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(54) Title: STANDBY POWER CONTROLLER WITH EXTERNAL INFORMATION CAPABILITY

(57) Abstract: A computer implemented system for reduction of electricity usage in an electricity supply network, the system is adapted to create a data link to an external remote management centre which includes a demand response controller receive from the demand response controller a demand response event request and upon receipt of the demand response event command the computer to enter a low energy power use state.
STANDBY POWER CONTROLLER WITH EXTERNAL INFORMATION CAPABILITY

FIELD OF THE INVENTION

The present invention relates to an apparatus and method to regulate the supply of power to and to control the power modes of a device, in particular a computer, in response to external information.

BACKGROUND

In a deregulated electricity market energy retailers undertake to supply electricity to consumers. The energy retailers then source this electricity from energy generators who generate the electricity using a variety of power plants, each having its own running costs and lead time to come on stream.

The price which the energy retailer pays the electricity generators for this electricity is affected by many factors including supply contracts and government regulation, but in general is driven by supply and demand. That is, in times of high demand, the price paid by the electricity retailer increases. Demand varies continuously by time of day and time of year. The price variation may be many orders of magnitude, with, for example, the marginal price of an additional kWh (kilowatt hour) varying from one cent to more than ten thousand dollars.

Due to commercial realities and political constraints, and technical limitations, it is not possible for the energy retailer to simply pass on the marginal cost directly to the consumer. The cost to the consumer of a kWh is generally fixed at a price significantly greater than the lowest marginal cost payable by the energy retailer, but very much less than the maximum possible marginal cost payable by the energy retailer; generally from tens to hundreds of cents per kWh. The consumer tariff may include coarse variation by time of day and time of year, with higher prices for periods expected to be peak demand periods, but there is no direct relationship between the marginal cost paid by an energy retailer at a given time and the amount being paid by the consumer using that marginal kWh.

Energy retailers, producers and distributors, in regulated or deregulated markets, may be placed in a position where demand for energy exceeds the available supply.
This can lead to brownouts where the electricity supply to some areas is cut in order to maintain supplies to at least some areas. Blackouts may also be experienced should demand cause the voltage in the distribution network to drop below critical levels.

Computer devices, in particular personal computer devices, are routinely designed to enter a low power or standby mode when a user has not operated the computer for a defined period of time. We refer to this mode as a low power standby mode.

The low power standby mode is a mode where the computer cuts or reduces the provision of power to superfluous areas of the computing device while the computer is not in use. Different degrees of reduction of power may be covered by the term low power standby mode which may be called "sleep" or "hibernate". These allow a user to resume working or operating a machine from the standby mode without having to go through an extended reboot process. The difference between them is likely to be the speed with which the computer is able to return to full operating mode from the standby mode.

Entering a low power standby mode on a computer device will provide energy savings. However, users may find such entry to be inconvenient, especially when it is unexpected. Since the delay period for entering standby is typically set by the user a user will often seek to avoid unexpected entry into standby mode by setting extended time frames for the low power standby mode to be entered resulting in a significant delay before the onset of the energy saving functionality.

Typically, a computer device will determine when to enter a low power standby mode based on a time period for which user input, usually in the form of keyboard or mouse use, is absent. Since a computer may be in use without such user input, this may lead to unexpected and unwanted activation of the low power standby mode. Such an occurrence is likely to prompt a user to greatly extend the time period before the low power standby mode is entered, meaning that the computer spends significant amounts of time unused but in a high power use mode.

In a business environment, it is not uncommon for users to disable the standby power mode, preferring the convenience of having the computer always on and ready to use without the need to provide user input (keyboard or mouse use) to stop
the computer entering into the standby mode when the user does not wish this to happen.

SUMMARY OF THE INVENTION

The invention may be said to lie in a computer implemented system for reduction of electricity usage in an electricity supply network, the system adapted to monitor an activity level of the computer in order to determine an activity mode of the computer,

upon determining that the activity mode has been other than active use mode for a time period exceeding a threshold time period;
activate a user interface allowing a user to provide a user indication indicating that the computer should not be placed in a low energy use power state;
where such user indication is not provided, command the computer to enter a low energy power use state;
further including instructions which when executed cause the computer to create a data link to an external demand response controller
receive from said demand response controller a demand response event request;
upon receipt of said demand response event request, activate the user interface allowing a user to provide a user indication indicating that the computer should not be placed in a low energy use power state;
where such user indication is not provided, command the computer to enter a low energy power use state.

In preference, the computer implemented system is, further adapted to activate the user interface following the demand response request only when the activity mode of the computer is determined to be other than active use mode.

The computer implemented system may be further adapted to communicate to the demand response controller the user indication such that the demand response controller can determine that the computer will or will not be placed in a low energy power state.

The invention may also be said to lie in a method for reducing load on an electricity supply network including the steps of;
supplying to a customer of the electricity supply network a power control device for
controlling electricity usage of a personal computer, said control device including a software control module installed on the personal computer; supply of said power control device including obtaining agreement from said customer to participate in a demand response program wherein said software control module may receive from a demand response controller a demand response event request; upon receipt of said demand response event request, the software module will activate a user interface allowing a user to provide a user indication indicating that the computer should not be placed in a low energy use power state; where such user indication is not provided, the software module will command the computer to enter a low energy power use state.

In preference the software module is adapted to monitor an activity level of the computer in order to determine an activity mode of the computer, upon determining that the activity mode has been other than active use mode for a time period exceeding a threshold time period; activate a user interface allowing a user to provide a user indication indicating that the computer should not be placed in a low energy use power state; where such user indication is not provided, command the computer to enter a low energy power use state; the software module adapted to cause the computer to create a data link to an external demand response controller adapted to issue a demand response event request.

In preference, the provision of the power control device on particular terms is conditional upon agreement by the customer to participate in the demand response program.

In a further form, the invention may be a system for reduction of electricity usage in an electricity supply network including a software control module adapted to monitor an activity level of the computer in order to determine an activity mode of the computer, upon determining that the activity mode has been other than active use mode for a time period exceeding a threshold time period; activate a user interface allowing a user to provide a user indication indicating that
the computer should not be placed in a low energy use power state;
where such user indication is not provided, command the computer to enter a low
energy power use state;
further including instructions which when executed cause the computer to create a
data link to an external demand response controller
receive from said demand response controller a demand response event request;
upon receipt of said demand response event request, activate the user interface
allowing a user to provide a user indication indicating that the computer should not be
placed in a low energy use power state;
where such user indication is not provided, command the computer to enter a low
energy power use state;
further including a power control device which includes an electrical inlet adapted to
connect to a general power outlet,
at least one monitored electrical outlet adapted to connect to the personal computer,
at least one peripherals electrical outlet adapted to connect to, and to supply
electrical power to, at least one peripheral device,
a switch adapted to control electrical connection of the inlet to the peripherals
electrical outlet, and thus to control supply of electric power to the at least one
peripheral device,
a sensor adapted to sense at least one characteristic of an electrical power flow
through the monitored electrical outlet to the computing device,
the power control device further adapted to remove power from the switched
electrical outlet when the sensor detects that the computer has entered a low energy
power use state.

In preference, the switch is adapted to remove power from the monitored electrical
outlet and the peripherals electrical outlet when the sensor means detects that the
computer has entered a low energy power use state.

In a further form, there is practiced a method for reducing load on an electricity
supply network, the network supplying electricity to a plurality of personal computers
running a software control module including the steps of;
receiving information from a software control module running on a plurality of said
personal computers indicating that the computers are available to participate in a
demand response event;
receiving from an energy supply utility associated with the electricity supply network a demand reduction request, being a request to reduce electricity consumption by devices supplied with electricity by the network;

issuing a demand response event request to a plurality of the software control modules;

the demand response event request causing the software control module to activate a user interface allowing a user to provide a user indication indicating that the computer should not be placed in a low energy use power state;

where such user indication is not provided, the software module will command the computer to enter a low energy power use state.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is an illustration of the elements of the system of the invention;

Figure 2 is a representation of a home computer installation including the system of the invention;

Figure 3 is a block diagram of the energy saving device included in Figure 2;

Figure 4 is a flow chart describing the Energy Saving Device Interaction Process;

Figure 5 is a flow chart describing the Hibernation Process;

Figure 6 is a flow chart describing the Cloud Communication Process;

Figure 7 is a warning splash screen displayed by an embodiment of the invention;

Figure 8 is a flow chart describing the Reduced Energy Use Process;

Figure 9 is a flow chart describing the PC Activity Monitor process in an embodiment of the invention;

Figure 10 is a flow chart describing overall operation of the SCM of Figure 1 in an embodiment of the invention.

**DETAILED DESCRIPTION OF THE INVENTION**

Referring now to Figure 1, there are a number of personal computer installations 100. These personal computers may be installed in individual premises, or groups of
computers may be installed in a single premises. These computer installations are supplied with electricity by an electricity supply network. At least some aspect of the electricity supply network is contributed by an Electricity Supply Utility 104. The Utility may be any or all of an electricity retailer, an electricity generator, an electricity distributor and an electricity network regulator. There may be more than one Utility.

The Utility provides or controls the provision of electricity to or by the electricity supply network. In a preferred embodiment, the Utility is an energy retailer. In high demand situations, energy retailers are forced to pay very high prices for electricity but are unable to pass these costs on to their customers. In such a situation, the Utility wishes to reduce electricity consumption by customers connected to the electricity supply network. Other possible scenarios, including restricted electricity supply, or restricted electricity distribution capacity may cause a Utility to wish to reduce electricity consumption by customers connected to the electricity supply network.

Each computer includes a Software Control Module (SCM) 101. Each SCM establishes communication with a Remote Management Centre (RMC) 105 via a communications network 102. The RMC is a processing system remotely located from the personal computer installation. The RMC is in communication with the Utility 104.

The RMC includes a Demand Response Controller (DRC) 103. The DRC may receive from the Utility a demand response event notification, being an indication that a reduction in load on the electricity supply network is desirable. The DRC is then able to issue a demand response event request to the personal computer installations 100.

The demand response event request is intended to elicit a response from at least some of the personal computer installations whereby the installations move to a lower energy use state, thus relieving the load on the electricity supply network.

In the preferred embodiments, the communications network is the public internet. The nature of the public internet is such that in general, a personal computer will not have unrestricted, two way access to remote devices via the internet. Some form of firewall and/or network address translation (NAT) is likely to be in place. Accordingly,
it is preferred that each SCM will establish the link to the RMC, allowing two way communications.

The RMC may be in communication many thousands of personal computer installations. Maintaining communications links requires resources at both the personal computer and the RMC. In order to reduce resource use, in an embodiment the link established between the RMC and each computer is held only briefly, for the time necessary for the computer to identify itself, and to transfer data concerning energy usage by the computer installation, and for the RMC to allow the DRC to indicate that a demand response event is in progress if that is the case. The link is then dropped and re-established by the personal computer at regular intervals. In a preferred embodiment, the interval is between five and fifteen minutes.

In other embodiments, the RMC may establish the communication link with some or all of the SCMs. In further embodiments, the link between the RMC and the personal computer installations may be permanently maintained.

Referring now to Figure 2, there is shown a diagram representing a typical personal computer installation of Figure 1.

The personal computer installation includes a computer 204, which has a monitor 203. Also connected to the computer there may be peripheral devices 202 such as a printer or a scanner.

The computer runs the SCM 101 as previously described.

Electricity is supplied to the computer 204, the monitor 203 and the peripheral device 202 via an energy saving device 201.

There is an electrical plug 205 which is connected to a General Power Outlet (GPO) which supplies electrical power to the energy saving device 201. The energy saving device includes monitored electrical outlet 206 which supplies electrical power to personal computer (PC) 204. Any suitable computing device may be used, and is encompassed by the term PC as used herein, including without limitation, Apple Macintosh computers; computers running Unix based operating systems; and laptop, notebook and tablet computers.
There is a switched electrical outlet 207 which provides electrical power to devices used in the computing environment which require power only when the PC itself is in use. This includes, without limitation, the computer monitor 203 and computer peripheral equipment 202. It may also include equipment which is not part of the computer installation, but is nonetheless only required when the computer itself is in use, such as a desk lamp. The term "computer peripherals", as used herein is to be taken to include, without limitation, at least all of the foregoing.

In an embodiment, the energy saving device also includes a communications channel 208 for communication to the PC, in a preferred embodiment, a USB channel. Other types of communication channel may be used, including, without limitation wireless communication ports and protocols. In other embodiments, communication between the energy saving device and the PC may not be direct, but may occur via a third device such as a communications server, or a public or private communications network, or any other suitable device or network.

Referring to Figure 3, which is a partial block diagram of the circuit of the energy saving device, there is provided a sensor 301 which monitors the power drawn through the monitored electrical outlet 206. The sensor may measure one or all of true RMS power, current, voltage and phase angle or power factor drawn by or across the load connected to the one or more monitored outlets 206.

There is also provided a switch 302, which operates to control the connection of electrical power from the GPO to the switched outlet or outlets 207.

There is a communication module 303 which provides data communication between the energy saving device and the SCM running on the PC. In the illustrated embodiment, this is a USB communications module, but any other suitable communication connection and protocol may be employed.

There is a processor 304. The processor receives the output of the sensor 301 and controls the switch 302. The processor also receives data from, and sends data to, the SCM via the communications module 303.

The processor receives data from the sensor describing the power being drawn through the monitored outlet or outlets at any time. The processor may use this data to calculate average power used over time. The processor may also determine the
aggregated power used over a period of time. This data is the power usage data for the energy saving device.

The power usage data is communicated to the SCM via the communications module. In alternative embodiments, the communications module may be incorporated into the processor. Alternatively, the processor may be absent and the communications module may provide for direct communication with the PC by the sensor and the switch. In these embodiments, all functions of the processor described herein are undertaken by software running on the PC or another remote processor.

In other embodiments, the sensor, processor and communications module functions may be provided by a single unit. In use the sensor output is monitored by the processor to determine a functional state of the PC. The functional state may be determined from the characteristics and/or magnitude of the power drawn by the PC, as detected by the sensor. In a preferred embodiment, small fluctuations over short time periods in the power supplied to the PC through the energy saving device are monitored. Any or all of relative magnitude, absolute magnitude and frequency of the fluctuations may be monitored.

A greater level of power fluctuations indicates that the PC is in active use. Lower levels of power fluctuations, or the absence of power fluctuations, indicate that the PC is not in active use, although it may still be operating at full power. The fluctuations occur as a result of rapidly varying processor load and power drawn by such things as storage drives and graphics display units, which occur when the PC is responding to input from a user.

In other embodiments, the functional state of the PC may be determined by comparing the power drawn by the PC through the energy saving device to one or more pre-determined thresholds. These thresholds may include a time component, that is meeting the threshold may require the power to be within a particular value range for a particular time. When to power drawn is below a certain threshold, the functional state of the PC is determined to be the corresponding state.
In a preferred embodiment, the processor distinguishes at least three functional states of the PC. These are Active Use, Full Power Standby, and Low Power Standby. Active Use is detected when the PC is in use, fully powered, and with a user interacting with or otherwise actively using the PC. Preferably, use which may not involve direct physical interaction with the PC, such as watching video material, or performing extended calculations, will be categorised as Active Use. Full Power Standby occurs when the PC is fully powered, but is not being actively used by a user, that is, there is no user interacting with the PC. Low Power Standby occurs when the PC has entered a low power state, in which the PC is not performing any significant processing function. These may be called "sleep" or "hibernate". These low power states may be separately identified by the processor. This state detection may also include the condition when the PC is off.

The determination of the functional state may include a duration component, that is, a change in state may be identified when a particular energy use situation has persisted for a given time period. The determination of a change in the determined functional state thus may not coincide in time with any specific change in the power usage of the PC.

In the preferred embodiment, the PC will be determined to be in Active Use functional state when a sufficiently high level of power fluctuations is detected, over a sufficiently short period of time. Relative and absolute power measurements may also be used. Full Power Standby will be determined to be the functional state of the PC when there is a lower level of power fluctuation detected by the sensor for a sufficiently long period of time. A particular range of values of absolute or relative average power use by the PC may also be required in order for the functional state of the PC to be categorised as Full Power Standby by the energy saving device. The categorisation of the functional state of the computing device as Full Power Standby indicates that the PC is not being actively used by a user, but has not entered a low power standby mode.

The processor will cause the switch to operate to remove power from the switched electrical outlet 207 when Low Power Standby functional state is detected, thus removing power from the computer peripherals. This ensures that the computer
peripherals are not drawing power unnecessarily during at least some of the time when the PC is not in use.

The PC runs the SCM which communicates with the energy saving device. This software may run as a stand-alone program, as a service, as part of the computer operating system, or in any other convenient manner. It is a function of the SCM to cause the PC to move from Full Power Standby to Low Power Standby. This saves energy in itself. Further, the move to Low Power Standby provides the opportunity for the energy saving device to remove the electricity supply to at least some components of the PC installation, which saves yet more energy.

When the processor determines the functional state of the PC to be Full Power Standby, the processor communicates this to the SCM via the Communication Module. In the simplest embodiment, this communication will be the single command "Hibernate", instructing the SCM to cause the PC to enter a low power standby mode, such as sleep or hibernate, if possible.

In some embodiments, the Full Power Standby and Low Power Standby states may not be distinguished. At any time when the functional state Active Use is not detected, the processor may communicate this to the SCM.

The identification of Full Power Standby is made by inference from the pattern of energy usage by the PC. It is possible that Full Power Standby may be misidentified. A determination of Full Power Standby may be made when in fact the mode is Active Use, that is, a user is engaged with the PC. The user may be only partly engaged, but may not wish the PC to move to Low Power Standby or to have power removed from the monitor and other peripherals. It is important that a user not be unduly inconvenienced. Accordingly, the SCM takes time - in a preferred embodiment on the order of 10-15 minutes - to move to Low Power Standby. In this time, warnings are provided which will be sensible to a present, fully or partly involved user, indicating that the move to Low Power Standby is imminent. Any interaction by the user with the PC will be sufficient to prevent the move to Low Power Standby. In the case where a demand response event notification has been received, avoiding user inconvenience is a lesser priority, so warnings may be curtailed.
The sensor detects the magnitude of the power use by the computer, which is communicated to the SCM. The energy use data may be collected at all times, including times when the computer is in active use, and times when the computer is in Low Power Standby. The energy saving device may include memory, allowing power data obtained by the sensor while the computer is in a Low Power Standby mode to be stored and communicated to the SCM when the computer returns to an active use mode. The SCM communicates power use data from the sensor to the RMC. This data is further communicated to the DRC to use to determine what power savings may be gained by a DR event request directed to that PC.

The RMC further uses this usage data to determine the total power usage, and patterns of usage, of all of the PCs in communication with the RMC. This information may be made available to the Energy Utility for load planning purposes.

The RMC is able to determine which ESD devices have been installed, and that they continue to be installed. The installation of the ESDs may have been made by the Energy Utility or in response to incentives provided by the Energy Utility. The usage data allows the Energy Utility to monitor the effectiveness of programs to install ESDs, including information as to which ESDs continue to be installed and the power consumption of the devices connected to these ESDs.

In further embodiments a sensor with multiple channels, or more than one sensor, may be provided. The additional channel or additional sensors monitor the power drawn through the switched electrical outlet or outlets 207. The power drawn through the switched outlets in the power drawn by the peripherals. The data describing the power drawn by the peripherals is communicated to the SCM, and subsequently to the RMC, in the same way as the data describing the power drawn through the monitored outlet 206 is communicated. This data allows the DRC to make a more accurate estimation of the power which will be saved in the event that the DRC initiates a demand response event.

The SCM runs three main processes. The first is Energy Saving Device Interaction Process 450 shown in Figure 4.

The SCM performs the action Monitor Energy Saving Device 400 wherein the USB port, or other communication channel of the PC, is monitored for incoming data
communicated from the energy saving device processor 304 via Communications Module 303.

An incoming communication from the ESD will be the power usage data described herein. This data is received 401 by the SCM. This data is stored for communication to the RCM as described herein. The SCM may also analyse this data and display results of this analysis to a user or communicate such results to the RCM.

Commands received from the energy saving device are checked 402, in order to detect a Hibernate command from the energy saving device. Where the command is not a Hibernate command, monitoring 400 continues. Where the command is a Hibernate command, the action Get Inactivity Figure 403 is performed.

The action Get Inactivity Figure returns a value User Inactivity indicating the degree to which the PC is not engaged in interactive activity with a user. In a preferred embodiment, this is the length of time since the PC has recorded a keystroke or a mouse movement. In the Microsoft Windows operating system, this value is available as the result of an API call, built into the operating system. Similar results are available when other operating systems are employed. In other embodiments, other means of detecting user interaction may be employed. This may include, without limitation, detection of movement using a camera attached to or integral with the PC; detection of touch on a touchscreen or touchpad; detection of use of a game pad, joystick or other user input device; presence detection using passive or active infrared sensors; and other suitable forms of presence detection. In these cases, User Inactivity is a value indicating the length of time since a user interaction with the PC has been detected.

The User Inactivity value is then checked 404 against an Inactivity Threshold. In a preferred embodiment, the Inactivity Threshold is a pre-set value which is the length of time that the PC is to be allowed to remain in Active Standby before being placed into Low Power Standby. The threshold value may be set by default, or the SCM may include a user interface which allows the Inactivity Threshold value to be set by a user. In further embodiments, the value of Inactivity Threshold may be communicated to Energy Saving Device Interaction Process by the energy saving device.
Where check 404 indicates that User Inactivity is greater than Inactivity Threshold, Energy Saving Device Interaction Process initiates 406 the process Hibernation Process. Where User Inactivity is less than Inactivity Threshold, a Wait command is communicated 405, via the Communication Module, to the energy saving device. This communication includes a value Wait Hibernate which is the time period which must elapse before the energy saving device will again send a Hibernate command to the Energy Saving Device Interaction Process. The value of Wait Hibernate is slightly more than Inactivity Threshold less User Inactivity. The energy saving device processor receives the value Wait Hibernate. No further Hibernate command will be sent from the energy saving device to the Hibernate Process until the Wait Hibernate time period has expired. This prevents the energy saving device from repeatedly sending Hibernate commands which will be ignored because the PC has not been in an Active Standby functional state for a sufficient period.

Following the sending of the Wait command, the Energy Saving Device Interaction Process continues from the Monitor Energy Saving Device function 400.

In other embodiments, the Wait Hibernate value is not calculated nor sent to the energy saving device. The Energy Saving Device Interaction Process simply returns to the Monitor Energy Saving Device function to await the next Hibernate command. In this embodiment, the energy saving device will preferably include a fixed delay between sending of Hibernate commands to avoid overloading the Energy Saving Device Interaction Process with redundant Hibernate commands.

The second process run by the SCM is the Hibernation Process which is the process whereby the PC is placed into a Low Power Standby mode.

The Hibernation Process provides a warning to a user that the PC is about to be placed in a Low Power Standby mode. The user is given an opportunity to indicate that the PC is in use and should not enter Low Power Standby. If no such indication is made, then the PC is placed in Low Power Standby mode. In a preferred embodiment, the warning is by way of a splash screen notification displayed on the monitor of the PC. In other embodiments, other visual or audible warnings may be used. These warnings include, without limitation, flashing lights, spoken word notifications and warning tones. The indication that the PC should not be placed into Low Power Standby mode may be by an explicit choice, such as selecting a specific
item from a displayed menu, or it may be assumed from any interaction with the PC, such as a keystroke or mouse movement.

The Hibernation Process is illustrated in the flowchart of Figure 5.

The Hibernation Process begins with a check 501 to determine if any uninterruptible process is running. This check is made by checking the status of operating system flags which allow a process to indicate that the process is running and should not be interrupted. Where check 501 indicates that an uninterruptible process is in progress, the occurrence is logged and the shutdown process is aborted 560.

Where no uninterruptible process is detected, the Hibernation Process continues to make any other relevant checks to ensure that the PC should be shut down if the period of Active Standby continues. In the illustrated embodiment there is a check for the time of day 502. The SCM may include a user interface which allows a user to set certain time periods during which no shutdown will take place, for example, Monday to Friday from 9:00 AM to 5:00 PM when it is known that the PC may be required for use on short notice and it is desired to avoid the PC being shut down.

Where check 502 indicates that the time of day is such that shutdown should not take place, the occurrence is logged and the Shutdown Process is aborted 560.

Where no impediment to moving the PC into a Low Power Standby mode is discovered, the process Initiate Hibernate Countdown Timer 503 is entered. A Hibernate Countdown Timer is set to a starting value. This starting value may be set by default or may be able to be pre-set by a user or by an external process. In a preferred embodiment, the value is set to ten minutes. This is the length of time during which the user is able to indicate that they are interacting with the PC and that they do not wish the PC to be placed into Low Power Standby mode. If no user is present, no such indication will be made, and the PC will be put into a Low Power Standby mode.

A warning of impending shut down is then displayed 504 as a splash screen on a PC monitor. An example warning is shown in Figure 7. The text of the warning indicates that the PC will shortly be placed into a nominated Low Power Standby mode, which may be "sleep" or "hibernate" or any other suitable low power use mode of operation. The text invites a user to interact with the PC, by keystroke or mouse movement, in
order to prevent the change in mode. The time left before shut down, being the value of the Hibernate Countdown Timer, may also be displayed.

The process then continues with a check 505 for any user interaction in response to the warning. If user interaction is detected, the Hibernate Process is then cancelled 560. No shut down takes place.

A check 507 is then made to see if the Hibernation Countdown Timer has reached zero.

If no user interaction is detected, the Hibernate Countdown Timer is decremented 506 according to the elapsed time. A further check 505 is then made. This continues until either user interaction is detected by check 505, or the value of the Hibernate Countdown Timer is found to be zero at check 507. When the Hibernate Countdown Timer reaches zero, the action Force Hibernate 511 is undertaken. This may be achieved by causing the operating system of the PC to place the PC into a Low Power Standby mode which may be "sleep" or "hibernate". Alternatively, the SCM may control the low power state directly. The SCM may individually instruct the hardware of the PC such as hard drives to enter low power states or to have power removed from them. The SCM may instruct the PC to end, suspend or hibernate individual processes or classes of process. In any case, the power usage of the PC will be lowered to a state identifiable as Low Power Standby.

It is a function of the energy saving device that the processor will cause the switch to operate to remove power from the switched electrical outlet 207 when Low Power Standby functional state is detected, thus removing power from the computer peripherals.

When the PC is forced into Low Power Standby by the Energy Saving Device Interaction Process, the power draw characteristics sensed by the sensor are analysed by the processor to identify that the PC is in Low Power Standby mode. The processor then controls the switch to remove power from the switched electrical outlet, thus removing power from the computer peripherals which are not needed when the PC is not in use.

Movement of the mouse, activation of the keyboard, or pressing the power on button on the PC will bring the PC out of Low Power Standby mode in the usual manner.
The energy saving device will detect this change in functional state. The processor will then operate the switch to return power to the switched electrical outlet returning power to the computer peripherals.

The terms keystroke and mouse movement as used herein include analogous actions performed using other hardware, including without limitation, virtual keyboards, touchscreens, touchpads, trackballs and thumbwheels.

In a preferred embodiment, the SCM is coded to select "sleep" as the Low Power Standby mode. In other embodiments, the Energy Saving Device Interaction Process may include a user interface which allows a user to pre-set which mode should be chosen.

In other embodiments, the display of the user warning may include an option to cause hibernation immediately, without waiting for the Hibernate Countdown Timer to count down. There may also be an explicit option which must be selected to prevent shut down, beyond merely moving a mouse or providing a key stroke.

In other embodiments, other measures indicating that the PC is in use, even if there is no user interaction, may be used in setting the value of User Inactivity. This may include, without limitation, the PC processor load, the throughput of any I/O (input/output) ports and whether the display of the computing device is active. These other measures may be used to directly set or to modify User Inactivity such that it is more or less likely to exceed the threshold and cause the PC to be instructed to enter a low power standby mode. For example, a high level of processor load, indicating active use, may cause the User Inactivity value to be decreased, meaning that a longer period without a user physically interacting with the PC would be required before the process Hibernation Process is initiated.

The third process run by the SCM is the Cloud Communication Process shown in Figure 6.

This process enables communication with the RMC to provide power usage data to the RMC. This communication also extends to the DRC in order for the PC installation to participate in a demand response event.
In use, the Energy Utility identifies a need to reduce load on the electricity supply network. The Utility requests the DRC to issue a demand response event notification. As each of the PCs running the SCM contacts the DRC, each is instructed to move to a Low Power Standby state if possible.

The first step in the Cloud Communication Process is Create Link to RMC 610. The process uses the PC’s internet connection to create a link to the RMC. The internet address which the process attempts to connect to is pre-set at the time of installation of the SCM. It is preferred that the SCM initiate contact rather than the RMC to avoid the need to negotiate firewalls and NAT devices which could make the SCM difficult or impossible to locate from the public internet.

In the preferred embodiment, communication is via the public internet, but any other network available to both the SCM and the RMC may be used.

As part of the link creation or separately the SCM identifies itself 602 to the RMC. This may be via an externally provided digital certificate, a unique identifier, or any other suitable identification process. It is preferred that no user action is required at any point in the identification process.

The identification is matched by the RMC to a database of SCM PC installations. This database includes such information as the electricity supply network to which the PC installation is connected, and any overall restriction on the participation of the installation in demand response events. The database may also include sufficient information about the installation to allow an estimate of the energy savings available from the participation of the installation in a demand response event.

In a preferred embodiment, information about the PC installation, held by the RMC database, will have been collected by the installer of the SCM and supplied to the RMC at the time of installation. In an alternative embodiment, these details are communicated to the RMC by the SCM.

The Cloud Communication Process sends 606 power usage data as described herein to the RMC.

The RMC receives power usage data from many SCMs. This data is combined with the information concerning the Utility supplying power to the PC connected to each
ESD, and the physical location of the PC, to determine characteristics of the power consumption of the PC both instantaneously and as a function of time. The RMC uses this data to model power usage over the PCs with which it is in communication. This may include predictions of future power use, reporting of current power use, and predictions of the magnitude of power reduction which could be achieved at a given time and place should such a reduction be desired by a Utility.

The RMC includes a Demand Response Controller (DRC) 103. The DRC may receive from the Utility a demand response event notification, being an indication that a reduction in load on the electricity supply network is desirable. The DRC is then able to issue a demand response event request to the personal computer installations 100.

The demand response event request is intended to elicit a response from at least some of the personal computer installations whereby the installations move to a lower energy use state, thus relieving the load on the electricity supply network.

The RMC may service more than one Utility. In a preferred embodiment, each PC installation is associated with one Utility. Demand response event notifications will only be passed to the SCM of a PC installation when the event has been requested by the associated Utility.

In an alternative embodiment, a PC installation may be associated with more than one utility. The PC installation may be informed of demand response events for each associated Utility. The identity of the Utility requesting the demand response notification may be passed to the SCM along with the notification.

The Cloud Communication Process makes contact 601 with the DRC. The Process then checks 603 with the DRC to ascertain if a demand response event notification relevant to the PC installation is current. If there is no current event, the process waits 604 for a period of time before again sending usage data to the RMC. In an embodiment where the link to the RMC is broken and remade for each communication, it is at this point that the link is broken before, and remade after, the Wait step.

Where it is determined that there is a relevant demand response event in progress, the process calls 605 the Hibernate Process. This call to the Hibernate Process
specifies that the Hibernate Countdown Timer should be set to a minimum value. In a preferred embodiment, this value is 30 seconds.

In an alternative embodiment, the result of determining that a demand response event is in progress is to set the value of the Inactivity Threshold of decision point 404 to a very low number, for example thirty seconds. This will ensure that if the PC is determined to be inactive for even a short period, the Hibernation Process will be called. The Hibernate Countdown Timer may also be set to a minimum value.

The Hibernate Process then runs normally. The reduced Countdown Timer value ensures that the PC is moved into Low Power Standby almost immediately where there is no user engagement with the PC. Where there is user engagement, the user will indicate that the PC should not be shut down by reacting to the displayed shut down warning, thus preventing the shutdown.

In a preferred embodiment, the shutdown warning displayed when the impending shutdown is in response to a demand response event notification includes the information that the impending shutdown is in response to a demand response event notification. In an embodiment where the identity of the Utility is passed to the SCM by the DRC, this identity may also be displayed. Where the shutdown is in response to a demand response event notification, a user may wish to participate by allowing the PC to be put into a standby mode even though this would otherwise be inconvenient. Therefore, in this embodiment, the Hibernation Process is called whenever a demand response notification is received, regardless of the activity level of the PC. The shutdown warning includes a facility allowing the user to explicitly accept or reject the option of allowing the PC to be placed in standby to participate in the DR event.

In a preferred embodiment, immediately prior to the Force Hibernate step 511 of the Hibernate Process, the fact that the PC is about to be shutdown will be communicated to the DRC. This may occur in all cases, or only when the shutdown occurs in response to a demand response event notification.

In an embodiment, the energy saving device includes a power sensor to sense the power consumption of the peripheral devices connected to the switched outlet 207. The device further includes a capability to communicate the sensed power
consumption by the peripherals to the SCM. The SCM communicates this information to the RMC.

In any embodiment, the RMC may receive information about the estimated power consumption of each PC installation. This may be received directly from the SCM reporting measured energy consumption as measured by the energy saving device, or it may be information from a database indicating what devices were found to be part of the PC installation at the time the SCM was installed.

The connection of each SCM indicates that the respective PC installation is not in a Low Power Standby mode. Where an SCM has not linked to the RMC for a period longer than the delay period of step 604 of Figure 6, the RMC may infer that the PC installation is in a low power state. In any case, the particular installation will not be able to be instructed to join a demand response event. The RMC may also receive notification directly from the SCM that the PC will immediately be put into a Low Power Standby state.

The RMC uses this information to estimate the possible energy savings which could be achieved in response to a demand response event notification. This estimate is made available to the Utility, to be used in deciding to request a demand response notification.

When the PC returns to use from a shutdown condition, the SCM will make contact with the RMC. The RMC can then determine that the PC is not in a Low Power standby state. The information about which PC installations were shutdown, with the information concerning when the installation returned to use, is communicated to the DRC which enables the DRC to calculate what magnitude of energy was saved over what period. This is reported to the RMC and hence to the Utility. The Utility may pay the RMC for this energy saving.

The DRC may have information concerning the geographical location of the customers having the SCM installed. This may be used to allow the Utility to restrict the demand response event notification to a particular are where, for example, the need to reduce demand is related to a distribution problem affecting only a limited area.
The DRC may be in communication with SCMs from PC installations provided with electricity by from a variety of supply networks and customers of a variety of Utilities. Each Utility will be provided information only about installations which are connected to its network or belonging to its customers.

Installation of the SCM and the corresponding energy saving device may be financed by the owner of the RMC or by the Utility. The co-operation of the consumer who owns the PC installation may be obtained by providing the energy saving device free of charge or at a reduced price. Other financial inducements or non-financial inducements may be provided to the customer to allow the installation of the SCM, and to participate in demand response events.

In an embodiment, the SCM may include a user interface allowing a customer to indicate that they wish to be notified of any demand response event, and given the opportunity to participate. In this embodiment, the SCM will display the shutdown warning whenever a demand response event notification is received, regardless of the power mode of the computer. Thus customer will then be given the opportunity to respond by either giving or refusing permission for shutdown to take place. There may also be given an indication of the duration of the event, allowing the customer to avoid bringing the PC out of shutdown for that period of time. Where this is combined with the ability of the DRC to record when the PC installation returned to use, the DRC can verify that an installation participated fully in the demand response event. The RMC owner or the Utility may provide some form of payment or reward for this participation.

A user may wish to participate in DR events, but may not be in a position to allow the computer to be shutdown. Many computers have energy saving features which allow for energy to be saved without shutting down the computer. These include, without limitation, such features as the ability to dim screens and monitors and to reduce CPU speeds. There may also be a capacity to spin down some or all hard drives. Devices with multiple GPUs may have a capacity to switch to a GPU which has lower performance and hence lower energy use. Fan operation may be reduced, either by the reduced energy consumption placing less strain on the cooling system, or by direct command. Operating temperatures may be permitted to rise temporarily to reduce fan use. Ethernet or other high speed communication channel use may use
significant energy and there may be a capacity to slow communications rates to save energy.

In an embodiment, the SCM defines a reduced energy use power use state which is defined by implementing at least one energy saving feature such as those listed previously. In a preferred embodiment the reduced energy use power use state is made up of a suite of settings for such features. The SCM may implement a user interface which allows a user to define the characteristics of the reduced energy use power use state. This user interface allows the user to predetermine whether the reduced energy power use state is available in response to a DR event.

Referring to Figure 5, in this embodiment, the function block "Record Occurrence and Abort Shutdown" 560 is replaced by process Reduced Energy Use Process 801 shown in Figure 8.

Referring to Figure 8, the process Reduced Energy Use Process 801 is illustrated. This process is entered only when a DR event is in progress, and the option to cause the PC to hibernate has been rejected.

The process checks, 802, whether the option to use the reduced energy power use state is available. If it is not, then the occurrence is logged and the shutdown is aborted, 560.

If the reduced energy power use state is available, the SCM commands 803 the PC to move to the reduced energy use power use state.

The reduced energy power use state may not always be convenient for the user. In order to avoid the user permanently disabling this function, reducing the available energy saving during a DR event, it is important that the user be provided with a convenient way to curtail use of the reduced energy power use state.

The SCM will display a user interface element which will give access to a user interface which will permit tailoring of the reduced energy use power use state or withdrawal from the DR event response. In the illustrated embodiment, a DR Icon is displayed 804 in the system tray of a Windows operating system, showing that a DR event is in progress.
The DR Icon awaits selection 805. While the DR Icon is not selected, the PC continues to operate in the reduced energy use power use state.

The SCM continues to communicate with the DRC as described in Figure 6. The SCM checks 806 to determine whether the DR event is still in progress. While the DR event continues, the SCM continues to display 804 the DR Icon.

When the SCM determines that the DR event is not continuing, the SCM then returns 807 the PC to the power state which it was in prior to the DR event.

If the user selects 805 the DR Icon, the SCM will display 808 a user interface which allows the user to adjust the parameters of the reduced energy use power use state or to withdraw from the DR event. The SCM implements any user instructions received through this user interface, changing the power use parameters, or, if the user wishes to withdraw from the DR event response, returning the PC to the power state it was in before the DR event.

The participation of the PC in the DR event, whether the PC participated in the DR event for the full duration of the event, withdrew from the event, or changed parameters during the event, is reported to the DRC. This enables the DRC to calculate the energy savings contributed to the DR event by the PC. The RMC or the Utility may provide some form of payment or reward based on the level of participation and the energy saved by that participation.

Referring to Figure 9, there is shown a flowchart of the operation of the PC Activity Monitor process of an embodiment of the SCM software. The PC Activity Monitor process runs in parallel to the process of Figure 4.

The SCM software runs on the PC. Upon initiation, the SCM runs the process Reset PC Power Management 901. PC operating systems include power management features which cause the PC to enter various lower power states depending upon the activity level of the PC. In order for the SCM process to control the power management of the PC, the process Reset PC Power Management 901 disables power management features, or sets the activation parameters of such features to values which ensure the features will never activate while the SCM controls the power management of the PC.
The SCM then runs the process Monitor PC Activity 903. This may use the process described in Figure 4, where an Inactivity Figure is obtained and compared to a threshold value. In addition or alternatively, the process Monitor PC Activity 903 directly monitors use of mouse, keyboard and other inputs, the level of use of PC resources such as processor capacity, and any flags which may be set by the operating system to indicate that the PC is in use.

The results of this monitoring activity are used to determine 904 whether the PC is inactive. If the PC is not inactive, the monitoring continues 903.

Where the PC is determined to be inactive, the Hibernation Process of Figure 5 is initiated 905.

When the Hibernation Process runs and moves the PC into a low power standby state, the ESD acts 906 to remove power from the switched outlets.

An advantage of having control of the power management taken by the SCM is that the low power standby mode can be the lowest possible power usage mode. Low power usage modes consist of disabling or reducing power to various hardware and software components of the PC. The modes, such as "sleep" and "hibernate" provided by the operating system may not be the optimum for reducing power consumption. Direct control of the individual components of the power saving mode allows the SCM to achieve to optimal power reduction.

In an embodiment, illustrated in Figure 10, the SCM acts 1001 to create a link directly to a remote Demand Response Controller (DRC). The DRC may be managed by any party having an interest in energy saving, including without limitation, an energy retailer, an electricity distributor or a Government agency.

When the manager of the DRC requires a reduction in energy usage across the electricity network, the DRC will issue a demand response request. The SCM will receive 1002 the demand response request.

In response to the demand response request, the SCM will cause 1003 the computer to enter a low energy power use state.

In other embodiments, the data link 208 between the SCM and the energy saving device may be absent or the energy saving device may be completely absent. In this
case, the Energy Saving Device Monitoring process acts as an inactivity monitor. Referring to Figure 4, the process begins from the Get Inactivity Figure step 403. The step 405 becomes a delay step between checks 403 of the inactivity figure.

In other embodiments, the Energy Saving Device Interaction Process may directly instruct the processor or the switch to remove power from the switched electrical outlet, before the PC is placed into a Low Power Standby mode.

In a further embodiment, the energy saving device may be adapted to remove power from both the peripherals outlet and the monitored outlet when the Low Power Standby mode is detected. This allows the standby energy consumption of the PC itself to be saved also. In this case, an interrupt is provided to allow a user to indicate to the energy saving device that they wish to use the PC and that power should be returned to the monitored outlet. The interrupt may be a user operated device such as a push button, or it may be a device for detecting user presence, such as a movement detector.

In a further embodiment, the functions of the monitored and peripherals outlets are combined in a single type of outlet, with the interrupt supplied. One or more such combined outlets may be provided. Multiple devices may be powered through a single such socket by use of a power board.

The energy saving device may take any desired form but preferably is a power board, a general power outlet (GPO), a wall plug or an energy centre. It is preferred that the system or method of the invention are used in connection with "plug-in" electrical devices, but the system or method may also be used with electrical devices which are permanently wired to mains electrical power. In the latter case, the energy saving device could be incorporated into the mains wiring infrastructure or incorporated as an integral part of mains powered equipment.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiments, it is recognised that departures can be made within the scope of the invention, which is not to be limited to the details described herein but is to be accorded the full scope of the disclosure so as to embrace any and all equivalent devices and apparatus.
CLAIMS

1. A computer implemented system for reduction of electricity usage in an electricity supply network, the system adapted to create a data link to an external remote management centre which includes a demand response controller receive from said demand response controller a demand response event request; upon receipt of said demand response event request command the computer to enter a low energy power use state.

2. The computer implemented system of Claim 1 further adapted to monitor an activity level of the computer in order to determine an activity mode of the computer, upon determining that the activity mode has been other than active use mode for a time period exceeding a threshold time period activate a user interface allowing a user to provide a user indication indicating that the computer should not be placed in a low energy use power state; where such user indication is not provided, command the computer to enter a low energy power use state; upon receipt of a demand response event request, activate the user interface allowing a user to provide a user indication indicating that the computer should not be placed in a low energy use power state; where such user indication is not provided, command the computer to enter a low energy power use state.

3. The computer implemented system of claim 2 wherein, when such a user indication indicating that the computer should not be placed in a low energy use power state is provided, instructions are executed to command the computer to enter a reduced energy use power use state.

4. The computer implemented system of claim 2, further adapted to activate the user interface following the demand response request only when the activity mode of the computer is determined to be other than active use mode.

5. The computer implemented system of claim 2, further adapted to communicate to the demand response controller the user indication such that the demand response controller can determine that the computer will or will not be placed in a low energy power state.
6. The computer implemented system of claim 1 further adapted to receive from an energy saving device monitoring power drawn by the computer, power usage data describing the power usage of the computer and communicating said power usage data to the remote management centre.

7. The computer implemented system of claim 1 further adapted to receive from an energy saving device monitoring power drawn by the computer and controlling power supply to at least one peripheral of the computer an indication that the energy saving device is installed and communicating said indication to the remote management centre.

8. A method for reducing load on an electricity supply network including the steps of; a personal computer supplied with electricity by the electricity supply network creating a data link to an external demand response controller adapted to issue a demand response event request; the personal computer receiving from the demand response controller a demand response event request; upon receipt of said demand response event request, activating a user interface allowing a user to provide a user indication indicating that said personal computer should not be placed in a low energy use power state; where such user indication is not provided, commanding the computer to enter a low energy power use state.

9. The method of claim 8 further including monitoring an activity level of the computer in order to determine an activity mode of the computer, upon determining that the activity mode has been other than active use mode for a time period exceeding a threshold time period; activating a user interface allowing a user to provide a user indication indicating that the computer should not be placed in a low energy use power state; where such user indication is not provided, commanding the computer to enter a low energy power use state.

10. The method of claim 8 further including supplying to a customer of the electricity supply network a power control device which includes an electrical inlet adapted to connect to a general power outlet, at least one monitored electrical outlet adapted to connect to the personal computer, at least one peripherals electrical outlet adapted to connect to, and to supply
electrical power to, at least one peripheral device,
a switch adapted to control electrical connection of the inlet to the peripherals
electrical outlet, and thus to control supply of electric power to the at least one
peripheral device,
a sensor adapted to sense at least one characteristic of an electrical power flow
through the monitored electrical outlet to the computing device,
wherein the power control device is adapted to remove power from the switched
electrical outlet when the sensor detects that the computer has entered a low
energy power use state.

11. The method of claim 10 wherein the provision of the power control device on
particular terms is conditional upon agreement by the customer to participate in
the demand response program.

12. A system for reduction of electricity usage in an electricity supply network
including a software control module adapted to
monitor an activity level of the computer in order to determine an activity mode of
the computer,
upon determining that the activity mode has been other than active use mode for
a time period exceeding a threshold time period;
activate a user interface allowing a user to provide a user indication indicating that
the computer should not be placed in a low energy use power state;
where such user indication is not provided, command the computer to enter a low
energy power use state;
further including instructions which when executed cause the computer to create
a data link to an external demand response controller
the software control module adapted to receive from said demand response
controller a demand response event request;
upon receipt of said demand response event request, to activate the user
interface allowing a user to provide a user indication indicating that the computer
should not be placed in a low energy use power state;
where such user indication is not provided, to command the computer to enter a
low energy power use state.

13. The system of claim 12 further including a power control device which includes an
electrical inlet adapted to connect to a general power outlet,
at least one monitored electrical outlet adapted to connect to the personal
computer,
at least one peripherals electrical outlet adapted to connect to, and to supply
electrical power to, at least one peripheral device,
a switch adapted to control electrical connection of the inlet to the peripherals
electrical outlet, and thus to control supply of electric power to the at least one
peripheral device,
a sensor adapted to sense at least one characteristic of an electrical power flow
through the monitored electrical outlet to the computing device,
the power control device further adapted to remove power from the switched
electrical outlet when the sensor detects that the computer has entered a low
energy power use state.
14. The system of claim 12 wherein the switch is adapted to remove power from the
monitored electrical outlet and the peripherals electrical outlet when the sensor
means detects that the computer has entered a low energy power use state.
15. A method for reducing load on an electricity supply network, the network
supplying electricity to a plurality of personal computers running a software
control module including the steps of;
receiving information from a software control module running on a plurality of said
personal computers indicating that the computers are available to participate in a
demand response event;
receiving from an energy supply utility associated with the electricity supply
network a demand reduction request, being a request to reduce electricity
consumption by devices supplied with electricity by the network;
issuing a demand response event request to a plurality of the software control
modules;
the demand response event request causing the software control module to
activate a user interface allowing a user to provide a user indication indicating that
the computer should not be placed in a low energy use power state;
where such user indication is not provided, the software module will command the
computer to enter a low energy power use state.
16. The method of claim 15 wherein, when such a user indication indicating that the
computer should not be placed in a low energy use power state is provided, the
software module will command the computer to enter a reduced energy use
power use state.
Figure 3
Monitor ESD

Receive Power Usage Data

Hibernate Message Received from ESD?

Yes

Get Inactivity Figure

Inactivity Figure > Inactivity Threshold?

No

Send Wait Hibernate to ESD

Yes

Initiate Hibernation Process with standard Hibernate Countdown Timer value

Figure 4
Create Link to RMC

Provide Identification to RMC

Send Power Usage Data to RMC

Contact DRC

DR Notification Current?

Call Hibernate Process with Minimum Hibernate Countdown Timer Value

Wait
Power saving is about to start!

You don’t seem to be using your computer at the moment.

Your computer will go to sleep in 10.00 minutes

To continue using your computer,

Move the mouse or Press any key

Figure 7
Reduced Energy Use Power Use State available?

N → Record Occurrence and Abort Shutdown

Y → Move PC to Reduced Energy Use Power Use State

Display DR Icon

Y → DR Icon Selected?

N → DR Event continuing?

Y → Return PC to pre-DR Event power state

N → Display UI to tailor or end DR Response

Report DR Event Participation to DRC

Figure 8
Reset PC Power Management

Monitor PC Activity

Is PC Inactive?

Run Hibernation Process

ESD Acts to Remove Power from Switched Outlets

Figure 9
Create Link to DRC

Receive DR Request

Place PC in Low Energy Power Use State

Figure 10
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

G05B 19/418 (2006.01)  G06Q 50/06 (2012.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPIAP, Google Patents, Google, with keywords (electricity, energy, power, management, consumption, usage, reduction, conservation, standby, remote, request, socket, switch, outlet, user indication) and the like terms. Search Google Patents, INTESS, AusPat, PAMS NOSE with the applicant name (Embertec Pty Ltd) and the inventor names (Domenico Gelonese, John Haskey).

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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X Further documents are listed in the continuation of Box C  X See patent family annex

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
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  "O" document referring to an oral disclosure, use, exhibition or other means
  "P" document published prior to the international filing date but later than the priority date claimed
  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "&" document member of the same patent family

Date of the actual completion of the international search
1 December 2015

Date of mailing of the international search report
01 December 2015

Name and mailing address of the ISA/AU

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Form PCT/ISA/210 (fifth sheet) (July 2009)
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<td>US 2013/01 16829 A1 (HOFF et al.) 09 May 2013 pars. [0014, 0016, 0020, 0022-24], fig. 1</td>
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This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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