Implications of large-scale bioenergy deployment on energy demand and agricultural supply: an inter-sectoral perspective from the IMACLIM-NLU model

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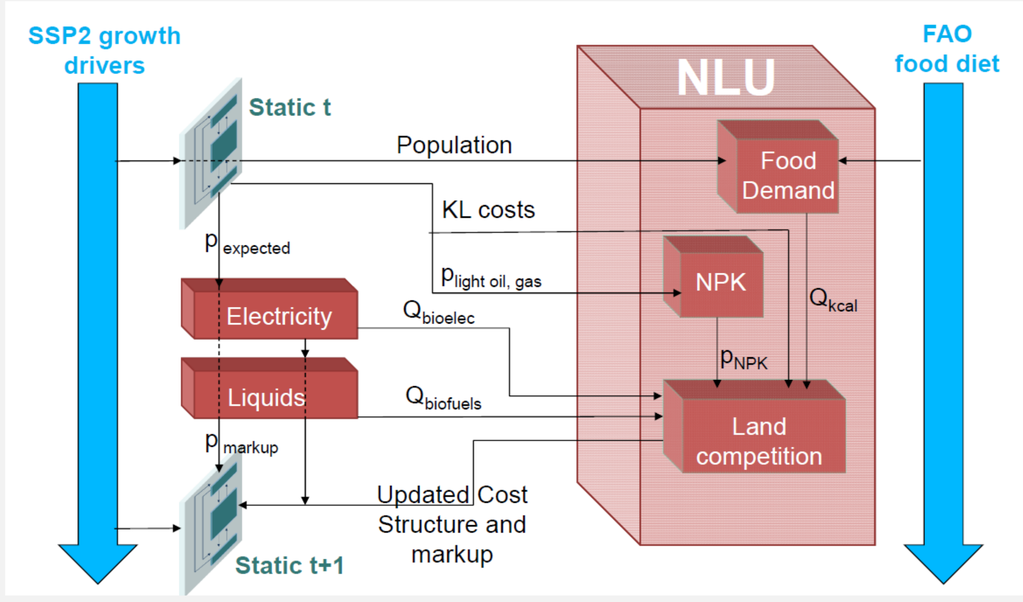
1. Context and objective

Stabilizing climate change requires a profound transformation of the world energy with a reorientation towards low-carbon energy, especially bioenergy production associated with carbon capture and sequestration supply with a reorientation towards low-carbon energy.

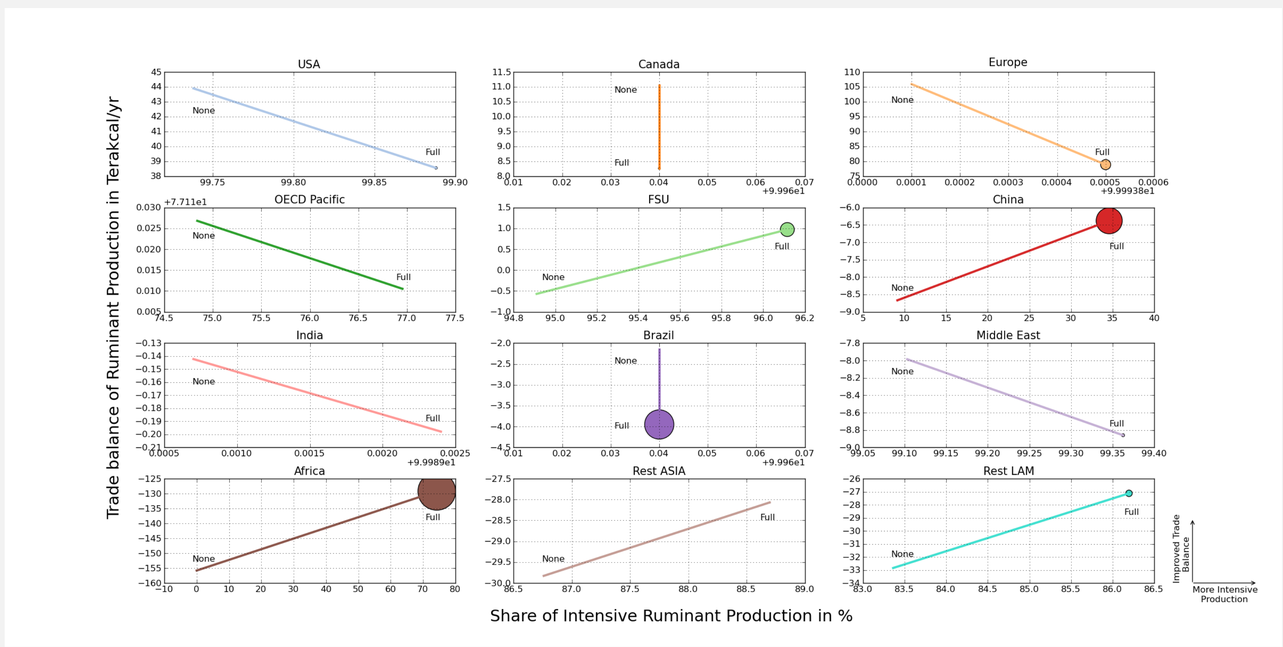
Our objective is to describe the joint implications of bioenergy production on AFOLU and on energy sectors.

The link between energy and AFOLU sectors is studied by coupling the multi-sector CGE model IMACLIM-R and the partial equilibrium model of land-use NLU.

IMACLIM-NLU Coupling: linking energy needs to land constraints



Regional trade balance of ruminant production vs share of extensive ruminant in total ruminant production with ("full") and without ("none") bioenergy production



2. Implications for the decarbonisation of agriculture

In the context of the scenarios studied in this paper, the production of dedicated energy crops is not supposed to involve any deforestation either directly or indirectly

The increased competition for land-use between crops, livestock and bioenergy production stimulates the intensification of the livestock sector.

By increasing production efficiency, the intensification of the ruminant sector stimulated by bioenergy production improves the terms of trade of the major biomass producing regions: Africa, China, Russia and Rest of Latin America

3. Implications for the energy sectors

The availability of bioliquids eases the low-carbon transition through two mechanisms:

(i) the demand for energy in transportation is less affected due to another low-carbon substitute;

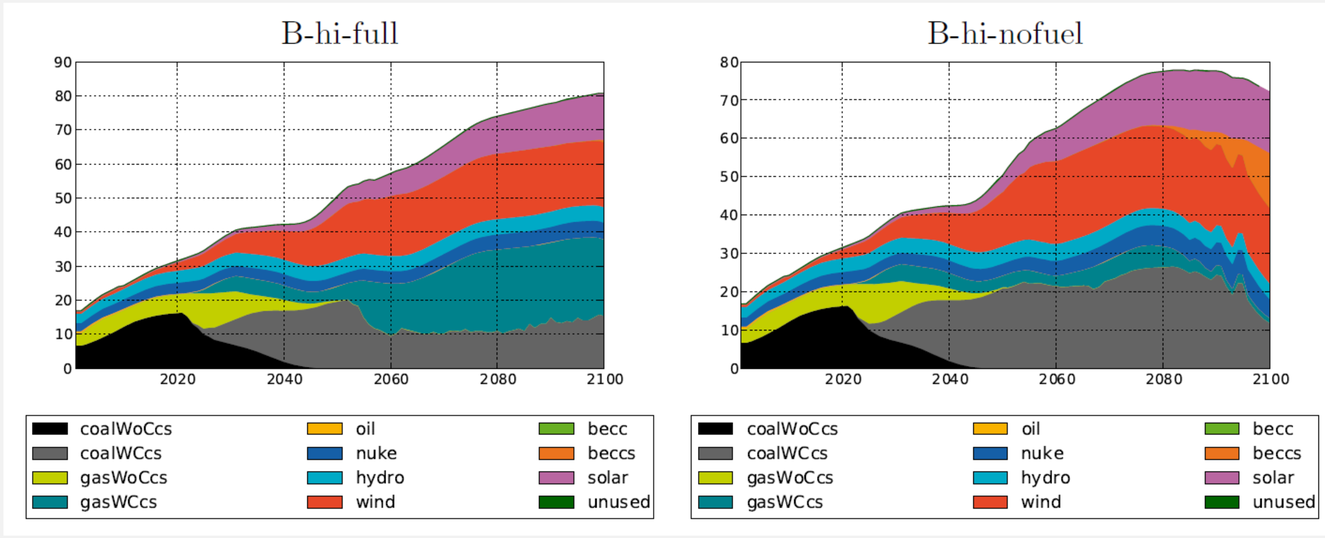
(ii) the carbon budget is achieved with a lower carbon tax, which alleviates the pressure on final energy demand.

The production of ligno-cellulosic fuels postpones the entry of bioelectricity by:

(i) increasing the biomass feedstock price and reducing the profitability of bioelectricity compared to other technologies;

(ii) alleviating oil price increase which favours investments in gas-fired power plants (with CCS) for the production of electricity.

Electricity mixes (103TWh/year). When cellulosic fuels are not available (B-hinofuel), the total demand of electricity is lower. Comparing to the B-hi-full scenarios, gas-fired power plants are substituted by coal with CCS power plants, renewables and a small share of bio-electricity



4. Conclusion and perspectives

Bioenergy technologies make it possible to achieve compliance with climate constraints while alleviating the economic pressure of the policy instrument (tax on emissions), all the while maintaining the level of energy services, especially in the transport sector.

The linkage of the energy-economic model Imaclim-R with the land-use model NLU sheds light on some inter- and intrasectoral implications of large scale deployment: accelerated intensification of livestock in most regions and postponed entry of bioelectricity.

Those results are robust to key assumptions regarding the AFOLU sector, especially in the case where deforestation is allowed.

References

F. Leblanc, T. Brunelle, P. Dumas, R. Bibas, C. Pelletier, R. Prudhomme. Implications of large-scale bioenergy deployment on energy demand and agricultural supply: an inter-sectoral perspective from the IMACLIM-NLU model. Submitted to Cimatic Change

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