Title: Superstructure-based synthesis and optimization of oil palm eco-industrial town: case study in Iskandar Malaysia

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Abstract: Malaysia is one of the world's top edible oil producers, having more than 5.23 million hectares of palm oil plantations and more than 400 palm oil mills. The oil palm industry produces millions of tonnes of biomass waste during harvesting and mill processing. This paper presents an oil palm eco-industrial town (EIT) that integrates a palm oil mill with nine downstream oil palm-based industries, as well as a community. The downstream industries produce various types of products such as crude palm oil, bio-fertiliser, bio-gas, bio-diesel, bio-pellet, medium-density fibreboard (MDF), and are also involved in the paper industry, and livestock production. Through the concept of industry symbiosis, the oil palm EIT promotes energy and material sharing among the industries and the community to reduce energy consumption, virgin material consumption, and waste generation. Therefore, this concept could provide economic and environmental benefits to upstream industries (utilisation of biomass), downstream industries (conversion of biomass to valuable products), and the community (job creation). In this work, a multi-objective linear programming model is formulated to maximise economic performance, while minimising waste generation in the oil palm EIT. The applicability of the model is demonstrated using a case study in Iskandar Malaysia (IM). The optimised model suggests that the most efficient way to utilise abundant oil palm biomass is via the production of crude palm oil, MDF, bio-paper, paper, bio-gas, and bio-diesel. The model could assist decision makers to identify the sub-industries in the EIT that would promote sustainability in the oil palm industry.