MODULE 3

REDUCING EMISSIONS IN THE HYDROGEN SUPPLY CHAIN – CASE STUDY OF LOGISTICS COMPANY H2TRANS LOGISTIC

Introductory note:
The described case is based on a model, educational situation prepared for the needs of a vocational course for hydrogen logisticians. The name "H2Trans Logistic Sp. z o.o." is fictitious, and all figures and solutions were developed based on real trends, technologies and industry reports. The aim of the study is not to present the activities of a specific company, but to illustrate the complexity and potential of reducing emissions in hydrogen logistics in a practical and systemic approach.

Introduction: Hydrogen and Its Logistic Carbon Footprint Energy transformation based on the hydrogen economy is becoming one of the key directions of the European Union's climate policy. However, the potential for decarbonization through the use of hydrogen depends not only on the production technology itself, but also on the emissions generated throughout the supply chain. Hydrogen logistics, including transport, handling and storage, must be designed in a way that allows for the reduction of greenhouse gas emissions to meet the assumptions of sustainable development.

Case Study: H2Trans Logistic Company's Business
H2Trans Logistic Sp. z o.o. is a hypothetical logistics company specializing in the transport of compressed hydrogen (CGH_2) in the CEE region. The main source of supply is a production plant located in southern Poland, using steam methane reforming technology (so-called grey hydrogen). Hydrogen is delivered to industrial recipients in the Czech Republic, Slovakia and Hungary using a fleet of tractor units equipped with high-pressure tankers.

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A life cycle analysis (LCA) conducted for the company showed that:

- 72% of emissions come from the hydrogen production process,
- 21% from medium-distance road transport (up to 500 km),
- 7% from transshipment, losses and storage.

In total, one full cycle of hydrogen delivery to a customer generated an average of more than 1.3 tonnes of CO_2 emissions, which the company and its customers identified as an area requiring urgent optimisation.

Decarbonization Activities – Implemented Solutions

The company has embarked on a decarbonisation process, introducing a number of improvements at both the strategic and operational levels:

1

Changing Sources of Hydrogen Production

A contract was signed to purchase green hydrogen (produced by electrolysis from renewable energy sources) from the German wholesale market, under the Guarantee of Origin (GO) system. This hydrogen was introduced into the supply mix as a low-emission component, reducing the overall carbon footprint.

2

Modernization of Fleet and Transport Logistics

As part of the pilot, three tractors powered by liquid hydrogen (LH_2) were purchased. The vehicles were used on routes between regional hubs, which allowed for the assessment of their efficiency and operating costs. Additionally, a TMS (Transport Management System) was implemented with route optimization and cargo management functions.
With new delivery schedules:

- the number of empty runs was reduced by 36%,
- fuel consumption in traditional vehicles reduced by 18%,
- average delivery time reduced by 12%.

3

Expansion of Distribution Infrastructure

The company, in cooperation with the Czech energy operator, established a local distribution hub in Ostrava, equipped with cryogenic tanks for storing LH_2. This allowed to shorten the final stages of delivery and reduce the load on the main warehouse.

Environmental and Economic Effects

After 9 months of implementing the changes, H2Trans Logistic achieved the following results (educational simulation based on industry data):

- Reduction in CO_2 emissions per delivery cycle: 38%
- Reduction in fleet operating costs: 11%
- Increased competitiveness in public and corporate sector tenders
- Introduction of ESG indicators to environmental reports, which enabled obtaining points in the evaluation of offers by institutional clients

Conclusions and Educational Significance

The described analysis shows how hydrogen logistics – considered to be the energy sector of the future – can become a driver of environmental and organizational innovations at the same time.

Supply chain transformation requires a combination of:

- investment in new technologies,
- data integration and automation,
- dialogue with recipients and openness to joint partnership activities.

For those studying to become hydrogen logistics professionals, the case study provides an example of how sustainable development strategies can be built on specific operational data. The data presented is model-based, but it reflects the directions that European companies operating at the intersection of energy, transport and climate are heading.

GROUP DISCUSSION QUESTIONS

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Objective: Deepening reflection, developing the ability to analyze the problem and implement solutions consistent with sustainable development.

Discussion – open questions:

1. What are the biggest logistical challenges related to hydrogen distribution in Central and Eastern Europe?
2. In your opinion, was the decision to purchase green hydrogen from the German market optimal? What are the alternatives?
3. How can local distribution hubs influence the energy and environmental efficiency of the supply chain?
4. What are the risks of investing in an LH_2-powered fleet in terms of infrastructure?
5. What are the social and environmental benefits of reducing emissions in hydrogen logistics?
6. Are the actions described in the case study possible to implement in small companies? What conditions would have to be met?
7. What competencies must a logistician responsible for implementing green innovations have?

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