
| R62913-2-3-025 | The resident/client is given a way to modify a current or planned opt-out | Table B.12 scenario 1 |
| R62913-2-3-026 | Opt-out is a one-time event | Table B.12<br>Table B.19 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-027 | Opt-out is prior to customization | Table B.10<br>Table B.11<br>Table B.12<br>Table B.13<br>Table B.17<br>Table B.18<br>Table B.19<br>Table B.20 |
| R62913-2-3-028 | Within the smart home the resident/client is given the possibility to monitor the occurrence of events according to his or her preferences | Table B.25<br>Table B.13<br>Table B.4<br>Table B.15 |
| R62913-2-3-029 | Within the smart home the resident/client is given the possibility to specify events he or she wants to track and the related channel to be used to send the associated warning message | Table B.25<br>Table B.13 scenario 1 |
| R62913-2-3-030 | Smart home gives its resident/client the capability to customize over different scopes (the whole smart home, one or several areas, one or several uses, one or several appliances) | Table B.25<br>Table B.13 |
| R62913-2-3-031 | Within the smart home the resident/client is given a way to customize his or her appliances' automatic responses | Table B.25<br>Table B.13 |
| R62913-2-3-032 | Smart home gives its resident/client the capability to define and apply the customization over different timescales: price periods, standard day, standard week, standard season, use, appliances time slot, … | Table B.25<br>Table B.13 |
| R62913-2-3-033 | Within the smart home the resident/client is given a way to customize depending on the type of price incentives | Table B.3<br>Table B.13 |
| R62913-2-3-034 | The resident/client of the smart home is given a way to customize via a UI connected to the CEM or DEM | Table B.3<br>Table B.13 |
| R62913-2-3-035 | The resident/client is given the possibility to customize the behaviour of the smart home as many times as he or she wants | Table B.25<br>Table B.13 |
| R62913-2-3-036 | The resident/client is given a way to modify a current or planned customization | Table B.25<br>Table B.13 |
| R62913-2-3-037 | Smart home gives its resident/client the capability to customize the behaviour of the smart home at any time | Table B.3<br>Table B.13 |
| R62913-2-3-038 | Within the smart home it is possible for the resident/client to read the current customization | Table B.3<br>Table B.13 |
| R62913-2-3-039 | Within the smart home a notification is sent to the resident/client to confirm a customization has been taken into account | Table B.3<br>Table B.13 |
| R62913-2-3-040 | It is possible to make smart home's electricity data available locally | Table B.4<br>Table B.14 scenario 2<br>Table B.14 scenario 3 |
| R62913-2-3-041 | It is possible to make smart home's electricity data available externally | Table B.3<br>Table B.4<br>Table B.14 scenario 1 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-042 | Electricity data of the smart home and electricity data of the smart building is made available to third party according to market rules and established contract with the client | Table B.4<br>Table B.3<br>Table B.6<br>Table B.7 |
| R62913-2-3-043 | It is possible to enhance the smart home electricity data with local data of the smart home | Table B.4<br>Table B.14 scenario 1<br>Table B.14 scenario 2 |
| R62913-2-3-044 | It is possible to enhance the smart home electricity data with external data | Table B.4<br>Table B.14 scenario 3 |
| R62913-2-3-045 | Within the smart home it is possible to provide alarms related to the smart home electricity behaviour to the resident/client | Table B.4<br>Table B.15 |
| R62913-2-3-046 | It is possible that neither the CEM nor the DEM receive the price schedule of the electricity supply tariff | Table B.5<br>Table B.10 |
| R62913-2-3-047 | It is possible that the smart home doesn't receive the exact price associated to the supplier index but just a price level information given with the index | Table B.5<br>Table B.10 |
| R62913-2-3-048 | Emergency signals are sent by the grid operator when the grid operator identifies an emergency situation on the grid | Table B.9<br>Table B.16 |
| R62913-2-3-049 | Within the smart home it is possible to receive a new emergency signal during an ongoing emergency period. New emergency signal is considered by the smart home as the starting of a new emergency event. | Table B.9<br>Table B.16 |
| R62913-2-3-050 | Within the smart home the resident/client of the smart home is informed of the reception of emergency signals and emergency messages through the UI | Table B.9<br>Table B.16 |
| R62913-2-3-051 | When an emergency signal is received, resident/client customization is taken into account in order to prioritize the usages regarding the resident/client preferences when defining the load strategy in emergency situation | Table B.9<br>Table B.16 |
| R62913-2-3-052 | After the reception of emergency signals, the smart home defines and carries out an emergency load management strategy | Table B.9<br>Table B.16 |
| R62913-2-3-053 | If it has the capability to establish an anticipation strategy and if an emergency message is received, the smart home is able to anticipate its electricity consumption by adapting loads | Table B.9<br>Table B.16 |
| R62913-2-3-054 | Smart home is able to switch off or automatically adapt loads during an emergency period | Table B.9<br>Table B.16 |
| R62913-2-3-055 | Smart home is able to switch back on loads if needed after an emergency period | Table B.9<br>Table B.16 |
| R62913-2-3-056 | It is not possible for the resident/client of the smart home to opt-out of the smart home emergency signals responses | Table B.9<br>Table B.16 |
| R62913-2-3-057 | Price incentives are<br>– dynamic peak periods,<br>– fixed peaks,<br>– other suppliers index changes, or<br>– peak or index changes notifications<br>Price incentives are price levels | Table B.5<br>Table B.10<br>Table B.8<br>Table B.17 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-058 | It is possible that a dynamic peak period includes one or many price periods therefore possible index changes | Table B.5<br>Table B.10<br>Table B.8<br>Table B.17 |
| R62913-2-3-059 | A peak period has a finite duration | Table B.5<br>Table B.10<br>Table B.8<br>Table B.17 |
| R62913-2-3-060 | DR request is applied on a period of time<br>DR request is either<br>– a single flexibility request message with a start of a period and a duration, or<br>– a couple of flexibility request messages, the first one with the indication of the beginning of the period of time the second one with the indication of the end of the period, or<br>– a flexibility notification | Table B.5<br>Table B.8<br>Table B.11<br>Table B.18 |
| R62913-2-3-061 | It is possible for the flexibility operator to send a flexibility notification.<br>If a flexibility notification is sent, it is associated to a future DR request | Table B.5<br>Table B.8<br>Table B.11<br>Table B.18 |
| R62913-2-3-062 | It is possible not to associate any starting date or estimated ending date to the emergency signal sent on the grid and received through the internal smart metering gateway | Table B.9<br>Table B.16 |
| R62913-2-3-063 | It is possible for the grid operator to send an emergency message before an emergency signal | Table B.9<br>Table B.16 |
| R62913-2-3-064 | Electricity data of the smart home is data related to the electricity behaviour of the smart home (at least global electricity data of smart meter sent through the internal smart metering gateway) | Table B.4<br>Table B.14 |
| R62913-2-3-065 | Electricity data of the smart building is data related to the electricity behaviour of the smart building (at least global electricity data of smart meter sent through the internal smart metering gateway) | Table B.7<br>Table B.21 |
| R62913-2-3-066 | Smart metering is able to receive timed actions to be executed in order to announce a dynamic peak period | Table B.10<br>Table B.17 |
| R62913-2-3-067 | Price incentives and change of electricity supplier index are received through the internal SMG | Table B.2<br>Table B.5<br>Table B.10<br>Table B.8<br>Table B.17 |
| R62913-2-3-068 | DR request and flexibility notifications are received through the smart grid connection point (that is to say the internal smart metering gateway or the EMG) | Table B.2<br>Table B.5<br>Table B.11<br>Table B.8<br>Table B.18 |
| R62913-2-3-069 | Global electricity data is sent collected through the internal smart metering gateway or through the external smart metering gateway | Table B.4<br>Table B.14<br>Table B.7<br>Table B.21 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-070 | Within the smart home and within the smart building, the global electricity data is collected via the internal smart metering gateway | Table B.4<br>Table B.14<br>Table B.7<br>Table B.21 |
| R62913-2-3-071 | Within the smart home and within the smart building, it is possible to receive external data through the smart grid connection point (that is to say the EMG or the internal smart metering gateway) | Table B.6<br>Table B.7<br>Table B.4<br>Table B.14<br>Table B.21<br>Table B.23 |
| R62913-2-3-072 | Emergency signals are received through the internal smart metering gateway | Table B.9<br>Table B.16 |
| R62913-2-3-073 | It is possible to receive an emergency message through the smart grid connection point | Table B.9<br>Table B.16 |
| R62913-2-3-074 | Within the smart home the CEM sends the load management strategy actions and the emergency load management strategy actions to the DEM in order to be executed | Table B.10 step 4.2<br>Table B.10 step 5.2<br>Table B.10 step 6.2<br>Table B.10 step 7.2<br>Table B.11 step 3.2<br>Table B.11 step 4.2<br>Table B.11 step 5.3<br>Table B.11 step 6.2<br>Table B.12 step 1.14<br>Table B.12 step 1.32<br>Table B.13 step 1.18<br>Table B.16 scenario 1<br>Table B.16 scenario 2 |
| R62913-2-3-075 | Within the smart home the CEM sends an alarm message on the channel customized by the resident/client when the event that the client has specified occurs | Table B.13 scenario 1<br>Table B.15 scenario 1 |
| R62913-2-3-076 | Within the smart home the CEM understands price incentives | Table B.5<br>Table B.10<br>Table B.13 |
| R62913-2-3-077 | Within the smart home the CEM understands DR request | Table B.5<br>Table B.11<br>Table B.13 |
| R62913-2-3-078 | Within the smart home the CEM understands smart metering data sent through the internal smart metering gateway | Table B.4<br>Table B.5<br>Table B.10<br>Table B.11<br>Table B.14<br>Table B.9<br>Table B.16 |
| R62913-2-3-079 | Within the smart home the CEM understands emergency signals | Table B.16<br>Table B.16 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-080 | Within the smart home the CEM understands DEM status | Table B.10<br>Table B.11<br>Table B.13<br>Table B.16 |
| R62913-2-3-081 | Within the smart home the DEM understands smart metering data sent through the internal smart metering gateway | Table B.10<br>Table B.14 |
| R62913-2-3-082 | Within the smart home the DEM understands CEM orders and queries | Table B.10<br>Table B.12 scenario 1<br>Table B.11<br>Table B.13<br>Table B.16 |
| R62913-2-3-083 | The smart meter implements a combination of meter-related functions from the smart metering reference architecture | Table B.2<br>Table B.5<br>Table B.10<br>Table B.9<br>Table B.16<br>Table B.4<br>Table B.14<br>Table B.8<br>Table B.17<br>Table B.7<br>Table B.21 |
| R62913-2-3-084 | The smart meter implements metrology functions including the conventional meter display (register or index) | Table B.2<br>Table B.5<br>Table B.10<br>Table B.9<br>Table B.16<br>Table B.4<br>Table B.14<br>Table B.8<br>Table B.17<br>Table B.7<br>Table B.21 |
| R62913-2-3-085 | Within the smart home the internal smart metering gateway implements the communication functions between the smart metering and the smart home | Table B.2<br>Table B.5<br>Table B.10<br>Table B.11<br>Table B.9<br>Table B.16<br>Table B.4<br>Table B.14 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-086 | The external smart metering gateway implements the communication functions between the smart grid and the smart meter | Table B.2<br>Table B.5<br>Table B.9<br>Table B.10<br>Table B.16<br>Table B.4<br>Table B.14<br>Table B.8<br>Table B.17<br>Table B.7<br>Table B.21<br>Table B.23 |
| R62913-2-3-087 | Within the smart home the CEM establishes the load management strategy and emergency load management strategy | Table B.10<br>Table B.11<br>Table B.12<br>Table B.13<br>Table B.16 |
| R62913-2-3-088 | Within the smart home the CEM has the processing ability to enhance global electricity data with external data | Table B.14 scenario 2<br>Table B.14 scenario 3 |
| R62913-2-3-089 | Within the smart home the CEM has the processing ability to enhance global electricity data with specific data within the smart home | Table B.14 scenario 1<br>Table B.14 scenario 2 |
| R62913-2-3-090 | Within the smart home the CEM monitors the occurrence of events | Table B.13 scenario 1<br>Table B.15 step 1.1 |
| R62913-2-3-091 | Within the smart home the DEM implements the functions adapting the operations of an electrical device depending on incoming orders, resident/client customization and potential opt-outs that may be manually done locally | Table B.10<br>Table B.11<br>Table B.12<br>Table B.13<br>Table B.16 |
| R62913-2-3-092 | Within the smart home the DEM shall carry out instructions | Table B.10<br>Table B.12<br>Table B.11<br>Table B.13<br>Table B.16 |
| R62913-2-3-093 | Within the smart home, it is possible to have information capability of the appliances, that is to say it is possible for the DEM to communicate its status. | Table B.10<br>Table B.11<br>Table B.13<br>Table B.16 |
| R62913-2-3-094 | Within the smart home the EMG implements the communications functions between the HAN and the WAN | Table B.16 scenario 2<br>Table B.14<br>Table B.15<br>Table B.11 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-095 | Within the smart home a direct communication between CEM and DEM exists | Table B.2<br>Table B.10 step 3.7<br>Table B.10 step 3.9<br>Table B.10 step 4.2<br>Table B.10 step 5.2<br>Table B.10 step 6.2<br>Table B.10 step 7.2<br>Table B.11 step 1.6<br>Table B.11 step 1.7<br>Table B.11 step 3.2<br>Table B.11 step 4.2<br>Table B.11 step 5.3<br>Table B.11 step 6.2<br>Table B.12 step 1.14<br>Table B.12 step 1.26<br>Table B.12 step 1.32<br>Table B.13 step 1.18<br>Table B.16 scenario 1<br>Table B.16 scenario 2 |
| R62913-2-3-096 | Within the smart home a direct communication between CEM and UI is possible | Table B.2<br>Table B.10 step 1.6<br>Table B.10 step 4.7<br>Table B.10 step 5.3<br>Table B.10 step 6.4<br>Table B.10 step 7.4<br>Table B.11 step 2.5<br>Table B.11 step 4.4<br>Table B.11 step 5.5<br>Table B.11 step 6.4<br>Table B.12 step 1.2<br>Table B.12 step 1.5<br>Table B.12 step 1.10<br>Table B.12 step 1.19<br>Table B.12 step 1.24<br>Table B.12 step 1.30<br>Table B.13 step 1.2<br>Table B.13 step 1.5<br>Table B.13 step 1.15<br>Table B.13 step 1.20<br>Table B.16 scenario 1<br>Table B.16 scenario 2<br>Table B.15 step 1.3<br>Table B.14 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-097 | Within the smart home a direct communication between DEM and UI is possible | Table B.2<br>Table B.10 step 2.6<br>Table B.10 step 4.4<br>Table B.10 step 5.7<br>Table B.10 step 6.7<br>Table B.10 step 7.7<br>Table B.11 step 3.7<br>Table B.11 step 4.7<br>Table B.11 step 5.8<br>Table B.11 step 6.7<br>Table B.11 step 7.5<br>Table B.13 step 2.2<br>Table B.13 step 2.5<br>Table B.13 step 2.10<br>Table B.13 step 2.14<br>Table B.16 scenario 1<br>Table B.16 scenario 2 |
| R62913-2-3-098 | Within the smart home a direct communication between internal smart metering gateway and DEM is possible | Table B.2<br>Table B.10 step 2.2<br>Table B.11 step 2.1<br>Table B.11 step 7.1<br>Table B.14 step 2.5 |
| R62913-2-3-099 | Within the smart home a direct communication between internal smart metering gateway and CEM exists | Table B.10<br>Table B.11<br>Table B.14 |
| R62913-2-3-100 | Within the smart home a direct communication between internal smart metering gateway and UI exists | Table B.16<br>Table B.14 |
| R62913-2-3-101 | Within the smart home the smart metering shall communicate through an internal smart metering gateway to which it is directly connected | Table B.2<br>Table B.10 step 1.1<br>Table B.10 step 2.1<br>Table B.10 step 3.1<br>Table B.11 step 2.1<br>Table B.11 step 7.1<br>Table B.9<br>Table B.16<br>Table B.14 step 1.1<br>Table B.14 step 1.3<br>Table B.14 step 2.1<br>Table B.14 step 3.1 |
| R62913-2-3-102 | Smart home has a smart meter | Table B.2<br>Table B.10<br>Table B.9<br>Table B.16<br>Table B.4<br>Table B.14 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-103 | The smart metering shall communicate with the smart grid through an external smart metering gateway to which the smart metering is directly connected with a bidirectional link | Table B.2<br>Table B.5<br>Table B.4<br>Table B.9<br>Table B.10 step 1.1<br>Table B.10 step 2.1<br>Table B.10 step 3.1<br>Table B.16<br>Table B.14 step 1.4<br>Table B.8<br>Table B.7<br>Table B.17<br>Table B.21 |
| R62913-2-3-104 | Within the smart home a direct communication from internal smart metering gateway to EMG is possible | Table B.14 |
| R62913-2-3-105 | Within the smart home a direct communication between EMG and CEM is possible | Table B.2<br>Table B.11 scenario 1<br>Table B.16 scenario 2<br>Table B.15 step 1.5<br>Table B.14 step 2.11<br>Table B.14 step 2.13 |
| R62913-2-3-106 | Within the smart home a direct communication between EMG and DEM is possible | Table B.2 |
| R62913-2-3-107 | Within the smart home a direct communication between EMG and UI is possible | Table B.2<br>Table B.15<br>Table B.16 scenario 2 |
| R62913-2-3-108 | The EMG of the smart home is connected to the WAN | Table B.16 scenario 2<br>Table B.14 |
| R62913-2-3-109 | Within the smart building the BEM sends the load management strategy actions and actions to the DEM in order to be executed | Table B.17<br>Table B.18<br>Table B.19<br>Table B.20<br>Table B.23 |
| R62913-2-3-110 | Within the smart building the BEM sends an alarm message on the channel customized by the client/energy manager when the event that the client has specified occurs | Table B.20<br>Table B.22 |
| R62913-2-3-111 | Within the smart building the BEM understands price incentives | Table B.8<br>Table B.17<br>Table B.20 |
| R62913-2-3-112 | Within the smart building the BEM understands DR request | Table B.8<br>Table B.18<br>Table B.20 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-113 | Within the smart building the BEM understands smart metering data sent through the internal smart metering gateway | Table B.8<br>Table B.7<br>Table B.17<br>Table B.18<br>Table B.21<br>Table B.23 |
| R62913-2-3-114 | Within the smart building the BEM understands DEM status | Table B.17<br>Table B.18<br>Table B.20 |
| R62913-2-3-115 | Within the smart building the DEM understands smart metering data sent through the internal smart metering gateway | Table B.17<br>Table B.21 |
| R62913-2-3-116 | Within the smart building the DEM understands BEM orders and queries | Table B.17<br>Table B.19<br>Table B.18<br>Table B.20<br>Table B.23 |
| R62913-2-3-117 | Within the smart building the internal smart metering gateway implements the communication functions between the smart metering and the smart building | Table B.8<br>Table B.7<br>Table B.17<br>Table B.18<br>Table B.21<br>Table B.23 |
| R62913-2-3-118 | Within the smart building the BEM establishes the load management strategy | Table B.17<br>Table B.18<br>Table B.19<br>Table B.20<br>Table B.23 |
| R62913-2-3-119 | Within the smart building the BEM has the processing ability to enhance global electricity data with external data | Table B.21 |
| R62913-2-3-120 | Within the smart home the BEM has the processing ability to enhance global electricity data with specific data within the smart building | Table B.21 scenario 1<br>Table B.21 scenario 2 |
| R62913-2-3-121 | Within the smart building the BEM monitors the occurrence of events | Table B.20<br>Table B.22 |
| R62913-2-3-122 | Within the smart building the DEM implements the functions adapting the operations of an electrical device depending on incoming orders, client/energy manager customization and potential opt-outs that may be manually done locally | Table B.17<br>Table B.18<br>Table B.19<br>Table B.20<br>Table B.23 |
| R62913-2-3-123 | Within the smart building the DEM carries out instructions | Table B.17<br>Table B.19<br>Table B.18<br>Table B.20<br>Table B.23 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-124 | Within the smart building, it is possible to have information capability of the appliances, that is to say it is possible for the DEM to communicate its status | Table B.17<br>Table B.18<br>Table B.20<br>Table B.23 |
| R62913-2-3-125 | Within the smart building the EMG implements the communications functions between the LAN and the WAN | Table B.18<br>Table B.21<br>Table B.22<br>Table B.23 |
| R62913-2-3-126 | Within the smart building a direct communication between BEM and DEM is possible | Table B.17<br>Table B.18<br>Table B.19<br>Table B.20<br>Table B.23 |
| R62913-2-3-127 | Within the smart building a direct communication between BEM and UI is possible | Table B.17<br>Table B.18<br>Table B.19<br>Table B.20<br>Table B.21<br>Table B.22<br>Table B.23 |
| R62913-2-3-128 | Within the smart building a direct communication between DEM and UI is possible | Table B.17<br>Table B.18<br>Table B.20<br>Table B.23 |
| R62913-2-3-129 | Within the smart building a direct communication between internal smart metering gateway and DEM is possible | Table B.17<br>Table B.18<br>Table B.21 |
| R62913-2-3-130 | Within the smart building a direct communication between internal smart metering gateway and BEM is possible | Table B.17<br>Table B.18<br>Table B.21<br>Table B.23 |
| R62913-2-3-131 | Within the smart building a direct communication between internal smart metering gateway and UI is possible | Table B.21 |
| R62913-2-3-132 | Within a smart building the smart metering shall communicate through an internal smart metering gateway to which it is directly connected | Table B.17<br>Table B.18<br>Table B.21<br>Table B.23 |
| R62913-2-3-133 | Smart building has a smart meter | Table B.8<br>Table B.7<br>Table B.17<br>Table B.21<br>Table B.23 |
| R62913-2-3-134 | Within the smart building a direct communication from internal smart metering gateway to EMG is possible | Table B.21 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-135 | Within the smart building a direct communication between EMG and BEM is possible | Table B.18<br>Table B.21<br>Table B.22<br>Table B.23 |
| R62913-2-3-136 | Within the smart building a direct communication between EMG and DEM is possible | |
| R62913-2-3-137 | Within the smart building a direct communication between EMG and UI is possible | Table B.22 |
| R62913-2-3-138 | The EMG of the smart building is connected to the WAN | Table B.21<br>Table B.23 |
| R62913-2-3-139 | Within the smart building a direct communication between BEM and CI is possible | Table B.23 |
| R62913-2-3-140 | Smart building offers energy consumption adaption mechanisms following the reception of market signals (price incentives or DR requests) received through the smart grid connection point | Table B.8<br>Table B.17<br>Table B.18 |
| R62913-2-3-141 | It is possible to have an anticipation capability within the smart building | Table B.8<br>Table B.17 seq diag 2/6<br>Table B.17 seq diag 3/6<br>Table B.18 seq diag 2/6<br>Table B.18 seq diag 3/6 |
| R62913-2-3-142 | If the smart building has the capability to establish an anticipation strategy, the smart building offers mechanisms to optimize the energy bill through anticipation of a dynamic peak period and price levels sent by the electricity supplier through the grid | Table B.8<br>Table B.17 seq diag 2/6<br>Table B.17 seq diag 3/6 |
| R62913-2-3-143 | If it has the capability to establish an anticipation strategy, the smart building anticipates electricity consumption by adapting loads before a peak and depending on the price levels of the next day | Table B.8<br>Table B.17 seq diag 2/6<br>Table B.17 seq diag 3/6 |
| R62913-2-3-144 | After the reception of price incentives or DR requests or flexibility notifications or customization modification or opt-outs, or local data transmitted by context information function, or external data that can have an impact on its process, the smart building defines and carries out load management strategy to take into account price incentives, DR requests, flexibility notifications as well as resident's customization and possible opt-outs | Table B.8<br>Table B.17<br>Table B.18<br>Table B.19<br>Table B.20<br>Table B.23 |
| R62913-2-3-145 | Price incentives, DR requests, flexibility notifications, external data that can have an impact on its process received by the smart building as well as resident's customization and possible opt-outs and local data transmitted by context information function are taken in account to adapt the load management strategy of the smart home | Table B.8<br>Table B.17<br>Table B.18<br>Table B.19<br>Table B.20<br>Table B.23 |
| R62913-2-3-146 | Smart building is able to switch off or automatically adapt loads during a peak period | Table B.8<br>Table B.17 |
| R62913-2-3-147 | Smart building is able to switch back on loads if needed after a peak period | Table B.8<br>Table B.17 |
| R62913-2-3-148 | If it has the capability to establish an anticipation strategy, the smart building is able to anticipate electricity consumption by adapting loads after the reception of a coming flexibility notification | Table B.8<br>Table B.18 seq diag 2/6<br>Table B.18 seq diag 3/6 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-149 | Smart building is able to switch off or automatically adapt loads during a DR request period | Table B.8<br>Table B.18 |
| R62913-2-3-150 | Smart building is able to define and carry out a load management strategy by switching back on loads if needed at the end of the DR request period | Table B.8<br>Table B.18 |
| R62913-2-3-151 | Smart building gives its energy manager the capability to opt-out of a planned automatic response after receiving a notification | Table B.8<br>Table B.17 seq diag 2/6<br>Table B.18 seq diag 2/6<br>Table B.19 |
| R62913-2-3-152 | Smart building gives its energy manager the capability to opt-out of an occurring automatic response during the execution of the automatic response that results from a price incentive or a DR request | Table B.8<br>Table B.17 seq diag 4/6<br>Table B.18 seq diag 4/6<br>Table B.19 |
| R62913-2-3-153 | Smart building gives its resident the capability to opt-out over different scopes (the whole smart building, one or several areas, one or several uses, one or several appliances) | Table B.8<br>Table B.17 seq diag 2/6<br>Table B.18 seq diag 2/6<br>Table B.17 seq diag 4/6<br>Table B.18 seq diag 4/6<br>Table B.19 |
| R62913-2-3-154 | Smart building gives its energy manager the capability to opt-out totally from the demand | Table B.8<br>Table B.17 seq diag 2/6<br>Table B.18 seq diag 2/6<br>Table B.17 seq diag 4/6<br>Table B.18 seq diag 4/6<br>Table B.19 |
| R62913-2-3-155 | Smart building gives its energy manager the capability to opt-out from the demand at a given level | Table B.8<br>Table B.17 seq diag 2/6<br>Table B.18 seq diag 2/6<br>Table B.17 seq diag 4/6<br>Table B.18 seq diag 4/6<br>Table B.19 |
| R62913-2-3-156 | The client/energy manager is given a way to check the current or planned status of his or her appliances | Table B.19 |
| R62913-2-3-157 | The client/energy manager is given a way to opt out as many times as he or she wants | Table B.19 |
| R62913-2-3-158 | The client/energy manager of the smart building is given a way to opt-out via a UI connected to the BEM | Table B.19 |
| R62913-2-3-159 | The client/energy manager is given a way to modify a current or planned opt-out | Table B.19 |
| R62913-2-3-160 | Within the smart building the client/energy manager is given the possibility to monitor the occurrence of events according to his or her preferences. | Table B.6<br>Table B.20<br>Table B.7<br>Table B.22 |
| R62913-2-3-161 | Within the smart building the client/energy manager is given the possibility specify events he or she wants to track and the related channel to be used to send the associated warning message | Table B.6<br>Table B.20 |

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| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-162 | Smart building gives its client/energy manager the capability to customize over different scopes (the whole smart building, one or several areas, one or several uses, one or several equipment) | Table B.6<br>Table B.20 |
| R62913-2-3-163 | Within the smart building the client/energy manager is given a way to customize his or her appliances' automatic responses | Table B.6<br>Table B.20 |
| R62913-2-3-164 | Smart building gives its client/energy manager the capability to define and apply the customization over different timescales: price periods, standard day, standard week, standard season, use, appliances time slot, … | Table B.6<br>Table B.20 |
| R62913-2-3-165 | Within the smart building the client/energy manager is given a way to customize depending on the type of price incentives | Table B.6<br>Table B.20 |
| R62913-2-3-166 | The client/energy manager of the smart building is given a way to customize via a UI connected to the BEM or DEM | Table B.6<br>Table B.20 |
| R62913-2-3-167 | The client/energy manager is given the possibility to customize the behaviour of the smart building as many times as he or she wants | Table B.6<br>Table B.20 |
| R62913-2-3-168 | The client/energy manager is given a way to modify a current or planned customization | Table B.6<br>Table B.20 |
| R62913-2-3-169 | Smart building gives its client/energy manager the capability to customize the behaviour of the smart building at any time | Table B.6<br>Table B.20 |
| R62913-2-3-170 | Within the smart building it is possible for the client/energy manager to read the current customization | Table B.6<br>Table B.20 |
| R62913-2-3-171 | Within the smart building a notification is sent to the client/energy manager to confirm a customization has been taken in account | Table B.6<br>Table B.20 |
| R62913-2-3-172 | It is possible to make smart building's electricity data available locally | Table B.7<br>Table B.21 scenario 2<br>Table B.21 scenario 3 |
| R62913-2-3-173 | It is possible to make smart building's electricity data available externally | Table B.6<br>Table B.7<br>Table B.21 scenario 1 |
| R62913-2-3-174 | It is possible to enhance the smart building electricity data with local data of the smart building | Table B.7<br>Table B.21 scenario 1<br>Table B.21 scenario 2 |
| R62913-2-3-175 | It is possible to enhance the smart building electricity data with external data | Table B.7<br>Table B.21 scenario 3 |
| R62913-2-3-176 | Within the smart building it is possible to provide alarms related to the smart building electricity behaviour to the client/energy manager | Table B.7<br>Table B.22 |
| R62913-2-3-177 | It is possible that neither the BEM nor the DEM have the capability to get the price schedule of the electricity supply tariff | Table B.8<br>Table B.17 |
| R62913-2-3-178 | It is possible that the smart building doesn't receive the exact price associated to the supplier index but just a price level information given with index | Table B.8<br>Table B.17 |
| R62913-2-3-179 | Within a smart building it is possible to get local data transmitted by context information function | Table B.23 |
| R62913-2-3-180 | Within a smart building the building resident is given the possibility to customize the behaviour of the smart building according to the right the energy manager has granted him or her | Table B.20 |

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#### 5.3.2 Other requirements

##### 5.3.2.1 External business rules (grid codes, market rules)

The smart home needs to comply with the connection codes and, in case of including distributed generator or storage, with requirements for generator connected to the grid.

##### 5.3.2.2 Performances

According to the grid codes and the operational security, the emergency response of the smart home shall operate in less than 10 minutes.

## 6 Energy storage

### 6.1 Purpose and scope

#### 6.1.1 Clause objective

The intention of Clause 6 is to present a business analysis of the energy storage domain, and more specifically to describe the smart grid requirements of the domain using the Use Case approach as defined in IEC SRD 62913-1.

This analysis is based on the inputs from domain experts as well as existing materials on energy storage in a smart grid environment.

The domain deals with electrical energy storage (EES) and its associated systems, which store energy using different mechanical, chemical, or electrical technologies but which can convert that stored energy into electricity. The EES domain covers only grid-connected energy storage systems, including connections at HV, MV, and LV power system levels. The only exception is electric vehicle batteries, since these are covered in a different domain. The EES connected at the MV and LV power system levels are also covered by the DER use cases described in Clause 4.

Energy storage systems which are in the scope of the EES domain include:

- battery storage systems including utility-scale EES connected to the MV power system (except inside electric vehicles);
- pumped hydro storage systems;
- compressed air storage systems;
- capacitor storage systems;
- EES within hybrid energy storage and renewable energy systems such as PV plus battery storage;
- EES management systems.

The different applications of energy storage and the associated services that can be delivered to various actors of the electric power system are in the scope of the analysis. However, the description of the business processes that can be optimized using energy storage are not included in this document and will be covered by the relevant domains.

#### 6.1.2 General context

##### 6.1.2.1 General

Two characteristics of electricity lead to general issues in its use, and by the same token generate the regulatory and market requirements for safety, reliability and flexibility.

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First, electricity is consumed virtually at the same time as it is generated. The proper amount of electricity must always be provided to meet the varying demand. An imbalance between electricity supply and demand may cause the grid to become unstable, unsafe and unreliable, while poor power quality (voltage and frequency) may affect consumer equipment. Flexibility is needed to keep the system in balance.

Second, power lines must be used to connect electricity production and electricity consumption. Usually the sites where electricity is generated may be located far from the locations where it is consumed. Generators and consumers are connected through power grids and form a power system. Power lines may become congested thus limiting the amount of power they can carry. Power lines may even fail due to equipment failures or natural disasters. This may cause power outages for all consumers relying on those power lines.

To deal with the variability of demand and generation – increased by the development of renewable energy sources – and congestions, different types of flexibilities may be needed, including flexibility in managing generation, consumption, and storage. The stakes are to develop new flexibility capacities in a cost-efficient way from a system perspective. Electrical energy storage is one of several ways to provide such flexibility. Its use will be based on its cost-efficiency compared to other solutions.

#### 6.1.2.2 Emerging trends in the electricity sector

##### 6.1.2.2.1 General

There are two major emerging trends in the electricity sector: renewable energy integration and smart grid revolution.

##### 6.1.2.2.2 Renewable energy integration

As previously indicated, the increased ratio of renewable generation may cause several issues in the power grid. First, in power grid operation, the fluctuation in the output of renewable generation makes system frequency control difficult, and if the frequency deviation becomes too wide system operation can deteriorate. Conventionally, frequency control is mostly managed by changing the power output of bulk power generators, which are often fossil fuel generators. When used for this purpose thermal generators are not operated at full capacity, but with some positive and negative power output margin (i.e. increases and decreases in output), which may be used to adjust frequency. If additional "spinning reserve" is needed, this might imply ensuring that some thermal generators must be available for fast response, which could lead to less than optimal operation of these generators. With greater penetration of renewable generation this output margin would need to be increased, which could decrease the efficiency of thermal generation even more. Renewable generation units themselves in most cases only supply a negative margin.

Secondly, renewable energy output from solar and wind sources may fluctuate in undependable manners, since it is affected by weather conditions. Some measures are available to cope with this. When renewable sources are only a small percentage of the overall generation, they can just be treated as negative load which also fluctuates and can be accommodated by the existing power systems. However, as renewable energy sources become a larger percentage of the overall generation, they must increasingly be monitored and controllable, so that even with undependability the power can be managed. Another concept is to spread the installations of renewable generators over a wide area, to take advantage of weather conditions changing from place to place and of smoothing effects expected from the complementarities of wind and solar generators. Nonetheless, these measures may not be enough to manage local fluctuations from renewable sources (particularly in power systems with North American style LV systems), and may require the extension of transmission power lines and the enhancements of distribution power lines and substations to cope with larger fluctuations.

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Considering the cost of constructing new power lines and substation facilities, new technologies such as EES are expected as promising alternative technologies, deferring such construction costs for a few years, if not avoiding them altogether.

#### 6.1.2.2.3 Smart grid and DER systems

In the electricity sector, the impacts and benefits of DER systems within the smart grid may create new technology challenges as new regulations require more sophisticated interactions with large numbers of DERs, and as market opportunities allow new players to enter this past "closed" bulk power energy market with new perspectives.

First, autonomous actions by DER systems at customer-sites can be utilized to control power flow and further maintain grid stability. One example is the use of DER systems to provide volt-var and volt-watt control to stabilize voltage levels.

Secondly, the use of a customer energy management system (CEMS) can automate responses in homes and buildings to the cost of power or the opportunities to provide ancillary services to the grid. Customers can become actively involved by letting the CEMS modify their energy usage patterns by monitoring and changing their actual consumption in real time.

EES has been used and is expected to accelerate the trends described above. Specific applications and relevant business services of EES are introduced in 6.2.

## 6.2 Business analysis

### 6.2.1 General overview

Market needs for EES have been extended from conventional ones raised from general characteristics of electricity to emerging trends due to the massive installation of renewable energy and EES relevant smart grid applications, as described in 6.1.2.2.

In 6.2, the services to utilize EES and their associated business that can be described in business Use Cases) delivered by EES operators are briefly described. These services have been identified through the research on Use Cases and discussion about business applications that exist in the electricity sector.

NOTE The services identified are a first set. This document will not limit the creation and promotion of new business models using EES and its necessary standardization in future.

### 6.2.2 EES grid services

#### 6.2.2.1 Overview of EES grid services

Table 14 identifies some of the key EES services, usually required by aggregating many EES and other DERs.

**Table 14 – Identified EES services**

| Identified services | Sub-domain |
|---|---|
| Energy shifting | Bulk energy services |
| Peak shaving | Bulk energy services |
| Load following | Bulk energy services |
| Frequency regulation | Balancing services |
| Operating reserves | Balancing services |
| Voltage support | Balancing services |
| Black start capabilities | Balancing services |

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| Identified services | Sub-domain |
|---|---|
| Improve grid stability | Customer energy management services |
| Islanding | Customer energy management services |

Through the researches and identifications of EES relevant services, the following points have been identified.

- An EES can be used for not only an individual purpose but for multiple applications as well (e.g. pumped hydro for frequency regulation and black start, etc.). Furthermore, the combination of different services which could be offered to several actors of the electric power system may even increase the cost-effectiveness of EESs while taking full advantage of their technical possibilities. Some services could be delivered simultaneously or in a sequential manner.
- EESs can be used to deliver many business services; however, they are not always as cost efficient as conventional technologies or solutions (e.g. for load following, the efficiency and cost of EES may be worse than conventional power generation plants due to the technical difficulty in, for example, duration of EES uses).
- As previously stated, storage can be considered as a type of flexibility like demand or generation. Multiple geographically dispersed EESs may be aggregated by market players to provide flexibilities to the system.
- The efficiency and relevant cost of an EES depends on its technical characteristics (power, capacity, …) and the circumstances, especially the EES location in a power system (e.g. for voltage support, the location of the EES should be well studied).

Figure 8 illustrates the domains, services and roles of market players within EES relevant markets. In general, the electricity sector consists of several domains including generation, distributed energy resource, transmission, distribution and customer premises. The services utilizing EES can be also categorized roughly into five domains. Some services are closed in a domain; however, several services are expanded to multiple domains as shown in Figure 8. Further, the roles of market players within EES market can be categorized into five domains as shown in Figure 8. The main impact of smart grid on EES centres on delivering innovative services to various actors of the electric power system through the use of EES.

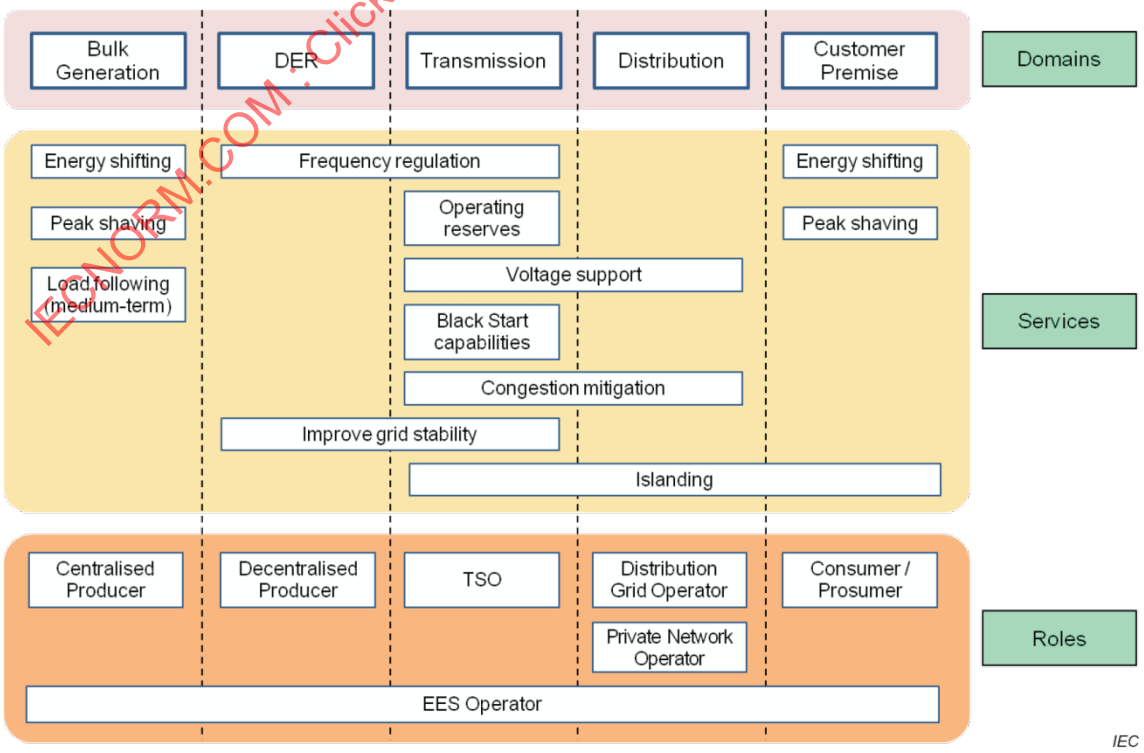


**Figure 8 – EES domains, services and roles**

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#### 6.2.2.2 Bulk energy services

##### 6.2.2.2.1 Energy shifting

An entity responsible for the electricity supply to customers constantly needs to prepare supply capacity to cope with increasing peak demand, and consequently develop power generation plants that produce electricity from primary energy. For some electricity supply retailers, the cost to purchase electricity from the wholesale electricity markets can be reduced by storing electricity at off-peak times, for example at night, and discharging it at peak times. If the gap in demand between peak and off-peak is large, the benefit of storing electricity becomes even larger.

Using EES to decrease the gap between daytime and night-time may allow generation output to become flatter, which leads to an improvement in operating efficiency and cost reduction in fuel. For these reasons many utilities, acting as power generation companies, network companies and electricity retailers, have constructed pumped hydro, and have recently begun installing large-scale batteries at substations.

##### 6.2.2.2.2 Peak shaving

Energy shifting not only allows time shift of energy but also works to reduce the necessity of installing additional facilities. EES can be used to reduce the need to construct power generation plants, mainly oil-fired thermal power which produces a large amount of carbon dioxide, to meet weekday peak demands.

Peak shaving can be also used by customers in order to curtail a part of their invoice that varies according to their highest power demand or if prices are higher during peak hours of the day. This service may be profitable if the peak demand is predictable and of relatively short duration.

##### 6.2.2.2.3 Load following

An entity matches the generation and loads in a power system, or locally, with the support of power generation plants by their steady ramping up or down of generation to follow large load changes throughout a day. EES can be used as an alternative of the power generation plants to carry out load following function.

##### 6.2.2.2.4 Generation following

An entity counteracts fluctuations in renewable generation in a power system, or locally, with the support of power generation plants by their steady ramping up or down of generation to follow these fluctuations. EES can be used as an alternative to the power generation plants to carry out the generation following function.

#### 6.2.2.3 Balancing services

##### 6.2.2.3.1 Frequency regulation

One of the primary responsibilities of network operators is to maintain the power quality of electricity supply. By momentarily matching power generation to demand in a power system, the grid frequency shall be maintained within ranges as regulated by authorities.

Grid-integrated EES charges or discharges electricity for frequency regulation either by direct commands from the balancing authority or through frequency-watt autonomous function. Its output is increased if there is a shortfall in generation. It charges power from a grid when there is a momentary excess of generation.

During emergency conditions if the frequency exceeds high or low limits, the EES can respond very rapidly by either decreasing generation (or increasing charging) or by increasing generation (or decreasing charging).

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#### 6.2.2.3.2 Operating reserves

Operation of electricity grids always needs a certain amount of power capacity which can be available in a short time after power generation plants become unavailable due to unplanned maintenance or troubles. Reserve power can be in the form of either generation or demand reduction to be able to deal with power demand being greater than forecast demand and/or plant unavailability. From its charging and discharging function, EES can be one of the sources for the operating reserves.

There are generally three types of operating reserves as follows.

- Spinning reserve (synchronized) – Spinning reserves are the fastest acting contingency reserve. Generators providing spinning reserves are synchronized to the grid (the turbine is "spinning" but not generating power), allowing the reserve to be provided very quickly.
- Non-spinning reserve (non-synchronized) – Non-spinning reserves are extra generating capacity that is not currently connected to the power system but can be brought online after a short delay.
- Supplemental reserves – Supplemental reserves, on the other hand, are not required to be synchronized to the grid and are a backup capacity for spinning and non-spinning reserves.

#### 6.2.2.3.3 Voltage support

TSOs and DSOs are required to maintain the power supply voltage within ranges specified by authorities. To do this, the operators manage reactance at the grid level by utilizing voltage support resources to offset active or reactive effects. Usually, power generation plants are used to generate reactive power to offset reactance in the grid.

EES can be used as a voltage support resource within the grid by responding according to a volt-var curve or a volt-watt curve.

#### 6.2.2.3.4 Black start capabilities

Black start capabilities are necessary to restore power to grids during a wide-area outage where power supply from the grid will not be available. Normally, so as to provide a black start, diesel generators or hydroelectric power plants are designated as the black start resources.

EES can be another source of black start capabilities, and help network operators during a catastrophic failure of grids by restoring its power.

### 6.2.2.4 Power grid infrastructure congestion services

In a power network, congestion may occur when transmission/distribution lines cannot be reinforced in time to meet increasing power demand or to carry away power produced by generation units (reverse flow). Though the addition of transmission capacity may relieve the congestion, it leads to the increase in cost of transmission/distribution network as well as their access charge.

In this case, EES installed at appropriate sites may mitigate the congestion thanks to the services (energy shifting, peak shaving, load following, generation following). For instance, electricity will be stored when there is no congestion on a power network, and it would be discharged to reduce peak transmission/distribution load and generation capacity requirements. These services thus help network operators to postpone or suspend the reinforcement of the network.

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#### 6.2.2.5 Customer energy management services

##### 6.2.2.5.1 Improve grid stability and reliability

The transmission system performance can be improved by compensating for transient electrical anomalies and disturbances such as voltage sag, unstable voltage, and sub-synchronous resonance. EES may be used for the transmission support in order to help the system become more stable.

Furthermore, high penetration of renewable energy may create grid stability issues in islanded grids. EES could become an important resource to mitigate the instability caused by ramping and variability of the renewable resources.

##### 6.2.2.5.2 Intentional islanding and microgrids

Electricity supply can be maintained even if there is a total loss of power from a power grid due to an area power outage. This service can be delivered with an energy resource which can continuously supply electricity to customer loads within a local power network (intentional island or microgrid).

EESs which effectively support customer loads could be owned by not only customers who control the EES inside their properties but also TSOs and DSOs to be able to minimize the influences of wide-area power outages.

### 6.2.3 List of business Use Cases and business roles of the domain

The business Use Cases listed are a result of the business analysis carried out previously – the list is not exhaustive, and it is likely to grow as new Use Cases come to light. Many of these business Use Cases are similar to those described for DER.

The Use Cases are associated with one or several of the business objectives of the domain, which include: optimize the configuration and development of EES in a cost-efficient way, deliver EES services at best cost, optimise the maintenance of EES in a cost-efficient way.

Table 15 lists the business roles that have been identified so far. This list is not exhaustive.

**Table 15 – Business roles of the domain**

| Business roles | Definition |
|---|---|
| EES operator | An entity who uses EES systems to deliver EES utilizing services such as for bulk power services, residential use, grid use or renewable energy. |
| Flexibility aggregator | A party which aggregates flexibilities for its customers.<br>May activate flexibility sites. |
| Consumer | A party that consumes electricity.<br>Additional information: This is a type of grid user. |
| Distribution system operator | Entity responsible for the planning, operation, maintenance, and the development in given areas of the electricity distribution network (LV, MV, and potentially HV), the quality of electricity supply (power delivery, voltage, etc.) and for customer access to energy supplier-retailer (ESR) market through his or her system under regulated conditions by managing constraints, emergency situations and faults in a cost-efficient way, using operational planning & scheduling and forecasting tools.<br>Equivalent to distribution network operator (DNO) or distribution grid operator.<br>In some countries, the distribution grid operator may also manage the metering system (e.g. France). |
| Grid operator | A party that operates one or more grids. |
| Grid user | A party connected to the grid and consuming and/or producing electricity. Grid users include consumers, producers, and prosumers.<br>Equivalent to Party Connected to the Grid. |

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| Business roles | Definition |
|---|---|
| Private network operator (PNO) | Responsible for operating and managing a private electrical network (e.g. within a building, factory, ...) |
| Producer | A party generating electric energy.<br>Additional information: This is a type of grid user.<br>[SOURCE: IEC 60050-617:2009, 617-02-01] |
| Transmission system operator (TSO) | According to Article 2.4 of the Electricity Directive 2009/72/EC (Directive): "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity". Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.<br>[SOURCE: EU Commission Task Force for smart grids, EG3] |

Table 16 lists and provides a brief description of the business Use Cases that have been identified.

**Table 16 – Identified business Use Cases of the domain**

| Index of the business Use Cases | Identified business Use Cases | Brief description | System Use Case required to enable/execute the business Use Case | Level of maturity |
|---|---|---|---|---|
| UC62913-2-3-B054 | Carry out planned maintenance operations and renewal programmes of the EES | The business Use Case describes how the EES operator manages the daily, weekly, monthly and annually planned EES maintenance programmes and decides to renew its EES systems and install new equipment. | | Already implemented / Adjustments in progress/ explorative |
| UC62913-2-3-B055 | Configure EES to be able to provide services to relevant parties | The business Use Case describes how an EES operator plans and develops an EES system to deliver services to its customer. | | Already implemented / Adjustments in progress/ explorative |
| UC62913-2-3-B056 | Contribute to the efficient integration of intermittent renewable energies in the electric power system | The business Use Case describes how the EES operator delivers services at the request of the producer in order to facilitate the integration of a plant in the electric power system. | • Make measurements at PCC<br>• Compute power reference in real-time<br>• Charge storage<br>• Discharge storage<br>• Make measurements of renewable sources instant power<br>• Perform renewable energy forecasts<br>• Elaborate a charge/discharge schedule | Already implemented / Adjustments in progress/ explorative |
| UC62913-2-3-B057 | Help customers to reduce the cost for purchasing electricity | | | Already implemented / Adjustments in progress/ explorative |

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| Index of the business Use Cases | Identified business Use Cases | Brief description | System Use Case required to enable/execute the business Use Case | Level of maturity |
|---|---|---|---|---|
| UC62913-2-3-B058 | Help power generation companies to reduce their investment | | | Already implemented / Adjustments in progress/ explorative |
| UC62913-2-3-B059 | Help the grid user or the grid operator improve the quality of supply | The business Use Case describes how the EES operator uses an energy storage to help the customer or the distribution grid operator improve the quality and ensure the continuity of supply (via frequency regulation, energizing a non-loopable feeder during an outage, etc.). The EES may be used to avoid load shedding or to compensate for electrical disturbances. | • Make measurements at PCC<br>• Compute power reference in real-time<br>• Charge storage<br>• Discharge storage<br>• Inject reactive power<br>• Consume reactive power<br>• Balance phases<br>• Perform harmonic compensation<br>• Perform black start and act as a voltage source<br>• Synchronize with the grid | Already implemented / Adjustments in progress/ explorative |
| UC62913-2-3-B060 | Make necessary contracts with customers and relevant parties | The business Use Case describes how an EES operator manages the service offer to customers and their contracts. It also covers the access of the EES to a power grid. | | Already implemented / Adjustments in progress/ explorative |
| UC62913-2-3-B061 | Monitor and carry out urgent maintenance of the EES | The business Use Case describes how the EES operator analyses real-time data and decides to carry out urgent maintenance operations to prevent faults – based on the analysis of the EES status through collected data and its indices. | | Already implemented / Adjustments in progress/ explorative |

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### 6.2.4 List of system Use Cases and system roles

#### 6.2.4.1 System Use Cases and system roles of the domain

Table 17 lists the system Use Cases which have been identified so far to enable the business Use Cases described above to operate. The list is not exhaustive and will be updated as new editions of IEC SRD 62913-2-3 are published. Business as usual functions have not been listed.

**Table 17 – Identified system Use Cases of the domain**

| Index of the system Use Cases | Identified system Use Cases |
|---|---|
| UC62913-2-3-S060 | Balance phases |
| UC62913-2-3-S061 | Charge EES |
| UC62913-2-3-S062 | Compute power reference in real-time |
| UC62913-2-3-S063 | Consume reactive power |
| UC62913-2-3-S064 | Couple EES to a grid |
| UC62913-2-3-S065 | Decouple EES from a grid |
| UC62913-2-3-S066 | Determine or defer the EES renewal |
| UC62913-2-3-S067 | Determine the urgent maintenance of EES |
| UC62913-2-3-S068 | Discharge EES |
| UC62913-2-3-S069 | Elaborate a charge/discharge schedule |
| UC62913-2-3-S070 | Establish communication, data collection and monitoring plan |
| UC62913-2-3-S071 | Establish new EES detection and synchronization plan |
| UC62913-2-3-S072 | Establish supervision, operation and control plan |
| UC62913-2-3-S073 | Evaluate and manage the operation results of EES |
| UC62913-2-3-S074 | Examine and evaluate the accumulated data |
| UC62913-2-3-S075 | Examine real-time data |
| UC62913-2-3-S076 | Exchange data with customers |
| UC62913-2-3-S077 | Exchange data with EES operators |
| UC62913-2-3-S078 | Exchange data with T&D network operators |
| UC62913-2-3-S079 | Forecast electricity price |
| UC62913-2-3-S080 | Forecast power demand |
| UC62913-2-3-S081 | Identify and solve communication network constraints |
| UC62913-2-3-S082 | Identify and solve grid coupling constraints |
| UC62913-2-3-S083 | Identify the specification of services to be delivered |
| UC62913-2-3-S084 | Implement scheduled maintenances |
| UC62913-2-3-S085 | Inject reactive power |
| UC62913-2-3-S086 | Make measurements at PCC (f, V) |
| UC62913-2-3-S087 | Make measurements of renewable sources instant power |
| UC62913-2-3-S088 | Monitor and communicate with EES |
| UC62913-2-3-S089 | Perform black start and act as a voltage source |
| UC62913-2-3-S090 | Perform harmonic compensation |
| UC62913-2-3-S091 | Perform renewable energy forecasts |
| UC62913-2-3-S092 | Produce time-stamped events |
| UC62913-2-3-S093 | Store and provide real-time data |
| UC62913-2-3-S094 | Study and determine the necessary specifications of EES |
| UC62913-2-3-S095 | Synchronize information with newly integrated EESs |
| UC62913-2-3-S096 | Synchronize with the grid |

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## 6.3 EES smart grid requirements

### 6.3.1 Smart grid requirements extracted from EES Use Cases

The energy storage requirements in 6.3 have been extracted from the following Use Cases described in Annex B according to the IEC 62559-2 Use Case template.

- Contribute to the efficient integration of intermittent renewable energies in the electric power system (see Table B.24).
- Help the grid user or the grid operator improve the quality of supply (see Table B.25).

It is expected that the IEC core standards will support the EES requirements listed in Table 18.

**Table 18 – Requirements extracted from EES Use Cases**

| Requirement ID | Requirement description | Link to Use Cases |
|---|---|---|
| R62913-2-3-181 | *Functional:* On request by the producer and to make use of unavoidable energy, EES operator provides control power when producer is required to provide ancillary services to system operators, storage is used instead of a voluntary degradation of primary energy. | Table B.24 Narrative |
| R62913-2-3-182 | *Functional:* On request by the producer and to make use of unavoidable energy the EES operator stores energy which cannot be injected to the grid and informs the producer which needed the power limitation. | Table B.24 Narrative |
| R62913-2-3-183 | *NFR:* To make use of unavoidable energy the producer has a contract for energy services with an EES operator and have a real-time communication interface between both entities. | Table B.24 Use Case conditions |
| R62913-2-3-184 | *Functional:* To guarantee a production schedule (capacity firming) the producer elaborates short-term generation forecasts, a production schedule (in day-ahead for instance) based on these forecasts and shall send it to the EES operator. | Table B.24 Narrative |
| R62913-2-3-185 | *Functional:* On request by the producer to guarantee a production schedule, the EES operator uses the storage in real-time operations to reduce the difference between the schedule and real generation output. | Table B.24 Narrative |
| R62913-2-3-186 | *Functional:* Following the detection of a fault, the grid operator manages the reconfiguration of the grid and requests the EES operator to start-up the electrical energy storage. | Table B.25 Narrative |
| R62913-2-3-187 | *Functional:* Suitable procedures are defined between grid operator and EES operator to ensure proper reconnection of the isolated grid powered by the storage to the rest of the network at the end of the power outage event. | Table B.25 Narrative |
| R62913-2-3-188 | *Functional:* On request by the grid operator the EES operator performs active filtering (voltage and harmonic compensation, balancing between phases) through their power conversion systems of their energy storage devices in order for the grid operator to meet its contractual obligations towards its grid user. | Table B.25 Narrative |
| R62913-2-3-189 | *Functional:* On request by a grid user the EES operator performs active filtering (voltage and harmonic compensation, balancing between phases) through their power conversion systems of their energy storage devices in order for the grid user to meet its contractual obligations towards its grid operator. | Table B.25 Narrative |
| R62913-2-3-190 | *NFR:* To perform active filtering, grid user has a contract in place with the EES operator. | Table B.25 Use Case conditions |
| R62913-2-3-191 | *NFR:* To perform active filtering, grid operator has a contract in place with the EES operator. | Table B.25 Use Case conditions |

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### 6.3.2 Other requirements

#### 6.3.2.1 Grid code EES requirements

EES systems should comply with the grid codes which specify technical requirements for grid connection to, and use of, electricity transmission and distribution systems. These grid codes

vary from region to region but are similar to those described in the DER and EES grid services subclauses 4.2.5 and 6.2.2.

#### 6.3.2.2 Performance requirements

For the installations, operations, control, maintenance and other stages in their lifecycle, EES systems need to satisfy the performance requirements in terms of, for example:

- reliability;
- availability;
- maintainability;
- safety.

Also, depending on their application, EES systems should respond very rapidly to discharge or charge electricity – for instance, to secure the electricity supply.

#### 6.3.2.3 Operations, back-up

The operation of EES systems and its associated data should be appropriately monitored and recorded in order to ensure the quality, stability and safety of the EES systems for a long period of time.

#### 6.3.2.4 Security

As with all DER, cyber security of EES systems and associated facilities should be included in all implementations, particularly those exchanging information that affects power system operations.

#### 6.3.2.5 Maintenance

EES systems should be properly maintained in order to maintain their efficiencies and stay ready for on-demand usage.

#### 6.3.2.6 Interoperability

Interoperability of equipment and services are needed for a competitive and open market of EES.

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# Annex A
(informative)

# Links with other TCs and gathered materials

In order to capture smart grid requirements for their domain, the domain's leader needs to establish contact with the technical committees working on topics related to their domain, to gather existing materials (standardization documents, User Stories, Use Cases, and Functional Architectures) and from this starting point coordinate the further work on smart grid requirements.

## A.1 Distributed energy resources

### A.1.1 Identified TCs

Below are listed the relevant TCs working on smart grid requirements of the domain.

- IEC TC 57: Power systems management and associated information exchange
  - WG 17: Power system intelligent electronic device communication and associated data models for distributed energy resources and distribution automation
- TC 8: System aspects of electrical energy supply
  - JWG 10: Distributed energy resources connection with the grid
- TC 65: Industrial-process measurement, control and automation

### A.1.2 Gathered materials

#### A.1.2.1 General

Subclause A.1.2 lists the materials collected and analysed to draft the Use Cases of the domain.

#### A.1.2.2 Existing User Stories

See Table A.1.

**Table A.1 – Existing User Stories**

| Name | Author or organization | Publication date | Source |
|---|---|---|---|
| The user wants to get the laundry done by 8:00 p.m. | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| The user wants to have their Electrical Vehicle charged by 8:00 a.m. | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| The customer wants to sell their own decentralized energy (e.g. PV) to smart grid | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| The customer wants to connect a new smart device to the CEM | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| The consumer wants to be informed on their historic and forecasted energy use | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| The customer wants to know an estimate of the yearly energy cost of smart device | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| The consumer wants a storage device to feed energy to the grid once the tariff reaches a certain threshold | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |

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### A.1.2.3 Existing Use Cases

Over 100 Use Cases have been collected from different sources, including those listed in Table A.2.

**Table A.2 – Existing Use Cases**

| Name | Author or organization | Publication date | Source |
|---|---|---|---|
| | EPRI Intelligrid project (2004-2005) (Nokhum Markushevich, Frances Cleveland) | | |
| | NEDO (Japan, Jim Reilly) | | |
| | SGIP PAP 7 (PJM, Frances Cleveland) | | |
| | CEC Distribution Automation functions (Frances Cleveland) | | |
| | CEC/CPUC Rule 21 Update Inverter Project [identified from EPRI project (Brian Seal) and IEC TR 61850-90-7 (Frances Cleveland)] | | |

### A.1.3 Description of the five-level hierarchical diagram

Today, increasing numbers of DER systems are being interconnected to distribution grids originally designed for one-way flows of power from substations through the grid to customer loads. Distributed generation introduces power generation equipment and two-way power flows at sites dispersed throughout the system; where the source is renewable energy, the generation itself is intermittent. At the same time, these DER systems are owned and operated by entities that generally have other purposes than just grid support. As long as DER penetration remains low, these purposes can be treated by distribution system operators (DSOs) as just variations on load.

However, higher penetrations of DER systems in the distribution systems are causing a paradigm shift in grid management. Direct control of DER by DSOs is neither technically feasible nor contractually acceptable for the thousands if not millions of DER systems interconnected with the distribution power system. At the same time, utilities are responsible for meeting the reliability and electrical requirements within their distribution systems and therefore require information on the locations, capabilities, and operational status of these DER systems. In addition, these DER systems can greatly assist in meeting these utility requirements effectively and efficiently, thus making their owner/operators proactive stakeholders in managing the electric power system.

Information exchange is critical to accommodate these complex and dynamic power system requirements, and management of these information exchanges needs to be organized and interoperable. Specifically, a hierarchical approach is necessary for the various stakeholders (utilities, aggregators, facilities, markets, and DER system operators) to exchange information. At the local level, DER systems generally manage their own generation and storage activities autonomously based on local conditions, pre-established settings, and DER owner preferences. DER systems can also be active participants in power system operations and must be coordinated with other DER systems and distribution equipment. In addition, the DSOs must interact with transmission system operators (TSOs), also known as regional transmission organizations (RTOs) and/or independent system operators (ISOs), for reliability and market purposes. In some regions, retail energy providers, aggregators, or other energy service providers are responsible for managing groups of DER systems either through operational actions or market actions.

This hierarchical approach can be described as hybrid combinations of five levels across multiple domains, as illustrated in the five-level hierarchical DER system architecture shown in Figure 1 and described in 1) to 5) below. The circled numbers in Figure 1 (numbers in brackets in the list below) identify the various logical information exchanges.

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1) Level 1 DER Systems (green in Figure 1) is the lowest level and includes the actual cyber-physical DER systems themselves. These DER systems will be interconnected to local grids at Electrical Connection Points (ECPs) and to the utility grid through the point of common coupling (PCC) (the ECP and the PCC may be the same if the DER is directly grid-connected). These DER systems will usually be operated autonomously. In other words, these DER systems will be running based on local conditions, such as photovoltaic systems operating when the sun is shining, wind turbines operating when the wind is blowing, electric vehicles charging when plugged in by the owner, and diesel generators operating when started up by the customer. This autonomous operation can be modified by DER owner preferences, pre-set parameter, and commands issued by utilities and aggregators. The communication protocols used internally (12) to DER include ModBus®[2], SunSpec Alliance profile for ModBus, and potentially GOOSE. For electric vehicles, IEC 15118 is used between the EV and the charging spot (EVSE).

2) Level 2 Facility DER Management (blue in Figure 1) is the next higher level in which a facility DER management system (FDEMS) manages the operation of the Level 1 DER systems. This FDEMS may be managing one or two DER systems in a residential home, but more likely will be managing multiple DER systems in commercial and industrial sites, such as university campuses and shopping malls. Utilities may also use a FDEMS to handle DER systems located at utility sites such as substations or power plant sites. For utilities, FDEMS are viewed as field systems and shown at the Station level of the SGAM; however, from a facility's point of view, they may be seen as enterprises in their own right, and they could then be shown at the Enterprise and Operations levels. The communication protocols used within a facility (10) are most often proprietary but could include IEC 61850, IEEE 2030.5 (SEP2), and BACnet.

3) Level 3 Third Parties: Aggregator or Retail Energy Provider (red in Figure 1) shows market-based aggregators and retail energy providers (REP) who request or even command DER systems (either through the facility's FDEMS or via aggregator-provided direct communication links) to take specific actions, such as turning on or off, setting or limiting output, providing ancillary services (e.g. volt-var control), and other grid management functions. Aggregator DER commands would likely be price-based either to minimize customer costs or to respond to utility requirements for safety and reliability purposes. The combination of third parties (this level) and facilities (level 2) may have varying configurations, responsibilities, and operational scenarios but, overall, still fundamentally provide the same services. The communication protocols used by aggregators (4, 5) are usually proprietary, but could include OpenADR for market-based interactions or potentially IEC 61850 or IEEE 2030.5 (SEP2) for technical interactions.

4) Level 4 Utility Operational Grid Management (yellow in Figure 1) applies to utility applications that are needed to determine what requests or commands should be issued to which DER systems. Distribution system operators (DSOs) must monitor the distribution power system and assess if efficiency or reliability of the power system can be improved by having DER systems modify their operation. This utility assessment involves many utility control centre systems, orchestrated by the distribution management system (DMS) and including the DER database and management systems (DERMS), geographical information systems (GIS), transmission bus load model (TBLM), outage management systems (OMS), and demand response (DR) systems. Transmission system operators (TSOs), regional transmission operators (RTOs), or independent system operators (ISOs) may interact directly with larger DER systems and/or may request services for the bulk power system from aggregated DER systems through the DSO or through the REP/aggregators. Once the utility has determined that modified requests or commands should be issued, it will send these either directly to a DER system, indirectly through the FDEMS, or indirectly through the REP/aggregator. The communication protocols used for direct control of DER systems (1) are either IEEE 1815 (DNP3) or IEC 61850, while indirect interactions through the facility or plant (2) use either IEC 61850 or IEEE 2030.5 (or in the case of wind plants, IEC 61400). The communication protocols used between the DSO and aggregators (3) may be IEC 61850 or IEEE 2030.5. Internal to the DSO (11), the Common Information Model (CIM) can be used to exchange power system models

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2 ModBus is the trademark of a product supplied by The ModBus Organization. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named.

between applications (IEC 61970) or for messaging between back office systems (IEC 61968). The DSO and TSOs may also exchange information on DER systems (6) using IEC 60870-6 (ICCP).

5) Level 5 Market Operations (purple in Figure 1) is the highest level, and it involves the larger energy environment where markets influence which DER systems will provide what services. The TSO markets are typically bid/offer transaction energy markets between individual DER owner/operators and the TSO. At the distribution level, the markets are not yet well-formed, and, over time as they evolve, they may be based on individual contracts, special tariffs, demand response signalling, and/or bid/offer transaction energy markets. The communication protocols used for market operations (7)(8)(9) include OpenADR, IEC 62325, and IEC 62746.

## A.2 Smart home/commercial/industrial/DR-customer energy management

### A.2.1 Identified TCs

Below are listed the relevant TCs working on smart grid requirements of the domain.

- IEC TC 57: Power systems management and associated information exchange
  - WG 21: Interfaces and protocol profiles relevant to systems connected the electrical grid
- IEC TC 65: Industrial-process measurement, control and automation
  - WG 17: System interface between industrial facilities and the smart grid
- IEC TC 8: System aspects of electrical energy supply
- IEC PC 118: Smart grid user interface

### A.2.2 Gathered materials

#### A.2.2.1 General

In Table A.3 are the materials collected and analysed to draft the Use Cases of the domain.

#### A.2.2.2 Standardization documents

**Table A.3 – IEC documents on smart home/commercial/industrial/ DR-customer energy management**

| Name | Author or organization | Status | Date | Relevant sections or pages (optional) |
|---|---|---|---|---|
| IEC TR 62746-2:2015 | TC 57 | TR | 2015-04-22 | User stories<br>Use Cases |
| Draft document IEC PC 118 | PC 118 | Draft TR | | |
| IEC TS 62872:2015 | TC 65/WG 17 | TS | 2015-12-11 | User Stories: Clause A.2<br>Use Cases: Clause A.3 |

#### A.2.2.3 Existing User Stories

See Table A.4.

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**Table A.4 – Existing User Stories**

| Name | Author or organization | Publication date | Source |
|---|---|---|---|
| JWG1 Flex start washing machine | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG2 Flex start EV charging | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG3 Severe grid stability issues | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG4 Power limitation PV | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG5 CEM manage simple device | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG6 Customer sells flexibility | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG7 Customer sells decentralized energy | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG8 Grid related emergency situation | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG9 Customer connects new smart device | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG10 Energy consumption information | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG11 Unexpected disconnect | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG12 Expected yearly cost of smart device | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG13 Energy storage and feed in based on tariff | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG14 Energy consumption management from external | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG15 Manage in premises battery system | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG16 Manage DER | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG17 Peak shift with battery aggregation | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG18 Control appliances based on price information | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG19 Control appliances based on energy savings signal | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG20 Control appliances before power cut | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG21 Control appliances in case of natural disaster | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG22 Bilateral DR negawatt | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG23 Lightning | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG24 Energy market flexibility management | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG25 Japanese building scenarios on energy management | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |

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#### A.2.2.4 Existing Use Cases

See Table A.5.

**Table A.5 – Existing Use Cases**

| Name | Author or organization | Publication date | Source |
|---|---|---|---|
| JWG1100-HLUC Flexible start of a smart device | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG1101 SD informs CEM about flexible start | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG-SPUC1.2 CEM informs SD about starting time | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG1103 CEM informs SD about slot shift | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG1110 Temperature control of smart appliances based on price information | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG1111 Fuel cell operation with fixed tariff profile | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG112x Mixed energy system like heat pumps with PV, storage battery. | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG113x Retrieve information from mixed energy system like heat pumps with PV, storage battery. | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG120x Provide local power managing capabilities. | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG121x Provide local power managing | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG2000 Demand supply adjustment | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG2001 Cascaded CEM | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG2002 District energy management | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG2010 Accelerate distributed power generation | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG202x Peak shift battery aggregation | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG2041 Power adjustment normal conditions | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG2042 Energy accommodation for buildings under disaster conditions | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG211x, based on WGSP211x) Tariff-consumption information exchange | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWG212x, based on WGSP212x) Direct Load-Generation Management | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWGSP2120 Direct load / generation management | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |
| JWGSP2140 Tariff synchronization | IEC TC 57/WG 21 | 2015-04-22 | IEC TR 62746-2:2015 |

Table A.6 identifies links between the user stories of IEC TC 57/WG 21 and the business Use Cases of IEC SyC Smart energy/WG 6/smart home/commercial/industrial/DR-customer energy management domain related to the smart home. Table A.6 may be modified after the in-depth analysis of the related Use Cases.

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**Table A.6 – Links between TC 57/WG 21 User Stories and SyC SE Use Cases**

| User stories | Business Use Cases | | | | | |
|---|---|---|---|---|---|---|
| | **SH/commercial/industrial/DR-CEM domain -BUC1 – Enable the interoperability between the smart home and the smart grid** | **SH/commercial/industrial/DR-CEM domain -BUC2 – Adapt the smart home behaviour to the resident/client preferences** | **SH/commercial/industrial/DR-CEM domain -BUC3 – Provide enriched smart home data to relevant parties in order to make the resident/client more active** | **SH/commercial/industrial/DR-CEM domain -BUC4 – Manage flexibility of the smart home on electricity demand and generation within the smart home from market signals** | **SH/commercial/industrial/DR-CEM domain -BUC5 – Manage flexibility on electricity demand and generation within the smart home from emergency signals** | **SH/commercial/industrial/DR-CEM domain -BUC6 – Assess the value of the flexibility of the smart home** |
| JWG1 Flex start washing machine | | X | | X | | |
| JWG2 Flex start EV charging (informative see IEC 62913-2-4) | X<br>(Once in the smart home the EV can be considered as any other device. It is necessary to detect the two following events: arrival of the EV in the smart home and departure of the EV from the smart home) (possible links with electric transportation domain BUC) | X | | X | | |
| JWG3 Severe grid stability issues | | | | | X | |
| JWG4 Power limitation PV | | X | | X | | |
| JWG5 CEM manage simple device | | X | | | | |
| JWG6 Customer Sells flexibility | | X | | | | |
| JWG7 Customer Sells Decentralized energy | | | | X | | X |
| JWG8 Grid related Emergency situation | | X | | | X | |

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| User stories | Business Use Cases | | | | | |
|---|---|---|---|---|---|---|
| | SH/commercial/industrial/DR-CEM domain -BUC1 – Enable the interoperability between the smart home and the smart grid | SH/commercial/industrial/DR-CEM domain -BUC2 – Adapt the smart home behaviour to the resident/client preferences | SH/commercial/industrial/DR-CEM domain -BUC3 – Provide enriched smart home data to relevant parties in order to make the resident/client more active | SH/commercial/industrial/DR-CEM domain - BUC4 – Manage flexibility of the smart home on electricity demand and generation within the smart home from market signals | SH/commercial/industrial/DR-CEM domain - BUC5 – Manage flexibility on electricity demand and generation within the smart home from emergency signals | SH/commercial/industrial/DR-CEM domain - BUC6 – Assess the value of the flexibility of the smart home |
| JWG9 Customer connects New Smart device | X | | | | | |
| JWG10 Energy Consumption information | | | X | | | |
| JWG11 Unexpected disconnect | X | | | | | |
| JWG12 Expected yearly cost of smart device | | | | | | |
| JWG13 Energy storage and feed in based on Tariff | | X | | X | | |
| JWG14 Energy consumption management from external | | | | | | |
| JWG15 Manage in premises Battery system | | X | | X | | |
| JWG16 Manage DER | | X | | X | | |
| JWG17 Peak shift with battery aggregation | | | | X | | |
| JWG18 Control appliances based on price information | | X | | X | | |

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| User stories | Business Use Cases | | | | | |
|---|---|---|---|---|---|---|
| | SH/commercial/industrial/DR-CEM domain -BUC1 – Enable the interoperability between the smart home and the smart grid | SH/commercial/industrial/DR-CEM domain -BUC2 – Adapt the smart home behaviour to the resident/client preferences | SH/commercial/industrial/DR-CEM domain -BUC3 – Provide enriched smart home data to relevant parties in order to make the resident/client more active | SH/commercial/industrial/DR-CEM domain - BUC4 – Manage flexibility of the smart home on electricity demand and generation within the smart home from market signals | SH/commercial/industrial/DR-CEM domain - BUC5 – Manage flexibility on electricity demand and generation within the smart home from emergency signals | SH/commercial/industrial/DR-CEM domain - BUC6 – Assess the value of the flexibility of the smart home |
| JWG19 Control appliances based on Energy savings signal | | X | | X | | |
| JWG20 Control appliances before power cut | | X | | | X | |
| JWG21 Control appliances in case of natural disaster | | | | | X | |
| JWG22 Bilateral DR negawatt | | | | X | | |
| JWG23 Lightning | | X | | X | | |

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### A.2.2.5 Existing Functional Architectures

#### A.2.2.5.1 General

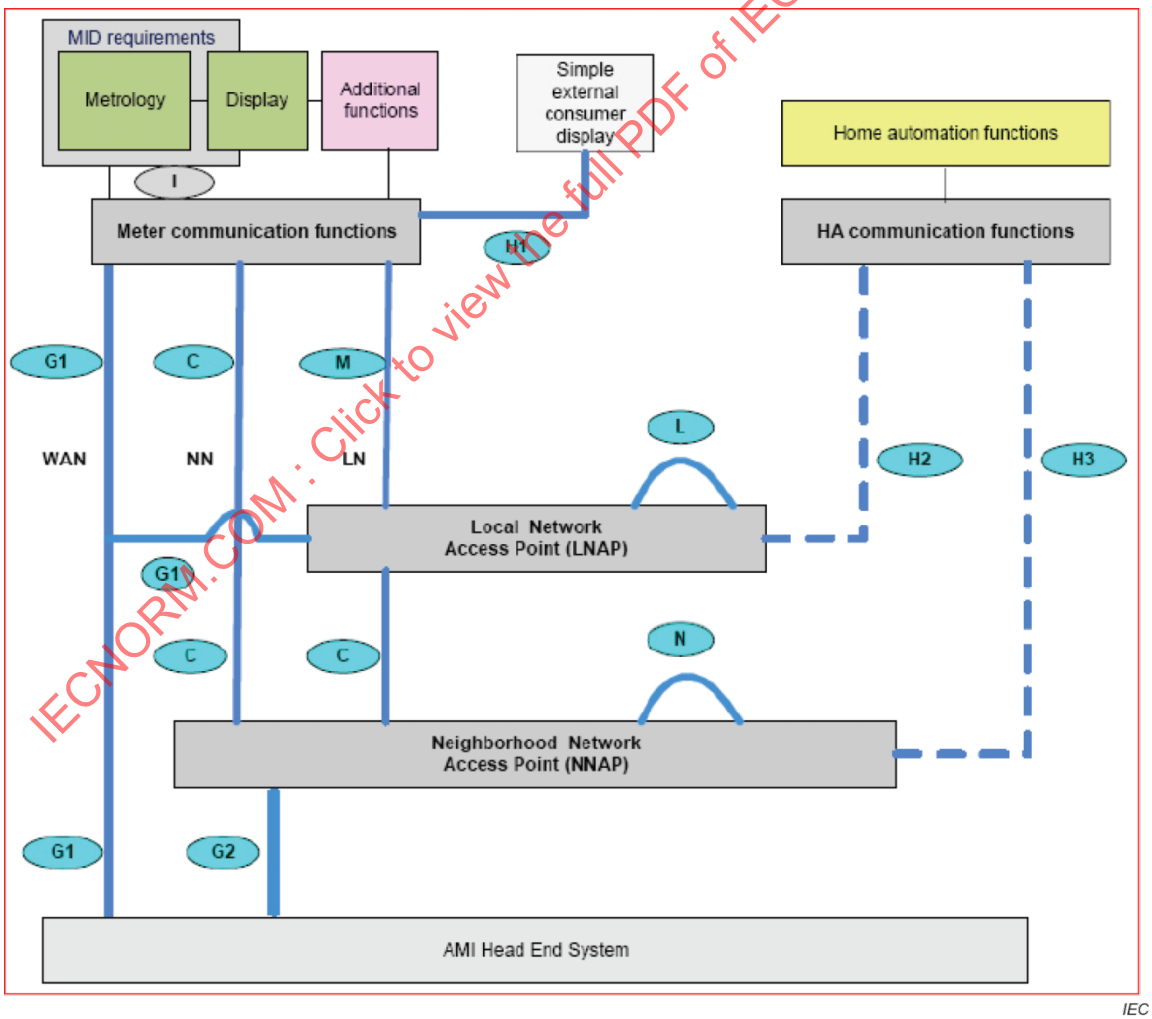
See Table A.7.

**Table A.7 – Existing User Stories**

| Name | Author or organization | Publication date | Source |
|---|---|---|---|
| M/461 – Smart meter Coordination Group | SMCG | | CEN/CLC/ETSI TR 50572:2011 |
| M/490 – Smart grid Coordination Group | SGCG | | |
| France | COSEI | | |
| NOTE Functional Architectures may be used in Use Cases, only if they are generic enough. | | | |

#### A.2.2.5.2 M/461 – CEN/CLC/ETSI TR 50572:2011

See Figure A.1.




**Key**

WAN wide area network

NN neighbourhood network

LN local area network

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**Figure A.1 – Reference architecture diagram for smart metering communications**

#### A.2.2.5.3 EU M/490 – SGCG – Flexibility Functional Architecture

See Figure A.2.

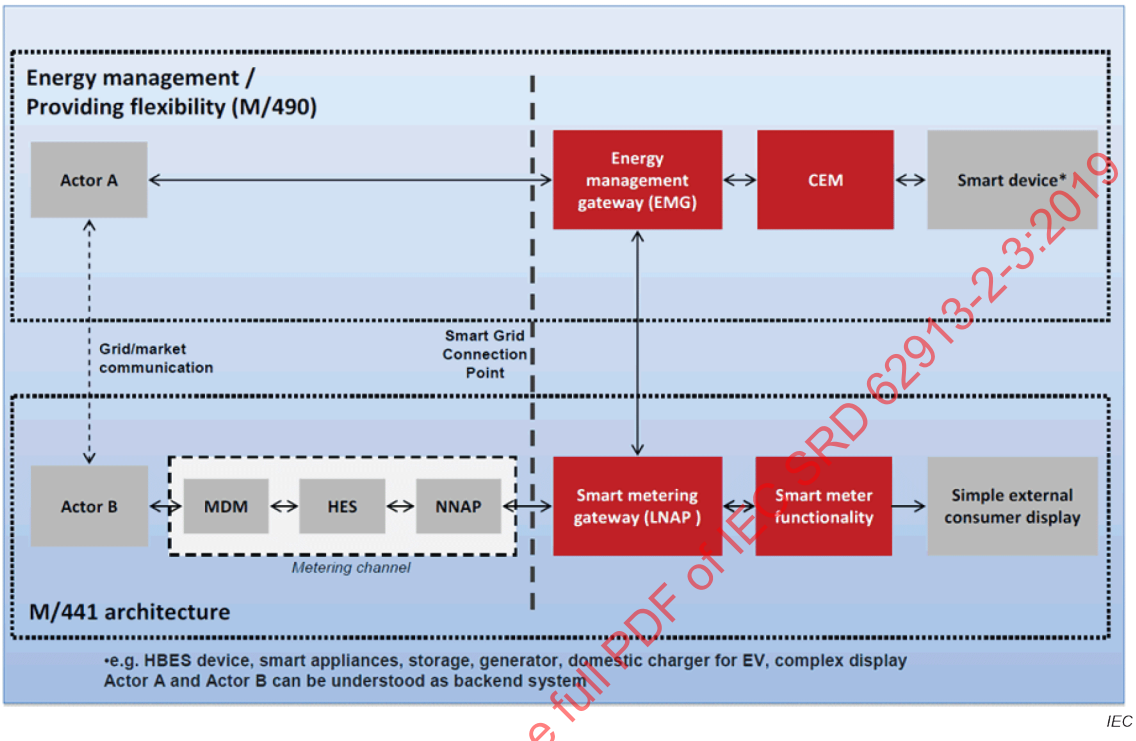


**Figure A.2 – EU M/490 – Flexibility Functional Architecture (CEN-CENELEC-ETSI)**

In this logical architecture the smart grid connection point represents the interface from the grid into the premises. The CEM provides the flexibility of connected smart devices, through the EMG, while the smart metering and the simple external consumer display provide a number of functionalities which are described in more detail in work of the Smart Meters Coordination Group. The EMG communicates with the metering channel and the smart metering through the smart metering gateway. The gateways in this architecture split different networks (wide area network, neighbourhood area network and local area network) and may be, as further described below, integrated with other functional entities.

The CEM is the central managing function. It decides and manages based on information coming from the grid and/or from the smart devices. The term "energy" within CEM reflects the demand of SGCG to focus on energy.

#### A.2.2.5.4 France – COSEI

This French committee elaborated three smart home high-level architectures (see Figure A.3) which enable the management of electrical flexibility within a smart home environment as well as the related customization and information services. The electrical flexibility of a smart home is its ability to increase or decrease its electricity consumption in response to signals intended to change its load curve.

These architectures are located downstream from the electricity meter scope. Their scope focuses on electricity-related residential services and includes neither security nor health care services nor electric vehicles.

In order to design these architectures, business roles and system roles have been defined and the flows of information between them have been described through a Use Cases approach.

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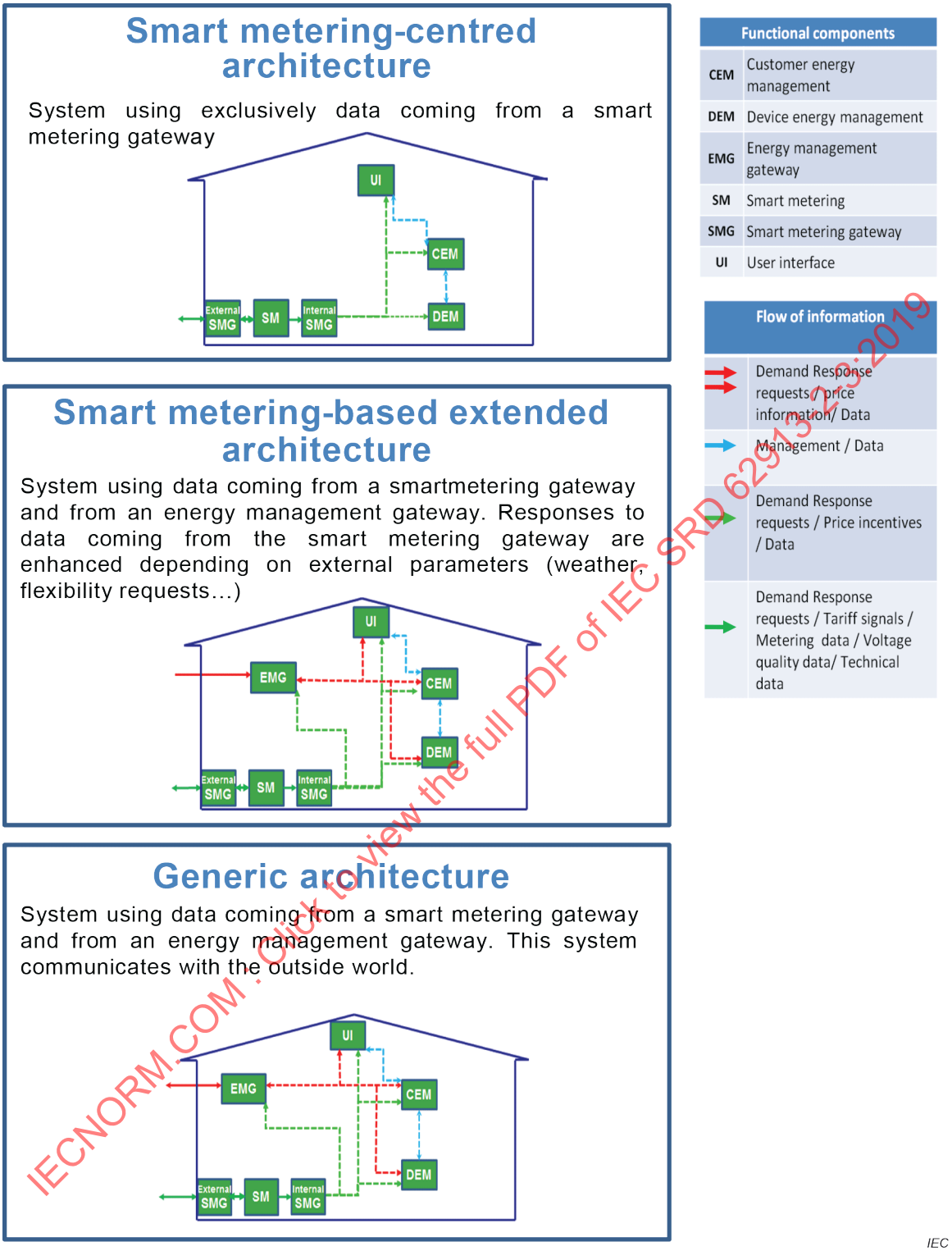


**Figure A.3 – France – COSEI architectures**

The above generic architecture entirely reflects a consensus among the French stakeholders. In this architecture, as the system uses data coming from two gateways, electrical flexibility can be managed in two different ways.

Each of the above system roles corresponds with one or several hardware components.

- Smart metering (SM) – Combination of the following meter-related functions from the smart metering reference architecture:

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  - metrology functions including the conventional meter display (register or index) that are under legal metrological control. When under metrological control, these functions shall meet the essential requirements of the MID (Measuring Instruments Directive – 2004/22/CE);
  - one or more additional functions not covered by the MID. These may also make use of the display;
  - meter communication functions.
- Internal smart metering gateway (internal SMG) – Borderline between the smart meter and the smart home.
- External smart metering gateway (external SMG) – Borderline between the area of grid and the smart meter.
- Energy management gateway (EMG) – Borderline between the WAN and the HAN.
- Device energy management (DEM) – Function adapting the operations of a given electrical device depending on the incoming orders, resident/client customization and potential opt-outs that may be manually done locally.
- Customer energy management (CEM) – Function enabling the definition of energy management strategies of one or several related DEMs depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, resident/client customization and potential resident dispensations. This function includes a processing ability, notably in order to take resident/client customization and electrical data enhancement into account.
- User interface (UI) – User interface for the resident or the client. The UI can be connected to the smart home HAN or to the WAN.

Figure A.4 presents the correspondence between some examples of hardware components that can be found in a smart home environment and their potential integrated functional components (system roles).

| | | Functional components | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | SM (Smart Metering) | Internal SMG (Internal Smart Metering Gateway) | SGCP (Smart Grid Connection Point) | | CEM (Customer Energy Management) | DEM (Device energy management) | UI (User Interface) |
| | | | | External SMG (External Smart Metering Gateway) | EMG (Energy Management Gateway) | | | |
| Hardware components | Smart Meter | x | x | x | | | | x |
| | SmartMeter-HAN | | x | | | | | x |
| | SmartMeter-MC | | | x | | | | |
| | WAN-HAN Interface | | | | x | | | x |
| | CEMS (Customer Energy Management System) | | | | | x | | x |
| | DCA (Directly Connected Appliance) | | | | | x | x | x |
| | ICA (Indirectly Connected Appliance) | | | | | | x | x |
| | BA (Binary Appliances) | | | | | | x | Optional |
| | IID (Interaction and/or Information Device) | | | | | | | x |

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**Figure A.4 – Correspondence table between hardware components and functional components (system roles)**

### A.2.3 Liaisons from other TCs contributing to the smart grid requirements of the domain

The list below shows the experts and liaisons from other TCs who have been contributing to the domain.

- IEC SyC Smart energy/WG 6, IEC TC 57/WG 3, WG 14, WG 15, WG 16, WG 17, WG 19, AHG 8.

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## A.3 Energy storage

### A.3.1 Identified TCs

Below are listed the relevant TCs working on the smart grid requirements of the domain.

- TC 57: Power systems management and associated information exchange;
- TC 120: Electrical energy storage (EES) systems.

### A.3.2 Gathered materials

#### A.3.2.1 General

Subclause A.3.2 lists the materials collected and analysed by the energy storage team to draft the Use Cases of its domain. They include standardization documents, User Stories, Use Cases, and Functional Architectures as well as the name of the documents, their authors or organizations, status, and dates.

#### A.3.2.2 Standardization documents

Tables A.8 and A.9 show the International Standards and other regional standards relevant to energy storage, respectively.

**Table A.8 – International Standards on energy storage**

| Name | Author or organization | Status | Date | Relevant sections or pages (optional) |
|---|---|---|---|---|
| IEC 60870-5-101<br>Telecontrol equipment and systems – Part 5-101: Transmission protocols – Companion standard for basic telecontrol tasks | IEC TC 57 | International Standard | 2003-02 | |
| IEC 60870-5-104<br>Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles | IEC TC 57 | International Standard | 2006-06 | |
| IEC 61000-4-19<br>Electromagnetic compatibility (EMC) – Part 4-19: Testing and measurement techniques – Test for immunity to conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz at a.c. power ports | IEC SC 77A | International Standard | 2014-05 | |
| IEC 61131 series<br>Programmable controllers | IEC TC 65/SC 65B | International Standard | | |
| IEC 61499 series<br>Function blocks | IEC TC 65/SC 65B | International Standard | | |

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| Name | Author or organization | Status | Date | Relevant sections or pages (optional) |
|---|---|---|---|---|
| IEC 61784-1<br>Industrial communication networks – Profiles – Part 1: Fieldbus profiles | IEC TC 65/SC 65C | International Standard | 2014-08 | |
| IEC 61850-7-4<br>Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes | IEC TC 57 | International Standard | 2010-03 | |
| IEC 61850-7-410<br>Communication networks and systems for power utility automation – Part 7-410: Basic communication structure – Hydroelectric power plants – Communication for monitoring and control | IEC TC 57 | International Standard | 2012-10 | |
| IEC 61850-7-420<br>Communication networks and systems for power utility automation – Part 7-420: Basic communication structure – Distributed energy resources logical nodes | IEC TC 57 | International Standard | 2009-03 | |
| IEC 62746-10-1<br>Systems interface between customer energy management system and the power management system – Part 10-1: Open automated demand response | IEC PC 118 | International Standard | 2018-11 | |

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The International Standards listed in Table A.8 are derived from IEC smart grid Standards Mapping Tool.

**Table A.9 – Regional and/or organizational standards on energy storage**

| Name | Author or organization | Status | Date | Relevant sections or pages (optional) |
|---|---|---|---|---|
| P2030.3 – Standard for Test Procedures for Electric energy storage Equipment and Systems for Electric Power Systems Applications | IEEE | Active project | | |
| | | | | |

### A.3.2.3 Existing Use Cases

See Table A.10.

**Table A.10 – Existing Use Cases on energy storage**

| Name | Author or organization | Publication date | Source |
|---|---|---|---|
| Community energy storage (CES) – Energy dispatch | American Electric Power | April 11, 2010 | SG3_Smart Grid Standards Mapping Tool |
| ISO uses energy storage for grid operations and control | California Independent System operator (California ISO) | November 12, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Frequency response | California ISO | November 12, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Reduce the intra-hour variability of renewables | California ISO | November 12, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Load following | California ISO | November 12, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Transmission loading mitigation | California ISO | November 12, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Transmission transient stability damping | California ISO | November 12, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Under/over frequency mitigation | California ISO | November 12, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Voltage and reactive power support | California ISO | November 12, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Energy or load shifting | California ISO | November 12, 2010 | SG3_Smart Grid Standards Mapping Tool |
| DER EMS direct interaction with energy storage | Smart Grid Interoperability Panel | April, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Utility market-based interactions with energy storage | Smart Grid Interoperability Panel | April, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Utility interactive and/or broadcast interactions with energy storage | Smart Grid Interoperability Panel | April, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Scheduled real power and ancillary services commands | Smart Grid Interoperability Panel | April, 2010 | SG3_Smart Grid Standards Mapping Tool |
| Online power system control by battery SCADA (virtual energy storage) | Yokohama Smart City Project (YSCP) | November 8, 2011 | SG3_Smart Grid Standards Mapping Tool |
| Utility and or customer provides electrical energy storage in conjunction with photovoltaic | EPRI | December 15, 2009 | SG3_Smart Grid Standards Mapping Tool |

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Given the above Use Cases and their descriptions, energy storage domain generalized them to 12 business Use Cases (or services) to be delivered by EES systems in a smart grid. See Table A.11.

In this process, the energy storage domain also confirmed that the generalized business Use Cases in the list can be equivalent to the business services described in 6.2. This fact also indicates that a business analysis, or top-down approach, in Clause 6 identified a sufficient first set of business Use Cases which are indispensable to realize on-going EES associated business projects in the market.

**Table A.11 – Existing Use Cases on energy storage**

| Generalized business Use Cases | Existing Use Cases |
|---|---|
| Battery SCADA | - Community energy storage (CES) – Energy dispatch<br>- Utility interactive and/or BROADCAST Interactions with energy storage<br>- Online power system control by battery SCADA (virtual energy storage) |
| Frequency regulation | - Frequency response<br>- Utility interactive and/or broadcast interactions with energy storage |
| Operating reserves for RE (short-term) | - Reduce the intra-hour variability of renewables<br>- Utility market-based interactions with energy storage<br>- Utility interactive and/or broadcast interactions with energy storage<br>- Scheduled real power and ancillary services commands |
| Load following (medium-term) | - Reduce the intra-hour variability of renewables<br>- DER EMS direct interaction with energy storage<br>- Utility market-based interactions with energy storage<br>- Utility and or customer provides electrical energy storage in conjunction with photovoltaic |
| Congestion mitigation | - Transmission loading mitigation |
| Improve grid stability | - Transmission transient stability damping<br>- Utility interactive and/or broadcast interactions with energy storage |
| Islanding (to avoid load shedding) | - Under/over frequency mitigation<br>- Utility interactive and/or broadcast interactions with energy storage |
| Voltage support | - Voltage and reactive power support<br>- Utility interactive and/or broadcast interactions with energy storage<br>- Scheduled real power and ancillary services commands |
| Energy shifting and peak shaving | - Energy or load shifting<br>- DER EMS direct interaction with energy storage<br>- Utility and or customer provides electrical energy storage in conjunction with photovoltaic |

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### A.3.3 Liaisons from other TCs contributing to the smart grid requirements of the domain

The list below shows the experts and liaisons from other TCs who have been contributing to the energy storage domain.

- TC 120/AHG 1 and SyC Smart energy/WG 5

# Annex B
(informative)

# Use Cases

## B.1 Distributed energy resources

The Use Cases given in Table B.1 cover the functionality of DER systems with autonomous functions, see Figure B.1. Some information may be received from external sources, such as updated settings or commands, but the focus is on the autonomous actions of the DER systems.

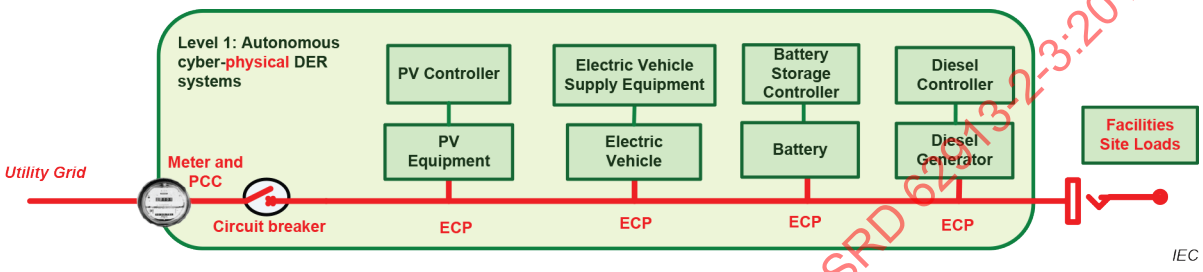


**Figure B.1 – Level 1 DER systems with autonomous functions at facility and DSO sites**

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**Table B.1 – DER Use Cases**

| Use Case title | Use Case brief narrative | Actors | Information exchanges | Additional information |
|---|---|---|---|---|
| **DER registration and interconnection** | | | | |
| Enter into interconnection agreement with DSO | The DER owner and/or DER operator enters into an interconnection agreement with the DSO that includes proof of meeting all DSO interconnection requirements for safe and reliable operations. | DER owner<br>DER operator<br>DSO | According to country or regional regulations | Off-line prior to installation and interconnection |
| Provide operational characteristics at initial interconnection and upon changes | The DER system provides operational characteristics to the DSO after initial interconnection and whenever changes are made to its operational status and capabilities. | DER system<br>FDEMS<br>DDEMS | According to country or regional regulations | Off-line or ICT: (may be prior to installation) Provide DER characteristics information to the DDEMS of the DSO |
| Initiate automated "discover" of DER systems | The DER system supports its automated "discovery" as interconnected to a location on the power system and initiates the integration and/or update process. | DER system<br>FDEMS<br>DDEMS | DER system nameplate information<br>DER locational information | ICT: DSO, REP, or FDEMS "discovers" a new or moved or updated DER system |
| DSO direct interactions with DER | | | | |
| DSO directly manages DER systems | Utilities may manage their own DER systems, typically located in substations or other critical locations. Utilities may also manage some customer DER systems.<br>The DSO is contractually authorized to manage DER systems at a facility. Using their DDEMS, the DSO undertakes the following:<br>• Determine DER capabilities and establish an operational plan based on these capabilities, DR pricing signals, DSO alert and emergency requirements, energy and ancillary services bids in the balancing authority market, etc.<br>• Monitor DER systems (generation, storage, and load) in real time.<br>• Analyse current energy conditions and near-term forecast energy conditions.<br>• Establish schedules and settings for DER autonomous actions.<br>• Issue control commands to DER systems if necessary.<br>• Receive metering and event log information.<br>• Perform settlements and billing. | DSO<br>DDEMS<br>DMS<br>DER SCADA<br>DER system | | |

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| Use Case title | Use Case brief narrative | Actors | Information exchanges | Additional information |
|---|---|---|---|---|
| **DER registration and interconnection** | | | | |
| DSO-initiated demand response | Utilities may initiate a demand response (DR) activity in order to shave demand during high peak power situations. Additional DR actions could be to request ancillary services such as "operational reserve", var support, or frequency support. | DSO operator<br>DR application<br>DER owner/ operator | DR pricing signal for load reduction or selected ancillary service | Use of OpenADR protocol for DR |
| **Real power DER functions** | | | | |
| Limit maximum real power output at the PCC to a preset value | DER systems are interconnected to the grid with a preset limit of real power output to be measured at the PCC. The reason might be that the DER system is sized to handle most of the local load behind the PCC, but occasionally that load decreases below a critical level and the increased real power at the PCC may be a reliability concern for the DSO. | DER system<br>FDEMS<br>DDEMS<br>Local EPS | Autonomous<br>Local: FDEMS monitors real power output at PCC | Autonomous<br>Local: FDEMS monitors real power output at PCC |
| Limit maximum real power output at the PCC upon a direct command from the DSO | The DSO issues a direct command via the DDEMS to limit the maximum real power output at the PCC. The reason might be that unusual or emergency conditions are causing reverse flow into the feeder's substation or because the total DER real power output on the feeder is greater than some percentage of total load. The command might be an absolute watt value or might be a percentage of DER output. | DER system<br>FDEMS<br>DDEMS | Real power limit<br>Start time<br>Time duration or end time | ICT: DDEMS issues a command to limit the real power output at the PCC |
| Set actual real power output at the PCC | The DSO issues a direct command via the DDEMS to set the actual real power output at the PCC (constant export/import if load changes; constant watts if no load). The reason might be to establish a base or known generation level without the need for constant monitoring. | DER system<br>FDEMS<br>DDEMS | Real power setpoint at PCC | ICT: DDEMS issues a command to set the real power output at the PCC |
| Schedule actual or maximum real power output at specific times | The DSO establishes (or pre-establishes) a schedule of actual or maximum real power output levels at the PCC via the DDEMS. The reason might be to minimize output during low load conditions while allowing or requiring higher output during peak load time periods. | DER system<br>FDEMS<br>DDEMS<br>Local EPS | Schedule of real power setpoints at the PCC | Autonomous<br>Local: Monitor real power output at PCC.<br>ICT: DDEMS or FDEMS updates the schedule of actual or maximum real power values |
| Modify real power output autonomously in response to local voltage variations | The DER system monitors the local (or feeder) voltage and modifies real power output in order to damp voltage deviations. Hysteresis and delayed responses could be used to ensure overreactions or hunting do not occur. | DER system<br>FDEMS<br>Local EPS | Autonomous<br>Local: Monitor voltage | Autonomous<br>Local: Monitor voltage |

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| Use Case title | Use Case brief narrative | Actors | Information exchanges | Additional information |
|---|---|---|---|---|
| **DER registration and interconnection** | | | | |
| Set or schedule the storage of energy for later delivery, indicating time to start charging, charging rate and/or "charge-by" time | The DER system has storage capabilities, such as battery storage or a combined PV + storage system or a fleet of electric vehicles. Preset time-of-charge values can be established. Different scenarios could include:<br>• Low load conditions at night are causing some renewable energy to be wasted, so charging energy storage DER systems at that time makes power system operations more efficient.<br>• DER controller charges at the specified rate (less than or equal to the maximum charging rate) until the state-of-charge (SOC) reaches a specified level.<br>• DER controller charges at the necessary rate in order to reach the specified SOC within the "charge-by" time. | DER system<br>FDEMS<br>DDEMS<br>Local EPS | Schedule for storage charging and/or discharging,<br>or<br>Time to start charging<br>Charge-by time | Autonomous<br>ICT: DDEMS or FDEMS updates the storage settings and/or schedule |
| Provide backup power after disconnecting from grid | The DER system, including energy storage and electric vehicles, has the ability to provide real power when the site is disconnected from grid power. The reason is for providing backup power and possibly black start capabilities. | DER system<br>FDEMS<br>DDEMS<br>Local EPS | Autonomous<br>Local: Monitor voltage, frequency, and connected load | Autonomous<br>Local: Monitor voltage, frequency, and connected load |
| **Reactive power DER functions** | | | | |
| Provide reactive power by a fixed power factor | The DER system sets the inverter to the specified power factor setting:<br>• DER controller contains pre-established power factor setting, and/or<br>• Power factor setting can be updated remotely by the FDEMS and/or DDEMS | DER system<br>FDEMS<br>DDEMS<br>Local EPS | Fixed power factor value | Autonomous<br>ICT: FDEMS or DDEMS sets the power factor |
| Provide dynamic reactive power injection through autonomous responses to local voltage measurements | The DER system implements volt-var curves that define the reactive power required at different voltage levels<br>• DER controller contains pre-established volt-var setting, and/or<br>• Volt-var setting can be updated remotely by the FDEMS and/or DDEMS | DER system<br>FDEMS<br>DDEMS<br>Local EPS | Volt-var curves (multiple)<br>Enable/disable function | Autonomous<br>Local: Monitor voltage<br>ICT: FDEMS or DDEMS updates volt-var curves |
| Provide reactive power through autonomous responses to temperature, current, or time-of-day | The DER system implements temperature-var curves that define the reactive power different ambient temperatures, similar to feeder capacitors. Curves could also be defined for current-var and for time-of-day-var. | DER system<br>FDEMS<br>DDEMS<br>Local EPS | Temperature-var curves<br>Enable/disable function | Autonomous<br>Local: Monitor ambient temperature<br>ICT: FDEMS or DDEMS updates-var curves |

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| Use Case title | Use Case brief narrative | Actors | Information exchanges | Additional information |
|---|---|---|---|---|
| **DER registration and interconnection** | | | | |
| **Frequency support DER functions** | | | | |
| Support frequency regulation by rapidly modifying real power output to counter minor frequency deviations | The DER system modifies real power output rapidly to counter minor frequency deviations. The frequency-watt settings define the percentage of real-power output to modify for different degrees of frequency deviations on a second or even sub-second basis. | DER system<br>FDEMS<br>DDEMS<br>Local EPS | Autonomous<br>Local: Monitor frequency<br>ICT: DSO updates the frequency-watt settings | Autonomous<br>Local: Monitor frequency<br>ICT: DSO updates the frequency-watt settings |
| Support frequency regulation by direct automatic generation control (AGC) commands | The DER system implements modification of real-power output based on AGC signals on a multi-second basis. Since TSOs are ultimately responsible for frequency, the AGC control signals could come from a TDEMS (part of the TSO EMS that manages large DER systems or large aggregations of smaller DER systems). | DER system<br>DDEMS<br>TDEMS | AGC signals | ICT: DDEMS or TDEMS issues AGC commands to modify real power output |
| **DER response to emergencies** | | | | |
| Support anti-islanding to trip off under extended anomalous conditions | The DER system disconnects from the local EPS if voltage or frequency limits are exceeded over specified time periods. | DER system<br>Local EPS | Autonomous<br>Local: Monitor voltage<br>Local: Monitor frequency | |
| DER protection devices react to system conditions | The DER system protection function responds to frequency and/or voltage levels that exceed value-time limits by disconnecting the DER system from the local EPS or, via a breaker at the PCC, from the area EPS. DER system protection supports system safety by preventing unintentional islanding. | DER system<br>DER protection function<br>Local EPS | Autonomous<br>Local: Monitor voltage<br>Local: Monitor frequency | |
| Support direct command to disconnect or reconnect | The DDEMS or the FDEMS commands the DER system to perform a disconnect or reconnect. Time windows are established for different DER systems to respond randomly within that window to the disconnect and reconnect commands. | DER system<br>FDEMS<br>DDEMS<br>DSO operator | Disconnect command<br>Reconnect command | ICT: DSO or FDEMS issues disconnect or reconnect command |
| Provide ride-through of low/high voltage excursions beyond normal limits | The DER system remains connected during voltage excursions beyond normal limits, based on extended voltage limits during specified time windows. The DER system would disconnect only when the ride-through window has expired. | DER system<br>Local EPS | Autonomous<br>Local: Monitor voltage | |
| Provide ride-through of low/high frequency excursions beyond normal limits | The DER system remains connected during frequency excursions beyond normal limits, based on extended frequency limits during specified time windows. The DER system would disconnect only when the ride-through window has expired. | DER system<br>Local EPS | Autonomous<br>Local: Monitor frequency | |

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| Use Case title | Use Case brief narrative | Actors | Information exchanges | Additional information |
|---|---|---|---|---|
| **DER registration and interconnection** | | | | |
| Counteract voltage excursions beyond normal limits by providing dynamic current support | The DER system counteracts voltage anomalies (spikes or sags) through "dynamic current support". The DER system supports the grid during short periods of abnormally high or low voltage levels by feeding reactive current to the grid until the voltage either returns within its normal range or the DER system is required to disconnect. | DER system<br>FDEMS<br>DDEMS<br>Local EPS | Autonomous<br>Local: Monitor voltage anomalies<br>ICT: DSO updates dynamic current settings | |
| Counteract frequency excursions beyond normal limits by decreasing or increasing real power | The DER system reduces real power to counteract frequency excursions beyond normal limits (and vice versa if additional generation or storage is available). Hysteresis can be used as the frequency returns within the normal range to avoid sudden changes by multiple DER systems. | DER system<br>FDEMS<br>DDEMS<br>Local EPS | Autonomous<br>Local: Monitor voltage anomalies<br>ICT: DSO updates frequency response settings | |
| Reconnect after grid power is restored | The DER system reconnects to the grid after power is restored. The time between power restoration and reconnection is preset. | DER system<br>Local EPS | Autonomous<br>Local: Monitor voltage<br>Local: Monitor frequency | |
| Create microgrid | After grid power is lost or disconnected, or upon command, the DER system enters into microgrid "mode" as either "leading" or "following" the microgrid frequency and voltage, while acting either as base generation or as load-matching, depending upon preset parameters. | DER system<br>MDEMS<br>Local EPS<br>Microgrid operator<br>DSO operator | Issue "microgrid mode" to DER systems within local EPS<br>Trip PCC breaker | Autonomous<br>ICT: DSO or MDEMS issues "microgrid mode" command |
| Microgrid synchronizes local EPS with area EPS | The MDEMS of a microgrid decides to reconnect with the area EPS. It synchronizes frequency across the PCC and then closes the breaker at the PCC to interconnect the local EPS with the DSO's area EPS. | DER system<br>MDEMS<br>Local EPS<br>Area EPS<br>Microgrid operator | Local: Measurement of frequency phases across PCC<br>Start synchronization of local EPS with area EPS<br>Close PCC breaker | |
| Provide "spinning" or operational reserve | The DER system provides emergency real power upon command at short notice (seconds or minutes), either through increasing generation or discharging storage devices. | DER system<br>FDEMS<br>DDEMS<br>DSO operator | Command to provide emergency real power | ICT: DSO issues command for emergency reserve |
| Provide black start capabilities | After a power outage, the DER system starts to operate as a microgrid (possibly just itself) and supports additional loads being added, so long as they are within its generation capabilities. | DER system<br>FDEMS<br>DDEMS<br>Local EPS<br>DSO operator | Black start mode command | ICT: DSO issues "black start mode" command |

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| Use Case title | Use Case brief narrative | Actors | Information exchanges | Additional information |
|---|---|---|---|---|
| **DER registration and interconnection** | | | | |
| **Economic responses by DER systems** | | | | |
| Manage real power output based on demand response (DER) pricing signals | The DER system receives a demand response (DER) pricing signal from a DSO or retail energy provider (REP) for a time period in the future and determines what real power to output at that time. | DER system<br>FDEMS<br>DDEMS<br>RDEMS<br>DR application | Pricing signal for real power<br>Start time<br>Duration or end time | ICT: DSO or aggregator issues DER pricing signal |
| Manage selected ancillary services based on demand response (DER) pricing signals | The DER system receives a DER pricing signal from a DSO or retail energy provider (REP) for a time period in the future and determines what ancillary services to provide at that time. | DER system<br>FDEMS<br>DDEMS<br>RDEMS<br>DR application | Pricing signal for ancillary services<br>Start time<br>Duration or end time | ICT: DSO or aggregator issues DER pricing signal |
| Provide low cost energy | DSO, REP, or FDEMS disaggregates a request to provide low cost energy and determines which DER systems are to generate how much energy over what time period in order to minimize energy costs. | DER system<br>FDEMS<br>DDEMS<br>RDEMS<br>DR application | Pricing signal for real power<br>Start time<br>Duration or end time | ICT: DSO or aggregator issues real power output level to each DER system |
| Provide low emissions energy | DSO, REP, or FDEMS disaggregates a request to provide low emission energy and determines which DER systems are to generate how much energy in order to minimize emissions. | DER system<br>FDEMS<br>DDEMS<br>RDEMS<br>DR application | Pricing signal for emission reduction<br>Start time<br>Duration or end time | ICT: DSO or aggregator issues real power output level to each DER system |
| Provide renewable energy | DSO, REP, or FDEMS disaggregates a request to provide renewable energy and selects which DER systems are to generate how much energy in order to maximize the use of renewable energy. | DER system<br>FDEMS<br>DDEMS<br>RDEMS<br>DR application | Pricing signal for real power from renewable sources<br>Start time<br>Duration or end time | ICT: DSO or aggregator issues real power output level to each DER system |
| **Wide area situational awareness of DER systems** | | | | |
| Provide emergency alarms and information | The DER system provides alarms and supporting emergency information to the FDEMS which aggregates this information to provide the relevant key emergency information to the DSO and/or REP. | DER system<br>FDEMS<br>DDEMS<br>RDEMS<br>DSO operator<br>Aggregator | DER operational status<br>DER alarms | ICT: DER system provides alarms and emergency information |
| Provide status and measurements on current energy and ancillary services | The DER system provides current status, power system measurements, and other real-time data (via the FDEMS) to the DSO and REP. (Metering data is provided via smart meters.) | DER system<br>FDEMS<br>DDEMS<br>RDEMS<br>DSO operator<br>Aggregator | DER real power output<br>DER reactive power output | ICT: DER system provides status and measurement values |

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| Use Case title | Use Case brief narrative | Actors | Information exchanges | Additional information |
|---|---|---|---|---|
| **DER registration and interconnection** | | | | |
| Forecast of available energy and ancillary services | The FDEMS provides forecast information for available energy and ancillary services over the next hours, days, weeks, etc. | FDEMS<br>DDEMS<br>RDEMS<br>DSO operator<br>Aggregator | Forecast schedule of energy<br>Forecast schedule of ancillary services | ICT: FDEMS provides forecast information |
| **Schedules for DER systems** | | | | |
| Follow schedules for energy and ancillary service outputs | The DER system receives schedules from the DSO and/or REP and follows these schedules for real power settings, reactive settings, limits, modes (such as autonomous volt-var, frequency-watt), and other operational settings. | FDEMS<br>DDEMS<br>RDEMS<br>Local EPS<br>DSO operator<br>Aggregator | Autonomous following of schedules<br>Schedules for different DER functions<br>Schedule enable/disable | Autonomous<br>ICT: DSO, REP, or FDEMS issues schedules to DER system |
| Issue generation and storage schedules | The FDEMS provides schedules of expected generation and storage reflecting customer requirements, maintenance, weather forecasts, etc. | FDEMS<br>DDEMS<br>RDEMS<br>DSO operator<br>Aggregator | Forecast schedule of storage energy<br>Forecast schedule of storage ancillary services | ICT: Provide scheduling information to DSO, REP, or FDEMS |
| **Maintenance DER functions** | | | | |
| Synchronize time of DER systems and FDEMS | The FDEMS synchronizes time to the required accuracy and precision via GPS or other synchronization source. DER systems synchronize their time either from the FDEMS or via other sources. | DER system<br>FDEMS<br>Time synchronization source | NTP time synchronization signals | |
| DER systems log significant events and store statistically important data | The DER system logs significant events and stores the statistically important data with the purpose to:<br>• provide GPS time-stamped records of events;<br>• provide record of system variables;<br>• provide record of system settings;<br>• provide record of system topology;<br>• allow for data access to different organizations;<br>• message processing and management;<br>• data maintenance. | DER archival data base<br>DER owner<br>FDEMS | Logs of significant alarms, events, and key measurements | |
| Test DER software patching and updates | The DER software updates are tested for functionality and for meeting regulatory and DSO requirements, including safety. | DER system<br>FDEMS<br>Testing facility | | Off-line, local, or ICT: (may be prior to installation or handled locally) Test DER software |

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## B.2 Smart home/commercial/industrial/DR-customer energy management

### B.2.1 Business Use Cases

See Table B.2 to Table B.9.

**Table B.2 – Adapt the smart home behaviour to the resident/client's preferences**

| UC62913-2-3-B042 Adapt the smart home behaviour to the resident/client's preferences | | |
|---|---|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| UC62913-2-3-B042 | Area: Energy system<br>Domain: Smart home | BUC-Adapt the smart home behaviour to the resident/client's preferences |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | Customization of the smart home.<br>The management of signals from the market or the management of emergency signals are out of the scope of the Use Case. |
| **Objective(s)** | – Customize automatic responses to these signals so that these responses are adapted to his or her comfort and/or financial objectives. |
| **Related business case(s)** | – Optimize the smart home behaviour. |

1.4 Narrative of Use Case

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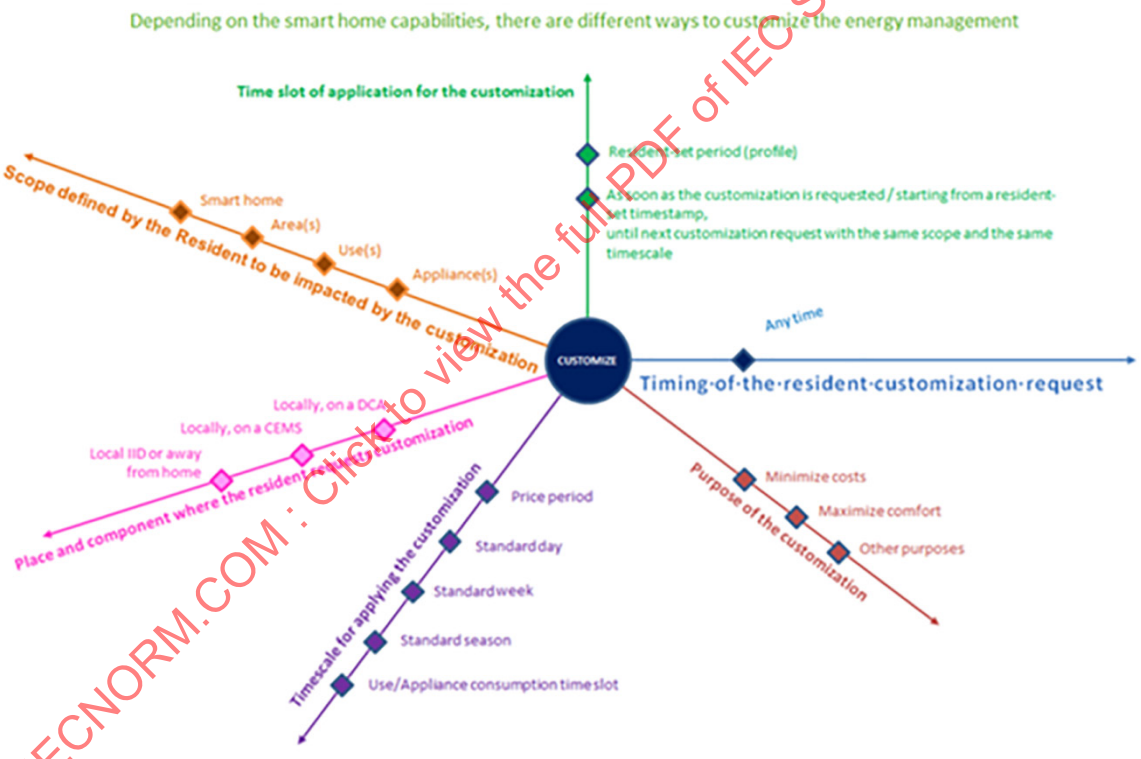
| UC62913-2-3-B042 Adapt the smart home behaviour to the resident/client's preferences |
|---|
| **Narrative of use case** |
| **Short description** |
| The business Use Case describes how the resident/client customizes the management of his or her appliance(s) namely during dynamic peak periods and the monitoring of events, according to his or her preferences (decision between comfort and economic optimization). He or she may choose to respond to events in manual mode or automatic mode, and may in this second case delegate the customization to an authorized Third Party. |
| **Complete description** |
| This Use Case include three scenarios:<br>– Scenario 1: Customize the smart home manually;<br>– Scenario 2: Customize the smart home with automatic responses;<br>– Scenario 3: Delegate the smart home customization to a Third Party by providing relevant data.<br>Scenarios 1 and 3 are possibilities offered to the smart home resident/client. However, the related customization process is only described for Scenario 2:<br>– Scenario 1 does not require smart grid function,<br>– Regarding Scenario 3, the needed information exchanges are described in Table B.14.<br>The figure below highlights the different ways to customize the energy management depending on the smart home capabilities.<br>  <br><br>**1-Customize the smart home manually**<br>The resident/client decides to customize the smart home manually. He or she does not configure his or her smart home to automatically respond to external signals (such as price incentives or DR requests) and adapt its behaviour.<br>In this case, he or she may decide to respond to external signals by manually modifying the behaviour of the smart home.<br>**2-Customize the smart home with automatic responses**<br>The resident/client customizes the behaviour of the smart home in order to automatically respond to external signals). The resident/client keeps the possibility to opt out of these signals. |

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**UC62913-2-3-B042 Adapt the smart home behaviour to the resident/client's preferences**

**2.1-Customize the automatic responses of the smart home**

Depending on the smart home capabilities and the resident/client needs, the customization may be defined and applied to different scopes, that is to say:

– the whole smart home,

– one or several areas (rooms),

– one or several uses,

– one or several appliances.

Depending on the smart home capabilities, the customization may be defined and applied to different timescales:

– price period,

– standard day,

– standard week,

– standard season,

– use/appliance consumption time slot.

**2.2-Customize warnings**

The resident/client customizes warnings, i.e. events to be tracked, and specifies the related emission channel.

The event to be tracked is exceeding an electricity data threshold in the smart home (such as a threshold of consumption in kWh).

**2.3-Receive a notification**

The resident/client receives a notification confirming that the new customization has been taken into account.

The resident/client may read the customization.

**3-Delegate the smart home customization to a Third Party by providing relevant data**

In order to deal with the complexity of the smart home management, the resident/client may contract with a Third Party, such as a service provider for instance, to manage the customization of the smart home.

**3.1-Authorize a third party**

The resident/client authorizes a designated third party to access smart home data and customize the smart home behaviour.

The resident/client may also indicate general preferences (financial optimization, comfort) to be taken into account for the customization.

**3.2-Analyse the data and propose a schedule**

Based on the analysis of the smart home data collected and preferences indicated by the resident/client, the third party elaborates a schedule with automatic responses to external events.

The third party sends the schedule to the resident/client.

**3.3-Validate the schedule and customize the smart home behaviour**

The resident/client validates the schedule.

If the resident/client does not validate the schedule, the mandated third party may elaborate and propose another one.

The third party customizes the smart home behaviour based on the validated schedule.

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1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

| UC62913-2-3-B042 Adapt the smart home behaviour to the resident/client's preferences |
|---|
| **Use case conditions** |
| **Assumption** |
| • See related system Use Case |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier |
| • The client's smart home is up and running |
| • The resident/client owns at least one UI |

1.7 Further information to the use case for classification / mapping

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| UC62913-2-3-B042 Adapt the smart home behaviour to the resident/client's preferences |
|---|
| **Classification information** |
| **Relation to other use cases** |
| BUC-Provide enriched smart home data to relevant parties to make the resident/client more active |
| BUC-Manage the flexibility on electricity demand and generation within a smart home from market signals |
| BUC-Manage flexibility on electricity demand and generation within the smart home from emergency signals |
| SUC-Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals) |
| |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| Business Use Case |
| **Further keywords for classification** |
| smart home, customization |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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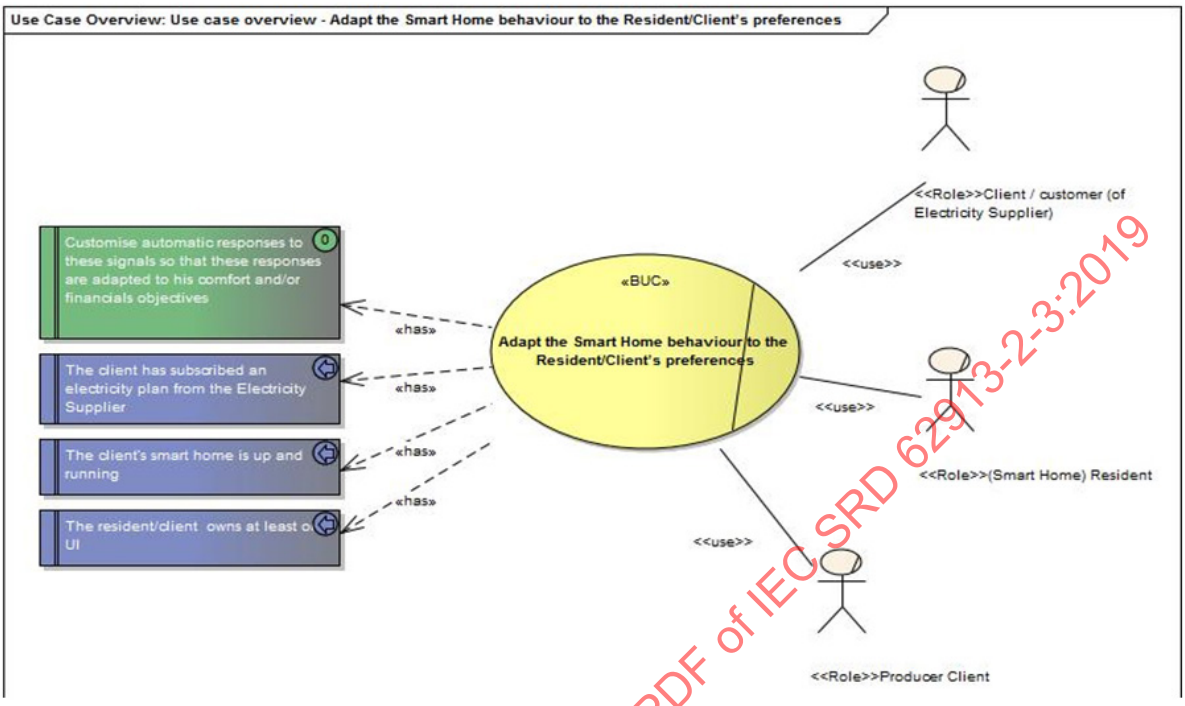
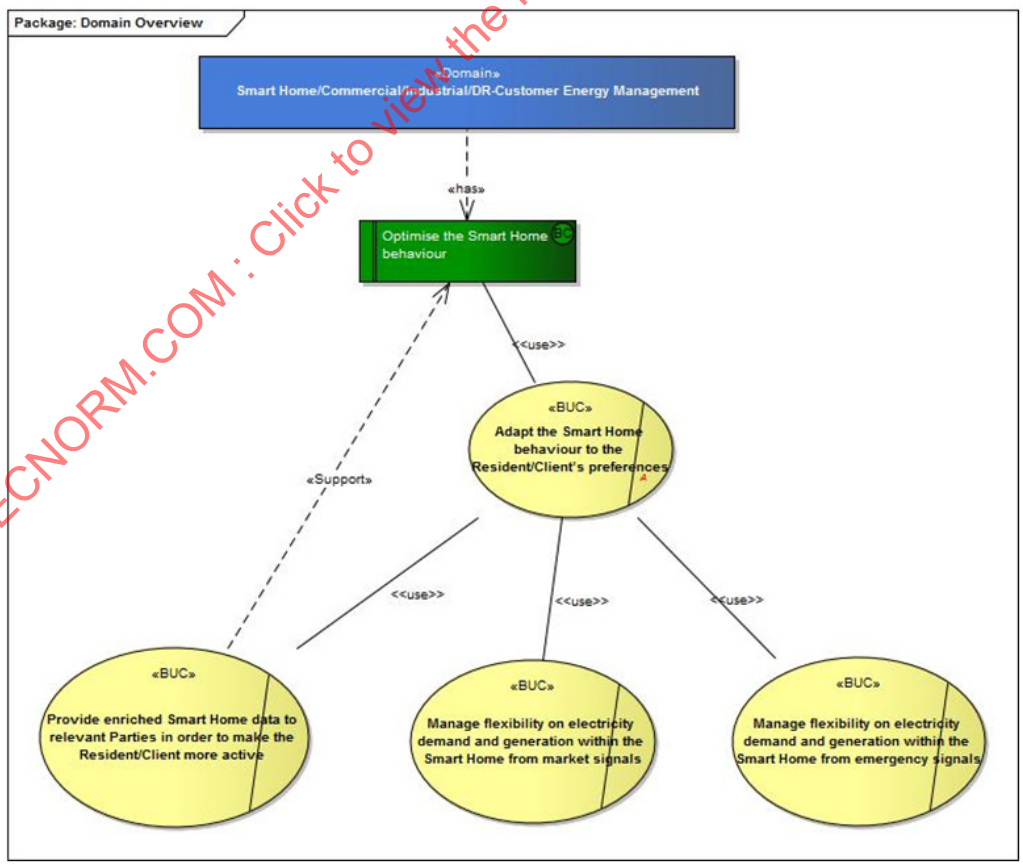
| UC62913-2-3-B042 Adapt the smart home behaviour to the resident/client's preferences |
|---|
| **Diagram(s) of use case** |

Use Case Overview diagram




Domain Overview diagram




BUC-SUC Relations diagram

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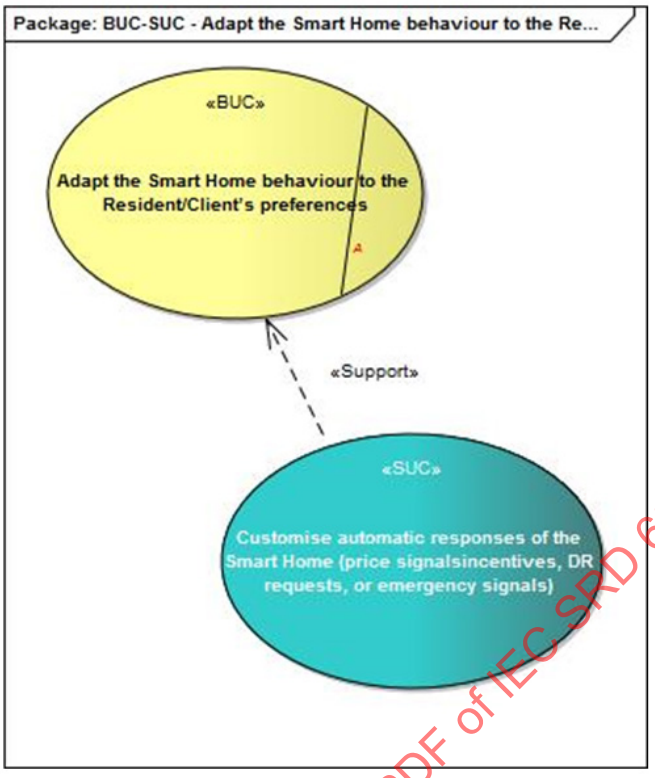
**UC62913-2-3-B042 Adapt the smart home behaviour to the resident/client's preferences**




3 Technical Details

3.1 Actors

| Actors | | | |
|---|---|---|---|
| **Grouping** | | **Group Description** | |
| | | | |
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| Resident | Role | Smart home end-user who can be a consumer resident, a producer resident or both. Certain consumers may also have their own production and/or storage capacity. It may be "passive" in the sense that it determines its consumption entirely with respect to its own needs, or "active" in the sense that it can interact with other players to determine or alter its consumption. | |
| Client/customer (of electricity supplier) | Role | A party connected to the grid that contracts for the ability to consume electricity at a metering point. | |
| Producer client | Role | A party connected to the grid at a metering point that generates and sells electricity through a contract. | |

3.2 References

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| UC62913-2-3-B042 Adapt the smart home behaviour to the resident/client's preferences | | | | | | |
|---|---|---|---|---|---|---|
| **References** | | | | | | |
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

| **Scenario conditions** | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-Condition** | **Post-Condition** |
| 1 | | | | | | |
| 2 | | | | | | |

4.2 Scenarios

| **Scenario name:** | | **No. 1 – X** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |
| **Scenario name:** | | **No. 2 – X** | | | | | | |
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

5 Information exchanged

| **Information exchanged** | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

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| UC62913-2-3-B042 Adapt the smart home behaviour to the resident/client's preferences | | |
|---|---|---|
| **Requirements (optional)** | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| R-1 | The way an opt-out is taken into account shall be consistent within a smart home. | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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## Table B.3 – Enable the interoperability between the smart home and the smart grid

| UC62913-2-3-B043 Enable the interoperability between the smart home and the smart grid |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| UC62913-2-3-B043 | Area: Energy system<br>Domain: Smart home | BUC-Enable the interoperability between the smart home and the smart grid |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | Approval status |
| 0.1 | 2014. 07.01 | EDF | First draft (short description, roles) | WD Working Document |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | Initial technical configuration of the smart home. It may include the installation and configuration of smart home devices.<br>The provision of smart home data to the relevant parties is out of the scope of the Use Case. It is described in Table B.7. |
| **Objective(s)** | • Set up the smart home so that it is correctly connected to the smart grid and customized. The automations within the smart home are running and taking in account the smart grid signals and the resident/client's preferences. |
| **Related business case(s)** | • Configure the smart home in order to enable the interoperability with the smart grid. |

1.4 Narrative of Use Case

| Narrative of use case |
|---|
| **Short description** |
| The business Use Case describes how the client configures his or her smart home to receive smart grid signals (market signals or emergency signals). The configuration may include the installation of smart home devices. |
| **Complete description** |
| |

1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |

1.6 Use case conditions

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| UC62913-2-3-B043 Enable the interoperability between the smart home and the smart grid |
|---|
| **Use case conditions** |
| **Assumption** |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier. |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| SUC-Configure the smart home in order to enable the interoperability with the smart grid |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| Business Use Case |
| **Further keywords for classification** |
| smart grid connection point, smart home |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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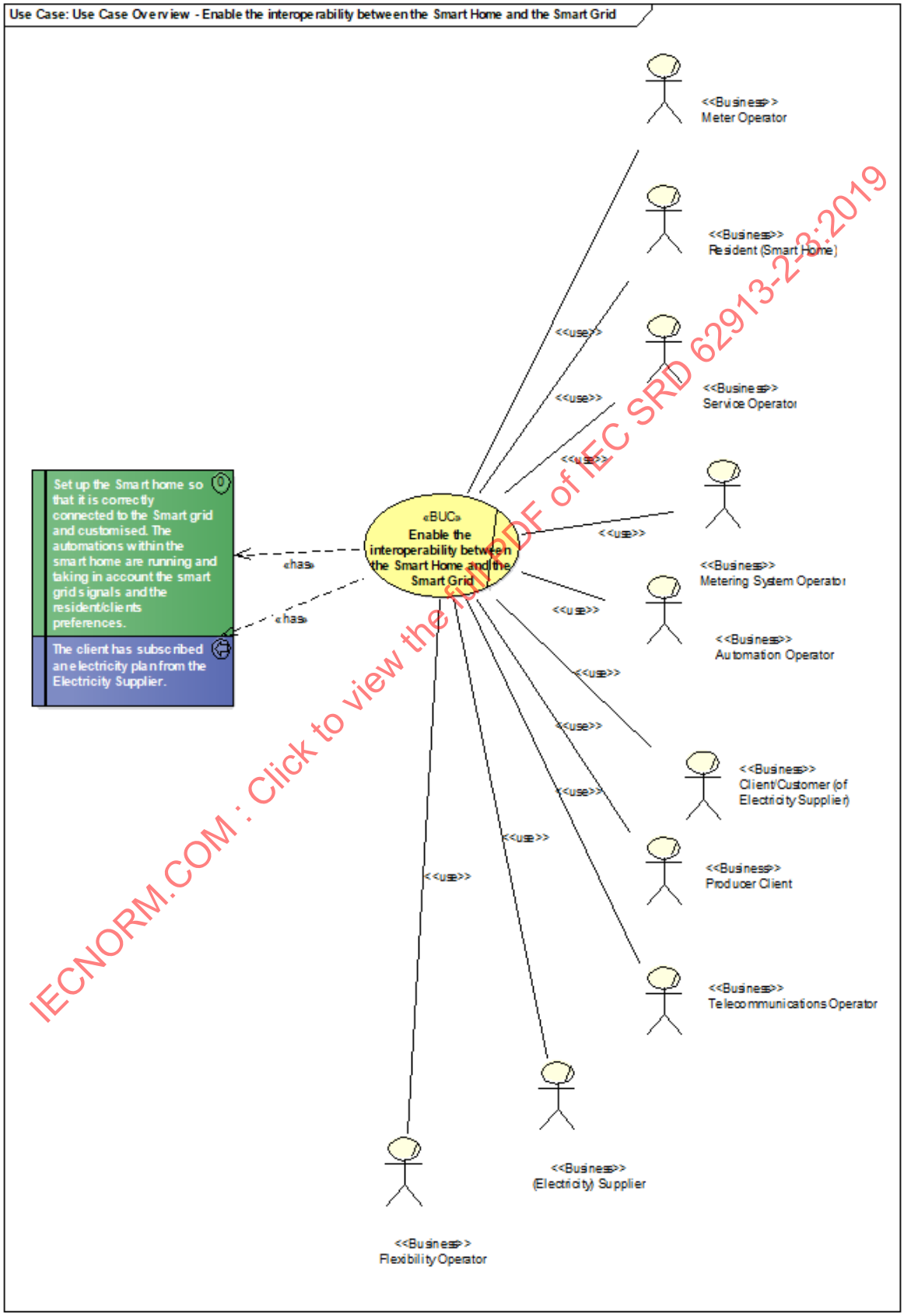
**UC62913-2-3-B043 Enable the interoperability between the smart home and the smart grid**

**Diagram(s) of use case**

Use Case Overview diagram

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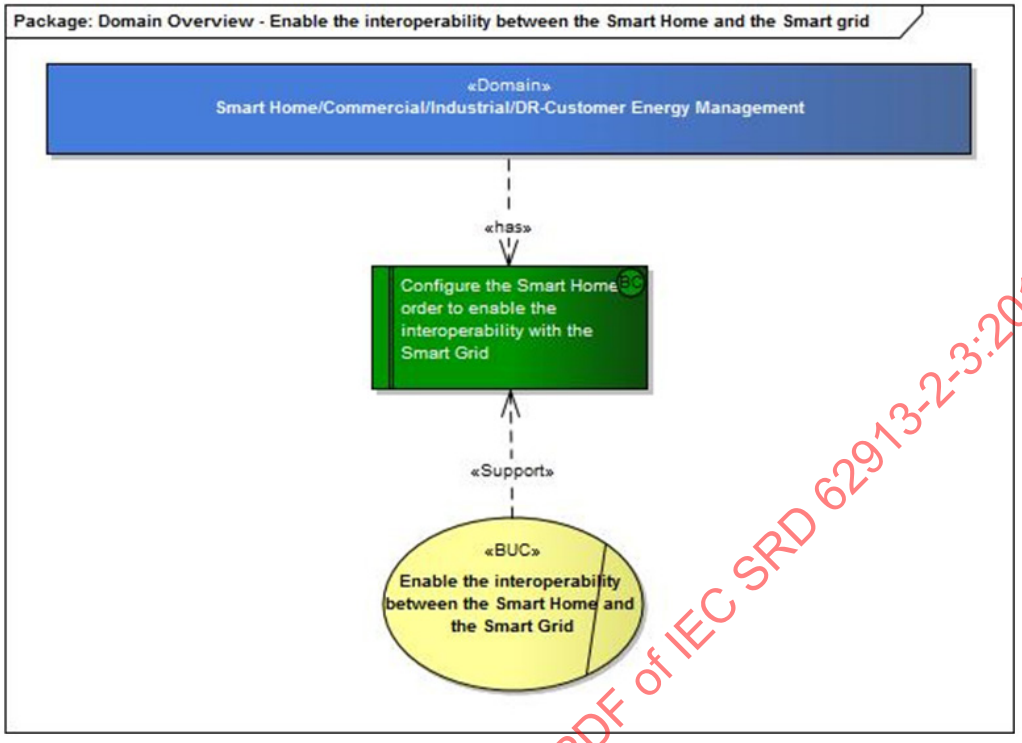
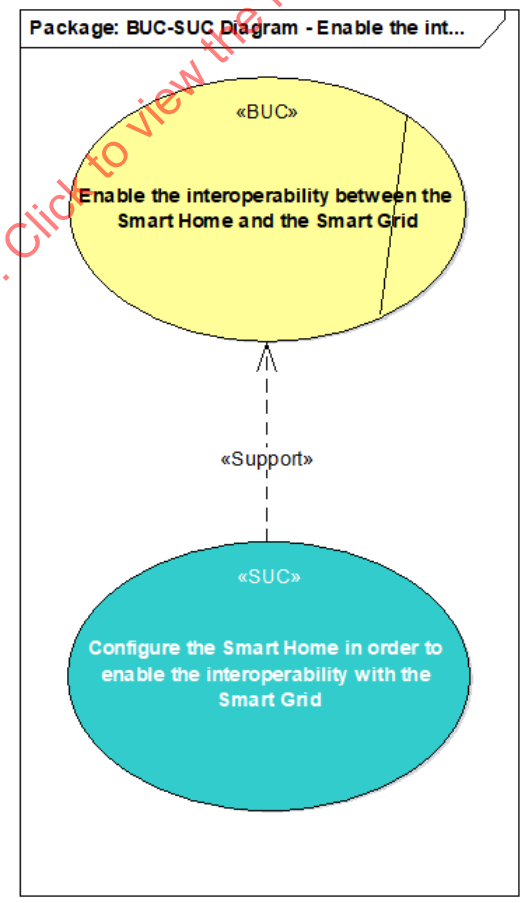
**UC62913-2-3-B043 Enable the interoperability between the smart home and the smart grid**

Domain Overview diagram




BUC-SUC Relations diagram

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**UC62913-2-3-B043 Enable the interoperability between the smart home and the smart grid**

3 Technical details

3.1 Actors

| Actors | |
|---|---|
| **Grouping** | **Group Description** |
| | |

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| UC62913-2-3-B043 Enable the interoperability between the smart home and the smart grid | | | |
|---|---|---|---|
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| Resident | Role | Smart home end-user who can be a consumer resident, a producer resident or both. Certain consumers may also have their own production and/or storage capacity. It may be "passive" in the sense that it determines its consumption entirely with respect to its own needs, or "active" in the sense that it can interact with other players to determine or alter its consumption. | |
| Client/customer (of electricity supplier) | Role | A party connected to the grid that contracts for the ability to consume electricity at a metering point. | |
| Producer client | Role | A party connected to the grid at a metering point that generates and sells electricity through a contract. | |
| Metering system operator | Role | A party responsible for:<br>- operations of the metering system, including communication with the metering points;<br>- meter reading and quality control of the reading – taking the role of Metered Data Collector defined by ENTSO-E, EFET, and eblX in their role model.<br>May also be referred to as AMI system operator. | |
| Meter operator | Role | A party responsible for installing, maintaining, testing, certifying and decommissioning physical meters in compliance with the regulated conditions for contract between ESR and their customers | |
| Service operator | Role | Entity connected to a service provider information system and to the home automation operator one. This entity operates services on behalf of a service provider. This entity can also collect and aggregate the smart home data before sending them to a service provider. | |
| Automation operator | Role | Entity managing home devices (electrical devices, electricity management devices, WAN-IAN interface). | |
| Telecommunication operator | Role | Entity that offers telecommunications services. | |
| Electricity supplier | Role | Entity whose activity is the wholesale purchase of electricity and the subsequent direct resale to client through a contract. The supplier may also deliver energy-related services such as providing flexibility through electricity price modulation (i.e. time-of-use, critical peak prices) or which can have value on energy markets and/or for network operations. | |

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**UC62913-2-3-B043 Enable the interoperability between the smart home and the smart grid**

| | | | |
|---|---|---|---|
| Flexibility operator (FO) | Role | Entity which links through contractual agreements (flexibility requests, notices, etc.) the role customer and its possibility to provide flexibilities to the roles market and grid; generic role that could be taken by many stakeholders. This entity can activate all or part of the flexibility resources during a period and regarding a specific location or geographical area. | |

3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-Condition** | **Post-Condition** |
| 1 | | | | | | |
| 2 | | | | | | |

4.2 Scenarios

| **Scenario name:** | | **No. 1 – X** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |
| **Scenario name:** | | **No. 2 – X** | | | | | | |
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

5 Information exchanged

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| UC62913-2-3-B043 Enable the interoperability between the smart home and the smart grid | | | |
|---|---|---|---|
| Information exchanged | | | |
| Information exchanged ID | Name of information | Description of information exchanged | Requirements IDs |
| | | | |
| | | | |

6 Requirements (optional)

| Requirements (optional) | | |
|---|---|---|
| Category ID | Categories for requirements | Category description |
| | | |
| Requirement ID | Requirement description | |
| | | |
| | | |
| Category ID | Categories for requirements | Category description |
| | | |
| Requirement ID | Requirement description | |
| | | |
| | | |

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| Term | Definition |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| Key | Value | Refers to Section |
| | | |
| | | |

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## Table B.4 – Provide enriched smart home data to relevant parties in order to make the resident/client more active

| UC62913-2-3-B046 Provide enriched smart home data to relevant parties in order to make the resident/client more active |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| UC62913-2-3-B046 | Area: Energy system<br>Domain: Smart home | BUC-Provide enriched smart home data to relevant parties in order to make the resident/client more active |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | Provision to a smart home resident/client or other relevant parties of electricity data related to the behaviour of the smart home (registers, load profiles, consumption per period, consumption per usage.) in real-time operations or in ex-post. |
| **Objective(s)** | – Empower the resident/client to be aware of his consumption habits, energy costs and behaviour by providing him with data regarding the electricity behaviour of the smart home.<br>– Make these data available to a third party (such as a service provider) according to market rules and established contracts with the client, in order to allow this third party to perform a service for the resident/client. |
| **Related business case(s)** | – Optimize the smart home behaviour. |

1.4 Narrative of Use Case

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| UC62913-2-3-B046 Provide enriched smart home data to relevant parties in order to make the resident/client more active |
|---|
| **Narrative of use case** |
| **Short description** |
| The business Use Case describes how the resident/client or an authorized third party receives electricity data regarding the electricity behaviour of the smart home. The occurrence of events is monitored and the resident/client is warned if an event occurs. |
| **Complete description** |
| These data can be made available to a third party:<br>• a role embodied by a physical person (client, resident) via a UI,<br>• an automated system that uses these data within the smart home.<br>These energy data are related to the electricity behaviour of the smart home (at least global electricity data that can be enhanced by specific data in the smart home).<br>These electricity data are available locally and can be made available:<br>• externally, off-site<br>• locally, in the smart home.<br>These electricity data can be enriched with:<br>• data located in the smart home,<br>• data located outside of the site These data may be for instance:<br>– dynamic peak notifications,<br>– weather forecast,<br>– consumption estimates,<br>– ...<br>Functions:<br>• Make the smart home's electricity data locally available.<br>• Make the smart home's electricity data externally available.<br>• Enhance the smart home's electricity data with local or external data.<br>• Provide alarms related to the smart home electricity behaviour to the client or resident.<br>• Monitor the occurrence of (the) event(s).<br>• Warn if an event occurs.<br>Principles<br>See related SUC.<br><br>Assumptions<br>See related SUC. |

1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

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| UC62913-2-3-B046 Provide enriched smart home data to relevant parties in order to make the resident/client more active |
|---|
| **Use case conditions** |
| **Assumption** |
| • |
| • |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier |
| • The resident/client owns at least one UI |
| • The client's smart home is up and running |
| • If necessary, the smart home is configured to feedback data |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| SUC-Provide a third party with enriched smart home electricity data |
| SUC-Provide alarms related to the smart home electricity behaviour to the client or resident |
| BUC-Adapt the smart home behaviour to the resident/client's preferences |
| BUC-Enable the interoperability between the smart home and the smart grid |
| **Level of depth** |
| |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| Business Use Case |
| **Further keywords for classification** |
| smart home, data |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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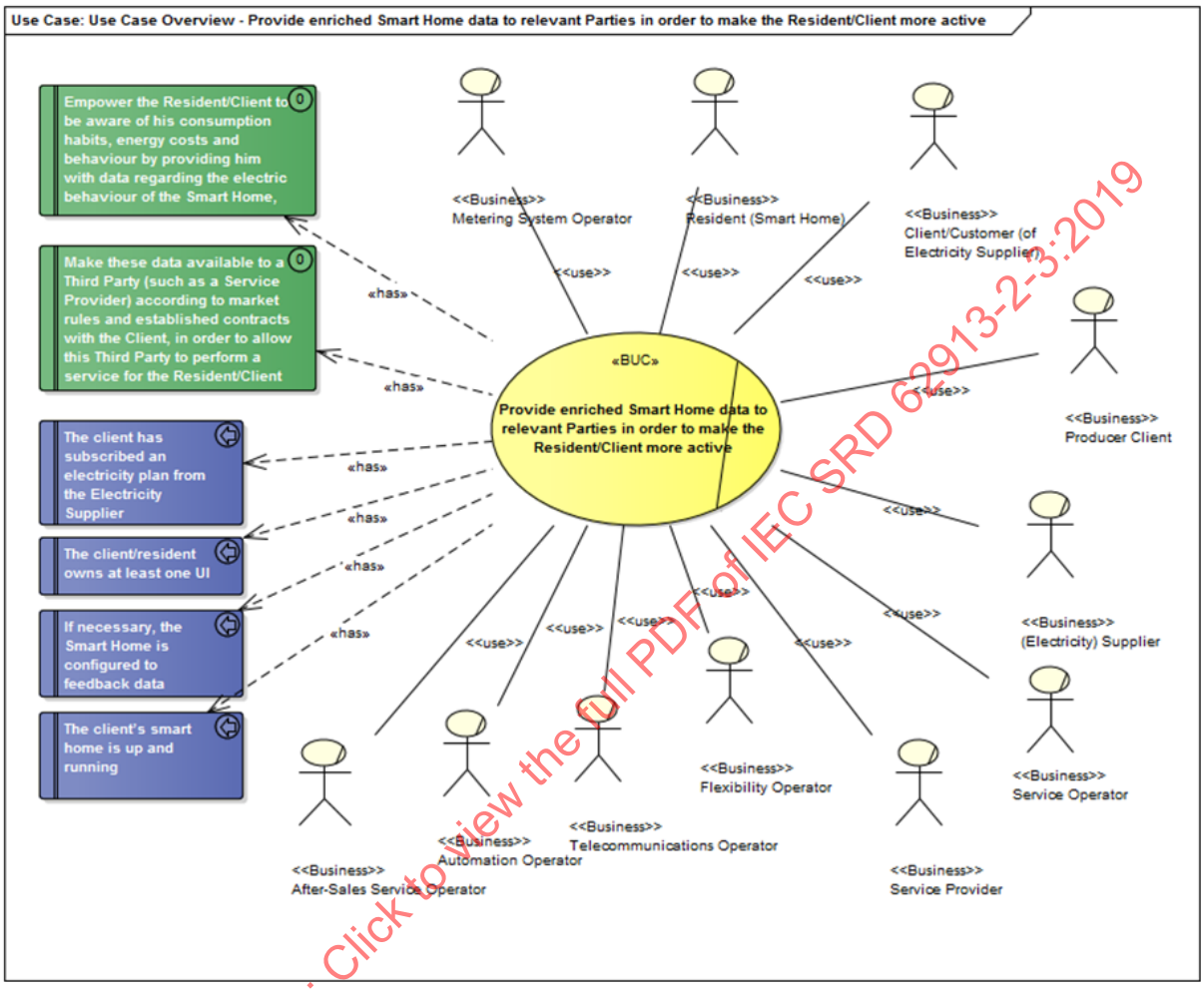
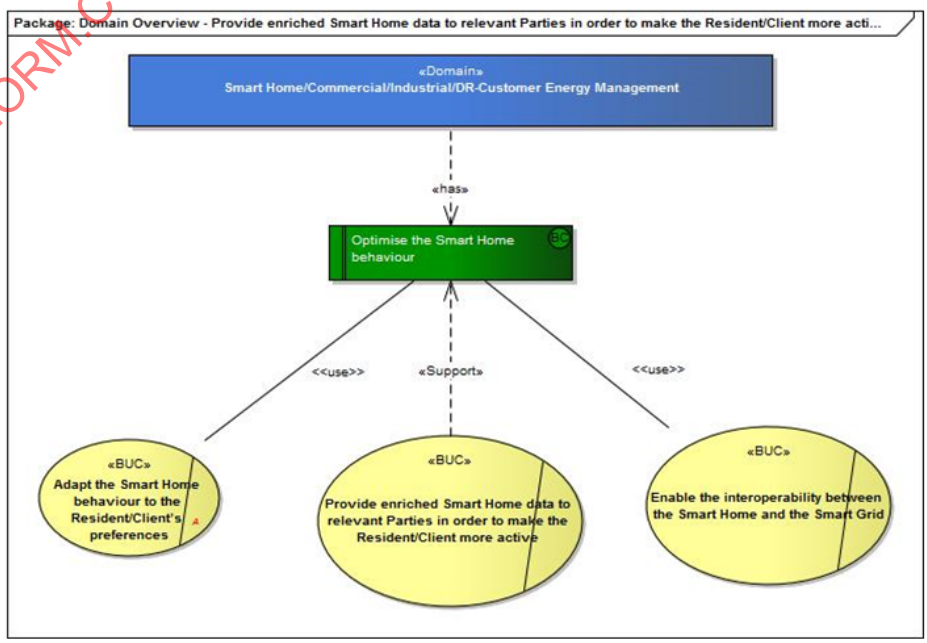
**UC62913-2-3-B046 Provide enriched smart home data to relevant parties in order to make the resident/client more active**

**Diagram(s) of use case**

Use Case Overview diagram




Domain Overview diagram

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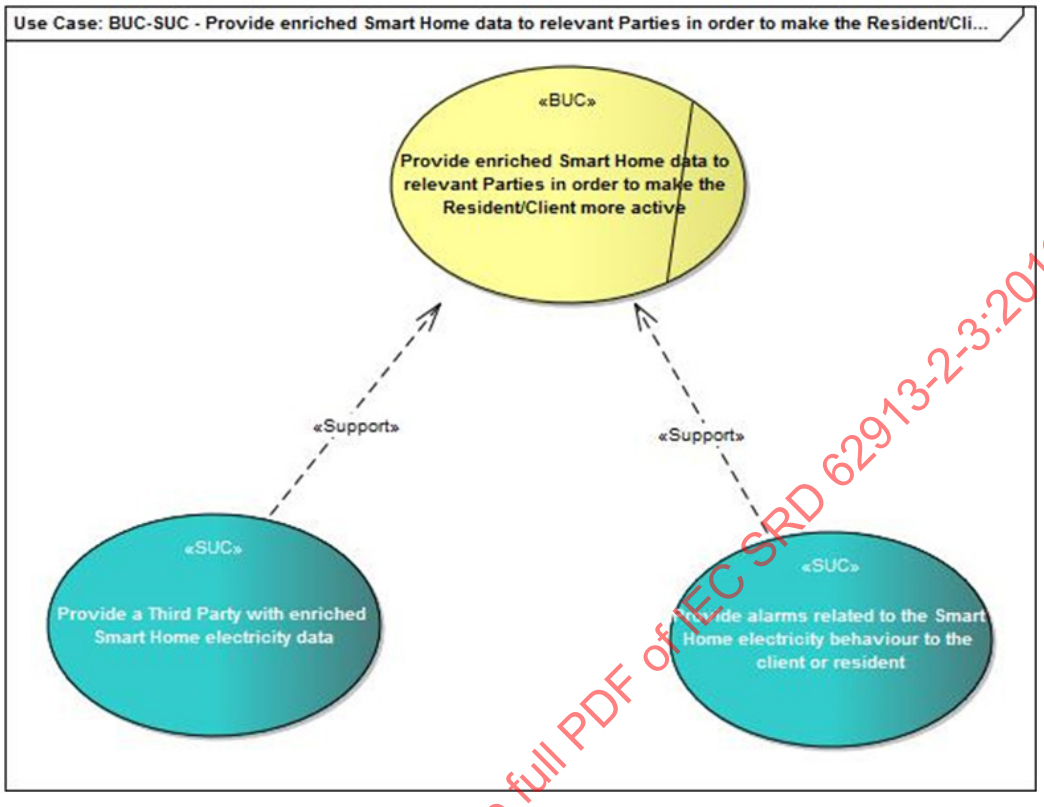
**UC62913-2-3-B046 Provide enriched smart home data to relevant parties in order to make the resident/client more active**

BUC-SUC Relations diagram




3 Technical details

3.1 Actors

| Actors | |
|---|---|
| **Grouping** | **Group Description** |
| | |

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| UC62913-2-3-B046 Provide enriched smart home data to relevant parties in order to make the resident/client more active | | |
|---|---|---|
| Resident | Role | Smart home end-user who can be a consumer resident, a producer resident or both. Certain consumers may also have their own production and/or storage capacity. It may be "passive" in the sense that it determines its consumption entirely with respect to its own needs, or "active" in the sense that it can interact with other players to determine or alter its consumption. |
| Client/customer (of electricity supplier) | Role | A party connected to the grid that contracts for the ability to consume electricity at a metering point. |
| Producer client | Role | A party connected to the grid at a metering point that generates and sells electricity through a contract. |
| Electricity supplier | Role | Entity whose activity is the wholesale purchase of electricity and the subsequent direct resale to client through a contract. The supplier may also deliver energy-related services such as providing flexibility through electricity price modulation (i.e. time-of-use, critical peak prices) or which can have value on energy markets and/or for network operations. |
| Service provider | Role | Entity providing services to players in the system (such as metering, telemonitoring, maintenance, etc.) other than aggregation and electricity storage. It includes service providers to the consumers. |
| Service operator | Role | Entity connected to a service provider information system and to the home automation operator one. This entity operates services on behalf of a service provider. This entity can also collect and aggregate the smart home data before sending them to a service provider. |
| Metering system operator | | A party responsible for:<br>- operations of the metering system, including communication with the metering points;<br>- meter reading and quality control of the reading – taking the role of Metered Data Collector defined by ENTSO-E, EFET, and ebIX in their role model.<br>May also be referred to as AMI system operator. |
| Flexibility operator | Role | Entity which links through contractual agreements (flexibility requests, notices, etc.) the role customer and its possibility to provide flexibilities to the roles market and grid; generic role that could be taken by many stakeholders. This entity can activate all or part of the flexibility resources during a period and regarding a specific location or geographical area. |
| Telecommunication operator | Role | Entity that offers telecommunications services. |
| Automation operator | Role | Entity managing home devices (electrical devices, electricity management devices, WAN-IAN interface). |
| After-sales service operator | Role | Entity that offers after-sales services at home. |

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3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

**UC62913-2-3-B046 Provide enriched smart home data to relevant parties in order to make the resident/client more active**

4 Step by step analysis of use case

4.1 Overview of scenarios

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-Condition** | **Post-Condition** |
| 1 | | | | | | |
| 2 | | | | | | |

4.2 Scenarios

| **Scenario name:** | | **No. 1 – X** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

| **Scenario name:** | | **No. 2 – X** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

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| UC62913-2-3-B046 Provide enriched smart home data to relevant parties in order to make the resident/client more active | | |
|---|---|---|
| **Requirements (optional)** | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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## Table B.5 – Manage the flexibility on electricity demand and generation within a smart home from market signals

| UC62913-2-3-B044 Manage the flexibility on electricity demand and generation within a smart home from market signals |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| UC62913-2-3-B044 | Area: Energy system<br>Domain: Smart home | BUC-Manage the flexibility on electricity demand and generation within a smart home from market signals |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | The scope is restricted to the smart home.<br>Emergency signals are out of the scope of the Use Case. |
| **Objective(s)** | – Adapt the behaviour of the smart home following the reception of market signals. |
| **Related business case(s)** | – Manage the flexibility of the smart home. |

1.4 Narrative of Use Case

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| UC62913-2-3-B044 Manage the flexibility on electricity demand and generation within a smart home from market signals |
|---|
| **Narrative of use case** |
| **Short description** |
| The business Use Case describes how the client/resident responds to market signals (price incentives or DR requests) and adapts the behaviour of the smart home. The resident/client may:<br>– optimize the energy bill through anticipation of a dynamic peak period send by the electricity supplier through the grid,<br>– define the load management strategy and adapt it depending on a DR request – if the resident/client has subscribed a contract with a flexibility operator,<br>– opt-out of a planned or occurring automatic response after receiving a notification or during the execution of an automatic response that results from a price incentive or a DR request. In that case, the smart home will not apply a strategy that takes into account price incentives or DR requests or will apply a new strategy that matches the resident/client's instructions. |
| **Complete description** |
| Clients/residents of a smart home may contribute to reduce peak electricity consumption by responding to market signals. The flexibility of ecosystems can be controlled in different ways:<br>– price incentives period corresponding to changes in electricity prices issued at the initiative of the electricity supplier to help anticipate, stop, reduce or postpone certain uses of ecosystems,<br>– flexibility requests.<br>The resident/client may decide to opt out of price incentives and demands of flexibility (according to the contract condition), if desired.<br>The resident/client opts-out of a planned or occurring automatic response after receiving a notification or during the execution of an automatic response:<br>– entirely or to a given level, i.e. either not to take into account price incentives or to apply an instruction that the resident/client wants;<br>– over different scopes: the whole smart home, one or several areas (rooms), one or several uses, one or several appliances.<br>Price incentives, resident/client customizations and possible opt-outs are taken into account so as to define the load management strategy.<br>Functions:<br>• Before a peak and depending on the price levels of the next day: anticipate if need be<br>• During a peak: shut off or automatically reduce loads within the customer's smart home<br>• After a peak: switch back on loads if need be<br>• After a change in supplier index: choose and execute a load management strategy<br>• Before a DR request if a notification is sent: anticipate if need be and if possible<br>• Upon receipt of the DR request: define and carry out a load management strategy<br>• At the end of the DR request period: define and carry out a load management strategy by switching back on loads if need be<br>• Opt-out<br>Principles<br>See related SUC |

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1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

**UC62913-2-3-B044 Manage the flexibility on electricity demand and generation within a smart home from market signals**

1.6 Use case conditions

| Use case conditions |
|---|
| **Assumption** |
| • See related system Use Cases |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier |
| • The resident/client may have subscribed a contract to make flexibilities available to a flexibility operator |
| • The client/resident's smart home is up and running |
| • The smart meter receives timed actions to be executed in order to announce a dynamic peak period (which means that beforehand, the electricity supplier has requested to activate a dynamic peak period for this client) |
| • The client/resident owns a least one UI |
| • If needed the smart home is configured to feedback data enabling to validate the activation of flexibilities (for example, the smart meter is configured in "load curve" mode) |
| • DR requests are received through the SGCP |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| SUC-Manage the flexibility of the smart home on electricity demand and generation from price incentives |
| SUC-Manage the flexibility of the smart home on electricity demand and generation from DR requests |
| SUC-Manage opt-outs of automatic responses (only price signals and DR requests, emergency excluded) including manual actions |
| BUC-Adapt the smart home behaviour to the resident/client's preferences |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| Business Use Case |
| **Further keywords for classification** |
| smart home, load management strategy, price incentive, DR request, opt-out |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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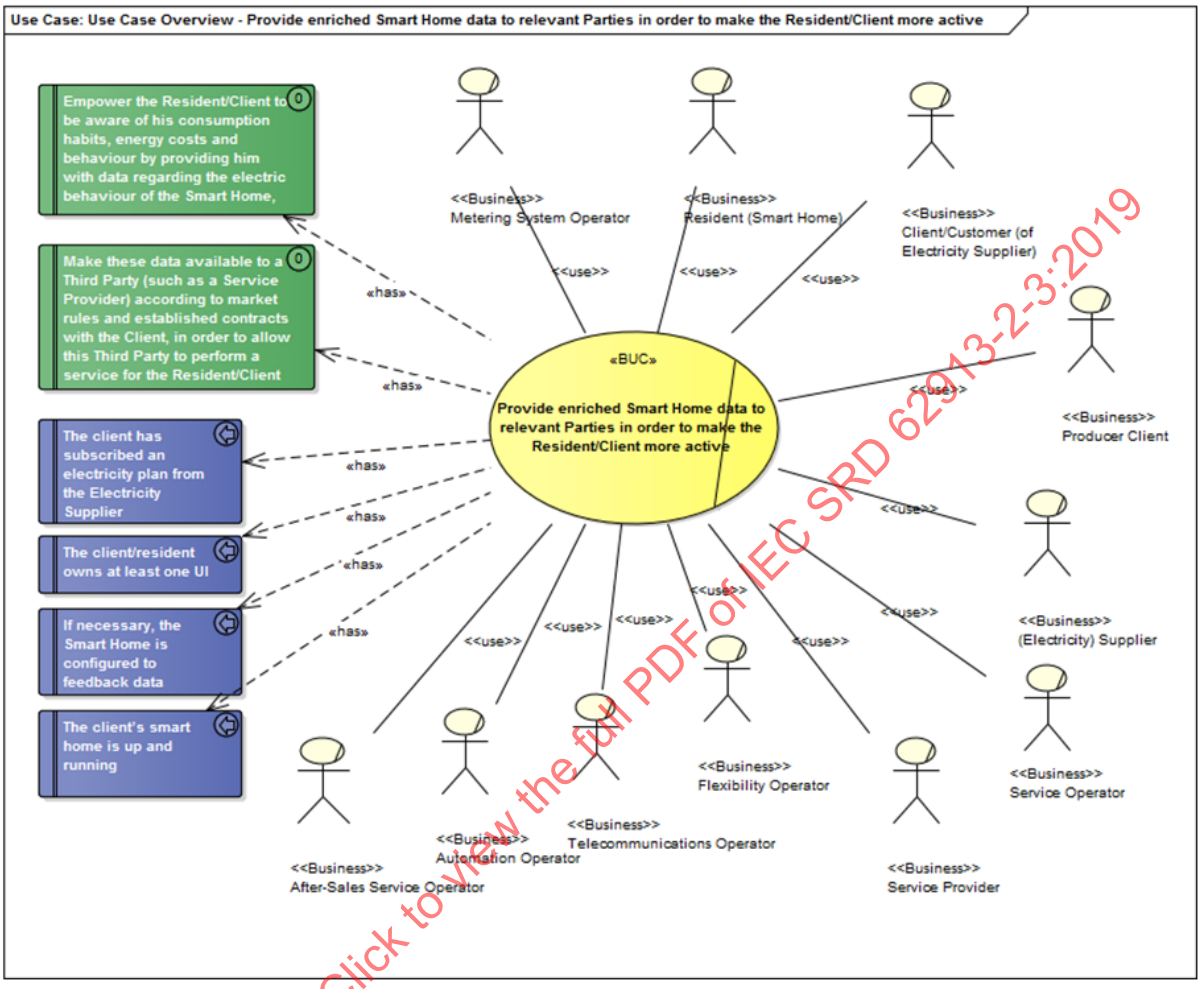
**UC62913-2-3-B044 Manage the flexibility on electricity demand and generation within a smart home from market signals**

**Diagram(s) of use case**

Use Case Overview diagram




Domain Overview diagram

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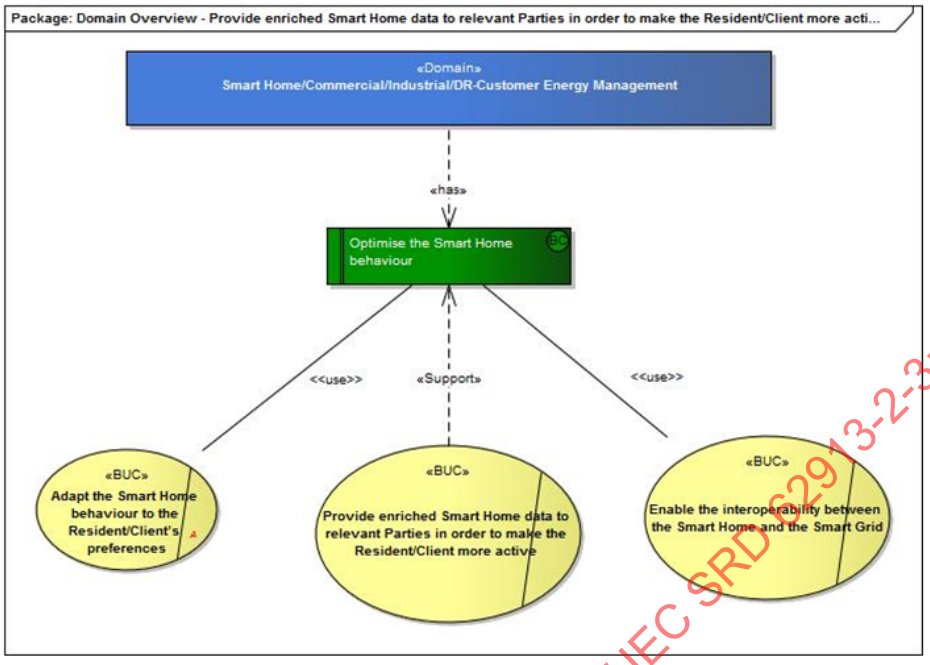
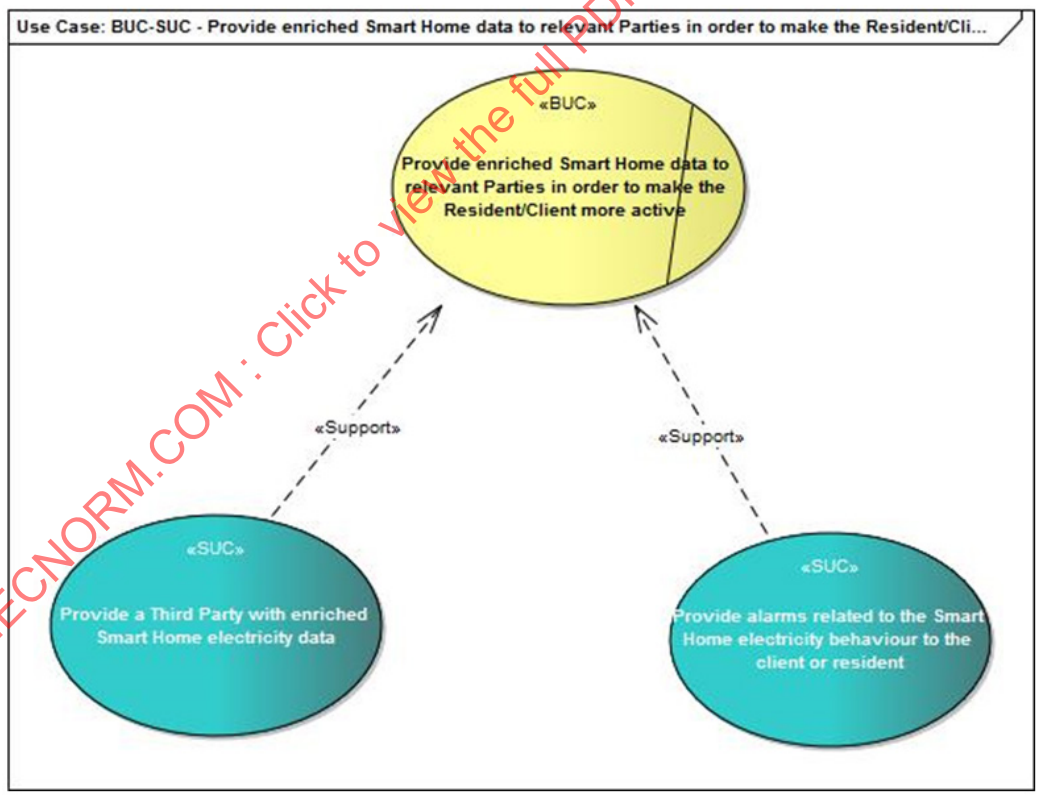
**UC62913-2-3-B044 Manage the flexibility on electricity demand and generation within a smart home from market signals**




BUC-SUC Relations diagram

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3 Technical details

3.1 Actors

| Actors | |
|---|---|
| **Grouping** | **Group Description** |
| | |

| UC62913-2-3-B044 Manage the flexibility on electricity demand and generation within a smart home from market signals | | | |
|---|---|---|---|
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| Resident | Role | Smart home end-user who can be a consumer resident, a producer resident or both. Certain consumers may also have their own production and/or storage capacity. It may be "passive" in the sense that it determines its consumption entirely with respect to its own needs, or "active" in the sense that it can interact with other players to determine or alter its consumption. | |
| Client/customer (of electricity supplier) | Role | A party connected to the grid that contracts for the ability to consume electricity at a metering point. | |
| Producer client | Role | A party connected to the grid at a metering point that generates and sells electricity through a contract. | |
| Electricity supplier | Role | Entity whose activity is the wholesale purchase of electricity and the subsequent direct resale to client through a contract. The supplier may also deliver energy-related services such as providing flexibility through electricity price modulation (i.e. time-of-use, critical peak prices) or which can have value on energy markets and/or for network operations. | |
| Metering system operator | Role | A party responsible for:<br>- operations of the metering system, including communication with the metering points;<br>- meter reading and quality control of the reading – taking the role of Metered Data Collector defined by ENTSO-E, EFET, and ebIX in their role model.<br>May also be referred to as AMI system operator. | |
| Flexibility operator | Role | Entity which links through contractual agreements (flexibility requests, notices, etc.) the role customer and its possibility to provide flexibilities to the roles market and grid; generic role that could be taken by many stakeholders. This entity can activate all or part of the flexibility resources during a period and regarding a specific location or geographical area. | |
| Telecommunication operator | Role | Entity that offers telecommunications services. | |

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3.2 References

| UC62913-2-3-B044 Manage the flexibility on electricity demand and generation within a smart home from market signals | | | | | | |
|---|---|---|---|---|---|---|
| **References** | | | | | | |
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-Condition** | **Post-Condition** |
| 1 | | | | | | |
| 2 | | | | | | |

4.2 Scenarios

| **Scenario name:** | | **No. 1 – X** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |
| **Scenario name:** | | **No. 2 – X** | | | | | | |
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

| Requirements (optional) | | |
|---|---|---|
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |

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| UC62913-2-3-B044 Manage the flexibility on electricity demand and generation within a smart home from market signals | | |
|---|---|---|
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| **Term** | **Definition** |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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**Table B.6 – Adapt the smart building behaviour to the energy manager/client's preferences**

| UC62913-2-3-B048 Adapt the smart building behaviour to the energy manager/client's preferences |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| UC62913-2-3-B048 | Area: Energy system<br>Domain: Smart building | BUC-Adapt the smart building behaviour to the client/energy manager's preferences |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| 0.1 | 2014 | EDF | First draft (short description, roles) | WD Working Document |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | Customization of the smart building<br>The management of signals from the market or the management of emergency signals are out of the scope of the Use Case. |
| **Objective(s)** | – Customize automatic responses to these signals so that these responses are adapted to the client/energy manager's business process and/or financial objectives. |
| **Related business case(s)** | – Optimize the smart building behaviour. |

1.4 Narrative of Use Case

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| UC62913-2-3-B048 Adapt the smart building behaviour to the energy manager/client's preferences |
|---|
| **Narrative of use case** |
| **Short description** |
| The business Use Case describes how the client/energy manager customizes the management of his or her equipment namely during dynamic peak periods and the monitoring of events, according to his or her preferences (decision based on economic optimization). He or she responds to events in automatic mode, and delegates the customization to an authorized third party. |
| **Complete description** |

This Use Case include two scenarios:

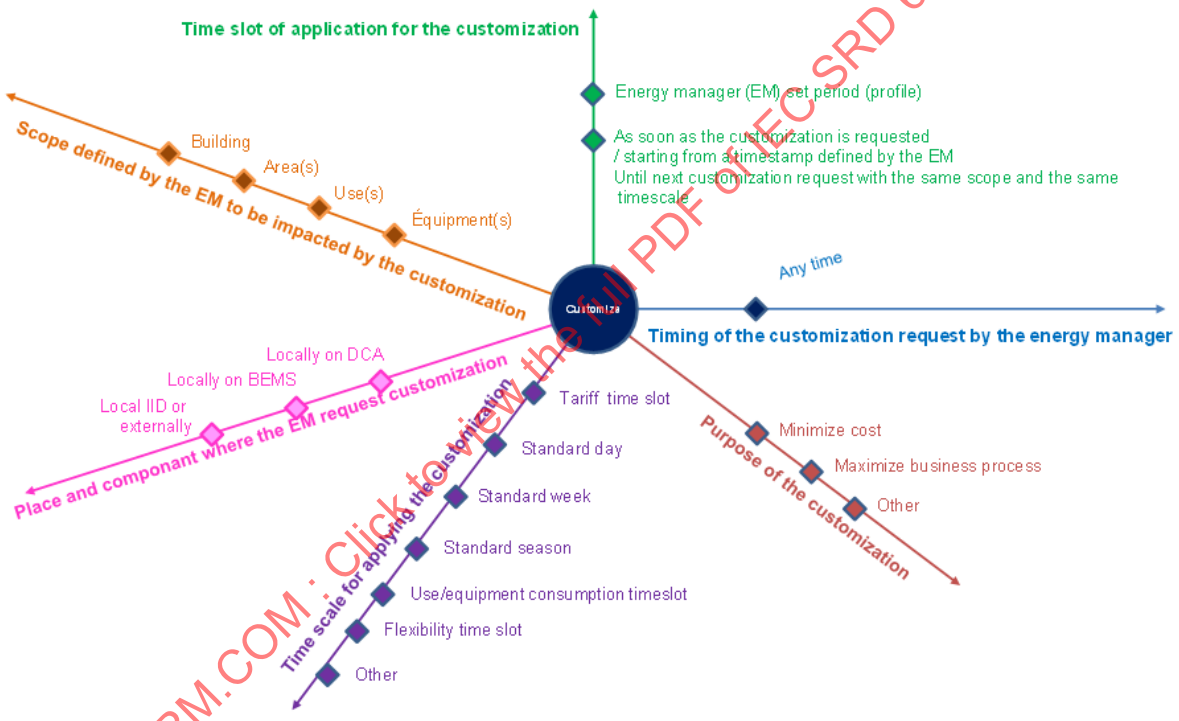
– Scenario 1: Customize the smart building with automatic responses;

– Scenario 2: Delegate the smart building customization to a third party by providing relevant data.

Scenarios 1 and 2 are possibilities offered to the client. However, the related customization process is only described for Scenario 1:

– Regarding Scenario 2, the needed information exchanges are described in Table B.14.

The figure below highlights the different ways to customize the energy management depending on the smart building capabilities.

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**1-Customize the smart home with automatic responses**

The client/Energy manager customizes the behaviour of the smart building in order to automatically respond to external signals. The client/energy manager keeps the possibility to opt out of these signals.

**1.1-Customize the automatic responses of the smart home**

Depending on the smart building capabilities and the client/energy manager needs, the customization may be defined and applied to different scopes, that is to say:

– the whole smart building,

– one or several areas,

– one or several uses,

– one or several equipment.

**UC62913-2-3-B048 Adapt the smart building behaviour to the energy manager/client's preferences**

Depending on the smart home capabilities, the customization may be defined and applied to different timescales:

– tariff time slot,

– standard day,

– standard week,

– standard season,

– flexibility time slot

– use/appliance consumption time slot.

**1.2-Customize warnings**

The energy manager/client customizes warnings, i.e. events to be tracked, and specifies the related emission channel.

For instance, the event to be tracked is exceeding an electricity data threshold in the smart building (such as a threshold of consumption in kWh).

**1.3-Receive a notification**

The client/energy manager receives a notification confirming that the new customization has been taken into account.

The client/energy manager may read the customization.

**3-Delegate the smart building customization to a third party by providing relevant data**

In order to deal with the complexity of the smart building management, the energy manager/client may contract with a third party, such as a service provider for instance, to manage the customization of the smart building.

**3.1-Authorize a third party**

The energy manager/client authorizes a designated third party to access smart building data and to customize the smart building behaviour.

The energy manager/client may also indicate general preferences (financial optimization, comfort) to be taken into account for the customization.

**3.2-Analyse the data and propose a schedule**

Based on the analysis of the smart building data collected and preferences indicated by the energy manager/client, the third party elaborates a schedule with automatic responses to external events.

1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

| Use case conditions |
|---|
| **Assumption** |
| • See related system Use Case |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier |
| • The client's smart building is up and running |
| • The energy manager/client owns at least one UI |

1.7 Further information to the use case for classification / mapping

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| UC62913-2-3-B048 Adapt the smart building behaviour to the energy manager/client's preferences |
|---|
| **Classification information** |
| **Relation to other use cases** |
| BUC-Provide enriched smart building data to relevant parties to make the resident/client more active |
| BUC-Manage the flexibility on electricity demand and generation within a smart building from market signals |
| BUC-Manage flexibility on electricity demand and generation within the smart building from emergency signals |
| SUC-Customize automatic responses of the smart building (price incentives, DR requests, or emergency signals) |
| SUC-Optimize the smart building behaviour regarding internal and external information received |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| Business Use Case |
| **Further keywords for classification** |
| smart building, customization |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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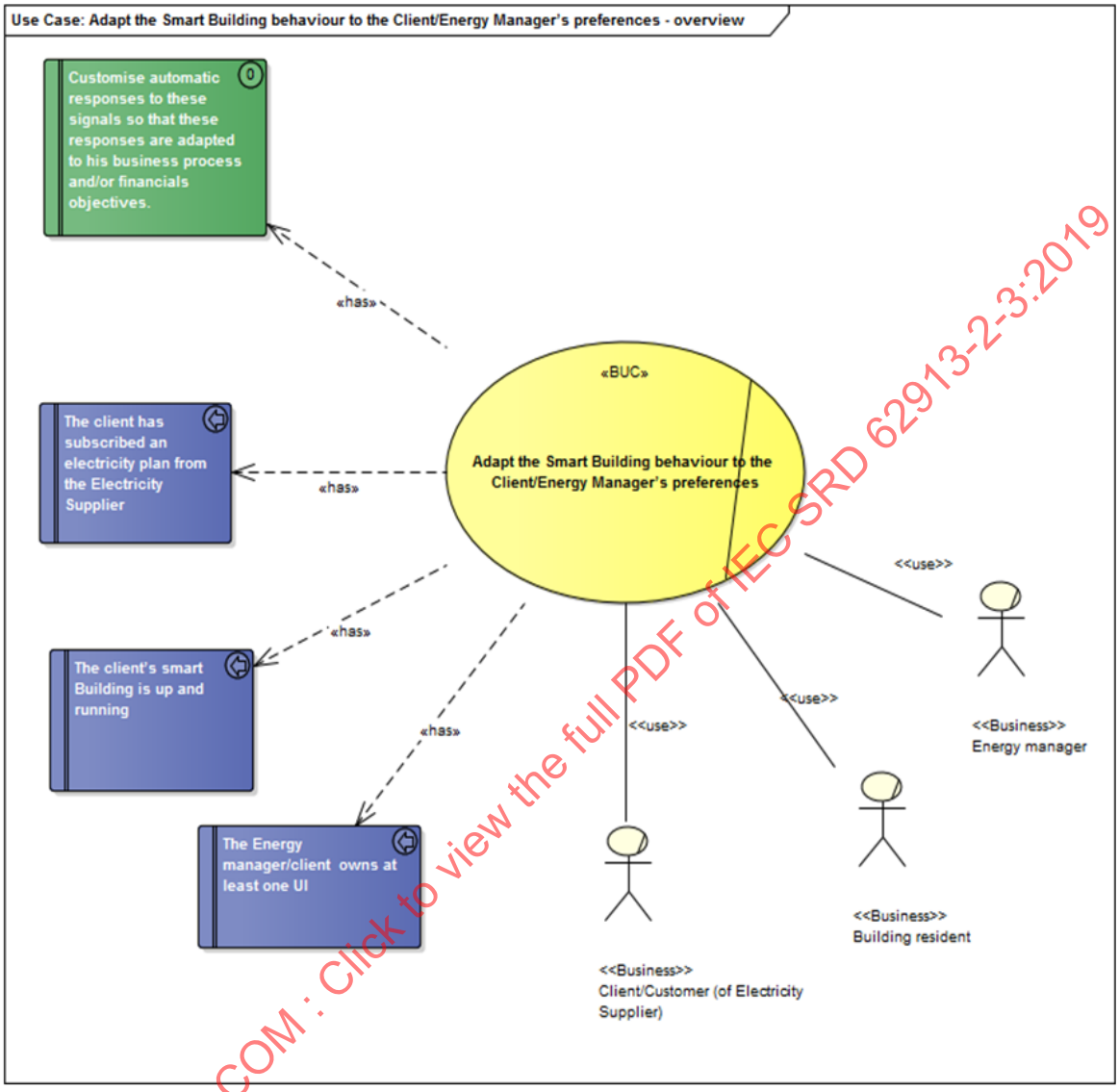
| UC62913-2-3-B048 Adapt the smart building behaviour to the energy manager/client's preferences |
|---|
| **Diagram(s) of use case** |
| Use Case Overview diagram |




Domain Overview diagram

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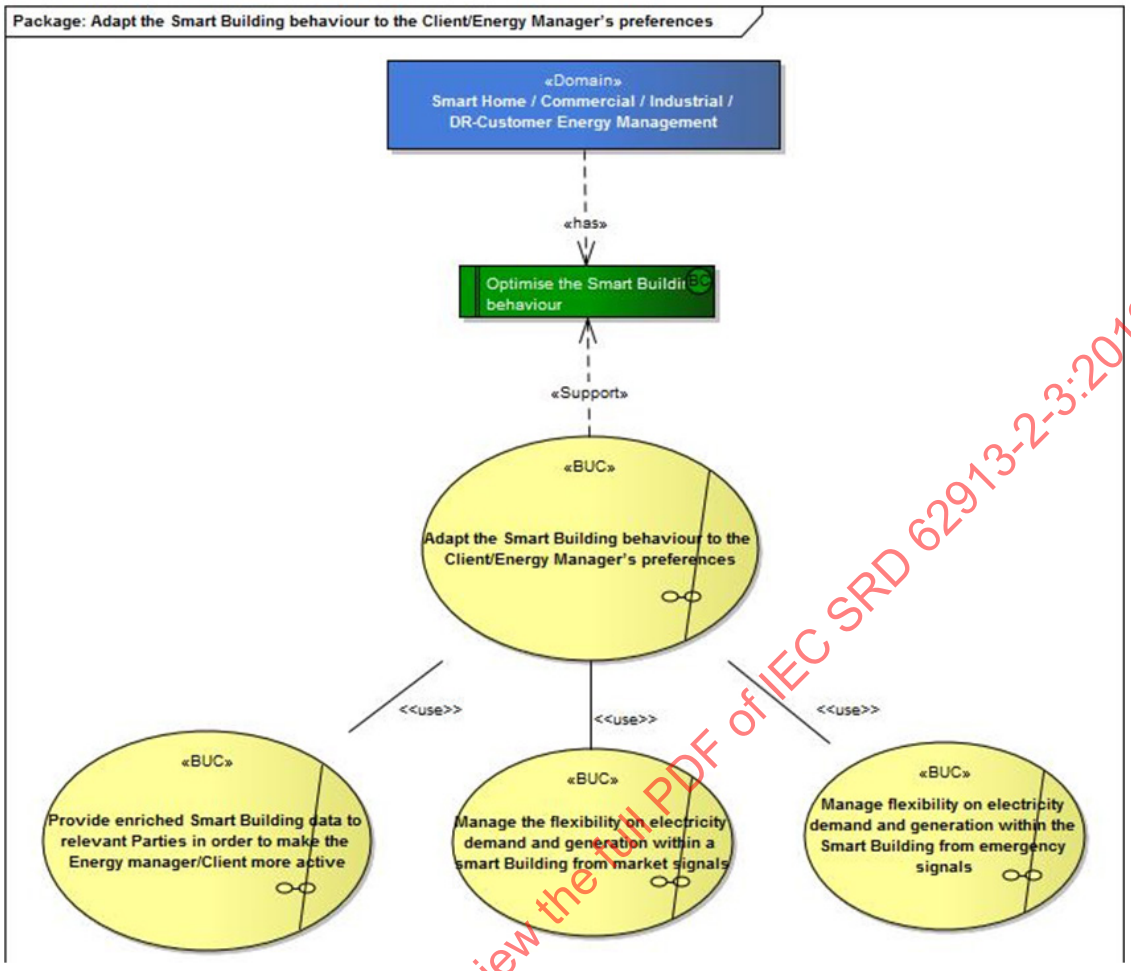
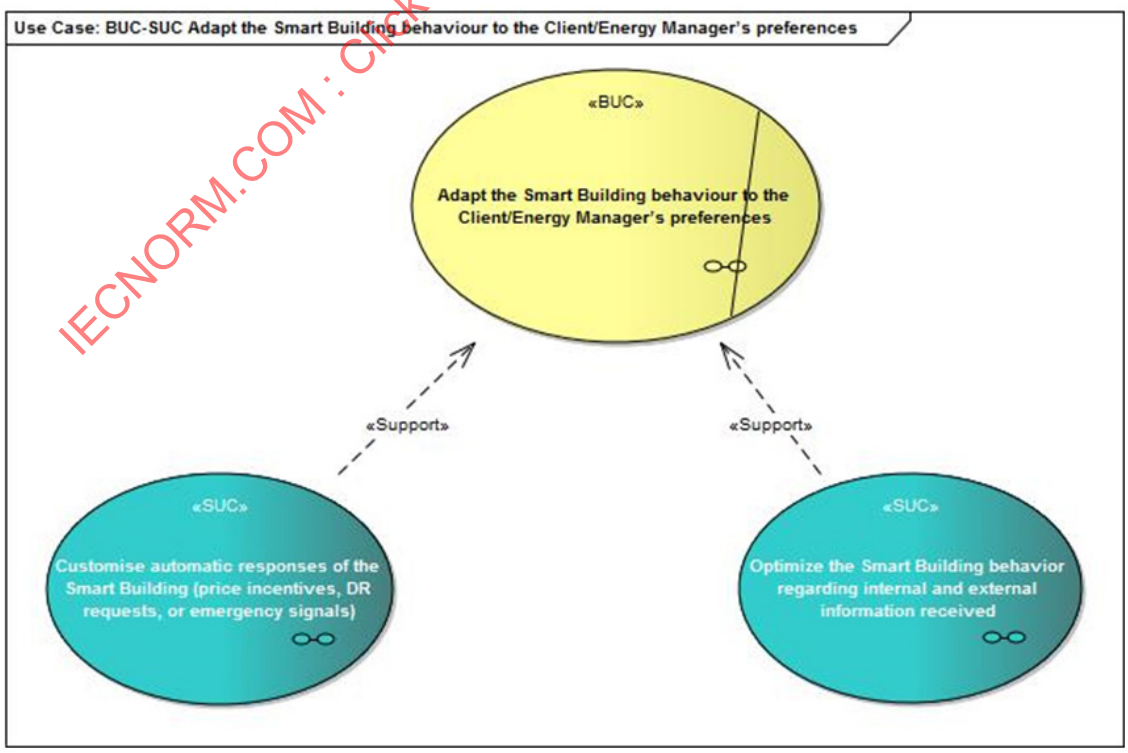
**UC62913-2-3-B048 Adapt the smart building behaviour to the energy manager/client's preferences**




BUC-SUC Relations diagram

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**UC62913-2-3-B048 Adapt the smart building behaviour to the energy manager/client's preferences**

3 Technical details

3.1 Actors

| Actors | | | |
|---|---|---|---|
| **Grouping** | | **Group Description** | |
| | | | |
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| | | | |
| Client/customer (of electricity supplier) | Role | A party connected to the grid that contracts for the ability to consume electricity at a metering point. The client may also be producer of electricity and may contract with the electricity feed in operator to feed electricity in the grid | |
| Building resident | Role | A party that is a resident of the building and that may customize some of the uses or equipment according to the rights that the energy manager has given to him or her | |
| Energy manager | Role | A party in charge of the energy management of the smart building | |

3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-Condition** | **Post-Condition** |
| 1 | | | | | | |
| 2 | | | | | | |

4.2 Scenarios

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| UC62913-2-3-B048 Adapt the smart building behaviour to the energy manager/client's preferences | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Scenario name: | | No. 1 – X | | | | | | |
| Step No. | Event | Name of process / activity | Description of process/ activity | Service | Information producer (actor) | Information receiver (actor) | Information exchanged (IDs) | Requirements R-IDs |
| | | | | | | | | |
| | | | | | | | | |
| Scenario name: | | No. 2 – X | | | | | | |
| Step No. | Event | Name of process / activity | Description of process/ activity | Service | Information producer (actor) | Information receiver (actor) | Information exchanged (IDs) | Requirements R-IDs |
| | | | | | | | | |
| | | | | | | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| Information exchanged ID | Name of information | Description of information exchanged | Requirements IDs |
| | | | |
| | | | |

6 Requirements (optional)

| Requirements (optional) | | |
|---|---|---|
| Category ID | Categories for requirements | Category description |
| | | |
| Requirement ID | Requirement description | |
| R-1 | The way an opt-out is taken into account shall be consistent within a smart building | |
| | | |
| Category ID | Categories for requirements | Category description |
| | | |
| Requirement ID | Requirement description | |
| | | |
| | | |

7 Common terms and definitions

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| UC62913-2-3-B048 Adapt the smart building behaviour to the energy manager/client's preferences | |
|---|---|
| **Common terms and definitions** | |
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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**Table B.7 – Provide enriched smart building data to relevant parties in order to make the energy manager/client more active**

| UC62913-2-3-B052 Provide enriched smart building data to relevant parties in order to make the energy manager/client more active |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| UC62913-2-3-B052 | Area: Energy system<br>Domain: Smart building | BUC-Provide enriched smart building data to relevant parties in order to make the energy manager/client more active |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | Provision to a smart building energy manager/client or other relevant parties of electricity data related to the behaviour of the smart building (registers, load profiles, consumption per period, consumption per usage.) in real-time operations or in ex-post. |
| **Objective(s)** | – Empower the energy manager/client to be aware of his consumption habits, energy costs and behaviour by providing him with data regarding the electricity behaviour of the smart building,<br>– Make these data available to a third party (such as a service provider) according to market rules and established contracts with the client, in order to allow this third party to perform a service for the energy manager/client. |
| **Related business case(s)** | – Optimize the smart building behaviour |

1.4 Narrative of Use Case

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| UC62913-2-3-B052 Provide enriched smart building data to relevant parties in order to make the energy manager/client more active |
|---|
| **Narrative of use case** |
| **Short description** |
| The business Use Case describes how the energy manager/client or an authorized third party receives electricity data regarding the electricity behaviour of the smart building. The occurrence of events is monitored and the energy manager/building resident is warned if an event occurs. |
| **Complete description** |
| These data can be made available to a third party:<br>• a role embodied by a physical person (client, energy manager) via a UI,<br>• an automated system that uses these data within the smart building<br>These energy data are related to the electricity behaviour of the smart building (at least global electricity data that can be enhanced by specific data in the smart building).<br>These electricity data are available locally and can be made available:<br>• externally, off-site<br>• locally, in the smart building.<br>These electricity data can be enriched with:<br>• data located in the smart building,<br>• data located outside of the site. These data may be for instance:<br>– dynamic peak notifications,<br>– weather forecast,<br>– consumption estimates,<br>– …<br>Functions:<br>• Make the smart building's electricity data locally available<br>• Make the smart building's electricity data externally available<br>• Enhance the smart building's electricity data with local or external data<br>• Provide alarms related to the smart building electricity behaviour to the client or energy manager<br>• Monitor the occurrence of (the) event(s)<br>• Warn if an event occurs<br>Principles<br>See related SUC<br>Assumptions<br>See related SUC |

1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

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| UC62913-2-3-B052 Provide enriched smart building data to relevant parties in order to make the energy manager/client more active |
|---|
| **Use case conditions** |
| **Assumption** |
| • |
| • |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier |
| • The client/energy manager owns at least one UI |
| • The client's smart building is up and running |
| • If necessary, the smart building is configured to feedback data |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| SUC-Provide a third party with enriched smart building electricity data |
| SUC-Provide alarms related to the smart building electricity behaviour to the client or energy manager |
| BUC-Adapt the smart building behaviour to the energy manager/client's preferences |
| BUC-Enable the interoperability between the smart building and the smart grid |
| **Level of depth** |
| |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| Business Use Case |
| **Further keywords for classification** |
| smart building, data |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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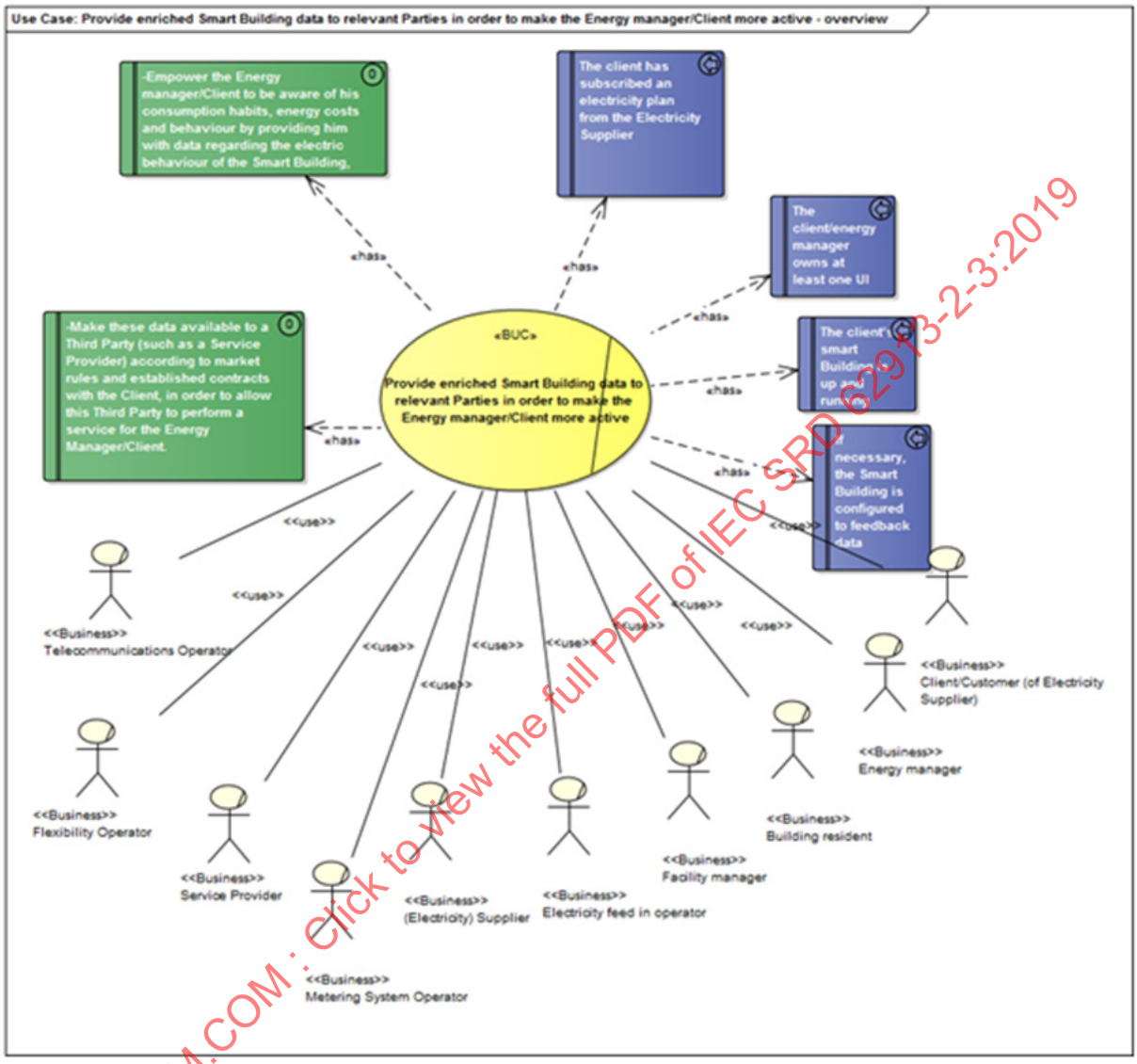
**UC62913-2-3-B052 Provide enriched smart building data to relevant parties in order to make the energy manager/client more active**

**Diagram(s) of use case**

Use Case Overview diagram

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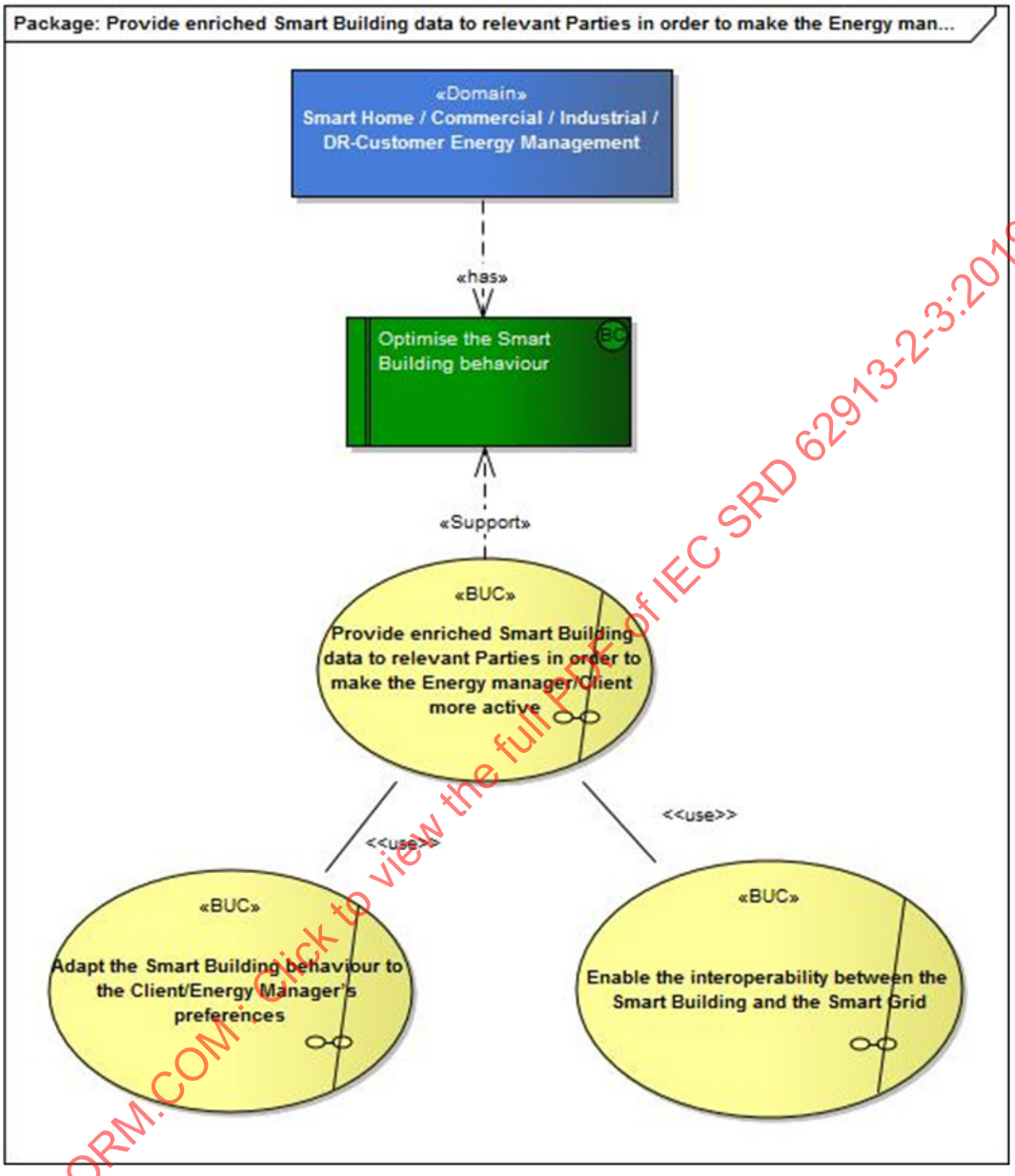
**UC62913-2-3-B052 Provide enriched smart building data to relevant parties in order to make the energy manager/client more active**

Domain Overview diagram

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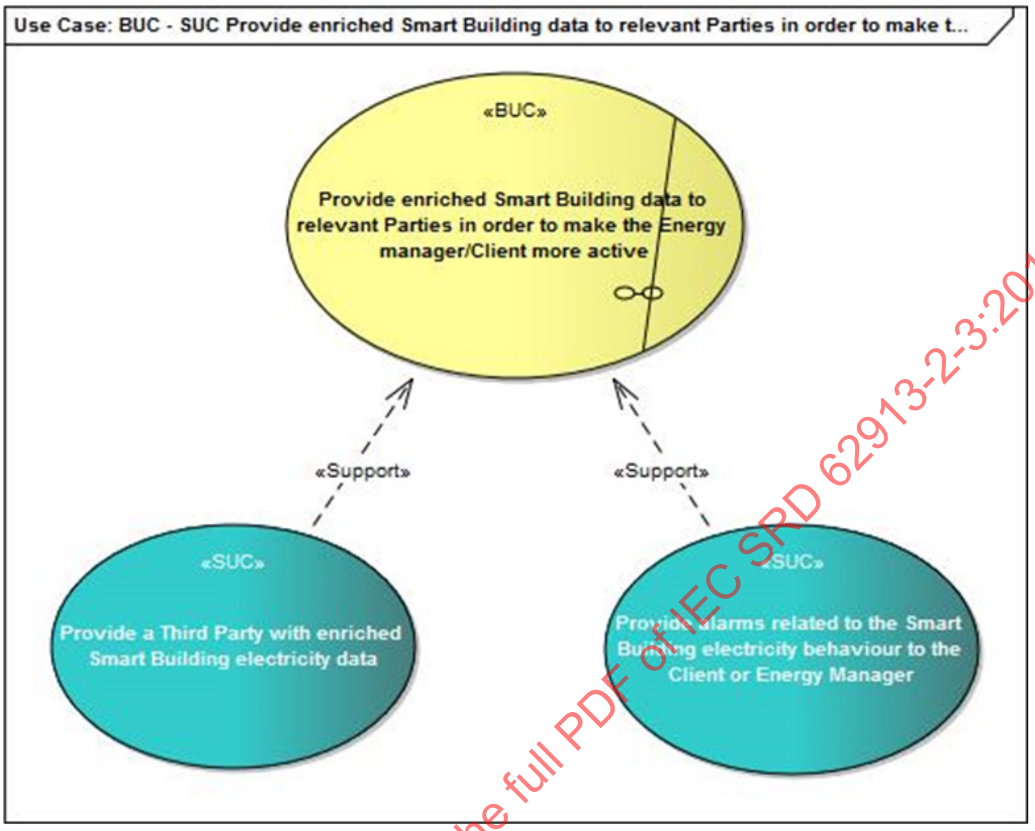
**UC62913-2-3-B052 Provide enriched smart building data to relevant parties in order to make the energy manager/client more active**

BUC-SUC Relations diagram




3 Technical details

3.1 Actors

| Actors | |
|---|---|
| **Grouping** | **Group Description** |
| | |

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| UC62913-2-3-B052 Provide enriched smart building data to relevant parties in order to make the energy manager/client more active | | | |
|---|---|---|---|
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| Client/customer (of electricity supplier) | Role | A party connected to the grid that contracts for the ability to consume electricity at a metering point. The client may also be producer of electricity and may contract with the electricity feed in operator to feed electricity in the grid | |
| Energy manager | Role | A party in charge of the energy management of the smart building | |
| Building resident | Role | A party that is a resident of the building and that may customize some of the uses or equipment according to the rights that the energy manager has given to him or her | |
| Facility manager | Role | A party in charge of supervising the equipment of the smart building | |
| Electricity feed in operator | Role | A party that remunerates the client for the electricity that the client had fed in the grid | |
| Electricity supplier | Role | Entity whose activity is the wholesale purchase of electricity and the subsequent direct resale to client through a contract. The supplier may also deliver energy-related services such as providing flexibility through electricity price modulation (i.e. time-of-use, critical peak prices) or which can have value on energy markets and/or for network operations. | |
| Service provider | Role | Entity providing services to players in the system (such as metering, telemonitoring, maintenance, etc.) other than aggregation and electricity storage. It includes service providers to the consumers. | |
| Flexibility operator | Role | Entity which links through contractual agreements (flexibility requests, notices, etc.) the role customer and its possibility to provide flexibilities to the roles market and grid; generic role that could be taken by many stakeholders. This entity can activate all or part of the flexibility resources during a period and regarding a specific location or geographical area. | |
| Metering system operator | | A party responsible for:<br>- operations of the metering system, including communication with the metering points;<br>- meter reading and quality control of the reading – taking the role of Metered Data Collector defined by ENTSO-E, EFET, and ebIX in their role model.<br>May also be referred to as AMI system operator. | |
| Telecommunication operator | Role | Entity that offers telecommunications services. | |

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**UC62913-2-3-B052 Provide enriched smart building data to relevant parties in order to make the energy manager/client more active**

3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-Condition** | **Post-Condition** |
| 1 | | | | | | |
| 2 | | | | | | |

4.2 Scenarios

| **Scenario name:** | | **No. 1 – X** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |
| **Scenario name:** | | **No. 2 – X** | | | | | | |
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

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| UC62913-2-3-B052 Provide enriched smart building data to relevant parties in order to make the energy manager/client more active |
|---|
| Requirements (optional) |

| Category ID | Categories for requirements | Category description |
|---|---|---|
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |
| | | |

| Category ID | Categories for requirements | Category description |
|---|---|---|
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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## Table B.8 – Manage the flexibility on electricity demand and generation within a smart building from market signals

| UC62913-2-3-B050 Manage the flexibility on electricity demand and generation within a smart building from market signals |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| UC62913-2-3-B050 | Area: Energy system<br>Domain: Smart building | BUC-Manage the flexibility on electricity demand and generation within a smart building from market signals |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| 0.1 | 2014. 07.01 | EDF | First draft (short description, roles) | WD Working Document |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | The scope is restricted to the smart building.<br>Emergency signals are out of the scope of the Use Case. |
| **Objective(s)** | – Adapt the behaviour of the smart building following the reception of market signals. |
| **Related business case(s)** | – Manage the flexibility of the smart building |

1.4 Narrative of Use Case

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| UC62913-2-3-B050 Manage the flexibility on electricity demand and generation within a smart building from market signals |
|---|
| **Narrative of use case** |
| **Short description** |
| The business Use Case describes how the client/energy manager responds to market signals (price incentives or DR requests) and adapts the behaviour of the smart building. He or she may:<br>– optimize the energy bill through anticipation of a dynamic peak period send by the electricity supplier through the grid,<br>– define the load management strategy and adapt it depending on a DR request – if the client/energy manager has subscribed a contract with a flexibility operator,<br>– opt-out of a planned or occurring automatic response after receiving a notification or during the execution of an automatic response that results from a price incentive or a DR request. In that case, the smart building will not apply a strategy that takes into account price incentives or DR requests or will apply a new strategy that matches the client/energy manager's instructions. |
| **Complete description** |
| Clients/energy manager of a smart building may contribute to reduce peak electricity consumption by responding to market signals. The flexibility of ecosystems can be controlled in different ways:<br>– price incentives period corresponding to changes in electricity prices issued at the initiative of the electricity supplier to help anticipate, stop, reduce or postpone certain uses of ecosystems,<br>– flexibility requests.<br>The client/energy manager may decide to opt out of price incentives and demands of flexibility (according to the contract condition), if desired.<br>The client/energy manager opts-out of a planned or occurring automatic response after receiving a notification or during the execution of an automatic response:<br>– entirely or to a given level, i.e. either not to take into account price incentives or to apply an instruction that the client/energy manager wants;<br>– over different scopes: the whole smart building, one or several areas, one or several uses, one or several equipment.<br>Price incentives, client/energy management customizations and possible opt-outs are taken into account so as to define the load management strategies.<br>Functions:<br>• Before a peak and depending on the price levels of the next day: anticipate if need be<br>• During a peak: shut off or automatically reduce loads within the smart building<br>• After a peak: switch back on loads if need be<br>• After a change in supplier index: choose and execute a load management strategy<br>• Before a DR request if a notification is sent: anticipate if need be and if possible<br>• Upon receipt of the DR request: define and carry out a load management strategy<br>• At the end of the DR request period: define and carry out a load management strategy by switching back on loads if need be<br>• Opt-out<br>Principles<br>See related SUC |

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1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

| UC62913-2-3-B050 Manage the flexibility on electricity demand and generation within a smart building from market signals |
|---|
| **Use case conditions** |
| **Assumption** |
| • See related system Use Cases |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier |
| • The client/energy manager may have subscribed a contract to make flexibilities available to a flexibility operator |
| • The client's smart building is up and running |
| • The smart meter receives timed actions to be executed in order to announce a dynamic peak period (which means that beforehand, the electricity supplier has requested to activate a dynamic peak period for this client) |
| • The client/energy manager owns a least one UI |
| • If needed the smart building is configured to feedback data enabling to validate the activation of flexibilities (for example, the smart meter is configured in "load curve" mode) |
| • DR requests are received through the SGCP |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| **SUC-Manage the flexibility of the smart building on electricity demand and generation from price incentives** |
| SUC-Manage the flexibility of the smart building on electricity demand and generation from DR requests |
| SUC-Manage opt-outs of automatic responses (only price signals and DR requests, emergency excluded) including manual actions |
| BUC-Adapt the smart building behaviour to the energy manager/client's preferences |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| Business Use Case |
| **Further keywords for classification** |
| smart building, load management strategy, price incentive, DR request, opt-out |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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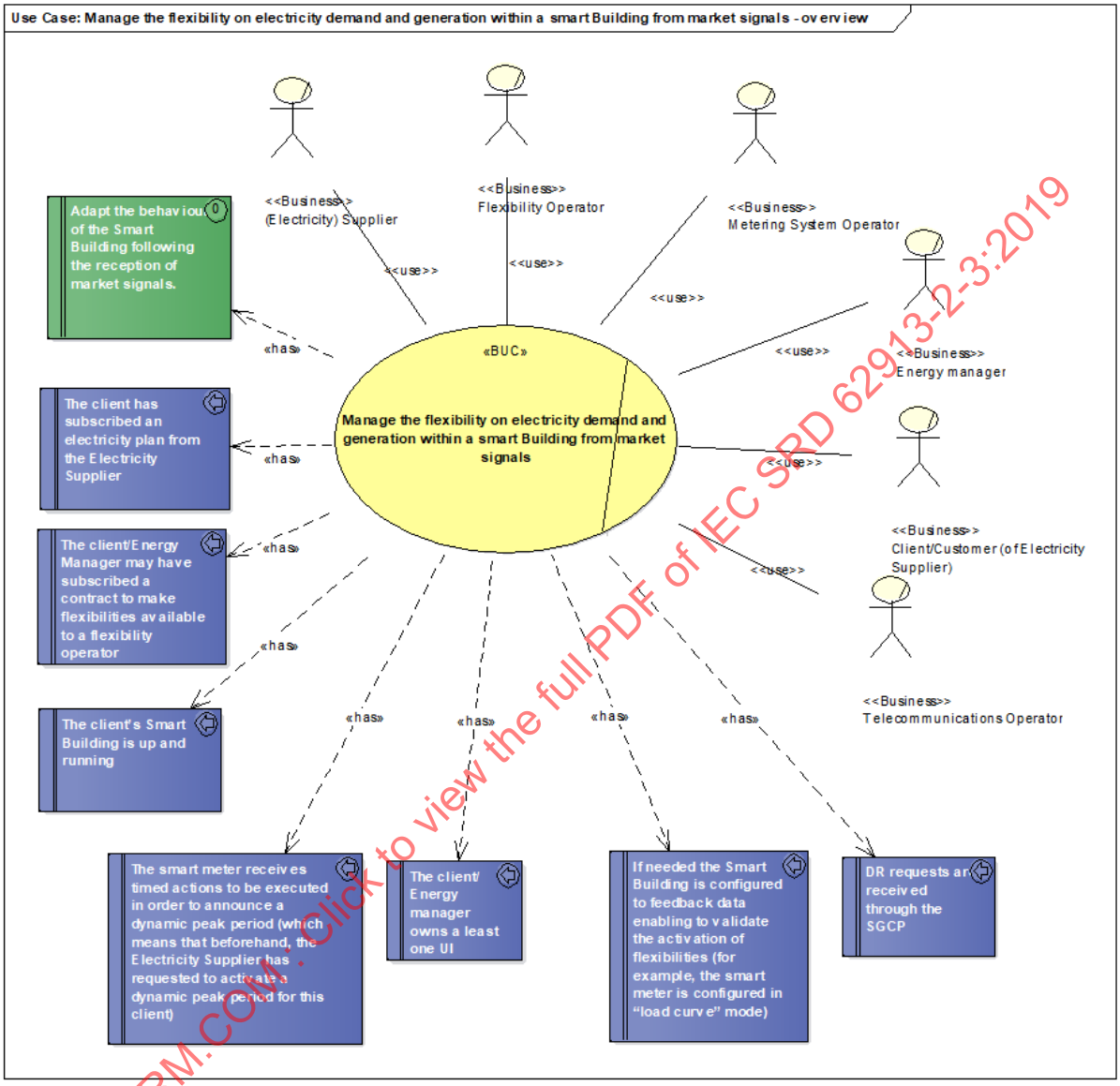
**UC62913-2-3-B050 Manage the flexibility on electricity demand and generation within a smart building from market signals**

**Diagram(s) of use case**

Use Case Overview diagram

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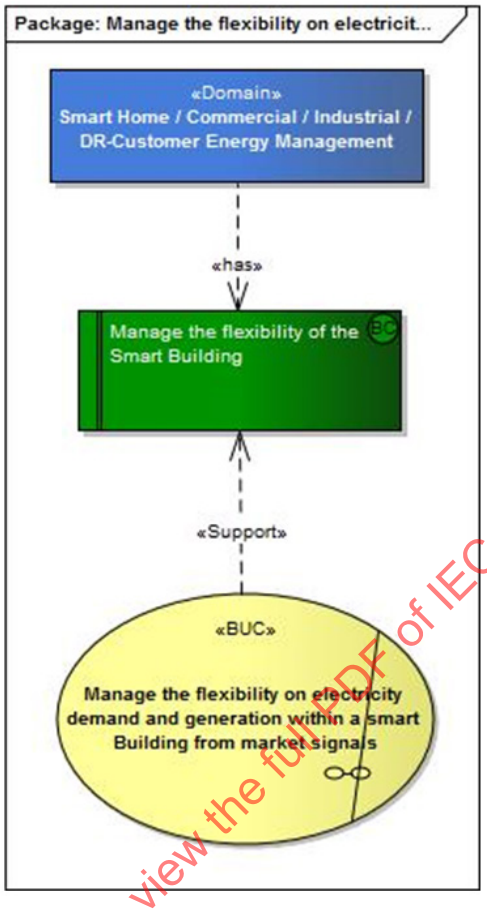
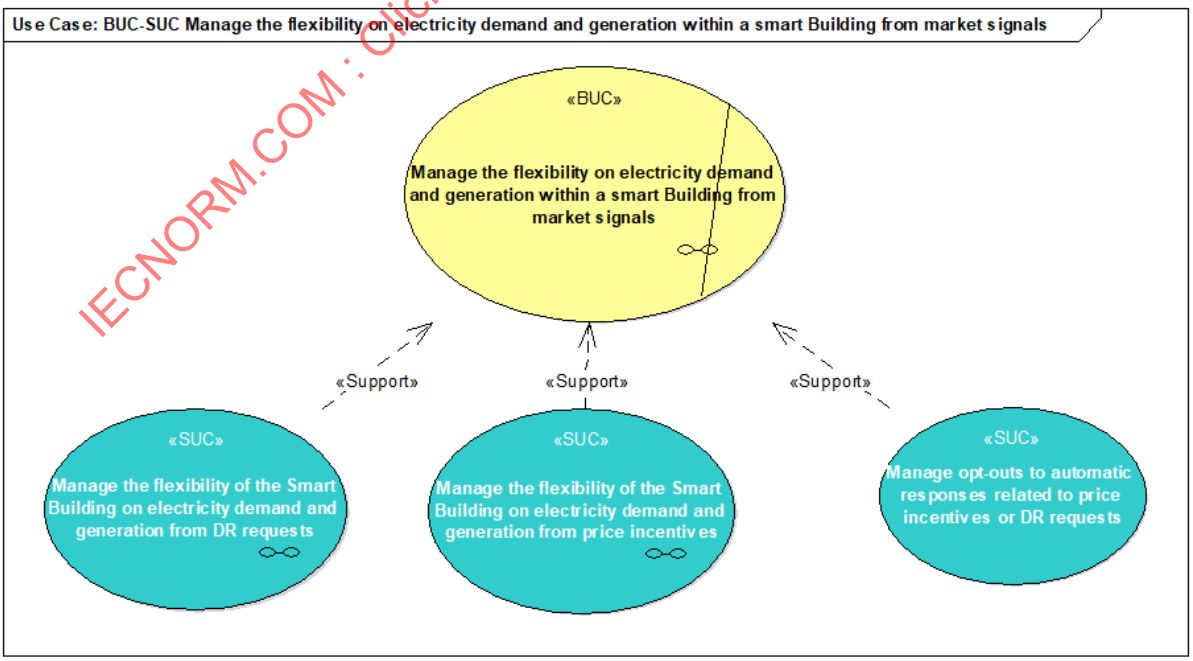
**UC62913-2-3-B050 Manage the flexibility on electricity demand and generation within a smart building from market signals**

*Domain Overview diagram*




BUC-SUC Relations diagram

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3 Technical Details

3.1 Actors

| UC62913-2-3-B050 Manage the flexibility on electricity demand and generation within a smart building from market signals | | | |
|---|---|---|---|
| **Actors** | | | |
| **Grouping** | | **Group Description** | |
| | | | |
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| Client/customer (of electricity supplier) | Role | A party connected to the grid that contracts for the ability to consume electricity at a metering point. The client may also be producer of electricity and may contract with the electricity feed in operator to feed electricity in the grid | |
| Energy manager | Role | A party in charge of the energy management of the smart building | |
| Electricity supplier | Role | Entity whose activity is the wholesale purchase of electricity and the subsequent direct resale to client through a contract. The supplier may also deliver energy-related services such as providing flexibility through electricity price modulation (i.e. time-of-use, critical peak prices) or which can have value on energy markets and/or for network operations. | |
| Metering system operator | Role | A party responsible for:<br>- operations of the metering system, including communication with the metering points;<br>- meter reading and quality control of the reading – taking the role of Metered Data Collector defined by ENTSO-E, EFET, and ebIX in their role model.<br>May also be referred to as AMI system operator. | |
| Flexibility operator | Role | Entity which links through contractual agreements (flexibility requests, notices, etc.) the role customer and its possibility to provide flexibilities to the roles market and grid; generic role that could be taken by many stakeholders. This entity can activate all or part of the flexibility resources during a period and regarding a specific location or geographical area. | |
| Telecommunication operator | Role | Entity that offers telecommunications services. | |

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3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

**UC62913-2-3-B050 Manage the flexibility on electricity demand and generation within a smart building from market signals**

4.1 Overview of scenarios

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-Condition** | **Post-Condition** |
| 1 | | | | | | |
| 2 | | | | | | |

4.2 Scenarios

| **Scenario name:** | | **No. 1 – X** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |
| **Scenario name:** | | **No. 2 – X** | | | | | | |
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

| Requirements (optional) | | |
|---|---|---|
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |

7 Common terms and definitions

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| UC62913-2-3-B050 Manage the flexibility on electricity demand and generation within a smart building from market signals | |
|---|---|
| **Common terms and definitions** | |
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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**Table B.9 – Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

| UC62913-2-3-B045 Manage the flexibility in electricity demand and generation within a smart home from emergency signals |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| UC62913-2-3-B045 | Area: Energy system<br>Domain: Smart home | BUC- Manage the flexibility in electricity demand and generation within a smart home from emergency signals |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| 0.1 | | EDF | First draft (short description, roles) | WD Working Document |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | The scope is restricted to the smart home |
| **Objective(s)** | The objective is to preserve the best electricity supply in emergency conditions.<br>Emergency signals can be sent in order to preserve the electricity grid or react to an external event met on the electricity grid.<br>The objective is to maintain in an emergency situation the supply of electricity to the maximum number of customers and to ensure the best supply to priority customers. This action will be taken according to the regulatory framework.<br>The emergency signal can be:<br>– a cut off,<br>– a reduction of subscribed power.<br>This second case may involve evolutions of the regulatory framework.<br>Three functions:<br>• Before an emergency signal if a notification is sent a few minutes before: anticipate if need be and if possible.<br>• Upon receipt of the emergency signal: define and carry out a load management strategy.<br>• At the end of the emergency signal: define and carry out a load management strategy by switching back on loads if need be.<br>Resident customizations are taken into account so as to define the load management strategies in order to prioritize electricity usages regarding the resident preferences in emergency situation. |
| **Related business case(s)** | Manage the flexibility of the smart home |

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**UC62913-2-3-B045 Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

1.4 Narrative of Use Case

| Narrative of use case |
|---|
| **Short description** |
| The load management strategy of the smart home is defined and adapted regarding emergency signals. The resident is informed if necessary. |
| **Complete description** |
| Principles:<br>See related SUC<br>Common scenario:<br>The grid operator identifies an emergency situation on the grid then sends an emergency signal to the smart home as a last possibility before a cut off.<br>The smart home receives an emergency notification or an emergency signal via the external smart metering gateway.<br>When an emergency notification is sent, the smart home can define a load management strategy, inform the resident if necessary and execute new instructions if any.<br>The resident cannot opt out of emergency signals responses.<br>Resident customizations are taken into account so as to define the load management strategies in order to prioritize the usage regarding the resident preferences in emergency situation. |

1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

| Use case conditions |
|---|
| **Assumption** |
| • See related system Use Cases |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier. |
| • The client's smart home is up and running |
| • The resident owns at least one UI |

1.7 Further information to the use case for classification / mapping

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| UC62913-2-3-B045 Manage the flexibility in electricity demand and generation within a smart home from emergency signals |
|---|
| **Classification information** |
| **Relation to other use cases** |
| SUC-Manage the flexibility in electricity demand and generation within a smart home from emergency signals |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| Business Use Case |
| **Further keywords for classification** |
| smart grid connection point, smart home, emergency signal |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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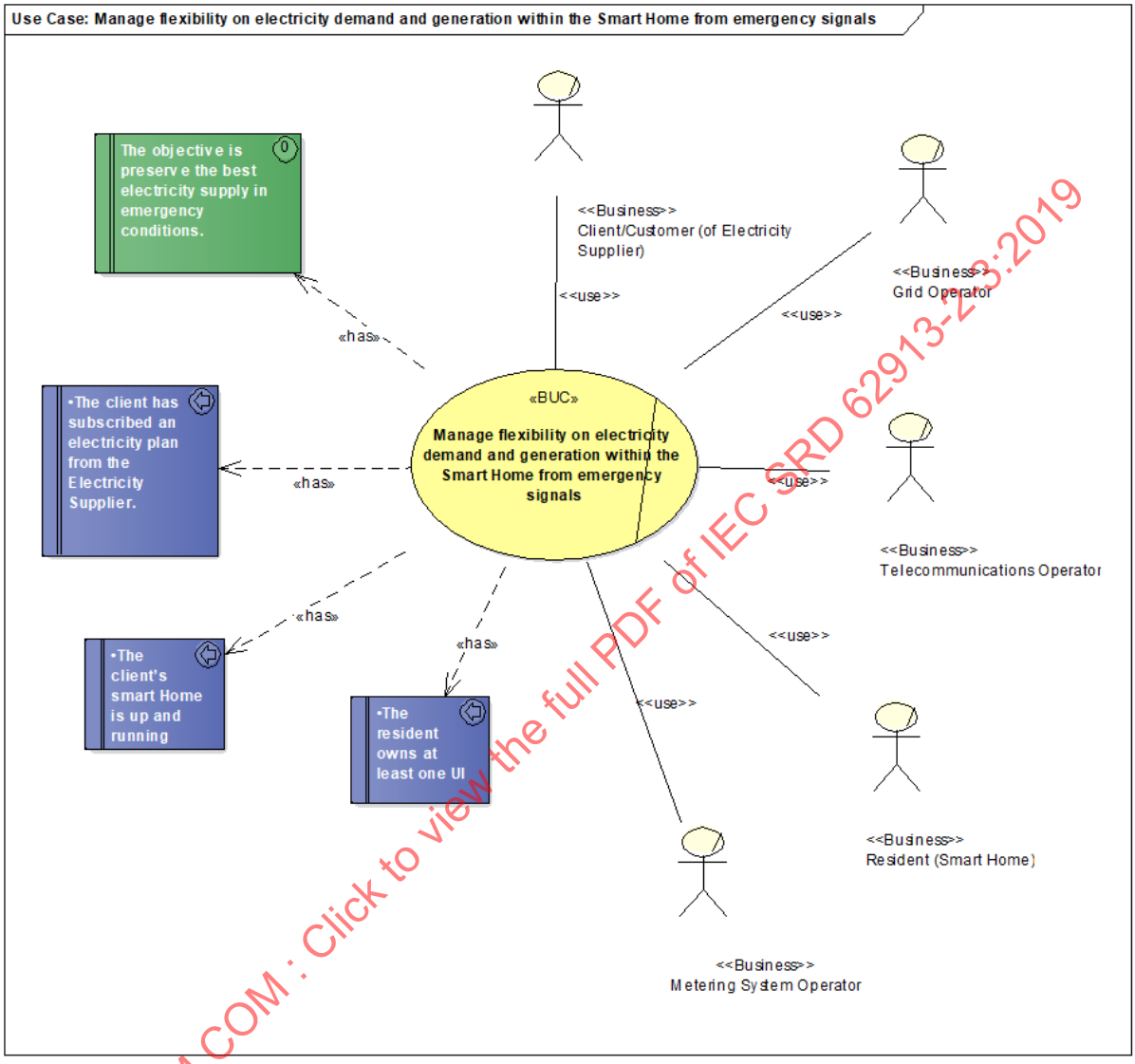
**UC62913-2-3-B045 Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

**Diagram(s) of use case**

Use Case overview




Domain Overview

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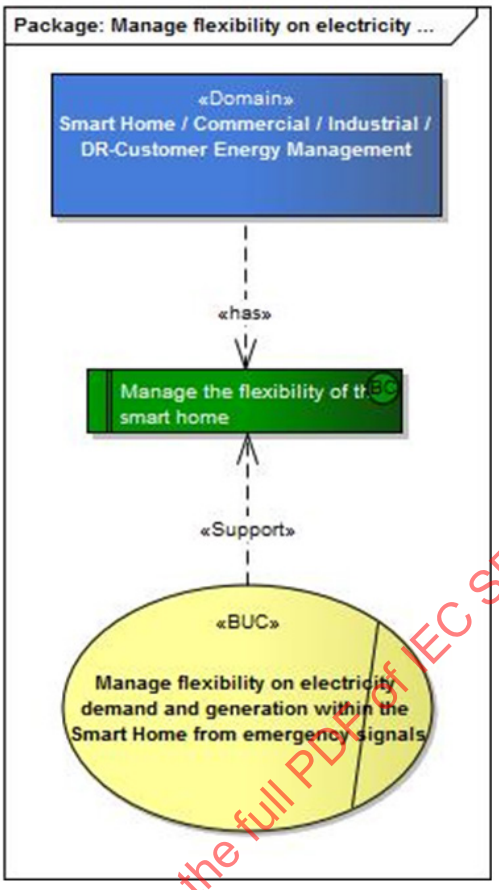
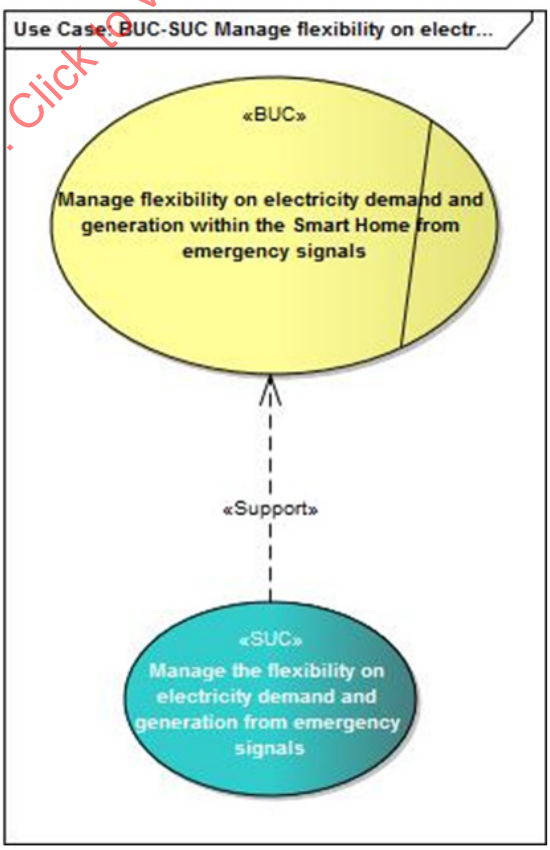
**UC62913-2-3-B045 Manage the flexibility in electricity demand and generation within a smart home from emergency signals**




BUC-SUC Relation Diagram

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**UC62913-2-3-B045 Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

3 Technical details

3.1 Actors

| Actors | |
|---|---|
| **Grouping** | **Group Description** |
| | |

| Actor name | Actor type | Actor Description | Further information specific to this Use Case |
|---|---|---|---|
| Grid operator | Role | Entity responsible for the planning, operation, maintenance, and the development in given areas of the electricity network (LV, MV, and potentially HV), the quality of electricity supply (power delivery, voltage, etc.) and for customer access to ESR market through his or her system under regulated conditions by managing constraints, emergency situations and faults in a cost-efficient way, using operational planning & scheduling and forecasting tools.<br>For the distribution network this entity is equivalent to distribution network operators (DNO) or distribution system operators (DSO).<br>In some countries, the distribution grid operator may also manage the metering system (e.g. France). | |
| Telecommunication operator | Role | Entity that offers telecommunications services. | |
| Resident | Role | Smart home end-user who can be a consumer resident, a producer resident or both. Certain consumers may also have their own production and/or storage capacity. It may be "passive" in the sense that it determines its consumption entirely with respect to its own needs, or "active" in the sense that it can interact with other players to determine or alter its consumption. | |
| Client of the electricity supplier | Role | | |

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3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

| UC62913-2-3-B045 Manage the flexibility in electricity demand and generation within a smart home from emergency signals | | | | | | |
|---|---|---|---|---|---|---|
| Scenario conditions | | | | | | |
| No. | Scenario name | Scenario description | Primary actor | Triggering event | Pre-Condition | Post-Condition |
| 1 | | | | | | |
| 2 | | | | | | |

4.2 Scenarios

| Scenario name: | | No. 1 – X | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Step No. | Event | Name of process/ activity | Description of process/ activity | Service | Information producer (actor) | Information receiver (actor) | Information exchanged (IDs) | Requirements R-IDs |
| | | | | | | | | |
| | | | | | | | | |

| Scenario name: | | No. 2 – X | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Step No. | Event | Name of process/ activity | Description of process/ activity | Service | Information producer (actor) | Information receiver (actor) | Information exchanged (IDs) | Requirements R-IDs |
| | | | | | | | | |
| | | | | | | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| Information exchanged ID | Name of information | Description of information exchanged | Requirements IDs |
| | | | |
| | | | |

6 Requirements (optional)

| Requirements (optional) | | |
|---|---|---|
| Category ID | Categories for requirements | Category description |
| | | |
| Requirement ID | Requirement description | |
| | | |
| | | |
| Category ID | Categories for requirements | Category description |
| | | |
| Requirement ID | Requirement description | |
| | | |
| | | |

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| UC62913-2-3-B045 Manage the flexibility in electricity demand and generation within a smart home from emergency signals |
|---|

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

### B.2.2 System Use Cases

See Table B.10 to Table B.23.

**Table B.10 – Manage the flexibility of the smart home on electricity demand and generation from price incentives**

| IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| IEC62913-2-3-S043 | Area: Energy system<br>Domain: Smart home | SUC-Manage the flexibility of the smart home on electricity demand and generation from price incentives |

1.2 Version management

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**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | Automatic response of the smart home from price incentives.<br>Virtual dry contacts and short messages are out of the scope of this Use Case. |
| **Objective(s)** | – Control the flexibility of ecosystems:<br>• Before a peak and depending on the price levels of the next day: anticipate if need be.<br>• During a peak: shut off or automatically reduce loads within the customer's smart home.<br>• After a peak: switch back on loads if need be.<br>• After a change in supplier index: choose and execute a load management strategy. |
| **Related business case(s)** | |

1.4 Narrative of Use Case

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| IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives |
|---|
| **Narrative of use case** |
| **Short description** |
| The system Use Case describes how the customer energy management system optimizes the energy bill through anticipation of a dynamic peak period and how the resident/client is informed. |
| **Complete description** |
| Functions:<br>• Before a peak and depending on the price levels of the next day: anticipate if need be<br>• During a peak: shut off or automatically reduce loads within the client's smart home<br>• After a peak: switch back on loads if need be<br>• After a change in supplier index: choose and execute a load management strategy<br>Principles<br>P2. A price incentive relates to dynamic peak periods, fixed peaks and other supplier index changes (e.g. going from "low rate hours" index to "high rate hours" index within a "high rate hours/low rate hours" subscription plan).<br>P3. This use case assumes that the CEM establishes a load management strategy and sends it to the DEM function(s) in order to be executed.<br>• This applies to a customer energy management system (CEMS) and to the indirectly connected appliances (ICA) that it controls<br>• This applies to a directly connected appliance (DCA), that is to say a smart appliance directly connected to a smart meter radio transmitter<br>P4. This use case considers the two following cases:<br>• case where the appliances can send information,<br>• case where the appliances cannot send information.<br>Short story:<br>At 4 p.m., The smart installation receives a price incentive via the external smart metering gateway.<br>At 8 p.m., the "dynamic peak period notification" timed action activates: a field of the RCI (remote customer information) is then modified.<br>This price incentive can be a dynamic peak period notification, a notification regarding price levels for the next day, a dynamic peak period start, a dynamic peak period stop, a change in supplier index or a change in the position of the physical dry contact.<br>The resident/client's customer energy management system (via its CEM function) reads the RCI (remote customer information) and understands that the kWh price will be higher from 6 p.m. to 8 p.m. on the following day.<br>In order to optimize the client's energy bill, the customer energy management system decides to anticipate this dynamic peak period.<br>To do so, on the next day, a few hours before the peak, the customer energy management system queries a set of connected electric heaters in order to know their current status (local opt-out). Being informed that they run on low power, it modifies their instructions in order to implement an anticipation strategy from 5 p.m. to 6 p.m.<br>Before implementing an anticipation strategy, the client is notified of the applied anticipation strategy via the energy manager's display (CEM function) but also optionally by the appliances via a LED that switches on each of them.<br>Resident/client customizations and possible opt-outs are taken into account so as to define or adapt the load management strategy. |

1.5 Key performance indicators

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| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

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| IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives |
|---|
| **Use case conditions** |
| **Assumption** |
| • There are 3 SDPPDs (standard dynamic peak period day), each of them being the description of a series of indexes over a finite duration. |
| • The way the dynamic peak period message is sent is based on metering information known to date. A dynamic peak period broadcast message can generate up to three timed actions for the meter. An example of a common scenario for a dynamic peak period (DPP) scheduled for day MM/08/YY between 6 p.m. and 8 p.m. would be:<br>1. Simultaneous reception of three timed actions by the smart meter on day MM/07/YY at around 4 p.m.:<br>Action A: "DPP1* notification on day MM/07/YY at 8 p.m."<br>Action B: "Dynamic peak period DPP1 start on day MM/08/YY at 6 p.m."<br>Action C: "Dynamic peak period DPP1 stop on day MM/08/YY at 8 p.m."<br>2. Activation of action A, on day MM/07/YY at 8 p.m.<br>3. Activation of action B, on day MM/08/YY at 6 p.m.<br>4. Activation of action C, on day MM/08/YY at 8 p.m. |
| • A dynamic peak period can include one or many price periods, therefore possibly index changes. |
| • It is assumed in this use case that neither the customer energy management system (CEMS), nor the directly connected appliances (DCA) necessarily have the capability to get the price schedule. This is a possible but not compulsory option. |
| • The fields of the standard RCI (remote customer Information) allow to detect DPP notifications, DPP starts and DPP stops. |
| • The resident/client is informed locally and/or away from home via any medium (dedicated display, appliance display, LED, SMS, etc.) |
| • It is assumed that neither the customer energy management system, nor the directly connected appliances necessarily have the capability to establish an anticipation strategy after receiving a DPP notification. |
| • If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. The UI mentioned in the sequence diagrams is a local UI within the smart home. |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier. |
| • The resident/client's smart home is up and running. |
| • The smart meter receives timed actions to be executed in order to announce a dynamic peak period (which means that beforehand, the electricity supplier has requested to activate a dynamic peak period for this client). |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| BUC-Manage the flexibility on electricity demand and generation within a smart home from market signals |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| System Use Case |
| **Further keywords for classification** |
| smart home, load management strategy, price incentives |

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| IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives |
|---|
| 1.8 General remarks |
| **General remarks** |
| |
| 2 Diagrams of use case |

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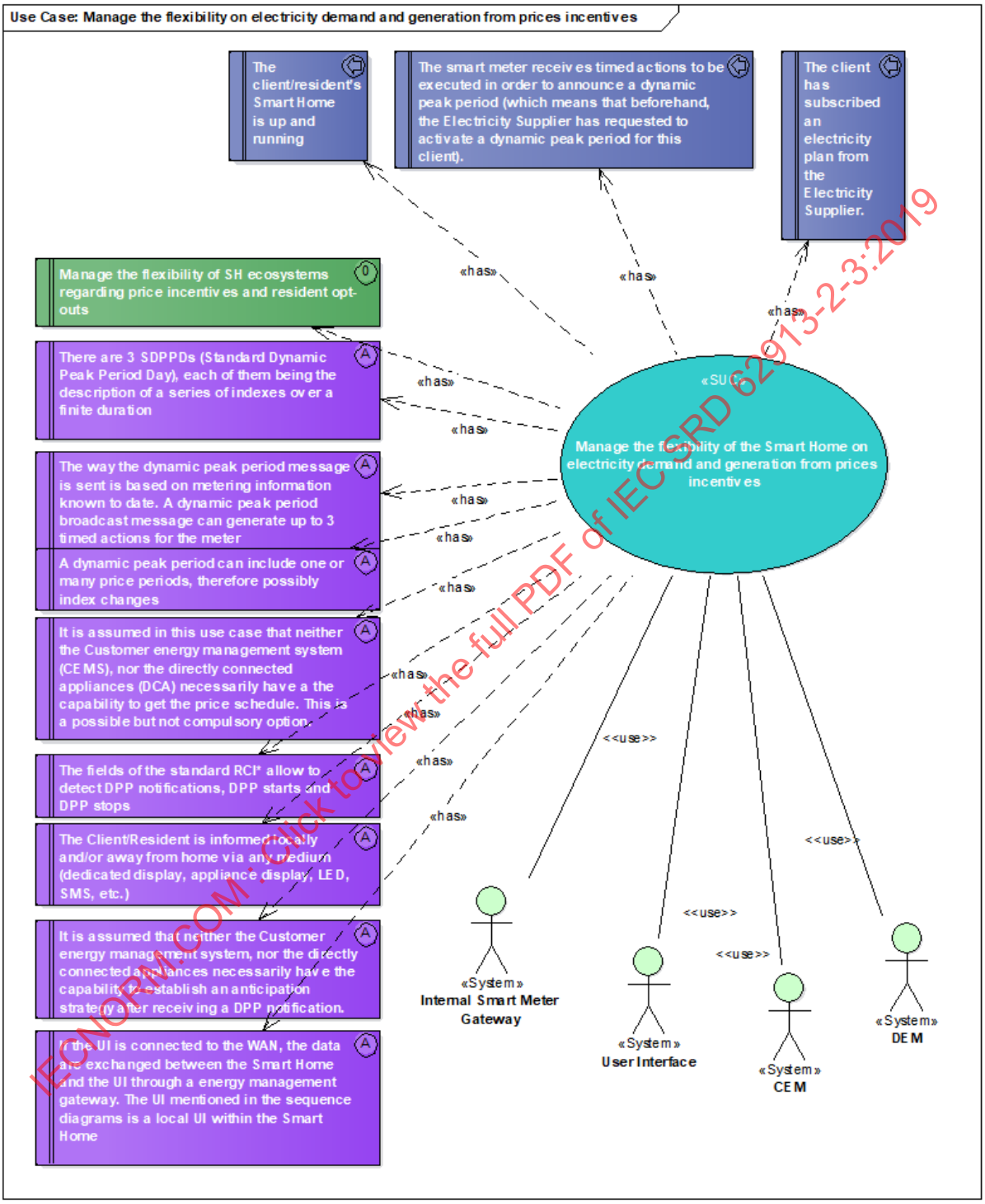
**Diagram(s) of use case**




RCI: remote customer information

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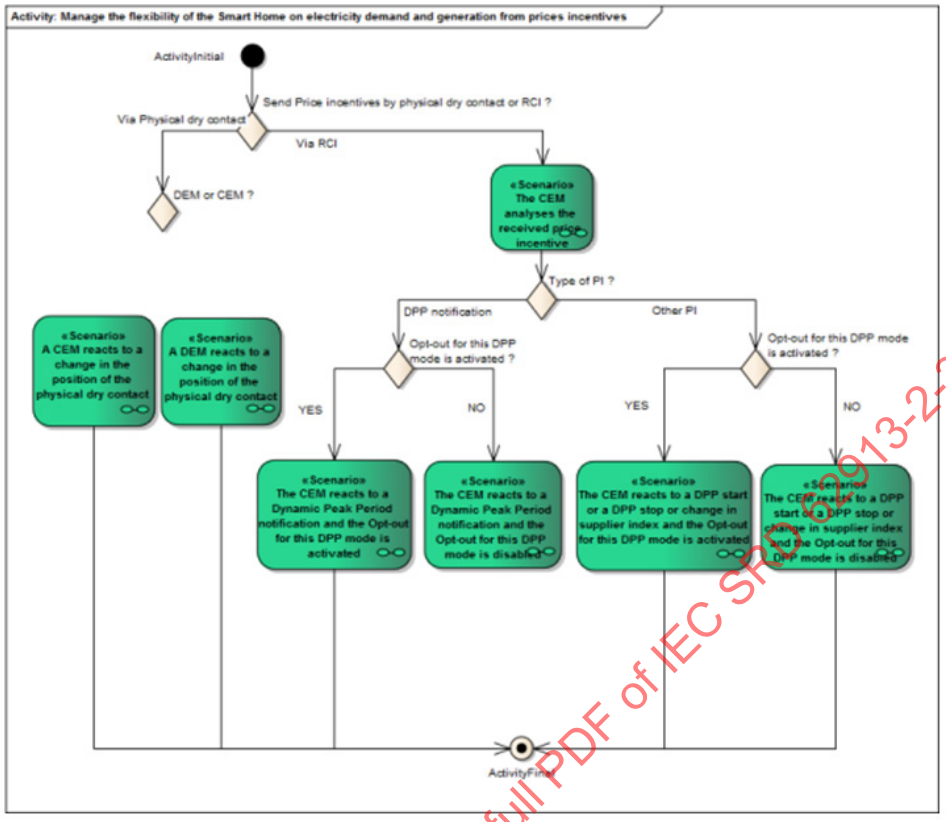


3 Technical details

3.1 Actors

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**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**

| Actors | |
|---|---|
| **Grouping** | **Group Description** |
| | |

| Actor name | Actor type | Actor Description | Further information specific to this Use Case |
|---|---|---|---|
| DEM | System | Function adapting the operations of a given electrical device depending on the incoming orders, resident customization and potential opt-outs that may be manually done locally. | DEM |
| Internal smart metering gateway | System | Communications functions between the smart metering and the smart home. | Internal smart metering gateway |
| CEM | System | Function enabling the definition of coordinated energy management strategies of one or several related DEM depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, resident/client customization and potential resident/client opt-outs.<br><br>This function includes a processing ability, notably in order to take resident/client customization and electricity data enhancement into account. | CEM |
| User interface | System | User interface (UI) can be connected to the smart home (HAN) or to the WAN. If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. | User interface |

3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

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**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-condition** | **Post-condition** |
| 1 | A CEM reacts to a change in the position of the physical dry contact | | | | | |
| 2 | A DEM reacts to a change in the position of the physical dry contact | | | | | |
| 3 | The CEM analyses the received price incentive | | | | | |
| 4 | The CEM reacts to a DPP start or a DPP stop or change in supplier index and the opt-out for this DPP mode is activated | | | | | |
| 5 | The CEM reacts to a DPP start or a DPP stop or change in supplier index and the opt-out for this DPP mode is disabled | | | | | |
| 6 | The CEM reacts to a dynamic peak period notification and the opt-out for this DPP mode is activated | | | | | |
| 7 | The CEM reacts to a dynamic peak period notification and the opt-out for this DPP mode is disabled | | | | | |

4.2 Scenarios

4.2.1 A CEM reacts to a change in the position of the physical dry contact

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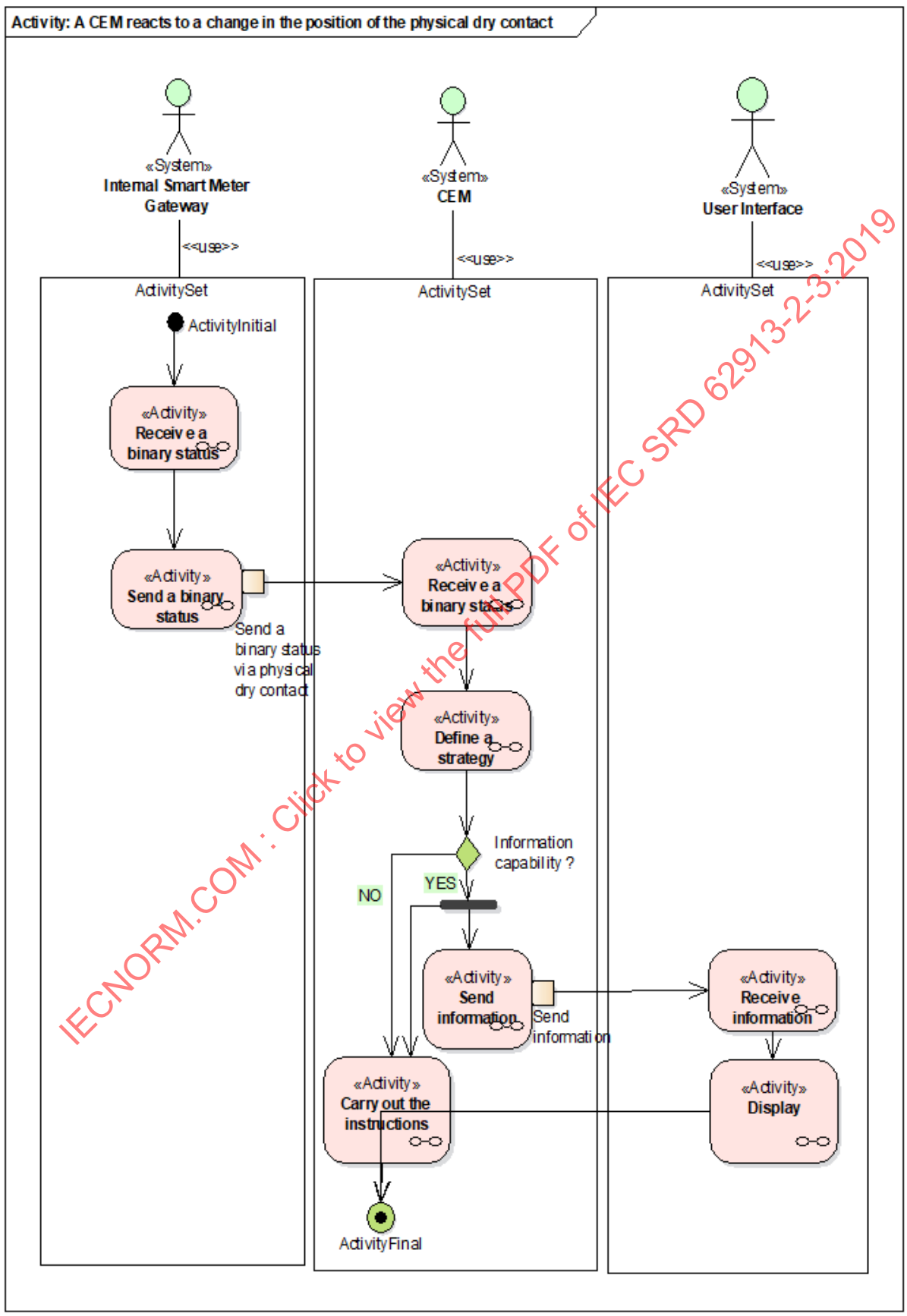


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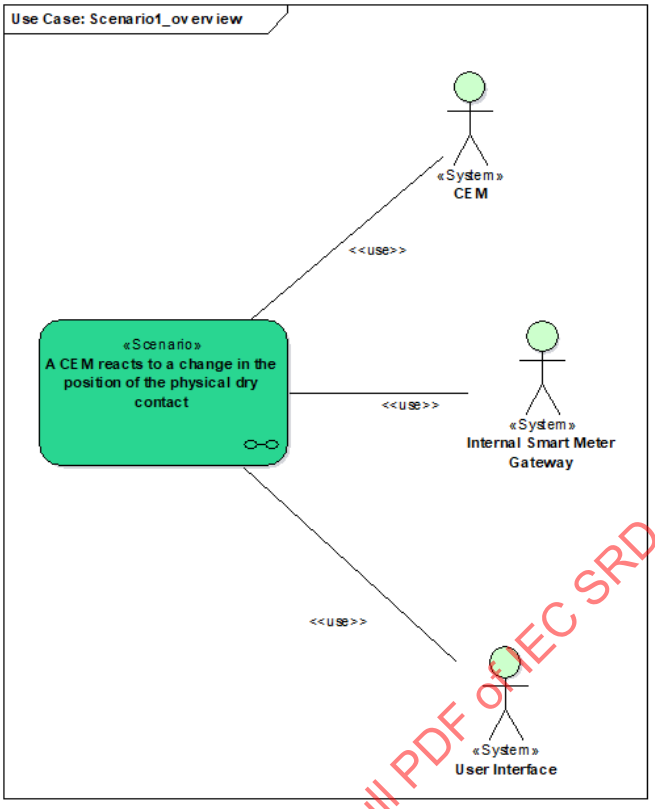


**Scenario step by step analysis**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | A CEM reacts to a change in the position of the physical dry contact | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 1.1 | | Receive a binary status | | | Internal smart metering gateway | Internal smart metering gateway | | |
| 1.2 | | Send a binary status | | | Internal smart metering gateway | CEM | | |
| 1.3 | | Receive a binary status | | | CEM | | | |
| 1.4 | | Define a strategy | | | CEM | | | |
| 1.5 | | Carry out the instructions | | | CEM | | | |
| 1.6 | | Send information | | | CEM | User interface | | |
| 1.7 | | Receive information | | | User interface | | | |
| 1.8 | | Display | | | User interface | | | |

4.2.2 A DEM reacts to a change in the position of the physical dry contact

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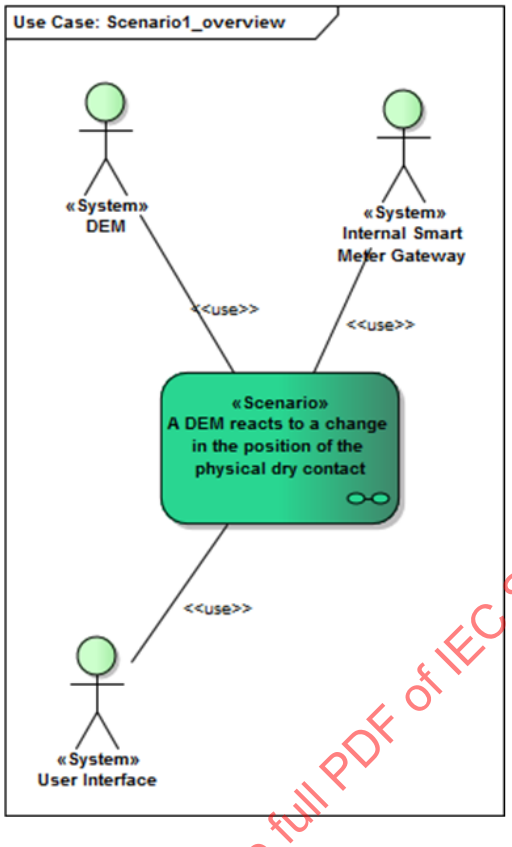


**Scenario step by step analysis**

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**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | A DEM reacts to a change in the position of the physical dry contact | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 2.1 | | Receive a binary status | | | Internal smart metering gateway | | | |
| 2.2 | | Send a binary status | | | Internal smart metering gateway | DEM | | |
| 2.3 | | Receive a binary status | | | DEM | | | |
| 2.4 | | Define a strategy | | | DEM | | | |
| 2.5 | | Carry out the instructions | | | DEM | | | |
| 2.6 | | Send information | | | DEM | User interface | | |
| 2.7 | | Receive information | | | User interface | | | |
| 2.8 | | Display | | | User interface | | | |

4.2.3 The CEM analyses the received price incentive

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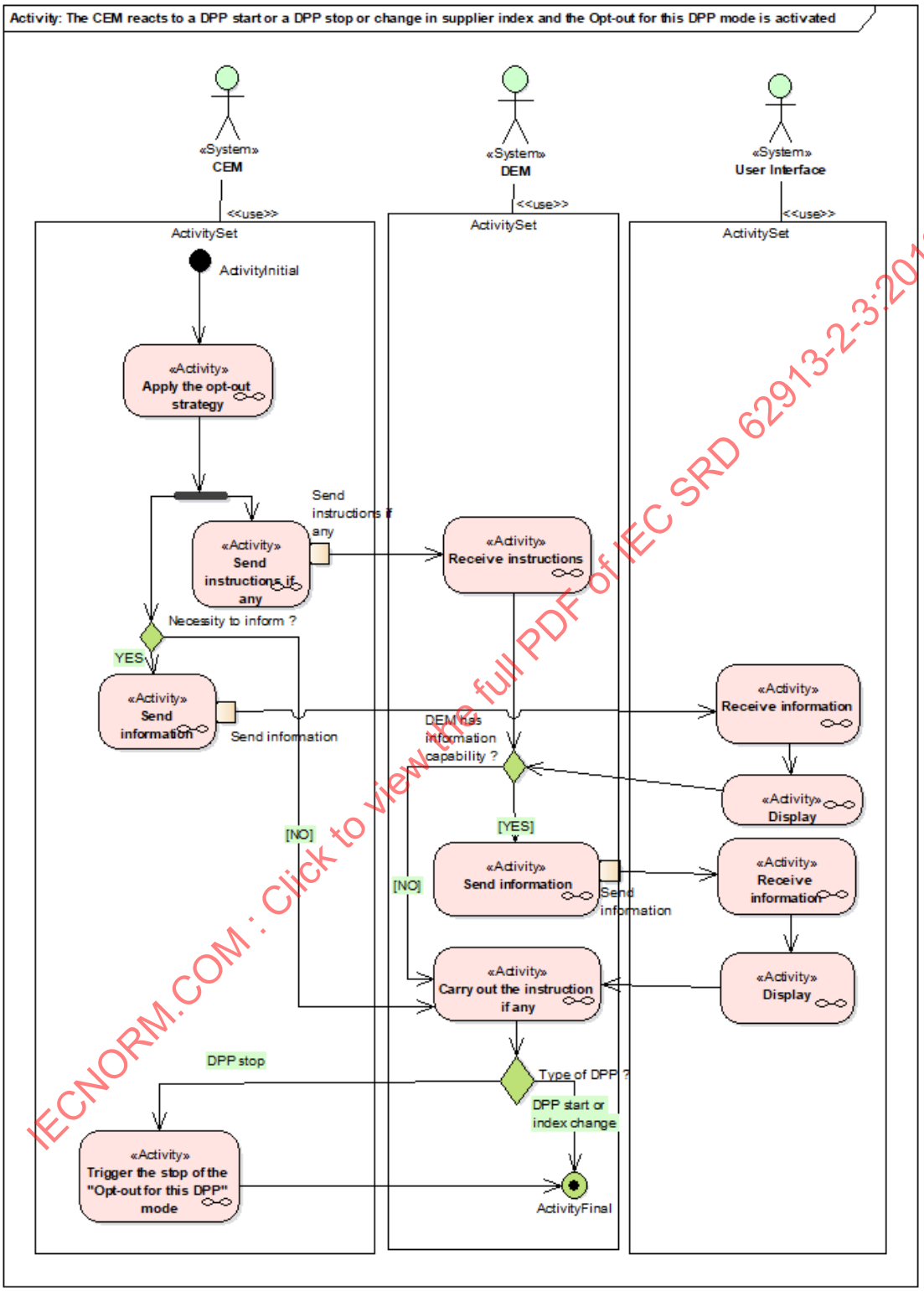


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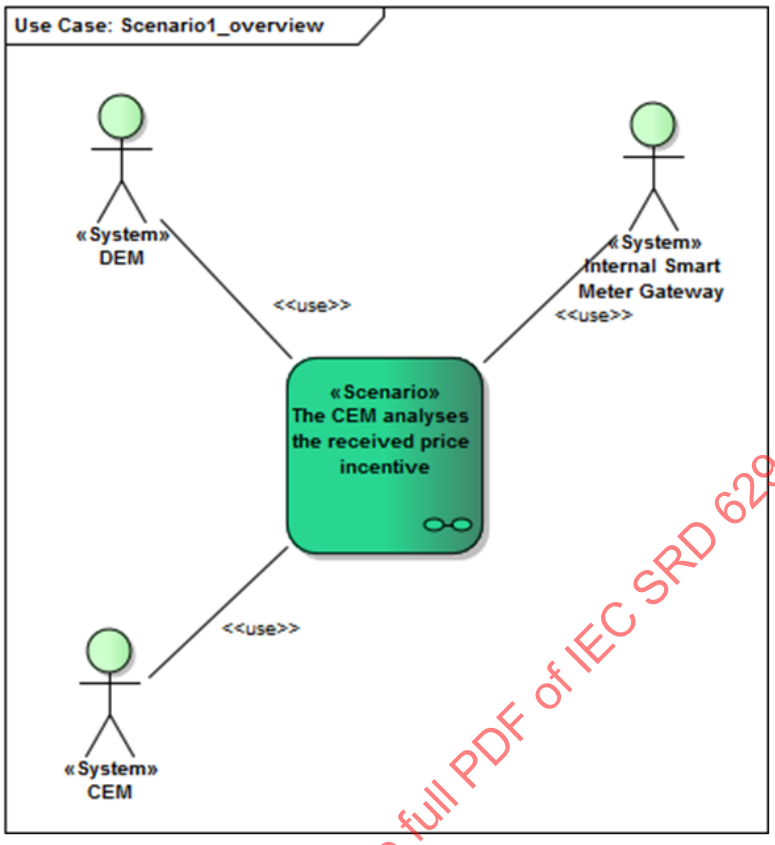


**Scenario step by step analysis**

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**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | The CEM analyses the received price incentive | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 3.1 | | Receive DPP notification or "DPP start" or "DPP stop" or "supplier index change" | | | Internal smart metering gateway | | | |
| 3.2 | | Activate DPP notification | | | Internal smart metering gateway | | | |
| 3.3 | | Send DPP notification | | | Internal smart metering gateway | CEM | | |
| 3.4 | | Receive a DPP notification | | | CEM | | | |
| 3.5 | | Analyse the price incentive | | | CEM | | | |
| 3.6 | | Learn the price schedule to adapt the preset energy management strategies | | | CEM | | | |
| 3.7 | | Send status query | | | CEM | DEM | | |
| 3.8 | | Receive a status query | | | DEM | | | |
| 3.9 | | Send a status | | | DEM | CEM | | |
| 3.10 | | Receive a status | | | CEM | | | |

4.2.4 The CEM reacts to a DPP start or a DPP stop or change in supplier index and the opt-out for this DPP mode is activated

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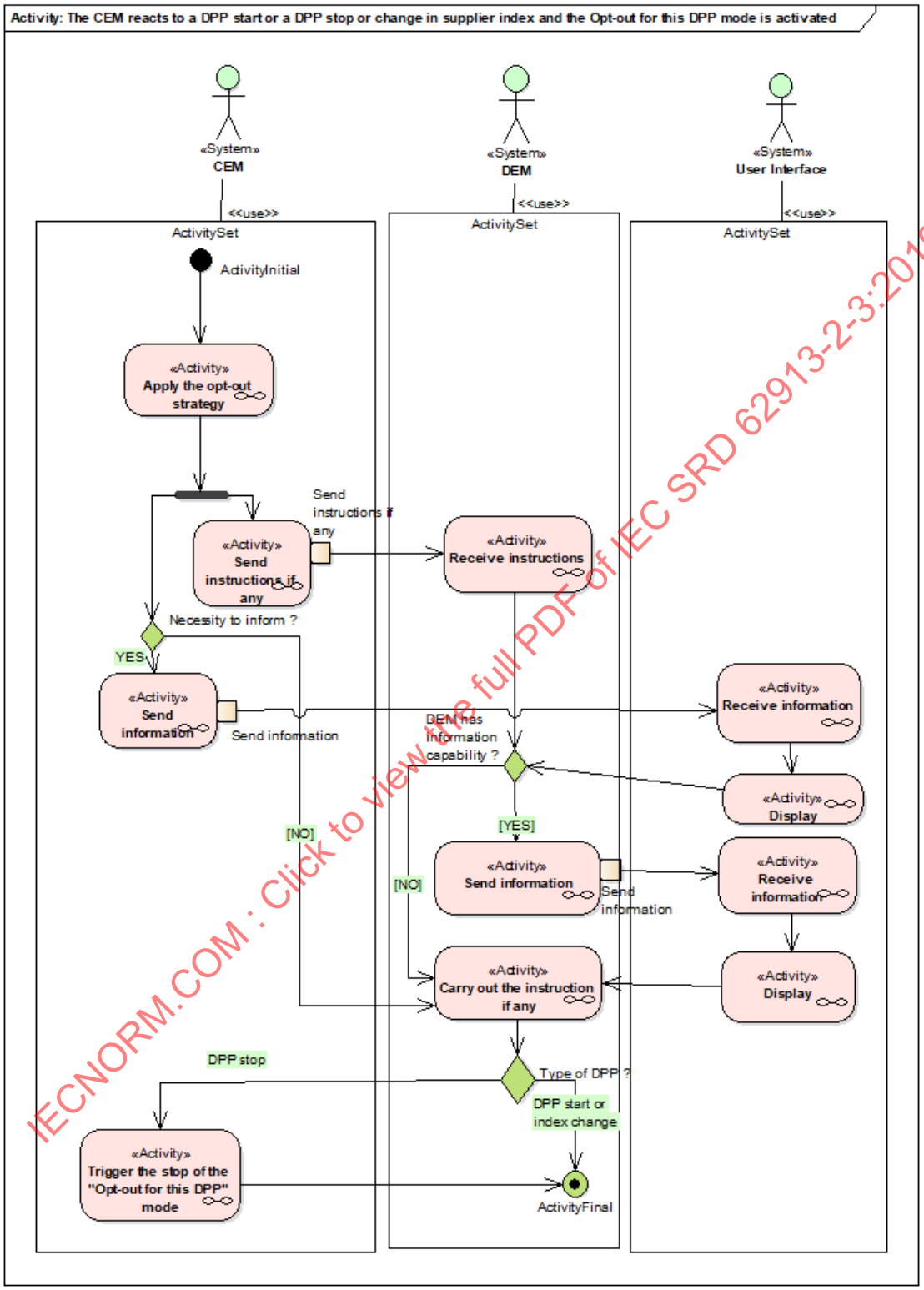


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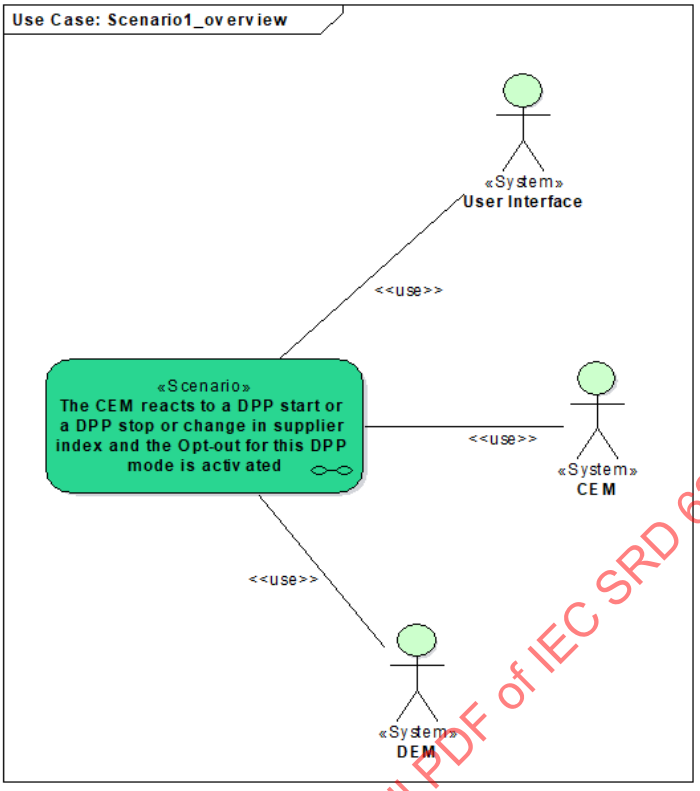
**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**




**Scenario step by step analysis**

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**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | The CEM reacts to a DPP start or a DPP stop or change in supplier index and the opt-out for this DPP mode is activated | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 4.1 | | Apply the opt-out strategy | | | CEM | | | |
| 4.2 | | Send instructions if any | | | CEM | DEM | | |
| 4.3 | | Receive instructions | | | DEM | | | |
| 4.4 | | Send information | | | DEM | User interface | | |
| 4.5 | | Receive information | | | User interface | | | |
| 4.6 | | Display | | | User interface | | | |
| 4.7 | | Send information | | | CEM | User interface | | |
| 4.8 | | Receive information | | | User interface | | | |
| 4.9 | | Display | | | User interface | | | |
| 4.10 | | Carry out the instruction if any | | | DEM | | | |
| 4.11 | | Trigger the stop of the "Opt-out for this DPP" mode | | | CEM | | | |

4.2.5 The CEM reacts to a DPP start or a DPP stop or change in supplier index and the opt-out for this DPP mode is disabled

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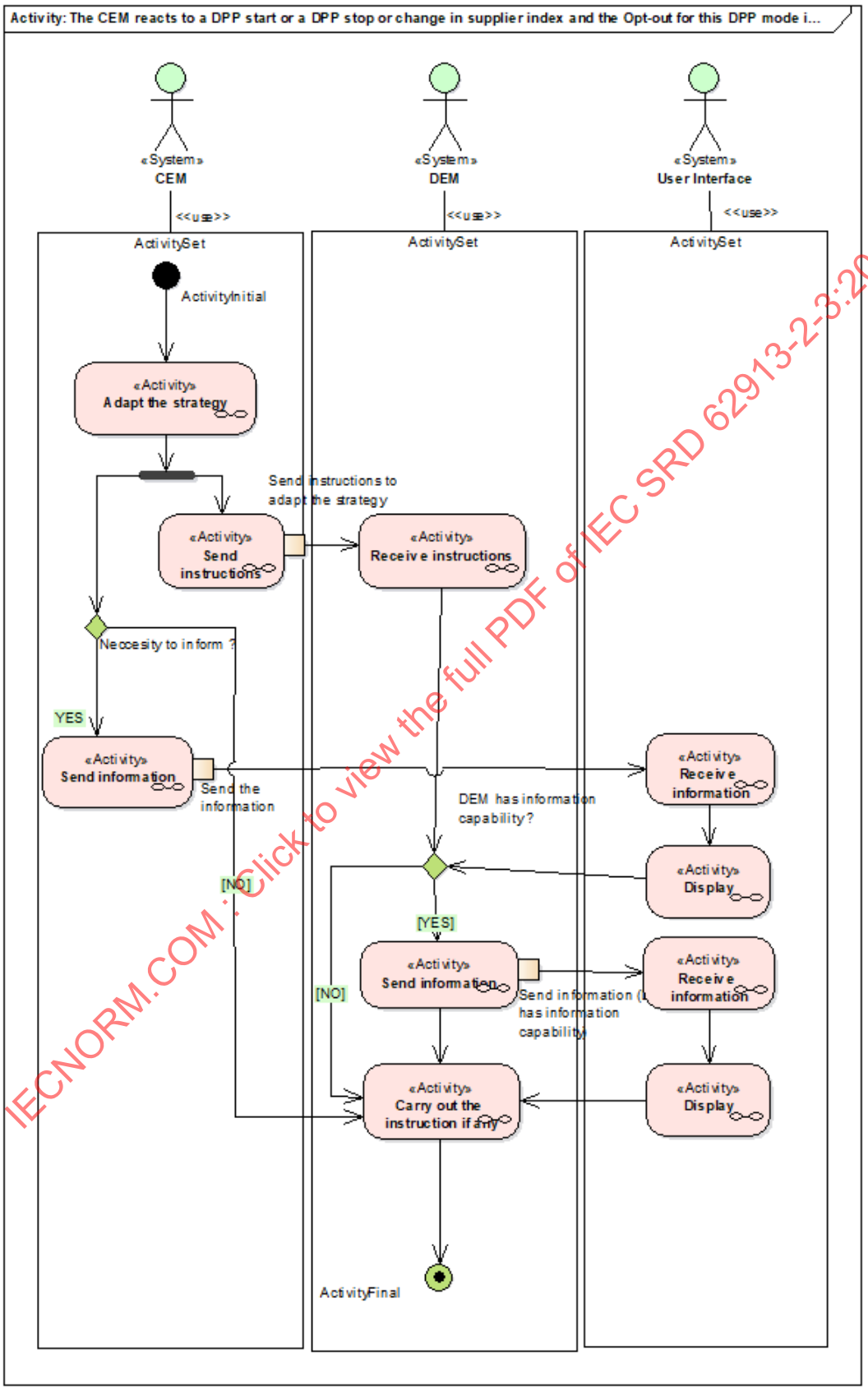


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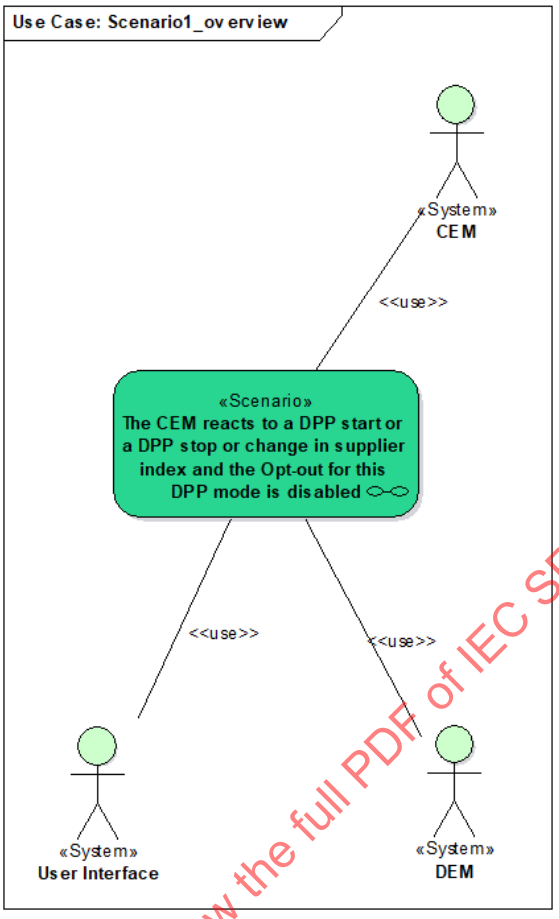
**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**




**Scenario step by step analysis**

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**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | The CEM reacts to a DPP start or a DPP stop or change in supplier index and the opt-out for this DPP mode is disabled | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 5.1 | | Adapt the strategy | | | CEM | | | |
| 5.2 | | Send instructions | | | CEM | DEM | | |
| 5.3 | | Send information | | | CEM | User interface | | |
| 5.4 | | Receive instructions | | | DEM | | | |
| 5.5 | | Receive information | | | User interface | | | |
| 5.6 | | Display | | | User interface | | | |
| 5.7 | | Send information | | | DEM | User interface | | |
| 5.8 | | Receive information | | | User interface | | | |
| 5.9 | | Display | | | User interface | | | |
| 5.10 | | Carry out the instruction | | | DEM | | | |
| | | | | | | | | |

4.2.6 The CEM reacts to a dynamic peak period notification and the opt-out for this DPP mode is activated

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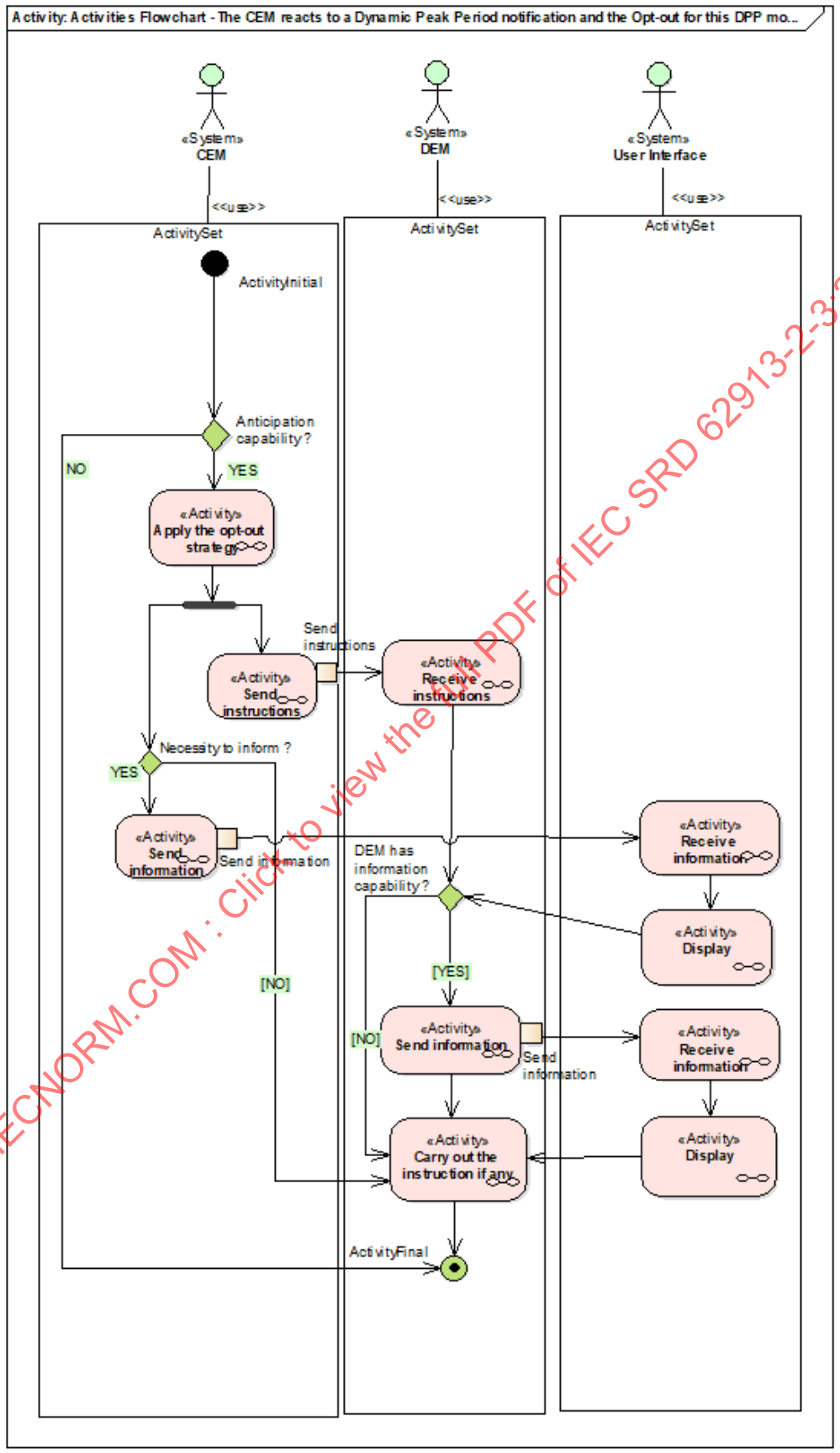


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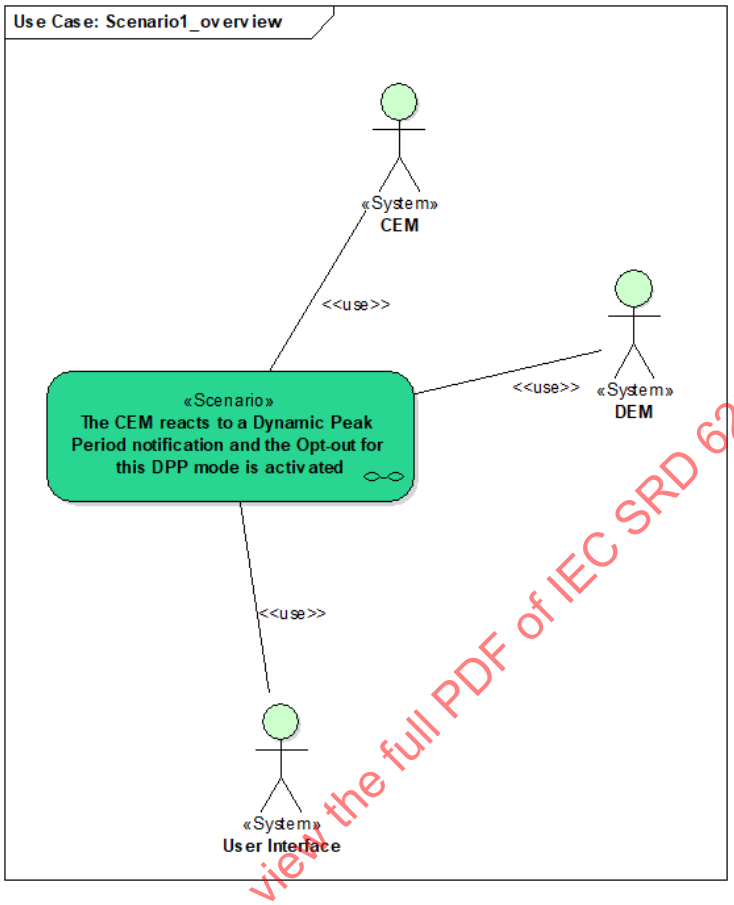
**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**




**Scenario step by step analysis**

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**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | The CEM reacts to a dynamic peak period notification and the opt-out for this DPP mode is activated | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 6.1 | | Apply the opt-out strategy | | | CEM | | | |
| 6.2 | | Send instructions | | | CEM | DEM | | |
| 6.3 | | Receive instructions | | | DEM | | | |
| 6.4 | | Send information | | | CEM | User interface | | |
| 6.5 | | Receive information | | | User interface | | | |
| 6.6 | | Display | | | User interface | | | |
| 6.7 | | Send information | | | DEM | User interface | | |
| 6.8 | | Receive information | | | User interface | | | |
| 6.9 | | Display | | | User interface | | | |
| 6.10 | | Carry out the instruction if any | | | DEM | | | |

4.2.7 The CEM reacts to a dynamic peak period notification and the opt-out for this DPP mode is disabled

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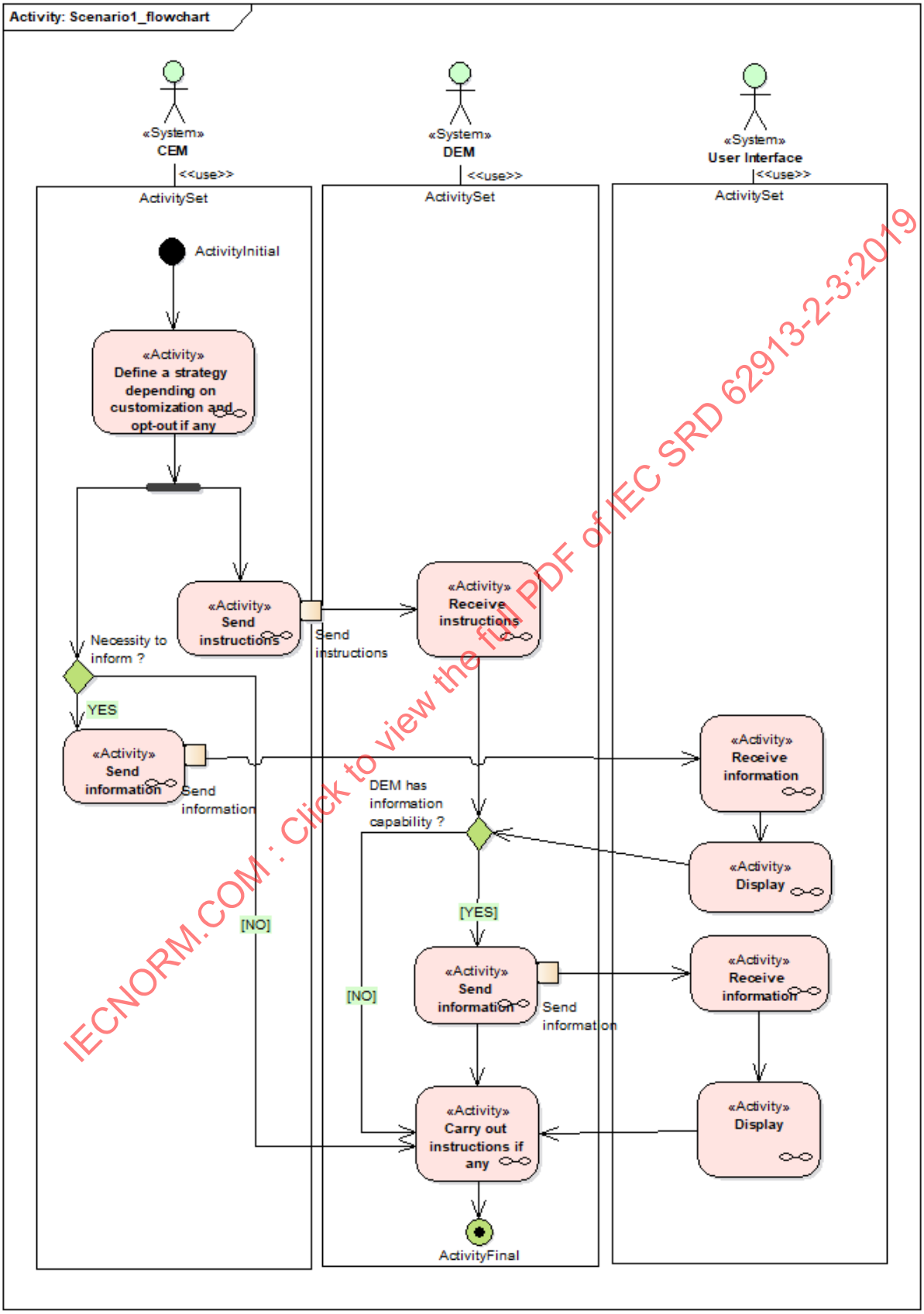


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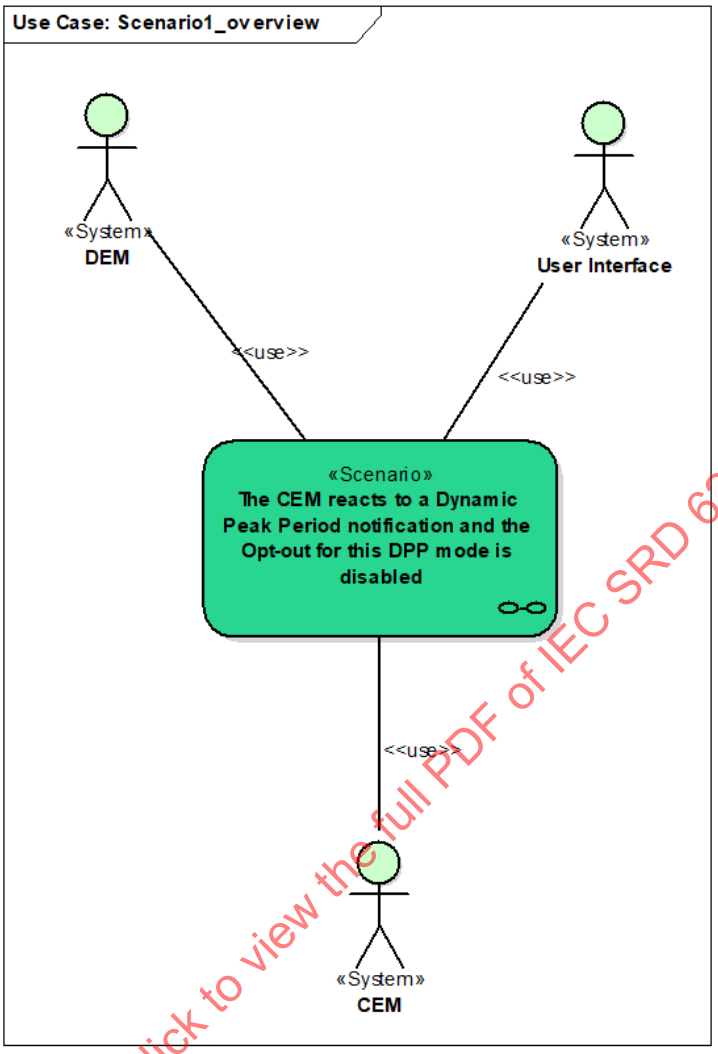


**Scenario step by step analysis**

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**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | The CEM reacts to a dynamic peak period notification and the opt-out for this DPP mode is disabled | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 7.1 | | Define a strategy depending on customization and opt-out if any | | | CEM | | | |
| 7.2 | | Send instructions | | | CEM | DEM | | |
| 7.3 | | Receive instructions | | | DEM | | | |
| 7.4 | | Send information | | | CEM | User interface | | |
| 7.5 | | Receive information | | | User interface | | | |
| 7.6 | | Display | | | User interface | | | |
| 7.7 | | Send information | | | DEM | User interface | | |
| 7.8 | | Receive information | | | User interface | | | |
| 7.9 | | Display | | | User interface | | | |
| 7.10 | | Carry out instructions if any | | | DEM | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

| Requirements (optional) | | |
|---|---|---|
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |

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**IEC62913-2-3-S043 Manage the flexibility of the smart home on electricity demand and generation from price incentives**

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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**Table B.11 – Manage the flexibility of the smart home on electricity demand and generation from DR requests**

| IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| IEC62913-2-3-S041 | Area: Energy system<br>Domain: Smart home | SUC-Manage the flexibility on electricity demand and generation from DR requests |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | Automatic response of the smart home from DR requests. |
| **Objective(s)** | – Give the possibility to the resident to opt out of tariff incentives and demands of flexibility, if desired for reasons of comfort:<br>• Before a DR request if a notification is sent: anticipate if need be and if possible.<br>• Upon receipt of the DR request: define and carry out a load management strategy.<br>• At the end of the DR request period: define and carry out a load management strategy by switching back on loads if need be. |
| **Related business case(s)** | |

1.4 Narrative of Use Case

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| IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests |
|---|
| **Narrative of use case** |
| **Short description** |
| The system Use Case describes how the CEM/DEM defines the load management strategy and adapts it depending on a DR request. The resident is informed if necessary. |
| **Complete description** |
| Principles<br>P1. This use case considers that DR requests apply on a period.<br>P2. This use case considers DR requests intended for:<br>• a reduction or termination of loads or electricity generation<br>• a rise in loads or electricity production<br>• a modulation (power…)<br>P3. A DR request can be:<br>• a flexibility request indicating the start of a period and a duration<br>• a first flexibility request message indicating the start of a period and then a second one indicating the end of the period<br>A notification can be sent to announce a future flexibility request. This notification is considered as a flexibility request message as well.<br>P4. This use case assumes that the CEM establishes a load management strategy and sends it to the DEM function(s) in order to be executed.<br>• This applies to a customer energy management system (CEMS) and to the indirectly connected appliances (ICA) that it controls.<br>• This applies to a directly connected appliance (DCA), that is to say a smart appliance directly connected to a smart meter radio transmitter.<br>P5. This use case considers the two following cases:<br>• case where the appliances can send information,<br>• case where the appliances cannot send information.<br>P6. The resident can opt out of a flexibility request.<br>P7. Depending on its capability, the CEM function of the CEMS and DCA arbitrate between flexibility requests and price incentives.<br>Common scenario<br>The smart home receives a flexibility request notification or a flexibility request via the EMG or via the external smart metering gateway.<br>When a flexibility request notification is sent, the smart home can define a load management strategy, inform the residents if necessary and execute new instructions if any.<br>When a flexibility request is sent, the smart home can adapt the load management strategy, inform the residents if necessary and execute new instructions if any.<br>Price incentives, resident customizations and possible opt-outs are taken into account so as to define or adapt the load management strategy. |

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1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

| IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests |
|---|
| **Use case conditions** |
| **Assumption** |
| • Flexibility requests are received via the smart grid connection point, that is to say the external SMG or the EMG. |
| • Standard RCI (remote customer information) fields enable to detect flexibility requests (flexibility requests messages received via the external SMG). |
| • A DR request notification can match a flexibility request message. |
| • The resident is informed locally and/or away from home via any medium (dedicated display, appliance display, LED, SMS, etc.). |
| • The anticipation capability is an option. |
| • The client of electricity supplier is also a client of a flexibility operator. |
| • If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. The UI mentioned in the sequence diagrams is a local UI within the smart home. |
| **Prerequisite** |
| • The client has subscribed an electricity contract from the electricity supplier. |
| • The client has subscribed a contract to make flexibilities available to a flexibility operator. |
| • The client's smart home is up and running. |
| • The smart home is configured to feedback data enabling to validate the activation of flexibilities (for example, the smart meter is configured in "load curve" mode). |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| BUC-Manage the flexibility on electricity demand and generation within a smart home from market signals |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| System Use Case |
| **Further keywords for classification** |
| smart home, load management strategy, DR request |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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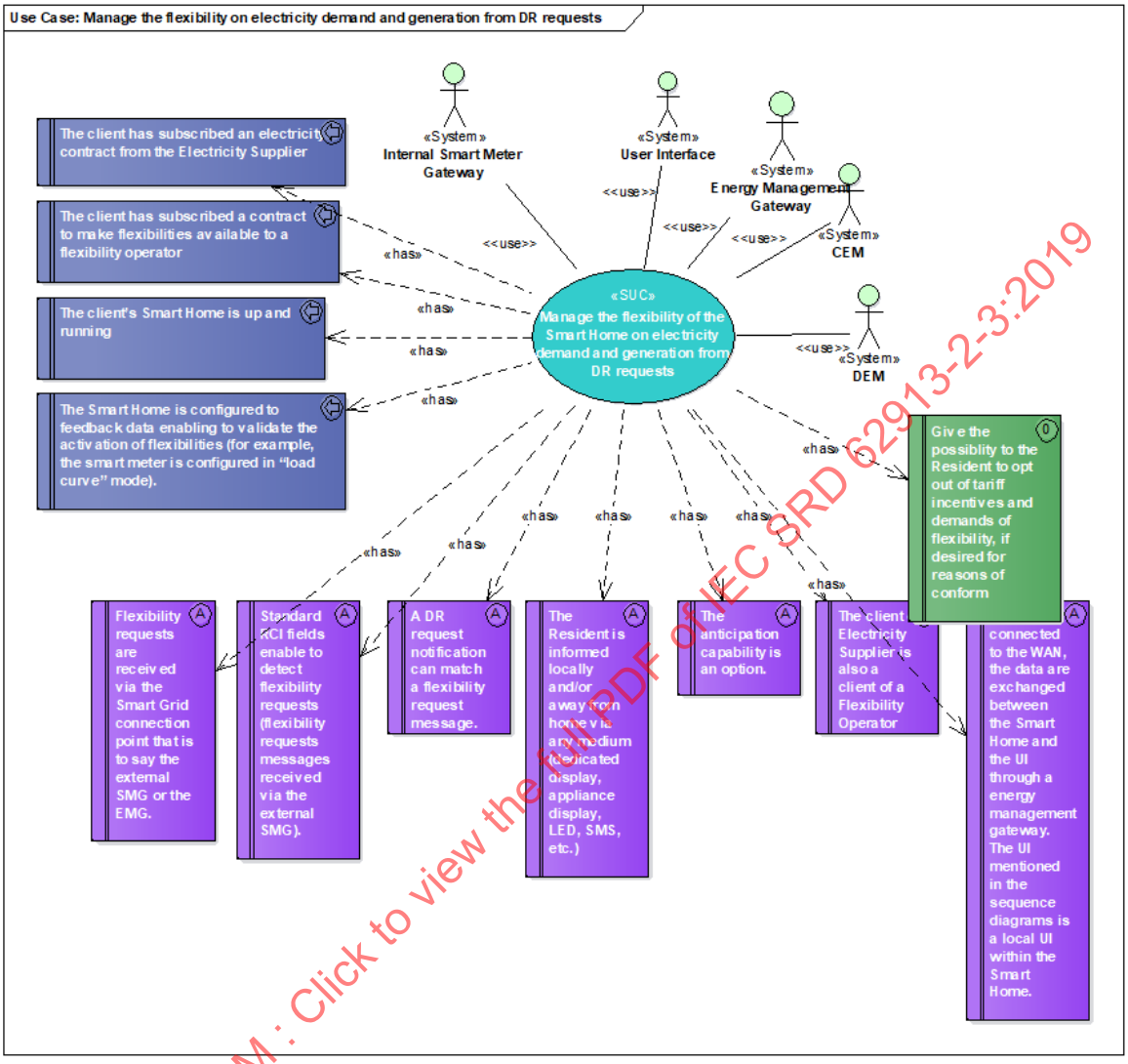
**Diagram(s) of use case**

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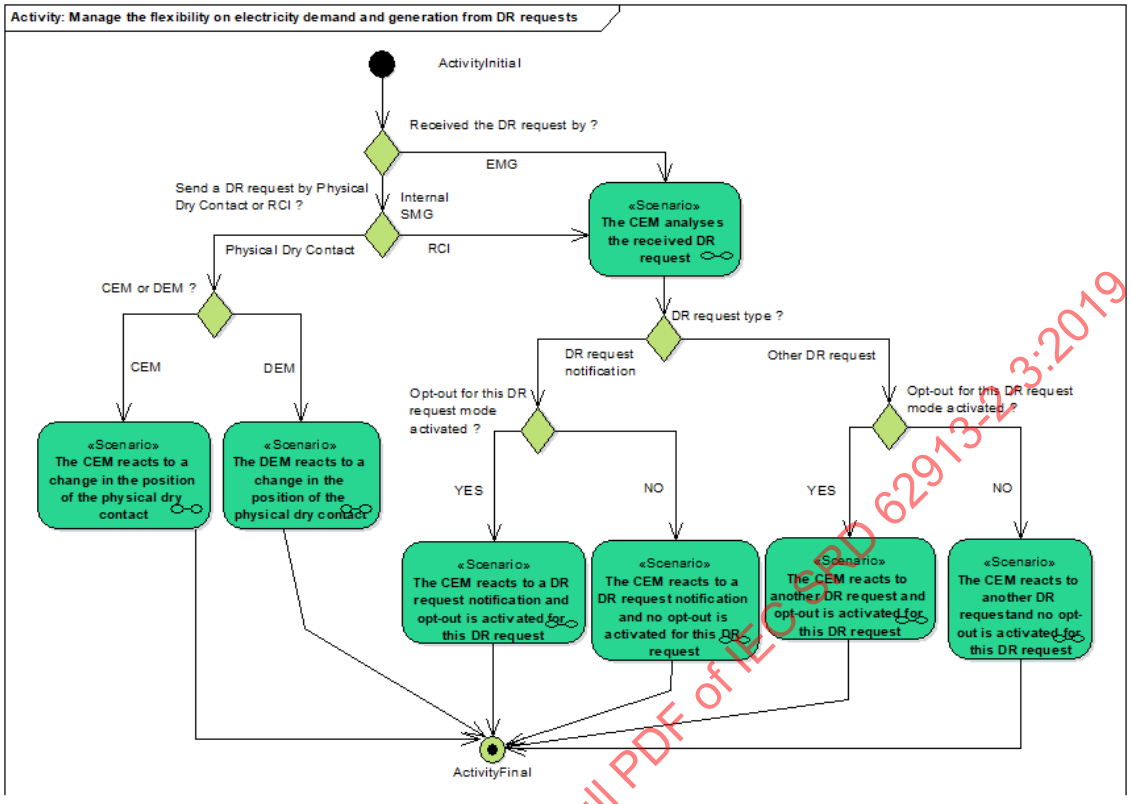


3 Technical details

3.1 Actors

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| Actors | |
|---|---|
| **Grouping** | **Group Description** |
| | |

| Actor name | Actor type | Actor Description | Further information specific to this Use Case |
|---|---|---|---|
| DEM | System | Function adapting the operations of a given electrical device depending on the incoming orders, resident customization and potential opt-outs that may be manually done locally. | DEM |
| Internal smart metering gateway | System | Communications functions between the smart metering and the smart home. | Internal smart metering gateway |
| CEM | System | Function enabling the definition of coordinated energy management strategies of one or several related DEM depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, resident/client customization and potential resident/client opt-outs.<br><br>This function includes a processing ability notably in order to take resident/client customization and electricity data enhancement into account. | CEM |
| Energy management gateway | System | Communication functions between the WAN and the HAN. | Energy management gateway |
| User interface | System | User interface (UI) can be connected to the smart home (HAN) or to the WAN. If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. | User interface |

3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

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**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-condition** | **Post-condition** |
| 1 | The CEM analyses the received DR request | | | | | |
| 2 | The CEM reacts to a change in the position of the physical dry contact | | | | | |
| 3 | The CEM reacts to a DR request notification and no opt-out is activated for this DR request | | | | | |
| 4 | The CEM reacts to a DR request notification and opt-out is activated for this DR request | | | | | |
| 5 | The CEM reacts to another DR request and opt-out is activated for this DR request | | | | | |
| 6 | The CEM reacts to another DR request and no opt-out is activated for this DR request | | | | | |
| 7 | The DEM reacts to a change in the position of the physical dry contact | | | | | |

4.2 Scenarios

4.2.1 The CEM analyses the received DR request

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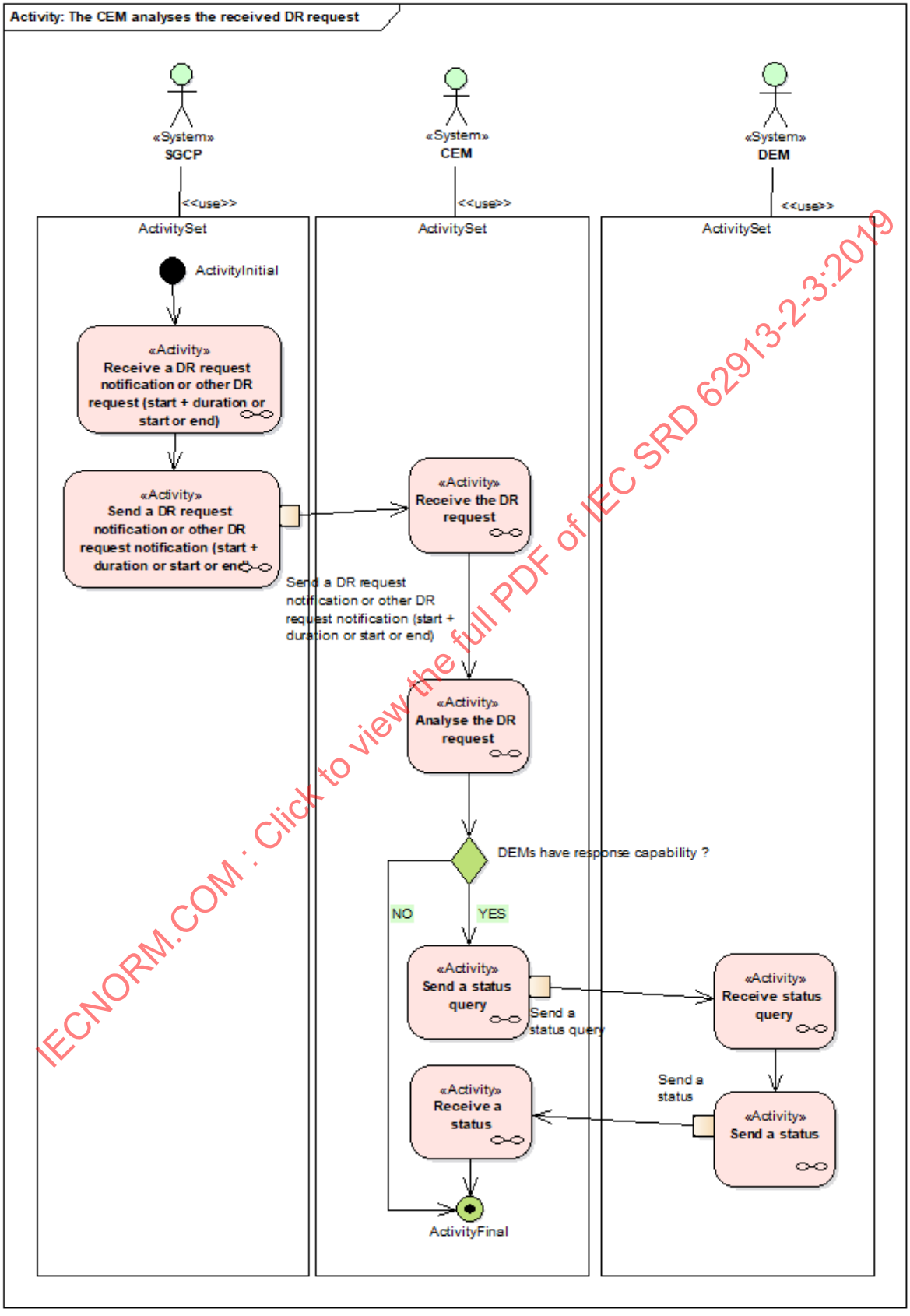


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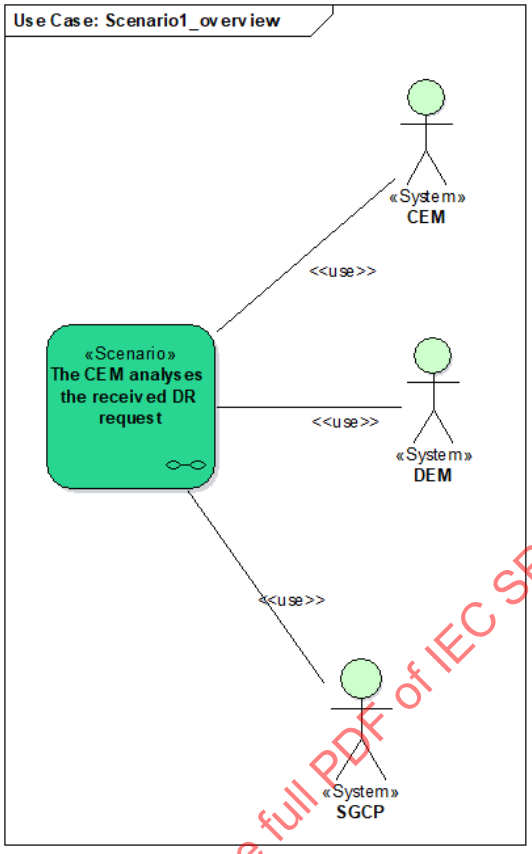


**Scenario step by step analysis**

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| IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | The CEM analyses the received DR request | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 1.0 | | Receive a DR request notification or other DR request (start + duration or start or end) | | | | Smart grid connection point | | |
| 1.1 | | Send a DR request notification or other DR request (start + duration or start or end) | | | Smart grid connection point | CEM | | |
| 1.2 | | Receive the DR request | | | CEM | | | |
| 1.3 | | Analyse the DR request | | | CEM | | | |
| 1.4 | | Send a status query | | | CEM | DEM | | |
| 1.5 | | Receive status query | | | DEM | | | |
| 1.6 | | Send a status | | | DEM | CEM | | |
| 1.7 | | Receive a status | | | CEM | | | |

4.2.2 The CEM reacts to a change in the position of the physical dry contact

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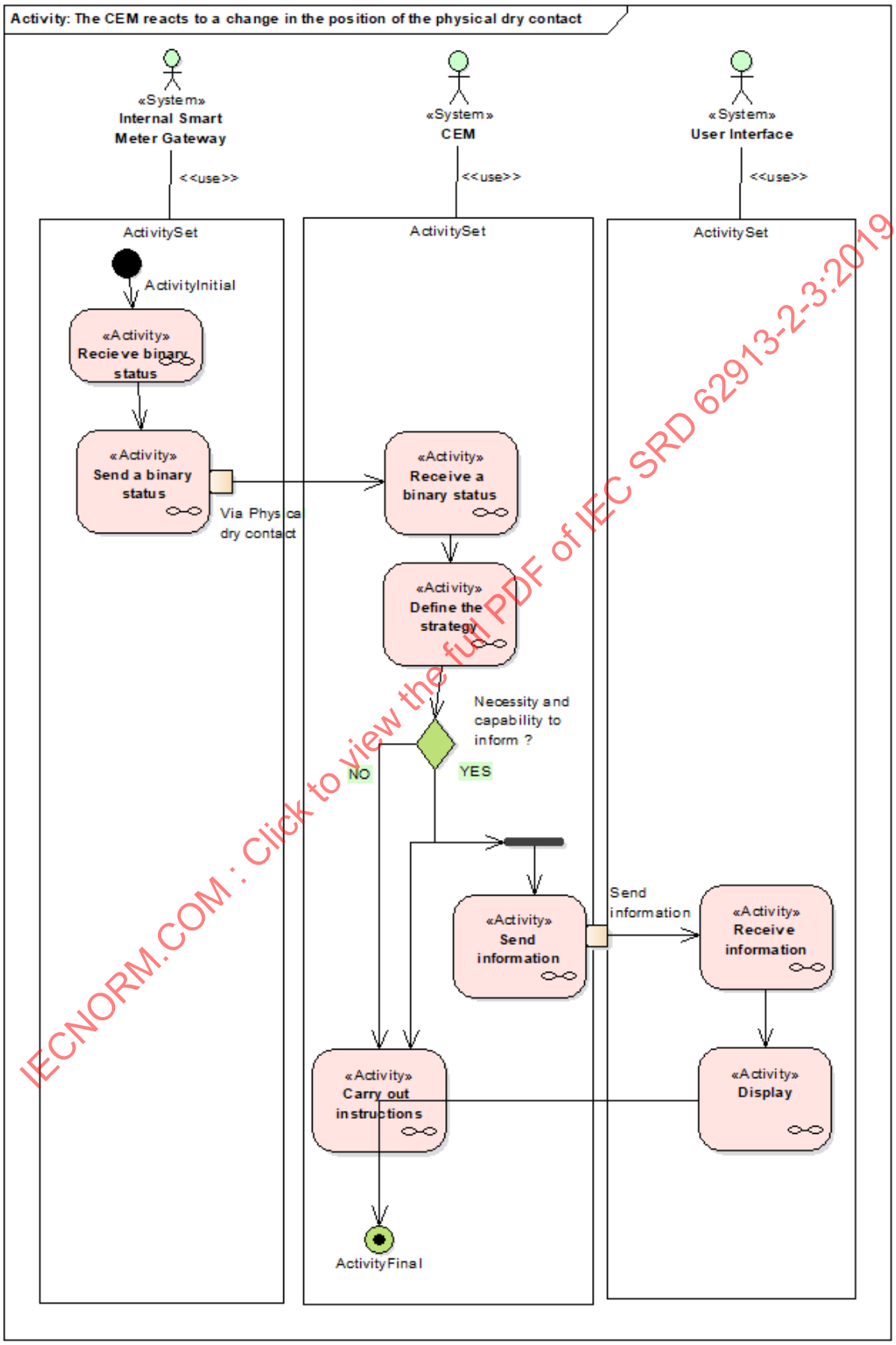
**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**

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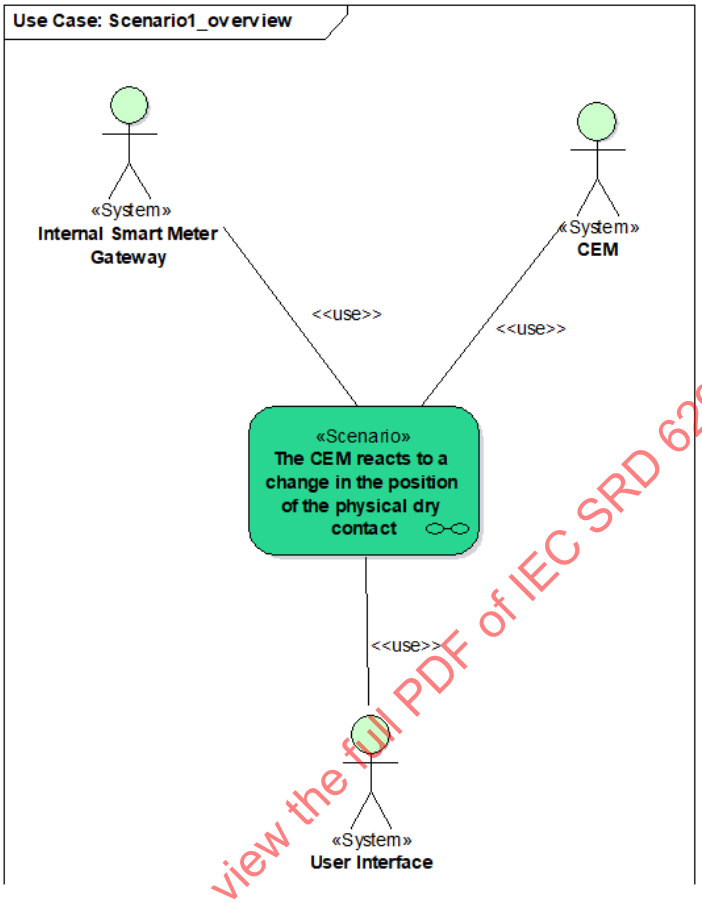
**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**




**Scenario step by step analysis**

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**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | The CEM reacts to a change in the position of the physical dry contact | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 2.0 | | Receive a binary status | | | | Internal smart metering gateway | | |
| 2.1 | | Send a binary status | | | Internal smart metering gateway | CEM | | |
| 2.2 | | Receive a binary status | | | CEM | | | |
| 2.3 | | Define the strategy | | | CEM | | | |
| 2.4 | | Carry out instructions | | | CEM | | | |
| 2.5 | | Send information | | | CEM | User interface | | |
| 2.6 | | Receive information | | | User interface | | | |
| 2.7 | | Display | | | User interface | | | |

4.2.3 The CEM reacts to a DR request notification and no opt-out is activated for this DR request

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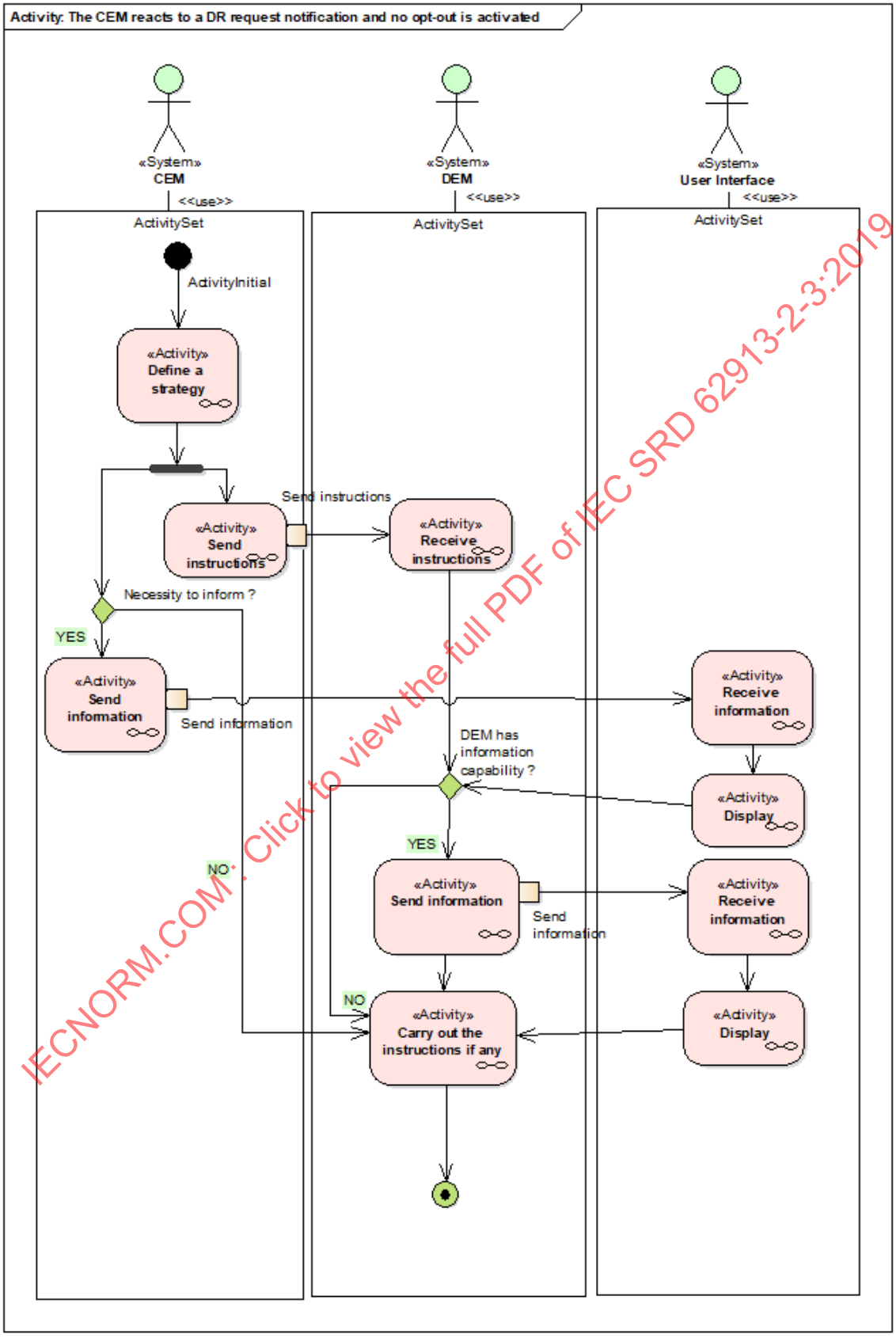
**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**

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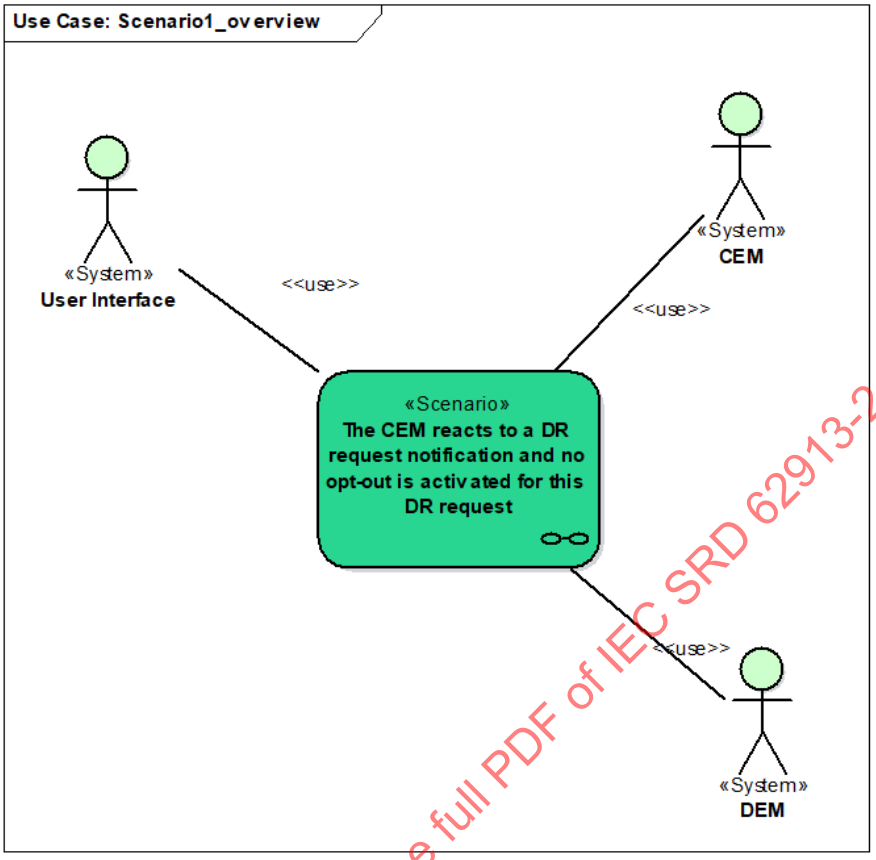
**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**




| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | The CEM reacts to a DR request notification and no opt-out is activated for this DR request | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 3.1 | | Define a strategy | | | CEM | | | |
| 3.2 | | Send instructions | | | CEM | DEM | | |
| 3.3 | | Receive instructions | | | DEM | | | |
| 3.4 | | Send information | | | CEM | User interface | | |
| 3.5 | | Receive information | | | User interface | | | |
| 3.6 | | Display | | | User interface | | | |
| 3.7 | | Send information | | | DEM | User interface | | |
| 3.8 | | Carry out the instructions if any | | | DEM | | | |
| 3.9 | | Receive information | | | User interface | | | |
| 3.10 | | Display | | | User interface | | | |

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| IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests |
| --- |
| 4.2.4 The CEM reacts to a DR request notification and opt-out is activated for this DR request |

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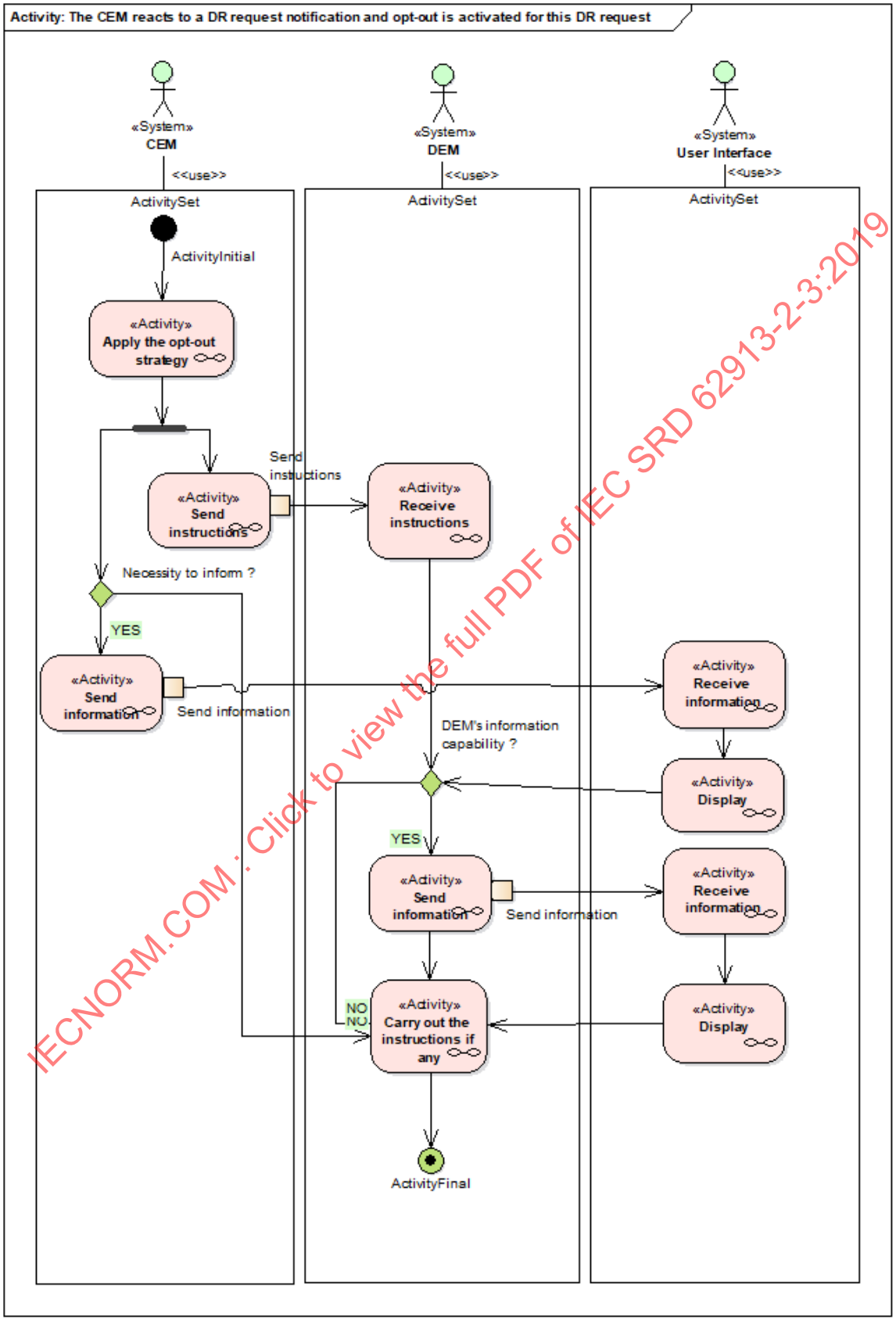


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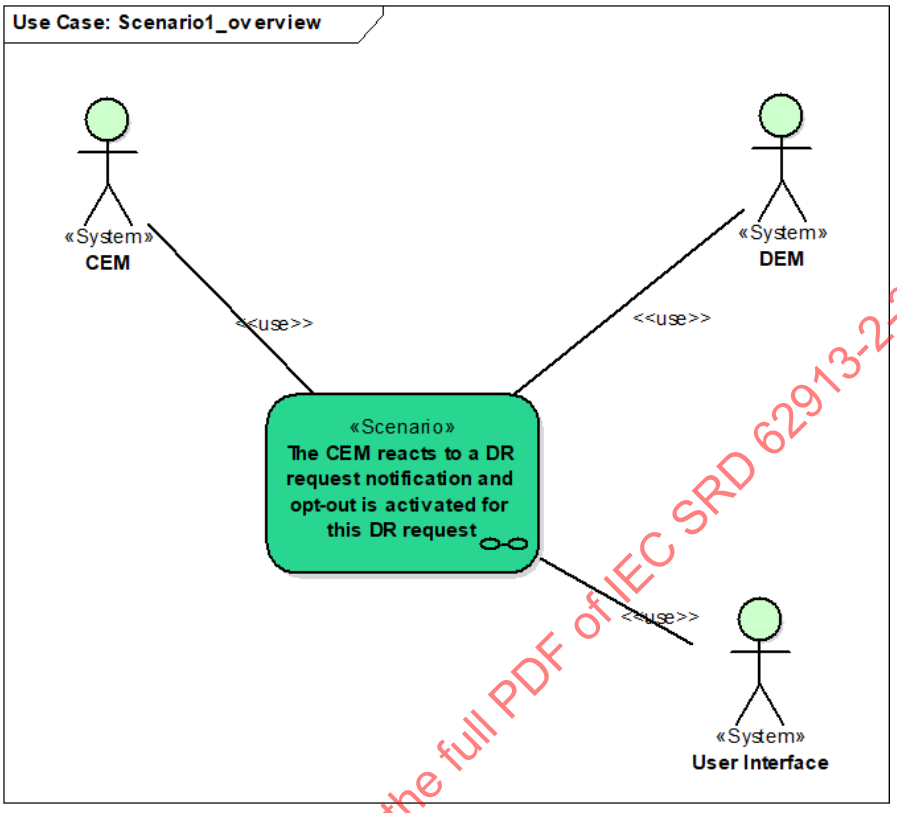
**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**




**Scenario step by step analysis**

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| IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | The CEM reacts to a DR request notification and opt-out is activated for this DR request | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 4.1 | | Apply the opt-out strategy | | | CEM | | | |
| 4.2 | | Send instructions | | | CEM | DEM | | |
| 4.3 | | Receive instructions | | | DEM | | | |
| 4.4 | | Send information | | | CEM | User interface | | |
| 4.5 | | Receive information | | | User interface | | | |
| 4.6 | | Display | | | User interface | | | |
| 4.7 | | Send information | | | DEM | User interface | | |
| 4.8 | | Receive information | | | User interface | | | |
| 4.9 | | Display | | | User interface | | | |
| 4.10 | | Carry out the instructions if any | | | DEM | | | |

4.2.5 The CEM reacts to another DR request and opt-out is activated for this DR request

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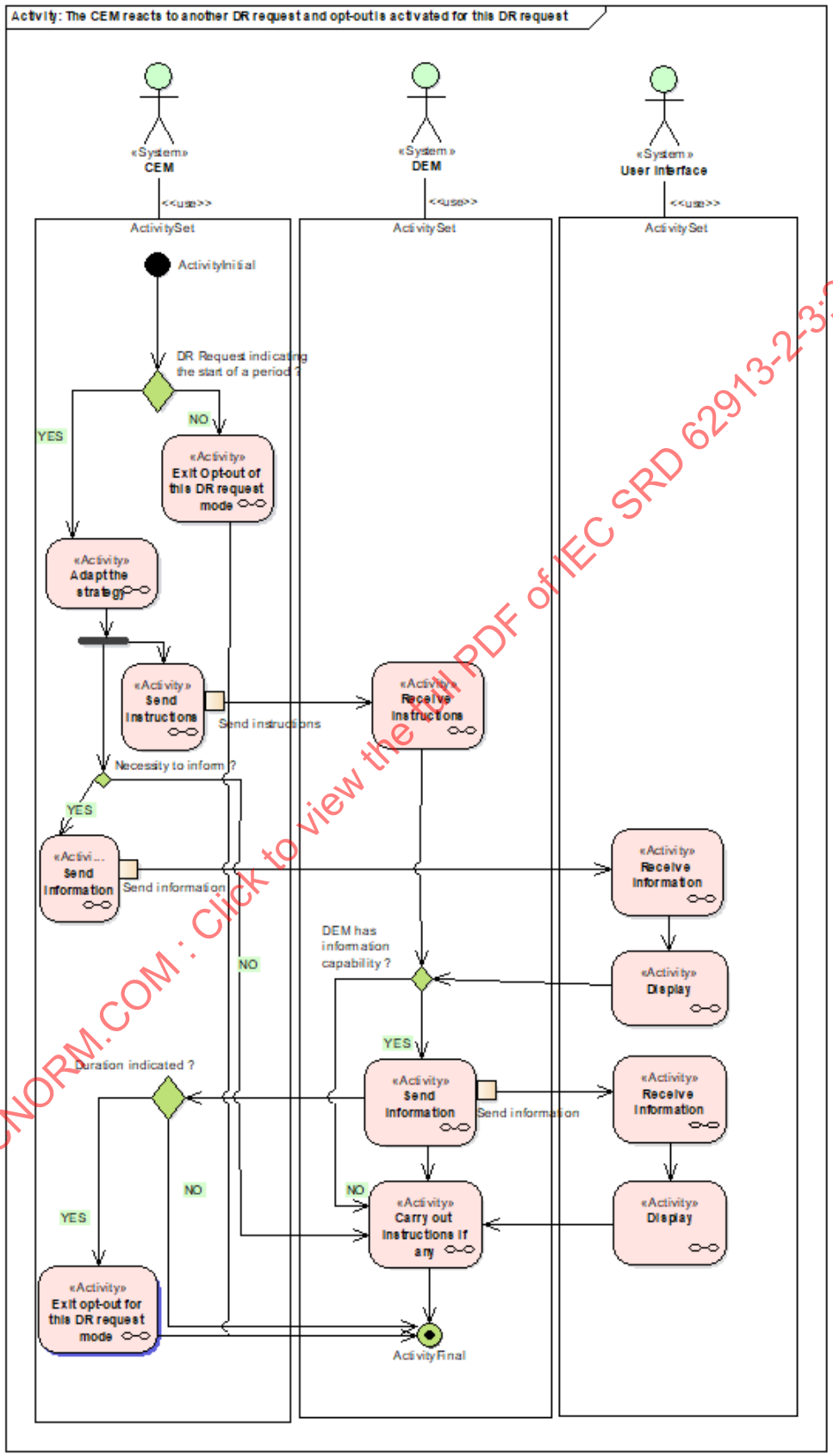
**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**

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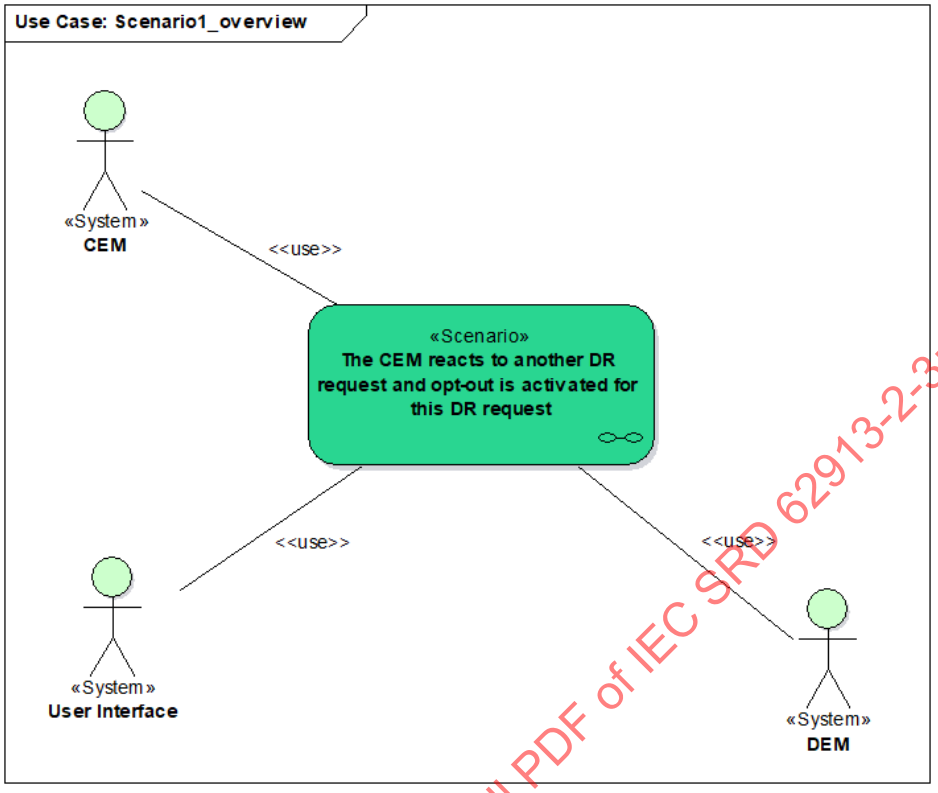
**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**




**Scenario step by step analysis**

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| IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | The CEM reacts to another DR request and opt-out is activated for this DR request | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 5.1 | | Exit opt-out for this DR request mode | | | CEM | | | |
| 5.2 | | Adapt the strategy | | | CEM | | | |
| 5.3 | | Send instructions | | | CEM | DEM | | |
| 5.4 | | Receive instructions | | | DEM | | | |
| 5.5 | | Send information | | | CEM | User Interface | | |
| 5.6 | | Receive information | | | User Interface | | | |
| 5.7 | | Display | | | User Interface | | | |
| 5.8 | | Send information | | | DEM | User Interface | | |
| 5.9 | | Carry out instructions if any | | | DEM | | | |
| 5.10 | | Exit opt-out of this DR request mode | | | CEM | | | |
| 5.11 | | Receive information | | | User Interface | | | |
| 5.12 | | Display | | | User Interface | | | |

4.2.6 The CEM reacts to another DR request and no opt-out is activated for this DR request

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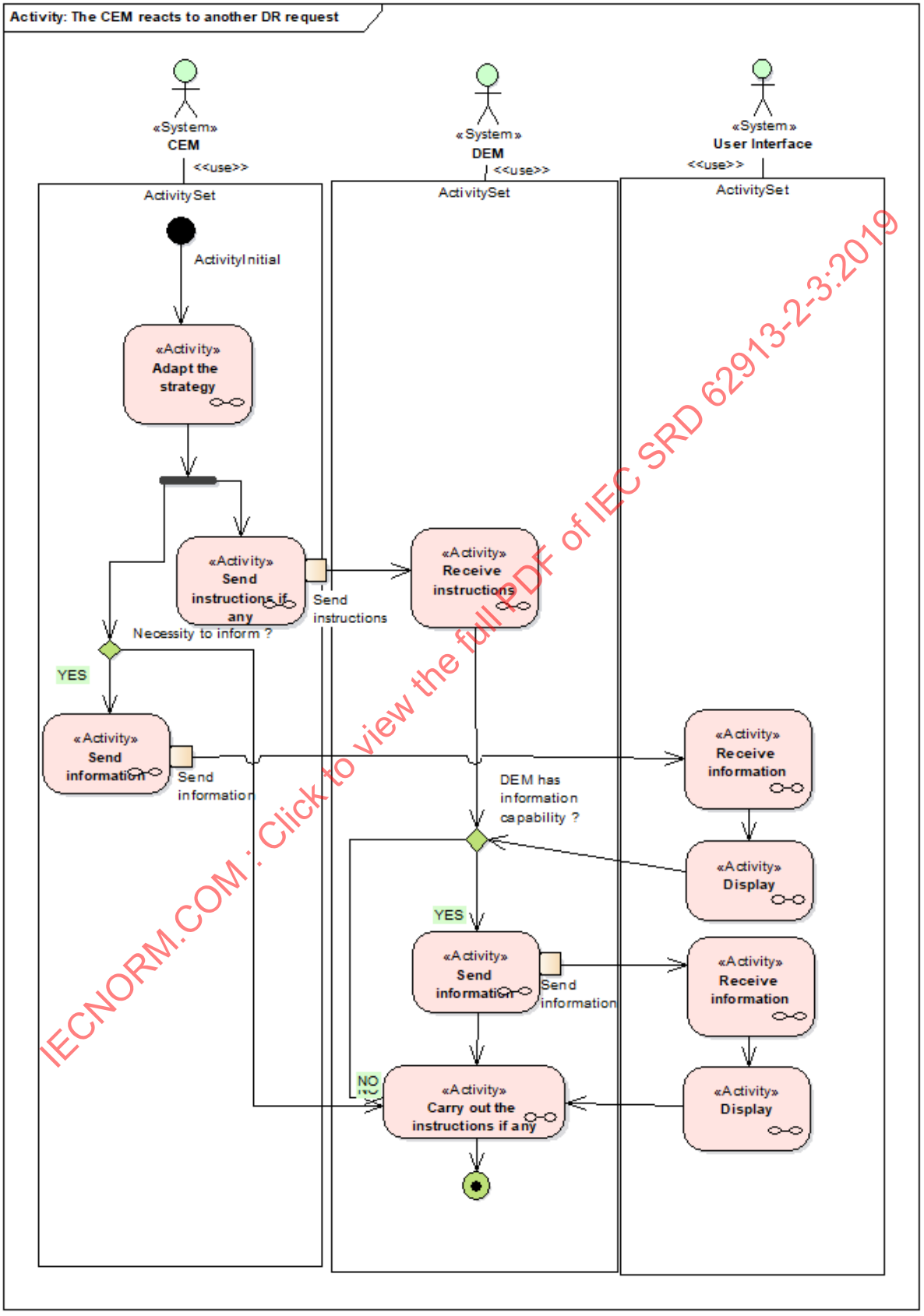


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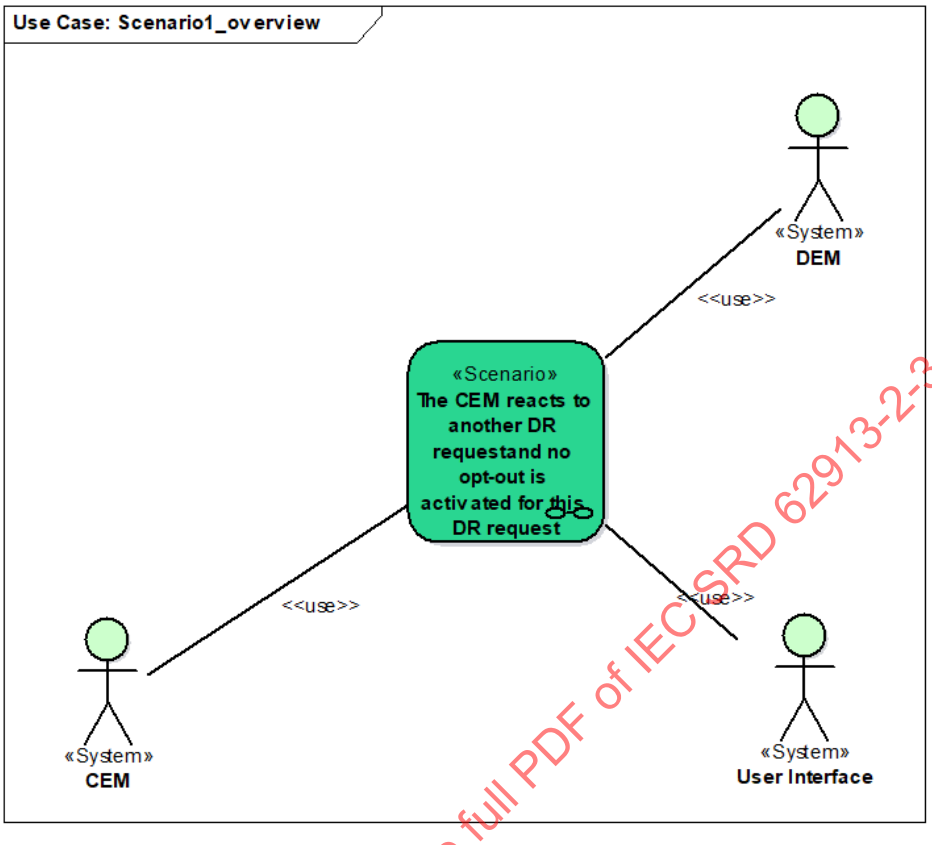
**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**




**Scenario step by step analysis**

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| IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | The CEM reacts to another DR request and no opt-out is activated for this DR request | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 6.1 | | Adapt the strategy | | | CEM | | | |
| 6.2 | | Send instructions if any | | Send instructions | CEM | DEM | | |
| 6.3 | | Receive instructions | | | DEM | | | |
| 6.4 | | Send information | | | CEM | User Interface | | |
| 6.5 | | Receive information | | | User Interface | | | |
| 6.6 | | Display | | | User Interface | | | |
| 6.7 | | Send information | | | DEM | User Interface | | |
| 6.8 | | Carry out the instructions if any | | | DEM | | | |
| 6.9 | | Receive information | | | User Interface | | | |
| 6.10 | | Display | | | User Interface | | | |

4.2.7 The DEM reacts to a change in the position of the physical dry contact

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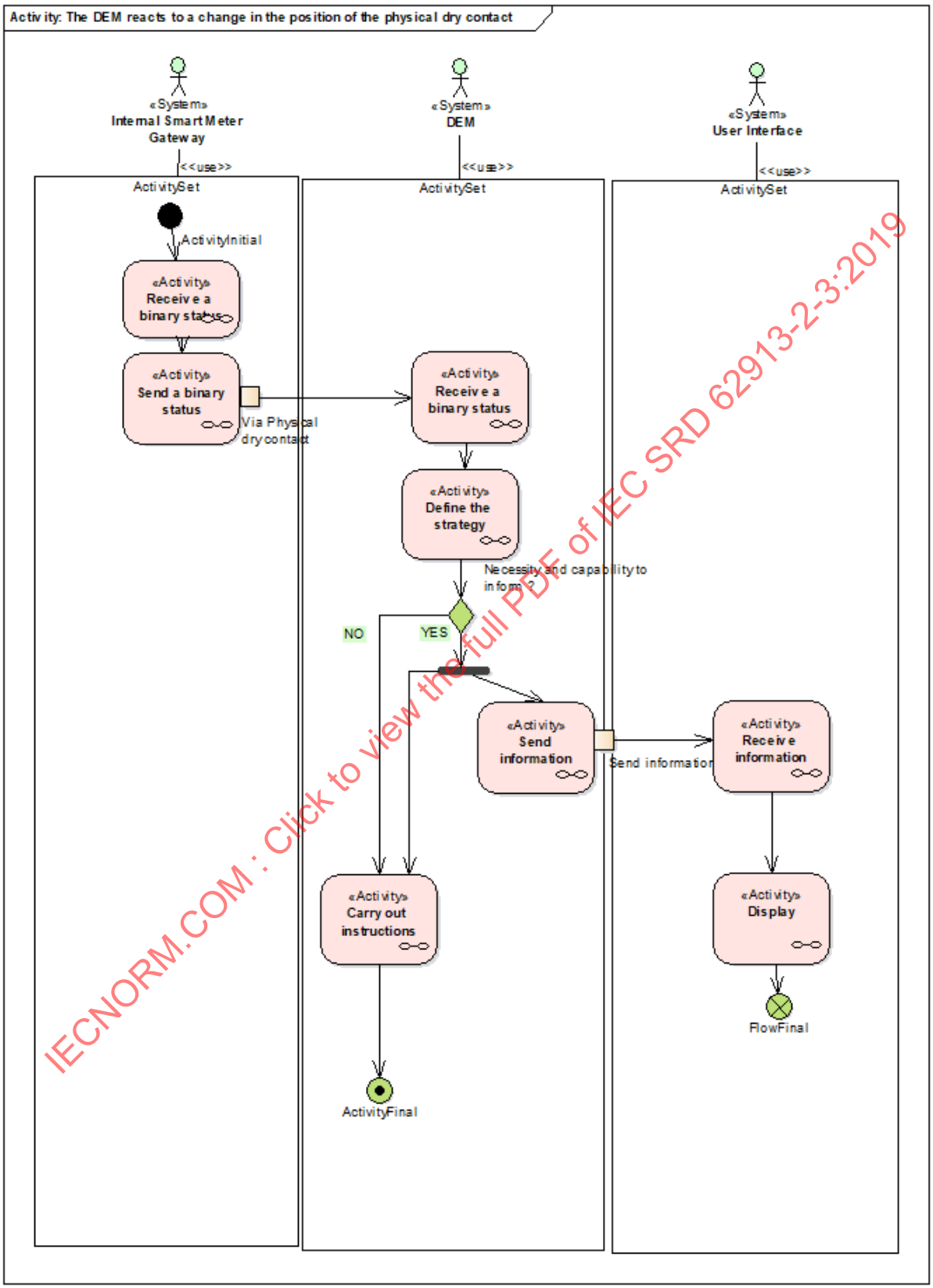


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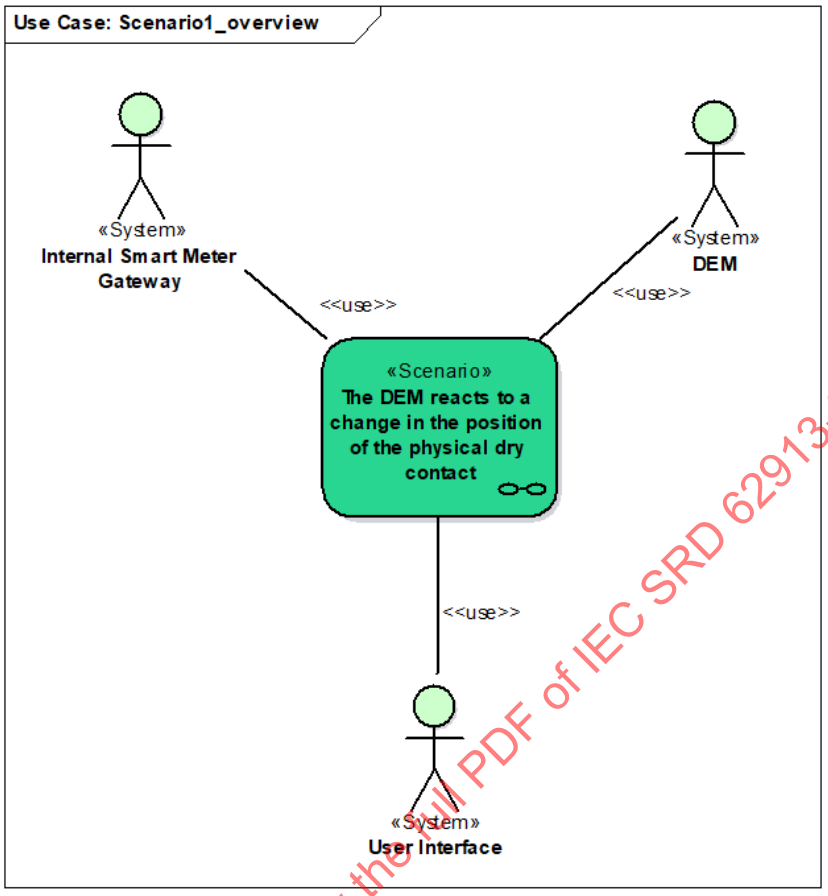
**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**




**Scenario step by step analysis**

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**IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | The DEM reacts to a change in the position of the physical dry contact | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 7.0 | | Receive a binary Status | | | | internal smart metering gateway | | |
| 7.1 | | Send a binary status | | | internal smart metering gateway | DEM | | |
| 7.2 | | Receive a binary status | | | DEM | | | |
| 7.3 | | Define the strategy | | | DEM | | | |
| 7.4 | | Carry out instructions | | | DEM | | | |
| 7.5 | | Send information | | | DEM | User Interface | | |
| 7.6 | | Receive information | | | User Interface | | | |
| 7.7 | | Display | | | User Interface | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

| Requirements (optional) | | |
|---|---|---|
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |

7 Common terms and definitions

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| IEC62913-2-3-S041 Manage the flexibility of the smart home on electricity demand and generation from DR requests | |
|---|---|
| **Common terms and definitions** | |
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

**Table B.12 – Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests**

| IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests | | |
|---|---|---|
| 1 Description of the use case | | |
| 1.1 Name of use case | | |
| **Use case identification** | | |
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| IEC62913-2-3-S044 | Area: Energy system<br>Domain: Smart home | SUC-Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests |
| 1.2 Version management | | |

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| | | | | |

1.3 Scope and objectives of use case

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| IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests | |
|---|---|
| **Scope and objectives of use case** | |
| **Scope** | Response of the smart home from price incentives or DR requests.<br>Emergency signals are out of the scope of this Use Case. |
| **Objective(s)** | – Give the possibility to the resident to opt out of tariff incentives and demands of flexibility, if desired:<br>– to a planned or occurring automatic response after receiving a notification or during the execution of an automatic response;<br>– entirely or to a given level, i.e. either not to take into account price or to apply an instruction that the resident wants;<br>– over different scopes: the whole smart home, one or several areas (rooms), one or several uses, one or several appliances. |
| **Related business case(s)** | |

1.4 Narrative of Use Case

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**IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests**

**Narrative of use case**

**Short description**

The system Use Case describes how the resident/client opts-out of a planned or occurring automatic response after receiving a notification or during the execution of an automatic response that results from a price incentive or a DR request. In other words, the smart home will not apply a strategy that takes into account price incentives or DR requests or will apply a new strategy that matches the resident/client's instructions.

**Complete description**

What for?

P1. Opt-out, entirely or to a given level, i.e.:

- either not to take into account price incentives (related to a Dynamic Peak Period (DPP) for example);
- or to apply an instruction that the resident wants (only for a Dynamic Peak Period (DPP) for example).

When?

P2. The resident opts-out of a planned or occurring automatic response after receiving a notification or during the execution of an automatic response.

For when?

P3. The time slot of application for a new instruction can be spread out between:

- 2 timestamps (opt-out start and opt-out stop) defined or customized (criteria-based customization) by the resident/client.
  - For the resident, this implies to ask a "set duration or criteria-based opt-out".
- The time when the resident/client requests to start opting-out and the time the resident requests to stop opting-out.
  - For the resident, this implies a "manual forcing" (implemented case that has not been described in the diagrams).
- The first price incentive related to a dynamic peak period and a dynamic peak period (DPP) stop.
  - For the client/resident, this implies asking to "opt-out for a current or upcoming DPP".

Over what?

P4. In all cases, depending on the capability of the smart home, the resident can, depending on his or her needs, opt-out over different scopes: the whole smart home, one or several areas (rooms), one or several uses, one or several appliances.

Where?

P5. Locally, opting-out is expressed on a CEM, i.e. on a DCA or on a CEMS, not on a DEM. Opt-out on an ICA is a manual forcing that has not been described in the diagrams.

P6. Depending on the smart home capabilities, the resident/client can opt-out away from home.

P7. The resident/client shall be given a way to modify the opt-out level and the scope to impact for a current or planned opt-out. He or she shall be given a way to opt-out as many times as he or she wants.

P8. Contrary to energy behaviour customization (not described in this use case), opting-out is a one-time event.

P9. The resident/client shall be given a way to check the current status and the planned status for his or her appliances.

Timing

T1. Regarding a DPP, the client/resident can request to opt-out as soon as he or she receives the notification message, until return to normalcy.

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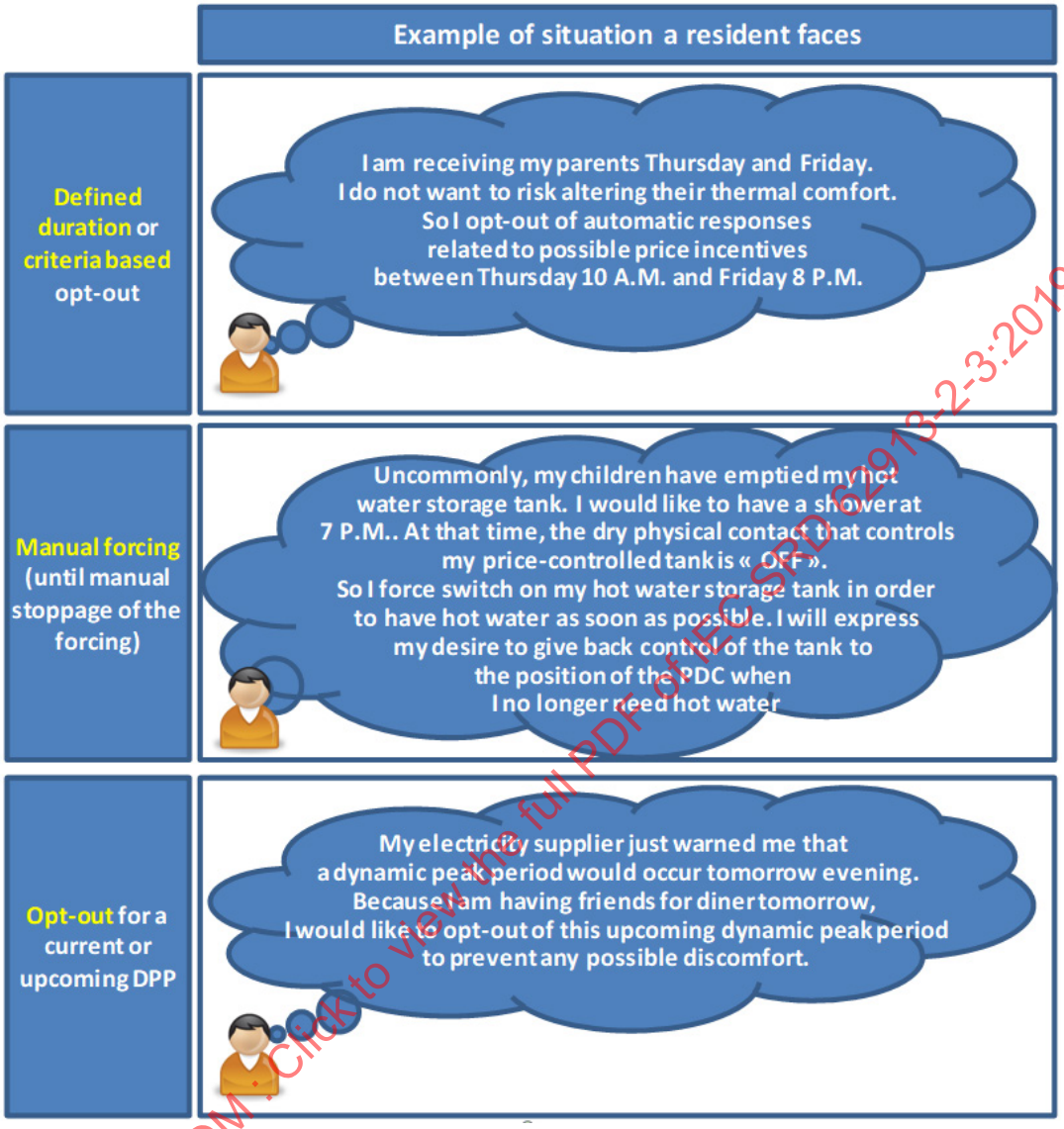


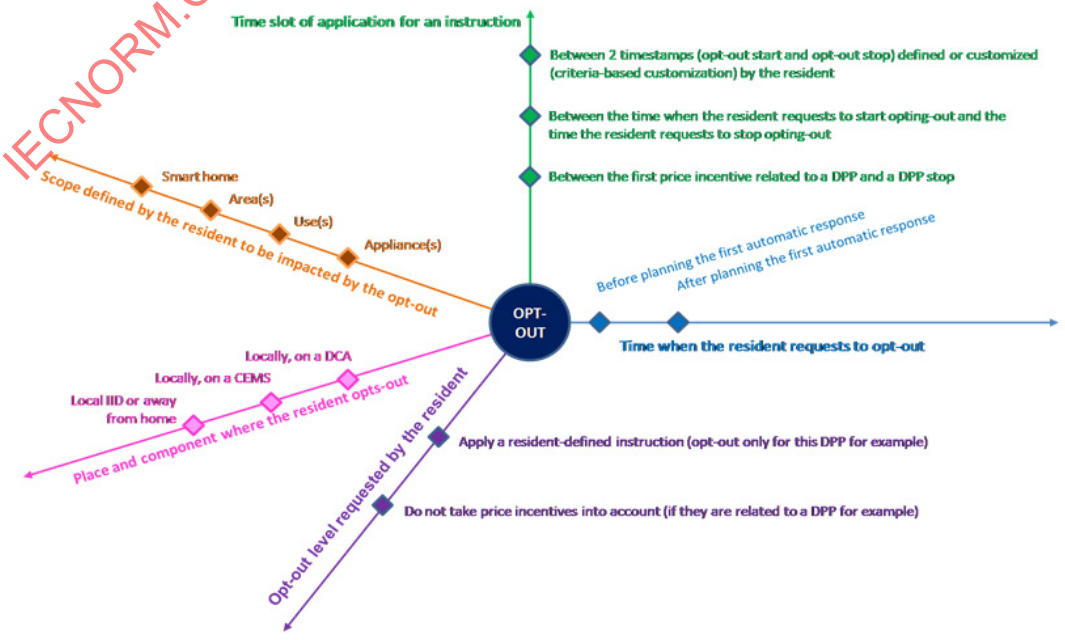


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**IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests**

**1-Customize the smart home manually**

The resident/client decides to customize the smart home manually. He or she does not configure his or her smart home to automatically respond to external signals (such as price incentives or DR requests) and adapt its behaviour.

In this case, he or she may decide to respond to external signals by manually modifying the behaviour of the smart home.

2-Customize the smart home with automatic responses

The resident/client customizes the behaviour of the smart home in order to automatically respond to external signals. The resident/client keeps the possibility to opt out of these signals.

**2.1-Customize the automatic responses of the smart home**

Depending on the smart home capabilities and the resident/client needs, the customization may be defined and applied to different scopes, that is to say:

– the whole smart home,

– one or several areas (rooms),

– one or several uses,

– one or several appliances.

Depending on the smart home capabilities, the customization may be defined and applied to different timescales:

– price period,

– standard day,

– standard week,

– standard season,

– use/appliance consumption time slot.

**2.2-Customize warnings**

The resident/client customizes warnings, i.e. events to be tracked, and specifies the related emission channel.

The event to be tracked is exceeding an electricity data threshold in the smart home (such as a threshold of consumption in kWh).

**2.3-Receive a notification**

The resident/client receives a notification confirming that the new customization has been taken into account.

The resident/client may read the customization.

**3-Delegate the smart home customization to a third party by providing relevant data**

In order to deal with the complexity of the smart home management, the resident/client may contract with a third party, such as a service provider for instance, to manage the customization of the smart home.

**3.1-Authorize a third party**

The resident/client authorizes a designated third party to access smart home data and customize the smart home behaviour.

The resident/client may also indicate general preferences (financial optimization, comfort) to be taken into account for the customization.

**3.2-Analyse the data and propose a schedule**

Based on the analysis of the smart home data collected and preferences indicated by the resident/client, the third party elaborates a schedule with automatic responses to external events.

The third party sends the schedule to the resident/client.

**3.3-Validate the schedule and customize the smart home behaviour**

The resident/client validates the schedule.

If the resident/client does not validate the schedule, the mandated third party may elaborate and propose another one.

The third party customizes the smart home behaviour based on the validated schedule.

1.5 Key performance indicators

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| IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests | | | | |
|---|---|---|---|---|
| **Key performance indicators** | | | | |
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

| Use case conditions |
|---|
| **Assumption** |
| • If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. The UI mentioned in the sequence diagram is a local UI within the smart home. |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier. |
| • The resident/client may have subscribed a contract to make flexibilities available to a flexibility operator. |
| • The resident/client's smart home is up and running. |
| • The smart meter receives timed actions to be executed in order to announce a dynamic peak period (which means that beforehand, the electricity supplier has requested to activate a dynamic peak period for this client). |
| • The resident/client owns a least one UI. |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| BUC-Manage the flexibility on electricity demand and generation within a smart home from market signals |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| System Use Case |
| **Further keywords for classification** |
| smart home, load management strategy, opt-out |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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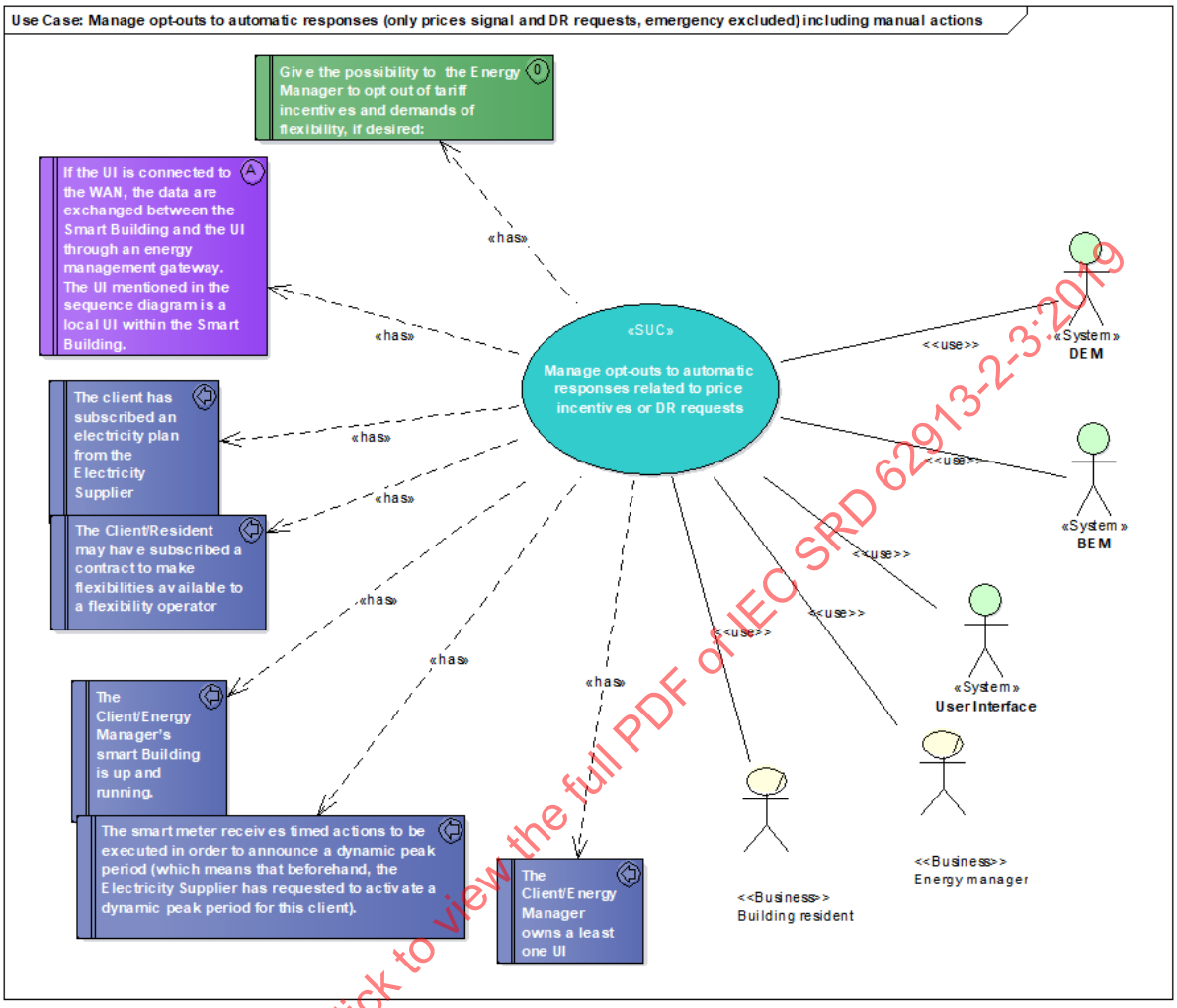
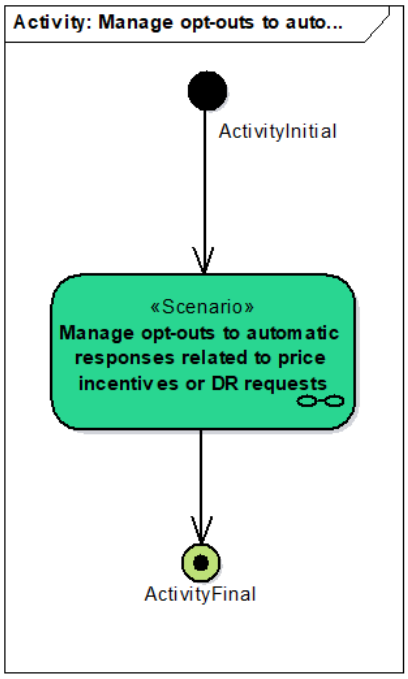
**IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests**

**Diagram(s) of use case**

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**IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests**

3 Technical details

3.1 Actors

| Actors | | | |
|---|---|---|---|
| **Grouping** | | **Group Description** | |
| | | | |
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| DEM | System | Function adapting the operations of a given electrical device depending on the incoming orders, resident customization and potential opt-outs that may be manually done locally. | |
| CEM | System | Function enabling the definition of coordinated energy management strategies of one or several related DEM depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, resident/client customization and potential resident/client opt-outs.<br><br>This function includes a processing ability notably in order to take resident/client customization and electricity data enhancement into account. | |
| Resident (smart home) | Role | Electricity end user residing in a smart home who can be a consumer resident, a producer resident or both, with capability of electricity flexibility and possible capability of energy storage | |
| User interface | System | User interface (UI) can be connected to the smart home (HAN) or to the WAN. If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. | |

3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

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| IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests | | | | | | |
|---|---|---|---|---|---|---|
| **Scenario conditions** | | | | | | |
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-condition** | **Post-condition** |
| 1 | Manage opt-outs to automatic responses related to price incentives or DR requests | | | | | |

4.2 Scenarios

4.2.1 Manage opt-outs to automatic responses related to price incentives or DR requests

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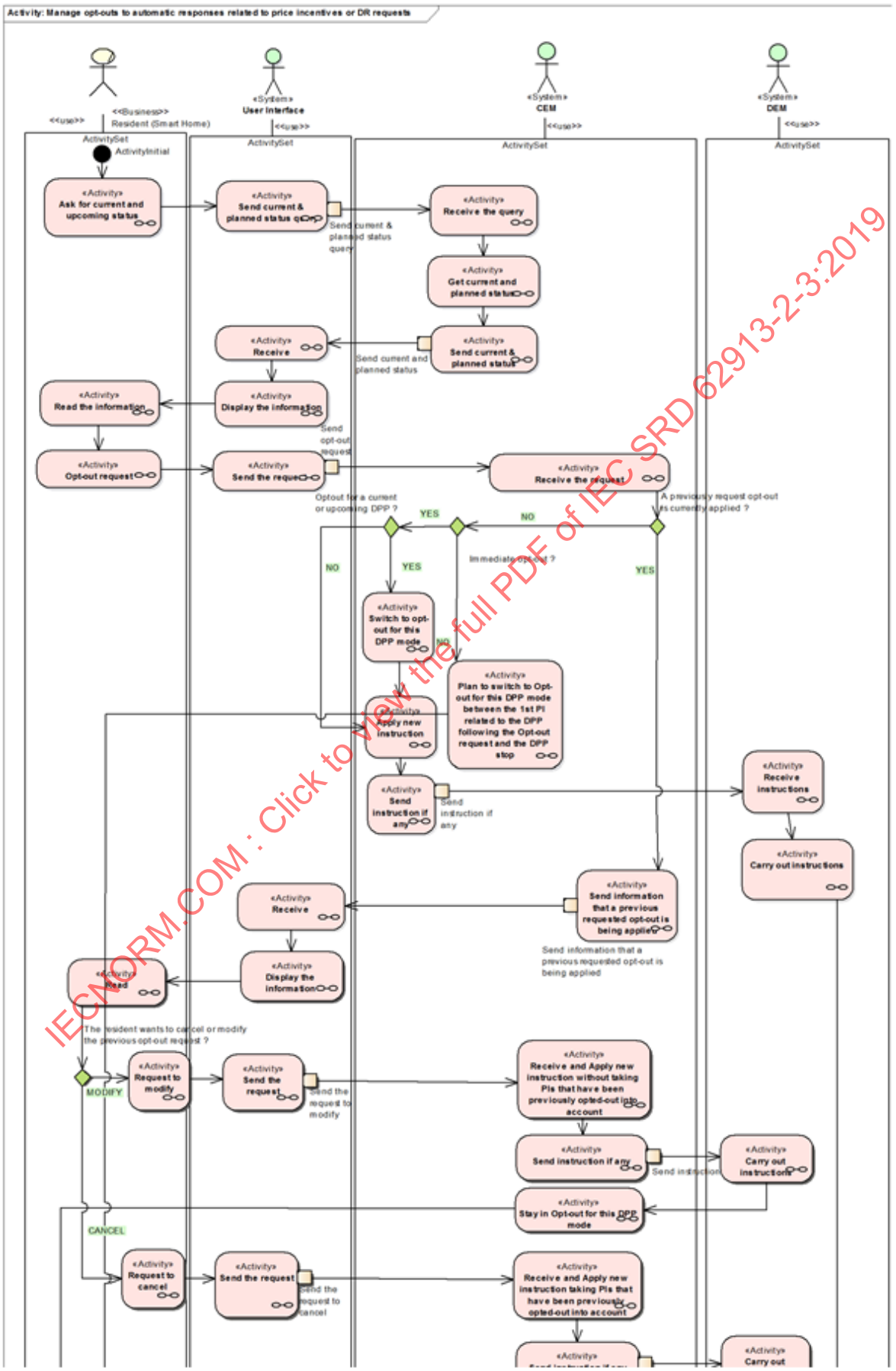
**IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests**

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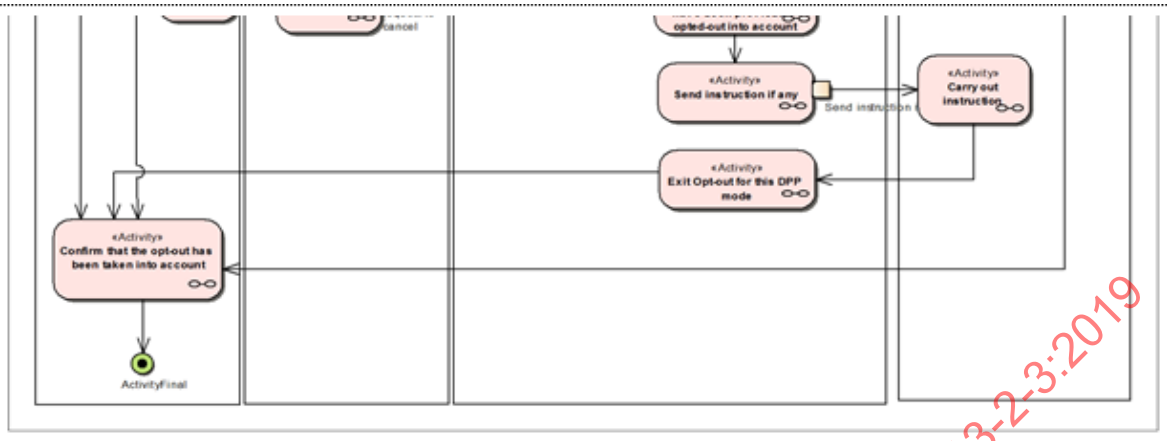


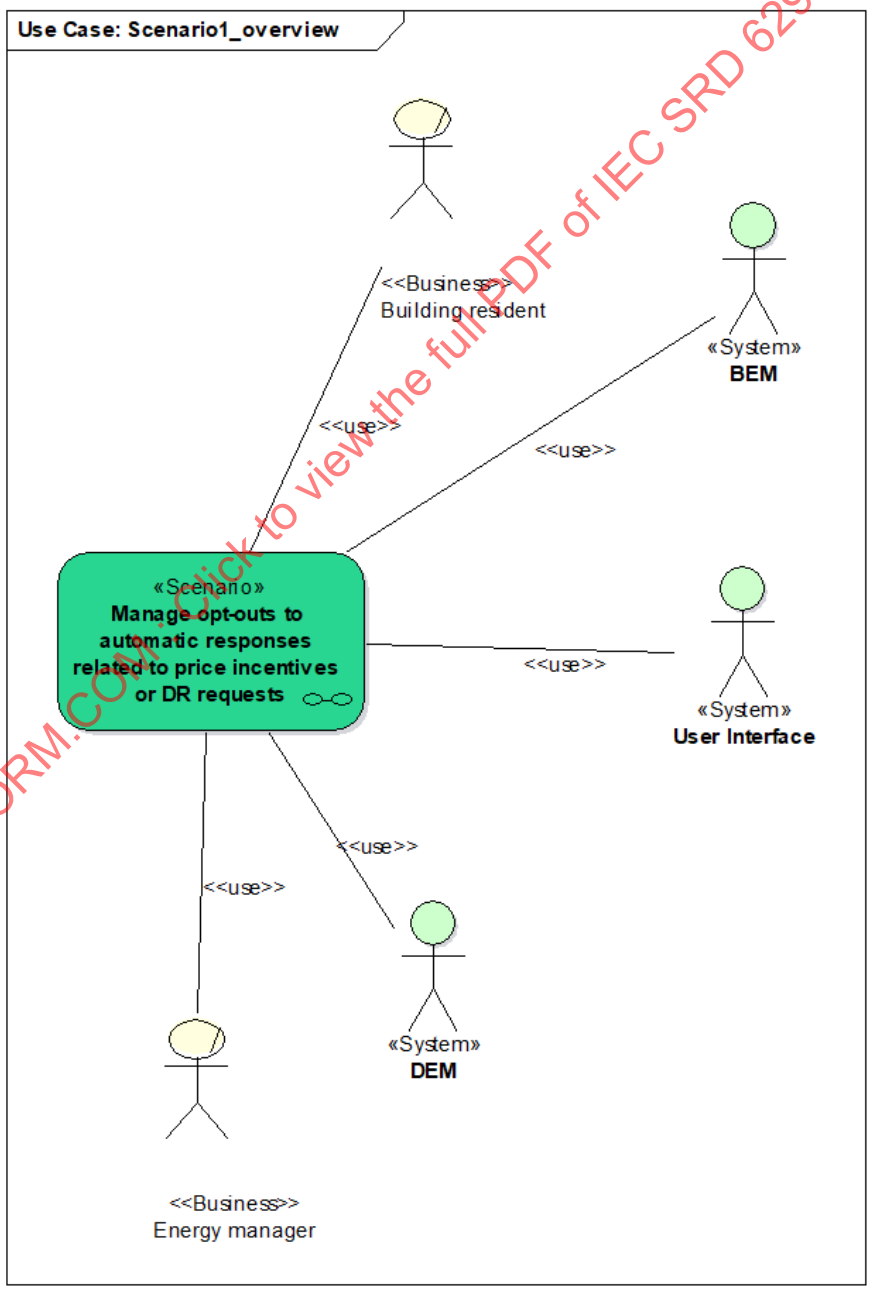


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**IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests**

**Scenario step by step analysis**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | Manage opt-outs to automatic responses related to price incentives or DR requests | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 1.1 | | Ask for current and upcoming status | | | Resident (smart home) | | | |
| 1.2 | | Send current & planned status query | | | User interface | CEM | | |
| 1.3 | | Receive the query | | | CEM | | | |
| 1.4 | | Get current and planned status | | | CEM | | | |
| 1.5 | | Send current & planned status | | | CEM | User interface | | |
| 1.6 | | Receive | | | User interface | | | |
| 1.7 | | Display the information | | | User interface | Resident (smart home) | | |
| 1.8 | | Read the information | | | Resident (smart home) | | | |
| 1.9 | | Opt-out request | | | Resident (smart home) | | | |
| 1.10 | | Send the request | | | User interface | CEM | | |
| 1.11 | | Receive the request | | | CEM | | | |
| 1.12 | | Switch to opt-out for this DPP mode | | | CEM | | | |
| 1.13 | | Apply new instruction | | | CEM | | | |
| 1.14 | | Send instruction if any | | | CEM | DEM | | |
| 1.15 | | Receive instructions | | | DEM | | | |
| 1.16 | | Carry out instructions | | | DEM | | | |
| 1.17 | | Plan to switch to opt-out for this DPP mode between the first PI related to the DPP following the opt-out request and the DPP stop | | | CEM | | | |
| 1.18 | | Confirm that the opt-out has been taken into account | | | Resident (smart home) | | | |

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| IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1.19 | | Send information that a previous requested opt-out is being applied | | | CEM | User Interface | | |
| 1.20 | | Receive | | | User Interface | | | |
| 1.21 | | Display the information | | | User Interface | | | |
| 1.22 | | Read | | | Resident (smart home) | | | |
| 1.23 | | Request to modify | | | Resident (smart home) | | | |
| 1.24 | | Send the request | | | User interface | CEM | | |
| 1.25 | | Receive and apply new instruction without taking PIs that have been previously opted-out into account | | | CEM | | | |
| 1.26 | | Send instruction if any | | | CEM | DEM | | |
| 1.27 | | Carry out instructions | | | DEM | | | |
| 1.28 | | Stay in opt-out for this DPP mode | | | CEM | | | |
| 1.29 | | Request to cancel | | | Resident (smart home) | | | |
| 1.30 | | Send the request | | | User interface | CEM | | |
| 1.31 | | Receive and apply new instruction taking PIs that have been previously opted-out into account | | | CEM | | | |
| 1.32 | | Send instruction if any | | | CEM | DEM | | |
| 1.33 | | Carry out instruction | | | DEM | | | |
| 1.34 | | Exit opt-out for this DPP mode | | | CEM | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

| Requirements (optional) |
|---|

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| IEC62913-2-3-S044 Manage opt-outs of the smart home to automatic responses related to price incentives or DR requests | | |
|---|---|---|
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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**Table B.13 – Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals)**

| IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals) |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| IEC62913-2-3-S039 | Area: Energy system<br>Domain: Smart home | SUC-Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals) |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | Customization of the smart home automatic responses to market signals and emergency signals.<br>This use case does not describe the warning involving outsourced monitoring. |
| **Objective(s)** | – Give to the resident/client the possibility to customize the smart home behaviour according to his or her comfort and savings preferences:<br>• Customize the automatic responses of the smart home<br>I. Depending on the smart home capabilities and the resident/client needs, the customization may be defined and applied to different scopes, that is to say: the whole smart home, one or several areas (rooms), one or several uses, one or several appliances.<br>II. Depending on the smart home capabilities, the customization may be defined and applied to different timescales:<br>price period,<br>standard day,<br>standard week,<br>standard season,<br>use/appliance consumption time slot.<br>• Customize warnings (events to be tracked) and specify the related emission channel<br>I. For instance, the event to be tracked is exceeding an electricity data threshold in the smart home (such as a threshold of consumption in kWh).<br>• Notify that the new customization has been taken into account.<br>• Read the customization. |
| **Related business case(s)** | |

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| IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals) |
| --- |
| 1.4 Narrative of Use Case |

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**IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals)**

**Narrative of use case**

**Short description**

The system Use Case describes how the client/resident customizes the management of his or her appliance(s) namely during dynamic peak periods, as well as the monitoring of events.

**Complete description**

Principles

P1. The resident/client shall be given a way to customize his or her appliances' automatic responses at any time.

P2. The resident/client shall be given a way to customize depending on the type of price incentive.

P3. The resident/client shall be given a way to customize the energetic behaviour of his or her smart home via a UI connected either to a CEM, or a DEM. In other words via an IID, a CEMS, an ICA or a DCA.

This customization is processed on site.

P4. A processing capability associated to the CEM is able to oversee the occurrence of an event. As a result, the customization related to the monitoring can only be taken into account on the CEM function.

P5. Depending on the capabilities of the smart home, the resident/client can customize away from home.

Requirements

R1. The way an opt-out is taken into account shall be consistent within a smart home.

Common scenario

A resident/client decides to customize the behaviour of some of his or her appliances, for example during dynamic peak periods. These appliances can be controlled by his or her customer energy management system.

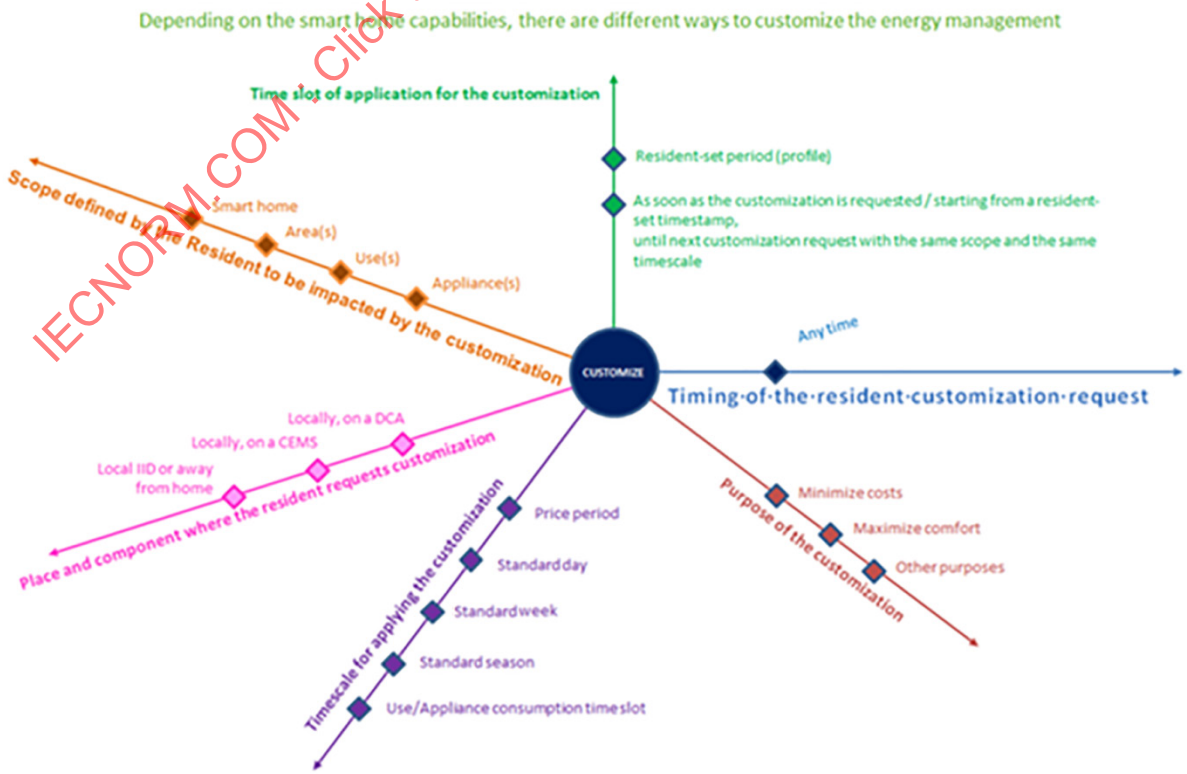
To do so, he or she decides to switch to customization mode and reads the current setting on a UI (user interface) that is connected to a CEM (customer energy management) or a DEM (device energy management).

Depending on the smart home capabilities and the resident/client needs, he or she defines a new customization via the UI.

This customization will be applied on the scope he or she wants, for example the whole smart home, one or several areas (rooms), one or several uses, one or several appliances.

Once the customization has been applied, a notification is sent to confirm that his or her new needs have been taken into account.

The resident/client can also customize the monitoring of events through the same activities.

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**IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals)**

1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

| Use case conditions |
|---|
| **Assumption** |
| • Customization does not have a set duration of application. |
| • Automatic management customization is activated again after opt-out is over. |
| • Customization is made via a UI (a UI that is only available locally). This assumption does not forbid to customize away from home but this is not described in this use case. This assumption is not incompatible with the identified flows between EMG, UI and CEM. |
| **Prerequisite** |
| • The CEM (CEMS or DCA) are customized during setup. |
| • The client has subscribed to an electricity supply plan. |
| • The resident/client owns at least one UI. |
| • The resident/client's smart home is up and running. |
| • The smart home has been configured during setup and the customization enables modifications of this first configuration. |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| BUC-Adapt the smart home behaviour to the resident/client's preferences |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| System Use Case |
| **Further keywords for classification** |
| smart home, customization |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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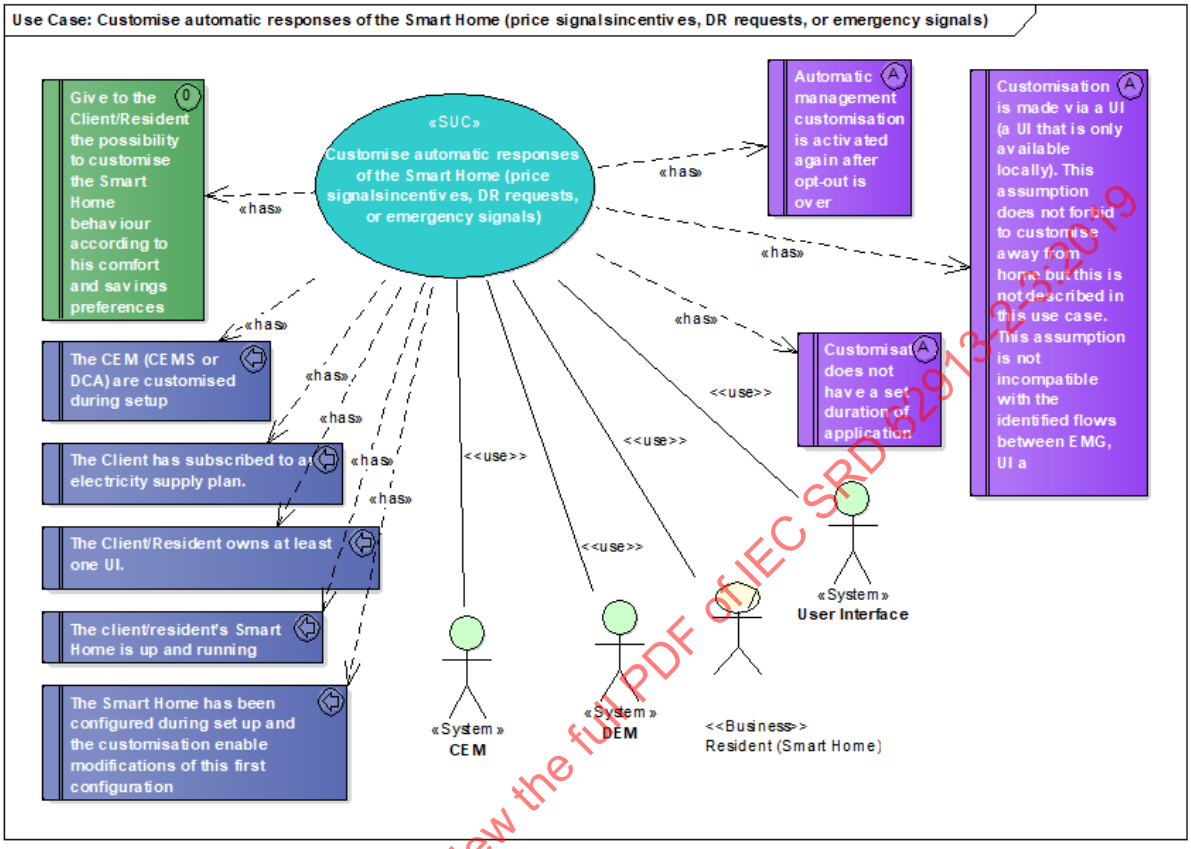
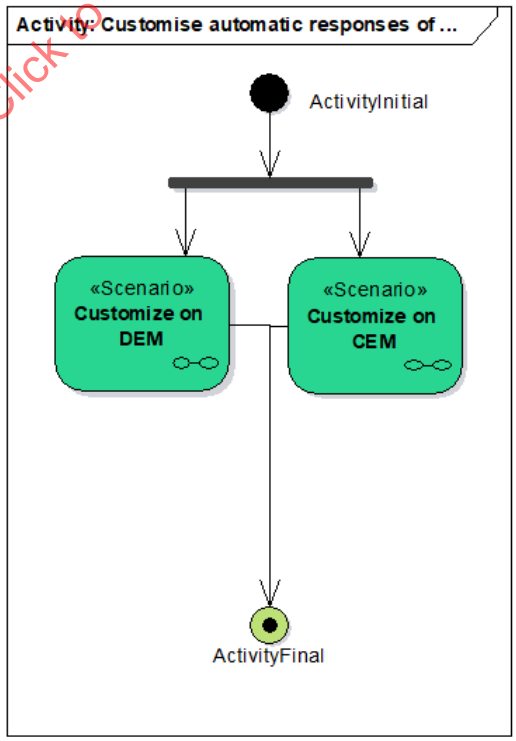
**IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals)**

**Diagram(s) of use case**

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**IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals)**

3.1 Actors

| Actors | | | |
|---|---|---|---|
| **Grouping** | | **Group Description** | |
| | | | |
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| DEM | System | Function adapting the operations of a given electrical device depending on the incoming orders, resident customization and potential opt-outs that may be manually done locally. | |
| CEM | System | Function enabling the definition of coordinated energy management strategies of one or several related DEM depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, resident/client customization and potential resident/client opt-outs.<br><br>This function includes a processing ability notably in order to take resident/client customization and electricity data enhancement into account. | |
| Resident (smart home) | Role | Electricity end user residing in a smart home who can be a consumer resident, a producer resident or both, with capability of electricity flexibility and possible capability of energy storage | |
| User interface | System | User interface (UI) can be connected to the smart home (HAN) or to the WAN. If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. | |

3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-condition** | **Post-condition** |
| 1 | Customize on CEM | | | | | |
| 2 | Customize on DEM | | | | | |

4.2 Scenarios

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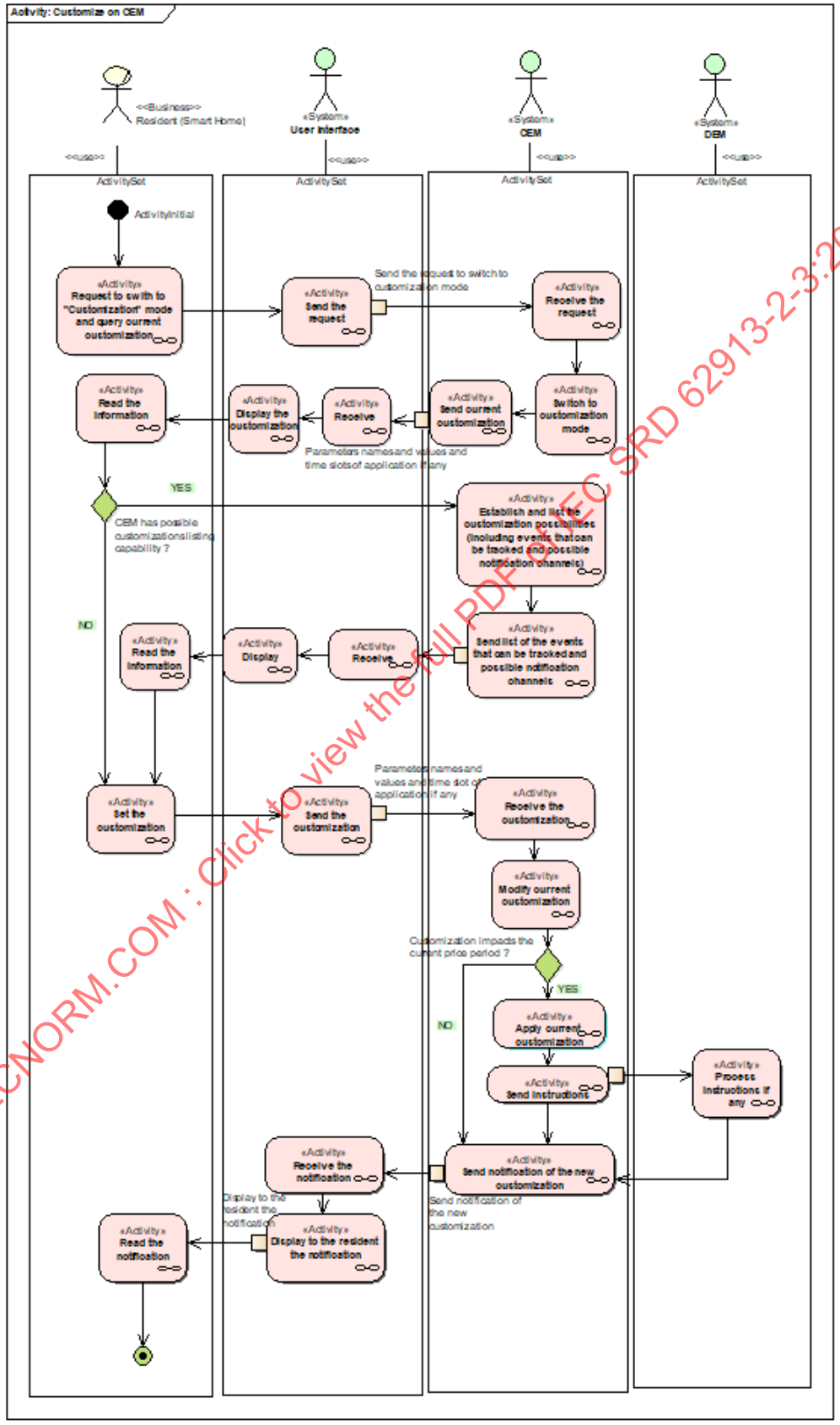
**IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals)**

4.2.1 Customize on CEM

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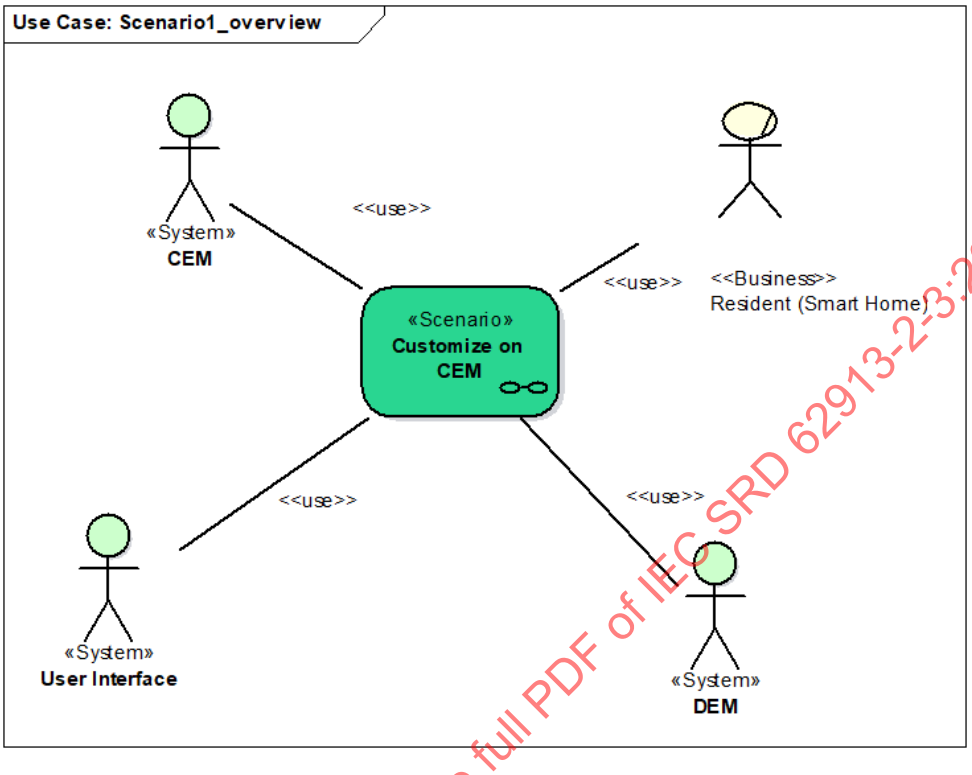
**IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals)**




**Scenario step by step analysis**

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| IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | Customize on CEM | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 1.1 | | Request to switch to "customization" mode and query current customization | | | Resident (smart home) | User interface | | |
| 1.2 | | Send the request | | | User interface | CEM | | |
| 1.3 | | Receive the request | | | CEM | | | |
| 1.4 | | Switch to customization mode | | | CEM | | | |
| 1.5 | | Send current customization | | | CEM | User interface | | |
| 1.6 | | Receive current customization | | | User interface | | | |
| 1.7 | | Display the customization | | | User interface | Resident (smart home) | | |
| 1.8 | | Read the information | | | Resident (smart home) | | | |
| 1.9 | | Establish and list the customization possibilities (including events that can be tracked and possible notification channels) | | | CEM | | | |
| 1.10 | | Send list of the events that can be tracked and possible notification channels | | | CEM | User interface | | |
| 1.11 | | Receive | | | User interface | | | |
| 1.12 | | Display | | | User interface | Resident (smart home) | | |
| 1.13 | | Read the information | | | Resident (smart home) | | | |
| 1.14 | | Set the customization | | | Resident (smart home) | User interface | | |
| 1.15 | | Send the customization | | | User interface | CEM | | |
| 1.16 | | Receive the customization | | | CEM | | | |
| 1.17 | | Modify current customization | | | CEM | | | |
| 1.18 | | Send instructions | | | CEM | DEM | | |
| 1.19 | | Process instructions if any | | | DEM | | | |

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| IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1.20 | | Send notification of the new customization | | | CEM | User interface | | |
| 1.21 | | Receive the notification | | | User interface | | | |
| 1.22 | | Display to the resident the notification | | | User interface | Resident (smart home) | | |
| 1.23 | | Read the notification | | | Resident (smart home) | | | |
| 1.24 | | Apply current customization | | | CEM | | | |

4.2.2 Customize on DEM

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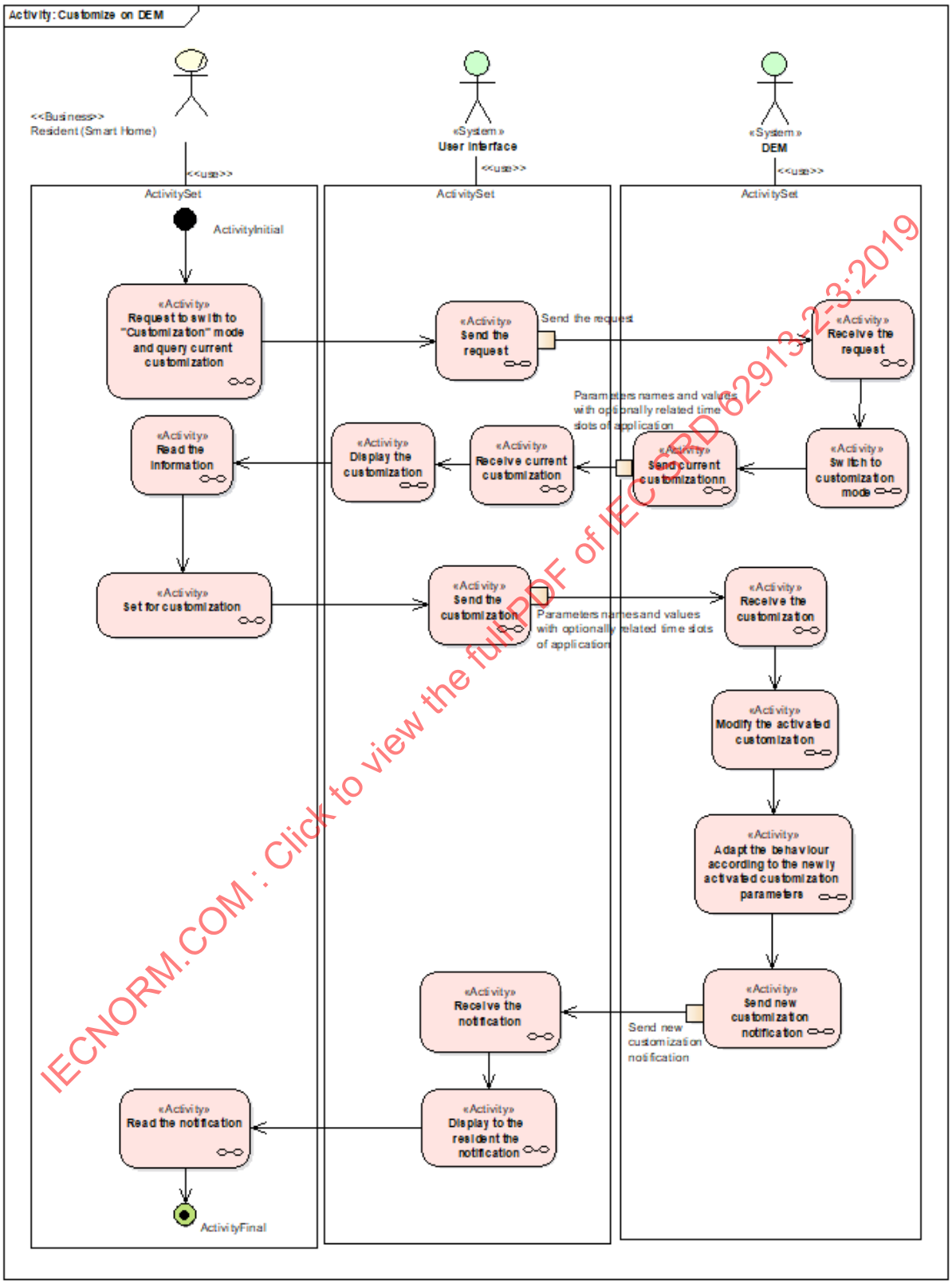


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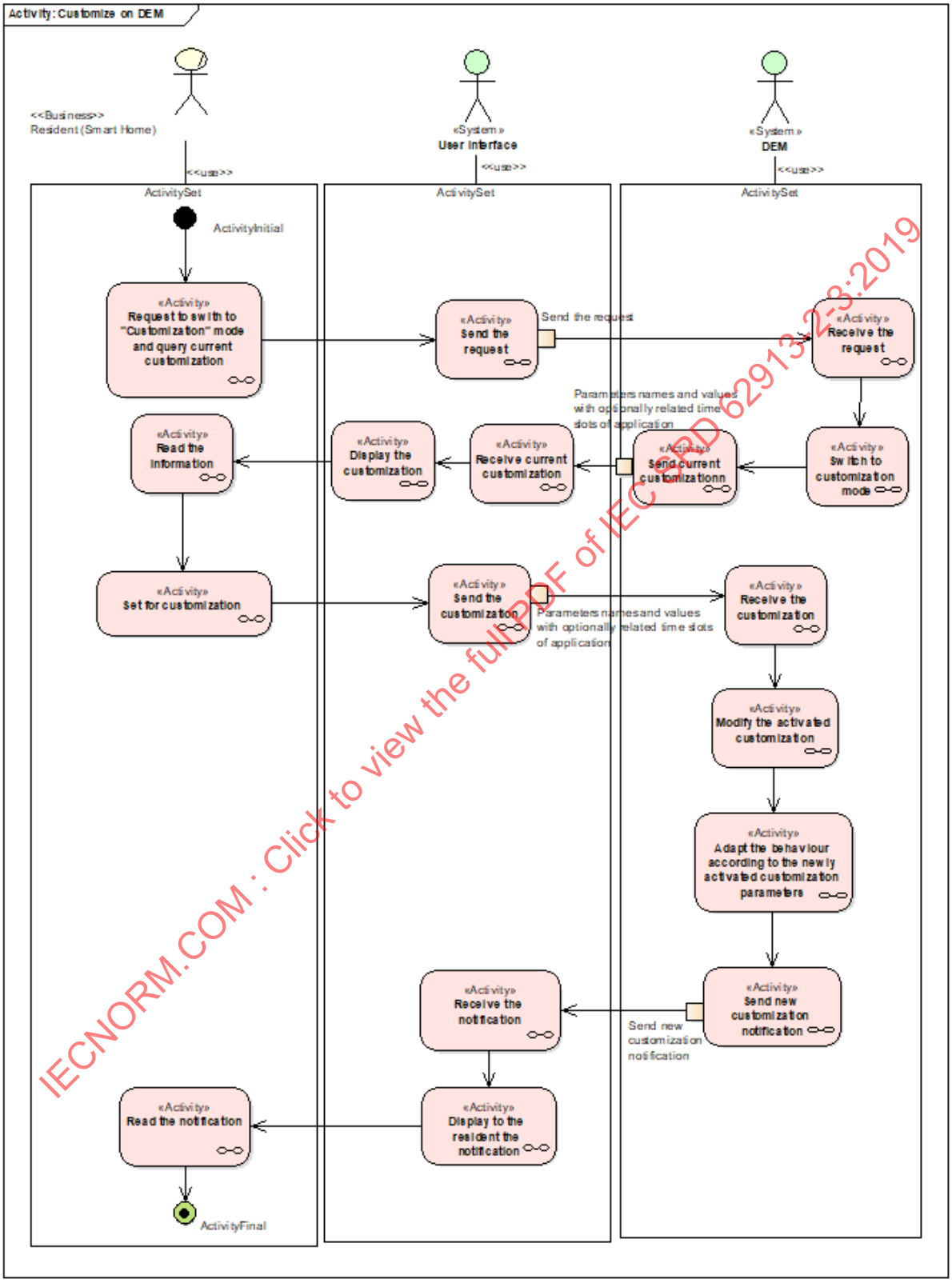


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**Scenario step by step analysis**

| IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | Customize on DEM | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 2.1 | | Request to switch to "customization" mode and query current customization | | | Resident (smart home) | | | |
| 2.2 | | Send the request | | | User interface | DEM | | |
| 2.3 | | Receive the request | | | DEM | | | |
| 2.4 | | Switch to customization mode | | | DEM | DEM | | |
| 2.5 | | Send current customization | | | DEM | User interface | | |
| 2.6 | | Receive current customization | | | User interface | | | |
| 2.7 | | Display the customization | | | User interface | | | |
| 2.8 | | Read the information | | | Resident (smart home) | | | |
| 2.9 | | Set for customization | | | Resident (smart home) | | | |
| 2.10 | | Send the customization | | | User interface | DEM | | |
| 2.11 | | Receive the customization | | | DEM | | | |
| 2.12 | | Modify the activated customization | | | DEM | | | |
| 2.13 | | Adapt the behaviour according to the newly activated customization parameters | | | DEM | | | |
| 2.14 | | Send new customization notification | | | DEM | User interface | | |
| 2.15 | | Receive the notification | | | User interface | | | |
| 2.16 | | Display to the resident the notification | | | User interface | | | |
| 2.17 | | Read the notification | | | Resident (smart home) | | | |

5 Information exchanged

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| IEC62913-2-3-S039 Customize automatic responses of the smart home (price incentives, DR requests, or emergency signals) | | | |
|---|---|---|---|
| **Information exchanged** | | | |
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

| **Requirements (optional)** | | |
|---|---|---|
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |

7 Common terms and definitions

| **Common terms and definitions** | |
|---|---|
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| **Custom information (optional)** | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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**Table B.14 – Provide a third party with enriched smart home electricity data**

| IEC62913-2-3-S056Provide a third party with enriched smart home electricity data |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| IEC62913-2-3-S056 | Area: Energy system<br>Domain: Smart home | SUC-Provide a third party with enriched smart home electricity data |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| 0.1 | 2013.04.11 | EDF | First draft (short description, roles) | WD Working Document |
| 0.2 | 2014.05.05 | EDF | Sequence diagram | WD Working Document |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | The scope is restricted to the smart home. |
| **Objective(s)** | – Make the smart home's electricity data locally available.<br>– Make the smart home's electricity data externally available.<br>– Enhance the smart home's electricity data with local or external data. |
| **Related business case(s)** | |

1.4 Narrative of Use Case

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**IEC62913-2-3-S056Provide a third party with enriched smart home electricity data**

**Narrative of use case**

**Short description**

The system Use Case describes how electricity data regarding the electricity behaviour of the smart home are made available externally or locally to a third party: a physical person (client, resident) via a UI or to an automated system that uses these data.

**Complete description**

These data can be made available to a third party:

– a role embodied by a physical person (client, resident) via a UI,

– an automated system that uses these data.

These energy data are related to the electricity behaviour of the smart home (at least global electricity data that can be enhanced by specific data in the smart home).

These electricity data are available locally and can be made available:

- externally, off-site (sub-use case 1),
- locally, in the smart home (sub-use case 2).

These electricity data can be enriched with:

- data located in the smart home (sub-use case 1 and sub-use case 2),
- data located outside of the site (sub-use case 2 only because in sub-use case 1, this enrichment is considered to be processed off-site). These data may be for instance:
  - dynamic peak notifications,
  - weather forecast,
  - consumption estimates,
  - ...

| | Sub-use case 1<br>Make energy data that the smart home contains available externally | Sub-use case 2<br>Make the energy data that the smart home contains available locally |
|---|---|---|
| Enhancement with **specific local data** | Processed on site by the CEM and made available via the EMG | Processed on site and made available via the CEM |
| Enhancement with **external data** | Processed off-site | Processed on site and made available via the CEM |

Principles:

P1. global electricity data are collected via the SMG.

1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

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| IEC62913-2-3-S056Provide a third party with enriched smart home electricity data |
|---|
| **Use case conditions** |
| **Assumption** |
| • These data are made available via a UI (a UI only locally available on site or a UI connected to the WAN). If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. The UI mentioned in the sequence diagram is a local UI within the smart home. |
| • This use case is generic and does not assume timing constraints. It can subsequently be made specific to timing constraints. |
| • Billing for making energy data available will be made according to contract terms (periodic…) and is not described in this use case. |
| **Prerequisite** |
| • The electricity supplier's client has subscribed a plan to the electricity supplier. |
| • The client/resident owns at least one UI. |
| • The client's smart home is up and running. |
| • If necessary, the smart home is configured to feedback data. |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| BUC-Provide enriched smart home data to relevant parties in order to make the resident/client more active |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| System Use Case |
| **Further keywords for classification** |
| smart home, data |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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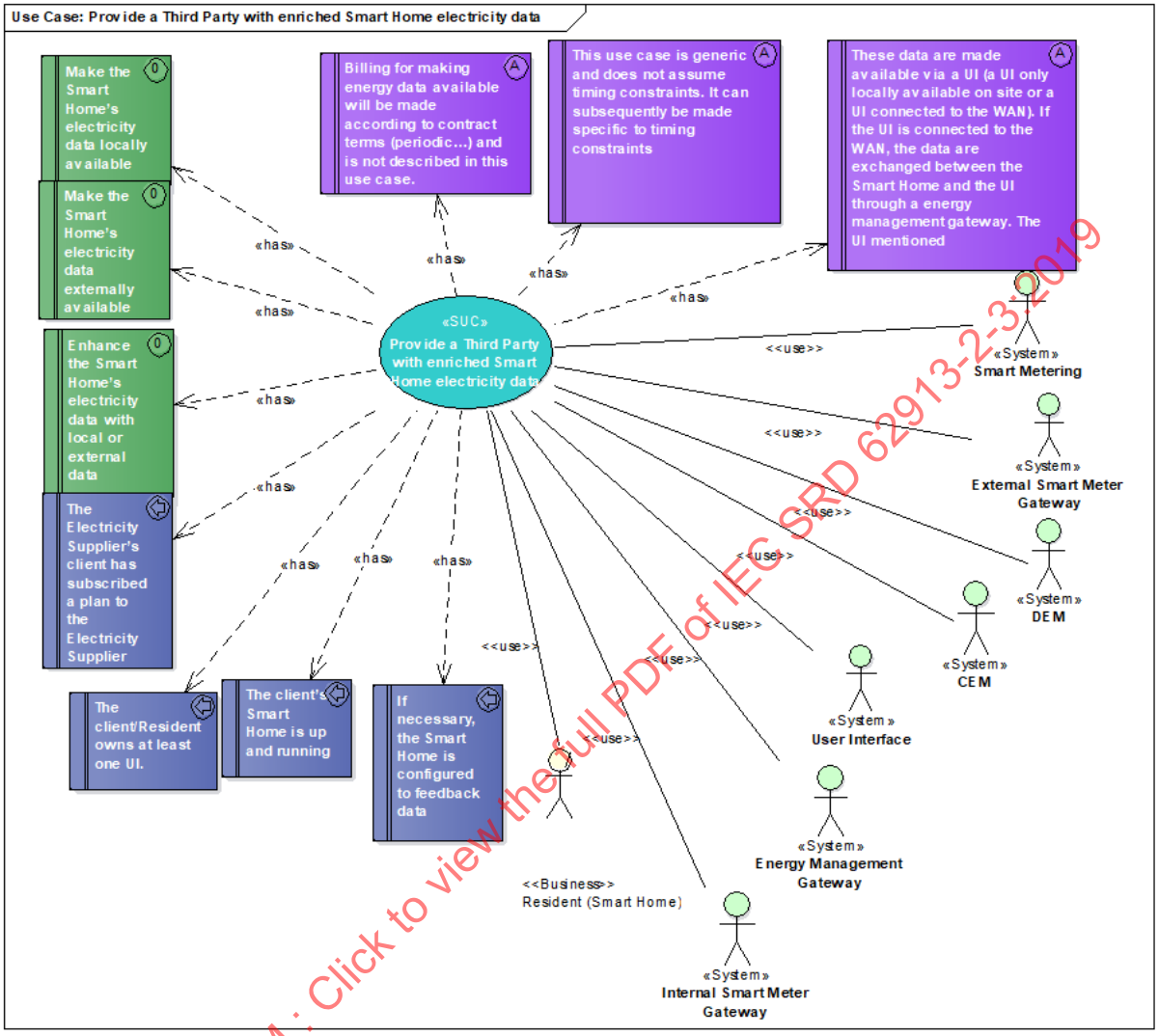
**IEC62913-2-3-S056Provide a third party with enriched smart home electricity data**

**Diagram(s) of use case**

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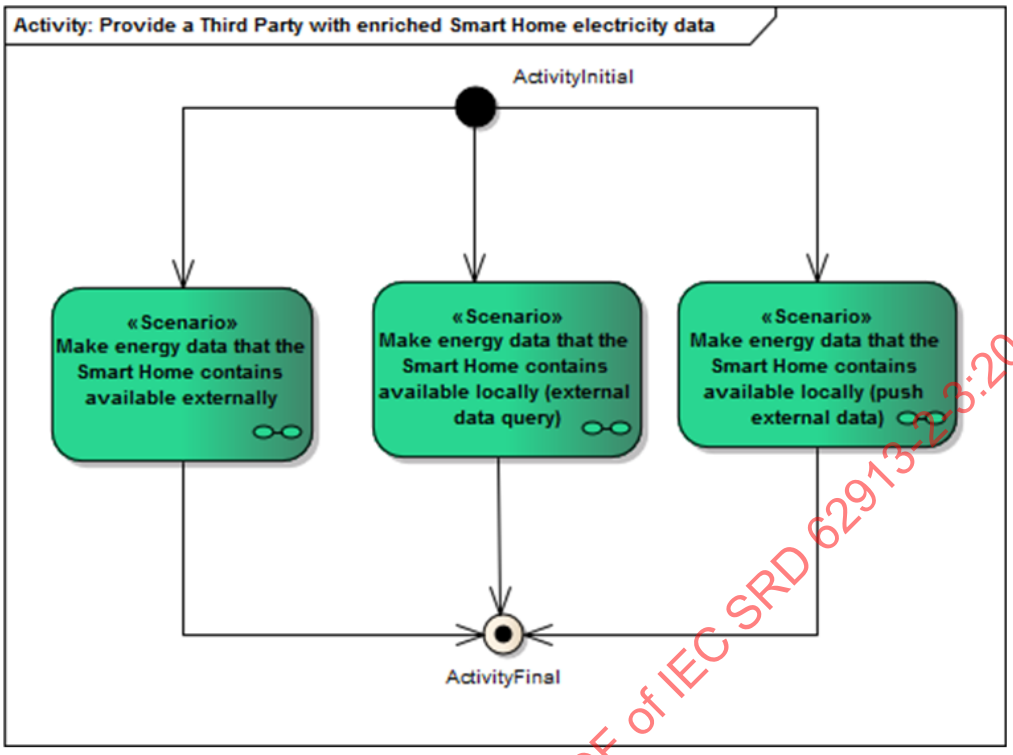
**IEC62913-2-3-S056Provide a third party with enriched smart home electricity data**




3 Technical details

3.1 Actors

| Actors | |
|---|---|
| **Grouping** | **Group Description** |
| | |

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| IEC62913-2-3-S056Provide a third party with enriched smart home electricity data | | | |
|---|---|---|---|
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| DEM | System | Function adapting the operations of a given electrical device depending on the incoming orders, resident customization and potential opt-outs that may be manually done locally. | DEM |
| External smart metering gateway | System | Communications functions between the smart grid area and the smart metering. | External smart metering gateway |
| Internal smart metering gateway | System | Communications functions between the smart metering and the smart home. | Internal smart metering gateway |
| CEM | System | Function enabling the definition of coordinated energy management strategies of one or several related DEM depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, resident/client customization and potential resident/client opt-outs.<br><br>This function includes a processing ability notably in order to take resident/client customization and electricity data enhancement into account. | CEM |
| Resident (smart home) | Role | Electricity end user residing in a smart home who can be a consumer resident, a producer resident or both, with capability of electricity flexibility and possible capability of energy storage | Resident (smart home) |
| Energy management gateway | System | Communication functions between the WAN and the HAN. | Energy management gateway |
| Smart metering | System | Combination of the following meter-related functions from the smart metering reference architecture:<br>• metrology functions including the conventional meter display (register or index);<br>• one or more additional functions. These may also make use of the display;<br>• meter communication functions.<br><br>[SOURCE: CEN/CLC/ETSI TR 50572:2011] | Smart metering |
| User interface | System | User interface (UI) can be connected to the smart home (HAN) or to the WAN. If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. | User interface |

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3.2 References

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

| IEC62913-2-3-S056Provide a third party with enriched smart home electricity data | | | | | | |
|---|---|---|---|---|---|---|
| Scenario conditions | | | | | | |
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-condition** | **Post-condition** |
| 1 | Make energy data that the smart home contains available externally | | | | | |
| 2 | Make energy data that the smart home contains available locally (external data query) | | | | | |
| 3 | Make energy data that the smart home contains available locally (push external data) | | | | | |

4.2 Scenarios

4.2.1 Make energy data that the smart home contains available externally

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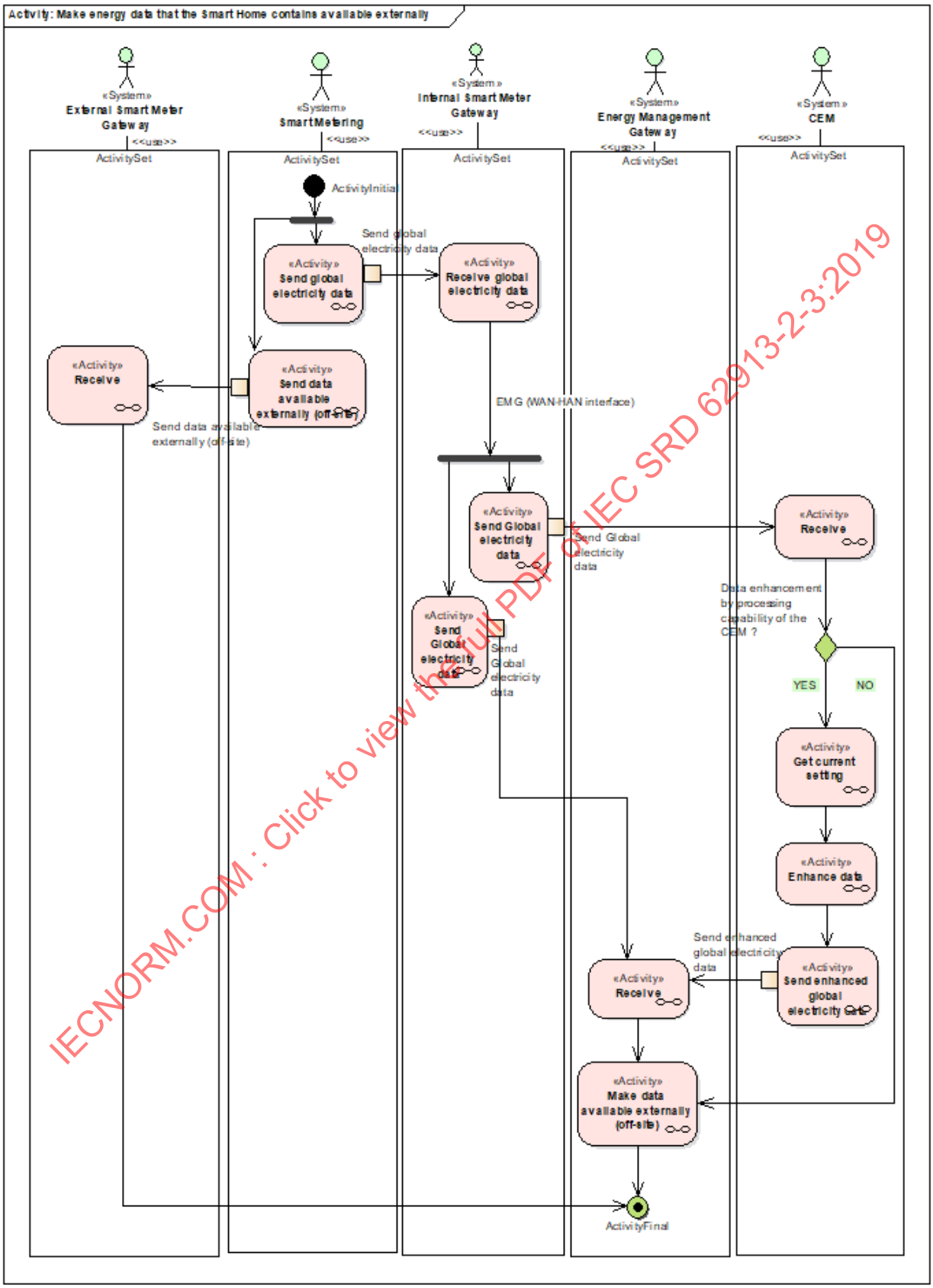
**IEC62913-2-3-S056Provide a third party with enriched smart home electricity data**

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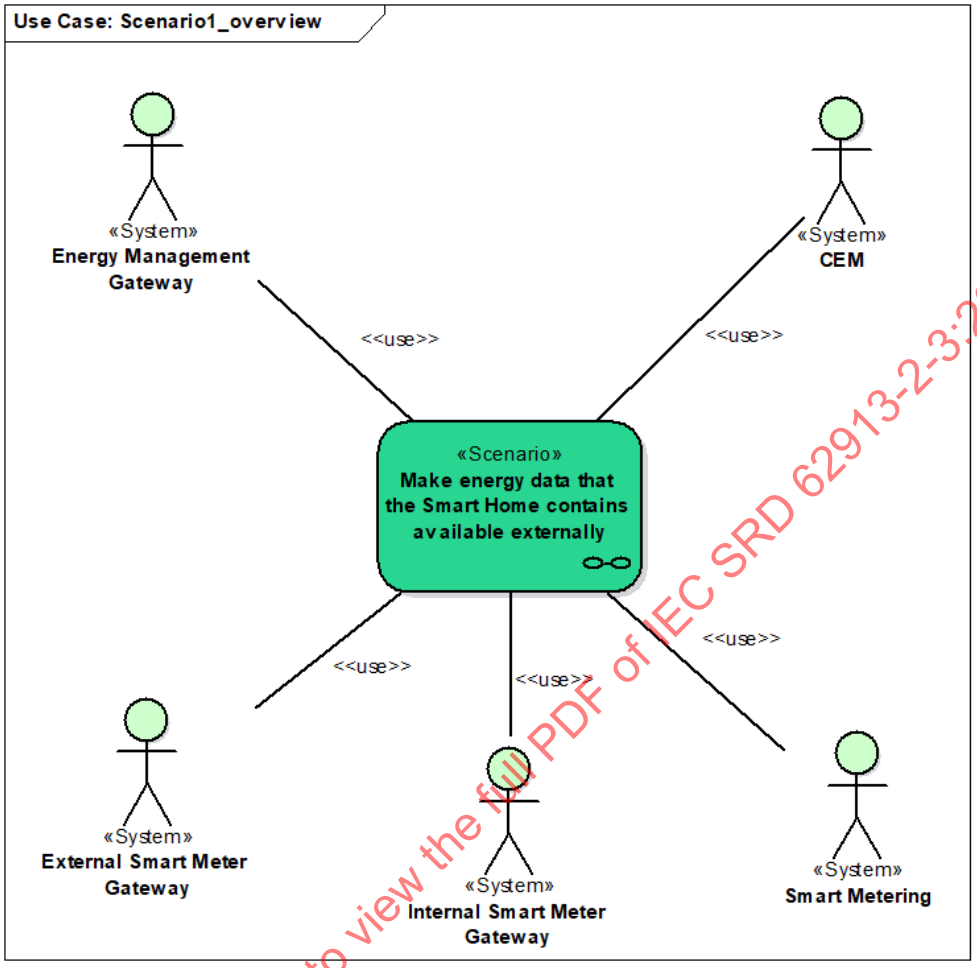
**IEC62913-2-3-S056Provide a third party with enriched smart home electricity data**




**Scenario step by step analysis**

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| IEC62913-2-3-S056Provide a third party with enriched smart home electricity data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | Make energy data that the smart home contains available externally | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 1.1 | | Send global electricity data | | | Smart metering | Internal smart metering gateway | | |
| 1.2 | | Send data available externally (off-site) | | | Smart metering | External smart metering gateway | | |
| 1.3 | | Receive | | | External smart metering gateway | | | |
| 1.4 | | Receive global electricity data | | | Internal smart metering gateway | | | |
| 1.5 | | Send global electricity data | | | Internal smart metering gateway | Energy management gateway | | |
| 1.6 | | Send global electricity data | | | Internal smart metering gateway | CEM | | |
| 1.7 | | Receive | | | CEM | | | |
| | | | | | | | | |
| 1.8 | | Get current setting | | | CEM | | | |
| 1.9 | | Enhance data | | | CEM | | | |
| 1.10 | | Send enhanced global electricity data | | | CEM | Energy management gateway | | |
| 1.11 | | Receive | | | Energy management gateway | | | |
| 1.12 | | Make data available externally (off-site) | | | Energy management gateway | | | |

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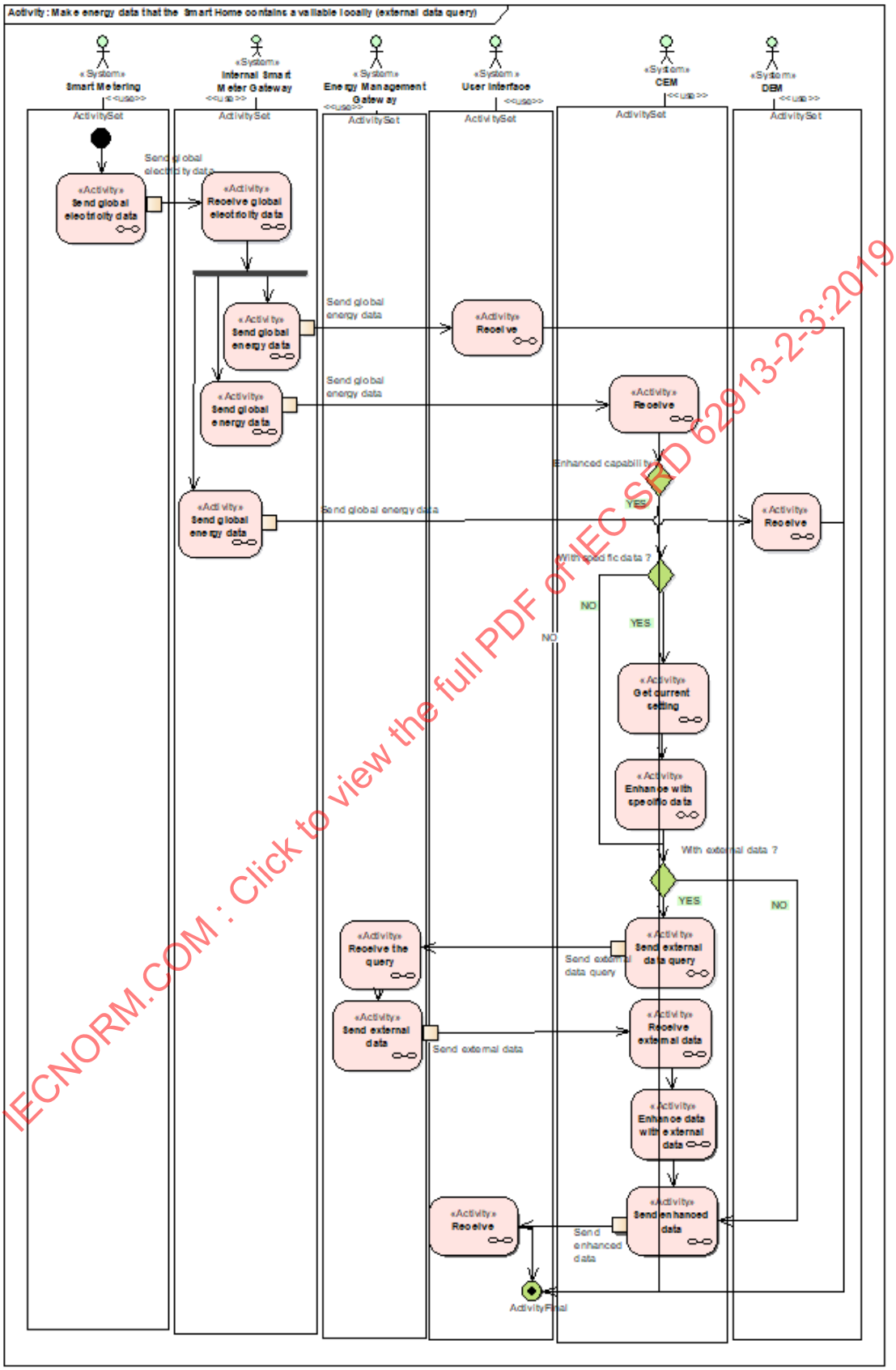
4.2.2 Make energy data that the smart home contains available locally (external data query)

**IEC62913-2-3-S056Provide a third party with enriched smart home electricity data**

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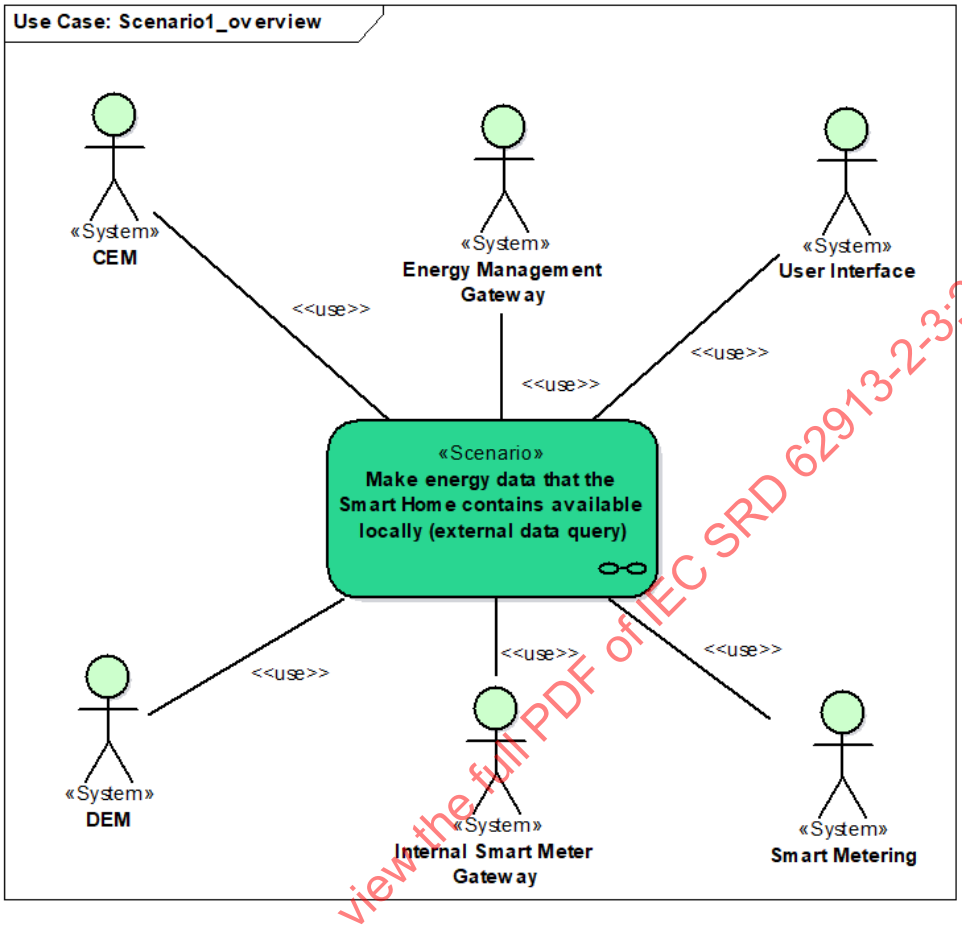
**IEC62913-2-3-S056Provide a third party with enriched smart home electricity data**




**Scenario step by step analysis**

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| IEC62913-2-3-S056Provide a third party with enriched smart home electricity data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | Make energy data that the smart home contains available locally (external data query) | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 2.1 | | Send global electricity data | | | Smart metering | Internal smart metering gateway | | |
| 2.2 | | Receive global electricity data | | | Internal smart metering gateway | | | |
| 2.3 | | Send global energy data | | | Internal smart metering gateway | CEM | | |
| 2.4 | | Send global energy data | | | Internal smart metering gateway | User interface | | |
| 2.5 | | Send global energy data | | | Internal smart metering gateway | DEM | | |
| 2.6 | | Receive | | | User interface | | | |
| 2.7 | | Receive | | | CEM | | | |
| 2.8 | | Receive | | | DEM | | | |
| 2.9 | | Get current setting | | | CEM | | | |
| 2.10 | | Enhance with specific data | | | CEM | | | |
| 2.11 | | Send external data query | | | CEM | Energy management gateway | | |
| 2.12 | | Receive the query | | | Energy management gateway | | | |
| 2.13 | | Send external data | | | Energy management gateway | CEM | | |
| 2.14 | | Receive external data | | | CEM | | | |
| 2.15 | | Enhance data with external data | | | CEM | | | |
| 2.16 | | Send enhanced data | | | CEM | UI | | |
| 2.17 | | Receive | | | UI | | | |

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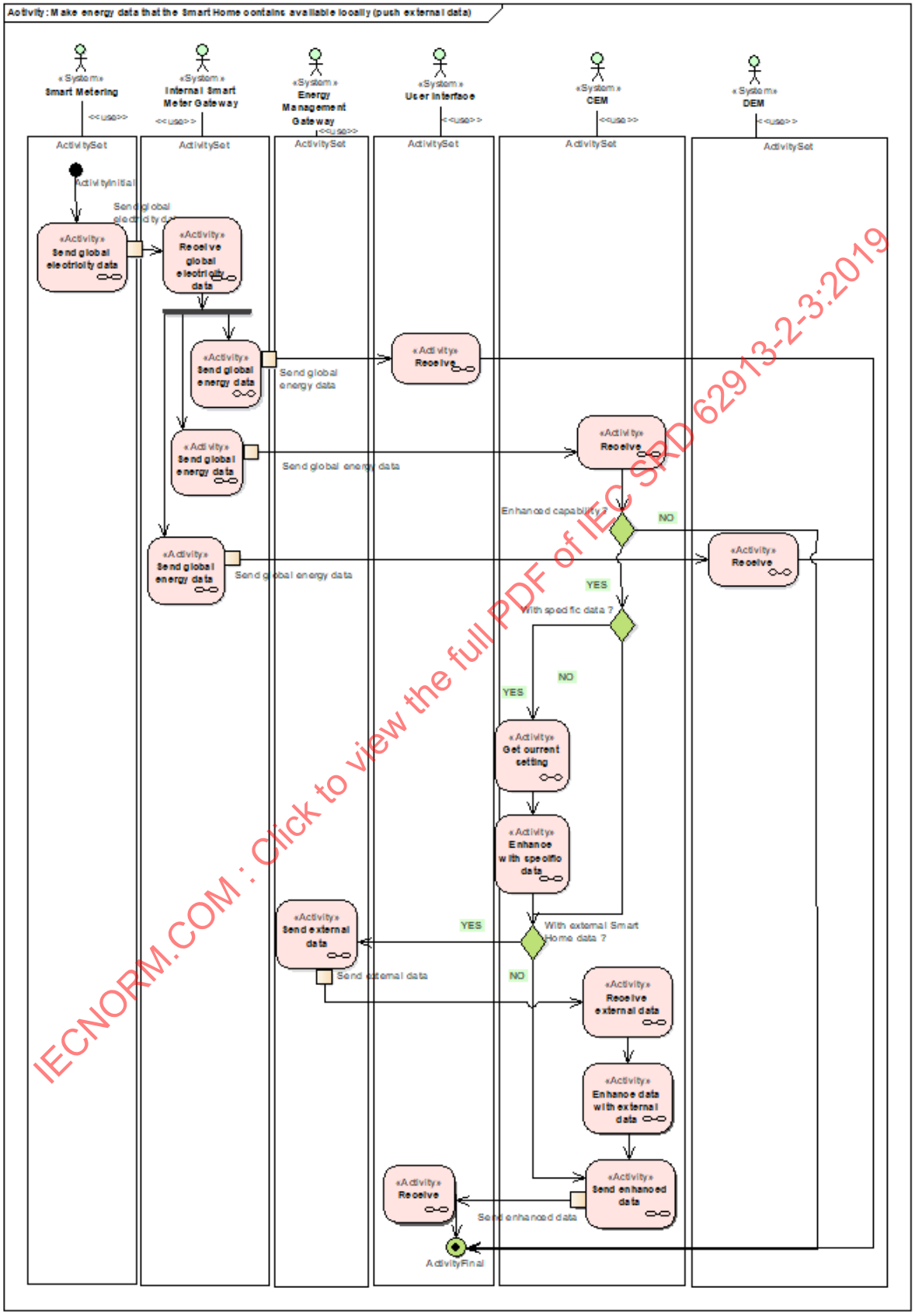
4.2.3 Make energy data that the smart home contains available locally (push external data)

**IEC62913-2-3-S056Provide a third party with enriched smart home electricity data**

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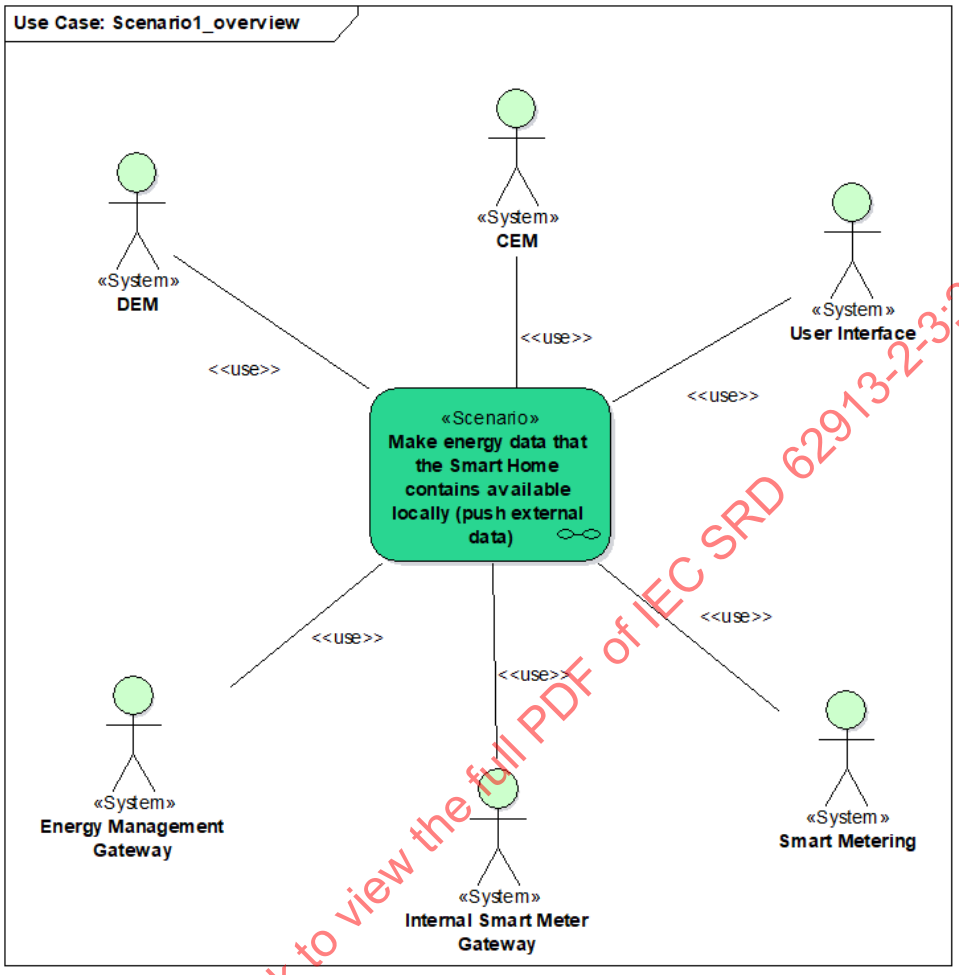
**IEC62913-2-3-S056Provide a third party with enriched smart home electricity data**




**Scenario step by step analysis**

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| IEC62913-2-3-S056Provide a third party with enriched smart home electricity data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | Make energy data that the smart home contains available locally (push external data) | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 3.1 | | Send global electricity data | | | Smart metering | Internal smart metering gateway | | |
| 3.2 | | Receive global electricity data | | | Internal smart metering gateway | | | |
| 3.3 | | Send global energy data | | | Internal smart metering gateway | User interface | | |
| 3.4 | | Send global energy data | | | Internal smart metering gateway | CEM | | |
| 3.5 | | Send global energy data | | | Internal smart metering gateway | DEM | | |
| 3.6 | | Receive | | | User interface | | | |
| 3.7 | | Receive | | | CEM | | | |
| 3.8 | | Receive | | | DEM | | | |
| 3.9 | | Get current setting | | | CEM | | | |
| 3.10 | | Enhance with specific data | | | CEM | | | |
| 3.11 | | Send external data | | | Energy management gateway | CEM | | |
| 3.12 | | Receive external data | | | CEM | | | |
| 3.13 | | Enhance data with external data | | | CEM | | | |
| 3.14 | | Send enhanced data | | | CEM | User interface | | |
| 3.15 | | Receive | | | User interface | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

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| IEC62913-2-3-S056Provide a third party with enriched smart home electricity data | | |
|---|---|---|
| **Requirements (optional)** | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| **Term** | **Definition** |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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**Table B.15 – Provide alarms related to the smart home electricity behaviour to the client or resident**

| IEC62913-2-3-S058 Provide alarms related to the smart home electricity behaviour to the client or resident |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| IEC62913-2-3-S058 | Area: Energy system<br>Domain: Smart home | SUC-Provide alarms related to the smart home electricity behaviour to the client or resident |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| 0.1 | 2013.04.11 | EDF | First draft (short description, roles) | WD Working Document |
| 0.2 | 2014.03.07 | EDF | Sequence diagram | WD Working Document |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | The scope is restricted to the smart home.<br>The sub-use case 3 does not describe the warnings that imply off-site monitoring. |
| **Objective(s)** | – Inform the resident/client of a local event associated with his or her smart home electricity data (consumption, production…):<br>• Monitor the occurrence of (the) event(s).<br>• Warn if an event occurs. |
| **Related business case(s)** | |

1.4 Narrative of Use Case

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| IEC62913-2-3-S058 Provide alarms related to the smart home electricity behaviour to the client or resident |
|---|
| **Narrative of use case** |
| **Short description** |
| The system Use Case describes how the CEM monitors the occurrence of events and warns the resident/client if an event occurs. |
| **Complete description** |
| Principles:<br>P1. global electricity data are collected via the internal SMG.<br>P2. The smart home has a processing capability that can monitor the occurrence of an event. This function is associated to the CEM function and Table B.14 describes how the electricity data are made available to the CEM.<br>P3. Table B.20 describes the configuration of the event to monitor and the configuration of the channel to send the alarm.<br>P4. The use case describes monitoring of a single event, but it is repeatable for several events.<br>P5. Threshold overrun of electricity data available on site is monitored (consumption threshold in kWh for example). |

1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |

1.6 Use case conditions

| Use case conditions |
|---|
| **Assumption** |
| • Electricity data available on site are made available via a UI (a UI only locally available on site or a UI connected to the WAN). |
| • This use case is generic and does not assume timing constraints. It can subsequently be made specific to timing constraints. |
| • Billing for generating alarm will be made according to contract terms (periodic, …) and is not described in this Use Case. |
| • Alarm channels:<br>– A compatibility table ensures the consistency between the nature of alert (alert history for information, real-time alerts for action, …) and the channel used to release it.<br>– The assumption is made that local alarms can have a real-time character and some alarms are issued requiring action and are also issued for information. The channels used for these various types of alarms shall be compatible with the alarms. |
| • If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. The sequence diagram describes the case of a local UI within the smart home. |
| **Prerequisite** |
| • The electricity supplier's client has subscribed a plan to the electricity supplier. |
| • The resident/client owns at least one UI. |
| • The client's site is up and running. |
| • If necessary, the smart home is configured to feedback data. |
| • The channel through which the alarms shall be issued (number of mobile phone, e-mail addresses, …) are configured and available. |

1.7 Further information to the use case for classification / mapping

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| IEC62913-2-3-S058 Provide alarms related to the smart home electricity behaviour to the client or resident |
|---|
| **Classification information** |
| **Relation to other use cases** |
| BUC-Provide enriched smart home data to relevant Parties in order to make the resident/client more active |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| System Use Case |
| **Further keywords for classification** |
| smart home |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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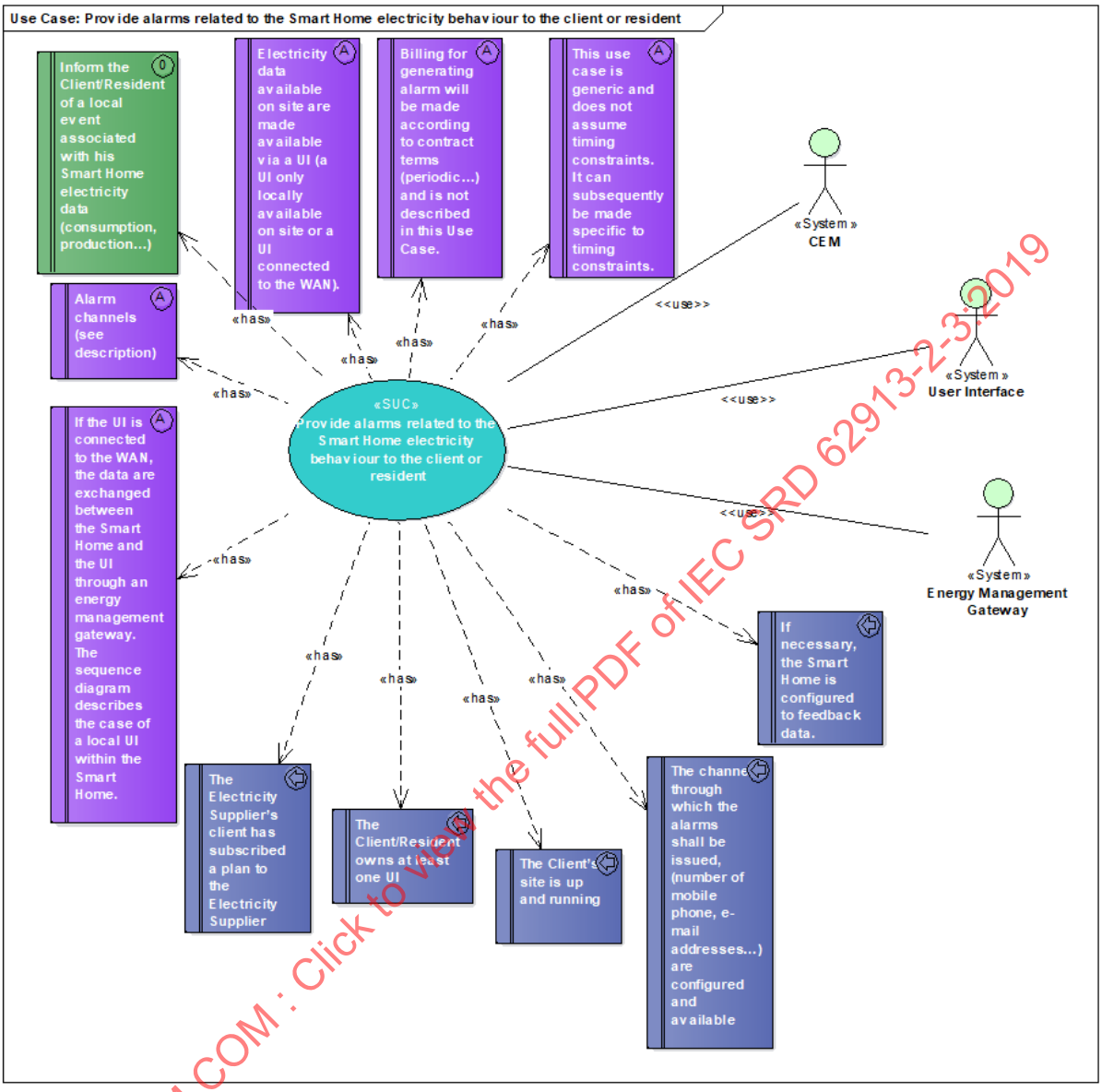
**IEC62913-2-3-S058 Provide alarms related to the smart home electricity behaviour to the client or resident**

**Diagram(s) of use case**

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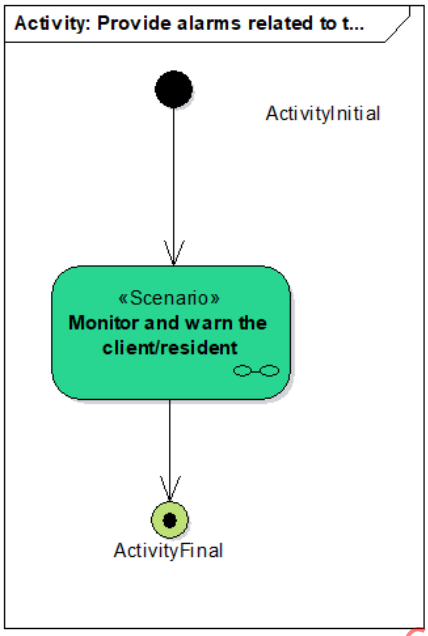
**IEC62913-2-3-S058 Provide alarms related to the smart home electricity behaviour to the client or resident**




3 Technical Details

3.1 Actors

| Actors | | | |
|---|---|---|---|
| **Grouping** | | **Group Description** | |
| | | | |
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| CEM | System | Function enabling the definition of coordinated energy management strategies of one or several related DEM depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, resident/client customization and potential resident/client opt-outs.<br><br>This function includes a processing ability notably in order to take resident/client customization and electricity data enhancement into account. | CEM |
| Energy management gateway | System | Communication functions between the WAN and the HAN. | Energy management gateway |
| User interface | System | User interface (UI) can be connected to the smart home (HAN) or to the WAN. If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. | User interface |

3.2 References

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| IEC62913-2-3-S058 Provide alarms related to the smart home electricity behaviour to the client or resident | | | | | | |
|---|---|---|---|---|---|---|
| References | | | | | | |
| No. | References Type | Reference | Status | Impact on use case | Originator / organization | Link |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| No. | Scenario name | Scenario description | Primary actor | Triggering event | Pre-condition | Post-condition |
| 1 | Monitor and warn the resident/client | | | | | |

4.2 Scenarios

4.2.1 Monitor and warn the resident/client

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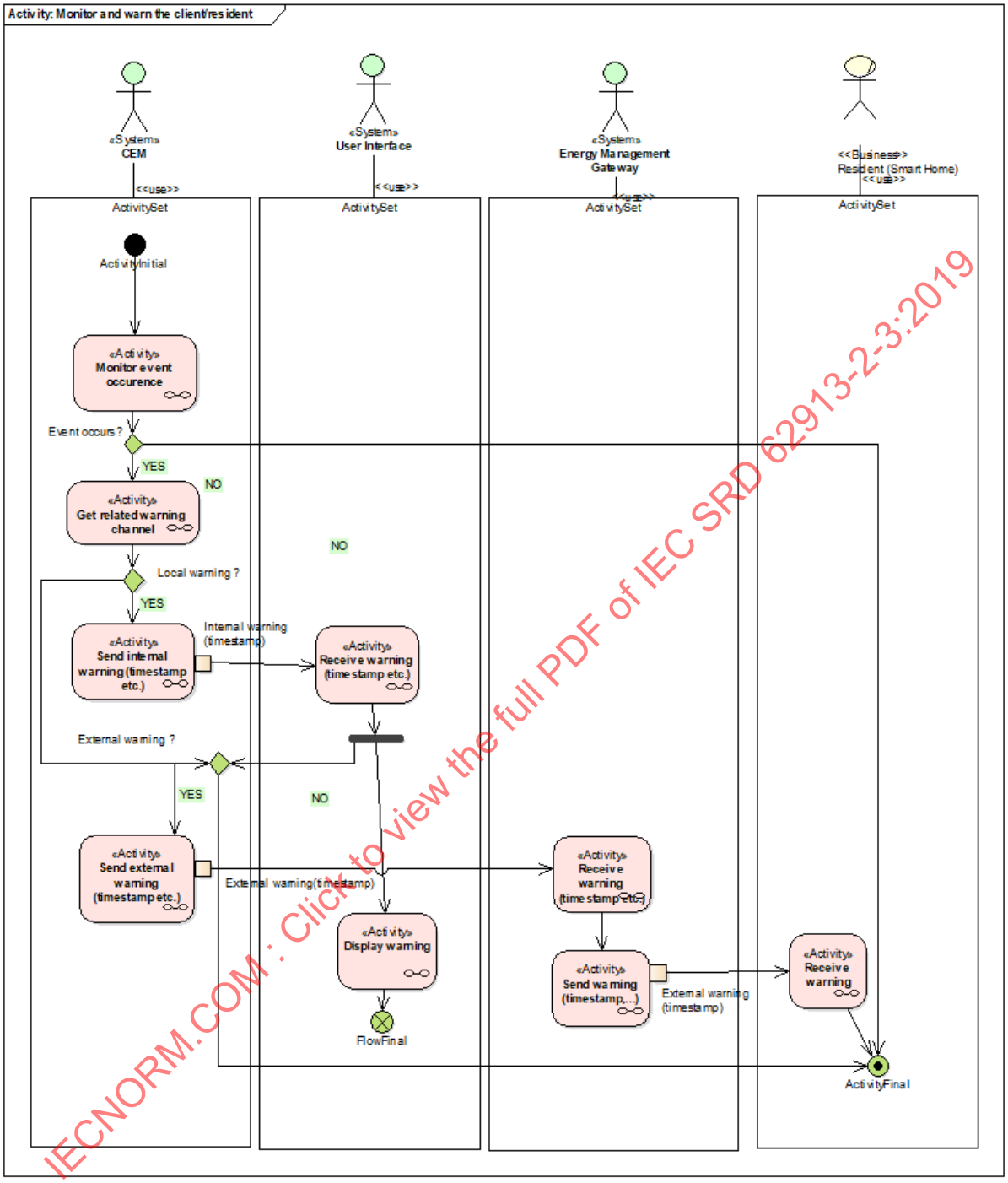
**IEC62913-2-3-S058 Provide alarms related to the smart home electricity behaviour to the client or resident**

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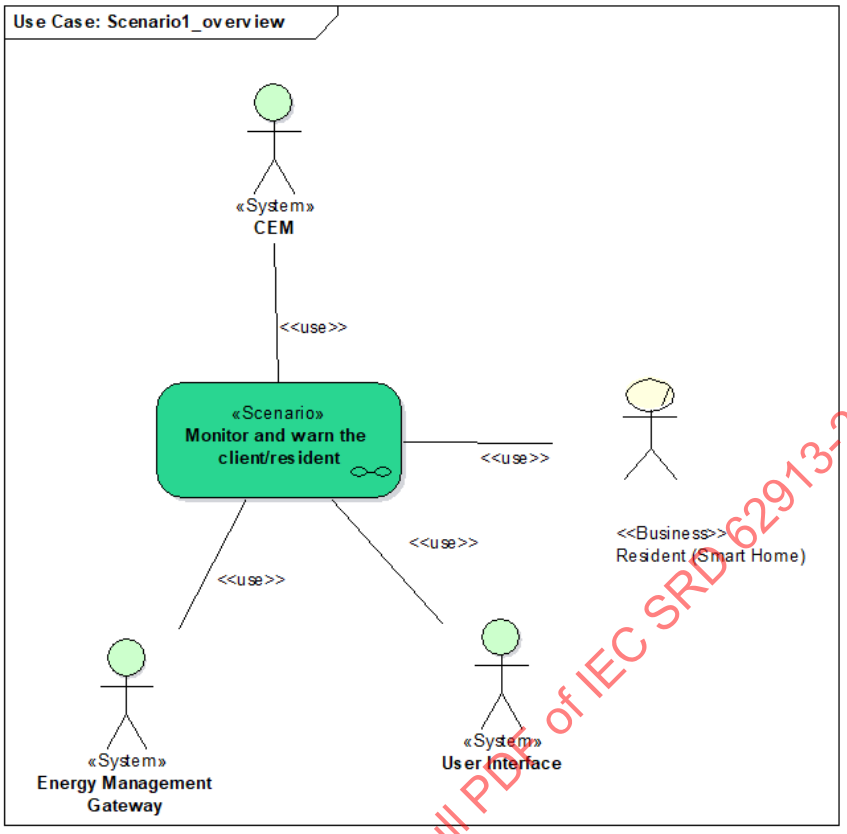
**IEC62913-2-3-S058 Provide alarms related to the smart home electricity behaviour to the client or resident**




**Scenario step by step analysis**

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| IEC62913-2-3-S058 Provide alarms related to the smart home electricity behaviour to the client or resident | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | Monitor and warn the resident/client | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| 1.1 | | Monitor event occurrence | | | CEM | | | |
| 1.2 | | Get related warning channel | | | CEM | | | |
| 1.3 | | Send internal warning (timestamp, etc.) | | | CEM | User interface | | |
| 1.4 | | Receive warning (timestamp, etc.) | | | User interface | | | |
| 1.5 | | Display warning (timestamp, etc.) | | | User interface | Resident | | |
| 1.6 | | Read warning | | | Resident | | | |
| 1.7 | | Send external warning (timestamp, etc.) | | | CEM | Energy management gateway | | |
| 1.8 | | Receive warning (timestamp, etc.) | | | Energy management gateway | | | |
| 1.9 | | Send warning | | | Energy management gateway | | | |
| | | | | | | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

| Requirements (optional) | | |
|---|---|---|
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |

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| IEC62913-2-3-S058 Provide alarms related to the smart home electricity behaviour to the client or resident |
|---|

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| **Term** | **Definition** |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |

**Table B.16 – Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

| IEC62913-2-3-S042 Manage the flexibility in electricity demand and generation within a smart home from emergency signals |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area/ Domain(s)/ Zone(s)** | **Name of use case** |
| IEC62913-2-3-S042 | Area: Energy system<br>Domain: Smart home | SUC-Manage the flexibility in electricity demand and generation within a smart home from emergency signals |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| 0.1 | 2014.04.5 | EDF | | WD Working Document |

1.3 Scope and objectives of use case

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**IEC62913-2-3-S042 Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

| Scope and objectives of use case | |
|---|---|
| **Scope** | The scope is restricted to the smart home. |
| **Objective(s)** | The objective is to preserve the best electricity supply in emergency conditions.<br>Emergency signals can be sent in order to preserve the electricity grid or react to an external event met on the electricity grid.<br>The objective is to maintain in an emergency situation the supply of electricity to the maximum number of customers and to ensure the best supply to priority customers.<br>The emergency signal can be:<br>– a cut off,<br>– a reduction of subscribed power.<br>This second case may involve evolutions of the regulatory framework.<br>Three functions:<br>– Before an emergency signal (reduction of subscribed power) if a notification is sent a few minutes before: anticipate if need be and if possible.<br>– Upon receipt of the emergency signal: define and carry out a load management strategy.<br>– At the end of the emergency signal: define and carry out a load management strategy by switching back on loads if need be.<br>Resident customizations are taken into account so as to define the load management strategies in order to prioritize electricity usages regarding the resident preferences in emergency situation. |
| **Related business case(s)** | |

1.4 Narrative of Use Case

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**IEC62913-2-3-S042 Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

**Narrative of use case**

**Short description**

The load management strategy is defined and adapted regarding emergency signals. The resident is informed if necessary.

**Complete description**

Principles:

P1. In order to solve grid constraint, the grid operator uses the flexibilities available on the energy market. Only in an emergency situation and in order to maintain the grid, the grid operator has the possibility to send an emergency signal. This is the last option before a cut off. This action will be taken according to the regulatory framework.

P2. An emergency signal can be a reduction of subscribed power. It is sent by the grid operator to the meters and displayed on the interaction/information devices (IID).

P3. The opt out is not an option. If the resident doesn't take in account the emergency signal there will be a cut off.

P4 This use case considers that emergency signals indicate a power value. A starting date and an estimated ending date may be associated to the power value. These data are received by the meter through the external SMG but the starting date and the estimated ending date are not necessarily broadcasted throughout the internal SMG to the smart home.

P5. A new emergency signal can be received during an ongoing emergency event; it is considered as the starting of a new emergency event.

P6. An emergency message informing of the situation may be associated to the emergency signal. This emergency message is sent through the SGCP, that is to say the EMG or the internal SMG.

P7. This use case assumes that the CEM establishes a load management strategy and sends it to the DEM function(s) in order to be executed.

- This applies to a customer energy management system (CEMS) and to the indirectly connected appliances (ICA) that it controls.
- This applies to a directly connected appliance (DCA), that is to say a smart appliance directly connected to a smart meter radio transmitter.

P8. This use case considers the two following cases:

- case where the appliances can send information,
- case where the appliances cannot send information.

P9. Depending on its capability, the CEM function of the CEMS and DCA arbitrate regarding resident prioritization in emergency situation.

Common scenario:

The grid operator identifies an emergency situation on the grid then sends an emergency signal to the smart home as a last possibility before a cut off.

The smart home receives an emergency notification or an emergency signal via the external smart metering gateway.

When an emergency notification is sent, the smart home can define a load management strategy, inform the resident if necessary and execute new instructions if any.

The resident cannot opt out of emergency signals responses.

Resident customizations are taken into account so as to define the load management strategies in order to prioritize the usage regarding the resident preferences in emergency situation.

1.5 Key performance indicators

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**IEC62913-2-3-S042 Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

| Use case conditions |
|---|
| **Assumption** |
| • Emergency messages are received through SGCP |
| • Emergency signals are received through the external SMG |
| • Standard RCI (remote customer information) fields and/or physical dry contact enable to detect emergency signals (received via the external SMG). |
| • The anticipation capability is an option. |
| • The resident is informed locally and/or away from home via any medium (dedicated display, appliance display, LED, SMS, etc.) |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier. |
| • The client's smart home is up and running. |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| |
| **Nature of the use case** |
| System Use Case |
| **Further keywords for classification** |
| |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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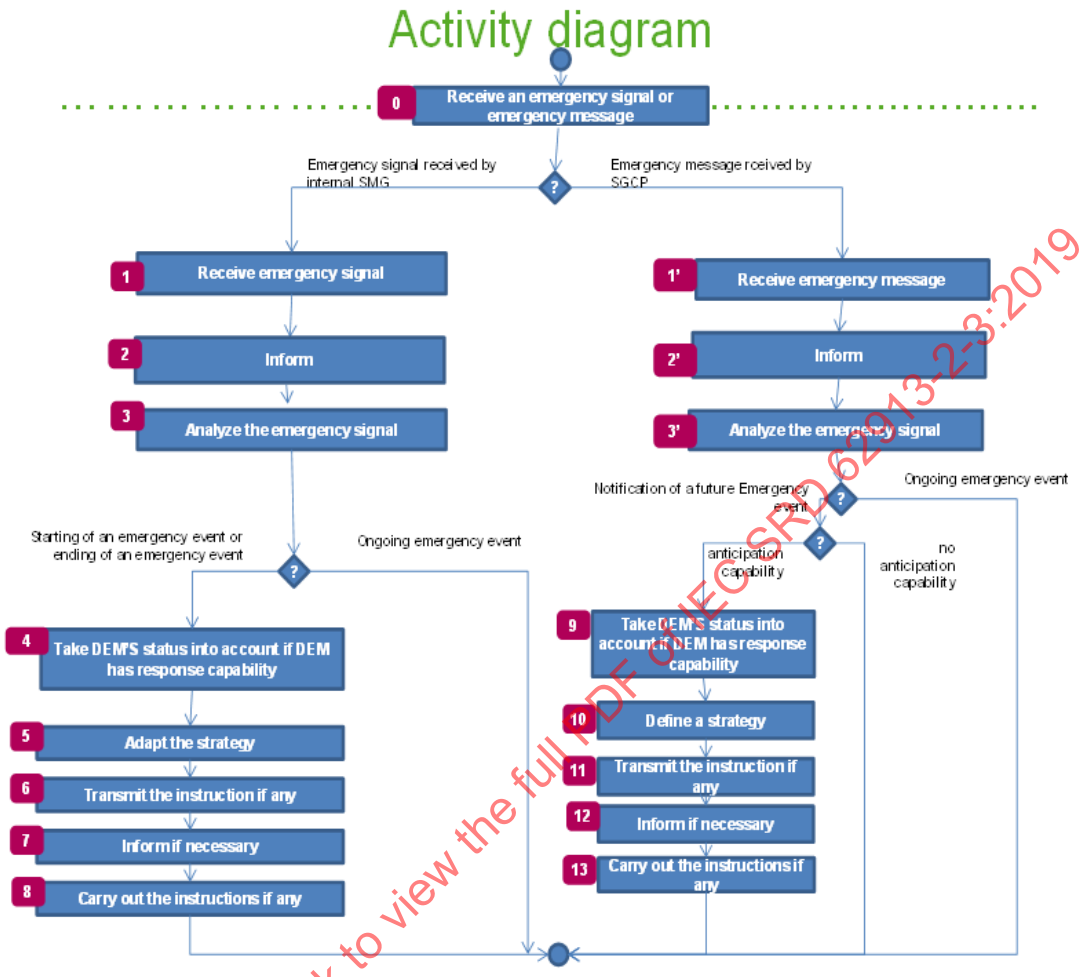
**IEC62913-2-3-S042 Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

**Diagram(s) of use case**




Timing

T1. The activities described in the activity diagram are iterated all day long.

3 Technical details

3.1 Actors

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**IEC62913-2-3-S042 Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

| Actors | | | |
|---|---|---|---|
| **Grouping** | | **Group Description** | |
| | | | |
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| External SMG | System | Communications functions between the smart grid area and the smart metering. | |
| SM | System | Combination of the following meter-related functions from the smart metering reference architecture:<br>• metrology functions including the conventional meter display (register or index);<br>• one or more additional functions. These may also make use of the display;<br>• meter communication functions.<br>[SOURCE: CEN/CLC/ETSI TR 50572:2011] | |
| Internal SMG | System | Communications functions between the smart metering and the smart home. | |
| UI | System | User interface (UI) can be connected to the smart home (HAN) or to the WAN. If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. | |
| CEM | System | Function enabling the definition of coordinated energy management strategies of one or several related DEM depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, resident/client customization and potential resident/client opt-outs.<br>This function includes a processing ability notably in order to take resident/client customization and electricity data enhancement into account. | |
| DEM | System | Function adapting the operations of a given electrical device depending on the incoming orders, resident customization and potential opt-outs that may be manually done locally. | |

3.2 References

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**IEC62913-2-3-S042 Manage the flexibility in electricity demand and generation within a smart home from emergency signals**

| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

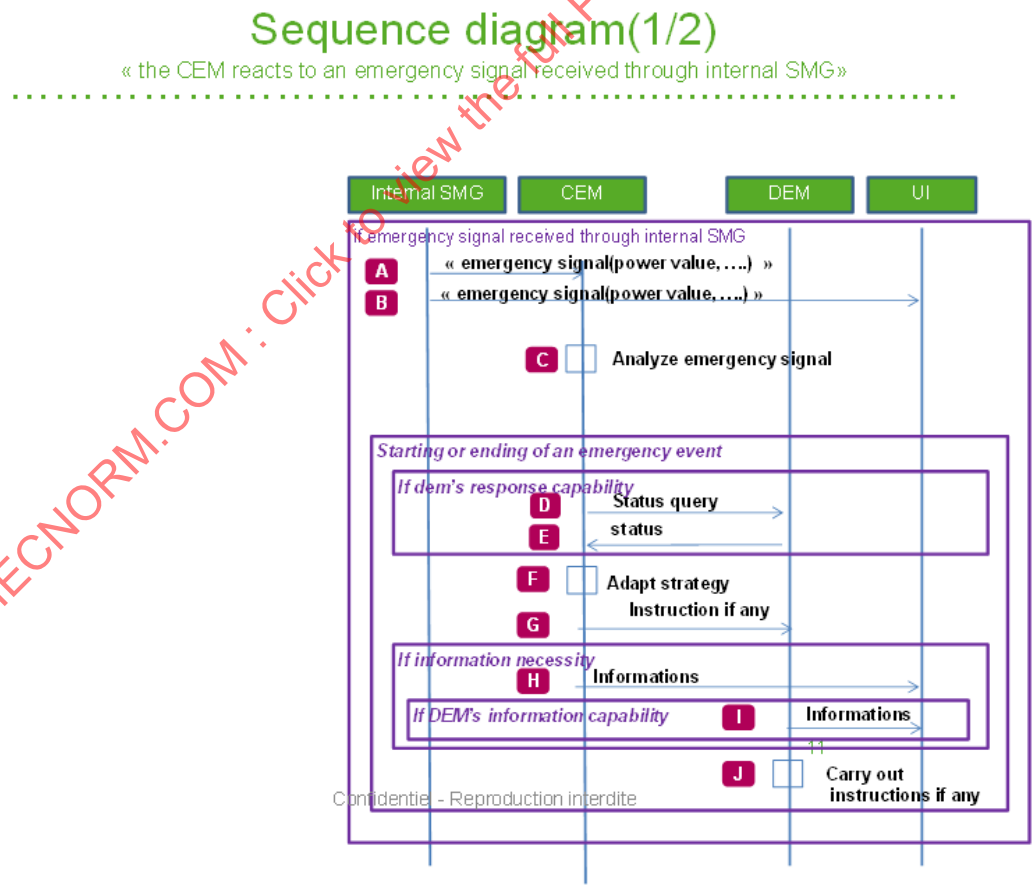
4 Step by step analysis of use case

4.1 Overview of scenarios

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-condition** | **Post-condition** |
| 1 | The CEM reacts to an emergency signal received through internal SMG | | | | | |
| 2 | The CEM reacts to an emergency message received through SGCP | | | | | |

4.2 Scenarios

4.2.1 The CEM reacts to an emergency signal received through internal SMG

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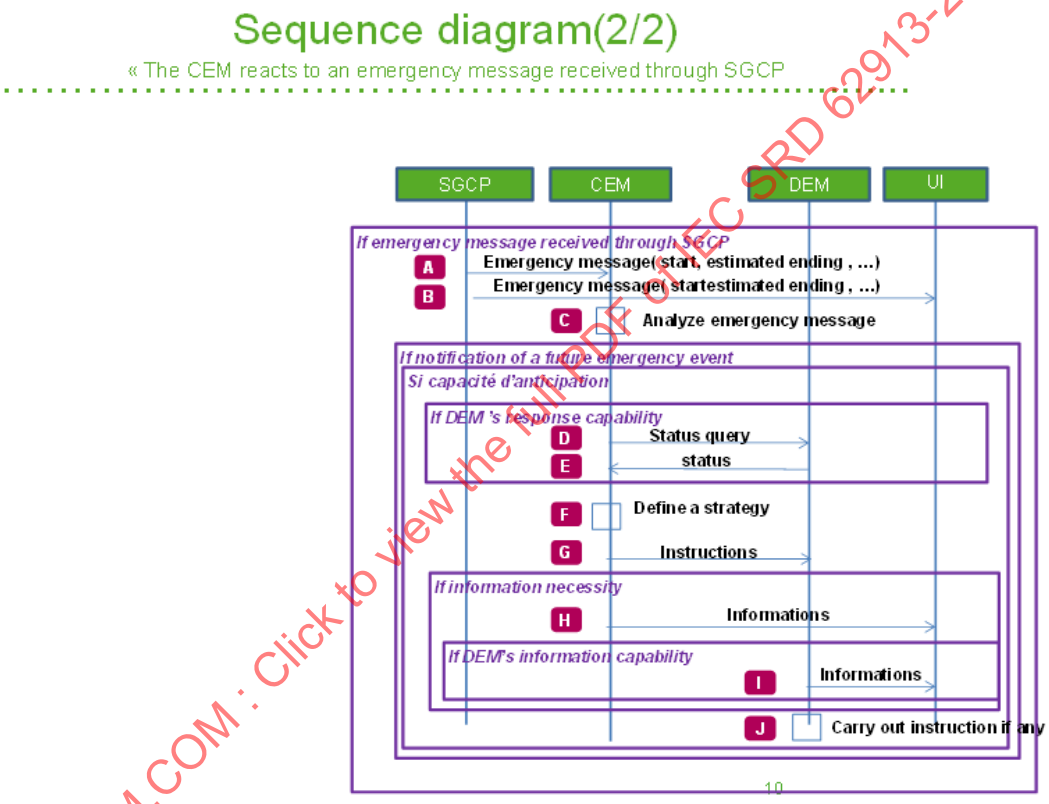
**Scenario step by step analysis**

| IEC62913-2-3-S042 Manage the flexibility in electricity demand and generation within a smart home from emergency signals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario** | | | | | | | | |
| **Scenario name** | | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

4.2.2 The CEM reacts to an emergency message received through SGCP

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**Scenario step by step analysis**

| Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Scenario name** | | | | | | | | |
| **Step No** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirement, R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

5 Information exchanged

| IEC62913-2-3-S042 Manage the flexibility in electricity demand and generation within a smart home from emergency signals | | | |
|---|---|---|---|
| **Information exchanged** | | | |
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

| **Requirements (optional)** | | |
|---|---|---|
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |

7 Common terms and definitions

| **Common terms and definitions** | |
|---|---|
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| **Custom information (optional)** | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

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**Table B.17 – Manage the flexibility of the smart building on electricity demand and generation from price incentives**

| IEC62913-2-3-S045 Manage the flexibility of the smart building on electricity demand and generation from price incentives |
|---|

1 Description of the use case

1.1 Name of use case

| Use case identification | | |
|---|---|---|
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| IEC62913-2-3-S045 | Area: Energy system<br>Domain: Smart building | SUC-Manage the flexibility on electricity demand and generation from price incentives |

1.2 Version management

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| 0.1 | 2013.11.26 | EDF | | WD Working Document |
| 0.2 | 2014.07.01 | EDF | | WD Working Document |
| | | | | |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | Automatic response of the smart building from price incentives.<br>Virtual dry contacts and short messages are out of the scope of this Use Case. |
| **Objective(s)** | – Control the flexibility of ecosystems:<br>• Before a peak and depending on the price levels of the next day: anticipate if need be.<br>• During a peak: shut off or automatically reduce loads within the customer's smart building.<br>• After a peak: switch back on loads if need be.<br>• After a change in supplier index: choose and execute a load management strategy. |
| **Related business case(s)** | |

1.4 Narrative of Use Case

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| IEC62913-2-3-S045 Manage the flexibility of the smart building on electricity demand and generation from price incentives |
|---|
| **Narrative of use case** |
| **Short description** |
| The system Use Case describes how the building energy management system optimizes the energy bill through anticipation of a dynamic peak period and how the client/energy manager is informed. |
| **Complete description** |
| Functions:<br>• Before a peak and depending on the price levels of the next day: anticipate if need be.<br>• During a peak: shut off or automatically reduce loads within the customer's smart building.<br>• After a peak: switch back on loads if need be.<br>• After a change in supplier index: choose and execute a load management strategy.<br>Principles<br>P2. A price incentive relates to dynamic peak periods, fixed peaks and other supplier index changes (e.g. going from "low rate hours" index to "high rate hours" index within a "high rate hours/low rate hours" subscription plan).<br>P3. This use case assumes that the BEM establishes a load management strategy and sends it to the DEM function(s) in order to be executed.<br>• This applies to a building energy management system (BEMS) and to the indirectly connected appliances (ICA) that it controls.<br>• This applies to a directly connected appliance (DCA), that is to say a smart appliance directly connected to a smart meter radio transmitter.<br>P4. This use case considers the two followings cases:<br>• case where the appliances can send information.<br>• case where the appliances cannot send information. |

1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

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| IEC62913-2-3-S045 Manage the flexibility of the smart building on electricity demand and generation from price incentives |
|---|
| **Use case conditions** |
| **Assumption** |
| • There are 3 SDPPDs (standard dynamic peak period day), each of them being the description of a series of indexes over a finite duration. |
| • The way the dynamic peak period message is sent is based on metering information known to date. A dynamic peak period broadcast message can generate up to three timed actions for the meter. An example of a common scenario for a dynamic peak period (DPP) scheduled for day MM/08/YY between 6 p.m. and 8 p.m. would be:<br>1. Simultaneous reception of three timed actions by the smart meter on day MM/07/YY at around 4 p.m.<br>Action A: "DPP1* notification on day MM/07/YY at 8 p.m."<br>Action B: "Dynamic peak period DPP1 start on day MM/08/YY at 6 p.m."<br>Action C: "Dynamic peak period DPP1 stop on day MM/08/YY at 8 p.m."<br>2. Activation of action A, on day MM/07/YY at 8 p.m.<br>3. Activation of action B, on day MM/08/YY at 6 p.m.<br>4. Activation of action C, on day MM/08/YY at 8 p.m. |
| • A dynamic peak period can include one or many price periods, therefore possibly index changes. |
| • It is assumed in this use case that neither the building energy management system (BEMS), nor the directly connected appliances (DCA) necessarily have the capability to get the price schedule. This is a possible but not compulsory option. |
| • The fields of the standard RCI (remote customer information) allow to detect DPP notifications, DPP starts and DPP stops. |
| • The client/energy manager is informed locally and/or away from home via any medium (dedicated display, appliance display, LED, SMS, etc.) |
| • It is assumed that neither the building energy management system, nor the directly connected appliances necessarily have the capability to establish an anticipation strategy after receiving a DPP notification. |
| • If the UI is connected to the WAN, the data are exchanged between the smart building and the UI through an energy management gateway. The UI mentioned in the sequence diagrams is a local UI within the smart building. |
| **Prerequisite** |
| • The client has subscribed an electricity plan from the electricity supplier. |
| • The client/energy manager's smart building is up and running. |
| • The smart meter receives timed actions to be executed in order to announce a dynamic peak period (which means that beforehand, the electricity supplier has requested to activate a dynamic peak period for this client). |

1.7 Further information to the use case for classification / mapping

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| IEC62913-2-3-S045 Manage the flexibility of the smart building on electricity demand and generation from price incentives |
|---|
| **Classification information** |
| **Relation to other use cases** |
| BUC-Manage the flexibility on electricity demand and generation within a smart building from market signals |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| System Use Case |
| **Further keywords for classification** |
| smart building, load management strategy, price incentives, opt-out |

1.8 General remarks

| General remarks |
|---|
| |

2 Diagrams of use case

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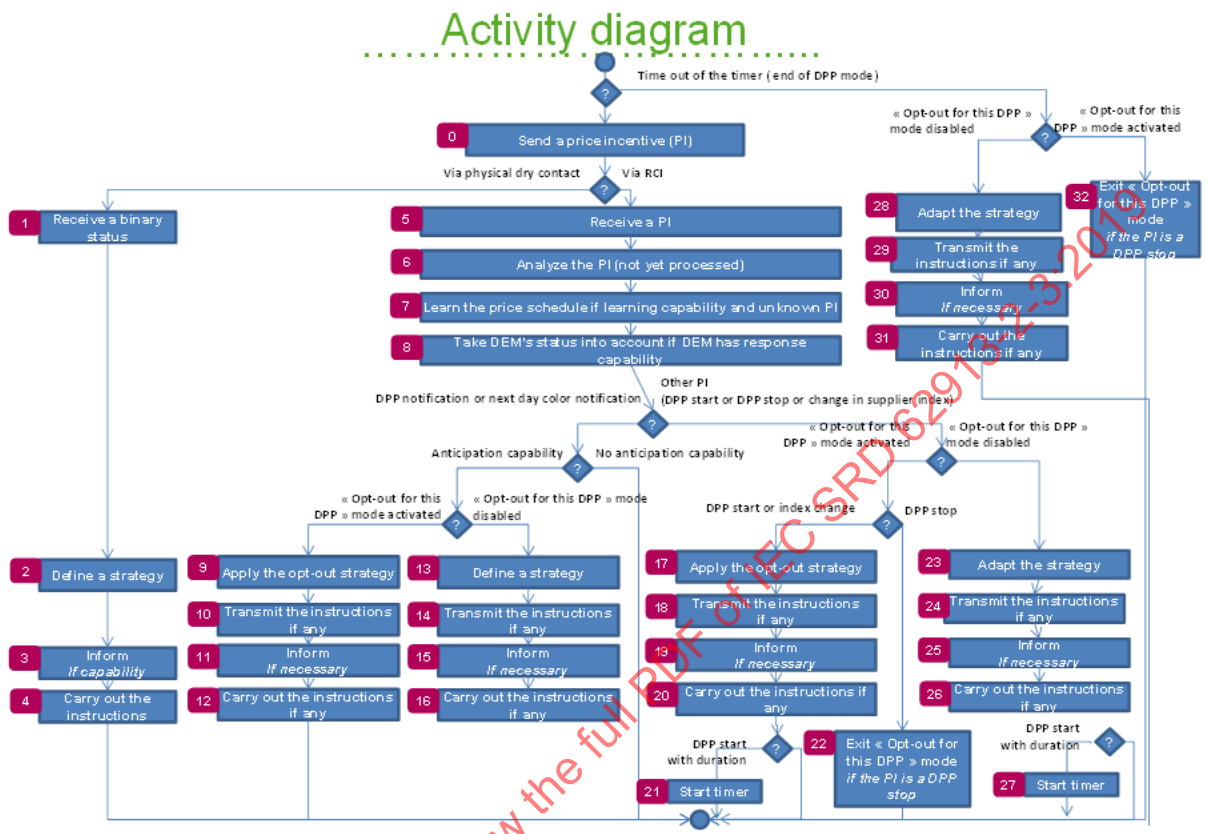
**IEC62913-2-3-S045 Manage the flexibility of the smart building on electricity demand and generation from price incentives**

**Diagram(s) of use case**

Macro-activities diagram




Timing

T1. The activities described in the activity diagram are iterated all day long.

Sequence diagram

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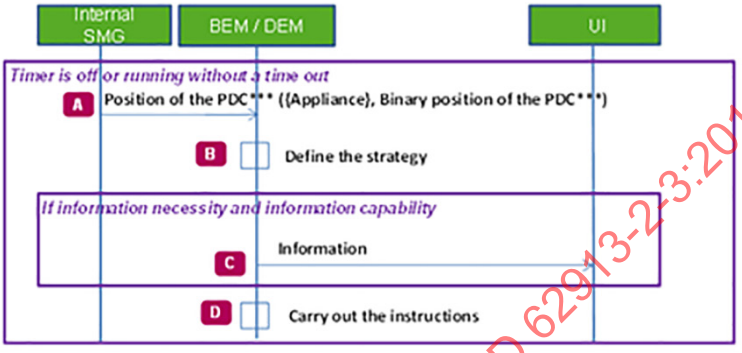
**IEC62913-2-3-S045 Manage the flexibility of the smart building on electricity demand and generation from price incentives**

## Sequence Diagram (1/6)

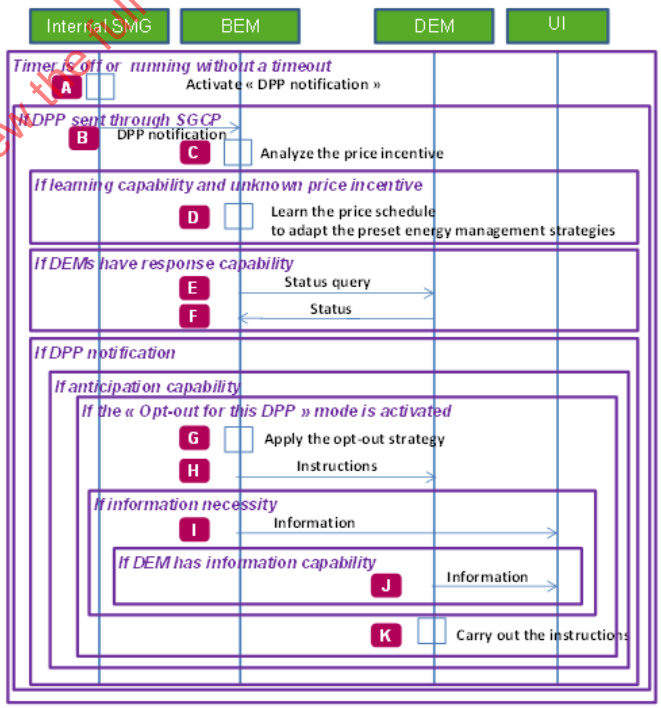
« A BA** reacts to a change in the position of the physical dry contact »




**BA: Binary appliance
***PDC: Physical Dry Contact

## Sequence Diagram (2/6)

« The BEM reacts to a DPP* notification and the « Opt-out for this DPP » mode is activated »




*DPP: dynamic Peak Period

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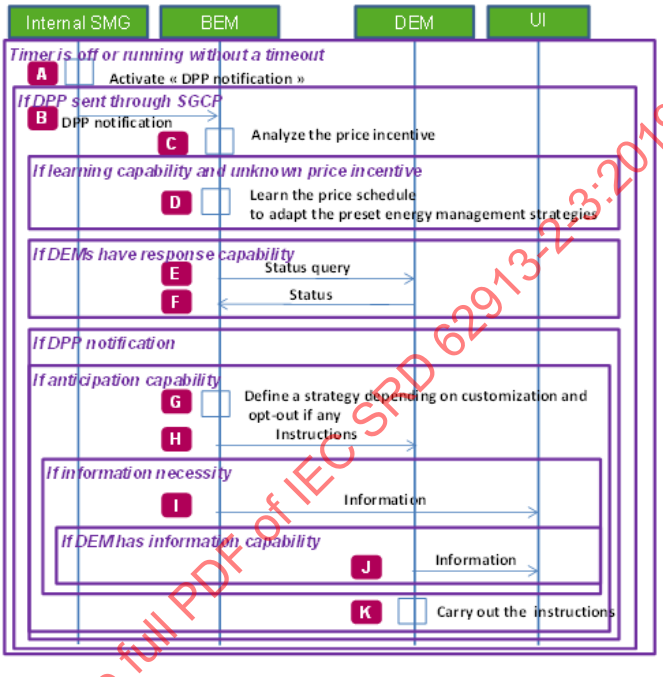
**IEC62913-2-3-S045 Manage the flexibility of the smart building on electricity demand and generation from price incentives**

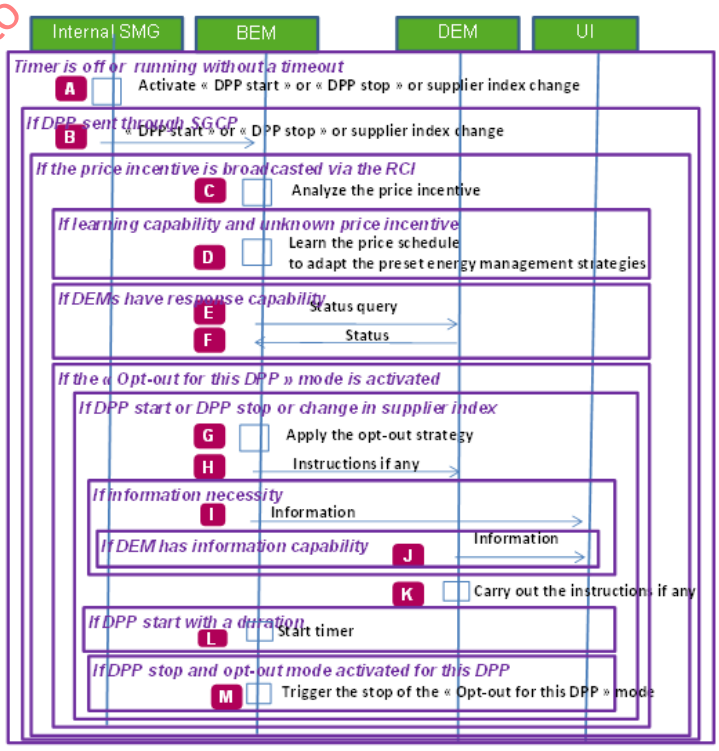
## Sequence Diagram (3/6)

«The BEM reacts to a DPP* notification **and** the « Opt-out for this DPP » mode is disabled »




## Sequence Diagram (4/6)

« The BEM reacts to a DPP start **or** a DPP stop **or** a change in supplier index **and** the « Opt-out for this DPP » mode is activated »

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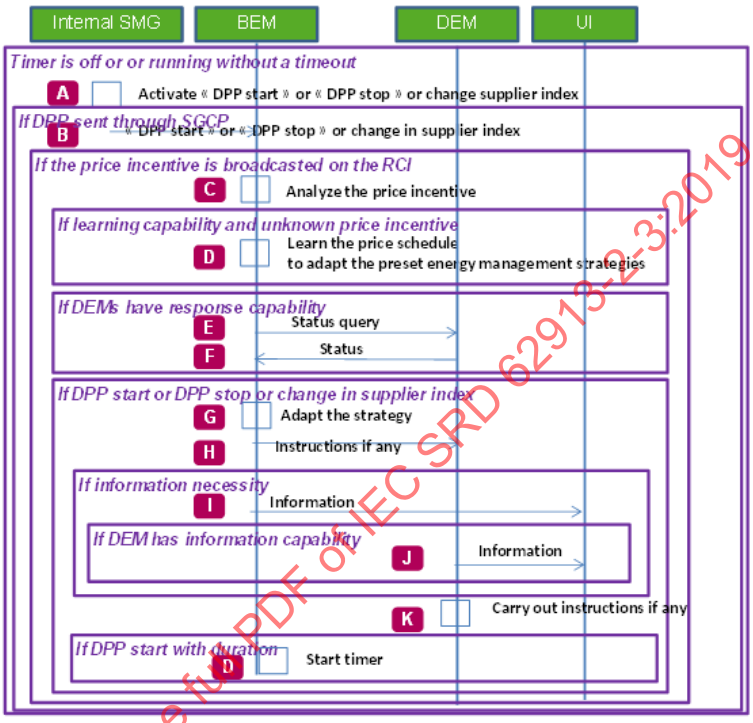
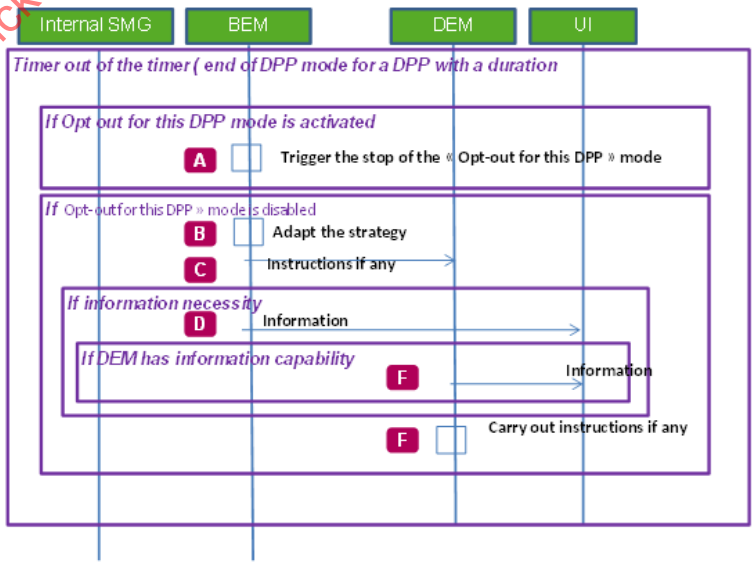
## Sequence Diagram (5/6)

« The BEM reacts to a DPP start **or** a DPP stop **or** a change in supplier index **and** the « Opt-out for this DPP » mode is disabled »




## Sequence Diagram (6/6)

« time out of the timer (end of the DPP mode ( DPP with a duration)) »

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3 Technical details

3.1 Actors

**IEC62913-2-3-S045 Manage the flexibility of the smart building on electricity demand and generation from price incentives**

| Actors | | | |
|---|---|---|---|
| **Grouping** | | **Group Description** | |
| | | | |
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| Energy manager | Business | A party in charge of the energy management of the smart building | |
| External SMG | System | Communications functions between the smart grid area and the smart metering. | |
| SM | System | Combination of the following meter-related functions from the smart metering reference architecture:<br>• metrology functions including the conventional meter display (register or index);<br>• one or more additional functions. These may also make use of the display;<br>• meter communication functions.<br>[SOURCE: CEN/CLC/ETSI TR 50572:2011] | |
| Internal SMG | System | Communications functions between the smart metering and the smart home. | |
| UI | System | User interface (UI) can be connected to the smart home (HAN) or to the WAN. If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. | |
| BEM | System | Function enabling the definition of coordinated energy management strategies of one or several related DEM in a smart building depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, energy manager and building resident customization and potential opt-outs.<br>This function includes a processing ability notably in order to take building manager customization and electricity data enhancement into account. | |
| DEM | System | Function adapting the operations of a given electrical device depending on the incoming orders, resident customization and potential opt-outs that may be manually done locally. | |

3.2 References

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| References | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **References Type** | **Reference** | **Status** | **Impact on use case** | **Originator / organization** | **Link** |
| | | | | | | |
| | | | | | | |

4 Step by step analysis of use case

4.1 Overview of scenarios

| Scenario conditions | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Scenario name** | **Scenario description** | **Primary actor** | **Triggering event** | **Pre-Condition** | **Post-Condition** |
| 1 | | | | | | |
| 2 | | | | | | |

4.2 Scenarios

| **Scenario name:** | | **No. 1 – X** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

| **Scenario name:** | | **No. 2 – X** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Step No.** | **Event** | **Name of process/ activity** | **Description of process/ activity** | **Service** | **Information producer (actor)** | **Information receiver (actor)** | **Information exchanged (IDs)** | **Requirements R-IDs** |
| | | | | | | | | |
| | | | | | | | | |

5 Information exchanged

| Information exchanged | | | |
|---|---|---|---|
| **Information exchanged ID** | **Name of information** | **Description of information exchanged** | **Requirements IDs** |
| | | | |
| | | | |

6 Requirements (optional)

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| IEC62913-2-3-S045 Manage the flexibility of the smart building on electricity demand and generation from price incentives | | |
|---|---|---|
| **Requirements (optional)** | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |
| **Category ID** | **Categories for requirements** | **Category description** |
| | | |
| **Requirement ID** | **Requirement description** | |
| | | |
| | | |

7 Common terms and definitions

| Common terms and definitions | |
|---|---|
| **Term** | **Definition** |
| | |
| | |

8 Custom information (optional)

| Custom information (optional) | | |
|---|---|---|
| **Key** | **Value** | **Refers to Section** |
| | | |
| | | |

**Table B.18 – Manage the flexibility of the smart building on electricity demand and generation from DR requests**

| IEC62913-2-3-S047 Manage the flexibility of the smart building on electricity demand and generation from DR requests | | |
|---|---|---|
| 1 Description of the use case | | |
| 1.1 Name of use case | | |
| **Use case identification** | | |
| **ID** | **Area /Domain(s)/ Zone(s)** | **Name of use case** |
| IEC62913-2-3-S047 | Area: Energy system<br>Domain: Smart building | SUC-Manage the flexibility of the smart building on electricity demand and generation from DR requests |
| 1.2 Version management | | |

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**IEC62913-2-3-S047 Manage the flexibility of the smart building on electricity demand and generation from DR requests**

| Version management | | | | |
|---|---|---|---|---|
| **Version No.** | **Date** | **Name of author(s)** | **Changes** | **Approval status** |
| 0.1 | 2013.11.26 | EDF | First draft (short description, roles) | WD Working Document |
| 0.2 | 2014.05.05 | EDF | Sequence diagram | WD Working Document |

1.3 Scope and objectives of use case

| Scope and objectives of use case | |
|---|---|
| **Scope** | Automatic response of the smart building from DR requests. |
| **Objective(s)** | – Give the possibility to the energy manager to opt out of tariff incentives and demands of flexibility, if desired for reasons of comfort:<br>• Before a DR request if a notification is sent: anticipate if need be and if possible.<br>• Upon receipt of the DR request: define and carry out a load management strategy.<br>• At the end of the DR request period: define and carry out a load management strategy by switching back on loads if need be. |
| **Related business case(s)** | |

1.4 Narrative of Use Case

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| IEC62913-2-3-S047 Manage the flexibility of the smart building on electricity demand and generation from DR requests |
|---|
| **Narrative of use case** |
| **Short description** |
| The system Use Case describes how the BEM/DEM defines the load management strategy and adapts it depending on a DR request. The energy manager is informed if necessary. |
| **Complete description** |
| Principles<br>P1. This use case considers that DR requests apply on a period.<br>P2. This use case considers DR requests intended for:<br>• a reduction or termination of loads or electricity generation,<br>• a rise in loads or electricity production,<br>• a modulation (power, …).<br>P3. A DR request can be:<br>• a flexibility request indicating the start of a period and a duration,<br>• a first flexibility request message indicating the start of a period and then a second one indicating the end of the period.<br>A notification can be sent to announce a future flexibility request. This notification is considered as a flexibility request message as well.<br>P4. This use case assumes that the BEM establishes a load management strategy and sends it to the DEM function(s) in order to be executed.<br>• This applies to a building energy management system (BEMS) and to the indirectly connected appliances (ICA) that it controls.<br>• This applies to a directly connected appliance (DCA), that is to say a smart appliance directly connected to a smart meter radio transmitter.<br>P5. This use case considers the two following cases:<br>• case where the appliances can send information,<br>• case where the appliances cannot send information.<br>P6. The energy manager can opt out of a flexibility request.<br>P7. Depending on its capability, the BEM function of the BEMS and DCA arbitrate between flexibility requests and price incentives.<br>Common scenario<br>The smart building receives a flexibility request notification or a flexibility request via the EMG or via the external smart metering gateway.<br>When a flexibility request notification is sent, the smart building can define a load management strategy, inform the energy manager if necessary and execute new instructions if any.<br>When a flexibility request is sent, the smart building can adapt the load management strategy, inform the energy manager if necessary and execute new instructions if any.<br>Price incentives, energy manager customizations and possible opt-outs are taken into account so as to define or adapt the load management strategy. |

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1.5 Key performance indicators

| Key performance indicators | | | | |
|---|---|---|---|---|
| **ID** | **Name** | **Calculation** | **Scope** | **Objective** |
| | | | | |
| | | | | |
| | | | | |

1.6 Use case conditions

| IEC62913-2-3-S047 Manage the flexibility of the smart building on electricity demand and generation from DR requests |
|---|
| **Use case conditions** |
| **Assumption** |
| • Flexibility requests are received via the smart grid connection point, that is to say the external SMG or the EMG. |
| • Standard RCI (remote customer information) fields enable to detect flexibility requests (flexibility requests messages received via the external SMG). |
| • A DR request notification can match a flexibility request message. |
| • The energy manager is informed locally and/or away from the smart building via any medium (dedicated display, appliance display, LED, SMS, etc.). |
| • The anticipation capability is an option. |
| • The client of electricity supplier is also a client of a flexibility operator. |
| • If the UI is connected to the WAN, the data are exchanged between the smart building and the UI through an energy management gateway. The UI mentioned in the sequence diagrams is a local UI within the smart building. |
| **Prerequisite** |
| • The client has subscribed an electricity contract from the electricity supplier. |
| • The client has subscribed a contract to make flexibilities available to a flexibility operator. |
| • The client's smart building is up and running. |
| • The smart building is configured to feedback data enabling to validate the activation of flexibilities (for example, the smart meter is configured in "load curve" mode). |

1.7 Further information to the use case for classification / mapping

| Classification information |
|---|
| **Relation to other use cases** |
| BUC-Manage the flexibility on electricity demand and generation within a smart building from market signals |
| **Level of depth** |
| Short version |
| **Prioritization** |
| |
| **Generic, regional or national relation** |
| Generic |
| **Nature of the use case** |
| System Use Case |
| **Further keywords for classification** |
| |

1.8 General remarks

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**IEC62913-2-3-S047 Manage the flexibility of the smart building on electricity demand and generation from DR requests**

| General remarks |
| --- |
| |

2 Diagrams of use case

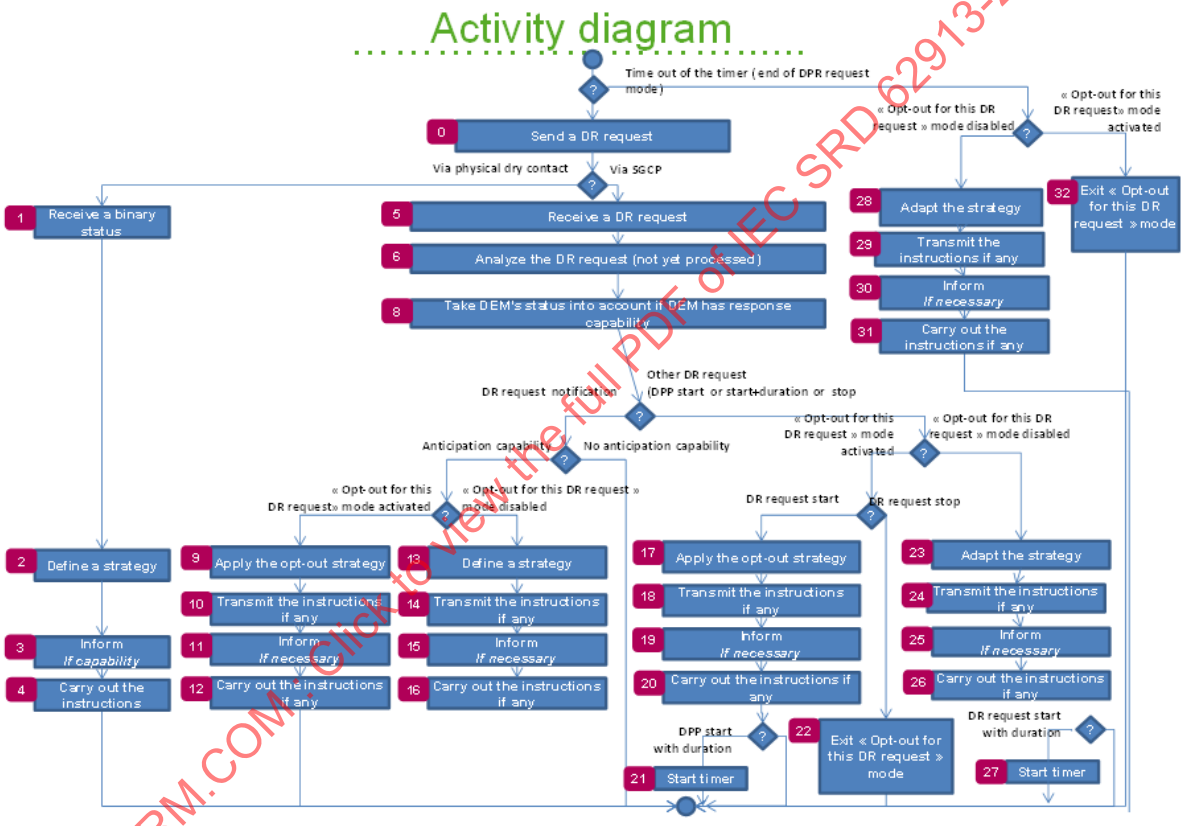
**Diagram(s) of use case**

Macro-activities diagram

Timing

T1. The activities described in the activity diagram are iterated all day long.

Sequence diagram

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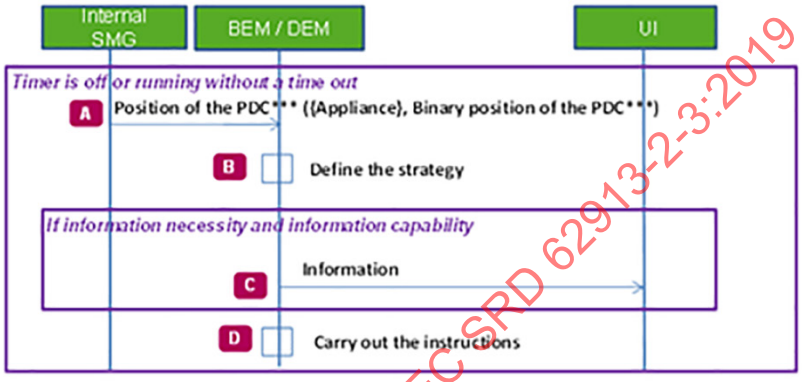
**IEC62913-2-3-S047 Manage the flexibility of the smart building on electricity demand and generation from DR requests**

## Sequence Diagram (1/6)

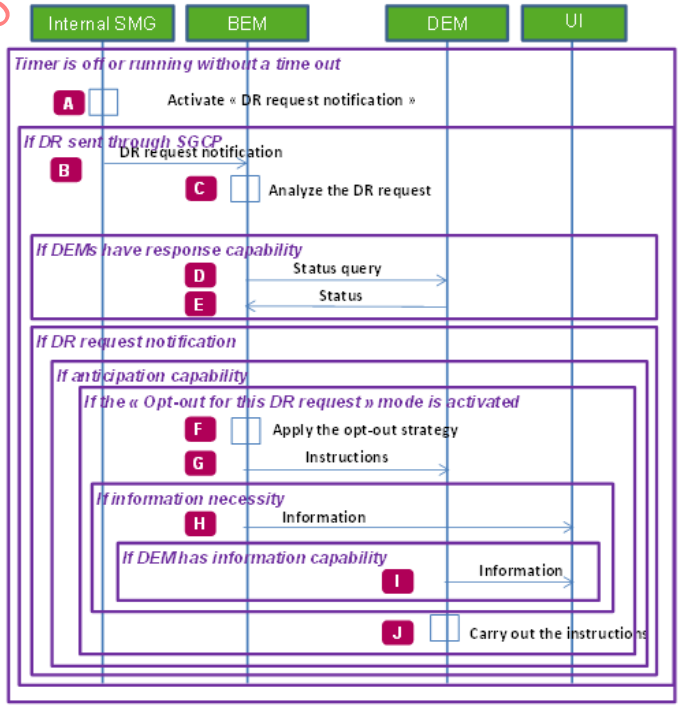
« A BA** reacts to a change in the position of the physical dry contact »




**BA: Binary appliance
***PDC: Physical Dry Contact

## Sequence Diagram (2/6)

« The BEM reacts to a DR request* notification and the « Opt-out for this DR request » mode is activated »

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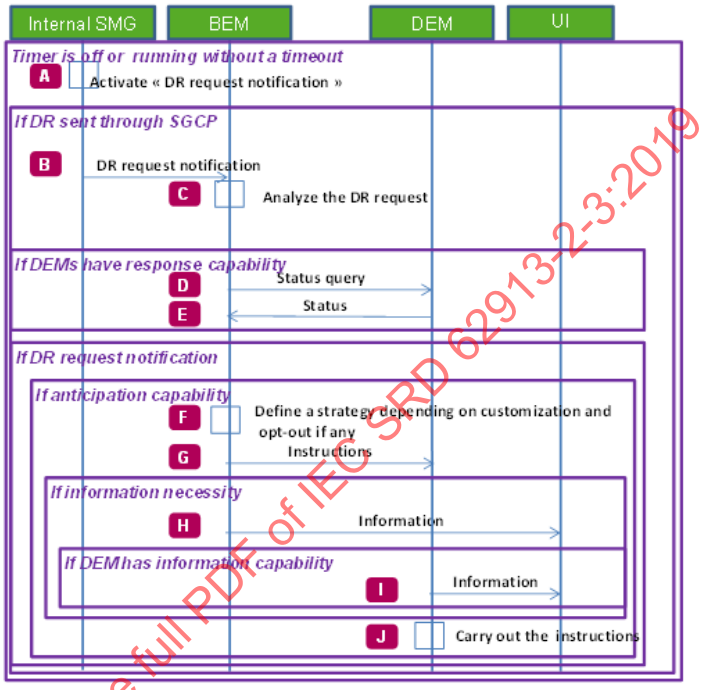
**IEC62913-2-3-S047 Manage the flexibility of the smart building on electricity demand and generation from DR requests**

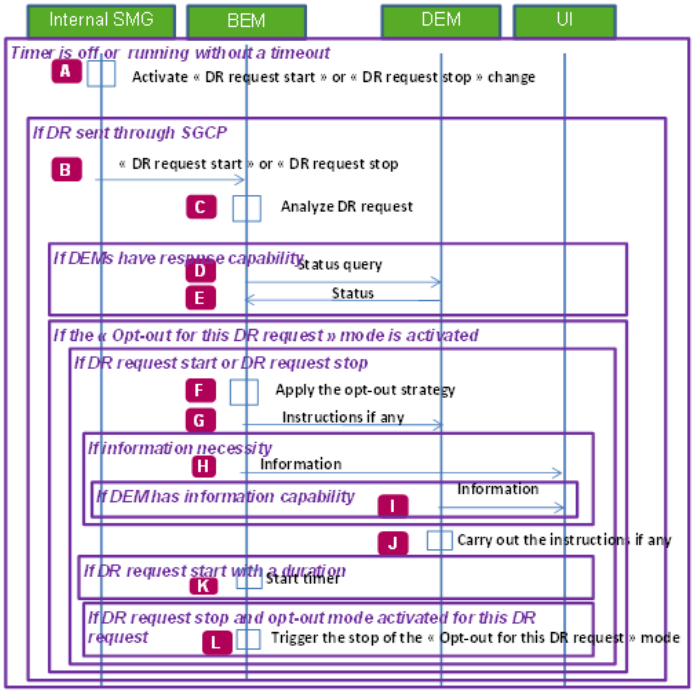
## Sequence Diagram (3/6)

«The BEM reacts to a DR request* notification **and** the « Opt-out for this DR request » mode is disabled »




## Sequence Diagram (4/6)

« The BEM reacts to a DR request start or a DR request stop and the « Opt-out for this DR request » mode is activated »

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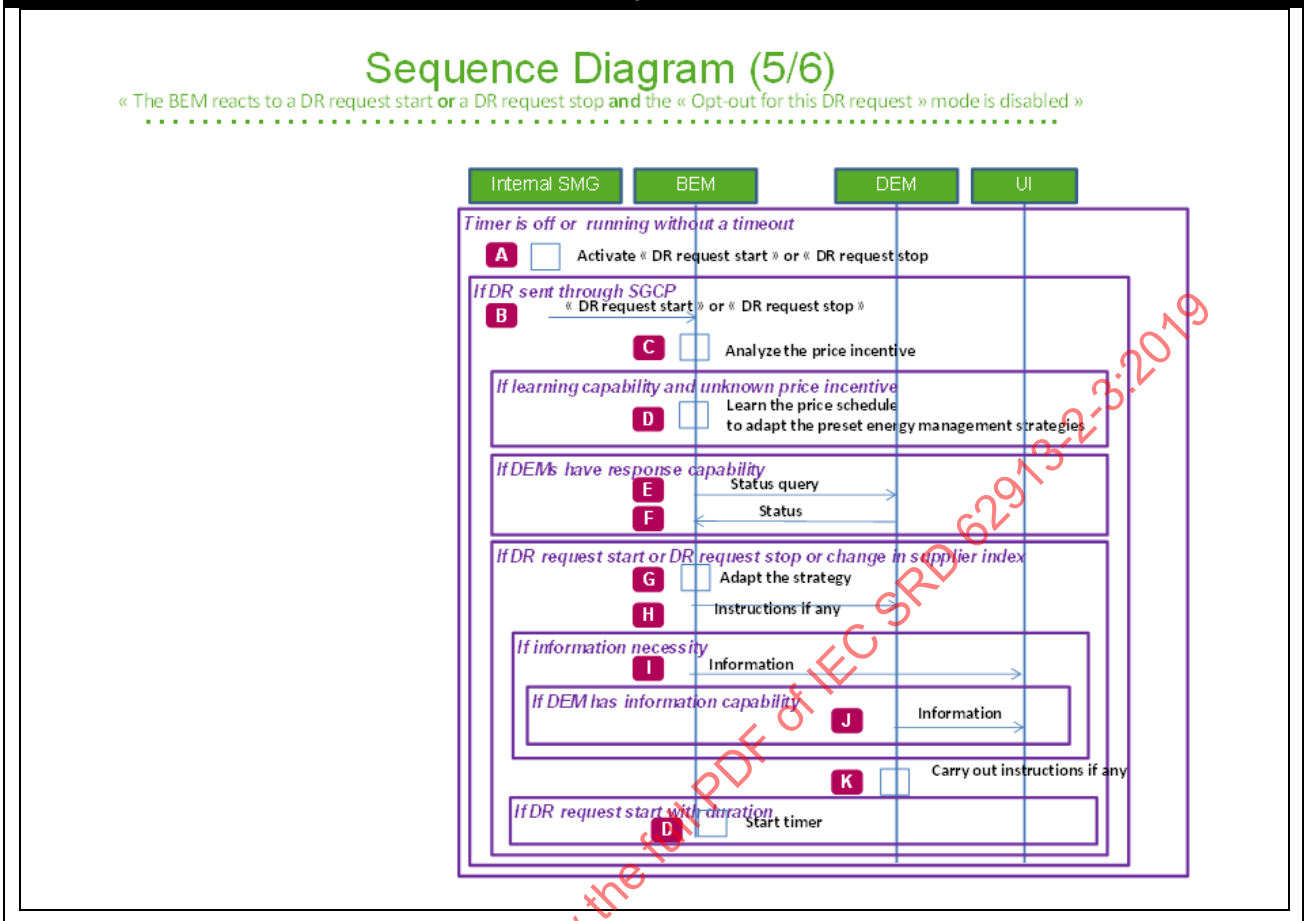


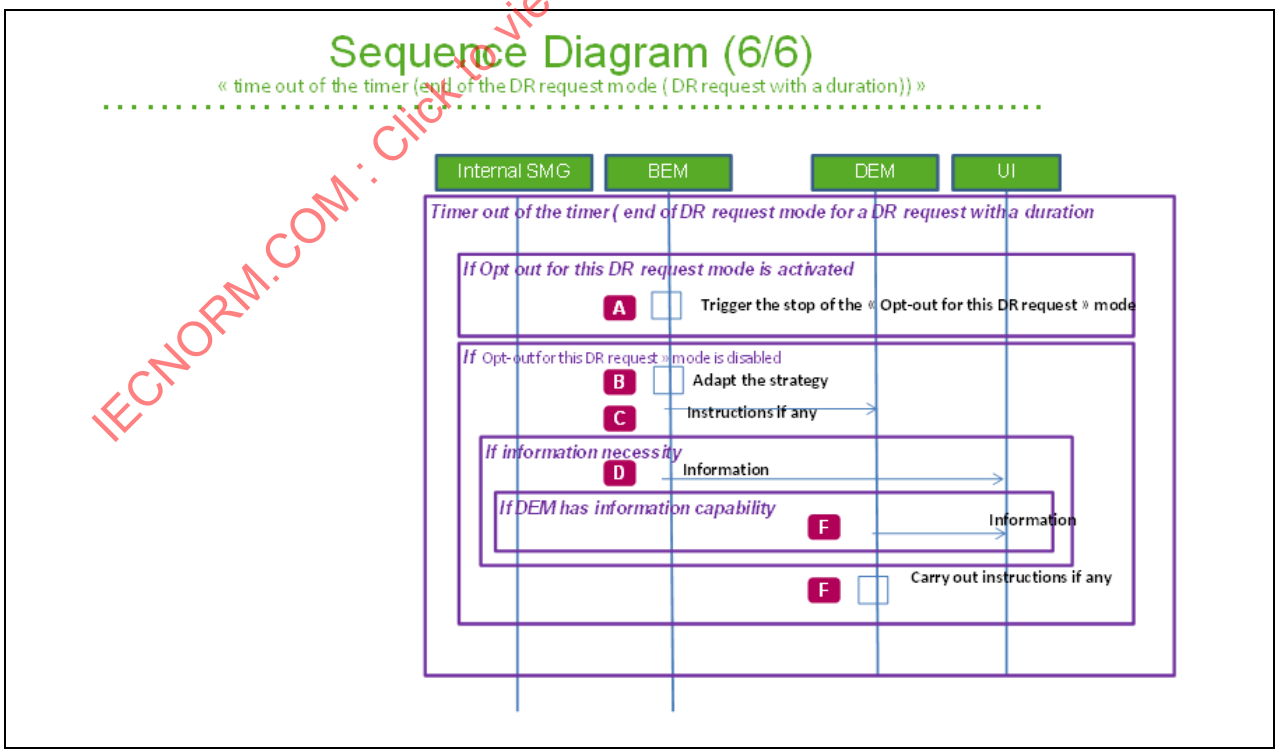


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3 Technical details

3.1 Actors

| IEC62913-2-3-S047 Manage the flexibility of the smart building on electricity demand and generation from DR requests | | | |
|---|---|---|---|
| **Actors** | | | |
| **Grouping** | | **Group Description** | |
| | | | |
| **Actor name** | **Actor type** | **Actor Description** | **Further information specific to this Use Case** |
| Energy manager | Business | A party in charge of the energy management of the smart building | |
| External SMG | System | Communications functions between the smart grid area and the smart metering. | |
| SM | System | Combination of the following meter-related functions from the smart metering reference architecture:<br>• metrology functions including the conventional meter display (register or index);<br>• one or more additional functions. These may also make use of the display;<br>• meter communication functions.<br>[SOURCE: CEN/CLC/ETSI TR 50572:2011] | |
| Internal SMG | System | Communications functions between the smart metering and the smart home. | |
| EMG | System | Communication functions between the WAN and the HAN. | |
| SGCP | System | | |
| UI | System | User interface (UI) can be connected to the smart home (HAN) or to the WAN. If the UI is connected to the WAN, the data are exchanged between the smart home and the UI through an energy management gateway. | |
| BEM | System | Function enabling the definition of coordinated energy management strategies of one or several related DEM in a smart building depending on metering data, price incentives, flexibility requests, additional information coming from other channels such as the Internet, energy manager and building resident customization and potential opt-outs.<br><br>This function includes a processing ability notably in order to take building manager customization and electricity data enhancement into account. | |
| DEM | System | Function adapting the operations of a given electrical device depending on the incoming orders, resident customization and potential opt-outs that may be manually done locally. | |

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3.2 References