

MODULE 4

PODCAST: CONTEMPORARY HYDROGEN LOGISTICS ADMINISTRATION

Welcome to another episode of our podcast! Today, we will explore the intriguing realm of contemporary hydrogen logistics management. This subject is particularly pertinent and rapidly evolving, especially in light of the increasing demand for sustainable energy sources.

Hydrogen, as an energy carrier, is emerging as a crucial component of the energy transition. However, its distinctive properties present particular logistical challenges. It cannot be handled in the same manner as conventional fuels. Every stage must be considered—from production to storage, transportation, and distribution to the final consumer. This is precisely the topic of our discussion today.

Trends in Hydrogen Transportation

Let us begin by examining the pivotal trends that are influencing the present hydrogen logistics landscape.

The foremost, and arguably most critical, factor is the enhancement of hydrogen infrastructure investment. This encompasses the establishment of new electrolyzers for hydrogen production, import and export terminals, pipeline networks, and refueling stations. In the absence of sufficient infrastructure, even the most ambitious hydrogen initiatives will remain theoretical. A pertinent example in Europe is the evolving European Hydrogen Backbone, anticipated to include over 28,000 km of hydrogen pipelines by 2040—primarily through the modification of existing gas pipelines, alongside the construction of new segments. This illustrates the magnitude of investment and aspiration involved.

Another trend is the advancement of hydrogen transportation technologies. Conventional hydrogen transport, particularly in gaseous form under high pressure, is costly and energy-intensive. Consequently, we are witnessing the swift evolution of alternative methods.

I am considering the transportation of hydrogen in liquid form, which necessitates extremely low temperatures but facilitates the movement of larger volumes. Another avenue involves hydrogen carriers, substances capable of "storing" hydrogen and releasing it when needed. Notable examples include ammonia and liquid organic hydrogen carriers (LOHC). These innovations have the potential to transform logistics, rendering it more adaptable and cost-effective. Germany is proactively investigating the transport of hydrogen in ammonia form, viewing it as a means to import substantial quantities of hydrogen from areas with significant renewable energy potential, such as Australia and the Middle East.

Digitalization and automation are indispensable. In the hydrogen logistics sector, as in any other logistics industry, data and advanced algorithms are pivotal. Real-time monitoring systems, artificial intelligence for route optimization, and blockchain for tracking hydrogen origins are integral components that enhance the efficiency, safety, and transparency of the hydrogen supply chain. Envision a system that perpetually analyzes demand, availability, and costs, automatically optimizing the entire delivery process. This is no longer a concept of science fiction; it is our reality. The Belgian company Fluxys is currently testing AI-driven solutions to optimize hydrogen flow within pipeline networks, with the objective of minimizing losses and maximizing efficiency. For instance, AI algorithms can forecast fluctuations in hydrogen production from renewable energy sources, such as wind or solar, and adjust hydrogen transmission accordingly to prevent downtime or excessive network strain.

A final, yet equally significant, trend is the increasing emphasis on certification and safety standards. Hydrogen, despite its environmental benefits, is a flammable gas. Consequently, it is imperative to uphold the highest safety standards throughout every phase of the supply chain. New international standards are being formulated, and companies are actively pursuing relevant certifications, thereby fostering trust among customers and partners. Safety must remain a paramount concern. The International Energy Agency (IEA) projects that global production of clean hydrogen could reach approximately 100-180 Mt (million tons) by 2030, underscoring the urgent need for the development of harmonized and stringent international safety standards to manage such volumes. These standards encompass all aspects, from electrolyzer design and storage tank specifications to transportation protocols and hydrogen vehicle refueling regulations.

Let us now transition to best practices, specifically established solutions that will assist you in effectively managing hydrogen logistics.

First, comprehensive supply chain planning and modeling are essential. It is insufficient to focus on a single stage; we must consider the entire landscape—from the production source, through storage and transportation, to the final customer. Employing advanced modeling tools enables us to simulate various scenarios, identify bottlenecks, and optimize costs. This facilitates informed decision-making prior to initiating any projects. A pertinent example is the HyDeal Ambition project, an initiative involving over a dozen European companies, including Engie, OGE, and GRTgaz. The objective is to produce and deliver 1.7 million tons of green hydrogen by 2030 at a competitive price. This project extensively employs advanced simulation models to optimize the entire supply chain, from electrolysis through transmission systems (pipelines) to heavy industry outlets (e.g., steelworks, fertilizer factories). These models facilitate the analysis of the impact of various factors, such as electricity prices, electrolyzer locations, pipeline routes, and customer demand, on the final cost of hydrogen and logistics efficiency. This comprehensive approach aids in minimizing risks and ensuring investment profitability.

Another best practice involves diversifying transportation methods. There is no singular, universal approach to transporting hydrogen that is applicable in every scenario. In some instances, pipelines represent the most effective solution, while in others, tankers may be preferable; in the future, specialized ships may also be required. The essential factor is flexibility and the capacity to integrate various transport modalities based on distance, volume, and specific supply needs. This strategy minimizes risk and ensures a continuous supply. In the Netherlands, where hydrogen is anticipated to play a pivotal role in industrial decarbonization, a hybrid approach is being adopted. For instance, dedicated hydrogen pipelines are being planned for large industrial clients in areas such as Rotterdam and Eemshaven. Conversely, for smaller clients, such as hydrogen refueling stations for public transport or trucks, high-pressure hydrogen tanker transport is utilized. Furthermore, for hydrogen imports from distant regions, ships transporting hydrogen in liquid form (LH₂) or as ammonia—more easily transported by sea and convertible back into hydrogen—are also under consideration. This variety of transport methods facilitates optimal adaptation to the scale and requirements of recipients.

The third practice involves investing in hydrogen storage. Hydrogen, similar to other renewable energy sources, is marked by fluctuating production levels. Therefore, storage is essential for ensuring supply stability.

This encompasses both above-ground and underground storage (e.g., in salt caverns), along with innovative solutions such as metal storage. Well-engineered storage systems facilitate the balancing of supply and demand while also accommodating sudden fluctuations in availability or demand. In the UK, the HyNet North West initiative seeks to establish the first fully integrated hydrogen ecosystem in the region. A pivotal component of this project is the utilization of hydrogen storage in salt caverns located near Manchester. These natural underground formations are optimal for storing substantial volumes of gas at high pressure. These storage facilities will accommodate green hydrogen generated from electrolysis, as well as low-carbon hydrogen derived from methane reforming with CO₂ capture. This arrangement enables the release of hydrogen from storage during periods of low renewable energy production or elevated demand, thereby ensuring a stable supply for industry, transportation, and heating.

The fourth best practice emphasizes the importance of close collaboration with business partners. The hydrogen supply chain is intricate and necessitates the participation of various stakeholders, including producers, technology suppliers, transport companies, distributors, and regulators. Effective communication, transparency, and the cultivation of long-term relationships founded on trust are essential for success. It is important to recognize that we are all in this together. Initiatives such as the Clean Hydrogen Partnership (formerly known as FCH JU - Fuel Cells and Hydrogen Joint Undertaking) within the European Union exemplify such collaboration. These initiatives unite companies, research institutions, and member states to collectively fund and coordinate hydrogen research and development projects. This collaborative approach facilitates the sharing of knowledge, resources, and risks, thereby expediting the advancement of hydrogen technologies, standardization, and the implementation of innovative logistics solutions. A notable project funded through this partnership is the development of next-generation hydrogen refueling stations, where electrolyzer manufacturers, gas suppliers, and station operators work together to establish an optimal supply and distribution model.

The Clean Hydrogen Partnership, formally recognized as the Clean Hydrogen Joint Undertaking (JU), is a pivotal European public-private initiative that significantly contributes to the advancement and implementation of clean hydrogen technologies across Europe. This partnership unites three principal stakeholders: the European Commission, the hydrogen industry (represented by Hydrogen Europe), and the research community (represented by Hydrogen Europe Research). Their collective objective is to position Europe as a frontrunner in the global hydrogen economy and to aid in the attainment of climate neutrality by 2050.

What are their objectives and domains of engagement?

The Clean Hydrogen Partnership is dedicated to advancing research and innovation (R&I) throughout the entire hydrogen value chain, encompassing production to end-use applications.

Key areas of focus include:

- **Clean Hydrogen Production:** Advancing electrolysis technologies (e.g., alkaline, PEM, SOEC) to lower costs and enhance the efficiency of green hydrogen production from renewable energy sources. Initiatives in this domain frequently investigate innovative approaches, such as seawater electrolysis or the integration of electrolyzers into industrial processes (e.g., steelmaking).
- **Hydrogen storage and distribution:** Advancement of secure and cost-effective techniques for hydrogen storage (gaseous, liquid, in carriers, in subterranean caverns) and effective distribution systems (pipelines, road, rail, maritime).
- **Hydrogen applications:** Advocating for the utilization of hydrogen across diverse sectors, including:
 - **Industry:** Decarbonization of high-emission sectors (steel, cement, chemicals) through the substitution of fossil fuels with hydrogen.
 - **Transport:** Advancement of hydrogen-powered vehicles (automobiles, trucks, buses, trains, ships, and even aircraft) and refueling infrastructure.
 - **Energy:** Utilization of hydrogen for the generation of heat and electricity (e.g., in fuel cells and gas turbines).
 - **Cross-cutting activities:** Encompassing safety, standardization, life-cycle analyses, skills development, digitalization, and support for hydrogen ecosystems.

The Clean Hydrogen Partnership is financing numerous projects that significantly contribute to the advancement of hydrogen technologies. In 2024, grants totaling €154.6 million were distributed among 26 new initiatives. By 2025, the budget for new projects increased to €184.5 million, with €80 million designated for the development of Hydrogen Valleys.

The Hydrogen Valley represents a cohesive ecosystem that integrates the production, storage, distribution, and utilization of hydrogen within a designated region.

An illustration of such an initiative in Europe is:

- **HySPARK (Poland):** This Polish initiative seeks to establish a hydrogen ecosystem centered on airports and public transportation. HySPARK is investigating the application of hydrogen in airport operations, including baggage carts, airport shuttles, and ultimately, aircraft, as well as in municipal bus fleets. This holistic strategy illustrates how hydrogen can facilitate the decarbonization of various sectors concurrently within a single region.
- **EASTGATEH2V (Slovakia):** This initiative seeks to establish a robust hydrogen ecosystem in the Košice region of Slovakia, concentrating on the generation of green hydrogen from renewable energy sources and its application in industry, transportation, and energy sectors, thereby fostering the region's economic growth.
- **Hylceland (Iceland):** This "Hydrogen Valley" in Iceland exemplifies the utilization of the country's abundant geothermal and hydropower resources to generate green hydrogen, which can be utilized locally or exported. Hylceland is investigating applications for hydrogen in maritime transport and in providing energy to remote communities, among other uses.

Other Clean Hydrogen Partnership initiatives encompass:

- Development of a 50 kW fuel cell utilizing hydrogen or methanol (RESCUE project).
- Research on the impact of pressure on hydrogen flames in turbines (InsigH2T project) – essential for the safe and efficient utilization of hydrogen in the energy sector.
- The development of frameworks and tools to guarantee the responsible and resilient implementation of hydrogen technologies (GUESS-Why, PROMISERS, FASTCH2ANGE, ECOPEM projects) exemplifies a holistic approach to safety and sustainability.

There are several primary avenues of engagement:

- 1. Applying for Funding (Call for Proposals):** The Clean Hydrogen Partnership frequently issues calls for proposals within the Horizon Europe framework program. Companies, research institutions, universities, and other organizations from EU Member States and Associated Countries are invited to submit project proposals that correspond with the partnership's research domains and objectives.
 - a. How does it function? Calls are generally announced annually, typically in January, with a deadline for proposal submissions set for April or May. Comprehensive information regarding the call topics, budgets, and application guidelines is available on the EU Funding & Tenders Portal. Projects may be categorized as Research and Innovation Actions (RIAs), which emphasize both fundamental and applied research, or Innovation Actions (IAs), which concentrate on the demonstration and implementation of technologies with significant industrial potential. Additionally, Coordination and Support Actions (CSAs) are designed to promote synergies and collaboration.
 - b. Where can they be found? The most effective locations to monitor current calls and download documentation are the official Clean Hydrogen Partnership website and the previously mentioned EU Funding & Tenders portal. Information Days are also regularly conducted, during which partnership representatives elaborate on the call and application processes.
- 2. Become an expert:** The Clean Hydrogen Partnership continually seeks experts to assess project proposals. If you possess technical knowledge and experience in the hydrogen sector (including production, storage, transport, applications, and safety), you may register in the European Commission's expert database. This presents an outstanding opportunity to remain informed about the latest trends and initiatives in the hydrogen industry while contributing to the advancement of European innovation.
- 3. Engagement in events and platforms:** The Clean Hydrogen Partnership organizes and co-organizes a variety of events, seminars, workshops, and conferences, including the annual Hydrogen Valley Days. These occasions present an excellent opportunity to network, share knowledge with industry leaders, explore new collaboration prospects, and stay informed about the latest advancements in the hydrogen sector. Active involvement in these platforms facilitates relationship building and the identification of potential project partnerships.

4. **Join Hydrogen Europe or Hydrogen Europe Research:** By becoming a member of either organization, you automatically integrate into the expansive Clean Hydrogen Partnership ecosystem. Hydrogen Europe advocates for the hydrogen industry, whereas Hydrogen Europe Research unites the research community. Membership grants access to exclusive information, networking opportunities, and the ability to shape the trajectory of the European hydrogen strategy.

Engaging with the Clean Hydrogen Partnership represents a strategic opportunity for those seeking to participate in the hydrogen revolution and contribute to the establishment of a sustainable energy future for Europe.

Summary and Perspective

In conclusion, contemporary hydrogen logistics management presents both challenges and significant opportunities. Current trends indicate a rise in investment in infrastructure, advancements in transport technologies, a growing emphasis on digitalization and automation, and a heightened focus on safety. By implementing best practices such as thorough planning, diversifying transportation methods, investing in warehousing, fostering close collaboration with partners (including initiatives like the Clean Hydrogen Partnership), and pursuing continuous optimization, one can establish an efficient, safe, and sustainable hydrogen supply chain.

The future of hydrogen logistics is poised to be exceptionally promising. Anticipated reductions in hydrogen production and transportation costs will enhance its competitiveness. Additionally, we will witness the integration of hydrogen systems with other energy sectors and the emergence of new hydrogen applications, necessitating further advancements in logistics. European hydrogen strategies project that hydrogen could satisfy up to 24% of global energy demand by 2050, highlighting the magnitude and importance of the logistics challenges ahead. The European Commission is actively endorsing cross-border initiatives and the establishment of hydrogen ecosystems, which will demand sophisticated logistics solutions on a continental scale.

I trust this podcast has equipped you with a substantial understanding of contemporary hydrogen logistics management. Keep in mind, this is merely the outset; however, with the appropriate knowledge and dedication, you can surmount any challenges.

Thank you for tuning in to this episode. I encourage you to delve deeper and join us in the future! Until next time!

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