

Advanced Sunshine-To-Petrol (S2P) technology framework: Methanol production from CO₂
using a direct carbon hydrogenation process

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Global warming and energy security are the most important topics due to the increasing consumption, rapid depletion and regional imbalance of conventional fossil fuels. One of the potential solutions is ‘Sunshine to Petrol’ (S2P) technology, which uses solar-thermal energy to convert CO₂ and water to liquid hydrocarbon. In this study, we proposed two new advanced S2P configurations using CO₂ hydrogenation to methanol production upon the baseline system of the conventional methanol synthesis route via synthesis gas (syngas). By developing rigorous process model using Aspen Plus, we comparatively analyzed technical and economic performances. The outstanding advantage of the new frameworks, over the baseline system, originate primarily in the direct use of CO₂, thereby reducing the utility consumption. Consequently, the proposed systems show the improved primary energy efficiency (up to 3%), while MSP (minimum selling price) comes with a decrease of 18% from the baseline system. Furthermore, we examined alternative scenarios to find the most optimistic conditions for the lowest MSP, which is relatively close to the market price of methanol.