

## Low Power Modulating Boiler :

### A new gas technology for a still better energy efficiency

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**Keywords:** 1. efficiency 2. modulation; 3. gas; 4. boiler 5. low power

#### Background

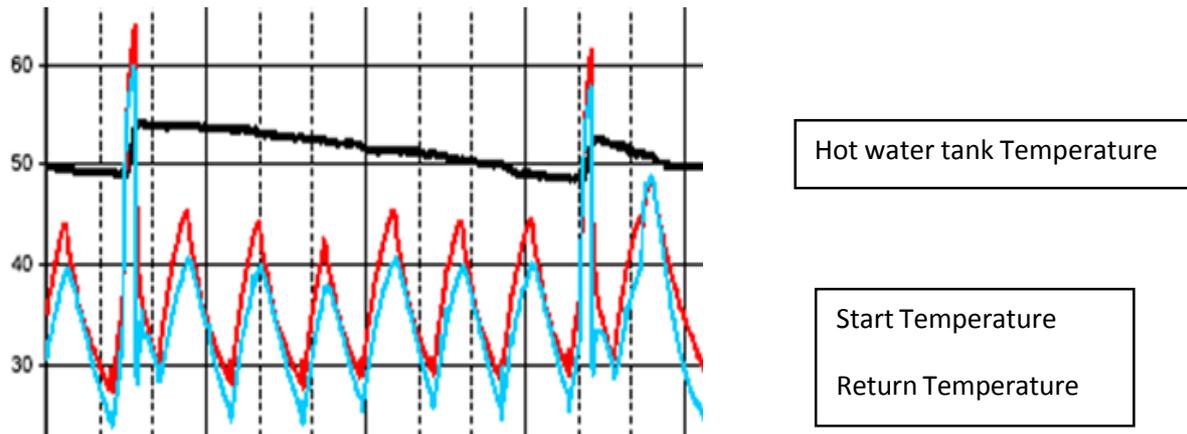
Regulation is the very first milestone to succeed because it gives the rules for the new investments which will be done by industrial and consumers. The Law, and the way it must be applied, orientates and organizes very deeply the new markets. In Europe and also in France, around one third (33%) of the energy consumption is due to buildings; acting on this sector is strategic to reach CO2 reduction objectives.

In France, the main key driver is primary energy. The parameter is clearly declined in the thermal regulation (RT 2012). Now when a consumer wants to build a new house his dwelling must consume less than 50 kWh/M2/year of primary energy. In France, in 2012, the consumption of gas for heating and hot water will represent 50 kWh EP/M2.year. If we compare this figure to the 162 kWh EP/M2.year accepted before, the consumptions are divided by four.

PRIMARY ENERGY REPARTITION IN FRANCE	HOUSES BEFORE 2008 * (ep)	OBJECTIVES OF PRIMARY ENERGY		
		RT 2012 EXISTING HOUSE LOW CONSUMPTION (ep)	RT 2012 NEW HOUSE LOW CONSUMPTION (ep)	2017 POSITIVE ENERGY HOUSE Average
1. HEATING	142 kWh <sub>ep</sub> /m <sup>2</sup> .year	±40 kWh <sub>ep</sub> /m <sup>2</sup> .year	±15 kWh <sub>ep</sub> /m <sup>2</sup> .year	< 10 kWh <sub>ep</sub> /m <sup>2</sup> .year
2. HOT WATER	21 kWh <sub>ep</sub> /m <sup>2</sup> .year	±25 kWh <sub>ep</sub> /m <sup>2</sup> .year	±25 kWh <sub>ep</sub> /m <sup>2</sup> .year	±15 kWh <sub>ep</sub> /m <sup>2</sup> .year
3. COLD	12 kWh <sub>ep</sub> /m <sup>2</sup> .year	±15 kWh <sub>ep</sub> /m <sup>2</sup> .year	±10 kWh <sub>ep</sub> /m <sup>2</sup> .year	<10 kWh <sub>ep</sub> /m <sup>2</sup> .year
4. LIGHTING				
5. ELECTRICAL AUXILIARY	30 kWh <sub>ep</sub> /m <sup>2</sup> .year	75 kWh <sub>ep</sub> /m <sup>2</sup> .year	60 kWh <sub>ep</sub> /m <sup>2</sup> .year	60 kWh <sub>ep</sub> /m <sup>2</sup> .year
INTERNET & COMPUTERS				
WASHING - MACHINES	75 kWh <sub>ep</sub> /m <sup>2</sup> .year			↘
<b>Consumptions (1+2+3+4+5)</b>	±205 kWh <sub>ep</sub> /m <sup>2</sup> .year	<b>80</b> kWh <sub>ep</sub> /m <sup>2</sup> .year	<b>50</b> kWh <sub>ep</sub> /m <sup>2</sup> .year	<b>0</b>

The problem is that the current gas technologies are not adapted to the new regulation.

Nowadays, boilers and heat pumps installed in the houses or flats are too powerful – from 6 to 28 kW – compared to the thermal needs needed in the new dwellings. This “overpower” generates very short running times which are degrading the efficiency, the energy savings and also are increasing the CO<sub>2</sub> and NO<sub>x</sub> emissions.



Profile of a standard generator during 24 hours (boiler – heat pump) = 10 stops & Goes

## Aims

In front of this situation which will put in danger gas technologies in a short run, GDF SUEZ threw it's the CRIGEN, its R&D Center, decided since 2010 to study new gas solutions to improve the efficiency of the boilers.

New buildings better isolated will need less heat and the comfort will depend on the high modulation of the power of the boiler.

The equation of a new gas product could be defined as :

High performance = Low Power + Modulation in Real Time

## Identify the new needs

If we compare this road-map with the 50 kWh EP/M<sup>2</sup>.year, and its consequences on the heating demand, it also means that the gas boiler have to be adapted to low power demands. For BBC buildings (“Bâtiment Basse Consommation” = Low Consumption Building) the power needed to heat a house of 100 squared meters, by – 7°C external temperature, is around 8 kW. Most of the time, the power needed is between 1 and 5 kW. It means that the power needed for heating is from 1 to 10 kW

Regarding sanitary hot water, with a tank of 150 liters, if the controller which gives priority to hot water production, the power of the boiler – 10 kW – is also well dimensioned.

## Create a new technology = Low Power and Modulating Boiler

Low consumption dwellings need low power but also absolutely need that this power could modulate “in real time”.

In fact this high level of isolation of the new dwellings has three consequences which are directly linked. The very first consequence, we saw it previously, is a very low demand of energy for heating with less than 10 kW, even when weather is very cold.

The second consequence is that the demand of heat is changing very rapidly but by little steps because of the high level of isolation. It means that modulation must be slow but nearly on real time to avoid “stops and goes” to the boiler.

To finish, the third consequence is linked to the hot water needs which are totally different from needs of heating. For hot water, the consumer needs a lot of power nearly “immediately” because a shower takes less than 10 minutes. It means that the boiler has to face with a pick demand of power on a very short period of time.

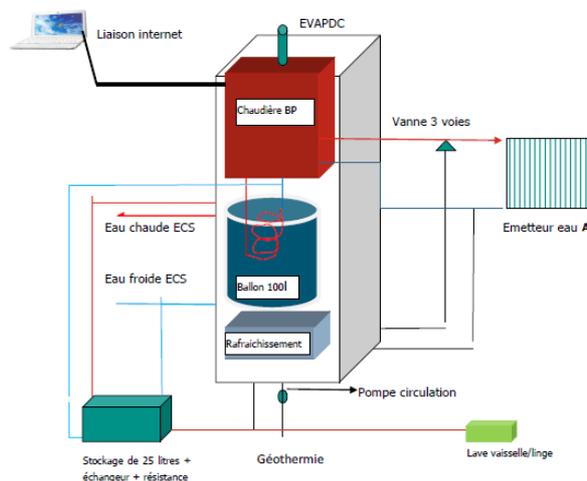
To conclude, when we add these three consequences it clearly appears that the new boiler we have to imagine has to be low power and modulating in real time.

## **METHOD :**

### **Precise the specifications**

In 2010, GDF SUEZ, threw the CRIGEN (Centre de Recherche et Innovation Gaz et Energies Nouvelles), has begun the technical development of such a condensing floor-boiler. The main characteristics of this low power modulating boiler were :

- To modulate its power “in real time” from 1 to 10 kW
- To start at 5kW and be able to go down to 1 kW in less than 10 seconds
- To integrate a hot water tank of 150 liters (or more)
- To have a controller which optimizes hot water production from solar panels.

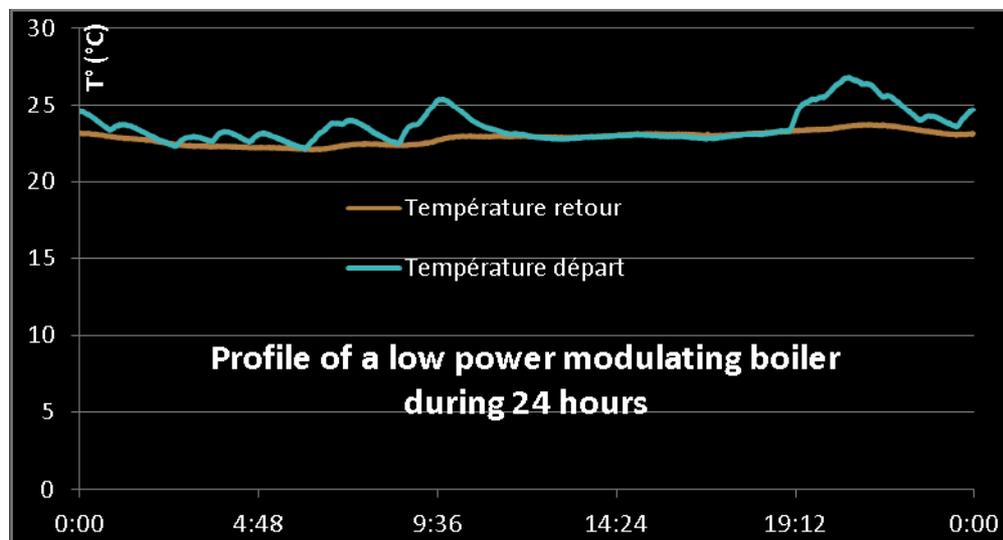


## RESULTS

### Technical Innovation :

After more than one year of technical researches, GDF SUEZ and a boilers' manufacturer found an innovation which allows to a boiler to modulate on real time, at a constant efficiency. We also found that the modulation due to this innovation was not from 1 to 10 kW, but from 0,8 kW to 30 kW (or more).

In October 2011, a patent was laid on this innovation. This innovation allows to the mix air-gas which arrives in the burner to be constant at any time the boiler is working. It means that the boiler which are equipped by this technology can modulate their power immediately and at very low power.



### Efficiency = Energy savings and low CO2 emissions

On the first hand, efficiency has been measured in December 2011, by an independent French laboratory- the Cétiat - for the certification of this boiler. The results are official and show that the efficiency is :

- 108 % at 0,8 kW
- 108,7 % at 30% of the nominal power, 3,6 kW
- 109,2 % at 12 kW, which is the nominal power

On the second hand, energy savings are estimated at 15% because the boiler has very few stops and goes. At the same time, CO2 emissions are reduced by 20% and NOx emissions are at a very low level (= 20 mg/kWh) which is the best level of emission in Europe (Class 5 = blue Angel).

### A new gas boiler for the residential market : 0,8 – 12 kW

This very high modulation allows GDF SUEZ to broaden the range of power of the manufactured product. It has been decided to apply this technology to a boiler that :

- Can modulate from 0,8 to 12 kW
- Have a hot water tank of 130 liters (with a high level of isolation)

After a period of tests in the CRIGEN's laboratories where we tested it with a "rotameter" which allows to see instantaneously the power delivered by the boiler, the technology was ready to be launched on the French Market.



Boiler with a hot water

Tank of 130 liters



Burner



Rotameter => 1 kW

## CONCLUSIONS

In November 2011, the Low Power Boiler was presented to the French Syndicate of Houses builders. Nearly 400 people voted for the best innovation presented during the congress. The Low Power Boiler developed by GDF SUEZ won the Golden medal. A first success for this new technology.

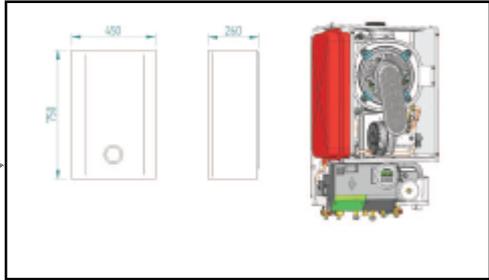
In February 2012, during Interclima, the French congress of the boilers' manufacturers, GDF SUEZ will officially launch this product on the French market.

**Chaudières à condensation**

**0,8 - 12 kW** Murale série **MC3**  
La modulation en continu de 0,8 à 12 kW

- NOx : Classe 5
- $\eta_{nom}$  : 100% FCV
- Degré d'équipement
- Condensateur INOX
- Adaptabilité au gaz

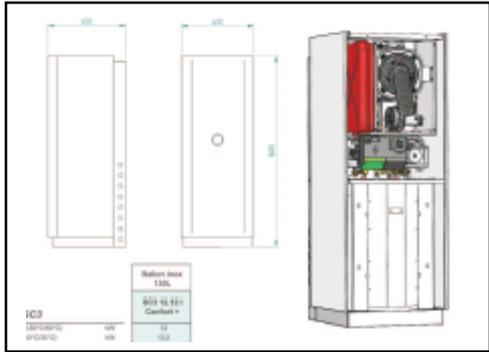
- Technologie tout inox
- Adaptable à tous les préparateurs sanitaires à échangeur
- Extrême compacité
- Circulateur à débit variable (PWM)
- Régulation "Thermactive" pour des performances optimales



**0,8 - 12 kW** Au sol série **SC3**  
Le confort sanitaire intégré

- NOx : Classe 5
- $\eta_{nom}$  : 100% FCV
- Degré d'équipement
- Condensateur INOX
- Boiler TB1

- Technologie tout inox
- Préparateur sanitaire inox de 130 L intégré
- Circulateur à débit variable (PWM)
- Régulation "Thermactive" pour des performances optimales
- Concept de raccordement "Modulflex"





The annual target production is 20 000 boilers to reach 15% of market share in France in new houses. GDF SUEZ trusts in this boiler which has the best efficiency of the market and also puts gas technologies at the top !!