Energy Information Standards (EIS) Alliance Customer Domain Use Cases

Draft

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Introduction

This document identifies the scenarios that require energy usage information to be shared between consumers and energy service providers.

The conceptual model of the smart grid includes a domain called the "Customer" domain. This domain includes the industrial, commercial, and residential buildings and equipment. In order to identify the energy usage information that needs to be shared between the customer domain and other domains within a smart grid, a set of use cases have been defined. These use cases identify the information that passes across a conceptual boundary into or out of the customer domain called the Energy Services Interface (ESI). The physical instantiation of the ESI has, by choice, not been identified. It may be embedded in a meter, utility equipment, or customer premises equipment without changing the use cases.

While developing these use cases, it became apparent that industrial, commercial, and residential customers have very similar requirements. This is particularly true when considering the needs of these customers in the future. For that reason, the use cases in this document cover the entire scope of the customer domain. Each use case has a section that identifies which building type is applicable. Using this format, the reader needs to understand that, particularly in the residential case, a single person may assume the role of multiple actors. For example, a residential homeowner can be considered a Facility Manager, Financial Manager, and Operations Personnel.

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UC-1 Manage Power Demand to Minimize Cost

Use Case Name

Manage power demand to minimize cost.

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-1

Brief Description

Customers manage and schedule activities to reduce electricity demand charges in accordance with the pricing rules defined in the purchase contract or rate tariff.

Related Use Cases

EIS-UC-4, "Balance Power Purchases Between Utility and On-site Generation" addresses the case in which a customer has the option of using on-site generation to reduce demand supplied by an energy provider.

Background

Electric power demand makes up a large portion of energy charges for many customers, especially industrial customers. Demand is the average rate of energy used over an established period of time (demand interval). Traditionally, demand charges are applied as a rate per kW for the highest single-period demand during one or more established time-of-use periods during the current billing period. In addition, a rate per kW may apply to the highest single-period demand over the previous year (ratchet penalty). These charges provide incentive for customers to avoid setting new demand peaks.

Narrative

In this use case, a customer monitors electrical power demand against a target. The target may be based on a number of factors. Operations personnel maintain a current list of shed-able and critical loads. The electric supplier, energy services company (ESCO) or aggregator provides pricing rules against which the economic impacts of actions taken are measured.

1. **Facility Manager determines power demand target.** The target may be based on several factors, including the following.

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a. Energy cost reduction goals

b. Existing peak power demand values during the current billing period and/or the 12-month ratchet period

c. Regulatory mandates

d. Requests for curtailment by the energy supplier, ESCO or aggregator

e. Real-time electrical energy pricing considerations

f. Environmental factors such as weather (current conditions and forecast)

g. Production requirements (during times of high production, production needs may take precedence over energy cost)

2. **The energy supplier and/or ESCO/Aggregator provide pricing rules.** Presently, pricing rules are, in general, embodied in a rate tariff. In the future, it is anticipated that pricing will become much more dynamic. This will require real-time sharing of pricing rules and other data between the energy supplier and/or Energy Services Company (ESCO) and the customer through the Energy Services Interface (ESI).

3. **Financial Manager notifies of pricing rules to aid in establishing target.** The electrical energy invoice has references to applicable pricing rules as well as historical demand peaks that apply to the invoice. The pricing rules help determine the load control decisions made by the energy management system.

4. **Operations personnel establish list of sheddable and critical loads.** Many factors enter into the determination of which loads may and may not be shed to achieve a demand target. The priority of sheddable loads is also established. The membership and priority of the sheddable load list typically varies depending on a variety of conditions. The following factors are typical.

a. Production schedules, customer delivery commitments, staffing schedules, shift differential and overtime considerations

b. Relationship of individual loads to core production processes

c. Flexibility of scheduling equipment and production operations

d. Cycle time constraints of individual loads (e.g. HVAC compressors)

e. Interdependencies of individual loads

f. Automatic restarting characteristics of individual loads

g. Personnel safety and comfort impact

h. State change interval, e.g. response time of system to a shed request

i. Environmental factors such as weather

j. Local codes: ASHRAE 62.1 ventilation requirements, ASHRAE 55 Thermal comfort requirements, ASHRAE 90.1 energy requirements

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5. **Loads report their energy usage to the energy management system (EMS).** Sheddable and critical loads include metering that reports energy usage and current power demand so that the EMS knows the possible effect of shedding individual loads on the overall facility demand.

6. **The EMS controls sheddable loads.** An energy management system may range from a manual system to a fully automated system; however, the basic control equation remains the same: control loads so that the end-of-interval demand does not exceed the target. The EMS needs to know the predicted end-of-interval demand for the current interval. This may be provided by energy supplier metering, the customer's metering equipment, or by the EMS system itself. The EMS compares the predicted demand to the established demand target. If load shedding is required, the EMS selects from the prioritized list of sheddable loads and load shedding strategies, and issues a shed load command.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Facility Manager
Energy Services Company (ESCO/Aggregator)
Energy Supplier
Financial Manager
Energy Management System (EMS)
Operations Personnel
Facility Loads
Metering
Weather Forecast Service

Table 1.1. Manage Power Demand Use Case Actors

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Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
1	Weather data
3	Pricing Rules
5	Instantaneous Aggregated Energy Usage
6	Instantaneous Energy Usage for Sub Loads
7	Available Shed-able Load
8	Critical Load
9	State Change Interval
10	Existing Demand Thresholds
14	Loads to Shed
26	Predicted End-of-Interval Demand

Table 1.2. Manage Power Demand Use Case Information

Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Operations Personnel	1,7,8	1,7,8
Facility Manager	7,8,9	1,3,6,10
Energy Services Company (ESCO/Aggregator)	1,3,5,10	1,9
Energy Supplier	3,5,10	1,9
Financial manager		3,10
Energy Management System (auto or manual)	6,7,8,9,14,26	1,3,5,6,7,8,9,10,26
Environmental manager		
Weather Forecast Service	1	
Facility Loads	6	14

Table 1.3. Manage Power Demand Use Case Transactions

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Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

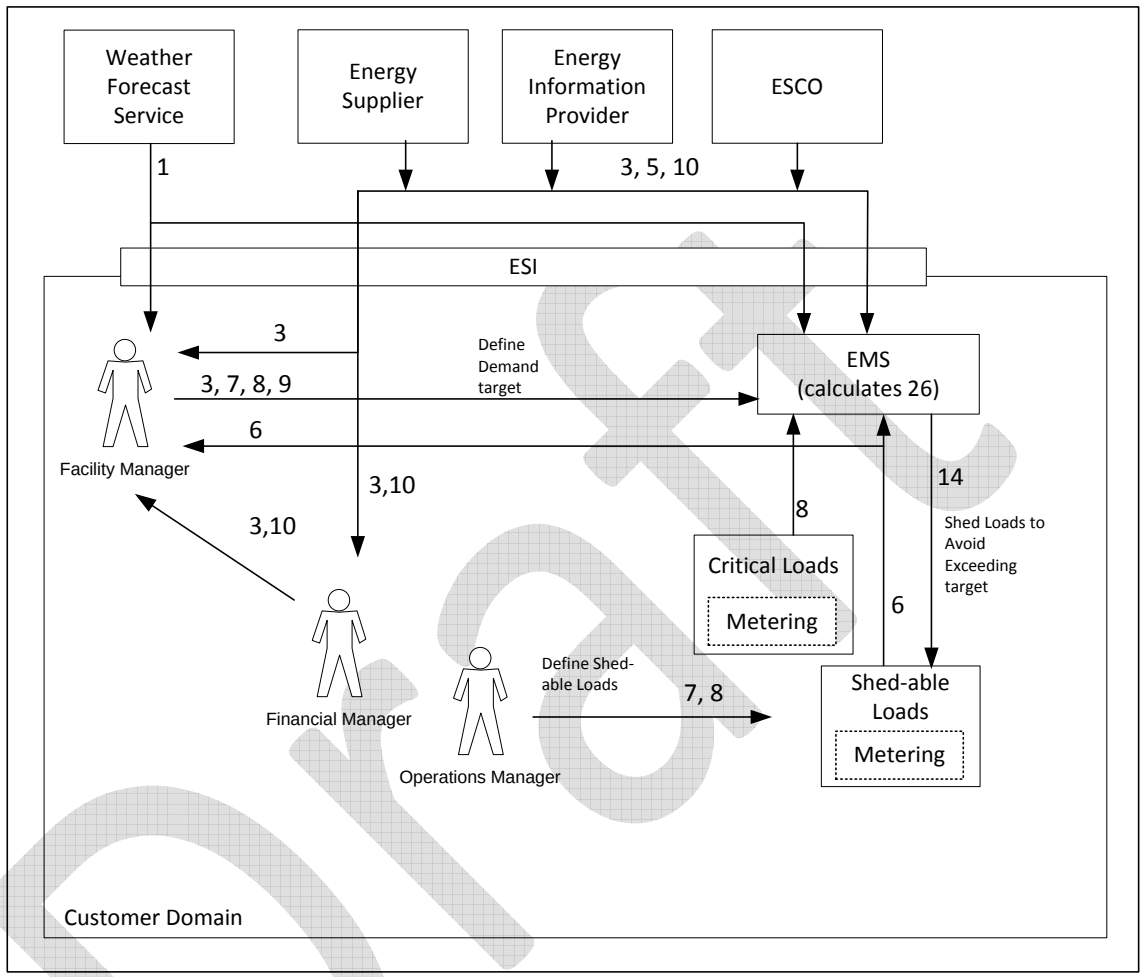

Figure 1.1. Manage Power Demand Use Case Diagram

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UC-2 Manage Production Needs with Power and Energy Management

Use Case Name

Manage production needs with power and energy management

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

ESI-UC-2

Brief Description

Many customers do not have visibility into energy usage data when managing production and so production becomes the primary objective. Power usage information at the operations level promotes energy accountability.

Related Use Cases

Not Applicable

Background

Many businesses were founded and facilities were constructed when energy was plentiful and cheap. Energy is no longer plentiful or cheap, and the impact of high energy usage on the environment is becoming evident. Although some electric power customers have established business systems that make energy an equal partner with other classes of business information, many more customers have not. A large proportion of customers know their energy usage only at the macro level. Providing operations managers and personnel with a line of sight to the operational impact on energy use and demand drives ownership and accountability.

Narrative

In this use case, the customer utilizes energy information alongside other business and production information to optimize production while balancing production, energy usage, cost, environmental and other considerations. The electric supplier, energy services company (ESCO) or aggregator provides pricing rules against which the economic impacts of actions taken are measured.

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1. **Facility Manager establishes energy reporting to operations.** An energy reporting subsystem provides the following general classes of information to operations manager and personnel.

    a. Energy cost reduction goals

    b. Energy usage compared to target for department or operation

    c. Historical energy usage information

    d. Current power demand compared to target

    e. Energy information on operational decisions

    f. Current and forecast status of energy attributes, e.g., price levels, energy provider shed requests, power quality conditions, etc.

    g. Environmental factors such as weather (current conditions and forecast)

    h. Local codes: ASHRAE 62.1 ventilation requirements, ASHRAE 55 Thermal comfort requirements, ASHRAE 90.1 energy requirements

2. **The Energy Supplier and/or ESCO/Aggregator provide pricing rules.** Presently, pricing rules are, in general, embodied in a rate tariff. In the future, it is anticipated that pricing will become much more dynamic. This will require real-time sharing of pricing rules and other data between the energy supplier and/or ESCO and the industrial customer through the Energy Services Interface (ESI).

3. **Financial Manager provides energy cost content.** The electrical energy invoice has references to applicable pricing rules as well as historical demand peaks that apply to the invoice. The pricing rules help determine the characteristics of the energy management system.

4. **Operations management and personnel evaluate energy information when making operations decisions.** Examples of using energy information are as follows.

    a. Deciding to delay operation of a process until lower energy pricing is in effect

    b. Deciding to utilize on-site generation or energy storage systems during times of high energy cost

    c. Deciding to utilize on-site thermal energy storage for cooling during times of high energy cost

    d. Comparing energy efficiency of similar processes

    e. Manually shutting down non-critical processes in response to a shed request from the energy supplier or ESCO

    f. Making schedule changes based on forecast weather, environmental, or energy supply conditions

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g. Evaluating progress toward energy usage and cost reduction goals

h. Understanding the contribution made by a process toward the aggregated energy cost of a facility

5. **The energy management system (EMS) reports energy information.** An energy management system may range from a manual system to a fully automated system. The EMS combines information from a variety of sources including plant utility metering, sub metering equipment, weather and environmental information services, historical energy usage storage and energy costing information. The EMS may report directly or through one or more Intelligent HMI Energy Devices.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Facility Manager
Energy Services Company (ESCO/Aggregator)
Energy Supplier
Financial Manager
Energy Management System
Operations Personnel
Facility Loads
Historical Energy Data Storage
Intelligent HMI Energy Device
Weather Forecast Service

Table 2.1. Manage Production Needs with Power Management Use Case Actors

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Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
1	Weather data
3	Pricing Rules
5	Instantaneous Aggregated Energy Usage
6	Instantaneous Energy Usage for Sub Loads
7	Available Sheddable Load
8	Critical Load
9	State Change Interval
10	Existing Demand Thresholds
11	Onsite generation
12	Onsite energy storage
13	Onsite thermal storage
16	Historical interval demand and PQ data
20	Load Characteristics
26	Predicted End-of-Interval Demand

Table 2.2. Manage Production Needs with Power Management Use Case Information

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463 ## *Information Transactions*

464

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Operations Personnel	1,7,8	1,7,8
Facility Manager	7,8,9	1,3,6,10
Energy Services Company (ESCO/Aggregator)	1,3,5,10	1,9
Energy Supplier	3,5,10	1,9
Financial manager		3,10
Energy Management System (auto or manual)	6,7,8,9,20,26	1,3,5,6,7,8,9,10,11,12,13,20,26
Weather Forecast Service	1	

465 Table 2.3. Manage Production Needs with Power Management Use Case Transactions

466 ## *Use Case Diagram*

467 The following diagram illustrates this use case. An explanation of the format of this
468 diagram can be found in Appendix C.

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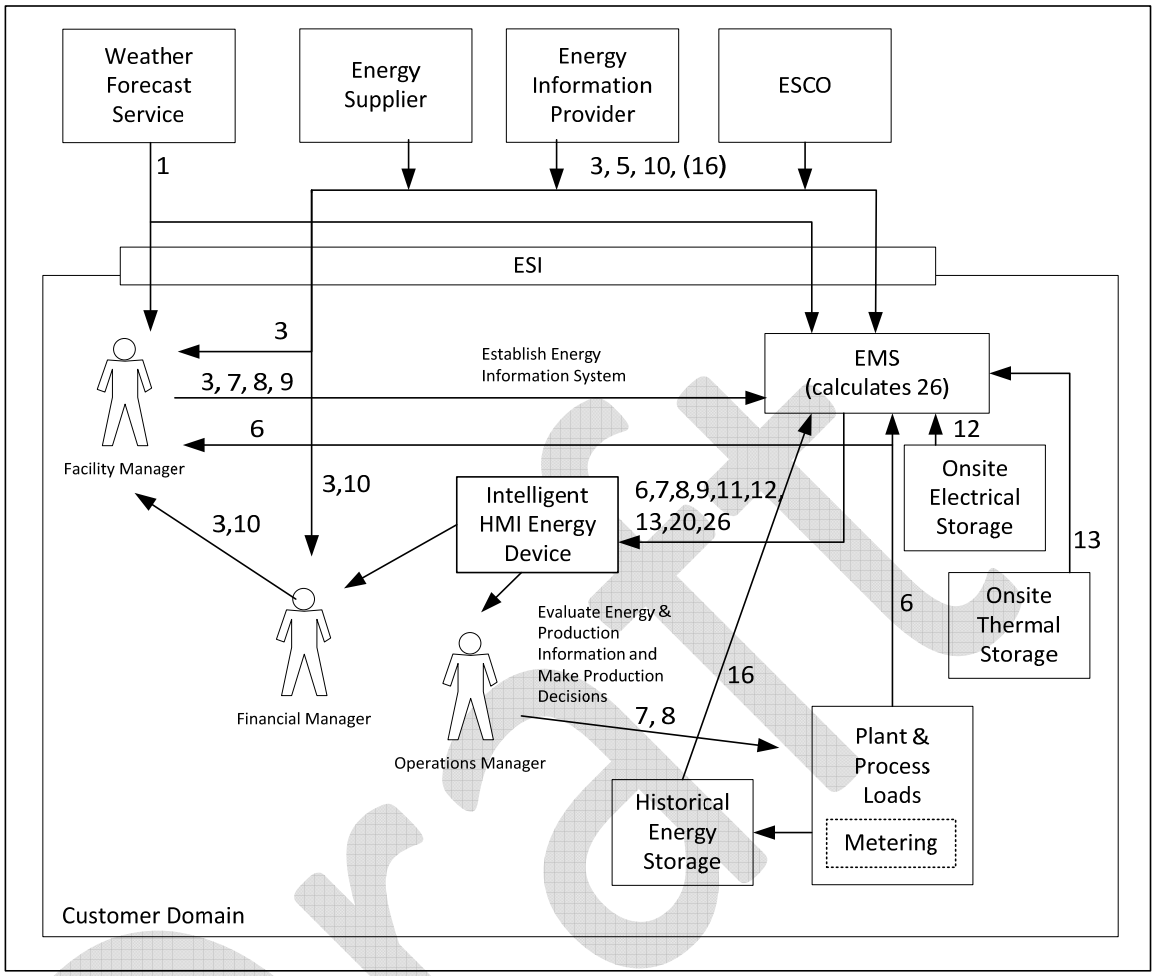

Figure 2.1. Manage Production Needs with Power Management Use Case Diagram

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UC-3 Forecast Power Usage

Use Case Name

Customer Forecasts Power Usage

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

ESI-UC-3

Brief Description

Industrial and Commercial customers who forecast power usage, one hour, one day, one month ahead, can better manage power costs and production schedules. Sharing this forecast information with power suppliers is a win-win and enables electric power providers to better plan and manage capacity and provide higher quality of service.

Related Use Cases

Not Applicable

Narrative

1. **Historical Interval Energy is provided to the Facility Manager.** There are four variants in this step depending where the historical data is kept.
    a. The Facility Manager retrieves historical energy consumption from an Energy Management System (EMS).
    b. The Facility Manager retrieves historical energy consumption from the Energy Supplier through the Energy Services Interface (ESI).
    c. The Facility Manager retrieves historical energy consumption from an Energy Information Provider through the Energy Services Interface (ESI).
    d. The Facility Manager retrieves historical energy consumption from the Energy Services Company through the Energy Services Interface (ESI).
2. **Onsite Generation Capacity and Availability is Determined.** The capacity and availability of any onsite generation equipment is provided to the Facility Manager by the onsite equipment or the EMS.

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a. The Facility Manager retrieves onsite generation capacity and availability from the onsite generation equipment.

b. The Facility Manager retrieves onsite generation capacity and availability from an Energy Management System (EMS).

3. **Onsite Electrical Storage Capacity and Availability is Determined.** The capacity and availability of any onsite electrical storage equipment is provided to the Facility Manager by the onsite equipment or the EMS.

a. The Facility Manager retrieves onsite electrical storage capacity and availability from the onsite storage equipment.

b. The Facility Manager retrieves onsite electrical storage capacity and availability from an Energy Management System (EMS).

4. **Onsite Thermal Storage Capacity and Availability is Determined.** The capacity and availability of any onsite thermal storage equipment is provided to the Facility Manager by the onsite equipment or the EMS.

a. The Facility Manager retrieves onsite thermal storage capacity and availability from the onsite storage equipment.

b. The Facility Manager retrieves onsite thermal storage capacity and availability from an Energy Management System (EMS).

5. **Weather Prediction Information is Determined.** The predicted weather for the interval being estimated is provided to the Facility Manager by Weather Service either directly, or via the EMS or EIP.

6. **Historical Production Data is Determined.** The historical production schedule that correlates to the Historical Interval Energy is provided by the Operations manager to the Facility Manager.

7. **Initial Production Scheduling Information is Determined.** The Facility Manager gets production scheduling information for the interval being estimated from the Financial Manager.

8. **A Preliminary Interval Energy Demand Forecast is Produced.** The Facility Manager takes the generation, storage, weather, and scheduling information and creates a preliminary energy demand forecast for the interval being estimated and sends it to the Financial Manager.

9. **Energy Pricing Rules and Information are Determined.** The Financial Manager retrieves rate information to determine the profitability of production. This information may come from any of the following energy information providers.

a. The Energy Pricing Rules are retrieved from the Energy Information Provider through the Energy Services Interface (ESI) for the interval being estimated.

b. The Energy Pricing Rules are retrieved from the Energy Services Company through the Energy Services Interface (ESI) for the interval being estimated.

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c. The Energy Pricing Rules are retrieved from the Energy Supplier through the Energy Services Interface (ESI) for the interval being estimated.

10. **Production Schedule and Energy Demand Forecast are Created.** The Financial Manager uses the Preliminary Interval Energy Demand and Energy Pricing Rules to create the Production Schedule and Energy Demand Forecast. The Energy Demand Forecast is sent to one or more of the following energy providers

a. The Energy Demand Forecast, for the interval being estimated, is sent to the Energy Supplier through the Energy Services Interface (ESI).

b. The Energy Demand Forecast, for the interval being estimated, is sent to the Energy Services Company through the Energy Services Interface (ESI).

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Facility Manager
Energy Services Company (ESCO)
Energy Information Provider (EIP)
Energy Supplier
Financial Manager
Energy Management System
Onsite Generation
Onsite Electrical Storage
Onsite Thermal Storage

Table 3.1. Forecast Power Usage Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
1	Weather data
3	Pricing Rules
11	Onsite Generation

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12	Onsite energy Storage
13	Onsite Thermal Storage
15	Demand Forecast
16	Interval Energy Demand

Table 3.2. Forecast Power Usage Use Case Information

Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Facility Manager	15	1, 11, 12, 13, 16
Energy Services Company (ESCO)	3, 16	15
Energy Information Provider	3, 16	15
Energy Supplier	3, 16	15
Financial Manager	15	3, 15
Energy Management System	16, 11, 12, 13	
Weather Forecast Service	1	
Onsite Generation	11	
Onsite Electrical Storage	12	
Onsite Thermal Storage	13	

Table 3.3. Forecast Power Usage Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

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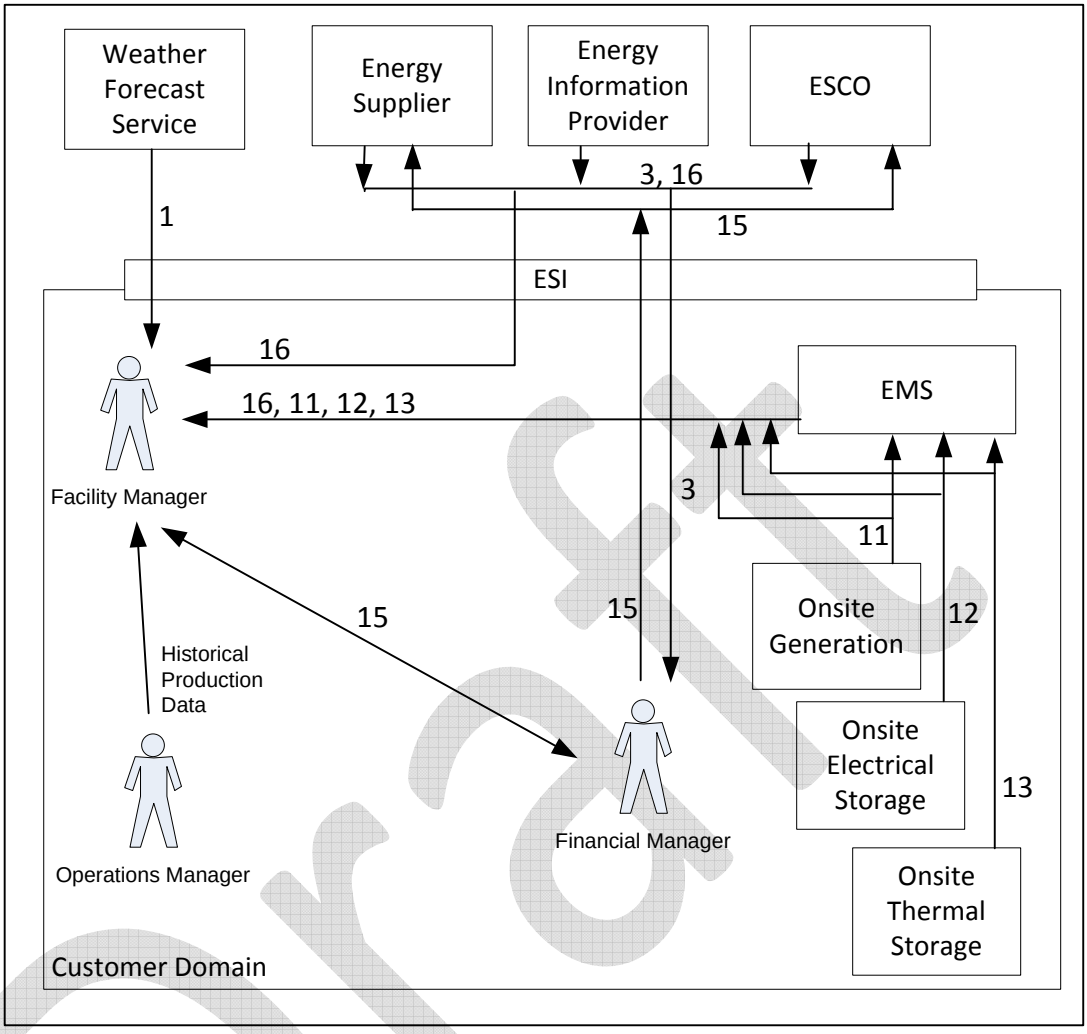

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563 Figure 3.1. Forecast Power Usage Use Case Diagram

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UC-4 Balance Power Purchases between Utility and On-site Generation

Use Case Name

Balance power purchases between utility and on-site generation

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

ESI-UC-4

Brief Description

Customer decides to make or buy power. In some instances, it also makes sense for the customer to resell energy to the utility.

Related Use Cases

See use case 5 and 6.

Narrative

Overview: This use case covers a scenario where the customer has onsite energy generation or storage capacity. The customer continuously monitors grid provided energy pricing and quality, and compares that with on-site generation capacity, availability, costs, and quality. This information is coupled with the on-site energy demand forecast (which requires the production schedule and weather forecast data) to determine how much energy to make onsite or buy from the utility. The make vs buy decision will vary over time as the input variables change.

1. **Facility Manager determines available on-site capacity and price point.** Capacity and price is based on several factors, including the following.
    a. Energy cost of production (bus bar price)
    b. Production rate and projection
    c. Generation equipment capacity and status
    d. Stock piles
    e. Orders

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f. Regulatory mandates

g. Real-time electrical energy pricing considerations

h. Environmental factors such as weather (current conditions and forecast)

2. **The Energy Supplier or ESCO provide pricing rules.** Presently, pricing rules are, in general, embodied in a rate tariff. In the future, it is anticipated that pricing will become much more dynamic. This will require real-time sharing of pricing rules and other data between the energy supplier (customer) and/or ESCO, ISO, local distribution company and the customer through the Energy Services Interface (ESI).

3. **The Financial Manager develops pricing rules to aid in establishing the cost of generation (bus bar cost) and sell targets.** The financial manager develops a "make or buy" electrical energy decisions to minimize cost. The pricing rules help determine the characteristics of the generation system operation.

4. **Operations personnel control the tie line between the utility and the customer site.** Many factors enter into the determination of a make or buy decision. Once the decision is made the operations personnel will have to operate the control system to raise or lower generation for the optimum financial set point. The following factors are typical.

   a. Production schedules, customer delivery commitments, staffing schedules, shift differential and overtime considerations

   b. Relationship of individual loads to core production processes

   c. Flexibility of scheduling equipment and production operations

   d. Cycle time constraints of individual loads (e.g. Chillers, heat treating, smelters, compressors, water heaters, etc.)

   e. Cycle time constraints of generation equipment

   f. Interdependencies of individual loads, generators and alternative power sources

   g. Automatic restarting characteristics of generators

   h. Personnel safety and comfort impact

   i. State change interval, e.g. response time of system to a request

   j. Environmental factors such as weather

5. **The Energy Management (or Balance of Plant BOP) control system manages this tie line requirement. EMS/BOP** systems range from a manual system to a fully automated system; however, the basic control equation remains the same: control generation so that the end-of-interval kWh meets the "tie line" target. The EMS/BOP control system needs to know the predicted and actual end-of-hour kilowatt-hours at the point of interconnection between the customer and the utility. This may be provided by energy supplier metering, the customer's metering equipment, or by the

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EMS/BOP system itself. The EMS/BOP compares the predicted kWh to the established hourly target. If generation needs to be increased or decreased, the EMS/BOP selects from the prioritized list of generators and issues a speed up or slow down command.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Operations Personnel
Facility Manager
Energy Services Company (ESCO)
Energy Supplier
Financial Manager
Energy Management System
Balance of Plant Control System (BOP)
Weather Forecast Service

Table 4.1. Balance Power Purchases Between Utility and Onsite Generation Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
1	Weather data
2	Power quality
3	Pricing Rules
5	Instantaneous energy use
11	Onsite generation
12	Onsite energy storage
13	Thermal energy storage
15	Demand forecast

Draft

Table 4.2. Balance Power Purchases Between Utility and Onsite Generation Use Case Information

Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Operations Personnel	15	
Facility Manager	11,12,13,15	1,3,5,11,12,13
Energy Services Company (ESCO)	3,5	11,12,13
Energy Supplier	3,5	11,12,13
Financial Manager		3,15
Energy Management System		1
Weather Forecast Service	1	

Table 4.3. Balance Power Purchases Between Utility and Onsite Generation Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

Draft

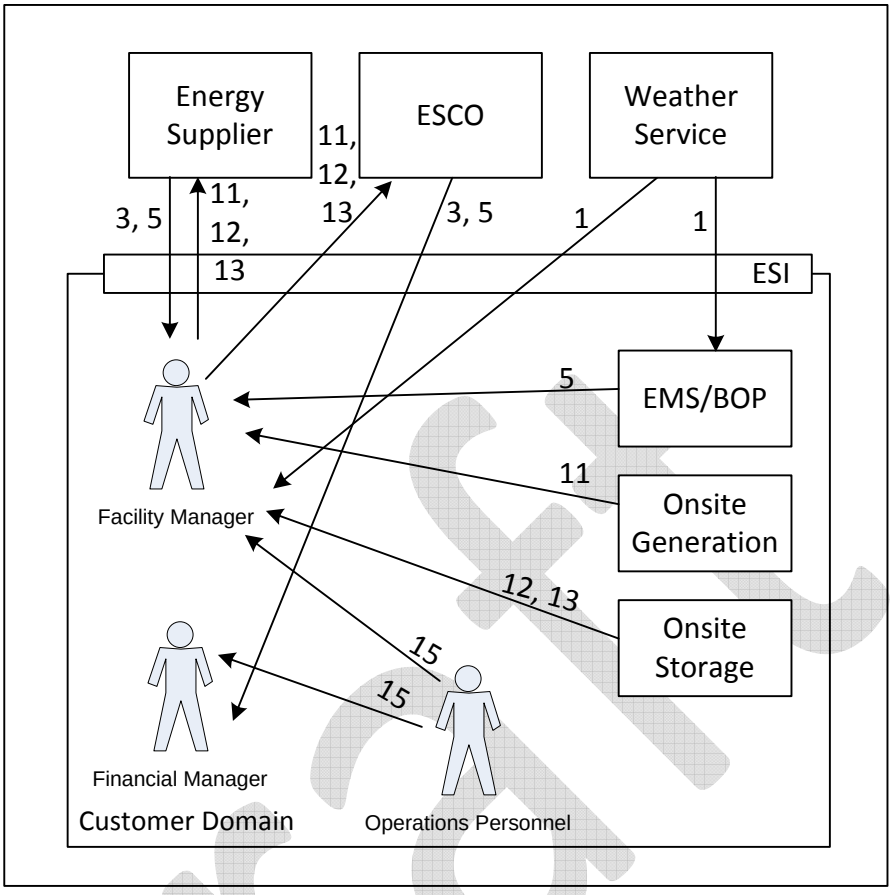


Figure 4.1. Balance Power Purchases between Utility and On-site Generation Use Case Diagram

Draft

UC-5 Balance Power Purchases between Multiple Utilities

Use Case Name

Balance power purchases between multiple utilities

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☐ Residential Customer Domain

Function ID

ESI-UC-5

Brief Description

Industrial customer decides how much power to purchase from each energy supplier. These customers select the cheapest or most reliable source.

Related Use Cases

See use case 4 and 6.

Narrative

Overview: This use case covers a scenario where the customer has multiple energy suppliers. The customer constantly monitors grid provided energy pricing and quality from all suppliers. This information is coupled with the on-site energy demand forecast (which requires the production schedule and weather forecast data) in order to decide how much energy to purchase from each supplier. The amount of power demanded from each supplier will fluctuate as the input variables change.

1. **Facility Manager determines available capacity from each utility supplier and the price points in time.** Capacity and price is based on several factors, including the following.
    a. Energy cost per supplier
    b. Production rate and projection
    c. Stock piles
    d. Orders
    e. Regulatory mandates
    f. Real-time electrical energy pricing considerations

Draft

g. Environmental factors such as weather (current conditions and forecast)

2. **The ESCO and Energy Supplier provide pricing rules.** Presently, pricing rules are, in general, embodied in a rate tariff. In the future, it is anticipated that pricing will become much more dynamic. This will require real-time sharing of pricing rules and other data between the energy supplier (industrial customer) and/or ESCO, ISO, local distribution company and the industrial customer through the Energy Services Interface (ESI).

3. **The Financial Manager develops pricing rules.** The financial manager determines the right balance of cost vs reliability from each supplier and sets rules.

4. **Operations personnel control the tie line between the utilities and the customer.** Once the decision is made the operations personnel will have to operate the control system to raise or lower demand from one supplier or the other.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Facility Manager
Energy Services Company (ESCO)
Energy Supplier
Financial Manager

Table 5.1. Balance Power Purchases Between Utilities Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
3	Pricing Rules
15	Forecasted demand

Table 5.2. Balance Power Purchases Between Utilities Use Case Information

Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Facility Manager	15	2,3

Energy Services Company (ESCO)	2,3	
Energy Supplier	2,3	15
Financial Manager		3,15

Table 5.3. Balance Power Purchases Between Utilities Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

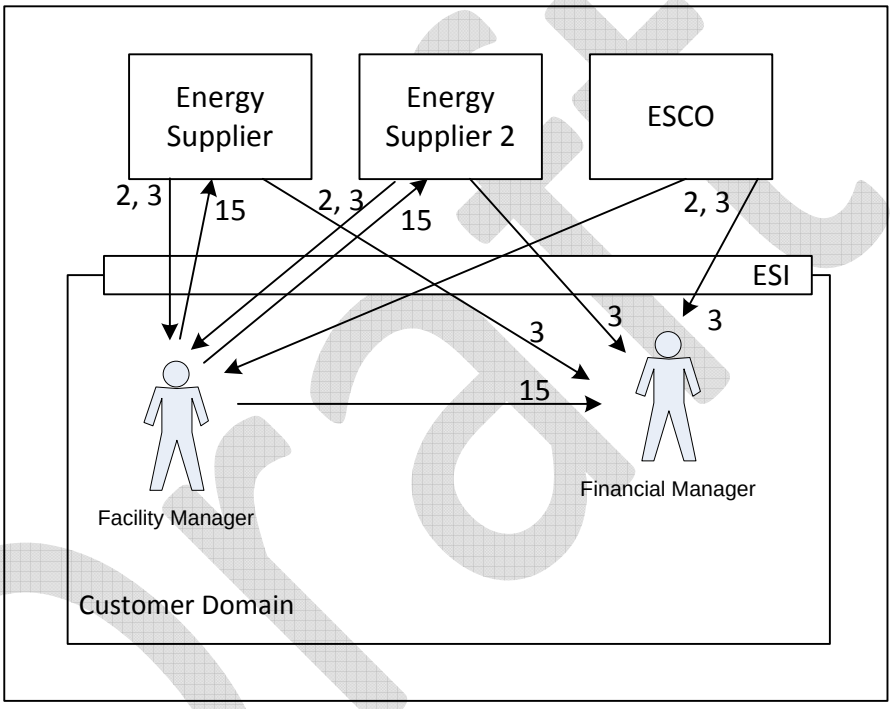


Figure 5.1. Validate Balance Power Purchase Between Utilities Use Case Diagram

Draft

UC-6 Buy or Sell Electric Power

Use Case Name

Buy or Sell Electric Power

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

ESI-UC-6

Brief Description

In this use case, the customer monitors the price of electrical power ($/kWh) hourly on the "grid". The price is based on a number of factors, available generation (supply), weather, current load and location. Operations personnel monitor their "available capacity", cost of generation, and the "price" on the grid. The independent system operator (ISO) provides pricing rules against which the economic impacts of actions taken are measured.

It can be deployed by:

- Cost of generation,
- Capacity restraint,
- Contractual obligation.

With the pricing rules defined in the purchase contract or rate tariff.

Related Use Cases

Not Applicable

Background

Facilities with on site electric power sources include paper mills, steel mills, tire and rubber manufactures, automotive plants and chemical companies, commercial and residential facilities with solar, wind or other alternative power systems. These facilities may have excess steam, waste heat, and solar arrays, wind turbines, etc. utilized for power production. Examples include:

- Boilers with steam turbine generators to reduce steam pressure rather than a throttling valve.

Draft

- Cogeneration plants with combustion turbines or reciprocating engines producing electricity and steam thorough a Heat Recovery Steam Generator (HRSG)

Due to reduced production demand, many industrial facilities are running at less than rated capacity.

Facilities with emergency stand by generation include municipal water and waste water facilities, chemical, semi conductor and pharmaceutical manufacturers, hospitals, data centers and educational facilities.

An Independent System Operator (ISO) is an organization formed at the direction or recommendation of the Federal Energy Regulatory Commission (FERC). An ISO coordinates, controls and monitors the operation of the electrical power system, usually within a single US State, but sometimes encompassing multiple states.

Similar to an ISO is a Regional Transmission Operator (RTO), the primary difference being that generally an RTO coordinates, controls and monitors the operation of the electric power transmission system over a wider area that crosses state borders.

Some ISO's and RTO's also act as a marketplace in wholesale power. Most are set up as nonprofit corporations using governance models developed by FERC.

FERC Orders 888 and 889 define how Independent Power Producers (IPP's) and power marketers would be allowed fair access to transmission systems, and mandated the implementation of the Open Access Same-Time Information System (OASIS) to facilitate the fair handling of transactions between electric power transmission suppliers and their customers.

Narrative

In this use case, the customer monitors the price of electrical power ($/kWh) hourly on the grid. The price is based on a number of factors, available generation (supply), weather, current load and location. Operations personnel monitor the available capacity, cost of generation (bus bar cost) and the price on the grid. The independent system operator (ISO) provides pricing rules against which the economic impacts of actions taken are measured.

1. **Facility Manager determines available capacity and price point.** Capacity and price is based on several factors, including the following.
    a. Energy cost of production (bus bar cost)
    b. Production rate and projection
    c. Generation equipment status
    d. Stock piles
    e. Orders

Draft

f. Regulatory mandates

g. Real-time electrical energy pricing considerations

h. Environmental factors such as weather (current conditions and forecast)

i. Local codes: ASHRAE 62.1 ventilation requirements, ASHRAE 55 Thermal comfort requirements, ASHRAE 90.1 energy requirements

2. **The ISO and local distribution company, provide pricing rules.** Presently, pricing rules are, in general, embodied in a rate tariff. In the future, it is anticipated that pricing will become much more dynamic. This will require real-time sharing of pricing rules and other data between the energy supplier (customer) and/or ESCO, ISO, local distribution company and the customer through the Energy Services Interface (ESI).

3. **Weather Prediction Information is Determined.** The predicted weather for the interval being estimated is provided to the Facility Manager by Weather Service either directly, or via the EMS or EIP.

4. **The Financial Manager develops pricing rules to aid in establishing the cost of generation (bus bar price) and sell targets.** The financial manager develops a make, buy or sell electrical energy decisions to maximize profits. The pricing rules help determine the characteristics of the generation system operation.

5. **Operations personnel control the tie line between the utility and the industrial customer.** Many factors enter into the determination of a make buy or sell decision. Once the decision is made the operations personnel will have to operate the control system to raise or lower generation for the optimum financial set point. The following factors are typical.

a. Production schedules, customer delivery commitments, staffing schedules, shift differential and overtime considerations

b. Relationship of individual loads to core production processes

c. Flexibility of scheduling equipment and production operations

d. Cycle time constraints of individual loads (e.g. Chillers, heat treating, metal melting and compressors)

e. Cycle time constraints of generation equipment

f. Interdependencies of individual loads and generators

g. Automatic restarting characteristics of generators

h. Personnel safety and comfort impact

i. State change interval, e.g. response time of system to a request

j. Environmental factors such as weather

k. Local codes: ASHRAE 62.1 ventilation requirements, ASHRAE 55 Thermal comfort requirements, ASHRAE 90.1 energy requirements

Draft

6. **The Balance of Plant (BOP) control system manages this tie line requirement.** BOP systems range from manual to fully automated systems; however, the basic control equation remains the same: control generation so that purchased or sold kWh meets the tie line target. The BOP control system needs to know the net kilowatt-hours at the point of interconnection between the Industrial and the utility (tie line). This may be provided by energy supplier metering, the customer's metering equipment, or by the BOP system itself. The BOP compares the predicted kWh to the established target. If generation needs to be increased or decreased, the BOP selects from the prioritized list of generators and issues a speed up or slow down command.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Facility Manager
Energy Services Company (ESCO)
Independent System Operator (ISO)
Energy Supplier
Financial Manager
Balance of Plant Control (BOP) System
Operations Personnel
Facility Loads
Weather Forecast Service

Table 6.1. Buy or Sell Electric Power Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
1	Weather data
3	Pricing Rules
5	Instantaneous Aggregated Energy Usage
9	State Change Interval

Draft

21	Instantaneous Energy Usage for Generation
22	Available Generation
23	Actual Generation
24	Peak Generation
25	Generators
26	Predicted End-of-Interval Demand

834 Table 6.2. Buy or Sell Electric Power Information Exchanged

835 ***Information Transactions***

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Operations Personnel	1,7,8	1,7,8
Facility Manager	7,8,9	1,3,6,10
Energy Services Company (ESCO/Aggregator)	1,3,5,10	1,9
Energy Supplier	3,5,10	1,9
Financial manager		3,10
BOP System (auto or manual)	6,7,8,9,A	1,3,5,6,7,8,9,A,10
Environmental manager		
Weather Forecast Service	1	
Operations Personnel	1,7,8	1,7,8

836 Table 6.3. Buy or Sell Electric Power Information Transactions

837 ***Use Case Diagram***

838 The following diagram illustrates this use case. An explanation of the format of this
839 diagram can be found in Appendix C.

Draft

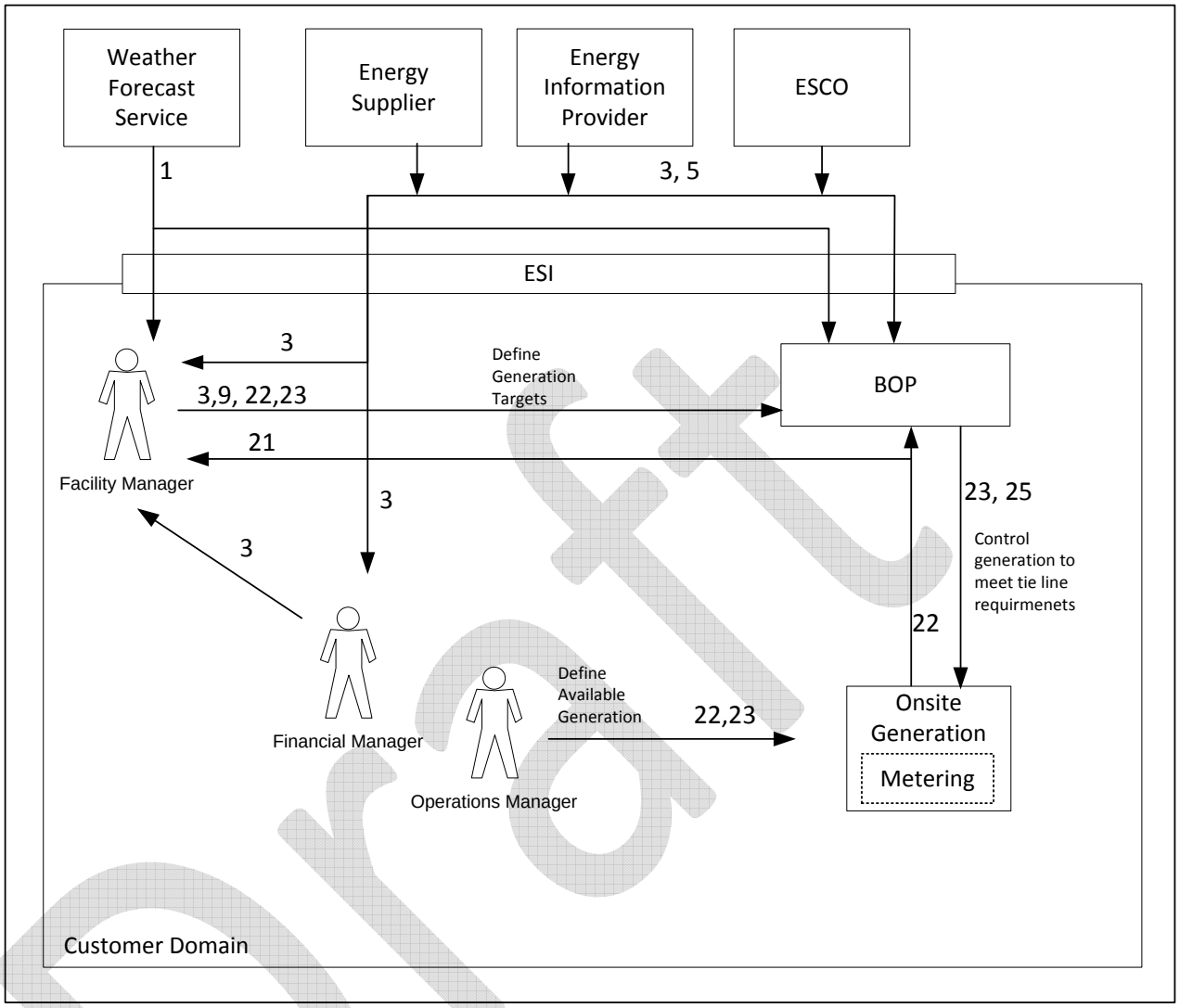


Figure 6.1. Buy or Sell Power Use Case Diagram

Draft

UC-7 Social, Environmental, and Regulatory Aspects of Energy Consumed

Use Case Name

Customer includes social, environmental and regulatory aspects of energy consumed into the business model.

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-7

Brief Description

A customer would like to include the social, environmental, and regulatory aspects of energy consumed in their existing business models in order to track, communicate, and/or better control these aspects.

Related Use Cases

Not Applicable

Narrative

1. **External Environmental, Social, and Regulatory Energy Related Information is Gathered and Shared.** Information on external environmental, social, and regulatory energy usage of the premise is gathered and distributed. This information is produced by the Energy Services Company, the Energy Information Provider, and/of the Energy Supplier. The information is distributed to the following recipient:
    a. The Environmental Manager.
2. **Internal Environmental, Social, and Regulatory Energy Related Information is Gathered and Shared.** Information on environmental, social, and regulatory energy usage of the premise is gathered from the energy related equipment onsite. This equipment includes; Generation Capabilities, Energy Storage, and Thermal Storage. The information is distributed to the following recipient:
    a. Facilities Manager.

Draft

3. **Internal Environmental, Social, and Regulatory Energy Related Information is Compiled and Shared.** Information on internal environmental, social, and regulatory energy usage of the premise is compiled by the Facilities Manager. The information is distributed to the following recipient:

   a. The Environmental Manager.

4. **Distribution of Environmental, Social, and Regulatory Energy Related Information is compiled and used for the premise owner.** The data provided externally or internally to the Environmental Manager is compiled and used in best way for premise owner business model.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Facility Manager
Energy Services Company (ESCO)
Energy Information Provider
Energy Supplier
Environmental Manager

Table 7.1. Social, Environmental, and Regulatory Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
4	Energy Attributes
11	Onsite Generation Capabilities
12	Onsite Energy Storage
13	Thermal Energy Storage
16	Historical interval demand and power quality data

Table 7.2. Environmental, Social, and Regulatory Use Case Information

Information Transactions

Actor	Information	Information

	Supplied (ID #)	Consumed (ID #)
Facility Manager	11, 12, 13	
Energy Services Company (ESCO)	4, 16	
Energy Information Provider	4,16	
Energy Supplier	4, 16	
Environmental Manager		4, 11, 12, 13, 16

Table 7.3. Environmental, Social, and Regulatory Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

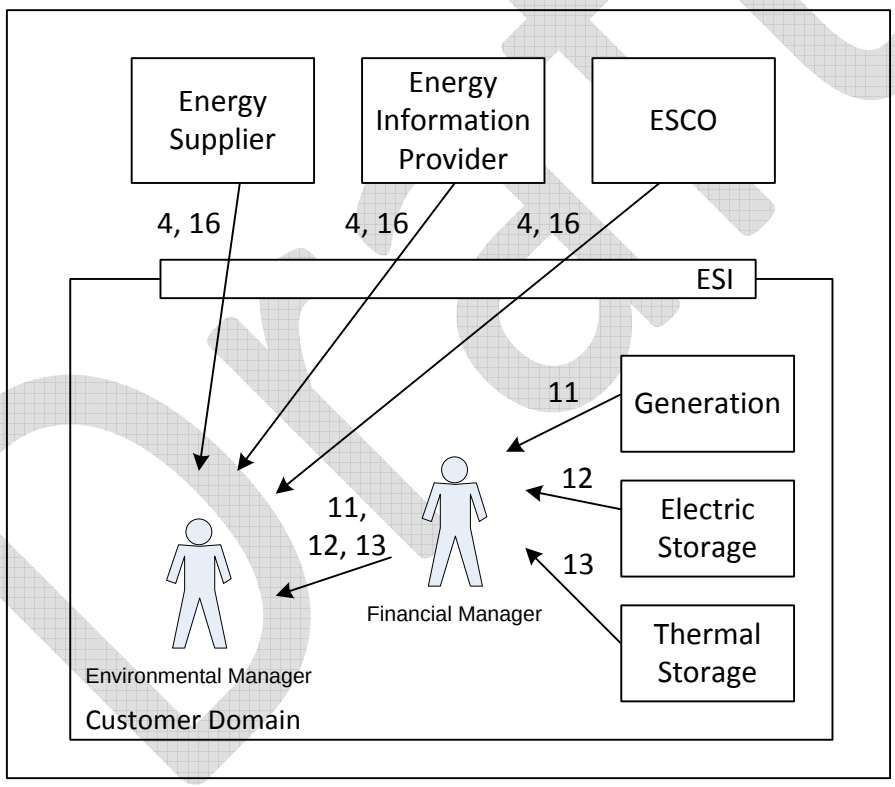


Figure 7.1. Environmental, Social, and Regulatory Use Case Diagram

Draft

UC-8: Measure Plug Load to calculate Cost and Consumption

Use Case Name

Measure Plug Load to calculate Cost and Consumption

Applicability

This use case applies to the following customer domains.

- ☐ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-8

Brief Description

A customer would like to measure the energy usage of devices connected to an outlet or circuit(s) and determine the associated cost of their consumption. The device may be a temporary or permanent intermediary device depending on the type of device used to provide the measurement. The devices which may be used for this purpose may be classified in various categories depending on the electrical load placed upon them:

a. At the outlet level using an energy monitoring device.

b. At the circuit level using a Smart Power Distribution Unit (SPDU) (circuit level)

c. At the Panel Level using a Sub-Meter

Related Use Cases

This use case is similar in scope to EIS-UC-9: Measure Equipment Power to calculate Cost and Consumption.

Narrative

7. **Energy Metering Equipment is installed.** A networked device (an intelligent endpoint) is installed to measure power consumption. There are multiple types of metering devices, the typical case is that of a Smart Power Strip (SPS).

   a. The Facility Manager/End Use Customer installs an SPS to measure energy and calculate energy cost at the device or receptacle level.

   b. The Facility Manager/End Use Customer installs an SPDU at the rack or room level to measure energy and calculate energy cost at the circuit level.

   c. The Facility Manager installs a Sub-Meter to measure energy and calculate energy cost at the building or floor level.

Draft

8. **Energy Consumption Measurements are Made.** The Energy Metering Equipment will monitor and/or track energy usage of its connected load. It will need to know the fixed or time varying price of energy at the time of energy consumption in order to calculate energy costs. The provider of energy cost information can vary:

   The Energy Metering Equipment obtains Customer-specific fixed pricing or RTP data tables from an Energy Services Company, Energy Information Provider, or Energy Supplier through the Energy Services Interface (ESI).

9. **The Energy Metering Equipment calculates (and may track) the Energy Cost of attached load using measured energy consumption and Pricing at the time of consumption.**

   a. If the customer has an Energy Management System (EMS) installed, it may also receive the energy usage data from the Energy Metering Equipment as well as Customer-specific fixed pricing or RTP data tables from an Energy Services Company, Energy Information Provider, or Energy Supplier through the Energy Services Interface (ESI). The EMS may also calculate energy costs for the loads attached to the Energy Metering Devices.

10. **Energy Cost Information may be used in the following manner:**

   a. By the Facilities Manager to provide Facility, Cost Center, Departmental, or Device level cost and usage reporting.

   b. Used by an Energy Services Company to track Facility or Equipment performance and analysis.

   c. Used by an Energy Supplier to determine demand or validate Energy Performance of Devices at contracted service level agreements.

   d. Used by an EMS reporting application.

   e. Displayed on an Intelligent HMI device to display cost and usage in order to encourage energy conservation behaviors.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Actor Name
Facility Manager
Energy Services Company (ESCO)
Energy Information Provider
Energy Supplier
Energy Management System

Draft

Intelligent Sub-Metering Device
Intelligent End Point
Intelligent HMI Energy Device

Table 8.1. Measure Plug Load to calculate Cost and Consumption Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
3	Pricing Rules
6	Instantaneous Energy Demand
17	Energy Cost

Table 8.2. Measure Plug Load to calculate Cost and Consumption Use Case Information

Information Transactions

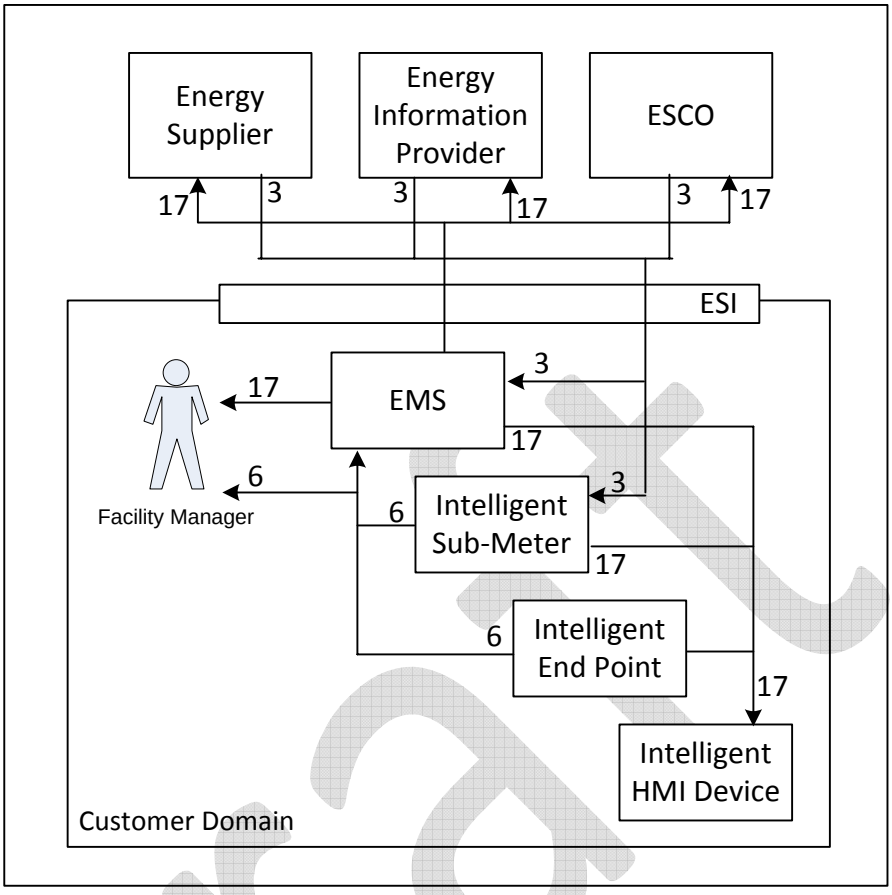
Actor	Information Supplied (ID #)	Information Consumed (ID #)
Facility Manager		6, 17
Energy Services Company (ESCO)	3	17
Energy Information Provider	3	17
Energy Supplier	3	17
Energy Management System	17	3, 6, 17
Intelligent Sub-Metering Device	6, 17	3
Intelligent End Point	6,17	
Intelligent HMI Energy Device		17

Table 8.3. Measure Plug Load to calculate Cost and Consumption Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

Draft



969

970 Figure 8.1. Measure Plug Load to calculate Cost and Consumption Use Case Diagram

971

Draft

UC-9: Measure Equipment Power to calculate Cost and Consumption

Use Case Name

Measure Equipment Power to calculate Cost and Consumption

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-9

Brief Description

The customer would like to measure the energy consumption of a particular electronic device and would like to determine the associated cost of its consumption. The measurement device may be a temporary or permanent intermediary device or it may be capable of measuring its own power consumption. Regardless, both of these types of devices are intelligent endpoints.

a. At the equipment using a electric sub-meter

b. The device of interest has communication capabilities and is capable of measuring its own energy consumption

Related Use Cases

This use case is similar in scope to EIS-UC-8: Measure Plug Load to calculate Cost and Consumption.

Narrative

1. **Energy Metering Equipment is installed.** A networked/non-networked device (an intelligent endpoint) is installed to measure power consumption. The typical case is that of an electric sub-meter.

    a. The Facility Manager installs a sub-meter to measure energy and calculate energy cost at the device.

    b. The Facility Manager configures the device of interest to measure energy consumption.

Draft

2. **Energy Consumption Measurements are Made.** The Energy metering equipment will monitor and/or track energy usage of its connected load. It will need to know the fixed or time varying price of energy at the time of energy consumption in order to calculate energy costs. The provider of energy cost information can vary:

    a. The Energy Metering Equipment obtains Customer-specific fixed pricing or RTP data tables from an Energy Services Company, Energy Information Provider, or Energy Supplier through the Energy Services Interface (ESI).

3. **The Energy Metering Equipment calculates (and may track) the Energy Cost of attached load using measured energy consumption and Pricing at the time of consumption.**

    a. If the customer has an Energy Management System (EMS) installed, it may also receive the energy usage data from the Energy Metering Equipment as well as Customer-specific fixed pricing or RTP data tables from an Energy Services Company, Energy Information Provider, or Energy Supplier through the Energy Services Interface (ESI). The EMS may also calculate energy costs for the loads attached to the Energy Metering Devices.

4. **Energy Cost Information may be used in the following manner:**

    a. By the Facilities Manager to provide Facility, Cost Center, Departmental, or Device level cost and usage reporting.

    b. By an Energy Services Company to track Facility or Equipment performance and analysis.

    c. By an Energy Supplier to determine demand or validate Energy Performance of Devices at contracted service level agreements.

    d. By an EMS reporting application.

    e. Displayed on an Intelligent HMI device to display cost and usage in order to encourage energy conservation behaviors.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Facility Manager
Energy Services Company (ESCO)
Energy Information Provider
Energy Supplier
Energy Management System

Draft

Intelligent Sub-Metering Device
Intelligent End Point
Intelligent HMI Energy Device

Table 9.1. Measure Equipment Power Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
3	Pricing Rules
6	Instantaneous Energy Demand
17	Energy Cost

Table 9.2. Measure Equipment Power Use Case Information

Information Transactions

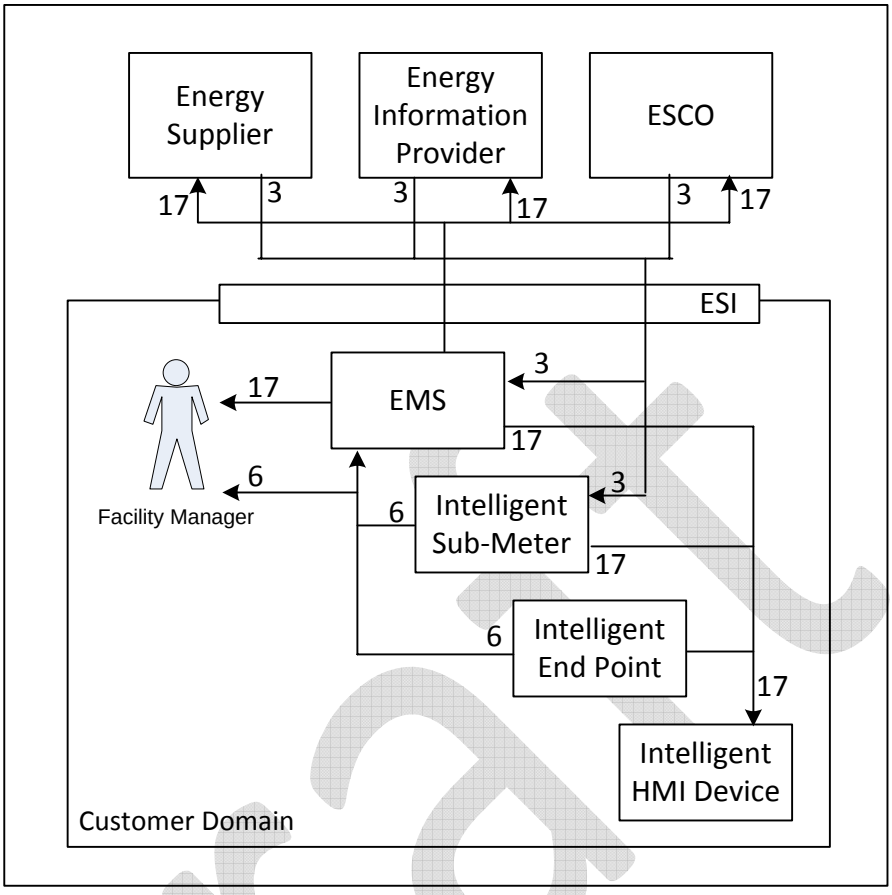
Actor	Information Supplied (ID #)	Information Consumed (ID #)
Facility Manager		6, 17
Energy Services Company (ESCO)	3	17
Energy Information Provider	3	17
Energy Supplier	3	17
Energy Management System	17	3, 6, 17
Intelligent Sub-Metering Device	6, 17	3
Intelligent End Point	6,17	
Intelligent HMI Energy Device		17

Table 9.3. Measure Equipment Power Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

Draft



1043

1044 Figure 9.1. Measure Equipment Power Use Case Diagram

1045

Draft

UC-10: Allocating Energy Costs

Use Case Name

Measure Energy to Allocate Energy Cost

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-10

Brief Description

A customer would like to measure energy cost and consumption in order to allocate energy costs.

Related Use Cases

This use case is similar in scope to EIS-UC-11: Measure Energy Cost, Emissions and Consumption for Display.

Narrative

1. **Energy Metering Equipment is Installed.** The existing Energy Management System (EMS) can be used to measure energy, or metering and sub-metering equipment is installed. The metering is installed in areas that are being allocated costs of the energy that that particular area consumes.
2. **Energy Pricing Rules Are Determined.** The Energy Pricing Rules are needed by the EMS and the Financial Manager to determine energy consumption costs. The Energy Pricing Rules are comprised of customer-specific real-time pricing (RTP) and demand-interval data (demand rules, tariffs, previous high demand, etc.). The source of the Energy Pricing Rules can vary, as follows:
    a. The Energy Supplier provides the Energy Pricing Rules,
    b. The Energy Information Provider provides the Energy Pricing Rules, or
    c. The Energy Services Company (ESCO) provides the Energy Pricing Rules.
3. **The Cost Of Energy Is Determined and Validated.** The Cost Of Energy over a specified time interval is needed by the Facility Manager and Operations Personnel

Draft

for validating the energy bill and to re-allocate energy costs. The source of the Cost Of Energy can vary, as follows:

a. The Energy Services Company (ESCO) provides the total Cost Of Energy.

b. The Energy Supplier provides the total Cost Of Energy.

c. The EMS provides the Cost Of Energy using information from the sub-meters and the energy pricing rules.

4. **Instantaneous Energy Costs are Allocated.** Information on the current instantaneous energy usage of specific metered subloads is distributed. This information is produced by the EMS from its meters and is distributed to the following recipients:

a. The End Use Customers so that they can manage their own energy usage patterns.

b. The Financial Manager for calculating current energy costs by the metered loads.

5. Interval (e.g. monthly) Energy Costs are Allocated. The cost of the energy over a period of time is allocated to particular End Use Customer by the Financial Manager. This allocation can be a bill (e.g. tenant billing), a cost accounting entry (e.g. budget allocation), or an informational report (e.g. monthly energy consumption report).

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
End Use Customer
Facility Manager
Energy Services Company (ESCO)
Energy Information Provider
Energy Supplier
Financial Manager
Energy Management System

Table 10.1. Allocating Energy Costs Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
3	Pricing Rules
6	Instantaneous Energy Demand
17	Energy Cost

Table 10.2. Allocating Energy Costs Use Case Information

Information Transactions

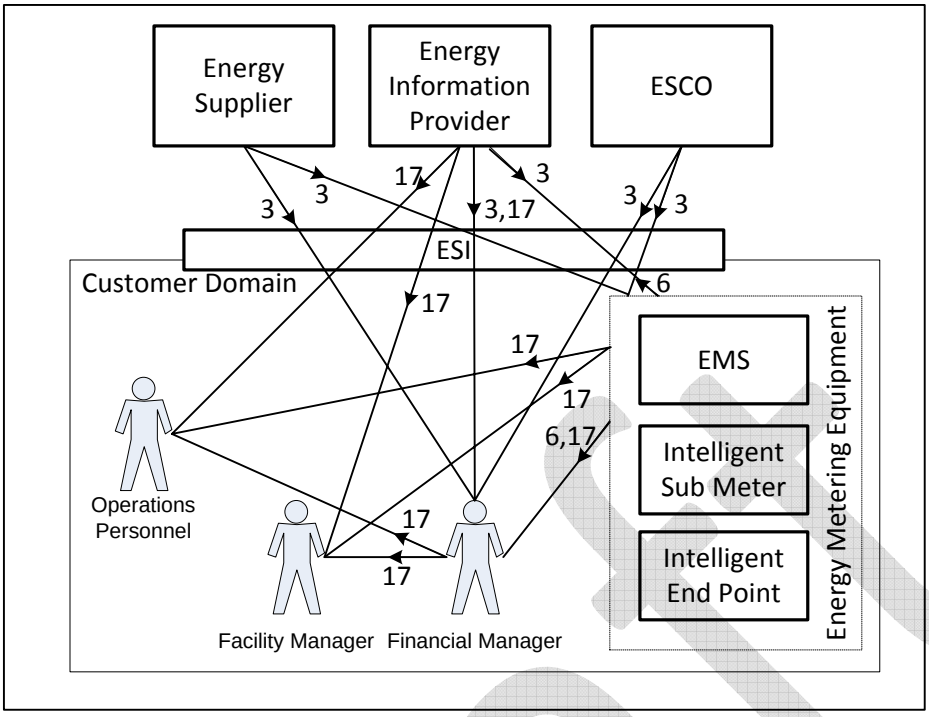
Actor	Information Supplied (ID #)	Information Consumed (ID #)
Operations Personnel		17
Facility Manager		17
Energy Services Company (ESCO)	3	
Energy Information Provider	3, 17	6
Energy Supplier	3	
Financial Manager	17	3, 6, 17
Energy Management System	6, 17	3

Table 10.3. Allocating Energy Costs Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

Draft



1107

1108 Figure 10.1. Allocating Energy Costs Use Case Diagram

1109

Draft

UC-11: Measure Energy Cost, Emissions and Consumption for Display

Use Case Name

Measure Energy Cost, Emissions and Consumption for Display

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-11

Brief Description

A customer would like to track energy cost, emissions and energy consumption in a report or a Human Machine Interface (HMI) display.

Related Use Cases

This use case is similar in scope to EIS-UC-10: Measure Energy to Allocate Energy Cost.

Narrative

1. **Energy Attributes Are Determined.** The Energy Attributes are needed by the EMS and/or Financial Manager the greenhouse gas content of the energy being consumed. It is anticipated that this information may change in near real-time depending upon the mix of fuel sources used to create the energy being consumed. It is also anticipated that some customers may get energy from multiple sources. The source of the Energy Attributes can vary, as follows:
    a. The Energy Supplier provides its Energy Attributes,
    b. An Energy Information Provider provides the Energy Attributes of all of the Energy Suppliers of a customer, or
    c. The Energy Services Company (ESCO) provides the Energy Attributes of the energy it is managing.
2. **Energy Pricing Rules Are Determined.** The Energy Pricing Rules are needed by the EMS and/or Financial Manager for determining the cost of the energy being consumed. The source of the Energy Pricing Rules can vary, as follows:
    a. The Energy Supplier provides the Energy Pricing Rules,

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b. The Energy Information Provider provides the Energy Pricing Rules, or

c. The Energy Services Company (ESCO) provides the Energy Pricing Rules.

3. **Energy emissions are calculated.** The consumption, pricing rules, and energy attributes are used to calculate the energy emissions. This information can be sent to:

a. An Intelligent HMI display for viewing.

b. An Energy Information Provider for benchmarking (e.g. Energy Start Rating) or regulatory reasons (e.g. Carbon Trading).

4. **Energy Cost and Energy Attributes are Shared.** This information may be provided by the Financial Manager, Energy Information Provider or the EMS to the Intelligent HMI Energy Device for display.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Energy Services Company (ESCO)
Energy Information Provider
Energy Supplier
Financial Manager
Energy Management System
Intelligent HMI Energy Device

Table 11.1. Measure Energy Cost, Emissions and Consumption for Display Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
3	Pricing Rules
4	Energy Emissions
6	Instantaneous Energy Demand

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17	Energy Cost
18	Energy Attributes

Table 11.2. Measure Energy Cost, Emissions and Consumption for Display Use Case Information

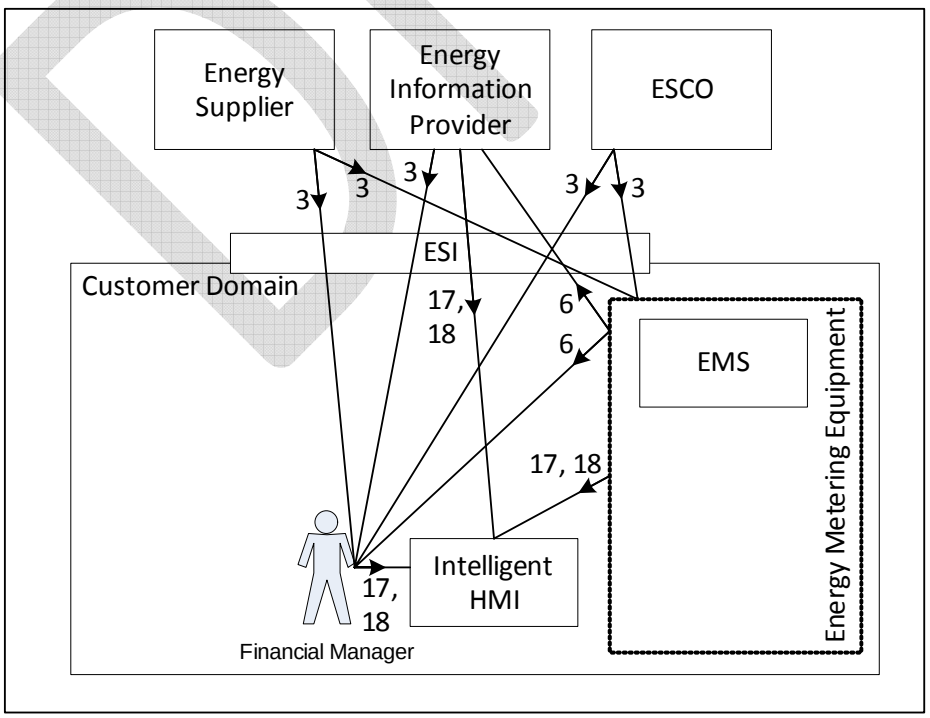
Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Energy Services Company (ESCO)	3, 4	
Energy Information Provider	3, 4, 17, 18	6
Energy Supplier	3, 4	
Financial Manager	17, 18	3, 6
Energy Management System	6, 17, 18	4,3
Intelligent HMI Energy Device		4,17, 18

Table 11.3. Measure Energy Cost, Emissions and Consumption for Display Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.



1169 Figure 11.1. Measure Energy Cost, Emissions and Consumption for Display Use Case
1170 Diagram

1171

Draft

UC-12: Measuring energy cost, emissions, and consumption to compare against building portfolio for benchmarking purposes

Use Case Name

Measure energy cost, emissions, and consumption to compare against building portfolio for benchmarking purposes.

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-12

Brief Description

The Industrial or Commercial customer would like to compare his/her energy profile (watts/ft^2) against other individually metered buildings in his enterprise. It should be noted that in the case of the Industrial customer, this may be a "production site" rather than a physical building, as in the case of petroleum refineries, cement producers, etc. However, for this use case scenario the term "building" will be used to cover all scenarios.

In the Residential market, this benchmarking may be used by the National Association of Home Builders with respect to programs such as Energy Star for Homes, LEED for Homes and LEED for Neighborhood Development.

Related Use Cases

This use case is similar in scope to EIS-UC-13: Measure energy cost, emissions and consumption to compare against similar buildings for benchmarking purposes.

Narrative

1. **Energy Metering Equipment is Installed.** The existing Energy Management System (EMS) can be used to measure energy, or metering and sub-metering equipment is installed.

2. **Energy Pricing Rules Are Determined.** The Energy Pricing Rules are needed by the EMS for selecting pre-set operational strategies and the Financial Manager for monitoring costs. The Energy Pricing Rules are comprised of customer-specific real-time pricing (RTP) and demand-interval data (demand rules, tariffs, previous high demand, etc.). The source of the Energy Pricing Rules can vary, as follows:

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a. The Energy Supplier provides the Energy Pricing Rules,

b. The Energy Information Provider provides the Energy Pricing Rules, or

c. The Energy Services Company (ESCO) provides the Energy Pricing Rules.

3. **The Cost Of Energy Is Determined.** The Cost Of Energy over a specified time interval is needed by the Facility Manager and Operations Personnel for determining additional strategies to re-allocate energy costs. The source of the Cost Of Energy can vary, as follows:

a. The Energy Information Provider provides the Cost Of Energy,

b. The Financial Manager provides the Cost Of Energy, or,

c. The EMS provides the Cost Of Energy.

4. **Information on Aggregated Demand is Shared.** Information on the aggregated energy usage of the building is distributed. This information is produced by the EMS from its meters and intelligent end points, is distributed to the following recipients:

a. The Energy Information Provider *(This is a new actor from the perspective of consuming the information. It is not only a provider, but consumes this information, as well)*, and

b. The Financial Manager.

5. **The Use of Energy is Normalized.** Benchmarking of building energy performance requires the use of normalized data to compensate for regional differences with respect to weather and climate. Additional normalization may occur such that buildings of a similar type and mission are compared. The energy consumption of a high rise office building would be very different from the energy used in a production facility. This information is produced by the Energy Information Provider and is distributed to the following recipients:

a. The Energy Management System, and

b. The Financial Manager.

6. **The Aggregated Energy Usage Information is Shared.** The energy usage information (Energy Cost per unit of time, Energy Attributes per kW) for buildings participating in the benchmarking is shared, for comparison purposes. This Information is provided by the Energy Information Provider or by the Energy Management System, and is distributed to the following recipients:

a. The Facility Manager, and

b. The Financial Manager.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Draft

Name
Facility Manager
Energy Services Company (ESCO)
Energy Information Provider
Energy Supplier
Financial Manager
Energy Management System

Table 12.1. Measure energy cost, emissions, and consumption to compare against building portfolio for benchmarking purposes Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
1	Weather
3	Pricing Rules
4	Energy Attributes
5	Instantaneous Energy Use, Aggregated
6	Instantaneous Energy Demand
16	Historical interval demand and power quality data
17	Energy Cost
18	Energy Attributes per kW

Table 12.2. Measure energy cost, emissions, and consumption to compare against building portfolio for benchmarking purposes Use Case Information

Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Facility Manager		1,3,4,5,16,17,18
Energy Services Company (ESCO)	3,4	
Energy Information Provider	1,3,4,5,16,17,18	
Energy Supplier	3,4	

Draft

Financial Manager		1,3,5,16,17,18
Energy Management System	1,5,16,17,18	3,4

Table 12.3. Measure energy cost, emissions, and consumption to compare against building portfolio for benchmarking purposes Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

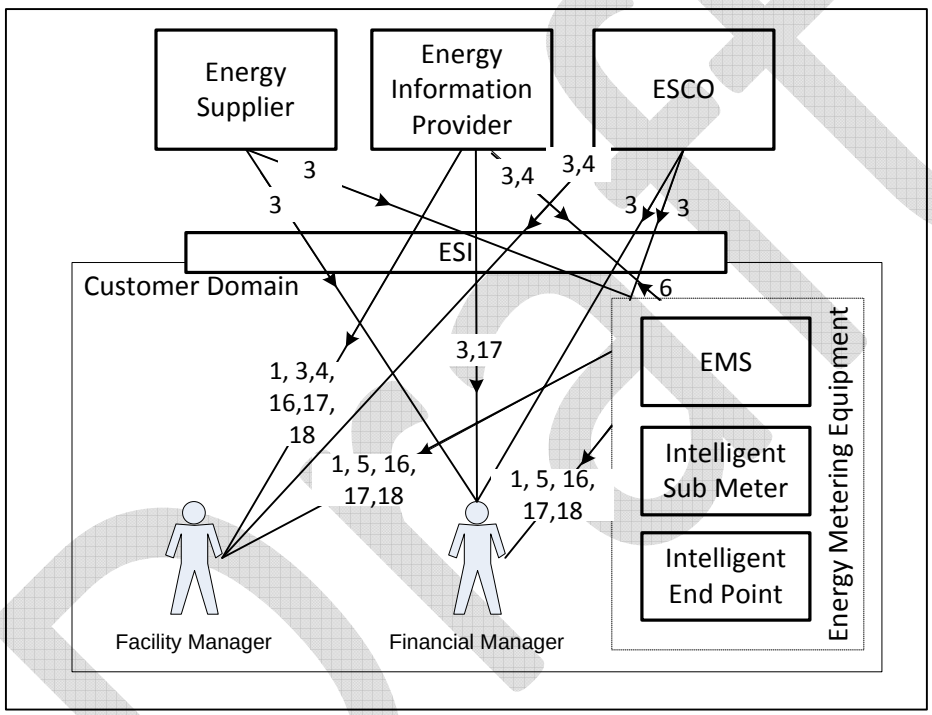


Figure 12.1. Measure energy cost, emissions, and consumption to compare against building portfolio for benchmarking purposes Use Case Diagram

UC-13: Measuring energy cost, emissions and consumption to compare against similar buildings for benchmarking purposes.

Use Case Name

Measure energy cost, emissions and consumption to compare against similar buildings for benchmarking purposes.

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-13

Brief Description

The customer would like to compare his/her energy profile (watts/ft^2) against other individually metered buildings external to his enterprise. It should be noted that in the case of the Industrial customer, this may be a "production site" rather than a physical building, as in the case of petroleum refineries, cement producers, etc. However, for this use case scenario the term "building" will be used to cover all scenarios.

In the Residential market, this benchmarking may be used by the National Association of Home Builders with respect to programs such as - Energy Star for Homes, LEED for Homes and LEED for Neighborhood Development. In the commercial (and industrial?) market, this benchmarking data may come from sources such as the Commercial Buildings Energy Consumption Survey (CBECS) or, eventually ASHRAE's Building Energy Labeling (ABEL) program.

Related Use Cases

This use case builds on UC12: Measure energy cost, emissions, and consumption to compare against building portfolio for benchmarking purposes.

Narrative

1. **Building Energy Consumption is Determined.** An Energy Information Provider receives interval (e.g. monthly) energy consumption and attribute information for the building being benchmarked from outside the Customer Domain. It may come from the Energy Provider back-office systems (e.g. OpenADE), directly from the Energy Provider's smart meter, or from an Energy Services Company (Aggregator).

Draft

2. **The Use of Energy is Normalized.** Benchmarking of building energy performance requires the use of normalized data to compensate for regional differences with respect to weather and climate. Additional normalization may occur such that buildings of a similar type and mission are compared. The energy consumption of a high rise office building would be very different from the energy used in a production facility. This Building Energy Report is produced by the Energy Information Provider and is distributed to the following recipients:

   a. The Energy Management System, and

   b. The Facility Manager, and

   c. The Intelligent HMI Energy Device, and (this makes the assumption that this does not depend on information from the EMS but, that it is a direct recipient of the information. Think of a Residential touch screen interface)

   d. The Financial Manager.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Facility Manager
Energy Information Provider
Financial Manager
Energy Management System
Intelligent HMI Energy Device

Table 13.1. Measure energy cost, emissions and consumption to compare against similar buildings for benchmarking purposes Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

Draft

ID	Name
19	Building Report – Common Data

Table 13.2. Measure energy cost, emissions and consumption to compare against similar buildings for benchmarking purposes Use Case Information

Information Transactions

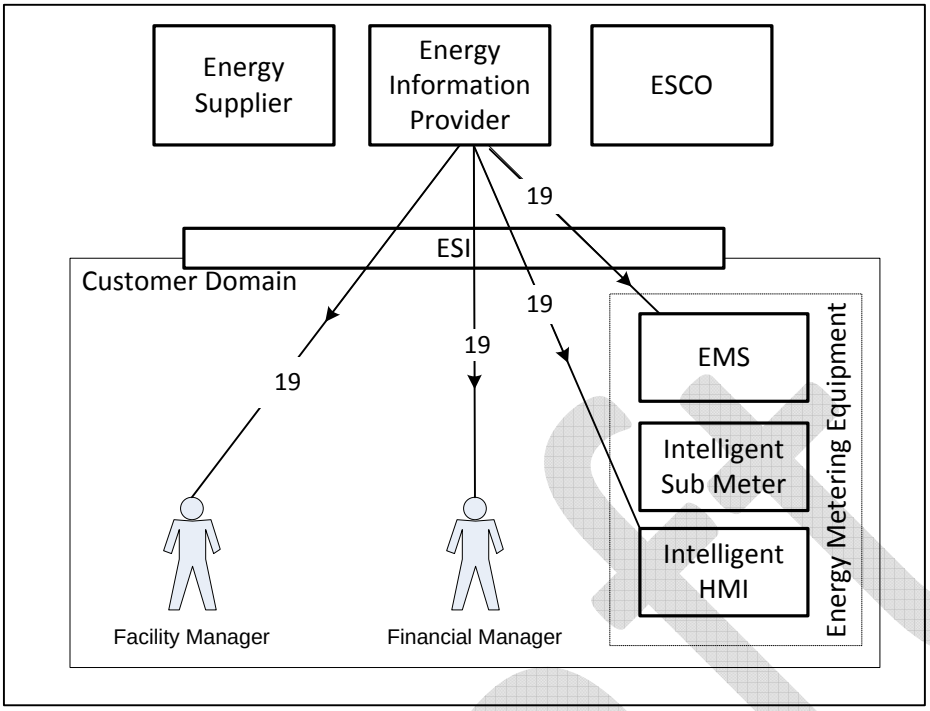
Actor	Information Supplied (ID #)	Information Consumed (ID #)
Facility Manager		19
Energy Information Provider	19	
Financial Manager		19
Energy Management System		19
Intelligent HMI Energy Device		19

Table 13.3. Measure energy cost, emissions and consumption to compare against similar buildings for benchmarking purposes Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

Draft



1317

1318 Figure 13.1. Measure energy cost, emissions and consumption to compare against similar
1319 buildings for benchmarking purposes

1320

Draft

UC-14: Validate Energy Consumption

Use Case Name

Measure Energy to validate Energy Consumption

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-14

Brief Description

A customer would like to perform measurement and verification (M&V) of an energy efficiency upgrade, in a time of use pricing or demand response environment, using temporary measurement equipment.

Related Use Cases

Not Applicable

Narrative

1. **Equipment Upgrade is Contracted.** There are three variants in this step depending upon who is paying for the upgrade.
    a. The Facility Manager contracts with an ESCO to replace one or more pieces of equipment. The contract requires guaranteed energy cost savings.
    b. The Facility Manager contracts with an ESCO to replace one or more pieces of equipment. The ESCO and Facility Manager shares any energy cost savings.
    c. The Facility Manager contracts with an ESCO to replace one or more pieces of equipment. The Energy Supplier requires validated energy reduction to provide energy efficiency incentive.
2. **Energy Metering Equipment is Installed.** Depending upon the equipment being upgraded, the Energy Management System or even the equipment being upgraded can be used to meter energy. The typical case is that temporary metering equipment is installed.
    a. The ESCO installs a temporary Intelligent Sub-Metering Device to measure energy and calculate energy cost.

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b. The ESCO uses a pre-installed Intelligent End Point (IEP) to measure energy and calculate energy cost.

c. The ESCO uses a pre-installed Energy Management System (EMS) to measure energy and calculate energy cost.

3. **Baseline Measurements are Made.** The Energy metering equipment needs to know the time varying price of energy and the demand intervals in order to calculate energy cost savings. Who provides this information is provided can vary.

a. The Energy Metering equipment obtains Customer-specific RTP data tables and demand interval data from an Energy Information Provider through the Energy Services Interface (ESI).

b. The Energy Metering equipment obtains Customer-specific RTP data tables and demand interval data from an Energy Aggregator through the Energy Services Interface (ESI).

c. The Energy Metering equipment obtains Customer-specific RTP data tables and demand interval data from the retail Energy Supplier through the Energy Services Interface (ESI).

4. **Energy Metering Equipment Provides Baseline Energy Consumption to Validate Energy Efficiency Incentives.** This information may go to one or more actors depending upon who is doing the energy accounting.

a. The Energy Metering Equipment provides baseline energy consumption to the Energy Information Provider through the Energy Services Interface (ESI).

b. The Energy Metering Equipment provides baseline energy consumption to the Energy Aggregator through the Energy Services Interface (ESI).

c. The Energy Metering Equipment provides baseline energy consumption to the retail Energy Supplier through the Energy Services Interface (ESI).

5. **Energy Metering Equipment Provides Baseline Energy Consumption and Cost for Contract Fulfillment.** This information may go one or more actors depending upon who is doing the cost accounting.

a. The Energy Metering Equipment Provides Baseline Energy Consumption and Cost to the Facility Manager.

b. The Energy Metering Equipment Provides Baseline Energy Consumption and Cost to an Intelligent Human Machine Interface (HMI) device.

c. The Energy Metering Equipment Provides Baseline Energy Consumption and Cost to the Financial Manager.

6. **Equipment is Upgraded.** After the baseline is captured, the upgrade is installed.

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7. **Post-Upgrade Measurements are Made.** The Energy metering equipment needs to know the time varying price of energy and the demand intervals in order to calculate energy cost savings. Who provides this information is provided can vary.

   a. The Energy Metering equipment obtains Customer-specific RTP data tables and demand interval data from an Energy Information Provider through the Energy Services Interface (ESI).

   b. The Energy Metering equipment obtains Customer-specific RTP data tables and demand interval data from an Energy Aggregator through the Energy Services Interface (ESI).

   c. The Energy Metering equipment obtains Customer-specific RTP data tables and demand interval data from a retail Energy Supplier through the Energy Services Interface (ESI).

8. **Energy Metering Equipment Provides Post-Upgrade Energy Consumption for Energy Efficiency Incentives.** This information may go to one or more actors depending upon who is doing the energy accounting.

   a. The Energy Metering Equipment provides post-upgrade energy consumption to the Energy Information Provider through the Energy Services Interface (ESI).

   b. The Energy Metering Equipment provides post-upgrade energy consumption to the Energy Aggregator through the Energy Services Interface (ESI).

   c. The Energy Metering Equipment provides post-upgrade energy consumption to the retail Energy Supplier through the Energy Services Interface (ESI).

9. **Energy Metering Equipment Provides Post-Upgrade Energy Consumption and Cost for Contract Fulfillment.** This information may go one or more actors depending upon who is doing the cost accounting.

   a. The Energy Metering Equipment Provides post-upgrade Energy Consumption and Cost to the Facility Manager.

   b. The Energy Metering Equipment Provides post-upgrade Energy Consumption and Cost to an Intelligent Human Machine Interface (HMI) device.

   c. The Energy Metering Equipment Provides post-upgrade Energy Consumption and Cost to the Financial Manager.

10. **Settlement**. With the pre and post upgrade energy consumption and costs, the savings can be calculated. The actors depend upon how the contact was created.

    a. The Facility Manager and ESCO agree on energy cost savings by comparing baseline to post-upgrade energy costs.

    b. The Facility Manager and Energy Supplier (Operations) agree on energy reduction by comparing baseline to post-upgrade energy consumption. Utility Operations authorizes energy efficiency incentive.

Draft

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Facility Manager
Energy Services Company (ESCO)
Energy Information Provider
Energy Supplier
Financial Manager
Energy Management System
Intelligent Sub-Metering Device
Intelligent End Point
Intelligent HMI Energy Device

Table 14.1. Validate Energy Consumption Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
3	Pricing Rules
6	Instantaneous Energy Demand
16	Interval Energy Demand
17	Energy Cost

Table 14.2. Validate Energy Consumption Use Case Information

Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)

Draft

Facility Manager		6, 17
Energy Services Company (ESCO)	3	16
Energy Information Provider	3	16
Energy Supplier	3	16
Financial Manager		16, 17
Energy Management System	16, 17	3, 6, 16, 17
Intelligent Sub-Metering Device	6, 16, 17	3
Intelligent End Point		3
Intelligent HMI Energy Device		16, 17

Table 14.3. Validate Energy Consumption Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

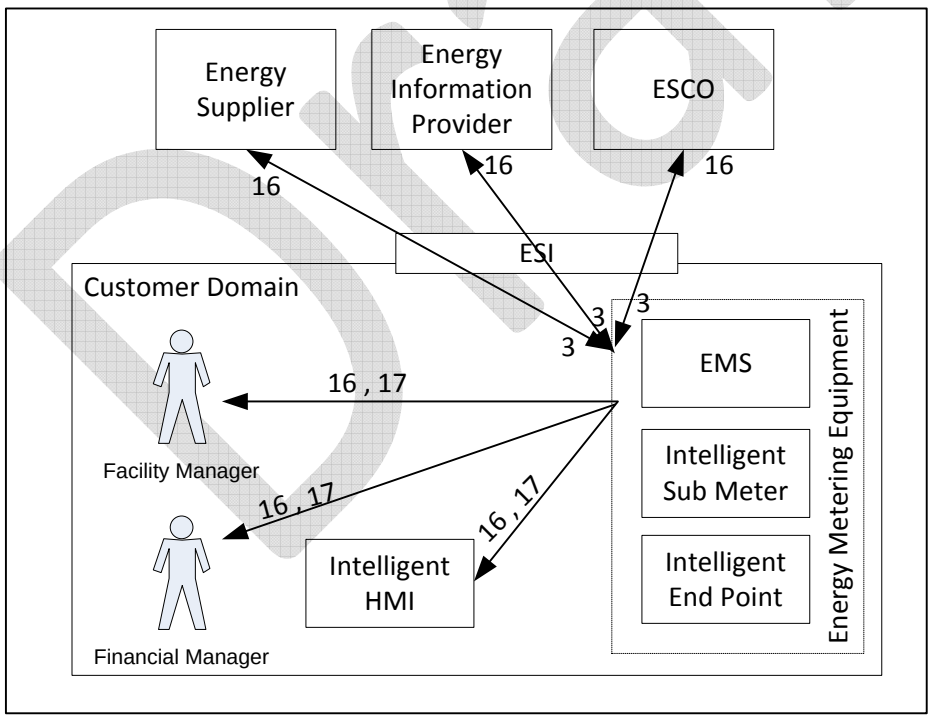

Figure 14.1. Validate Energy Consumption Use Case Diagram

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UC-15: Communicate Generation for Grid Maintenance and Planning

Use Case Name

Communicate Generation Status for Grid Maintenance and Planning

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-15

Brief Description

The Service Provider needs to understand status of any customer internal Distributed Generation Resources prior to performing distribution system maintenance. This information is also valuable for system planning, for example when the Energy Service Provider is considering upgrades to the customer's distribution infrastructure.

Related Use Cases

Not Applicable

Narrative

Overview: This use case covers grid maintenance in the presence of customer on-site generation (and storage) capacity. The utility wants to know the generation status now and in the near future to ensure employee safety while performing grid maintenance. Though on-site energy generation must be disconnected from the grid when no energy is detected (entering from the grid), it may be useful for utility or service provider employees to have information about the on-site capabilities to ensure employees remain safe while performing system maintenance. It is also useful for customers to know about grid maintenance in advance to ensure they have enough on-site energy to meet planned production needs. With respect to utility employee safety, this information is not a fail-safe method for identifying on-site generation—but it can provide utilities with additional insight.

1. **Energy generation or storage equipment is on the customer premise.** There are a number of ways a customer can provide on-site energy generation/storage. They may deploy fuel powered gen sets, motor generators, renewable generation or

batteries (to list a few). These resources may operate autonomously or in conjunction with grid power. It's up to the customer to balance load and generation sources.

2. **Energy Management System provides a summary of on-site generation capacity and status.** This information may go to one or more actors depending upon who is performing grid maintenance.

   a. The Energy Management System collects on-site generation capacity and status information from the distributed generation equipment (intelligent end devices), automated maintenance management systems, or Operations/Facilities input in order to summarize the capabilities and status for the ESCO and the Energy Supplier.

3. **The ESCO or Energy Supplier acknowledges receipt of on-site generation status message.** The utility confirms that it has knowledge of the customer's on-site generation capability and status.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Energy Services Company (ESCO)
Energy Supplier
Energy Management System
Intelligent End Point

Table 15.1. Communicate Generation Status for Grid Maintenance Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
11	Onsite generation capabilities (and availability--spinning and non-spinning reserves)
12	Onsite energy storage (and availability)

Table 15.2. Communicate Generation Status for Grid Maintenance Use Case Information

Draft

Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Energy Services Company (ESCO)		11,12
Energy Supplier		11,12
Energy Management System	11,12	
Intelligent End Point	11,12	

Table 15.3. Communicate Generation Status for Grid Maintenance

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

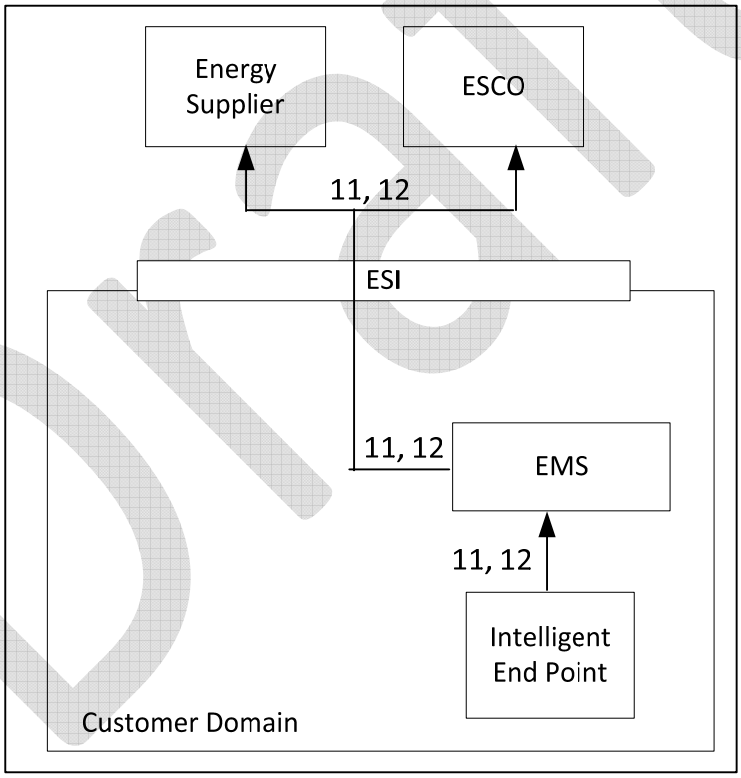

Figure 15.1. Communicate Generation Status for Grid Maintenance Use Case Diagram

Draft

UC-16: Receive Grid Maintenance Planning Information

Use Case Name

Receive Grid Maintenance Planning Information

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-16

Related Use Cases

Not Applicable

Brief Description

A customer would like receive grid maintenance planning information from the utility to enable effective planning and cooperation. With advanced knowledge of scheduled disruptions, or scheduled maintenance which may change the delivered power quality attributes, a customer may schedule production or other activities differently.

Narrative

Overview: This use case covers the communication by the utility to the customer of planned maintenance events which will or could result in outages or lower power quality being received by the customer. Both outages and power quality degradation can negatively impact various operational processes to reduce production quality, throughput and equipment tolerances.

1. **Energy Supplier or Energy Services Company schedules a planned maintenance event with potential negative impact on delivered power quality.** The following are the attributes of this planned event which are of interest to the customer.
    a. The planned maintenance has a scheduled starting time and a projected completion time.
    b. The planned maintenance event has a potential to negatively impact the delivered power quality to a known population of customers. This potential impact should be quantified or qualified (tiered?).

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2. **Energy Supplier or ESCO communicates the above attributes to the population of potentially impacted customers.** The customers will evaluate the notice provided to determine whether or not any changes to their operational plans are required.

3. **The customer acknowledges receipt of the communication and evaluates what impact this should have on production activities.** The "customer" may be the Operations or Facility Manager, or an Energy Management System or Intelligent HMI Energy Device.

    a. The customer may delay or reschedule production activities to be outside the planned window of grid maintenance.

    b. The customer may determine that the risk or the impact is insignificant and not modify any production activities.

4. **Energy Supplier communicates when grid maintenance is complete, or that the maintenance window is being extended.** The Energy Supplier will communicate completion of the grid maintenance activity or that the planned completion time has been pushed back.

    a. The customer will acknowledge receipt of the communication.

    b. The customer will adjust his/her production activities accordingly.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Operations Manager
Facility Manager
Energy Services Company (ESCO)
Energy Supplier
Energy Management System
Intelligent HMI Energy Device

Table 16.1. Receive Grid Maintenance Planning Information Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name

Draft

2	Power Quality

1562 Table 16.2. Receive Grid Maintenance Planning Information Use Case Information

1563

1564 ## *Information Transactions*

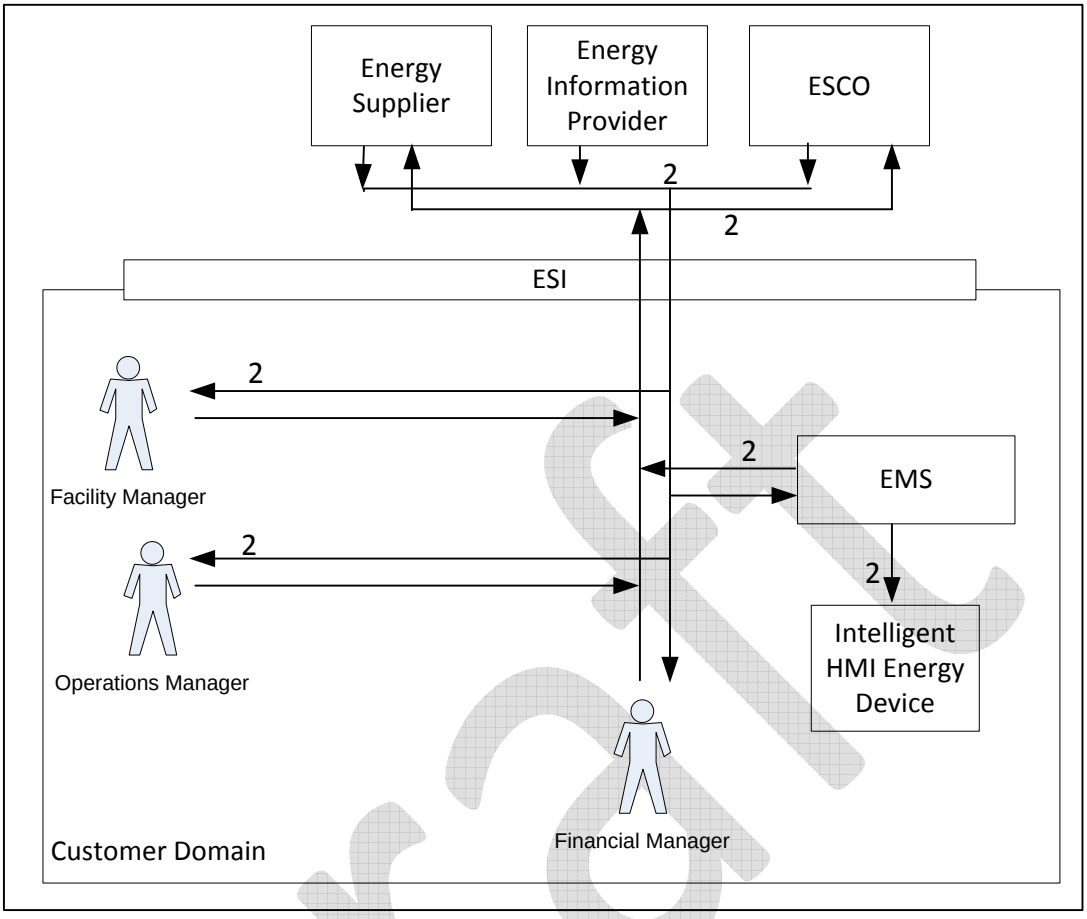
Actor	Information Supplied (ID #)	Information Consumed (ID #)
Operations Manager		2
Facility Manager		2
Energy Services Company (ESCO)	2	
Energy Supplier	2	
Energy Management System		2
Intelligent HMI Energy Device		2

1565 Table 16.3. Receive Grid Maintenance Planning Information Use Case Transactions

1566 ## *Use Case Diagram*

1567 The following diagram illustrates this use case. An explanation of the format of this
1568 diagram can be found in Appendix C.

Draft



1569

1570 Figure 16.1 Receive Grid Maintenance Planning Information Use Case Diagram

1571

Draft

UC-17: Receive Instantaneous Power Quality to Validate Power SLA

Use Case Name

Receive Instantaneous Power Quality to Validate Power SLA

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☐ Residential Customer Domain

Function ID

EIS-UC-17

Brief Description

A utility offers a Service Level Agreement (SLA) on power quality to a customer. The customer receives power quality information in real-time from the utility. The customer can track and project performance against the SLA over various periods of time.

Related Use Cases

Not Applicable

Narrative

Overview: This use case covers the communication by the utility to the customer of instantaneous power quality being delivered to the customer.

1. **Energy Supplier or Energy Services Company communicates instantaneous power quality measures to customers.**
    a. The power quality measurements must be determined at the service entrance, not further upstream into the grid.
2. **The customer is interested in receiving this information.**
    a. The utility may have entered into a Service Level Agreement (SLA) with the customer detailing a contracted level of power quality performance over a period of time.
    b. The customer may not have an SLA with the utility, but may still be interested in tracking and measuring power quality attributes as it impacts their production activities.

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3. **The customer acknowledges receipt of the communication of the power quality reporting.** The "customer" may be the Operations or Facility Manager, or an Energy Management System or Intelligent HMI Energy Device.

   a. The customer may collect the data, trend and report as appropriate.

   b. The Financial Manager or Energy Information Provider may utilize this information in negotiations and price adjustments with the utility.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Operations Manager
Facility Manager
Energy Services Company (ESCO)
Energy Information Provider
Energy Supplier
Financial Manager
Energy Management System
Intelligent HMI Energy Device

Table 17.1. Receive Instantaneous Power Quality to Validate Power SLA Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
2	Power Quality

Table 17.2. Receive Instantaneous Power Quality to Validate Power SLA Use Case Information

Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Operations Manager		2
Facility Manager		2

Energy Services Company (ESCO)	2	
Energy Information Provider		2
Energy Supplier	2	
Financial Manager		2
Energy Management System		2
Intelligent HMI Energy Device		2

Table 17.3. Receive Instantaneous Power Quality to Validate Power SLA Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

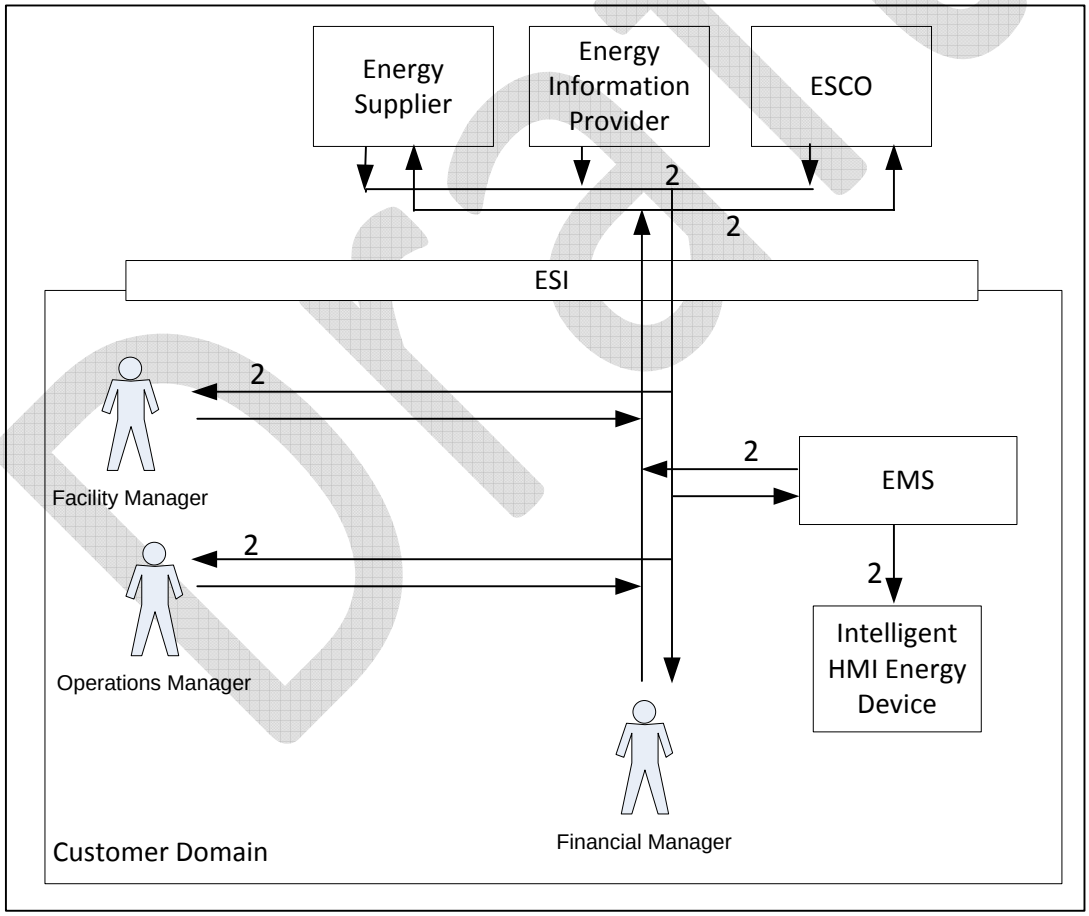

Figure 17.1 Validate Energy Consumption Use Case Diagram

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UC-18: Use Case to Loads Controlled by an External Source

Use Case Name

Load(s) Controlled by External Source

Applicability

This use case applies to the following customer domains.

- ☑ Industrial Customer Domain
- ☑ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-18

Brief Description

A customer would like to participate in Direct Load Control by an external source. Load(s) have ability to react to a control signal and do or don't send response indication. This can include multiple loads with individual end point controls.

Use Case assumes there is no master control capability on site.

Related Use Cases

None.

Narrative

1. **End Point Control Agreement is Contracted.** There is no master energy control system in place. There are two variants to installation:
    a. The Facility Manager contracts for direct load control on end point load(s) without regard to pricing signal and may or may not send verification signal
    b. The Facility Manager contracts for direct load control on end point load(s), receives pricing signal from provider and each load determines response to signal and may or may not send verification signal.
2. **End Point Control Equipment is Installed.**
    a. End Point Control Equipment may be installed directly by provider
    b. End Point Control Equipment may be installed by Facility Manager and provisioned by provider

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Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Name
Energy Services Company (ESCO)
Energy Supplier
Intelligent End Point

Table 18.1. Validate Energy Consumption Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
3	Pricing Rules
6	Instantaneous Energy Demand
21	Equipment State

Table 18.2. Validate Energy Consumption Use Case Information

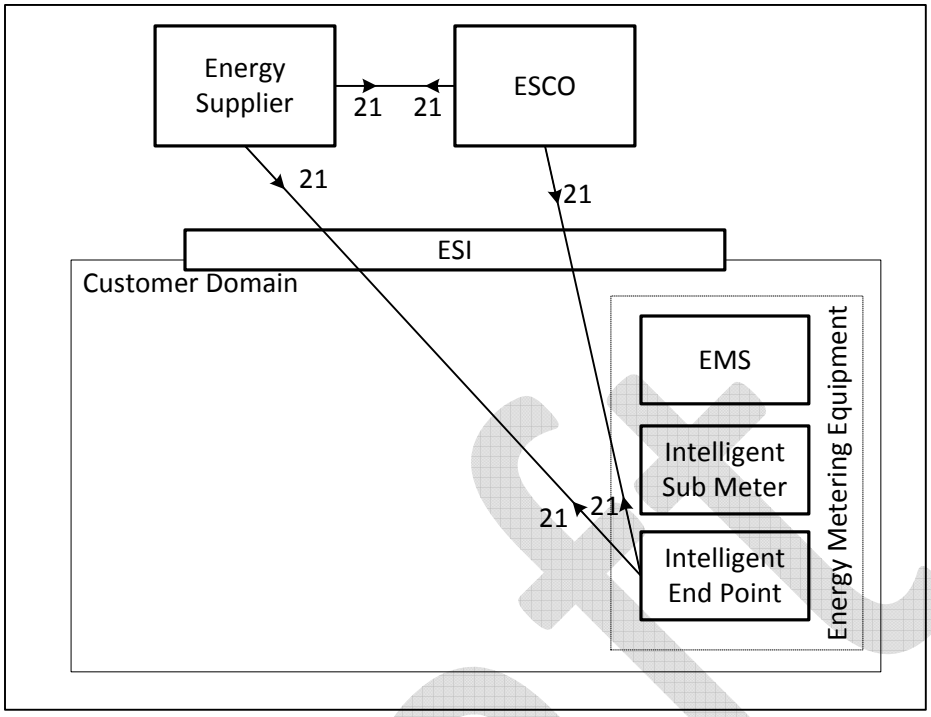
Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Energy Services Company (ESCO)	21	3, 21
Energy Supplier	21	3, 21
Intelligent End Point	6, 21	21

Table 18.3. Validate Energy Consumption Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.



1670
1671 Figure 18.1. Validate Energy Consumption Use Case Diagram

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UC-19: Use Case to Choose Response to DR Signal

Use Case Name

Make Choices Regarding DR Signal from Utility

Applicability

This use case applies to the following customer domains.

- ☐ Industrial Customer Domain
- ☐ Commercial Customer Domain
- ☑ Residential Customer Domain

Function ID

EIS-UC-19

Brief Description

A customer would like premise EMI or end point load(s) to determine response type to DR signal from utility. Based on level of intelligence, load control system takes actions necessary to optimize premise requirements and energy consumption.

Related Use Cases

None.

Narrative

1. **Energy Metering Equipment is Installed.** The existing Energy Management System (EMS) can be used to measure energy, or metering and submetering equipment is installed. Two cases exist:
    a. The existing EMS has the necessary meters and submeters already installed. Installers and service technicians of premise equipment are provided information (auto or manual) to optimize building requirements and energy efficiency
    b. The necessary meters and submeters are added to the EMS.
2. **Energy Pricing Rules Are Distributed.** The Energy Pricing Rules are needed by the EMS (for selecting pre-set operational strategies), intelligent end point loads, intelligent sub-metering devices, HMI, and the Landlord or Homeowner for monitoring costs. The Energy Pricing Rules are comprised of customer-specific real-time pricing (RTP) and demand-interval data (demand rules, tariffs, previous high demand, etc.). The source of the Energy Pricing Rules can vary, as follows:
    a. The Energy Supplier provides the Energy Pricing Rules,

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b. The Energy Information Provider provides the Energy Pricing Rules, or

c. The Energy Services Company (ESCO) provides the Energy Pricing Rules.

3. **DR signal is acted on based on pre-set operational strategies.** DR signal information is received, distributed and/or acted on by EMS, intelligent sub-metering devices, landlord or homeowner via HMI.

Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case. A complete description of the actors can be found in Appendix A.

Actor Name
Energy Management System
Energy Services Company (ESCO)
Energy Information Provider
Energy Supplier
Intelligent Sub-Metering Device
Intelligent End Point
Intelligent HMI Energy Device
Weather Forecast Service
Home Owner
Landlord
Installer (service tech)

Table 19.1. Choose Response to DR Signal Use Case Actors

Information Exchanged

The following information is transferred across the Energy Services Interface (ESI) in this use case. A complete description of the information exchanged can be found in Appendix B.

ID	Name
1	Weather
3	Pricing Rules

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4	Energy Attributes
5	Instantaneous Energy Use
6	Instantaneous Energy Demand
7	Available Sheddable Load
8	Non Sheddable Critical Load
15	Forecasted Demand

Table 19.2. Choose Response to DR Signal Use Case Information

Information Transactions

Actor	Information Supplied (ID #)	Information Consumed (ID #)
Energy Services Company (ESCO)	1,3,4,5	
Energy Information Provider	1,3,4,5	5,6,7,8,15
Energy Supplier	3,4,5	
Energy Management System	5,15	1,3,4,5,6,7,8,15
Intelligent Sub-Metering Device	6	
Intelligent End Point	6	
Intelligent HMI Energy Device		5,6
Weather Forecast Service	1	
Home Owner	1,3,4,7,8,15	1,3,4,5,6,7,8,15
Landlord	1,3,4,7,8,15	
Installer (or service technician)	3,4,7,8	

Table 19.3. Choose Response to DR Signal Use Case Transactions

Use Case Diagram

The following diagram illustrates this use case. An explanation of the format of this diagram can be found in Appendix C.

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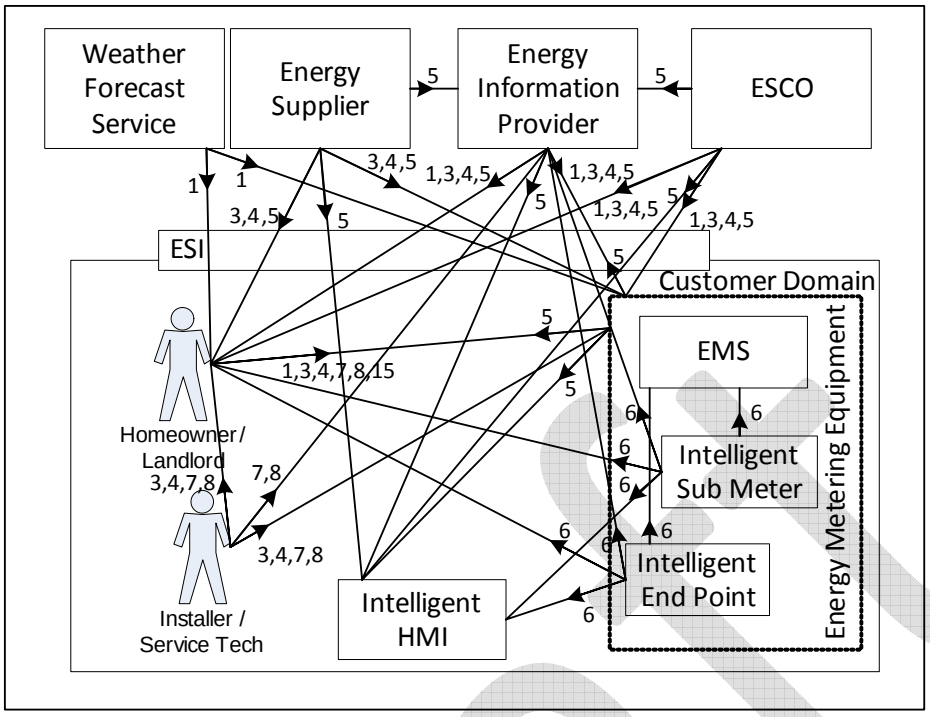

Figure 19.1. Choose Response to DR Signal Use Case Diagram

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Appendix A: Actor (Stakeholder) Descriptions

Name	Type	Description
Facility Manager	Person	Person responsible for the maintenance and operation of the facility. In the Residential market, this is the home owner, or building superintendent.
End Use Customer	Person	Residential customer or other person in a commercial/industrial building that is consuming energy. This customer may also be an entity (e.g. department, tenant) within a larger building.
Energy Services Company (ESCO)	Organization	Business providing energy savings, efficiency, and generation solutions.
Energy Information Provider	Organization	Business providing energy supply or demand information.
Energy Supplier	Organization	A company that delivers electricity to end use customers.
Energy Management System	Device	A system used to monitor and control the energy consuming devices in a building.
Intelligent Sub-Metering Device	Device	A system that measures, collects, and analyzes energy cost/consumption of external equipment.
Intelligent End Point	Device	A system that internally measures, collects, and analyzes its energy cost/consumption. Examples: Smart Power Strip, Smart Power Distribution Unit
Intelligent HMI Energy Device	Device	A device that is capable of displaying power consumption of one or more devices, areas, buildings, or campuses.
Intelligent HMI Energy Device	Device	A system that displays information on the energy cost/consumption of one or more devices in a building. HMI = Human, Machine Interface. This could be a stand-alone device, separate from an EMS or, it could be a display connected to an EMS. Examples include

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		Touch-screen interface for system control in a home, an energy kiosk in a lobby, etc.
Financial Manager	Person	Person that is responsible for cost accounting and developing financial strategies for an industrial or commercial business.
Home Owner	Person	Owner of residence
Landlord	Person	Owner or manager of multi-premise dwelling
Installer (service tech)	Person	Installer of intelligent end-point loads, DR loads, or EMS system and components
Operations Manager	Person	Person that is responsible for the production activities within an industrial or commercial building.

1732 Table A.1. Customer Domain Use Case Actors

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Appendix B: Information Exchange Table

ID	Name	Description
1	Weather	Forecast weather, and related conditions, including: temperature, relative humidity, hours of sunshine, sunrise, sunset, precipitation, wind speed and direction, ozone, smog, particulates, allergens, etc.
2	Power Quality	Various attributes of Power Quality on both an instantaneous as well as historical or scheduled (future) perspective. Attributes would include appropriate elements of the following: • Communication time stamp • Power availability • Power quality (voltage, frequency, harmonics) • Scheduled Maintenance start time • Scheduled Maintenance completion time • Scheduled Maintenance quantified or qualified projected impact on power quality during the Maintenance window
3	Pricing Rules	Customer-specific real-time pricing (RTP) data tables and demand interval data (e.g. demand rules, tariffs, previous highest demand etc)
4	Energy Attributes	Information used to quantify the environmental burden created during the generation of the power. This could be power received from an energy supplier or, it could pertain to energy generated onsite (e.g. Carbon, CO_2, NOx, other by-products of fossil-fuel combustion).
5	Instantaneous Energy Use, Aggregated	Instantaneous energy usage of the facility or production site, as an aggregate.
6	Instantaneous Energy Demand	Instantaneous energy usage of the sub loads being monitored (conditional on sub metering installed).
7	Available Shed-able Load	Individual loads and their aggregate value that may be shed to reduce power demand
8	Critical Load	Individual loads deemed to be critical, and their aggregate value, which may not be shed
9	State Change	How quickly sub loads can respond to a shed command to

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	Interval	reduce power demand
10	Existing Demand Thresholds	Existing peak demand in current billing period; existing maximum demand during ratchet demand period
11	Onsite generation capabilities (and availability--spinning and non-spinning reserves)	The on-site generation capabilities, current and future status are summarized.
12	Onsite energy storage (and availability)	The on-site energy storage capacity as well as current and future status is summarized. To the outside, on-site energy storage is stored energy that will appear as generation capacity.
13	Onsite thermal storage	The capacity and availability of on-site thermal energy storage.
14	Loads to Shed	Specific loads the EMS commands to shed.
15	Demand Forecast	Forecasted demand (based on production schedule and historical data).
16	Historical interval demand and power quality data	Historical information about the energy consumed per block of time (e.g. 15 minute sliding window), as well as the power quality data for that block of time.
17	Energy Cost	Energy cost per unit of time (e.g. minute, hour).
18	Energy Attributes per kW	"Energy Attributes" (ID 4, above) per kilowatt of power used.
19	Building Report – Common Data	Information related to building energy usage information, including information about consumption, cost, and emissions.
20	Load Characteristics	Efficiency, RLA, LRA, etc.
21	Instantaneous Energy Usage for Generation	Instantaneous energy usage of the generation being monitored (conditional on sub metering installed).
22	Available Generation	Individual generators and their aggregate value that may be raised to meet tie line requirements
23	Actual Generation	Individual generation, and their aggregate value, which may be increased or decreased
24	*Reserved for future use.*	
25	Generators	Specific generators the BOP control system commands to raise

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		or lower
26	Predicted End-of-Interval Demand	A prediction of the power demand during the current demand interval

Table B.1. Customer Domain Use Case Information Exchange

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Appendix C: Use Case Diagram Explanation

Use Case diagrams are intended to be visual representation of the functionality provided within a use case. As shown in Figure C.1, the diagrams in this document consist of the following components:

1. **External Actors.** External actors are entities, devices, or people that are producing or consuming use case information outside of the customer domain. Typical external actors include the Energy Supplier or Energy Information Provider.
2. **Internal Actors.** Internal actors are entities, devices, or people that are producing or consuming use case information inside of the customer domain. Typical internal actors include a Facility Manager, Financial Manager, or Energy Management System.
3. **Customer Domain.** The Customer Domain is the equipment and physical premises owned by the customer. The customer domain can be a residence, multi-tenant building, commercial building/campus, or industrial building/campus.
4. **Energy Services interface.** The Energy Services Interface (ESI) is the gateway between the internal and external actors. This interface bridges the customer domain to the external world.
5. **Sub-domain**. A sub-domain is typically equipment that performs a similar function. For example, equipment that can perform metering, like a submeter, energy management system, and intelligent end devices may be considered an energy metering sub-domain.
6. **Information Transaction**. An information transaction is an indication that an actor is producing information that is consumed by another actor. The direction of the arrow on this transaction indicates the consumer of the information.
7. **Information Exchanged**. The information exchanged is an indication of the types of information that is passed in an Information Transaction. The ordinals are references to a data table that lists the characteristics of the data being passed.

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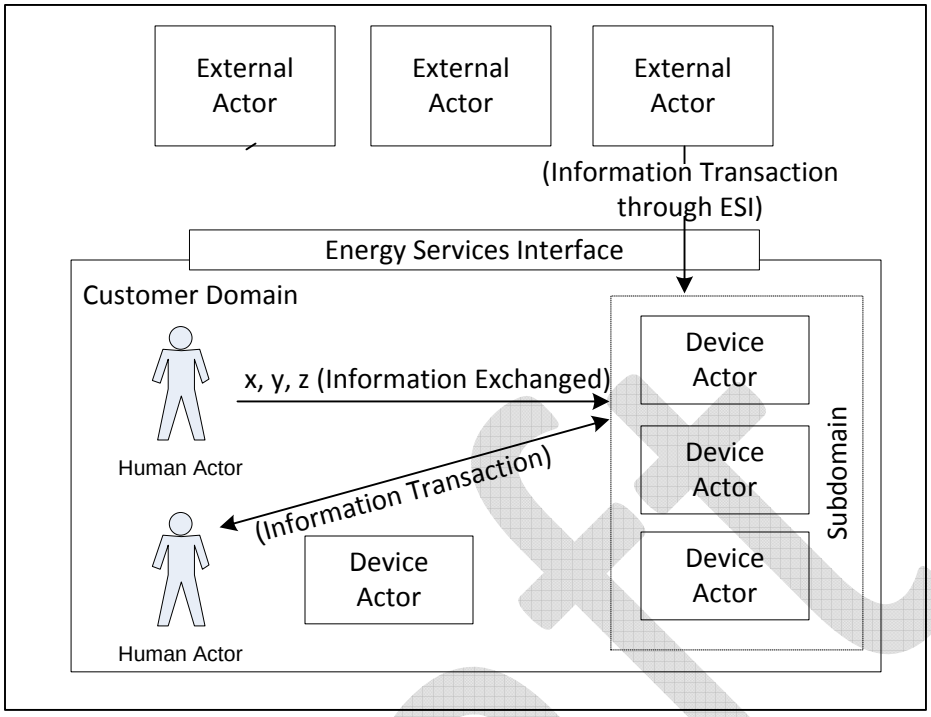

Figure C.1. Use Case Diagram Legend

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1772 # Appendix D: Glossary

Acronym	Name	Description
ASHRAE	American Society of Heating Refrigeration and Air-Conditioning Engineers	International technical society focused on heating, ventilation, air-conditioning, and refrigeration equipment.
ABEL	ASHRAE Building Energy Labeling	Commercial building energy labeling program managed by ASHRAE.
BOP	Balance of Plant	A manual or automatic control system used to monitor and control the making, taking (buying) from the grid or supplying (selling) of electricity to the grid.
	Bus Bar Cost	The cost per kilowatt hour of producing electricity; it includes the cost of capital, debt service, operation and maintenance, and fuel. The power plant bus, or busbar, is that point beyond the generator but prior to the voltage transformation point in the plant switchyard.
CBECS	Commercial Buildings Energy Consumption Survey	A national sample survey that collects information on the stock of U.S. commercial buildings.
EIS	Energy Information Standards	Standards that define the creation and consumption characteristics of energy used within a residential, commercial, or industrial building.
EMS	Energy Management System	A system used to monitor and control the energy consuming devices in a building.
ESCO	Energy Services Company	Business providing energy savings, efficiency, and generation solutions.
ESI	Energy Services Interface	The point of demarcation between the customer domain and the remainder of the smart electric grid.
ESP	Energy Service Provider	Energy Service Providers include utilities, energy information providers, and bill handling services.
HMI	Human Machine Interface	A system in which people interact with a

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		machine, typically graphically.
IEP	Intelligent End Point	A system that internally measures, collects, and analyzes its energy cost/consumption.
KW	Kilo Watt	Unit of measure for electrical power, equal to one thousand watts.
LEED	Leadership in Energy Efficiency Design	An internationally recognized green building certification program administered by the US Green Buildings Council (USGBC).
LRA	Locked Rotor Amps	The magnitude of the inrush current measured when AC motors are started with full voltage.
M&V	Measurement and Verification	Energy measurements that can be determined to a degree of accuracy and trust that is acceptable to all stakeholders.
OpenADE	Open Automated Data Exchange	A collection of requirements for a Standardized Machine-to-Machine (M2M) interface that permits utilities to share, at the consumer's request and under the consumer's direction, a broad set of that consumer's utility data with specific 3rd Parties.
	Production	Production output is dependent upon the specific domain. In industrial domain, production may be goods produced. In retail this may be goods sold. In healthcare this may be patient and staff health. In education, this may be test scores and occupant health.
RTP	Real Time Pricing	The price a consumer pays for electricity that varies based upon the wholesale electricity market prices.
RLA	Rated Load Amps	The designed safe operating load for the equipment under prescribed conditions.
SLA	Service Level Agreement	A part of a service contract where the level of service is formally agreed upon.
SPDU	Smart Power Distribution Unit	A device that measures and distributes electric power to an electrical circuit.
SPS	Smart Power Strip	A residential power strip that measures electrical power being drawn by the connected equipment.

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	Tie Line	A connection between a customer and a utility provider through which power is bought and sold.
UC	Use Case	A story, told in structured and detailed steps, about how participants in an Application collaborate to reach a goal.

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