US008170886B2

(12) **United States Patent**
Luff

(10) **Patent No.: US 8,170,886 B2**
(45) **Date of Patent: May 1, 2012**

(54) **SYSTEMS, METHODS, AND APPARATUS TO GENERATE AN ENERGY CONSUMPTION INDEX**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 423 days.

(21) Appl. No.: **12/414,289**

(22) Filed: **Mar. 30, 2009**

(65) **Prior Publication Data**

US 2010/0082499 A1 Apr. 1, 2010

Related U.S. Application Data

(60) Provisional application No. 61/040,466, filed on Mar. 28, 2008.

(51) **Int. Cl.**
G06Q 10/00 (2012.01)

(52) **U.S. Cl.** **705/1.1**; 705/63; 33/361; 73/324

(58) **Field of Classification Search** 705/1.1, 705/63; 33/361; 73/324
See application file for complete search history.

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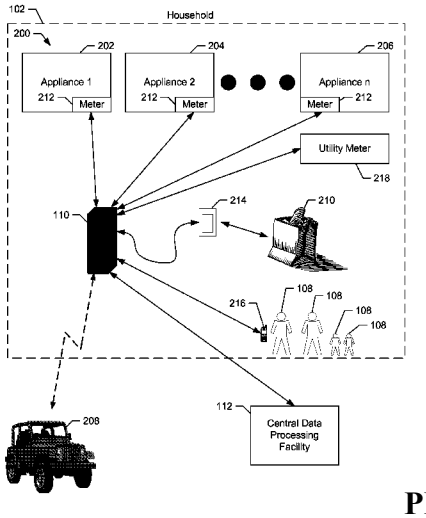
Primary Examiner — Heidi Riviere
(74) *Attorney, Agent, or Firm* — Hanley, Flight & Zimmerman, LLC

(57) **ABSTRACT**

Systems, methods, and apparatus to generate an energy consumption index are disclosed. In one described example, a method to generate an energy consumption index is disclosed, the method including measuring resources consumed at a home associated with a first person and calculating a home energy value indicative of the resources consumed at the home and measuring resources consumed by the person while located outside the home and calculating an out of home energy value indicative of the resources consumed by the person while located outside the home. The example method further includes identifying goods purchased by the person and calculating a purchase energy value indicative of the resources associated with the purchased goods, and generating an energy consumption index associated with the person based on the home energy value, the out of home energy value, and the purchase energy value.

19 Claims, 16 Drawing Sheets



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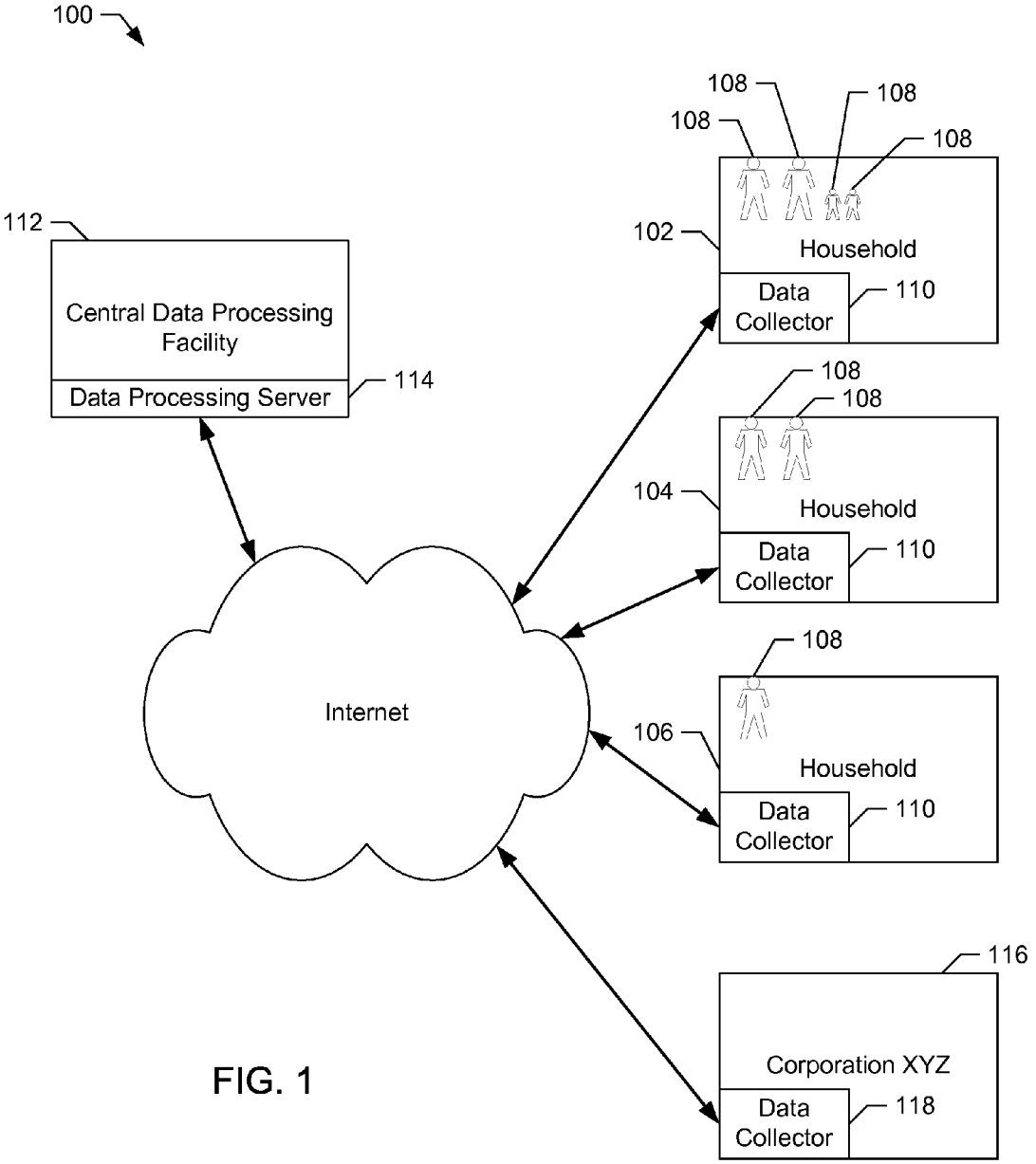
100
108
108
108
108
112
Central Data Processing Facility
Data Processing Server
114
102
Household
Data Collector
110
108
108
104
Household
Data Collector
110
Internet
108
106
Household
Data Collector
110
116
Corporation XYZ
Data Collector
118

FIG. 1

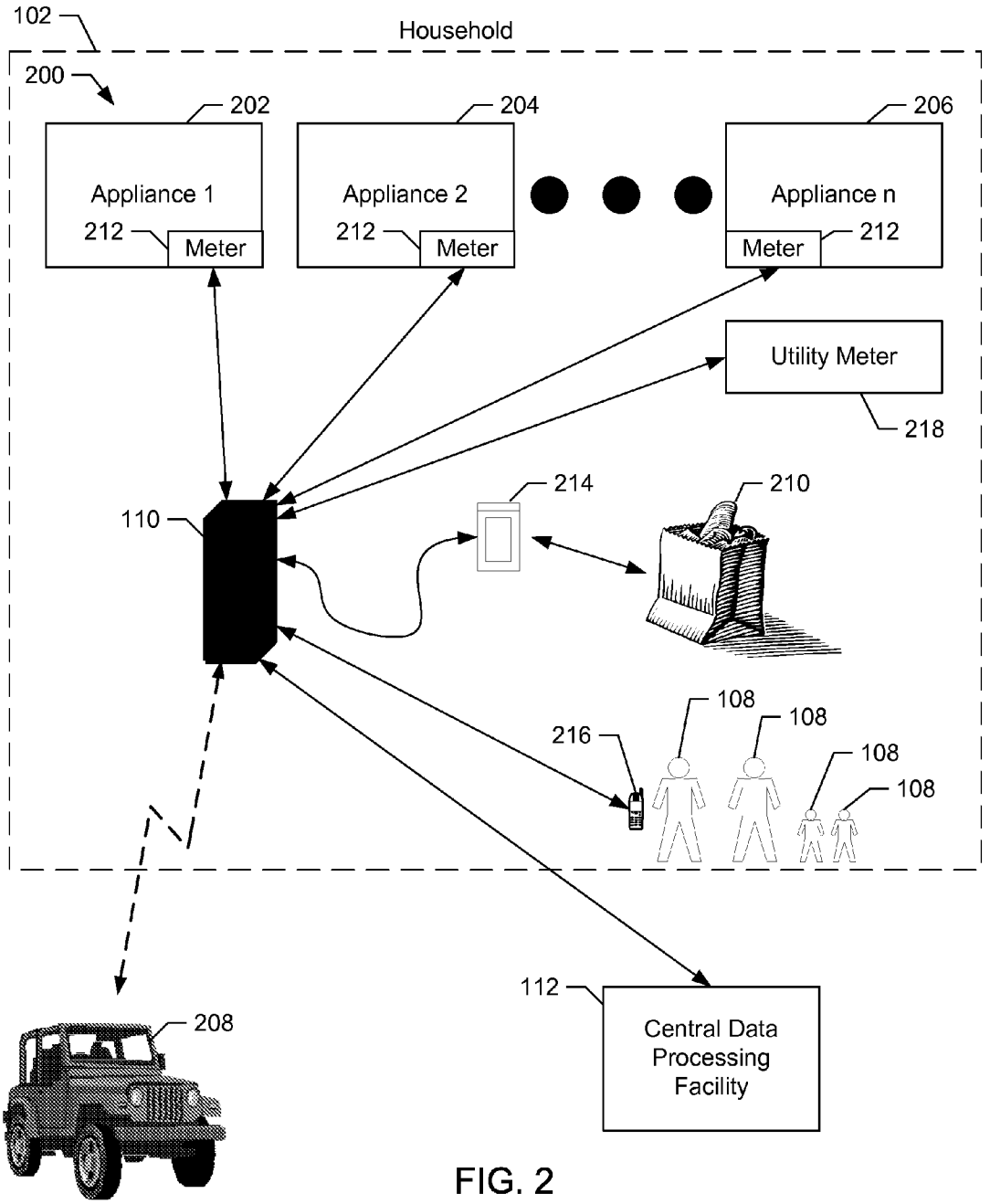
102
Household
200
202
204
206
Appliance 1
212
Meter
Appliance 2
212
Meter
Appliance n
Meter
212
Utility Meter
218
214
210
110
108
108
216
108
108
112
Central Data Processing Facility
208

FIG. 2

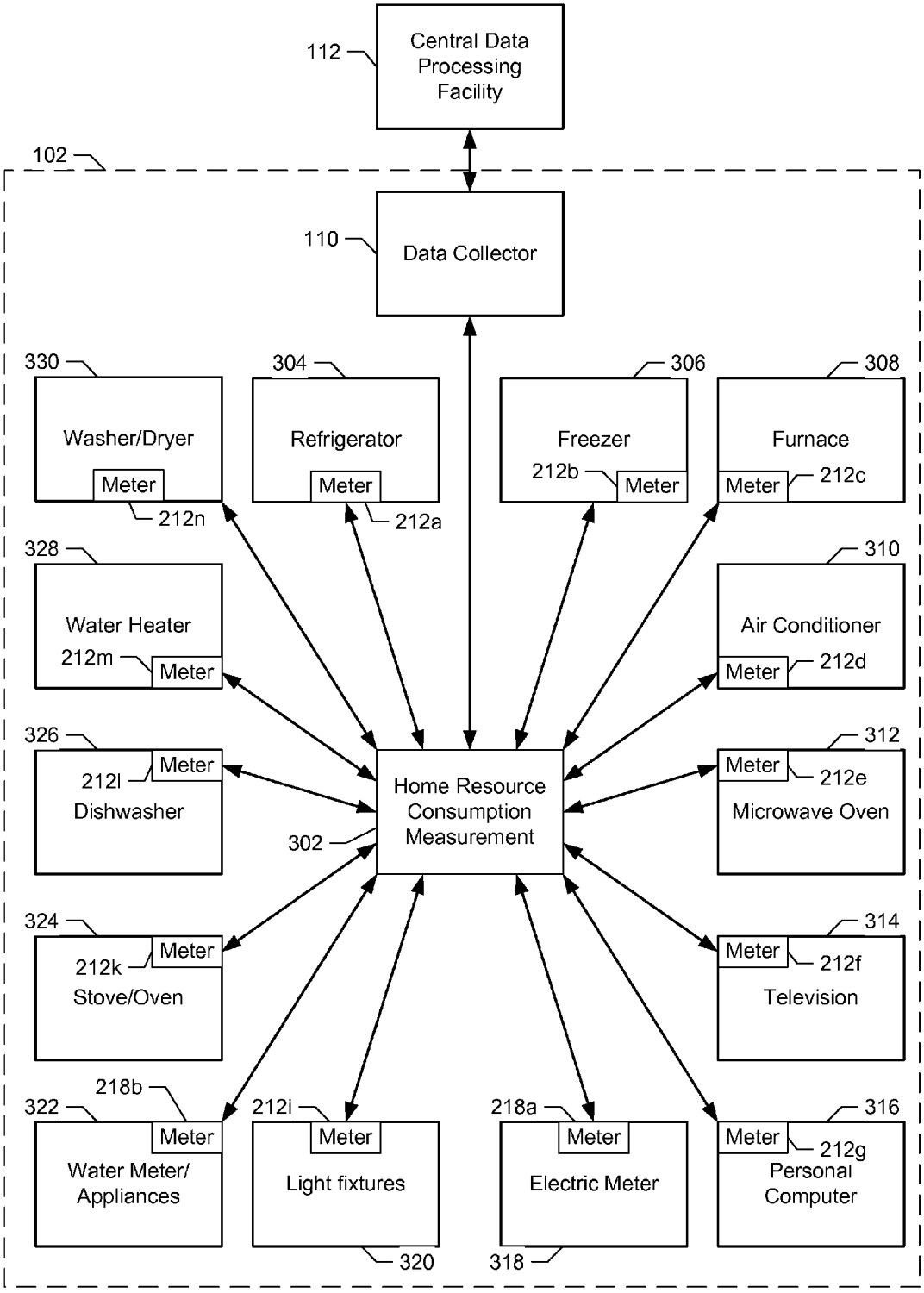
112
Central Data Processing Facility
102
110
Data Collector
330
Washer/Dryer
Meter
212n
304
Refrigerator
Meter
212a
306
Freezer
212b
Meter
308
Furnace
Meter
212c
328
Water Heater
212m
Meter
310
Air Conditioner
Meter
212d
326
Meter
212l
Dishwasher
302
Home Resource Consumption Measurement
312
Meter
212e
Microwave Oven
324
Meter
212k
Stove/Oven
314
Meter
212f
Television
218b
322
Meter
Water Meter/ Appliances
212i
Meter
Light fixtures
320
218a
Meter
Electric Meter
318
316
Meter
212g
Personal Computer

FIG. 3

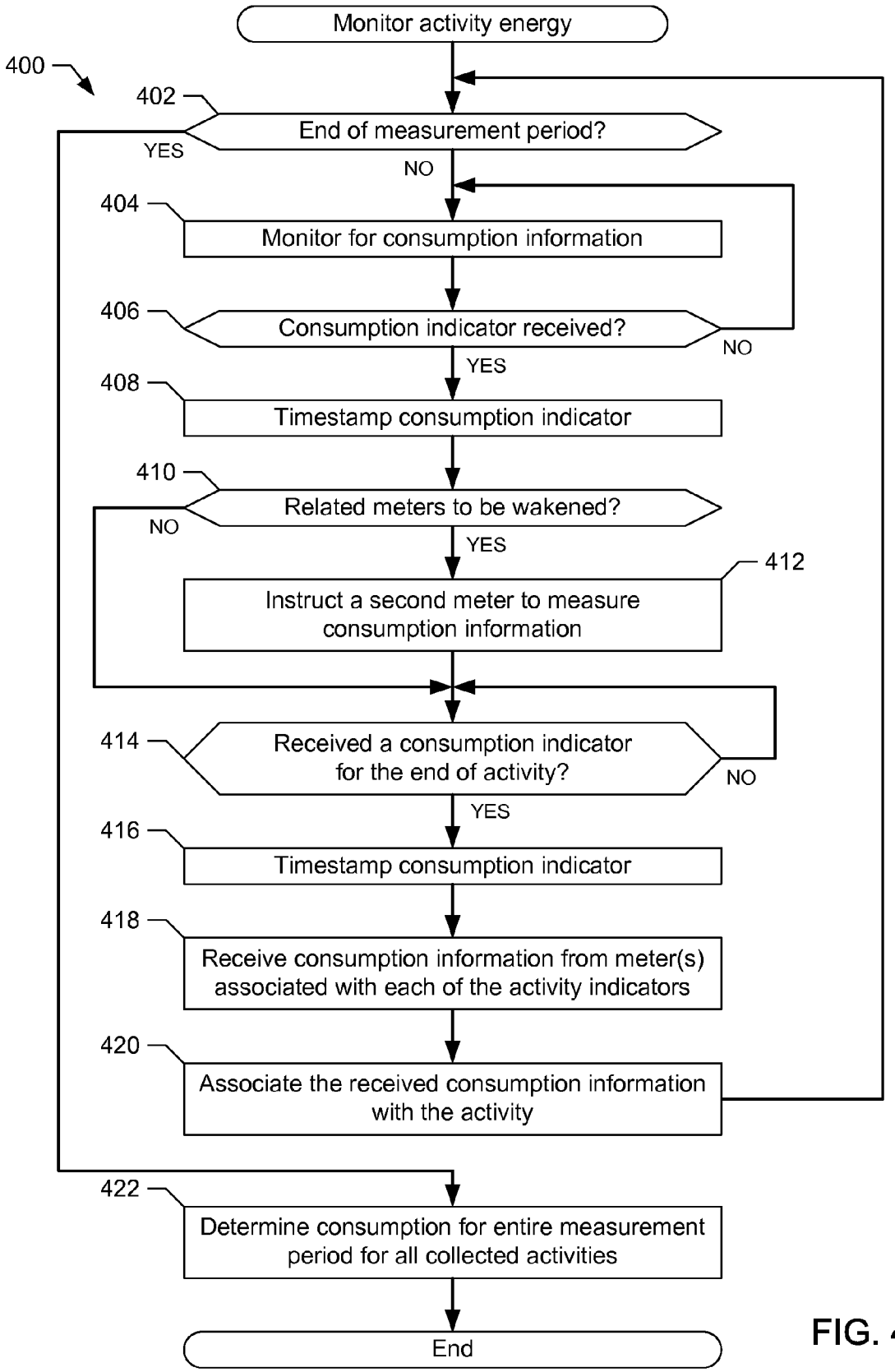
Monitor activity energy
400
402
End of measurement period?
YES
NO
404
Monitor for consumption information
406
Consumption indicator received?
NO
YES
408
Timestamp consumption indicator
410
Related meters to be wakened?
NO
YES
412
Instruct a second meter to measure consumption information
414
Received a consumption indicator for the end of activity?
NO
YES
416
Timestamp consumption indicator
418
Receive consumption information from meter(s) associated with each of the activity indicators
420
Associate the received consumption information with the activity
422
Determine consumption for entire measurement period for all collected activities
End

FIG. 4

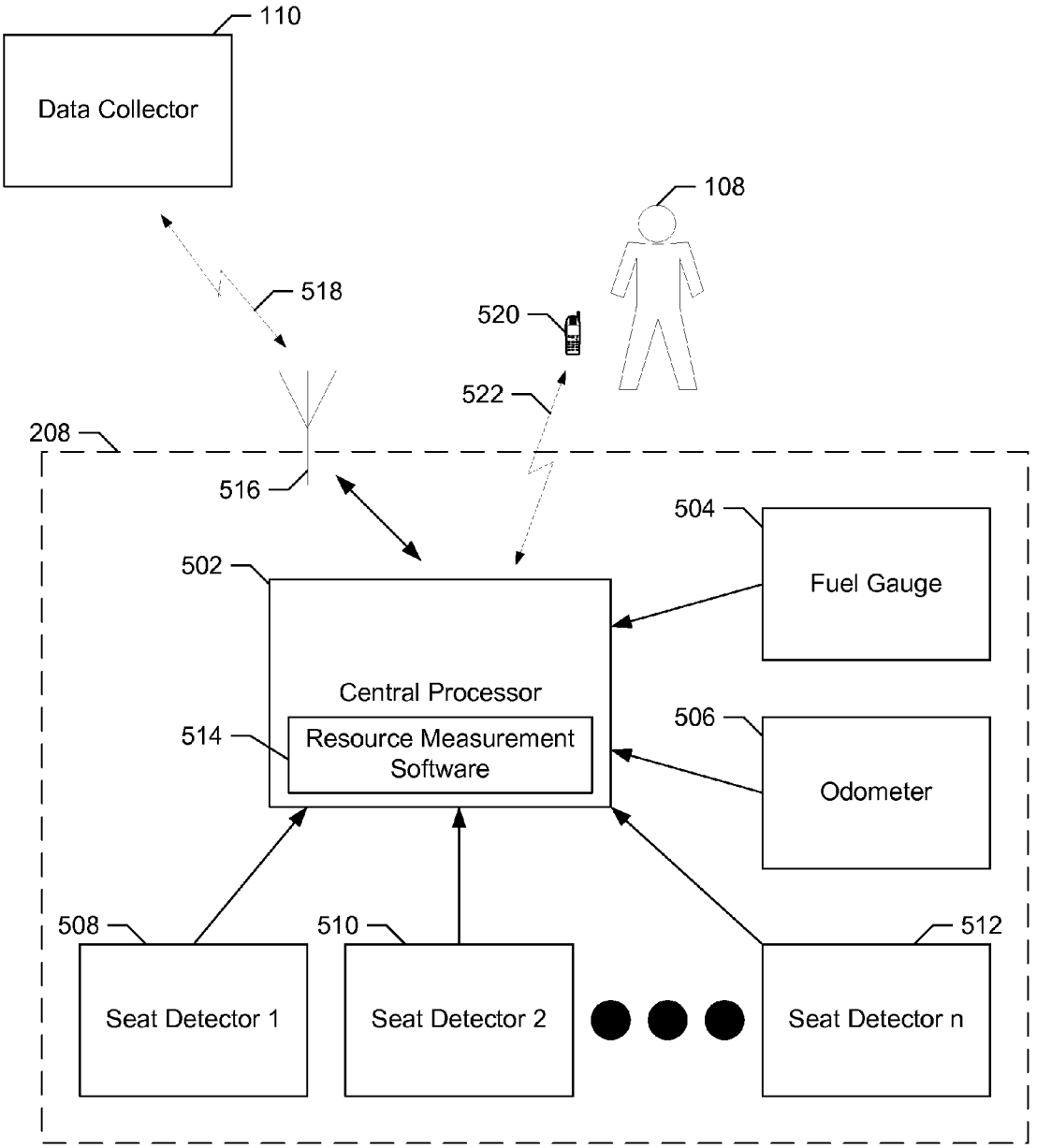
110
Data Collector
108
518
520
522
208
516
504
502
Fuel Gauge
Central Processor
514
Resource Measurement Software
506
Odometer
508
510
512
Seat Detector 1
Seat Detector 2
Seat Detector n

FIG. 5

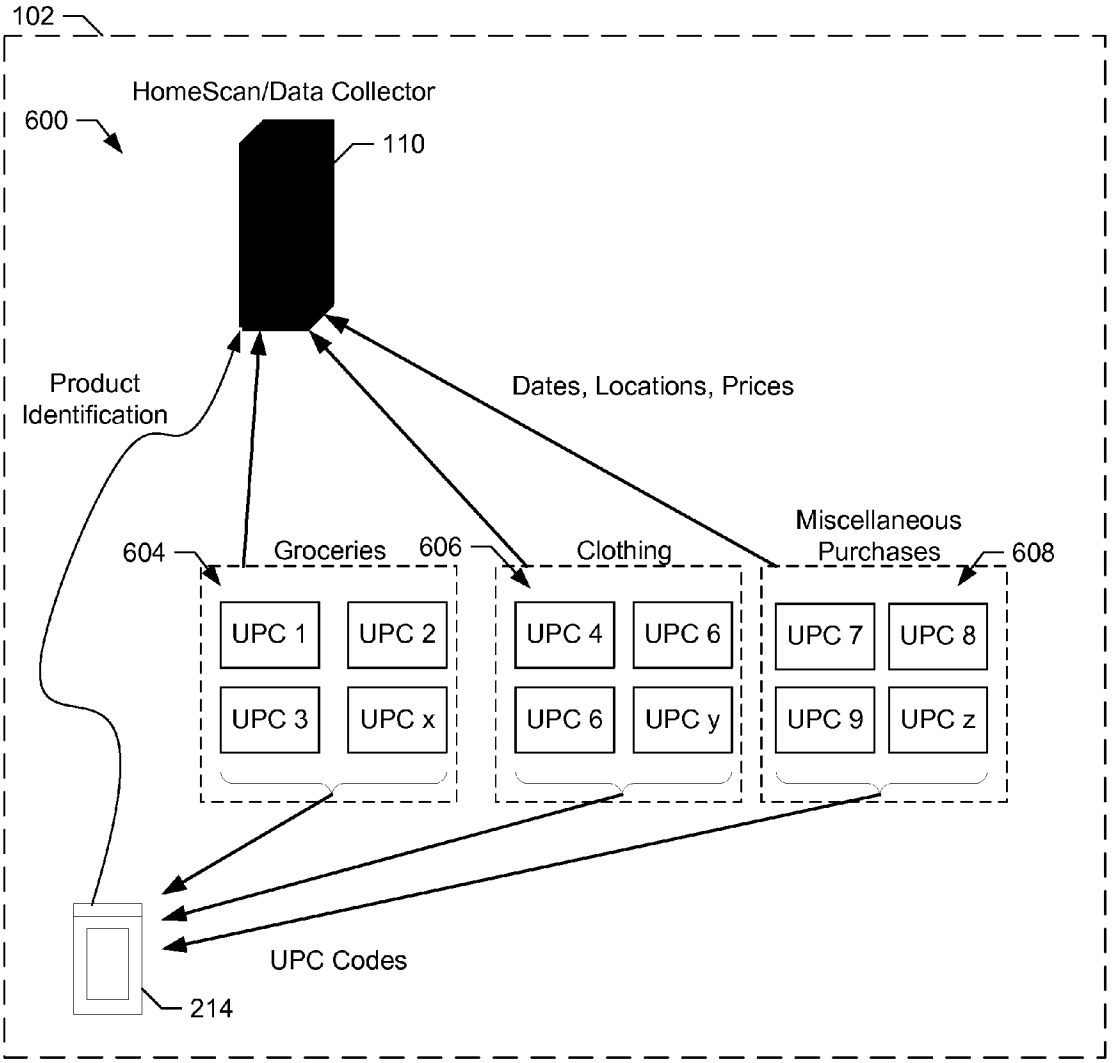
102
HomeScan/Data Collector
600
110
Product
Identification
Dates, Locations, Prices
604
Groceries
606
Clothing
Miscellaneous
Purchases
608
UPC 1
UPC 2
UPC 3
UPC x
UPC 4
UPC 6
UPC 6
UPC y
UPC 7
UPC 8
UPC 9
UPC z
UPC Codes
214

FIG. 6

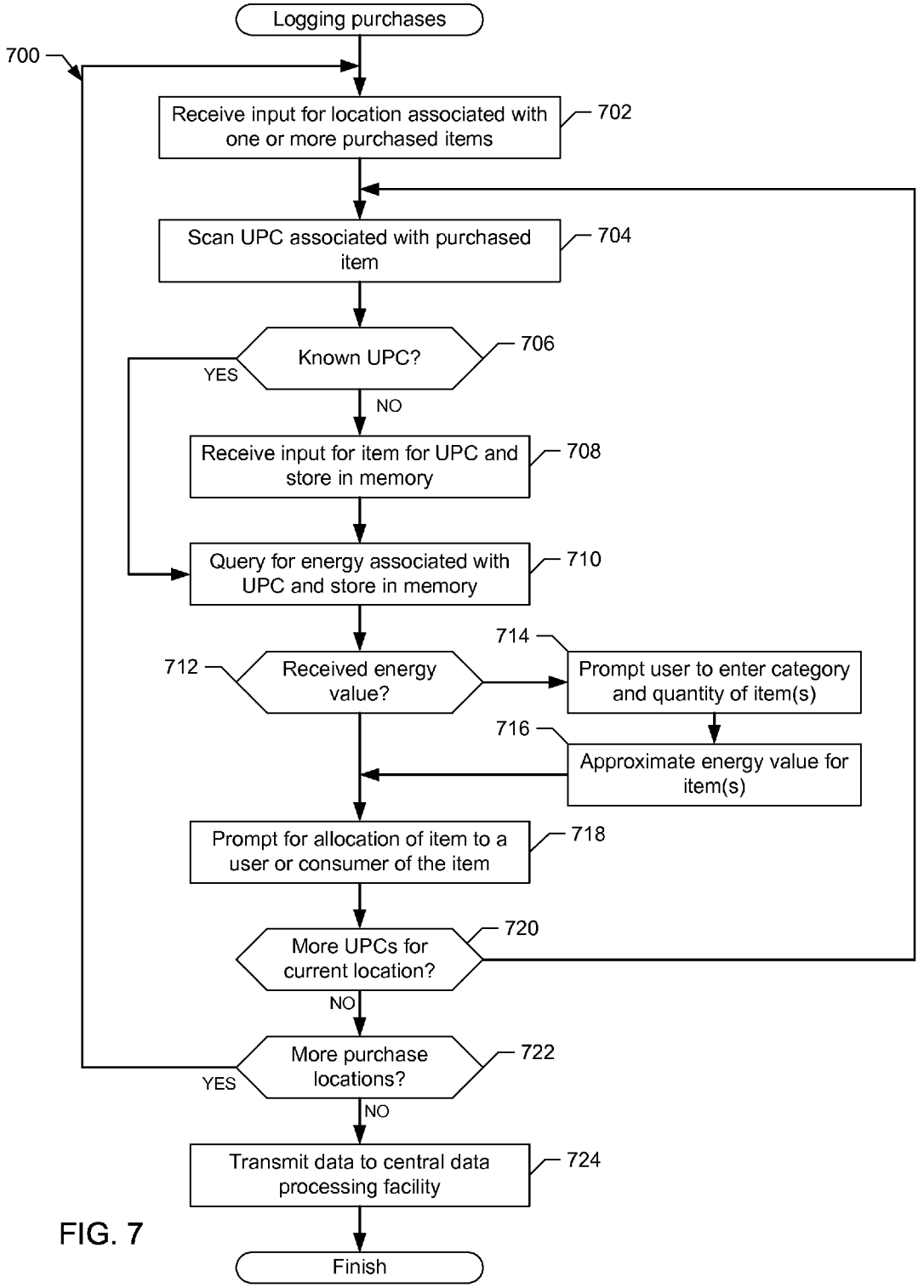
Logging purchases
700
Receive input for location associated with one or more purchased items
702
Scan UPC associated with purchased item
704
Known UPC?
706
YES
NO
Receive input for item for UPC and store in memory
708
Query for energy associated with UPC and store in memory
710
714
712
Received energy value?
Prompt user to enter category and quantity of item(s)
716
Approximate energy value for item(s)
Prompt for allocation of item to a user or consumer of the item
718
More UPCs for current location?
720
NO
More purchase locations?
722
YES
NO
Transmit data to central data processing facility
724
Finish

FIG. 7

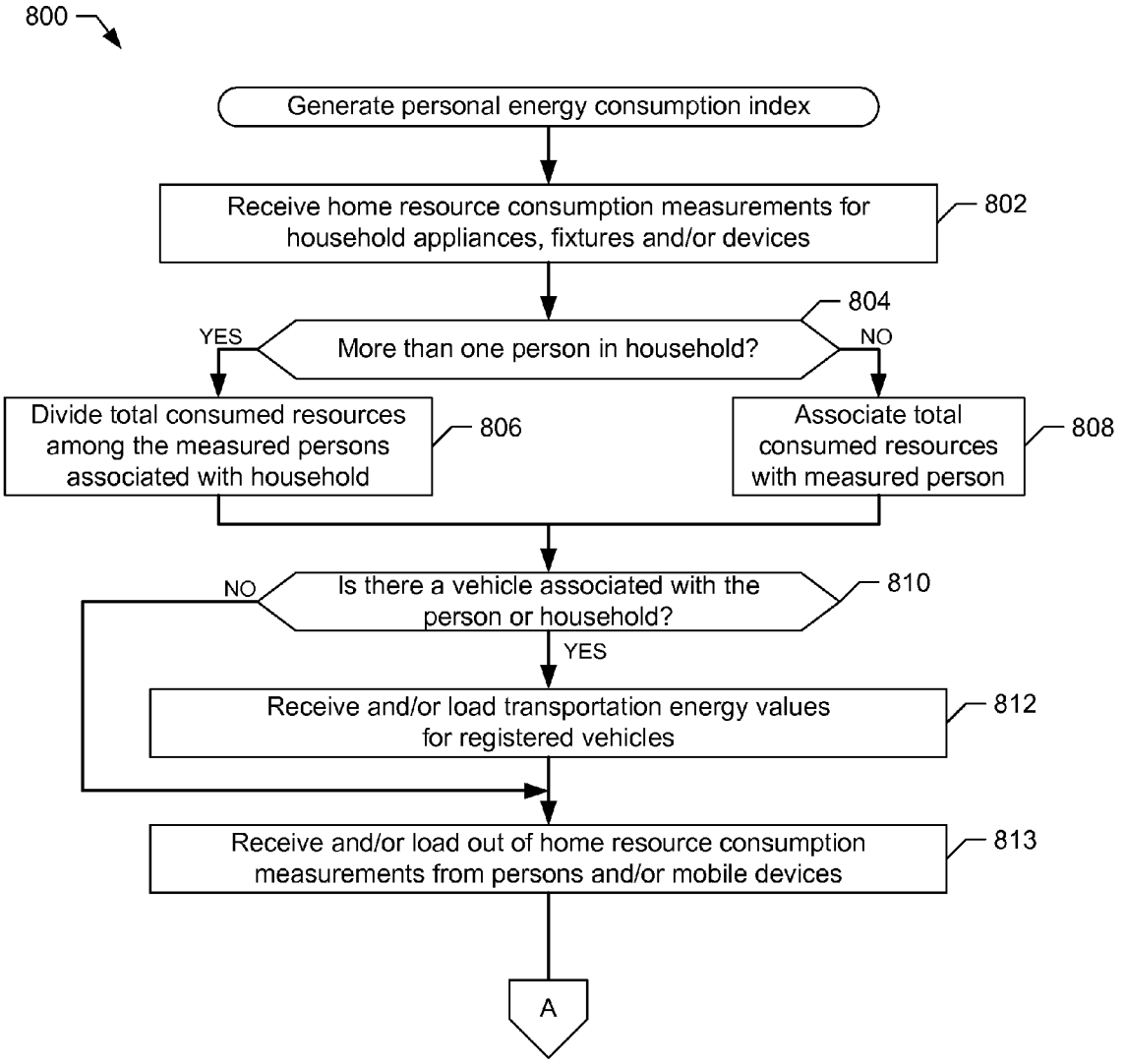
800
Generate personal energy consumption index
Receive home resource consumption measurements for household appliances, fixtures and/or devices
802
804
YES
More than one person in household?
NO
Divide total consumed resources among the measured persons associated with household
806
Associate total consumed resources with measured person
808
NO
Is there a vehicle associated with the person or household?
810
YES
Receive and/or load transportation energy values for registered vehicles
812
Receive and/or load out of home resource consumption measurements from persons and/or mobile devices
813
A

FIG. 8A

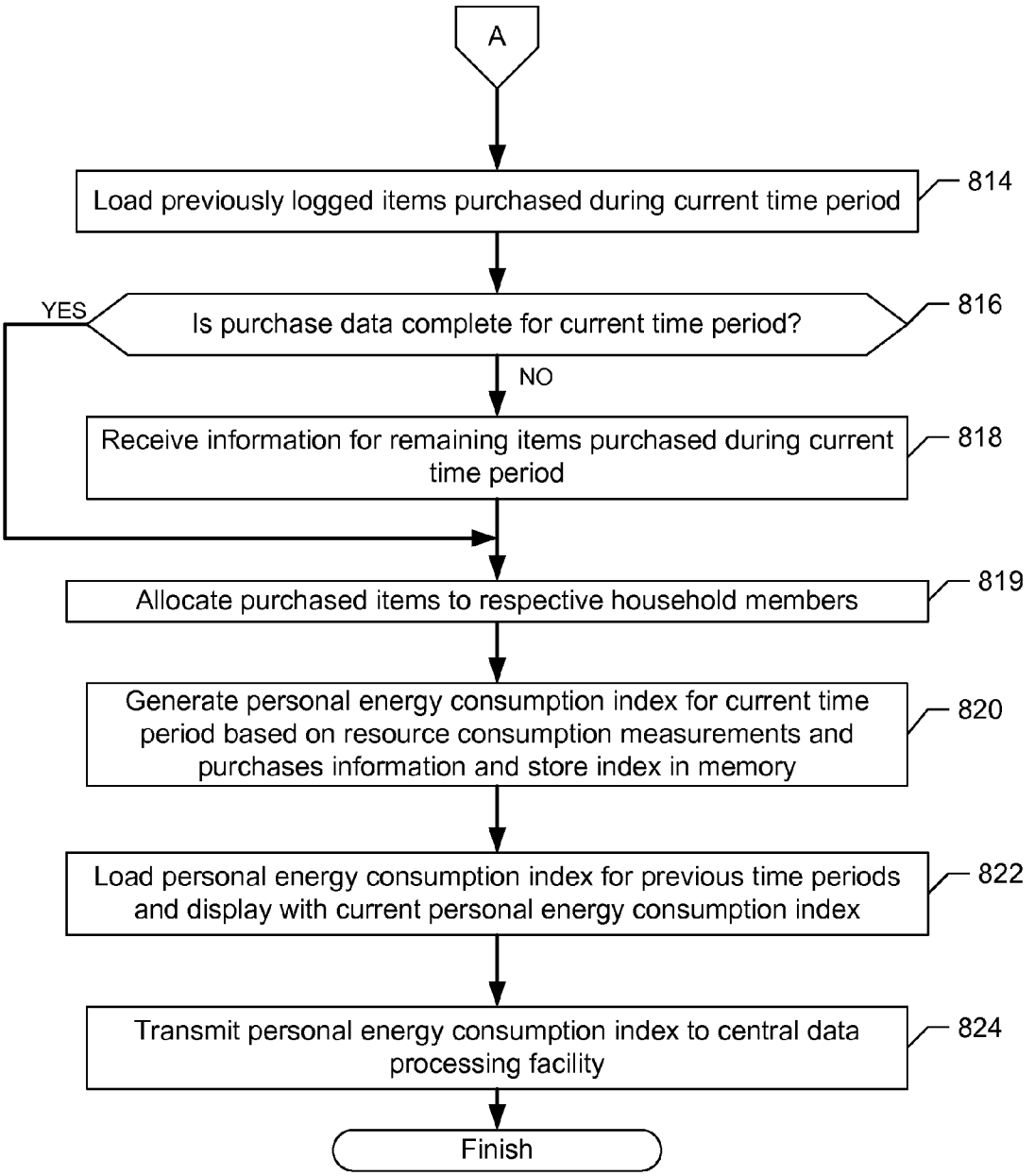
A
Load previously logged items purchased during current time period
814
YES
Is purchase data complete for current time period?
816
NO
Receive information for remaining items purchased during current time period
818
Allocate purchased items to respective household members
819
Generate personal energy consumption index for current time period based on resource consumption measurements and purchases information and store index in memory
820
Load personal energy consumption index for previous time periods and display with current personal energy consumption index
822
Transmit personal energy consumption index to central data processing facility
824
Finish

FIG. 8B

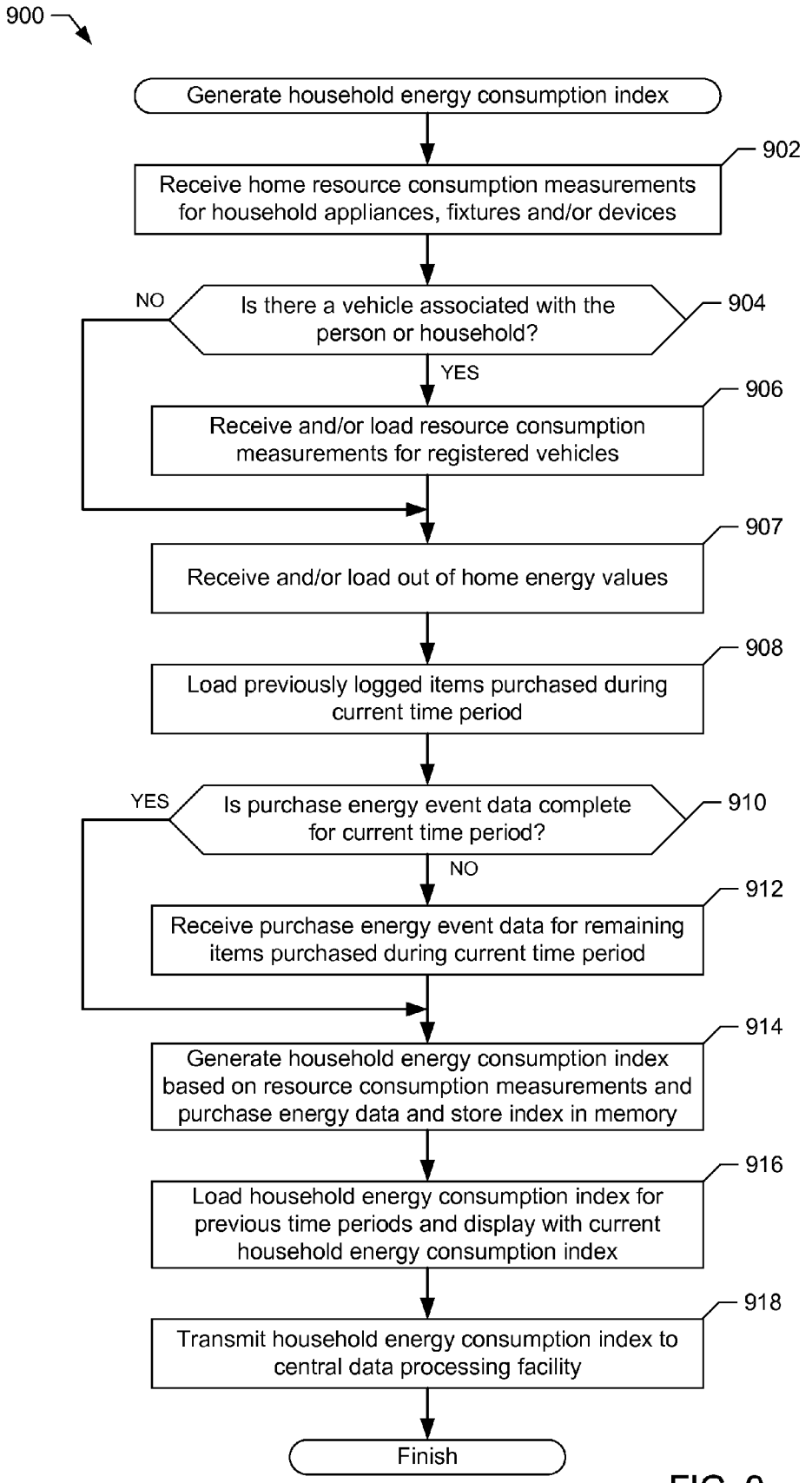
900
Generate household energy consumption index
902
Receive home resource consumption measurements for household appliances, fixtures and/or devices
NO
Is there a vehicle associated with the person or household?
904
YES
906
Receive and/or load resource consumption measurements for registered vehicles
907
Receive and/or load out of home energy values
908
Load previously logged items purchased during current time period
YES
Is purchase energy event data complete for current time period?
910
NO
912
Receive purchase energy event data for remaining items purchased during current time period
914
Generate household energy consumption index based on resource consumption measurements and purchase energy data and store index in memory
916
Load household energy consumption index for previous time periods and display with current household energy consumption index
918
Transmit household energy consumption index to central data processing facility
Finish

FIG. 9

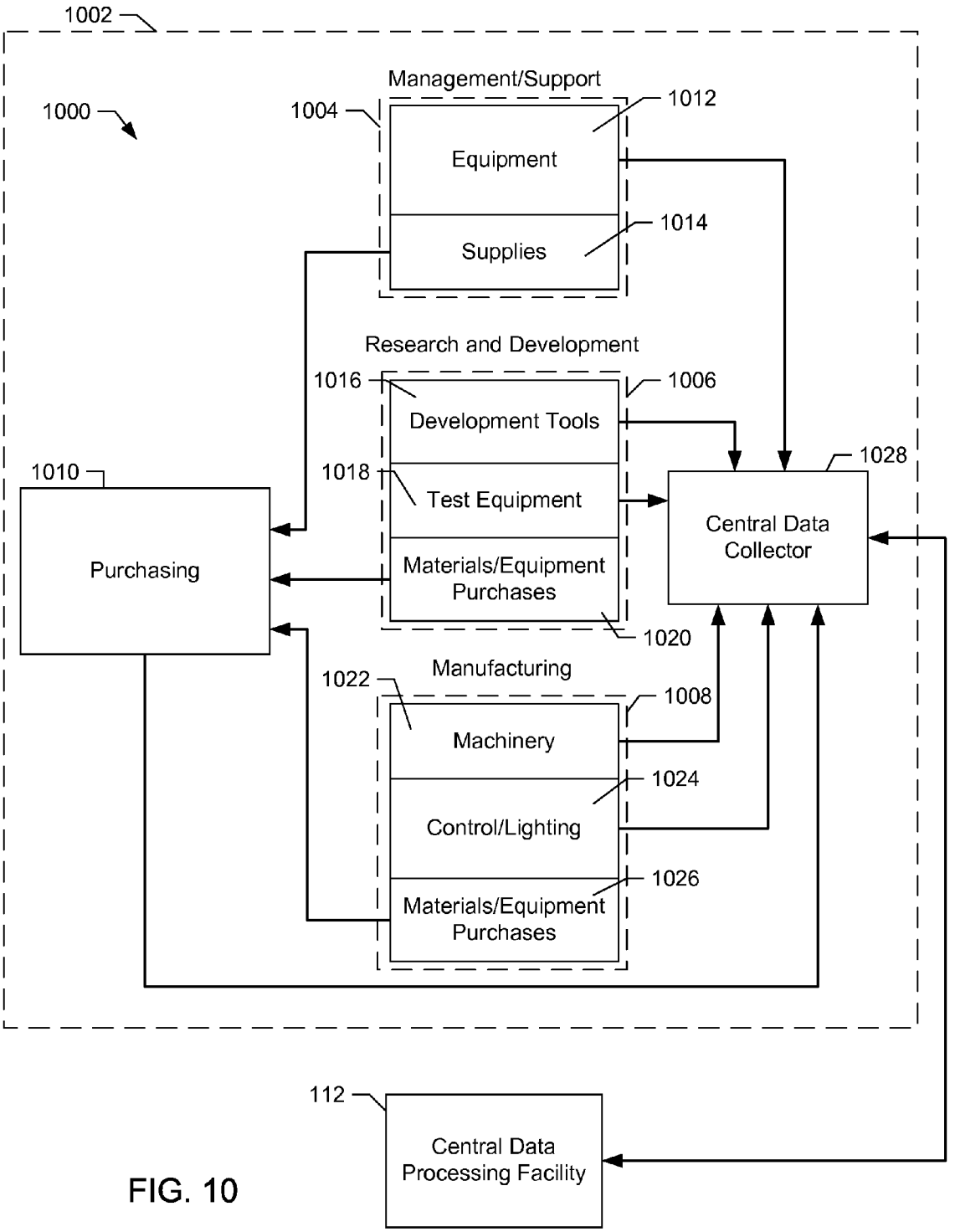
1002
1000
Management/Support
1004
1012
Equipment
1014
Supplies
Research and Development
1016
1006
Development Tools
1018
Test Equipment
Materials/Equipment Purchases
1020
1010
Purchasing
1028
Central Data Collector
Manufacturing
1022
1008
Machinery
1024
Control/Lighting
1026
Materials/Equipment Purchases
112
Central Data Processing Facility

FIG. 10

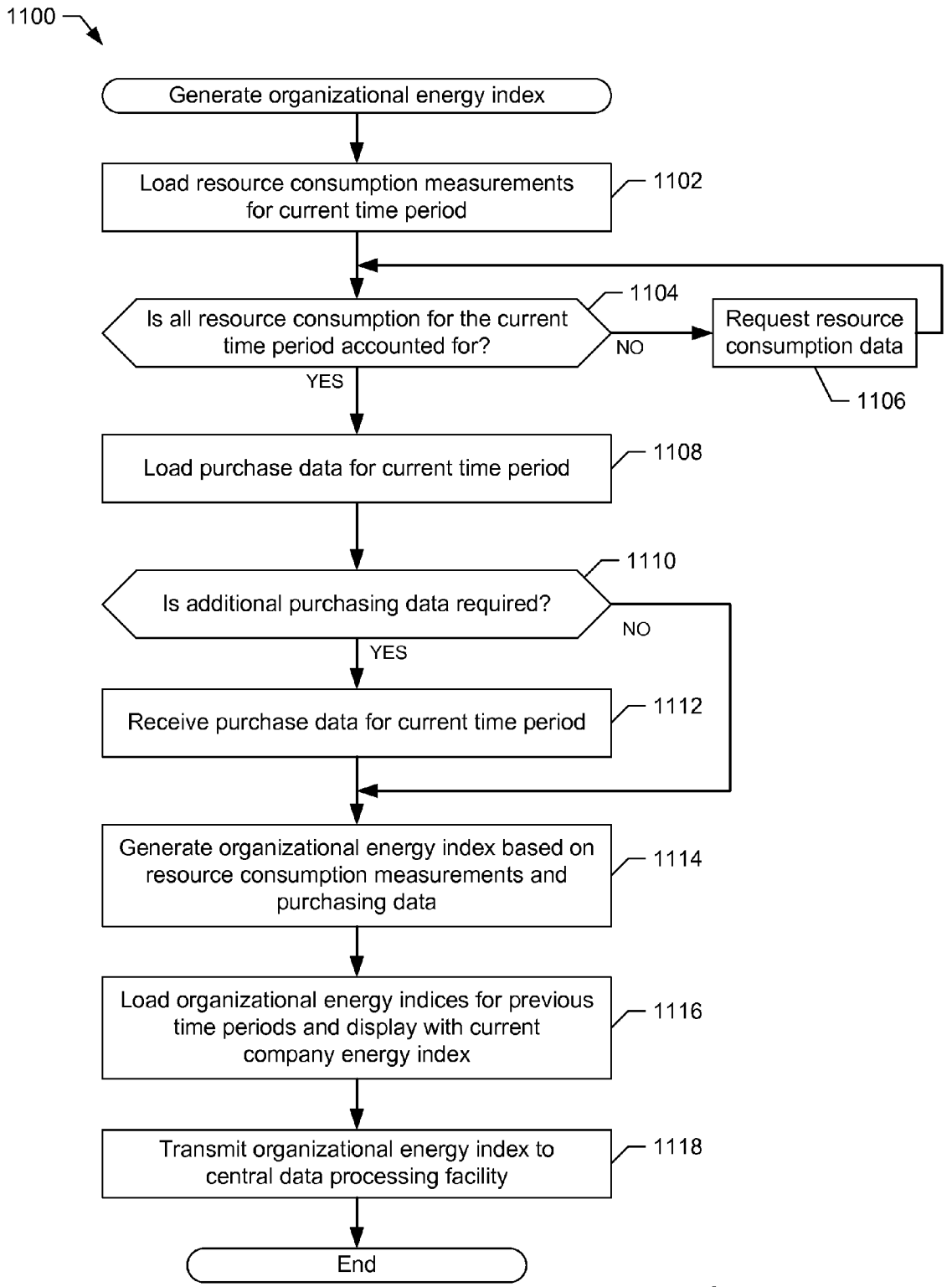
1100
Generate organizational energy index
Load resource consumption measurements for current time period
1102
Is all resource consumption for the current time period accounted for?
1104
NO
Request resource consumption data
1106
YES
Load purchase data for current time period
1108
Is additional purchasing data required?
1110
NO
YES
Receive purchase data for current time period
1112
Generate organizational energy index based on resource consumption measurements and purchasing data
1114
Load organizational energy indices for previous time periods and display with current company energy index
1116
Transmit organizational energy index to central data processing facility
1118
End

FIG. 11

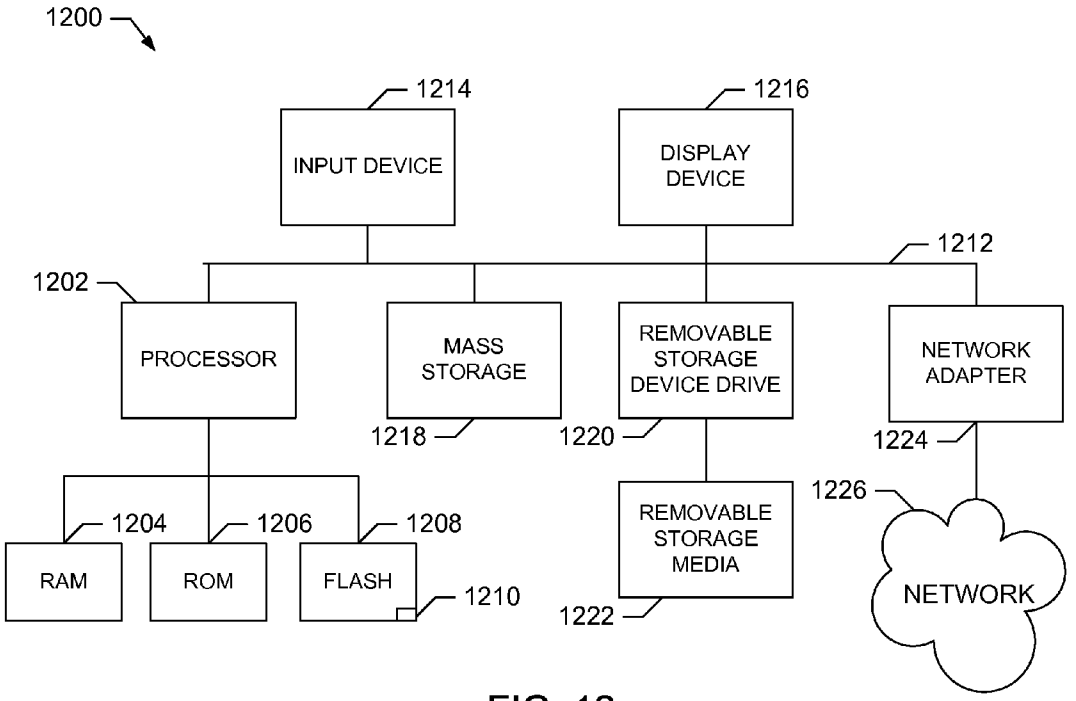
1200
1214
INPUT DEVICE
1216
DISPLAY DEVICE
1212
1202
PROCESSOR
MASS STORAGE
REMOVABLE STORAGE DEVICE DRIVE
NETWORK ADAPTER
1218
1220
1224
1226
1204
1206
1208
RAM
ROM
FLASH
1210
REMOVABLE STORAGE MEDIA
1222
NETWORK

FIG. 12

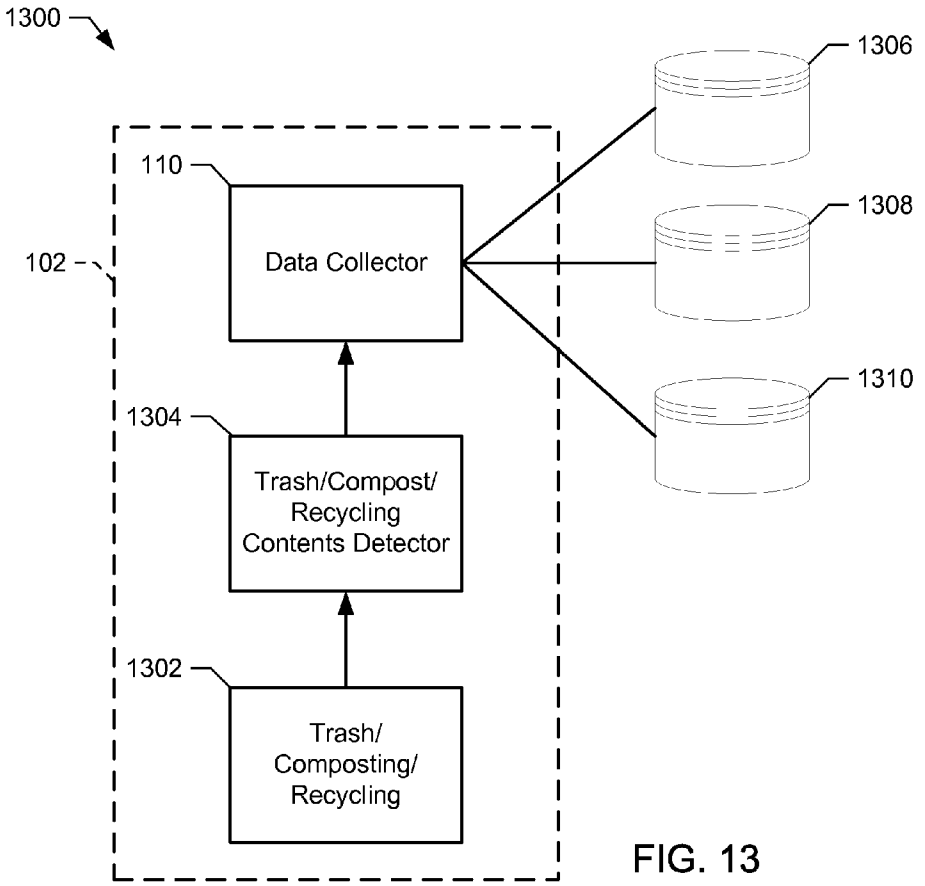
1300
1306
110
1308
102
Data Collector
1310
1304
Trash/Compost/ Recycling Contents Detector
1302
Trash/ Composting/ Recycling

FIG. 13

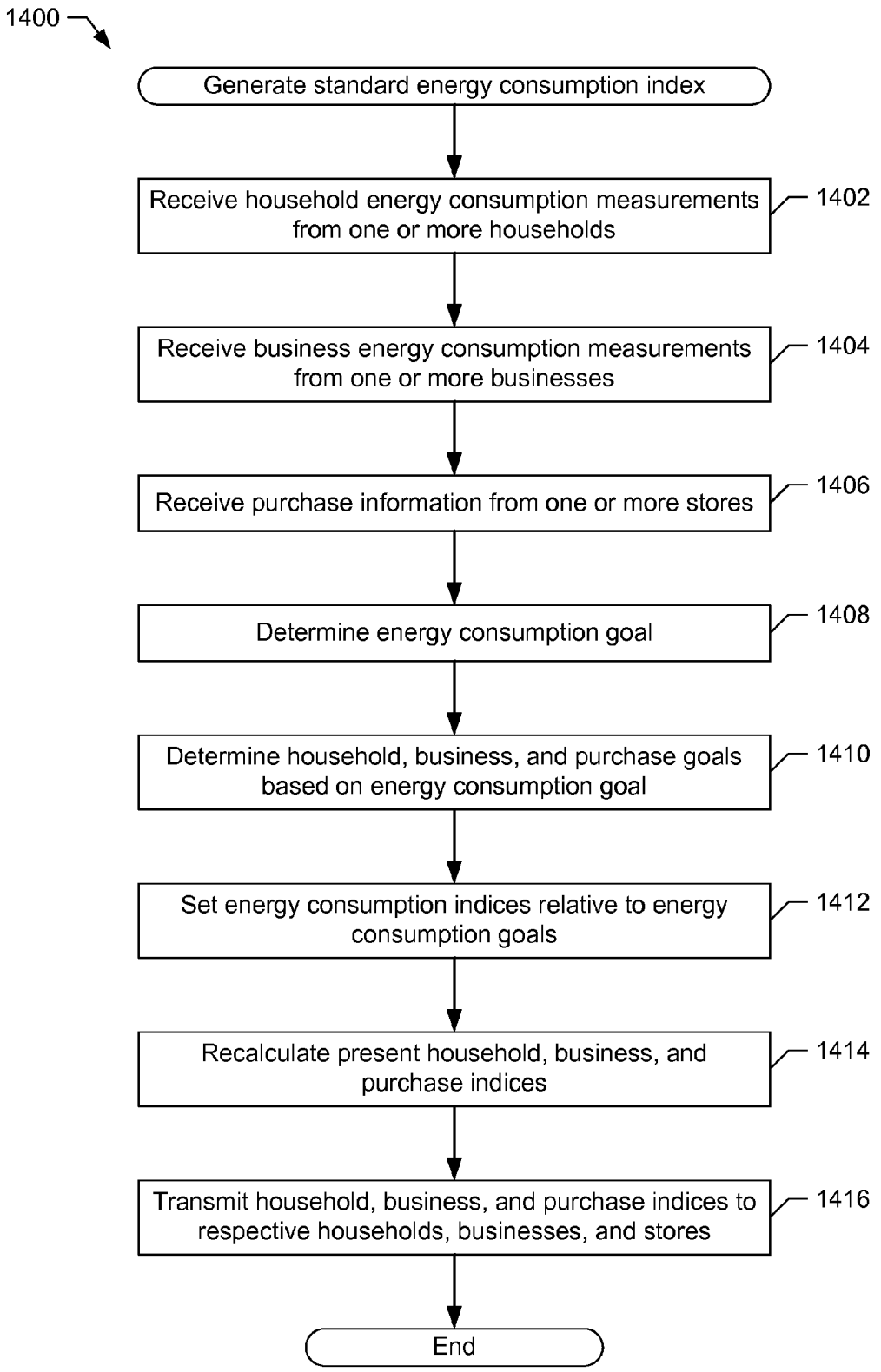
1400
Generate standard energy consumption index
Receive household energy consumption measurements from one or more households
1402
Receive business energy consumption measurements from one or more businesses
1404
Receive purchase information from one or more stores
1406
Determine energy consumption goal
1408
Determine household, business, and purchase goals based on energy consumption goal
1410
Set energy consumption indices relative to energy consumption goals
1412
Recalculate present household, business, and purchase indices
1414
Transmit household, business, and purchase indices to respective households, businesses, and stores
1416
End

FIG. 14

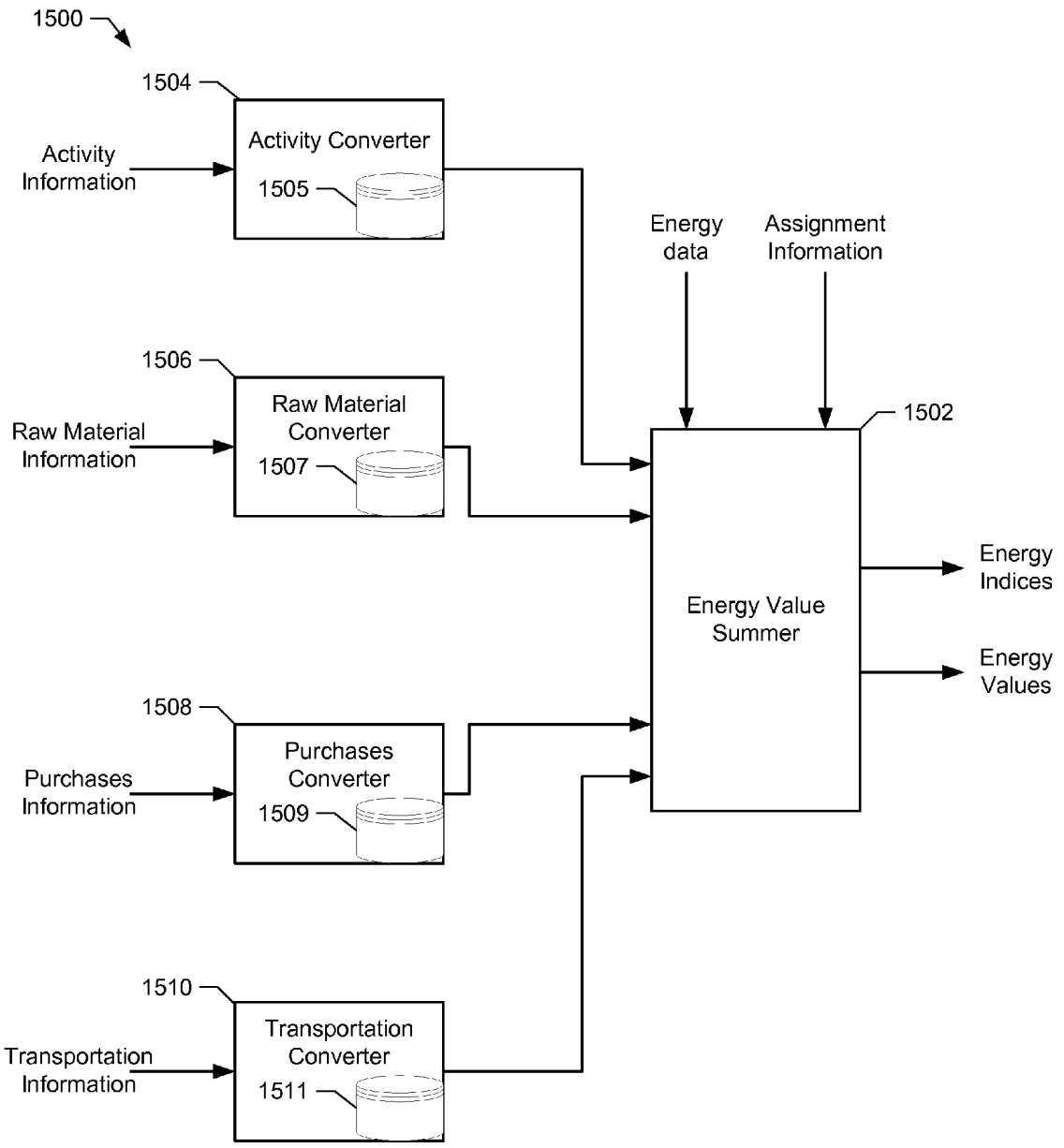
1500
1504
Activity Converter
1505
Activity Information
1506
Raw Material Converter
1507
Raw Material Information
1508
Purchases Converter
1509
Purchases Information
1510
Transportation Converter
1511
Transportation Information
Energy data
Assignment Information
1502
Energy Value Summer
Energy Indices
Energy Values

FIG. 15

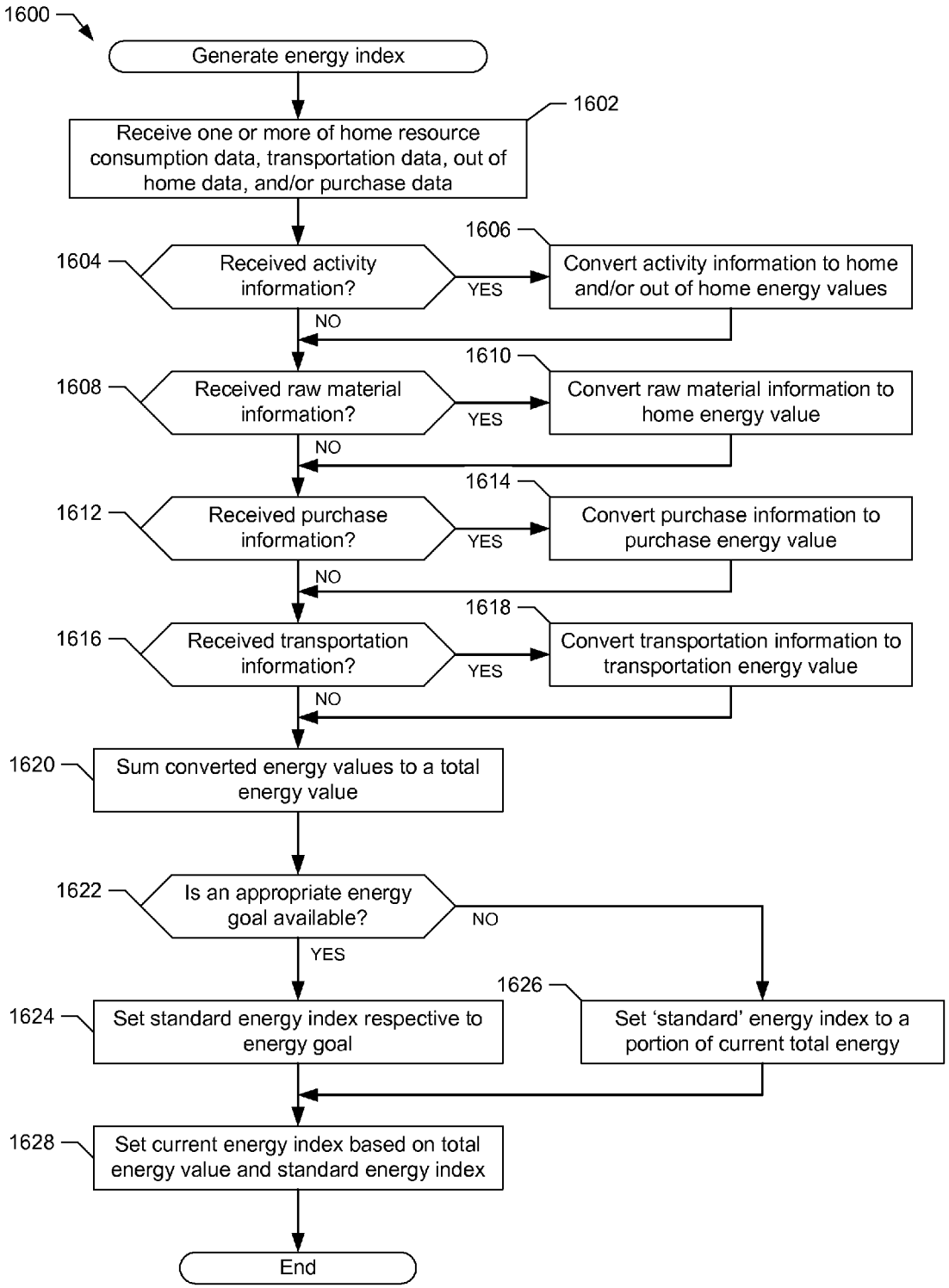
1600
Generate energy index
1602
Receive one or more of home resource consumption data, transportation data, out of home data, and/or purchase data
1604
Received activity information?
YES
1606
Convert activity information to home and/or out of home energy values
NO
1608
Received raw material information?
YES
1610
Convert raw material information to home energy value
NO
1612
Received purchase information?
YES
1614
Convert purchase information to purchase energy value
NO
1616
Received transportation information?
YES
1618
Convert transportation information to transportation energy value
NO
1620
Sum converted energy values to a total energy value
1622
Is an appropriate energy goal available?
NO
YES
1624
Set standard energy index respective to energy goal
1626
Set 'standard' energy index to a portion of current total energy
1628
Set current energy index based on total energy value and standard energy index
End

FIG. 16

SYSTEMS, METHODS, AND APPARATUS TO GENERATE AN ENERGY CONSUMPTION INDEX

RELATED APPLICATIONS

This patent claims the benefit of U.S. Provisional Application 61/040,466, filed Mar. 28, 2008, the entirety of which is incorporated by reference.

FIELD OF THE DISCLOSURE

This disclosure relates generally to the measurement of energy consumption and, more particularly, to systems, methods, and apparatus to generate an energy consumption index.

BACKGROUND

Energy management and conservation has become an increasing public concern. Agencies such as the United States Environmental Protection Agency have developed programs like Energy Star to assist businesses and the public in general in making environmentally-conscious decisions when it comes to electrical devices and home appliances. Tools such as "carbon footprint" calculators can assist an individual, family or business in determining the environmental impact of their consumption. Further, some governments use emissions trading as a way to encourage the reduction in polluting emissions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of an example system to collect resource consumption information from a panel of persons, households and/or companies.

FIG. **2** is an illustration of an example system to collect resource consumption information from different of sources within a selected household.

FIG. **3** is a block diagram of an example system to receive resource consumption information from appliances associated with a measured home.

FIG. **4** is a flowchart representative of example machine readable instructions that may be executed to associate an activity with energy consumption.

FIG. **5** is a block diagram of an example system to receive resource consumption information from a vehicle associated with a measured person or household.

FIG. **6** is a block diagram of an example system to collect resource consumption information associated with purchases made by a measured person or household.

FIG. **7** is a flowchart representative of example machine readable instructions that may be executed to collect data associated with purchases made by a household.

FIG. **8**A-**8**B illustrate a flowchart representative of example machine readable instructions that may be executed to generate a personal energy consumption index for a person.

FIG. **9** is a flowchart representative of example machine readable instructions that may be executed to generate a household energy consumption index for a household.

FIG. **10** is a block diagram of an example system to generate an organizational energy consumption index.

FIG. **11** is a flowchart representative of example machine readable instructions that may be executed to generate an organizational energy consumption index for a company.

FIG. **12** is a diagram of an example processor system that may be used to implement the example machine readable instructions of FIGS. **4**, **7**, **8**, **9**, **11**, and/or **14** to implement the example systems, methods, and/or apparatus described herein.

FIG. **13** is a block diagram illustrating an example system to monitor energy consumption due to trash, composting, and/or recycling.

FIG. **14** is a flowchart representative of example machine readable instructions that may be executed to generate energy consumption information.

FIG. **15** is a block diagram illustrating an example energy index generator that may be used to implement the example data collector of FIGS. **1** and **2**, and/or the example Central Data Collector of FIG. **10**.

FIG. **16** is a flowchart representative of example machine readable instructions that may be executed to generate an energy index.

DETAILED DESCRIPTION

Although the example systems and apparatus described herein include, among other components, software executed on hardware, such systems and apparatus are merely illustrative and should not be considered as limiting. For example, it is contemplated that any or all of the disclosed hardware, firmware, and/or software components could be embodied exclusively in dedicated hardware, exclusively in software, exclusively in firmware or in some combination of hardware, firmware, and/or software.

Homes and consumers typically have many opportunities to reduce personal consumption. However, there are few sources to provide feedback on how effective a person's efforts to reduce personal consumption are on reducing emissions. Additionally, no systems currently exist to relate and/or index personal conservation efforts to a larger public or government goal. While government agencies and utilities currently have access to macro-level data of energy consumption, the macro-level data lacks detail and granularity. Such data is not very useful for creating fair, effective government energy conservation programs to meet personal, local, and/or national goals.

An easily understandable public vocabulary facilitates private, public and/or government conservation efforts by standardizing energy measurements. An understandable public vocabulary may be achieved by facilitating open dialog, sharing best practices, and/or via friendly person-to-person or state-to-state comparisons or competition.

To achieve energy conservation goals, governmental agencies and the public would benefit from standard systems, methods, apparatus, and articles of manufacture to uniformly track and communicate energy consumption. The example systems, methods, apparatus, and articles of manufacture described herein enable individuals, households, businesses, governments, agencies, and/or other entities to take control of daily energy consumption by providing granular energy consumption data. Granular data illustrates the significance of daily activities and the corresponding effects on energy consumption. Based on the data, individuals, households, businesses, governments, agencies, and/or other entities can act appropriately to efficiently reduce energy consumption at reduced costs. Additionally, public policy makers may use such additional granular data with details such as the number of people in the household or demographic details to better represent and/or define local, state, national, and/or other official goals to drive public or private conservation efforts.

Some example systems, methods, apparatus, and articles of manufacture described herein enable a uniform approach to determining a personal energy index, a home energy index, a

household energy index, a business energy index, and/or any other energy index. Some example systems, methods, and apparatus facilitate generation of local, national, personal, home, household, business, agency, and/or other entity energy averages. Such averages may be considered by age, gender, ethnicity, income, marital status, size of building, construction material, style of building, or by any other factor. The energy indices and/or averages can be used to understand and/or form fact-based policies and provide tools to track conservation progress at the personal, local, organizational, and/or national levels in a consistent manner.

In general, example systems, methods, apparatus, and articles of manufacture described herein may be used to measure, calculate, and/or identify resource and/or energy consumption by a person, household, agency, corporation, company, government, and/or other entity. Disclosed example systems, methods, apparatus, and/or articles of manufacture facilitate generation of an energy consumption index to reflect the resource and/or energy usage patterns of corresponding entities and/or individuals. In some examples, portions of the resource and/or energy consumption by a household or company are assigned to individual persons associated with the household or company so that the consumption total of tracked person(s) is equal to the total household and/or company consumption(s). In some examples, individual energy consumption data is sorted and/or aggregated to define consumption for a collection of individuals (e.g., a household, a company, or any other organization).

In some examples, a data collector aggregates resource consumption data from sources used by the person, household, company, and/or other entity (collectively and individually "the monitored entity") calculates the energy associated with generating, transporting, disposing of, and/or otherwise utilizing the resources, and reports the resources and/or energy consumed by the monitored entity. In some examples, the data collector reports to the monitored entity using the resources and/or reports to another party (e.g., a research agency, a government agency, etc.) responsible for collecting data from multiple monitored entities.

In some examples, a data collector collects personal consumption information for a monitored individual and generates a personal energy index based thereon. The example personal consumption information includes at least a portion of home resource consumption allocated to the monitored individual, resource consumption by the monitored individual outside the home, and purchase information allocated to the monitored individual. The data collector receives the personal consumption information, generates a personal energy index, displays the personal energy index at a location visible to the monitored person, and/or transmits the personal energy index and/or the personal consumption information to a third party such as a research agency who can draw statistical conclusions concerning a wider population based on monitored individuals (e.g., panelists).

In some example systems and apparatus described herein for monitoring home or household energy consumption, a data collector receives data from several sources, including home appliances, fixtures, devices, electrical meters, water meters, and/or natural gas meters. It also receives data reflecting vehicle usage, purchasing information, and/or other data sources. The example data received from the home appliances, fixtures, meters, and devices is used to determine how much energy is consumed by the home. The data may also be analyzed to identify consumption trends. Energy consumption habits are determined for certain activities, such as cooking or watching television.

Additionally, the example data collector uses the data received from a vehicle associated with the person(s) living in the monitored home to determine how much energy is consumed by each person for travelling activities. Consumed energy is divided among and assigned to the persons traveling in the monitored vehicle(s). In some examples, the data collector also receives data associated with purchases made by the person(s) in the monitored home, determines the energy associated with the purchases, and assigns the energy and/or purchases to one or more of the persons in the monitored household. Thus, as used herein, "home energy" refers to energy consumed within a home. "Transportation energy" refers to energy consumed by travel in a vehicle. "Out of home energy" refers to energy consumed outside the home excluding transportation energy. "Purchases energy" refers to energy associated with purchased goods and/or services. "Household energy" refers to the sum of home energy, transportation energy, out of home energy, and purchases energy for the monitored household.

In some examples, the data collector generates one or more energy indices based on the resource consumption data received. Each person associated with a monitored household, as well as the household itself, is assigned an energy index. The personal and/or household energy indices are displayed on the data collector for the persons to observe, allowing them to track energy conservation efforts over time.

In some examples, a central data collector generates an organizational energy index based on resource consumption information from resource meters, equipment energy consumption meters, and/or purchasing information from a purchasing system relating to monitored organizations such as a company, business, or agency. The central data collector receives the resource consumption information and purchasing information, generates an organizational energy index based on the received information, and displays the organizational energy index to one or more persons associated with the monitored organization. The example central data collector may also allocate resource consumption information and purchasing information to unit(s) and/or individual(s) associated with the monitored organization to generate other unit and/or individual energy indices for the unit(s) and/or person (s).

Turning now to the drawings, FIG. **1** is an illustration of an example system **100** to collect resource consumption information from a panel of persons, households, agencies, and/or companies (collectively and/or individually "entities"). As used herein, the term "household" is taken to mean one or more persons living together in a living space. The households **102**, **104**, **106** may be any type of residence to be monitored. A living space is also referred to as a "home," and may include, but is not limited to, single and/or multi-family houses, condominiums, townhouses apartments, and/or duplexes. A number of households, including households **102**, **104**, and **106**, are selected as panelists. The panelists may be selected, for example, by statistical methods to represent a population of interest. Each household **102**, **104**, and **106** is associated with a number of persons **108** living in the respective household. These persons **108** consume resources such as food, clothing, electricity, natural gas, water, and/or other resources associated with the household. The households **102**, **104** and **106** may also be respectively associated with vehicles (not shown) used for, among other things, transportation of one or more persons **108**.

In the example of FIG. **1**, each household **102**, **104**, **106** includes a data collector **110** that collects resource consumption data, based on the activities of person(s) **108** and/or the households **102**, **104**, and **106**. As described below in detail,

the data collector **110** receives resource consumption data from household appliances, purchases associated with the persons **108**, vehicles, and/or other sources. The example collected data is compiled and/or interpreted, and then transmitted to a central data processing facility **112** having a data processing server **114**. Alternatively, the data may be forwarded to the central data processing facility **112** without being processed.

The data processing server **114** of the illustrated example is connected to the data collectors **110** via the Internet, and receives the data from the data collectors **110** for analysis and storage. Alternatively, the data processing server **114** may be connected to the data collectors **110** via another medium, such as a direct modem connection via the public switch telephone network (PSTN). Depending on the amount of information to be analyzed, there may be several data processing servers **114** within the central data processing facility **112**. Likewise, there may be several central data processing facilities **112**.

The central data processing facility **112** of the illustrated example also collects data from organizations, such as the example company Corporation XYZ **116**. Corporation XYZ **116** uses a data collector **118** which may be the same, substantially the same, or different than the data collectors **110** used in the monitored households **102**, **104** and **106**. For example, the data collector **118** may be implemented as a software module on a computer network of Corporation XYZ and/or have a larger number of inputs corresponding to the larger number of resource-consuming equipment. The data collector **118** also communicates with the central data processing facility **112**.

FIG. **2** is an illustration of an example system **200** to collect resource consumption information from different sources within a monitored household. For ease of discussion, the following description will refer to the example household **102** shown in connection with FIG. **1**. Several persons **108** are associated with the example household **102**. There are also a number of appliances **202**, **204**, and **206** within the household **102** that use energy or resources. In addition to resource-consuming equipment inside the household **102**, there are also one or more vehicles **208** associated with the household **102** and/or the persons **108**. Lastly, the persons **108** purchase goods **210** from outside the household **102** for consumption. As described below, the energy consumption associated with any or all of these activities (e.g., the home energy, the transportation energy, the out of home energy, the purchases energy, and/or the household energy) are monitored and/or analyzed.

The example vehicle **208** is used by one or more persons **108** associated with the household **102** to travel between the household **102** and among other locations. To transport the persons **108** in the vehicle **208**, the vehicle **208** must consume resources such as fuel, engine fluids, and tire rubber. The consumed resources are measured and allocated to the persons **208** being transported in the vehicle, as described in detail below.

The household **102** includes a data collector **110** for receiving data associated with resource consumption from different sources such as those mentioned above. To receive data, the data collector **110** is communicatively coupled to meters configured to measure and report resource consumption data. Such meters include, but are not limited to, appliance meters **212**, barcode scanners **214**, mobile (e.g., portable or handheld) devices **216**, and/or utility meters **218**.

In the illustrated example, appliance meters **212**, discussed in greater detail below, are coupled to respective household appliances, fixtures, and/or other energy consuming devices to collect resource consumption information. For example, appliance meters **212** are coupled to, among other things, a refrigerator (e.g., an appliance **1**), an electrical outlet (e.g., a fixture), and/or a television (e.g., a device). The appliance meters **212** measure resource consumption data for one or more types of resources and report the resource consumption to the data collector **110** at regular and/or irregular intervals. The data collected by the appliance meter **212** are generally categorized as home energy.

The barcode scanner **214** of the illustrated example scans universal product codes (UPCs) associated with purchased items **210** to identify the same. The collected UPC codes are sent to the data collector **110**. The data collector **110** references a database (either locally or remote via, for example, the Internet) to identify the product(s) associated with the code(s). The identities of the products are then used to access a database (again, either locally or remote) correlating products to purchase energy values. (Alternatively, the UPC codes may be already correlated to the purchase energy values.) The purchase energy values reflect, for example, an amount of energy required to manufacture the corresponding product and its packaging, the amount of energy required to transport the corresponding product to the point of sale, an amount of waste associated with the use of the product (e.g., landfill space requirements, bio-degradability, etc.), and/or the recyclability of the product. The data collector **110** associates the purchase energy values with the one or more persons **108** in the household **102** who made the purchases. The persons **108** associated with the purchases may be identified by scanning an identifier bar code identifying the household member when scanning the UPC codes.

The mobile device **216** monitors resource consumption by a monitored person while located outside the household **102**. The mobile device **216** of the illustrated example utilizes global positioning system (GPS) technology and/or cellular telephone signals to track the geographic locations of the individual carrying the device. The location information may be used to infer energy consumption (e.g., time spent at the movie theater is indicative of watching a movie and can be attributed to an out of home energy value). The mobile device **216** may also accept manual inputs to enable the user to identify activities throughout a day. The identification of activities may be made, for example, by selecting from a drop down menu of activities or typing in an activity name. Then, for example, activities such as working at the office, going to a museum, eating lunch, going to a doctor, visiting a hospital, smoking, going to a bar, etc. can all be assigned out of home energy values that are allocated to the person participating in the activity. The out of home energy values, like the other energy values described in home, may have values per unit of time. Thus, the mobile device **216** preferably collects both the activity identification information and the time information indicating how much time was spent participating in the activity.

A utility meter **218** is used to collect data reflecting the amount of energy entering the house. For example, a first utility meter **218** is used to meter the amount of water used by the house, a second utility meter **218** is used to measure the amount of natural (or other) gas used by the house, a third utility meter **218** is used to measure the amount of electricity used by (or in the case of a home with solar panels, produced by) a home, etc. The outputs of the utility meters **218** are typically categorized as home energy.

The level of resolution of resource consumption information may depend on the type and/or quantity of meters **212**, **218** used. Appliance meters **212** that measure resource consumption by individual appliances typically provide informa

tion with more resolution or precision than utility meters **218**. However, the utility meters **218** may ensure all or substantially all of the resource consumption by the household **102** is logged. For example, the utility meters **218** may not be able to determine that a particular appliance (e.g., the refrigerator) consumes a relatively large portion of energy, but it can determine how much energy the household **102** is using as well as the hours of the day when the most energy is used (e.g., peak consumption times, low consumption times, etc.). In contrast, an appliance meter **212** coupled to the refrigerator can determine how much electrical energy the refrigerator is using, but may not be able to determine how much energy the entire household **102** is using.

To determine how the household resource consumption (e.g., the home energy values, etc.) is allocated among the household members, the example household **102** also includes a device to detect the presence of the monitored persons **108** associated with the household **102**. For example, each person **108** may carry a device (e.g., the mobile device **216**) that allows the data collector **110** to detect the proximity of the person. Alternatively, the data collector **110** may be programmed with information indicating when each person **108** is typically at the household or away from the household. This information could indicate allocation rules such as, for example, a certain person **108** is typically away from the household **102** from 8 AM to 5 PM, Monday through Friday of each week and, thus, does not consume household resources during these times. The persons **108** may additionally or alternatively input exceptions to the allocation rules, and/or input times at the household **102** and/or away from the household **102** for the times that do not have defined allocation rules.

Although the example system of FIG. **2** collects multiple types of energy values (e.g., home energy values, transportation energy values, out of home energy values, and purchase energy values), preferably all of the energy values are similarly scaled so that they may be easily scanned to produce a household energy value.

Household Resource Consumption

FIG. **3** is a block diagram of an example system **300** to receive resource consumption data (e.g., home energy values) from appliances **304-330** associated with a measured household. For ease of discussion, the example system **300** of FIG. **3** will be considered part of the household **102** being measured. The example system **300** has a Home Resource Consumption Management (HRCM) device **302**. The HRCM device **302** receives information from a number of meters associated with respective appliances, fixtures and/or other devices associated with household **102**. Example devices include a refrigerator **304**, a freezer **306**, a furnace **308**, an air conditioner **310**, a microwave oven **312**, a television **314**, a personal computer **316**, a home electric meter **318**, a light fixture **320**, home water meter(s) **322**, a stove and/or oven **324**, a dishwasher **326**, a water heater **328**, a clothes washer and/or a dryer **330**. This list of appliances **304-330** is intended to be illustrative rather than limiting. The home water meter (s) may be implemented using, for example, a water meter for the entire household and/or water meters to measure water usage at each particular faucet and/or water-using appliance. Any of the appliances, fixtures or other devices (e.g., consumer electronics, etc.) listed or not listed may be combined or split into multiple appliances, fixtures and/or devices. Although the appliances, fixtures and/or devices **304-330** are shown in FIG. **3** as within the household **102**, appliances such as the air conditioner **310** may be located outside the household **102** as is conventional.

In the illustrated example, each appliance, fixture and/or device has one or more appliance meters **212***a-n* coupled thereto to measure the resources used by the respective appliance, fixture, or device. For example, a clothes dryer may use natural gas to heat clothes being dried while using electricity to power a tumbling device, requiring multiple meters **212** or one meter **212***n* capable of measuring electricity and natural gas consumption.

Appliances may be added or subtracted from this list to adjust the resolution or granularity of data desired. For example, when measuring resources it may be desirable to use meters **212***a-n* to individually measure appliances, fixtures and/or devices that consume a relatively large portion of electricity or have special features, such as the air conditioner **310**, microwave oven **312**, and television **314**. A utility meter **218***a* may then be used to track the home electrical meter **318** (used by a power company providing power to the household **102**) to measure the amount of power used by the household as a whole. Subtracting the electricity used by the metered appliances from the total electricity used by the household reveals the amount of electricity used by the non-individually metered appliances, fixtures and devices associated with the household **102**. This approach saves meters from being used to measure, for example, individual light fixtures **320** from which high-resolution data may not be necessary. The same may be done for the home water meter **322** as an alternative to measuring every faucet that uses water.

The appliance meters **212***a-n* and the utility meters **218***a* and **218***b* are communicatively coupled to the HRCM device **302** to report measured data to the HRCM device **302**. The reporting may be performed at regular and/or irregular intervals, continuously or substantially continuously, on demand from the HRCM device **302**, and/or manually. The HRCM device **302** may passively receive data from the appliance meters **212***a-n* and the utility meters **218***a-b* and/or may actively request data from any or all of the meters **212***a-n* and/or **218***a-b*. After receiving data, the HRCM device **302** may store the data or process it to obtain a particular data format. For example, the HRCM device **302** may receive an electricity usage measurement from an appliance meter **212**, determine the energy in Joules and/or the associated carbon load required to produce the electricity, and store the information in a memory or a home energy value for later transmission.

The example HRCM device **302** of FIG. **3** is also communicatively coupled to the data collector **110** for the household **102** to report raw and/or processed data. For example, the HRCM device **302** of FIG. **3** is a module that is communicatively and mechanically coupled to the data collector **110**. Alternatively, the HRCM device **302** may be integrated into the data collector **110** as software. The example system **300** may also have a multiplexing device or switch between the HRCM device **302** and the meters **212***a-n* and/or **218***a-b* to reduce the number of physical inputs required at the HRCM device **302**. The HRCM device **302** may additionally or alternatively utilize a wireless link instead of or to complement wired connection(s) from the meter(s) to the data collector **110** and/or to transmit resource consumption measurements.

To differentiate the resource consumption measurements sent to the HRCM device **302** from the appliance and utility meters **212***a-n* and **218***a-b*, the meters **212***a-n* and **218***a-b* of the illustrated example provide an identification code with their data. The identification code may be transmitted before, during, and/or after the resource consumption measurement information is transmitted. Alternatively, each meter **212***a-n* and **218***a-b* may encode the transmitted consumption measurement information with a unique code to identify the

source of the transmitted information to the HRCM device **302**. Similarly, if the HRCM device **302** requests resource consumption information from an example meter **212***a*, the HRCM device **302** may transmit a code with the request to identify the desired meter **212***a*.

While the example HRCM device **302** and the meters **212***a-n* and **218***a-b* of FIG. **3** are shown as connected in a star topology, the HRCM device **302** and the meters **212***a-n* and **218***a-b* may be connected in a ring, mesh, or any other network topology.

Home resource consumption measurements may be collected and/or reported for any type of resources, including, but not limited to, electricity, natural gas, gasoline, fuel oil, kerosene, propane, wood, light, temperature, water, and/or heating oil. Measurements as collected and/or reported may have different units depending on the resource measured, and may be converted to a standard unit of measurement (e.g., joules, tons of CO_2, any other unit, and/or a unitless measure that is standardized) by the data collector **110**, HRCM device **302**, the appliance meters **212***a-n*, the utility meters **218***a-b*, and/or a central data processing facility (e.g., the central data processing facility **112** or data processing server **114** as described in FIGS. **1** and **2**).

The example HRCM device **302** and/or the example data collector **110** include a user interface to enter and/or adjust resource consumption information. Some types of resource consumption, such as for burning wood, is difficult for a machine to measure. The user interface allows a person **108** to input resource consumption measurements to the HRCM device **302** and/or the data collector **110** to log such resource consumption (e.g., 3 logs burned).

The example HRCM device **302** and/or the example data collector **110** of FIG. **3** are also useful for determining energy consumption associated with different household activities, such as cooking or watching television. For example, a person **108** may be in a kitchen of the example household **102** to cook a meal. To cook the meal, the person utilizes the stove and/or oven **324**, the microwave oven **312**, and a television **314** located in the kitchen, each having a meter **212***e*, **212***f*, and **212***k* that transmits a consumption indicator to the HRCM device **302** when the meters **212***e*, **212***f*, and **212***k* register the beginning of resource consumption at the metered appliances.

In the example activity, the person **108** first turns on the stove/oven **324**, which begins to consume a relatively large amount of electrical or gas energy. The meter **212***k* registers the increase in consumed power and sends a consumption indicator to the HRCM device **302** for the stove/oven **324**. On receiving the indicator, the HRCM device **302** signals the meters **212***e* and **212***f* associated with the microwave oven **312** and television **314** to monitor the microwave oven **312** and the television **314**, respectively, for resource consumption. The person **108** additionally turns on the television **314** and cooks part of the meal in the microwave oven **312**, which cause the meters **212***e* and **212***f* to measure the corresponding consumed resources.

When the person **108** has finished cooking, the stove/oven **324**, microwave oven **312** and television **314** are turned off The meters **212***e*, **212***f* and **212***k* then send resource consumption measurements (e.g., home energy values representative of the amount of energy used by the corresponding appliances) to the HRCM device **302**, which associates the energy values with the cooking activity and transmits the data to the data collector **110**. The data collector **110** may, for example, determine the resources consumed by the cooking activity for an entire time period (e.g., a month) and display it for the person **108** to analyze.

Although three appliances/devices were used in the example activity, it is contemplated that more or fewer appliances may be monitored and/or measured for any appropriate activity. For example, the washer/dryer **330** may be monitored for an activity such as doing laundry.

Additionally, for an activity such as cooking, appliances and/or devices (e.g., a food processor or a blender) may be used and then put away. Although such appliances and/or devices may not require an appliance meter **212**, using, for example, information from an electrical meter for the entire household **102** may not provide the desired granularity of information for the cooking activity. In this example case, it may be desirable to provide an appliance meter **212** or a utility meter **218** for each kitchen electrical outlet to measure resource consumption for appliances and/or devices drawing energy from the kitchen electrical outlets. Although in the above example, the appliance meters are described as calculating energy values, in alternative examples the meters simply monitor on/off events and the HRCM device **302** computes the energy values. For example, the HRCM device **302** may log on and off events to determine usage times and then multiple the usage times by an average energy per unit of time factor for the corresponding metered appliances to calculate the energy value for the activity.

In some examples, indirect tools are used to measure energy consumption on individual subsystems. For example, the circuit breaker box or fuse box of the household **102** is fitted with one or more non-contact sensor(s), such as Hall Effect sensor(s). The Hall Effect sensor(s) measure the energy consumption on individual circuit(s). Data from several such sensors could be combined at the data collector **110** to recognize a "load signature" for individual appliances and/or activities. For example, a vacuum cleaner requires a substantial amount of energy for short time periods, and the vacuum cleaner is moved from room to room (i.e., subsystem to subsystem or circuit to circuit). When the data collector **110** recognizes the load signature corresponding to vacuuming on one or more subsystems, the data collector **110** determines that someone is vacuuming and logs the energy consumed by the subsystem as occurring due to vacuuming activity.

As described in FIG. **2**, the data collector **110** communicates with the central data processing facility **112**. The data collector **110** sends raw and/or processed energy consumption data (e.g., energy values) to the central data processing facility **112** for aggregation and/or additional processing. At periodic and/or aperiodic intervals, the central data processing facility **112** returns the processed energy consumption data to the data collector **110**. In some examples, the energy consumption data includes 'standard' energy consumption data for the monitored appliances (e.g., an amount of energy that an appliance should consume, an energy consumption goal for a given type of appliance), which allows the data collector **110** to determine the energy consumption indices for the corresponding appliances **304-330** of the household **102**. Appliances, activities, and/or resources may also be individually tracked or sorted to display the conservation progress of the household **102**. In some examples, the central data processing facility **112** provides local, regional, institutional, entity, and/or national progress updates, which, in combination with the individual household's **102** progress, can provide encouragement to continue and/or improve conservation efforts.

FIG. **13** is a block diagram illustrating an example system **1300** to monitor energy consumption due to trash, composting, and/or recycling. In the example household **102** of FIGS. **1-3**, one or more individuals regularly discard used materials into a trash, compost, and/or recycling container **1302**. A

trash/composting/recycling contents detector **1304** may be included to determine the types of trash, compost, and/or recycling that are discarded. The trash/composting/recycling contents detector **1304** may be implemented using a motion-activated camera and video recognition system and/or a simple weight sensor to determine the weight of the trash, compost, and/or recycling. In other examples, the individual discarding the trash, compost, and/or recycling can report to the data collector **110** the nature and amount of material discarded, as well as the method of disposal (e.g., trash, composting, or recycling). The data collector **110** then accesses a trash database **1306**, a composting database **1308**, and/or a recycling database **1310** to determine energy consumption data for the discarded item. For example, the energy consumption associated with a piece of trash may include transportation energy costs and local landfill price per unit weight of trash converted to an energy value. A non-biodegradable factor and/or a hazard factor for chemicals can be used to weight the energy consumption associated with trash. Similarly, the energy consumption for recycling may include the energy costs for transportation to the recycling plant, subtracted by the energy saved by recycling. Energy costs for composting may include the cost of transporting the compost material, less the energy saved by composting.

As noted above, the trash/compost/recycling contents detector **1304** may also be used to adjust the cost of disposal based on the nature of the trash contents. This adjustment may be affected by adjusting the energy cost for disposing trash by an amount to offset long term landfill usage (e.g., non-biodegradable plastics), hazardous materials (e.g., paints or household chemicals), etc. These factors may be pre-set based on empirical or other studies and determined by accessing a lookup table or other database using the trash type as the key for performing the lookup. Similarly, the cost to an individual or household for recycling may be modified based on current market values of the materials. A government, agency, or other entity may encourage participation in energy tracking by offering incentives to those who report trash and recycling data and/or to those who keep trash levels below a target (e.g., index **100**).

Such incentives would increase the detail of the data available. The data may also be used to price and compare trash and recycling programs between municipalities.

FIGS. **4**, **7-9**, **11**, **14**, and **16** are flowcharts representative of example processes that may be executed to implement the example data collector **110**, central data processing facility **112**, the example barcode scanner **214**, the example HRCM device **302**, the example central processor **502**, the example mobile device **520**, the example central data collector **1028**, and/or, more generally, the example systems **100** and/or **1000** of FIGS. **1-3**, **5**, **6**, **10** and **13**. The example processes of FIGS. **4**, **7-9**, **11**, **14**, and **16** may be executed by a processor, a controller, and/or any other suitable processing device. For example, the example processes of FIGS. **4**, **7-9**, **11**, **14**, and **16** may be implemented using coded instructions stored on a tangible medium such as a flash memory, or random access memory (RAM) associated with a processor (e.g., the processor **1212** shown in the example processor platform **1200** and discussed below in conjunction with FIG. **12**). Alternatively, some or all of the example flowcharts of FIGS. **4**, **7-9**, **11**, **14**, and **16** may be implemented using ASICs, programmable logic devices (PLD), field programmable logic devices (FPLD), discrete logic, hardware, firmware, etc. In addition, some or all of the example flowcharts of FIGS. **4**, **7-9**, **11**, **14**, and **16** may be implemented manually or as a combination of any of the foregoing techniques, for example, a combination of firmware, software, and/or hardware. Further, although the example processes of FIGS. **4**, **7-9**, **11**, **14**, and **16** are described with reference to the flowcharts of FIGS. **4**, **7-9**, **11**, **14**, and **16**, many other methods of implementing the example data collector **110**, barcode scanner **214**, HRCM device **302**, central processor **502**, mobile device **520** or central data collector **1028**, and/or, more generally, the example systems **100** and/or **1000** of FIGS. **1-3**, **5**, **6**, **10**, and **13** may be employed. For example, the order of execution of the blocks may be changed, and/or some of the blocks described may be changed, eliminated, sub-divided, and/or combined. Additionally, the example processes of FIGS. **4**, **7-9**, **11**, **14**, and **16** may be carried out sequentially and/or carried out in parallel by, for example, separate processing threads, processors, devices, circuits, etc.

FIG. **4** is a flowchart representative of example machine readable instructions **400** that may be executed to associate activities with energy consumption. The example instructions **400** may be executed to implement the example HRCM device **302** or the example data collector **110** described in FIG. **3**. The HRCM device **302** or the data collector **110** collects energy consumption information for a period of time (e.g., a month). Each monitored period of time may result in different measured energy consumption based on, for example, energy conservation measures, weather, or habits of a measured person or household. Thus, each monitored time period has an associated energy index based on the energy consumed by the measured person or household during the monitored time period. The instructions **400** begins by determining whether the measurement period has ended (block **402**).

If the measurement period has not ended (block **402**), the HRCM device **302** monitoring for consumption information (e.g., monitoring one or more of the example appliance meters **212***a-n* and/or utility meters **218***a-b* shown in FIG. **3**) associated with an appliance (e.g., example the stove/oven **324** shown in FIG. **3**) (block **404**) and determines whether the meter **212***k* has issued a consumption indicator (block **406**). For ease of reference, we will hereinafter refer to the stove/oven **324** as an oven in describing this example.

If no consumption indicator has been issued (block **406**), control returns to block **404** to monitor the meter. The example oven **324** typically utilizes a relatively small amount of resources when not actively used. At some time, a person **108** utilizes the oven **324** for a cooking activity, which requires the person **108** to turn on the oven **324** and cause it to consume a larger amount of resources. When the meter **212***k* detects the larger consumption, it issues a consumption indicator to the HRCM device **302**. The HRCM device **302** receives the consumption indicator (block **406**) and responds by timestamping the consumption indicator to identify the beginning or end of an activity (block **408**). The example HRCM device **302** then determines whether additional appliance meters **212***a-n* and/or utility meters **218***a-b* are to be wakened (e.g., from a sleep mode) (block **410**). If related meters are to be wakened (block **410**), the HRCM device **302** instructs a second meter (e.g., meter **212***e*) to measure consumption information (block **412**). For example, the HRCM device **302** may respond to the person **108** turning the oven **324** on by instructing the meter **212***e* coupled to the microwave **312** to measure resources consumed by the microwave **312** while the oven **324** is on.

While the person **108** continues cooking, the HRCM device **302** monitors for a second consumption indicator (e.g., indicative of the person turning the oven off) (block **414**). When the second consumption indicator is received (block **414**), the HRCM device **302** timestamps the consumption indicator (block **416**). The HRCM device **302** receives the

consumption information from the meters **212***e* and **212***k* (block **418**). The meters **212***e* and **212***k* may be configured to transmit the measurements to the HRCM device **302** in response to a stop measurement instruction and/or an information request. On receiving the consumption information from the meters **212***e* and **212***k*, the HRCM device **302** associates the consumption information with the cooking activity (block **420**). Control then returns to block **402** to determine whether the measurement period is over and/or to monitor for additional activities.

If the data collector **110** or the HRCM device **302** determines at block **402** that the measurement period has ended, the HRCM device **302** determines the total energy consumption attributed to each monitored activity (block **422**). The total energy consumption for each activity may then be displayed for one or more persons to see and/or analyze.

In addition to the example instructions **400**, the HRCM device **302** and/or data collector **110** may continuously or substantially continuously receive resource consumption measurements from the meters **212***a-n* and **218***a-b*. Similarly, the meters **212***a-n* and **218***a-b* may continuously or substantially continuously measure resource consumption associated with the household appliances, fixtures, and/or devices **304-330** to which the meters **212***a-n* are coupled.

Energy Index Generation

FIG. **15** is a block diagram illustrating an example energy index generator **1500** that may be used to implement the example data collector **110** of FIGS. **1** and **2**, and/or the example Central Data Collector **1028** of FIG. **10**. The example energy index generator **1500** receives energy and/or resource consumption information, generates energy values (e.g., home energy values, transportation energy values, out of home energy values, and/or purchase energy values), and one or more energy indices. An energy value summer **1502** receives one or more energy values from several energy converters, as described below, and generates one or more energy indices based on the energy values and/or external energy data.

The illustrated energy index generator **1500** includes an activity converter **1504**. The activity converter **1504** receives activity information (e.g., from user input, from energy signature detection, from a mobile device, etc.) and determines the energy values associated with the received activity information. The example activity converter **1504** determines the energy values by querying a database **1505**. The activity converter then outputs energy values corresponding to the activities (e.g., out of home energy values, home energy values) to the energy value summer **1502**. The example energy index generator **1500** also includes a raw material converter **1506**.

The raw material converter **1506** receives raw material information (e.g., from appliance and/or utility meters, from user input, etc.) such as, for example, electricity used, natural gas and/or other natural resources used, trash/compost/recycling, and/or other raw material information. The raw material converter **1506** converts the raw material information to energy values (e.g., home energy values) and sends the energy values to the energy value summer **1502**. The example raw material converter **1506** determines the energy values by querying a database **1507**.

The example energy index generator **1500** further includes a purchases converter **1508**. The example purchases converter **1508** receives purchases information (e.g., by scanning purchase UPCs, from user input, by downloading information from a point-of-sale, etc.). The purchases converter **1508** converts the purchases information to purchase energy values for use by the energy value summer **1502**. The example purchases converter **1508** determines the energy values by querying a database **1509**. A transportation converter **1510** receives transportation information (e.g., from user input, from a vehicle monitor, etc.). Transportation information may include, for example, fuel used, distance traveled, method of travel, and/or other transportation information. The transportation converter **1510** converts the transportation information to a transportation energy value and sends the value to the energy value summer **1502**. The example transportation converter **1510** determines the energy values by querying a database **1511**. Any one or more of the example database(s) **1505**, **1507**, **1509**, and **1511** are implemented via one or more of local storage and/or an external database.

The energy value summer **1502** receives the home energy values, the out of home energy values, the purchase energy values, and/or the transportation energy values. The example energy value summer **1502** receives assignment information to assign one or more of the received energy values to one or more different individuals, vehicles, households, organizational units, and/or any other monitored entity. Additionally, the example energy value summer **1502** receives external energy data corresponding to, for example, individual, organizational, household, governmental, agency, and/or any other public and/or private energy data. Such data may include a target energy usage for a particular type of monitored entity. Based on the energy values from the converters **1504-1510** and/or the external energy data, the energy value summer **1502** generates an energy index representative of the energy values.

In some examples, the energy index is a relative figure to illustrate how much energy a monitored entity consumes relative to a similar entity or a desired energy usage goal for that particular entity. In contrast, the example energy values are defined in terms of units of energy. Different monitored entities may have different desired energy usage goals; for example, a monitored individual will have a much different energy usage goal than a monitored multi-national corporation. However, the energy value summer **1502** may provide separate energy indices for an individual and a corporation that are similar or equal, because the energy indices are relative to an appropriate energy value. For example, both the monitored individual and the monitored corporation may have target energy indices equal to '100.' However, the energy value corresponding to the individual's energy index is much smaller than the energy value corresponding to the corporation's energy index.

In another example, an energy index generator **1500** receives activity information, raw material information, purchases information, and transportation information for a country. The activity converter **1504**, the raw material converter **1506**, the purchases converter **1508**, and the transportation converter **1510** convert the respective received information to respective energy values. The example energy value summer then receives the energy values and external energy information. In this example, the external energy information is an energy value determined by governmental or agency policy makers as a national energy usage goal. The energy value summer **1502** sets the energy usage goal as a standard energy index, and determines the current national energy index relative to the standard energy index. In this manner, the example energy index generator **1500** generates easily understandable energy indices for many different types of monitored entities.

The example energy index generator **1500** may be modified to add or subtract converters similar to the converters **1504-1510**, which receive resource and/or energy usage information and convert the information to a corresponding

energy value in a uniform unit. Additional or alternative converters may include converters to convert business, governmental, agency, manufacturing, not-for-profit, and/or any other type of information concerning energy or resource usage into an energy value.

FIG. **16** is a flowchart representative of example machine readable instructions **1600** that may be executed to generate an energy index. The example instructions **1600** may be executed to implement the example energy index generator **1500** of FIG. **15**. The example instructions **1600** begin by receiving one or more of activity information, raw material information, purchases information, and/or transportation information (block **1602**). The example information is received from any one or more of the example barcode scanner **214**, HRCM device **302**, and/or mobile device **520** of FIGS. **2**, **3**, and/or **5**.

If the energy index generator **1500** has received activity information (block **1604**), the example activity converter **1504** converts the activity information to home and/or out of home energy values (block **1606**). If the energy index generator **1500** has not received activity information (block **1604**), control passes to block **1608**. If the energy index generator **1500** has received raw material information (block **1608**), the example raw material converter **1506** converts the raw material information to home energy values (block **1610**). If the energy index generator **1500** has not received raw material information (block **1608**), control passes to block **1612**. If the energy index generator **1500** has received purchase information (block **1612**), the example purchases converter **1506** converts the purchase information to purchase energy values (block **1614**). If the energy index generator **1500** has not received purchase information (block **1612**), control passes to block **1616**. If the energy index generator **1500** has received transportation information (block **1616**), the example transportation converter **1506** converts the transportation information to transportation energy values (block **1618**). If the energy index generator **1500** has not received transportation information (block **1616**), control passes to block **1620**.

When the energy value summer **1502** receives the energy values (blocks **1604-1618**), the energy value summer **1502** sums the converted energy values to a total energy value (block **1620**). The energy value summer **1502** then determines whether an appropriate energy goal in available (block **1622**). The energy goal may be available via, for example, the Internet. If an energy goal is available (block **1622**), the energy value summer **1502** sets a standard energy goal respective to the energy goal (block **1624**). In some examples, the energy value summer **1502** sets the standard energy goal equal to an energy index of '100.' However, any index may be used to represent the goal.

If an appropriate energy goal is unavailable (block **1624**), the example energy value summer sets the standard energy index to a portion of the current total energy (block **1626**). As a result, the example energy value summer **1502** generates an energy usage goal based on the current energy usage. In some examples, a user may adjust the energy usage goal. When a standard energy index has been established (block **1622** or **1624**), the energy value summer **1502** sets the current energy index based on the total energy value received and relative to the standard energy index. Thus, if the standard energy index is equal to **100**, which corresponds to an example energy usage goal of 1000 kilowatt-hours (kWh), then a total energy value of 1100 kWh yields a current energy index of 110. The example instructions **1600** may be repeated on a periodic or aperiodic basis to update the energy usage and/or the energy usage goal, which is reflected in a new current energy index.

Vehicle And Remote Resource Consumption

FIG. **5** is a block diagram of an example system to receive resource consumption information from a vehicle **208** associated with a monitored person or household. The example vehicle **208** is equipped with a central processor **502**, which handles many of the vehicle functions. The central processor **502** is provided to the vehicle **208** by the manufacturer. Among other functions, the example central processor **502** receives fuel gauge measurements from a fuel gauge **504**, distance measurements from an odometer **506**, and seat occupation indications from seat detectors **508-512**. The fuel gauge measurements may indicate how much fuel was used in an example trip. The processor **502** may use this fuel consumption information to determine the energy consumed by this trip. The odometer measurements may be used by the processor **502** to determine other resources that were used, such as tire wear, carbon emissions, and/or engine fluid contamination. The odometer measurements may be used in combination with the fuel gauge measurements to determine the efficiency of the example trip and/or of the driver's driving techniques.

Each seat in the example vehicle **208** is equipped with a seat detector **508**, **510**, **512** to determine whether the seat is occupied. The occupancy information is then used to determine or allocate the resources consumed by each person **108** on the example trip. For example, if one gallon of fuel is used with a driver and no passengers, 1 gallon of fuel is reported as consumed by the driver. However, if one gallon of fuel is used with a driver and three passengers, each passenger and the driver is reported to consume ¼ gallon of fuel.

The example central processor **502** uses resource measurement software **514** to collect and process measurements and indications from the gauges and sensors **504-512** of the vehicle **208**. Because such software is not currently included with a vehicle, the software and/or hardware may be installed at a time after the vehicle **208** is constructed and/or sold. The central processor **502** may also be implemented utilizing a separate processing system coupled to the central processing system provided with the vehicle **208**. Such a separate processing system may be configured to interface with the central processing system of the vehicle **208** to extract the desired resource consumption measurements from the gauges and sensors **504-512** via the central processing system. A third alternative is to couple a separate processing system directly to the sensors and gauges **504-512** in parallel with the central processing system of the vehicle **208**.

To communicate with the data collector **110**, the central processor **502** of the illustrated example is coupled to an antenna **516**, which allows the central processor **502** to transmit data via a wireless connection **518**. Protocols that may be used include WLAN (IEEE 802.11), Bluetooth or any other wireless protocol. Alternatively, the person **108** driving the car may carry a device **520**, such as a mobile phone, PDA, or portable storage device (e.g., a USB flash drive), which may be communicatively coupled to the central processor **502** via a wireless or wired connection **522**. Data associated with a trip may be downloaded to the device **520**, which is then carried into the household **102** by a person **108** and communicatively coupled to the data collector **110** via a wireless or wired connection.

Data may also be collected by manually reporting fuel consumption and mileage of the drivers and passengers of the vehicle **208**. For example, the driver (or any person **108**) of the vehicle **208** may log the passengers identities and mileage for each trip. When the vehicle **208** is refueled, the driver logs the total fuel and the total mileage. The driver manually inputs the logged information into the data collector **110**, which allo

cates some or all of the consumed fuel to the driver and any passenger(s) according to the fuel consumption and personal mileage for each driver and passenger. Logging may be performed manually (e.g., paper and pencil) or on a device (e.g., the portable device **520**). By logging the fuel and mileage information (e.g., transportation energy data) to the device **520**, the device **520** may easily transmit the logged information to the data collector **110** with less effort required of the persons **108**.

On receiving the transportation energy data from the central processor **502**, the data collector **110** processes the data (if processing was not performed by the central processor **502** and/or device **520**) and stores the processed data (e.g., transportation energy values) into memory or into a data store.

Additionally or alternatively, the device **520** associated with the person **108** may track the travel of the person **108**. Such travel may include riding public transportation, air travel or other travel not associated with a measured vehicle **208**. For example, the device **520** may periodically determine geographical coordinates or other location information and log the information in an internal data store to be transmitted to the data collector **110** at a later time. An example device **520** that may be used for this purpose is a Nielsen® NPod™ which is described in U.S. patent application Ser. No. 11/668,931, which is hereby incorporated by reference in its entirety. The device **520** may then process and/or transmit the transportation data for the person **108** to the data collector **110** via a wired or wireless link. The monitored person may manually enter data reflecting usage of non-monitored vehicles (e.g., bus, train, plane, taxi, boat, etc.) by selecting from a pull down menu or typing in data reflecting the vehicle type and distance traveled information.

Purchase-Related Resource Consumption

FIG. **6** is a block diagram of an example system **600** to collect resource consumption information associated with purchases made by a monitored person or household. Resource consumption information for purchases is linked to energy consumption by monitored persons or households by determining an energy value for each item purchased. Energy values for a given item may be derived from, among other things, the energy associated with the raw materials for the item, the energy required to produce and/or grow the item, the energy required to package the item, the energy required to transport the item from the producer to the consumer, and/or the energy required to maintain the quality of the item at a store (e.g., refrigeration, etc.).

To demonstrate an example calculation for the purchase energy value of a purchased item, an apple will be considered. To determine the energy for the raw materials and production of the apple, the average amount of fertilizer, water, and fuel (and their corresponding energy values) to grow and gather a harvest of apples is divided by the average number of apples gathered from the harvest. Next, the energy required to sort the apples is divided by the number of apples. The energy value of the packaging material used to package the apples is divided by the apples in a package. Next, the average fuel to transport a truck load of apples (and other items) to a grocery store is divided by the apples (and other items) in the truck load. Finally, the average energy to keep the apples fresh while at the grocery store is divided by the average number of apples in the grocery store. Any further energy values associated with additional processing of the apples may also be taken into account. The sum of the energy values described is used as the purchase energy value for each purchased apple. Other purchased items may have energy values calculated in a similar way or using any other method to determine the approximate energy associated with purchasing that item. For example, some purchased items may have energy values that are based on the energy required to dispose of or recycle them in addition to or as an alternative to the energy values described above.

For ease of discussion, the following description of FIG. **6** will refer to the example household **102** shown in connection with FIG. **1**. Within the household **102** is the data collector **110** as described in FIGS. **1-3** and **5**. The data collector **110** may integrate with a system such as the Nielsen® HomeScan™ system, which logs purchases for market research. In the example system **600**, the data collector **110** is provided with a barcode scanner **214** (e.g., a HomeScan™ scanner) to read machine-readable indicia (e.g., UPC codes) associated with purchases made by the persons **108** associated with the household **102**. Purchases may include groceries **604**, clothes **606**, or any other items or services **608** bought via any commercial arena (e.g., a retail store, via the Internet, etc.). Some purchases, such as grocery produce, do not necessarily have a UPC code or other type of machine-readable indicia. To enter data into the data collector **110** for such items, a user (e.g., a person **108**) may use an input device such as a touchscreen, keyboard, or other input device (e.g., the input devices **1124** described in connection with the processing system of FIG. **11**).

The example data collector **110** also has a display device (such as one of the display devices **1124** described in connection with the processing system of FIG. **12**) to provide output to a user (e.g., a person **108**) while the user enters purchase data into the data collector **110**. Output may include context-sensitive menus, selection lists, prompts, confirmations, or any other type of output to assist the user in entering data.

An example entry process may occur when a person **108** being measured returns to the household **102** from a shopping trip. While on the example shopping trip, the person **108** makes purchases at a grocery store, a clothing store, and a general merchandise store. When the person **108** returns to the household **102**, the person **108** logs the purchases made from each store. In this example, the person **108** logs the purchases from the grocery store first. The person **108** enters the grocery store location (e.g., by selecting from a list and/or entering a store name and/or location) into the data collector **110**. Once the location (and date, if necessary) is entered, the person **108** scans the UPC **1** code associated with the first item with the barcode scanner **214** (e.g., the HomeScan™ scanner) to identify the first item. If price data is desired, the data collector may prompt the person **108** to enter the price of the item. If the item is to be attributed to a specific household member, the user is provided the opportunity to identify the same. The person continues scanning UPC codes **604** and entering data in this fashion to identify the purchases made from the grocery store. If a purchased item (e.g., broccoli) does not have a UPC code, the person **108** may enter the item and quantity by doing a keyword search, selecting from a list, or by using other method of data entry.

An alternative method of receiving purchase information is to provide the data collector **110** with an image scanner and optical character recognition software to scan a purchase receipt. The data collector **110** may scan the receipt with the image scanner, and analyze the image with optical character recognition to determine any or all of the data that would otherwise be input by a person **108**. A second alternative method for receiving purchase information is to receive a purchase log directly from a store system. For example, the data collector **110** may communicate with a grocery store purchase system via the Internet to download a file for the household purchase(s) in question, which may contain purchased items information, UPC codes, store name, store loca

tion, purchase dates, prices, and/or any other information that may be used to determine energy values for the purchased items. Once all the purchased items are logged for the grocery store, the person **108** repeats the logging for the items purchased from the clothing store (e.g., using UPC codes **606**) and the general merchandise store (e.g., using UPC codes **608**).

When all of the purchases are logged into the data collector **110** or, alternatively, after each purchased item is logged, the data collector **110** performs a query to find the energy associated with each purchased item. The data collector **110** may access a local storage device or data store to retrieve energy values. The data store may store data values for all known items or, alternatively, for frequently-purchased items. If the query does not result in an energy value for the purchased item(s), the data collector **110** may query an outside server via, for example, the Internet. For example, the central data processing server **114** may store the calculated energy values for any or all UPC codes, and/or for items that do not have UPC codes, such as produce. If the outside server does not respond with an energy value, the person **108** may be requested to classify the item via a list, wherein each classification has an approximate energy value per unit quantity. The identity of the purchased item, the purchase energy value associated with the item, and the identity of the person(s) who are to use the purchased item (if applicable) are stored in a memory of the data collector **110**.

As an alternative to the data collector **110** querying for purchase energy values and storing the purchased item information with the corresponding purchase energy values, the data collector **110** may instead store a list of purchased items, person(s) for whom the purchases were made, and store(s) where the purchases occurred. The list may then be transmitted to an external server, such as the central data processing server **114**, for processing. The external server in this example determines corresponding energy consumption information based on the list. The central data processing server **114** returns the purchase energy values to the data collector **110** for further analysis.

A purchased item may be allocated to one or more persons **108** to associate the energy for the purchased item with the one or more persons **108** consuming the item. This allocation is in contrast to dividing the energy for the purchased item among all members of the household **102** equally. For example, an adult may typically do the purchasing for a household, but certain items, such as baby diapers or formula, are not consumed by the adult. Thus, allocating the purchases of baby diapers and/or formula to the baby, instead of sharing the energy associated with the purchases equally, may generate more accurate personal energy indices for both the adult and the baby.

In addition to purchased goods and services consumed in or near the household **102**, the example data collector **110** also logs goods and services purchased and consumed away from the household **102**. Example goods and services purchased away include, foods and/or drinks purchased from a restaurant, an automotive care service, a lawn care service, a car rental, and/or any other goods or services the example person **108** may purchase that are not brought into the household **102** for consumption. If the person **108** prefers to log purchases on a later day, the date the purchases were made may be entered as well.

FIG. **7** is a flowchart representative of example machine readable instructions **700** that may be executed to collect data associated with purchases made by a monitored individual or household. The example instructions **700** may be performed by, for example, the data collector **110** of FIGS. **1-3**, **5** and **6**. The instructions **700** begin when a person (e.g., the person **108** of FIGS. **1-3**, **5** and **6**) starts to log purchases. The data collector **110** receives input identifying the location of the point of sale associated with one or more purchased items (block **702**). The data collector **110** may also receive purchase date information if, for example, the items are not logged the same day they are purchased. Next, the user **108** scans (e.g., via the barcode scanner **214** of FIGS. **2** and **5**) a UPC code for a purchased item and the data collector **110** attempts to recognize the UPC (block **704**). If the UPC is not recognized by the data collector **110** (block **706**), the data collector **110** may request the person **108** to input the type and quantity of the item, which is stored in memory with the associated UPC code (block **708**).

If the UPC is recognized by the data collector **110** (block **706**), or after the person **108** inputs the item information (block **708**), the data collector **110** performs a query for the energy associated with the item(s) (block **710**). The query may search a local data store at the data collector **110** and/or an external server (e.g., the data processing server **114** described in connection with FIG. **1**). If a query does not return energy values, the data collector **110** prompts the user to classify and input a quantity of the item(s) (block **714**). The data collector **110** then approximates the energy associated with the item based on the classification and quantity.

If the data collector **110** receives an energy value as a result of the query (block **712**), or after estimating the energy value (block **716**), the data collector **110** requests the person **108** to allocate the item to one or more persons **108** associated with the household to reflect the user(s) or consumer(s) of the item (block **718**). For example, if one person **108** of the household is the only one to eat a certain type of food product, purchases of that food product are allocated to that person **108** to reflect the energy consumption by that person **108**. The person **108** entering the purchases may allocate the item to one or more persons **108** by, for example, selecting a photo and/or name of the person from a drop down or other list. Purchased items may not be allocated to a household member if the final consumer or user of the item is not known or is not a household member (e.g., a gift). Alternatively, the item may be allocated to the user or consumer after the item is consumed by selecting the item and associating the user or consumer with the item.

When a purchase energy value has been identified (via the query or classification) (blocks **710-716**) and allocated to a person (block **718**), the data collector **110** prompts the user as to whether there are additional purchases from the current location (block **720**). If there are additional purchases, control returns to block **704** to scan another UPC code. If there are no more purchases for the current location (block **720**), the data collector prompts the user as to whether there is another point of sale location (block **722**). If there is another location where items were purchased, control returns to block **702** to input the next point of sale location. Otherwise, the logging session ends and the data collector **110** transmits the purchase energy data (e.g., the energy values and allocations) to the central data processing site **112** (block **724**). The data collector **110** may alternatively wait until all purchases are logged to query for purchase energy values. In this case, any items for which a purchase energy value is not returned may result in an associated prompt for more information from the user.

Alternatively, the instructions **700** may omit the purchase energy value query and, instead, transmit a list of purchased items to an external server (e.g., the central data processing server **114** of FIG. **1**). The central data processing server **114** then generates the purchase energy values associated with the purchased items and, if appropriate, sorts them by user or

consumer according to the allocation of the purchased items. After generating the purchase energy values corresponding to the purchased items, the central data processing server **114** transmits the example list of purchased items and corresponding purchase energy values to the data collector **110**.

Energy Consumption Index

FIGS. **8**A and **8**B illustrate a flowchart representative of example machine readable instructions **800** that may be executed to generate a personal energy consumption index for a person **108**. The example machine readable instructions **800** may be used to implement a function of the data collector **110** described in FIGS. **1-3**, **5** and **6**. During a particular time period (e.g., a week, a month, etc.), the data collector **110** receives resource consumption data from appliances, fixtures, and/or devices (e.g., via appliance meters **212***a-n* and/or the utility meters **218***a-b* described in FIG. **3**) associated with a measured household (e.g., the example household **102** described in FIGS. **1**, **2**, **5** and **6**). Receiving may be done by accepting measurements, requesting data from the appliance meters **212***a-n* and/or the utility meters **218***a-b*, and/or any other method or technique for receiving data (block **802**). After the resource consumption measurements for the example month have been received, the data collector allocates them to the persons **108** associated with the household **102**. If there is more than one measured person associated with the household **102** (block **804**), the resource consumption is divided among the measured persons **108** associated with the household **102** (block **806**). Division of the resources may be done equally between each person in the household (e.g., for four persons **108**, each person **108** is allocated ¼ of the total resources) or according to another resource allocation scheme (e.g., adults are allocated more per person than children). If there is only one measured person **108** associated with the household **102** (block **804**), the data collector **110** associates all of the resource consumption to the measured person **108** (block **808**).

The data collector **110** next determines whether there are any vehicles associated with the household **102** (block **810**). For example, vehicles may be registered in the data collector **110** during the initial setup of the data collector **110** and/or when persons **108** associated with the household **102** rent, purchase, acquire (borrow, buy, etc.) and/or dispose of vehicles. If there is a vehicle **208** associated with the household **102** or a person **108** (block **810**), the data collector **110** loads and/or receives transportation energy values for the vehicle **208** (block **812**). The data collector **110** receives and/or loads transportation energy value data for each measured vehicle **208**. Additionally or alternatively, the data collector **110** may load or receive additional transportation energy data associated with the person **108**. This data may represent travel by the person **108** using, for example, public transportation.

If there are no vehicles associated with the example household **102** or person **108** (block **810**) or after the data collector **110** loads and/or receives all the relevant transportation energy value data for the individual (block **812**), the data collector **110** receives and/or loads out of home resource consumption measurements (block **813**). The out of home consumption measurements may be input via a drop down or other menu, or may be downloaded from the example mobile device **520** described in FIG. **5**.

After receiving the out of home information, the data collector **110** loads purchase energy event data (e.g., from a data store) for items logged during the measured month (block **814**). When the purchase energy event data is loaded, the data collector **110** determines whether the purchase energy event data for the example month is complete (block **816**). This may be accomplished by, for example, prompting a person **108** to enter final purchase data or determining the logging habits of the person **108** relative to the end of the example month. If the purchase energy event data is incomplete (block **816**), the data collector **110** receives the remaining purchase energy event data for the time period (block **818**). When the purchase data is complete (block **816**) or when the complete purchase data is received (block **818**), the resources are allocated to the household members (block **819**). The resources may be allocated by, for example, equal distribution of the associated purchase energy values among the household members and/or allocating purchase energy values associated with individual items to particular household members.

When the appropriate energy value data has been received, allocated, and loaded into the memory of the data collector **110** (blocks **802-819**), the data collector **110** generates a personal energy consumption index for the example month based on the home energy values, the transportation energy values, the out of home values, and the purchase energy values and stores the index in memory (block **820**). To generate an example personal energy consumption index, the data collector **110** sums the home energy values, the transportation energy values, the out of home values, and the purchase energy values attributed to the person **108**. The personal energy consumption index may then be compared to a standard personal energy consumption index, which may be based on, for example, demographics, location, seasonal weather, and/or other appropriate resource consumption factors. The personal energy consumption index may also be used without comparison to a standard amount, using any desired units such as carbon units or energy.

After the personal energy consumption index is generated, it may then be displayed with personal energy consumption indices for previous time periods for the example person **108** to view changes (block **822**). This comparison will allow the person **108**, for example, to view how conservation efforts he/she is undertaking are affecting the personal energy consumption index over time. The example data collector **110** also transmits the personal energy consumption index to a central data processing facility (e.g., the central data processing facility **112** and/or data processing server **114** described in FIGS. **1** and **2**) for storage and/or for the processing (e.g., grouping with other indices for other monitored users to identify trends, etc.) (block **824**). The example central data processing facility **112** uses the personal energy consumption index, which may be associated with demographic information for the person **108**, to generate statistical data.

Alternatively, the instructions **800** may omit generating the personal energy consumption index. Instead, the instructions **800** may transmit the home energy values, the transportation energy values, the out of home energy values, and the purchase energy values associated with the household **102**, vehicle **208** and purchases to an external location (e.g., the central data processing server **114** of FIG. **1**). The central data processing server **114** receives the home energy values, the transportation energy values, the out of home energy values, and the purchase energy values and generates a personal energy consumption index, which may then be transmitted to the data collector **110** for display to the person **108**.

FIG. **9** is a flowchart representative of example machine readable instructions **900** that may be executed to generate a household energy consumption index for a household **102**. The household **102** is associated with one or more persons **108**, who each may have a personal energy consumption index as described herein. The example instructions **900** is used to implement a function of the data collector **110** described in FIGS. **1-3**, **5** and **6**. During a particular time

period (e.g., a month), the data collector **110** receives resource consumption data (e.g., home energy values, transportation energy values, out of home energy values, and/or purchase energy values) from different sources. For example, home energy values (or data enabling calculation of home energy values) are received from appliances, fixtures (e.g., electrical receptacles), and/or other devices (e.g., via appliance meters **212***a-n* and/or utility meters **218***a-b* described in FIG. **3**) associated with a measured household (e.g., the example household **102** described in FIGS. **1**, **2**, **5** and **6**). Receiving may be done by accepting measurements from appliance meters **212***a-n* and/or utility meters **218***a-b*, requesting data from the appliance meters **212***a-n* and/or utility meters **218***a-b*, and/or any other method for receiving data (block **902**).

To collect transportation energy values (or data) from a vehicle (e.g., the vehicle **208** described in FIGS. **2** and **5**), the data collector **110** first determines whether there are any vehicles associated with the household **102** (block **904**). For example, vehicles may be registered in the data collector **110** during the initial setup of the data collector **110** and/or when persons **108** associated with the household **102** acquire or get rid of vehicles. If there is a vehicle **208** associated with the household **102** or a person **108** (block **904**), the data collector **110** loads and/or receives all the relevant transportation energy values for the vehicle **208** (block **906**). Example methods of communicating data from a vehicle **208** to the data collector **110** may include a wireless communication link (e.g., wireless link **508**) or via a mobile unit (e.g., the mobile unit **520**) associated with a person **108**, which downloads transportation energy data from the vehicle **208** and uploads the data to the data collector **110**. The data collector **110** receives and/or loads transportation energy values for each measured vehicle **208**. Additionally or alternatively, the data collector **110** may load or receive miscellaneous transportation data associated with measured persons **108** from devices **520** corresponding to those persons. This miscellaneous transportation data may represent transportation by persons **108** using, for example, public transportation.

If there are no vehicles associated with the example household **102** or person **108** (block **904**) or when the data collector **110** loads and/or receives transportation energy values for the vehicle (block **906**), the data collector receives and/or loads all relevant out of home energy values (block **907**) for the individuals associated with the monitored household **102**. Out of home energy information is received from, for example, the mobile units **520** carried by household members. The data collector **110** loads purchase energy event data (e.g., from a data store) for items logged during the measured month (block **908**). For example, a person **108** may log purchases for each week on a particular day. When the purchase energy event data is loaded, the data collector **110** determines whether the purchase energy event data for the example month is complete (block **910**). This may be accomplished by, for example, prompting a person **108** to enter final purchase energy event data or determining the logging habits of the person **108** relative to the end of the example month. If the data collector **110** determines that the purchase energy event data is incomplete (block **910**), the data collector **110** receives the remaining purchase energy event data for the time period (block **912**). If the data collector determines the purchase energy event data is complete (block **910**) or when the complete purchase energy event data is received (block **912**), the data collector **110** is prepared to generate the household energy consumption index.

When the appropriate resource consumption data (e.g., home energy values, transportation energy values, out of home energy values, and/or purchase energy values) has been received and loaded into the memory of the data collector **110** (blocks **902-912**), the data collector **110** generates a household energy consumption index for the time period of interest (e.g., a period corresponding to the data such as a week, a month, etc.) based on the energy values and stores the index in memory (block **914**). The household energy consumption index may be generated using any desired units, such as joules or tons of CO_2. The current household energy consumption index may then be displayed with household energy consumption indices for previous time periods for the example household **102** (block **916**). This will allow the persons **108** associated with the household **102**, for example, to view how conservation efforts being undertaken are affecting the household energy consumption index over time and continue, modify and/or end particular efforts accordingly. The example data collector **110** also transmits the household energy consumption index to a central data processing facility (e.g., the central data processing facility **112** and/or data processing server **114** described in FIGS. **1** and **2**) for storage and/or processing (block **918**). The central data processing facility **112** uses the household energy consumption index, which may be associated with demographic information for measured persons **108** associated with the household **102**, to generate statistical data.

Alternatively, the instructions **900** may omit generating the household energy consumption index. Instead, the process **900** may transmit the household resource consumption data and/or the personal resource consumption data for the persons **108** associated with the household **102**, vehicle **208**, and purchases to an external location (e.g., the central data processing server **114** of FIG. **1**). The central data processing server **114** receives the resource consumption data and generates a household energy consumption index and/or the personal energy consumption indices, which may then be transmitted to the data collector **110** for display to the persons **108** associated with the household **102**.

The example processes **800** and **900** are executed at the end of a particular time period such as the example months described. Additionally or alternatively, any or all of the blocks of the example processes **800** and/or **900** may be executed at any time during a time period to gather information or generate intermediate personal or household energy indices for any desired time period.

Organization Energy Consumption Index

FIG. **10** is a block diagram of an example system **1000** to generate an organization energy consumption index. An organization energy consumption index may be generated for any sort of group (e.g., a not-for-profit organization, a church, a school, a government, a governmental agency, a private company, a corporation, an army, etc.) To illustrate the collection of data in support of and generation of an organization energy consumption index, the following will focus on an example company **1002**. The example company **1002** has four departments: Management and Support **1004**, Research and Development **1006**, Manufacturing **1008** and Purchasing **1010**. The Management/Support department **1004** has equipment **1012** (e.g., computers, printers, storage equipment) and supplies **1014** (e.g., copy paper, pens, pencils, paper clips). The Research and Development department **1006** includes Development Tools **1016** (e.g., design computers, prototyping machines), Test Equipment **1018** (e.g., scopes, meters), and Materials/Equipment Purchases **1020** (e.g., office supplies, chemicals, circuit components, building materials). The Manufacturing department **1008** includes Machinery **1022** (e.g., manufacturing, packaging, and shipping machines), Control and Lighting **1024** (e.g., operator interface equip

ment, lights, HVAC), and Materials/Equipment Purchases **1026** (e.g., raw materials, reagents, machinery). The example Purchasing department **1010** has Purchasing systems (e.g., computers and printers) **1027** to, among other things, collect and log purchasing data from the other departments.

Additionally, the example system **1000** includes a Central Data Collector **1028**. The Central Data Collector **1028** may be implemented as software executing on a server, as a separate Central Data Collector system coupled to the network of the company, or as some combination of components.

The example company **1002** practices a conventional method of submitting purchase requests to the Purchasing Department **1010**, which is responsible for organizing and procuring the requested item(s). As a result, the Central Data Collector **1028** obtains the purchase information from the Purchasing **1010** systems. The purchasing information may be organized by individual, group, department, product line, product, manufacturing line, or by any other criteria depending on the information contained in Purchasing **1010** systems. The Central Data Collector **1028** may passively receive and/or actively request purchasing information from the Purchasing **1010** systems.

After receiving the purchasing information, the Central Data Collector **1028** determines an amount of energy (e.g., an energy value) associated with each purchase. The Central Data Collector **1028** calculates a total purchase energy value from all purchases for the company **1002** and/or allocates purchase energy values to one or more levels or categories within the organization (e.g., individual, group, department, product line, product, and/or manufacturing line).

In addition to receiving purchase information, the example Central Data Collector **1028** receives resource consumption information (e.g., home energy values, transportation energy values, out of home energy values, and/or purchase energy values) from the Management/Support **1004**, Research and Development **1006** and Manufacturing **1008** departments. The example resource consumption information collected in the system **1000** includes any of electricity, natural gas, gasoline, fuel oil, kerosene, propane, wood, light, temperature, water, and/or heating oil. Information associated with other types of resources may also be measured and collected. To collect the resource consumption measurements, the example system **1000** implements appliances, utility, vehicle, and/or mobile meters similar to the meters **212***a-n*, **218***a-b*, **504-512** and **520** described in connection with FIGS. **3** and **5**. Additionally or alternatively, the example system **1000** may use other types of meters, resource management software, and/or other tools to provide resource consumption information to the Central Data Collector **1028**.

After receiving the resource consumption information, the Central Data Collector **1028** converts resource measurements (if not performed by the meter or system providing the measurement) to a standard unit (e.g., energy values which may be reflected in any desired units, such as Joules, kilocalories, tons of CO_2, etc.). The energy values are then used to generate an organizational energy consumption index. The organizational energy consumption index may be used to compare energy consumption by the example company **1002** during different time periods or to measure the effectiveness of conservation efforts. Additionally or alternatively, other energy consumption indices may be generated for individual employees, departments, product lines, products, manufacturing lines and/or other organizational units. For example, a Research and Development department energy consumption index may be generated based on purchases originating from the Research and Development **1006** department (e.g., Materials and Equipment purchases **1020**) and the measured consumption of resources by the Development Tools **1016** and Test Equipment **1018**.

The example Central Data Collector **1028** also transmits generated energy consumption indices and/or other data (e.g., energy values) to a Central Data Processing Facility (e.g., the Central Data Processing Facility **112** described in connection with FIGS. **1** and **2**). At the Central Data Processing Facility **122**, the generated energy consumption indices, energy values, and/or raw data may be used to track the use of Carbon Units, which are units of emissions traded among companies that allow the companies to emit a certain volume of pollutants per Carbon Unit. The generated energy consumption indices, energy values, and/or raw data may also be used to more accurately and/or more precisely assign energy consumption values (e.g., energy values) to goods and/or services purchased by a household (as described in connection with FIGS. **2** and **6-9**). In particular, companies may be expected and/or required by law to label their products with energy values.

The Central Data Collector **1028** may collect purchase information and resource consumption measurements from the departments **1004-1010** using any appropriate method. The manner in which the Central Data Collector **1028** collects information and generates energy consumption indices may depend on, for example, the software systems used by the company **1002**. As an example, a small company may not have a purchasing department or use purchasing software and may instead prefer to enter any purchases into the Central Data Collector **1028** manually. This may be done by entering purchase information into a computer terminal, loading payment information from a credit card, scanning and recognizing an invoice, downloading purchase histories from a supply company web site, and/or any combination of the described or other methods. Additionally or alternatively, the bar code scanner approach explained in connection with FIG. **2** could be employed in a business. Resource consumption information may be manually entered using the information contained in a utility bill rather than employing utility meters.

The example Central Data Collector **1028** may also measure resource consumption by activities that are engaged in by the company, such as manufacturing. To measure resource consumption associated with an activity, the Central Data Collector **1028** monitors equipment via resource consumption meters or utility meters for information indicative of a particular activity. When the Central Data Collector **1028** receives an indication that a particular activity is starting, the Central Data Collector **1028** may begin to monitor additional meters to measure the energy consumed by that particular activity. In the illustrated example, the Central Data Collector **1028** associates material or supply usage information with activities. While the activity is performed, the Central Data Collector **1028** monitors the associated equipment until one or more indications are received that the activity has ceased. The measured energy consumption and any materials or supply usage information are then used to determine the energy consumed by the activity (e.g., an energy value). Any other types of information, resources, and/or monitoring techniques may be used to determine the energy consumption (e.g., an energy value) by an activity.

An example activity that may be measured is manufacturing one thousand units of a circuit board. Prior to the start of manufacturing, the Central Data Collector **1028** monitors a number of meters coupled to equipment on an example production line such as a conveyor belt, a soldering oven, a part placement machine, and a packaging machine. To begin the production of the circuit boards, the conveyor belt is turned

on. The meter coupled to the conveyor belt signals to the Central Data Collector **1028** that it has been turned on, and the Central Data Collector **1028** begins to further monitor the meters coupled to the soldering oven, the part placement machine, and the packaging machine. As the circuit boards are manufactured, the monitored equipment consumes energy, the amount of which is measured by the meters and transmitted to the Central Data Collector **1028**.

When the example manufacturing process is complete, the conveyor belt is turned off and the meter coupled thereto sends an indication to the Central Data Collector **1028** indicating that the activity has ended. The Central Data Collector **1028** then determines the total energy (e.g., energy values) consumed by the equipment, as well as energy associated with the components, solder and packaging for the circuit board. The energy values are totaled to determine the energy (e.g., energy values) to manufacture the one thousand circuit boards. By dividing the total energy value by the quantity, the energy value associated with one circuit board can be calculated.

Although the described example includes manufacturing a fixed quantity of objects, the energy of any activity may be monitored by measuring the energy consumption of the appropriate equipment and/or materials. Further, the Central Data Collector **1028** may transmit the energy consumption information and materials information to an external server (e.g., the central data processing server **114** of FIG. **1**) to determine the total consumed energy and/or unit(s) energy (e.g., energy per unit, energy per time).

Many companies and nearly as many business models exist. The example of FIG. **10** is illustrative, and many modifications may be made to adapt the example system **1000** to other business types. Further, individuals who work at home may divide home energy consumption between personal and business consumption using a data collector (e.g., the data collector **110** of FIGS. **1-3**).

FIG. **11** is a flowchart representative of example machine readable instructions **1100** that may be executed to generate an organizational energy consumption index for an organization such as the company **1002**. The example process **1100** may be implemented by the example Central Data Collector **1028** described in FIG. **10**. The Central Data Collector **1028** loads resource consumption measurements for a current time period (e.g., the current month) from a memory or data store (block **1102**). The measurements for the current time period may not include all resources consumed for the current time period, so the Central Data Collector **1028** determines whether the resource consumption information for the current time period is accounted for (block **1104**). For example, the Central Data Collector **1028** may query meters and/or other sources (e.g., Equipment **1012**, Development Tools **1016**, Test Equipment **1018**, Machinery **1022** and/or Control/Lighting **1024** described in FIG. **10**). If the resource consumption measurements are not complete for the current time period, the Central Data Collector **1028** requests measurements from meters and/or any other sources (block **1106**). After requesting and receiving additional resource consumption information, control returns to block **1104**.

If the resource consumption measurements are complete for the current time period (block **1104**), the Central Data Collector **1028** receives purchasing data corresponding to the query from the purchasing systems **1027** (block **1108**). The Central Data Collector **1028** then analyzes the purchasing data from the Purchasing systems **1027** to determine whether additional purchasing data is required (block **1110**). For example, purchasing data may be pushed by the purchasing systems **1027** to the Central Data Collector **1028** at regular or irregular intervals. If the purchasing data is not updated when the example time period is over, the Central Data Collector **1028** may require the remaining purchasing data to generate an accurate organizational energy index.

If the example Central Data Collector **1028** determines that further purchasing data is necessary (block **1110**), the Central Data Collector **1028** receives additional purchasing data (block **1112**). The additional purchasing data may be remaining data for the example current period (i.e., only the data not already received by the Central Data Collector **1028**) or may be the complete data or substantially complete purchasing data for the current period, including data already received by the Central Data Collector **1028**. The purchasing data may be received by the Central Data Collector **1028** in response to, for example, a request from the Central Data Collector **1028** to the purchasing systems **1027** containing the purchasing data.

If additional purchasing data is not required (block **1110**) or after additional purchasing data is received (block **1112**), the Central Data Collector **1028** generates an organizational energy index based on the resource consumption measurements and the purchasing data (block **1114**). The Central Data Collector may also generate energy indices for one or more individual employees, departments, product lines, products, manufacturing lines and/or other organizational units. When the organizational energy index has been generated, the Central Data Collector **1028** loads additional organizational energy indices from previous time periods and displays the energy indices with the current organizational energy index for analysis (block **1116**). Display of the indices may occur on a display, printed medium, or other human- and/or machine-readable means. Additionally or alternatively, the Central Data Collector **1028** transmits the organizational energy index to a central data processing facility (e.g., the example central data processing facility **112** of FIGS. **1** and **2**) to be analyzed and compared (block **1118**).

Alternatively, the process **1100** may omit generating the organizational energy consumption index. Instead, the process **1100** may transmit the resource consumption data and purchasing data to an external location (e.g., the central data processing server **114** of FIG. **1**). The central data processing server **114** receives the resource consumption data and purchasing data and generates an organizational energy consumption index and/or other organizational or employee energy consumption indices, which may then be transmitted to the Central Data Collector **1028** for display.

FIG. **14** is a flowchart representative of example machine readable instructions **1400** that may be executed to generate an energy consumption index. The example instructions **1400** of FIG. **14** are implemented by the example central data processing facility **112** of FIGS. **1-3** and **10**. By way of example, assume the government determines that the nation should achieve self-sufficiency with respect to energy usage within 10 years. By comparing the nation's current energy deficit and the current detailed average energy consumption indices (e.g., for household, family, and business), the gap between produced and consumed energy can be understood in terms of the energy consumption indices. The 'target' index for each individual to achieve national energy self-sufficiency is then set to a value (e.g., '100'). Under this example, an individual energy consumption index of '120' indicates that the individual is consuming 20% more energy than the individual energy goal. Similarly, if a family's energy consumption index is '90,' and the family's index goal is 100, the family is using 10% less energy than the goal.

The central data processing facility **112** begins by receiving household energy consumption measurements (e.g.,

home energy values, transportation energy values, out of home energy values, and/or purchase energy values) (block **1402**). The measurements may be provided by one or more data collectors (e.g., the data collectors **110** of FIGS. **1-3**) from respective households. The central data processing facility **112** then receives energy consumption measurements (e.g., home energy values, transportation energy values, out of home energy values, and/or purchase energy values) from one or more businesses (block **1404**). The measurements may be provided by one or more central data collectors (e.g. the central data collector **1028** of FIG. **10**) from respective businesses. The central data processing facility **112** also receives purchase information from one or more stores (e.g., retailers, grocery stores, etc.) (block **1406**). The purchase information may supplement or replace any purchase information in the household and business energy consumption measurements.

The central data processing facility **112** then determines an energy consumption goal (block **1408**). The goal may be based on, for example, all or a portion of the gross national energy production. The energy usage goal may also be graduated, where the goal gradually decreases to encourage further reductions in energy consumption. Based on the energy consumption goal, the central data processing facility **112** determines individual household, business, and purchase goals (block **1410**). The household, business, and purchase goals may be individualized based on individual household or business factors, such as size and/or geographic location.

The central data processing facility **112** then sets one or more energy consumption indices relative to the energy consumption goals (block **1412**). Thus, each household or business may have the same (e.g., **100**) or different indices that represent an energy consumption goal. The goals are not necessarily equal from household to household or business to business, but goals should be similar for households or businesses with similar traits. Based on the energy consumption goals and energy consumption indices, the central data processing facility **112** calculates the current household, business, and/or purchase indices with respect to their index goals (e.g., **100**) (block **1414**). For example, if a household is consuming 20% more energy than the household's goal, the household's energy consumption index is 120. The central data processing facility **112** then transmits the energy consumption indices to the respective households and businesses (block **1416**). The central data processing facility **112** may also transmit local and national status indicator relative to the goals.

In cases where an individual, family, or business has an energy consumption index greater than their goal, the individual, family, or business should investigate the causes for excess energy consumption. For example, the data collector **110** of FIGS. **2** and **3** receives energy consumption data for the appliances and equipment in a household and 'standard' energy consumption data for the same categories of appliances from the central processing data facility **112**. The standard energy consumption data may be based on local data or national data. The data collector **110** then compares the energy consumption data to the standard energy consumption and displays the differences to the individual, family, or business. The data collector may rank the differences for easy identification. With the differences provided by the data collector, the individual, family, or business may make the most effective and cost-efficient improvements to lower their corresponding energy consumption index.

In another example, regulatory agencies may decide to mandate energy consumption index reporting on products and/or equipment. Products such as computers and/or battery chargers may have two energy consumption index ratings: one rating for '24/7' operation, and a second rating that assumes the product is only on for a particular usage period per day (e.g., turned off at night). Two ratings may encourage individuals to recognize the benefits of turning off products when not used. The energy consumption index rating of a product may also be matched to the UPC code of the product. When a consumer shops online for a product or scans a product with a scanner or smartphone, the UPC is used to retrieve the energy consumption index rating. An example shopping device may then retrieve similar products possessing lower energy consumption indices. As a result, consumers can comparison shop by energy consumption indices.

FIG. **12** is a diagram of an example processor system **1210** that may be used to execute the example machine readable instructions described herein, to implement the data collector **110**, central data processing facility **112**, appliances **202-206**, meters **212**, barcode scanner **214**, mobile devices **216** and **520**, HRCM device **302**, appliances and devices **304-330**, central processor **502**, fuel gauge **504**, odometer **506**, seat detectors **508-512**, equipment **1012**, supplies **1014**, development tools **1016**, test equipment **1018**, machinery **1022**, control/lighting **1024** and/or purchasing systems **1027** of FIGS. **1-3**, **5**, **6**, **10**, and **13**.

Turning now to FIG. **12**, an example processor system **1200** includes a processor **1202** having associated memories, such as a random access memory (RAM) **1204**, a read only memory (ROM) **1206** and a flash memory **1208**. The flash memory **1208** of the illustrated example includes a boot block **1210**. The processor **1202** is coupled to an interface, such as a bus **1212** to which other components may be interfaced. In the illustrated example, the components interfaced to the bus **1212** include an input device **1214**, a display device **1216**, a mass storage device **1218** and a removable storage device drive **1220**. The removable storage device drive **1220** may include associated removable storage media **1222** such as magnetic or optical media.

The example processor system **1200** may be, for example, a conventional desktop personal computer, a notebook computer, a workstation or any other computing device. The processor **1202** may be any type of processing unit, such as a microprocessor from the Intel® Pentium® family of microprocessors, the Intel® Itanium® family of microprocessors, and/or the Intel XScale® family of processors. The memories **1204**, **1206** and **1208** that are coupled to the processor **1202** may be any suitable memory devices and may be sized to fit the storage demands of the system **1200**. In particular, the flash memory **1208** may be a non-volatile memory that is accessed and erased on a block-by-block basis.

The input device **1214** may be implemented using a keyboard, a mouse, a touch screen, a track pad, a barcode scanner or any other device that enables a user to provide information to the processor **1202**.

The display device **1216** may be, for example, a liquid crystal display (LCD) monitor, a cathode ray tube (CRT) monitor or any other suitable device that acts as an interface between the processor **1202** and a user. The display device **1216** as pictured in FIG. **12** includes any additional hardware required to interface a display screen to the processor **1202**.

The mass storage device **1218** may be, for example, a conventional hard drive or any other magnetic or optical media that is readable by the processor **1202**.

The removable storage device drive **1220** may, for example, be an optical drive, such as a compact disk-recordable (CD-R) drive, a compact disk-rewritable (CD-RW) drive, a digital versatile disk (DVD) drive or any other optical drive. It may alternatively be, for example, a magnetic media drive. The removable storage media **1222** is complimentary

to the removable storage device drive **1220**, inasmuch as the media **1222** is selected to operate with the drive **1220**. For example, if the removable storage device drive **1220** is an optical drive, the removable storage media **1222** may be a CD-R disk, a CD-RW disk, a DVD disk or any other suitable optical disk. On the other hand, if the removable storage device drive **1220** is a magnetic media device, the removable storage media **1222** may be, for example, a diskette or any other suitable magnetic storage media.

As described in detail hereinafter, the disclosed system enables the processor **1202** to read information from the removable storage media **1222** placed in the removable storage device drive **1220** in a pre-boot environment. This functionality is imparted to the processor **1202** through a firmware extension that is stored on the removable storage media **1222** at, for example, the time the removable storage media **1222** is formatted. For convenience, the example processor system **1200** of FIG. **12** will be used to describe the format, write, read and boot processes described herein. It will be understood, however, that one or more of these processes may be carried out by different processor systems. For example, a software manufacturer may format an optical disk to include the firmware extension using a first processor to execute the format process and a consumer who purchases the software may use a second processor to execute the read process on his/her system to install the software.

Although this patent discloses example systems including software or firmware executed on hardware, it should be noted that such systems are merely illustrative and should not be considered as limiting. For example, it is contemplated that any or all of these hardware and software components could be embodied exclusively in hardware, exclusively in software, exclusively in firmware or in some combination of hardware, firmware and/or software. Accordingly, while the above specification described example systems, methods and articles of manufacture, persons of ordinary skill in the art will readily appreciate that the examples are not the only way to implement such systems, methods and articles of manufacture. Therefore, although certain example methods, apparatus and articles of manufacture have been described herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers all methods, apparatus and articles of manufacture fairly falling within the scope of the appended claims either literally or under the doctrine of equivalents.

What is claimed is:

1. A method to generate an energy consumption index, the method comprising:

measuring, via a first sensor, resources consumed at a home associated with a person and calculating a home energy value indicative of the resources consumed at the home;

measuring, via a second sensor, resources consumed by the person while located outside the home and calculating an out of home energy value indicative of the resources consumed by the person while located outside the home;

identifying goods purchased by the person and calculating a purchase energy value indicative of an amount of energy required to manufacture the goods and to manufacture packaging of the goods; and

generating, via a logic circuit, an energy consumption index associated with the person based on the home energy value, the out of home energy value, and the purchase energy value.

2. A method as defined in claim **1**, further comprising allocating at least a portion of the home energy value, a portion of the out of home energy value, or a portion of the purchase energy value from the person to a second person.

3. A method as defined in claim **1**, further comprising displaying the personal energy consumption index at a location visible to the person.

4. A method as defined in claim **1**, further comprising measuring resources consumed by the person associated with a vehicle and calculating a transportation energy value indicative of the resources consumed by the vehicle.

5. A method as defined in claim **1**, wherein the resources consumed at the home comprise at least one of electricity measurements, natural gas measurements, gasoline measurements, fuel oil measurements, kerosene measurements, propane measurements, wood measurements, light measurements, temperature measurements, water measurements, and/or heating oil measurements.

6. A method as defined in claim **1**, further comprising transmitting the energy consumption index to an external server for aggregating with an additional energy consumption index.

7. A method as defined in claim **6**, further comprising displaying the energy consumption index and the aggregated energy consumption indices at a location visible to the person.

8. An apparatus to generate an energy consumption index, comprising:

an activity converter to convert activity information associated with activities performed by one or more household members to at least one of a home energy value or an out of home energy value;

a raw material converter to convert raw material information associated with raw material usage to a second home energy value;

a purchases converter to convert purchases information associated with purchased goods to a purchase energy value indicative of an amount of energy required to manufacture the goods and to manufacture packaging of the goods;

a transportation converter to convert transportation information associated with transporting one or more household members to a transportation energy value; and

a logic circuit to compute an energy index based on one or more of the first home energy value, the out of home energy value, the second home energy value, the purchase energy value, and the transportation energy value.

9. An apparatus as defined in claim **8**, wherein the energy value summer further receives data associated with an energy usage goal, and wherein the energy index is further based on the energy usage goal.

10. An apparatus as defined in claim **8**, wherein the energy value summer sums the received energy values, and outputs at least one of the energy index or the summed energy values to an external data processor.

11. An apparatus as defined in claim **8**, wherein the raw material information comprises at least one of electricity measurements, natural gas measurements, gasoline measurements, fuel oil measurements, kerosene measurements, propane measurements, wood measurements, light measurements, temperature measurements, water measurements, or heating oil measurements.

12. A tangible article of manufacture, storing machine readable instructions which, when executed, cause a machine to at least:

measure resources consumed at a home associated with a person and calculate a home energy value indicative of the resources consumed at the home;

measure resources consumed by the person while located outside the home and calculate an out of home energy

value indicative of the resources consumed by the person while located outside the home;

identify goods purchased by the person and calculate a purchase energy value indicative of an amount of energy required to manufacture the goods and to manufacture packaging of the goods; and

generate an energy consumption index associated with the person based on the home energy value, the out of home energy value, and the purchase energy value.

13. An article of manufacture as defined in claim **12**, wherein the instructions further cause the machine to allocate at least a portion of the home energy value, the out of home energy value, or the purchase energy value from the person to a second person.

14. An article of manufacture as defined in claim **12**, wherein the instructions further cause the machine to display the energy consumption index at a location visible to the person.

15. An article of manufacture as defined in claim **12**, wherein the instructions further cause the machine to measure resources consumed by a vehicle and to calculate a transportation energy value indicative of the resources consumed by the vehicle.

16. An article of manufacture as defined in claim **12**, wherein the resources consumed at the home comprise at least one of electricity measurements, natural gas measurements, gasoline measurements, fuel oil measurements, kerosene measurements, propane measurements, wood measurements, light measurements, temperature measurements, water measurements, and/or heating oil measurements.

17. An article of manufacture as defined in claim **12**, wherein the instructions further cause the machine to transmit the energy consumption index to an external server for aggregating with an additional energy consumption index.

18. A method to generate energy consumption data, comprising:

querying a database for a purchases energy value associated with an item purchased by an individual;

querying the database or a second database for an out of home energy value associated with activity information corresponding to the individual for an out of home, non-transportation activity;

combining, via a logic circuit, the purchases energy value and the out of home energy value;

assigning a combined energy value to a purchasing household or a purchasing individual; and

outputting an indicator representing energy consumption of the household or the individual.

19. A method as defined in claim **18**, further comprising:

querying the database, the second database, or a second database for a transportation energy value associated with the transportation information associated with the individual,

wherein the indicator representing the energy consumption of the household or the individual is based on the purchases energy value, the out of home energy value, and the transportation energy value.

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