COMUNE DI VENEZIA

MINISTERO DELL'AMBIENTE E DELLA TUTELA DEL TERRITORIO E DEL MARE

BIO-ENERGIA VERITAS

Ricerca sperimentale e applicata in Veritas

il GREENPROPULSIONLABORATORY

Piattaforma multidisciplinare per la sperimentazione e industrializzazione di tecnologie avanzate per il settore ambientale, energetico e dell' Economia Circolare

Graziano Tassinato, Ph.D

R&D Manager - Green Propulsion Laboratory - Gruppo Veritas SpA Venezia

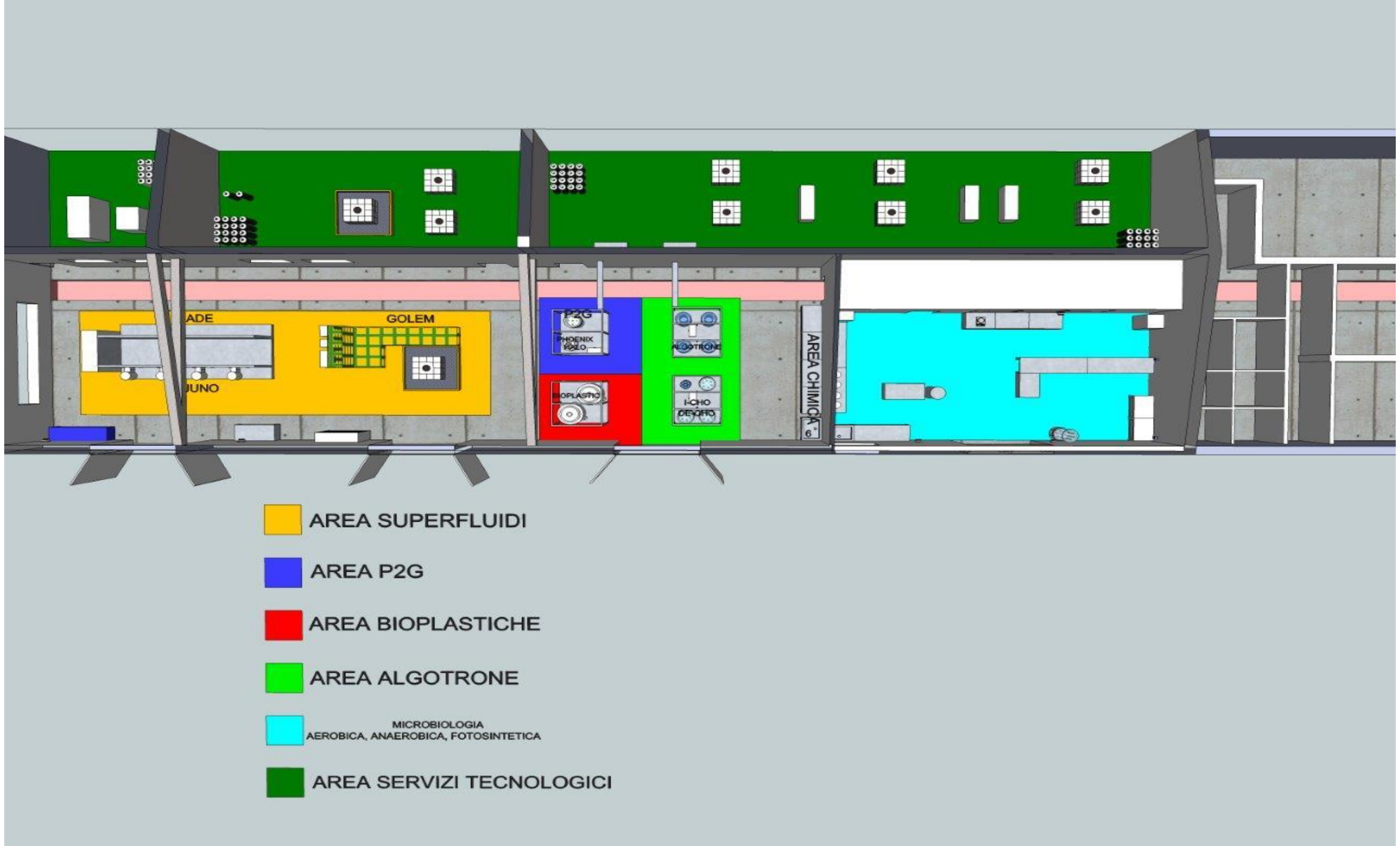
Green**Propulsion**Laboratory

Il Green**Propulsion**Laboratory rientra nell' ambito dell'Accordo "*Realizzazione di progetti finalizzati ad interventi di efficienza energetica ed all'utilizzo di fonti di energia rinnovabile all'Isola della Certosa e a Porto Marghera*" in essere tra il Comune di Venezia e Ministero dell'Ambiente e della Tutela del Territorio e del Mare.

Il valore dell'investimento è di 6.500 Meuro cofinanziato da Veritas nella misura del 20%.

I «Green Pillar» della **Chimica Verde** e del **Green Deal**

GREENPROPULSIONLABORATORY



- **BIOTECNOLOGIE**
- **SUPERFLUIDI**
- **ENERGETICA**
- **NUOVI MATERIALI**

GPLAB - Accreditamenti

BIO-ENERGIA VERITAS

MINISTERO DELL' ISTRUZIONE, DELL'UNIVERSITÀ E DELLA RICERCA

Anagrafe Nazionale delle Ricerche - cod. 000718_IMPR

INNOVENETO
CENTRI DI RICERCA PER L'INNOVAZIONE

Portale **INNOVENETO** - Regione Veneto

GREENPROPULSIONLABORATORY

GPLAB - una galassia di aziende

GREENPROPULSIONLABORATORY

BIO-ENERGIA VERITAS

GPLAB - PEOPLE

14 stagisti

12 tesisti

6 dottorandi

7 assegnisti di ricerca

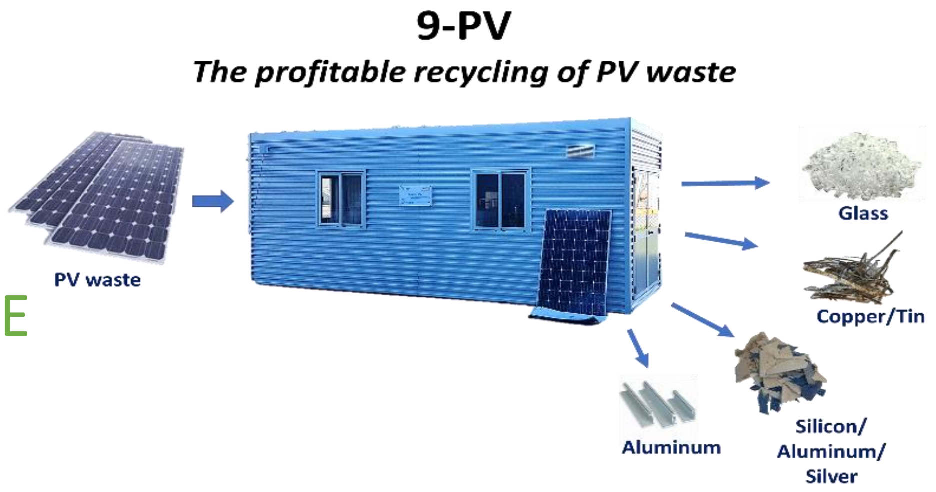
5 contratti di ricerca

GREENPROPULSIONLABORATORY

BIO-ENERGIA VERITAS

StartUpInnovative

9-Tech



BIO-ENERGIA VERITAS

Recupero **materiali strategici** da RAEE

HBI

Energia e chemicals da FORSU mediante **carbonizzazione idrotermica**

Low Energy CO_2 Removal Giammarco - Vetrocoke Since 1955

Giammarco Vetrocoke

CCS - CARBON**CAPTURE**&STORAGE

Progetti

BIO-ENERGIA VERITAS

GREENPROPULSIONLABORATORY

GPLab - H_2 projects

Open Space Innovation Platform

ESA – **European Space Agency**

Towards a Sustainable Hydrogen Production Technology - call 2021

Hydrogen production from immobilized cells in photo-bioreactors

MaSE - **Ministero dell’ Ambiente e Sicurezza Energetica**

Piano triennale 2019-2021 della Ricerca di Sistema Elettrico nazionale

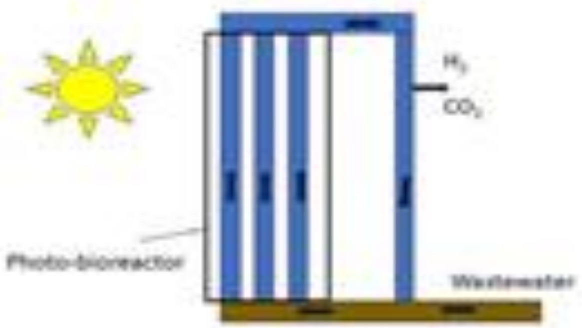
MODSEN - MODel of Saving electric ENergy from organic waste fermentation

European Space Agency

BIO-ENERGIA VERITAS

Idea I-2021-01895

Purple-B: Hydrogen production from immobilized cells in photo-bioreactors



Subcontractors:

9-Tech

Università Ca'Foscari Venezia

Università degli Studi di Padova

GREEN PROPULSION LABORATORY

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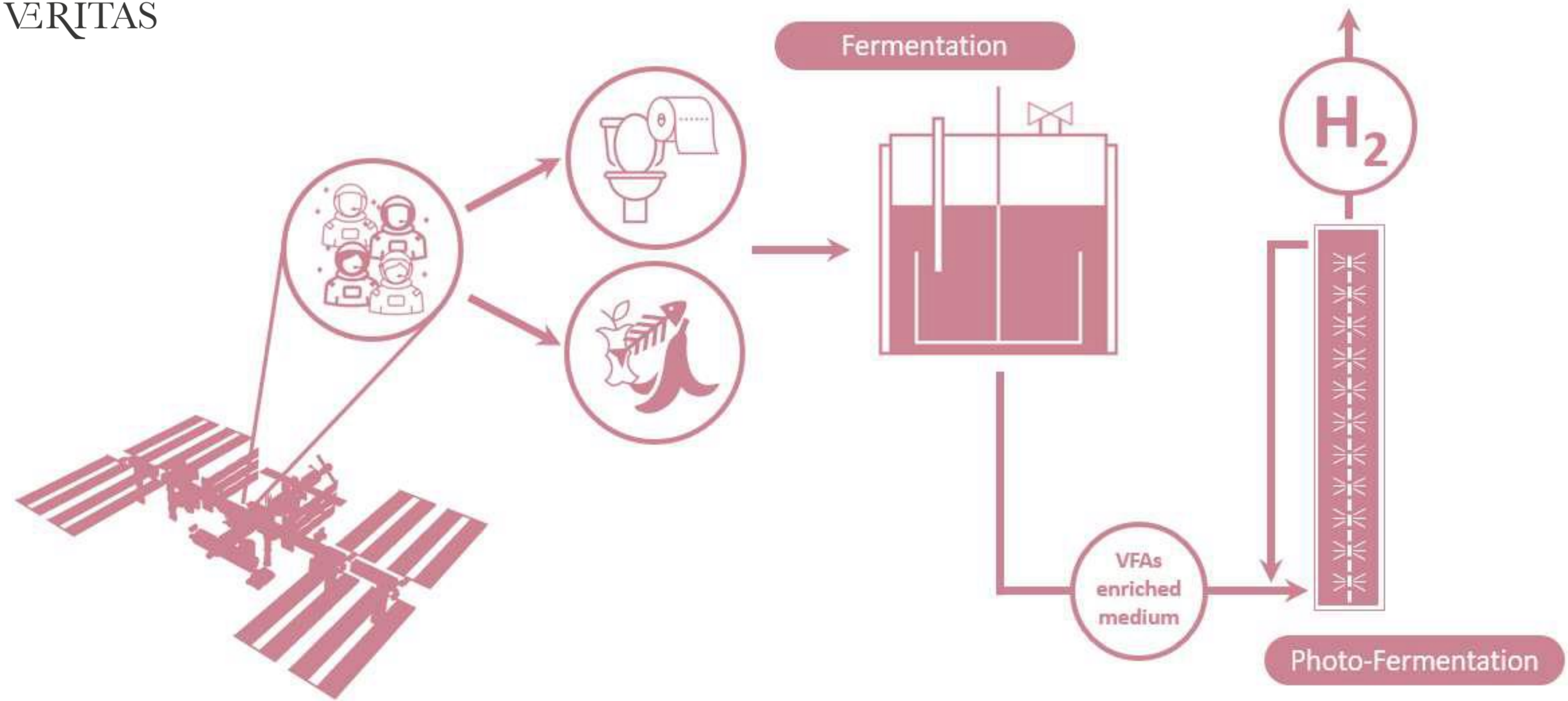
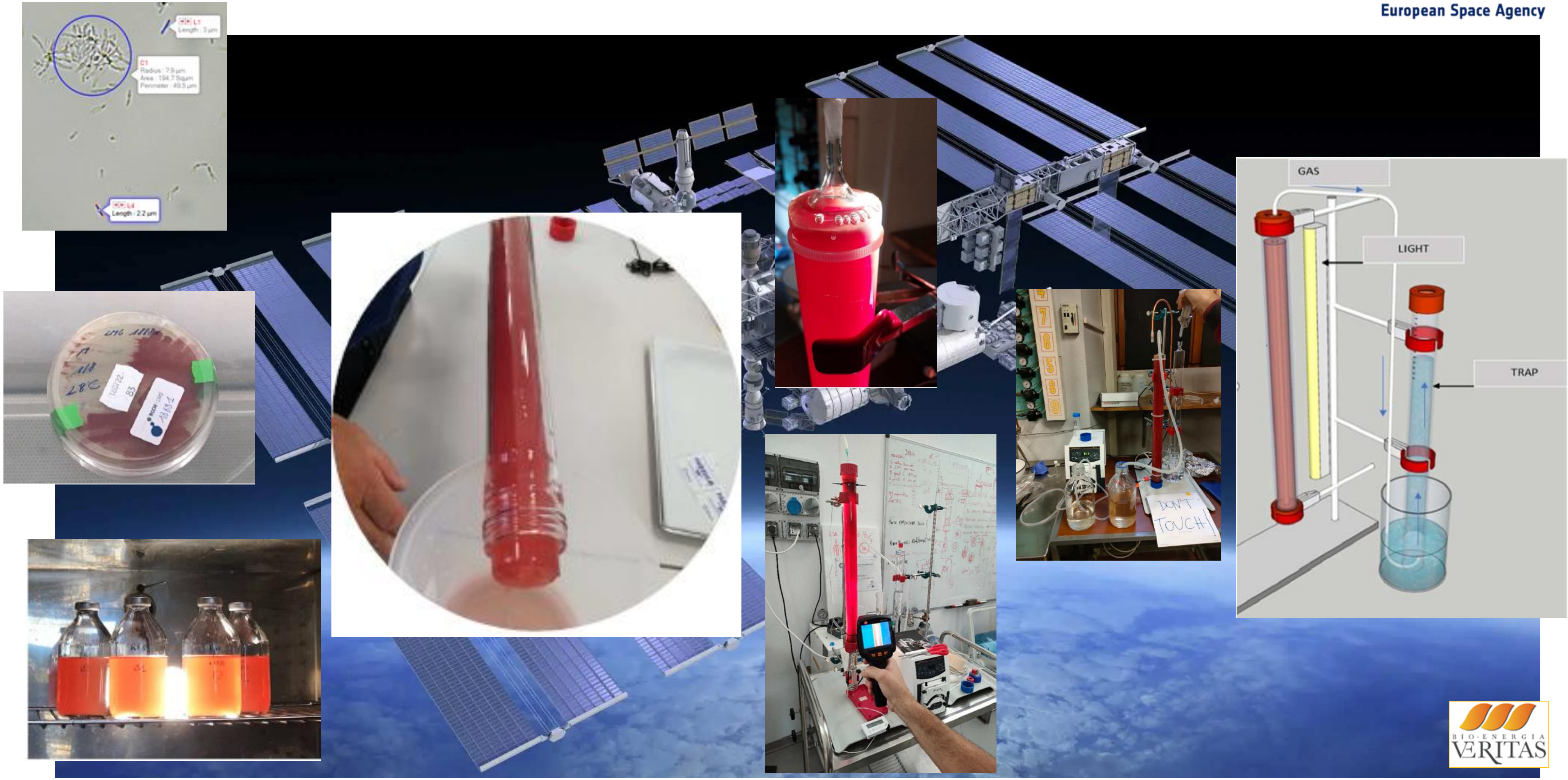
BIO-ENERGIA VERITAS

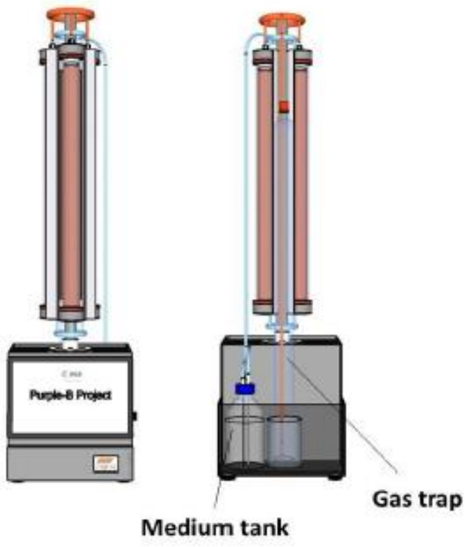


Purple-B **Project**

European Space Agency

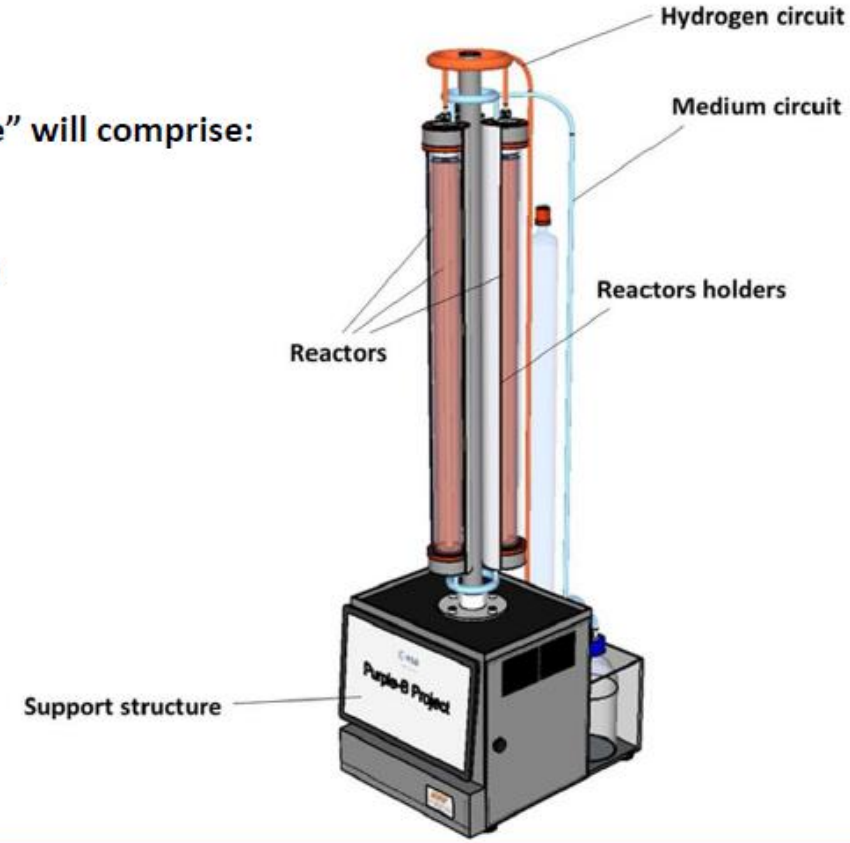


WP3 T 3.1 →design and rendering of the structural and functional components of the Purple-B reactor



The "Purple-B module" will comprise:

1. 3 Reactors
2. Support structure
3. Reactor holders
4. Medium tank
5. Gas trap
6. Medium circuit
7. Hydrogen circuit
8. Sensors



Purple-B Project

Hydrogen production from immobilized cells in photo-bioreactors

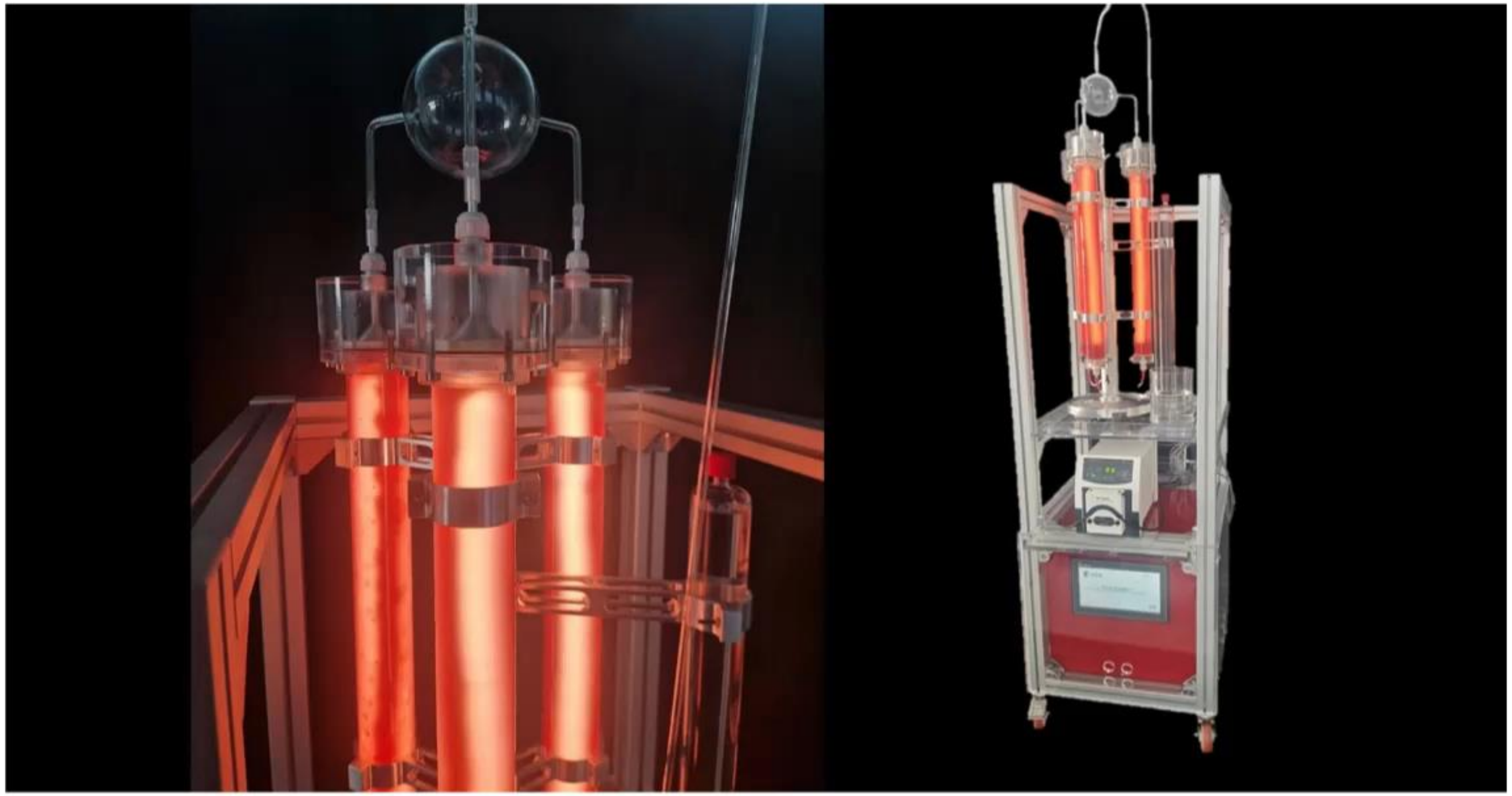
Idea I-2021-01895

Contract No. 4000137190/22/NL/GLC/ov

European Space Agency

BIO-ENERGIA VERITAS

GREENPROPULSIONLAB



Università degli Studi di Padova

9-Tech

BIOMOON PROJECT

LOW GRAVITY BIOREFINERY PLATFORM

and

TOPICAL TEAM LIFE SCIENCE

Sustainable Low-Gravity Biorefinery Models for
Energy, Food and Chemicsl production in the
Space Missions

GREEN PROPULSION LABORATORY

BIO-ENERGIA VERITAS

GREENPROPULSIONLABORATORY

BIOMOONPROJECT

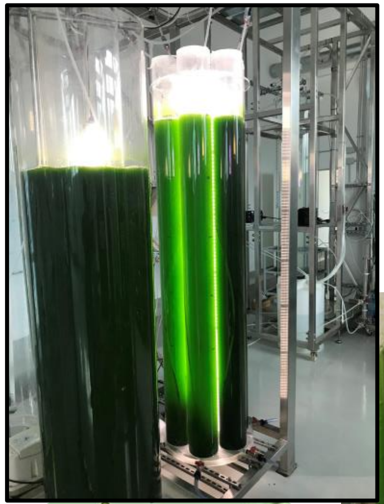
LUNAR GRAVITY BIOREFINERY

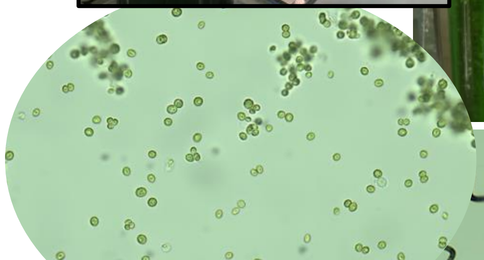
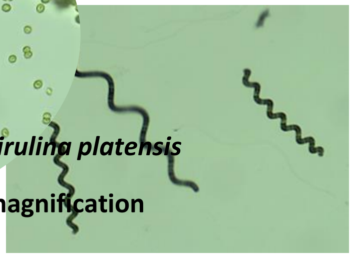
VERITAS

GREENPROPULSIONLABORATORY

Gruppi Metabolici

- FOTOAUTOTROFI

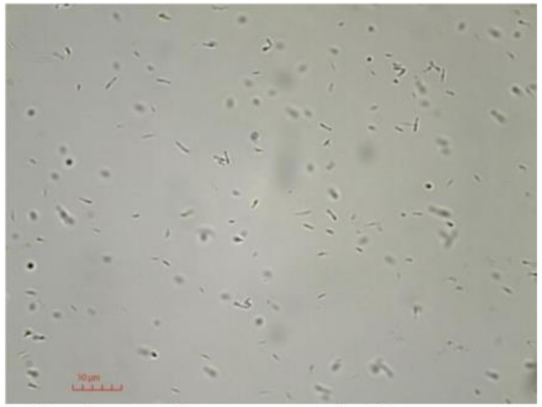


Scenedesmus obliquus e Spirulina platensis

optical microscope, 100x magnification

- FOTOETEROTROFI



Rhodopseudomonans palustris
optical microscope, 100x magnification

- CHEMIOETEROTROFI-METANIGENI

Fanghi granulari anaerobici

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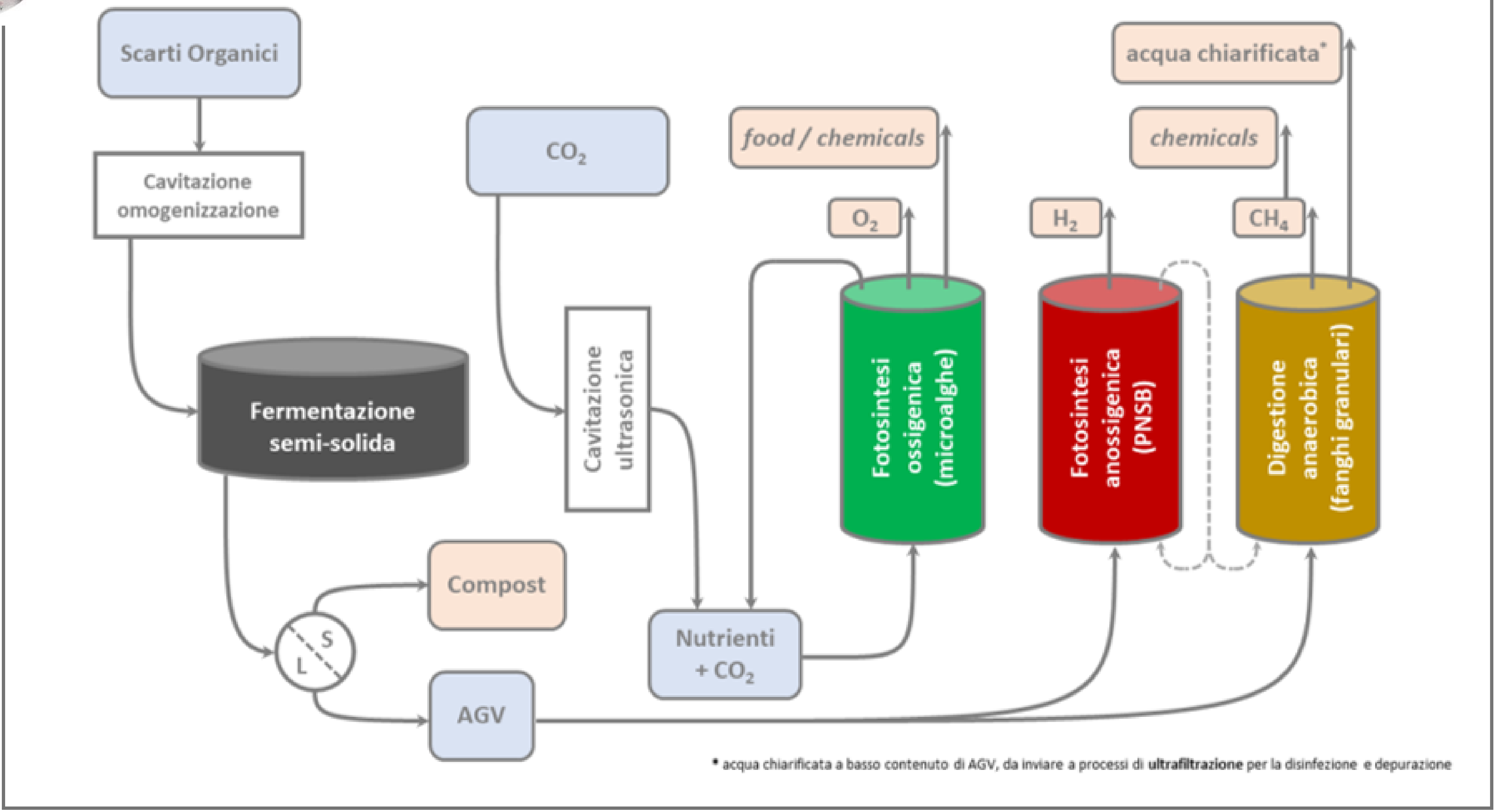


GreenPropulsionLaboratory

VENICE
MICROLIFE SPACE LABORATORY

BIO-ENERGIA VERITAS

GREEN PROPULSION LABORATORY

R&D o P&D

PARADOSSI & ALTRI INCIDENTI

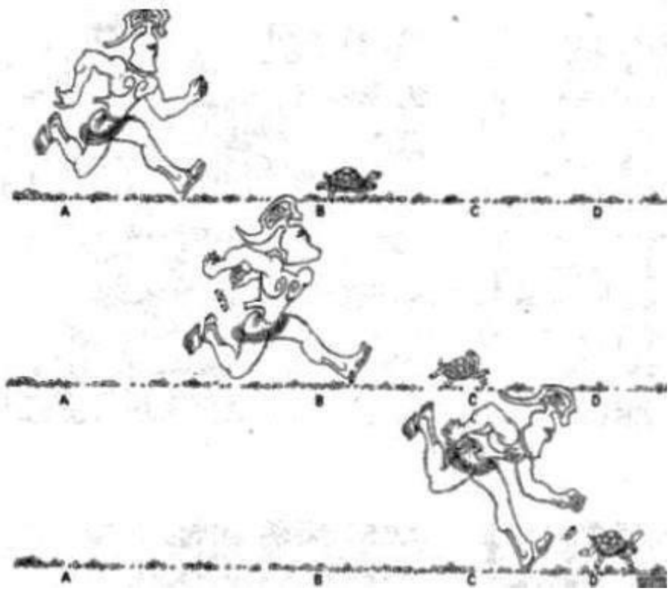
SCIENZA E **LOGICA CREATIVA:** la potenza dei paradossi in R&S

*«Proposizione formulata in **apparente contraddizione** con l'esperienza comune (i p. degli stoici) o con i **principi elementari della logica**,*

MA…

che all'esame critico si dimostra valida»

- Foreste liquide
- Fiamme d'acqua
- Soli in bottiglia



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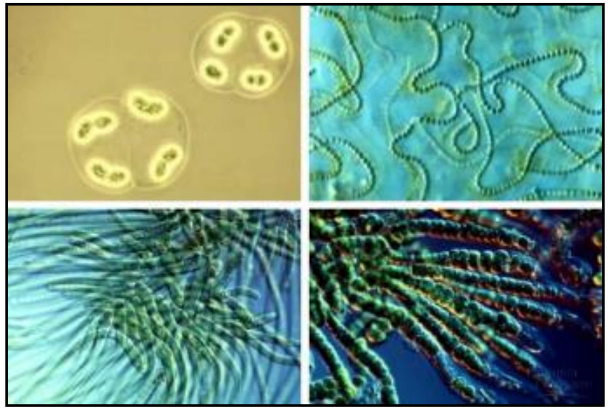
BIO-ENERGIA VERITAS

FORESTE**LIQUIDE**

Biotecnologie fotosintetiche:
microalghe per catturare **CO_2**
e produrre energia e nuovi materiali

BIO-ENERGIA VERITAS



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La Foresta Liquida™

BIO-ENERGIA VERITAS

Contenuti

NEXT

- Abbattimento della CO_2 dei fumi industriali su scala reale
- Produzione di biomassa microalgale
- Ridotto ingombro in pianta

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BRUCIARECONL'ACQUA
I superfluidi

Piattaforma **SUPERFLUIDS**

Progetto **ADE**

Bruciare i rifiuti con

acqua «**supercritica**»

a 400 atm e 900 C°

BIO-ENERGIA VERITAS

GREENPROPULSIONLABORATORY

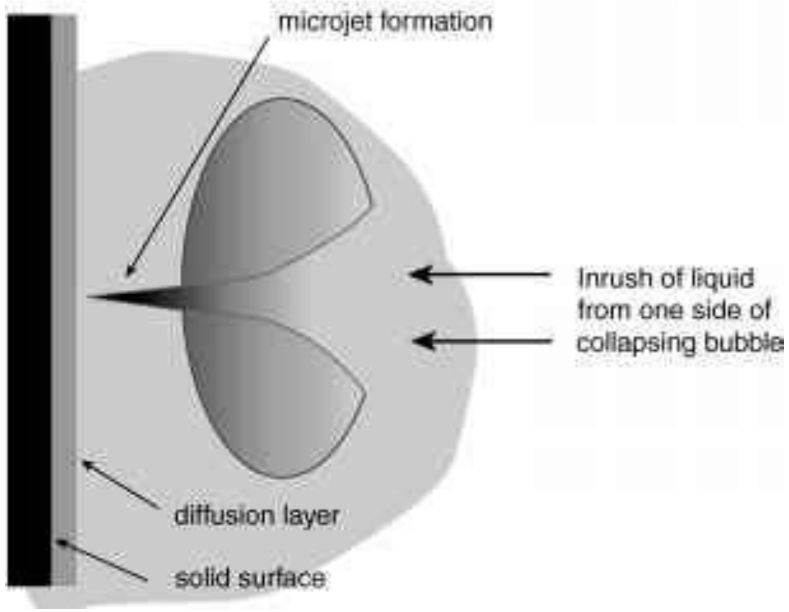
NESS - NEar Solar Surface reactions

ENERGIA DA BOLLE CAVITAZIONALI

BIO-ENERGIA VERITAS

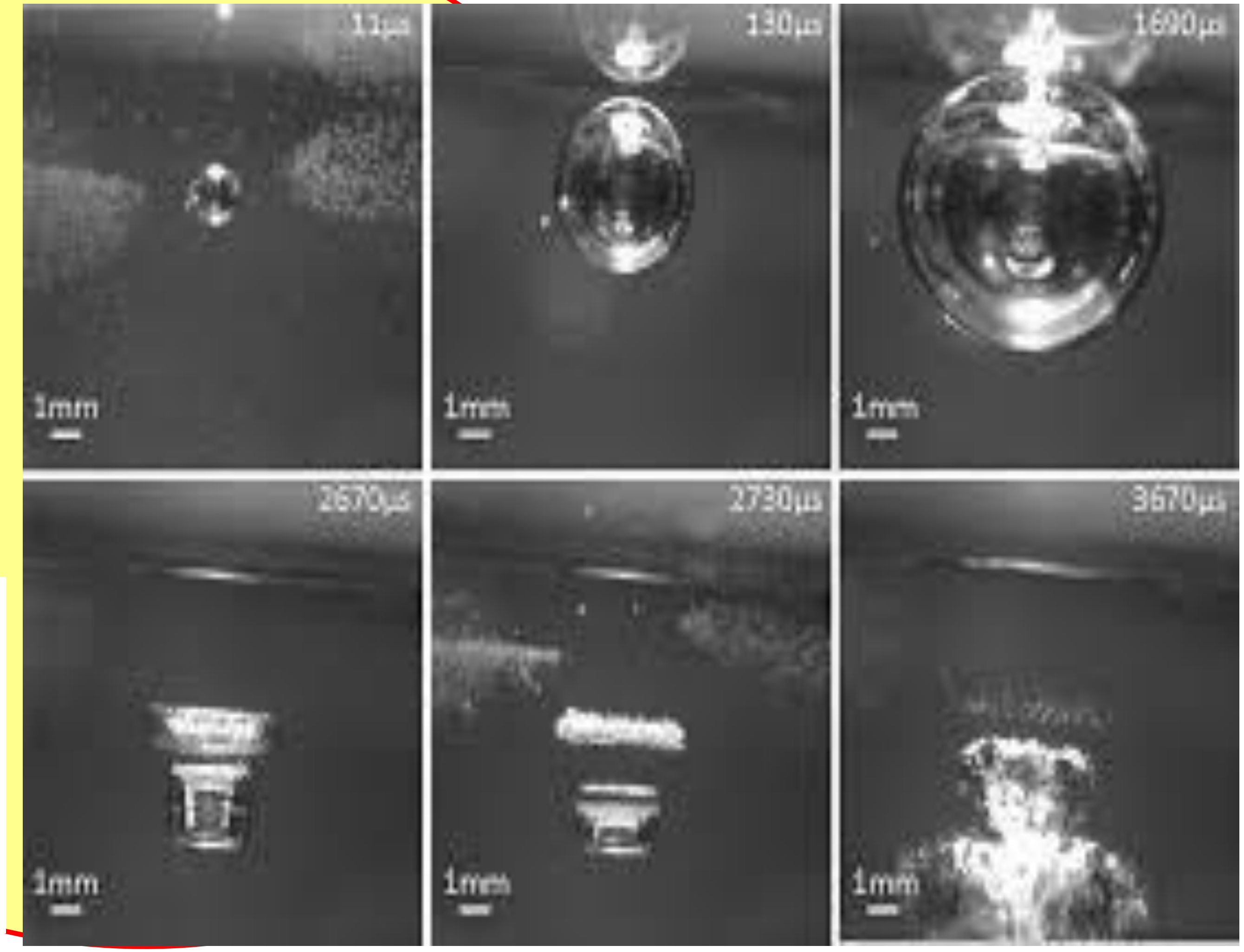
GREEN PROPULSION LABORATORY

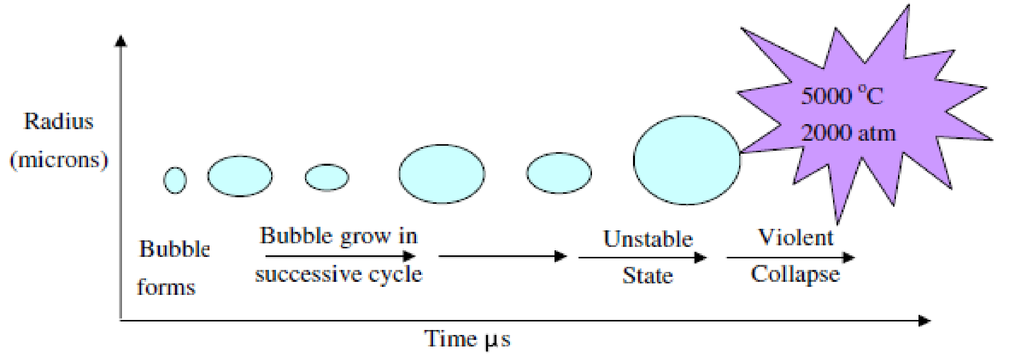
Cavitazione: effetti&difetti



GreenPropulsionLaboratory

Cavitazione: tanti piccoli soli che implodono in un bicchiere d'acqua....





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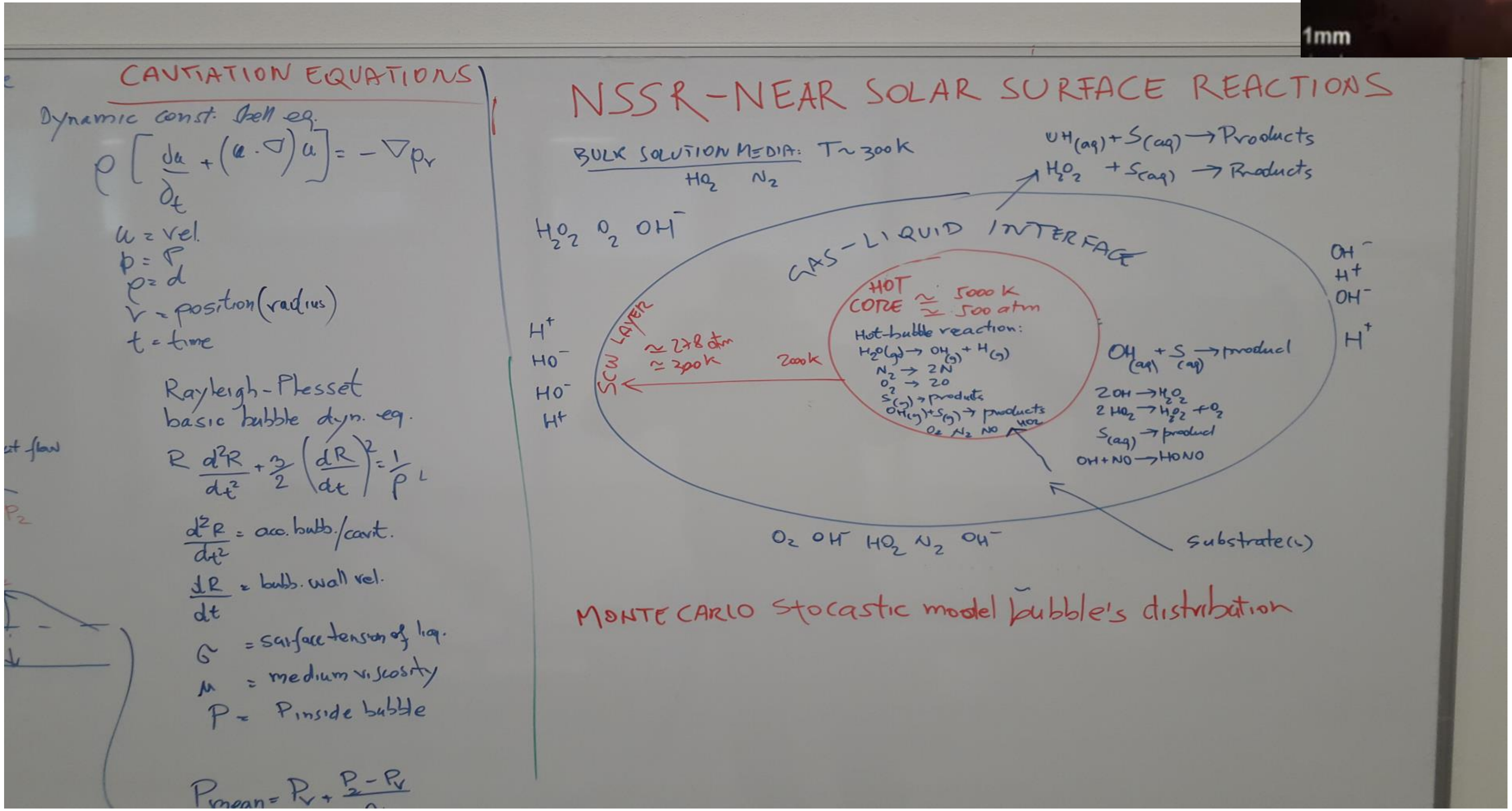
NEar Solar Surface reactions
NESSie o l'area riccioli d'oro



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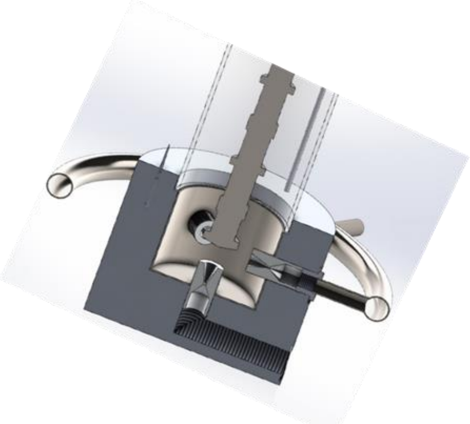
NESSie - Reattore a bolle cavitazionali

BIO-ENERGIA VERITAS



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BIO-ENERGIA VERITAS

POSSIBILI **SVILUPPI** DELLA TECNOLOGIA **NESS**

- Processi **avanzati** di chimica sostenibile
- Distruzione di **inquinanti emergenti**
- Nuove generazioni di **carburanti** sostenibili
- Bonifica di **aree** industriali
- Idrogeno

ICheapP 16

16th International Conference on Chemical and Process Engineering - Naples, Italy | Jun 04 | 2023

Near Solar Surface reactions: towards the new horizons of green chemistry

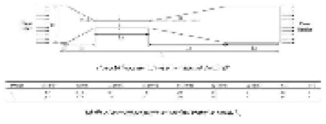
Tassinato G [1], Nisato F [1], Stoppato A.[2], Benato A.[2], De Vanna F.[2].

[1] Green Propulsion Laboratory - Gruppo Veritas SpA; [2] Dep. Industrial Engineering - University of Padua

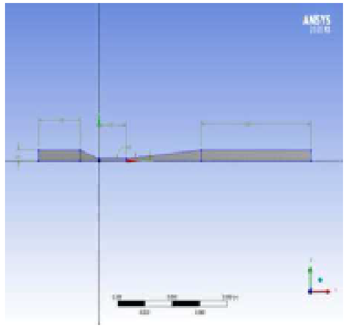
Abstract:

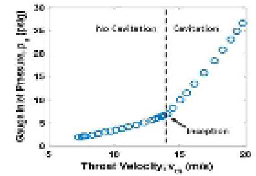
Cavitation is defined as a phenomenon of formation, growth, and collapse of microbubbles or cavities, occurring in a few milli/microseconds at multiple locations and then, releasing a large quantity of energy in a short amount of time. Cavitation starts with the formation of vapor cavities (bubbles or voids) when liquid enters the low-pressure region. Subsequently, these cavities attain a maximum size under the conditions of isothermal expansion. In the successive compression cycle, an immediate adiabatic collapse occurs, resulting in a supercritical state of high local temperature and pressure, known as hot spots. Due to the collapse of cavitation bubble, massive temperatures and pressures evolve (5000 K and 500 bar) under conditions such of those reached on the solar surface. The extreme conditions of the hot spots area lead to the formation of excited states, breaking bonds, and generating radicals. Compared to the use of initiators or catalysts, cavitation-induced radical reactions allow for clean and safe operation because no separation is required afterward, and the formation of radicals can be externally controlled. High temperatures and pressures create radicals and excited state particles from the compounds trapped in the microbubbles. It has been stated that cavitation reactions occur directly in the microbubble and in the solution as free radicals are generated in the cavitation bubble. A considerable applicative interest is the hydrolytic reactions; hydrolysis of hydrogen peroxide, which occurs in conditions of hydrodynamic cavitation, causes a flow of hydroxyls able to oxidize complex organic molecules entirely. The goal of hydrodynamic cavitation is to generate the cavitating microbubbles, and a frequently used instrument for doing so is the Venturi tube. Currently, the prediction of cavitating flows using computational methods is still a critical issue, and very few results are available in the literature. This study describes a systematic numerical strategy to model the two-phase flow mechanics occurring in a Venturi tube for inducing cavitation. The numerical approach employs computational fluid dynamics methods in a Reynolds-Averaged Navier-Stokes framework. A robust meshing technique is analyzed, which compares alternative mesh sizes and turbulence closure to find the optimal balance of accuracy and processing time. Numerical outcomes are compared with experimental data available in the literature.

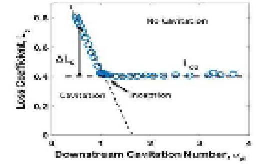
Venturi tube CFD by Ansys:



CFD model:
- Grid 1: 77'500 elements
- Grid 2: 310'000 elements
- Grid 3: 1'240'000 elements







Perspectives:

High temperatures and pressures inside NESS area create radicals and excited state particles from the compounds trapped in the micro-bubble. It has been stated that the cavitation reactions occur directly in the micro-bubble and reactions in the solution as free radicals generated in the cavitation bubble. A considerable applicative interest are the hydrolytic reactions that occur in the NESS area; hydrolysis of hydrogen peroxide (H2O2) which occurs in conditions of hydrodynamic cavitation (HC) generates a flow of hydroxyls (OH) able to oxidize completely complex organic molecules (OM).

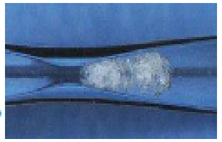
$HC + H_2O_2$

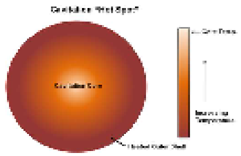
$H_2O_2 \rightarrow OH + OH$

$OH + H_2O_2 \rightarrow HO_2 + H_2O$

$OH + HO_2 \rightarrow H_2O + O_2$

$HO_2 + H_2O_2 \rightarrow OH + H_2O + O_2 \longrightarrow OM + OH \rightarrow CO_2 + H_2O$





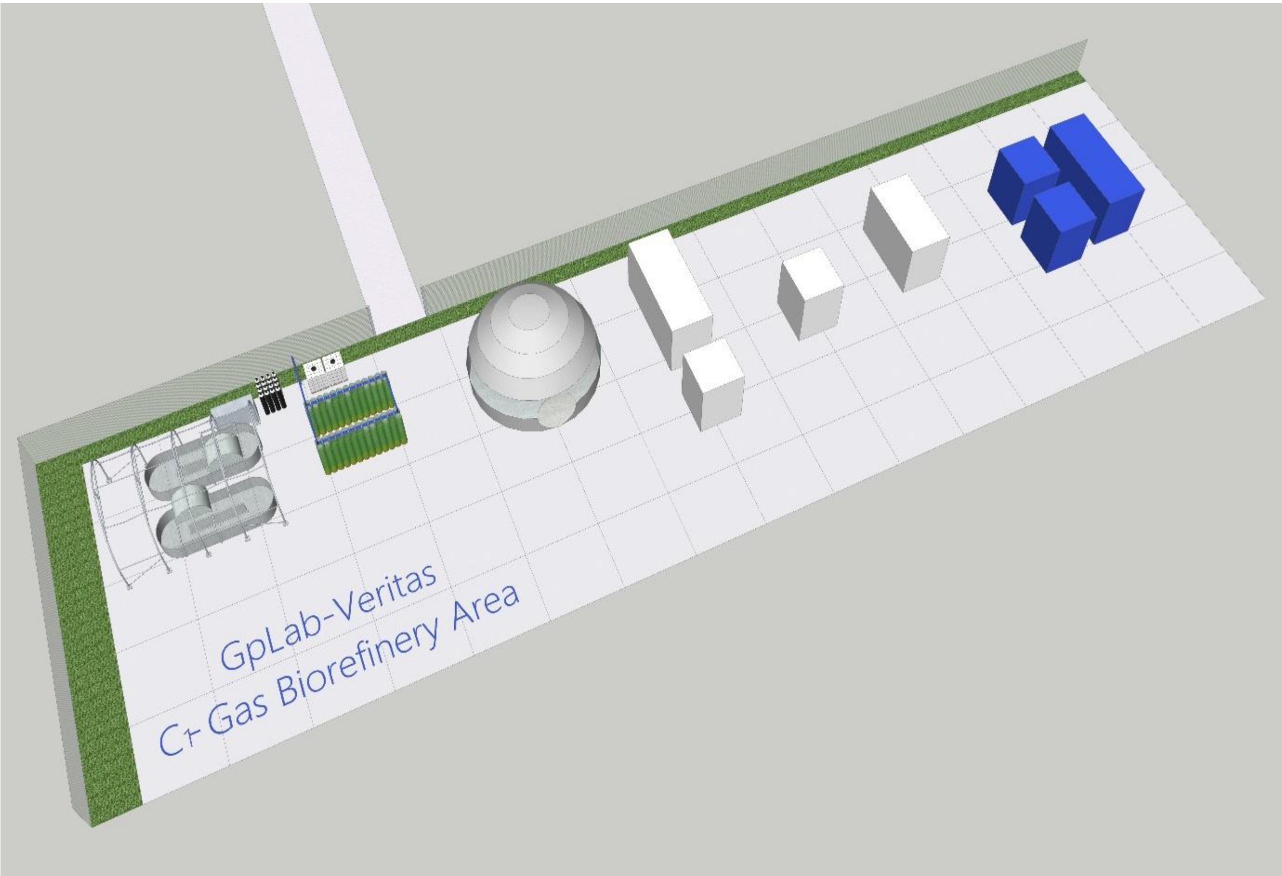
The effect of HC combined with chemical oxidation processes such as hydrogen peroxide (HC/H_2O_2), ferrous activated persulfate ($HC/Na_2S_2O_8/FeSO_4$) and HC coupled with advanced oxidation processes such as conventional Fenton ($HC/FeSO_4/H_2O_2$), advanced Fenton ($HC/Fe/H_2O_2$) and Fenton-like process ($HC/CuO/H_2O_2$) on the extent of degradation of OM.

GREENPROPULSIONLAB

C_1 – GAS BIOREFINERY

GREENPROPULSIONLABORATORY

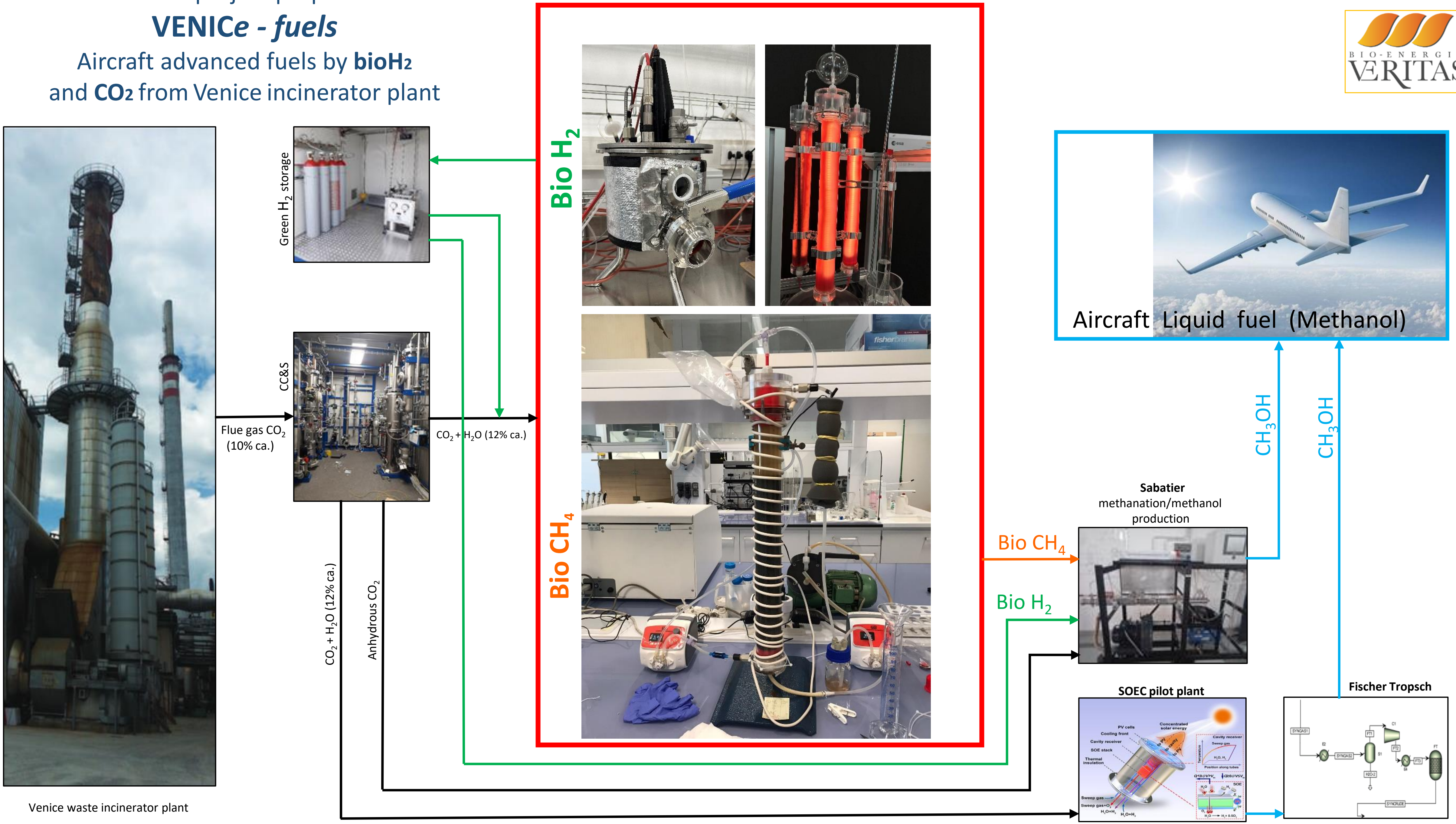
Impianto pilota di **1000 mq** per la produzione **integrata** di **energia** e **green chemicals** dalla CO_2 catturata da fumi industriali



GPLab project proposal

VENICe - *fuels*

Aircraft advanced fuels by **bioH2**
and **CO2** from Venice incinerator plant



Piano Nazionale di Ripresa e Resilienza (PNRR)
Realizzazione di impianti di produzione di idrogeno rinnovabile in aree industriali dismesse

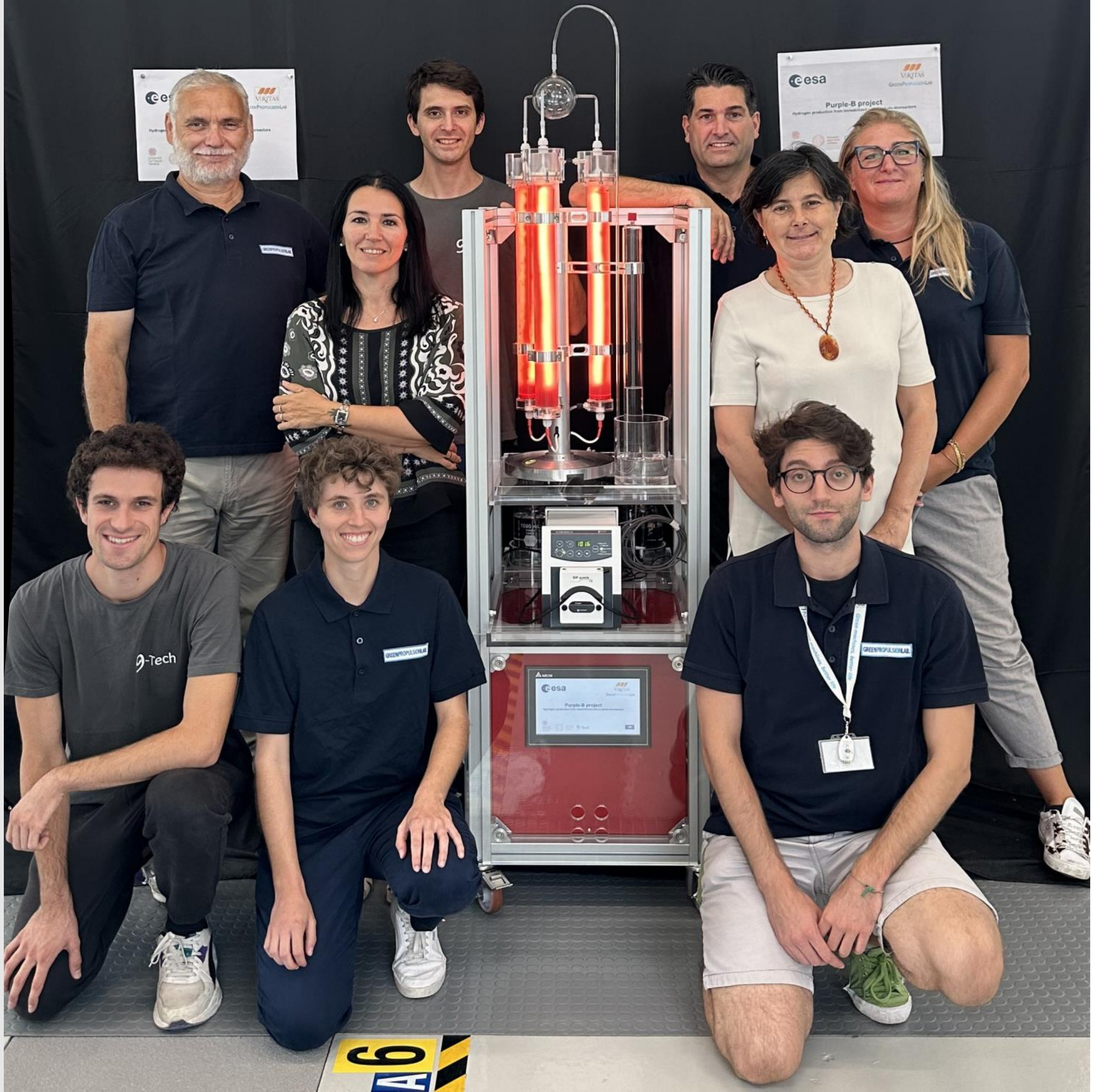
HYDROGEN**VALLEY**VENEZIA

GPLab Veritas - **R&D** HV Venezia

- Decarbonizzazione dei fumi industriali (CC&S) e riconversione energetica della CO_2 mediante H_2 verde (CCUS/P2G);
- Impiego di H2 verde in processi avanzati di chimica verde;
- Produzione di H2 da fonti rinnovabili (es. bio - idrogeno da rifiuti);
- Nuovi materiali e carburanti a base H2/CO2;

THANKS FOR WATCHING

Graziano TASSINATO, Ph.D
R&D Manager GPLAB VERITAS
VENICE
g.tassinato@gruppoveritas.it
M. 345 0337343 – T. 0417293647



BIO-ENERGIA VERITAS

GREENPROPULSIONLABORATORY