The Future of Solar Fuels: When could they become competitive?

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Solar energy driven processes with H2O and CO2 as basic feed-stocks can produce "solar fuels" that could substitute their fossil based counterparts. This article summarizes the main findings of a techno-economic analysis of systems that can generate different types of fuels with renewable energy as starting point. These "renewable fuels" could potentially play a key role in future energy systems, both as storage medium in the power sector and as energy carrier in e.g. the transport sector, or deliver fundamental building blocks for the chemical industry. We determine whether, how, and when renewable fuels might become competitive alternatives for fossil fuels. The technologies required to produce renewable fuels are analyzed by the application of learning curves associated with individual system components. We thereby make projections for possible decreases in investment costs and reductions in fuel production costs. In an optimistic scenario we find that competitivity could be reached between 2025 and 2048 for all seven renewable energy production pathways that we investigate, for hydrogen, syngas, methanol, and diesel.