



**UNI
FR**
■

BRIDGE

**WISSENSCHAFT.
BEWEGEN**
GEBERT RUF STIFTUNG

**Peter Bopp
Stiftung** für Forschung
und Technik

 **Innosuisse**

**VENTURE
KICK** 

FRIUP


venturelab

Dr. Timur Ashirov
CEO

CO₂ : 10-15%

N₂ : 70-85%

H₂O : 5-15%

- 1. Lack of an affordable CO₂ capture system**
- 2. Lack of CO₂ valorization pathway**

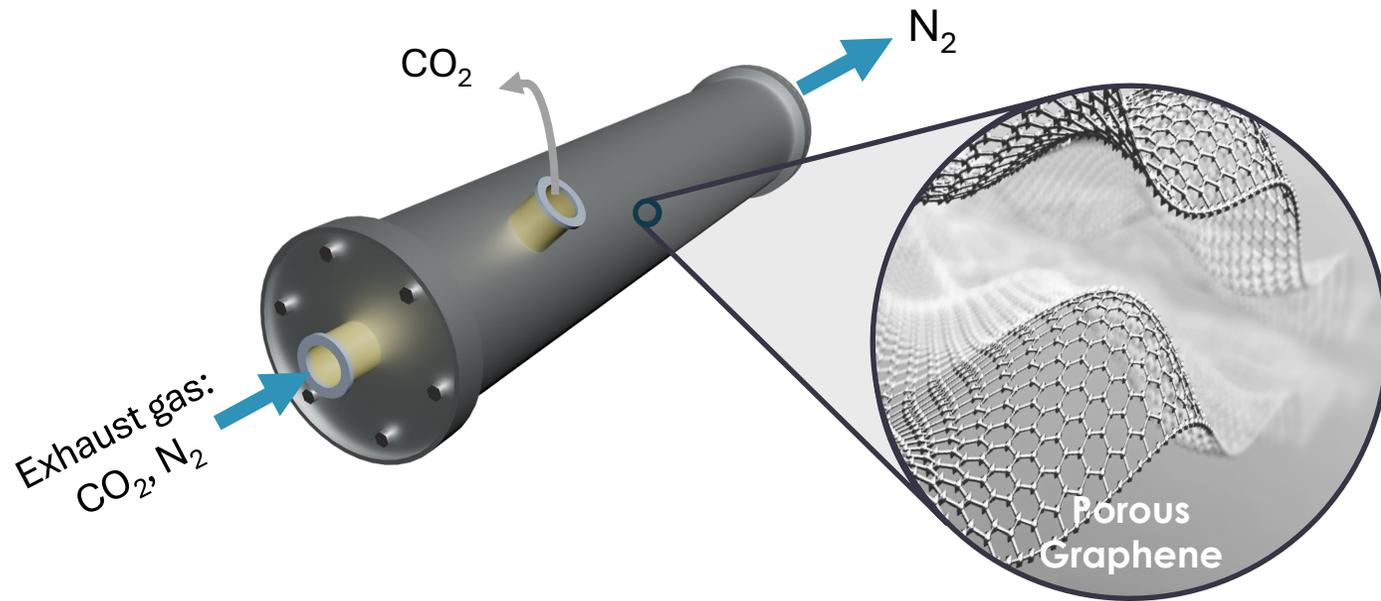
Addressing carbon emissions

TalCo Aluminum plant, Tursunzoda, Tajikistan



Our Solution/Technology

- SEPARATIC-CO₂: a gas separation membrane



- Patent pending:** PCT/EP2024/086354 – Process of producing porous graphene membranes
- Projected Cost:** OPEX <26 CHF/tCO₂
CAPEX <100 CHF/tCO₂/year

UNIQUE SELLING PROPOSITION



3–5x lower CAPEX and **4–9x lower OPEX** than amine scrubbing/membranes.



End-to-end Solution, including Carbon Valorization



Compact & Modular Design – ~100x smaller footprint.



No Chemical Solvents, No Toxic Waste.

Business Model:

- end-to-end solution provider for CO₂ capture and valorization
- accelerating the creation of a carbon circular economy

Value Proposition:

- Tax savings (~120 CHF/ton in Switzerland, ETS credits in the EU (~75 EUR/ton))
- Revenue generation by valorizing captured CO₂ (~100-150 CHF/ton)
- Pressing regulations
- Sustainability: CO₂-free manufacturing

TAM 1'298 million CHF

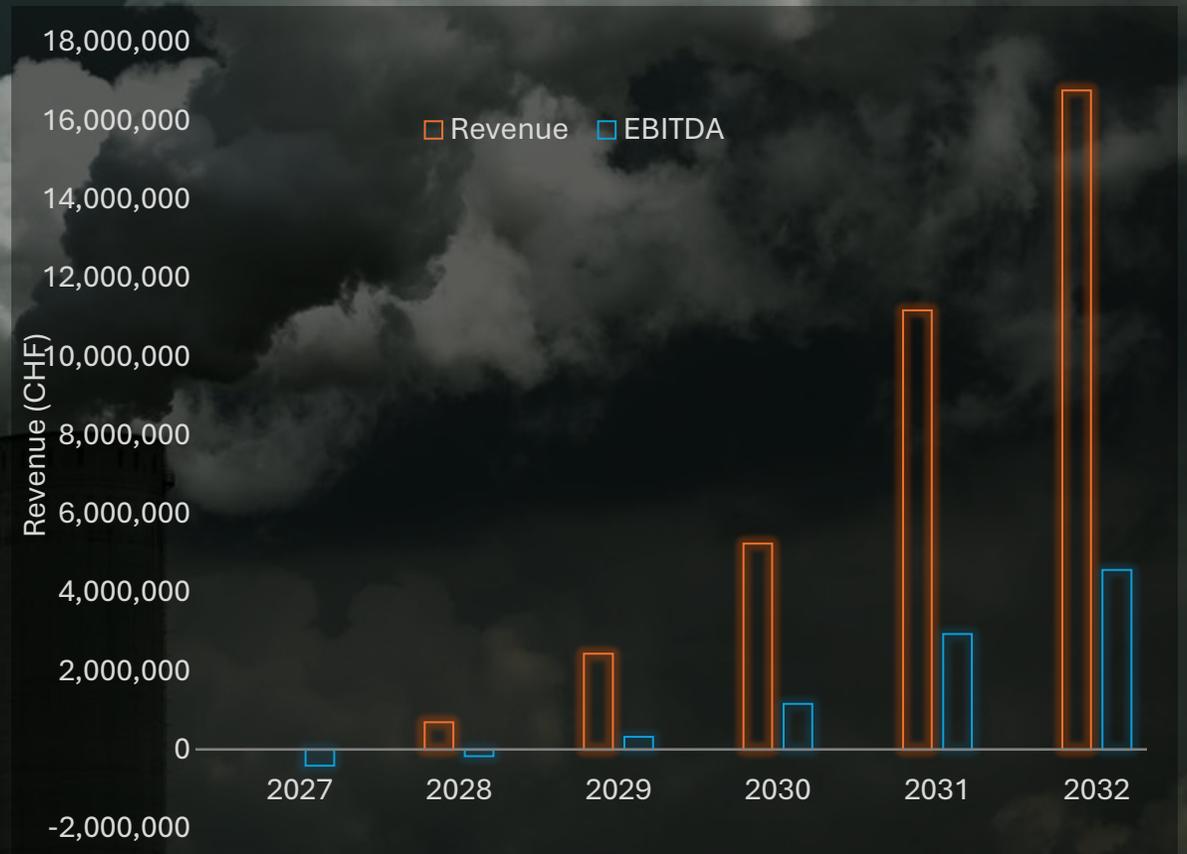
+Manufacturing: 4.2 million tCO₂

SAM 793 million CHF

+Industrial process: 3.4 million tCO₂

SOM 384 million CHF

Energy sector: 3.2 million tCO₂



Record \$63 billion raised from carbon allowance sales in 2022 - report

By Susanna Twidale

March 22, 2023 3:24 PM GMT+1 · Updated 2 years ago



The lignite (brown coal) power plant complex of German energy supplier and utility RWE is reflected in a puddle in Neurath, north-west of Cologne, Germany, February 5, 2020. REUTERS/Wolfgang Rattay [Purchase Licensing Rights](#)

LONDON, March 22 (Reuters) - Governments globally raised a record \$63 billion from the sale of carbon allowances in emission trading systems in 2022, as many countries increased ambitions to cut pollution despite record high energy prices following Russia's invasion of Ukraine, a report said on Wednesday.

The EU Has Released Its Nearly \$105B Clean Industrial Deal

by Sasha Ranevska · February 27, 2025 · 3 minute read



Image courtesy of Pixabay

in

X

✉

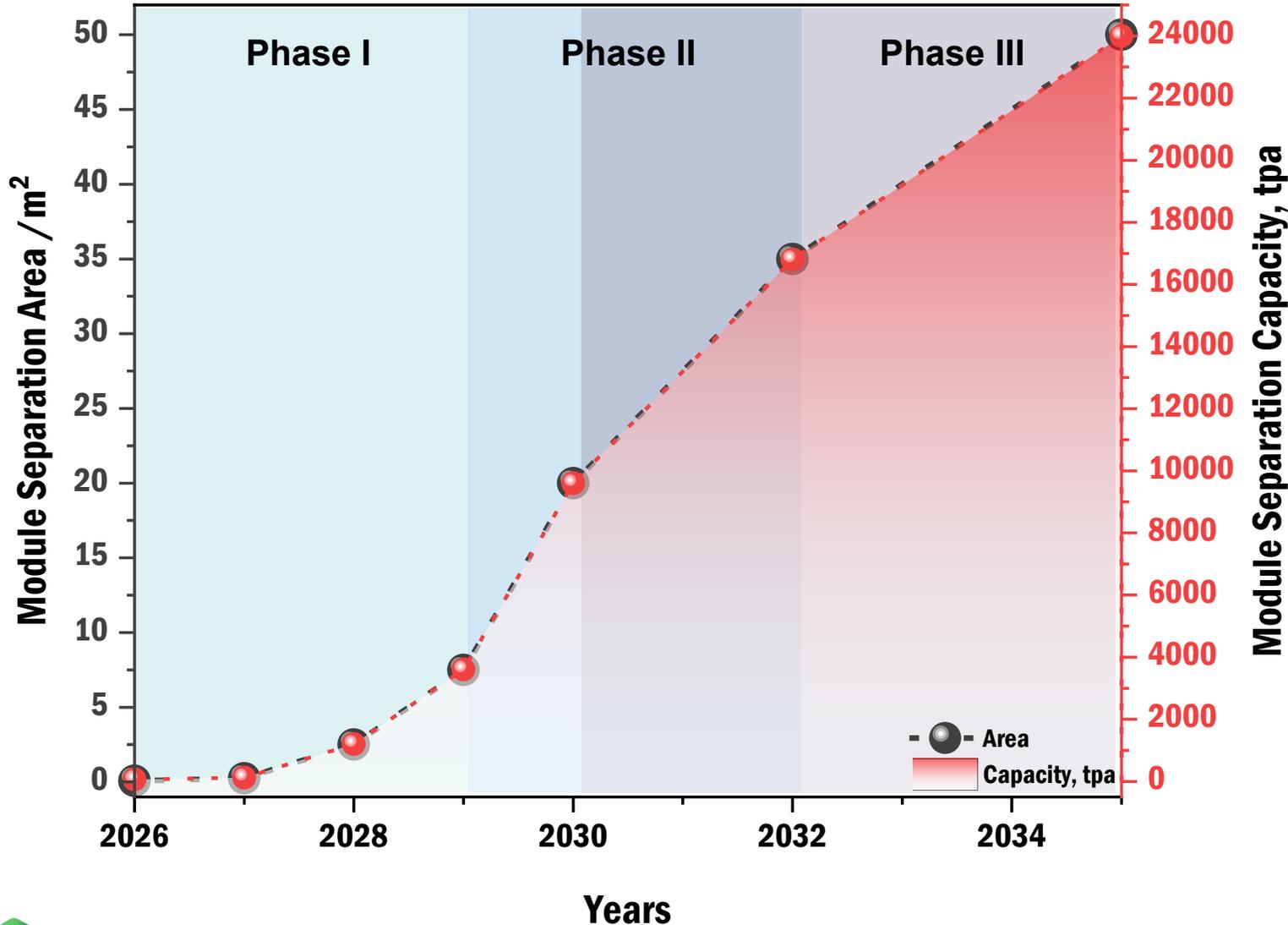
The European Commission has released the EU Clean Industrial Deal, dedicating nearly \$105 billion (€100 billion) for strengthening industrial competitiveness, accelerating decarbonization, and transitioning towards clean energy.

This plan intends to fortify the EU's industrial power in a turbulent and changing global market,

GO-to-MARKET STRATEGY

Our main customers are large waste-to-energy plants that emit thousands of tons of emissions. However, we need to ramp up the membrane production to meet their demand.

The main limiting factor is module size; we need a few years to ramp up production capability and increase module area/size.



Market strategy will be in phases:

- Phase I (2026-2029): Carbon capture from non-emissions sources, which doesn't require valorisation: Biogas upgrading, wastewater treatment, biogenic H₂ production, manufacturing, integrators.
- Phase II: (2029-2032): Waste-to-Energy plants, kiloton-scale carbon capture, including valorisation.
- Phase III (2030 onwards): **The Ultimate Goal**: Capture-as-a-Service. Selling carbon credits by capturing and permanently trapping CO₂ from biogenic sources. Entering the Brazilian market for the first plant installation and operation.

GO-to-MARKET STRATEGY

Phase 1

Carbon capture from non-emissions sources



INEOS



celsius groupe

techfina



SOLGROUP
a breath of life

KEBAG



Air Liquide
Carbagas

MESSER
Gases for Life

Phase 2

Waste-to-Energy plants, kiloton-scale carbon capture.

kva linth
energie + recycling



s a i d e f

Kanadevia
Technology for people and planet

Phase 3

The long-term goal is to offer capture-as-a-service. By sequestering CO₂ from biogenic sources and selling credits.



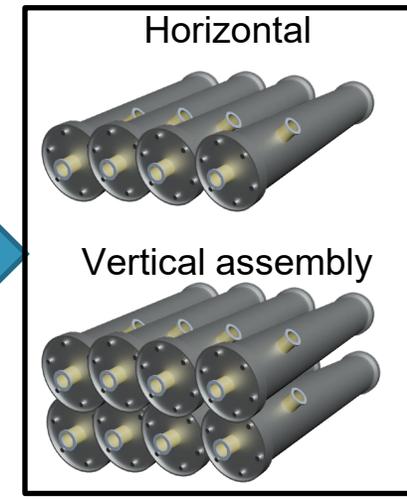
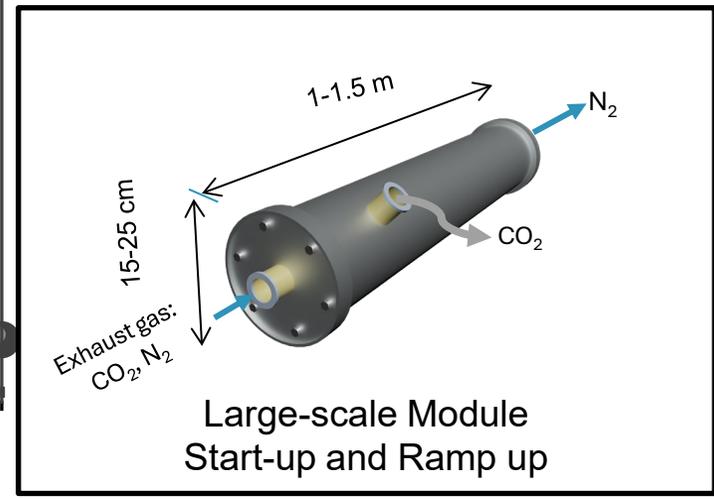
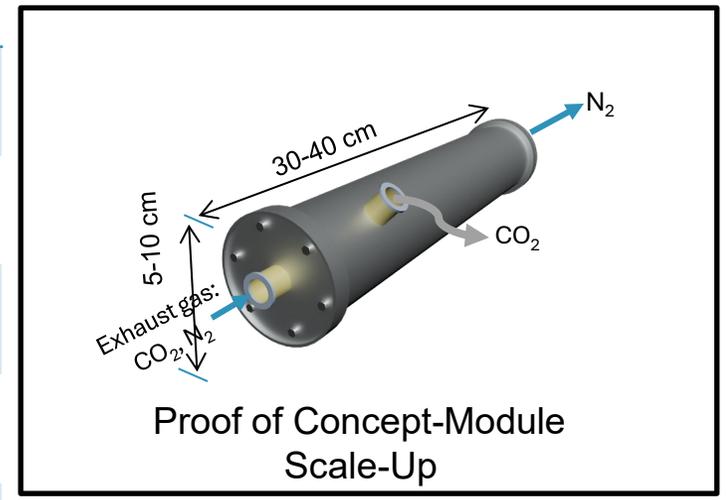
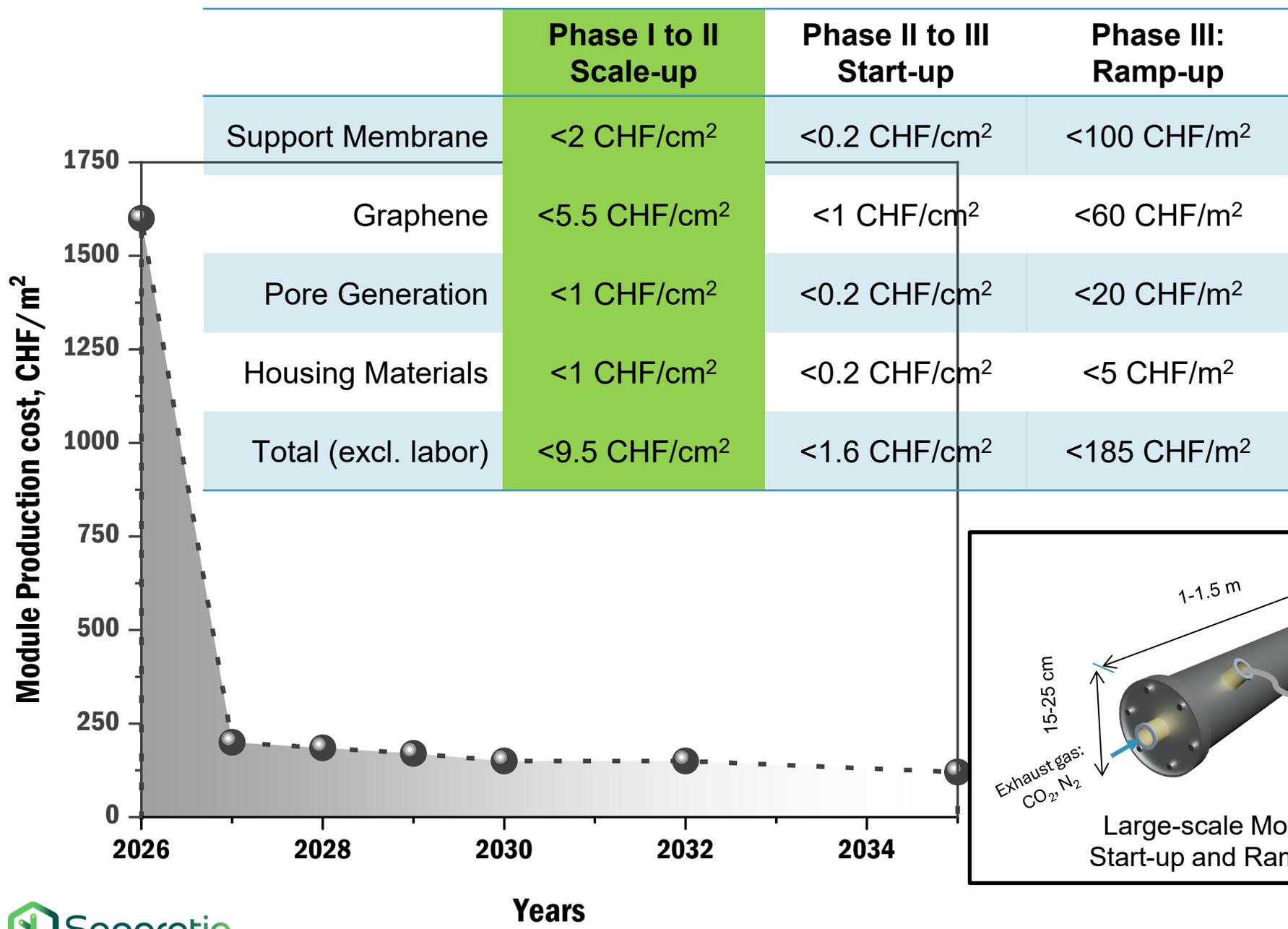
Meta

Alphabet



THE ULTIMATE GOAL

PRODUCTION



HISTORY/ROADMAP/TRACK RECORD

2022 2023 2024 2025 2026 2027

BRIDGE
183'000 CHF

- Novel pore generation method on graphene discovered
- Lab-scale prototype built and tested
- Patents filed

Innosuisse ~365'000 CHF
WISSENSCHAFT. BEWEGEN
GEBERT RUF STIFTUNG 150'000 CHF

- Industrial Prototype** development for pilot testing

Peter Bopp Stiftung für Forschung und Technik
Implementation Grant
~200'000 CHF

UNI FR
Startup Grant
~150'000 CHF

- Income from the pilot testing

swiss mnt network micro & nanotechnology
2'000 CHF
2022 Ph.D. award

UNI FR Vigener Prize 2023
2'000 CHF

CME STEM
ACS Global Outstanding Student Award
6'500 CHF

MARS HABITAT CHALLENGE 2023
05.05.2023
Coaching Voucher: 1'000 CHF

SCIENCE SLAM
2nd Place: 750 CHF

UNI FR Research Pool Grant
42'000 CHF

- Carry out engineering work for an industrial prototype
- Material Purchase

Seed Fundraising
~3-5 million CHF

Incorporation of SEPARATIC

UNI FR HEIA-FR HTA-FR AMMACAT
50'000 CHF

- Feasibility of the membranes for indoor carbon capture

UNI FR 46'000 CHF

- Development of an industrial prototype
- Engineering Support

VENTURE KICK
Stage I & II: 50'000 CHF

PROTOTYPES FOR HUMANITY Selected in top 5 worldwide
~5'000 CHF

AIT India 2024 ~2'500 CHF
venturelab

China-Swiss Startups Roadshow 2024 ~3'000 CHF
venturelab

Innosuisse Initial coaching

Marketing & Sales

celsius groupe viridhys technologies
Linde KEBAG
LOI received

celsius groupe KEBAG
Linde viridhys
Pilot testing and first installations

Expanding customer base beyond Switzerland

Founders



50%

Dr. Timur Ashirov
CEO

Ph.D. in membranes for
carbon capture



Co-developed
social startup



20%

Vincent Racciati
COO&CFO

M.A. in business and
management



20%

Ali Goktug Attar
Head of R&D



10%

Prof. Ali Coskun
CSO

Prof. in carbon capture
using porous materials

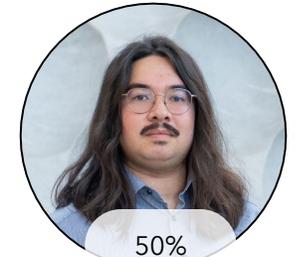


The Team



50%

Valentin Pasche
Mechanical
Engineer



50%

Yves Hartmann
Chemical
Engineer



Advisors



Dr. Krzysztof Piech
Technical advisor



Dr. Valeria Mozzetti
IP & Legal advisor



Dr. Eliav Haskal
Business advisor



Coaches



Roman H. Schmidt



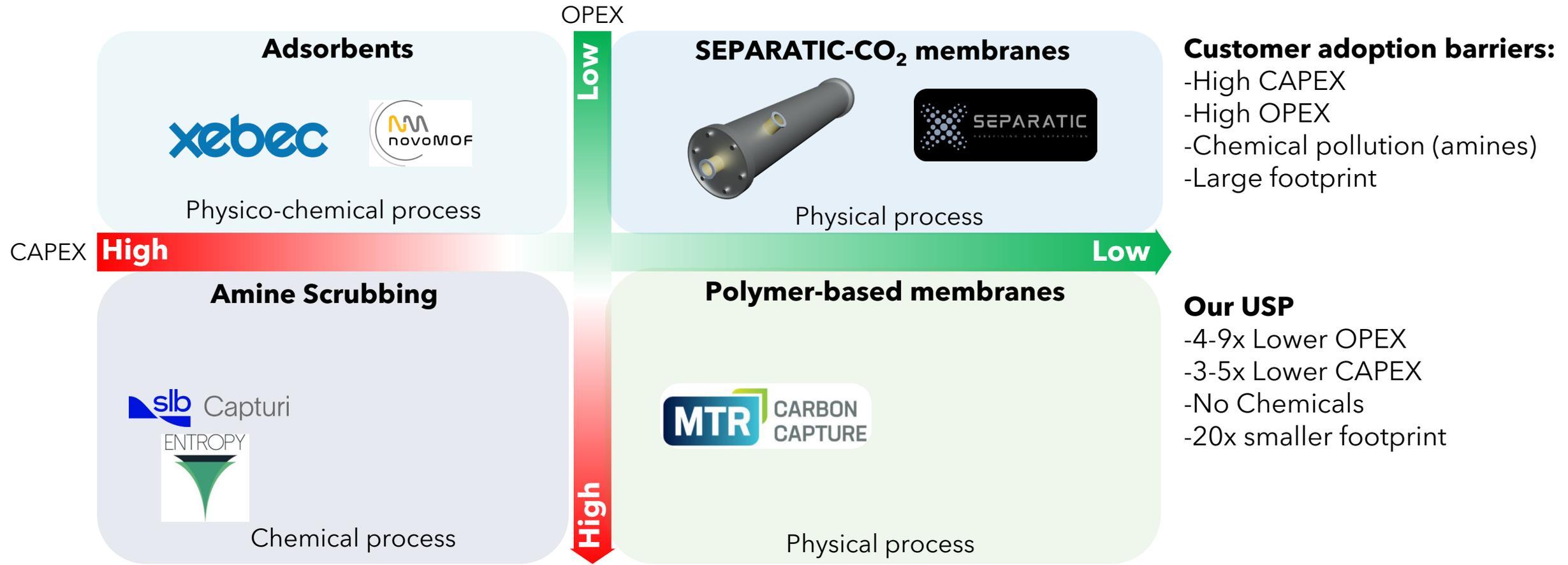
Dr. Robert Sum



Joseph Ayuso

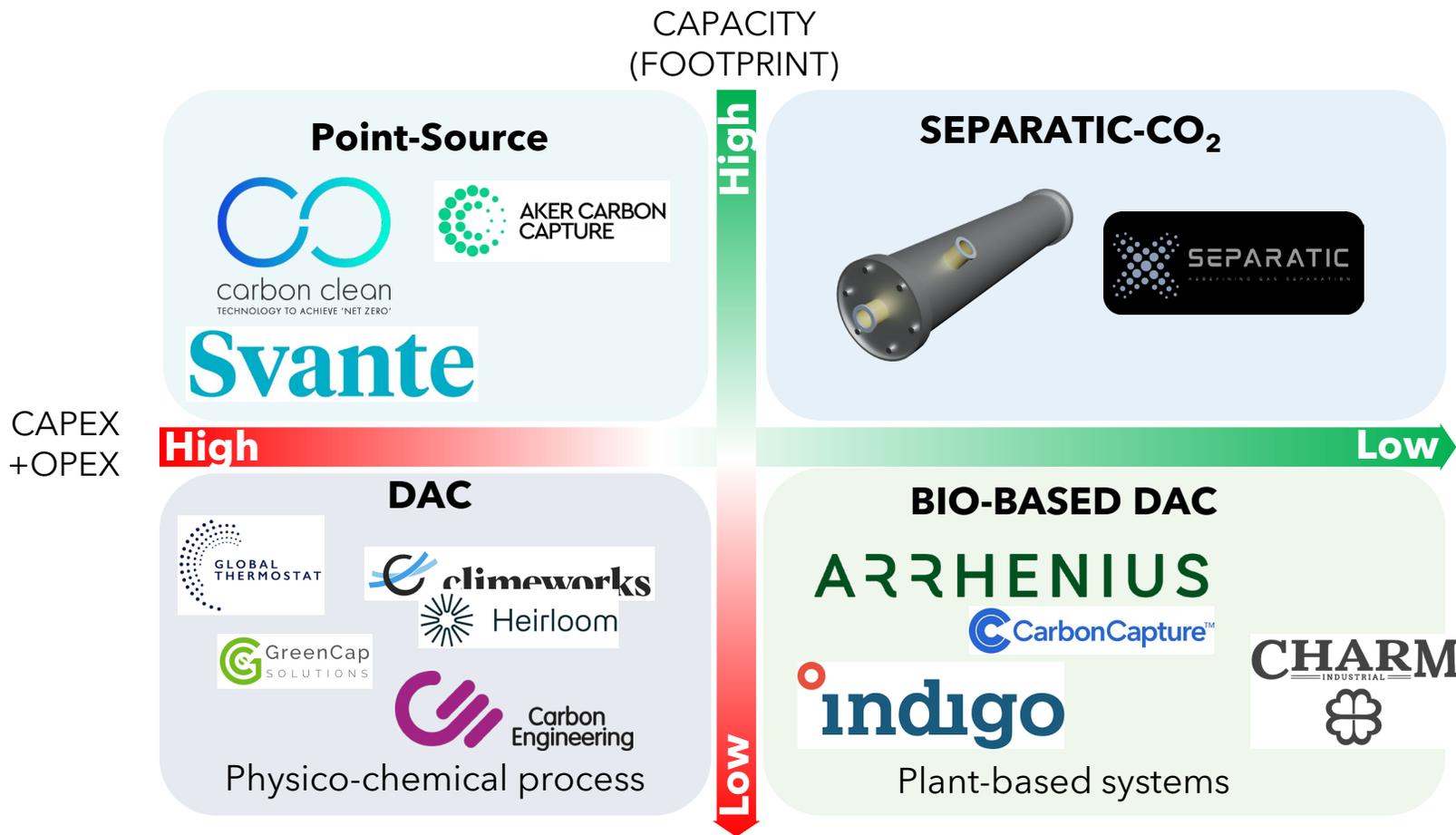


COMPETITION: DIRECT



- **Amine Scrubbing:** Mitsubishi Heavy Industries, SLB Capturi, Entropy, Fluor Corporation, Carbon Clean, Kanadevia Inova, etc.
- **Adsorbents:** Linde Xebec, NovoMOF, AirLiquide, Carbon Clean, Swante, Verdox, Generon, etc.
- **Polymeric membranes:** AirLiquide MEDAL, MTR Polaris, Evonik SEPURAN, AirProducts PRISM, Honeywell Separex, Generon, etc.

COMPETITION: INDIRECT, CARBON CREDITS



- Customer requirements:**
- Certified, traceable capture
 - Transparency
 - Cheaper price per tCO₂
 - More efficient capture process

- Our USP**
- Traceable, certified process
 - Transparent pipeline
 - Cheaper credit price
 - Higher efficiency

- **DAC:** Climeworks, Heirloom Carbon, Global Thermostat, GreenCap Solutions, Carbon Engineering, etc.
- **Post-combustion capture:** Carbon Clean, Svante, Aker Carbon Capture, etc.
- **Bio-based DAC:** Arrhenius, CarbonCapture Inc, Indio Ag, Charm Industrial, Carbon Gold, Pachama, etc.

**2035-Install a \$5 million CO₂ capture plant
To provide clean air to my community**

TalCo Aluminum plant, Tursunzoda, Tajikistan





Thank you for your attention!

Saving our planet takes
time; better act now!

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+41 (77) 415 76 92

Our Journey

Click for more info

ALMA & GEORGES

Webzine | Université de Fribourg – Universität Freiburg

SWISS MNT NETWORK

MICRO & NANOTECHNOLOGY



**Swiss Nanotechnology
PhD Award 2022**

Separatic
Redefining Gas Separation
Idea establishment

EST. 1954
CME
STEM
**2023 ACS Global
Outstanding Graduate
Student Award**

MARS HABITAT CHALLENGE 2023
05.05.2023
**3rd Place at Mars Habitat
Challenge**

SC SUCCEED
CONSULTING
**Swiss-China Innovation
Roadshow**

**HEIA-FR
HTA-FR**
AMMACAT Project

**Innovation project
supported by**

 Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Innosuisse – Swiss Innovation Agency

2018

2022

2023

2024

2025

BRIDGE
Grant number
211778

**Swiss National
Science Foundation**
Grant number
175947

**UNI
FR**
UNIVERSITÉ DE FRIBOURG
UNIVERSITÄT FREIBURG
Vigener Prize 2023

**SCIENCE
SLAM**
**2nd Place at the
Science Slam 2023**

**VENTURE
KICK**
Stage I and II

**PROTOTYPES
FOR HUMANITY**

**UNI
FR**
UNIVERSITÉ DE FRIBOURG
UNIVERSITÄT FREIBURG
Research Pool Grant

**BASEL
AREA**
MORE TO *DISCOVER*
Selected for
i4challenge 2024

venturelab
AIT India Program

**WISSENSCHAFT.
BEWEGEN**
GEBERT RUF STIFTUNG
GRS InnoBooster Grant

CleantechAlps

CUSTOMERS

➤ LOI received



➤ Interest confirmed



Customer ready



Wood burner

~230 tonCO₂/year

SEPARATIC-CO₂ Membranes

30-40 cm

~5-10 cm

~1.0-2 cm

>90% CO₂

Industrial Pilot Project



Volume:

0.25-0.5 tCO₂/day



Duration:

6-9 months



Location:

Belfaux, Fribourg

Impact of PBS Funding



Advancing from TRL3 to TRL6



Industrial and validation prototype development



Demonstrator pilot for future customers and investors

USE of Funding



Personnel: Junior Researcher - 137'000 CHF



Chemicals: 1'100 CHF



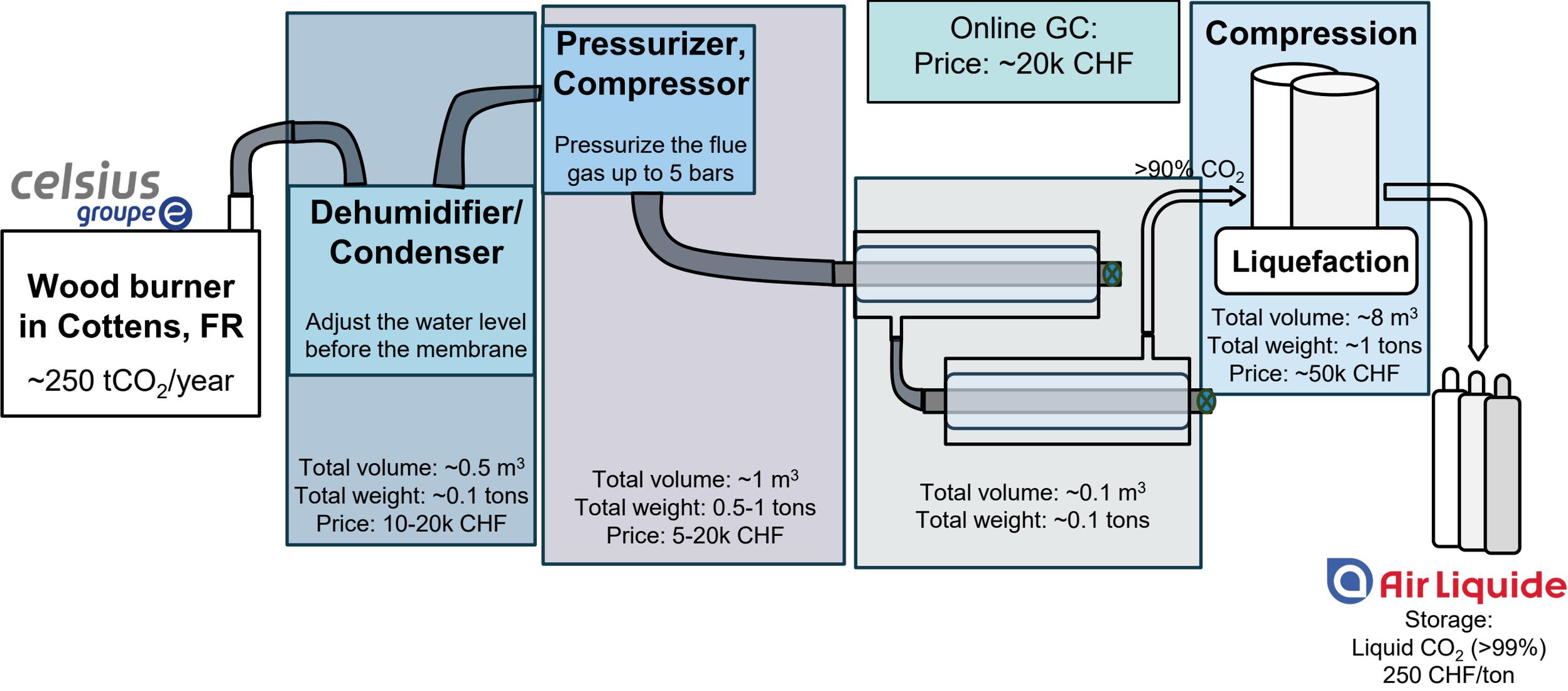
Prototyping Materials: 50'700 CHF



Analysis & Testing: 12'000 CHF

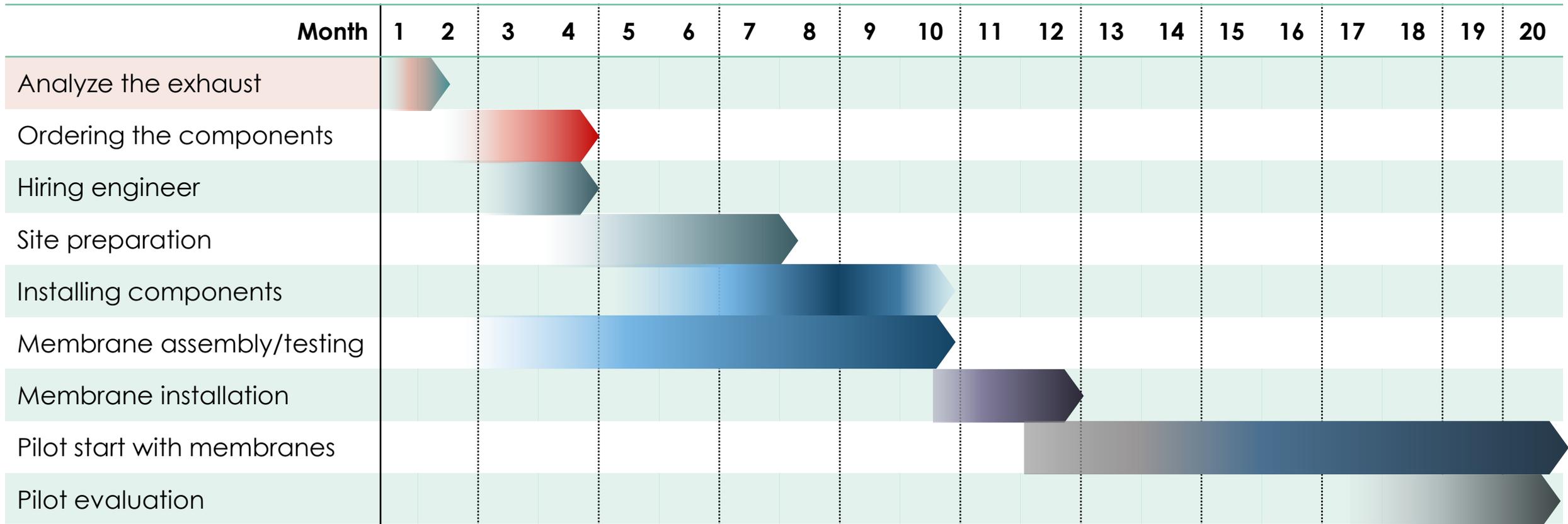
IMPLEMENTATION: DEMONSTRATION UNIT

> Detailed plan

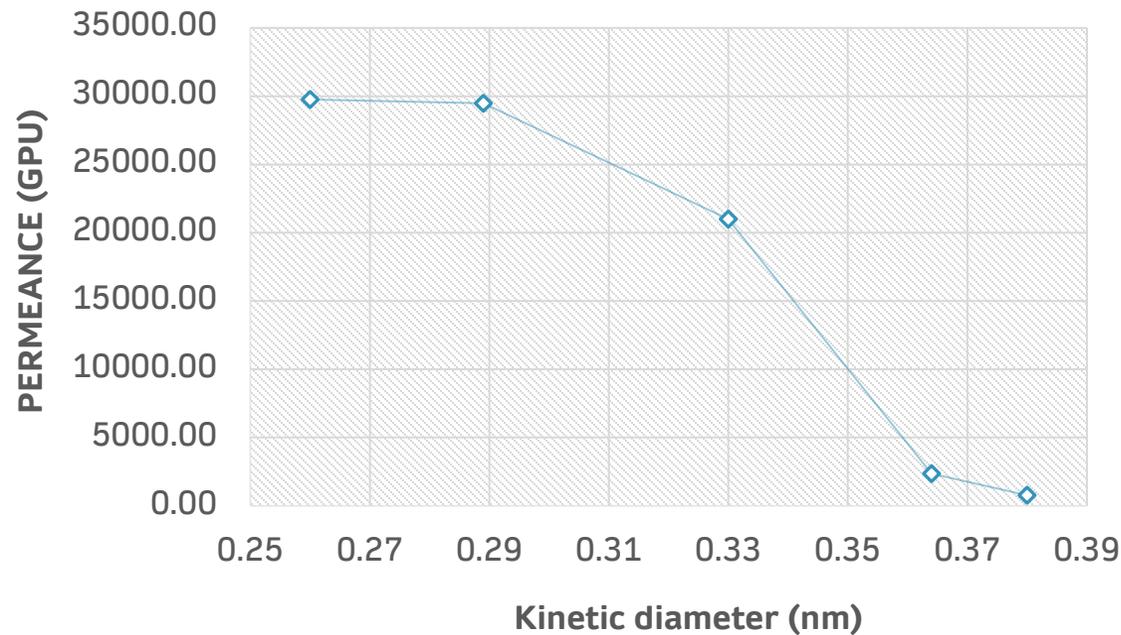


GROUPE E CELCIUS PILOT TIMELINE

➤ Peter Bopp Stiftung Implementation Grant



IMPLEMENTATION: DEMO UNIT



- ◆ **H_2 permeance:** 30'000 GPU
- ◆ **CO_2 permeance:** 21'000 GPU
- ◆ **CO_2/N_2 selectivity:** ~40.0
- ◆ **CO_2/CH_4 selectivity:** 27.0
- ◆ **H_2/CH_4 selectivity:** 38.0

COMPETITION

System required for capturing of ~950 tCO₂/year

Technology	Membranes	Adsorbents (PSA)	Graphene membranes
Companies	Evonik (Sepuran), AirPlus, MTR	AirLiquide, HyGear, Linde Xebec	University of Fribourg spin-off: SEPARATIC-CO ₂
Pressure	10-20 bar	20-30 bar	5 bar
Size	1 container 12 meters, 80 m ³	2 containers 12 meters, 80 m ³	1 container 10 m ³
CAPEX	850 000 CHF	1 400 000 CHF	300 000 CHF
OPEX	175 000 CHF	95 000 CHF	25 000 CHF
CO₂ purity	~97%	~98%	>95%
TRL	9	9	3-4
ROI	5-6 years	6-7 years	2-3 years

COMPETITION: CLOSE UP

Competing Technologies			
Product attributes	SEPARATIC-CO ₂ membranes (UniFR)	Divea (EPFL)	UniSieve (ETH Zurich)
Technology	Porous graphene	Porous graphene blended with polymer	Mixed matrix membranes
Permeability	10	6	3
Scalable	9	5	10
Selectivity	6	5	7
Used for?	CO ₂ separation	CO ₂ separation	CO ₂ separation
Material costs/price	7	5-6	4-7

(yes or no and scale from 1 to 10, 1 = very poor, 10 = excellent)

COLLABORATORS for CO₂ VALORIZATION

➤ Companies focused on CO₂ valorization

ARRHENIUS ➤ Converts CO₂ to algae



➤ Converts CO₂ into minerals for underground storage



hydrogenerous[®] ➤ Converts CO₂ into Hydrogen

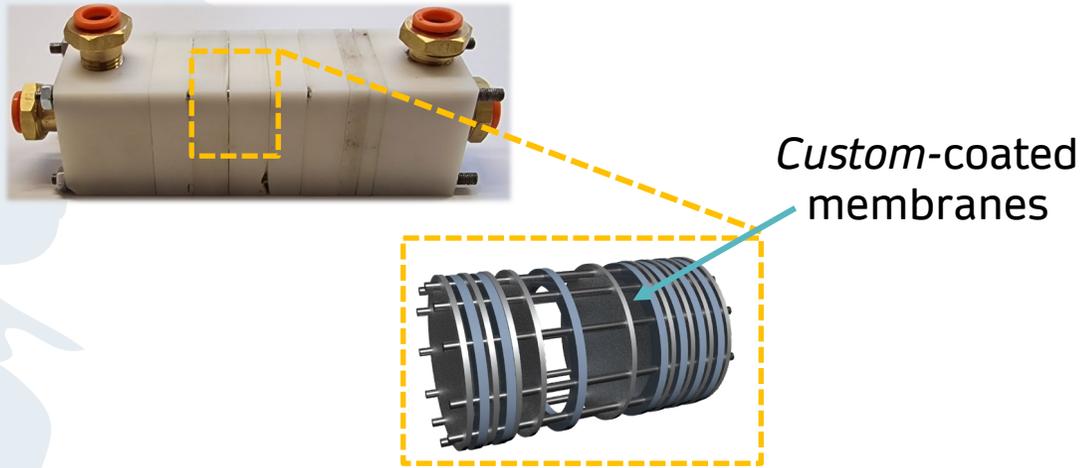
**Carbon
Catalyst** ➤ Pumps CO₂ into offshore oil shells



➤ Focused on trapping CO₂ in mineral for permanent storage

Products

SEPARATIC H₂



US 18/265'271 | EP 21 847 943.4

Small-scale trace gas removal

- ✓ Hydrogen recovery
- ✓ Direct-air-capture

SEPARATIC CO₂



PCT/EP2024/086354

Continuous gas separation:

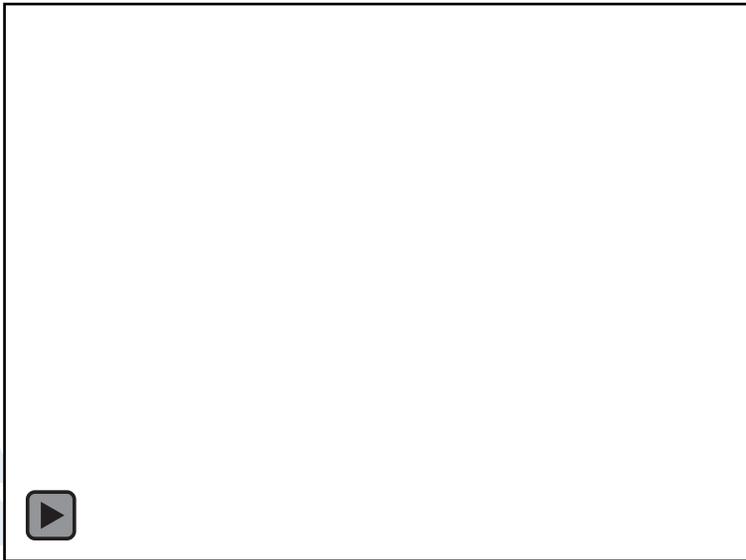
- ✓ Carbon capture from flue gas
- ✓ Biogas treatment
- ✓ Nitrogen rejection

Products

SEPARATIC H₂



Adsorptive separation



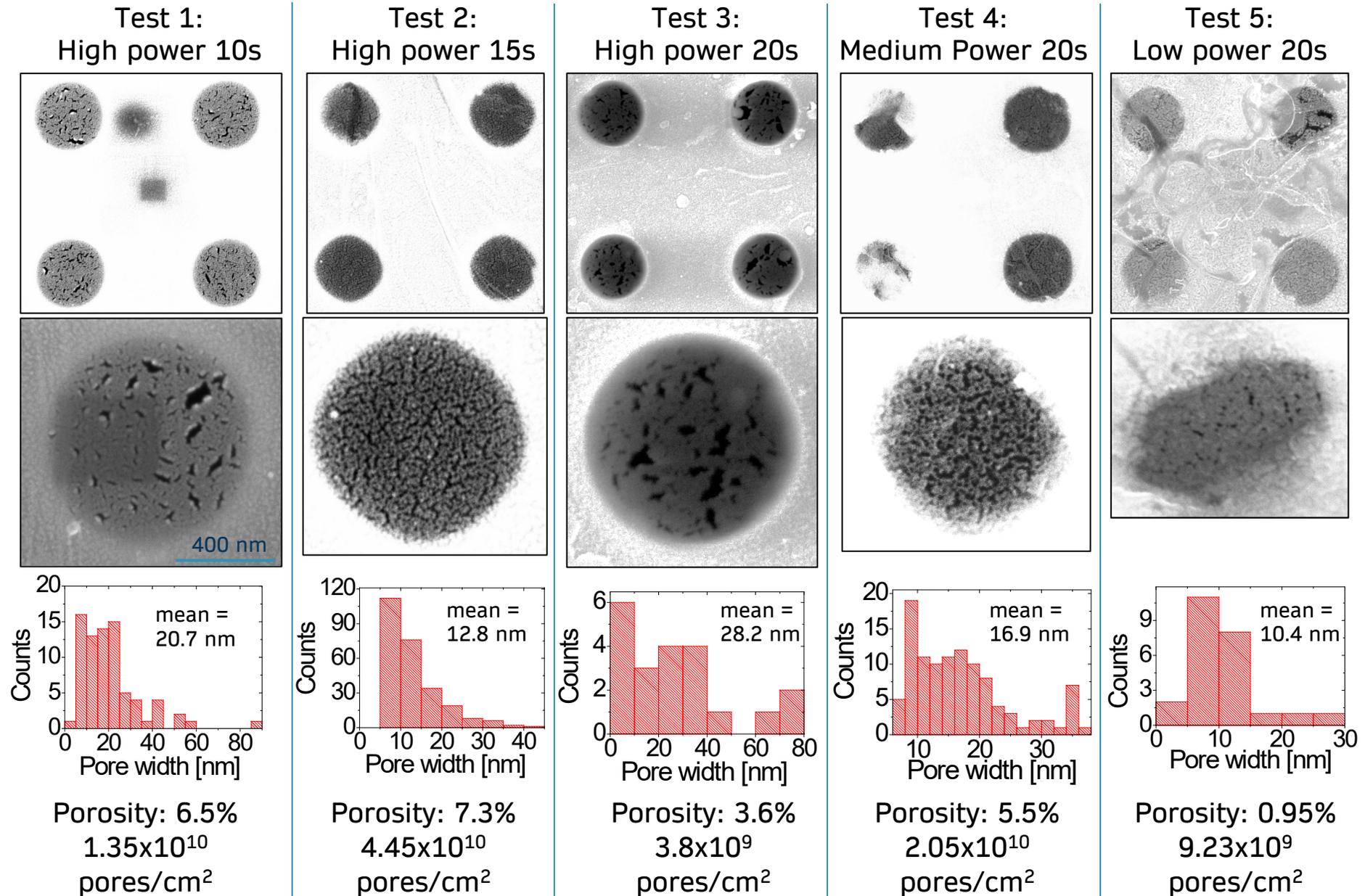
SEPARATIC CO₂



Highly selective porous graphene with ultrahigh permeance

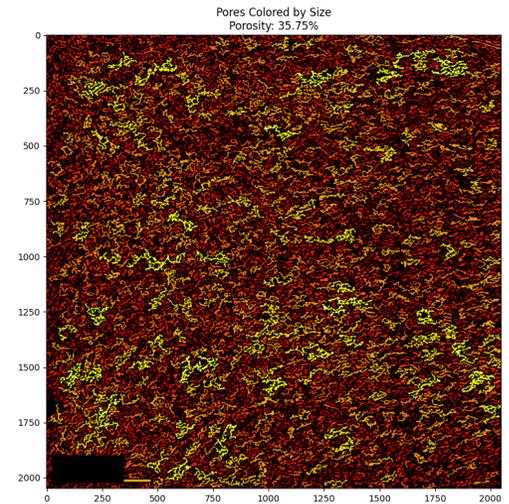
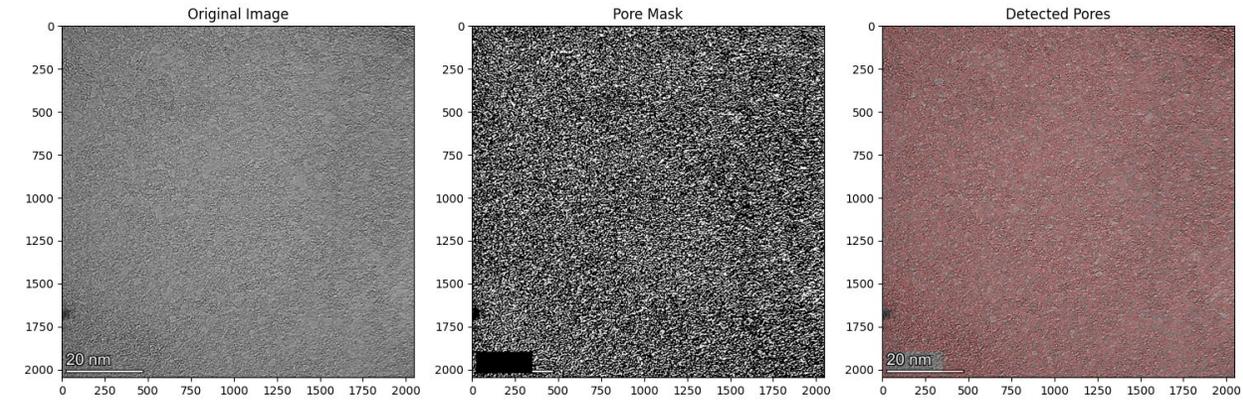


Novel Pore Generation On Graphene



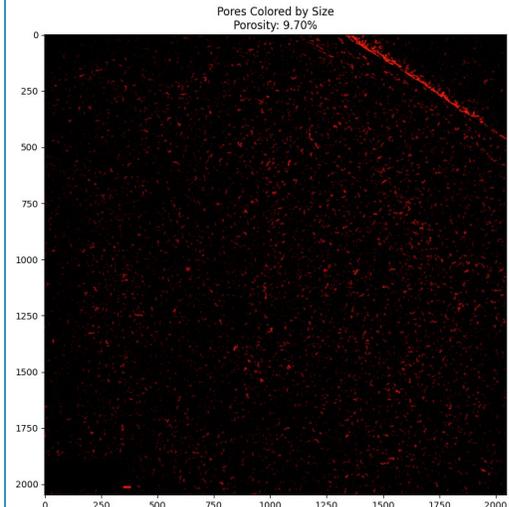
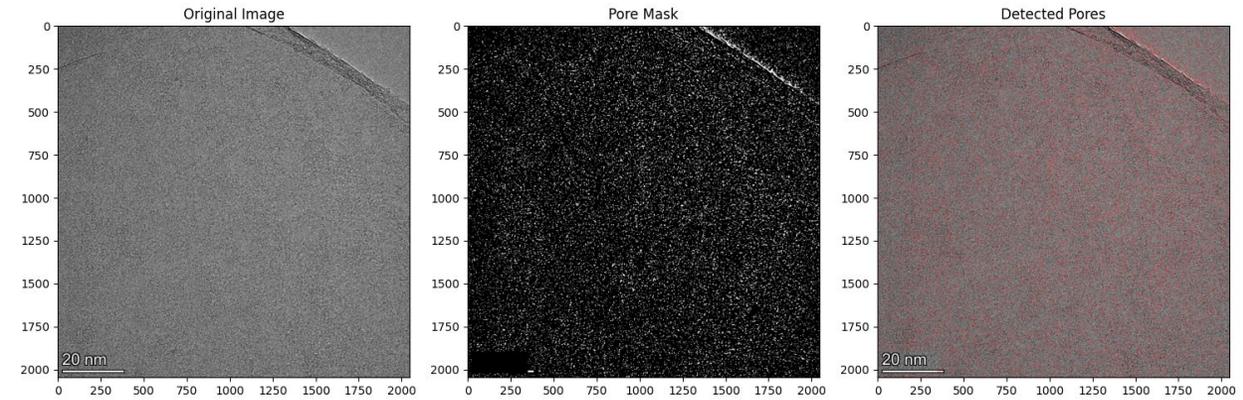
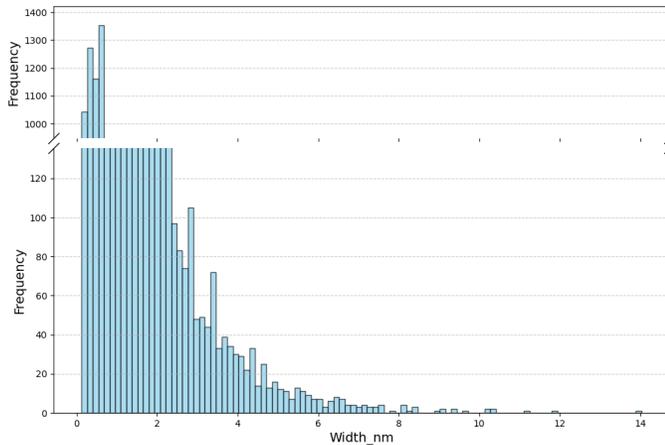
Confidential

Extended Test Results



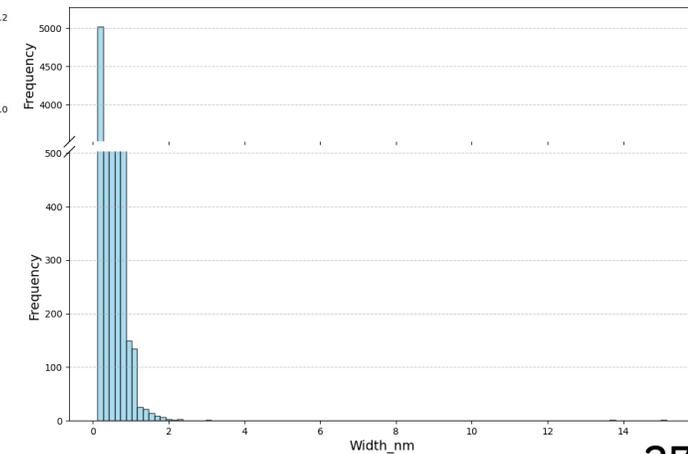
Porosity: ~35%

Distribution of Width_nm

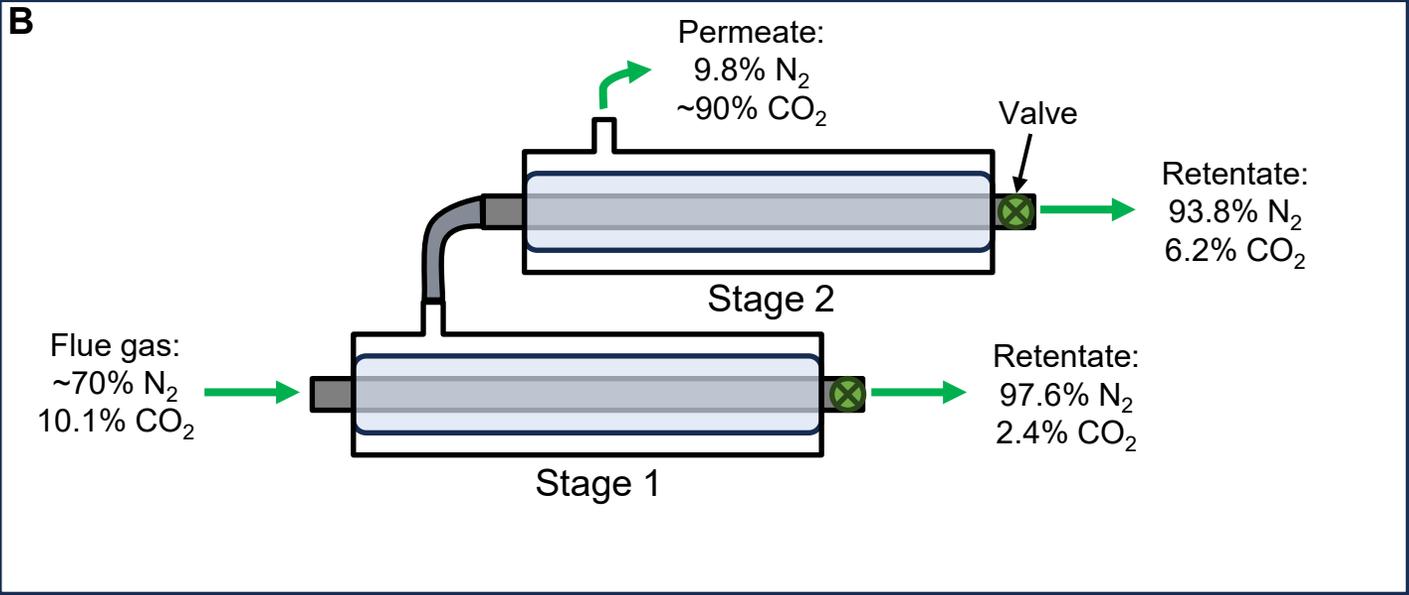
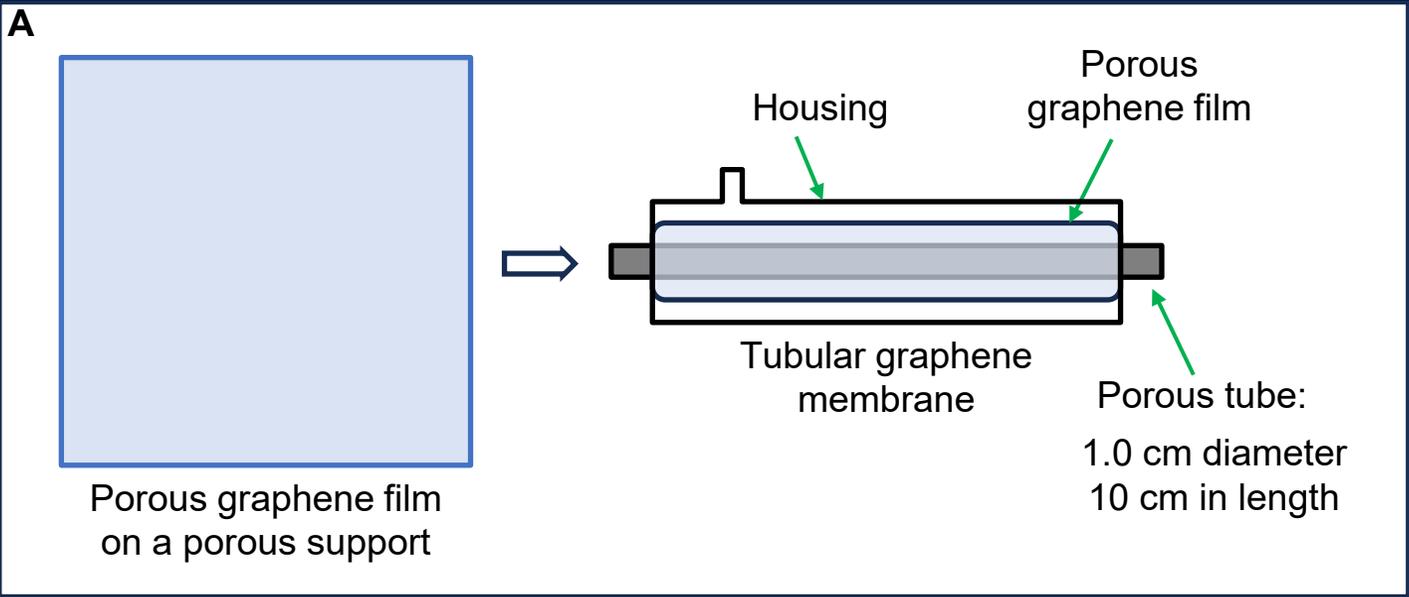


Porosity: ~10%

Distribution of Width_nm



CURRENT DEVELOPMENT STAGE



Area required: ~400 cm² on each stage