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ANALYZING THE GLOBAL SUBSTITUTION POTENTIAL FOR FOSSIL FUELS-A SYSTEM DYNAMICS APPROACH

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Abstract
Not only in the context of scarcity of fossil fuels, but also regarding environmental constraints to mankind's economic activity, fuel substitution and conversion becomes more and more important. Macroeconomic literature provides a set of possible solutions both on the demand side – e.g. increasing energy efficiency and conversion coefficients – and the supply side – e. g. backstop technologies. The production of synthetic fuels creates additional interdependencies of combustibles. Coal can be converted to natural gas (coal-to-gas, GTL) or liquid fuels (coal-to-liquids, CTL), while natural gas can replace oil when transformed into gas-to-liquids (GTL). Biomass, reproducible and easily accessible since any kind of plant material can be used as input, can also be converted into a synthetic fuel (biomass-to-liquid, BTL).
Even though ecological innovations and technological progress are widely regarded as the ideal way towards sustainable development, energy forecasts should not neglect the energy systems' dependence on natural resources, whether exhaustible or not. This study therefore aims to develop a System Dynamics model to illustrate the determinants of and the interdependencies between global resource prices and supply respective demand. The simulation is run from 2005 to 2030, analysing the effect of fuel substitution and conversion on the global markets for oil, natural gas, coal and biomass. Several scenarios regarding substitution options are discussed, taking into account the impact of peak oil scenarios, post-Kyoto-Protocol climate protection effects and synthetic fuels.

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