Green Ammonia Linz

17. Januar 2024

GREEN AMMONIA LINZ

Verbund LAT Nitrogen

Funded by the European Union NextGenerationEU

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Green Ammonia Linz
A decarbonisation partnership of VERBUND and LAT Nitrogen

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VERBUND
Austria's leading energy utility

Austria's **leading** energy utility and electricity company

Most valuable company at Vienna stock exchange with market cap of **EUR >30bn**

Route length of electricity transmission grid of around **3,400** km

129 VERBUND hydropower plants with over 8,200 MW of maximum electricity capacity

~97% of the total electricity generation stemming from renewables

And approximately **900** gas transmission pipeline kilometres

Active RES positions in AT, DE, RO, ES, and AL with capacity additions of **3.8 GW** by 2030

LAT Nitrogen
Austria's leading producer of ammonia, fertilizers and technical nitrogen products

LAT Nitrogen Linz GmbH is a member of **Agrofert Group**

Owns the majority of the **Chemical Park Linz** and supplies utilities and services to industrial customers on site

The largest hydrogen producer and consumer in Austria, with approx. **100,000 tonnes per year of hydrogen,** as an intermediate for ammonia production

Owns and operates **two** ammonia plants, **two** nitric acid plants, **three** fertilizer plants and **two** melamine plants in Linz

Produces more than **500,000 tonnes per year of ammonia** from hydrogen and nitrogen

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Current production of LAT Nitrogen is based on natural gas

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- Ambition to offer **green climate neutral products** to customers: **ammonia** and ammonia based final products like fertilizers, urea, melamine, and AdBlue
- In this particular **hard-to-abate** industrial sector it possible to decarbonise by **replacement of grey H_2 by green H_2**
- “Green Ammonia Linz – GrAmLi” is an important step along LAT Nitrogen’s **decarbonisation roadmap** based on green H_2 and green gases
- The project is well in line with the **Austrian H_2 Strategy**
- It strengthens the **energy independence** from Russian fossil fuels
- **Regulatory pressure** from ETS and RED III

Hydrogen and VERBUND – from green power to green hydrogen

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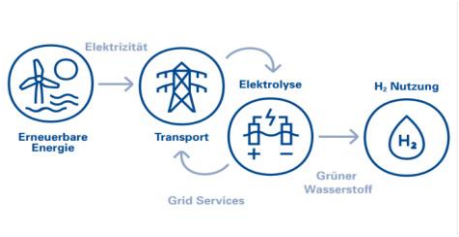
VERBUND strategy 2030 / Mission V

Mission V based on VERBUND Strategy 2030 focusing on three main pillars:
[1] strengthening of the **integrated home market**
[2] expansion of **renewables**
[3] positioning as **European H2 player**

- The **transformation** of our energy system depends on the expansion of renewables
- Additional solutions are needed for a sustainable energy landscape → **green H2 as a key solution**

H2 as key player for the energy transition



- VERBUND builds upon its know-how of an integrated energy company and experience in power plant construction
- Expansion of the value chain: **from green power to green hydrogen** → VERBUND as long-term decarbonisation partner
- Green H2 usage focused on **hard-to-abate sectors** like ammonia, petro-chemicals, steel, long-haul transportation and aviation
- Additional potential in facilitating **stability in the electricity systems** being increasingly penetrated by volatile RES production

VERBUND as decarbonisation partner

- VERBUND drives activities for building an hydrogen economy **in the short and long-term** to ensure security of supply with diversified and cost competitive H2:

  Short-term: deployment of **local H2 production** facilities with partners for direct use in industry

  Long-term: covering increasing hydrogen demands via **diversified imports** from regions with favourable RES & H2 production conditions

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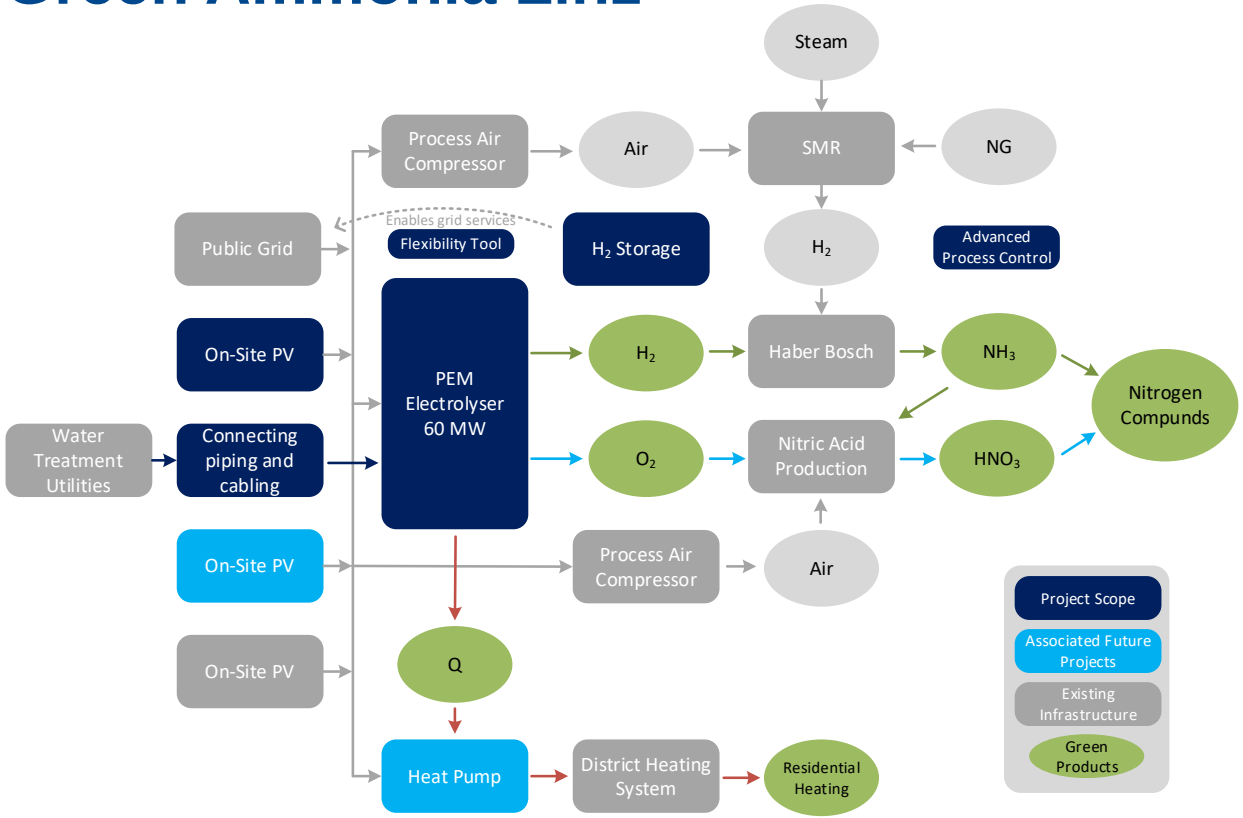

NEW FACILITIES:

- **60 MW PEM ELECTROLYSER**
- **H2 STORAGE**
- **H2 CONDITIONING**
- **O2 CONDITIONING**

Substitution of up to 10% of grey H_2 conventionally used in ammonia production **reducing up to 90,000 t_{CO2}/a**

Full **integration** in existing industrial complex:

Reduced need for new utility facilities improving overall cost efficiency

Provision of grid services facilitating deep **renewable penetration**

Utilization of O_2 in nitric acid production improving economics

Utilization of waste heat further reducing CO_2 emissions

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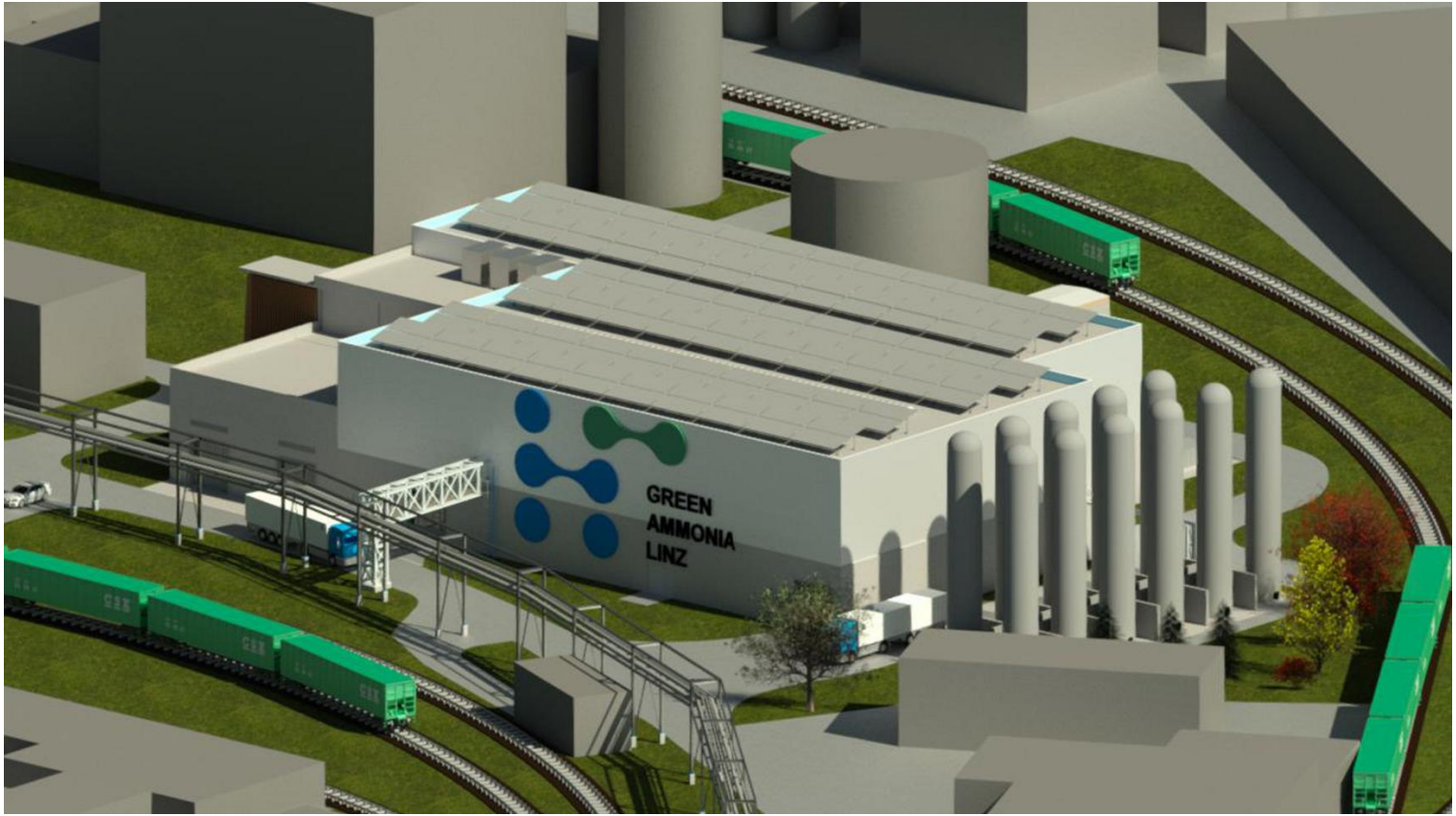
Project Rendering



Engineering Design
Key Facts & Conceptual Decisions

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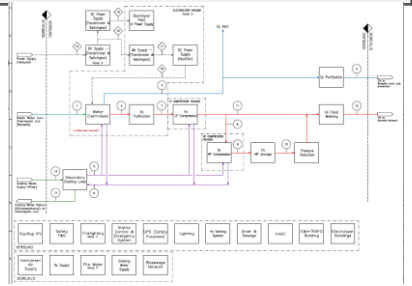
Main constraints & design objectives:

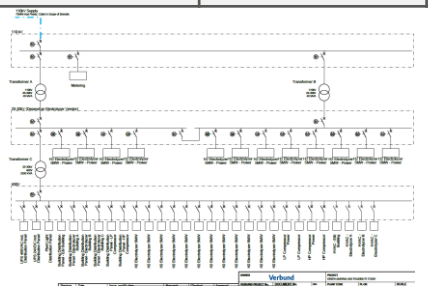
Safety, available plot, available grid capacity, downstream process requirements, capabilities of SMR, sustainability, CAPEX, OPEX, permitting (safety, noise, landscape, river temperature)

Conceptual Decisions

Sizing	1 t/h
Electrolysis Technology:	PEM, pressurized
Compressor Technology:	Reciprocating, dry running
H_2 Storage:	Compressed gaseous hydrogen, 80 bar
	Vertical pressure vessels
Housing:	Concrete building
Cooling:	River water / Heat pump

Green H_2 produced & utilized	1 t/h	7,000 t/a
Green O_2 produced	8 t/h	56,000 t/a
Green O_2 utilized directly	2.4 t/h	16,800 t/a
Waste Heat produced	> 14.5 MW	
Green Ammonia produced	5.7 t/h	40,000 t/a
Green nitric compounds	Fertilizer, Nitric Acid, Urea, Melamine	
power available for grid services	< 50 MW	
CO_2 emissions avoided		90,000 t/a
Natural gas replaced		434 GWh/a
Power saved indirectly		7 GWh/a
Additional power demand	< 60 MW	
Process water demand	9.5 m³/h	66,400 m³/a





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Current Status and Outlook

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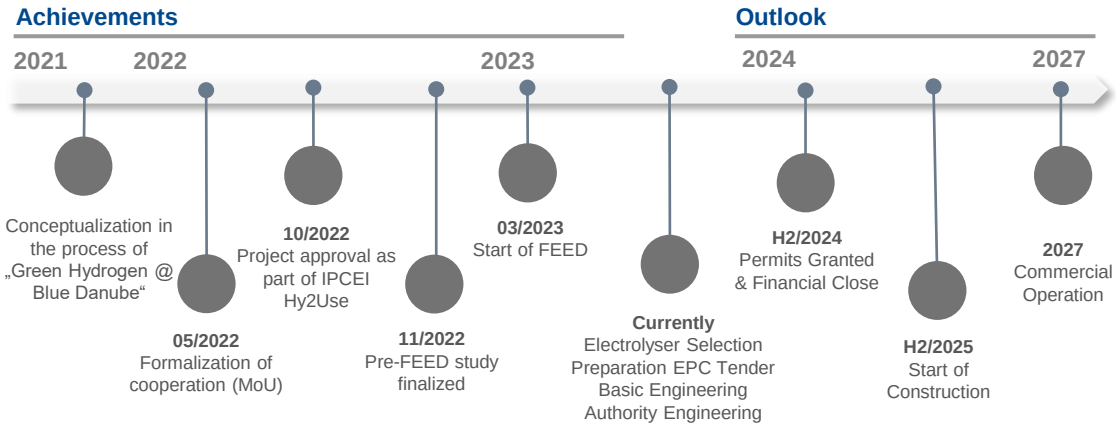
GREEN AMMONIA LINZ IS A TRUE LIGHTHOUSE PROJECT FOR THE DECARBONISATION OF AMMONIA PRODUCTION AND OF INDUSTRY IN GENERAL. IT WILL PROVIDE THE NEEDED EARLY APPLICATION CHANCE FOR NOVEL H_2 TECHNOLOGIES.

Scalability

- GrAmLi will serve as an important reference for the decarbonisation of the entire industrial cluster Linz and a first step for the ammonia production operations of LAT Nitrogen Linz GmbH.
- The solutions developed within this project are intended to be utilized more broadly in any hydrogen application located within industrial parks and existing industrial settings



Challenges

I Technological novelty

PEM electrolysis of this scale
Combination of flexible operation and constant offtake using H_2 storage
Utilization of side products

II Economics

Production of grey ammonia still less costly

Macroeconomic environment

III Regulatory uncertainty

Required regulatory framework in development

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GrAmLi‘s approach to Innovation Fund LSC-2022

Maturity

The project was already well defined and matured

- Application and notification of IPCEI Hy2Use
- Concept and feasibility study by third party
- First contractual arrangements between partners

Effort

5 months from decision to participate to submission

Dedicated team incl. third party assistance

Overall effort of more than 20 person months

Sequence of focus and decisions

1. Principal product & project boundaries
2. Basic business case & assessment of possible funding vs. chance of success
3. Technical definition,
4. Innovation, project planning, risk management, knowledge sharing, support letters
5. Business plan

Result: Strengths and weaknesses of gramli

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Innovation

+ Scale-up of mature technologies
+ Innovative business model
+ Ancilliary services (flexible operation & side products)
+ Context of other IF-supported project established

~ innovation not considered disruptive, breakthrough or first of its kind

Maturity

+ Degree of design and planning maturity
+ Risk register and management plan
+ Degree of detail of business plan
+ Letters of Commitment, Support & Intent
+ Additional state aid already secured
- Level of detail w.r.t schedule risks, governance, elaboration of construction and permitting risks

GHG impact

+ relative GHG emission avoidance >100%
+ quality of calculation
- Absolute GHG emission avoidance ~ 1 Mt

Scalability

+ Credible role as industry blueprint
+ Well elaborated quantification of world-wide potential
+ Comprehensive knowledge sharing plan

Learnings and Tips

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Do not underestimate the effort required – reserve resources and get external support in time

Application is beneficial to project maturation due to its broad requirements

A good project idea is not sufficient – the project needs to be established already

Align strategy with management before start of the application

Start with establishing sector, principal product and project boundaries

Do not underestimate difficulty to maintain consistency across documents

The grant agreement preparation process is resource intensive as well


www.gramli.at
Vielen Dank!
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