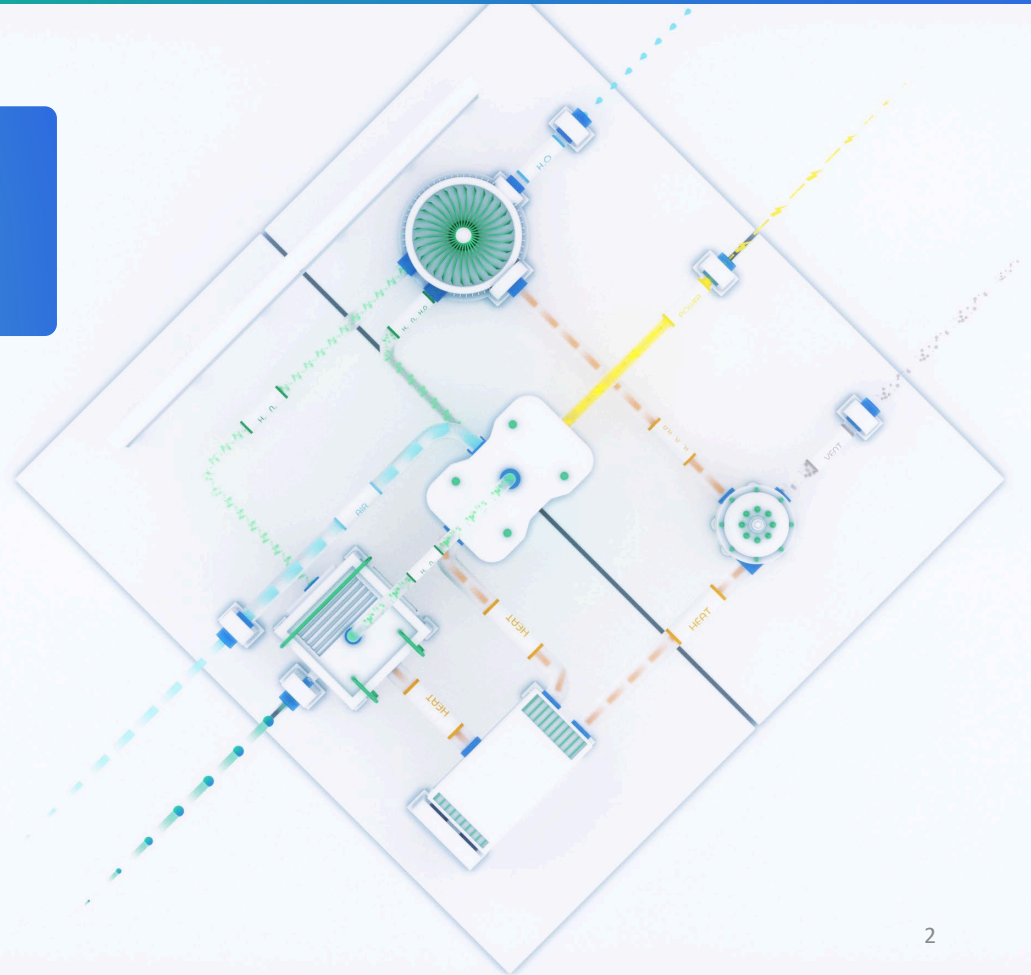




Project Overview

Agenda

- Objective and Outcomes
- Technology Concept
- Beyond State of art
- Excellence
- Impact
- Workplan
- Dissemination



Specific Objectives

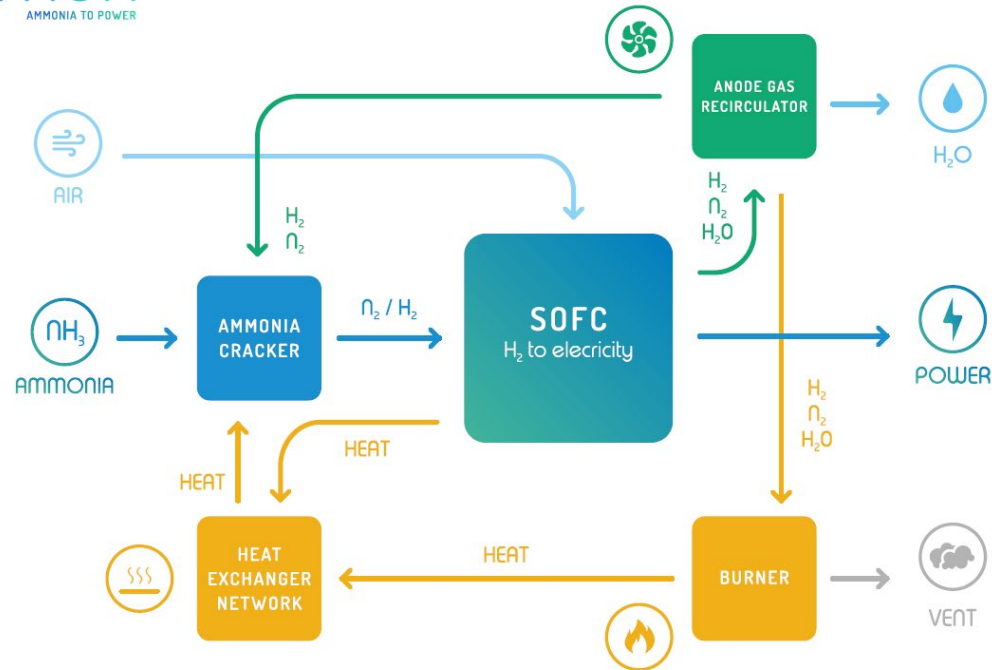
SO1	Design and develop a fuel cell stack module at a scale of 8 kWel, tested and qualified to convert (directly or through an integrated ammonia reformer) ammonia into power , possibly using the internal reforming capacity of a solid oxide cell operating at high temperature and managing the power output through the control of the cell fuel utilization. The stack module will be qualified through cell testing (electrochemical, long term and posttest analysis), SRU testing (to qualify interconnecting materials to ammonia), single stack testing (to qualify long term durability, optimization of cell control and fuel utilization, heat balance), and full stack module testing (to qualify and test the specific module operating modes and qualify the stack highest efficiency and specific control strategy).
SO2	Qualify a system 100% tolerant to ammonia in all the components and related materials, including heat exchangers, burner and potential reformers and anode gas recirculation, as well as the fuel cell in all the building materials, layers and interconnects.
SO3	Target 70% system electric efficiency , pursued by the optimal use of the cell to reduce heat generation and consumption and leveraging the fuel utilization to a maximum, integrating novel solutions such as anode gas recirculation to eventually be utilized.
SO4	Validate the stack and system flexibility to allow for 30% partial load and full flexibility in the overall range.
SO5	Qualify the system for at least 3000 hrs operation with demonstrated 90% availability in the operating hours and less than 3% degradation rate at nominal power condition measured over 1000 hours of continuous operation.

Expected Outcomes

Expected outcome of the Topic TC4-02	AMON Specific Objectives
Support EU industry across the whole value chain in the development of the next generation power appliances utilising ammonia as a fuel.	Several players of the relevant EU industry, representing the value chain, are part of the AMON Consortium: stack supplier (SOLYDERA), system integrator (ALDK) and technology end user (SAPIO) to bring the technology to the application sectors.
Demonstration of high efficiency, fuel cell-based systems operated on ammonia to provide new options for decarbonization of different energy sectors and facilitate establishing value chains between fuel cell industry and existing players in industrial markets	A pilot testing will be run for a total period of 6 months and a minimum time of 3000 hours of operation. This will be done in a maritime environment, at the port of Venice, where ammonia is expected to be a commodity through the import of the NEOM project by Air Products – SAPIO. The piloting will involve the validation of several operating modes including the sectors related to autonomous power systems. An end user board will be activated to link the development of AMON technology to the different final sectors
Contribute to the decarbonisation of autonomous power systems operated on a liquid carbon-free fuel e.g., digital data transmission sector, such as telecom (5-15 kWel), communication support for critical infrastructures (up to 5 kWel), energy supply (up to 10 kWel) for early warning systems (i.e., hazardous climate-related event transmitters). These market opportunities represent a suitable steppingstone to deploy fuel cell systems with highly efficient energy conversion rate of ammonia fuel to power within a reasonable timeframe	A full FC ammonia system will be operated at a scale of 8 kWel, in line with all the potential autonomous power systems identified. At the same time, the Consortium will establish a relationship with the port of Venice to demonstrate the system in the harbour as well as engaging further end users , to support the decarbonization pathway of the site.
Set the basis for the development of large power generators in the 100 kW and MW scale for e.g., harbours where ammonia is available as commodity already today. Green ammonia figures as a candidate to become the future standard fuels in maritime applications	A scaled-up design for the AMON system will be performed looking for systems at the hundred kW and MW scales , based on demonstration of the AMON prototype in a maritime environment
Gain and transfer knowledge and experiences to the maritime providing sector	SAPIO has several business relationships with Italian ports, Venice, and Livorno above all, where the specific location of the port of Venice will be utilized as pilot testing site. The port of Venice will be part of the End User Advisory Board (EAB).
Prepare and demonstrate the next generation of fuel cells for stationary applications able to run under (renewable) hydrogen-rich fuels whilst keeping high performance Target: <ul style="list-style-type: none"> • Electrical efficiency of the system $\geq 50\%$. • total system power degradation $\leq 2,5\%$ at nominal power measured over at least 1,000 hours of continuous operation. • availability of the system $\geq 90\%$ during whole testing period gathering $\geq 3,000$ operating hours. • fuel cell system able to operate at partial loads; 	SOFC in AMON will be fully qualified to be operated with ammonia, validating from the single cell to the stack module against most of the relevant operational parameters. The targeted efficiency of the AMON system is $\geq 70\%$ with an optimal Hot Bop for heat recovery over all dynamic ranges of operation. Total system power degradation $\leq 2,5\%$ at nominal power measured over at least 1,000 hours of continuous operation, conducting to an availability of the system of $\geq 90\%$ during the entire testing period gathering $\geq 3,000$ operating hours ; fuel cell system able to operate at partial loads down to 30%;
Fuel cells operating on alternative (renewable) fuels. Target: <ul style="list-style-type: none"> • 5-15 kW fuel cell system operating with green ammonia including operation at partial load; 	The AMON fuel cells will be operating in a stack module of 8 kWel composed of G8X cells by SOLYDERA, supporting partial load operation down to 30% of the nominal capacity . Hot and Cold BoP (Balance of plant) will be developed to guarantee such dynamic range of operation (30-100%).
New technologies and components to reduce costs and improve flexibility in operation. Target: <ul style="list-style-type: none"> • fuel cell system costs $\leq 5,000$ €/kWel for 100 MW annual production. 	The AMON target cost of the system is confirmed to be $\leq 5,000$ €/kWel for 100 MW annual production , with a target for the FC to be $\leq 2,500$ €/kWel in the same production capacity

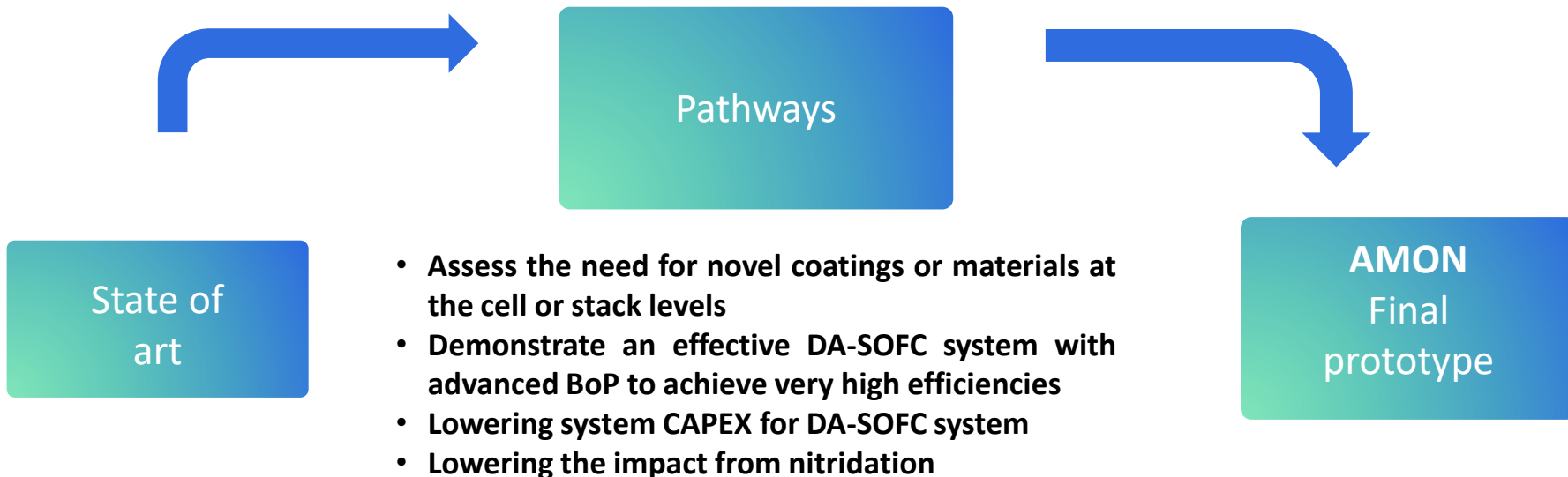
Beyond SRIA

- Simple conceptual layout of the technology
- Develop novel SOFC stack, Burner, HXs, Control unit
- Option to design and develop ammonia cracker and anode gas recirculator



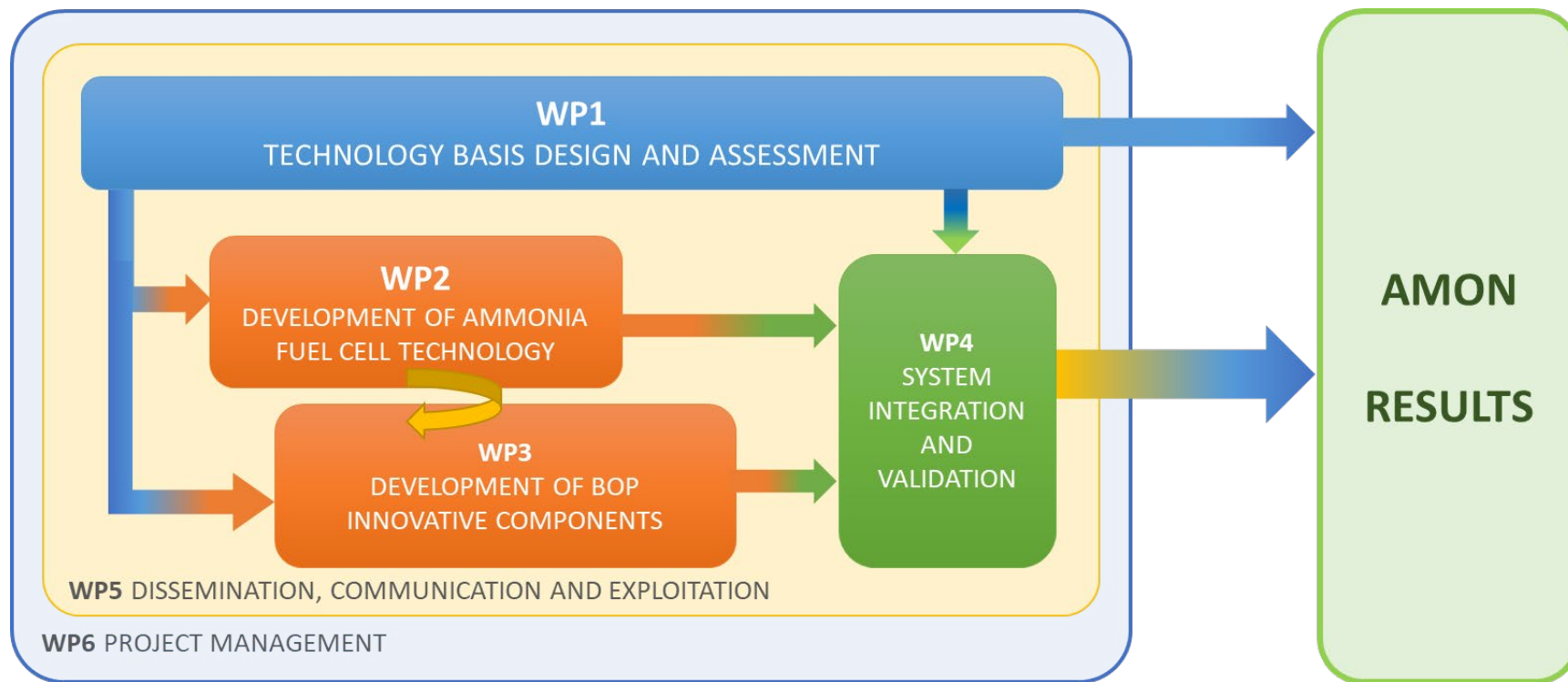
The heating value of ammonia makes 70% in electricity

Beyond the state of art



Impact

SPECIFIC NEEDS	EXPECTED RESULTS	D & E & C MEASURES
<p><u>Security of Supply</u>: In response to recent events, Europe feel the urge to diversify energy supplies and accelerate renewable energy roll-out to replace fossil fuels in homes, industries and in power generation.</p> <p>Ammonia represents one of the best solutions for efficient long-distance transportation of renewable and low-carbon energy sources and can be directly used as fuel in such applications through highly efficient SOFC.</p> <p><u>Unlock wide markets potential</u>: Renewable Ammonia in efficient conversion systems to <u>decarbonize hard-to-abate sectors</u> such as maritime, autonomous power systems, where volumetric density and long-term storage solutions are key requirements.</p> <p><u>Raise industrial interest in ammonia</u>: components used in the fuel cell system are still at prototype phase. With AMON, we can develop new components, validate those components in a relevant environment and bring them at industrial scale.</p>	<p>Novel SOFC stack module resistant to ammonia fuel validated.</p> <p>Novel Ammonia BOP components such as: resistant heat exchangers, catalytic burner, (optional) ammonia cracker and (optional) anode gas recirculatory qualified and tested.</p> <p>Ammonia fuel cell system at an 8 kW SOFC, with high conversion efficiency, long term system durability.</p> <p>Realisation and validation of the AMON integrated system in a relevant environment.</p> <p>Validation of the material exposed at very high temperature in a relevant environment. Estimation of the lifetime expected from those material and components.</p> <p>Safety analysis and technology certification guideline</p> <p>Scaled up technology layout with techno economic analysis</p> <p>Market assessment and specific business case development</p>	<p>Exploitation: a further development to a higher TRL of the new system developed within the project to consolidate the technology and eventually propose it to new customers; development of a new ammonia market as a renewable and low-carbon hydrogen and energy carrier.</p> <p>Dissemination towards end users, scientific community and potential clients: organization of a workshop and a final dissemination event involving external stakeholders, participation to relevant FCH conferences, seminars, events, and fairs, scientific publications in high-impact journals and in ORE platform, open access of research data, in line with IPRs, engagement of local educational institutions.</p> <p>Communication towards citizens: public website and social media, graphic and video materials, participation in science events organised as part of activities in WP5 targeting the broad public.</p> <p>Communication towards EU and National institutions: to raise the interest on a novel validated solution and to support the specific market growth with proper policy actions.</p> <p>Market assessment and Business case: to identify the specific characteristics and need of the targeted priority market to pivot the technology design and development, the communication strategy, the end user engagement, and the future exploitation actions after the project end. This measure would include the analysis of the business case including all valorisation patterns, whatever direct or indirect, towards the various stakeholders.</p>



Visibility and Networking

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📌 AMON filed to South Korea!
At the end of October, our partner **Alfa Laval** | **Alfa Laval - Marine solutions** participated in **#Kormarine** Conference and Exhibition 2023.
📌 AMON Project EU has been mentioned among the ongoing activities of the company in the field of **#ammonia**. In the presentation "Development of Methanol & Ammonia related Products for Decarbonization of Shipping"

Read more on our website! 📄
#dissemination #event #conference #exhibition #shipping #decarbonisation #maritime
Nicoletta Spazzadeschi Davide Rossin - PMP 📧 MBA Debasish Chakraborty

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📌 **#Ammonia** is an emerging key topic in the **#decarbonisation** process and **AMON Project EU** wants to be part of it! 📄

📌 **Debasish Chakraborty** - Principal Scientist at **Alfa Laval**, presented the **#project** at the **6th European Power to Ammonia Conference**. 📄

The **#Conference** is part of the **NH3 Event Europe 2023** and took place on the **8th and 9th of June**, in **Rotterdam**.

Click "Follow" and stay tuned for more updates! 📄
#hydrogen #energy #green #event #power #innovation

FBK-SE | **The Centre for Sustainable Energy** | **Bruno Kessler Foundation** | **SolydEra Group** | **Alfa Laval** | **Alfa Laval - Marine solutions** | **Sapio Group** | **Kiwa Nederland** | **Kiwa Italia** | **VTT** | **DTU - Technical University of Denmark** | **EPFL** (École polytechnique fédérale de Lausanne) | **European Electrolyser and Fuel Cell Forum** | **Lucerne University of Applied Sciences and Arts**

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📌 **First conference for AMON Project EU** 📄

📌 **Matteo Testi** and **Dario Montinaro** participated in the roundtable "Ammonia to Power" organised within the **First Italian #Workshop on #Ammonia #Energy**, held in **Florence** on **May 31, 2023**.

📌 **Matteo Testi** - Coordinator of **#AMON** and researcher at **FBK-SE** | **The Centre for Sustainable Energy** | **Bruno Kessler Foundation**, outlined the activities of the Centre in the **#ammonia** field and focused on **#AMON**.

📌 **Dario Montinaro** - Innovation Technology Manager at **SolydEra Italia**, explained the **#technology** that will be developed within the project.

This **#project** is financed by the **Clean Hydrogen Partnership** and is coordinated by **Fondazione Bruno Kessler - FBK**, through the **Centre SE**.
For more information 📄 <https://energy.fbk.eu/news>

#hydrogen #energy #green #workshop #SOFC #power #innovation

Website and Social media

- <https://www.linkedin.com/company/amon-project-eu/>
- <https://twitter.com/AmonProjectEU>
- <https://amon-project.eu/>

08/02/2024

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📌 The **European Hydrogen Week** is the biggest annual event dedicated to **#hydrogen**, and **AMON Project EU** could not miss it! 📄

📌 Join us at the booth of **Fondazione Bruno Kessler - FBK** at the **Hydrogen Europe Research Pavilion!** You will meet the **Project Coordinator Matteo Testi** and the researcher **Luca Praticò** from **FBK-SE** | **The Centre for Sustainable Energy** | **Bruno Kessler Foundation**.
At the event are also present other **#project** partners as **Alfa Laval** and **EFCF - European Electrolyser and Fuel Cell Forum**.

📌 We are looking forward to meeting you there!

#exhibition #fair #conference #dissemination #ammonia #greenhydrogen #maritime #sofc



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📌 The activities of **AMON Project EU** have been presented at the 10th edition of the **#EFCF23 Conference** 📄
Luca Praticò, researcher at the **FBK-SE** | **The Centre for Sustainable Energy** | **Bruno Kessler Foundation** presented the work entitled "From direct use of ammonia in solid oxide fuel cells to the next generation of ammonia fuel cell systems" within the session **Alternative Fuels**. 📄

Read more about it on the website! 📄
#dissemination #energy #hydrogen #ammonia #greenpower #conference #fuelcellsystem #SOFC

FBK-SE | **The Centre for Sustainable Energy** | **Bruno Kessler Foundation** | **Companie: SolydEra Italia** | **SolydEra Group** | **Alfa Laval** | **Alfa Laval - Marine solutions** | **Sapio Group** | **Kiwa Nederland** | **Kiwa Italia** | **Research centres: VTT** | **DTU - Technical University of Denmark** | **EPFL** (École polytechnique fédérale de Lausanne) | **EFCF - European Electrolyser and Fuel Cell Forum** | **Lucerne University of Applied Sciences and Arts**

For more information 📄 <https://fbk.it/dU84b64R>



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AMMONIA TO POWER

PROJECT PROTOTYPE RESULTS NEWS

NH₃ → P
AMMONIA TO POWER

A novel system for the utilization and conversion of ammonia into electric power at high efficiency using a solid oxide fuel cell system.

THANK YOU
more info www.amon.eu

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the Clean Hydrogen Partnership
and its members Hydrogen Europe
and Hydrogen Europe Research
under Grant Agreement No 101101521

