LATENT DRIVE

Hydrogen Innovation Initiative
Demonstrations 25/26

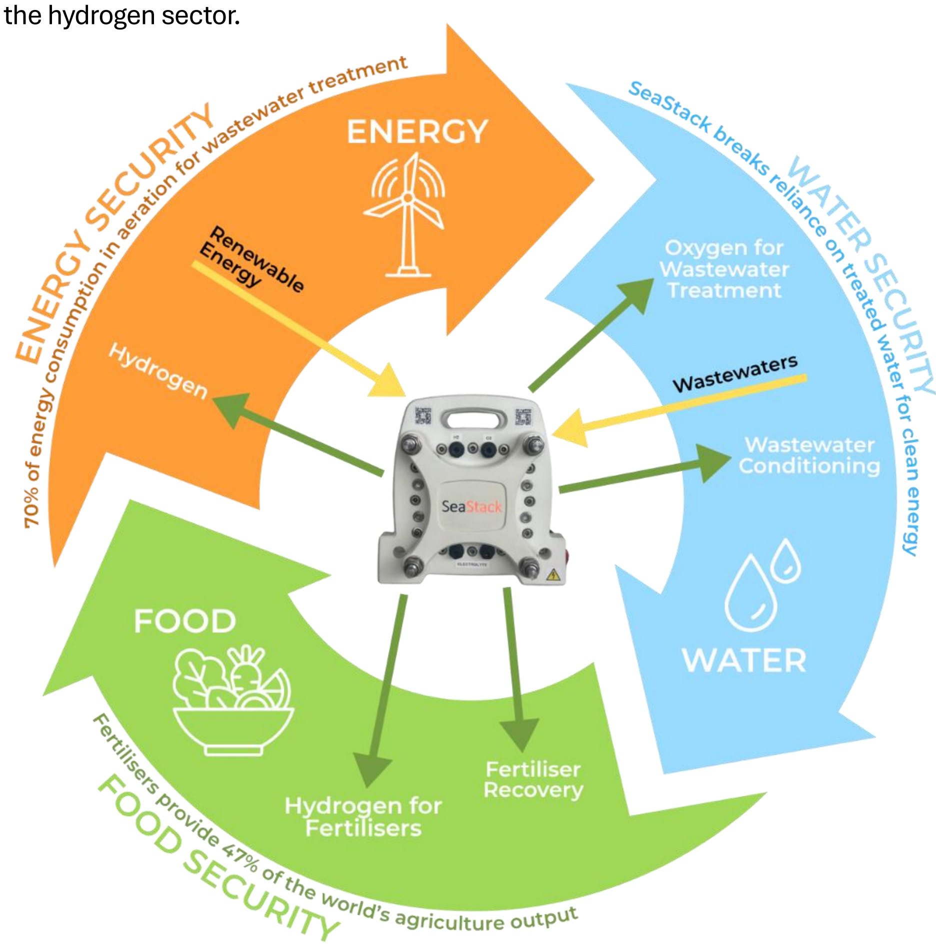
SeaStack

1. EXECUTIVE SUMMARY

The global transition towards low-carbon energy, combined with increasing concerns over energy security, freshwater availability and geopolitical instability, has accelerated interest in hydrogen production technologies that can be deployed in coastal, offshore and industrial environments. Green hydrogen can be produced by passing electricity through water, splitting the H_2O molecules into their constituent parts of hydrogen and oxygen. This is the process of electrolysis – a carefully engineered electrochemical process to split water molecules and separate the resulting gases.

Conventional electrolysers require high-purity water, creating additional cost, complexity and infrastructure requirements through desalination and purification. A recent UK Government study found that freshwater consumption is typically 42-52kg of water, per kg of hydrogen produced. Alternative technologies capable of producing hydrogen directly from seawater, brines and wastewater streams offer a route to simplify deployment while reducing reliance on constrained freshwater resources.

Water scarcity is emerging as a critical consideration in the global expansion of hydrogen production. Conventional electrolysis relies on large volumes of high-purity water, creating an inherent tension between the need to decarbonise industry and the need to protect increasingly scarce freshwater resources. Technologies that can utilise seawater, brines and treated wastewater directly offer a route to decouple hydrogen production from freshwater demand, improving the long-term sustainability and resilience of the hydrogen sector.



Overview of the Demonstration

This project successfully delivered a live demonstration of Latent Drive's SeaStack technology at Portland Port. SeaStack is a direct seawater electrolysis platform designed to produce hydrogen without desalination or conventional water purification. The electrolysis of saltwater has well known problems because it contains several salts, particularly sodium chloride. These salts typically cause unwanted side reactions, releasing corrosive chlorine compounds on the oxygen side of each cell, and scale deposits on the hydrogen side. We have designed an unconventional cell architecture to overcome these problems. This is essentially an engineering solution to a chemistry problem.

During the demonstration, the SeaStack system produced hydrogen from three challenging water sources: seawater, concentrated brine and treated wastewater effluent from a municipal sewage treatment works. The demonstration was carried out under real portside conditions at Portland Port, using a mobile system integrated with supporting electrical, fluid handling, monitoring and safety infrastructure.

This represented an important step beyond laboratory testing, showing that the SeaStack architecture can operate using real-world saline and wastewater feedstocks in an industrial coastal environment.

SeaStack Prototype

SeaStack Mobile Enclosure

Key Findings and Outcomes

Headline results: Sea and wastewaters were successfully split, producing hydrogen by electrolysis – without the classical problems of scale blockages and chlorine gas evolution.

Conventional mains water supply was not required for the demonstration.

The demonstration successfully showed hydrogen production from seawater, concentrated brine and treated municipal wastewater effluent, validating the core purpose of the SeaStack system under practical operating conditions. Some technical details are omitted from this report to protect our unique Intellectual Property (IP) regarding seawater electrolysis.

Several difficult problems were encountered and solved in the run-up to the demo and on the day itself. This shows the real-life risks of innovation, and the importance of government backed funding to overcome these risks and develop commercially viable products.

The project demonstrated the integration of the electrolyser within a deployable, transportable and marinised trailer platform, including the associated pumping, power, ventilation, gas monitoring and safety systems. This provided valuable operational insight into the requirements for deploying direct seawater and wastewater electrolysis systems outside the laboratory.

Key technical learning was generated around system integration, feedstock handling, operating procedures, gas separation, safety management and component durability. The demonstration also reinforced the importance of continued development of key components, including hybrid bipolar plates and bipolar membranes, for future scale-up.

Overall, the project has significantly advanced SeaStack from laboratory development to real-world demonstration. It provides a strong foundation for future pilot deployments in ports, offshore environments, industrial brine applications and wastewater treatment settings.

2. INTRODUCTION

Purpose of the Report

This report summarises the activities, execution and outcomes of the SeaStack demonstration project undertaken by Latent Drive as part of the Hydrogen Innovation Initiative Demonstrations 2025/26 programme. It documents the design, manufacture, integration and deployment of the SeaStack system, together with the results of the live demonstration at Portland Port.

The report also provides an overview of the technology, the challenges encountered during development, the lessons learned throughout the project, and the implications of demonstrating direct hydrogen production from seawater, concentrated brine and treated wastewater effluent under real operating conditions.

Background on the Technology

SeaStack is a direct seawater electrolysis system developed by Latent Drive to enable hydrogen production from seawater, industrial brines and wastewater streams without the need for desalination. The technology combines Latent Drive's proprietary catalysed stainless-steel electrodes, Catrodes, with advanced bipolar membrane technology to enable efficient electrolysis in challenging saline environments while suppressing corrosion and undesirable side reactions.

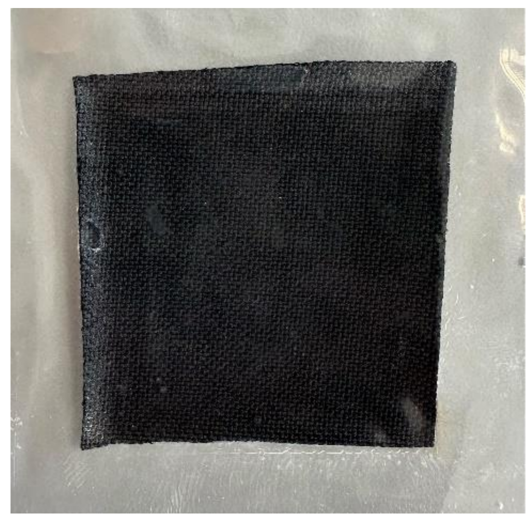
We have taken an engineering approach to the problems, which is markedly different to the approaches published in the research literature. Most seawater electrolysis research assumes a conventional electrolysis cell with the use of seawater as the electrolyte. This inevitably results in unwanted side reactions with the salt content (sodium chloride) of the seawater. Common problems are scale deposits on the hydrogen electrode, and chlorine gas evolution on the oxygen side. Either of these can cause failure within minutes or hours of operation. To overcome these problems research focuses on special selective catalysts, operation within limited voltage windows, and the mixing of seawater with other electrolytes.

Our view is that these approaches may work on single cells in laboratory conditions, but they do not provide a scalable industrial solution. For green hydrogen to compete on cost with hydrogen from fossil fuels it is necessary to get "behind the meter" and connect directly to renewable solar or offshore wind. To harvest the maximum energy from these variable resources the electrolysers need to accommodate a wide operating range. This does not suit the conventional approach of limiting cell voltage to favour oxygen evolution over chlorine. Another major problem is achieving industrial scale. This requires the stacking of many cells to build an electrolyser stack – which may have up to a hundred cells and operate at hundreds of volts. Again this can cause aggressive side-reactions and intense corrosion. These practical issues are neglected in the academic literature, but critical to real world industrial scale seawater electrolysis.

Our patented approach uses both bipolar plates, and bipolar membranes. The aim is to constrain the seawater to certain parts of the cell and control the pH at which reactions are carried out. We also develop hybrid bipolar plates to address the problems of cell stacks. Bipolar plate development was a key part of preparation for this demonstration, which is the first time that seawater electrolysis in multi-cell stacks has been demonstrated.

By eliminating the requirement for purified water, SeaStack has the potential to reduce system complexity, lower infrastructure costs and expand the range of locations where green hydrogen can be produced. Potential applications include ports, offshore renewable energy installations, coastal industrial sites, wastewater treatment works and industries producing saline process streams.

Catrodes – Catalysed electrodes, our proprietary solution for mass-produced low-cost electrodes that also function as highly effective catalysts.



Bipolar Membrane – keeps both gases and electrolytes separate. Critical for separation of hydrogen and oxygen, whilst also preventing unwanted side reactions.

Objectives of the Demonstration

The primary objective of the demonstration was to validate the SeaStack technology under real-world operating conditions by producing hydrogen directly from challenging water sources without prior desalination or purification.

The project sought to:

- Demonstrate hydrogen production from seawater, concentrated brine and treated municipal wastewater effluent,
- validate operation of the SeaStack electrolyser in a real port environment at Portland Port,
- demonstrate integration of the electrolyser within a transportable, deployable and marinised system,
- evaluate system performance, operability and safety using real-world feedstocks,
- generate operational data and engineering experience to support further development, scale-up and commercial deployment of the technology,
- demonstrate the potential for direct electrolysis of saline and wastewater streams as an alternative to conventional purified-water electrolysis.

3. PROJECT DESCRIPTION

Hydrogen Technology and Preceding Development

The technology demonstrated in this project was Latent Drive's SeaStack electrolysis platform, developed to produce hydrogen directly from seawater, concentrated brines and other saline or wastewater streams without desalination. The system combines Latent Drive's proprietary catalysed stainless-steel electrodes (Catrodes) with advanced bipolar membrane technology to enable efficient electrolysis while minimising corrosion and undesirable side reactions associated with challenging water chemistries.

Prior to this project, the SeaStack concept had been validated through extensive laboratory-scale testing. Single-cell electrochemical experiments confirmed the feasibility of hydrogen production from seawater and established the operating principles of the system. The Hydrogen Innovation Initiative demonstration represented the first deployment of the technology outside the laboratory in a fully integrated, transportable system operating under real industrial conditions.

Location and Partners

The demonstration was carried out at Manor Marine based at Portland Port. The project was led by Latent Drive, developer of the SeaStack technology, with Manor Marine providing a representative coastal industrial environment for the demonstration.

The location offered direct access to seawater together with the infrastructure required to safely operate the transportable demonstration system. Additional feedstocks, including concentrated brine and treated municipal wastewater effluent, were transported to the site to demonstrate the versatility of the SeaStack technology across multiple challenging water sources.

Conducting the demonstration within an operational port environment provided an opportunity to assess the practical deployment of the technology under conditions representative of future commercial applications in ports, offshore energy, coastal industry and wastewater treatment.

Demonstration Site

SeaStack Demonstration Deployed at Portland Port

Preparation for the Demonstration – and problems encountered

During the project, the SeaStack demonstration system was designed, manufactured, assembled and integrated within a transportable enclosure before being commissioned and deployed at Portland Port.

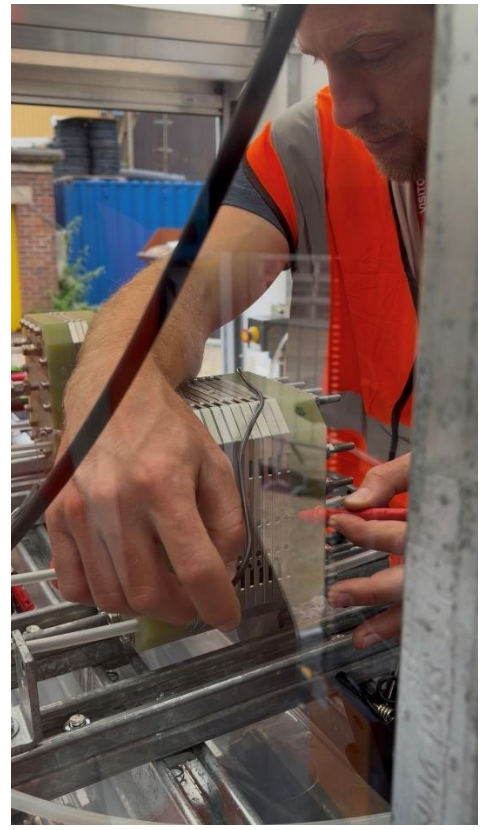
Several issues were encountered:

- Lead times for delivery of high-pressure seawater feed pumps. Most pumps were on lead times of months, which was too long for the project timeline. Special thanks to Michael Smith Engineers who were able to quickly adapt a stock Hydra-Cell pump to our specification. This worked faultlessly throughout our trials.
- Multiple iterations of prototype bipolar plates. The original mass-production concept proved too difficult to prototype during the 3-month project timeline. So, alternatives were explored using CNC machining followed by selective coating with salt resistant coatings. Special thanks to MK Restorations for prototype CNC machining, and Para Tech Coatings for specialised coatings.
- On the day of the demonstration an electrical fault shorted and damaged the main power supply. A short-term solution was arranged for the demonstration which allowed the full test programme to continue but did limit some of the automated data logging that we intended to collect. Back-up datalogging allowed the demonstration to continue.

Despite these problems, the demonstration successfully achieved hydrogen production from three different feedstocks: seawater, concentrated brine and treated municipal wastewater effluent. Operation validated the integration of the electrolyser stack with fluid handling equipment, instrumentation and safety systems within a deployable platform suitable for operation outside the laboratory. Thanks to all of our team for overcoming the difficulties of technical innovation on a tight timeline and budget.

The project also generated valuable engineering and operational experience relating to system commissioning, feedstock handling, control systems and safe operation under real portside conditions. These lessons will inform the continued development of SeaStack as the technology progresses towards larger-scale pilot deployments and commercialisation.


System Setup Before Demonstration


SeaStack Setup

4. DEMONSTRATION ACTIVITY

Equipment and Infrastructure Used

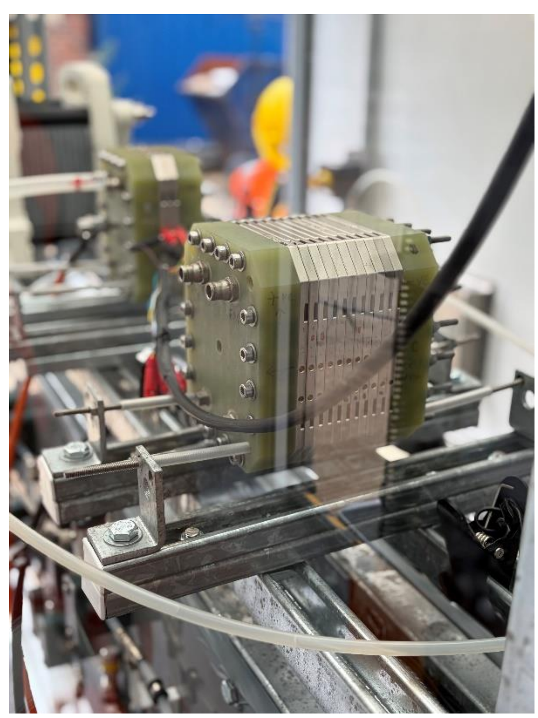
The demonstration system comprised the SeaStack electrolyser integrated within a transportable, marinised enclosure designed for deployment in coastal and industrial environments. The system incorporated the electrolyser stack, electrical power supply, electrolyte storage and circulation systems, gas-liquid separation, process instrumentation and safety systems.

Three different feedstocks were evaluated during the demonstration: natural seawater collected at Portland Port, concentrated brine, and treated wastewater effluent obtained from a municipal sewage treatment works. These feedstocks were circulated through the system using dedicated pumps and fluid handling equipment designed to provide stable operating conditions throughout the demonstration.

The system incorporated continuous monitoring of key operating parameters, including cell voltage, current, electrolyte flow and pressure, together with hydrogen detection and forced ventilation to ensure safe operation within the enclosed demonstration platform.

Hydrogen produced during the demonstration was safely vented following gas separation. The objective of the demonstration was to validate hydrogen production and system operation under realistic conditions rather than to compress or store the generated hydrogen.

SeaStack Enclosure



SeaStack Electrolyser Stack

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Methodology and Procedures

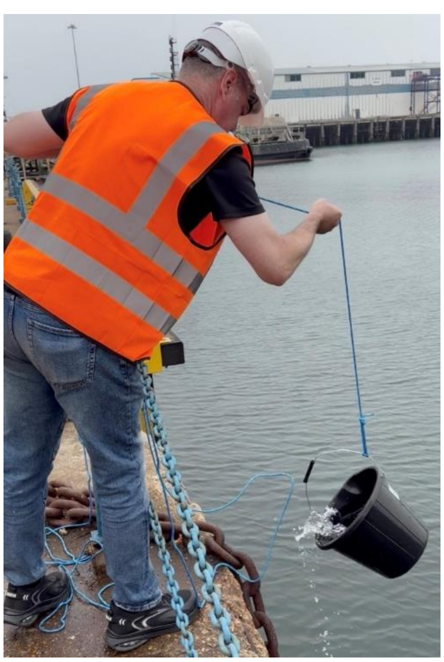
The demonstration was carried out at Portland Port using the integrated SeaStack system under representative operating conditions.

Following system installation and commissioning, the electrolyser was operated sequentially using seawater, concentrated brine and treated municipal wastewater effluent. Prior to each trial, electrical systems, fluid circuits and safety systems were inspected, feedstock circulation was established and the system was verified to be operating within the required parameters before electrical power was applied.

During operation, hydrogen production was demonstrated from each feedstock while key operating parameters were continuously monitored. In the video the output hydrogen can be seen bubbling up through the gas separator, and this was confirmed by inserting a handheld hydrogen sensor into the vent pipe above the trailer – the sensor immediately went to full scale reading with each electrolyte in turn.

The seawater and wastewaters were analysed before and after electrolysis using handheld meters to measure salinity and pH and a Yinmik pool meter was used to check chlorine levels. To confirm these readings a traditional refractometer was also used – this is an optical meter that uses the principle of optical refraction to measure changes in dissolved salts. This was calibrated against standardised solutions of known concentration.

The trials assessed the ability of the SeaStack architecture to operate reliably using chemically diverse saline and wastewater streams without desalination or conventional water purification. Each operating period concluded with a controlled shutdown, inspection of the system and preparation for the subsequent feedstock.



Seawater Collection from Portland Port

Sewage Treatment Plant Effluent

Safety, Risk Management, and Regulatory Considerations

Operation of the demonstration system involved electrical equipment, hydrogen generation and challenging saline electrolytes. Appropriate engineering controls and operating procedures were therefore incorporated throughout the design and execution of the demonstration.

The electrolyser operated at low pressure, with hydrogen separated from the electrolyte and safely vented rather than compressed or stored. The transportable enclosure was designed with separate ATEX and non-ATEX compartments to isolate electrical equipment from areas where hydrogen could potentially accumulate. The ATEX compartment was fitted with forced ventilation using an ATEX-rated extraction fan, while continuous hydrogen monitoring was provided using a dedicated hydrogen sensor.

Electrical power was supplied via a 63A three-phase connection and protected through appropriate isolation, distribution and emergency shutdown systems. Additional safety features included ATEX-rated lighting, an emergency stop system, dedicated cable management and controlled gas venting arrangements for both hydrogen and oxygen.

Risk assessments and operating procedures were developed before deployment and followed throughout commissioning and demonstration activities, ensuring the system was operated safely under real portside conditions.

ATEX-rated Ventilation Fan

Built-in Hydrogen Sensor

Data Collection and Monitoring Methods

Measurements included cell voltage, current, electrolyte flow rates, pressure and qualitative confirmation of hydrogen production while operating with seawater, concentrated brine and treated municipal wastewater effluent. Observations relating to system behaviour, operability and feedstock handling were also recorded throughout the demonstration. Since this was a single day demonstration, long term durability was not tested. In this case the hydrogen was vented to atmosphere, but our ongoing work at Portland will include drying and compressing the hydrogen for use in a fuel cell power vessel. These aspects will be investigated in further testing.

The experience gained from this project provides an important benchmark for future development of the SeaStack platform and will be used to support continued optimisation, scale-up and future field demonstrations.

Data Monitoring - during demonstration

5. RESULTS AND ANALYSIS

Environmental Impact

The demonstration highlighted the potential environmental benefits of direct saline-water electrolysis by producing hydrogen without reliance on freshwater abstraction or desalination.

The salinity and pH (acidity) of the sea water was measured before and after processing through the SeaStack electrolyser. The changes in both salinity and pH were negligible and within the normal margin of error for the measuring equipment. This demonstrates that our approach is effective in preventing a build up of salinity at discharge back to the sea. We also tested for the presence of free chlorine in the discharged water. None could be detected. This was exactly as expected, since the SeaStack cell architecture avoids exposing the seawater to oxidation reactions – thus sidestepping a common problem in direct seawater electrolysis.

Electrolyte	As sourced			After Electrolysis		
	Acidity pH	% Salinity	Free Chlorine	Acidity pH	% Salinity	Free Chlorine
Seawater	7	3.18	None detected	7.1	3.23	None detected
Treated Effluent (from local sewage works)	7.2	0.22	None detected	7.2	0.21	None detected
Concentrated Brine	7	9.8	None detected	7.2	9.9	None detected

The acidity of the oceans is a well-known environmental issue, slowing shell growth for crustations and corals. The oceans are also the earths largest carbon sink as they absorb carbon dioxide from the atmosphere – but this is dependent on the pH balance of the oceans. So it's important that SeaStack does not increase acidity. The results of this test are encouraging in demonstrating that SeaStack does not harm the marine environment.

In laboratory tests we have been able to manipulate the discharge pH, actively making seawater less acidic. This has potential environmental benefits, so we are continuing research in this area.

Successful operation using seawater, concentrated brine and treated municipal wastewater effluent demonstrates the opportunity to utilise alternative water resources that are often readily available in coastal and industrial environments. This has the potential to reduce demand for freshwater, simplify plant infrastructure and enable hydrogen production in locations where conventional electrolysers would require significant water treatment.

The ability to utilise treated wastewater also offers opportunities for greater integration between hydrogen production and wastewater treatment infrastructure, supporting improved resource utilisation and circular economy principles.

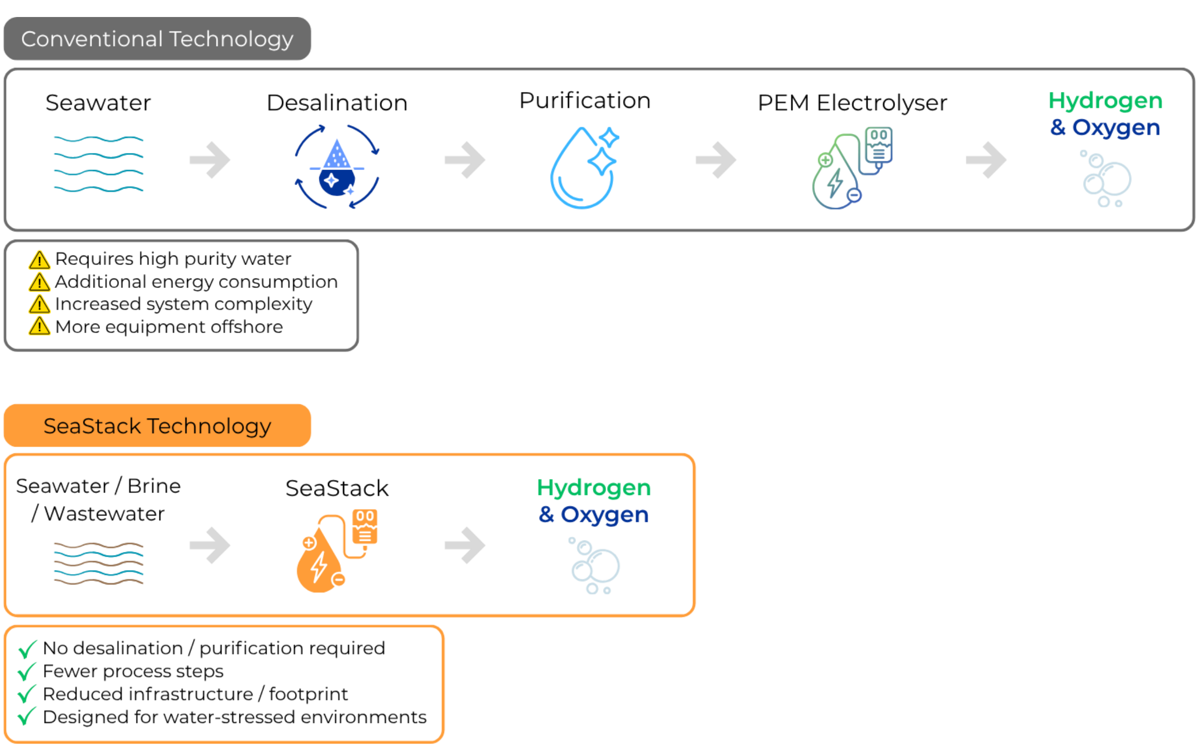
Comparison with Conventional Technologies

All commercially available electrolysers require specially purified water for durable operation. This would normally be drawn from potable water supplies and then further purified to ASTM type I or II standards for laboratory water. The stochiometric analysis shows that 9kg of water will produce 1kg of hydrogen and 8kg of oxygen. But this is just part of the water consumption. Much larger amounts are required for water purification and cooling. A UK Government study found that between 42-52 litres of fresh water is required for every kg of hydrogen produced. Ref: DESNZ, *Water Demand for Hydrogen Production*, March 2024.

Reverse osmosis (RO) desalination is often cited as a simple solution for coastal hydrogen production. However, normal RO water is not pure enough, and will quickly damage conventional electrolysers. Before it can be used in a conventional electrolyser, it must be further purified to ultra-high-purity deionised water. The DESNZ 2024 study found that the minimum treatment required two successive passes through dedicated RO plant, followed by a de-ionisation process.

These additional treatment stages increase capital cost, operating cost, energy consumption and overall system complexity, particularly for coastal and offshore installations where only seawater is available, and plant maintenance is very difficult. The SeaStack demonstration has shown an alternative approach by producing hydrogen directly from three representative non-potable water sources without desalination or purification. While further development and long-term durability testing remain necessary, the demonstration illustrates the potential to simplify hydrogen production systems by removing a major balance-of-plant requirement.

This capability may offer particular advantages for ports, offshore renewable energy projects, coastal industries, wastewater treatment works and industrial facilities generating saline process streams, where suitable feedstocks already exist and can potentially be utilised without pre-treatment.

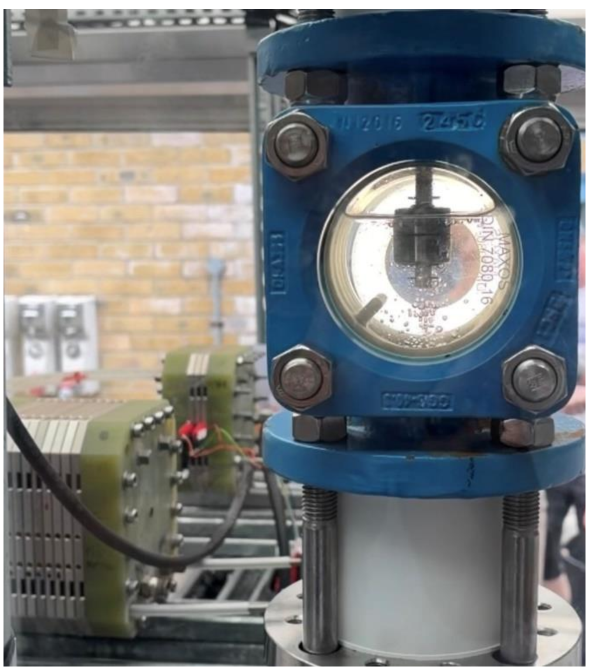


Performance of the Technology

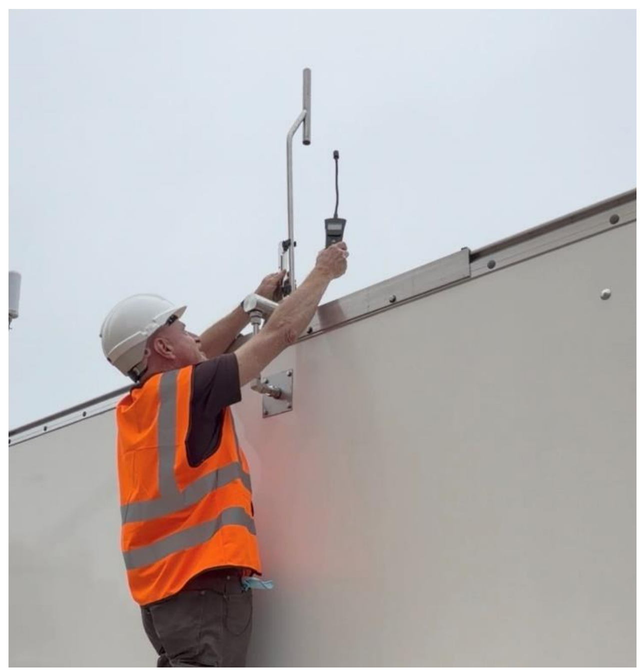
The live demonstration successfully produced hydrogen from three challenging water sources: natural seawater, concentrated brine and treated municipal wastewater effluent under real portside conditions at Manor Marine, Portland Port.

Operation across all three feedstocks demonstrated the versatility of the SeaStack architecture and confirmed that hydrogen production could be achieved without desalination or conventional water purification.

The demonstration represented a significant progression beyond laboratory testing by verifying operation under practical deployment conditions and providing valuable operational experience for future scale-up.



Gas Separator - view of the gas separator showing hydrogen bubbles leaving the seawater electrolyte



Hydrogen Output - Checking the vent pipe for hydrogen output with a handheld detector

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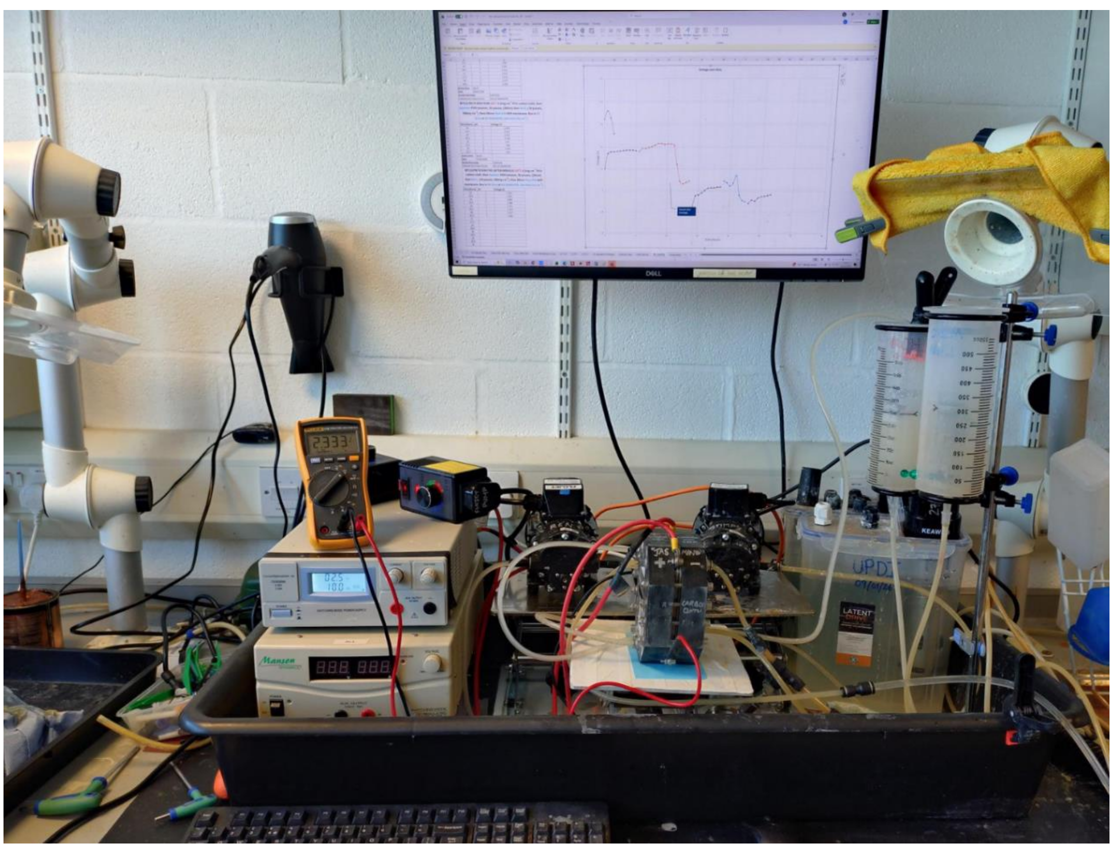
Validation Against Design or Models

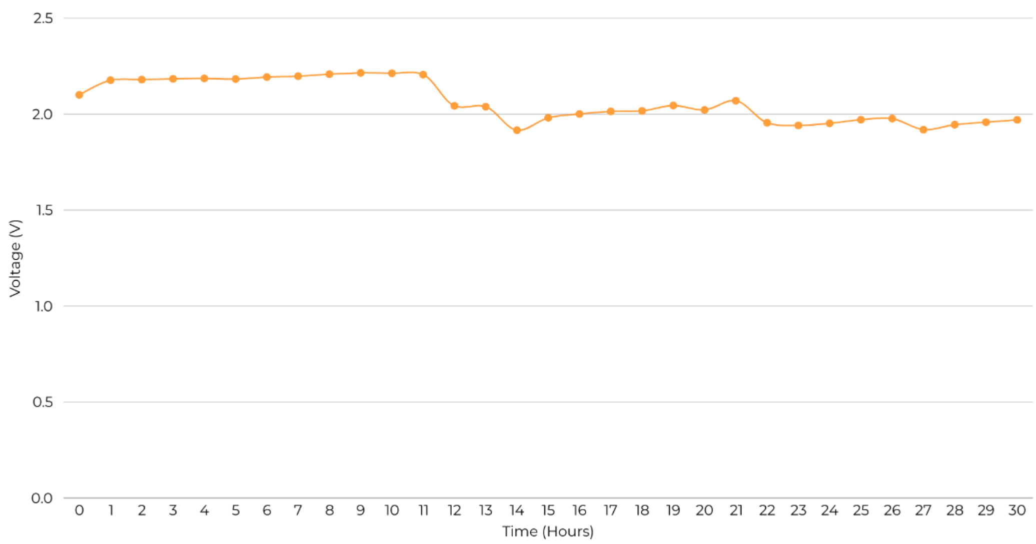
The demonstration successfully validated the core operating principles previously established through laboratory testing.

Earlier laboratory studies had demonstrated stable operation using seawater over extended operating periods and had shown the expected reduction in cell voltage with increasing operating temperature. The port demonstration confirmed that these laboratory findings could be translated into an integrated field system operating under real-world conditions.

Importantly, the demonstration extended previous validation by successfully producing hydrogen from concentrated brine and treated municipal wastewater effluent in addition to seawater. This demonstrated that the SeaStack architecture is capable of operating with a broader range of saline and contaminated water sources than originally investigated during laboratory development.



Seawater Stability Test Station in Laboratory



Seawater Stability Test - 30-hour Results

This 30-hour test was carried out during our bipolar plate development work, and showed improving performance over the test run as the electrolyser was conditioned (this can be seen as a reduction in the cell driving voltage). This was very encouraging as our early lab work had shown the classic problems of scale deposits and corrosion would usually occur within a few hours, and would cause obvious deterioration of performance. This indicates that our patented engineering approach has solved the fundamental problems.

Further work is continuing to assess long term durability, improve performance, and refine the SeaStack design.

Economic Considerations

A detailed techno-economic assessment was beyond the scope of this demonstration. However, successful hydrogen production from seawater, concentrated brine and treated municipal wastewater effluent without desalination or conventional water purification demonstrates the potential to simplify hydrogen production systems.

Conventional electrolysers deployed in coastal environments typically require desalination and deionised water production, adding both capital equipment and ongoing operating costs. These costs become severe for offshore installations where maintenance is difficult and platform space has a high capital cost. By eliminating these upstream treatment requirements, the SeaStack approach has the potential to reduce overall system complexity, energy consumption and maintenance requirements.

The e-bridge 2024 report for AquaVentus in Germany analyses the economics of producing green hydrogen offshore. They found that using hydrogen pipelines alongside traditional electrical interconnectors could generate massive savings and double revenues for offshore wind projects. Germany is implementing a massive expansion of green hydrogen production from the North Sea to power heavy industry and chemical production, whilst also reducing dependence on Russian gas. A key obstacle to this is the limited capacity of electrical grids. **The key finding of the e-bridge report is that offshore hydrogen production can reduce costs by €31 billion, mostly by avoiding the need to expand European electrical grids and connections.**

Latent Drive's SeaStack technology is the solution to this – designed for offshore use with minimal balance of plant and direct connections to wind turbines. Processing water directly from the surrounding sea is an enormous advantage in this situation.

The ability to utilise locally available saline and wastewater resources also reduces infrastructure requirements and improves the economic viability of hydrogen production at **ports, onshore renewable energy installations, industrial sites and wastewater treatment facilities.**

CHALLENGES AND SOLUTIONS

Technical Issues Encountered During Development

One of the most significant technical challenges encountered during the project was the development of hybrid bipolar plates capable of operating reliably in saline environments. Unlike conventional electrolysers, which operate with high-purity water, the SeaStack system is designed to process seawater, concentrated brine and wastewater streams, placing considerably greater demands on component materials and corrosion resistance.

The project therefore focused on developing bipolar plate architectures that provide high electrical conductivity while also suppressing unwanted side reactions. This must be combined with excellent corrosion resistance, robust sealing and practical manufacturability. Achieving these requirements simultaneously proved to be one of the most technically demanding aspects of the demonstration programme.

In parallel, continued development of Latent Drive's in-house bipolar membrane manufacturing process improved both membrane performance and manufacturability while reducing dependence on commercially available components.

Although these developments required multiple design iterations, they ultimately enabled successful completion of the SeaStack demonstration and provided a strong technical foundation for continued product development.

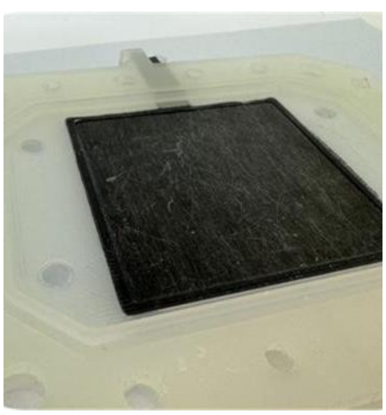
HYBRID BIPOLAR PLATE DEVELOPMENT

Development of the hybrid bipolar plate was one of the principal engineering activities undertaken during the project. Latent Drive worked with Fraunhofer UMSICHT to assess early concepts and potential manufacturing routes, providing valuable external input into the development process.

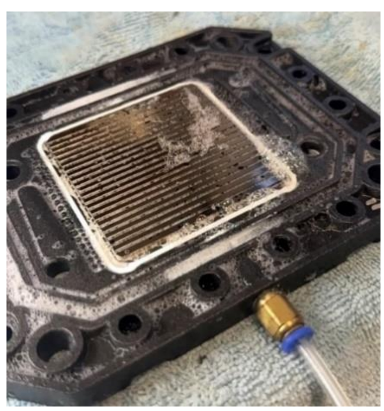
Multiple design concepts and manufacturing approaches were evaluated, with each iteration providing insight into materials compatibility, corrosion resistance, sealing performance and manufacturability under saline operating conditions. Early concepts demonstrated technical feasibility but highlighted challenges that required further refinement before deployment.

The key challenges were to avoid scale deposition in the flow field – which has many small channels, and prevent corrosive chlorine reactions within the stack.

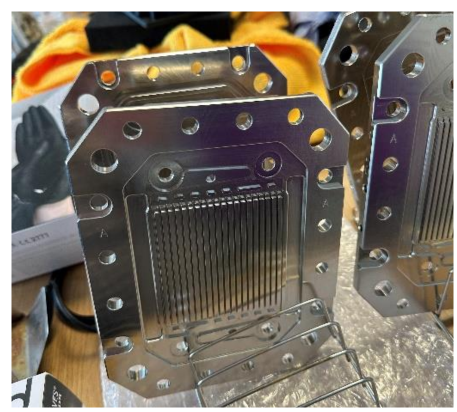
Through this iterative process, the design was progressively improved until a robust solution was identified that was suitable for the Portland Port demonstration. While the demonstrated design met the requirements for successful operation during the project, further development will focus on manufacturing methods better suited to large-scale, cost-effective production without compromising long-term performance or durability.



Early bipolar plate concept developed with Fraunhofer UMSICHT



Surface protection testing during bipolar plate development



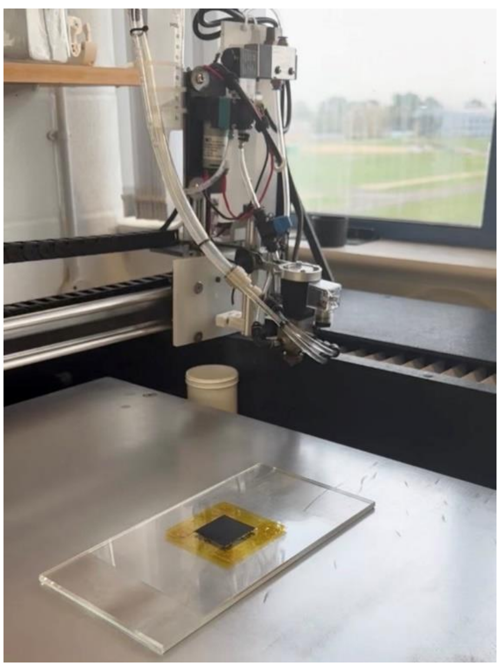
Demonstration-ready bipolar plates

BIPOLAR MEMBRANES

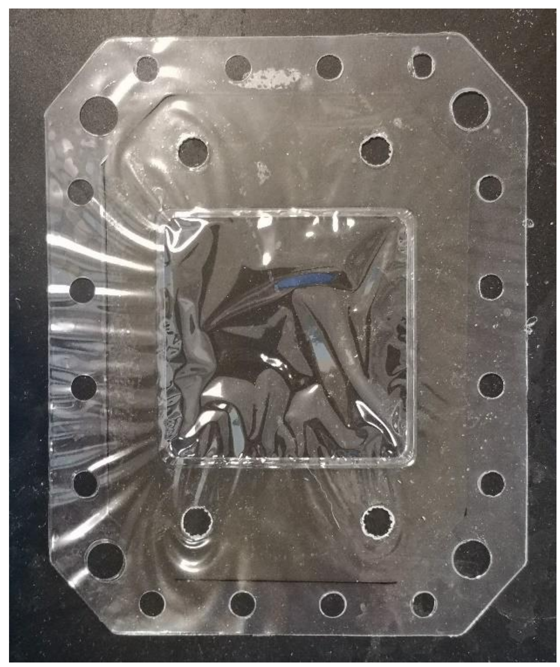
During the project, work was undertaken to further refine and optimise our in-house bipolar membrane (BPM) fabrication processes, which form a key component of the SeaStack architecture.

Manufacturing techniques and catalyst integration at the membrane junction were further optimised to improve reproducibility, reduce manufacturing cost and enhance electrochemical performance. Development of a dedicated membrane support frame also simplified stack assembly while improving handling of the fragile membrane structure during manufacture and integration.

The successful use of these in-house fabricated membranes during the demonstration increased confidence in both their performance and their suitability for future commercial manufacture.



Bipolar Membrane Manufacture



Membrane Frame

6. KEY LEARNINGS

Technical Lessons Learned

The demonstration confirmed that direct hydrogen production from challenging water sources is technically achievable outside the laboratory. Successful operation using seawater, concentrated brine and treated municipal wastewater effluent showed that the SeaStack architecture can tolerate a wider range of feedstocks than conventional purified-water electrolysis systems.

The project also reinforced the importance of materials compatibility when operating in saline and contaminated environments. Hybrid bipolar plates, protective coatings, bipolar membranes and sealing systems all require careful design and validation, as small weaknesses can become significant when exposed to chloride-rich or variable wastewater chemistries.

A key learning was that field demonstrations require a different level of system robustness compared with laboratory testing. Components must be easy to inspect, replace and operate under practical conditions, and critical items such as power supplies should have backup options available.

7. CONCLUSION

Summary of Key Findings

The SeaStack demonstration successfully achieved its primary objective of producing hydrogen directly from three challenging water sources, seawater, concentrated brine and treated municipal wastewater effluent, under real portside conditions at Portland Port.

The project demonstrated the successful integration of the SeaStack electrolyser within a transportable demonstration platform, validating the operation of the electrical, fluid handling, monitoring and safety systems required for deployment outside the laboratory. The demonstration also generated valuable engineering knowledge relating to system integration, materials selection and operation using saline and wastewater feedstocks.

Overall, the project has significantly increased the technical maturity of the SeaStack platform and demonstrated the feasibility of direct hydrogen production from alternative water sources without conventional desalination or water purification.

Impact on Future Hydrogen Projects

The demonstration provides an important step towards the wider adoption of hydrogen production technologies capable of operating with non-potable water resources. By demonstrating successful operation using seawater, concentrated brine and treated municipal wastewater effluent, the project has expanded the potential range of applications for electrolysis in coastal, offshore and industrial environments.

The engineering experience gained during the project will inform future system development while helping to reduce technical risk for larger-scale pilot projects and commercial deployments. The findings also demonstrate the value of field demonstrations in accelerating the transition from laboratory research to practical industrial implementation.

Next Steps and Future Development Areas

Building on the success of the Portland Port demonstration, Latent Drive will continue to optimise the SeaStack platform through further improvements in component durability, manufacturing methods and overall system performance.

Future development will focus on increasing system scale, extending operational lifetime and validating the technology across a broader range of industrial water sources. Particular emphasis will be placed on integration with ports, offshore renewable energy, wastewater treatment facilities and industries generating saline process streams.

Beyond hydrogen production, SeaStack offers opportunities to support wider industrial decarbonisation through integration with applications such as ammonia production, synthetic fuels, water treatment and resource recovery. Continued development and larger-scale demonstrations will support progression towards commercial deployment and help establish direct saline-water electrolysis as a practical alternative to conventional hydrogen production technologies.

The successful completion of the SeaStack demonstration represents an important milestone in the commercial development of direct saline-water electrolysis and provides a strong foundation for the next stage of technology scale-up and industrial deployment