Biomass & Stainless steel

The bioenergy market in France: What opportunities for stainless steel industry?

Context

❑ A growing sector: 2020 horizon is favorable

The biomass energy (or bioenergy) sector is part of the renewable energy production method. Biomass is transformed into energy by a thermo-chemical or a bio-chemical process. In ecology, biomass represents all the living matter in a given natural habitat. According to the French law, biomass is « the biodegradable part of products, waste coming from agriculture, including plant and animal material from the land and sea. Forestry and related industries, as well as the biodegradable part of industrial and domestic waste are concerned. » (Energy code, article L211-2)

The bioenergy sector develops due to regional and national policies which aim at durability by increasing the part of renewable energies in the total energy mix. In 2009, biomass energy production (excluding biofuels and domestic or municipal waste combustion) was estimated at around 9.6 Mtoe (including 9.1 Mtoe for wood energy and 0,5 Mtoe for biogas). In France, The Grenelle Environment Forum wished that part of renewable energy in the total energy mix should reach 20 Mtoe by 2020 (including 17 Mtoe from biomass, ie. 7.5 Mtoe more than the 2009 level).

Since 2007, the French government has facilitated the energy transition by developing fiscal tools and promoting bioenergy. The State commitment thus shows that bioenergy is regarded as a way to take action on climate change as well as to diminish the dependency on fossil energy. Stabilization of energy prices and secure supplies appear as major challenges to face episodes of sharp increases in oil prices.

The State commitment to make the bioenergy sector one major contributor to the renewable energy goals (according to the Grenelle Forum, 23% of the total consumption mix by 2020) unfolds in two main sectors. First comes the wood energy sector that recovers biomass with a thermo-chemical process (combustion). Second comes the biogas sector that recovers biomass throughout different processes including thermo-chemical and also bio-chemical processes like methanation. These two sectors can produce heat and electricity. Though it has been an attractive sector for developing countries with strong agro-industrial capacities, recovering biomass for biofuels is not part of the French goals for renewable energy by 2020.

❑ What are the challenges for the market of stainless steel?

The sustainable and efficient development of biomass into electricity and heat requires technological progress, and the development and restructuring of the facilities sector. The current issue concerning the construction of plants for energy recovery from biomass raises questions about the opportunities of this sector concerning the market of stainless steel. Its components are present in all facilities dedicated to energy production from biomass: boiler, digester, fermenter (biofuels).
The choice of materials used in these units often depends on the specifications developed by the client which is somewhat related to economic logic. This reality explains why stainless steel is not systematically chosen despite its interesting properties for such structures.

Evaluation of the potential of the biomass subfields: biogas in top position

❑ The wood energy sector: despite a real development, little room for stainless steel

Goal of the Grenelle**:** multiply the production capacity by 5 by 2020.

➢ Boilers

Boiler rooms are growing significantly in France. These are wood combustion units of various sizes supplying district heating networks. The boilers and the pipes can be constructed of stainless steel. Nevertheless, it will not be the most widely used material unless the boiler is operated at very high temperatures to extract the maximum energy from the combustion or biomass which is very corrosive, such as when straw is used.

- **Cogeneration plants**

Unlike the boiler rooms these plants can generate heat and electricity. There is a strong political will to develop the production of heat and electricity from cogeneration. There are few projects of cogeneration plants due to the implementation time.

The visit of a COFELY cogeneration plant in Grand-Couronne (Seine-Maritime, France) showed that in these facilities stainless steel is not prominent because other types of steel meet customer needs and are more economically competitive. Moreover, reflection on the long-term profitability of the chosen material does not occur because operators are considering their operation on a time step short enough, about twenty years. In fact, stainless steel does not appear as an attractive solution when alternative materials exist.

COFELY Cogeneration plant,
Grand Couronne, France

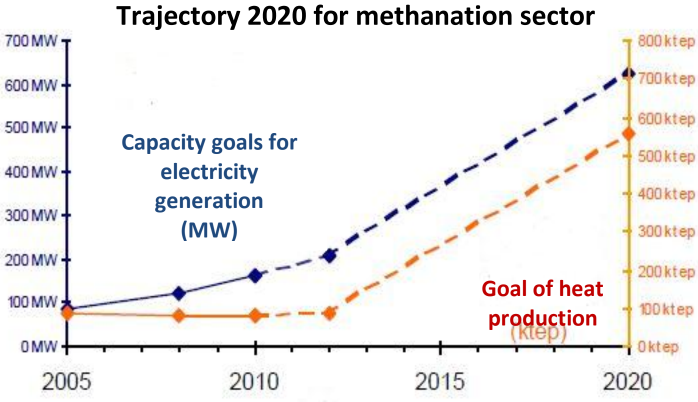
The biogas sector: better potentials for stainless steel

The process of digestion requires facilities whose features naturally require the use of stainless steel for large volumes. A biogas plant produces biogas by biochemical conversion of biomass. The technology involves the fermentation of organic biomass by bacteria in anaerobic conditions (without oxygen) in a reactor called a digester. Biomass is converted into biogas. The biogas can be upgraded in various ways: biofuel, electricity and heat cogeneration, heat-only boiler by injection into the gas network. The material used for anaerobic biomass is a fermentable organic and methanogenic material: sludge, agricultural waste, industrial and household sewage sludge. The liquid residue from the fermentation, called digestate, can be valued as an amendment or organic soil in addition to traditional chemical fertilizers.

Goals:

Cogeneration: 625 MW in 2020 vs. 164 MW late 2010 (Production multiplied by 4)

Heat / Injection: 555 ktoe in 2020 vs. 86 ktoe in 2009 (Production multiplied by 6)



Source: T. Pertuiset, Directorate General for Energy and Climate, MEDDTL April, 2012.

The competitive advantages of stainless steel for anaerobic biomass processing

In this type of biomass processing, the technical characteristics of stainless steel meet particular customer needs. This may be the digester (tank and roof) and biogas (biomethane) recovery unit and storage (tank). The composition of the very aggressive gas attacks many materials and requires the use of a corrosion-resistant material. The choice of stainless steel to build the tank walls and parts is justified by the fact that it is a resistant material that allows for lower maintenance and longer life of the installation. Moreover, the biogas process requires maintaining a constant temperature. The choice of stainless steel for the heating system ensures a constant temperature.

Agricultural biogas plant, Gruffy, France
Source : http://www.legrenelle-environnement.fr

❑ Strong competition from alternative materials

Concrete

This is the most economical alternative for a large-diameter and low-height digester because it requires fewer resources for implementation. The major drawbacks are the drying time of concrete, its fragility in aggressive environments, and its difficulty to work (drilling, etc.). However, for energy efficiency, large-volume biogas plants are required. But by increasing the height of the digester, concrete is no longer economically profitable.

Steel epoxy (cheaper), vitrified steel (steel melting and glass) and galvanized steel, aluminum

These materials have properties consistent with the process of anaerobic digestion and are less expensive than stainless steel. Among other features, being less flexible than stainless steel, they are less prone to leakage problems in bolted structures. They therefore require less maintenance for the operator and represent a gain for the customer. The choice of these alternative materials is therefore justified by economic considerations.
It offers an economical corrosion protection. The zinc coating gives protection against impact and abrasion.
Stainless steel is a material that has proven its use in a corrosive environment. Its strength induces usability, performance and efficiency of plant operation. Despite its higher cost compared to other materials, its stainless character is all the more a competitive factor as these facilities are directly subject to external agents (rain, wind, etc.). In fact, the life of these plants to the quality / price an asset in terms of the profitability of the installation in relation to investment. These benefits, although they are not exclusive to stainless steel, are real customer benefits.

❑ A policy of proactive support for biogas

As wood-energy, biogas has the strong commitment of the State which is expressed in the deployment of a support system. Although still undeveloped in France, incentives have enabled the emergence of many projects.

At the national level: promotion of the production of biogas

- Purchase price rates of electricity and injected biogas

- **Melt Heat**: endowed with 1.2 billion euros over 5 years, Melt Heat has for objective to finance the projects of heat production from renewable energies while guaranteeing a lower price than that of the heat produced from conventional energies. It also has as an objective to favor employment and investment in this sector.
The Heat Fund should allow the additional production of 5.5 million toe of renewable heat or recovery by 2020.

- **Melt Waste**: endowed with 571 M euros over the 2009-2011 period to help reduce and better recover waste, it allows to grant subsidies to methanation projects.

- **2009-2013 Energy Performance Plan for farms**: the State sets a target of 30% of farms with low energy dependence in 2013. One hundred projects already exist or are under way and **1,000 biogas plants are expected by 2020**. A bonus will be allocated for the treatment of livestock manure to promote agricultural units and improve profitability.

At the territorial level: a tool for the energy independence of territories

The State provides financial assistance and project optimization for part of a territorial logic through the waste management policy and to guide the use of biogas towards the best solution.
The support should allow an estimated biogas production from January to February of Mtoe of primary energy per year (produced by digesters) by 2020. To meet this objective, new digesters are expected to offer great potential for the market of stainless steel.
Anaerobic digestion is characterized by a wide disparity in investment and operating costs according to facility size, waste and territorial constraints.

❑ And biofuels? A high potential sector

Biofuels (bioethanol, biodiesel) are not included in the commitment to make the bioenergy sector a major contributor to the renewable energy goals. However, their development is considerable. In 2020, European Directive 2009/28/EC, the Directive called ENR, sets a target of 10% incorporation of renewable fuels for transport in each Member State and the EU as a whole. In 2010, France had achieved a rate of 5.3%. For that reason, the growth of this market should be closely followed. With the development of 2nd-generation biofuels, the market could quickly evolve and become interesting for stainless steel producers.

Indeed, stainless steel could be used for production units which use fermentation tanks.

- ❑ **Competitiveness and sustainability of the bioenergy sector**

- ❑ **Wood sector**:

Heat production from biomass is already profitable thanks to state subsidies: Heat Funds helped make the price of gas and biomass almost identical.

Natural gas is the biggest competitor of wood energy. The cost of wood is currently incompressible, and because it is a resource “flow” (not “stock”), its management is a fundamental parameter in fuel prices. The profitability of the wood energy sector could be improved by modernizing and streamlining the supply chain upstream that is still too archaic. This requires strong political will and powerful levers.

On the other hand the competitiveness of electricity generation is impossible without the support of the state over the long term because it only concerns the purchase prices (and not the facilities). The state subsidies for biomass energy are evolving to encourage industrials to improve the energy efficiency of their facilities. The amount of investment in these facilities depends on their size. Regarding cogeneration plants, projects are not realized below 30 million euros because the state does not give grants to small facilities that are more fragile in a context of a tensed economic equilibrium.

In France, the low number of cogeneration plants is explained by the fact that the system of purchase prices is complex: the State agrees to buy electricity for 20 years, but it is not easy to have a vision of 20 years for a company. But these facilities are only profitable in the long term.

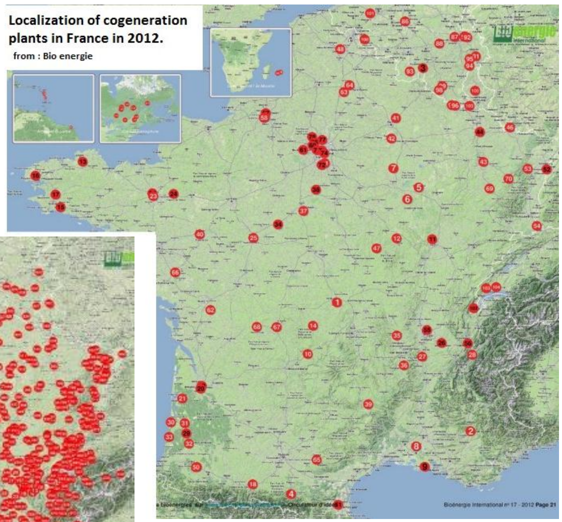
- ❑ **The strategy of the location of biomass plants**

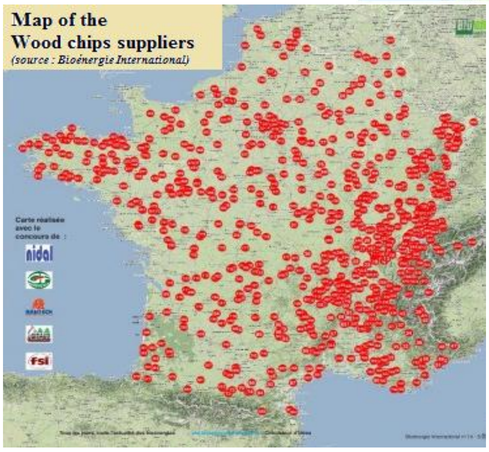
Biomass plants are mainly situated near production sites of raw material or waste storage.

The choice depends on 3 criteria:

- Reducing transport and specific investment costs to the minimum (collection area between 10 and 40 km and power networks),
- Technical feasibility (generated electricity)

From a strategic point of view, plants should be located near raw materials. For example, in France, according to these two maps, wood chip suppliers are mostly located in the East and near the Paris region. Cogeneration plants are also mostly located near the Paris region.





Source: “Bio-energy” (Feb-March 2012)

Conclusions

The development of biomass energy is justified in part by a desire for energy independence, expressed at all levels: national and local. State aids are driving the deployment of bioenergy that streamlines the energy production strategy (raw materials sources and local production for local consumption vs centralized energy power).

This autonomy seems to be given to local jurisdictions to respond to a new challenge for many actors. Thanks to this, small projects of local biomass units are increasing. Most cogeneration plant construction projects are also small because the investment costs are heavy (for example 55 M€ for the Grand-Couronne plant) and because they are in competition with other energy sources. Despite this, methanation furnaces and units tend to increase.

To date, there is a lack of knowledge and precise figures to accurately assess the market potential of bioenergy for stainless steel. The table below shows some indicators that can help assess the evolution of biomass energy in time.

Sectors	Indicators
Wood (heat, electricity, cogeneration)	Calls for tender of the State (Ministry of Environement)
	Structuring of forest biomass
Biogaz (heat, electricity, injection)	Tariffs heat/injection
	Structuring of agricultural biomass
Biofuels (biomethane)	Publication of tariffs for biomethane was an determining to proceed to the practical implementation of these projects.
	Research and development of second generation biofuels
General (all sectors included)	Fossil fuel prices
	State/regions Framework (agreement on a project between the State and a region)
	Strategic location of a biomass plant - Urban centers - Large agricultural areas
	Assessment of deposits (e.g.: recent creation of an "observatory of biomass" by the Ministry of Agriculture)

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