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BIO-DIESEL: A NEW DIESEL BASESTOCK COMPONENT OF INTEREST FOR REFINERS

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Overview

Up to now, diesel basestock was composed of a blend of petroleum based components. With the introduction of bio-diesel as a basestock used to produce diesel engine fuel, refiners have to adapt the diesel pool composition in order to comply with quality specifications. Bio-diesel quality and price are the two main parameters conditioning the competitiveness of bio-diesel compared with other diesel basestocks. In this paper a refining linear programming (LP) model is used to analyse bio-diesel technico-economic competitiveness from the demand side, i.e. the refiners, point of view. The bio-diesel substitution potential is studied and the demand curve is built by parameterization. Sensitivity analysis of bio-diesel demand is also provided with regard to crude oil cross-price elasticities. Finally, postponement in hydrocracking units are considered, comparing the situation with and without biofuel provisioning in the year 2009 when sulphur specifications are expected to tighten up. We show in this paper that, for refiners, bio-diesel can be very interesting because of its technical characteristics (low sulphur content, high cetane number) but also because of its price, which seems interesting in comparison with investing in hydrocracking units.

Methods

This work is based on a linear programming model representing the French refining industry. This model consists in minimizing short and long run costs of the “French” refinery under refining unit capacity constraints, end-product demand and specification constraints as well as balanced product constraints (Saint-Antonin, 1998). Furthermore, as the bio-diesel use by refiners is closely linked to the diesel market, a calibration process was implemented to improve the modelling of French diesel imports from Russia and the European Union.

The study of bio-diesel competitiveness in comparison with other petroleum basestock components is made on the basis of short-run optimization in the conditions of the year 2005. The main quality constraints for diesel, i.e. density, sulphur content, cetane number, viscosity and cloud point are taken into account to study the demand-side interest for diesel. On this basis, a classical microeconomic analysis of factor demand is developed using dual prices from the simplex optimization method and a parameterization process of bio-diesel price. An analysis of bio-diesel demand sensitivity to crude oil price is also carried out.

Concerning investment in refining units, long-run optimizations for year 2009 are compared when the use of biofuel is possible and when it is not. Possibility to invest in hydrocracking units, which seems to be soon inevitable (Concawe, 1999), is given in order to allow refiners to comply with the tightening of diesel sulphur content specifications from 2009 on.

Results

Technical aspects of bio-diesel use

This paper shows that bio-diesel use as a basetock in the diesel pool is limited to one third in quantity because of density specification constraint. Up to this ceiling, bio-diesel can be

considered as a perfect substitute for petroleum diesel basestocks and beyond it becomes a complementary factor to the refiner.

Economic aspects of bio-diesel demand

Without any fiscal incentive or regular ratio limitation to bio-diesel blending, refiners are willing to buy the first ton of biofuel at 484 $/t. From this price to 387 $/t we can observe a rapid substitution of petroleum basestocks for diesel by bio-diesel. After that, no more incorporation is possible because of the maximal density constraints.

Sensitivity of bio-diesel demand to crude oil price, measured by cross price elasticity, is high for quantities of bio-diesel lower than 6 Mt since, at this point the refiners decide to reduce their crude oil charge and gasoline exports.

Postponement in refining unit investment

Without hydrocracking investment possibilities, French refiners will be unable to reach diesel specifications in 2009. Nevertheless an investment in 11Mt of hydrocracking capacity would make it possible. Another way to delay investment in hydrocracking is to use bio-diesel. When bio-diesel incorporation is allowed in 2009, a massive use of both bio-diesel and diesel imports will allow hydrocracking investment to be delayed and diesel sulphur specifications to be reached.

Conclusions

The analysis developed in this paper allows a better understanding of demand-side interest for bio-diesel. We show that, for refiners, bio-diesel can be very interesting regarding its technical characteristics (low sulphur content, good cetane number) but also because of its price which seems interesting in comparison with investment in hydrocracking units. Consequently, if other problems are avoided (such as bio-diesel provisioning, use in diesel engines up to a mixture of 30%, and distribution), bio-diesel could be an inescapable component of diesel basestock from 2009 on.

References

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