



# PROJECT CAFE

## COFFEE & CLEANTECH CRIN Network Innovative Projects

October 29, 2024

powered by

**CRIN**  
Clean Resource  
Innovation Network

# Network of Networks

CRIN does not replicate or compete, we are committed to amplifying and supporting the existing networks in the cleantech ecosystem, providing opportunities to collaborate, convene and collide.



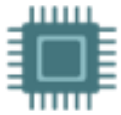
A few of CRIN's active industry members (including Canada's largest oil & gas producers):

- Arc Resources
- Cenovus Energy
- ConocoPhillips Canada
- Canadian Natural Resources Limited
- Imperial Oil Limited
- Pacific Canbriam Energy
- Suncor Energy
- Tourmaline Oil

# 7 Technology Themes across 5 Sectors



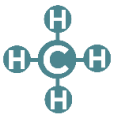
CLEANER FUELS - REDUCING CARBON INTENSITY



DIGITAL OIL AND GAS TECHNOLOGY



CARBON CAPTURE AND VALUE-ADDED PRODUCTS



METHANE MONITORING, QUANTIFICATION AND ABATEMENT



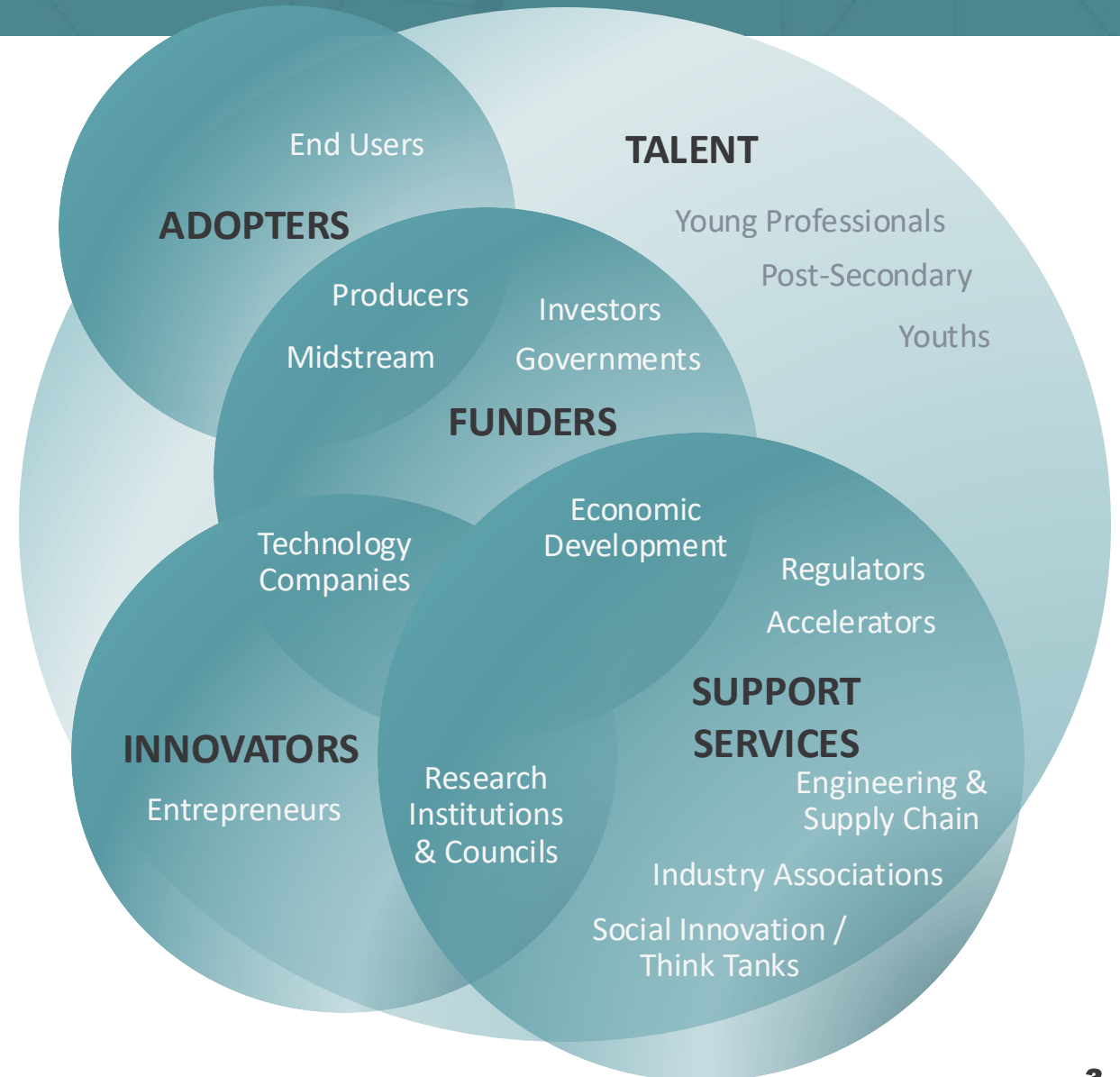
NOVEL HYDROCARBON EXTRACTION



NOVEL LAND AND WELLSITE RECLAMATION



WATER TECHNOLOGY DEVELOPMENT

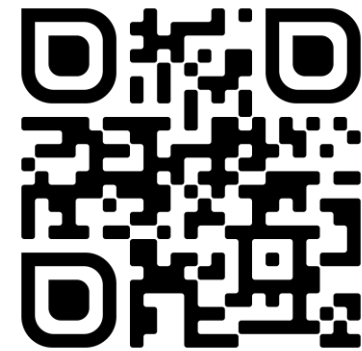


# Join CRIN



- Free to join
- Network with members across the ecosystem
- Access CRIN discussion groups on LinkedIn
- Access CRIN events calendar
- Marketing opportunities for your organization
- Participate in events/panels
- CRIN newsletters
- Follow CRIN on LinkedIn

Join the CRINetwork!



# Land Acknowledgement

Acknowledgement of the land is an important step toward reconciliation. Today, we are gathering from across Canada, please take a moment to recognize the land where you reside and work.

This event is being hosted from Calgary, where we acknowledge and pay tribute to the traditional territories of the peoples of Treaty 7, which include the Blackfoot Confederacy (comprised of the Siksika, the Piikani, and the Kainai First Nations), the Tsuut'ina First Nation, and the Stoney Nakoda. The City of Calgary is also home to the Métis Nation of Alberta (Districts 5 and 6).



# AGENDA

1. Welcome	Marc Godin
2. H2Nano Inc. <i>Solar-Activated Water Treatment to Accelerate Oil Sands Process-Affected Water Return</i>	Zac Young
3. Cnergreen <i>Testing Nanoparticle-based Foam Technology to Improve the Efficiency of CO2 Enhanced Oil Recovery and CO2 Storage</i>	Ali Telmadarreie
4. Hyfold Technology Corp. <i>Stationary Seismic Monitoring</i>	Trent Hunter
5. Cvictus Inc. <i>Mannville Enhanced Hydrogen Recovery Project</i>	Katrina Stewart
6. Hydron Energy <i>Waste to Fuel: Accelerating Commercialization of the Lowest Cost &amp; Smallest Scale Novel Biogas-to-RNG Upgrading System</i>	Soheil Khiavi
5. Q&A, Wrap-up, Coffee!	



# Solar-Activated Accelerated Water Treatment for Oil Sands Mine Water

CRIN Project Cafe

October 29, 2024 | Calgary, AB

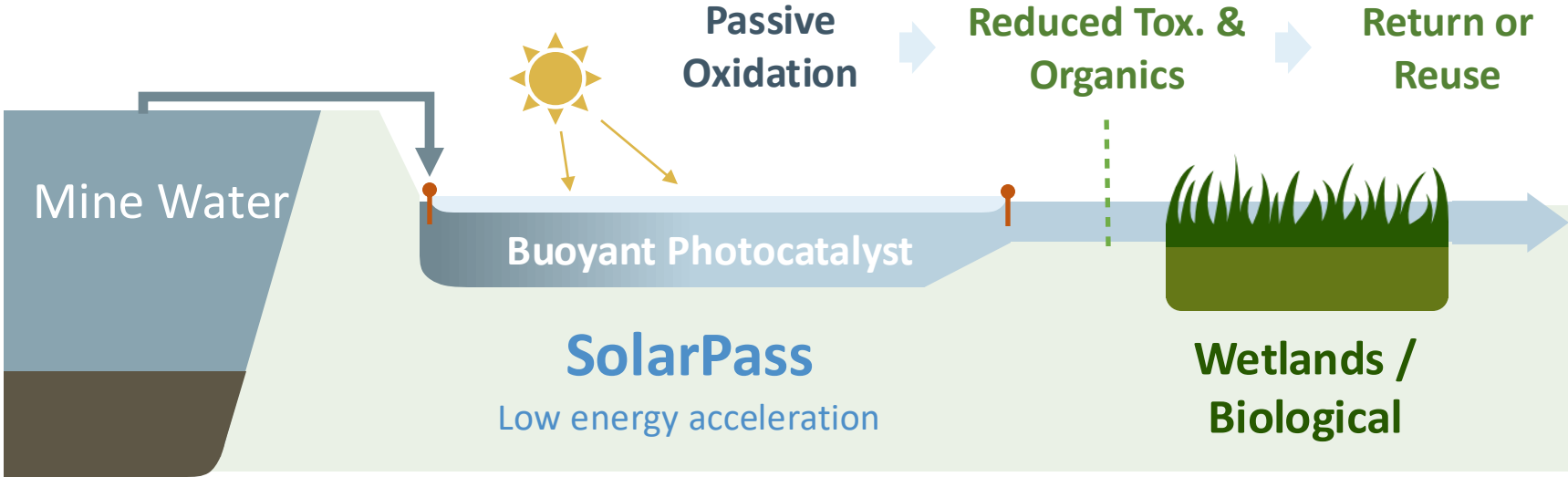


# Oil Sands Mine Water: Passive Treatment Solution

>500M m<sup>3</sup> of stored mine water for accelerated treatment.



OSQAR, Suncor, 2014 (Online Blog)





# Oil Sands - Accelerated Passive Treatment

**1-2 days**

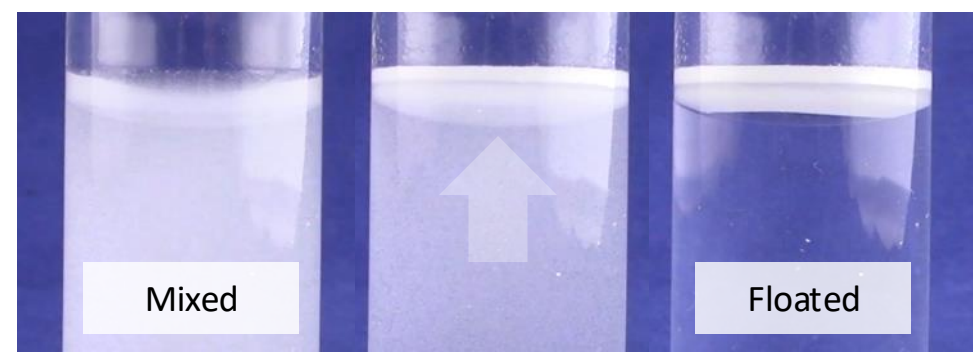
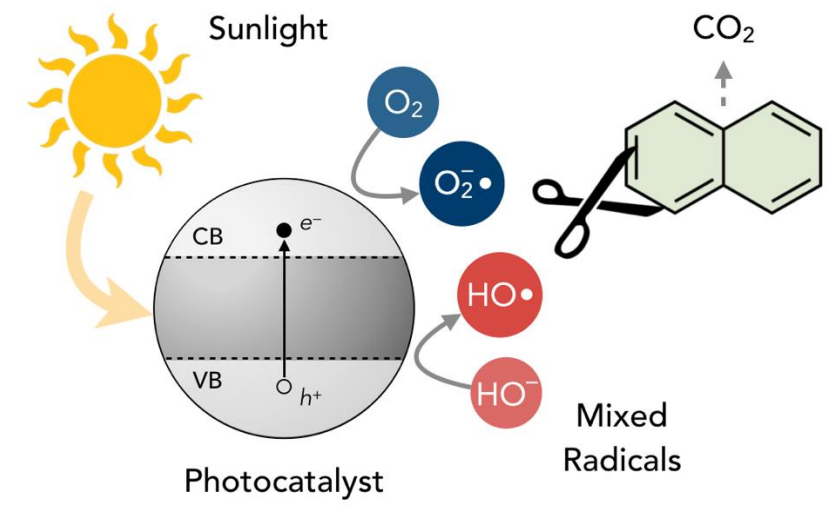
**Acute toxicity elimination**

(n = 4, Rainbow trout)

**< 0.01 mg/L**

**Naphthenic acid fraction compounds reduction**

(n = 5)



- PAHs
- PHCs
- BTEX
- Phenols
- Naphthenic Acids
- Sulfides
- Ammonia



# Oil Sands - Accelerated Passive Treatment

## 1-2 days

### Acute toxicity elimination

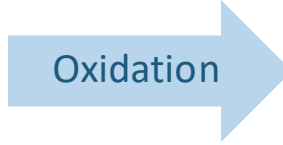
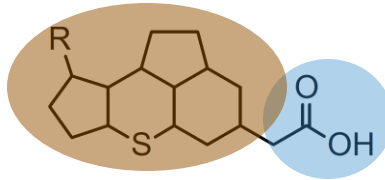
(n = 4, Rainbow trout)

## < 0.01 mg/L

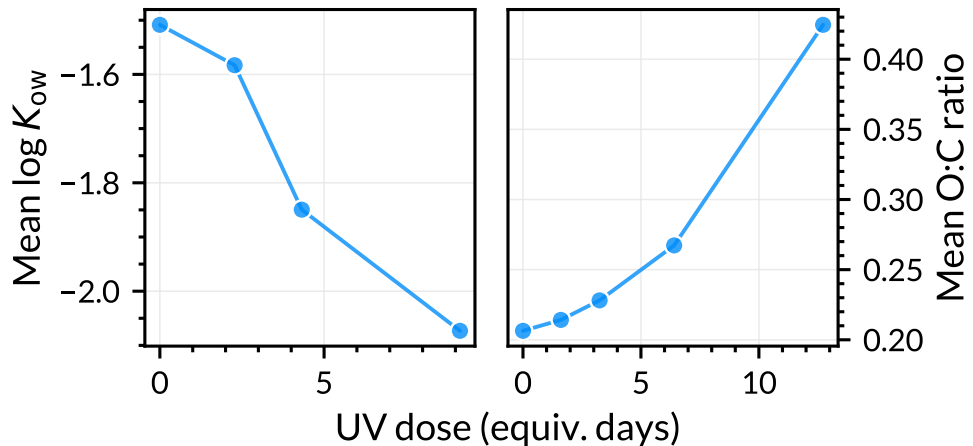
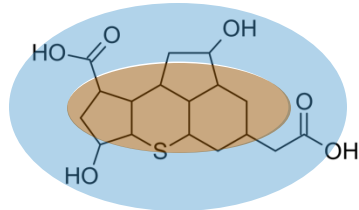
### Naphthenic acid fraction compounds reduction

(n = 5)

### Untreated NAFCs



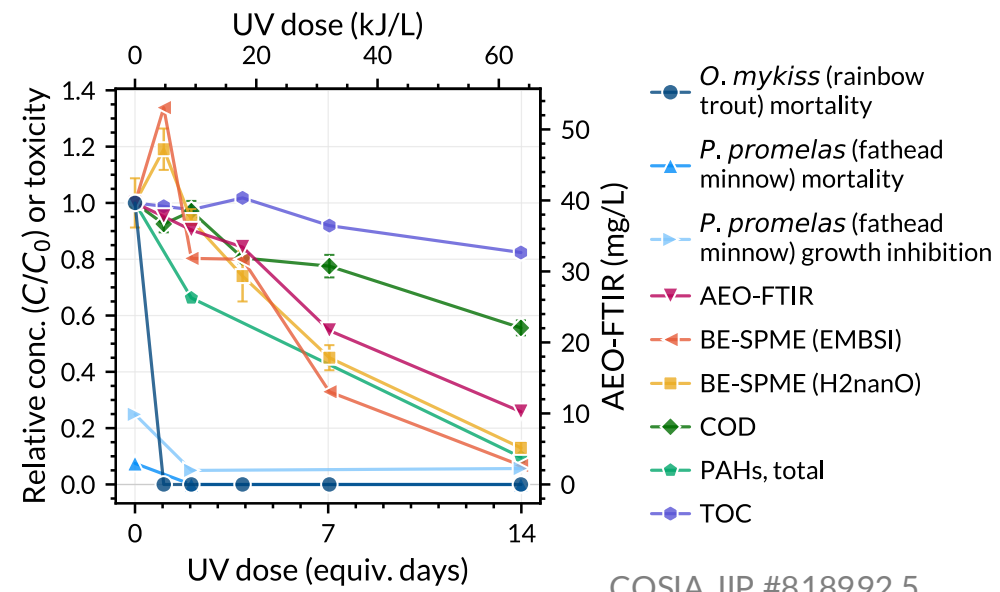
### Treated NAFCs



- PAHs
- PHCs
- BTEX
- Phenols
- Naphthenic Acids
- Sulfides
- Ammonia

# Oil Sands - Accelerated Passive Treatment

## Targeted Organics Treatment



COSIA JIP #818992.5



### A Light Touch: Solar Photocatalysis Detoxifies Oil Sands Process-Affected Waters Prior to Significant Treatment of Naphthenic Acids

Timothy M. C. Leshuk, Zachary W. Young, Brad Wilson, Zi Qi Chen, Danielle A. Smith, Greg Lazaris, Mary Gopanchuk, Sean McLay, Corin A. Seelemann, Theo Paradis, Asfaw Bekele, Rodney Guest, Hafez Massara, Todd White, Warren Zubot, Daniel J. Letinski, Aaron D. Redman, D. Grant Allen, and Frank Gu\*

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## Scaling Demonstration (2023)



- Largest total volume trial
- Optimization of solar dose
- Pre-deployment de-risking



# SolarPass + Wetlands

Combining passive treatment strengths for better total quality.

Reducing aquatic toxicity  
Treating organics and metals  
Low energy, no wastes



Indoor Mesocosms



SolarPass + Wetlands Pilot



# CRIN + H2nanO

**Key advancements in demonstration scale & capacity for field readiness.**

1. SolarPass can accelerate OSPW remediation, not requiring total organics mineralization.
2. SolarPass can treat a wide range of trace elements in OSPW.
3. SolarPass, as a pre-treatment for wetlands, helps to promote health.
4. Process designs are ready for scale-up.



**Technology scaling & de-risking**

**Growth in team capacity**

**Generating new knowledge**



**H2nanO Incorporated**

ERA Funding: **\$1,850,000**

Project Value: **\$7,600,000**



Contact us:

**Zac Young, COO**

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[www.h2nano.ca](http://www.h2nano.ca)

## Sustainable water management, powered by nature.



### SolarPass

#### Solar Advanced Oxidation

Sunlight-activated  
organics and metals  
treatment.



### Oasis

#### Enhanced Evaporation

Accelerated solar-thermal  
brine concentration and  
dewatering.



### Stratus

#### Reactive Emissions Barrier

GHGs, VOCs and odor  
trapping and in-situ  
treatment.

- 1. New mining, energy and utilities scale-up pilot partners.**
- 2. Engagement with stakeholders, regulators and public partners.**



Contact us:

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[www.h2nano.ca](http://www.h2nano.ca)

# Sustainable water management, powered by nature.



## SolarPass

Solar Advanced  
Oxidation



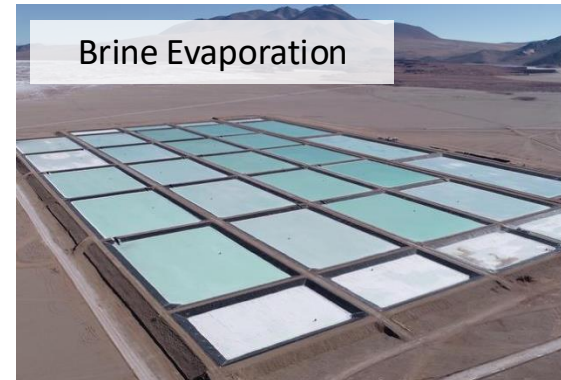
## Oasis

Enhanced  
Evaporation



## Stratus

Reactive Emissions  
Barrier





# CNERGREEN

Clean and Efficient Hydrocarbon Production

Putting carbon where it's meant to be!

## Testing Nanoparticle-based Foam Technology to Improve the Efficiency of CO<sub>2</sub> Enhanced Oil Recovery and CO<sub>2</sub> Storage

October 29, 2024

Ali Telmadarreie – CEO

[ali.telmadarreie@cnergreen.ca](mailto:ali.telmadarreie@cnergreen.ca)

[www.cnergreen.ca](http://www.cnergreen.ca)





# What do we do?

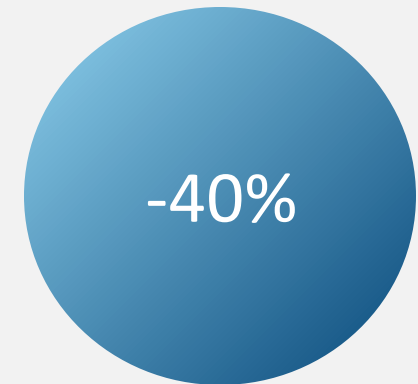
Energy Startup since 2019



 Oil Recovery Rate



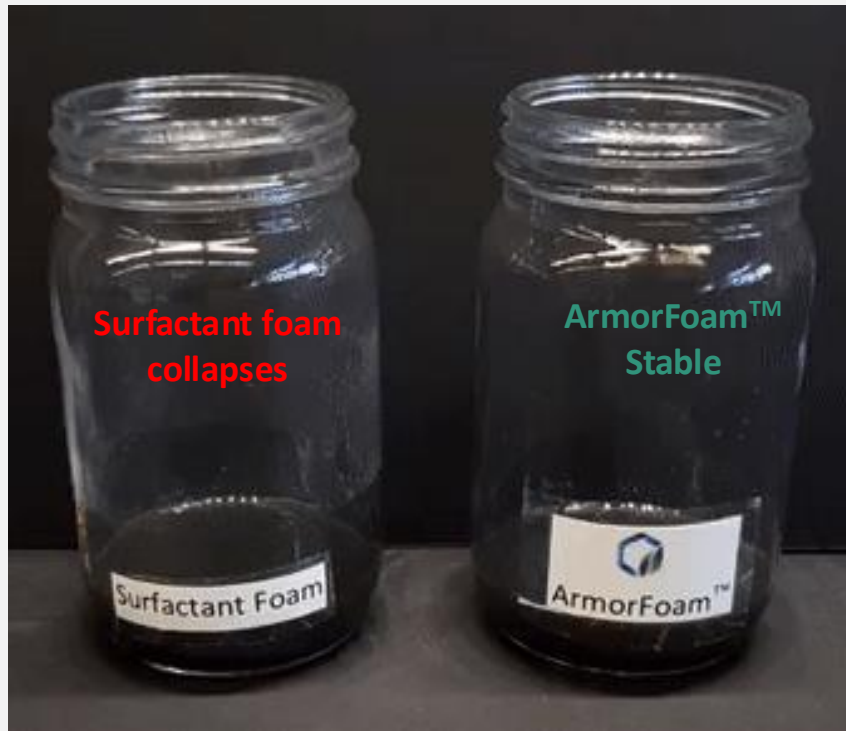
 CO<sub>2</sub> Storage



 CO<sub>2</sub> / bbl Emissions

# How do we do it?

Novel nanoparticle-based foam and injection technology that remains stable in harsh reservoir conditions unlike any other foams = **ArmorFoam™**

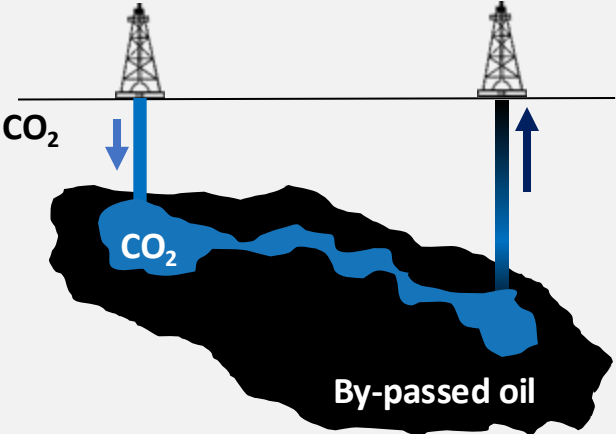


## Stability in contact with:

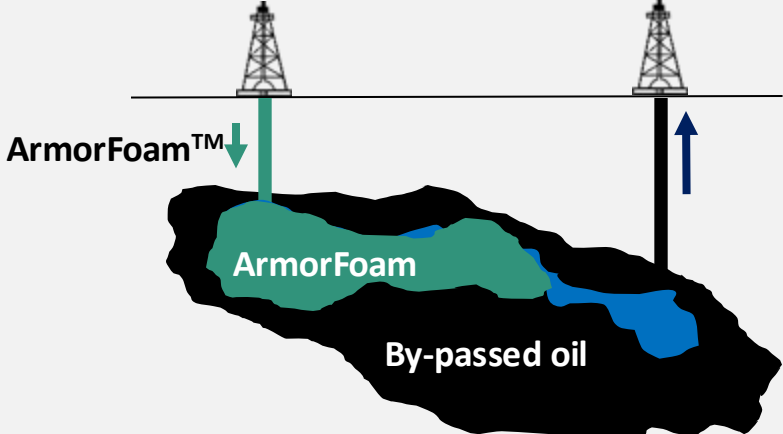
- Crude oil (light and heavy crudes)
- High salinity water (up to 20% salinity)
- High temperatures (240 °C)

**ArmorFoam™ blocks** short circuits,  
 creates **new pathways**  
 that **produce more oil**  
 unlocks **pore space** for **CO<sub>2</sub> storage**

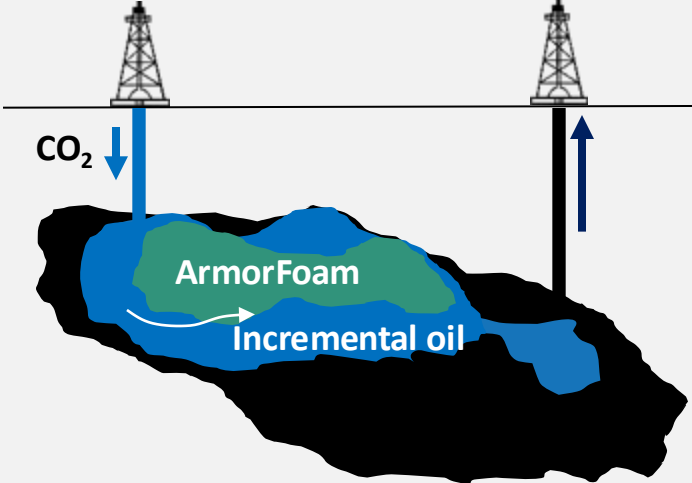
Status Quo



ArmorFoam Injection



Post-ArmorFoam



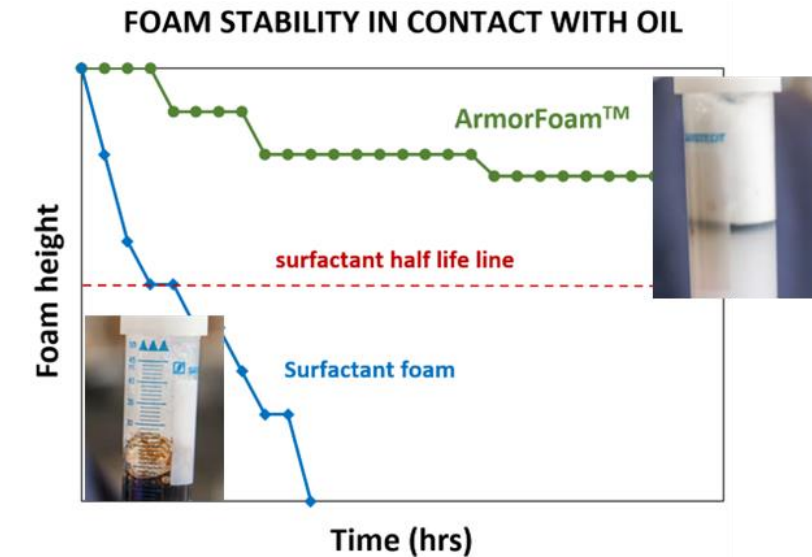
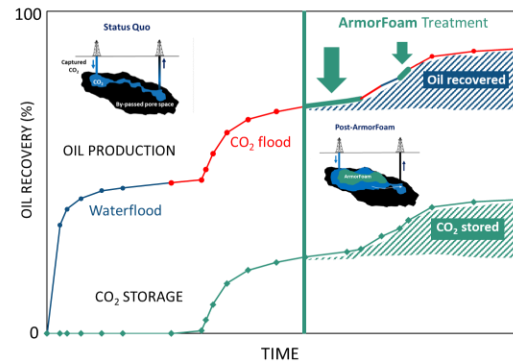
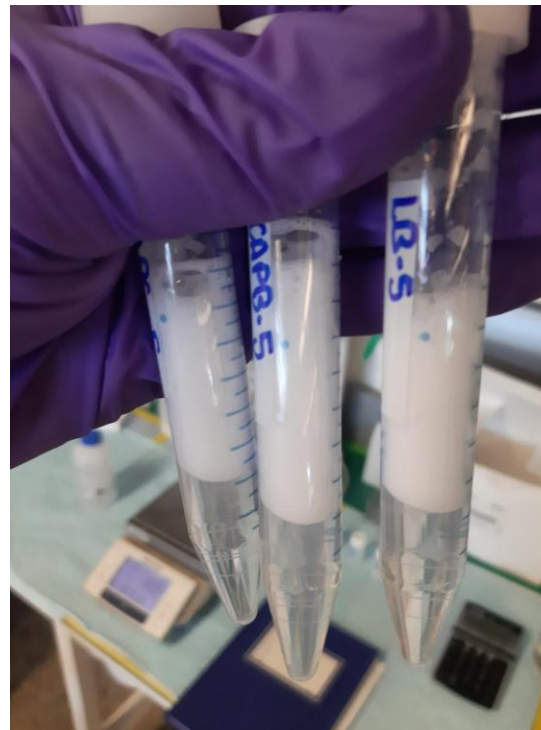
- CO<sub>2</sub> Recirculation
- CO<sub>2</sub> storage
- Oil recovery
- CO<sub>2</sub> / bbl Emissions

- CO<sub>2</sub> Recirculation
- CO<sub>2</sub> storage
- Oil recovery
- CO<sub>2</sub> / bbl Emissions

# ArmorFoam™ from lab to field

## Formulation design

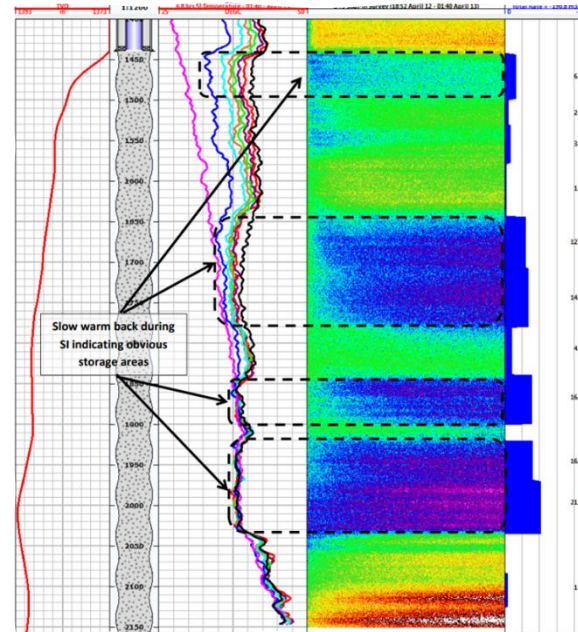
- Brine composition, reservoir pressure, temperature, permeability, porosity etc.



# ArmorFoam™ from lab to field

## Pilot design and manufacturing

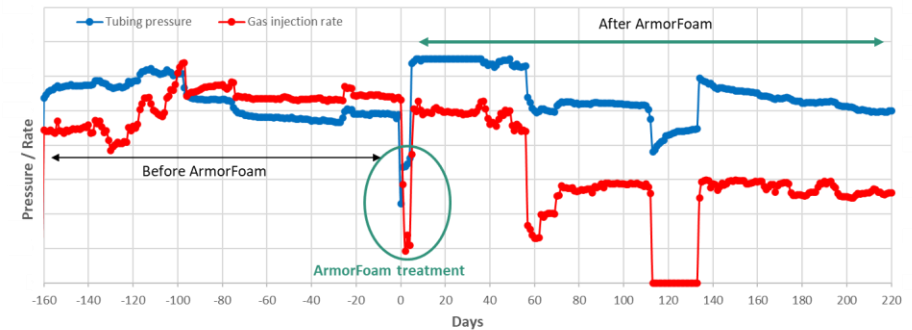
- Injection/production data, reservoir studies, Injection schedule



Stage 1	Product	Volume (m <sup>3</sup> )	Rate (L/min)	Injection Time (hrs)
Day 1	ArmorFoam solution" (AFS)	20	250	1.33
Day 1	CO <sub>2</sub>	100	10000	0.17
Day 1	ArmorFoam solution" (AFS)	20	250	1.33
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Day 1	CO <sub>2</sub>	100	10000	0.17
Day 1	ArmorFoam solution" (AFS)	20	250	1.33

# ArmorFoam™ from lab to field

Pilot deployment and data analysis



# ArmorFoam™ pilot's summary

Operator, Well	Problem	Solution: ArmorFoam™ Treatment			
		Time since treatment	CO <sub>2</sub> saving	Oil rate	Incremental oil
Operator A, well #1	Oil production is limited by CO <sub>2</sub> handling capacity	11 months	+17k tons	+10-20%	+3500 bbl
Operator A, well #2	Conformance, high CO <sub>2</sub> injection/production	4 months	+1k tons	+5%	+1000 bbl
Operator B, well #1	Declining oil rate in newly drilled well	2 months	TBD*	+300%	+2500 bbl

\*Still on water injection after treatment due to considerable increase in oil rate

# Next Steps & Collaboration Opportunities

## Next Steps

- Continuing the current pilots
- Multiple new pilots in progress
- Expansion to US and new applications

## Strategic partners for field tests

- CO<sub>2</sub>/gas EOR
- Waterflood
- Hydraulic fracturing
- Thermal EOR



**Unique manufacturing plant (up to 30 ton/day)**







# PROJECT CAFE

## Mannville Enhanced Hydrogen Recovery Project

Oct 29, 2024

*powered by*

**CRIN**  
Clean Resource  
Innovation Network

# AGENDA

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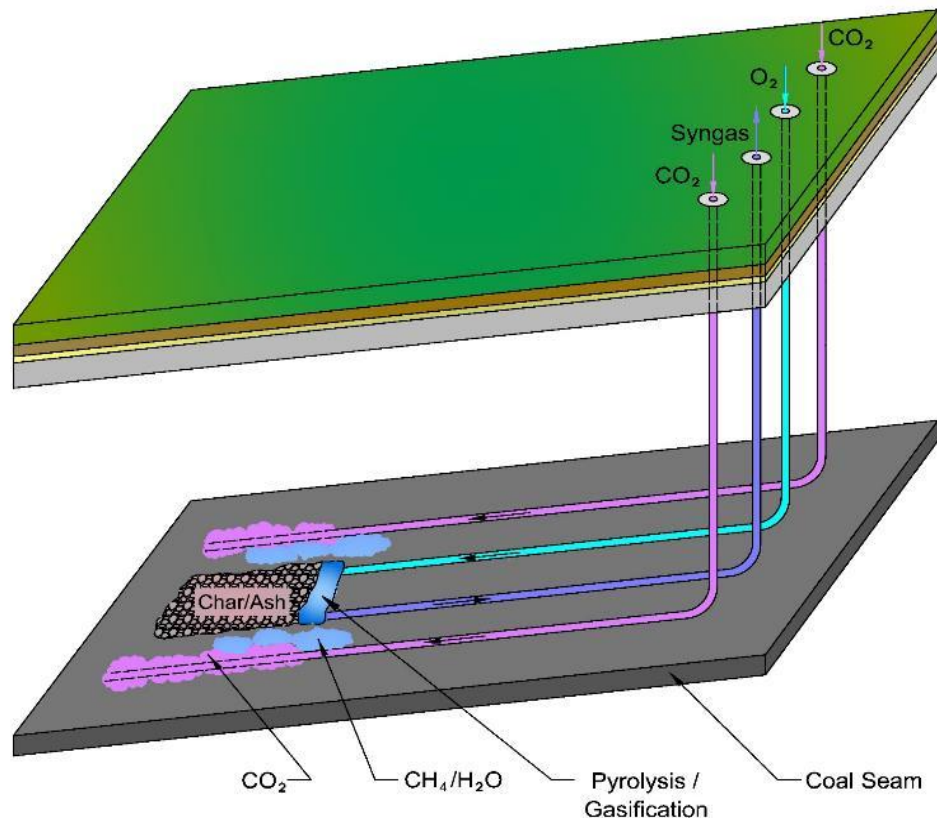
1. Project Objectives  
*Low cost, low-carbon hydrogen supply*
2. Successes and Lessons  
*Major engineering finalized; new IP*
3. Challenges Encountered  
*Emerging industries are always changing*
4. Next Steps  
*Drilling!*

# Project Objectives

- 1. The Hydrogen Economy is facing a chicken-&-egg problem – Cvicus will produce a commercially meaningful but logistically manageable amount of clean hydrogen (7 t/d) to close the gap between new production techniques and market demands.*
- 2. This project is the first-of-it's kind – proving Enhanced Hydrogen Recovery™ can produce the Greenest Blue H<sub>2</sub>™ at a lower cost than conventional gray hydrogen*
  - EHR™ is a low-emission process helping CRIN meet their reductions targets*
  - The system takes advantage of saline, formation water reducing fresh water demands typical in hydrogen production processes*
  - The scale of EHR™ is massive – we can access 5 PJ/a from just three wells and process the gas in a small facility (1 LSD)*

# Enhanced Hydrogen Recovery

(US Patents No. 11,125,069, 11,441,408, 12,098,621)



Combines proven proprietary UCG (TRL 9) and CCS (TRL 9)

- ✓ lowest cost
- ✓ lowest carbon intensity
- ✓ tiny land-use footprint
- ✓ low freshwater use
- ✓ globally scalable
- ✓ dense primary energy source
- ✓ tight process control

# Successes / Lessons

- *This is game-changing*
  - *Results from studies and modelling (U of C; Brightspot) indicate we may be able to achieve even lower carbon intensity than initially projected*
  - *Major engineering, well design finalized – final costs are aligned with strong economic results*
- *New patent awarded (12,098,621)*
  - *Injection of carbon containing fluids in deep coal – now IP protected*
  - *Future plans for field testing raw flue gas injection at the site – route to net zero*



# Challenges

- *The hydrogen (and CCS) industries are still finding their footing*
  - *Regulations and standards need to be in place to allow projects to develop with correctly mitigated risk*
  - *2022 CCUS ITC details and guidance not published until June 2024*
- *Hydrogen delivery is not standard*
  - *Different compression requirements for filling / dispensing*
  - *Logistics of transportation*
- *Supply and demand are waiting for each other*
  - *Offtake / end uses can't commit*

## Next Steps

- *Site preparation (pad development) in the works*
- *Drilling asap – and initial gas production*
- *Equipment procurement & construction (modular surface plant)*

## *Future Steps*

- *Pilot testing of raw flue gas injection*
- *Scale up to beyond 7 tpd hydrogen → methanol*



# Hyfold Technology Corp.

*Stationary  
seismic  
monitoring*

Trent Hunter, President, CEO  
[trent.hunter@hyfold.ca](mailto:trent.hunter@hyfold.ca)  
403.828.8055 cell



- Brief project overview
  - Innovative source for Low GHG seismic surveys
  - Now TRL-9/commercial
- Successes and lessons learned to date
  - Safe and cost-effective field mobilization
  - High reliability (no moving parts)
  - 'Tunable' frequency capability
  - Transition to mobile surveys - expand market
  - S/N optimization in acquisition
- Current challenges and asks of the network
  - Supply chain
  - Strategic Partnerships
  - IP
- What is the next phase
  - Facility Solar node - 2025 - \$250k
  - Mobile RC chassis - 2025 - \$250k





# Hyfold Technology Corp.

*Innovative Seismic Source for  
Low GHG Surveys*

Trent Hunter, President, CEO  
[trent.hunter@hyfold.ca](mailto:trent.hunter@hyfold.ca)  
403.828.8055 cell



- 100% electronic impulsive source
- Electro-fluidic proprietary technology
- Zero moving mechanical parts, small footprint
- High signal, broad band
- Low energy, low GHG solution
- Environmental +/-45C
- Power; on/off-grid; generator or solar panels
- Excellent shot to shot repeatability
- Event timing integrated with GPS
- Integrates with all recording sensor systems
- Facilitating economic high-density acquisition
- Universally adaptable for various applications
  - ✓ Stationary, quasi-permanent monitoring
  - ✓ Mobile surveys (2D, 3D, 4D, check shot, VSP etc.)
- Ideal Measurement, Monitoring and Validation System
  - ✓ Asset management (CCUS, SAGD etc.) and compliance monitoring

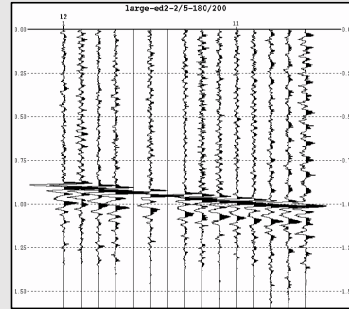




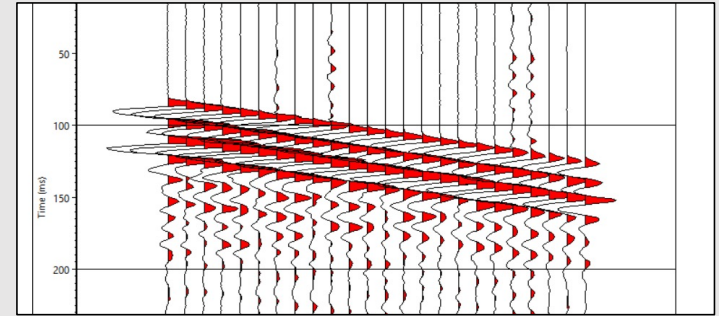


## Permanent Monitoring Examples

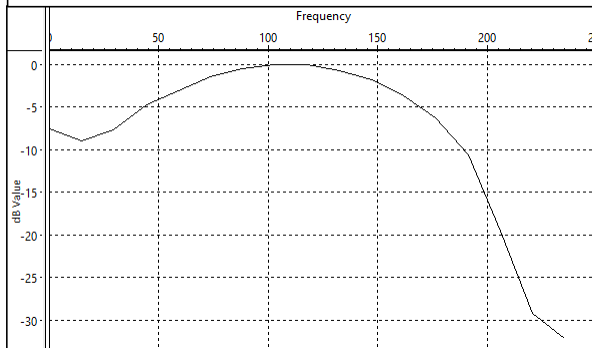
Texas  
(Wellbore array @ 10k')



Alberta  
(CCUS)

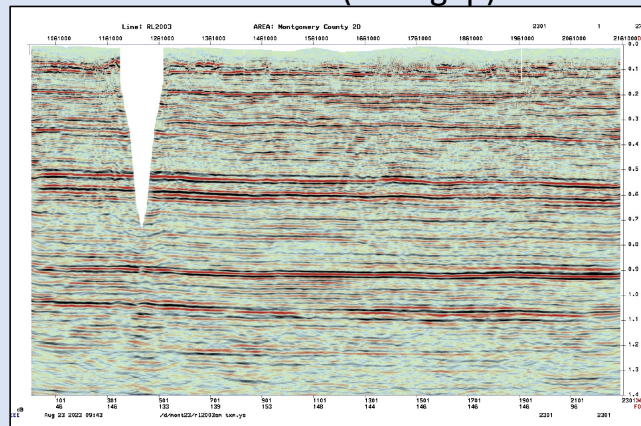


## Spectral Content

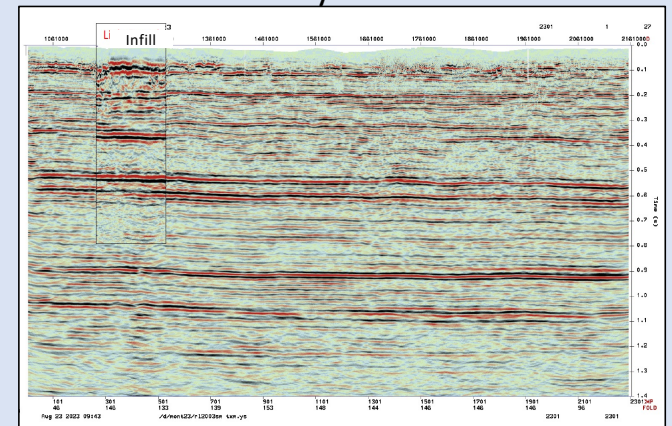


## Mobile Survey Example Illinois 2D providing continuous reflectors

Vibroseis (data gap)



3 miles Hyfold Infilled



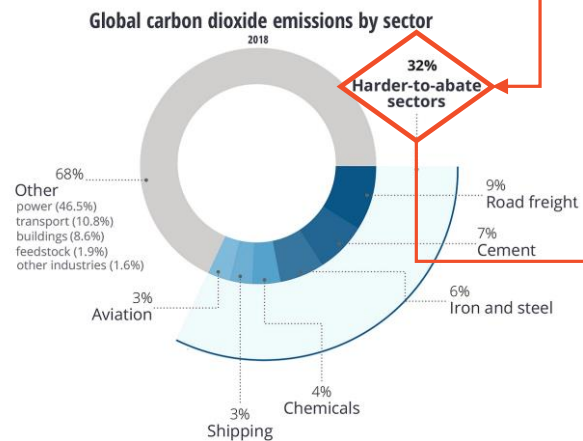
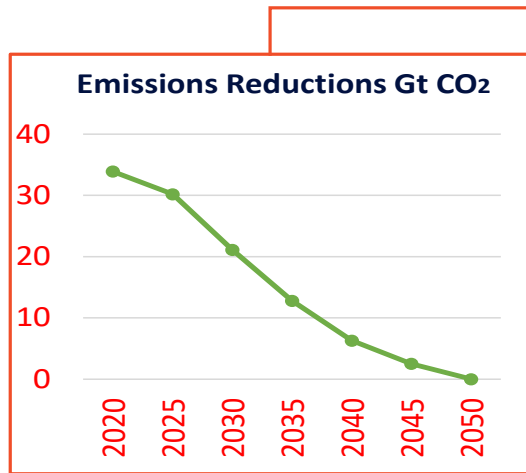


**HYDRON**  
ENERGY

# Fueling Net-Zero Transformation



# The Net-Zero Challenge



- 32% of the global emissions is **Hard-to-abate**.
- Wind, Solar, Hydrostatic, and Electrification falls short.
- Biofuels are the recognized path for this challenge.
- Biofuels must be upgraded for the end consumer.
- Conventional upgrading solutions does not work:
  - High cost.
  - High carbon footprint.

## Solution: A Disruptive Technology

- Significantly lower in cost:
- Low in carbon footprint

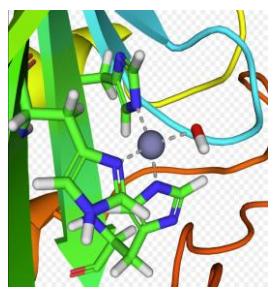
## To be economically viable for:

- Direct Air Capture → e-Methanol
- Biogas Upgrading → RNG
- Syngas Upgrading → Hydrogen

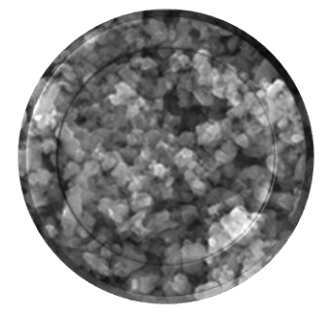
# 1/2 Cost & 3/4 Lower Carbon Footprint



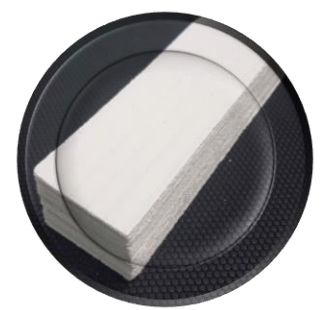
**I. Novel Sorbent**



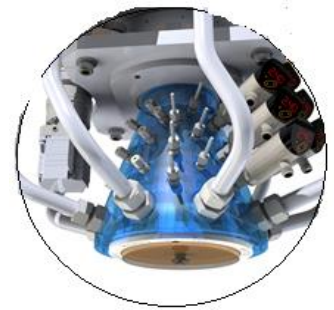
**II. Nano Porous Media**



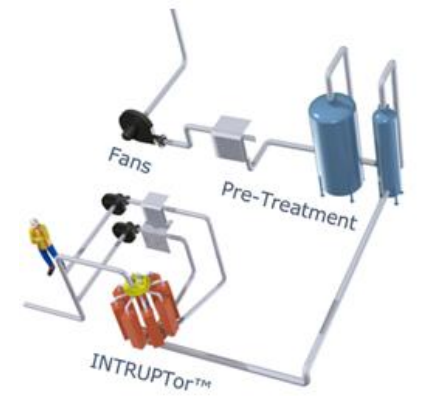
**III. Parallel Passage Contactors**



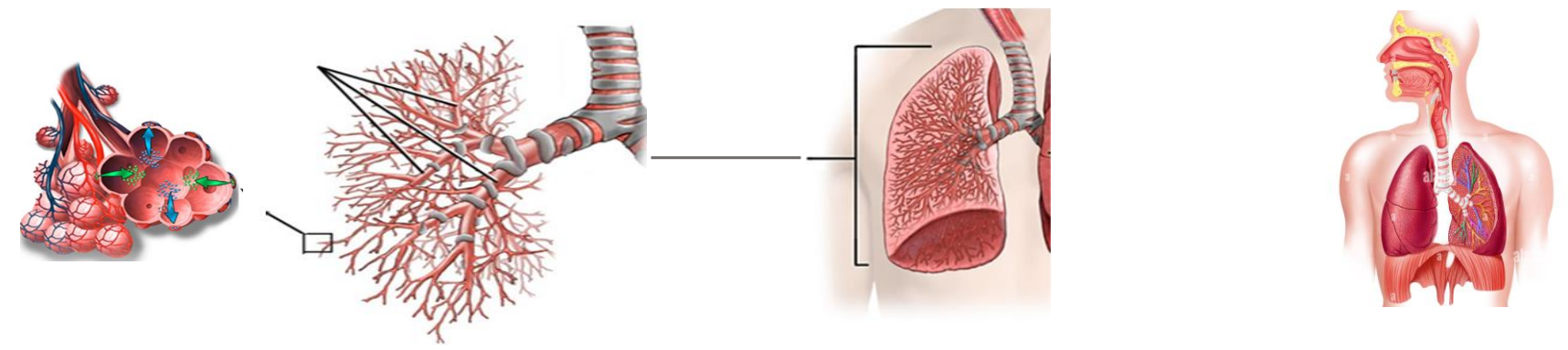
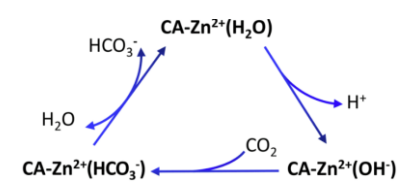
**IV. Dynamic Rotary Valves**



**V. Ambient Operation**



Nature had millions of years to evolve with a playbook of best materials and processes, that we identify, understand, mimic, and utilize them in cleantech industries.



# Platform Technology Value

## 1. Biogas Upgrading: Biogas upgrading @ 50% lower cost.

- Only 0.1% of pipeline capacity is utilizing RNG, goal is to reach 20%.
- Current Market is for \$4 billions annually & our share is \$120 millions/year



✓ Biogas Upgrading

## 2. DAC: 95% pure CO<sub>2</sub> for USD \$275/ton for e-fuel production.

- Market growth: 61% CAGR.



✓ Direct Air Carbon Capture

## 3. Rare Gases: Working with Boeing for rare gas production.

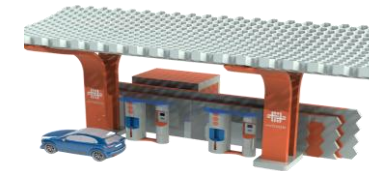
- Strategic market: \$1 billion.
- Enables first DAC plants as a by-product.



✓ Rare Gas Production

## 4. Clean Hydrogen: Hydrogen purification from syngas

- Market will reach to 18.2 billions by 2030 with 15% CAGR.



• Clean Hydrogen

# Progress Update

## Commercialization, RNG

1. Developed and manufactured **Mobile Biogas Upgrader**.
  - 50% Lower Cost
  - 85% Lower Carbon Footprint
2. In **Commercial Agreement** with Canadian Utility, **FORTIS**.
3. A **Project Bid** in hand from a major US Gas Utility.



## Commercialization, DAC

1. Developed & tested **Direct Air Capture** technology.
2. Pilot demo project is in progress, **BC Fast Pilot**.
3. Signed **MOU** with a major e-methanol producer.



## Commercialization, Rare Gas

1. Developed & tested **process** for **Rare Gas** production from air.
2. Signed **LOI** with major **Aerospace** industry.
3. Negotiating supplier agreement for **Satellite Propellant Gas**.



# Hydron Energy

## Founder

Successful entrepreneur:  
Soheil Khiavi

- Svante: 2007 - 2019 ~ \$1B
- **Hydron** in December 2020

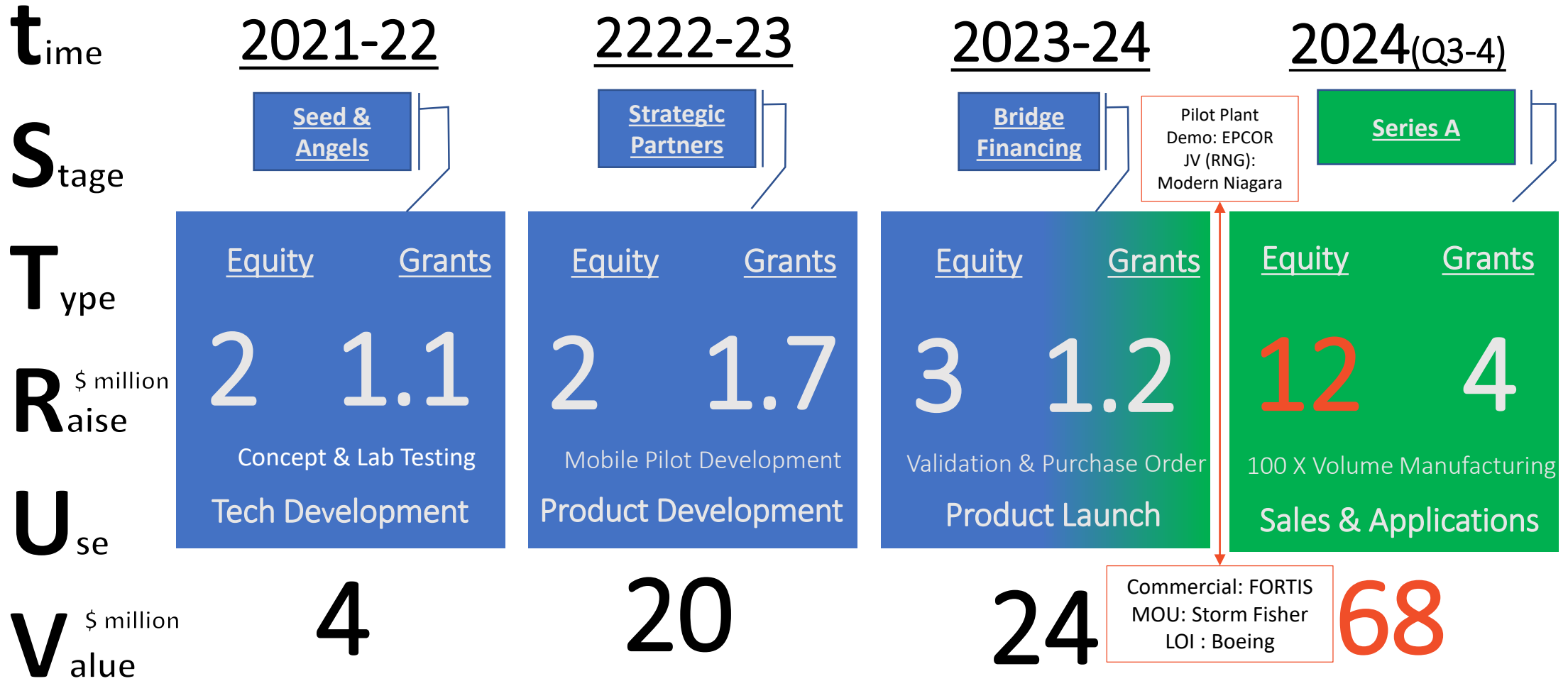
## Hydron Energy

- Commercialization phase
- Early revenue stage
- **20 FTE**, Full time staff
- **21,500 ft<sup>2</sup>** facilities

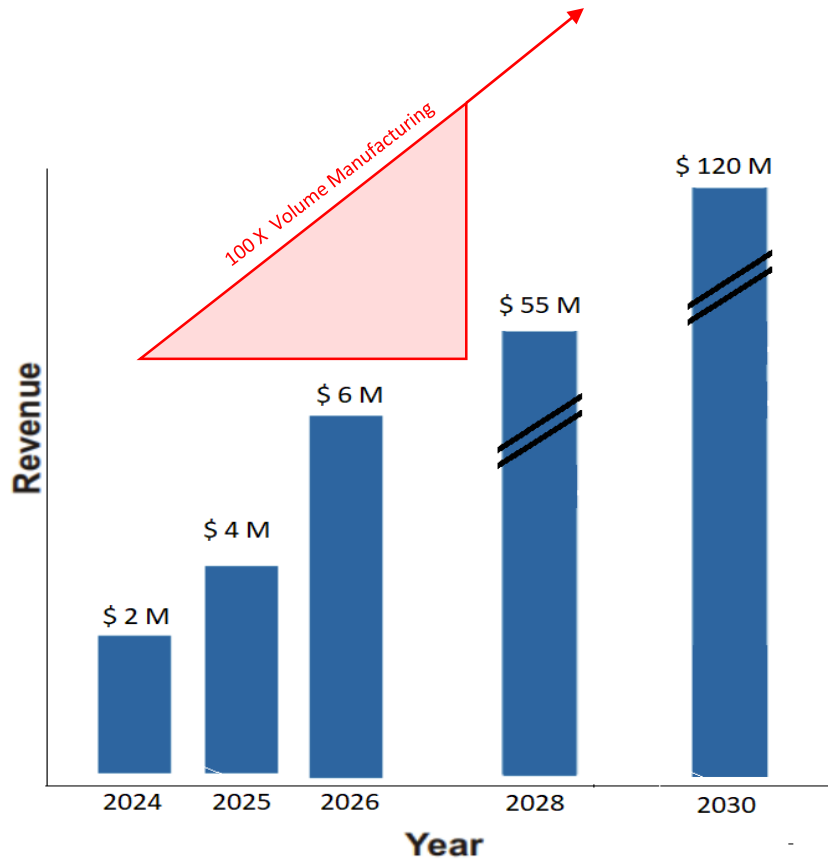
## Financing

1. Raised & received
  - i. over \$6 million in Seed round
  - ii. over \$4 million in grants.
2. Raising remaining **\$1 million** bridge round.
  - i. Extend runway for series A
  - ii. Support commercial project with **Fortis**
3. Opening Series **A** round for **\$12 million**:
  - i. Volume manufacturing.
  - ii. Fulfilling biogas upgrading orders
  - iii. Launch biogas commercial business unit
  - iv. Deploy DAC technology for e-methanol
  - v. Launch rare gas production project

# Corporate Financing



# Use of Funds



RNG Business Commercialization Unit

RNG m3/Hr	No of Plants	Price \$ million	Sales \$ million
120	22	1.5	33
250	9	2.2	20
480	8	3.0	24
750	4	4.0	16
1,200	3	5.0	15
1,800	2	5.5	11
2,800	1	7.0	7.0
<b>Total</b>	<b>51</b>		<b>126</b>

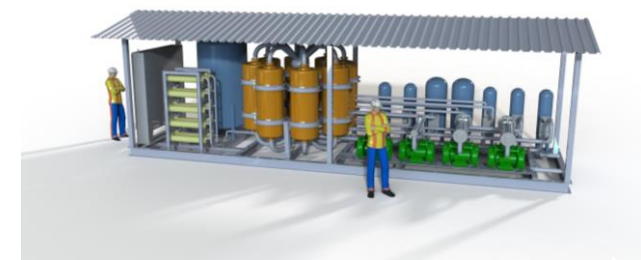
Volume Manufacturing



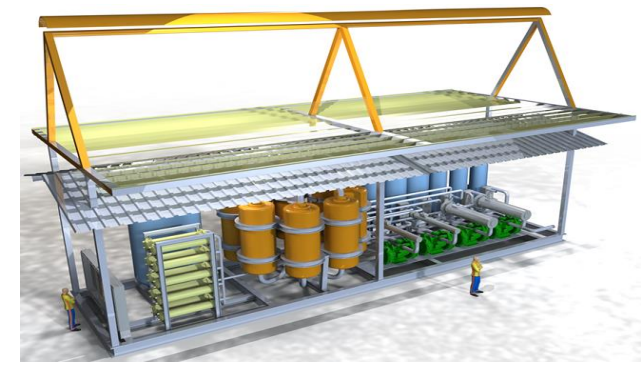
Mobile 50 – 120 [m<sup>3</sup>/hr]



Mini 80 – 220 [m<sup>3</sup>/hr]



Mid: 220 – 1000 [m<sup>3</sup>/hr]



Max: 1000 – 3800 [m<sup>3</sup>/hr]

# Partnerships



MODERN  
NIAGARA





# CONTACT US

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[www.hydron.ca](http://www.hydron.ca)



How did we do today?



October 29, 2024

9:00am MT