INTERREG BAYERN–ÖSTERREICH · BioH2Region (Project No. BA0100157h)

From an open question to an optimized energy concept

A stepwise pathway for SME process-heat decarbonization with green gases

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The challenge

SMEs in Bavaria and Upper Austria cover their process heat with heating oil or natural gas. They rarely have the in-house capacity to judge which green alternative fits their site and a wrong first step is expensive. BioH2Region turns that open question into a dimensioned energy concept in five steps, and tests the method on real businesses on both sides of the border.

At a glance

Duration July 2024 – June 2027

Funding € 1,025,564.40

Target groups SMEs, municipalities, the public, business support organizations

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The pathway *five steps from site to concept*

1

Site analysis

Regulatory conditions, grid and gas connection, permits and bottlenecks; primary energy available on site, space and safety distances; regional options such as energy communities.

2

Technology selection

Which renewables can be expanded and under which funding scheme, whether process efficiency can be raised first, which storage fits, and how mature each candidate is.

3

System Sizing

The load profile is translated into equipment: heat demand and available PV set electrolyzer rating and storage volume; seasonal surplus is made usable.

4

System modeling

Processes are represented as time-resolved consumption profiles at 15–60 min resolution and combined with weather data, so operating costs become realistic.

5

Optimization

The design is tested through sensitivity analysis and optimized for energy, cost and emissions — the result is a concept an SME can put out to tender.

The pathway applied — two SME cases

01 Coffee roasting — Salzburg (AT)

SIZING · SYSTEM MODELING · OPTIMIZATION

PV on site → **PEM electrolyzer** 10 kW → **Compression** 30 → 300 bar → **Roaster burner** replaces NG

738 kg
hydrogen demand per year

21.11 €/kg
levelized cost of hydrogen, base case

15.60 €/kg
at 50 % lower electrolyzer CAPEX

- A MATLAB/Simulink model of the PV array, the PEM electrolyzer, two-stage compression and the fluidized-bed roaster feeds an MILP schedule over one full year.
- Discount rate, PV CAPEX and electrolyzer CAPEX dominate the levelized cost of hydrogen.
- Halving the electrolyzer CAPEX cuts the LCOH by roughly a quarter. At SME scale the economics are decided by capital cost, not by conversion efficiency.
- Storage strategy is the second lever: pressure level and electrolyzer utilization trade grid purchases against storage investment.

Model: MATLAB/Simulink (PV, PEM, compression, roaster) coupled to an MILP schedule in MATLAB, hourly resolution over one year.

02 Craft bakery — Ruhstorf (DE)

SITE ANALYSIS

Ovens at 200–250 °C, fired with heating oil; 19 electricity supply points at 14 locations. Three pathways were assessed against the same six criteria: maturity, retrofit depth, infrastructure, energy cost, regulation and product quality.

2,000–2,300
MWh/a process heat (estimate*)

60–70 t
hydrogen per year if switched to H_2

2.2 ×
total electricity use if produced on site

1. Electrification

Proven in bakeries. The decisive cost driver is not the oven but the grid connection: 150–300 kW of new capacity, plus load management to cap peaks.

2. Bio-LPG / biomethane

Drop-in for existing ovens after a burner swap; 80–90 % less CO_2 than heating oil. Payback 10–12 years today, 4–6 years with the expected CO_2 price rise.

3. Hydrogen

On-site electrolysis would need 3,100 MWh/a — more than twice the company's entire electricity use — and Landkreis Passau is not on the planned H_2 core network.

** Analogy estimate from a reference bakery of the same size class (≈ 200,000–230,000 L heating oil per year). Fuel use at the production site is not yet metered.*

Green gases shift the cost from the meter to the balance sheet. Hydrogen at SME scale is driven by CAPEX, not efficiency; electrification by grid connection capacity; bio-LPG by the CO_2 price trajectory. The right question is not which fuel is cleanest, but which cost an SME can carry.

Project partners

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