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(54) **METHOD OF EFFICIENTLY MANAGING ENERGY**

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(52) **U.S. Cl.**

CPC ***B60L 11/1861*** (2013.01); ***B60L 11/1809*** (2013.01); ***G01C 21/362*** (2013.01); *B60L 2240/72* (2013.01)

(57) **ABSTRACT**

A method is provided for managing energy. The method comprises collecting information relating to amounts of energy stored by a plurality of members of a group, and relating to energy requirements of the members. The method further comprises determining a price for distributing energy to a non-member of the group, determining whether to supply energy stored by the members to the non-member at the determined price, and issuing instructions to distribute energy upon determining that energy stored by the plurality of members should be supplied to the non-member.

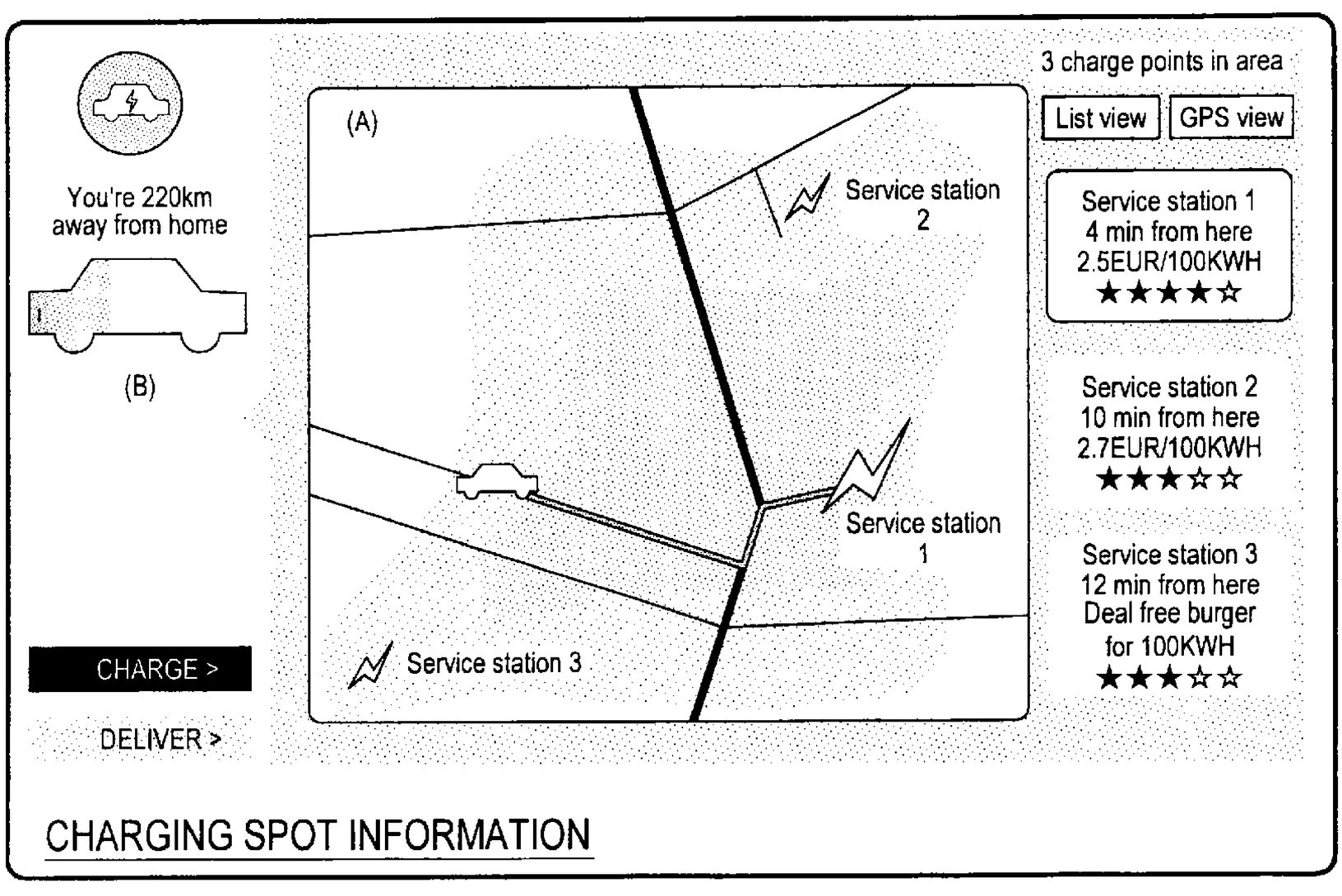


FIG.1

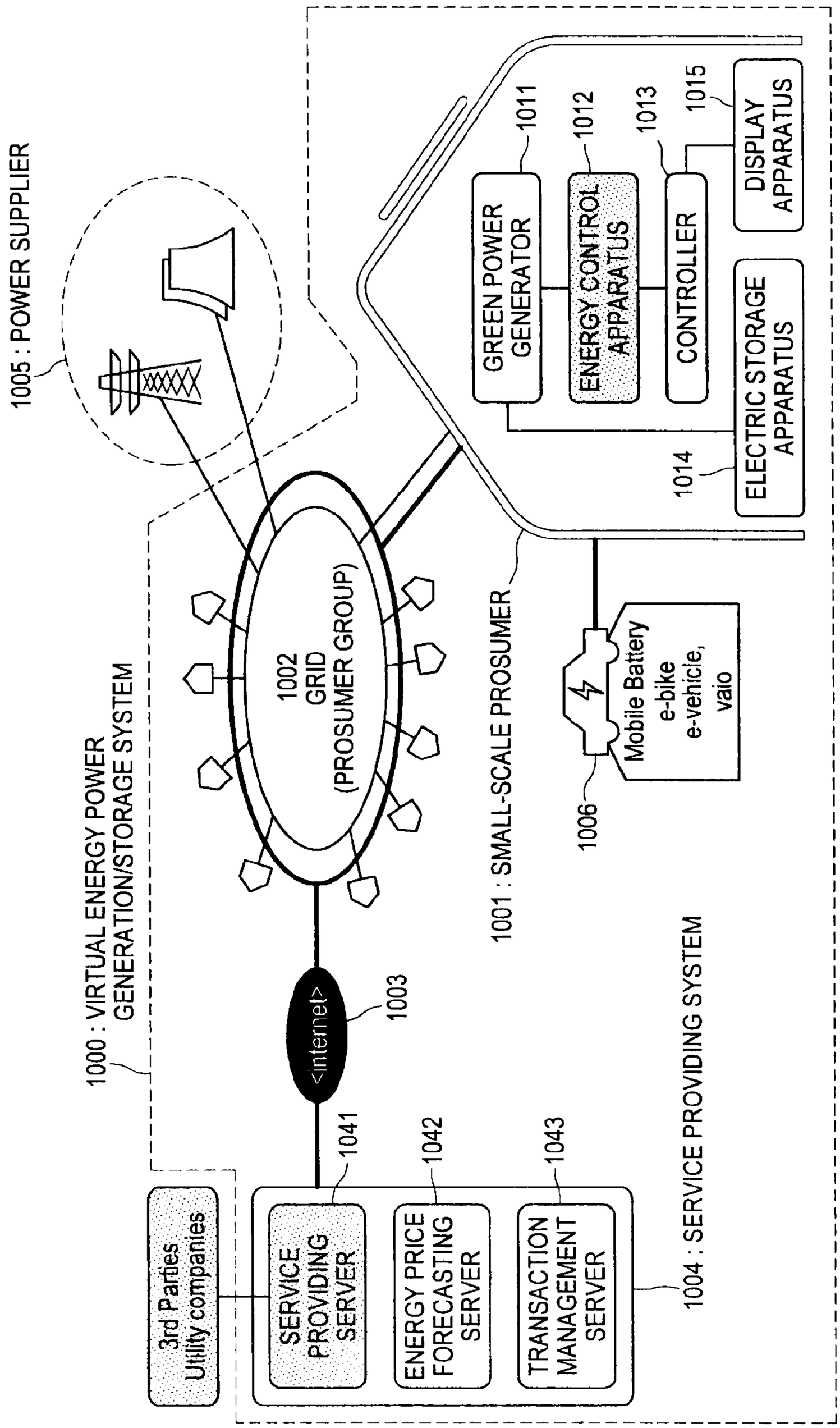
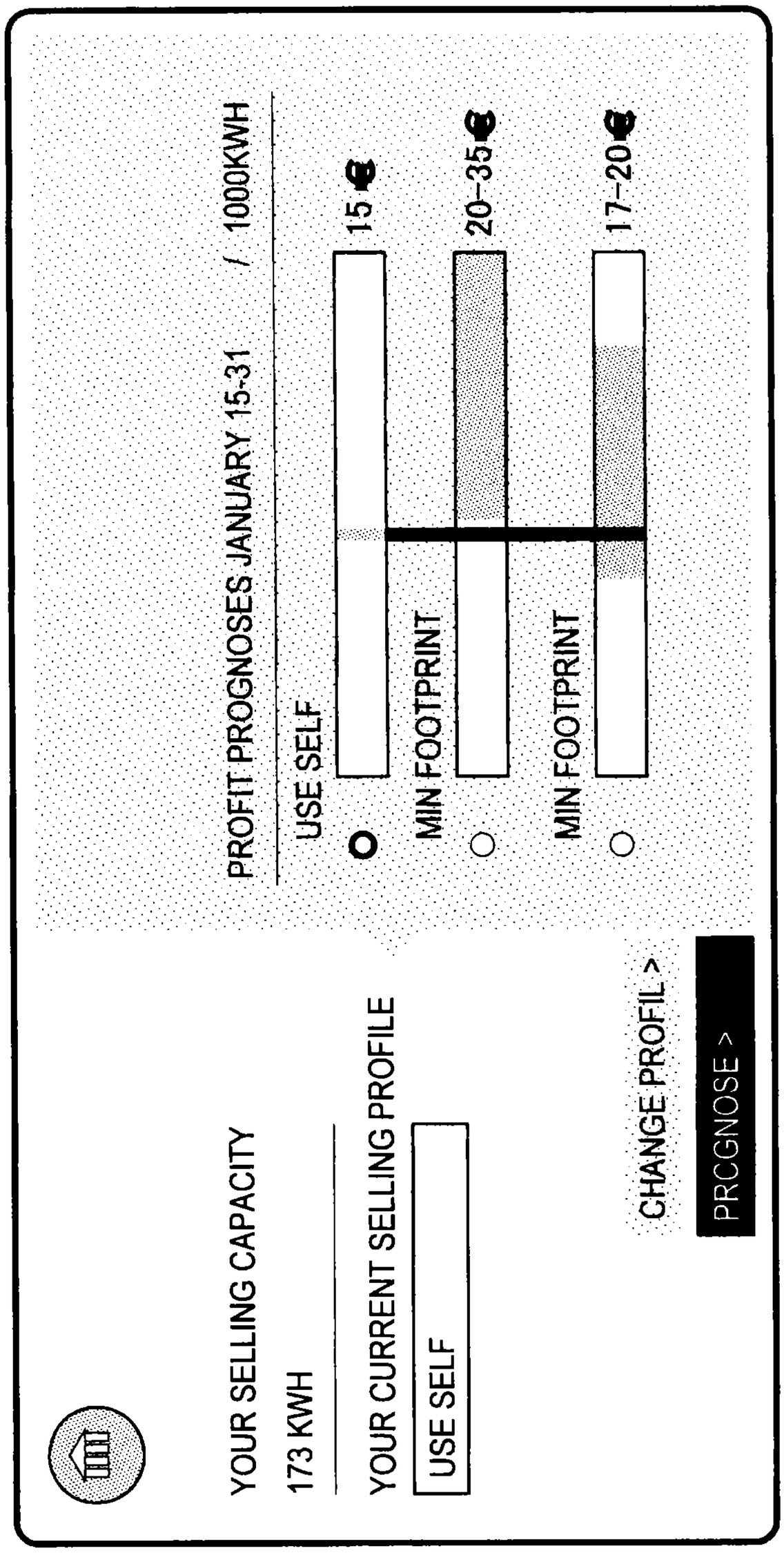

1000 : VIRTUAL ENERGY POWER GENERATION/STORAGE SYSTEM
1005 : POWER SUPPLIER
1002 GRID (PROSUMER GROUP)
<internet>
1003
1001 : SMALL-SCALE PROSUMER
GREEN POWER GENERATOR
1011
ENERGY CONTROL APPARATUS
1012
CONTROLLER
1013
DISPLAY APPARATUS
1015
ELECTRIC STORAGE APPARATUS
1014
Mobile Battery e-bike e-vehicle, vaio
1006
3rd Parties Utility companies
SERVICE PROVIDING SERVER
1041
ENERGY PRICE FORECASTING SERVER
1042
TRANSACTION MANAGEMENT SERVER
1043
1004 : SERVICE PROVIDING SYSTEM

FIG.2



(*) MIN FOOTPRINT : MINIMUM AMOUNT OF CO_2 EMISSION

FIG.3

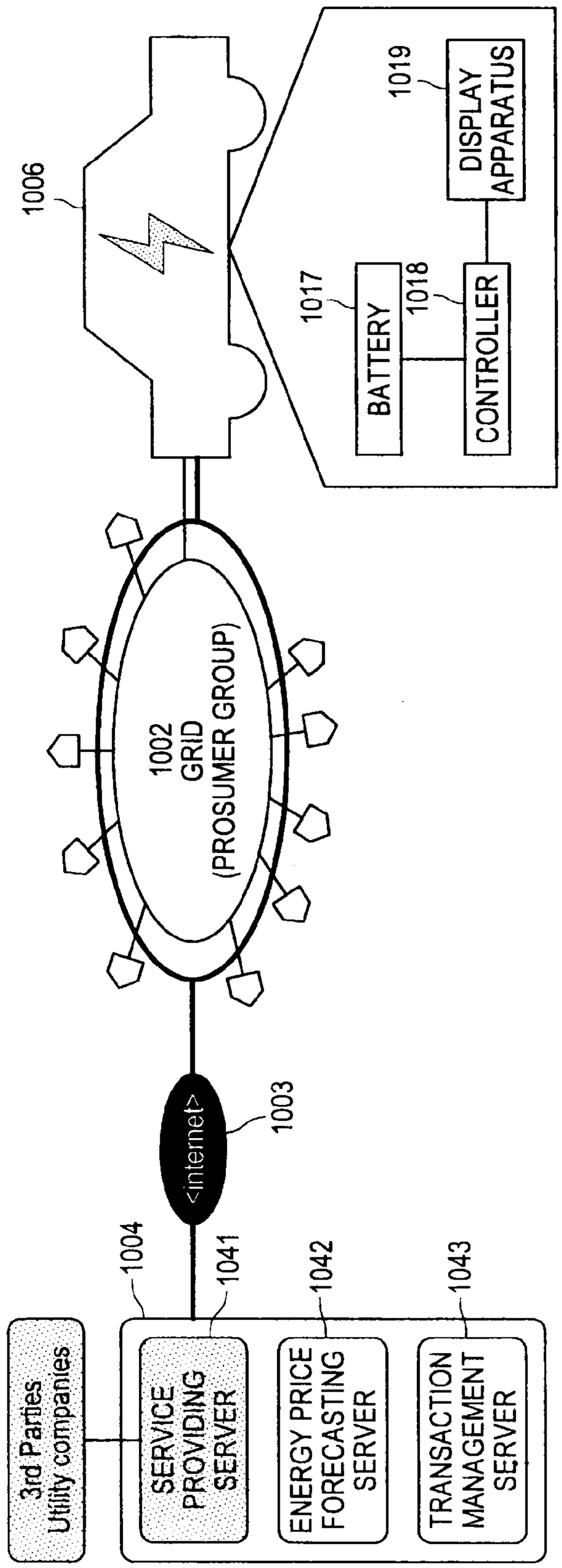

1006
1019
DISPLAY APPARATUS
1017
BATTERY
1018
CONTROLLER
1002
GRID
(PROSUMER GROUP)
<internet>
1003
3rd Parties
Utility companies
1004
SERVICE PROVIDING SERVER
1041
ENERGY PRICE FORECASTING SERVER
1042
TRANSACTION MANAGEMENT SERVER
1043

FIG.4

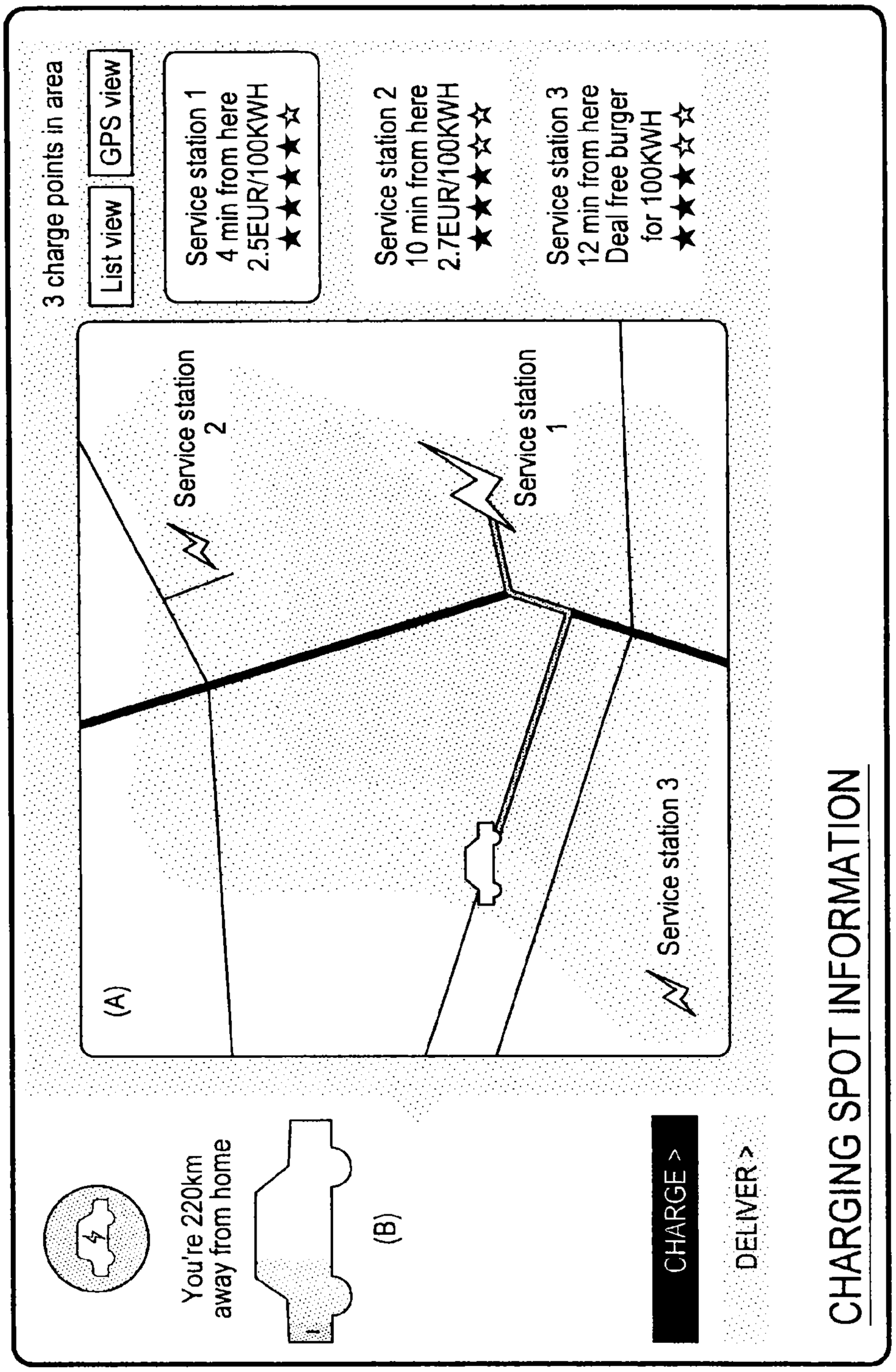

3 charge points in area
List view
GPS view
Service station 1
4 min from here
2.5EUR/100KWH
★★★★☆
Service station 2
10 min from here
2.7EUR/100KWH
★★★☆☆
Service station 3
12 min from here
Deal free burger
for 100KWH
★★★☆☆
(A)
Service station 2
Service station 1
Service station 3
You're 220km
away from home
(B)
CHARGE >
DELIVER >
CHARGING SPOT INFORMATION

FIG.5

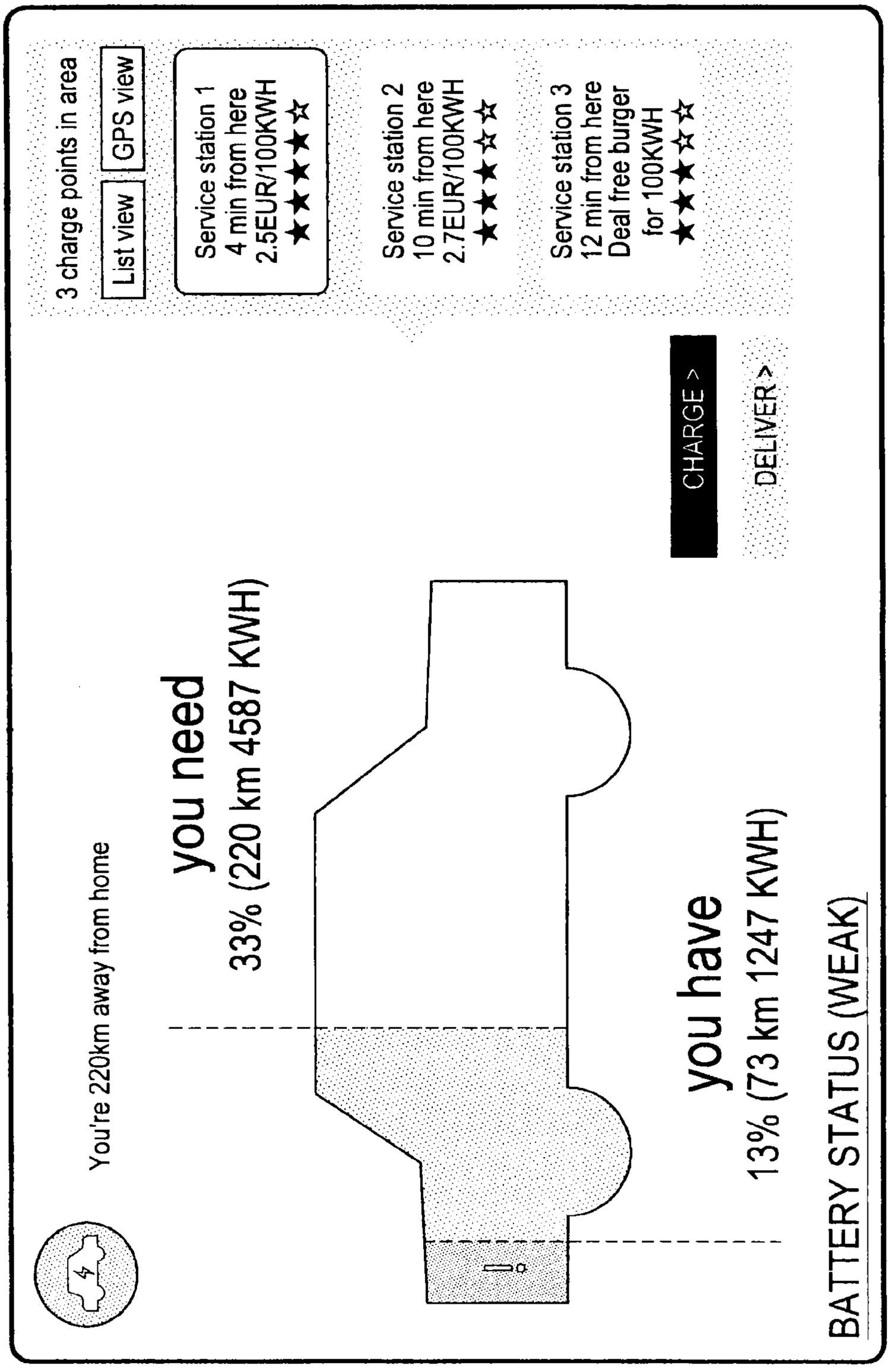

3 charge points in area
List view
GPS view
Service station 1
4 min from here
2.5EUR/100KWH
Service station 2
10 min from here
2.7EUR/100KWH
Service station 3
12 min from here
Deal free burger
for 100KWH
CHARGE >
DELIVER >
You're 220km away from home
you need
33% (220 km 4587 KWH)
you have
13% (73 km 1247 KWH)
BATTERY STATUS (WEAK)

FIG.6

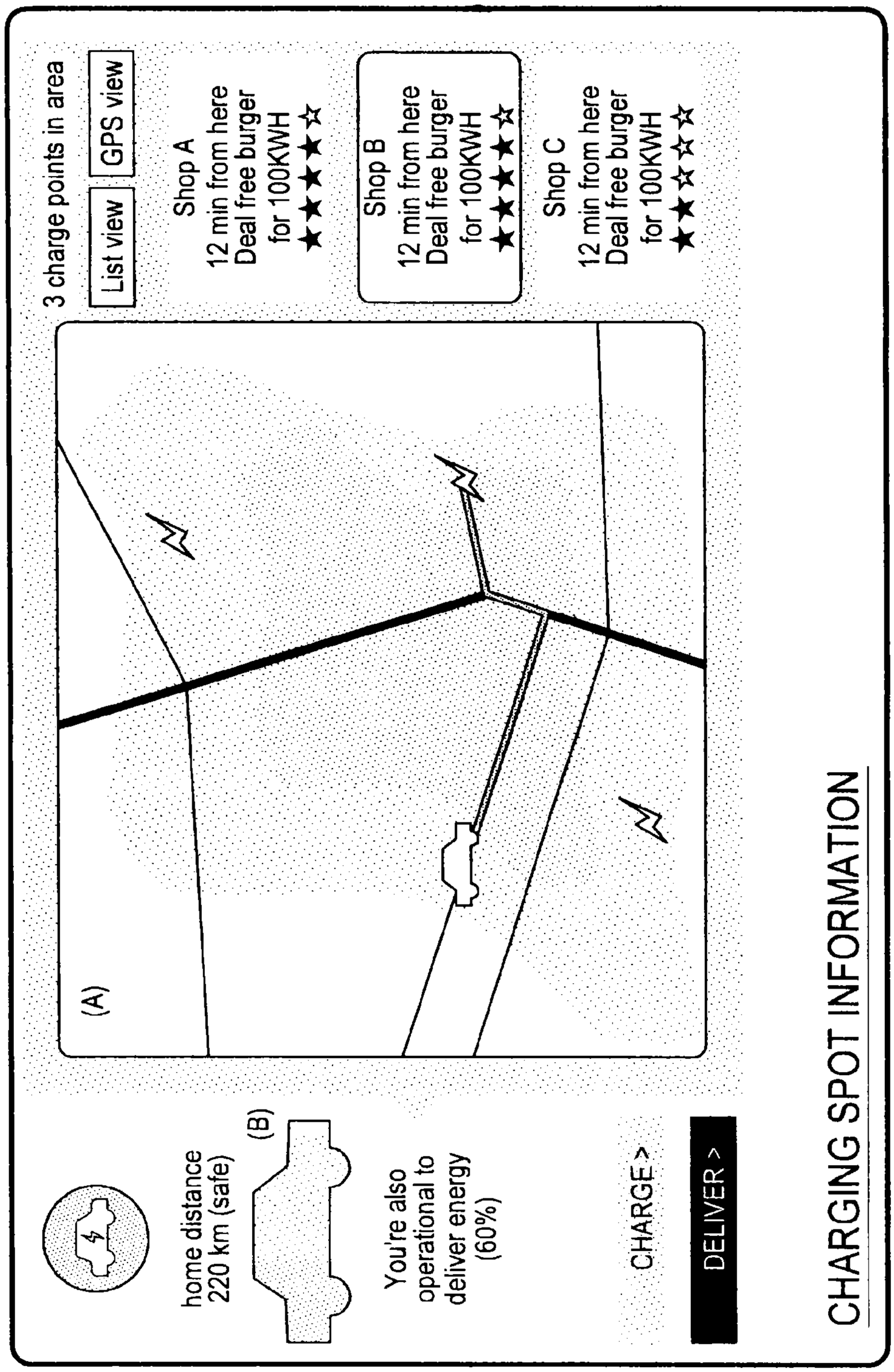

3 charge points in area
List view
GPS view
Shop A
12 min from here
Deal free burger
for 100KWH
Shop B
12 min from here
Deal free burger
for 100KWH
Shop C
12 min from here
Deal free burger
for 100KWH
(A)
home distance
220 km (safe)
(B)
You're also
operational to
deliver energy
(60%)
CHARGE >
DELIVER >
CHARGING SPOT INFORMATION

FIG.7

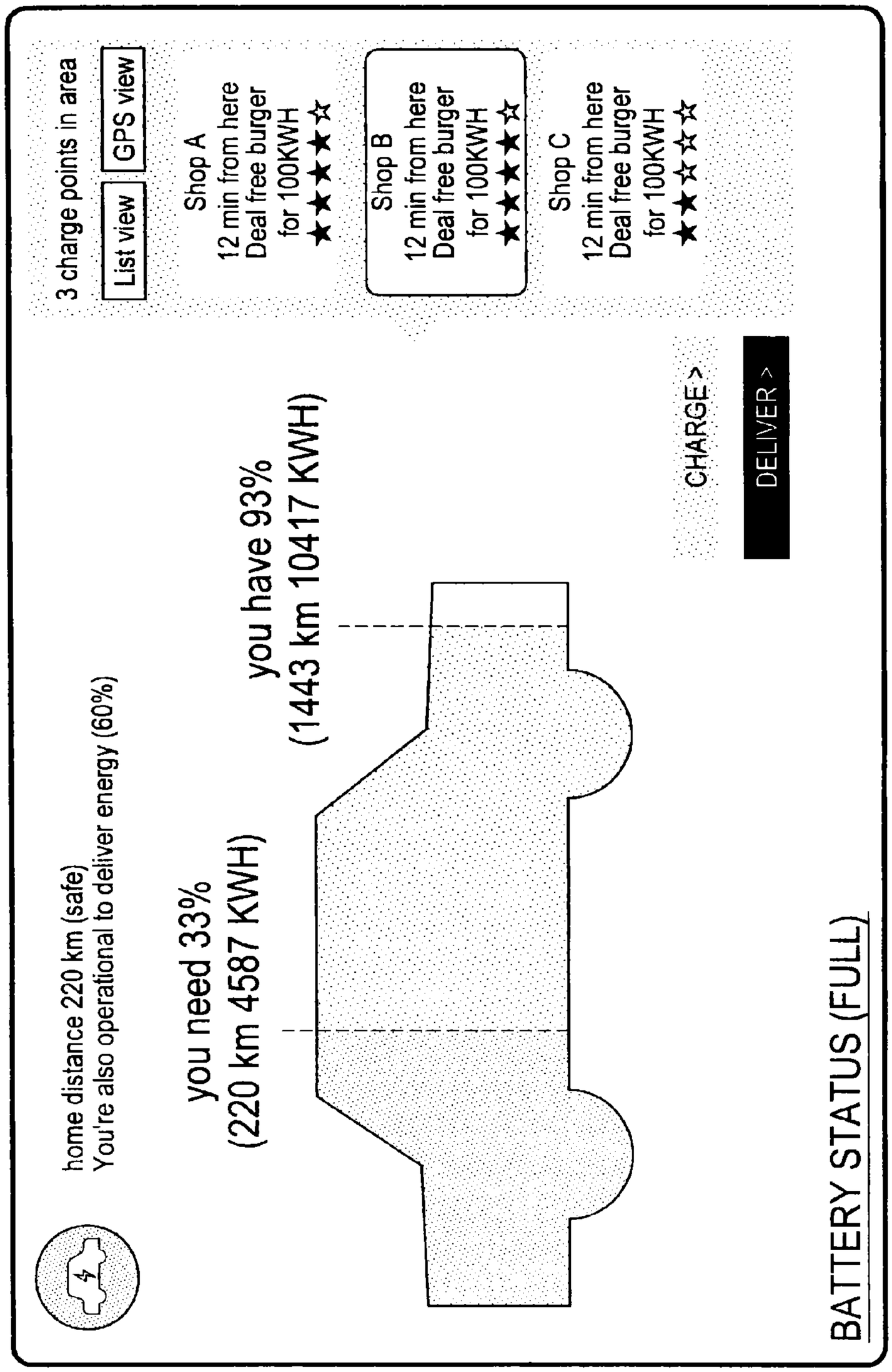

3 charge points in area
List view
GPS view
Shop A
12 min from here
Deal free burger
for 100KWH
Shop B
12 min from here
Deal free burger
for 100KWH
Shop C
12 min from here
Deal free burger
for 100KWH
CHARGE >
DELIVER >
home distance 220 km (safe)
You're also operational to deliver energy (60%)
you need 33%
(220 km 4587 KWH)
you have 93%
(1443 km 10417 KWH)
BATTERY STATUS (FULL)

FIG.8

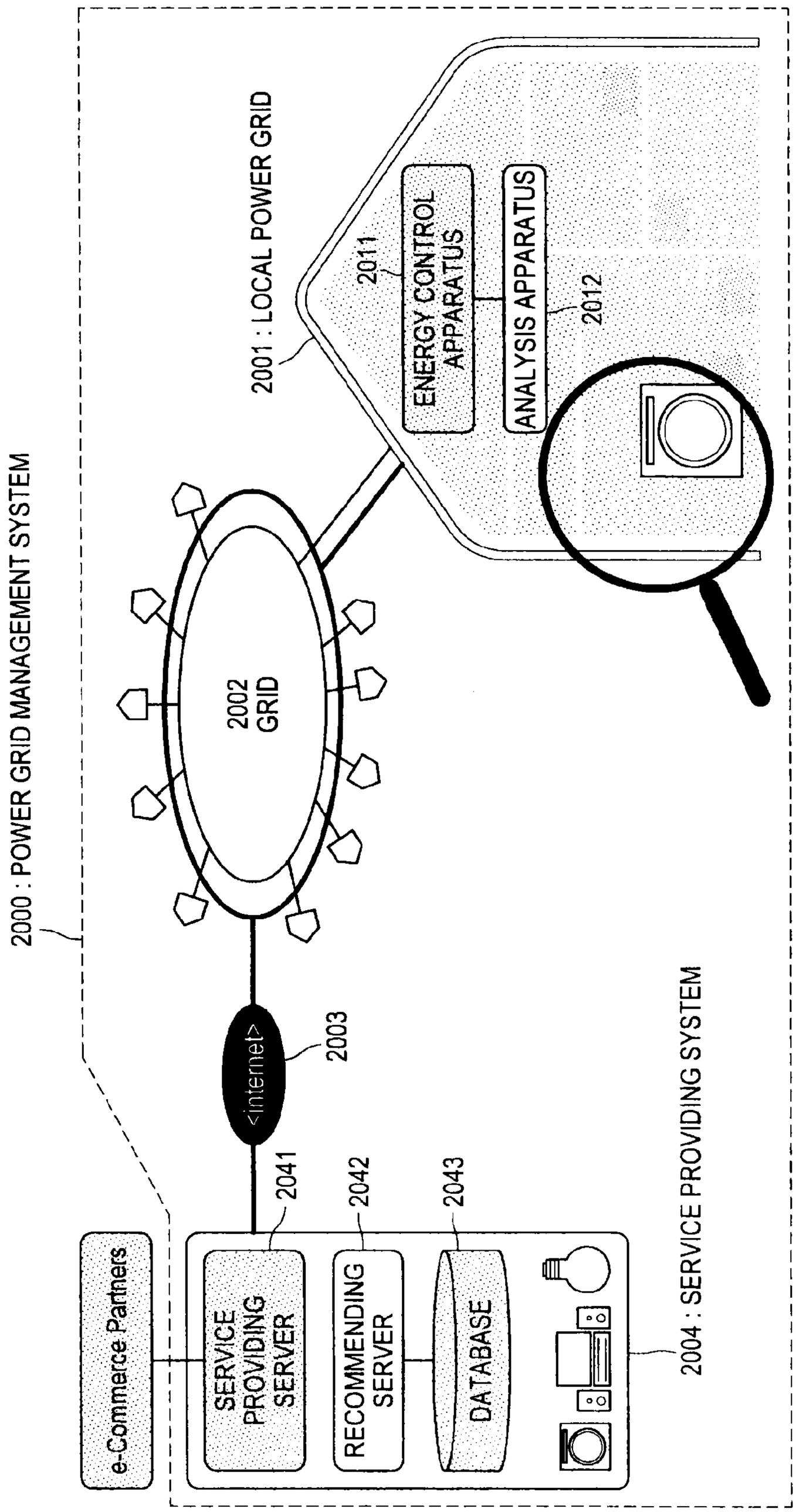

2000 : POWER GRID MANAGEMENT SYSTEM
2001 : LOCAL POWER GRID
2011
ENERGY CONTROL APPARATUS
ANALYSIS APPARATUS
2012
2002 GRID
<internet>
2003
2041
2042
2043
e-Commerce Partners
SERVICE PROVIDING SERVER
RECOMMENDING SERVER
DATABASE
2004 : SERVICE PROVIDING SYSTEM

FIG.9

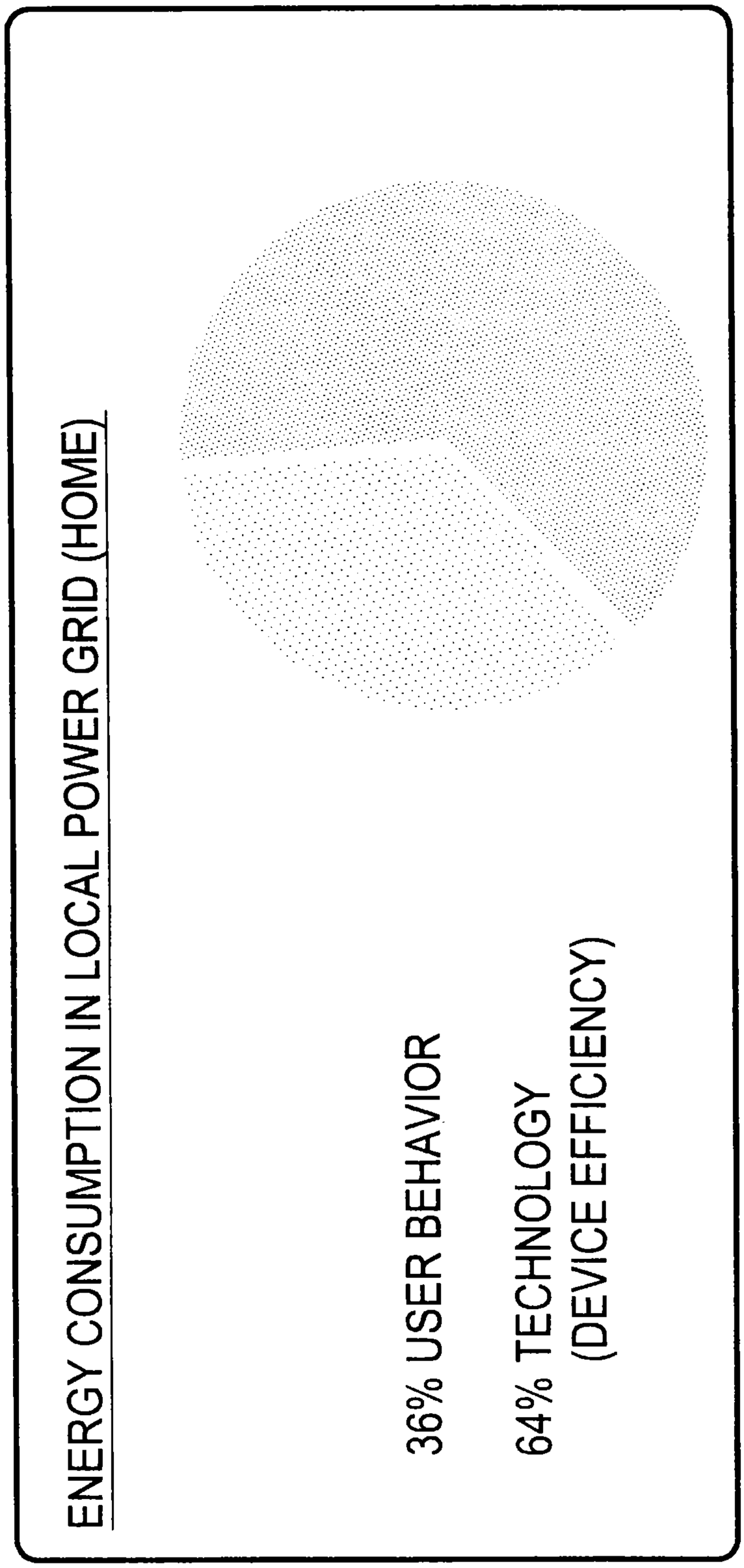

ENERGY CONSUMPTION IN LOCAL POWER GRID (HOME)
36% USER BEHAVIOR
64% TECHNOLOGY
(DEVICE EFFICIENCY)

FIG.10

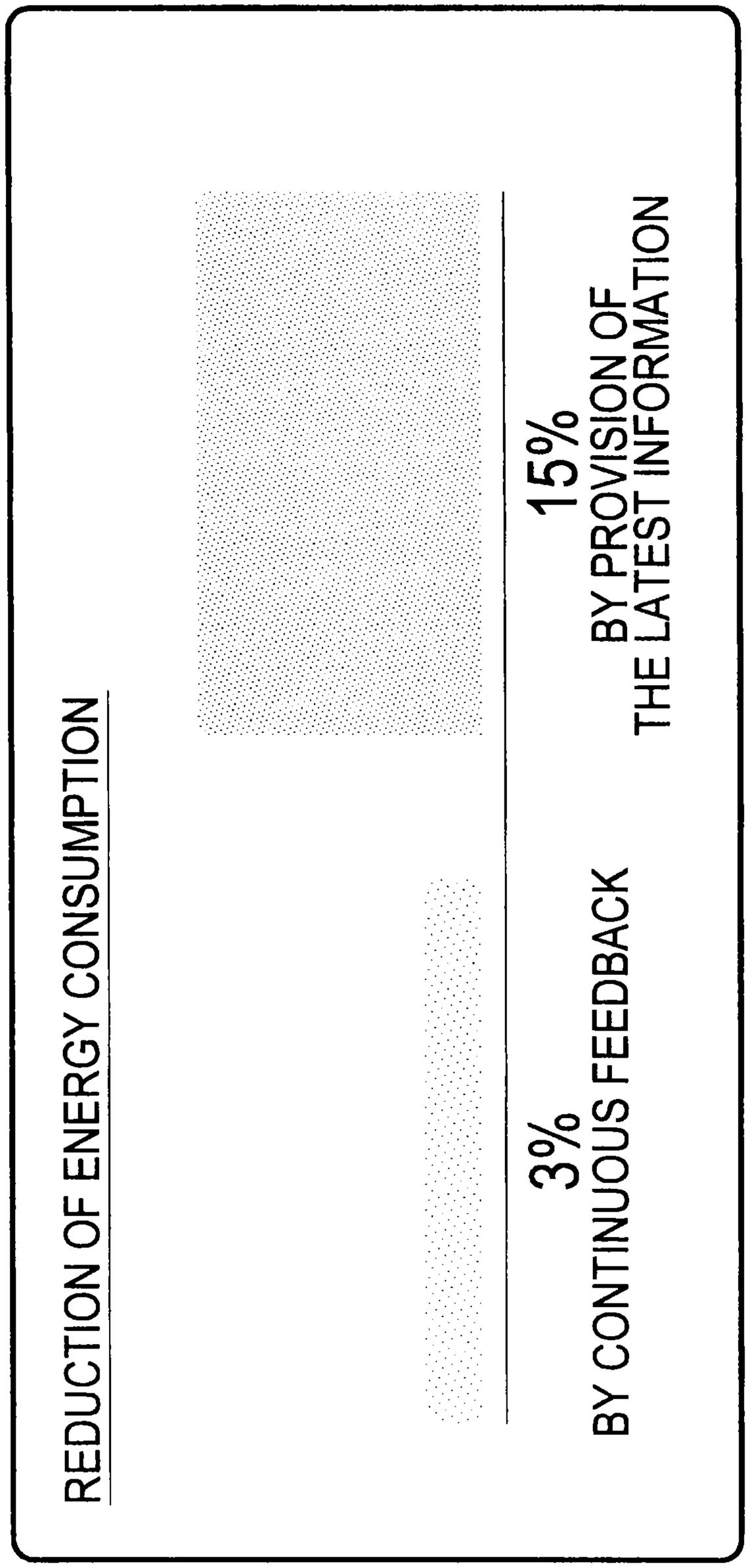

REDUCTION OF ENERGY CONSUMPTION
3%
BY CONTINUOUS FEEDBACK
15%
BY PROVISION OF
THE LATEST INFORMATION

FIG.11

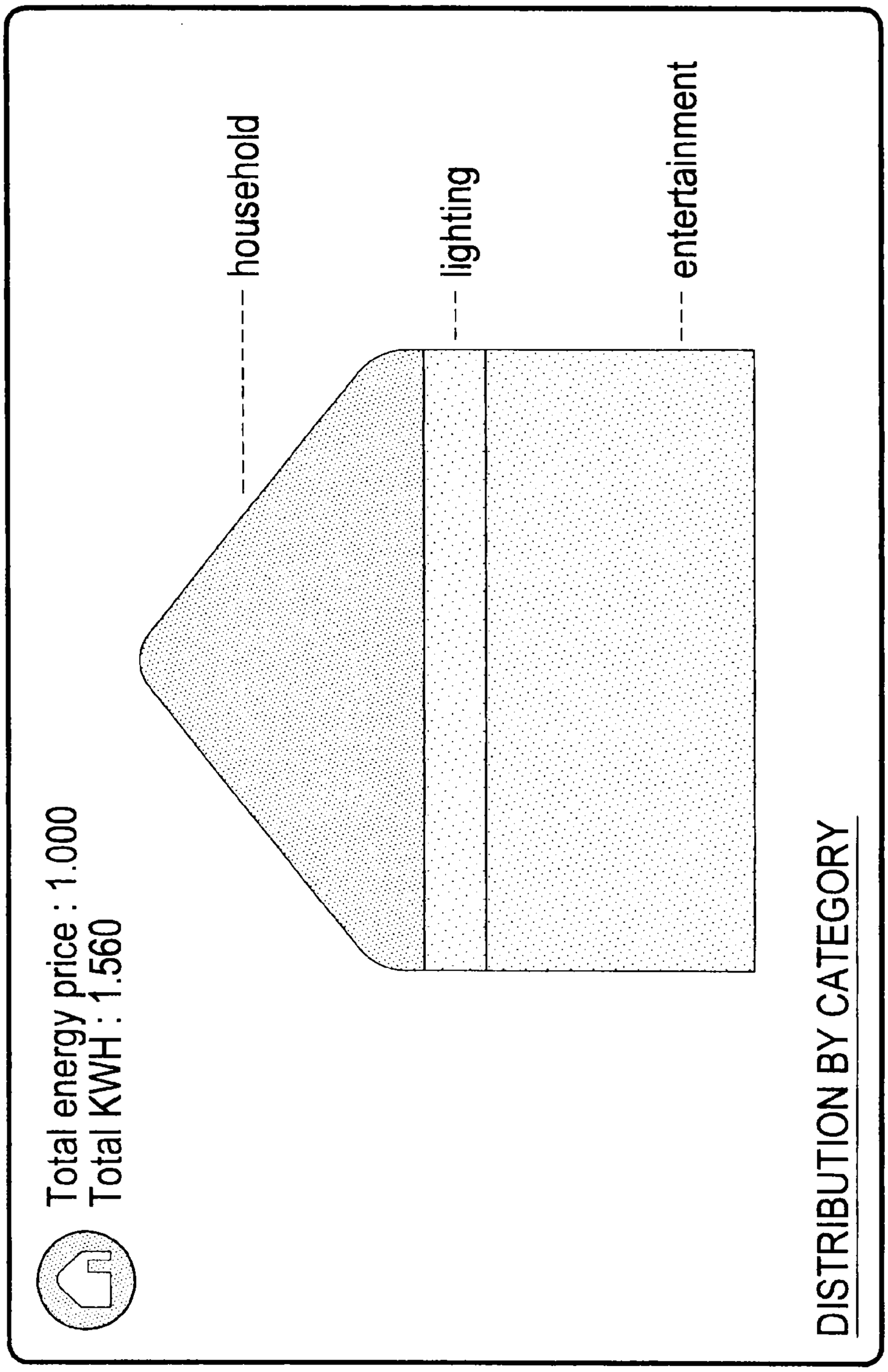

Total energy price : 1.000
Total KWH : 1.560
household
lighting
entertainment
DISTRIBUTION BY CATEGORY

FIG.12

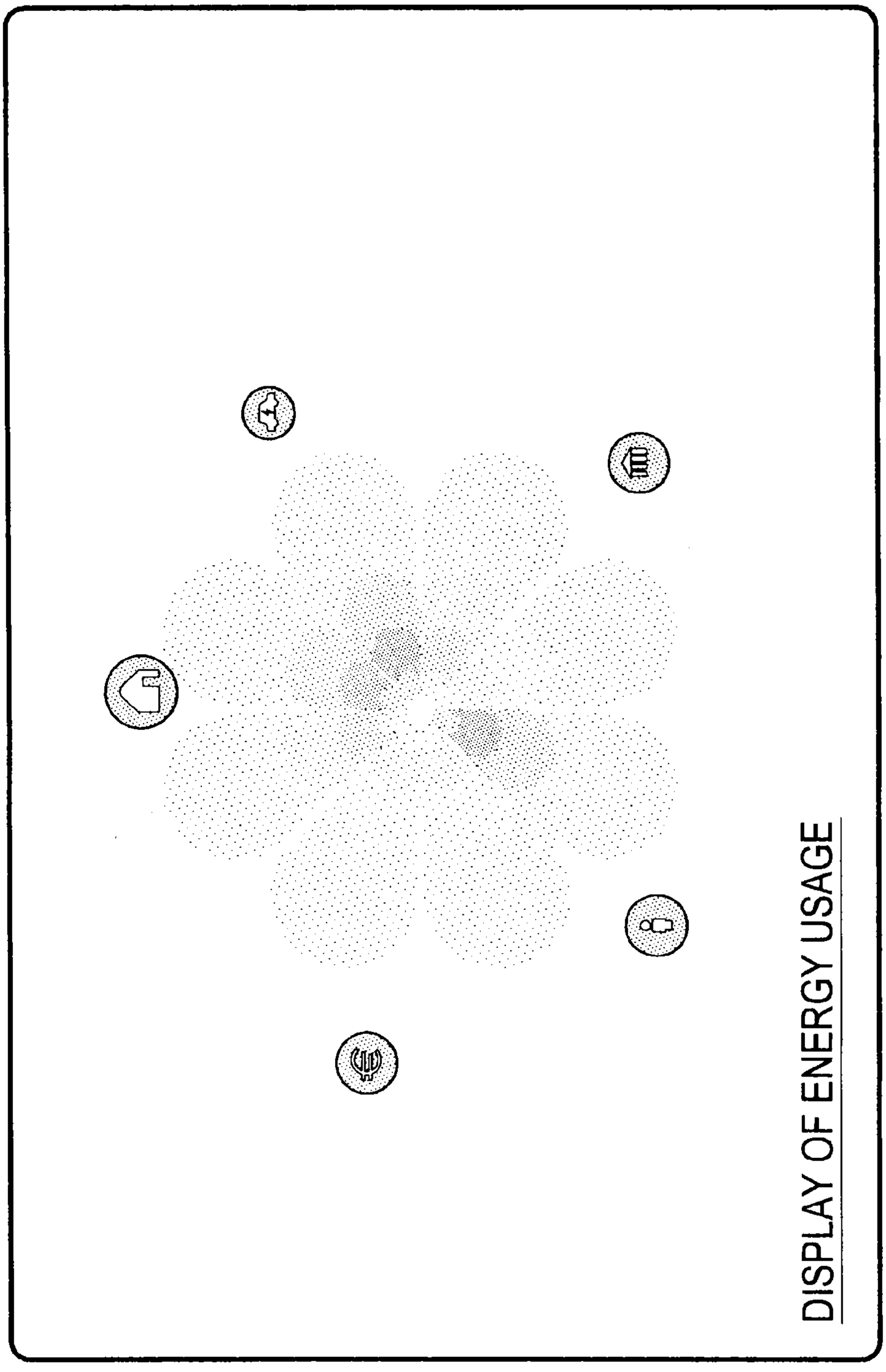


FIG.13

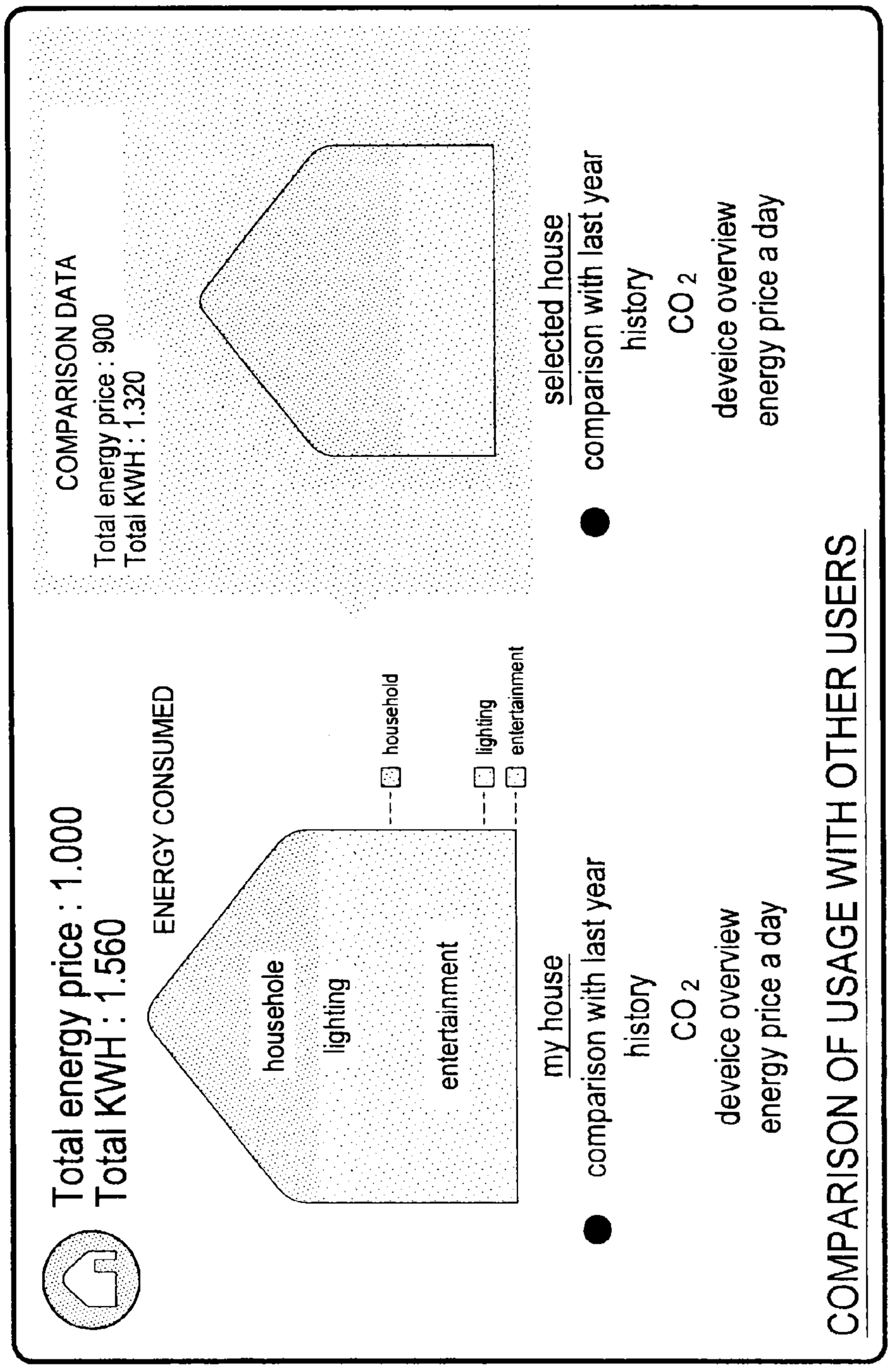

Total energy price : 1.000
Total KWH : 1.560
ENERGY CONSUMED
household
lighting
entertainment
household
lighting
entertainment
my house
comparison with last year
history
CO_2
deveice overview
energy price a day
COMPARISON DATA
Total energy price : 900
Total KWH : 1.320
selected house
comparison with last year
history
CO_2
deveice overview
energy price a day
COMPARISON OF USAGE WITH OTHER USERS

FIG.14

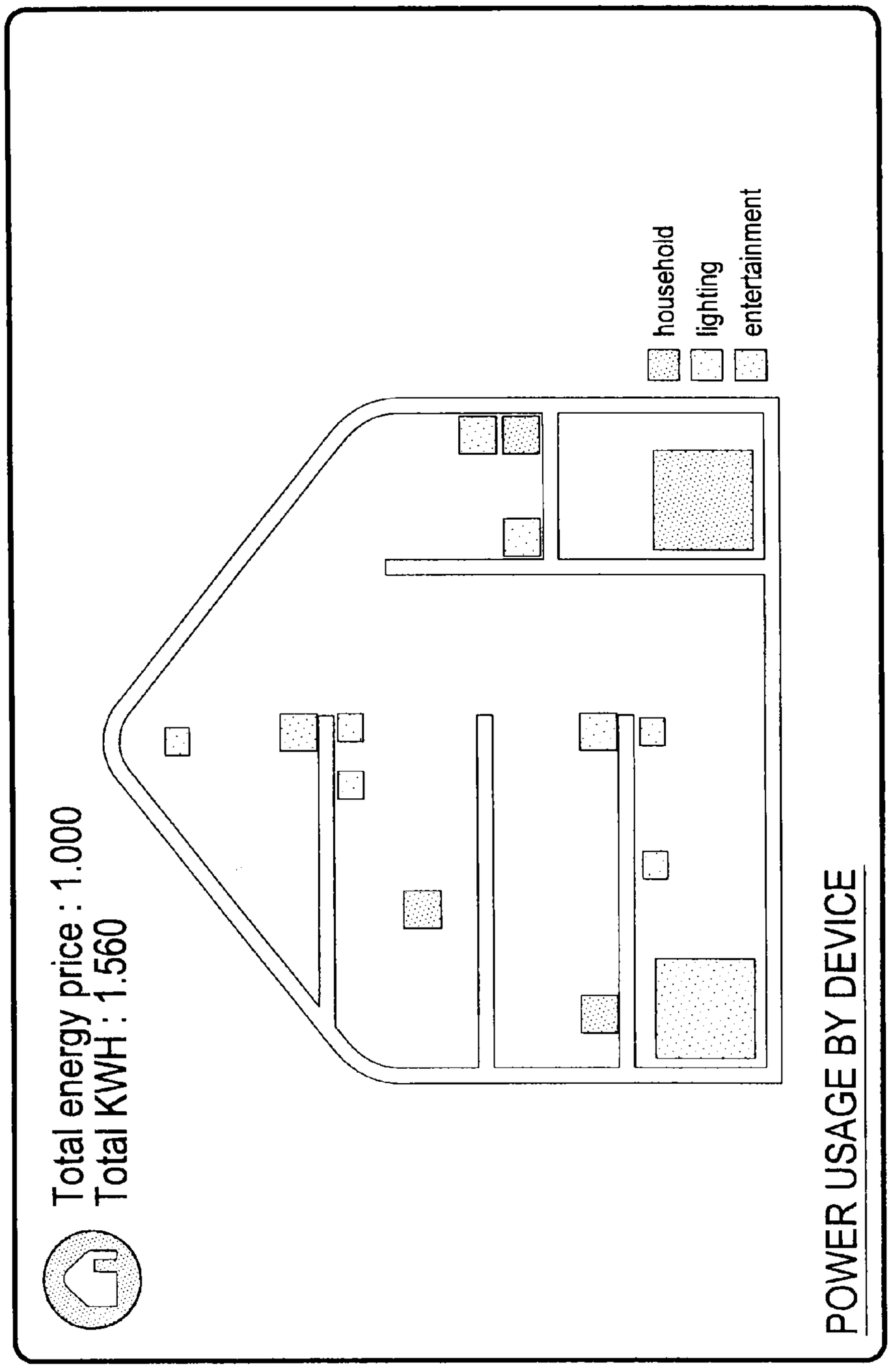

Total energy price : 1.000
Total KWH : 1.560
household
lighting
entertainment
POWER USAGE BY DEVICE

FIG.15

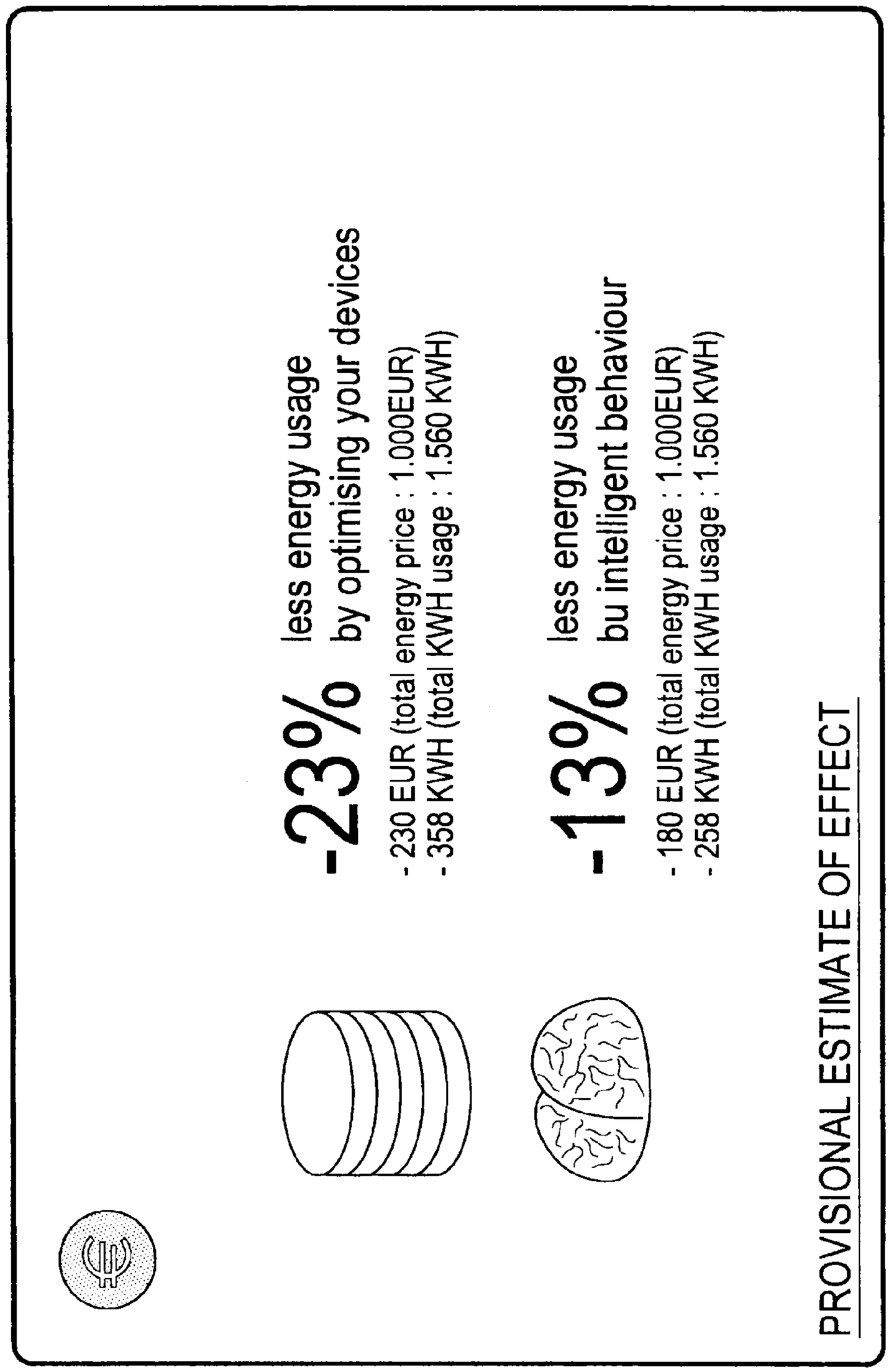

PROVISIONAL ESTIMATE OF EFFECT
-23%
less energy usage
by optimising your devices
- 230 EUR (total energy price : 1.000EUR)
- 358 KWH (total KWH usage : 1.560 KWH)
-13%
less energy usage
bu intelligent behaviour
- 180 EUR (total energy price : 1.000EUR)
- 258 KWH (total KWH usage : 1.560 KWH)

FIG.16

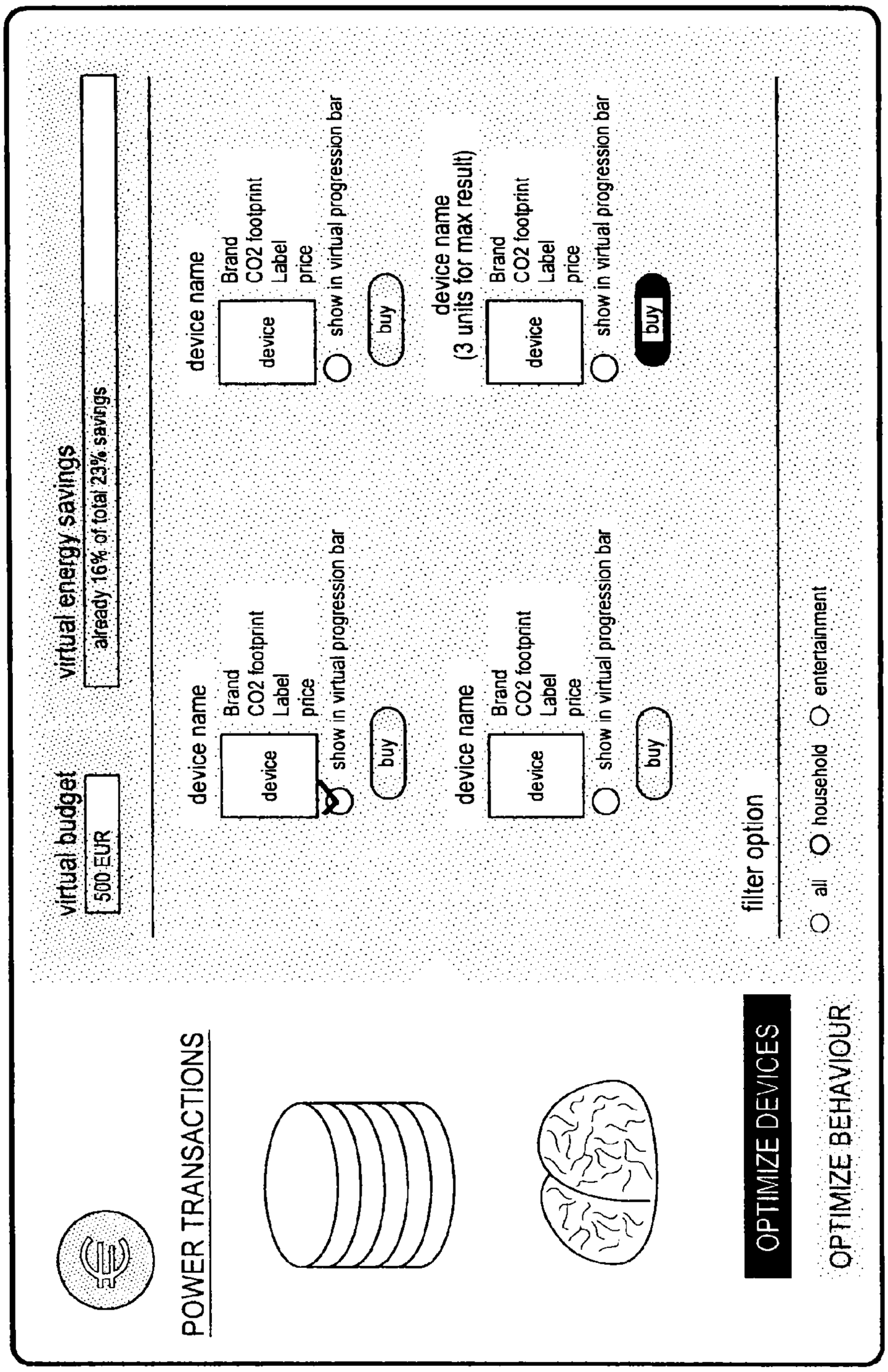

virtual budget
500 EUR
virtual energy savings
already 16% of total 23% savings
POWER TRANSACTIONS
device name
Brand
CO2 footprint
Label
price
device
show in virtual progression bar
buy
device name
(3 units for max result)
filter option
all
household
entertainment
OPTIMIZE DEVICES
OPTIMIZE BEHAVIOUR

FIG.17

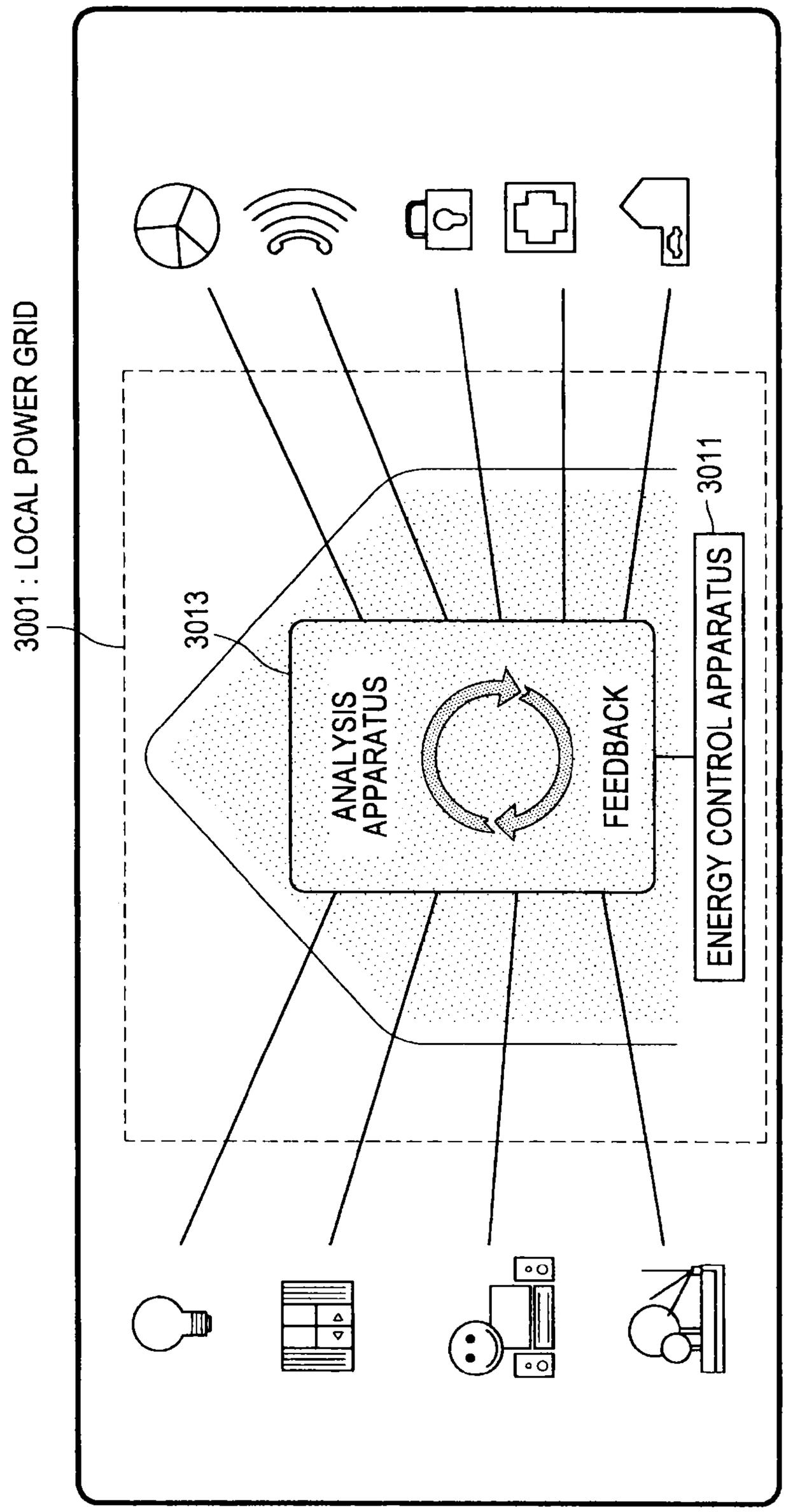

3001 : LOCAL POWER GRID
3013
ANALYSIS APPARATUS
FEEDBACK
3011
ENERGY CONTROL APPARATUS

FIG.18

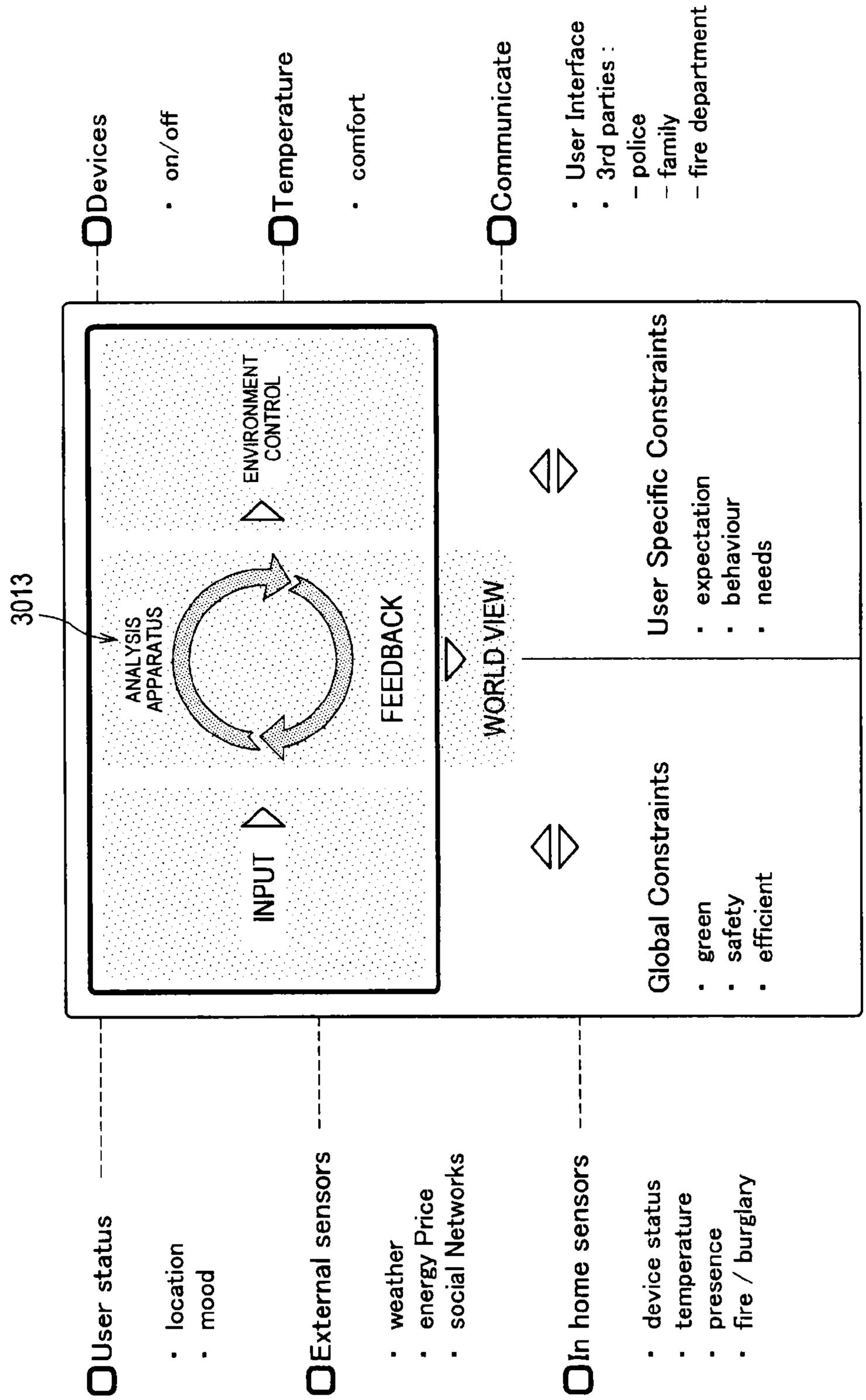
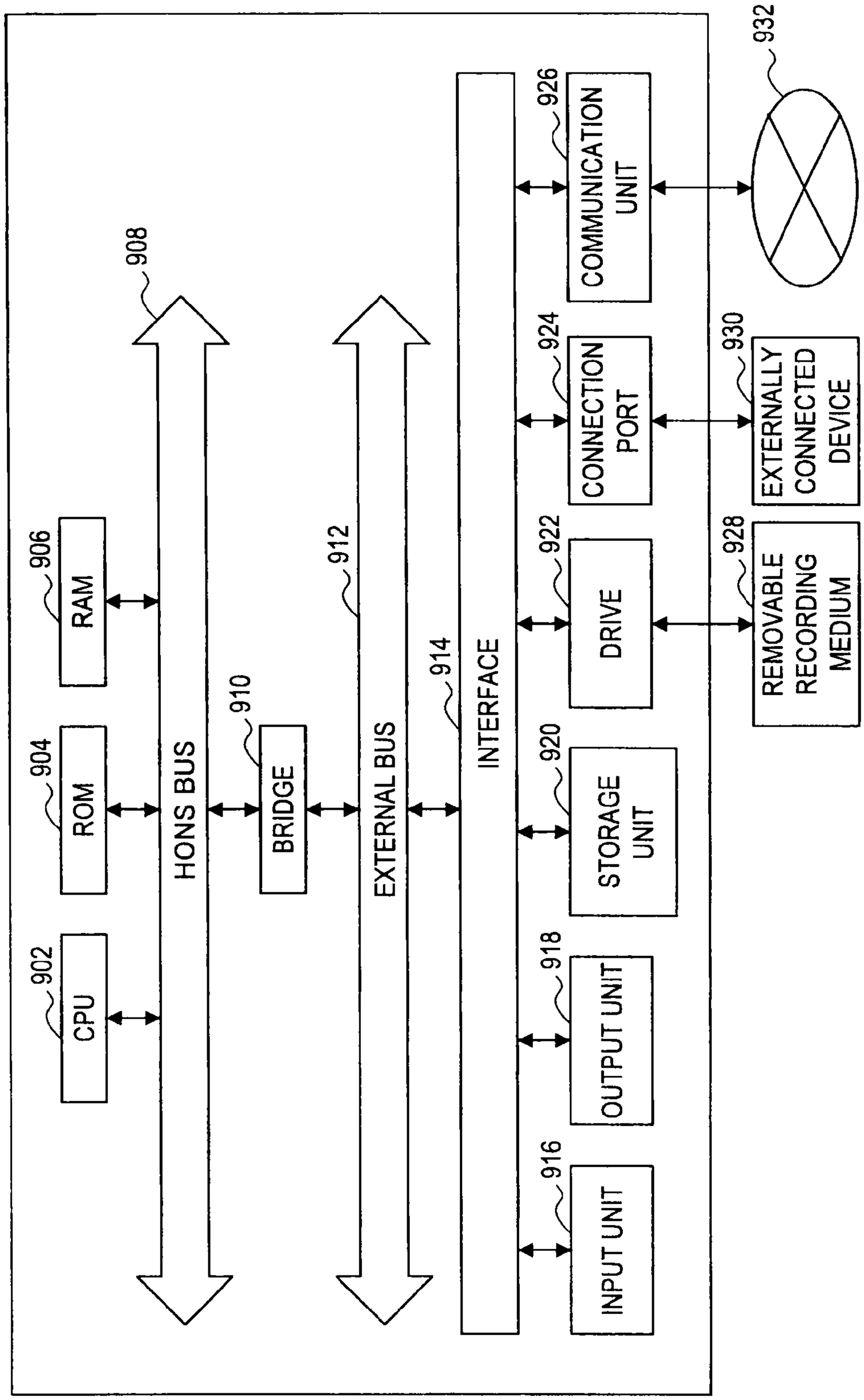

3013
ANALYSIS APPARATUS
INPUT
FEEDBACK
ENVIRONMENT CONTROL
WORLD VIEW
User status
location
mood
External sensors
weather
energy Price
social Networks
In home sensors
device status
temperature
presence
fire / burglary
Devices
on/off
Temperature
comfort
Communicate
User Interface
3rd parties :
police
family
fire department
Global Constraints
green
safety
efficient
User Specific Constraints
expectation
behaviour
needs

FIG.19


902
CPU
904
ROM
906
RAM
908
HONS BUS
910
BRIDGE
912
EXTERNAL BUS
914
INTERFACE
916
INPUT UNIT
918
OUTPUT UNIT
920
STORAGE UNIT
922
DRIVE
924
CONNECTION PORT
926
COMMUNICATION UNIT
928
REMOVABLE RECORDING MEDIUM
930
EXTERNALLY CONNECTED DEVICE
932

METHOD OF EFFICIENTLY MANAGING ENERGY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 13/164,758, filed Jun. 20, 2011, the entire contents of which are incorporated herein by reference. U.S. application Ser. No. 13/164,758 is a National Stage of PCT/JP2011/000229, filed Jan. 18, 2011, and claims the benefit of priority under 35 U.S.C. §119 of Japanese Application No. 2010-013690, filed Jan. 25, 2010.

TECHNICAL FIELD

[0002] The present invention relates to a method of efficiently managing energy.

BACKGROUND ART

[0003] In recent years, a technology called a smart grid has gained attention. The smart grid is a technical framework to realize efficient energy usage by constructing a new transmission network having a communication channel along with the transmission network and using the intelligent transmission network. The idea of the smart grid, as a background, is to realize efficient management of energy usage, swift handling of an incident when such an incident occurs, remote control of energy usage, distributed energy generation using energy generation facilities outside the control of an energy company, or charging management of an electric vehicle. Particularly, effective utilization of in-house energy generating stations using renewable energy by ordinary households or operators other than energy companies and charging management of various motor-driven movable bodies typically including electric vehicles have attracted considerable attention. Incidentally, renewable energy is energy generated without using fossil fuel.

[0004] Energy generated by ordinary households or operators other than energy companies is used by energy generation operators. Excessive energy after being used by the energy generation operators is currently purchased by energy companies. However, purchasing energy supplied from energy generation facilities outside the control of an energy company is a heavy burden to the energy company. For example, amount of energy supplied from photovoltaic energy generation facilities depends on the weather. Moreover, amount of energy supplied from in-house energy generating stations of ordinary households depends on energy usage of ordinary households that largely changes day by day. Thus, it is difficult for energy 'companies to receive stable energy supply from energy generation facilities outside the control of energy companies. For the above reason, it may be difficult for energy companies to purchase energy in the future.

[0005] Thus, a home battery initiative that uses energy generated by energy generation facilities outside the control of energy companies after being temporarily stored in batteries has recently gained attention. For example, a method of using energy generated by photovoltaic energy generation facilities by storing such energy in batteries and making up for shortages in the night or when the weather is bad is considered. Further, methods of limiting amount of energy received from an energy company in accordance with the battery storage amount and using energy stored in batteries in the daytime when energy rates are higher by storing energy in batteries supplied by an energy company in the night when energy rates are lower are considered. Batteries can store energy as DC, which eliminates the need for DC/AC conversion or AC/DC conversion during transmission so that losses during conversion can be reduced.

[0006] Thus, various expectations regarding energy management mingle with one another amid the smart grid initiative. To realize such energy management, the smart grid initiative is premised on having a communication channel along with a transmission network. That is, exchanging information about energy management by using the intelligent transmission network is assumed. However, in a region where a communication infrastructure has been built, instead of using a transmission network as a communication channel, information about energy management may be exchanged by using a network constructed by the deployed communication infrastructure. That is, what is important in the smart grid initiative is how efficiently to use energy generation facilities and storage facilities that are not managed in a unified manner.

[0007] In Patent Document I shown below, for example, a technology that detects a current waveform of a current consumed by each electronic device or the like as a characteristic amount from a plurality of electronic devices and sends the characteristic amount to a server is disclosed. Further, a technology by which a server that received a characteristic amount identifies individual electronic devices by comparing the received characteristic amount with characteristic quantities registered with a database in advance is disclosed. In the smart grid initiative, for example, energy supply control to the electronic device identified in this manner is exercised or information about energy consumption of electronic devices is collected.

CITATION LIST

Patent Literature

[0008] [PTL 1]

[0009] Japanese Patent Application Laid-Open No. 2008-109849

Technical Problem

[0010] However, when a user generates energy derived from renewable energy in the smart grid initiative, a concrete management method of whether it is more efficient to accumulate surplus energy for use or to sell energy is still unclear. Moreover, small-scale energy producers, consumers, and combined consumers/producers (hereafter referred to as "prosumers") have doubts about whether it is more efficient to be under the energy supply management of energy under the control of an energy supplier such as an energy company or to manage energy independently. Further, doubts about how to acquire information to reduce energy costs and whether such information can easily be acquired are present among users. In addition, users have deep doubts about what kind of energy management is preferable for individual users or each region, or worldwide.

[0011] The present invention has been made in view of the above issues and it is desirable to provide a novel and improved method of efficiently managing energy capable of realizing more efficient energy management by controlling a set of small-scale energy producers, consumers, and prosumers.

Solution to Problem

[0012] Accordingly, one aspect is directed to a method of managing energy. The method may comprise collecting information relating to amounts of energy stored by a plurality of members of a group, and relating to energy requirements of the members. The method may further comprise determining a price for distributing energy to a non-member of the group, determining whether to supply energy stored by the members to the non-member at the determined price, and issuing instructions to distribute energy upon determining that energy stored by the plurality of members should be supplied to the non-member.

[0013] Another aspect is directed to an apparatus for managing energy. The apparatus may comprise a collecting unit for collecting information relating to amounts of energy stored by a plurality of members of a group, and relating to energy requirements of the members. The apparatus may further comprise a prediction unit for determining a price for distributing energy to a non-member of the group. The apparatus may also comprise a managing unit for determining whether to supply energy stored by the members to the non-member at the determined price, and issuing instructions to distribute energy upon determining that energy stored by the plurality of members should be supplied to the non-member.

[0014] Another aspect is directed to a computer-readable storage medium storing instructions which, when executed by a processor, cause a computer to perform a method. The method may comprise collecting information relating to amounts of energy stored by a plurality of members of a group, and relating to energy requirements of the members. The method may further comprise determining a price for distributing energy to a non-member of the group, determining whether to supply energy stored by the members to the non-member at the determined price, and issuing instructions to distribute energy upon determining that energy stored by the plurality of members should be supplied to the non-member.

[0015] Yet another aspect is directed to method for transmitting energy by a member of an group of energy consumers. The method may comprise determining an amount of energy generated by a generating unit associated with the member. The method may further comprise issuing instructions to store unused generated energy in an energy storage unit associated with the member, and transmitting, in response to a request, information regarding the amount of stored energy in the energy storage device, and the energy requirements of the member. The method may also comprise receiving transmission instructions from a transmission controller, and distributing energy in accordance with the transmission instructions to a non-member of the group.

[0016] Accordingly, more efficient energy management can be realized by controlling a set of small-scale energy producers, consumers, and prosumers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** is an explanatory view showing a configuration example of a virtual energy generation/storage system;

[0018] FIG. **2** is an explanatory view showing an operation screen configuration example of an energy transaction management system;

[0019] FIG. **3** is an explanatory view showing an energy management method using batteries of an electronic vehicle;

[0020] FIG. **4** is an explanatory view exemplifying a display method of charging spot information;

[0021] FIG. **5** is an explanatory view exemplifying the display method of the charging spot information;

[0022] FIG. **6** is an explanatory view exemplifying the display method of battery status of the electronic vehicle;

[0023] FIG. **7** is an explanatory view exemplifying the display method of the battery status of the electronic vehicle;

[0024] FIG. **8** is an explanatory view showing a configuration example of an energy grid management system;

[0025] FIG. **9** is an explanatory view showing a breakdown of energy consumption in a local energy grid;

[0026] FIG. **10** is an explanatory view showing an effect of reducing energy consumption in the local energy grid;

[0027] FIG. **11** is an explanatory view showing the distribution of energy consumption by category in the local energy grid;

[0028] FIG. **12** is an explanatory view showing a display configuration example of energy uses in the local energy grid;

[0029] FIG. **13** is an explanatory view showing a comparison result of energy consumed in the local energy grid of another user;

[0030] FIG. **14** is an explanatory view showing energy usage by device;

[0031] FIG. **15** is an explanatory view showing a provisional estimate result of effect by energy management;

[0032] FIG. **16** is an explanatory view showing a configuration example of a user interface used for energy transactions;

[0033] FIG. **17** is an explanatory view illustrating the configuration of the local energy grid;

[0034] FIG. **18** is an explanatory view illustrating the configuration of the local energy grid; and

[0035] FIG. **19** is an explanatory view showing a hardware configuration example.

DESCRIPTION OF EMBODIMENTS

[0036] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the appended drawings. Note that, in this specification and the appended drawings, structural elements that have substantially the same function and structure are denoted with the same reference numerals, and repeated explanation of these structural elements is omitted.

[0037] (Explanation Items)

[0038] 1: First Embodiment

[0039] 1-1: Configuration of Virtual Energy Generation/Storage System **1000**

[0040] 1-1-1: Small-scale prosumers **1001**

[0041] 1-1-2: Service providing system **1004**

[0042] 1-2: Energy Management Method Using Electronic Vehicle **1016**

[0043] 2: Second Embodiment

[0044] 2-1: Configuration of Energy Management System

[0045] 2-1-1: Analyzer

[0046] 2:1-2: Recommended service

[0047] 3: Third Embodiment

[0048] 4: Hardware Configuration Example

I. First Embodiment

[0049] First, a first embodiment will be described. The present embodiment is directed to energy management of an aggregate formed of small-scale energy producers, consum-

ers, and "prosumers" (that is, a combined consumer and producer, or a microgrid) and an energy transaction method in a microgrid. Particularly, the present embodiment is concerned with a mechanism by which green energy produced and stored by small-scale prosumer or the like are bundled to realize an energy generation/storage mechanism of green energy and in which energy transactions are carried out. If the expression of "green energy" or "green energy" is used herein, the expression means energy or energy derived from renewable energy or energy or energy generated by using resources of low environmental load.

[0050] While the configuration of the virtual energy generation/storage system **1000** shown in FIG. **1** will be described in detail below as an example of a virtual energy generation/storage function of green energy, motivation leading to the invention of the above mechanism will be first summarized in brief. A prosumer has an energy generation unit. However, an energy generation unit that generates energy derived from renewable energy is assumed here. Such an energy generation unit continues to generate energy if energy generation conditions are met regardless of whether the prosumer uses energy thereof. Thus, if the prosumers do not use energy, energy generated by the energy generation unit will be wasted. Therefore, the prosumer desires to effectively use energy generated under the circumstances when energy is not used.

[0051] One method of effectively using energy generated under the circumstances when the prosumer does not use energy is to provide an accumulation unit to accumulate energy generated by the energy generation unit therein while no energy is used. Another method thereof is to sell energy generated by the energy generation unit while no energy is used to an energy company or the like. Here, the prosumer considers whether it is more efficient to accumulate energy generated by the energy generation unit while no energy is used and to use the energy later or to sell energy to an energy company or the like, but it is difficult to find the best method.

[0052] When energy is sold to an energy company or the like, transactions are often carried out based on an energy rate determined by an energy company or the like, which could result in sales of energy at an unreasonably low price.

[0053] In view of such circumstances, the inventors of the present invention invented a mechanism by which small-scale prosumers are grouped to enable transactions in the group. The very mechanism is the virtual energy generation/storage system **1000**. Thus, by grouping small-scale prosumers to enable exchanges of energy in the group, energy of a prosumer can be sold to other prosumers while the prosumer does not use energy or the prosumer can receive energy of other prosumers while the other prosumers do not user energy. By enabling supply and reception of energy between prosumers in this manner, it is assumed to be able to sell energy at a price higher or to purchase energy at a price lower than an energy rate determined by an energy company or the like as well as wasting no energy generated by the energy generation unit.

[0054] (1-1: Configuration of Virtual Energy Generation/Storage System **1000**)

[0055] The configuration of the virtual energy generation/storage system **1000** according to the present embodiment will be described below with reference to FIG. **1**. FIG. **1** is an explanatory view showing a configuration example of the virtual energy generation/storage system **1000** according to the present embodiment.

[0056] As shown in FIG. **1**, the virtual energy generation/storage system **1000** is constituted of the small-scale prosumers **1001**, a prosumer group **1002**, a wide-area network **1003**, and the service providing system **1004**. The prosumer group **1002** is an aggregate of a plurality of small-scale prosumers **1001** mutually connected by a communication network and an energy grid. While the prosumer group **1002** and the small-scale prosumers **1001** are separately shown in the example in FIG. **1**, the small-scale prosumers **1001** actually constitute members of the prosumer group **1002**.

[0057] An energy supplier **1005** is present outside the virtual energy generation/storage system **1000** and the prosumer group **1002** can receive energy from the energy supplier **1005**. The wide-area network **1003** is an information network such as the Internet. The energy supplier **1005** is an energy company or the like.

[0058] In the virtual energy generation/storage system **1000**, energy inside the prosumer group **1002** is managed by the service providing system **1004**. For example, the service providing system **1004** adds the small-scale prosumer **1001** to the prosumer group **1002** or deletes the small-scale prosumer **1001** from the prosumer group **1002**.

[0059] The service providing system **1004** also carries out energy transactions of energy stored by the predetermined small-scale prosumer **1001** or arbitrary energy stored inside the prosumer group **1002**. For example, the service providing system **1004** sells energy, stored by the predetermined small-scale prosumer **1001** or arbitrary energy stored inside the prosumer group **1002** when the energy rate is at a peak price, to non-members of prosumer group **1002**.

[0060] The service providing system **1004** also manages purchases and sales of energy, and exchanges (distribution) of energy between members inside the prosumer group **1002**. That is, the service providing system **1004** provides energy transaction service inside the prosumer group **1002**, where a member may receive energy from another member for storing. Incidentally, the service providing system **1004** may be configured to be able to purchase or sell energy on the energy transaction market outside the virtual energy generation/storage system **1000** or with the energy supplier **1005**. Further, the service providing system **1004** may provide a prediction service of the energy rate.

[0061] In the foregoing, the configuration of the virtual energy generation/storage system **1000** has been described.

[0062] (1-1-1: Small-Scale Prosumers **1001**)

[0063] The small-scale prosumer **1001** will be described in more detail. As shown in FIG. **1**, the small-scale prosumer **1001** includes a green generator **1011**, an energy control apparatus **1012**, a controller **1013**, an accumulation apparatus **1014**, and a display unit **1015**.

[0064] The green generator **1011** is an energy generation unit that generates energy derived from renewable energy or an energy generation unit that generates energy by using resources of low environmental load. Examples of the green generator **1011** include, for example, photovoltaic energy generators, wind turbine generators, geothermal energy generators, fuel cells, biomass energy generators, and atomic energy generators.

[0065] The energy control apparatus **1012** stores energy generated by the green generator **1011** in the accumulation apparatus **1014**, transmits energy generated by the green generator **1011** to the other small-scale prosumers **1001**, or transmits energy generated by the green generator **1011** to non-members of the prosumer group **1002**. The energy control

apparatus **1012** also transmits energy stored in the accumulation apparatus **1014** to the other small-scale prosumers **1001**, to energy supplier **1005**, and to a non-member of the prosumer group **1002**. The energy control apparatus **1012** may determine an amount of energy generated by the green generator **1011**, and may store unused generated energy in accumulation apparatus **1014**. Energy control apparatus **1012** also controls charging and discharging of batteries of the electronic vehicle **1016** in the same manner as the accumulation apparatus **101.4**. However, the operation of the energy control apparatus **1012** is controlled by the controller **1013**.

[0066] The controller **1013** receives instructions and determines a transmission destination of energy by the energy control apparatus **1012** or controls the energy control apparatus **1012** so that energy is transmitted to the transmission destination. The controller **1013** also has a function of communicating with the service providing system **1004**. Responsive to a request for information from the service providing system **1004**, the controller **1013** transmits information such as an amount of energy generated by the green generator **1011**, an amount of accumulated energy stored in the accumulation apparatus **1014**, or energy requirements of small-scale prosumer **1001** to the service providing system **1004**. Upon receiving an instruction from the service providing system **1004**, controller **1013** may control the energy control apparatus **1012** to transmit energy to a non-member of prosumer group **1002** at a location designated by a received transmission destination.

[0067] Further, the controller **1013** displays information about energy transactions, information about a discharged amount or accumulated energy, information provided by the service providing system **1004**, or information about the residual quantity of battery, the distance that can still be traveled and the like of the electric vehicle **1016** in the display unit **1015**. The controller **1013** has an input unit (not shown) to input information provided therein. The user uses the input unit to input instructions into the controller **1013** of storage of energy in the accumulation apparatus **1014**, use or sales of energy stored in the accumulation apparatus **1014**, or use or sales of energy generated by the green generator **1011**. As the input unit, for example, a user interface (transaction screen example) shown in FIG. **2** is used.

[0068] In the foregoing, the small-scale prosumers **1001** have been described.

[0069] (1-1-2: Service providing System **1004**)

[0070] Next, the service providing system **1004** will be described in more detail. As shown in FIG. **1**, the service providing system **1004** includes a service providing server **1041**, an energy price prediction server **1042**, and a transaction management server **1043**.

[0071] The service providing server **1041**, or collecting unit, collects information relating to amounts of energy stored by a plurality of members of prosumer group **1002**, and also information relating to energy requirements of prosumer group **1002**. For example, service providing server **1041** may collect information about generated energy or accumulated energy from the controller **1013** held by the individual small-scale prosumers **1001** or issues instructions to the controller **1013** concerning the transmission destination of energy generated by the green generator **1011** or the transmission destination of energy stored in the accumulation apparatus **1014**. Further, the service providing server **1041** manages addition/deletion of the small-scale prosumer **1001** to/from the prosumer group **1002**. The service providing server **1041** further manages information such as accumulated energy and generated energy inside the prosumer group **1002**.

[0072] The energy price prediction server **1042**, or prediction unit, may determine a price for the distribution of energy, such as to a non-member of prosumer group **1002**. For example, energy price prediction server **1042** may predict the energy rate in the future from changes in price of energy whose transactions are carried out inside the prosumer group **1002**. In this case, the energy price prediction server **1042** predicts the energy rate based on the energy rate presented by the energy supplier **1005** or market data of an external energy transaction market. The energy price prediction server **1042** may also be configured to be able to predict the energy rate on an external energy transaction market based on market data of the energy transaction market.

[0073] The transaction management server **1043**, or managing unit, determines the price at which transactions regarding distribution of energy should be carried out inside the prosumer group **1002**. That is, transaction management server **1043** may determine whether to supply energy, such as to a non-member of prosumer group **1002**, at the determined price. Transaction management server **1043** accepts a selling order or purchase order input by the individual small-scale prosumers **1001** via the controller **1013**, and manages the success or failure of transactions, based on factors such as the determined price if a transaction is made via the service providing server **1041**, the transaction management server **1043** may determine whether to supply energy at a determined price, and issue instructions, to the controller **1013** of the small-scale prosumer **1001** that has placed a selling order, to distribute energy, such as to another member or non-member of prosumer group **1002**. Transaction management server **1043** may also issue instructions to the controller **1013** of the small-scale prosumer **1001** that has placed a purchase order to receive energy.

[0074] In the foregoing, the service providing system **1004** has been described.

[0075] (1-2: Energy Management Method Using Electronic Vehicle **1016**)

[0076] Next, the energy management method using the electronic vehicle **1016** will be described with reference to FIG. **3**. FIG. **3** is an explanatory view illustrating the energy management method using the electronic vehicle **1016**. As the electronic vehicle **1016**, for example, an electric car, electric bike, electric bicycle, electric ship, or electric plane can be raised.

[0077] As shown in FIG. **3**, the electronic vehicle **1016** has a battery **1017**, a controller **1018**, and a display unit **1019** mounted thereon. The electronic vehicle **1016** uses energy stored in the battery **1017** to operate a driving mechanism (not shown). The electronic vehicle **1016** is constructed so that energy of the battery **1017** can be transmitted to the outside by receiving control of the controller **1018**. Like the controller **1013** held by the small-scale prosumers **1001**, the controller **1018** can communicate with the service providing system **1004**. The controller **1018** also transmits accumulated energy of the battery **1017** to the service providing system **1004**.

[0078] When viewed from the whole prosumer group **1002**, the battery **1017** of the electronic vehicle **1016** can be considered a very large energy storage system. Further, the electronic vehicle **1016** is movable and thus, the battery **1017** of the electronic vehicle **1016** can be considered an energy moving system. For example, a use form in which the electronic vehicle **1016** charged at home is moved to a shopping area or

office to use energy of the battery **1017** at that place can also be considered. For the electronic vehicle **1016**, however, there is a danger that the electronic vehicle **1016** may become unable to run on its own if energy of the battery **1017** is consumed in a place in which changing is unavailable. Therefore, it is necessary to pay attention to use of the battery **1017** of the electronic vehicle **1016**.

[0079] Incidentally, the method of using the battery **1017** of the electronic vehicle **1016** is not limited to simply using energy at a movement destination and it is better to put use of energy of the battery **1017** for energy transactions in perspective. However, even the case where transactions of energy stored in the battery **1017** of the electronic vehicle **1016** are carried out is basically the same as the case where transactions of energy of the accumulation apparatus **1014** held by the small-scale prosumers **1001** are carried out. However, the case of the electronic vehicle **1016** is different from the case where energy of the accumulation apparatus **1014** or the like is used for transaction in that the electronic vehicle **1016** can be moved to an energy selling spot where energy can be sold. Thus, this point will be described.

[0080] As described above, the electronic vehicle **1016** can move to an energy selling spot. A case where energy is sold by transmitting energy to the energy selling spot from the battery **1017** of the electronic vehicle **1016** that has reached the energy selling spot will be considered. In this case, the electronic vehicle **1016** can sell surplus energy after leaving energy necessary to reach a charging spot of energy stored in the battery **1017**. However, it is difficult for the user to correctly know how much energy is necessary to reach a charging spot. Thus, a mechanism to display electric energy that can be sold in an easily understandable manner to the user is demanded.

[0081] Thus, the inventors of the present invention devised a display configuration as shown in FIGS. **4** to **7**. FIG. **4** shows, in part A, information about charging spots relative to the current spot of the electronic vehicle **1016**. FIG. **4** shows, in part B, the residual quantity of the battery **1017** and accumulated energy necessary for the electronic vehicle **1016** to reach a charging spot. FIG. **5** is an enlargement of part B of FIG. **4**. An enlarged display like FIG. **5** may be made when the position of (B) on the screen of FIG. **4** is touched or clicked.

[0082] As shown in FIGS. **4** and **5**, the user can easily know surplus energy by map information of charging spots relative to the current spot of the electronic vehicle **1016**, reachable areas, the residual quantity of the battery **1017**, and the residual quantity of the battery **1017** necessary to reach the nearest charging spot being shown to the user. However, the example in FIGS. **4** and **5** shows that there is no surplus energy and the residual quantity of the battery **1017** is in a state that does not allow the electronic vehicle **1016** to reach the nearest charging spot. In this case, it is necessary to charge the battery **1017** by some other means.

[0083] On the other hand, FIG. **6**A shows information about energy selling spots relative to the current spot of the electronic vehicle **1016**. FIG. **6**B shows the residual quantity of the battery **1017** and surplus energy obtained by subtracting accumulated energy necessary for the electronic vehicle **1016** to reach a charging spot from the residual quantity. FIG. **7** is an enlargement of FIG. **6**B. An enlarged display like FIG. **7** may be made when the position of (B) on the screen of FIG. **6** is touched or clicked. As shown in FIGS. **6** and **7**, the user can easily know energy that can be sold by map information of energy selling spots relative to the current spot of the electronic vehicle **1016**, the residual quantity of the battery **1017**, and surplus energy obtained by subtracting the residual quantity of the battery **1017** necessary to reach the nearest charging spot being shown to the user.

[0084] The displays shown in FIGS. **4** to **7** may be configured to be switchable. Information indicating the current spot of the electronic vehicle **1016** is obtained by the electronic vehicle **1016** via a GPS or the like and sent to the service providing server **1041**. Map information relative to the current spot thereof and information about charging spots and energy selling spots are acquired by the service providing server **1041**. Further, information about movable areas based on the residual quantity of the battery **1017** is calculated by the service providing server **1041**. Then, the map information, information about charging spots, information about energy selling spots, and information about movable areas are sent to the controller **1018** of the electronic vehicle **1016** and displayed in the display unit **1019**.

[0085] In the foregoing, the energy management method using the electronic vehicle **1016** has been described.

[0086] As described above, by grouping and managing the small-scale prosumers **1001**, energy generated by the green generator **1011** can be used efficiently and further transactions of energy can be carried out under relatively favorable conditions. Further, by placing the battery **1017** of the electronic vehicle **1016** under control, a new use form of energy, which is an energy transaction using a movement energy source, is created.

2: Second Embodiment

[0087] Next, a second embodiment will be described. The present embodiment concerns a configuration that enables the user to easily view the state of use of energy and supports the reduction in energy costs. However, the present embodiment provides a mechanism that not simply presents energy usage to the user, but' also analyzes the state of use of energy by the user to present an analysis result thereof to the user. The present embodiment also provides a mechanism that makes improvement proposals of the user environment based on the analysis result or recommends a method of improving efficiency in energy use.

[0088] By providing such a mechanism, reference information to solve questions such as how much energy a device uses wastefully, which devices should be replaced by other devices, how much energy efficiency is improved if replaced by other devices, and how much capital investment is effective are obtained. Moreover, by allowing energy control of devices to be automatically exercised using the above analysis results, when compared with a case where the user manually replaces devices or limits energy use, higher energy saving is achieved. Also, energy use can be made more efficient based on information not easily available to the user.

[0089] (2-1: Configuration of Energy Management System **2000**)

[0090] First, the configuration of an energy grid control system **2000** according to the present embodiment will be described with reference to FIG. **8** and a method of analyzing the state of use of energy by the user will be described therein. As shown in FIG. **8**, the energy grid control system **2000** includes a local energy grid **2001**, an energy grid **2002**, a wide-area network **2003**, and a service providing system **2004**. In the example in FIG. **8**, different numerals and names are given to components substantially the same as those in the

first embodiment to make an understanding of technical content in the present embodiment easier.

[0091] As shown in FIG. **8**, the local energy grid **2001** includes an energy control apparatus **2011** and an analyzer **2012**. The energy control apparatus **2011** is a control unit that controls energy supply to some device inside the local energy grid **2001**. If an accumulation unit is contained in the local energy grid **2001** as a device, the energy control apparatus **2011** also controls charging and discharging. The analyzer **2012** is a unit that acquires information (hereinafter, device information) about energy usage of devices connected to the local energy grid **2001**, use time zones, life time of devices, energy efficiency of devices and the like to analyze the acquired device information.

[0092] The energy control apparatus **2011** and the analyzer **2012** are connected to the service providing system **2004** via the wide-area network **2003**. The energy control apparatus **2011** transmits device information to the service providing system **2004**. The analyzer **2012** transmits analysis results to the service providing system **2004**. Such device information analysis results are received by a service providing server **2041** present in the service providing system **2004**.

[0093] As shown in FIG. **8**, the service providing system **2004** includes the service providing server **2041**, a recommendation server **2042**, and a database **2043**. The service providing system **2004** collects device information in the local energy grid **2001** transmitted from the energy control apparatus **2011**. The service providing server **2041** controls the energy control apparatus **2011** based on the collected device information and to exercise energy control of each device in the local energy grid **2001**.

[0094] The recommendation server **2042** presents a recommended energy management pattern or devices to be replaced to the user based on analysis results received from the analyzer **2012** via the service providing server **2041**. In doing this, the recommendation server **2042** refers to information about devices stored in the database **2043**. The database **2043** stores device information about existing devices of various brands. Thus, the recommendation server **2042** can recommend information about high-performance devices by comparing device collected by the energy control apparatus **2011** and device information stored in the database **2043**.

[0095] For example, the recommendation server **2042** transmits information about a recommended energy management pattern or devices to be replaced to the analyzer **2012** to cause a display unit (not shown) of the analyzer **2012** to display the information. The recommendation server **2042** may also be encouraged to advertise recommended devices to the user in a tie-up with a mail-order house or the like of devices.

[0096] For example, the methods shown in FIGS. **9** to **15** are known as display methods of energy information in the local energy grid **2001**. FIG. **9** shows what factors decide energy consumption in the local energy grid **2001**. FIG. **10** shows how much energy usage can be reduced in the local energy grid **2001**. FIG. **11** shows energy consumption by category in the local energy grid **2001**. Categories include, for example, household appliances, lighting, and entertainment (for example, video devices and music players).

[0097] FIG. **12** shows a display configuration visually representing energy uses. FIG. **13** shows a comparison with energy usage in the local energy grid **2001** of another user. FIG. **14** shows energy usage by device in the local energy grid **2001**. With the installation locations and uses of devices clearly shown as in FIG. **14**, it is obvious to the user which device to replace and to which device to pay attention to keep watch on energy consumption.

[0098] FIG. **15** compares efficiency when the user attempts to efficiently use energy manually and when the user automatically promotes efficient energy uses by using analysis results by the analyzer **2012**. Thus, it becomes evident by applying the analysis method that it is more efficient to automatically exercise energy control of each device by the energy control apparatus **2011** using analysis results than to diligently turn on and turn off devices manually by the user. FIG. **16** shows a user interface for selling energy used when energy transactions are carried out.

3: Third Embodiment

[0099] (3-1: Efficient Environment Control)

[0100] A local energy grid **3001** according to the present embodiment will be described with reference to FIGS. **17** and **18**. FIGS. **17** and **18** are explanatory views illustrating the local energy grid **3001** according to the present embodiment.

[0101] The local energy grid **3001** according to the present embodiment includes, as illustrated in FIG. **17**, an energy control apparatus **3011** and an analyzer **3013**. The local energy grid **3001** according to the present embodiment has one or a plurality of electronic devices (not shown) whose energy supply is managed by the energy control apparatus **3011** provided therein. The local energy grid **3001** also has various green generators (not shown) and an accumulation apparatus (not shown) to store energy generated by the green generators provided therein. The local energy grid **3001** also has various sensors to acquire information about the installation environment in which the local energy grid **3001** is installed provided therein.

[0102] The green generator is an energy generation unit that generates energy derived from renewable energy or an energy generation unit that generates energy by using resources of low environmental load. Examples of the green generator include, for example, photovoltaic energy generators, wind turbine generators, geothermal energy generators, fuel cells, biomass energy generators, and atomic energy generators.

[0103] The accumulation apparatus stores energy generated by green generators or transmits such energy to the other local energy grid **3001**.

[0104] The energy control apparatus **3011** also controls electronic devices, green generators, and the accumulation apparatus provided in the local energy grid **3001**.

[0105] The analyzer **3013** has a function of acquiring information about electronic devices present inside the local energy grid **3001**, information about the installation environment of the energy grid and/or information about transactions of energy generated in the energy grid. The analyzer **3013** analyzes conditions of use and the state of use of electronic devices connected to the energy grid based on the acquired information and setting information (for example, setting information set by the user) for the energy grid. The analyzer **3013** also controls electronic devices based on analysis results via the energy control apparatus **3011**.

[0106] The local energy grid **3001** uses these apparatuses to monitor or analyze various kinds of information or to behave based on analysis results. Energy is controlled by saving energy. Various kinds of comfort, pleasure, or entertainment can be provided to the user. Moreover, safety is provided and monitored by providing various kinds of security to the user

and others. Services of medical care/health care can also be provided. Further, communication with third parties can be promoted via various external servers or the like.

[0107] FIG. **18** illustrates various kinds of information acquired by the analyzer **3013** together. The analyzer **3013** analyzes detected/acquired information (input information) based on global restrictions or user characteristics set by the user and controls devices or the environment based on an analysis result thereof. The analyzer **3013** can also make various analyses based on statistical data or the like acquired from outside and also make heuristic analyses using various kinds of history information of acquired data.

4: Hardware Configuration Example

[0108] The function of each component held by the controllers **1013**, **1018** and the service providing system **1004** can be realized by using, for example, the hardware configuration of the information processing apparatus shown in FIG. **19**. That is, the function of each component is realized by controlling the hardware shown in FIG. **19** using a computer program. The form of the hardware is arbitrary and, for example, a mobile information terminal such as a personal computer, mobile phone, PHS, and PDA, a game machine, and various home information appliances are contained therein. The PHS is an abbreviation of Personal Handy-phone System. The PDA is an abbreviation of Personal Digital Assistant.

[0109] As shown in FIG. **19**, this hardware mainly includes a CPU **902**, a ROM **904**, a RAM **906**, a host bus **908**, and a bridge **910**. Furthermore, this hardware includes an external bus **912**, an interface **914**, an input unit **916**, an output unit **918**, a storage unit **920**, a drive **922**, a connection port **924**, and a communication unit **926**. Moreover, the CPU is an abbreviation for Central Processing Unit. Also, the ROM is an abbreviation for Read Only Memory. Furthermore, the RAM is an abbreviation for Random Access Memory.

[0110] The CPU **902** functions as an arithmetic processing unit or a control unit, for example, and controls an entire operation or a part of the operation of each structural element based on various programs recorded on the ROM **904**, the RAM **906**, the storage unit **920**, or a removal recording medium **928**. The ROM **904** is means for storing, for example, a program to be loaded on the CPU **902** or data or the like used in an arithmetic operation. The RAM **906** temporarily or perpetually stores, for example, a program to be loaded on the CPU **902** or various parameters or the like arbitrarily changed in execution of the program.

[0111] These structural elements are connected to each other by, for example, the host bus **908** capable of performing high-speed data transmission. For its part, the host bus **908** is connected through the bridge **910** to the external bus **912** whose data transmission speed is relatively low, for example. Furthermore, the input unit **916** is, for example, a mouse, a keyboard, a touch panel, a button, a switch, or a lever. Also, the input unit **916** may be a remote control that can transmit a control signal by using an infrared ray or other radio waves.

[0112] The output unit **918** is, for example, a display device such as a CRT, an LCD, a PDP or an ELD, an audio output device such as a speaker or headphones, a printer, a mobile phone, or a facsimile, that can visually or auditorily notify a user of acquired information. Moreover, the CRT is an abbreviation for Cathode Ray Tube. The LCD is an abbreviation for Liquid Crystal Display. The PDP is an abbreviation for Plasma Display Panel. Also, the ELD is an abbreviation for Electro-Luminescence Display.

[0113] The storage unit **920** is a device for storing various data. The storage unit **920** is, for example, a magnetic storage device such as a hard disk drive (HDD), a semiconductor storage device, an optical storage device, or a magneto-optical storage device. The HDD is an abbreviation for Hard Disk Drive.

[0114] The drive **922** is a device that reads information recorded on the removal recording medium **928** such as a magnetic disk, an optical disk, a magneto-optical disk, or a semiconductor memory, or writes information in the removal recording medium **928**. The removal recording medium **928** is, for example, a DVD medium, a Blu-ray medium, an HD-DVD medium, various types of semiconductor storage media, or the like. Of course, the removal recording medium **928** may be, for example, an IC card on which a non-contact IC chip is mounted or an electronic device. The IC is an abbreviation for Integrated Circuit.

[0115] The connection port **924** is a port such as an USB port, an IEEE1394 port, a SCSI, an RS-232C port, or a port for connecting an externally connected device **930** such as an optical audio terminal. The externally connected device **930** is, for example, a printer, a mobile music player, a digital camera, a digital video camera, or an IC recorder. Moreover, the USB is an abbreviation for Universal Serial Bus. Also, the SCSI is an abbreviation for Small Computer System Interface.

[0116] The communication unit **926** is a communication device to be connected to a network **932**, and is, for example, a communication card for a wired or wireless LAN, Bluetooth (registered trademark), or WUSB, an optical communication router, an ADSL router, or various communication modems. The network **932** connected to the communication unit **926** is configured from a wire-connected or wirelessly connected network, and is the Internet, a home-use LAN, infrared communication, visible light communication, broadcasting, or satellite communication, for example. Moreover, the LAN is an abbreviation for Local Area Network. Also, the WUSB is an abbreviation for Wireless USB. Furthermore, the ADSL is an abbreviation for Asymmetric Digital Subscriber Line.

[0117] It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

[0118] In the above description, the management method, transaction method, analysis method and the like mainly intended for energy have been described, but the technical scope of the present invention is not necessarily limited to energy and is similarly applicable to the management method, transaction method, analysis method and the like of other energy.

REFERENCE SIGNS LIST

[0119] **1000** Virtual energy generation/storage system
[0120] **1001** Small-scale prosumer
[0121] **1011** Green generator
[0122] **1012** Energy control apparatus
[0123] **1013** Controller
[0124] **1014** Accumulation apparatus
[0125] **1015** Display unit
[0126] **1016** Electronic vehicle
[0127] **1017** Battery

[0128] **1018** Controller
[0129] **1019** Display unit
[0130] **1002** Prosumer group
[0131] **1003** Wide-area network
[0132] **1004** Service providing system
[0133] **1041** Service providing server
[0134] **1042** Energy price prediction server
[0135] **1043** Transaction management server
[0136] **1005** Energy supplier
[0137] **2000** Energy grid control system
[0138] **2001** Local energy grid
[0139] **2011** Energy control apparatus
[0140] **2012** Analyzer
[0141] **2002** Energy grid
[0142] **2003** Wide-area network
[0143] **2004** Service providing system
[0144] **2041** Service providing server
[0145] **2042** Recommendation server
[0146] **2043** Database

1. (canceled)

2. An apparatus for managing a usage of energy by an electric vehicle having a display and a battery capable of storing the energy, the apparatus comprising:

circuitry configured to

acquire information about a position of the electric vehicle, a selected destination of the electric vehicle, and an amount of the energy stored in the battery;

determine an amount of the energy needed to reach the selected destination;

perform a comparison between the amount of the energy needed to reach the selected destination and the amount of the energy stored in the battery; and

control the display to display an indication of the comparison.

3. The apparatus of claim **2**, wherein the circuitry is further configured to control the display to display a current driving range of the electric vehicle.

4. The apparatus of claim **2**, wherein the circuitry is configured such that the indication comprises an indication of an amount of a difference between the amount of the energy needed to reach the selected destination and the amount of the energy stored in the battery, the difference being shown relative to an entire capacity of the battery.

5. The apparatus of claim **2**, wherein the circuitry is further configured to display a location of at least one charging station within a current driving range of the position of the electric vehicle.

6. The apparatus of claim **5**, wherein the circuitry is configured such that the indication of the location comprises a map display.

7. The apparatus of claim **5**, wherein the circuitry is configured such that the indication of the location comprises a list display.

8. The apparatus of claim **7**, wherein the circuitry is configured such that the indication of the location is switchable between the list display and a map display.

9. A method for managing a usage of energy by an electric vehicle having a display and a battery capable of storing the energy, the method comprising:

acquiring, through circuitry, information about a position of the electric vehicle, a selected destination of the electric vehicle, and an amount of the energy stored in the battery;

determining an amount of the energy needed to reach the selected destination;

performing a comparison between the amount of the energy needed to reach the selected destination and the amount of the energy stored in the battery; and

displaying, on the display, an indication of the comparison.

10. The method of claim **9**, further comprising displaying, on the display, a current driving range.

11. The method of claim **9**, wherein said displaying comprises displaying an indication of an amount of a difference between the amount of the energy needed to reach the selected destination and the amount of the energy stored in the battery, the difference being shown relative to an entire capacity of the battery.

12. The method of claim **9**, further comprising displaying, on the display, a location of at least one charging station within a current driving range of the position of the electric vehicle.

13. The method of claim **12**, wherein the indication of the location comprises a map display.

14. The method of claim **12**, wherein the indication of the location comprises a list display.

15. The method of claim **14**, wherein the indication of the location is switchable between the list display and a map display.

16. A non-transitory computer-readable storage medium storing instructions which, when executed by a processor, cause a computer to perform a method comprising:

acquiring information about a position of an electric vehicle, a selected destination of the electric vehicle, and an amount of the energy stored in a battery of the electric vehicle;

determining an amount of the energy needed to reach the selected destination;

performing a comparison between the amount of the energy needed to reach the selected destination and the amount of the energy stored in the battery; and

controlling a display to display an indication of the comparison.

17. The storage medium of claim **16**, wherein the method further comprises displaying, on the display, a current driving range.

18. The storage medium of claim **16**, wherein said displaying comprises displaying an indication of an amount of a difference between the amount of the energy needed to reach the selected destination and the amount of the energy stored in the battery, the difference being shown relative to an entire capacity of the battery.

19. The storage medium of claim **17**, wherein the method further comprises displaying an indication of a location of at least one charging station within a current driving range of the position of the electric vehicle.

20. The storage medium of claim **19**, wherein the indication of the location comprises a map display.

21. The storage medium of claim **19**, wherein the indication of the location comprises a list display.

22. The storage medium of claim **21**, wherein the indication of the location is switchable between the list display and a map display.

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