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1 **Life cycle assessment and nutrient analysis of various processing pathways in algal biofuel**
2 **production**

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11 **Abstract:**

12 This study focuses on analyzing nutrient distributions and environmental impacts of
13 nutrient recycling, reusing, and discharging in algal biofuels production. The three biomass
14 conversion pathways compared in this study were: hydrothermal liquefaction technology (HTL),
15 hydrothermal hydrolysis pretreatment +HTL (HTP), and wet lipid extraction (WLE). Carbon,
16 nitrogen, and phosphorous (C, N, P) flows were described in each pathway. A primary cost
17 analysis was conducted to evaluate the economic performance. The LCA results show that the
18 HTP reduced life cycle NO_x emissions by 10 % from HTL, but increased fossil fuel use,
19 greenhouse gas emissions, and eutrophication potential by 14%, 5%, and 28% respectively. The
20 cost of per gallon biodiesel produced in HTP was less than in HTL. To further reduce emissions,
21 efforts should be focused on improving nutrient uptake rates in algae cultivation, increasing
22 biomass carbon detention in hydrothermal hydrolysis, and/or enhancing biomass conversion
23 rates in the biooil upgrading processes.

24 **Highlights:**

- 25 • A majority of synthetic nutrients added to the algae to biofuel system will eventually be
26 discharged into the environment via wastewater.

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