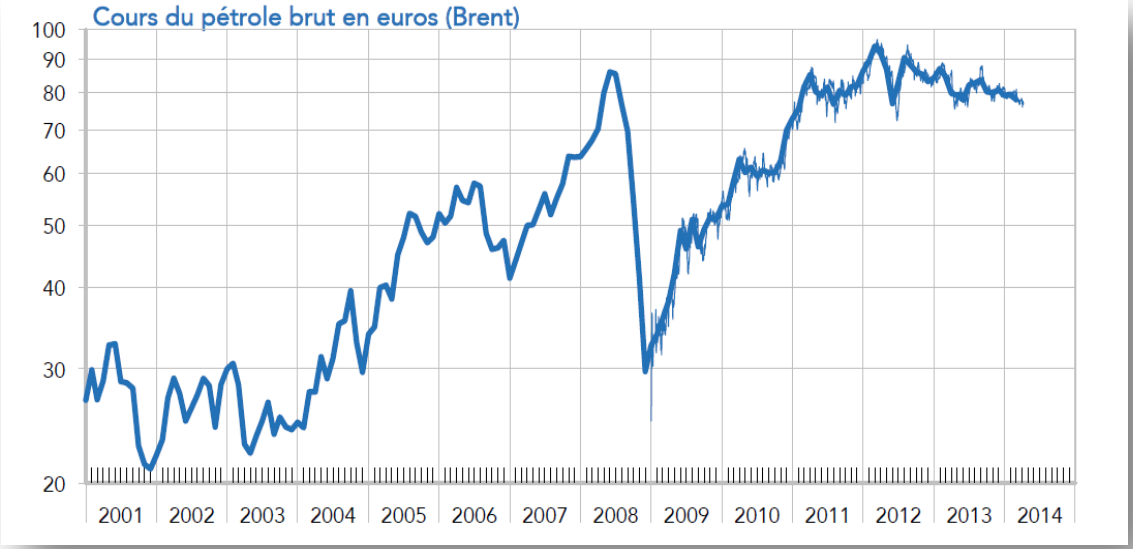
Eco-efficiency

Eurotherm®

by Schneider Electric

Why Eco-efficiency

- **As a premium brand, Eurotherm is keen on promoting value added solutions for industrial customers.**
- **Today the key challenge for our customers is the cost of energy, Oil, Gas and electricity. For instance the price of the Brent was multiplied by 3 (from 25€ to more than 80€) during the past twelve years and the trend recently is from mid 20's and is now late 40's and rising**



Why Eco-efficiency?

- **For instance a furnace will cost more in energy consumption than its capital cost.**
  - **Cost of a Glass Boosting 3MWatt = 300k€.**
  - **Average consumption 2MWatt / 24h / 365days / 1year :**
    - **Contract = 246.000€**
    - **Power Consumption = 2.190.000€**
    - **Cost of 1kWh = 10ct€**
- **If we save 10% on the Energy bill, the payback of the boosting system will be less than 18 months.**
  - **10% of Saving means 328.500€ of saving after 18 months**
  - **The furnace will last more than 12 years :**
    - **Total payback = 3.942.000€**

What is Eco-efficiency ?

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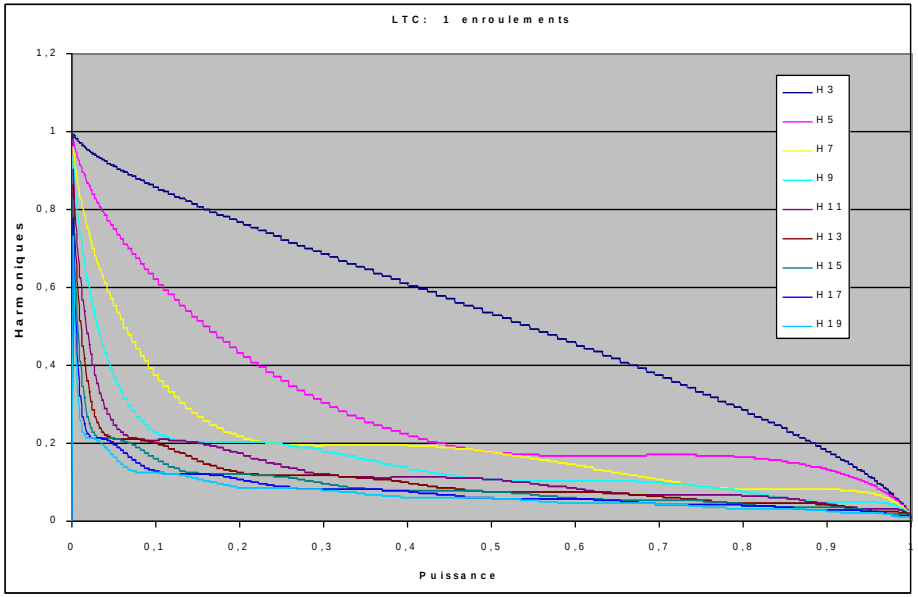
Our strategy for eco-efficiency

- During the past years, the Power Applications Department has developed new power management solutions on Boosting, Furnaces and Bushing applications.
- The goal of these developments was to reduce the cost of ownership through efficiency improvements and the capital cost through the improvement of the power line design.
- Our strategy is based on Power Factor and the THDI (Harmonics) improvements through the promotion of the burst firing mode or the Load Tap Changing instead of the Phase Angle mode.



Our strategy for eco-efficiency

- The concept was validated on many applications where the heaters are driven by a Thyristor in phase angle mode through a transformer.
  - Bushing : The Thyristor drives a primary side of a transformer and the secondary side is connected to the Bushing plate.
  - Glass Boosting : Through a transformer, the Thyristor drives the electrodes diving into the molten glass.

  - **Heat treatment and Vacuum furnaces : The Thyristor controls the primary side of the transformer and the secondary side is connected to the heating elements.**

EPower : A revolution in the power management

- FLEXIBILITY : A unique product that fits all the applications
- PEACE OF MIND: Reliability, an efficient control of the process
- EFFICIENCY : Energy cost reduction and optimisation of the owner cost thanks to new functionalities :
  - Burst Firing
  - PLM (Predictive Load Management)

Burst Firing and Eco-efficiency

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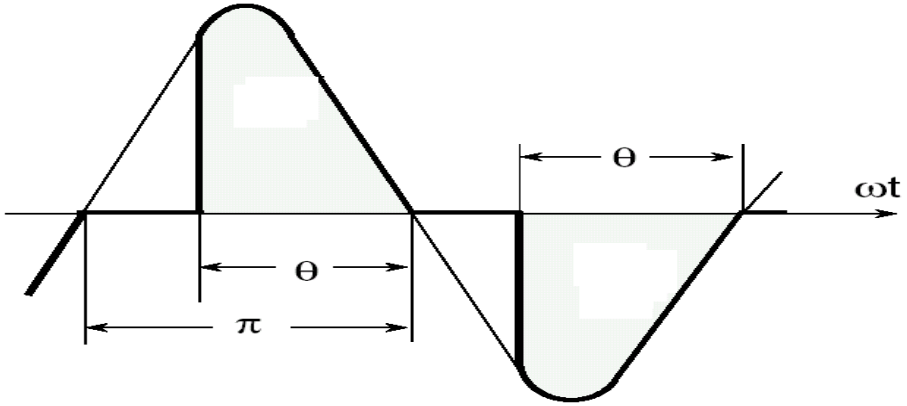
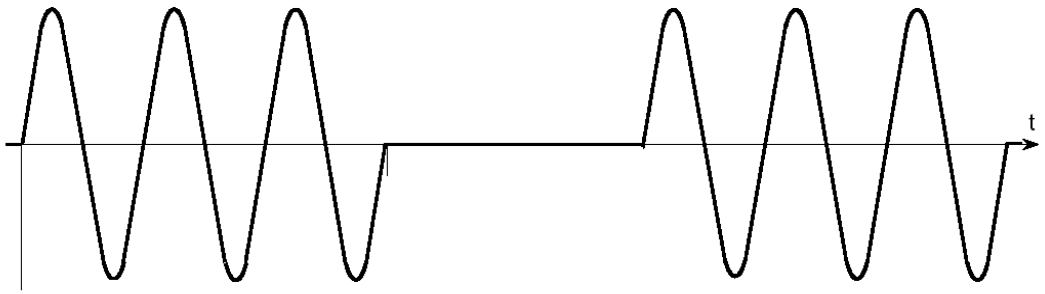
Phase Angle mode



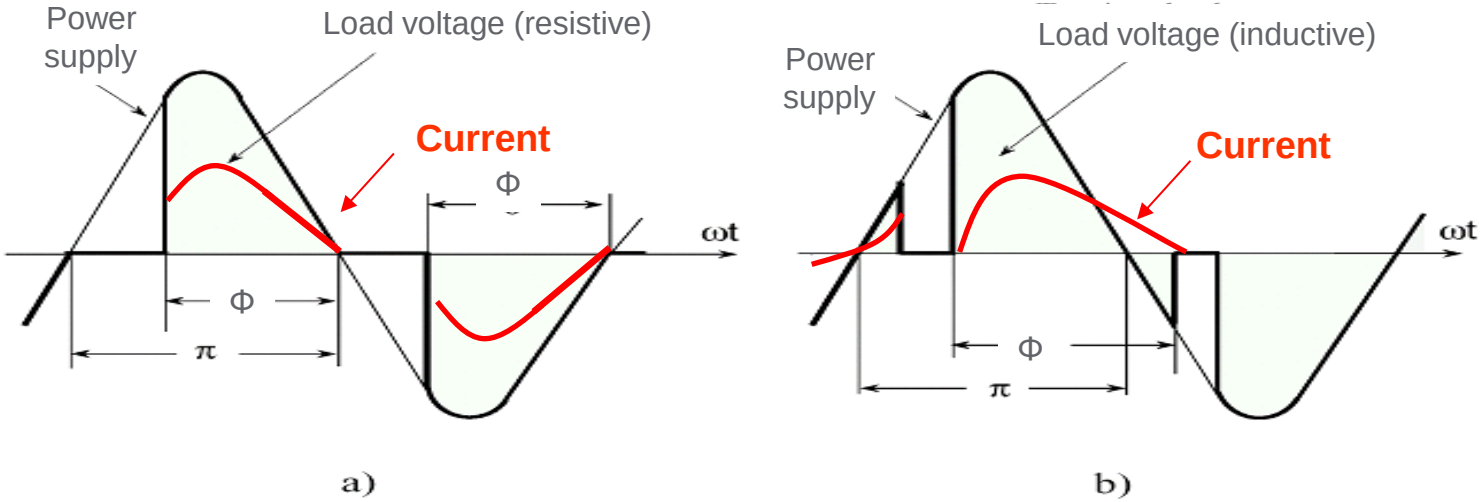
- In phase angle mode we cut the sinus voltage delivered by the grid.
- The energy delivered to the load depends on the delay : ∏ - θ.
- The Phase Angle mode impacts the Power factor.
- The Phase Angle mode generates harmonics
- ***<u>The Phase Angle has an impact on the power factor</u>***

Burst Firing mode



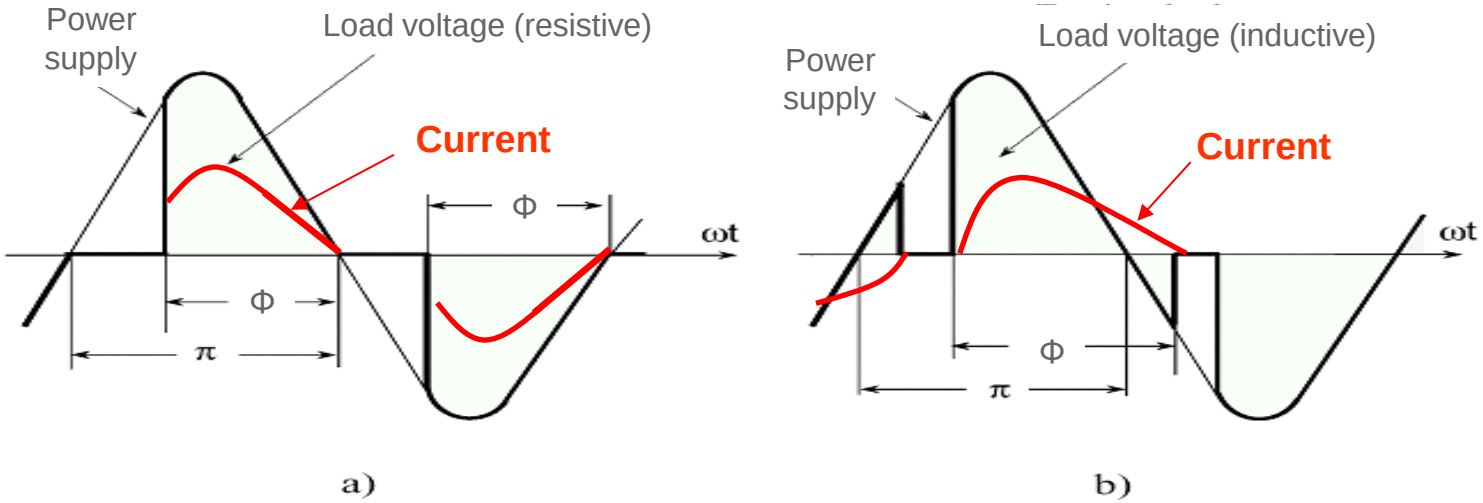
- In Burst we consume the full sinus delivered by the grid.
- The energy delivered to the load depends on : Ton / (Ton + Toff)
- The burst mode doesn’t impact the Power factor
- The burst mode doesn't generate harmonics
- ***The Burst Firing mode has a no impact on the power factor***

Power factor and Tan(fi)



- The phase angle firing mode has a direct impact on the power factor and the tan(fi).
- The energy providers apply penalties when FP < 0.93 or Tan(fi) > 0,4
- A process running in Phase angle mode needs to use capacitors in order to improve the power factor and the Tan(fi).
- ***The Burst Firing mode has a no impact on the power factor***

Impact on the efficiency



A Phase angle firing mode has an impact on the efficiency:

- Loss in transformer efficiency (Joules and Hysteresys losses)
- Integration of the capacitors losses (Power factor improvement).
- Heating of the Wires
- Reduction of the life-time of the installation

PLM and
Energy efficiency

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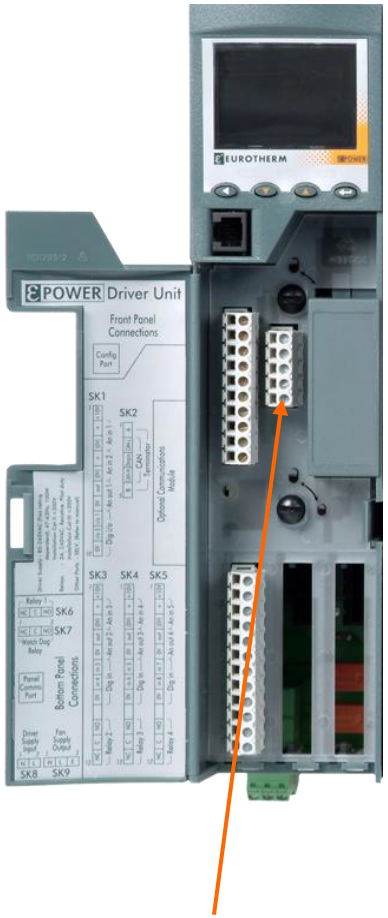
PLM – Predicitive Load Management



Predictive Load Management Module

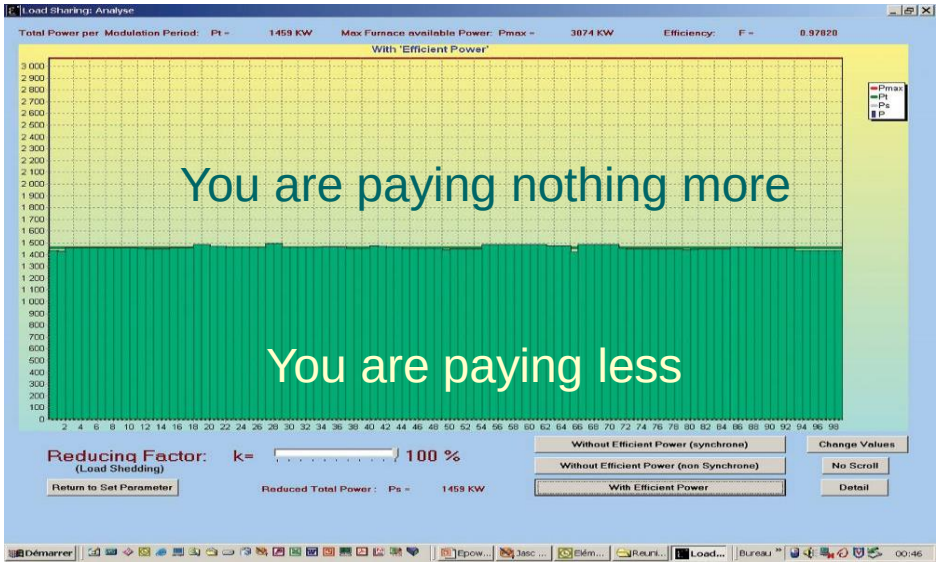
- ENERGY EFFICIENCY
  - Load sequencing
    - ➢ Energy where you need it
  - Load sharing (power smoothing)
    - ➢ Energy when you need it
  - Load shedding
    - ➢ Energy where and when you need it
  - Energy counter
  - Up to 64 zones
- AUTOMATIC CHOICE OF THE MASTER AND REDUNDANCY
- Reliability insured

PLM – Typical power demand

Energy where you need it but <u>not when</u> you need it

- Still power demand peaks
- The average power consumption is below the maximum power
- The energy bill depends on the time, the season and your power contract

PLM : a revolutionary power management



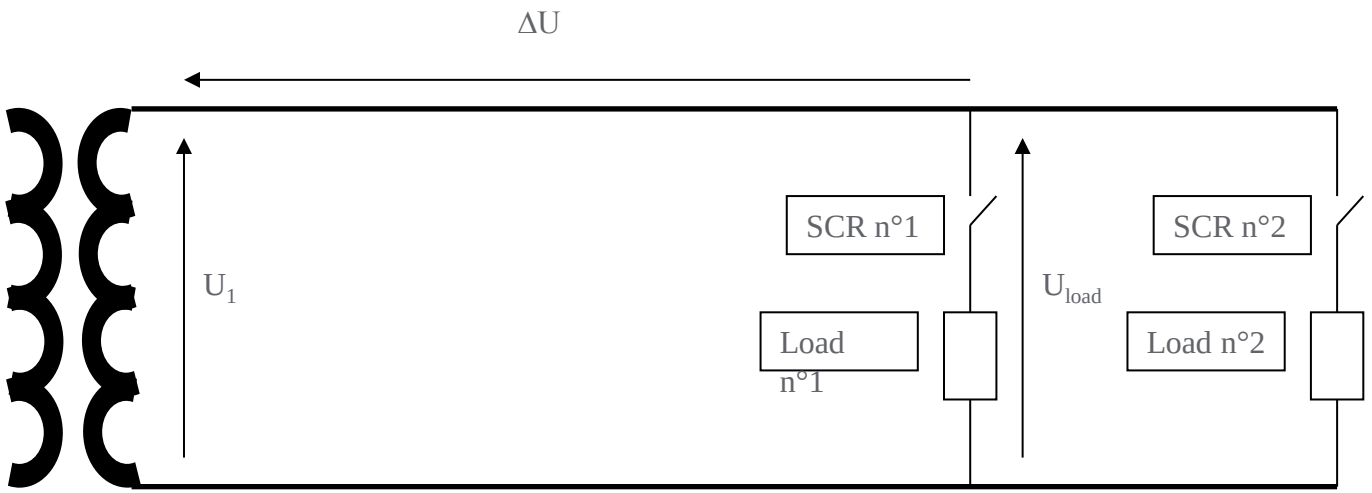
Energy where you need it <u>and when</u> you need it

- The suppression of the power peaks demands enables to reduce the fixed part of your energy bill
- the dynamic modification of the power limitation enables to reduce the variable part of your energy bill

PLM and Eco-efficiency

The firing synchronization of the different channels generates a smoothing of the power consumption. This feature impacts favourably the global efficiency of the process.

How ? : by reducing the heating losses in the electrical equipments , like cables, TGBT, transformers…etc**.**



PLM and Eco-efficiency

Why? : because it is better to consume at equivalent power, a current equal to 'I' during a 'T' period instead of a current equal to '2xI' during a 'T/2' period .

Effectively, the heating losses in the resistive components (cables, transformers…etc.) are proportional to the square of the current :

- $Pj1 = R \times I^2 \times T$
- $Pj2 = R \times (2I)^2 \times T/2 = 2 (R \times I^2 \times T)$
- => $Pj2 = 2 \times Pj1$