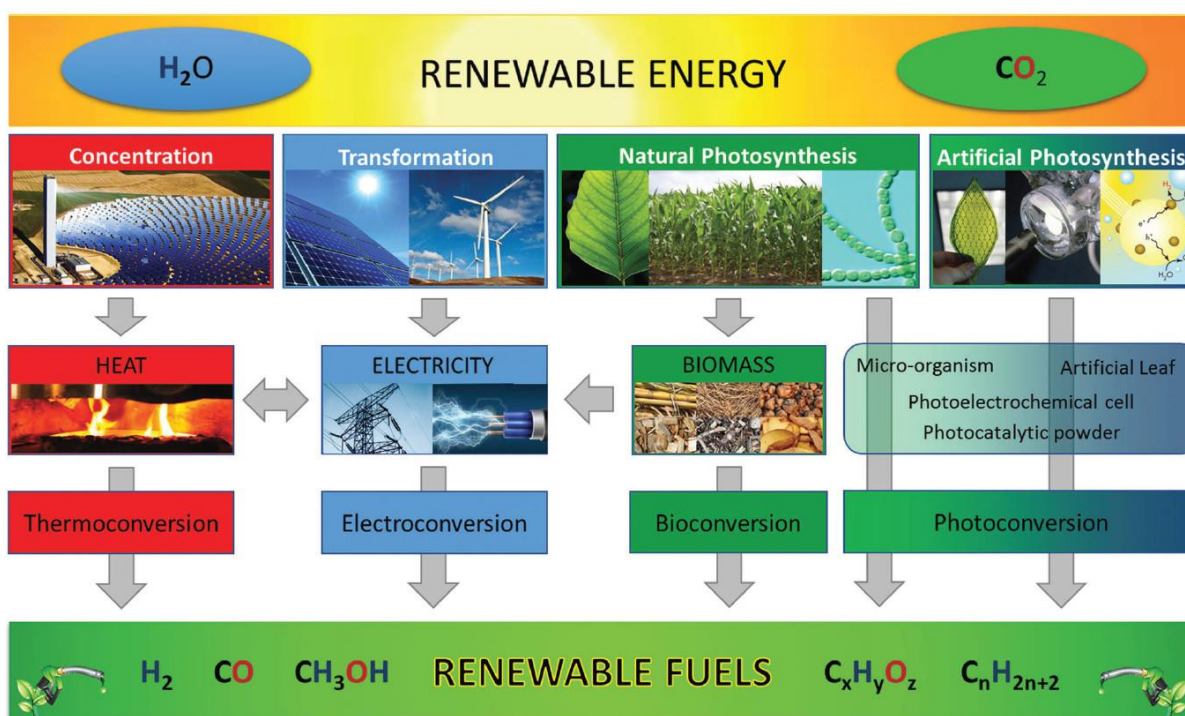




Renewable / Solar Fuels

Solar energy driven processes with H₂O and CO₂ as basic feedstocks can produce 'solar fuels', replacing their fossil based counterparts. These 'renewable fuels' are key to sustainable future energy systems, not only as an energy carrier in e.g. transportation, but also as potential storage medium in the power sector.

The production of renewable fuels requires renewable energy and H₂O and CO₂ as basic feedstocks. Four main categories exist, each consisting of multiple options, characterized by different stages of development, efficiencies, and costs:



- **Concentration:** solar light is concentrated to generate heat, which can be used in thermoconversion processes or for electricity generation.
- **Transformation:** renewable energy (e.g. wind, solar, geothermal, hydro, or tidal) is transformed into electricity, which is used to drive electroconversion processes such as electrolysis.
- **Natural photosynthesis:** natural biosystems transform H₂O, CO₂, and light into biomass, which subsequently can be converted into fuels, chemicals, heat, or electricity. Under this category, also (either genetically modified or not) organisms such as micro-algae can be converted into fuels, or can themselves produce fuels and chemicals in a direct photoconversion process by excreting the desired products out of their cells.
- **Artificial photosynthesis:** this category includes a collection of direct but non-bio based conversion processes, which use photoactive materials that capture sunlight and thereby drive a photoconversion process, e.g. in an artificial leaf, a photoelectrochemical cell, or photocatalytic powder.

From: R.J. Detz, J.N.H. Reek and B.C.C. van der Zwaan: 'The future of solar fuels: when could they become competitive?', in: *Energy & Environmental Science*. DOI: 10.1039/C8EE00111A.