

ENESCO industrial

Industrial **E**nergy **E**fficiency **S**ervices & **C**ombustions **O**ptimizations

Iasi, Str. Friederick, Nr. 6
RO 33132962,
J22/781/2014

Waste heat recovery from industrial processes: potential, advantages, costs

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Heat consumption in industry

| Use of heat in industry | The main heat consumers in industry |
|------------------------------|------------------------------------------------------------------------------------------|
| <u>Technological heating</u> | <u>Industrial units that use heat for steam drives</u> |
| <u>Space heaters</u> | <u>Industrial units and installations where heat is used for technological processes</u> |
| <u>Hot water preparation</u> | <u>Heating, ventilation, air conditioning and hot water supply systems</u> |
| | <u>High temperature processes</u> (500 °C – 1000 °C) |

The concept of energy conservation in industry

Energy conservation in industry involves:

- Increasing energy efficiency under the conditions of a given technology, through increasingly elaborate and improved technological modifications from an energy point of view;
- Changing technologies and resorting to more efficient technologies from an energy point of view;
- A shift towards a fuel mix that allows for the reduction of the use of scarce fuels (generally more expensive), respectively hydrocarbons, in favour of more abundant fuels (generally cheaper);
- Substituting the use of scarce fuels for energy purposes with new energy sources;
- A wide range of technical and organizational measures adapted to each category of technological consumers.

In the industrial sector, the requirement to reduce energy demand by increasing energy efficiency is increasingly being imposed.

Economic and energy efficiency of energy conservation in industry

Economic efficiency

- *Economic efficiency requires that the effect (result) exceed the effort (expenditure).*

Energy efficiency

- *Energy efficiency involves reducing specific energy consumption and increasing the level of labor utilization.*

- Energy conservation should not be an end in itself - both consumers and society can obtain important benefits if they approach it rationally.
- The promotion and implementation of energy conservation always starts from the need to identify these benefits, in their physical, economic and social dimensions.

The economic efficiency of energy conservation in industry

- *Economic efficiency represents the final threshold for verifying all types of efficiency, given that it outlines the framework for sizing the efforts that an industrial enterprise can make, as well as the effects obtained by using the allocated resources.*
- *It can be concluded that improving the performance of an industrial enterprise is achieved mainly based on reducing manufacturing costs. One of the methods of achieving this goal is to consume less energy for the same purpose and to use cheaper energy.*
- *An exchange of ideas with companies specialized in increasing energy efficiency in industry will always benefit users.*

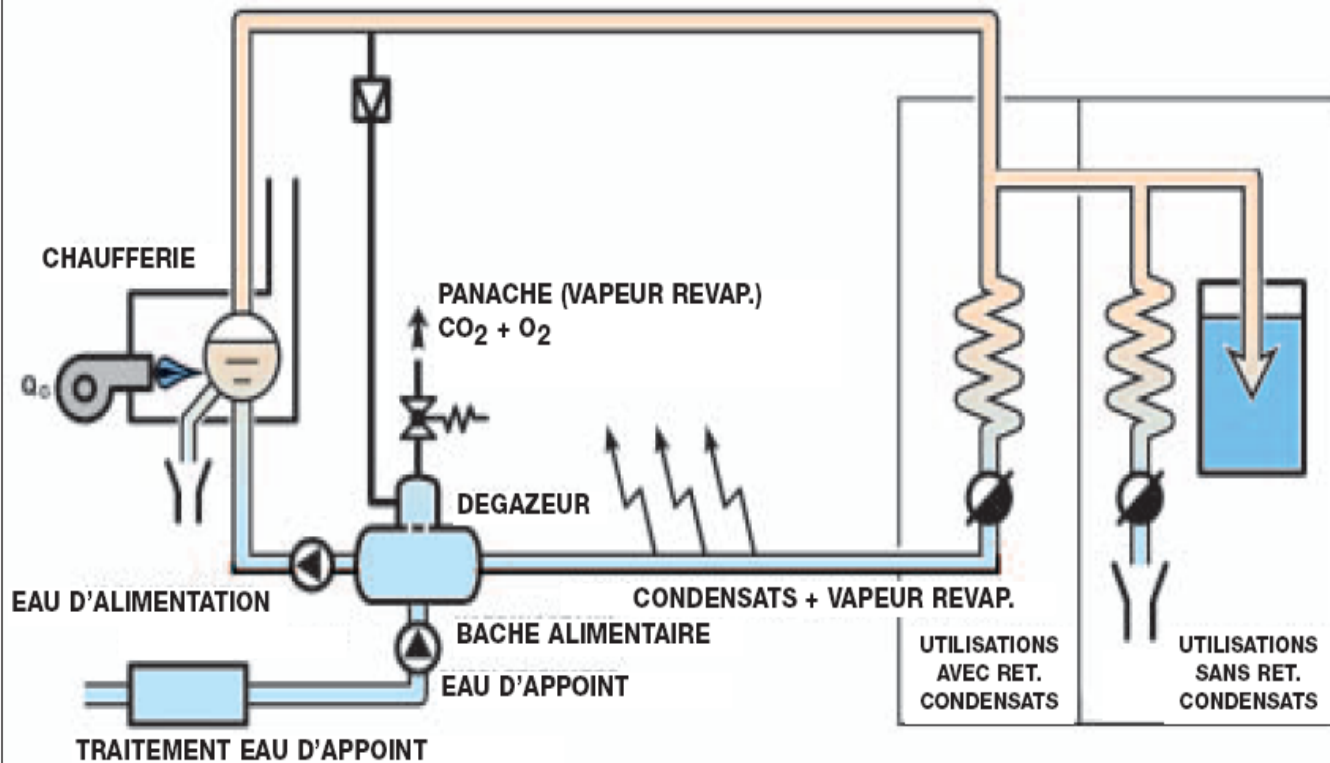
The credibility of any energy optimization measure and implicitly the decision to implement it has as key factors the price of energy (reduction of energy expenses) and the possibilities of purchasing fuels.

Energy efficiency of energy conservation in industry

Centralized heat (steam) production in industry

The classic way to ensure the heat requirement in industry is:

Fig. 5: Schéma type d'un réseau de distribution de vapeur



- Heating a thermal agent (steam, superheated water, diathermic oil) in a boiler to the desired temperature;
- Transporting this fluid through a distribution network to the consuming facilities;
- Transferring heat to users;
- Partial or total return of the fluid to the boiler.

Energy efficiency of energy conservation in industry

Yields:

$$\eta = \eta_c \cdot \eta_d \cdot \eta_u$$

$$\eta_c = \frac{\text{Net heat at the boiler outlet}}{\text{Heat of combustion}} = \frac{Q_1}{Q_g}$$

$$\eta_d = \frac{\text{Net heat available to the user}}{\text{Net heat at the boiler outlet}} = \frac{Q_2}{Q_1}$$

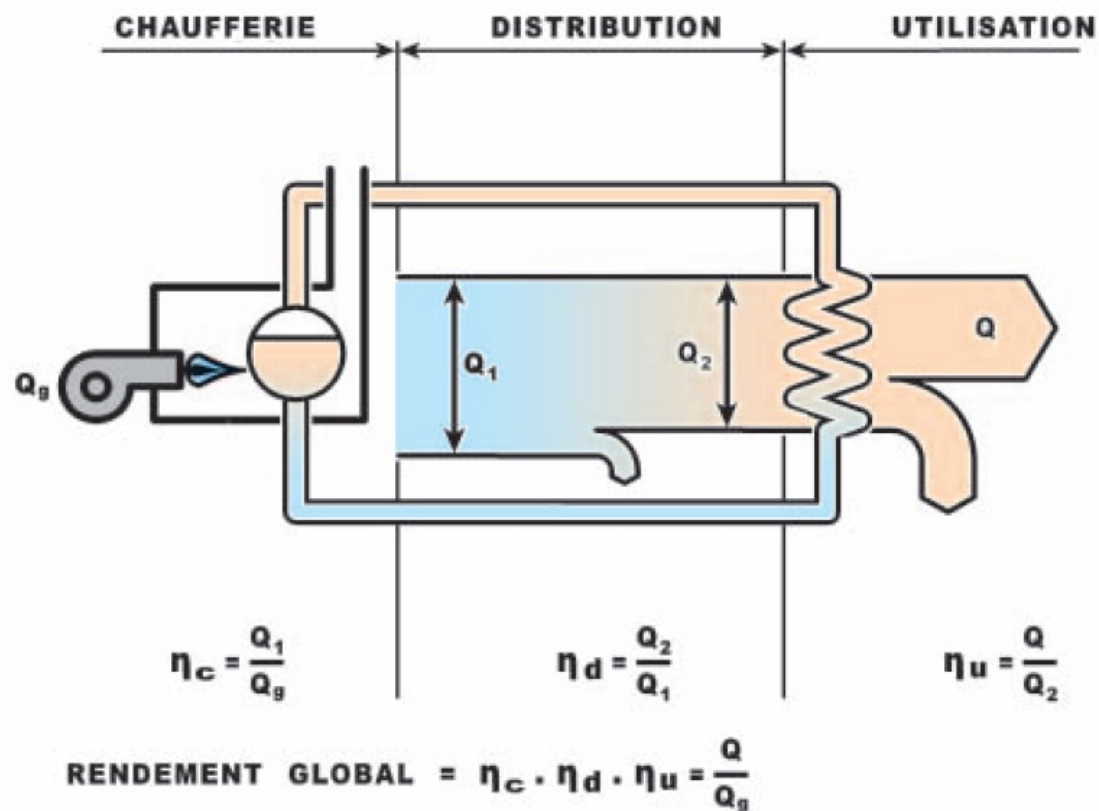
$$\eta_u = \frac{\text{Useful heat for the user}}{\text{Net heat available to the user}} = \frac{Q}{Q_2}$$

$$\eta = \frac{\text{Useful heat for the user}}{\text{Heat of combustion}} = \frac{Q}{Q_g}$$

In a favourable case we would have :
 $\eta_c=0,92$, $\eta_d=0,91$, $\eta_u=0,95$.

This gives an overall yield of 80%, which is exceptionally good.

Fig. 6: Rendement global d'un système centralisé de production de vapeur



Heat losses in industrial processes

Heat losses in thermal power plants

Flue gas losses (10 %)

- Depends on the type of fuel, the excess combustion air and the smoke/combustion air temperature difference ($T_f - T_a$)

Convection and radiation losses (2-5 %)

- They depend on the temperature and surface area of both the boiler and all the containers installed in the plant.

Internal losses (1,5-3 %)

- It is due to the suction of cold air that passes through the boiler while the burner is off.

Purifications
(0,2 %)

- Necessary to reduce the salt concentration in the boiler water

Heat losses in industrial processes

The efficiency of a boiler with an “all or nothing” burner as a function of load

Efficiency of a boiler with a modulated burner (20-100%) depending on load

Fig. 8.1: Rendement d'une chaudière avec un brûleur "tout ou rien"

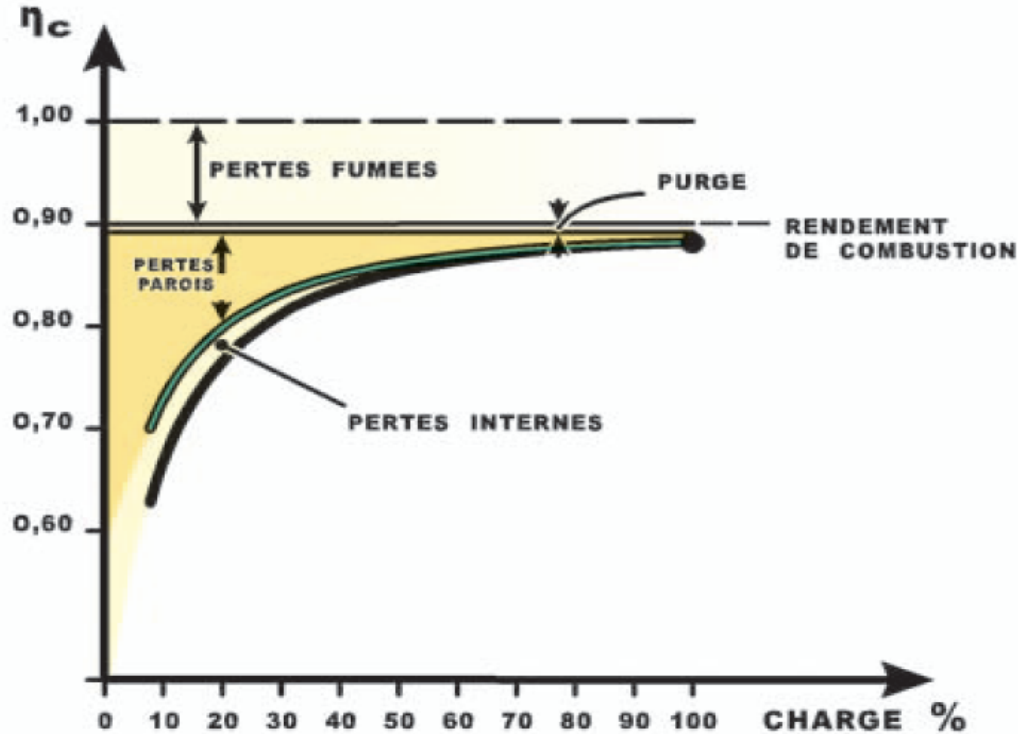
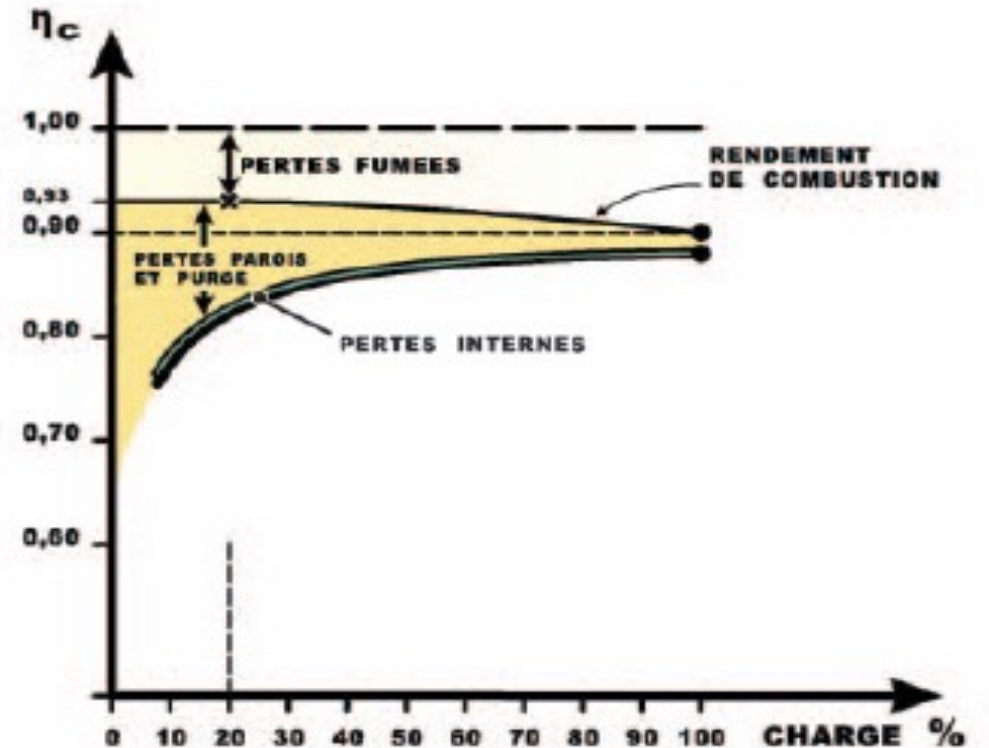


Fig. 8.2: Rendement d'une chaudière avec un brûleur modulant (20-100%)



Heat losses in industrial processes

Heat losses through the distribution network

- They depend on the temperature of the heat carrier (steam, hot water, etc.), the length of the distribution network and the quality of the insulation.
- When estimating heat losses, it is necessary to take into account the accessories of the steam distribution circuits such as valves, bleeders, clamps, supports, etc., which are difficult to insulate. An uninsulated valve has losses equivalent to 10 m of insulated pipe.
- Steam and condensate leaks also contribute to these losses.
- A good distribution network, however, has losses between 0.2% and 0.4% of the power of the plant, per 100 m of pipe.

Heat losses in industrial processes

Heat losses at consumers

- The efficiency of heat use is variable depending on the type and characteristics of the user installation and the settings.

Elements that can disrupt the operation of a heating installation:

- Thermal inertia of the heat exchanger; Leaky steam valves;
- Poor functioning of the purge valves (steam reaches the condensate network);
- Heat exchangers that are too bulky (oversized) and operate intermittently;
- Lack of control precision.

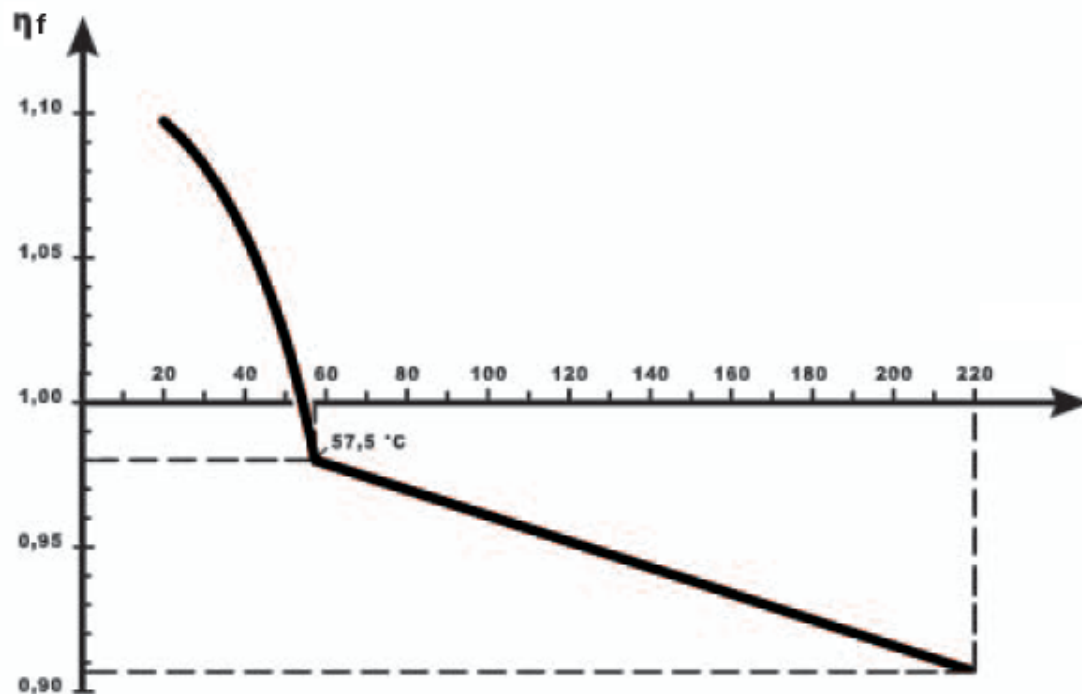
Heat recovery from flue gases

Combustion efficiency as a function of flue gas temperature

10% - excess air

20°C - combustion air temperature

Fig. 9: Rendement de combustion et température des fumées
(10% d'excès d'air, air de combustion 20 °C)



- Flue gases, a major source of losses, produce a loss of about **10%** of the heat released by fuel combustion, at the exhaust stack, even if combustion is complete.
- It is therefore normal to recover, as much as possible, the heat from the flue gases.
- Flue gas losses depend on the type of fuel, the excess combustion air and the smoke/combustion air temperature difference.

How is the heat of the flue gases recovered?

Flue gas
recuperators /
condensers

- They are stainless steel devices with sufficient exchange surface, capable of condensing water vapor from the flue gases, provided that the inlet temperature of the preheated fluid is below 50 °C.

Economizers and
air preheaters

- They are devices with a smaller heat exchange surface, and in which the inlet temperature of the preheated fluid is above 60 °C, so that condensation does not occur.

What is done with the recovered heat?

Preheating the feed water

- It can be made from the flue gases in the economizer, providing an increase of approximately 25 °C, from 105 °C to 130 °C.

Preheating of the make-up water before entering the degasser

- It is done in an exchanger/condenser mounted downstream of the economizer. Condensation occurs because the make-up water usually has a temperature of approx. 20 °C.

Combustion air preheating

- The combustion air can be preheated from 20 °C to 170 °C. The recuperator must be resistant to possible condensation on the flue gas side. The possible energy saving is 6 %

Hot water preparation

- Gas-water heat recovery/economizers are used.
- The recovered heat can be used for domestic hot water preparation or space heating.

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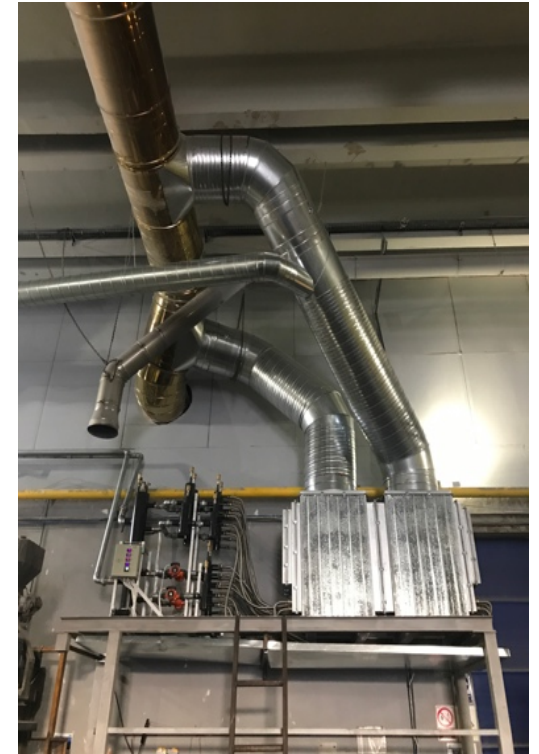
Waste heat recovery from industrial processes: potential, advantages, costs (case study)

= *TERMOREK* =

**Simple, safe and efficient
industrial gas/water heat recovery/economizer
for all types of fuels**

- *Protect the environment and... your money!*

- **We produce, serially or customized, gas/water heat recovery/economizers and we can help you find the best solutions for recovering and reusing heat from... smoke!!!**



CONSTRUCTION PRINCIPLE

- Original and innovative project, for the purpose of heating water using heat recovered from flue gases, in TERMOREK heat recovery/economizers, produced by us, the transfer of heat from flue gases to water is done through recovery plates placed so that the flue gases wash both sides of the recovery plates.



USES / BENEFITS

Uses

- *It is used in domestic or industrial boilers, power plants and thermal furnaces to increase energy efficiency and reduce energy costs;*
- *Recovers the heat lost with flue gases from boilers and furnaces or thermal power plants that operate with solid, liquid or gaseous fuel, using it either for preheating the water in the boiler or for producing hot water or for heating.*

USES / BENEFITS

Benefits

- *Reduces heat losses with flue gases by over 50%;*
- *Reduces energy costs and increases profits*
- *Contributes to increasing sustainability and business development*
- *Creates a differentiating image of the company as a promoter of technical solutions with an impact on environmental protection by reducing CO₂ emissions, as a result of increasing energy efficiency by recovering heat lost with flue gases discharged into the atmosphere.*

Why TERMOREK?

Advantages

- *Resistant to corrosion or abrasion, without significantly influencing the draft and without producing condensation or soot, TERMOREK heat recovery units can be successfully used with all types of fuels;*
- *Having, by design, a very low fouling factor and being easy to clean, they are ideal for use with solid or liquid fuels, where the flue gases may contain solid suspensions or soot, but, with the same high efficiency, they are also used with gaseous fuels;*

Why TERMOREK

Advantages

- **The devices are very safe in operation and can be passed through by combustion gases even if they are not connected to the hydraulic system. This makes it possible to significantly reduce the installation time, the connection to the hydraulic system and even the system itself can be made later, without interrupting combustion;**
- **Having a modular construction, the devices can be designed and executed customized, adapted to local conditions;**
- **The price of the devices ensures the recovery of the investment in less than 1 year of operation (approx. 100 euros/kW recovered).**

OUR STORY

- The first attempts and tests to create a flue gas heat recovery unit for domestic applications were made in 2005, and the first commercialized devices were sold in 2007 through DEDEMAN stores in Iași, Suceava and Bacău.
- They contained a single recovery plate placed longitudinally and diametrically inside a section of stainless steel tubing with a diameter of 200 mm and a length of 1000 mm. They could be used to recover heat from small boilers or fireplaces operating with wood, and provided a recovered power of approx. 3 Kw.



OUR STORY

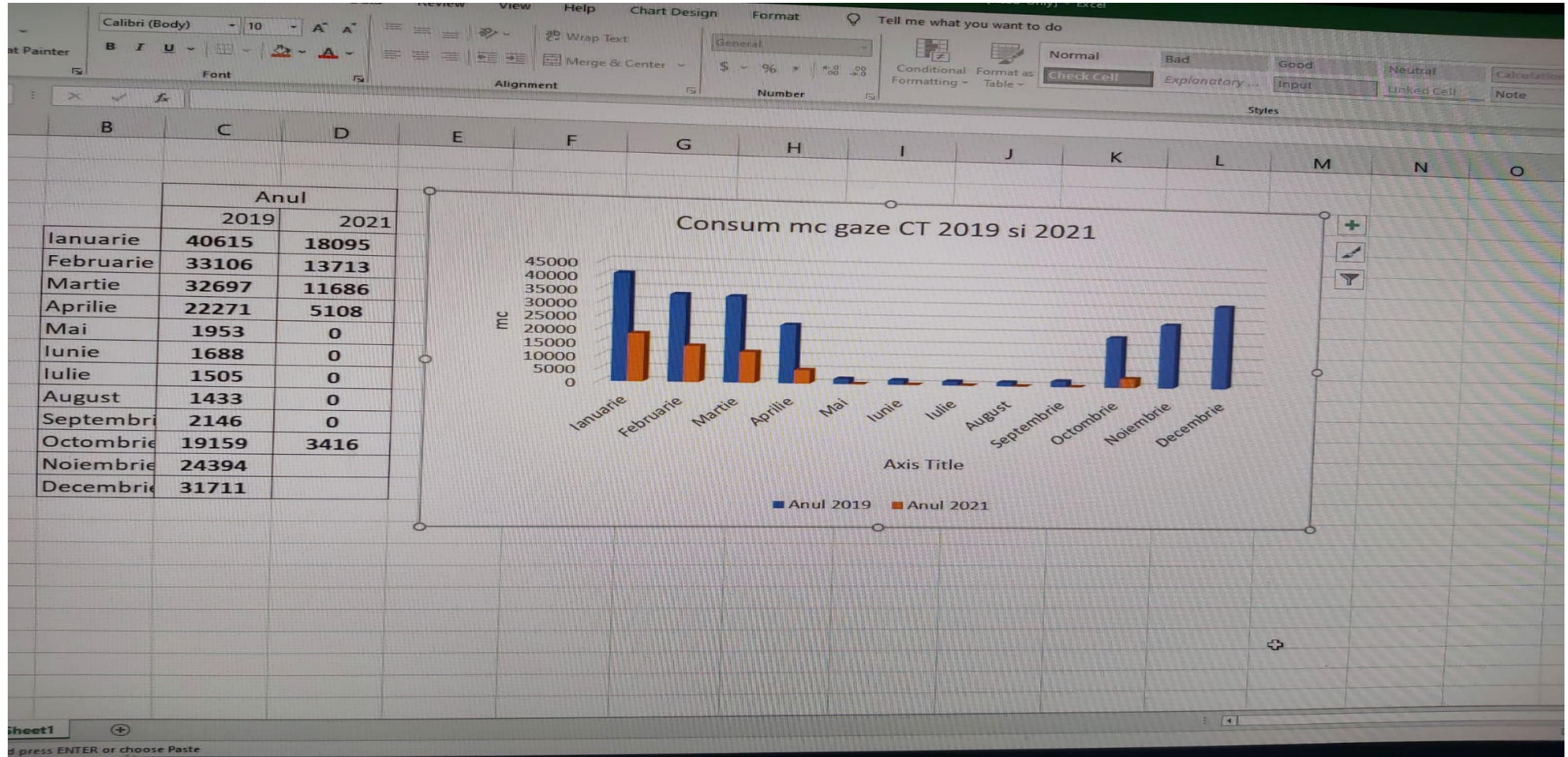
- In 2007 we produced an improved version, for boilers and thermal power plants of higher power and for several types of fuels. With this version we started industrial applications.
- Today we have come to produce a particularly efficient and safe flue gas heat recovery unit, covering a very diverse range of applications.
- The price of the device depends on the size of the heat exchange surface and is recoverable in less than a year for any application.



OUR STORY

- A confirmation of these statements is the qualification of the TERMOREK flue gas heat recovery unit in the first three places in the E.ON Energy Globe Award Romania 2017 competition, in the Companies category:
- The E.ON Energy Globe Award Romania jury nominated 15 projects and initiatives that entered the final of the 2017 competition. They were selected from a total of over 160 projects in the field of energy efficiency and environmental protection, registered on the www.energyglobe.ro platform.
- By producing an innovative range of flue gas heat recovery units, we aim to contribute to protecting the environment, improving energy efficiency and increasing the efficiency of combustion installations, as well as to significantly reducing the costs of heating and/or hot water preparation for industrial or domestic consumers.

Efficiency of TERMOREK at heat recovery installation on aluminum melting furnaces



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Thank you for your attention!

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