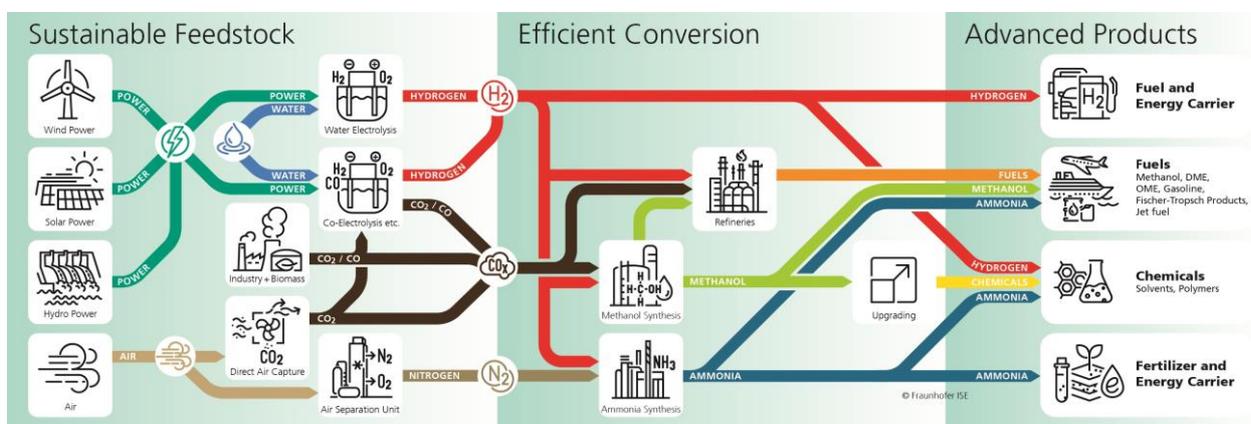


**Process dynamic operational strategies und intensification as key "enablers" for PtX technologies realization and achieving sustainable society goals: examples Power to- Methanol and -Ammonia**

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Sustainability is not anymore optional ...!

Vast amounts of green H<sub>2</sub> and PtX products are required and addressed in several studies as one of the only viable solutions to achieve the national energy transition ("Energiewende") targets from economic and ecological perspective in the intended time frame until 2050. Methanol (MeOH) and ammonia (NH<sub>3</sub>) as Power-to-Liquids (PtX) product with interesting key characteristics and a broad spectrum of applications as energy carriers, sustainable fuels, and as important chemical building blocks. Currently, MeOH and NH<sub>3</sub> are mainly produced based on fossil feedstock as natural gas or coal. The shift to renewable feedstock from CO<sub>2</sub> and hydrogen will require advanced pathways to produce these important PtX to achieve economic competitiveness. PtX processes boundary conditions require advanced strategies matching with the feedstock fluctuations. Shortcutting the gap between ideas, lab experimentation, simulation and industrial realization is an urging research aspect in that context. Our group Power to Liquids at Fraunhofer-Institut für Solare Energiesysteme ISE is developing together with industrial partners tailor made methodologies and equipment for these purposes. Process intensification as modern approach with several benefits in PtX context will be highlighted in this presentation. Robust process equipment coupled with high edge analytics opens the horizon for demonstration of highly integrated unit operations under dynamic operating conditions and importantly; at high TRL. The way between such demonstrations and industrial deployments is not anymore so long. Some of the state-of-the-art and emerging production pathways will be presented. Particular focus is hereby put on the process intensification approach and its influence on the overall process enhancements. Last but not least, techno-economic insights into a Pt-MeOH and PtA processes highlighting outstanding research endeavors will be given.



**Figure 1** PtX value chain at Fraunhofer ISE