



GREEN AMMONIA STORAGE IN SOLID STATE



www.saftammonia.com

PARTNERS

ATD, founded in 2013, is a Spanish technology group that began its activity through the development and manufacture of advanced ceramic products. As a result of an intense and constant R&D activity, with the institutional support of various European and National projects, ATD has developed cutting-edge catalysts for use in devices for the synthesis and dissociation of ammonia, H₂ electrolyzers and fuel cells. Recently, solid-state ammonia and hydrogen storage technologies.

Since its foundation, ATD held offices in Mexico and the United States.

www.atdevices.com

ATD
ESPAÑA
ADVANCED THERMAL DEVICES S.L.



PARTNER



Founded in 2000

Spanish company pioneer in renewable energies.
Promotion, Engineering, EPC, O&M.



Financial Capacity

1,100,000€ of Share Capital



More than 700 installations carried out

Satisfied customers



Works High qualification

We have highly trained staff with many years of
experience



International company

With projects on different continents



Certified Quality Company

ISO 9001  ISO14001  HORIZON 2020 



Social Enterprise

SA8000 

FUNDACIÓN GFM RENOVABLES



www.gfmfotovoltaica.com



NEED



1° ISSUE

Traditional ammonia plants mean large investments due to minimum size required by Haber-Bosch process.
Conclusions: a few players and 7 to 10 years for a new plant.



2° ISSUE

H2 very low energy density means problems for storage and transportation. Extra costs for containers. High pressures (700 bar) and extra safety issues.



3° ISSUE

Traditional “fears” about ammonia. Maritime transportation has to migrate to ammonia or methanol, both toxics. Special homologated facilities required.

SOLUTIONS



1° SOLUTION

Scalable Plants. Starting with less investments for small-medium scales and to growing to large scale according to the market demand.



2° SOLUTION

H₂ packing into NH₃ (17,6% in weigh). Liquid NH₃ (19 bar) contains 170 g of H₂ (5.88 kWh). More energy density than liquefied H₂. NH₃ is a demanded product itself (fertilizers)-.

NON
TOXIC

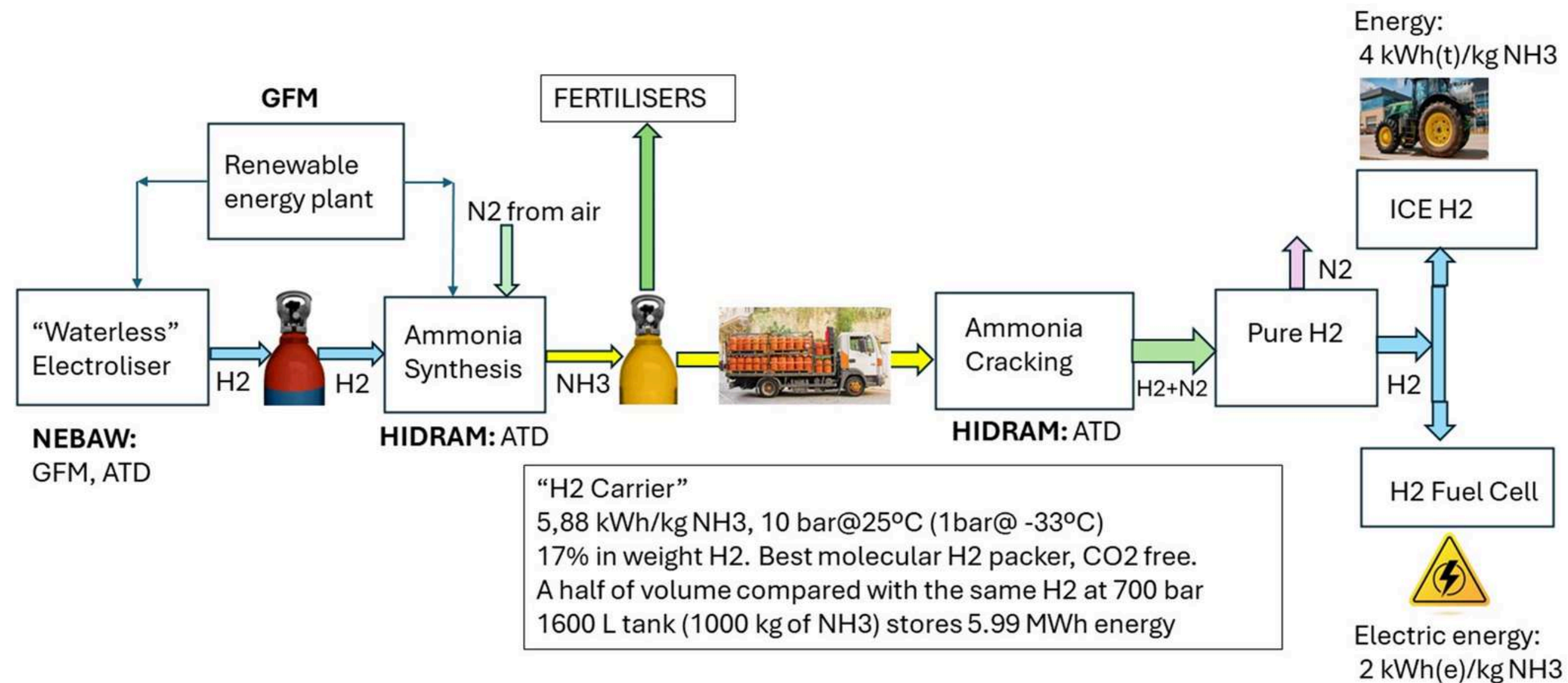


3° SOLUTION

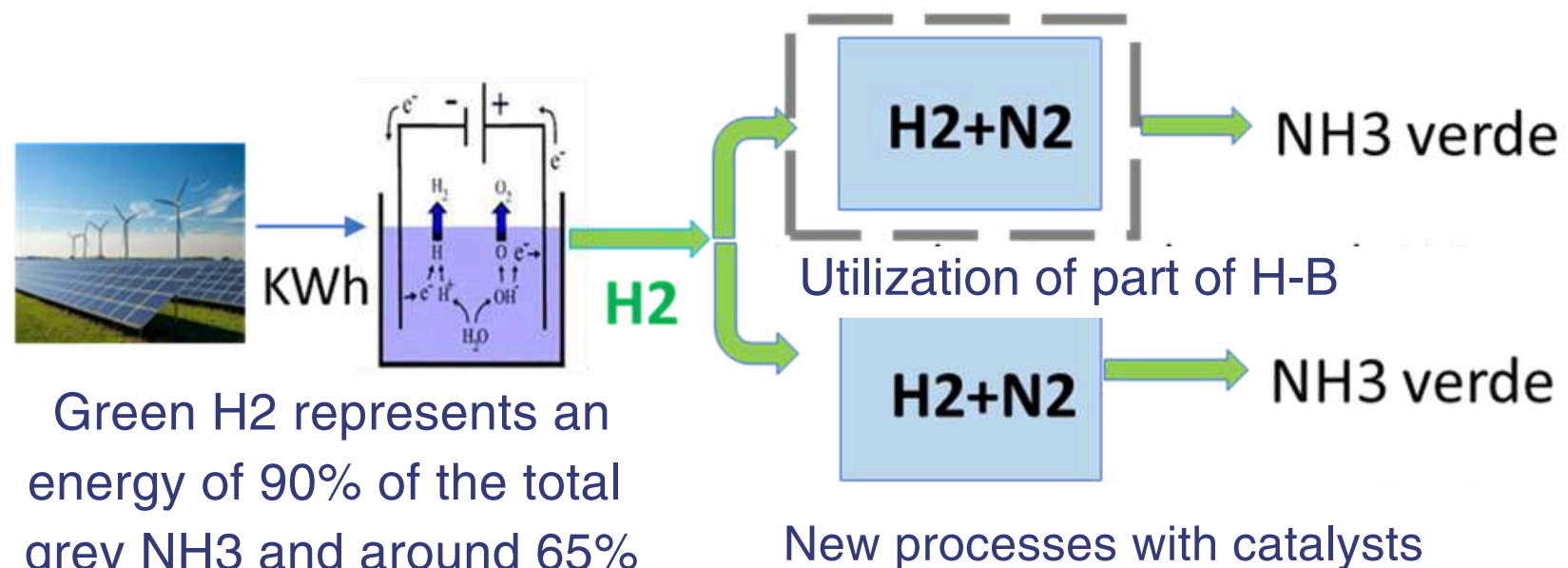
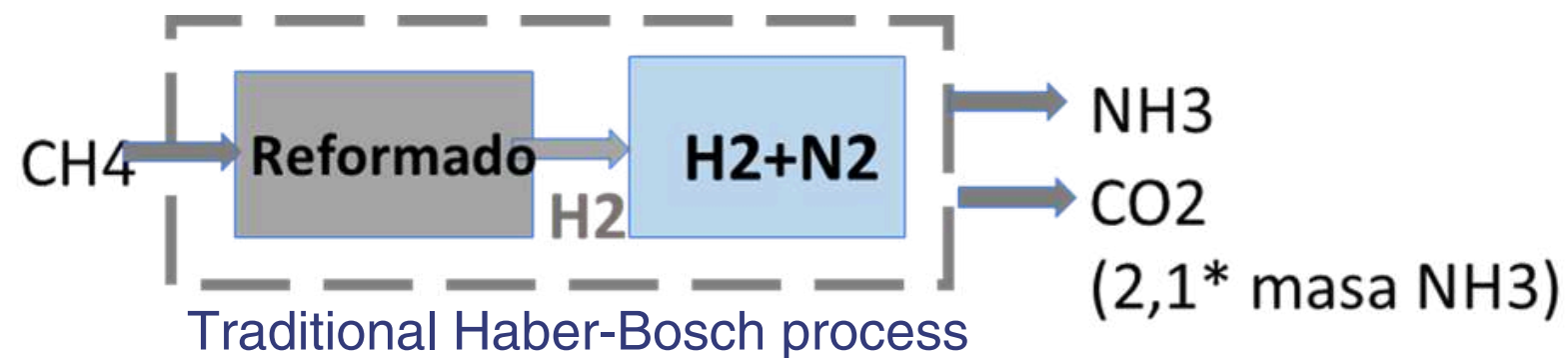
Solid State Ammonia. SAFT: Safe Ammonia Fuel Technology. Up to 50% in weight stored in an inert and not toxic material. No ammonia release at ambient temperature and atmospheric pressure.

Green H2 and liquefied NH3 (10 bar) chain

AMMONIA TOXICITY ISSUE. HOMOLOGATED CONTAINERS AND INSTALATIONS NEEDED..



SYNTHESIS OF GREEN NH₃ FROM RENEWABLE H₂



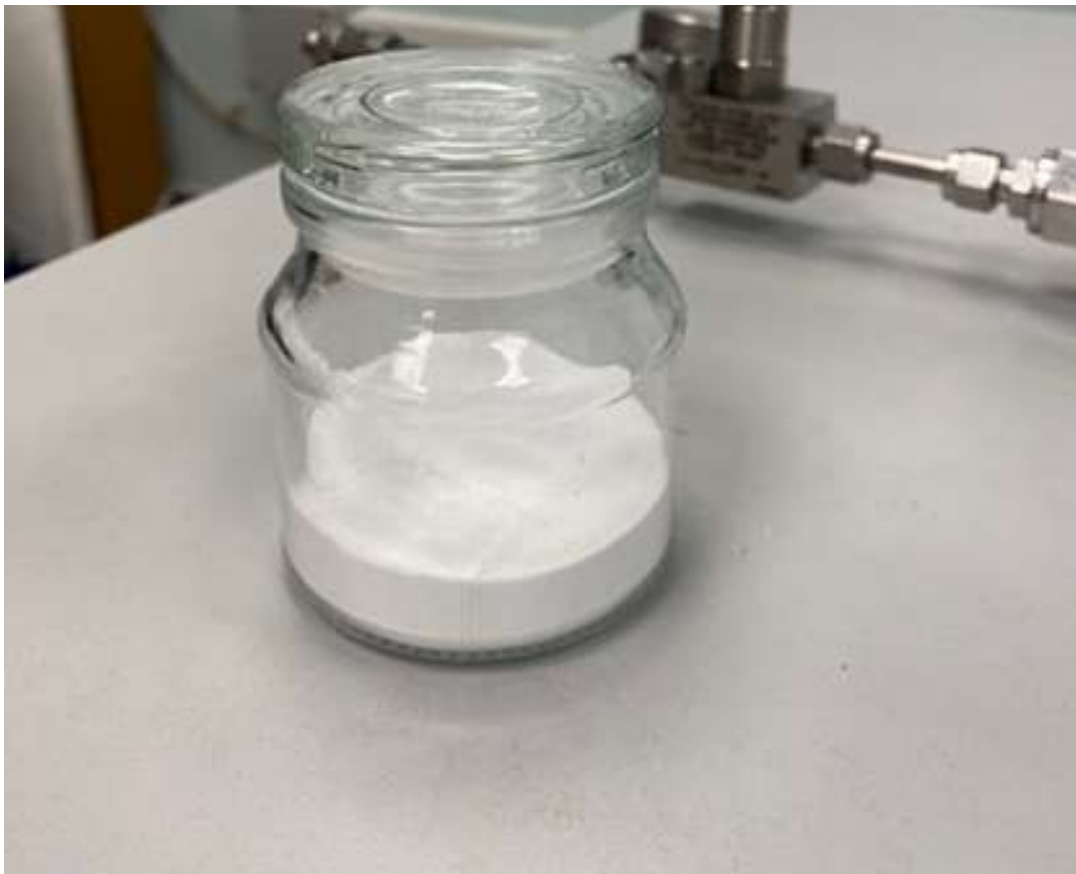
Green H₂ represents an energy of 90% of the total grey NH₃ and around 65% -75% of the new Green NH₃

REPLACEMENT OF GREY H₂ IN THE HABER-BOSCH PROCESS WITH GREEN H₂

It is necessary to replace the H₂ production process (natural gas reforming, CH₄) with green H₂ (normally by electrolysis). This is known as **SECOND GENERATION H-B**.

The impact is considerable on current H-B systems, **AND ALTERNATIVE PROCESSES MAY BE MADE VIABLE**, especially those based on catalysts.

SAFT. SAFE AMMONIA FUEL TECHNOLOGY



Material 'charged with ammonia'

VOLUME AND WEIGHT FOR 3 MWh ENERGY STORED USING DIFFERENT VECTORS



NH3-ASES (1 bar)
1.000 kg, 800 L
(1.200 Kg^(*))



NH3 (10 bar)
510 kg, 816 L
(2.000 Kg^(*))



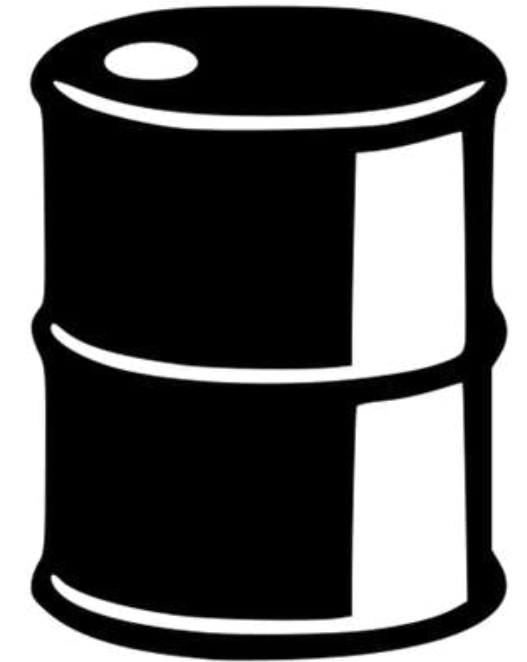
H2 (liquid)
90 kg, 1.270 L
(3.500 Kg^(*))



H2 (700 bar)
90 kg, 1,440 L
(3,100 Kg^(*))



H2 (350 bar)
90 kg, 2,880 L
(5.000 Kg^(*))



Li-ion batts
12.000 kg, 6,700 L

(*) Estimado con depósito incluido

TRANSPORT OF NH₃ IN SOLID STATE

(SAFT: Solid Ammonia Fuel Technology)

KNOWN FACT: AMINES OF THE M(NH₃)_xA_y TYPE with M metal and A halogen. Problems:

Increase in volume x2 or more. Destruction of material shapes and problems in the loading tank.

High energy for the extraction of NH₃ from the amine.

SOLUTIONS:

- A non-toxic amine is designed, compatible with the environment, even with water (discharges into the sea).
- A compound is configured so that it does not release NH₃ at least up to 60°C
- A compound and processes are configured to minimize the extraction energy, resulting in:
- Energy optimization mode: <3% of the energy contained in the processed NH₃ and up to 33% of storage by weight. (Less than what is lost in storing and transporting H₂).
- Storage optimization mode: <8.5% of the energy contained in the processed NH₃ and up to 51% of storage by weight.
- From the powdered material, shapes can be manufactured: pellets (the most convenient for transport and even "pumping"), discs, cylinders, etc.
- Tested: non-flammable and fireproof against direct flame, not soluble in water (no contamination in spills) and can even be useful as a direct slow-release fertilizer. (Tests at ICV-CSIC).

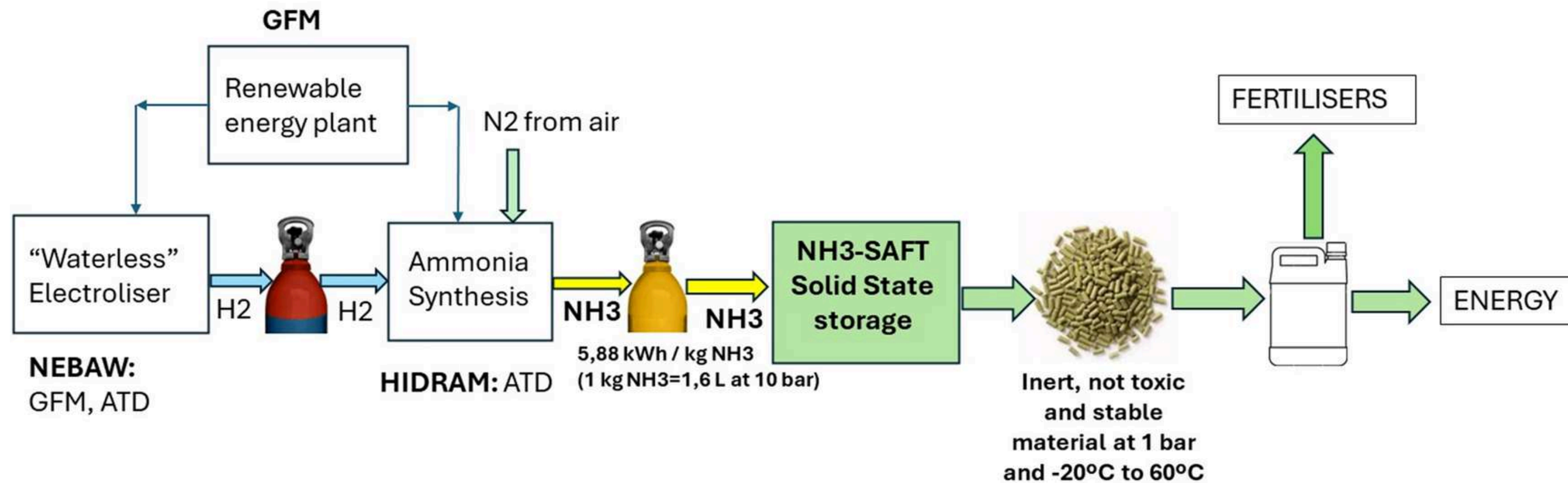


SPANISH PATENT.



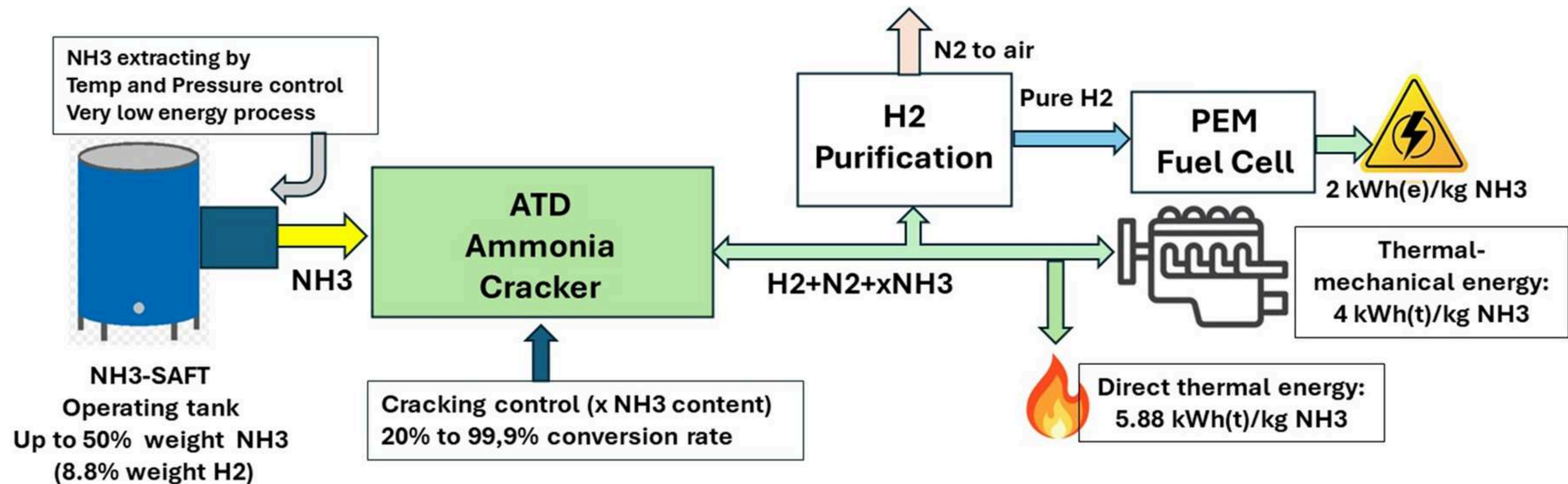
GREEN H₂ AND LIQUEFIED NH₃ (10 BAR) CHAIN WITH: SAFT, SAFE AMMONIA FUEL TECHNOLOGY

Inert and safe material can be stored and transported in any container, even Sacks.



Green H2 and liquefied NH3 (10 bar) chain WITH: SAFT, Safe Ammonia Fuel Technology

Ammonia is stored in an inert, no toxic material. Then ammonia is extracted and cracked for free CO2 energy applications based on green H2.



SYNTHESIS OF GREEN NH₃ FROM RENEWABLE H₂



TARGET MARKET 1

Fertilizers
Energy in farms



TARGET MARKET 2

Maritime transportation
Decarbonization Fuel



TARGET MARKET 3

Industry. Thermal
energy intensive users and
chemical users

COMPETITIVE ADVANTAGES

ADVANTAGE 1



Small and medium
scale plants starting
investments.
Scalable to large plants

ADVANTAGE 2



Patented technology.
Protected know-how.
No third dependences

ADVANTAGE 3



Safe Ammonia for
storage and transport
(solid state).
SAFT: Safe Ammonia Fuel
Technology

ADVANTAGE 4



All the chain elements
included: production,
transport and
applications

COMPARATIVE STUDIES AND REFERENCES



SYNTHESIS OF AMMONIA

- Tsubame-Mitsubishi (Japón)
- Starfire (EEUU)



CRACKER OF AMMONIA

- Amogy (EEUU)
- Starfire (EEUU)
- H2Site (España)



REFERENCE

- Proyecto Europeo (NEMESIS)
- Proyectos Nacionales

OUR TIMELINE

2024

Agreements ATD and GFM

2025

First SAFT AMMONIA plant
in Castilla-La Mancha,
(Saft Solidification)

2026

Synthesizing Green
Ammonia

2027

Scalability third
countries



100,000 €
Own Investment



9,000,000 €
9,000,000 €



New funding round



CONTACT



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