Gaya demonstration project : towards industrialization of an innovative and integrated 2nd generation bioSNG pathway through biomass gasification

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- GAYA DEMONSTRATION PROJECT† - TOWARDS INDUSTRIALIZATION OF AN INNOVATIVE AND INTEGRATED 2ND GENERATION bioSNG PATHWAY TROUGH BIOMASS GASIFICATION

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Abstract

Biomass gasification is a promising way to make renewable energy. It produces a syngas which can be turned into different kinds of energy: CHP (Combined Heat Power), bio-fuel or combined biomethane fuel (or BioSNG: a green Substitute Natural Gas) and heat. Combined Biomethane/heat is environment-friendly (high energetic and chemical yields, local heat valorisation, reasonable biomass supply volume and radius) and is complementary to the other renewable energies [3].

Project "GAYA", started in June 2010, is aiming to develop and prepare industrialization of the combined 2nd generation biomethane/heat pathway, through a demonstration operation and an R&D pilot plant to be erected in St Fons (France). This demonstrator unit represents a unique experimental tool in Europe in order to allows industrialization of 2G biomethane pathway from 2017 onward. The project objective is to develop an efficient and environmental friendly 2nd generation pathway from biomass to biomethane and injection in natural gas grid. The project has identified optimized configurations of each process blocks. Innovations and improvements will be developed in order to reach the highest energetic efficiency and a better environmental balance in comparison with others 2nd generations' pathways.

1- INTRODUCTION

The development of renewable energy is a major topic all over the world, in response to various environmental (reducing greenhouse gases emissions), geopolitical (reducing dependency on fossil fuels) and economic (developing new activities) issues.

Biomass gasification is a promising way to make renewable energy. It produces a syngas which can be turned into different kinds of energy: CHP (Combined Heat Power), bio-fuel or combined biomethane fuel (or BioSNG: a green Substitute Natural Gas) and heat [1][2]. Combined Biomethane/heat is environment-friendly (high energetic and chemical yields, local heat valorisation, reasonable biomass supply volume and radius) and is complementary to the other renewable energies [3].

Amongst the various pathways for advanced conversion of biomass into biofuels, bioSNG currently represents one of the most promising [2], both for its ability to access virtually the entire lignocellulosic biomass source, due to its flexibility, and for its high overall energy efficiencies, the only ones amongst the 2nd generation processes to exceed 50 %.

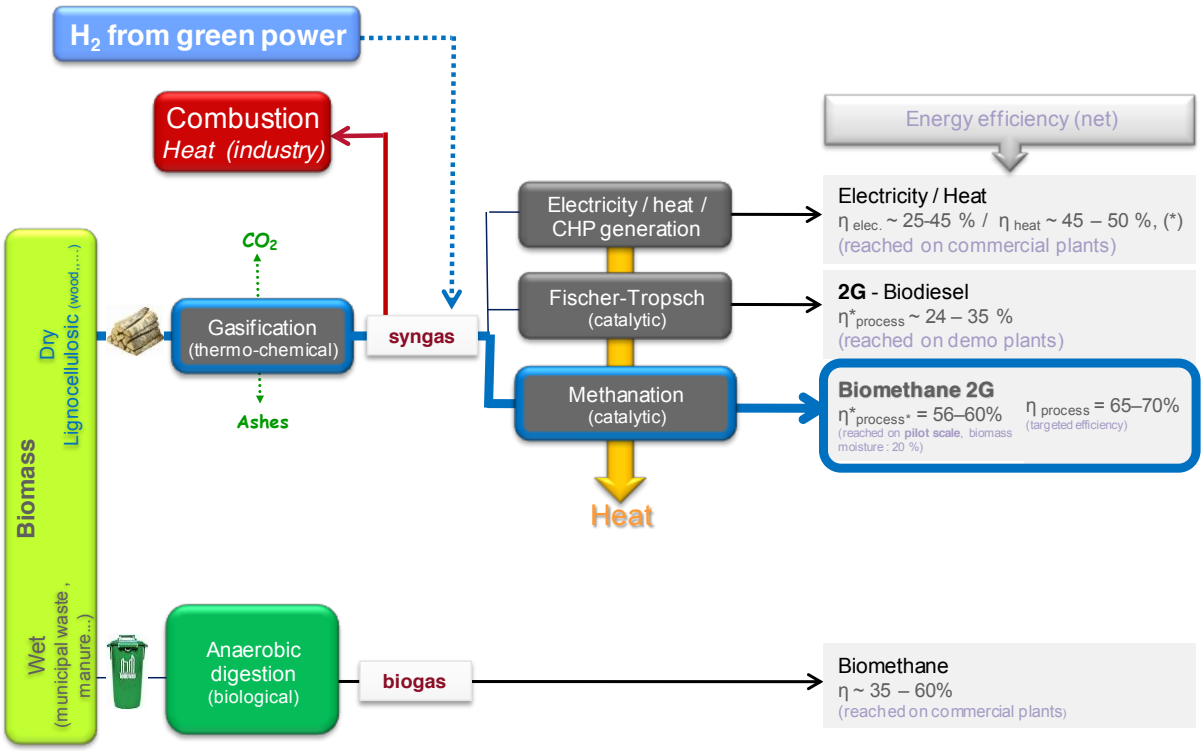

Figure 1 : BioSNG pathway among the various biomass conversion pathways to energy.

Due to the advantages intrinsic to methanation synthesis reactions: (i) no synthesis of energy-greedy carbon chains, (ii) high selectivity for methane synthesis: on average, over 95 % of carbon monoxide conversion achievable [4], methanation processes currently exhibit very high overall energy efficiencies, with an average of 55 % to 60 % (biomass to biomethane).

For the production of biomethane, methanation, through the use of gasification type thermochemical processes, allows access to a greater choice of biomass substrates and to a potential almost 10 times larger than biological methanisation (a potential of 24 MToe of lignocellulose vs 2.4 Mtoe of waste biomass in France [5]). Highly complementary processes (Figure 1), biological methanisation and gasification/methanation target quite different types of biomass although each plays a role in the production of a single energy vector: biomethane (or bioSNG), whose physico-chemical and thermal properties are identical to those of natural gas.

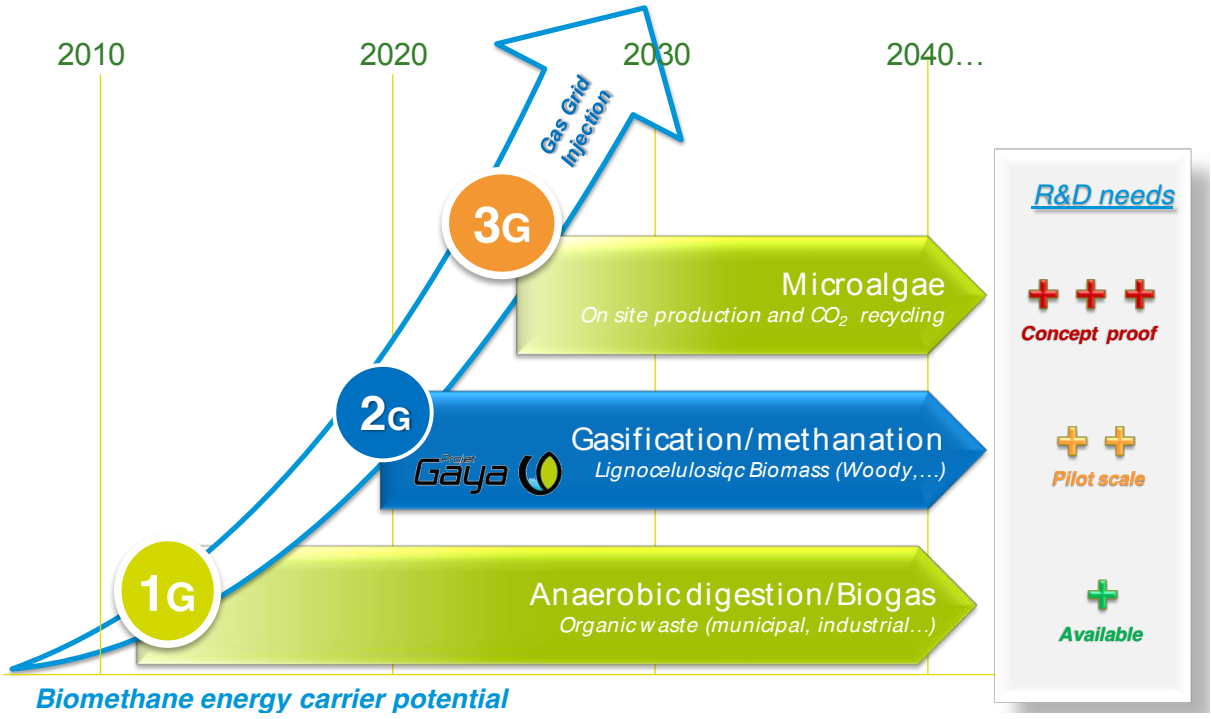

Figure 2. Biomethane RoadMap for industrialization.

2- PROJECT DESCRIPTION

Project "GAYA", which started in June 2010, is aiming to develop and prepare industrialization of the 2nd generation biomethane pathway, through a demonstration operation and an R&D pilot plant that is erected in St Fons (France). With the support of the French agency ADEME† and coordinating by GDF SUEZ, the project brings together 10 major players of European research on gasification (CEA, CIRAD, LRGP, ENSTIMAC), catalysis (UCCS), design and simulation of processes (CEA, LGC, CRIGEN), biomass and supply chain (FCBA, CTP and UCFF), and an Austrian engineering company of gasification process (REPOTEC).

3- STATUS OF THE GAYA R&D PLATFORM

The project has engaged the construction of an experimental platform with a complete chain of pilot scale units from biomass to the final gas upgrading part of biomethane to natural gas grid specifications. The platform is located in St Fons in France (figure 4) and is representing an unique experimental tool in Europe in order to allows industrialization of 2G biomethane pathway from 2017 onward.

Figure 4 : Platform GAYA in ST Fons (France) – Construction under progress.

3- FIRST RESULTS

The project objective is to develop an efficient and environmental friendly 2nd generation pathway from biomass to biomethane and injection in natural gas grid [6] with decentralized industrial units with a supply radius up to 50 km (Figure 3).

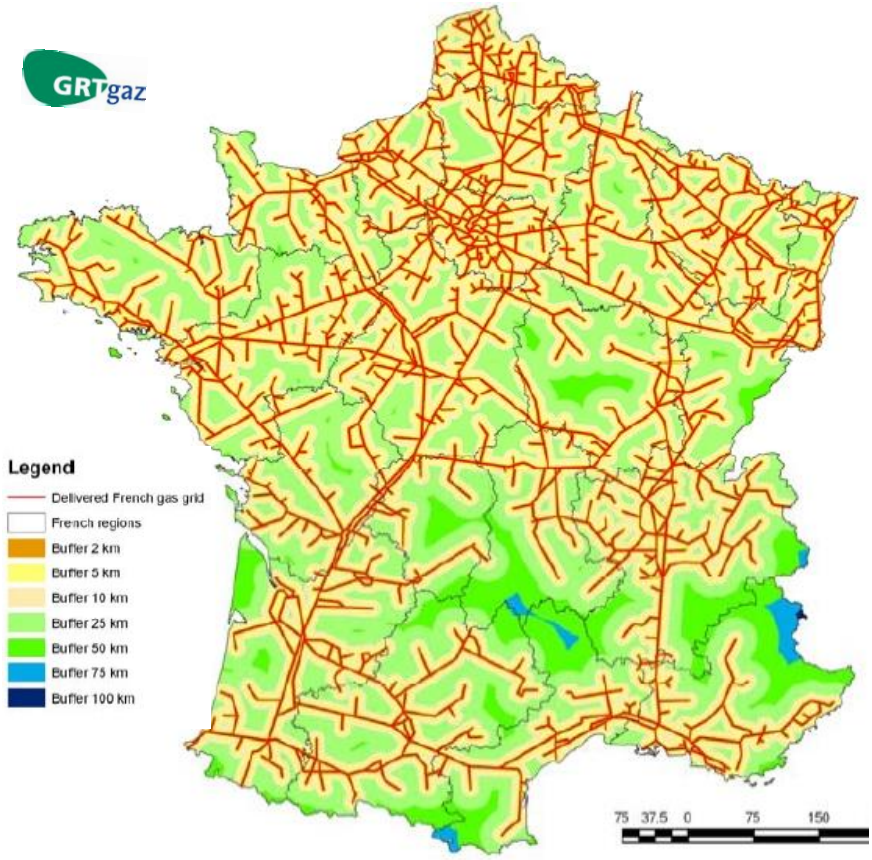

Figure 3. Impact of biomass supply radius on injection into gas grid

The project has identified optimized configurations of each process blocks. Innovations and improvements are developed in order to reach the highest ratio energetic efficiency on production costs and a better environmental balance in comparison with others 2nd generation's pathways. Current work is spread over the different part of the process line in order to prepare industrial design and to validate optimizations and innovations (potential assessment of different biomass feedstock's, supply chain optimization, overall process integration, environmental assessment,....)

The project has developed innovative optimisation tools to optimise the biomass supply chain and anticipate local competition on biomass feedstocks.

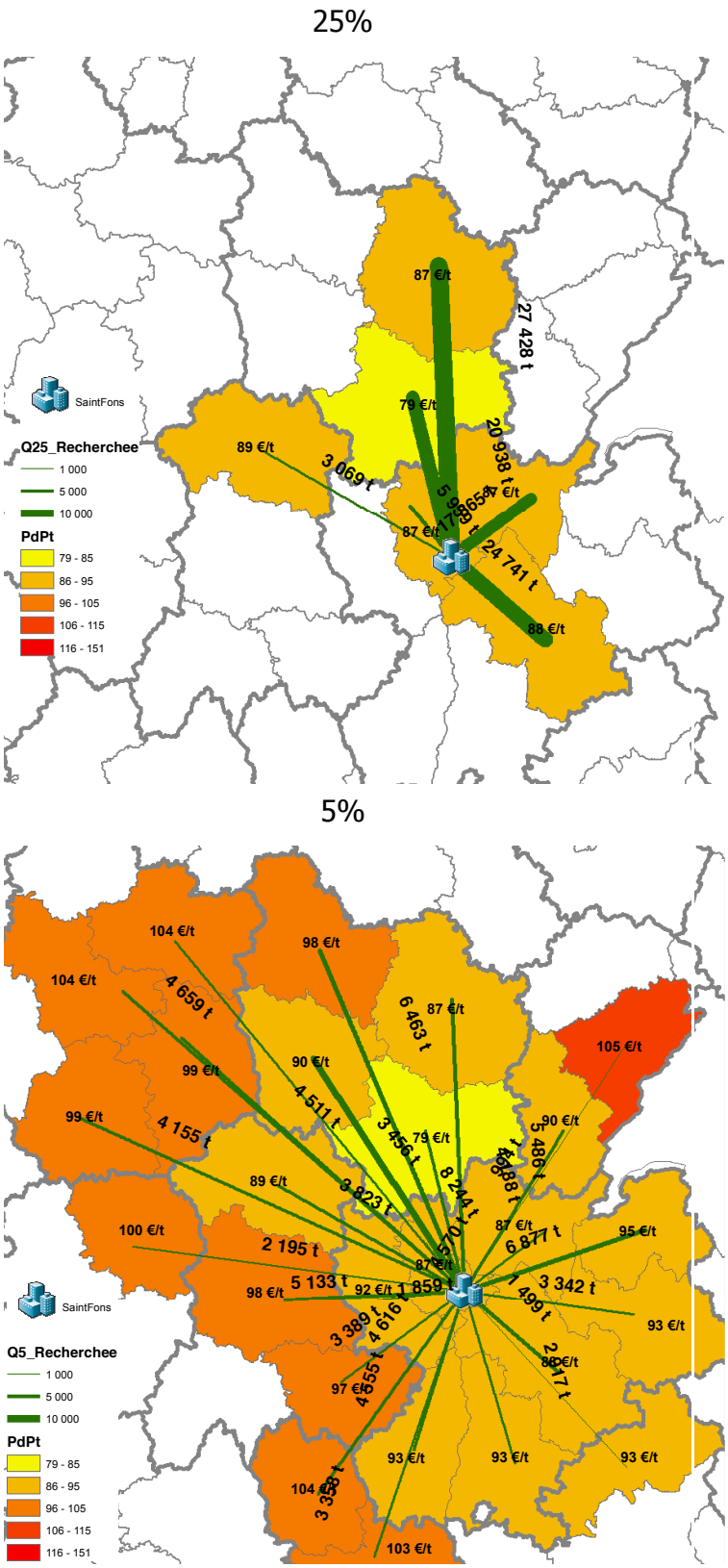

Figure 4 : Cartographic tools for biomass supply of future industrial BioSNG plants.

Based on a first life cycle assessment, the decentralised bioSNG pathway complies with the requirements of the directive with gains of -78 % and -83 % observed for scenarios with and without external recovery of surplus heat. This pathway ranks favourably with respect to the other second generation biofuels and its balance is comparable with those obtained by the other second generation pathways such as BtL which do not include conversion and use in their balances [7].

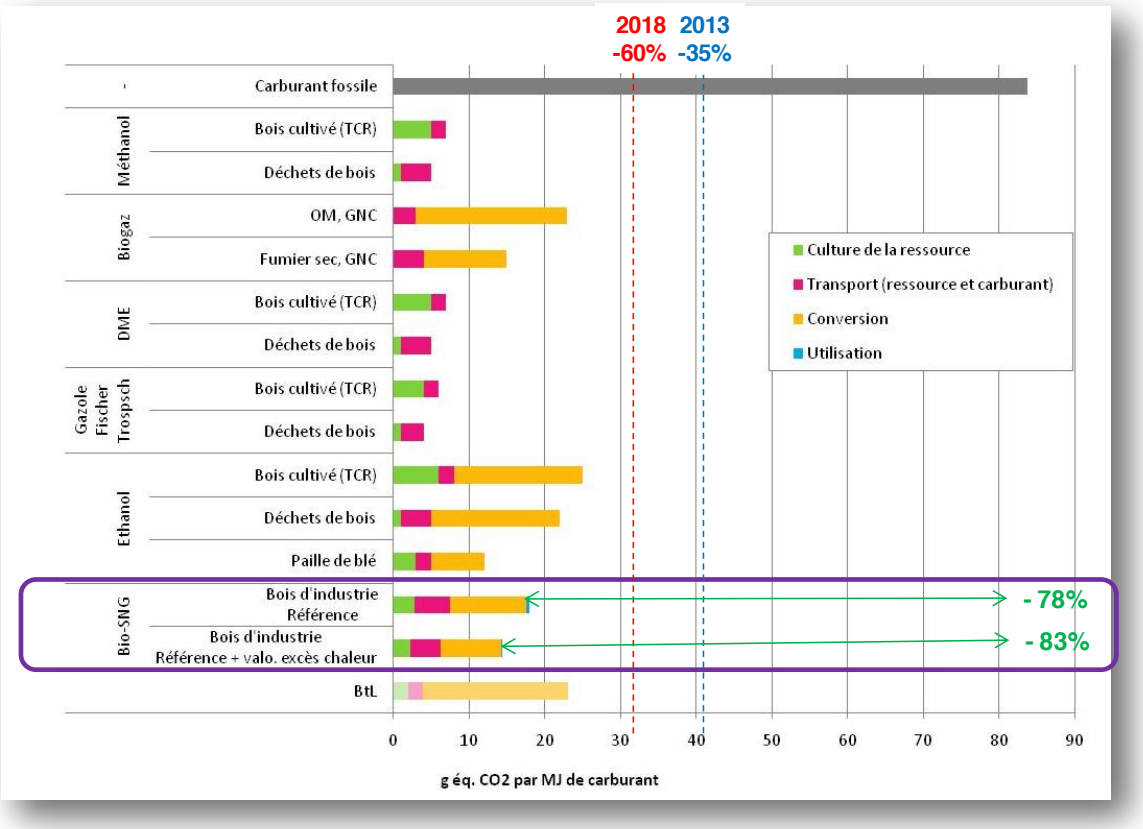

Figure 3 : Contribution of BioSNG decentralised pathway to environmental impacts.

5- CONCLUSIONS

While the feasibility of a robust and cost efficient production chain has not yet been demonstrated at industrial scale, the thermochemical biomethane production pathway can already be considered as an essential part of the future European energy landscape. The consortium of the GAYA Project is developing innovations and optimisations to bring to industrialisation this promising pathway before 2020.

6- ACKNOWLEDGMENTS

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