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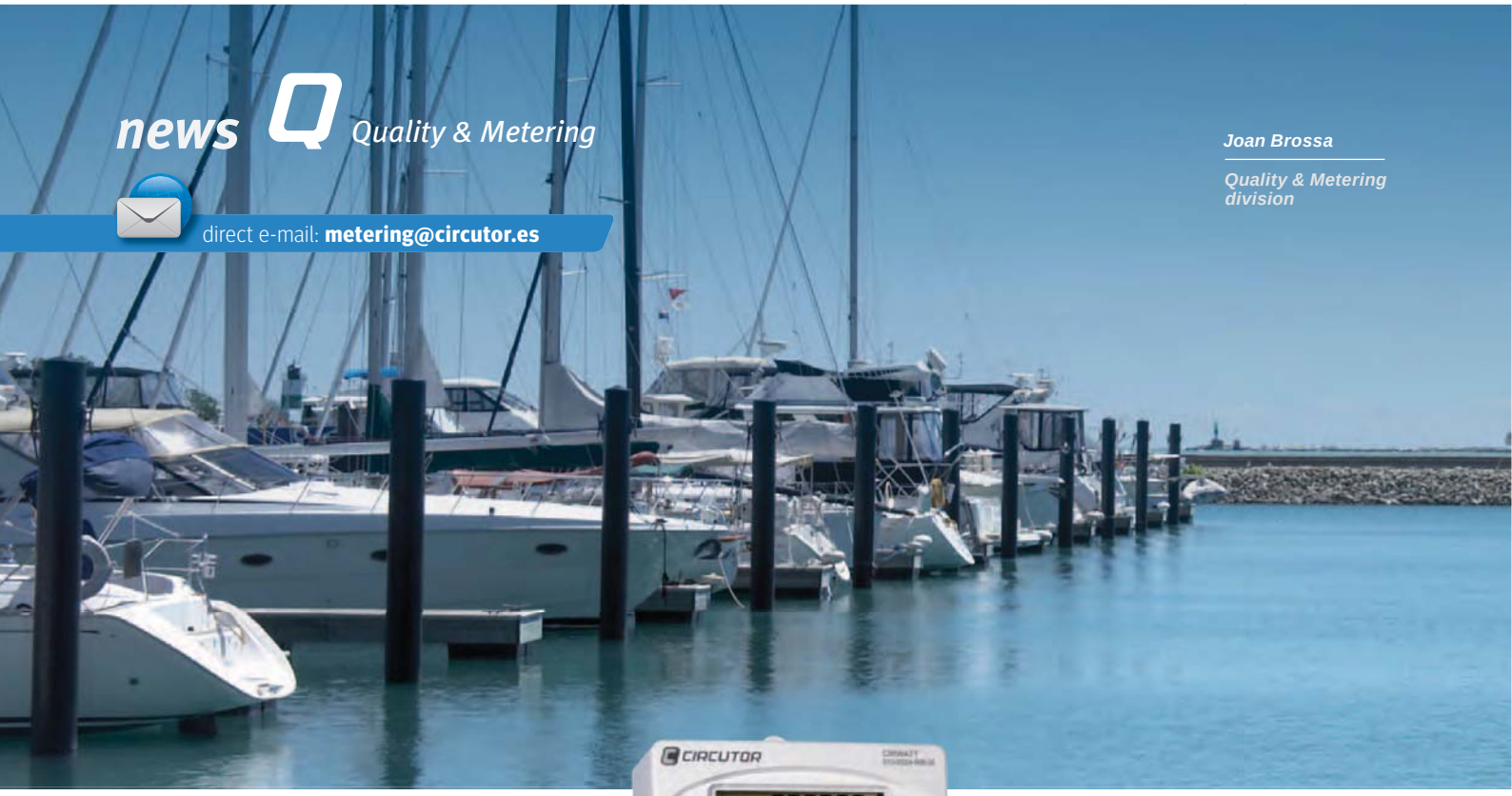


Pre-paid energy meters

An efficient energy management tool

Pre-paid systems are becoming a useful energy management tool in countries with emerging economies in which there is a need to reduce fraud, and are an efficient solution for controlling consumption in marinas and camp sites.

In many cases, end users prefer pre-paid energy, as, from an economic point of view, it helps them better manage their finances.

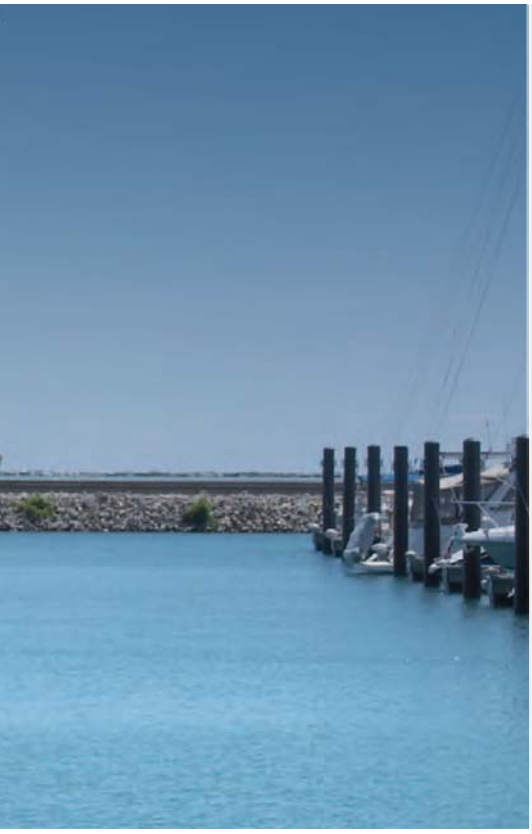
CIRCUTOR has opted to use RFID technology, which it already uses in its electric vehicle charging systems. Compared to other options like the numeric keyboard, it uses smart cards, which Circutor considers to be a simpler and more robust system.
The first pre-paid systems appeared at the beginning of the last century, and their operation was linked to the mechanical energy meters that were used at that time. Coins were inserted into a slot, turning it and sending the coin down into the coin box located at the bottom of the device. A spring located in the top of the pre-paid device would increase the energy meter credit by one unit. As the rotor turned, the main spring gradually unwound, and when it reached zero a switch lever was tripped, opening the circuit through the energy meter.

From these devices offering solutions based on mechanical designs to the current electronic meters, a technological leap has been made that allows us to offer compact and robust solutions.

The main advantages provided by pre-paid systems from the user point of view are as follows: They improve management of the family budget; they are easy-to-use systems; they prevent debt creation; there are no monthly bills; there are no errors in reading energy logs. In addition, pre-paid systems provide information on energy consumed and credit available, enabling good management of energy consumption.

This type of system also entails a number of significant benefits to utilities: The use of pre-paid systems facilitates collecting energy payments; operating costs are lower because, for example, regular consumption readings are not necessary; and, lastly, one of the key points is improved fraud control. One of the most important features of pre-paid systems is security. CIRCUTOR has included an encryption system in this new family of energy meters known as the AES-128.

The AES (Advanced Encryption Standard), a Federal Information Processing Standard (FIPS), is a cryptographic algorithm that can be used to protect electronic information. The AES algorithm can encrypt and decrypt digital information. The AES



- Credit mode.
- Energy dispenser mode.

In **pre-paid mode**, the energy meter functions as a conventional pre-paid device. The balance (kWh) is loaded onto the energy meter using the RFID card. When the balance hits zero, the energy meter opens its internal circuit breaker and does not close it until the card is topped up with a new balance, purchased beforehand by the customer. There is also a mode that lets users recover available credit to later load it onto another device.

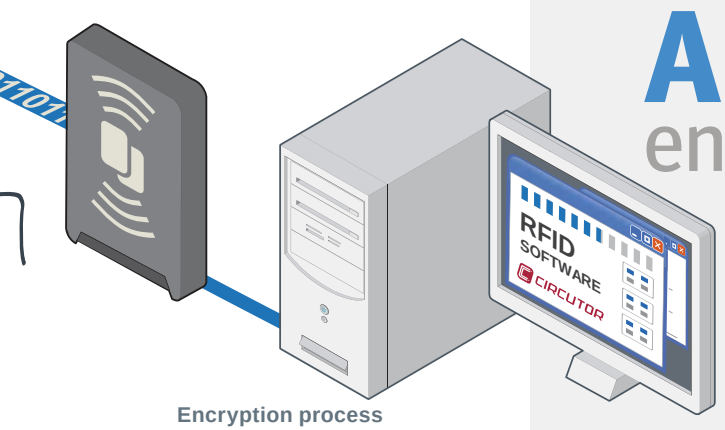
In **credit mode**, the user initially loads a credit expressed in days onto the energy meter, using the RFID card. During this period they can consume energy freely, saving their consumption in the appropriate log for each active tariff depending on the programming. The contract has an expiry date, corresponding to the days elapsed since the last charging.

as camp sites, utilities where it is difficult to collect energy payments or marinas.

Pre-paid mode with recovery: For installations where customers wish to bill for electrical energy up front and to be able to transfer the electrical energy to another energy meter, such as for example utilities in which it is difficult to collect energy payments in second homes, marinas when switching from one mooring to another or in charging electrical vehicles

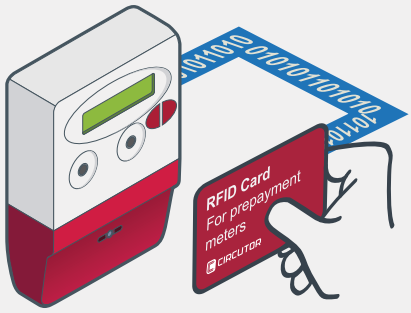
Credit mode: For installations where subscribers are made to regularly visit the charging centre to check their supply. It could be a good solution in managing extended-stay camp sites and marinas, and like the aforementioned modes it can be used to facilitate payments to utilities.

Dispenser mode: This operating mode is designed to facilitate the management of Smartgrids (an intelligent network able to interactively balance



Encryption process

AES encryption



Decryption process

algorithm can use 128-, 192- and 256-bit cryptographic keys.
In June 2003, the National Security Agency (NSA) of the United States announced that AES-128 can be used for information classified as SECRET and AES-192/256 for documents at the TOP SECRET level.

The information exchanged between the management software, responsible for recording and reading the cards, and the energy meters, responsible for managing energy consumption based on available credit, is encrypted using AES-128.

The energy meter series developed by CIRCUTOR has three operating modes:

- Pre-paid mode, with or without credit recovery.

Periodically, the user must swipe the card through the energy meter's reader, where the consumption by tariff to date is recorded. Once the consumption is loaded onto the card, the user can pay for the energy consumed.

In **dispenser mode**, the customer contracts consumption in kWh, with a daily maximum and a validity period (in days), which are loaded onto the energy meter with the RFID card.
These are some of the typical applications of the pre-paid energy meters' different operating modes.

Pre-paid mode without recovery: For installations where customers wish to bill for electrical energy up front, such

consumption and generation for any energy source, transforming it for end use by a consumer), with the most common example being controlling own consumption in small installations.

With this new series of pre-paid energy meters, CIRCUTOR aims to introduce a robust and competitive solution to the market, answering energy management needs.
With the introduction of pre-paid energy analyzers, CIRCUTOR completes its range of energy meters made up of residential and industrial energy meters and the PRIME telemanagement system. ◗