**Vetytalous Etelä-Pohjanmaalla**
**Hydrogen economy in South Ostrobothnia**

# WP4 Deliverable – Hydrogen Economy in South Ostrobothnia: Action Plan

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## TIIVISTELMÄ/ABSTARCT

This report presents the strategic basis and action plan for developing a clean hydrogen economy in South Ostrobothnia, based on the results of completed and ongoing work packages of the VEPE project. The analysis begins with a comprehensive review of the state of the art in the regional hydrogen context, examining global, European, and national hydrogen trends alongside local conditions. While hydrogen is widely recognised as a key enabler of the green transition, the report highlights the need for realistic, phased, and regionally based approaches.

The findings show that South Ostrobothnia currently has no active hydrogen projects but benefits from strong renewable electricity generation capacity, a robust agricultural base, and a strategic geographic location. These strengths provide a solid foundation for future hydrogen development, particularly through the production of ammonia for fertilisers, which supports food security, regional self-sufficiency, and resilience. At the same time, the analysis identifies critical challenges, including investment costs, limited hydrogen infrastructure, water resource constraints, a lack of skilled personnel, and the need to create a market and coordinate stakeholders.

Ecosystem analyses underscore that hydrogen development is perceived as a long-term, systemic transition, rather than an isolated investment opportunity. The ecosystem concept developed in work package 2 ("VetyVisio Ekosysteemi EP") provides a structured model for ecosystem emergence, stakeholder roles, value creation, and governance, enabling the region to gradually integrate into national and international hydrogen networks. Complementary analyses of the value chain, water resources, and skills further highlight the importance of wastewater reuse, sectoral integration, and the development of specific skills.

Based on these findings, the report defines strategic objectives in infrastructure, industrial utilisation, sectoral integration, research and innovation platforms, skills development, and resilience. A phased action plan and roadmap are proposed, focusing on preparing the region for the opportunities offered by the hydrogen economy, ecosystem governance, financing mechanisms, monitoring indicators, and communication activities. The report concludes with recommendations for implementing

the action plan, strengthening regional collaboration, securing funding, and improving the visibility of South Ostrobothnia as an emerging clean hydrogen region.

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# 1 State of the Art

This section provides a synthesis of the current knowledge base and analytical groundwork that informs the hydrogen economy action plan for South Ostrobothnia. Drawing from completed and ongoing work packages, it outlines the region's strengths, challenges, and emerging opportunities in clean hydrogen development. The findings highlight the importance of renewable energy availability, stakeholder engagement, value chain identification, water resource constraints, and competence gaps, all of which shape the strategic direction of the action plan. The foundation for the action plan is built on completed work packages.

## 1.1 Regional Hydrogen Status

The regional hydrogen status report highlights that while no hydrogen projects are currently active in South Ostrobothnia, the region has strong renewable energy production (wind power and solar photovoltaic), which provides a solid basis for future hydrogen development (Siekkinen, 2024).

**Introduction and Background:** The significance of the hydrogen economy in Finland and Europe has risen especially due to the green transition and investments in energy technologies. In media and public discussion, the opportunities of hydrogen production have been described in an exceptionally optimistic manner. However, according to the report WP1, the reality is much more contradictory. The development and investments in the sector have so far lagged behind the targets (Siekkinen, 2024). In 2024, only 205 MW of electrolyser capacity has been installed globally, even though investment decisions have been made for 3500 MW. The need, however, would be as high as 30,000 MW per year to meet the EU's 2030 targets. The report WP1 examines the hydrogen economy both as an opportunity and a challenge, reviewing the current state of the hydrogen sector in South Ostrobothnia, national and international targets, investment costs, network structures, and regional competitive factors.

**Definition and Historical Development of the Hydrogen Economy:** The hydrogen economy refers to an energy system where hydrogen plays a significant role in various industries, transportation, and energy production. The roots of the hydrogen economy date back to the 1800s, when electrolysis was invented, and from the 1970s, hydrogen has been considered a replacement for fossil fuels. Various reports and international studies emphasise that hydrogen will become part of carbon-neutral societies in the long term.

**Current State of the Hydrogen Economy and Investment Costs:** The need for clean hydrogen is growing, especially in industry, for example, in the production of ammonia and fertilisers, where most of the hydrogen used is still grey. Additionally, hydrogen's importance is increasing in iron ore reduction (green steel) and maritime and air transport. Despite this, the scaling of clean hydrogen production is progressing slowly. In 2023, global electrolyser capacity was only 1400 MW, covering only 0.1% of the current hydrogen demand. Investment costs have risen significantly: the investment level for electrolysis systems is 4-5 times higher than the estimates at the beginning of the 2020s, and the production cost of clean hydrogen is up to 8 times higher than grey hydrogen. The slowdown in cost development means that achieving the targets will require much more public support, especially in Finland.

**National and International Targets:** The European Union's REPowerEU plan aims for 20 million tons of clean hydrogen production annually by 2030, 10 million tons within the EU and 10 million tons imported. This target is extremely ambitious, as the current production capacity is only a fraction of what is needed. For example, BloombergNEF estimates the actual clean hydrogen production in Europe for 2030 at 2.4 million tons, clearly below the set target. Finnish government programs aim for Finland to achieve a 10% share of the EU's clean hydrogen production, practically meaning doubling Finland's electricity consumption in five years if hydrogen production is to be expanded according to the cluster strategy. Unrealistic targets create pressure on investments, network infrastructure, expertise, and support policies.

**South Ostrobothnia's Competitive Advantage and Local Opportunities:** South Ostrobothnia has significant competitive advantages for production, especially in terms of geographically scalable electricity generation capacity and bottlenecks in the national electricity grid, which can support local hydrogen production. The region has enough wind power and solar photovoltaic projects that could theoretically cover the hydrogen consumption of two large steel plants. According to initial conversations with stakeholders within the work package 1, there is potential in both industry and transportation, but the prerequisite is efficient investment in infrastructure, development of logistics models, and expansion of expertise.

**Stakeholders, Value Chain, and Logistics:** Developing the hydrogen economy requires regional cooperation, including neighboring regions' hydrogen studies, local companies, industry, energy, and logistics sectors, as well as public actors. For example, Central Ostrobothnia and Pirkanmaa have their own ongoing projects, from which lessons can be learned and cooperation opportunities built. Logistics in hydrogen production is emphasised, as clean hydrogen production moves to downstream products and usage chains (e.g., ammonia, synthetic fuels). Expertise directly affects the success of innovations and projects, the region needs new technological and business expertise, support structures, and comparison with other renewable energy supports.

**Summary and Recommendations**

- The growth of the hydrogen economy in Finland and South Ostrobothnia requires realistic production targets, significant investments, and substantial public support.
- The region's competitive advantage is based especially on electricity generation capacity and strategic location, but practical implementation requires extensive stakeholder cooperation, ecosystem development, and market building.
- Infrastructure, expertise, and logistics for hydrogen production are critical factors whose development should be supported by policy and project planning.
- It is recommended to model, prioritise, and pilot the most profitable parts of the value chain and ensure sufficient resources for exploiting market potential in the region.
- According to the report WP1, it is especially important to monitor cost development and market emergence and prepare for the possibility that targets may change due to technological development or international competition.

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## 1.2 Stakeholder Perspectives and Ecosystem Insights

In particular, the WP2 report called Clean Hydrogen Ecosystem for South Ostrobothnia places strong emphasis on understanding stakeholder perspectives as a critical foundation for building a viable clean hydrogen ecosystem (Pinilla-De La Cruz, 2025; Pinilla-de La Cruz, 2026). The objective of this work is to support regional stakeholders including public, private, and educational in understanding how to structure, coordinate, and practically develop hydrogen-related activities as part of the clean energy transition. This work builds directly on previous analyses and provides a conceptual and operational model for a regional hydrogen ecosystem that can evolve over time and connect with national and international networks (Pinilla-De La Cruz, 2024, 2025; Pinilla-de La Cruz, 2026).

Among various stakeholders, there is a common recognition of clean hydrogen as a long-term opportunity, but also a widespread understanding that South Ostrobothnia is still in an early and emerging stage of ecosystem development (Lind, 2025b; Pinilla-de La Cruz, 2026). Stakeholders do not view hydrogen as an isolated investment opportunity, but rather as a systemic transition requiring coordination, learning, and gradual capacity building (Lind, 2025b) .

The ecosystem model presented in WP2 report integrates previous findings into the so-called "VetyVisio Ekosysteemi EP". The model consists of four interconnected components: 1. Ecosystem emergence stage, recognising that the region is in an early stage of development; 2. Ecosystem map, describing the actors and their interactions; 3. Needs and value propositions, specifying the challenges the ecosystem addresses and the value it delivers; 4. Ecosystem architecture and processes, describing how cooperation and coordination could work in practice (Asplund et al., 2021; Pinilla-De La Cruz, 2024; Thomas, 2022; Thomas et al., 2022). The model is designed to allow the ecosystem to grow, adapt, and connect with larger hydrogen valleys and national initiatives over time (Katri Valkokari et al., 2021; Pinilla-De La Cruz, 2025; Pinilla-de La Cruz, 2026).

## 1.3 Value Chain and Water Resource Analysis

In WP3, the work included the identification of a relevant and value-generating clean hydrogen value chain for South Ostrobothnia, along with an assessment of the region's readiness and the investment and infrastructure requirements necessary for its implementation (Pinilla-De La Cruz, 2026). The clean hydrogen value chain was identified to align with the region's industrial structure and characteristics, mapping business activities across all key segments, from hydrogen production to applications and end-use options, and clarifying the roles of the various stakeholders involved. Based on these findings, a techno-economic analysis of the selected value chain was conducted, identifying the main cost drivers, infrastructure needs, and investment requirements necessary to integrate and implement the value chain in South Ostrobothnia. Taken together, these results provide a concrete analytical basis for decision-making, prioritisation, and the next steps toward practical implementation (Pinilla-De La Cruz, 2026).

Value chain analysis identifies clean ammonia as the most promising hydrogen application for the region, aligned with its agricultural strengths (Pinilla-De La Cruz, 2026). Ammonia production represents a significant future opportunity for South Ostrobothnia, particularly by leveraging the region's strong agricultural base and its growing role in the clean hydrogen economy. For this region, locally produced ammonia could support regional fertiliser production, strengthen food security, and contribute to national climate goals (Hydrogen Cluster Finland, 2023; Laurikko et al., 2020). Currently, Finland relies heavily on imported ammonia, exposing the agricultural and food system to the volatility of global supply and prices.

Beyond agriculture, ammonia also opens new opportunities in the marine and industrial fuel markets. Clean ammonia is increasingly recognised as a promising low-carbon marine fuel, driven by stricter international regulations on decarbonising shipping (Frost and Sullivan, 2022). During the transition period, ammonia can also be blended with conventional fuels, reducing emissions and facilitating its phased adoption. Finland's long maritime tradition, technological expertise, and innovative capacity create favourable conditions for participation in this emerging market. Furthermore, new opportunities may arise from collaboration with surrounding hydrogen hubs in areas such as steelmaking or as a flexible resource for energy systems (Frost and Sullivan, 2022; Hydrogen Cluster Finland, 2023).

For the materialisation of clean hydrogen production initiatives, it would be crucial to consider the availability of water as a key resource. Surface and groundwater resources are limited. However, wastewater reuse offers a viable and sustainable solution for hydrogen production, as highlighted in the regional water initial survey developed by SEAMK (Lind, 2025a).

## 1.4 Skills and Competence Mapping

In South Ostrobothnia, the education and skills situation related to the hydrogen economy is currently based on the region's strong agricultural, food industry and nutrient cycle expertise, but actual training packages specialised in the hydrogen economy are lacking (Lind, 2026). Hydrogen economy-related content is only partially included in existing training in the region, and core technical skills, such as process and chemical engineering, electrical and automation engineering and energy system integration, are largely based on the offerings of universities in neighboring regions. Key skills gaps in the region have been identified as expertise in electrolysis and gas processes, hydrogen and ammonia storage and safety, process safety and regulatory expertise, and system integration between renewable energy and agriculture (Lind, 2026).

# 2 Strategic Goals

This section outlines the key strategic priorities that would guide the region's transition toward a sustainable and resilient hydrogen ecosystem, with a focus on enabling technologies, sectoral integration, and long-term competitiveness in both domestic and international markets. Here, the strategic goals for the hydrogen economy in South Ostrobothnia reflect the region's unique strengths and challenges. While the area benefits from abundant renewable energy resources and a strong agricultural base, the development of a clean hydrogen value chain requires targeted actions across infrastructure, industrial applications, education, and collaboration.

## 2.1 Infrastructure

The development of new infrastructure to produce clean hydrogen and ammonia would have far-reaching implications for the region. These include the need for specialised equipment, land use and environmental permits, and proximity to electricity distribution and transmission networks to ensure a reliable energy supply for operations. Access to water resources is also a critical factor, especially given the lack of seawater sources in the region. Therefore, careful long-term resource planning will be required to ensure sufficient water for hydrogen production without compromising other essential uses, such as drinking water, agriculture, or the sustainability of natural water systems. In this context, alternative solutions, such as the reuse of agricultural effluents and treated wastewater, may require further research and evaluation.

The availability of enabling infrastructure, including road and rail networks and proximity to seaports, is another important consideration. These transport routes are essential both for supplying inputs to production plants and for distributing intermediate materials and finished products to end users (Frost and Sullivan, 2022). Therefore, logistics infrastructure would play a key role in the effective integration of the value chain.

Access to hydrogen pipeline infrastructure is an additional strategic factor, both for distributing pure hydrogen to the national grid and for obtaining it from the grid to produce derivatives. Currently, the national hydrogen transmission network is planned to run along the West Coast but it does not include South Ostrobothnia (Gasgrid, 2025). This limitation must be carefully considered in regional planning, as it has direct implications for future supply options and the distribution of clean hydrogen and its derivatives.

## 2.2 Industrial Utilisation, Internationalisation, Export and Resilience

Today, ammonia plays a vital role in a wide range of applications, including refrigeration, mining, pharmaceuticals, water treatment, plastics and fibre production, and nitrogen oxide emissions reduction (Fichtner, 2025; Rouwenhorst, 2026). However, its most significant application lies in agriculture: approximately 85% of global ammonia production is used to manufacture nitrogen fertilisers, making it an indispensable element for food production systems worldwide (Fichtner, 2025; Rouwenhorst, 2026).

Ammonia's prominent role in fertiliser production directly links its availability, price, and sustainability to food security and agricultural resilience. In Europe, this link is particularly significant. Nowadays, there are around 35 ammonia production plants, but the region remains heavily dependent on external supply chains. These plants consume around 2 million tonnes of hydrogen annually, representing approximately 25% of Europe's total hydrogen demand. Therefore, Europe continues to import at least 2.5 million tonnes of ammonia annually (Aisling Deasy-Millar et al., 2025).

Recent geopolitical dynamics have highlighted the vulnerability of these supply chains. Since 2022, disruptions to ammonia production and exports have contributed to price volatility and supply uncertainty, posing tangible risks to fertiliser availability and, by extension, food production (Sosa et al., 2025). Without targeted measures, these vulnerabilities could intensify and undermine agricultural stability. In this context, clean ammonia, produced using clean hydrogen and renewable electricity, offers a strategic opportunity. Scaling up green ammonia production for fertilisers would simultaneously decarbonise a high-emissions value chain, reduce dependence on ammonia and fertiliser imports, and strengthen regional self-sufficiency and food security.

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For both Europe and Finland, boosting domestic clean ammonia production is therefore not only an industrial or climate priority, but also a matter of long-term economic resilience and food system stability. Clean ammonia production in Europe is still in its early stages. Currently, only a handful of plants are in commercial operation, with a combined capacity of approximately 100 000 tonnes per year (Sosa et al., 2025).

Regulatory frameworks such as the Renewable Energy Directive III (RED III) are expected to incentivise the production of clean hydrogen and, indirectly, clean ammonia in the coming years. However, implementation challenges remain, and not all countries have fully integrated ammonia into their hydrogen targets (Aisling Deasy-Millar et al., 2025). This creates uncertainty for investors and slows project development, reinforcing the need for coordinated national and regional strategies.

While fertiliser production remains the cornerstone of ammonia demand, new emerging markets for green ammonia are attracting increasing attention. A particularly relevant example for Finland is the maritime and shipping sector, which boasts a long industrial and technological tradition in the country (Frost and Sullivan, 2022; Hydrogen Cluster Finland, 2023). Therefore, developing clean ammonia production capacity can open additional market opportunities beyond agriculture, supporting industrial diversification and export potential. According to the Frost and Sullivan (2022), ammonia for shipping could be enhanced by creating a Nordic regional alliance to invest in ammonia production infrastructure and accelerate its adoption as a marine fuel.

For regions with a strong agricultural base, renewable energy potential as South Ostrobothnia, ammonia production represents a key strategic industry, capable of supporting regional self-sufficiency today while simultaneously driving growth and innovation tomorrow.

## 2.3 Sector Integration

For South Ostrobothnia region, which is in the early stages of integrating into the hydrogen economy, initiatives in this field represent a fundamentally new and highly complex challenge. Developing a

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hydrogen ecosystem would require integrating a new value chain from renewable energy production to downstream use, effectively constituting a completely new undertaking (Pinilla-De La Cruz, 2026). One of the main challenges would be aligning and connecting the various components into a coherent system (Alho et al., 2024; Hydrogen Europe, 2023).

This includes securing the inputs for hydrogen production through commercial agreements with renewable energy providers, ensuring sufficient water availability, and coordinating with developers of hydrogen and ammonia production facilities. Simultaneously, collaboration with logistics and infrastructure operators will be necessary to identify suitable solutions for the compression, storage, and transport of hydrogen and ammonia, considering different end uses and potential synergies with end users. In the case of fertilisers, close collaboration with the agricultural and food sectors would be essential to determine appropriate technologies, specific nitrogen fertiliser products, and viable production volumes. Similar collaboration will be required with other sectors that can utilise hydrogen or ammonia for the decarbonisation of other hard-to-abate sectors. In the early stages of development, it would be crucial to engage stakeholders from all segments of the value chain and bring them together within a common framework.

This work will ensure clarity regarding roles and responsibilities and facilitate agreements that secure the necessary conditions for production and use. Implementing new processes as those mentioned before are inherently laborious and would likely require iterative discussions and negotiations, given the high level of uncertainty and risk faced by each participant. Consequently, success will depend on establishing an environment of trust, transparent dialogue, and clear leadership and connected with the national hydrogen networks, while initially implementing modest but robust pilot steps to mitigate risk. Once value chain integration has been demonstrated at a smaller scale and the results are positive, the evidence and lessons learned can support more ambitious initiatives, increasing the feasibility of subsequent projects and their potential to generate and capture value for all partners involved.

## 2.4 RDI Platforms

Building upon the ecosystem model developed in this project, with its defined architecture, identified processes and stakeholders, and the initial implementation of the "core team" or initial orchestration team (described in the report WP2) during the ecosystem's genesis stage, these developments are expected to serve as the starting point for structuring a social network in the region (Katri Valkokari et al., 2021; Pinilla-de La Cruz, 2026; Valkokari et al., 2017). This network would connect regional stakeholders to capitalise on the opportunities offered by the energy transition, such as the integration of clean hydrogen.

During the project, relevant connections and collaborations were established with clean hydrogen networks, particularly the Both2nia network. Both2nia network has expressed its willingness to support initiatives arising in South Ostrobothnia, therefore, it is expected that current and new members from the region will utilise this connection as a bridge to transfer knowledge and expertise, and to attract investment to the region in the field of hydrogen.

Furthermore, during the project, initial contacts were made with some surrounding clean hydrogen hubs for example, with Kristiinankaupunki, which could represent valuable opportunities in the future to accelerate the development of the clean hydrogen economy in South Ostrobothnia. It is expected that both municipalities and other regional actors will take advantage of these connections and enhance them in the future.

## 2.5 Skill and Training Needs

The most potential development direction for the hydrogen economy is not the creation of separate hydrogen economy training courses, but the modular integration of hydrogen economy-related content into existing training packages, especially at the engineering and technical level (Green Skills for Hydrogen, 2023). In terms of the profile of South Ostrobothnia, linking the hydrogen economy to fertilisers and green ammonia will become central, whereby education and skills development directly support the region's key industries and long-term development goals (Lind, 2026).

Cooperation between SEAMK, Satakunta University of Applied Sciences (SAMK), Vaasa University of Applied Sciences (VAMK) and Centria University of Applied Sciences would offer South Ostrobothnia a significant opportunity to develop hydrogen economy skills, considering the regions' own strengths. In cooperation, these universities form a complementary competence entity, in which SEAMK's strong agricultural, food industry and nutrient cycle expertise is combined with SAMK, VAMK and Centria's expertise in process, chemical, energy and electrical and automation technology. This would enable the development of educational content related to the hydrogen economy without the need for all technical specialisations to be located in one province. Common study modules, shared laboratory and simulation environments and RDI projects support multidisciplinary and working life-oriented education, in which hydrogen economy applications (especially green ammonia and fertilisers) can be directly linked to regional industries. Cooperation between educational institutions strengthens the effectiveness of education and improves the availability of expertise (Lind, 2026).

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# 3 Action Plan

The action plan is structured around a phased roadmap with a long-term vision, infrastructure development, and capacity building. It is based on an ecosystem structure and collaboration model developed in WP2, which defines a core team as the orchestration team in the initial stages, a shared vision, clear roles, along with governance mechanisms that enable co-creation and collective decision-making (Pinilla-de La Cruz, 2026). The plan identifies potential funding sources at the EU, national, and private levels, recognising that investment viability depends on value chain integration and market development. Progress could be monitored using indicators aligned with the Regional Council's framework, covering business engagement, innovation outcomes, and skills development, and will be complemented by targeted communication activities to increase visibility, raise awareness, and attract new stakeholders.

## 3.1 Roadmap

Starting from the current baseline year (2026), the roadmap emphasises the importance of establishing a shared regional vision as the foundation for all subsequent activities (Figure 1). It then proposes a phased approach that includes identifying interested municipalities, assessing their readiness levels, conducting comprehensive feasibility studies, implementing a small-scale pilot plant, and scaling up gradually based on operational performance and commercial experience. Funding considerations are integrated into the roadmap: initial-stage activities can be funded through regional and municipal resources, while later phases are expected to rely on national and EU instruments, such as Business Finland programs, combined with private sector investment. It includes three stages and steps as:

- **Baseline 2026**:
  - **Step 01**: Define a clear vision for the region in terms of how to prepare towards the hydrogen economy.

- **First stage**:
  - **Step 02**: **Determine solid interest towards hydrogen**: Identify, map, and engage municipalities that have expressed interest in developing clean hydrogen infrastructure in the future, and provide them with specific information and guidance. This step will help clarify levels of commitment on a regional scale and allow for more focused and efficient progression to the subsequent planning and implementation phases.
  - **Step 03**: **Readiness level of municipalities**: Define the industrial setting and operative environment, industrial settings and operative environment. It includes: i) development of water studies by municipalities (water availability for clean hydrogen ensuring water security, etc.); ii) identification of potential locations for clean hydrogen facilities taking into consideration the relevance of geographical proximity to the upstream and downstream segments of the value chain; iii) identify logistics for the value chain integration (constrains and strengths); iv) identify the use context for clean hydrogen including hydrogen derivatives; v) identify land availability for those purposes; vi) identify the related environmental permitting and incentives; and vii) identify key actors and competences (existing and gap).

- **Second stage**:
  - **Step 04**: **Feasibility studies**: Evaluate the technical, economic, and operational feasibility of the project under real-world regional conditions. This will be crucial given the implications of decentralised production, whose success will largely depend on value chain integration. The study could assess key aspects such as appropriate technologies for the scale and use, inputs, infrastructure needs, regulatory requirements, and estimated costs and revenues. It would help to clarify the scale, design options, and associated risks of the plant, offering a realistic view of what can be implemented in practice. The relevance of conducting a feasibility study before making significant investments is crucial, as it allows stakeholders to test assumptions, validate the value chain, and identify bottlenecks with low risk and cost. It facilitates informed decision-making, reduces technical and financial uncertainty, and helps avoid premature or excessive investment.

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- **Third stage**:
    - **Step 05: Pilot plant**: Small scale implementation (small as possible). Test the value chain integration and offtakers commitment.
    - **Step 06: Scaling-up**: based on the pilot plant performance and commercial results would be possible to define the opportunities for scaling-up the clean hydrogen production facility.

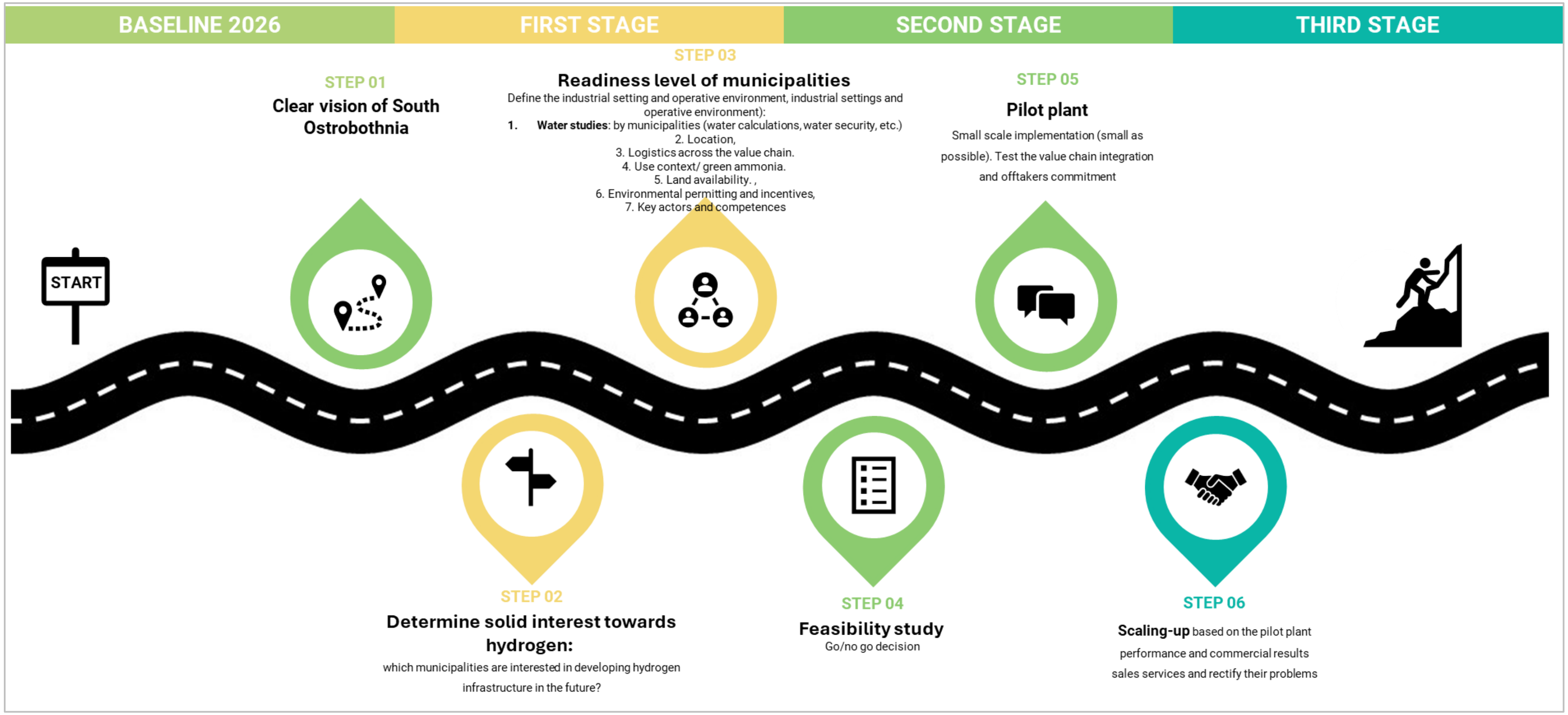


**Figure 1. Roadmap for the development of the hydrogen economy in South Ostrobothnia. Visual design adapted from canva.com**

## 3.2 Ecosystem Structure and Collaboration Model

The results of the WP2 report on governance models for innovation ecosystems are intended to serve as a foundational reference for the region (Pinilla-de La Cruz, 2026). We emphasise the need to analyse the transformations in society, and the case of the hydrogen economy in the regional contexts with systematic lenses, beyond purely technical solutions (Pinilla-De La Cruz, 2025; Pinilla-de La Cruz, 2026). These changes affect one social, economic, and cultural dimensions alongside technological aspects. In this context, technological development must be embedded within and supported by appropriate social structures and governance mechanisms (Pinilla-De La Cruz & Rabetino, 2024).

Drawing on established academic literature and enriched by empirical insights gathered from real-world stakeholders, our WP2 report provides valuable insights that it is expected to be taken into consideration by regional actors and that, in the future, it would support the demonstration of tangible progress toward a well-established hydrogen ecosystem, grounded in processes of value co-creation, shared learning, and collective governance (Thomas et al., 2022).

## 3.3 Funding and Investments

As outlined in the roadmap for the development of clean hydrogen in South Ostrobothnia, the initial stages require active and visible participation from municipalities. In this phase, municipalities play a crucial role by openly expressing their interest in the hydrogen economy and initiating concrete preparatory actions. These include identifying suitable locations, assessing the availability of local resources, clarifying environmental permitting requirements, and analysing the logistical conditions necessary to integrate hydrogen production and use into regional value chains. Given its public good nature and long-term relevance, some of these initial activities can be adequately supported through municipal and regional funding instruments, which helps reduce uncertainty and build trust among stakeholders.

When initiatives progress to later stages of development, and as clearer project concepts and stronger commitments from key stakeholders emerge, more substantial funding mechanisms will generally be required. At this point, project promoters can access national funding instruments, such as those provided by Business Finland, including co-creation or co-innovation programs that support collaborative development between industry, research organisations, and public stakeholders. Depending on the ambition, scale, and structure of the initiative, a well-established consortium can also seek European-level funding through programs such as Horizon Europe. The choice of funding route will ultimately depend on the project's maturity, its technological and commercial prospects, and its alignment with national and European policy priorities.

In the specific context of South Ostrobothnia, attracting investment and supporting future investment decisions requires more than isolated projects. It demands the gradual creation of favourable framework conditions, including the integration of hydrogen into regional value chains, the development of enabling infrastructure, and the availability of suitable industrial zones operating within clear environmental and regulatory frameworks. By addressing these conditions in parallel with financing efforts, the region can position itself as an attractive and credible location for clean hydrogen investments and support the long-term development of a decentralised hydrogen production.

## 3.4 Monitoring and Evaluation

As consistently highlighted in the project's technical reports and results presentations, the region has significant opportunities in the hydrogen economy, as well as the capacity to position itself to capitalise on them while market frameworks and final investment decisions for key projects are being developed. However, it is crucial that the region begin acting without delay, guided by a clear vision, a structured plan, and well-defined objectives at each stage.

Equally important is the early establishment of synergies with key private-sector partners across the production, transport, and distribution segments of the value chain. This ensures that regional plans reflect not only public-sector priorities but also the perspectives of the companies that will be responsible for implementation, commercialisation, and long-term operation (Pinilla-De La Cruz, 2024; Pinilla-De La Cruz et al., 2022; Pinilla-De La Cruz & Rabetino, 2024).

To keep momentum and credibility, measurable, jointly agreed-upon, and achievable objectives must be defined so that regional stakeholders can clearly recognise progress toward the overall vision. A systemic approach is needed that does not treat hydrogen development as an isolated initiative, but rather fully integrates it into the South Ostrobothnia Regional Strategy. This includes clearly defined leadership roles, well-established monitoring indicators and synergies, as well as active collaboration with industrial hydrogen hubs in neighbouring regions and national hydrogen networks across Finland.

## 3.5 Communication and Visibility

When introducing entirely new topics to regional stakeholders as clean hydrogen in South Ostrobothnia, a careful approach to communication is essential. This approach helps foster a shared understanding of the issues and assists stakeholders in connecting new technologies with existing economic practices and activities in the region. Therefore, awareness-raising is a critical element of the innovation integration process.

For this reason, communication and dissemination activities were given special emphasis throughout the VEPE project. A range of channels was used to inform stakeholders about project objectives and activities, including the organisation of workshops and seminars, as well as active engagement on social media. In particular, LinkedIn served as a key platform, where the project profile created by the University of Vaasa has grown to 170 followers. In addition, project results and knowledge outputs are disseminated through the dedicated project website developed by the University of Vaasa, as well as via the SEAMK website and associated social media channels. It is expected that South Ostrobothnia continues with the dissemination and communication of further information on the development of clean hydrogen in the region.

## 3.6 Contextual Embedding

For South Ostrobothnia to proactively prepare for the integration of a clean hydrogen economy, it is crucial to incorporate this emerging theme into existing regional strategies. In particular, clear alignment with objectives related to climate neutrality, the circular economy, and security of supply is required. Positioning hydrogen within these strategic frameworks helps transform it from an abstract concept of the future into a concrete development pathway that supports the region's long-term economic resilience and sustainability.

This alignment also allows for the creation of meaningful connections between hydrogen development and the strategic priorities shaping South Ostrobothnia's future economy. By linking hydrogen to regional strengths and established policy objectives, new development opportunities can emerge that reinforce both environmental ambitions and economic competitiveness.

Currently, regional stakeholders often perceive hydrogen as a long-term or distant goal. However, this perception should not hinder the early establishment of connections with key regional industries such as food production, agriculture, and energy, which already play a central role in the regional economy. These sectors offer significant opportunities for early experimentation, pilot projects, and learning processes related to hydrogen use, production, and infrastructure. To support this transition, it is crucial to foster synergies not only within the hydrogen value chain itself but also between hydrogen-related activities and adjacent sectors. Step by step, this cross-sector collaboration can integrate hydrogen into the regional development framework in a practical and context-specific manner. This phased integration approach lowers barriers to entry, reduces perceived risks, and helps stakeholders identify realistic and economically viable applications.

Over time, these processes can drive the development of concrete alternatives and business models in the region, increasing trust among stakeholders and strengthening the attractiveness of investment for private capital. In this way, clean hydrogen can evolve from a long-term vision to a fundamental strategic component of the economic transformation of South Ostrobothnia (Thomas, 2022; Thomas et al., 2022).

# 4 Summary and Next Steps

After the VEPE project concludes, the following actions are recommended to ensure continuity and long-term impact:

- **Operationalise the Action Plan:** Implement the roadmap and strategic goals developed during the project, ensuring alignment with regional strategies and stakeholder priorities.
- **Launch Pilot Projects:** Initiate demonstration projects, particularly in ammonia production, alternative water sources, for example, wastewater-based hydrogen generation, and renewable energy integration.
- **Strengthen Ecosystem Governance:** Formalise the core team's role as a regional hydrogen ecosystem facilitator or orchestrator, with clear responsibilities, meeting routines, and decision-making structures.
- **Establish Long-Term Collaboration Platforms:** Create permanent RDI and education-industry collaboration platforms to support hydrogen-related innovation and workforce development.
- **Secure Funding and Investments:** Pursue national and EU-level funding opportunities and engage private investors to support infrastructure and technology deployment.
- **Monitor and Evaluate Impact:** Continue tracking key indicators and update the action plan based on market developments and stakeholder feedback.
- **Enhance Regional Visibility:** Organise annual hydrogen forums, publish results, and maintain active communication channels to position South Ostrobothnia as a hydrogen innovation region.

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