CSI Technologies (Pty) Ltd
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I-ENERGY

Intelligent Energy Management System

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Let the mind wonder …

The Energy situation in the world is becoming more and more difficult. Our next global energy crises will start right after the end of the current economical crises. Currently, the worldwide demand for energy is very low and we have enough capacities to supply the slow growing industry. The price of energy at present, presents an incorrect picture. We pay far much more than before….

After a rising energy demand, we will still have enough capacity to feed a fast growing economy, but only for a limited period. The price we pay for energy will climb up to astronomical levels. Our resources are not endless. Sure, we will find other ways to produce energy. But, the easiest, cost effective and environmentally friendliest way is to save our current resources. Everybody should be able do this - this means, everybody should be in charge of our mother-earth.

The human species is part of all creatures on earth and, its behaviour is like all other creatures. Natural creatures have their special habits. For instance, an Impala goes every day the same way to his preferred water dam. It is not easy to teach it other different ways of reaching the same dam, because it is not so comfortable to walk a longer way. We, as the most intelligent creatures on earth, are also enslaved by non-creative and wasteful habits.

Energy saving is not a personal need. The power comes through the plug or the A/C switch. Yes, we can switch off the A/C, but we have to use a much more efficient and reliable way to switch off the A/C before we leave our residences and offices. Our excuse: “Sorry, I forgot …” means “I forgot to switch off the A/C” or means “I forgot, I am responsible for my environment for the future of my kid’s”? I don’t like to blame, I don’t like to point fingers to my fellows humans. I am part of humankind and I also make excuses: “Sorry, I forgot …”

I, as an engineer, have an obligation, because I have the tools to help others to stop making excuses: “Sorry, I forgot…”. Together with a very skilled team of professionals, we developed an intelligent energy management system, I-Power.

Be aware of the following amazing possibility to protect the environment, our mother earth, next generation kids, yourself …and the Impala.

Joerg Ploetz Dipl. Ing.
Johannesburg, *Feb 2009*

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Introduction

The power crisis in South Africa is serious and we have to deal with it. It will take at least 3 years to build new power stations and to refurbish the power grid. The only way to support the new developments and the existing private and economical sector is to shift and save power. The new technologies for power generation are helpful, but unfortunately too expensive.

Our solution provides assistance in implementing energy saving measures . We have developed an automated system that enables shifting the energy from peak times to none peak times (with enough energy). Furthermore, our system helps control power consumption and can prevent energy wastage during times when there is little need for A/C's, geysers or other equipment.

The system can be automatically programmed from the control-operator of a building, and the operator will at all times be able to react accordingly.

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DMS - Demand Side Management

"When a utility that supplies electricity influences the way of use by customers this activity is known as Demand Side Management (DMS). DMS is the process by which electricity utilities achieve predictable changes in customer demand, which can be considered as alternatives to the provision of additional generation plants."

Source: Sanyai Patel - Eskom

The I-Energy System is the perfect tool to fit in two of the preferred tools for DMS from Eskom – load **SHEDDING** and load **SHIFTING**

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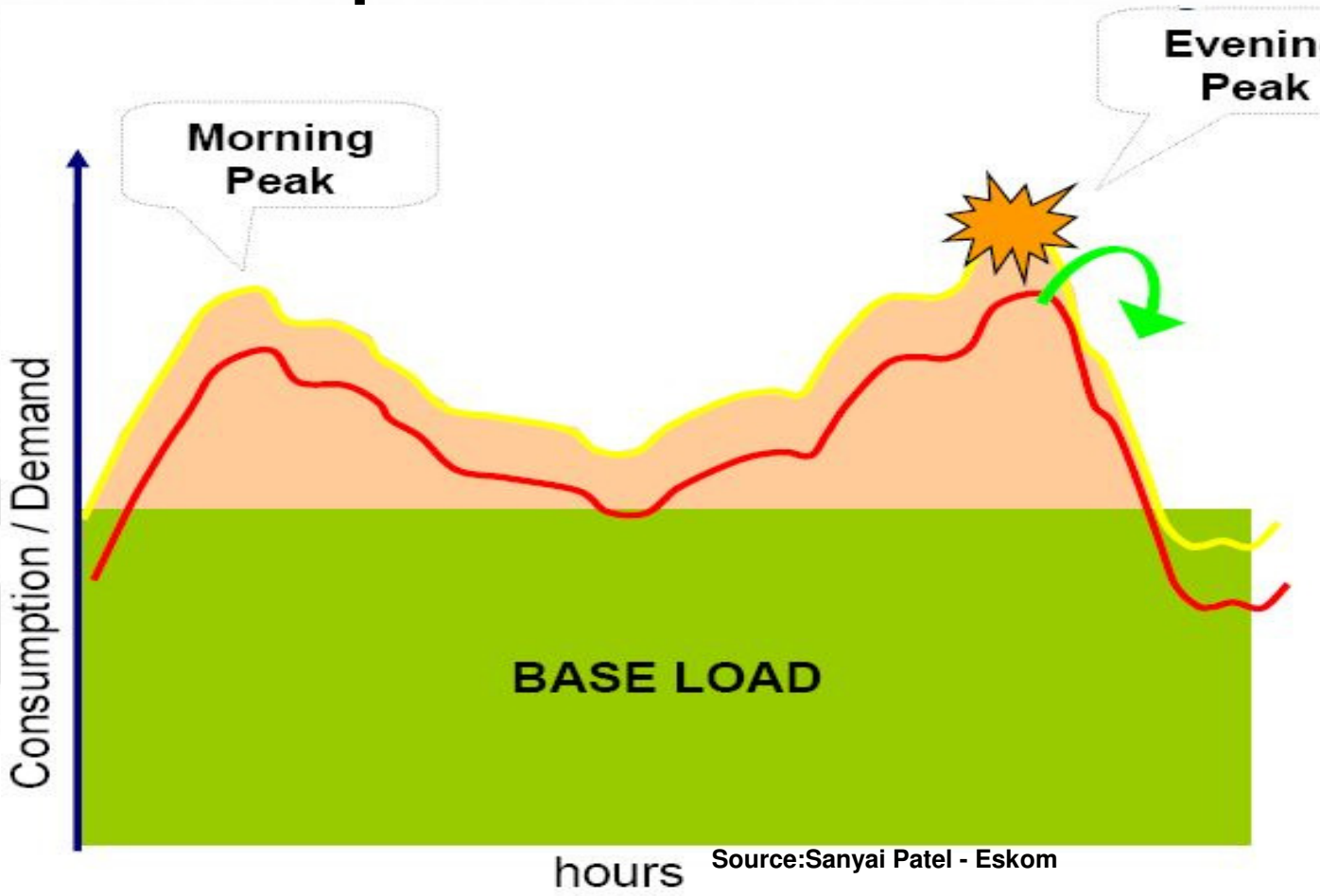
Power consumption scheme



Source:Sanyai Patel - Eskom

This graph illustrates high & low energy consuming peak periods; I-Energy can prevent a massive power usage during these peak periods.

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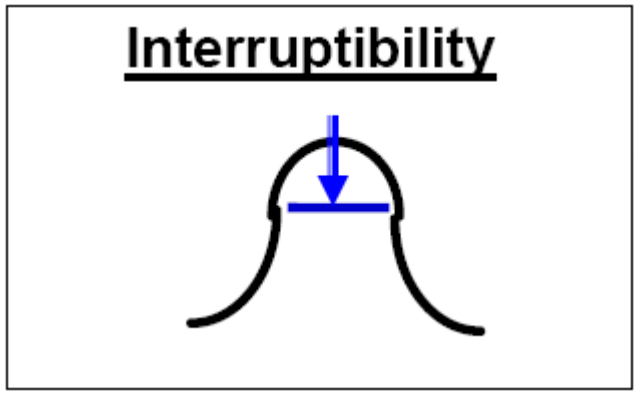
Load shedding (power interruptions)

Load **shedding** means - **to cut off some high power consuming products**, **when the demand of energy exceeds the total required supply of energy**. Without this sanction, the whole power grid and generation plant will be in danger.

This respects the national, the local (substations) and the particular (supply point on suburbs, estates, buildings) supply side. m1

To prevent the total loss of power, it is necessary to cut some power consumptions, like an entire suburb, estates, buildings or certain devices within a building.



Source: Eskom

This action cuts the peak of power usage for a limited time.
The I-Energy can control geysers A/C's, pumps, fans, compressors, etc.
The I-energy user can decide what is priority and what is not. He can prevent penalties in the future with the decision to switch off AC's and geysers during this time, or when not needed? m2

Folie 6

m1 Does he mean "represents"?
monkwef; 18.03.2009

m2 Just a suggestion
monkwef; 18.03.2009

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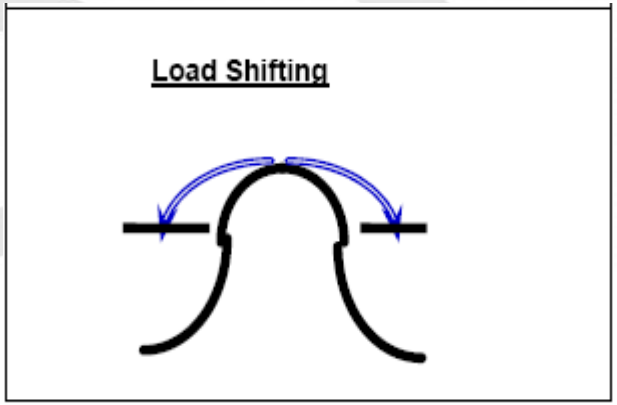
Load shifting

Load **shifting** is the shift/move from power consumption during the peak times to a non peak time. It doesn't save energy, but keeps the load of the electricity grid on a more constant level. The consumption doesn't exceed the limit from the supply side.

This target can be achieved, if you are using AC's not permanently during peak times, when the geysers are off during this time (tanks normally contain enough water to cover this time with hot water).



Source: Eskom

With the I-Energy system you have a tool to control every kind of high power consumers and you can create your own power usage plan for your premises. You can't save energy, but pure money. The energy usage during peak times is much more expensive than during the off peak times.
Your power usage plan will run the system automatically and you are every time able to change this or to switch manually

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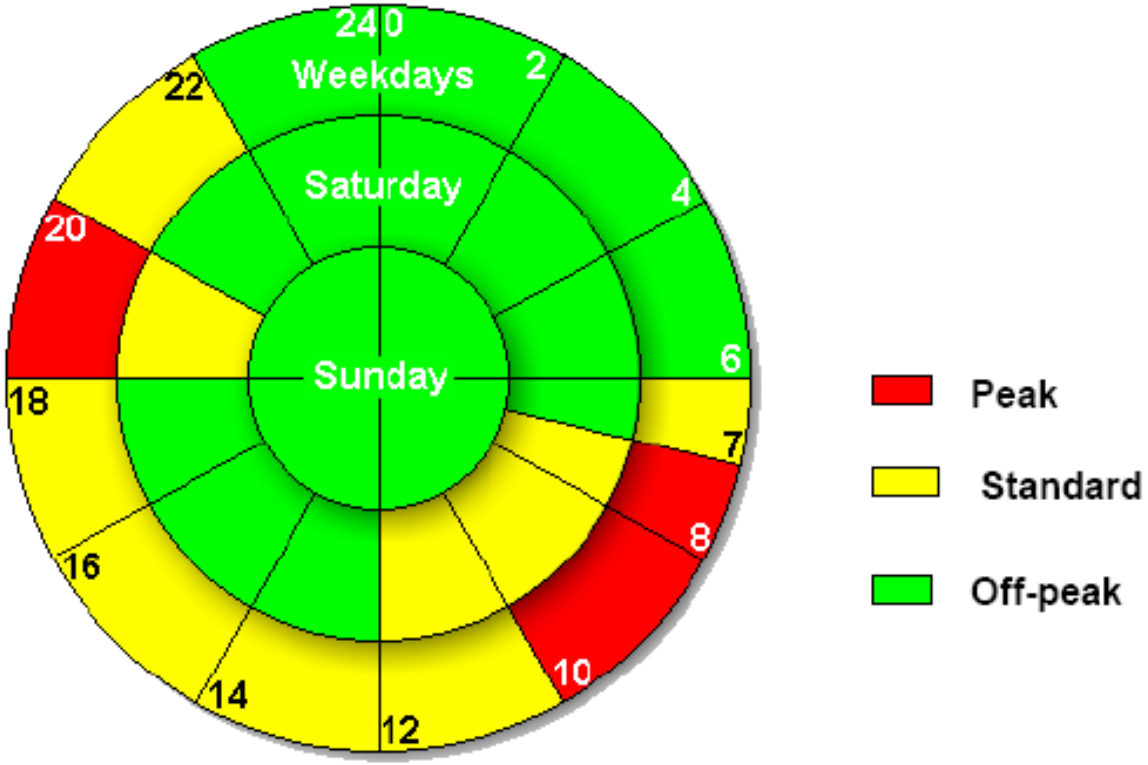
Eskom's TOU tariff defined time periods



Source: Eskom Tariff Book

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Official Eskom price list 2008/2009

PRICE INCREASE 35,90%

TARIFF COMPONENTS	Homelight 1		Homelight 2		Homepower		Homepower BULK*		Businessrate		Landrate	
	2008/9	+VAT	2008/9	+VAT	2008/9	+VAT	2008/9	+VAT	2008/9	+VAT	2008/9	+VAT
SERVICE CHARGE (R/DAY)							R4,67	R5,32				
1					R1,85	R2,11			R4,95	R5,64	R7,75	R8,84
2												
3												
4												
10 Amperes / Dx											R15,43	R17,59
NETWORK CHARGE (R/DAY)							R0,92	R1,05				
1					R2,85	R3,25			R4,74	R5,40	R8,15	R9,29
2					R6,16	R7,02			R6,85	R7,81	R12,52	R14,27
3					R12,38	R14,11			R13,40	R15,28	R20,03	R22,83
4					R1,47	R1,68					R6,48	R7,39
ACTIVE ENERGY CHARGE (c/kWh)					40,58	46,26	34,19	38,98	34,52	39,35	36,58	41,70
2.5 Amps	62,38	71,11										
20 Amps	62,38	71,11	54,17	61,75								
60 Amps	70,17	79,99	61,97	70,65								
Hometake 60A or Landrate 4 or Businessrate 4									81,95	93,42	73,15	83,39

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I-Energy

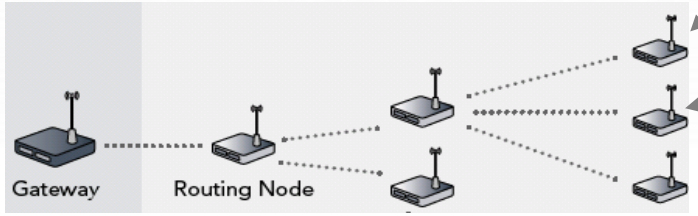
Our objective is to offer a full automatic system to control every kind of power consumption. We find a way to do this with a combination of Internet technology, a special wireless network & databases

Devices:

-Geyser
-Air conditioners
-Escalators
-Compressors
-Pumps
-Lights
-Cool rooms
-Lifts
-Fans
-Heaters

Central Management

automated
or
interactive



The use of solar energy has not been opened up because the oil industry does not own the sun.

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I-Energy - The highlights

The system was designed under following aspects:

Installation

-No additional wires except power
-No programming on site
-defined interfaces
-Without special tools
-qualified and experienced electricians are able to install the devices
-very short time on site
-central administration
-automatic documentation

Maintenance

-Modular concept
-self organizing network
-replacement of devices take less then 10 min
-self reporting
-remote administration
-self healing network
-no single point of failure
-low training

Functionality

-meter reading
-device switching
-sensor reading
-flexible reports
-interface to other management systems
-two way communication
-open interfaces
-flexible with third party product
- free Radio licence

Usability

-Software is web-based
-no computer hardware requirement
-easy to understand
-world wide access to the system
-flexible configuration
-no big manual required

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Requirements

The I-Energy system needs only small changes on the power distribution board. We need an additional automatic circuit breaker for each circuit to control. The I-Energy on site control box can switch up to 4 circuits and is powered from the normal grid.

It's also possible to place the device directly together with the power consumer, like A/C, geyser or heater.

In addition to the I-Energy device, we install only a wireless gateway and a control box in your control room or data centre. This will be connected to your local computer network.

An option is to setup a link to the Internet for **remote administration**. Our company is able to provide switches, firewalls and routers.

We offer you a turnkey solution.

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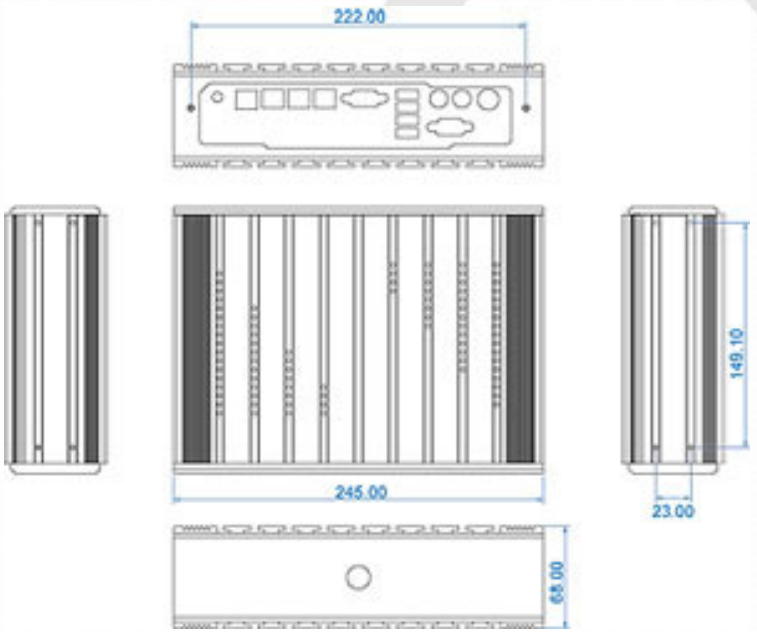
I-Energy control box – How does it look



The heart of the system is a computer-based control box, using a Linux operating system, the most stable system for automation purposes. The box contains the control software, interface to the Internet, firewall and the wireless network interface.

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I-Energy wireless gateway – How does it look

The gateway for the wireless modules is a small box and is directly connected to the control box. It works in the world wide 868MHz free radio band. This box collects all the data from the reading and switching modules.

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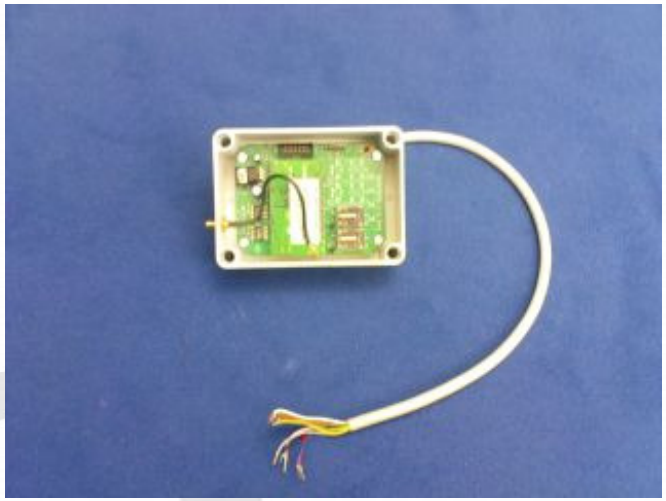
I-Energy wireless module – How does it look



The Module is directly connected to the power distribution board. It transmits the data from the meter and receives the commands to switch the power consumers. It can be powered by battery or 12V power supply.

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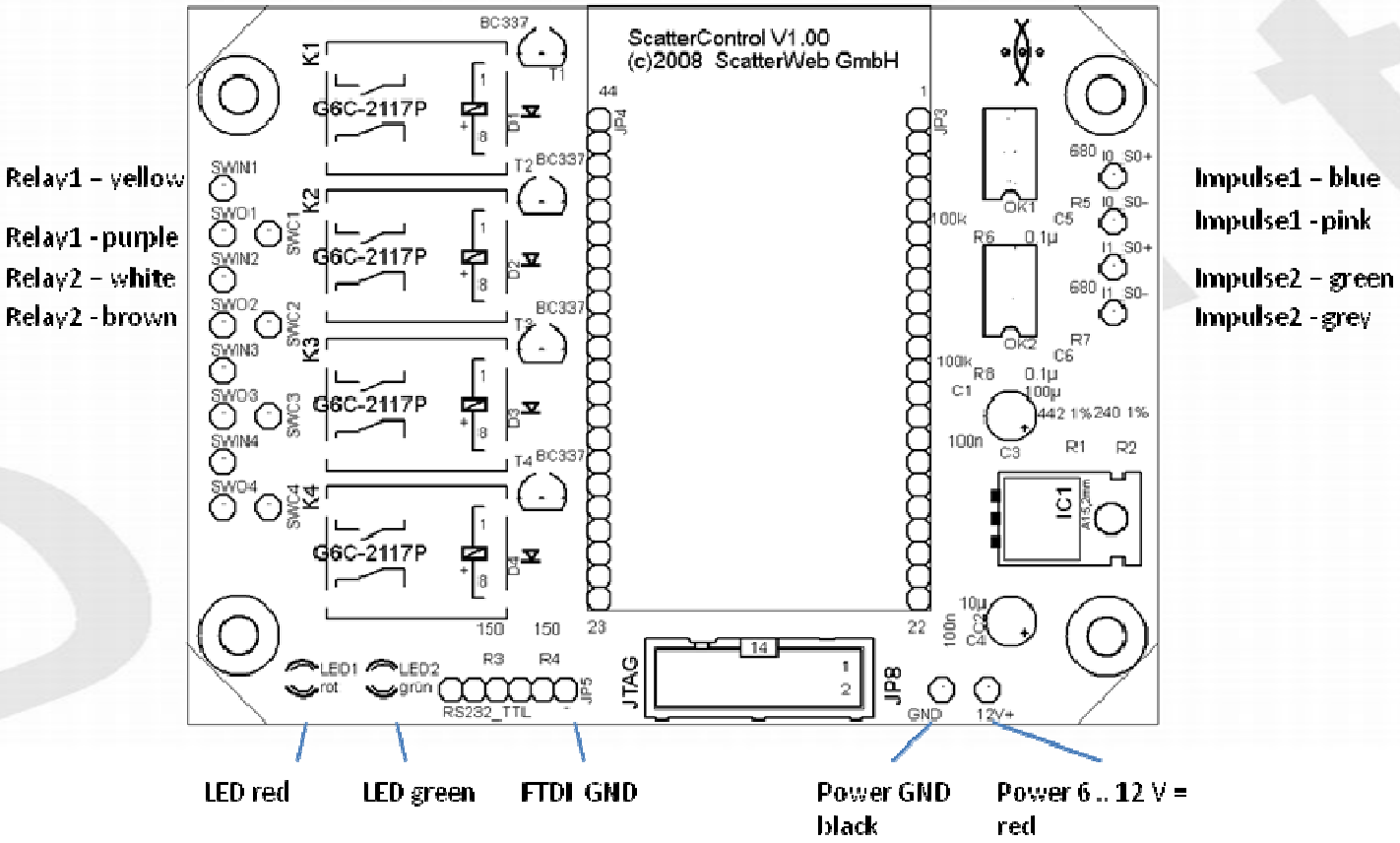
I-Energy wireless module – How does it look



The module contains up to four relays to switch different power consumers. In addition, we have two interfaces to read out the pulse for KWh and KVA from a power meter. These interfaces are also able to read water, gas, heat or other meters.

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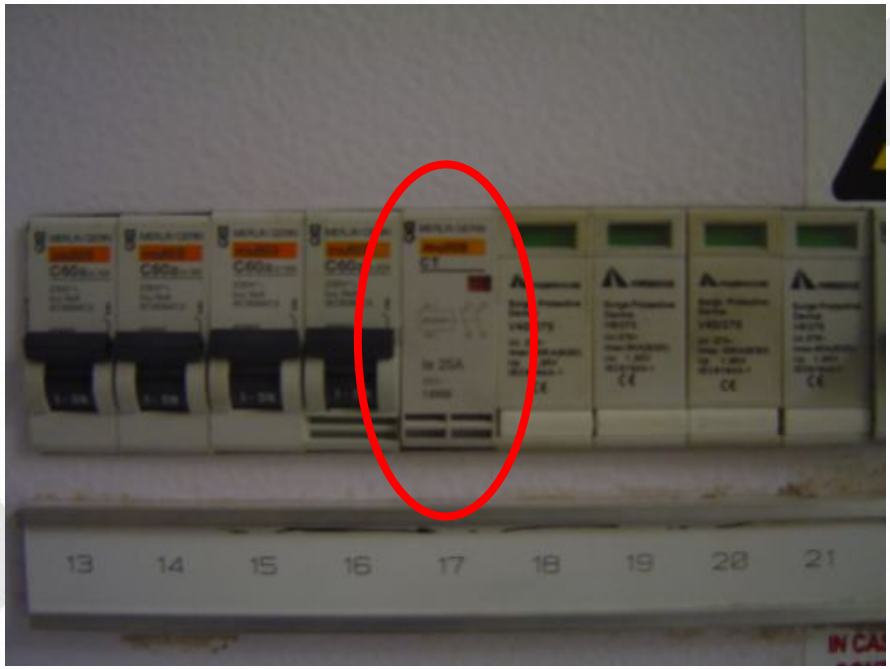
Automated switch – How does it look



This switch is a standard part of the electrical industry and is controlled by the I-Energy Module

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Automated switch – How does it look

These are the only parts to implement on site. It takes less than a hour for a flat, house or shop. Any qualified and skilled electrician is able to install this.

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I-Energy – How does it work

The I-Energy system is divided in two general parts. The first part, **passive**, is the AMR site and gives us the possibility to monitor your power consumption. We can do this on different scales. The minimum is to read the main meter from the building. With these values, we are able to create a plan for an optimised switching plan. m4

After collecting data, we will, together with you, group the power consumers for different stages to bring the power down, during a critical time of power demand. In addition we will setup a shift plan to move the power consumption from the peak time to the off peak time.

As an example, a shop opens at 9:00AM. The peak time in the morning starts at 6:00 and ends at 9:00. To have a nice cooled room in the morning, we will pre-cool the shop from 5:00 to 6:00. The cold air will remain for a while, because the shop doors are closed. At 9:00, we switch on the A/C again, the peak time elapses without power consumption for air conditioning.

All of my work is based on nature. I grew up in a rural environment and living in the Bay Area allows for immediate access to wonderful natural environs. Basically nature is my Genus

m4 write it out in full, then abbreviate.
monkwef; 18.03.2009

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I-Energy – How does it works

The second part is the **active**, the self-switching. Most of the time, our system is running automatically. Every integrated power consumer gets a signal to switch on or off at the preset time. In some cases, there are exceptions which require manual interaction with the system.

As an example, having a video conference with a company in the Far East at 2:00 in the morning - the operator needs to switch on the heater. He can do this with one mouse click in the control room. If the system is connected with the Internet, he is also able to do this from home. Another option is to give the tenants themselves the right to switch some of their devices.

It is easy to create different user levels with limited rights. Access is via a normal website provided through the internet. A cell phone with internet access is enough to control the system.

I addition, the tenants get an overview of the I-Energy system conditions on their site.

For the future, we can also provide measurements for temperature, humidity, brightness, vibration or we can support moving detectors, smoke detectors, laser beams, glass break detectors, and any kind of sensor.

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I-Energy – Future options

The current solution indicates only the power consumption from a building or a complex. With some additional development, we are be able to consider the national energy situation. This means, we can shut down some of the not so important power consumers (like A/C's, geysers) for whole buildings or complexes during a time without enough energy from ESKOM.

The effect will be a supply of power for the important devices for everybody. The power cuts are not anymore effecting the whole area, like past times.

The short time for the installation of the system and the easy way to do this, is a possibility to prevent future load shedding with the well known inconvenience for the citizenship.

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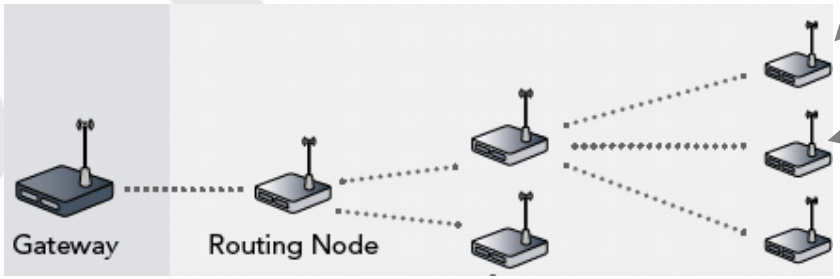
I-Energy – Future options

Eskom

Automatic adjustment



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I-Energy – Future Business Case

The vision from CSI is to start a local factory to manufacture locally. The agreement with the University of Berlin (FU Berlin) and aci Computers is to use their technology under license.

All the components are available locally and employees will be trained by our German partners.

Future research and development is also a part of our local company. We are starting with the research and development department of Eskom. With their inputs, we will continuously improve our solution over time. We also consider inputs from local customers, business partners and the government, in our relentless pursuit to ensure the incremental development of a value adding solution.

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I-Energy

User manual

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I-Energy -Start

The system was developed to control buildings and housing complexes. The main function is energy management.

Hardware requirements are **very minimal** - a basic computer running a Firefox browser and a network connection; the control box contains an **embedded web server.**

The IP address from the box gives you access to the I-Energy Control Centre. You can book mark this or setup an icon on the desktop.

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I-Energy – Main screen

After login authentication, the screen with the information about the installed system comes up. You can monitor the current network activities on the right hand site of the screen. A description of the data logs is found at the appendix.

The left window allows you the possibility to select an I-Energy Module for monitoring or control purposes. The icon bar on top shows the most important buttons to control the system manually.

The highlighted button show you current position.
-The shop button brings you to the position, where you are now
-Groups, the pre configured groups to assign the single units
-With the A/C button, you can switch manually all A/C's
-Offline runs a routine during a power failure (or load shedding)
-Online is the routine after reconnecting to the power grid (both routines run also automatically)

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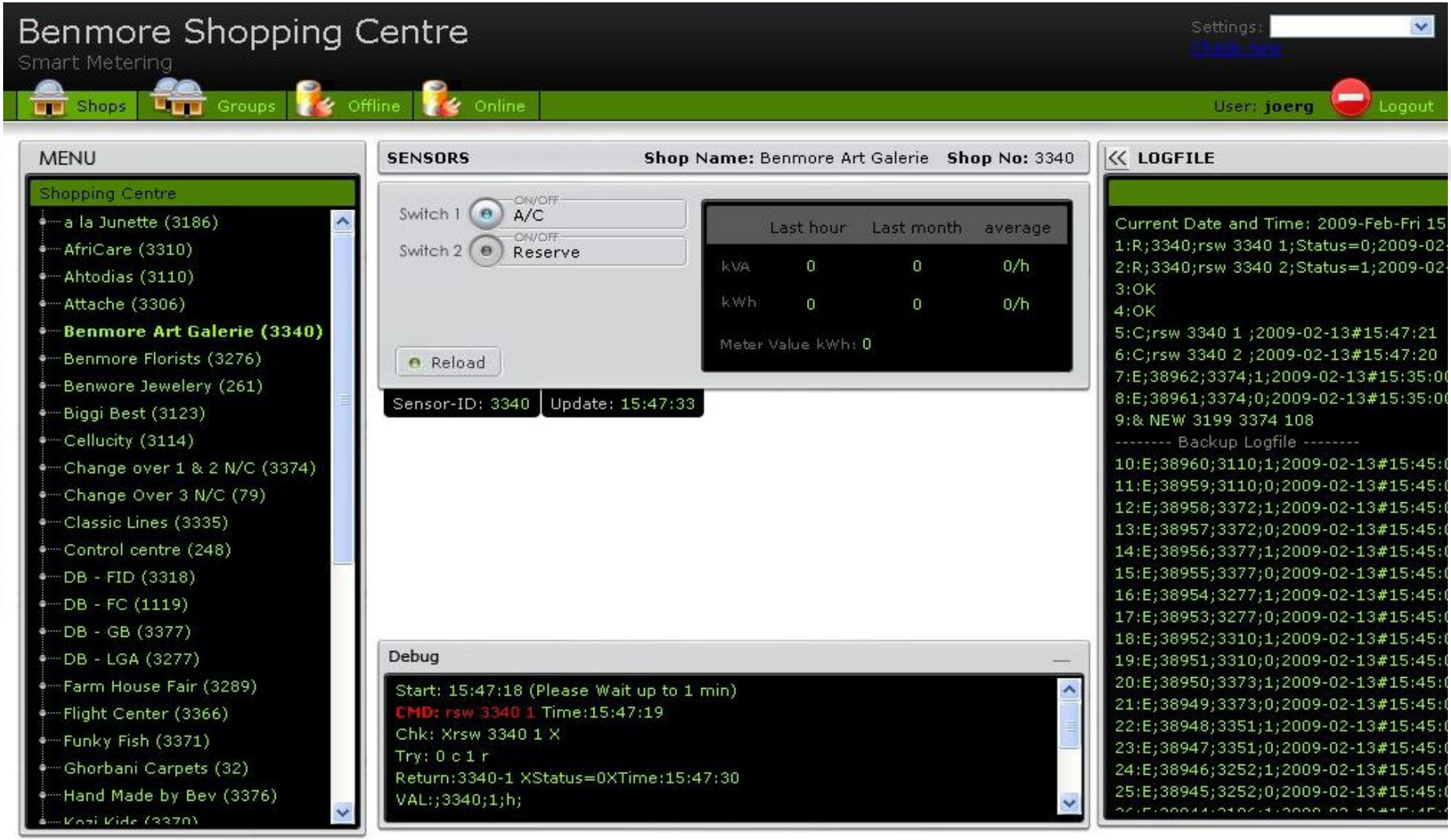
I-Energy – Main screen



We have forgotten how to be good guests, how to walk lightly on the earth as its other creatures do.

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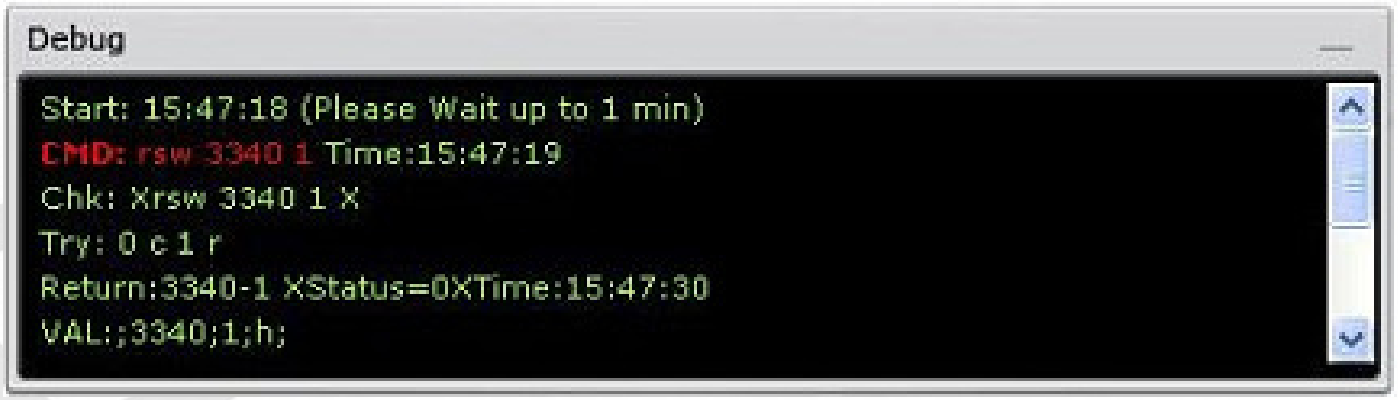
I-Energy – Main screen

The debug Window is for purposes to get information about the transmitting behaviour of the network for this special module. For more information please refer the appendix.



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I-Energy – Main screen

The middle part of the main screen shows you on the top the status of the selected module and offers you, depended on the number of connected relays or pulse indicators, buttons to switch devices.

The reload button send a request to the module to refresh the screen. The delay is depend on the hops to reach this module. It can take up to a minute.

The diagram button shows you the power consumption for the last 24 hours or the last 30 days. You can select this for KVA and KWh.

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I-Energy – Main screen

This is only a general information and you can find a more informative break down at a special program part (under ??????)

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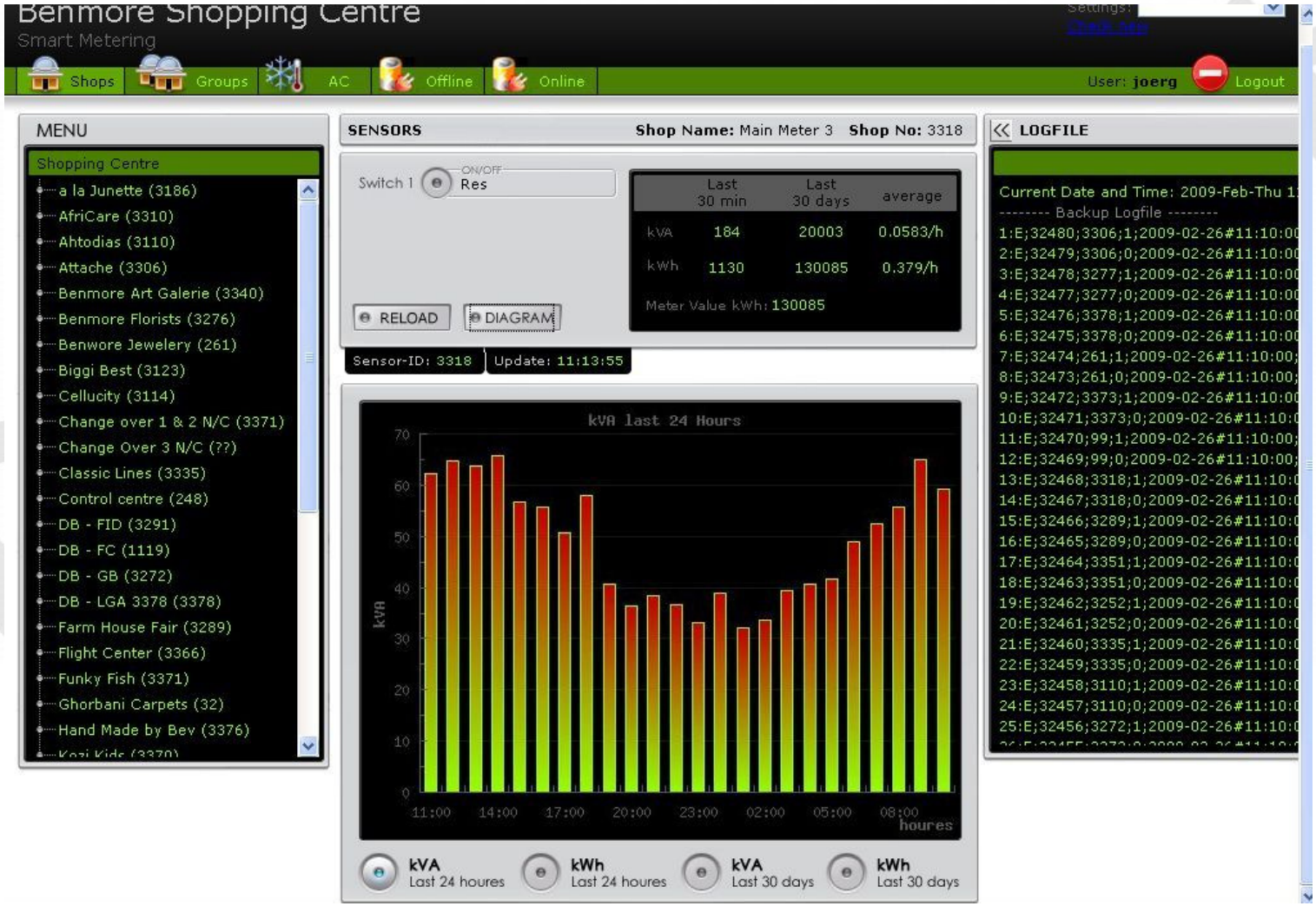
I-Energy – Main screen with KVa Diagram



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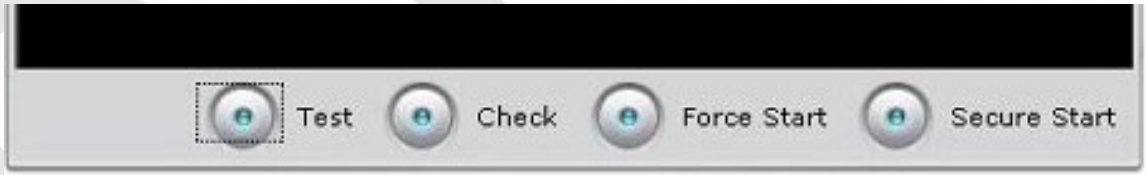
I-Energy – Manual switching modules

The software offers you a range of combined operations. This can be a follow up after a power cut, a procedure for maintenance or a simple group switching for a non scheduled process.
This manual switching modules have to be implemented from the company for installation the system after your requirement.

This modules offers you the possibility to do a so called dry test.



The Test button shows you all the operation they will be proceeded. Check gives you an overview about the current status about the included devices The Force Start button starts the routine without waiting for an response from the I-Energy Module. With the Secure Start button, you will be informed about the process (done or not)

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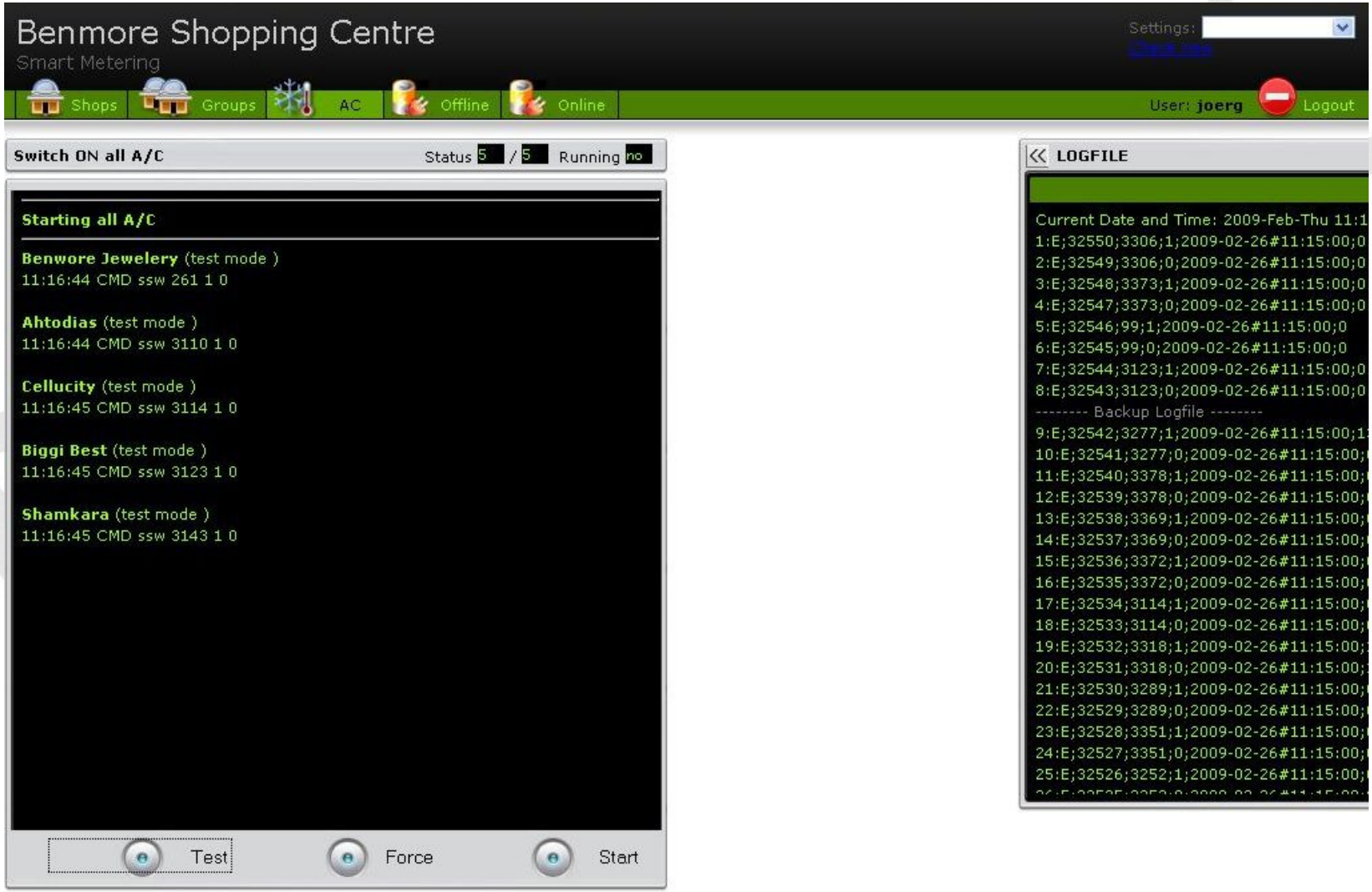
I-Energy – Group switching manual



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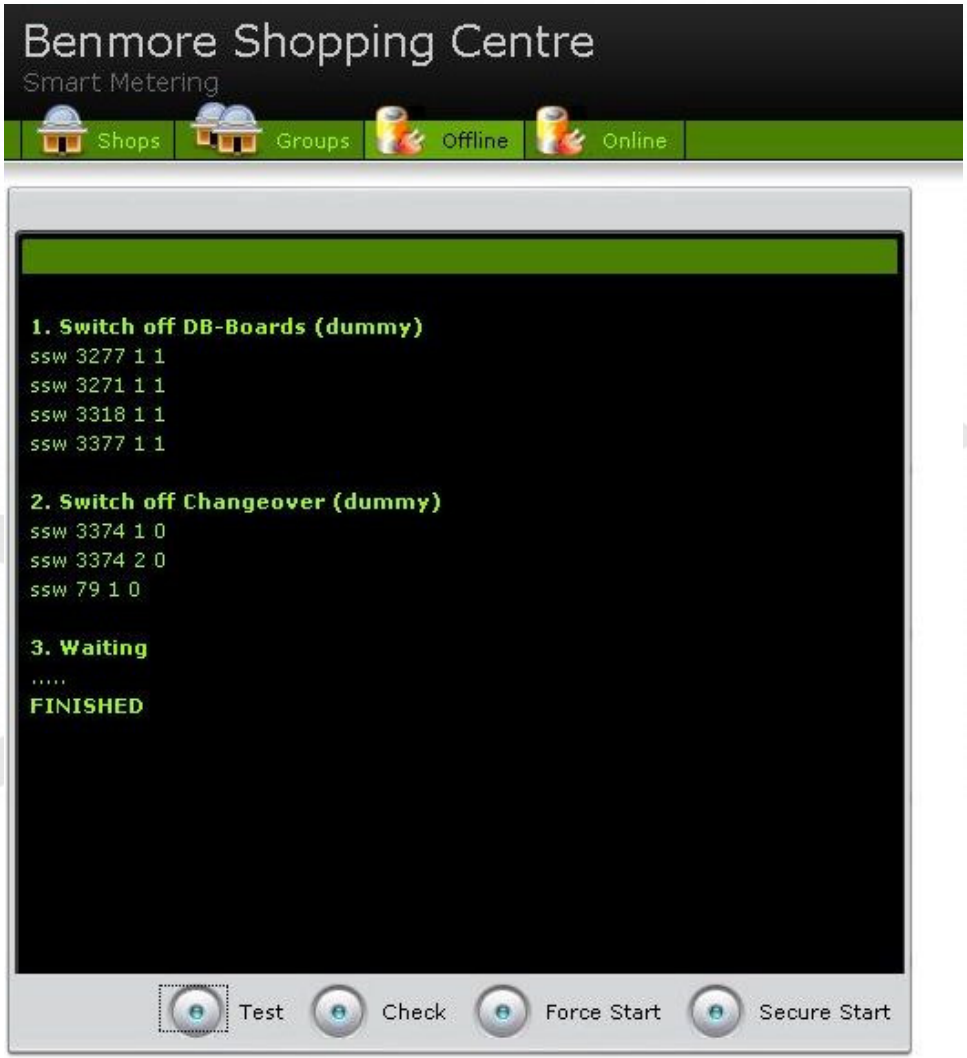
I-Energy – Generator setting test



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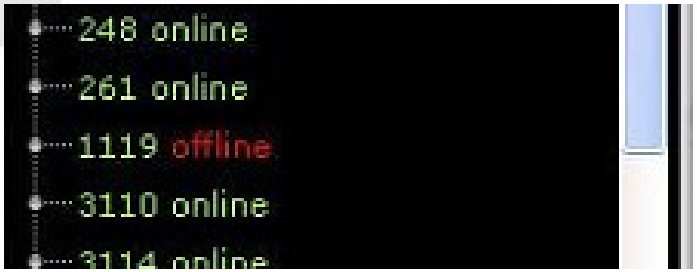
I-Energy – Network Monitor

This provides you with an overview what's happened in your network. The three gives an indication ho many hops are used for each I-Energy Module.

The next screen provides you with the online status of each module. If a module longer offline, it will indicate a faulty module. You have to check this module (power supply). In case of a broken module, it have to be replaced. Please remember to replace also the module number in Shop setting. This is the only required action.



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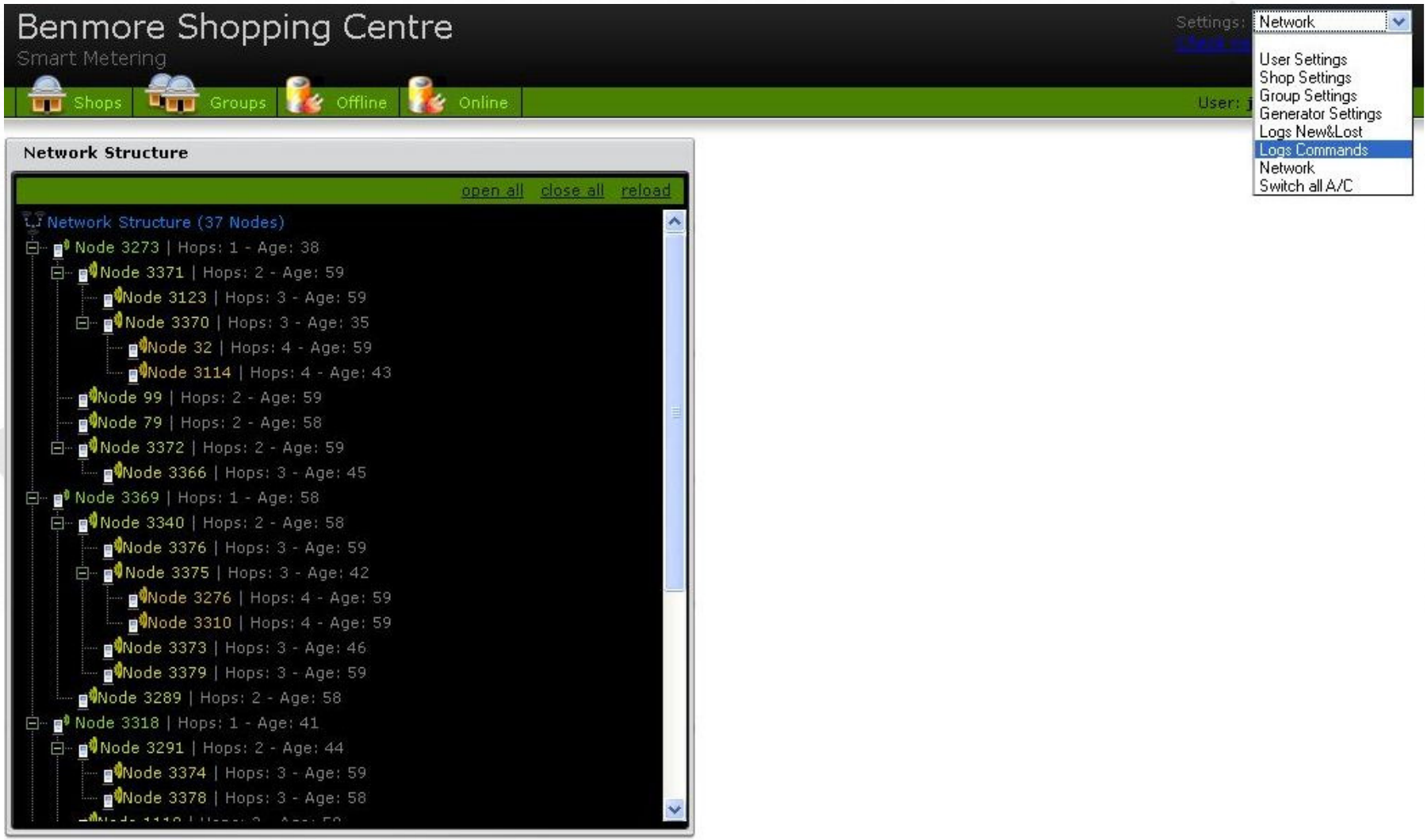
I-Energy – Network



The U.S. goverment was the first to start an automobile junkyard on the Moon.

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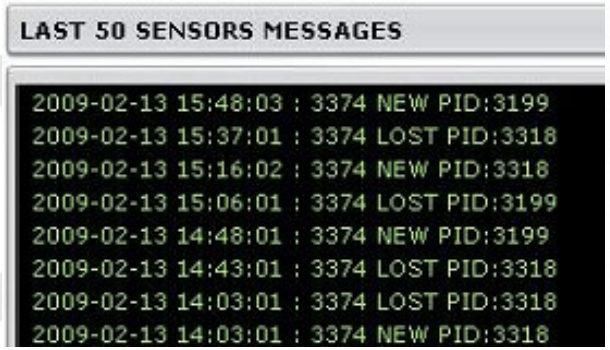
I-Energy – Network Monitor Messages

The network messages indicates the permanent activities at the network and shows you a healthy behaviour. Because of the self organizing nature of the system, the modules looking permanent for the most effective way to deliver there data's. A loss and new within a minute is an indication, a module is not "happy" with his connection way and looks for an better way. Means, the currant way is not a bad or faulty way, but not the optimum.



The module No. 3374 is trying the best way and made the decision to go over the neighbour No. 3199 after using the 3318. This can be happened when the network environment changes, like a normal door is replaced with a steal door. The disconnecting time is only for a second.

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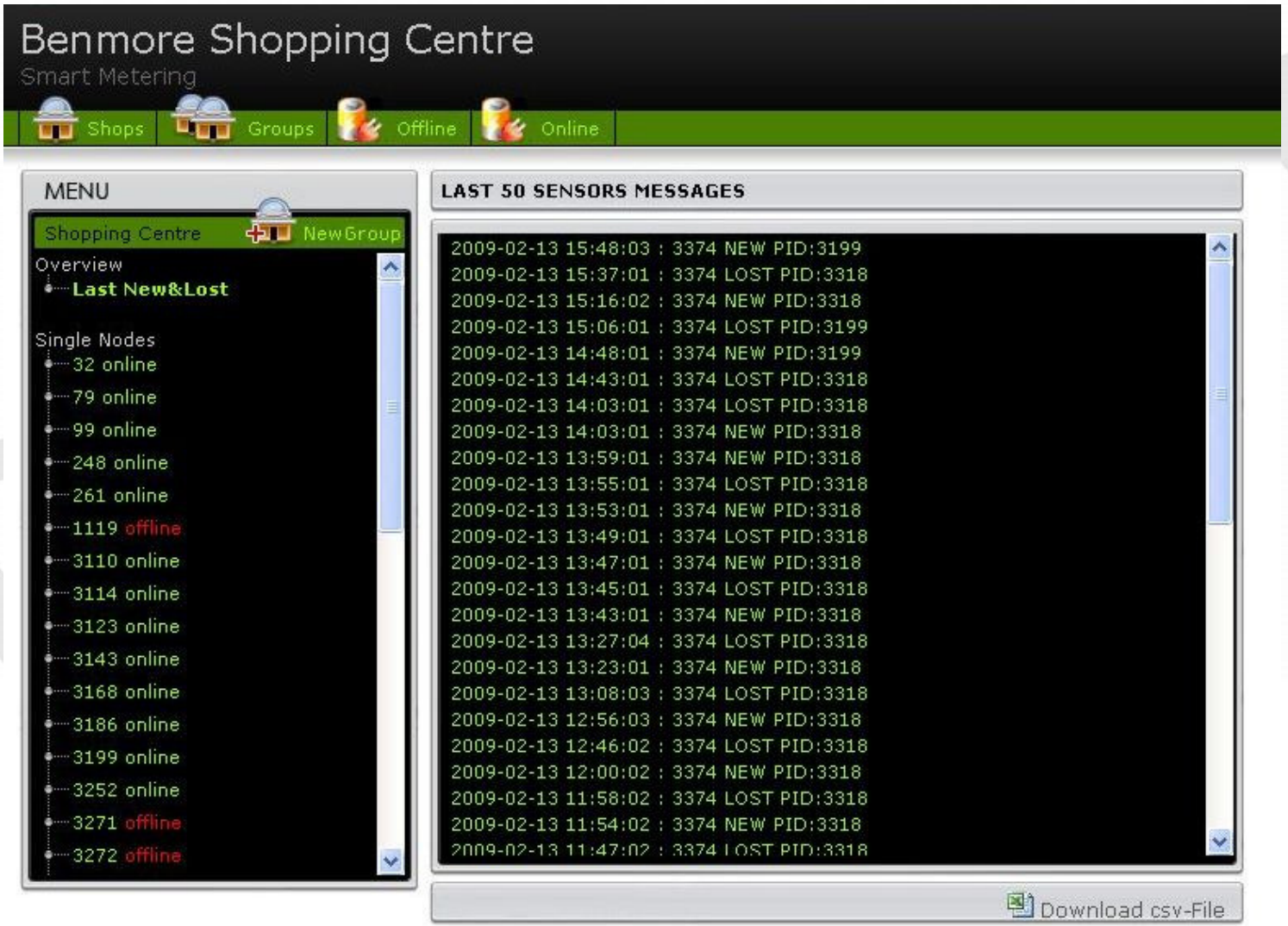
I-Energy – Network monitor



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I-Energy – Settings

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I-Energy – Preparing before start

The I-Energy software requires only a few, but important settings. A good decision is to collect some data before the implementation.

Information to collect:
- Floor plans of the building
-The places for the Power Distribution Boards
- Drawings from the electrical grid
-Names of the shops, offices and other places to control
-Important phone numbers

The installation of the modules and the setup for the software can be done independently. The control box with the gateway can be installed before the modules. It will be an ideal approach, because disturbances to the tenants or lessees will be very minimal, if you do all above upfront.

An announcement of the electricians visitations to the tenants is essential and will save a lot of time.

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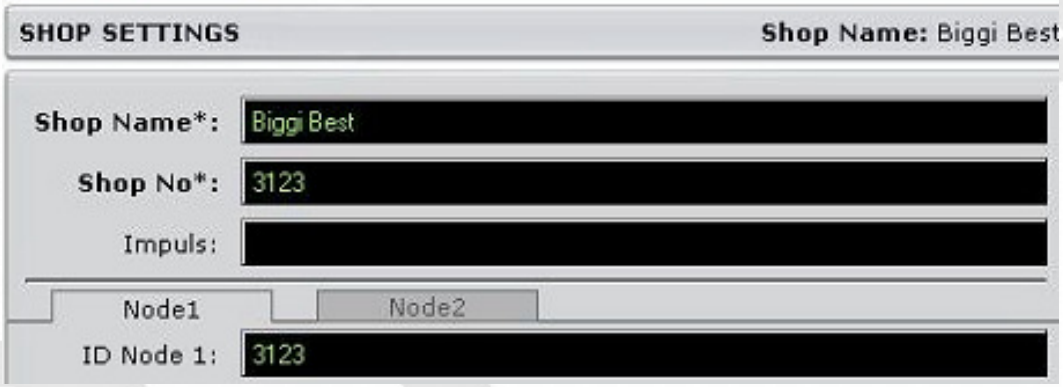
I-Energy – Shop settings

The shop settings are the main settings for the whole system. Every other software part takes this values as reference.



- Shop name refers to the name of the place.
- The shop number can be used to systemize the the installation. This can be the module number or a combination out of building number, section number and room number.
- The Impulse field field is to setup the right factor to count the pulse from the meter
- ID Node is the number of the module to link up this to the control box. This number is a unique number in your network. It is possible to setup more then one module for a shop or office.

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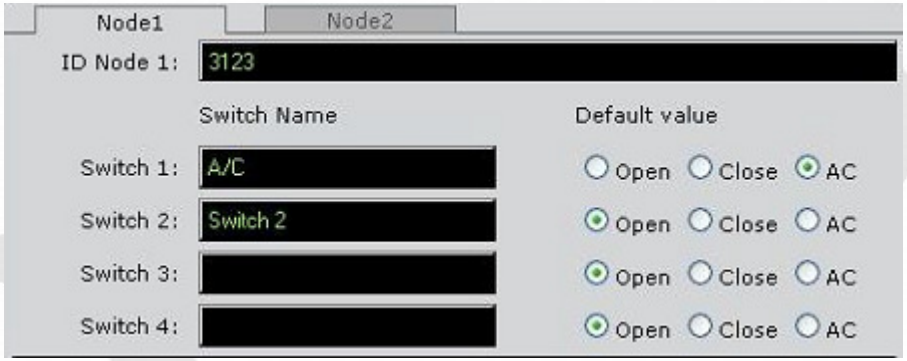
I-Energy – Shop settings switches

To setup the switches you have to allocate a name to that. If the name filed is empty, the switch will be not considered. The name will indicate the kind of device to switch and can also contain a serial number and any other information.



The default value indicates the condition after starting or restarting the module. This will indicate if a relay is normally closed or open. The AC button describes the main function of the module and is used to group the modules in general. The section can be extended with a button for Geyser, Lights, Emergency circuits or other power consuming products.

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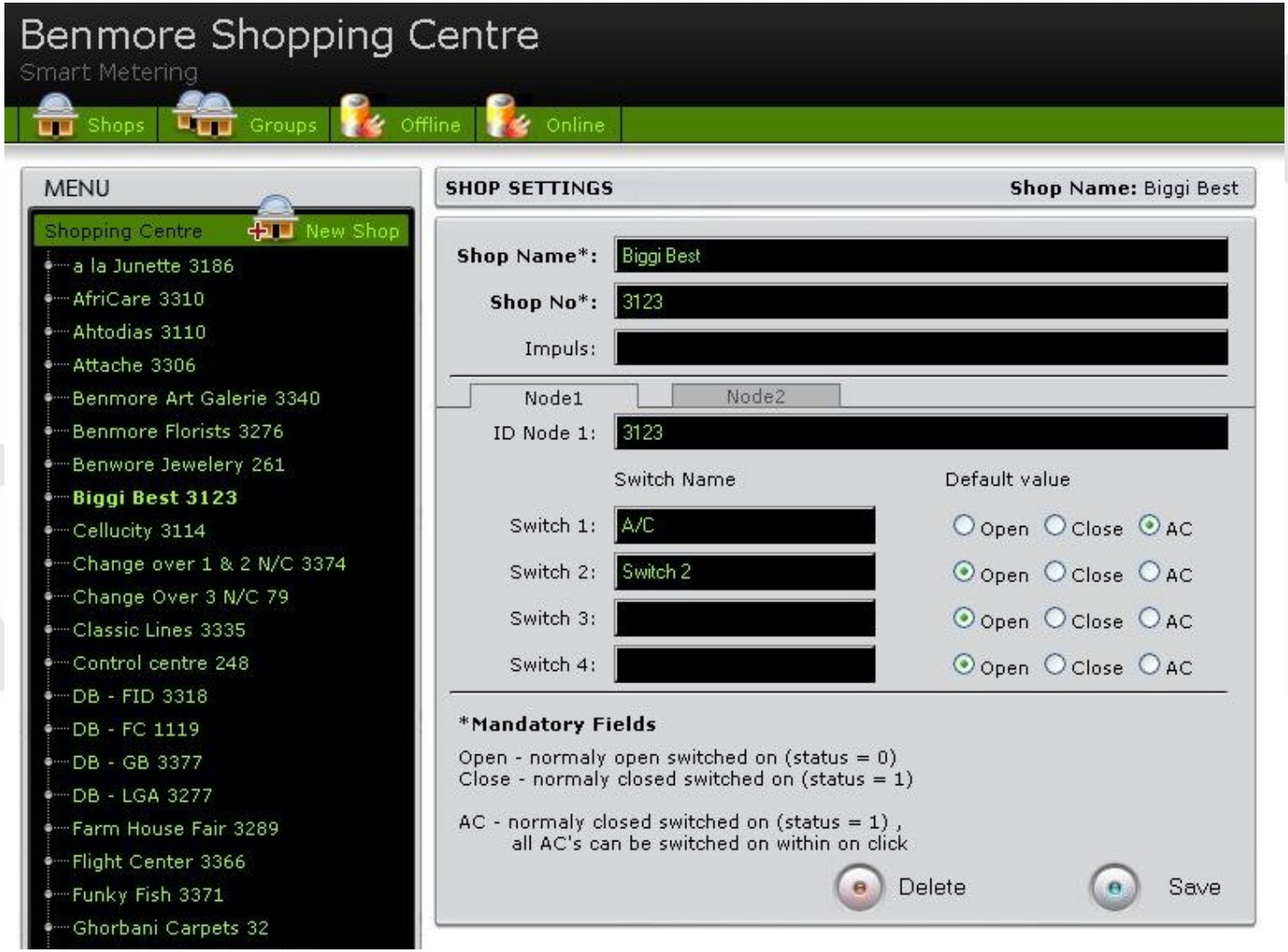
I-Energy – Shop settings



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I-Energy – User settings

User settings gives different users different rights to operate the system. The System Administrator is able to control the whole system (Level 99). The users with the Level 9 are administrators and they can also control every thing except the user rights. Centre Managers are able to do the daily work. He is prohibited to change the settings for Generator or the main DB's.

Lower levels allow the owner of a shop to control only his devices. It is also possible to give only reading rights, in order to supply / avail information when required.

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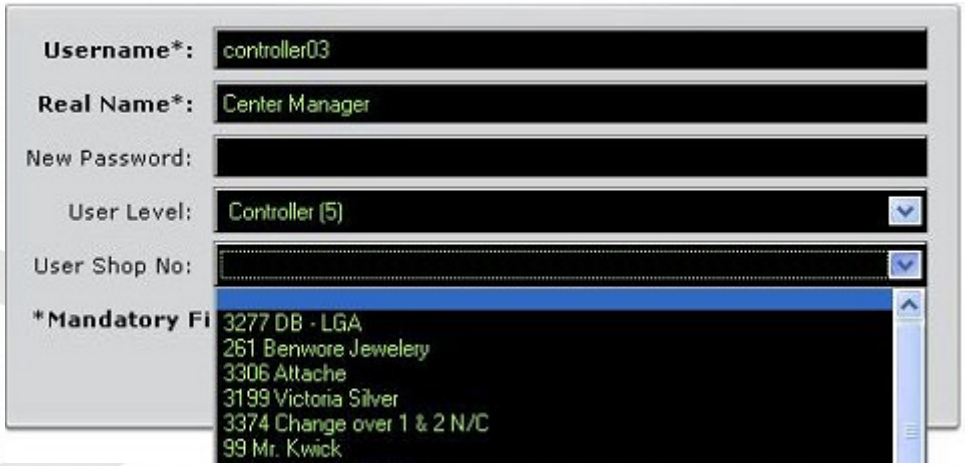
I-Energy – User settings

The username is a personal account name of an operator and is used to identify the person by login, password as per his allocated personal identification on the system.



- The user level assign rights to him.
- Shop number assigns the module to be controlled or monitored.

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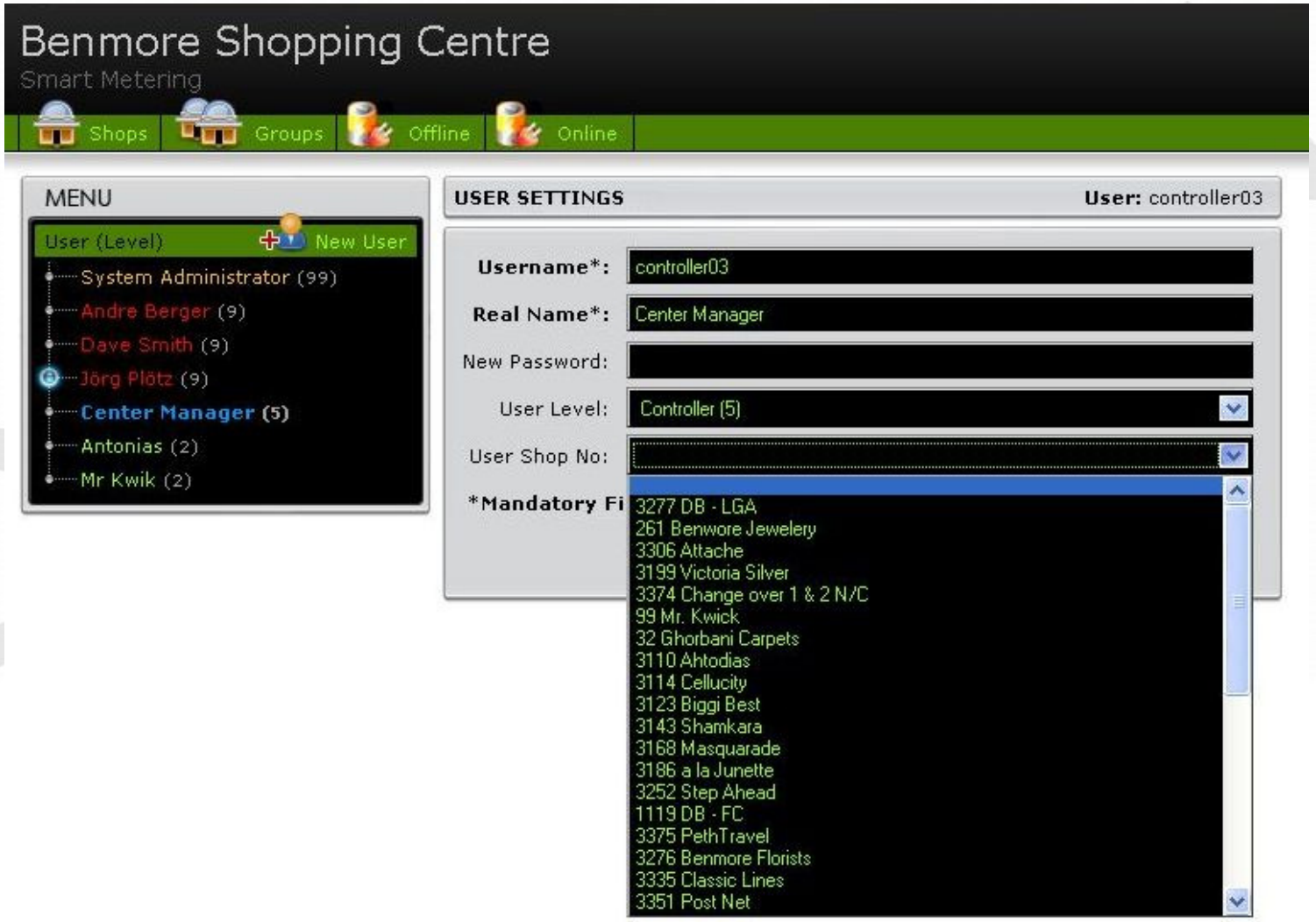
I-Energy – User settings



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I-Energy – Groups settings

- The groups are designed to control the system automatically during different conditions of the energy situations.
- You can create a matrix out of the modules and different actions will depend on times or events.
- In this matrix you are able to assign a module to one or more action plans.
- As an example: 255 different action groups, you are be able to create a high sensitive adjustment for your power management.
- This section is still undergoing continuous research & development for further improvement and an automatic update will be provide to all customers through a maintenance contract - (SLA).

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I-Energy – Groups

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I-Energy – Groups settings

The groups can be designed for different actions like: the power loss from the public grid, different energy saving modes, day modes, night modes, summer and winter modes, maintenance modes or different modes controlled by different environment conditions.

Each group contains different dependencies for different modes together with other groups

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I-Energy – Groups settings

To define a group, a name and a group number has to be allocated. The power loss field describes the condition of the module during the power loss. Through the delay field , you can control the switching times in order to prevent switching all devices at the same time.

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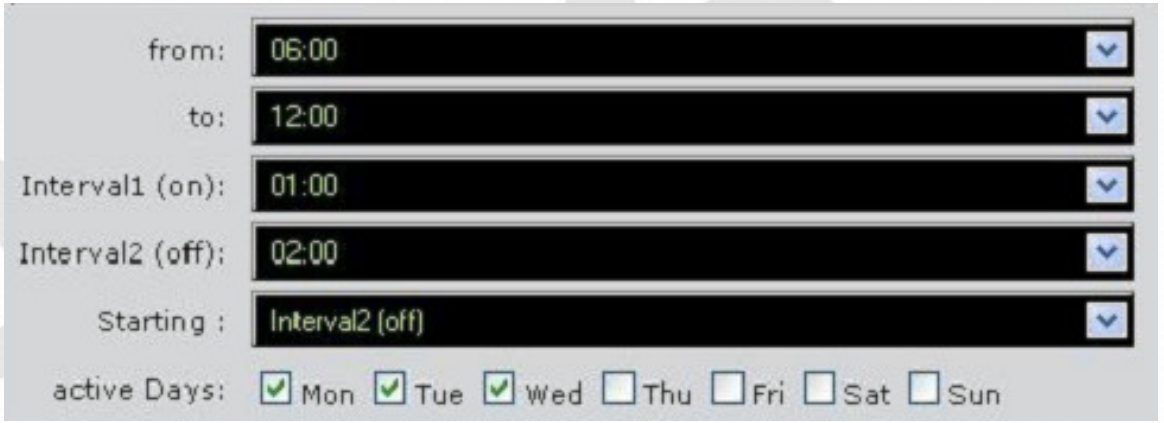
I-Energy – Groups settings

For different power saving modes, you can define groups, so that they automatically run at specific times for a limited/specified time period.

The activation of this group can be assigned / determined for any preferred weekdays.



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I-Energy – Group settings

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I-Energy – Generator settings

This section is the controlling part/section of Generators and main switches for a power loss situation. Most of the actions are automatically controlled. But for some reasons one is able to interact.

As an example: If the power stays off from 15H00 in the afternoon up to 12H00 midnight. You can switch off all sections like banks or other shops since they are closing at latest from 18H00 to save Generator Diesel. During the weekends, you can further switch off these sections from 15H00.

The controlling of a Generator and Substation Main switches are special customer requirements and is normally not part of the standard system.

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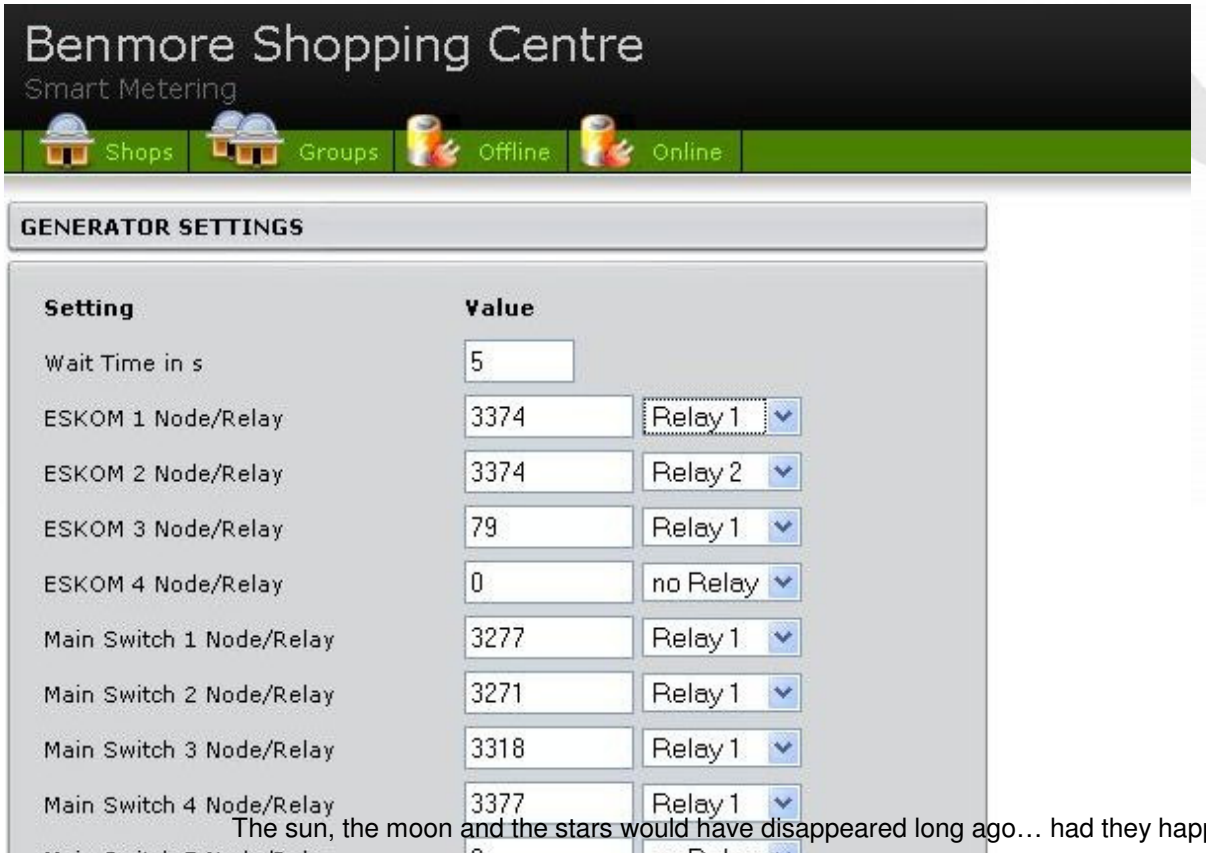
I-Energy – Generator settings



The sun, the moon and the stars would have disappeared long ago… had they happened to be within the reach of predatory human hands.

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Appendix

What is load shedding?
Eskom Glossary

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What is load shedding?

Eskom's business is one of supply and demand. Its customers demand power every time they switch on an electrical appliance, or light switch, and Eskom supplies the power to meet that demand. For a full 24 hours, every day of the year Eskom's system controllers must supply the national grid with just enough electricity to meet the demand.

Power users such as steel producers, aluminium smelters, mines, cities and agriculture are all sources of load to the system controllers. On a typical weekday, load starts increasing from 02:00 – two o'clock in the morning, climbing steadily as people wake up, get ready for work and open shops, offices and factories. Between 06:00 and 09:00 the system experiences its morning peak load, when the demand can get close to the available capacity.

Then the load eases off until the afternoon peak, which usually starts around 16:00, when people get home and entertainment centres come to life. In summer air conditioners and in winter electric heaters form a heavy load. And all the time the ubiquitous geyser silently gobbles up electricity, keeping its load of water hot. Unless it has an insulating blanket, the geyser uses more electricity in winter than in summer because it loses heat through its metal walls.

Winter is also the time when the morning and evening peaks get higher every year, bringing the demand closer and closer to the supply. Usually the supply is adequate and the peak passes without incident.

Occasionally, however, problems arise. A huge turbo-generator in a power station develops a fault and "trips" – shuts down, no longer contributing to the supply, as happened to one of the Koeberg units recently.

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When this happens, load exceeds supply, and the load has to be reduced to a point where the available capacity can handle it, otherwise the result for the whole system could be serious. So the system controllers “shed some load” – they switch off the supply to various customers for a short while.

Eskom has contracts with some large power users that allow it to do this. These customers can cope with being switched off, as long as the interruption does not exceed specified periods – say 30 minutes. Usually that is enough time for total demand to ease a little and for the problem to pass.

If not, Eskom must switch off another large user and restore power to the first. Occasionally, when demand goes unexpectedly high, cities suddenly become victims of load shedding. In most cases this does not last longer than two hours.

Eskom follows certain principles when implementing load shedding. Load shedding is done on a rotational basis, limiting it to two hours per area. Where possible, Eskom tries to avoid load shedding in areas where there are critical and sensitive services like hospitals, economic hubs like shopping centres, strategic product areas and high security areas.

So, if your lights go off unexpectedly, it might be a local fault affecting a comparatively small area around you, or it might be a problem at a power station that takes time to fix.

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< less than

≤ less than or equal to

> greater than

≥ greater than or equal to

A ampere

c cents

c/kvarh cents per reactive kilovolt-ampere-hour

c/kWh cents per kilowatt-hour

GWh gigawatt-hour

kVA kilovolt-ampere

kvarh reactive kilovolt-ampere-hour

kV kilovolt

kW kilowatt

kWh kilowatt-hour

MVA megavolt-ampere

N/A Not applicable

NER National Electricity Regulator

PF Power factor

R Rand

R/kVA Rand per kilovolt-ampere

R/kW Rand per kilowatt

TOU Time-of-Use

V volt

VAT value added tax

W watt

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Energy charge: A fixed or time and/or seasonally differentiated charge linked to each kWh (unit of energy) consumed.
Service charge: A fixed charge payable per premise every month, whether electricity is consumed or not. It is a contribution towards fixed costs such as meter reading, billing and meter capital.
Billing period: The period that stretches from one meter reading date to the following meter reading date.
Connection fee: The minimum, one-off, up-front payment for new or additional capacity.
Demand charge: A R/kVA or R/kW charge which is time and/or seasonally differentiated and is applied to the chargeable demand registered during the month.
Key customer: Typically a customer under a common management structure that uses a minimum of 5 GWH of electricity on a contiguous site in any 12 consecutive months.
Reactive energy charge: This charge is applicable to Time-of-Use. It is levied on every kvarh which is registered in excess of 30% of the kWh supplied during the specified periods of the month. There is no reactive energy charge for a customer operating with a power factor of 0, 96 or better. The method of calculating this excess differs and is described with the respective tariff.