Master's Thesis project proposal

Deployment of biomass conversion technologies for liquid transport fuels: short-term and long-term evolution of costs based on learning theory

Background

The project will focus on liquid advanced biofuels – defined as liquid fuels produced from lignocellulosic feedstocks from agriculture, forestry and waste – and liquid renewable alternative fuels produced from renewable hydrogen and CO2 streams. The commercialisation of these renewable transport fuels requires providing market stakeholders with consistent knowledge, data and tools, for estimating efficiencies, costs and environmental impact along the complete value chain from biomass sources and conversion technologies to marketable products and their end use.

In this context, the project will use a database with available process inventory data for thermochemical and biochemical conversion technologies targeting at methanol, ethanol, butanol, dimethylether, Fischer-Tropsch products (gasoline, diesel, kerosene) and methane as potential biofuels for road, aviation and maritime transport.

Aim

The aim of this project is to investigate ways of deployment of biomass processes in short- and long-term timeframes, quantifying the dependency of cost reductions with respect to various technology (and market) drivers (e.g. technology maturity levels, cumulative installed capacity growth rates, critical CAPEX and OPEX factors). The most prevalent framework to succeed in this quantification is the approach of learning curves, which typically describe the estimated cost reduction as a result from the experience of the technology implementation in terms of numbers of units implemented (i.e., referring to "learning by doing" mechanisms). A characteristic parameter of this approach is the "learning rate," defined as the fractional reduction in cost for each doubling of cumulative installed capacity. It is important to study if cost reductions may lead to a higher market uptake of liquid transport biofuels, investigate if cost reductions can be expected, and estimate required cost reductions for advanced biofuels to become cost competitive. Thus, the main project tasks are:

- Extensive literature search of methods and data for technological learning of biofuel production processes
- Enrichment of a database of liquid biofuel production paths with economic data and technological learning factors
- Application of the learning curve theory and assessment of cost reductions of liquid biofuels production, incorporating rigorous sensitivity analysis to assess the critical factors which affect their competitiveness

Additional information

The Master's thesis is part of the project ADVANCEFUEL (http://www.advancefuel.eu/). The project can be carried out by one or two students. The work corresponds to 30 ECTS credits (approximately 20 weeks).

Prerequisites

The students are expected to have a background in chemical, process or energy engineering (e.g., from, but not limited to, master programs Sustainable Energy Systems or Innovative and Sustainable Chemical Engineering). The students are also expected to have some basic knowledge and/or interest in cost engineering and sustainability.

Supervisors and Contact information

The project supervisors will be Dr. Paraskevi Karka and Associate Professor Stavros Papadokonstantakis.

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