



# 13º Fórum do **BIOGÁS**

O ponto de encontro  
internacional de investidores  
em **BIOGÁS** e **BIOMETANO**

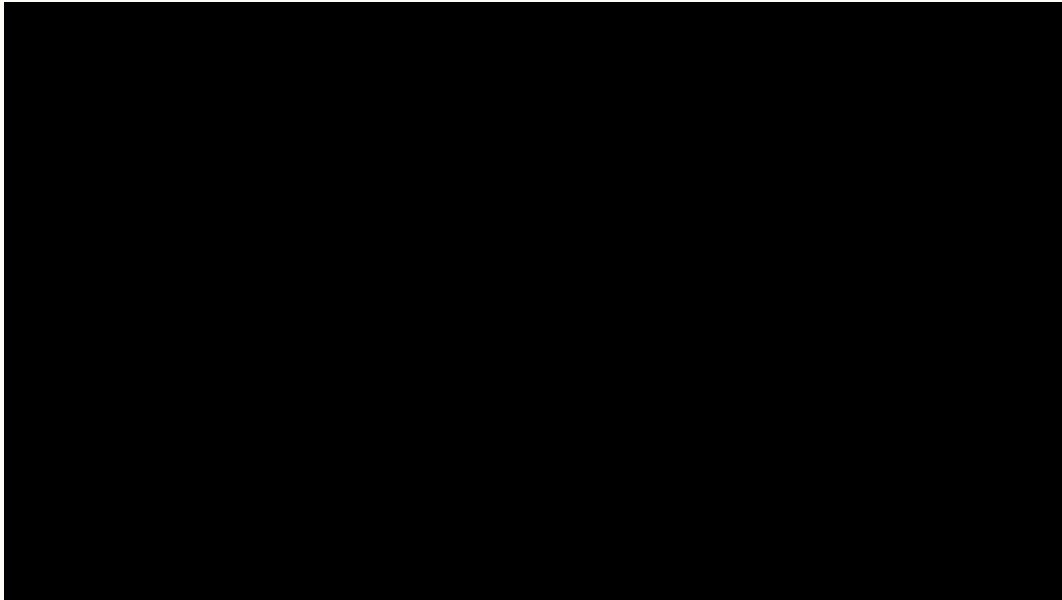


**PSA SYSADVANCE:**  
*Know-how em adsorção e engenharia de  
processo para o scale-up do biometano no Brasil*

Patrick Bárcia  
VP Technology

# Sysadvance in “1 min”

*Company Presentation*



**in 2002 at University of Porto**

**Cleantech for Gas Separation**

**Industry, Healthcare &  
Renewable Gas**

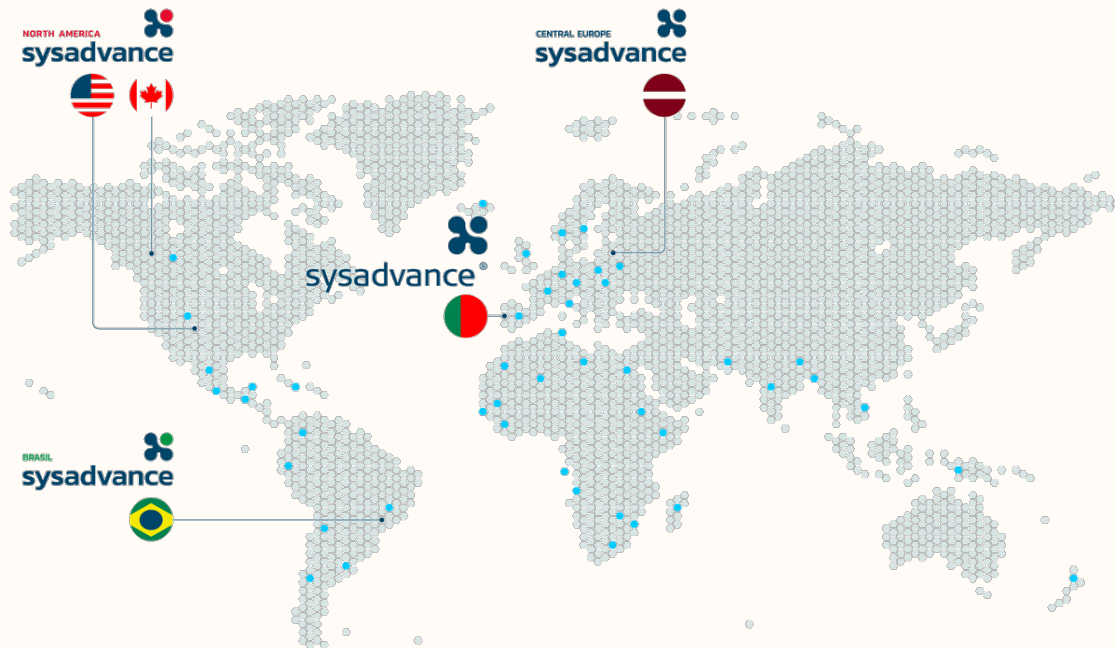
**Comprehensive Adsorption  
Tech Portfolio**





# Sysadvance in “1 min”

## *Global Presence*



**+ 4000 PSA WORLDWIDE**

**+ 60 COUNTRIES**

**+ 14 PROCESSES FOR GASES**  
→ 11 PATENTS

**+150 STAFF MEMBERS**  
→ incl. +9 PhD

**WHERE WE ARE**  
PORTUGAL (HQ)  
NORTH AMERICA  
CENTRAL EUR  
BRAZIL



# Sysadvance in “1 min”

*Served Industries & Sectors*



## INDUSTRIAL



On-site source of  $O_2$  /  $N_2$  and high-value gases purification & reuse of gases like He,  $H_2$  or  $SF_6$ ...



## MEDICAL



Reliable & safe source of  $O_2$  for hospitals



## ENERGY

Enabling the production of renewable gas and valorisation of Biogenic  $CO_2$



# Sysadvance in “1 min”

## *Renewable Gas Plants*



**PRODUCTION CAPACITY  
IN OPERATION Q4/26:**

**+12 COUNTRIES**

**+55 VPSA BIOMETHANE TRAINS**

**4 H<sub>2</sub> PURIFICATION PLANTS**

**ANNUAL PRODUCTION:**

**~260 000 000 m<sup>3</sup>**

**~ 2.6 TWh**

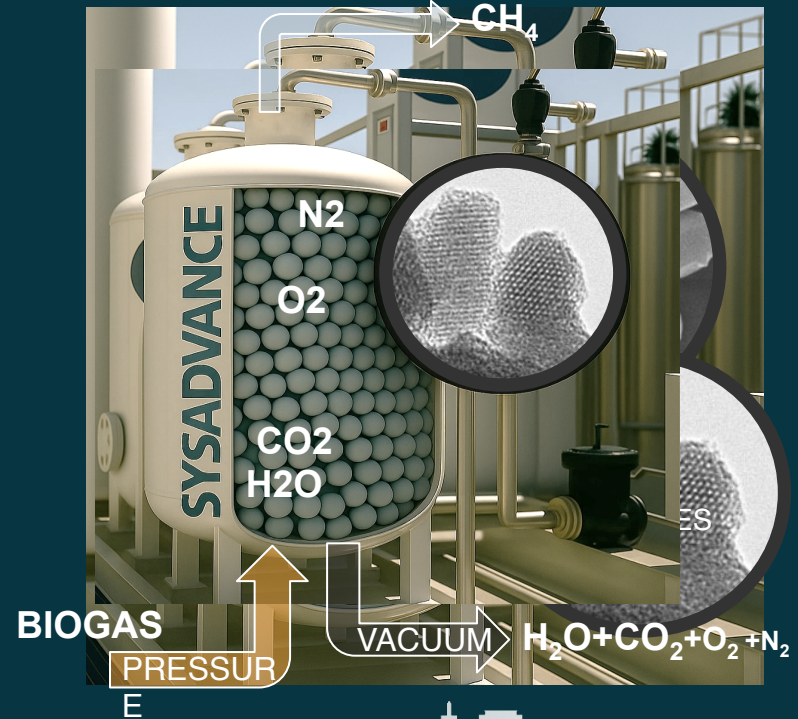


# Cyclic Adsorption Process

How does it work?

## The Skarstrom PSA Cycle:

- **Adsorption:** Feed gas enters; target gas passes while impurities are adsorbed
- **Depressurization:** Pressure is lowered to release adsorbed impurities
- **Purge/Vacuum:** Small flow of product gas/vacuum cleans residual impurities
- **Repressurization:** Bed is brought back to operating pressure for next cycle

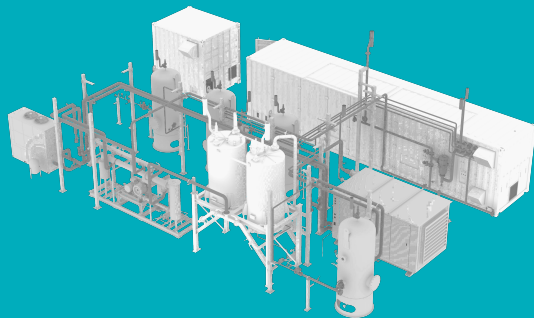




# Anaerobic Digestion vs. Landfill Gas

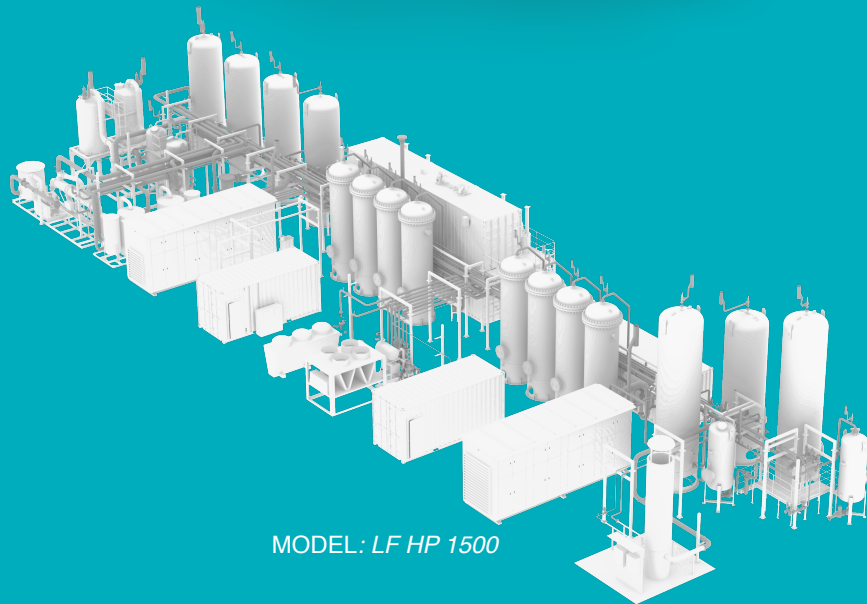
2 Technologies for Distinct Applications

**METHAGEN** **AD**  
*Anaerobic Digestion*



MODEL: AD 500

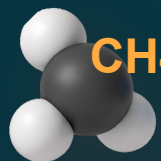
**HIGH PERFORMANCE**  
**METHAGEN** **LF**  
*Landfill Gas Upgrading*



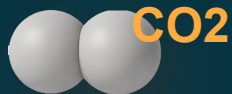
MODEL: LF HP 1500

# METHAGEN<sup>AD</sup>

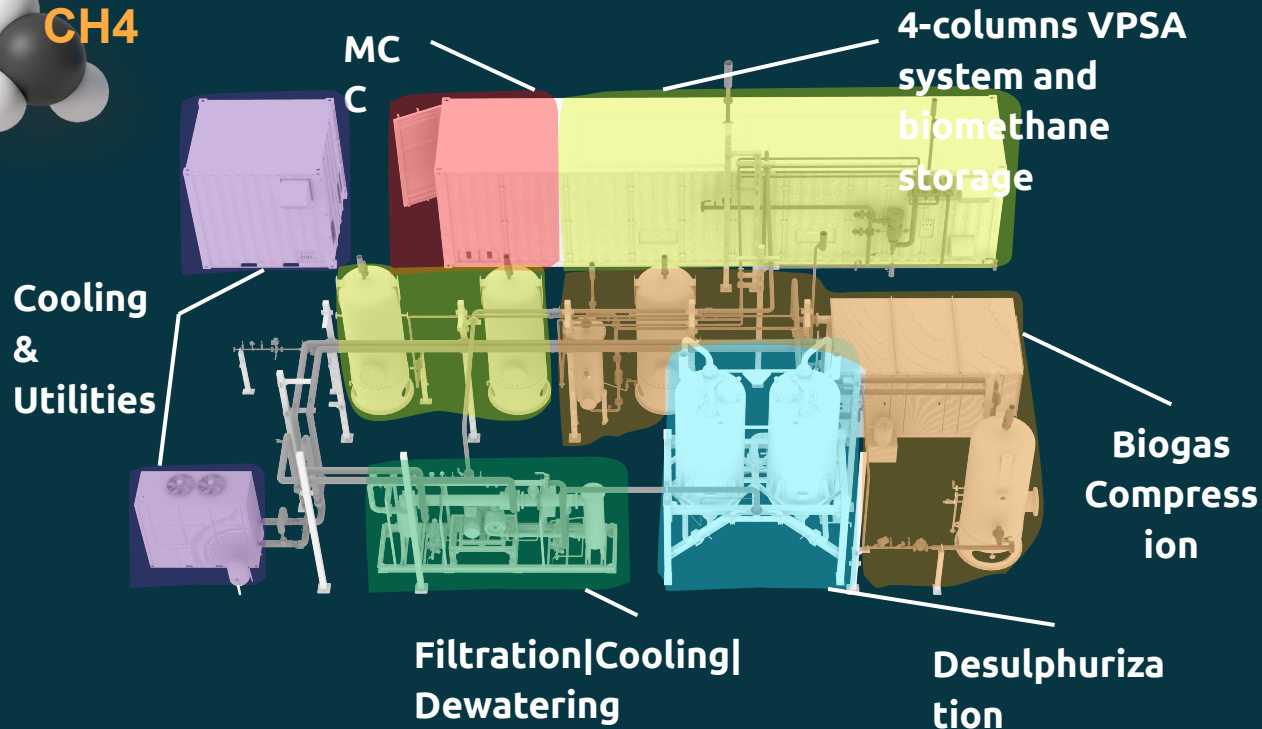
Anaerobic Digestion



CH<sub>4</sub>



CO<sub>2</sub>



M1000 AD (Skrudaliena, Lithuania)



**BIOGAS**

360 Nm<sup>3</sup>/h

**FEEDSTOCK**

10.000 tons/yr (potato peels)

**BIOMETHANE**

1,2 MCM/yr (self consumption)

**GHG EMISSIONS**

1200 tons<sub>avoided</sub>/yr





**BIOGAS**   
750 Nm<sup>3</sup>/h

**FEEDSTOCK**  
Cow Manure

**BIOMETHANE**  
3 MCM/yr (Grid Injection)





## **BIOGAS**

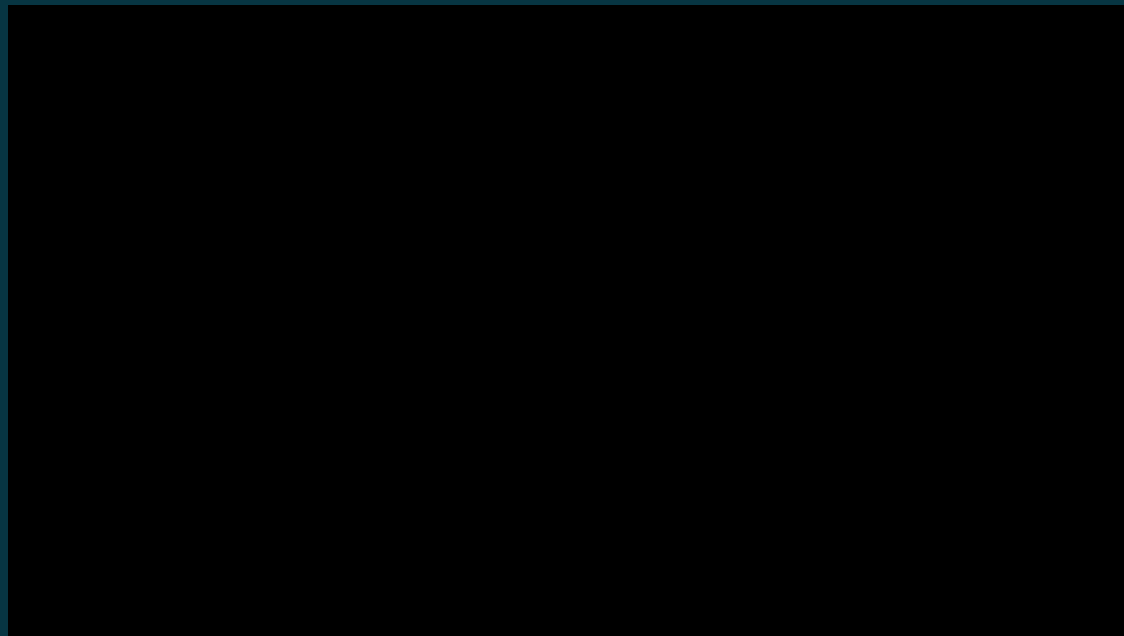
3000 Nm<sup>3</sup>/h

## **FEEDSTOCK**

Chicken Manure

## **BIOMETHANE**

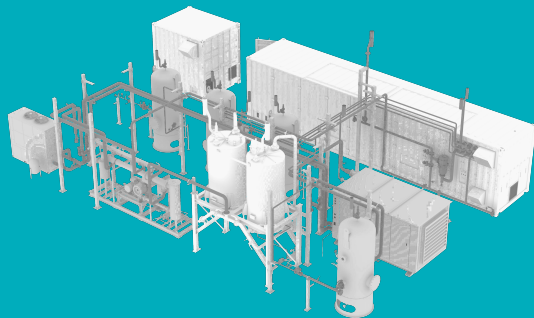
12 MCM/yr (MP Grid Injection)



# Anaerobic Digestion vs. Landfill Gas

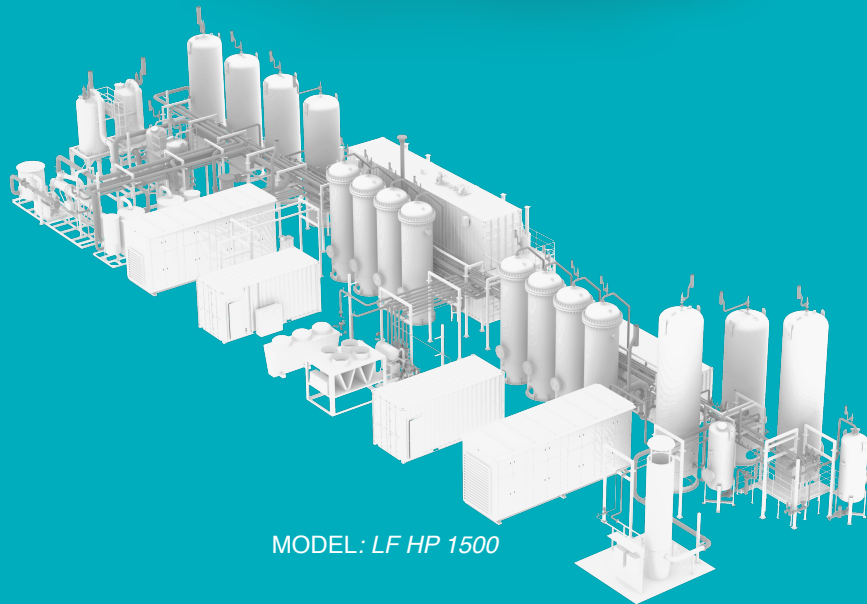
2 Technologies for Distinct Applications

**METHAGEN** **AD**  
*Anaerobic Digestion*



MODEL: AD 500

**HIGH PERFORMANCE**  
**METHAGEN** **LF**  
*Landfill Gas Upgrading*

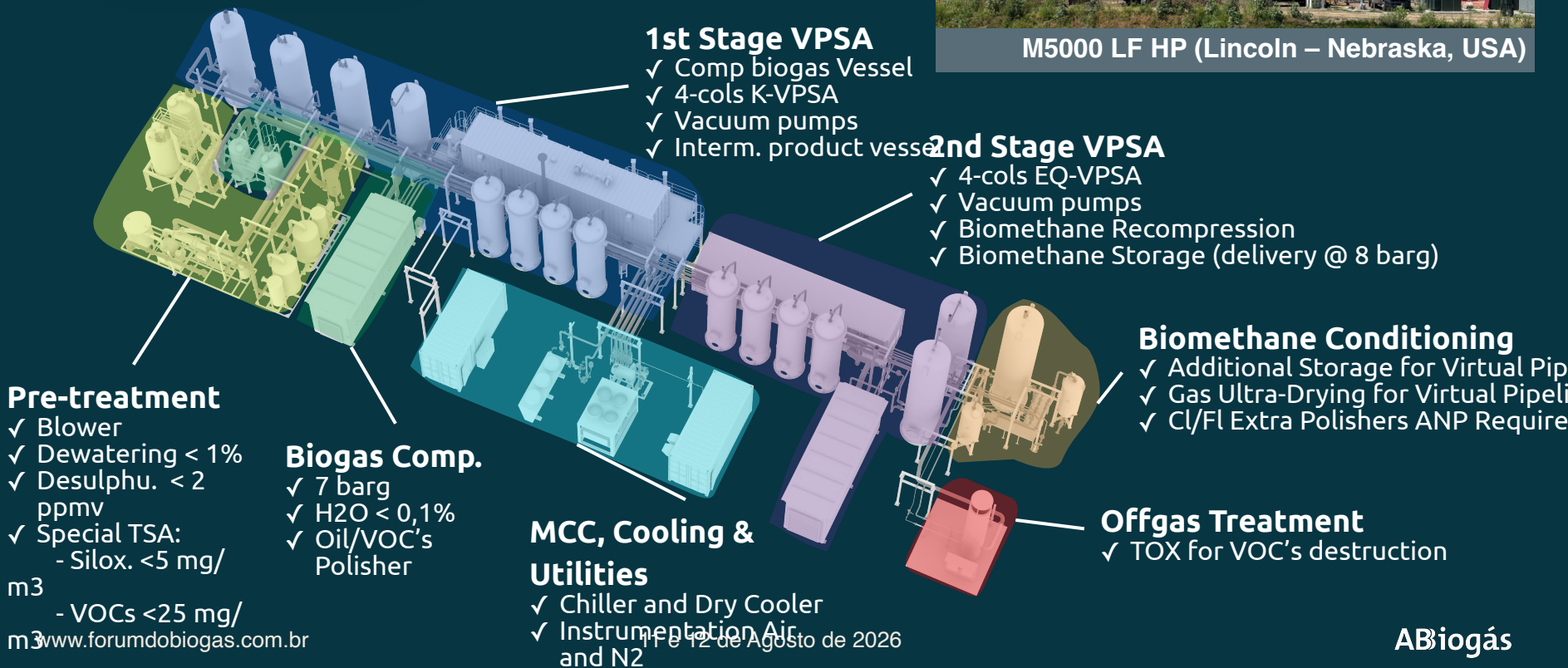


MODEL: LF HP 1500

**HIGH PERFORMANCE**  
**METHAGEN<sup>LF</sup>**  
 Landfill Gas Upgrading



**M5000 LF HP (Lincoln – Nebraska, USA)**



# Patented Technology

## METHAGEN<sup>LF</sup>

Landfill Gas Upgrading

- ✓ Dual-stage VPSA for landfill gas purification
- ✓ Patent filed in Brazil in 2019
- ✓ Grant awarded by MDIC/INPI in 2025

  
US 20210229027A1

(19) **United States**  
(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0229027 A1**  
**DA SILVA BARCIA et al.** (43) **Pub. Date: Jul. 29, 2021**

(54) **MULTI-STAGE PSA PROCESS TO REMOVE CONTAMINANT GASES FROM RAW METHANE STREAMS** (52) **U.S. CL. CPC** ..... **B01D 53/0476** (2013.01); **B01D 2259/40075** (2013.01); **C07C 7/43** (2013.01); **B01D 53/002** (2013.01); **B01D 2253/306** (2013.01); **B01D 2257/104** (2013.01); **B01D 2258/05** (2013.01); **B01D 2259/4062** (2013.01); **B01D 2259/41** (2013.01); **B01D 2257/504** (2013.01); **B01D 2259/40079** (2013.01); **B01D 2256/245** (2013.01); **B01D 2257/304** (2013.01); **B01D 2257/80** (2013.01); **B01D 2258/102** (2013.01); **B01D 2259/414** (2013.01); **B01D 2253/308** (2013.01); **B01D 2253/116** (2013.01); **B01D 2259/40081** (2013.01); **B01D 2257/102** (2013.01); **B01D 51/10** (2013.01)

(71) Applicant: **SYSADVANCE - SISTEMAS DE ENGENHARIA S.A.,** Póvoa de Varzim (PT)

(72) Inventors: **Patrick DA SILVA BARCIA,** Vila Do Conde (PT); **Daniel Antonio SANTOS SILVA FERREIRA,** Porto (PT); **Silvio Daniel DA SILVA CARVALHO MONTEIRO,** Gondomar (PT)

(21) Appl. No.: **15/734,803**  
(22) PCT Filed: **Jun. 14, 2019**  
(86) PCT No.: **PCT/IB2019/054996**  
§ 371 (c)(1),  
(2) Date: **Dec. 3, 2020**  
(30) **Foreign Application Priority Data**

(57) **ABSTRACT**  
A multi-stage process to remove contaminant gases from raw methane streams is provided. The present technology is an innovative solution to recover and purify biogas by use of a process having at least two pressure swing adsorption stages. Taking advantage of the presence of carbon dioxide

  
**REPÚBLICA FEDERATIVA DO BRASIL**  
**MINISTÉRIO DO DESENVOLVIMENTO, INDÚSTRIA, COMÉRCIO E SERVIÇOS**  
**INSTITUTO NACIONAL DA PROPRIEDADE INDUSTRIAL**



CARTA PATENTE Nº BR 112020025549-1

O INSTITUTO NACIONAL DA PROPRIEDADE INDUSTRIAL concede a presente PATENTE DE INVENÇÃO, que outorga ao seu titular a propriedade da invenção caracterizada neste título, em todo o território nacional, garantindo os direitos dela decorrentes, previstos na legislação em vigor.

(21) **Número do Depósito:** BR 112020025549-1  
(22) **Data do Depósito:** 14/06/2019  
(43) **Data da Publicação Nacional:** 16/03/2021  
(51) **Classificação Internacional:** B01D 53/047; B01D 51/00; B01D 53/00; B01D 46/00.  
(30) **Prioridade Unionista:** PT 110787 de 14/06/2018.  
(54) **Título:** PROCESSO DE ADSORÇÃO POR OSCILAÇÃO DE PRESSÃO DE MÚLTIPLOS ESTÁGIOS PARA REMOVER GASES CONTAMINANTES DE FLUXOS DE METANO EM BRUTO  
(73) **Titular:** SYSADVANCE - SISTEMAS DE ENGENHARIA S.A., Pessoa Jurídica. Endereço: RUA COMENDADOR BRANDÃO, 461 - BEIRIZ 4495-375 POVOA DE VARZIM, PORTUGAL(PT), Portuguesa  
(72) **Inventor:** PATRICK DA SILVA BÁRCIA; DANIEL ANTÔNIO SANTOS SILVA FERREIRA; SÍLVIO DANIEL DA SILVA CARVALHO MONTEIRO.  
(87) **Publicação PCT:** WO 2019/239381 de 19/12/2019  
**Prazo de Validade:** 20 (vinte) anos contados a partir de 14/06/2019, observadas as condições legais  
**Expedida em:** 21/10/2025

Assinado digitalmente por:  
**Alexandre Dantas Rodrigues**  
Diretor de Patentes, Programas de Computador e Topografias de Circuitos Integrados





# 1<sup>st</sup> PROJECTS | FRANCE & SPAIN

Producing RNG from LFG Since 2018...

## PROCESSING CAP

500 Nm<sup>3</sup>/h

## RAW GAS

LANDFILL GAS (up to 14% N<sub>2</sub>)

## BIOMETHANE

France: LP Grid Injection

Spain: BioGNV (250 barg)



# ORIZON+ASJA | SABARÁ - MG

Some References

## PROCESSING CAP

7500 Nm<sup>3</sup>/h

3 process trains

## RAW GAS

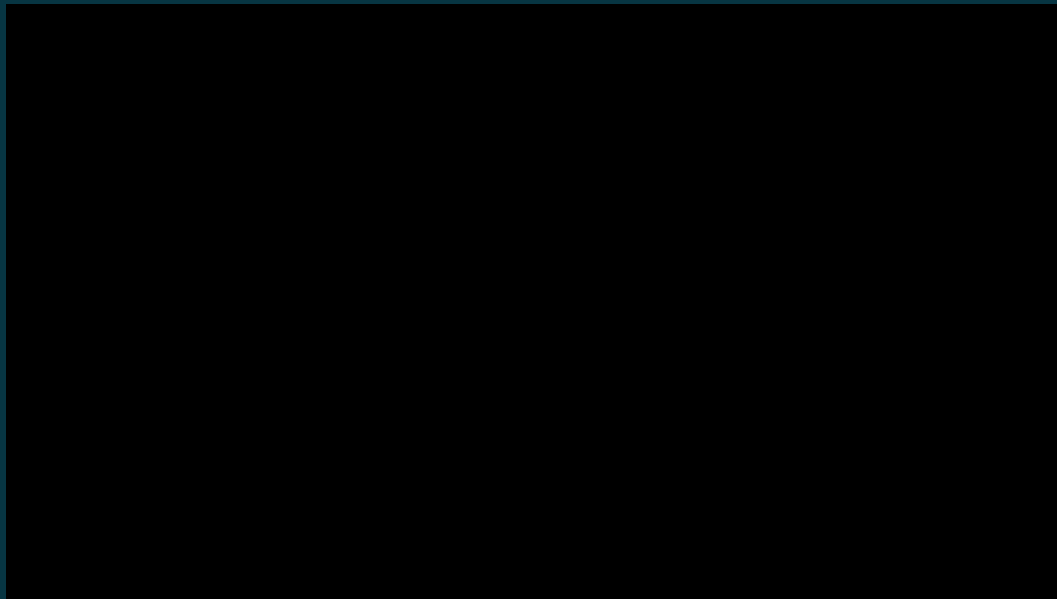
LANDFILL GAS (12% N<sub>2</sub>)

## BIOMETHANE

28 MCM/yr (Virtual Pipeline)

## STATUS

Commissioning Q3 2026



# VIRIDI I NEBRASKA USA

Some References

## PROCESSING CAP

5000 Nm<sup>3</sup>/h  
1 single process train

## RAW GAS

LANDFILL GAS (12% N<sub>2</sub>)

## BIOMETHANE

18 MCM/yr (Grid Injection)

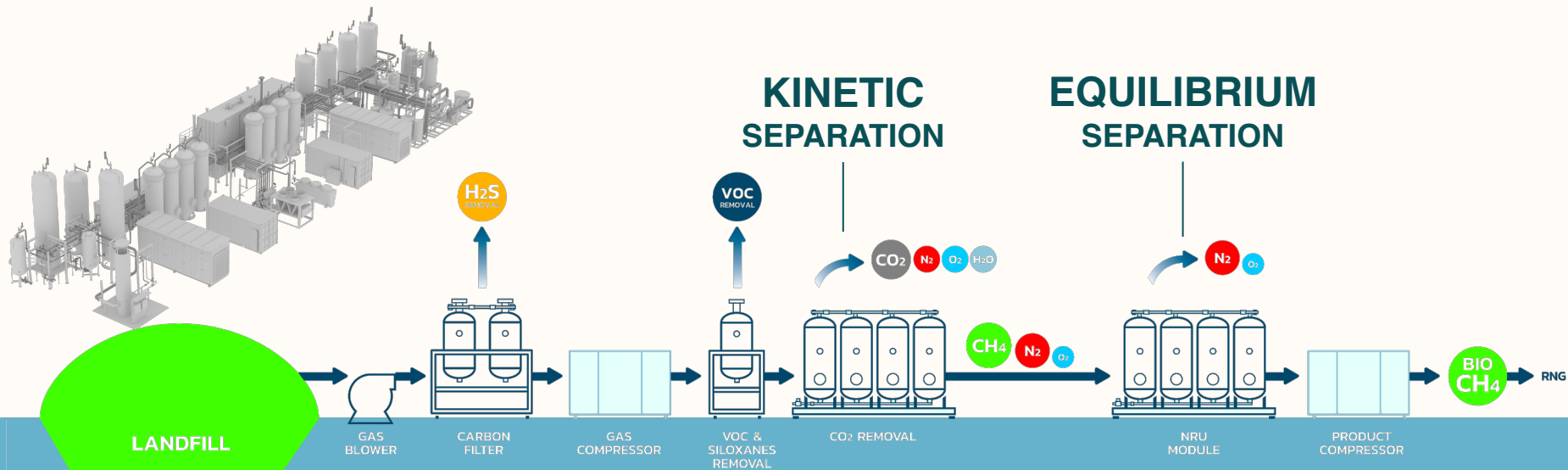
## STATUS

Under Construction



# SEPARATION & ENERGY EFFICIENCY

Engineering High-Performance Landfill Gas Separation

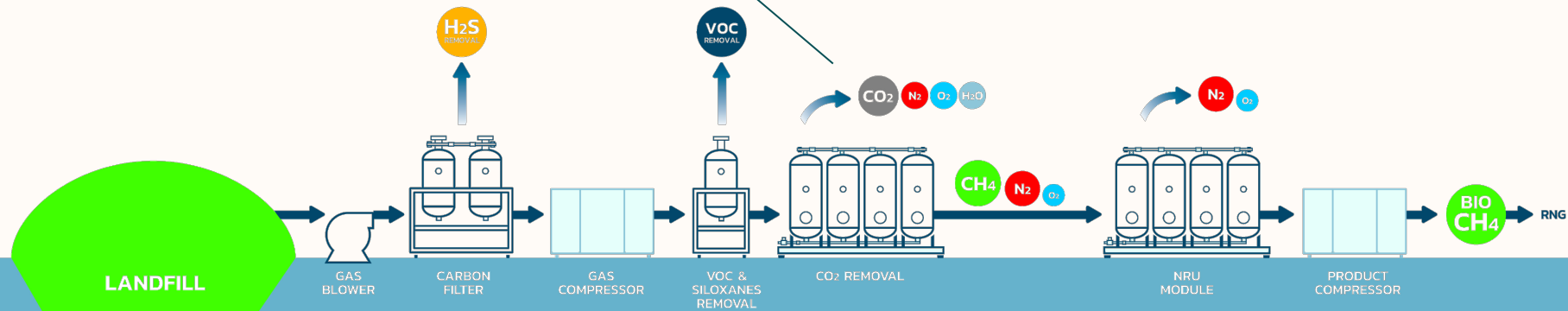
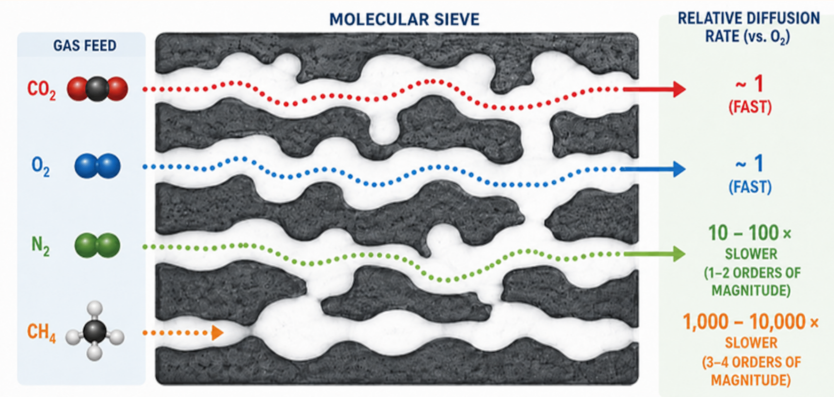




# SEPARATION & ENERGY EFFICIENCY

Optimizing  $\text{CH}_4/\text{CO}_2$  and  $\text{CH}_4/\text{O}_2$  Selectivity

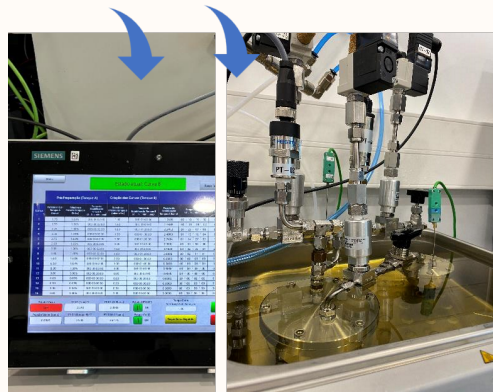
## KINETIC SEPARATION



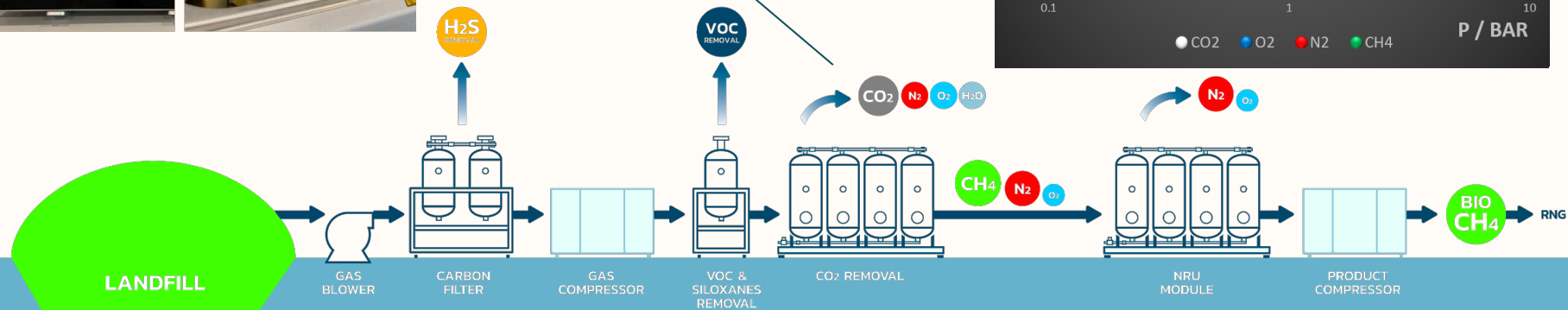
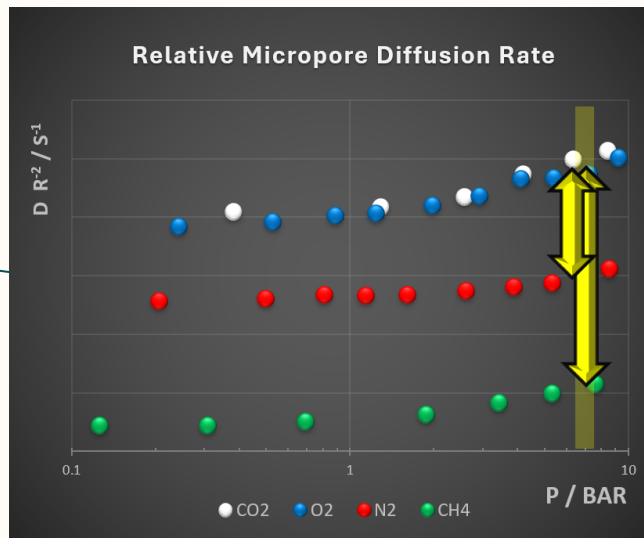
# SEPARATION & ENERGY EFFICIENCY

Optimizing  $\text{CH}_4/\text{CO}_2$  and  $\text{CH}_4/\text{O}_2$  Selectivity

FULLY AUTOMATED VOLUMETRIC  
UPTAKE MEASUREMENTS SETUP



## KINETIC SEPARATION

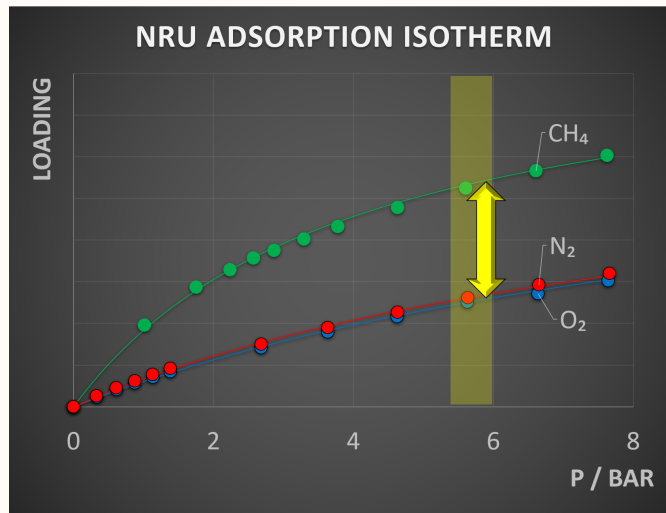


# ENGINEERING FOR EFFICIENCY

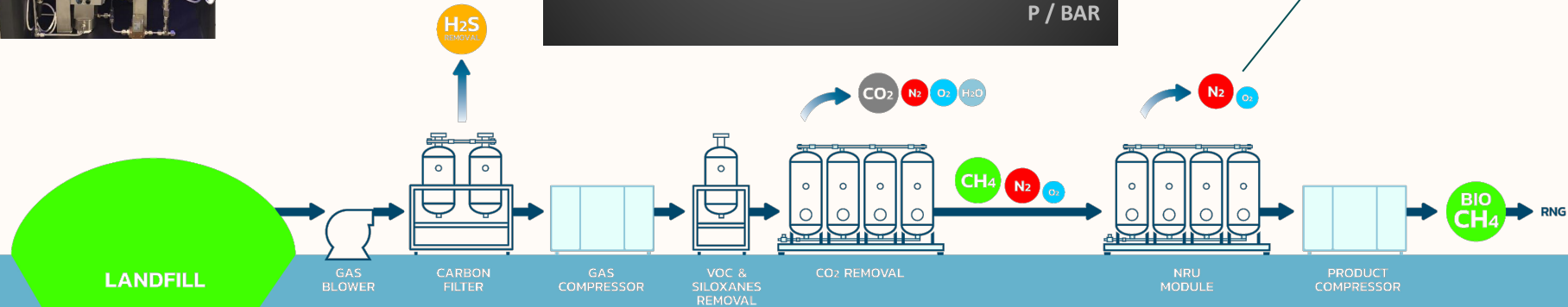
## Process Design for Superior N<sub>2</sub> Rejection



MULTICOMPONENT  
BREAKTHROUGH SETUP

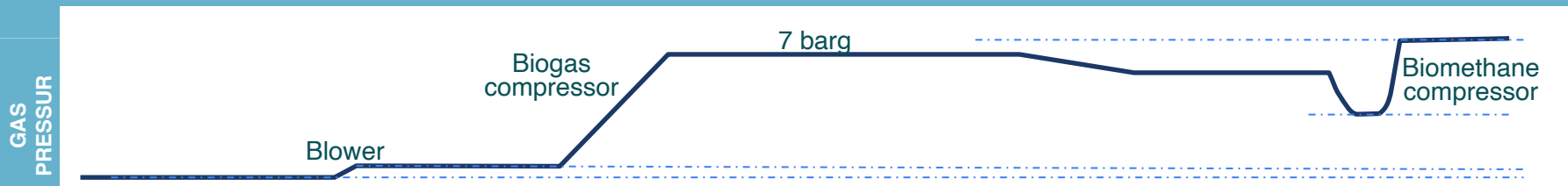
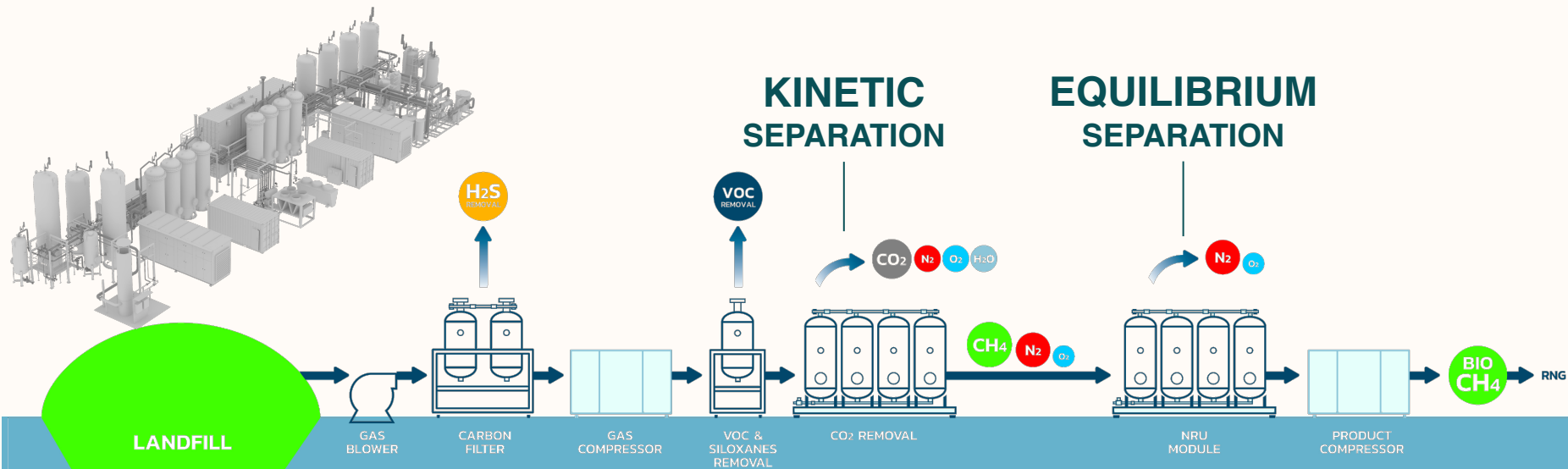


**EQUILIBRIUM  
SEPARATION**

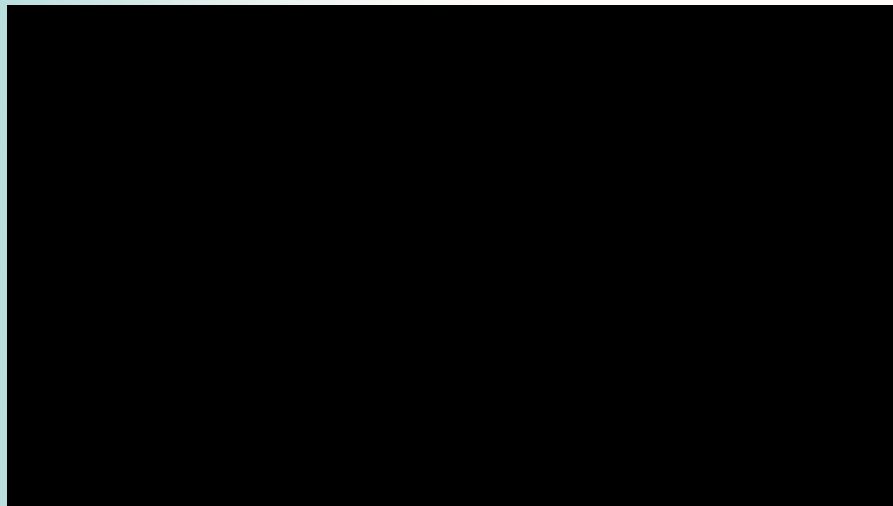


# SEPARATION & ENERGY EFFICIENCY

Process Design for Lower Energy Demand



Juntos, acelerando o futuro  
do biometano no Brasil!





# Considerações Finais



[www.sysadvance.com](http://www.sysadvance.com)

**Visitem-nos no Stand S25** e conheçam nossa equipe local

**Marco, Travis, William** e nossos engenheiros e técnicos

**Aproveitem** também para participar do nosso **Happy Hour**,  
com **banda ao vivo**, que começará em breve!

**Muito obrigado pela atenção!**

