

TECHNO-ECONOMIC ANALYSIS OF VARIOUS POWER2X CONCEPTS FOR THE INTEGRATION OF CO₂-BASED SYNTHESIS

Sebastian Stiebel*, Görges Deerberg, Torsten Müller, Anna Grevé, Thomas Marzi

Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT, Osterfelder Strasse 3, 46047 Oberhausen, Germany

Phone* +49 208 8598-1525, E-mail* sebastian.stiessel@umsicht.fraunhofer.de, www.umsicht.fraunhofer.de

MOTIVATION

The increasing share of fluctuating renewable energy (RE) and the stronger regulations for emitting flue gases lead industrial plant operator to combine and optimize processes even across actual sectoral borders.

These cross-industrial cooperations focus on technologies like power-to-gas or power-to-chemicals which offer the ability to integrate new synthesis routes by using flue gases, containing CO and CO₂ and electrochemical produced hydrogen. Different product lines for bulk chemicals, fuels, fertilizer or polymers are possible concepts.

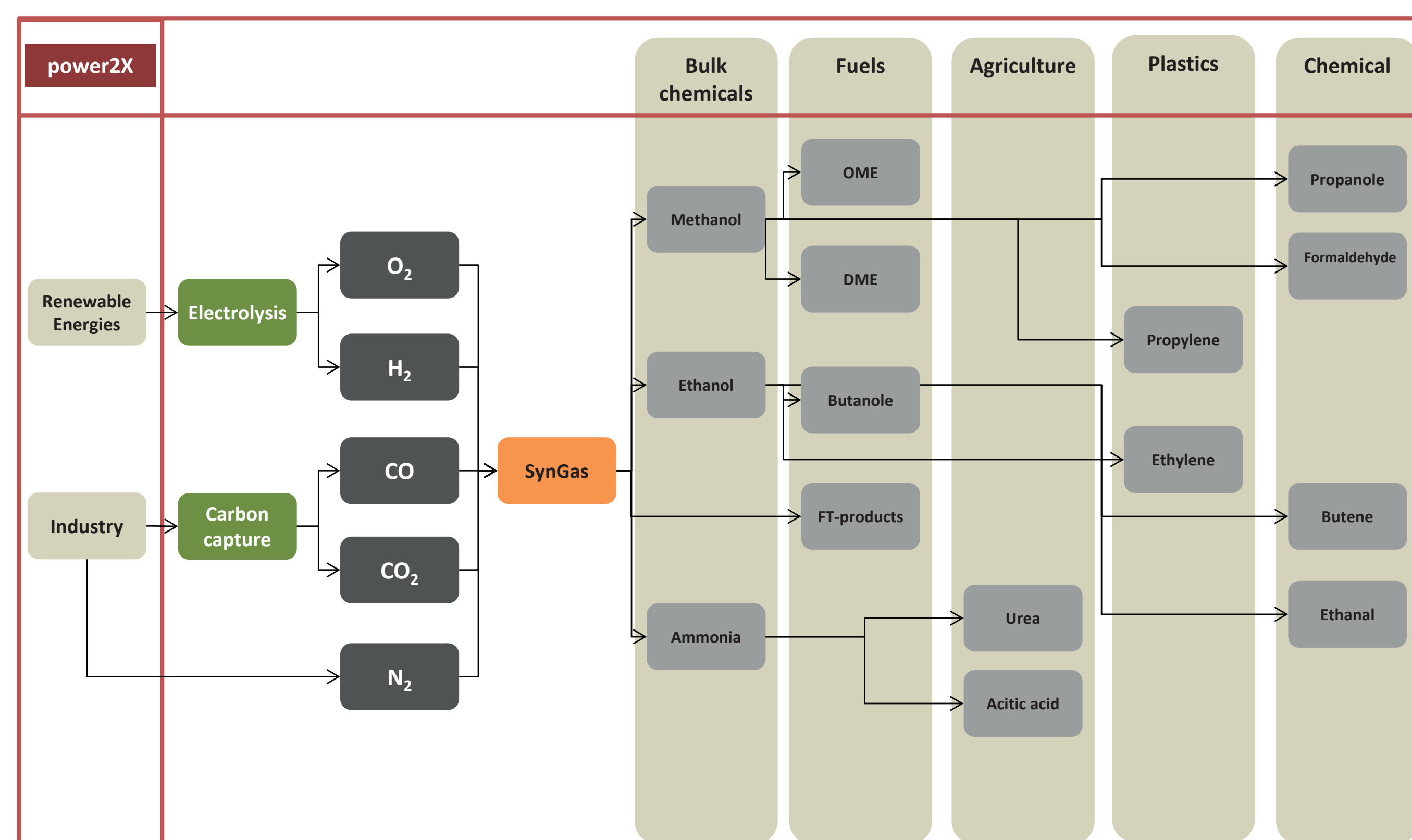


Fig. 1: Synthesis routes based on renewable hydrogen and industrial flue gases with possible target sectors

Main drivers for the integration of these technologies are the identification of efficient synthesis routes and the evaluation of potential regions. Previous work generally deals with the feasibility of the conversion of H₂ and CO₂ to higher value products, without an optimized siting on the basis of local infrastructure.

APPROACH AND RESULTS

It was developed a 5-step-approach to identify and evaluate potential locations by determining central evaluation criteria.

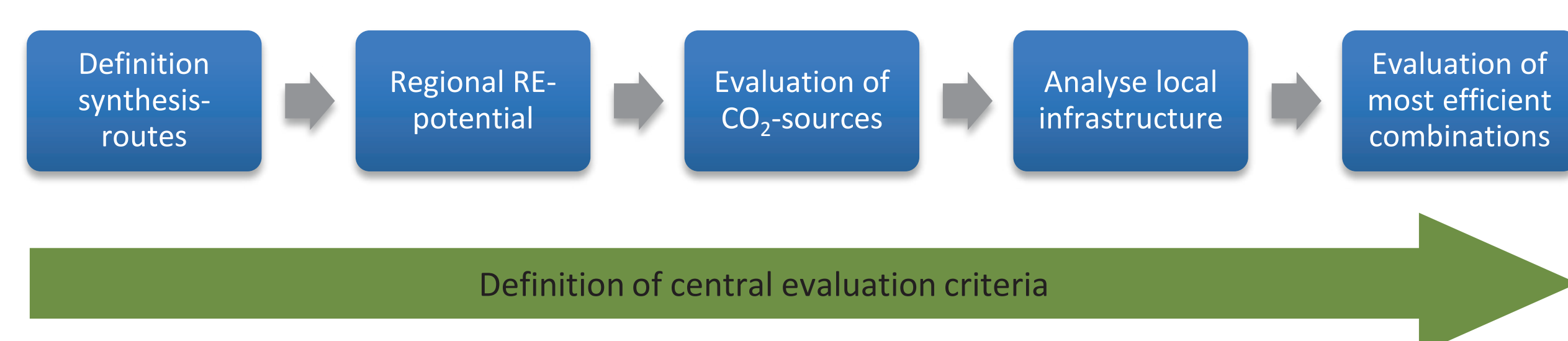


Fig. 2: 5-step approach to evaluate local potentials

The state North Rhine-Westphalia (Germany) was selected for the validation of this approach and different regions with various CO₂ sources regarding different quantity and quality of the CO₂ were analyzed to show possible options by focusing different parameter.

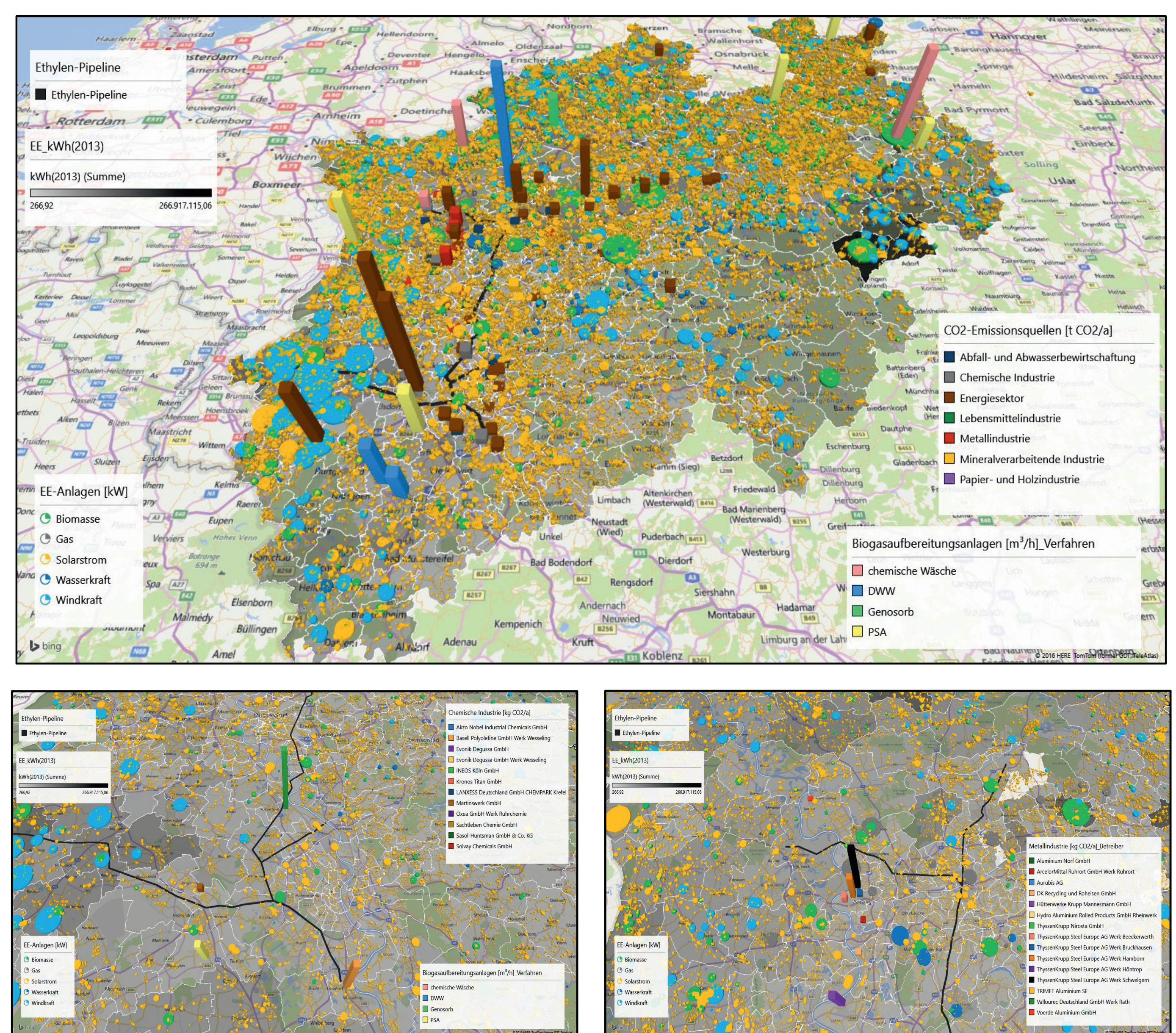


Fig. 3: Overview of the analysed region and the specific potentials in NRW (top); model region A (down left) and model region B (down right)

Besides CO₂-emitting sources and local transport-infrastructure, existing plants producing electrical power by renewable energy were identified. Using renewable energies for power generation is one of the main criteria for the successful and CO₂-reducing integration of power2X-concepts.

Finally this approach induces relevant evaluation criteria for different regions and concepts:

- CO₂ emissions
- CO₂ concentration in flue gas
- Cost of CO₂ separation
- Energy demand for separation
- Flue gas conditions (temperature, pressure)
- Open space for plant installation
- Content of trace gases
- Number of local RE-types
- Power of local RE-plants
- Additional transport-infrastructure (H₂, CO₂/CO, end product)
- Distance to possible purchaser