# From Theory to Demo: Scaling up a new methanol process for small decentral sustainable feedstocks

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## Abstract

The search for more efficient and environmentally friendly ways of producing chemicals has become a central concern of modern chemical research. With the growing challenges of climate change and sustainable resource extraction, the need to find and scale up innovative solutions quickly is more urgent than ever.

One example is the computational design of a new, highly efficient catalyst for methanol production that significantly reduces environmental impact.
Methanol is now produced at a rate of 100 megatonnes per year, with the old process responsible for around 1% of global $CO_2$ emissions. As the shipping industry increasingly turns to sustainable green methanol for defossilization, there is an additional market potential of up to 500 megatonnes per year, representing a significant potential for saving fossil marine fuels. In addition to the shipping industry, the aviation industry is also turning to green methanol as a feedstock for SAF fuels. Adding the potential of green methanol-to-olefins further increases the potential for defossilization on the path to a sustainable methanol economy.

Conventional methanol plants are not suitable for small-scale, decentralised and load-flexible production from renewable energies and raw materials. Only a new, highly efficient technology can close this gap and at the same time be competitive with conventionally produced methanol.

By developing a new homogeneous catalyst system, it has been shown that the temperature can be drastically reduced from 260°C to 120°C and the pressure from 50 bar to less than 20 bar compared to the conventional process. The conversion of reactants per reactor run was also significantly increased from 15% to over 95%, which also allowed a significant simplification of the engineering systems. The high purity of the product also eliminates the need for energy-intensive water separation.
This new methanol production process has been scaled up from computer simulations to laboratory bench scale, 5L continuous mini pilot scale and 100L container scale in an industrial environment. Based on the promising progress, planning for a 10+ tonne per day pre-commercial demonstration has started.

These technical advantages allow much smaller and cheaper plants to be built alongside small-scale sustainable carbon feedstocks such as biomass, biogas, plastic waste, sewage sludge and hard-to-replace $CO_2$ point sources.