

ENERGY STORAGE



29 giugno, 2022
ore 15:00

Webinar series



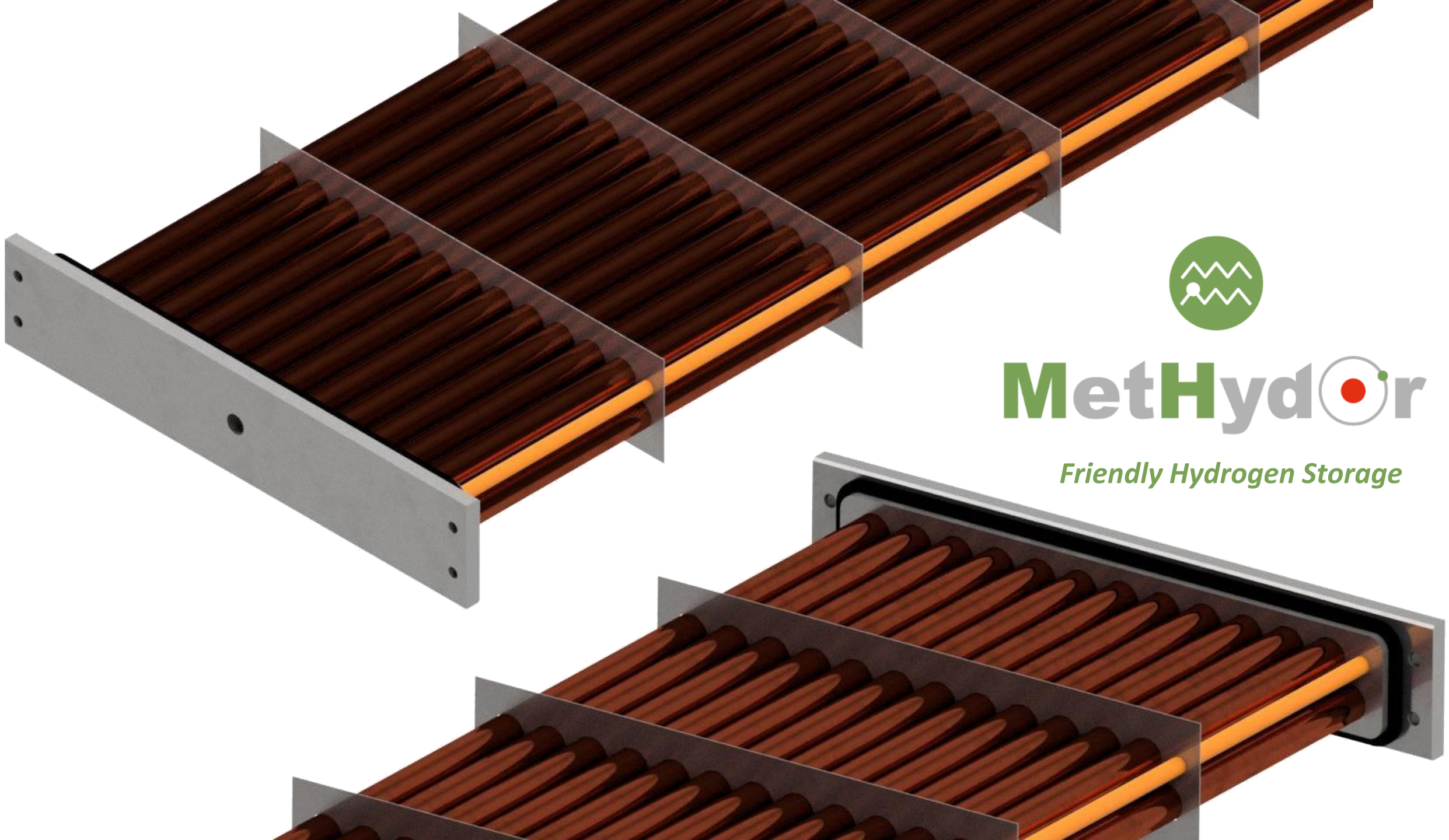
IDRURI METALLICI

UNA SOLUZIONE ALLO STOCCAGGIO ENERGETICO



Relatore

Ing. Thomas Lamberti – Presidente CdA Methydor



MetHydor

Friendly Hydrogen Storage



Established in 2021 as a joint venture between three companies active in the hydrogen field since many years

MetHydor, "*beyond water*", aims to exploit the metal hydride technology to safely store large quantities of hydrogen at low pressure and ambient temperature, but not only...



Integration and industrialization

- **PhD. Marine and Naval Eng.**
Senior R&D manager
- **PhD. Mechanical Engineer**
Expert in H2 technology
- **Control Technician**
Control & electronics expert

Energy storage expertise

- **MBA**
Senior business manager
- **Energy specialist**
Expert in storage technologies

Consultancy

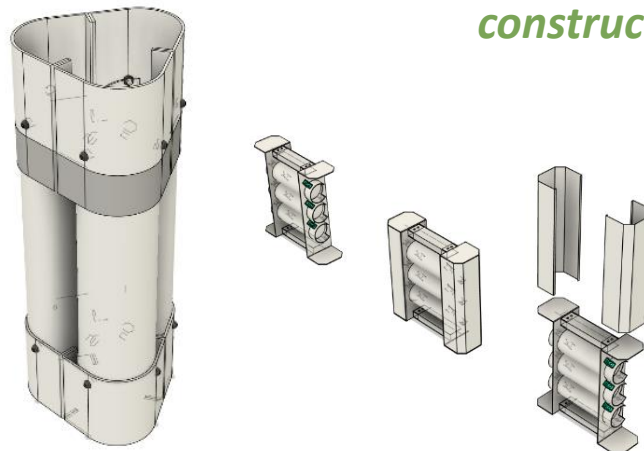
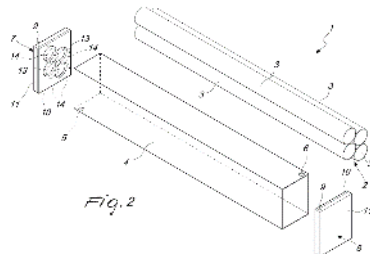
Facility and building capacity

- **Mechanical production**
Engineering of special systems
- **Welding specialists**
Patented inox welding

MH knowledge and experience

- **Prof. Eng. Metal Hydride**
Senior prof. expert of MH
- **PhDs and Researchers**
Powder technicians experts

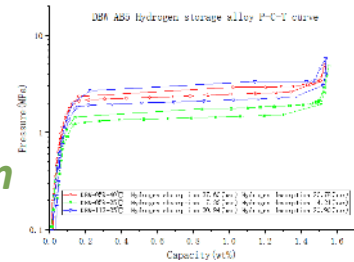
MH Tank patented



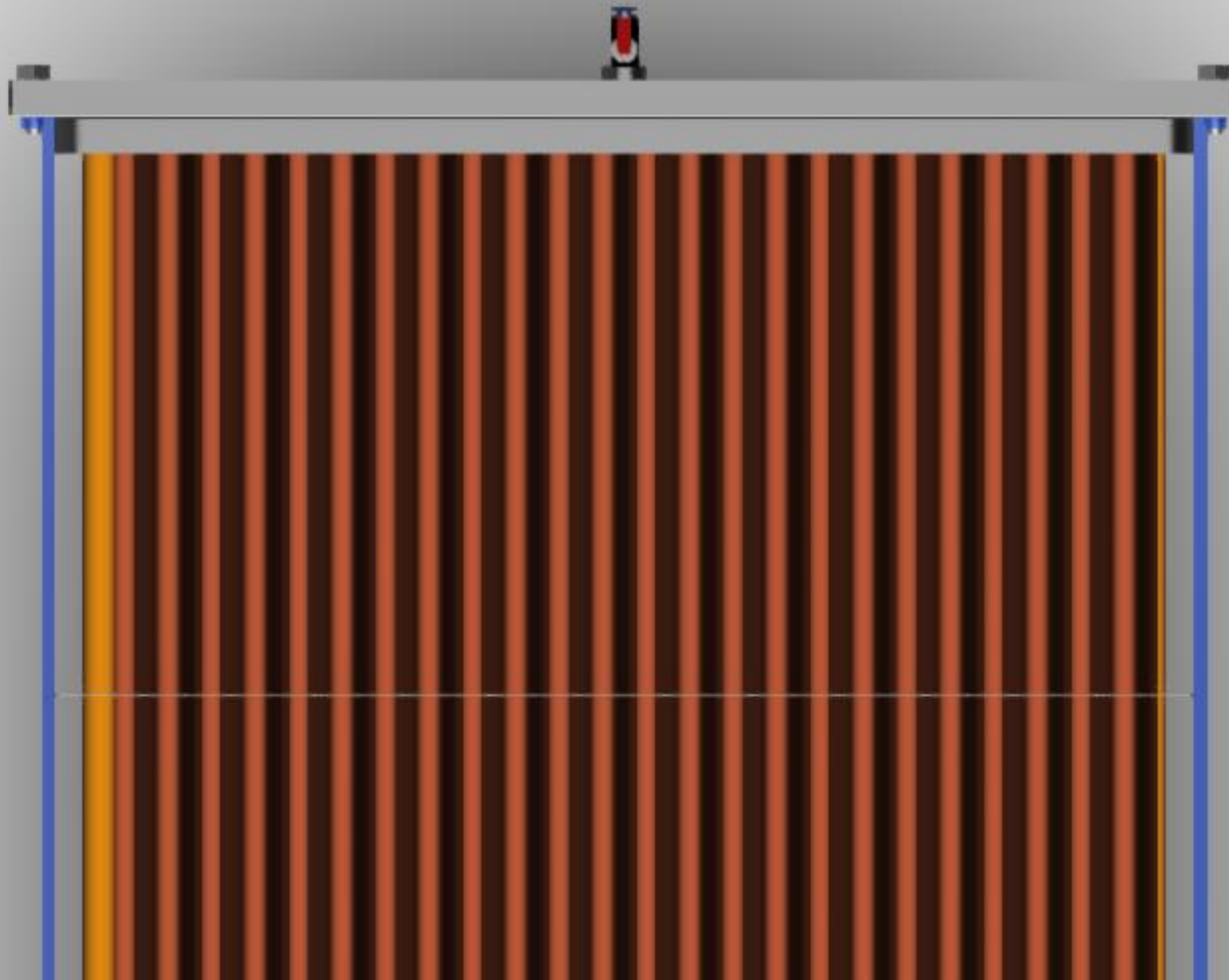
System construction



Powder definition



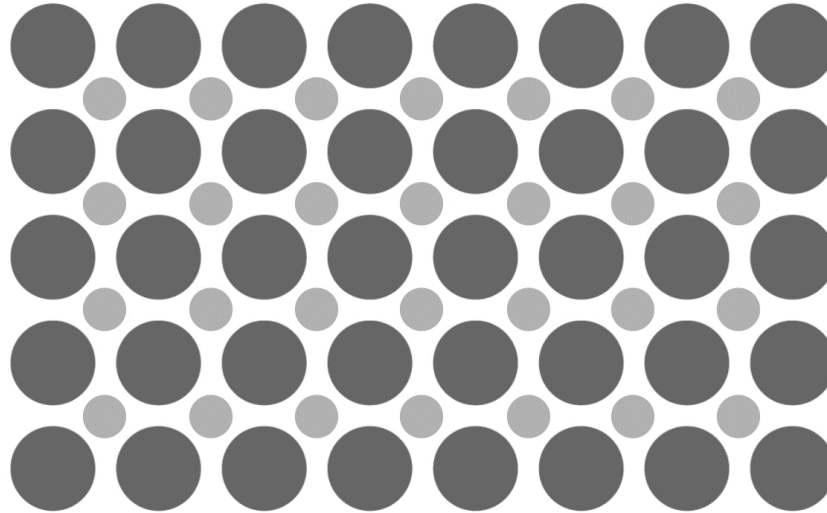
Metal Hydride H2 Storage Startup



Hydrogen absorption



← Heat



Hydrogen desorption



← Heat

Hydrogen absorption

23.5 kJ/mol
3.2 kWh/kgH₂
25 °C



AB	FeTi
AB ₂	TiCr ₂
AB ₅	LaNi ₅

Hydrogen desorption

27.7 kJ/mol
3.8 kWh/kgH₂
25 °C

Volume and weights

$$1 \text{ l } H_2O = 1 \text{ kg } H_2O$$

$$H_2: 2 \text{ uma}$$

$$H_2O: 18 \text{ uma}$$

$$0.11 \text{ kg } H_2 = 1.2 \text{ m}^3 H_2$$

$$0.89 \text{ kg } O_2 = 0.62 \text{ m}^3 O_2$$

$$p < 10 \text{ bar}$$
$$T = \text{ambient}$$



Each H_2O kg contain $1/9$ kg H_2

Energy

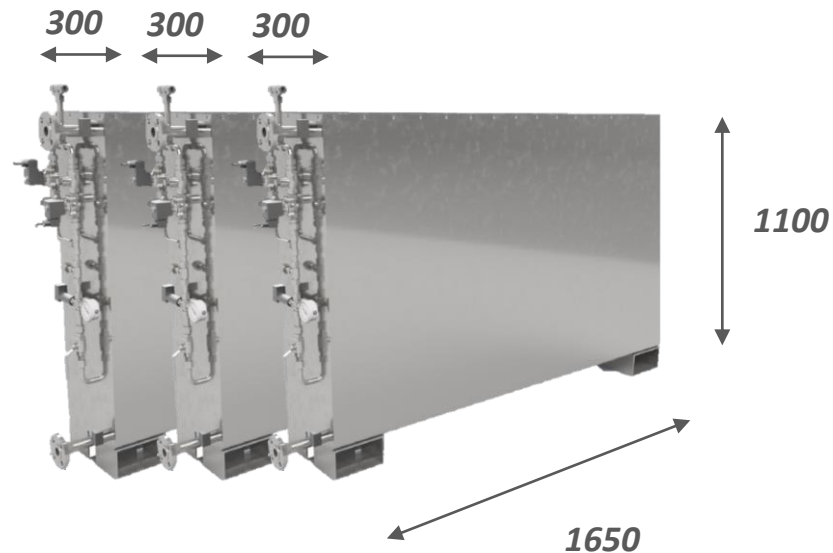
$$0.11 \text{ kg } H_2 = 3.7 \text{ kWh}$$

50% fuel cell efficiency

$$3.7 \text{ kWh} = 1.8 \text{ kWh}$$

70% efficiency
48 kWh/kg H_2

1 MWhe from RES
20.8 kg H_2
187.5 kg H_2O



Tank concept

External heat exchange concept

- Standard diameter system
- Protection against air contact
- Adjustable to different tank forms and sizes

Small pipes diameter advantages

- Higher heat exchange area
- Reduced powder packing effect

From November 2022

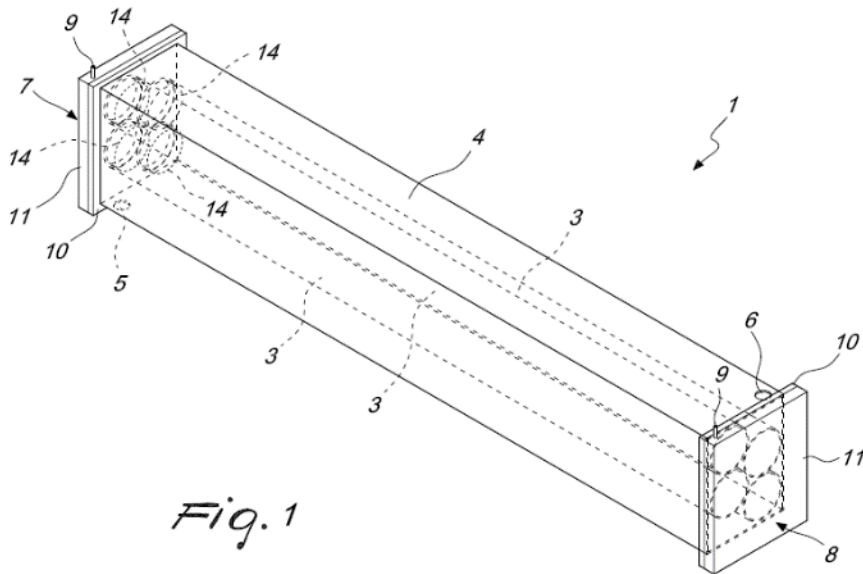
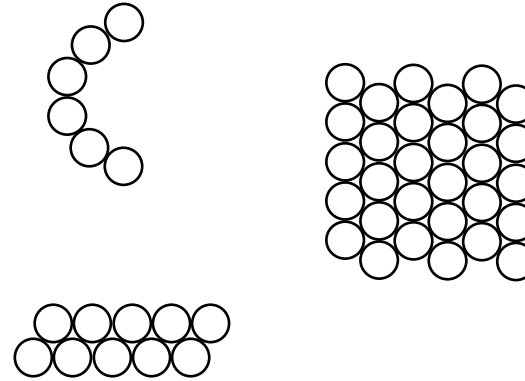


Fig. 1

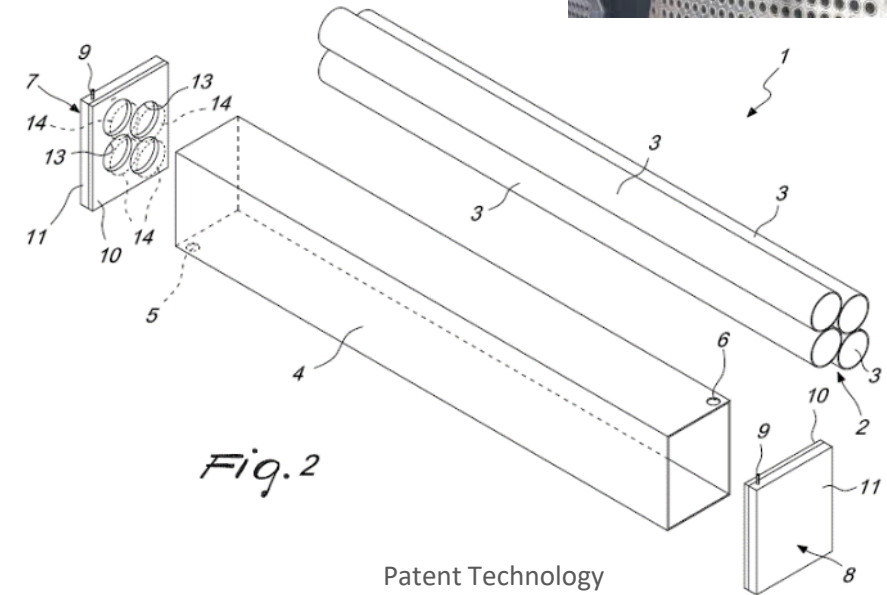
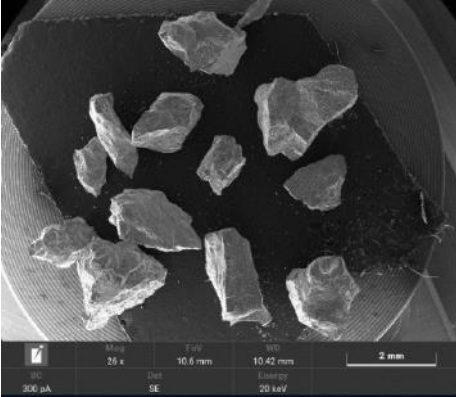


Fig. 2

Patent Technology

Powder Characterization

Powder Morphology



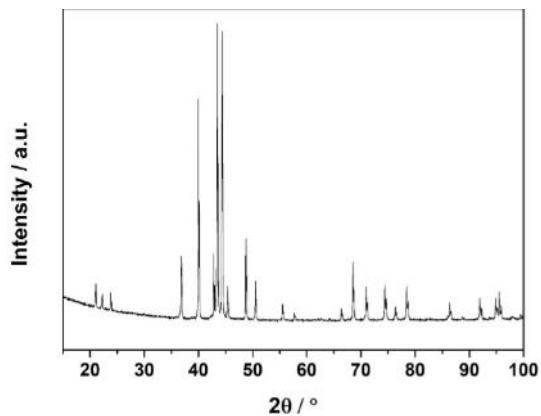
Powder Composition

Ti	Zr	Mn	V	Fe
27 wt. %	2.8 wt. %	51.8 wt %	14.2 wt. %	3 wt. %
Ti + Zr 29.8 wt. %			V + Fe 17.2 wt. %	

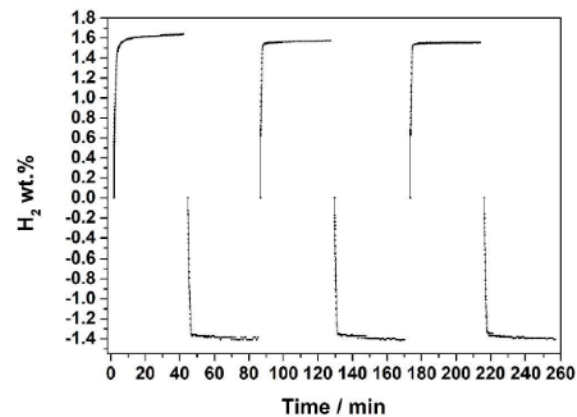
Eg. AB, AB₂ and AB₅ intermetallic alloys

- Powder analysis competence on metal hydrides
- Powder quality assessment
- Italian powder provider under investigation

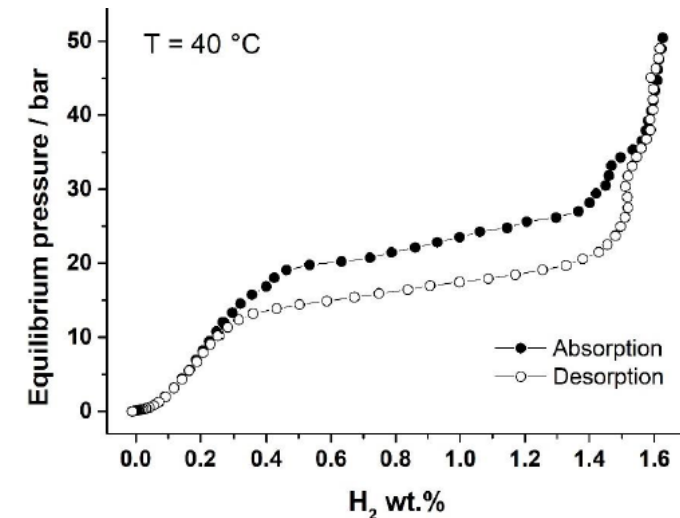
Phase's Investigation



Activation Procedures



H₂ Sorption Properties

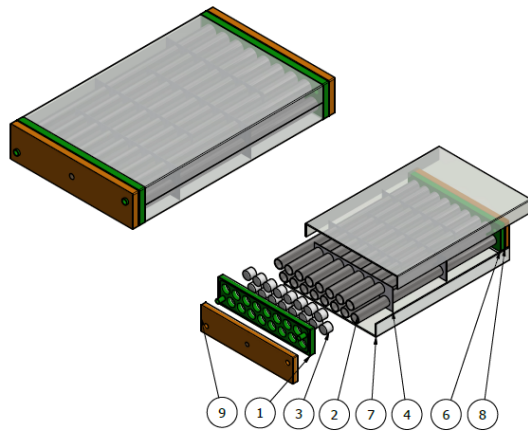


System Design and Integration

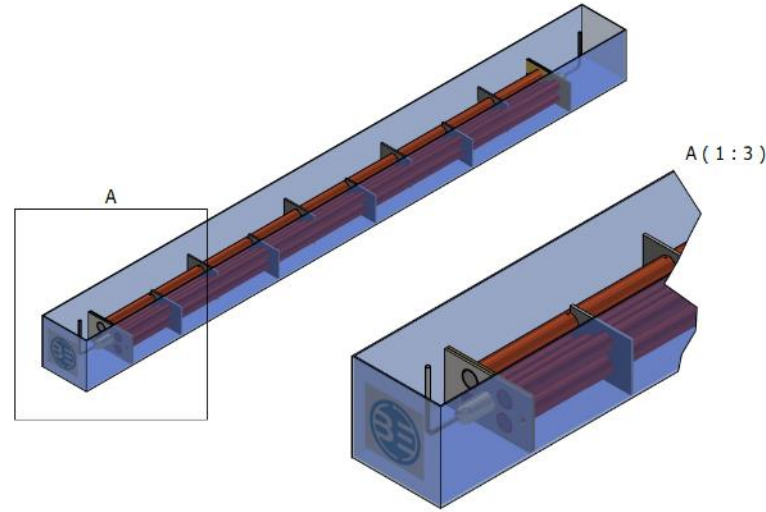
- Internal Tank design (patented)
- Heat Exchange analysis
- System integration assessment

*Different Sample designed and tested
2 large tanks prototype under study
MH single tube test concept based*

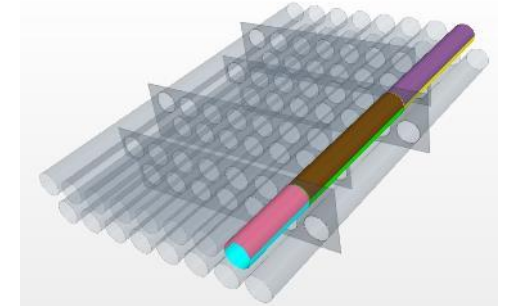
Sample A design



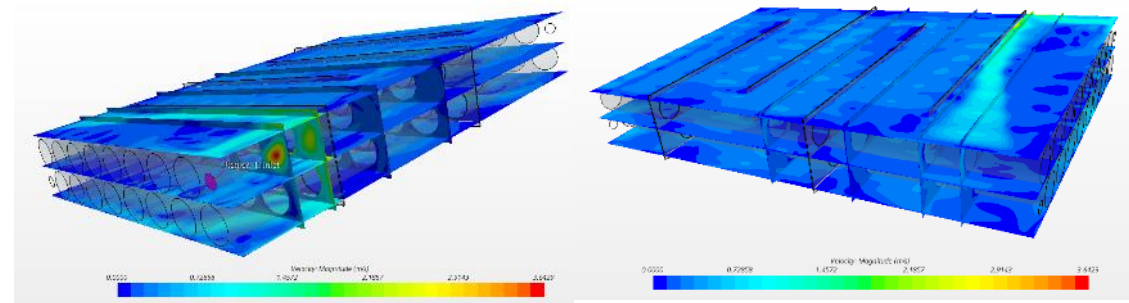
*Prototyping design
and test*



Thermal analysis

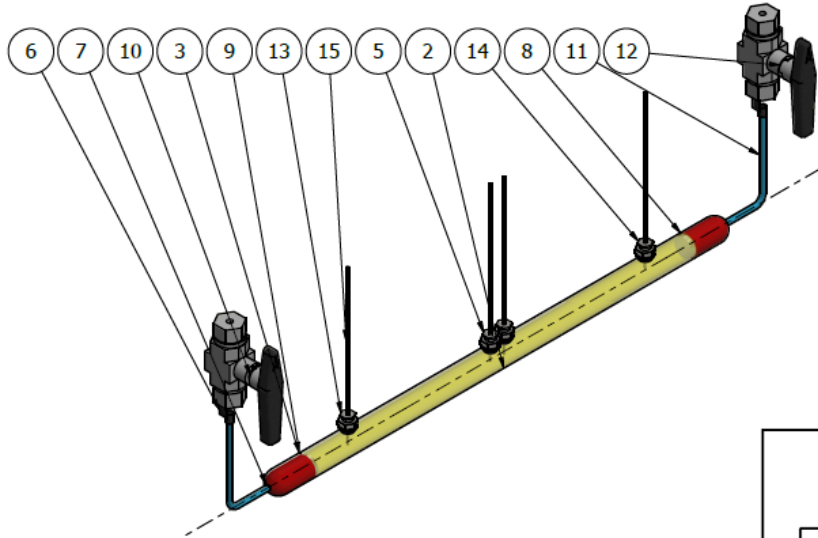


CFD analysis



Tank construction and certification

Prototyping with sensors

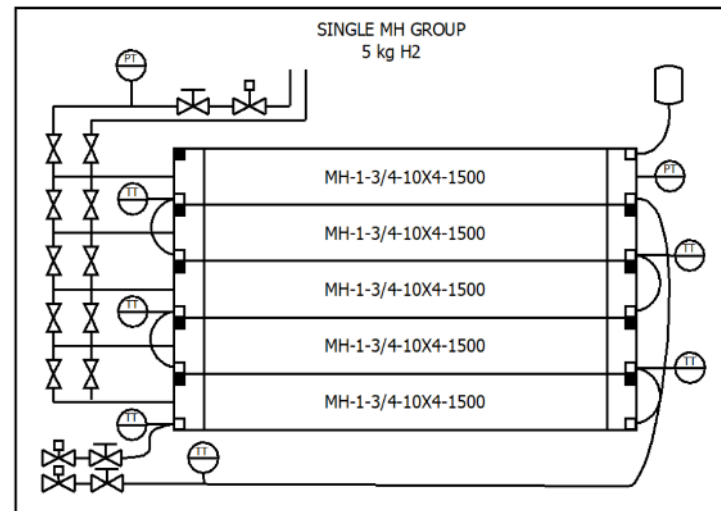


- New design based on single tube prototypes
- Test rigs available
- 3 Sample A systems under investigation

Building Facility

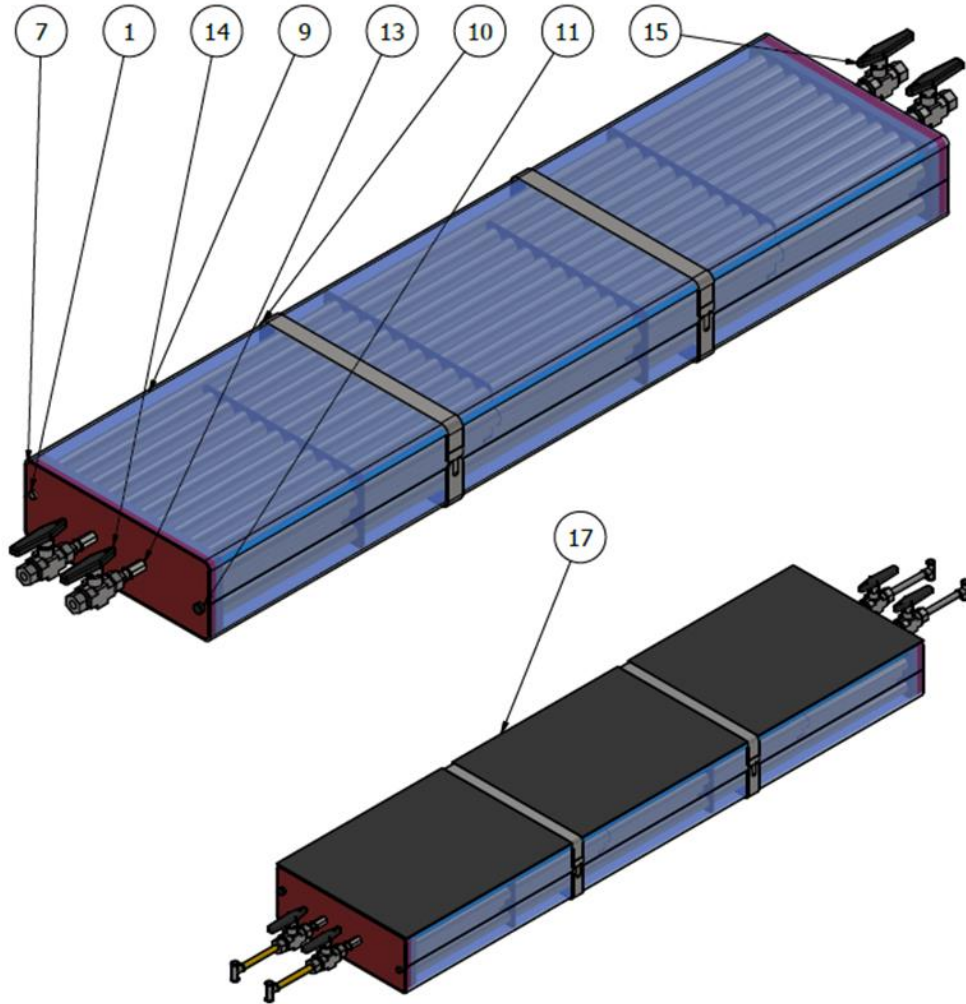
- 1200 m² of cover surface equipped with
- Nr 1 Crane with 6,3 t
- Nr 1 Forklift 2 t
- Nr 2 orbital welding machines
- Nr 8 TIG welding machines
- Nr 1 mass spectrometer
- Nr 1 inert glove box
- Nr 1 clean room

P&ID system



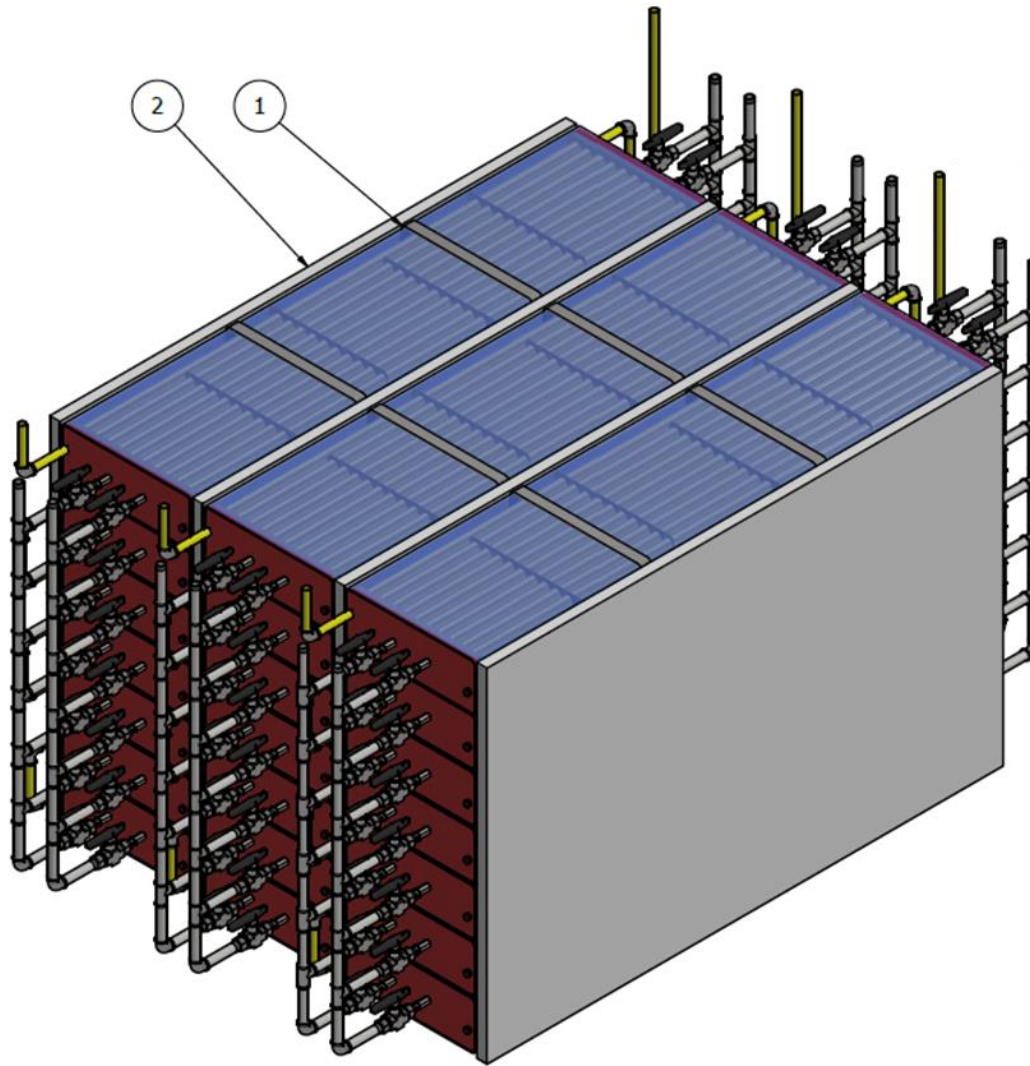
Inert Glove box

Module concept



- **Performance**
Low Temperature
Low Pressures
Air or Water cooled
- **Safety and Reliability**
Inox steel
Safety valves
PED certified
- **Modularity**
16 pipes modules
From 500mm up to 2000mm length
Single module up to 12 module Towers

Adaptable size systems



- **Size**
From 0.5 kgH2 up to 100 kgH2 systems
Compact and integrated
- **Integration**
PLC with valves control
Module, Tower, System integration
Standard container versions available
- **Maintenance**
Easier installation
single modules can be changed



MetHydOr

Friendly Hydrogen Storage

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