

sympheny

# BG GROUP Feasibility studies for green hydrogen production

Authors: Shanshan Hsieh

Year: 2023



Illustrations: SAM Architekten / Filippo Bolognese Images

## Introduction

Engineers from BG turned to Sympheny to help them to study the commercial viability of optimal resource utilization for green hydrogen production. Our web application efficiently analyzed data from various energy streams and successfully highlighted the benefits of sector coupling. This enabled BG Group to identify the optimal system design to use excess renewable electricity produced from PV panels for green hydrogen production and achieve the project's decarbonization goals.

## Key facts

- Type of site: industrial and residential sites
- System highlights:
  - Green hydrogen production with on-site PV
  - Heavy mobility decarbonization
  - Waste heat recovery

## What was achieved

- Decarbonisation goals
- Cost effectiveness
- Optimal design and operation strategies

## Framing the Opportunity

Feasibility studies for green hydrogen production address two major challenges: the competition for on-site renewable resources, and the cost of production. Energy planners must capture complex technology interactions when analyzing multi-energy systems scenarios to address these concerns. The many variables that need to be considered challenges the traditional variant comparison methods.

Engineers from BG used Sympheny's platform to explore a large number of possible scenarios in the context of a feasibility study on coupling energy sources (heat, hydrogen, and diesels) for two sites in Western Switzerland:

### The industrial site

a 20,000 m<sup>2</sup> available surface for PV installation and hydrogen production facilities. The produced green hydrogen can be used directly as fuel for trucks or be stored and used later to produce heat and electricity via fuel cells. Subsequent heat production from fuel cells and electrolyzers could be used to supply heating to the residential site via a thermal network.

### The residential site

a small neighborhood with 14 multi-family houses, totaling 3,200 m<sup>2</sup>. The rooftops of these homes are available for PV installation. Besides hydrogen storage, other storage technologies such as batteries, boreholes, and hot water tanks are also present at respective sites.

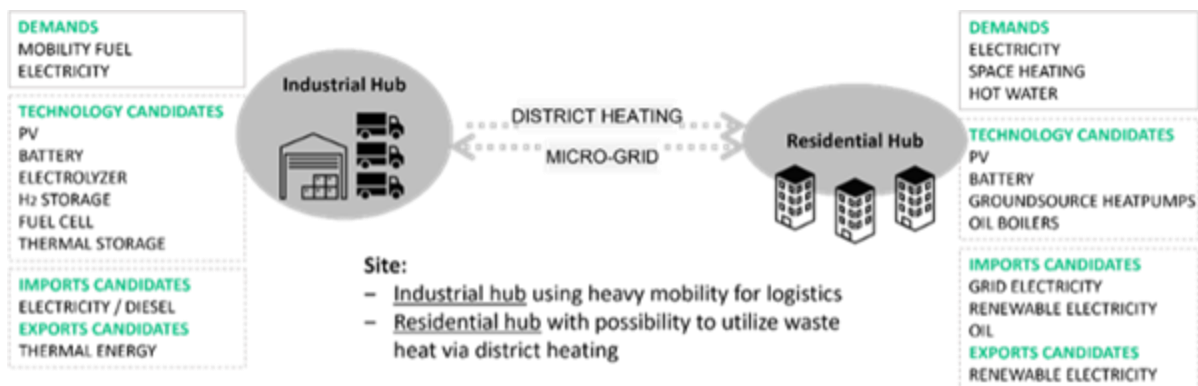


Figure 1 Site description of this case study.

## The story of BG Group

The BG Group is an international engineering consulting firm. Founded in 1954, it operates in Switzerland and France, providing planning and development support to its global clients and assessing of infrastructure, environment, building and energy projects. The company offers multidisciplinary management and engineering services in the infrastructure, environment, construction, and energy sectors.

## Why Sympheny

As a winner of BG'S Boost My Startup Challenge 2021, Sympheny has partnered multiple times with BG on projects featuring multi-energy systems, with a special focus on sector coupling. The company's engineers have used our platform to model systems and flexibly integrate and adapt data structures while ensuring transparency and reliability throughout the early planning stage. Thanks to our software, BG Group was able to effectively model all relevant technologies holistically and communicate results to stakeholders easily and transparently.

## How Sympheny was used

For this study, engineers from BG Group configured a digital twin of an integrated system including hydrogen production technologies using our software. They combined this with their internal knowledge on economic and performance parameters from real hydrogen, storage, multi-energy, and mobility projects. Thanks to the digital twin set up in the web application, our algorithm was able to identify several system design variants in less than 10 minutes. A benchmark was configured to simulate a reference system with fossil-based technologies, such as diesel trucks, oil boilers, and grid electricity.

## Results and benefits

By holistically modelling and identifying the optimal energy system design through our software, the engineers at BG were able to provide a clear and reliable answer regarding the commercial and operational feasibility of integrating green hydrogen production at its industrial and residential sites.

### Decarbonisation goals:

- A 60% reduction in CO<sub>2</sub> equivalent emissions compared to the fossil-based business-as-usual systems, while remaining cost competitiveness.
- A roadmap towards near zero emissions: The algorithm identified suggestions to utilize even more renewable energy resources and quantify the additional costs required to achieve it.

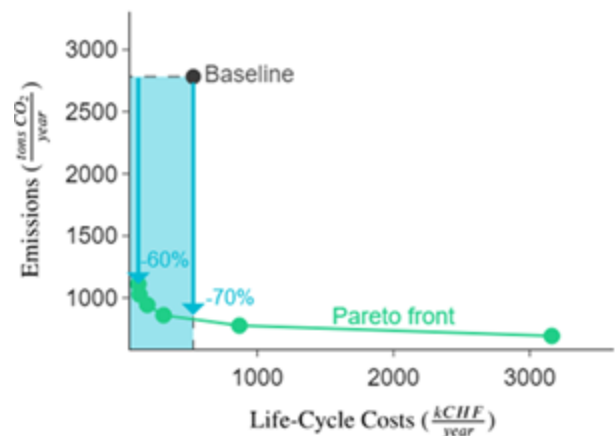


Figure 2. Costs and emissions performances of six system design variants as well as the reference (baseline) system for comparison. The reference system utilizes 100% fossil resources, which are diesel trucks, oil boilers, and grid electricity.



### Cost effectiveness:

- A 60Up to 26% less life cycle costs compared to the reference system
- Green H<sub>2</sub> production cost comparable with the price of diesel\*.

*\*The production cost of green H<sub>2</sub> includes the capital costs of electrolyzers, compressors, and H<sub>2</sub> storage. In this case study, the price of replacing diesel trucks with H<sub>2</sub> trucks is not considered.*

### Operational efficiency:

- Increased system resilience

In addition to cost and emission reduction, the identified energy system allows for self-sufficiency for the site (zero import) for at least 15% of the time compared to the initial reference system that entirely relies on import of electricity and fuel.

- Identifying the best use of renewable resources according to seasonality

The six optimal design variants allowed BG engineers to better understand the trade-offs of the different design possibilities". For these sites, replacing 60-70% of diesel with green hydrogen produced by PV electricity makes the most economic sense. In summer, excess electricity from the residential site can be used to produce green hydrogen in the industrial site, while the waste heat from green hydrogen production would be enough to supply hot water for multi-family houses. During winter, the electricity produced by PV at the residential site can be used directly to supply electricity demand and heating demand via heat pumps, while the supply of H<sub>2</sub> fuel for the industrial area would be provided through storage and PV electricity produced on site.

## Conclusion

The feasibility of green hydrogen production is highly context specific, thus requires individual analyses for each site. We have demonstrated that Sympheny is an efficient and effective tool for pre-feasibility study for emerging technologies under fast changing market conditions.

Visit [www.sympheny.com](http://www.sympheny.com) to view more case studies or  
contact us to discuss your projects!