TAP Water

Transformation Acceleration Platform for Water Splitting

Programm / Ausschreibung	FTI Initiative für die Transformation der Industrie 2024 inkl. CETP	**Status**	abgeschlossen
Projektstart	01.04.2025	**Projektende**	30.10.2025
Zeitraum	2025 - 2025	**Projektlaufzeit**	7 Monate
Keywords	automated infrastructure; green hydrogen; high-throughput electrolysis; sustainable catalyst materials; applied machine learning		

Projektbeschreibung

Das Projekt TAP Water (Transformation Acceleration Platform for Water Splitting) führt die Idee einer innovativen, modularen und automatisierten Laborinfrastruktur ein, um die Entwicklung und Kommerzialisierung von katalytischen Materialien für die nachhaltige Wasserstoffproduktion zu beschleunigen. Im Einklang mit dem ehrgeizigen Ziel der EU, bis 2030 10 Millionen Tonnen grünen Wasserstoff zu produzieren, wird TAP Water die Dekarbonisierung und Nachhaltigkeit der Industrie unterstützen, indem es die gesamte Entwicklungsprozesskette für Wasserspaltungstechnologien vorantreibt.
Die Plattform umfasst miteinander verbundene Module für Materialabscheidung, Charakterisierung und In-Operando-Elektrolyseur-Tests, um den Übergang von Experimenten im Labormaßstab zur marktreifen Technologie zu beschleunigen. Durch den Einsatz von Techniken wie der kombinatorischen physikalischen Gasphasenabscheidung (PVD), der Hochdurchsatzcharakterisierung und der KI-gesteuerten Analytik verbessert die TAP die Ressourceneffizienz, verkürzt die Testzeiten und erleichtert die Skalierbarkeit. Darüber hinaus ermöglicht das Design eines speziellen Hochdurchsatz-Elektrolysemoduls mit Inline-Analytik eine rasche Bewertung der Katalysatorleistung und -stabilität und unterstützt so effiziente, nachhaltige Wasserstofflösungen für den großtechnischen Einsatz. Dieser Ansatz steht im Einklang mit Österreichs Klimaneutralitätszielen und den Zielen der industriellen Transformation, indem die Abhängigkeit von kritischen Rohstoffen verringert und gleichzeitig die Ressourceneffizienz und betriebliche Flexibilität gefördert wird.
Durch eine detaillierte Nachhaltigkeits- und Marktverträglichkeitsprüfung will TAP Water die Realisierbarkeit und das Potenzial der vorgeschlagenen Infrastruktur bewerten. Die Plattform wird ein einzigartiges Unterfangen sein, das Österreich als Zentrum für Spitzenforschung und Industrieinnovationen fördert und potenziell als Blaupause für künftige automatisierte Labors und Produktionsumgebungen dienen kann. TAP Water beabsichtigt, zur Transformation der Industrie beizutragen, indem es die Produktion von grünem Wasserstoff vorantreibt, um den Übergang zur Klimaneutralität zu beschleunigen, und indem es einen umfassenden Rahmen für die digitale Transformation hin zu KI-gesteuerter Automatisierung einführt.

Abstract

The TAP Water project (Transformation Acceleration Platform for Water Splitting) introduces the idea of an innovative, modular, and automated laboratory infrastructure to accelerate the development and commercialization of catalytic materials for sustainable hydrogen production. In alignment with the EU's ambitious target of 10 million tons of green

hydrogen production by 2030, TAP Water will support the decarbonization and sustainability of industries by advancing the whole development process chain for water splitting technologies.
The platform incorporates interconnected modules for material deposition, characterization, and in-operando electrolyzer testing to streamline the transition from laboratory-scale experiments to market-ready technology. By employing techniques such as combinatorial Physical Vapor Deposition (PVD), high-throughput characterization and AI-driven analytics, the TAP enhances resource efficiency, reduces testing times, and facilitates scalability. Additionally, the design of a dedicated high-throughput electrolysis module with in-line analytics enables rapid evaluation of catalyst performance and stability, supporting efficient, sustainable hydrogen solutions for large-scale adoption. This approach aligns with Austria's climate-neutrality targets and industry transformation goals, aiming to reduce dependency on critical raw materials while promoting resource efficiency and operational flexibility.
Through a detailed sustainability and market impact assessment, TAP Water aims to evaluate the viability and potential of the proposed infrastructure. The platform will be a unique endeavor, promoting Austria's role as a center for cutting-edge research and industry innovations and potentially serving as a blueprint for future automated laboratories and manufacturing environments. TAP Water intends to contribute to the transformation of industry by advancing green hydrogen production to accelerate the transition towards climate neutrality as well as by adopting a comprehensive framework for the digital transformation towards AI-driven automation.

Endberichtkurzfassung

The TAP Water project set out to evaluate the feasibility and impact of an automated, modular laboratory platform designed to accelerate the discovery and industrial deployment of new materials for water-splitting technologies.

A central outcome is the development of a detailed and realistic platform design that integrates high-throughput material deposition, characterization, and electrolysis testing into a unified automated workflow. The infrastructure was planned in three scalable configurations ("core," "full," and "maxi"), demonstrating strong modularity and flexibility in both functionality and investment.

In developing concepts for high-throughput electrolysis testing, several technical approaches were examined. A promising solution based on parallelized electrolysis test stands as well as point-wise electrolysis measurements of combinatorial samples was defined. This design can significantly increase throughput, leveraging the bottleneck of for testing the performance of novel catalytic materials for water splitting.

The project quantified the platform's acceleration potential, revealing process-specific acceleration factors between 4.2 and 121.8 compared with manual experimentation. Continuous autonomous operation and parallelized testing were identified as the main drivers of acceleration. For electrolyzer testing in particular, the time required to bring new materials to market could be reduced by up to 29-fold, while also enabling exploration of a much larger material space.

Resource-saving potentials were demonstrated through comparative estimates of electricity consumption, embodied CO2-equivalent emissions, and labor costs. While not a full techno-economic analysis, these metrics clearly indicate that automation can substantially reduce material, energy, and personnel demands per experiment.

Finally, a broad stakeholder and market analysis enriched the platform design and highlighted Austria's rapidly growing need for advanced electrolyzer materials. With electrolyzer capacity expected to expand from 28.3 MW to over 500 MW in planned projects, and potentially to 1 GW by 2030, accelerated materials development will be essential for meeting national climate and hydrogen-strategy targets. The platform directly supports this need by enabling faster, more reliable, and more cost-efficient innovation cycles.

Overall, the project not only confirmed the feasibility of the proposed automated infrastructure but also underscored the increasing urgency of accelerating materials research to support the transition to green hydrogen and climate neutrality.

Projektpartner

- AIT Austrian Institute of Technology GmbH