Mr. Ashish Kumar

CBGPF
COMPRESSED BIOGAS PRODUCER FORUM
IFGE
INDIAN FEDERATION OF GREEN ENERGY

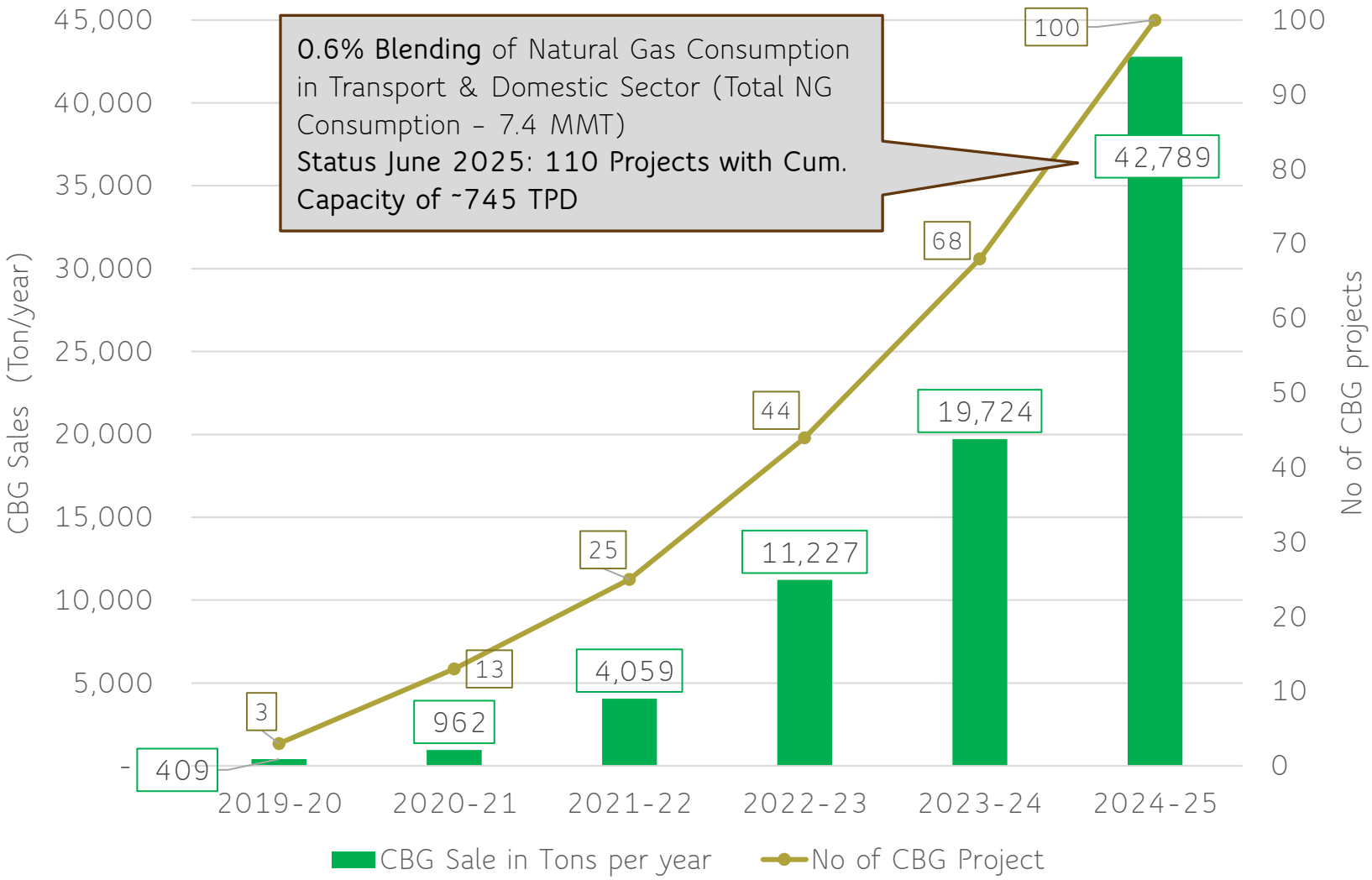
Evolving Biomethane (CBG) Policy Framework in India: Status-quo and Key Action Demand Areas

25 JUNE 2025

Overview of CBG Policies in India – Status-quo

Feedstock Type	UPSTREAM	MIDSTREAM	DOWNSTREAM
Agri-Residue	**Biomass Aggregation Machinery (MoPNG) -** 50% Subsidy on collection machinery up to ₹ 90 Mio / $ 1.1 Mio per project **Crop Residue Management (MoA&FW) -** 65% Subsidy on machinery cost up to ₹ 10 Mio / $ 0.12 Mio per farmer; no limit on number of farmers per project	**Capital Subsidy** (MNRE) – **Maximum of** ₹ 100 Mio / $ 1.2 Mio per project under Waste to Energy Program **Capital Subsidy (State)-** Several States are promoting by granting capital subsidy in range of ₹ 50-200 Mio / $ 0.6-2.4 Mio per project **Priority Sector Lending (RBI)**	**CBG Offtake via Grid Injection-** Development of Pipeline Infra Scheme with max. subsidy of ₹ 287 Mio / $ 3.3 Mio per project **CBG Pricing-** Uniform CBG procurement price under **SATAT** & **CBG CGD Synch scheme** on Energy basis ₹ 1,478 / $ 17.2 per MMBtu excl. compression (MoPNG) **CBG Blending Obligation-** Blending Mandate of CBG into Gas Sector starting at 1% from FY25-26 upto 5% in FY 28-29 (MoPNG) **FOM-** Market Development Assistance for Disbursal of Fermented Organic Manure at ₹ 1500 / $ 17.5 per Ton (MoC&F)
MSW	**Waste Segregation-** State level bodies (MC/ULBs) to provide 90-93% segregated waste **Processing fee (selected Municipalities) / Reverse bidding or Royalties (high demand centers)**		
Press Mud & Animal Waste	**Raw Material Supply Chain** linked with waste producer (Sugar Mills/ Animal Shelters). **Waste Procurement Agreement** between Waste producer & CBG Project owner		

CBG Projects & Volume Development 2019-24



Overview of Key Action Demand Areas

Feedstock Type	UPSTREAM	MIDSTREAM	DOWNSTREAM
Agri-Residue	**Biomass Aggregation Machinery (MoPNG) -** - Subsidy Allocation to be linked with project capacity - Inclusion of **aggregators as beneficiaries** **Guidelines for Biomass Storage - Protocol and Standards to be formalized** - Biomass Storage depots & quality retention parameters - Operation and management protocols - **Financial assistance on biomass storage infrastructure**	**Capital Subsidy** (MNRE) - Increase in capacity build-up support for Large CBG projects up to 25-30 TPD - Milestone based subsidy disbursal	**CBG Green Attribute-** - Administrative Mechanism to fulfill the shortfall in blending obligation by introducing the tradable commodity i.e. Renewable Gas Certificate (RGC) - Mechanism for tradability & monetization of RGC to be implemented - Implementation of blending obligation on priority with provisions of open access and penalty mechanism **Grid Injection** - Implementation of DPI - Guidelines for CBG injection in Transmission & Distribution Network to be finalized which are under development **FOM** - Market Development Assistance (MDA) for Disbursal of Fermented Organic Manure for lifetime of project. - Production linked disbursal of MDA. - Review increase in MDA till mechanism of monetization of green attribute is in place (MoC&F)
MSW	**Waste Segregation-** Assured raw material supply round the year with committed segregation level **Processing fee to be standardized across Municipalities**		
Press Mud & Animal Waste	Mechanism/Guidelines protecting the raw material prices		

Thanks for your time!!

MEMBERS

CBG PRODUCERS FORUM

Dr. Bernhard Drosg

IEA Bioenergy
Technology Collaboration Programme



IEA Bioenergy
Technology Collaboration Programme
Task 37 - Energy from Biogas

Bernhard Drosg

Task Leader

Lessons for policymakers from last work programme 2022-2024

The IEA Bioenergy Technology Collaboration Programme (TCP) is organised under the auspices of the International Energy Agency (IEA) but is functionally and legally autonomous.
Views, findings and publications of the IEA Bioenergy TCP do not necessarily represent the views or policies of the IEA Secretariat or its individual member countries.

IEA Bioenergy TCP

Mission:

To increase knowledge and understanding of bioenergy systems in order to facilitate the deployment of:

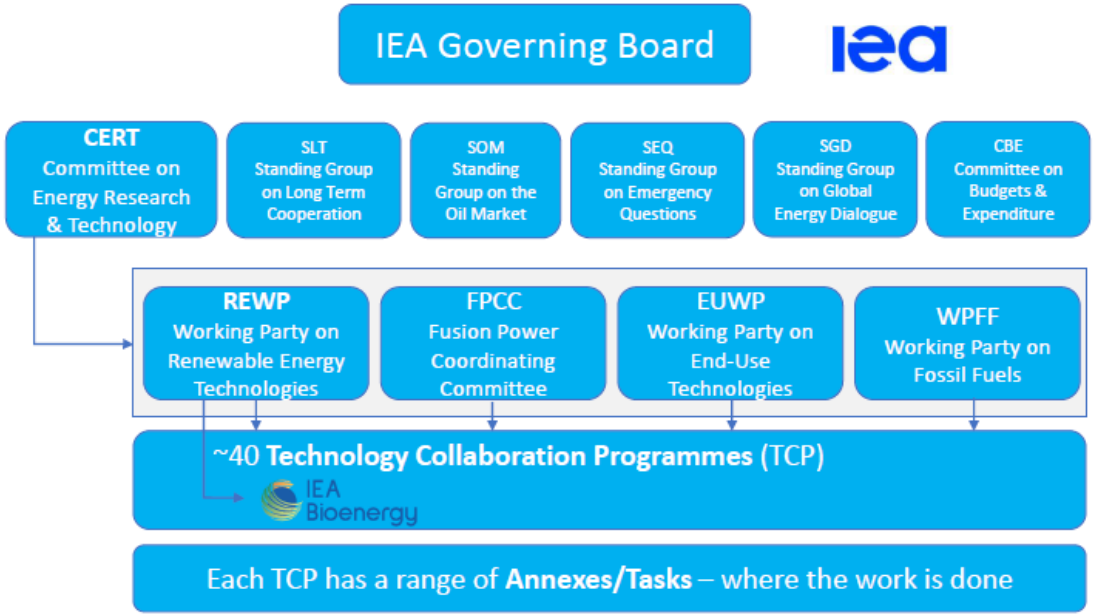
- **environmentally sound**
- **socially acceptable and**
- **cost-competitive bioenergy systems**

Key Role:

Independent collaborative body focused on delivering clear and verified information on bioenergy

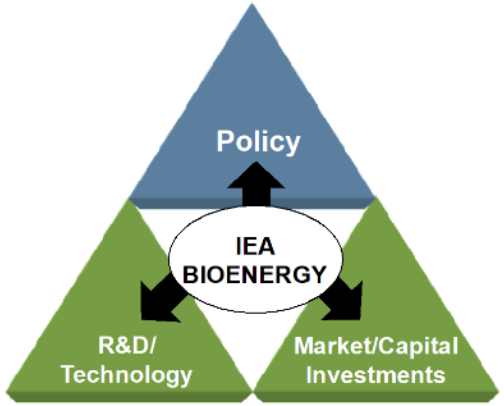
IEA Bioenergy TCP

Technology Collaboration Programme (TCP) functioning within a framework created by the **International Energy Agency** (IEA)

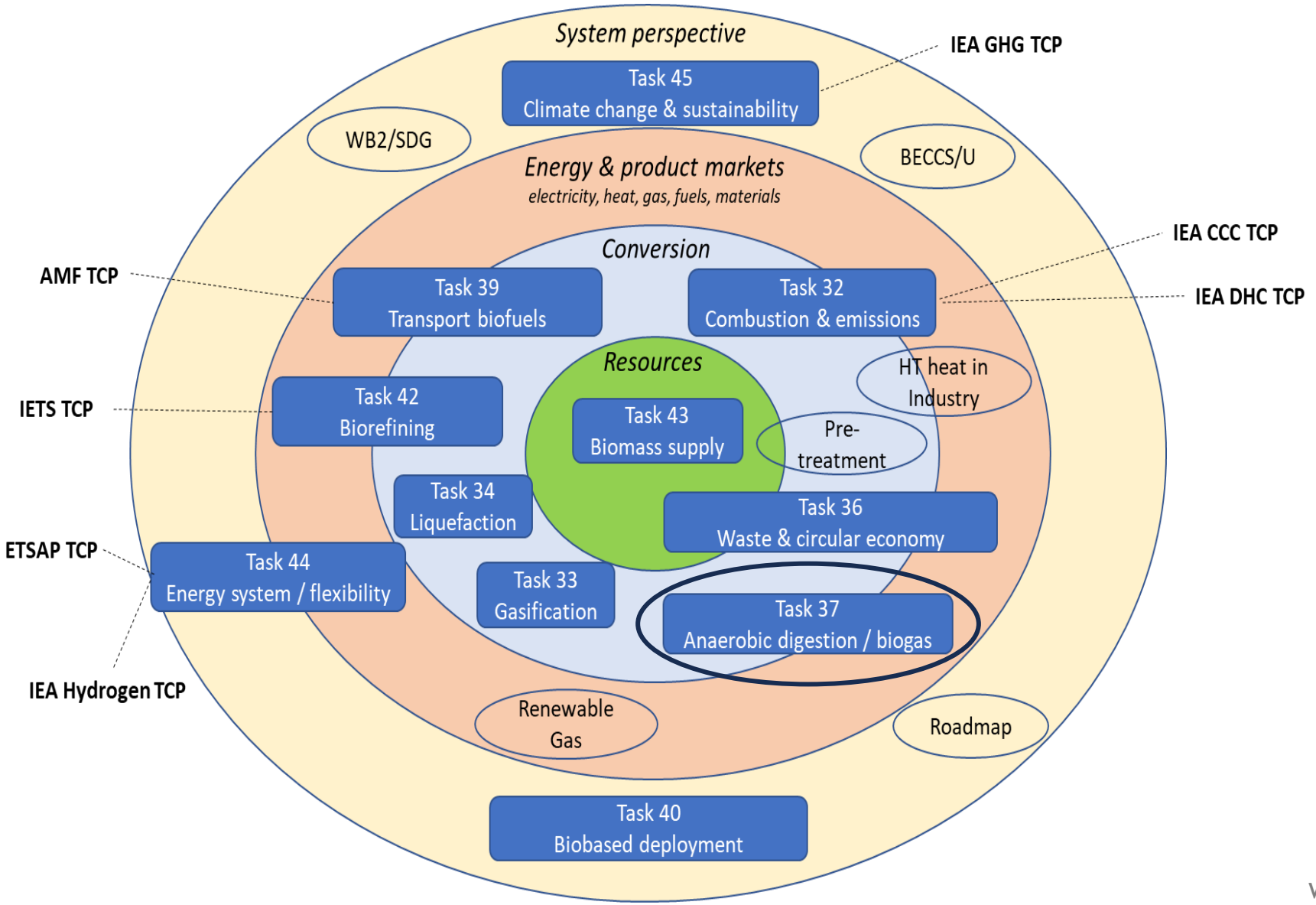


Work programme carried out through **Tasks** and **Special Projects**, covering the full value chain from feedstock to final energy product

26 members: *15 European countries + EC, US, CND, BR, China, India, Japan, Korea, AUS, NZ, SAfr*



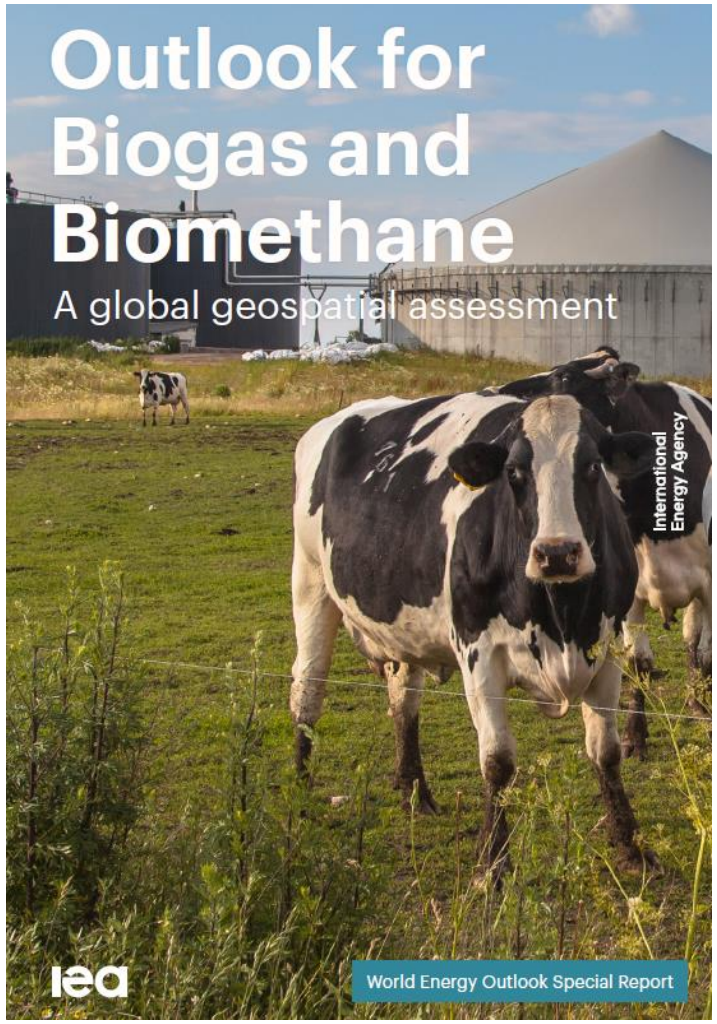
Activities/Tasks in IEA Bioenergy TCP



Task 37 Energy from Biogas -
17 Participating Countries in Triennium 2025-2027

- Austria
- Australia
- Brasil
- Canada
- Denmark
- European Commission
- Finland
- France
- Germany
- India
- Ireland
- Italy
- Netherlands
- Norway
- Sweden
- Switzerland
- UK

Messages in IEA headquarter biogas outlook report



"A relatively small share of the untapped potential for biogases is cost-competitive, but more can be unlocked if co-benefits are valued."

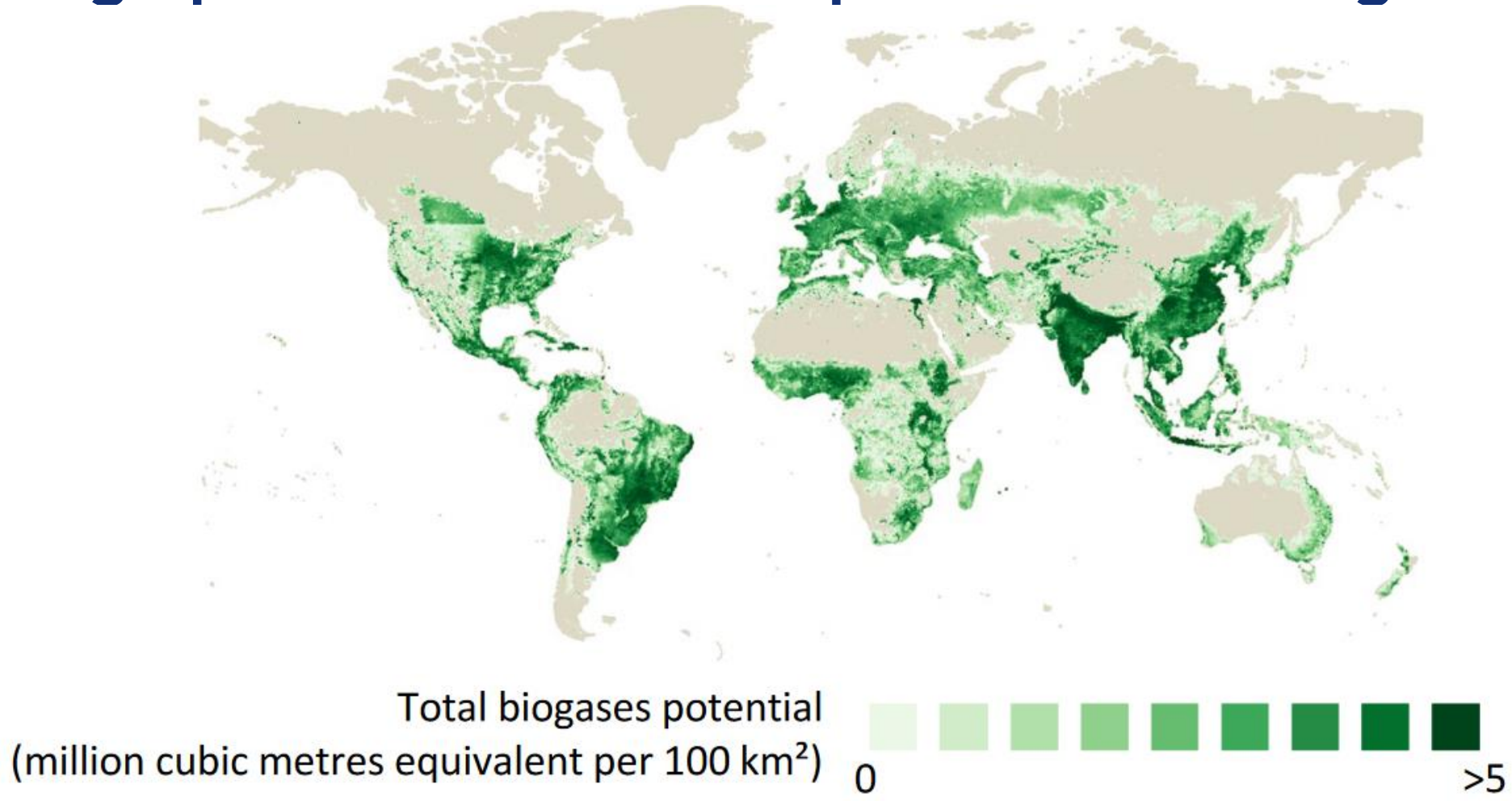
"The investment case for biogases is strongest when local economic development is a priority."

"Logistical hurdles and complex permitting procedures have held back increases in biogases production in many countries."

"Consistent and robust policy support is essential"

IEA – International Energy Agency (2025) Outlook for Biogas and Biomethane - A global geospatial assessment, https://www.iea.org/reports/outlook-for-biogas-and-biomethane

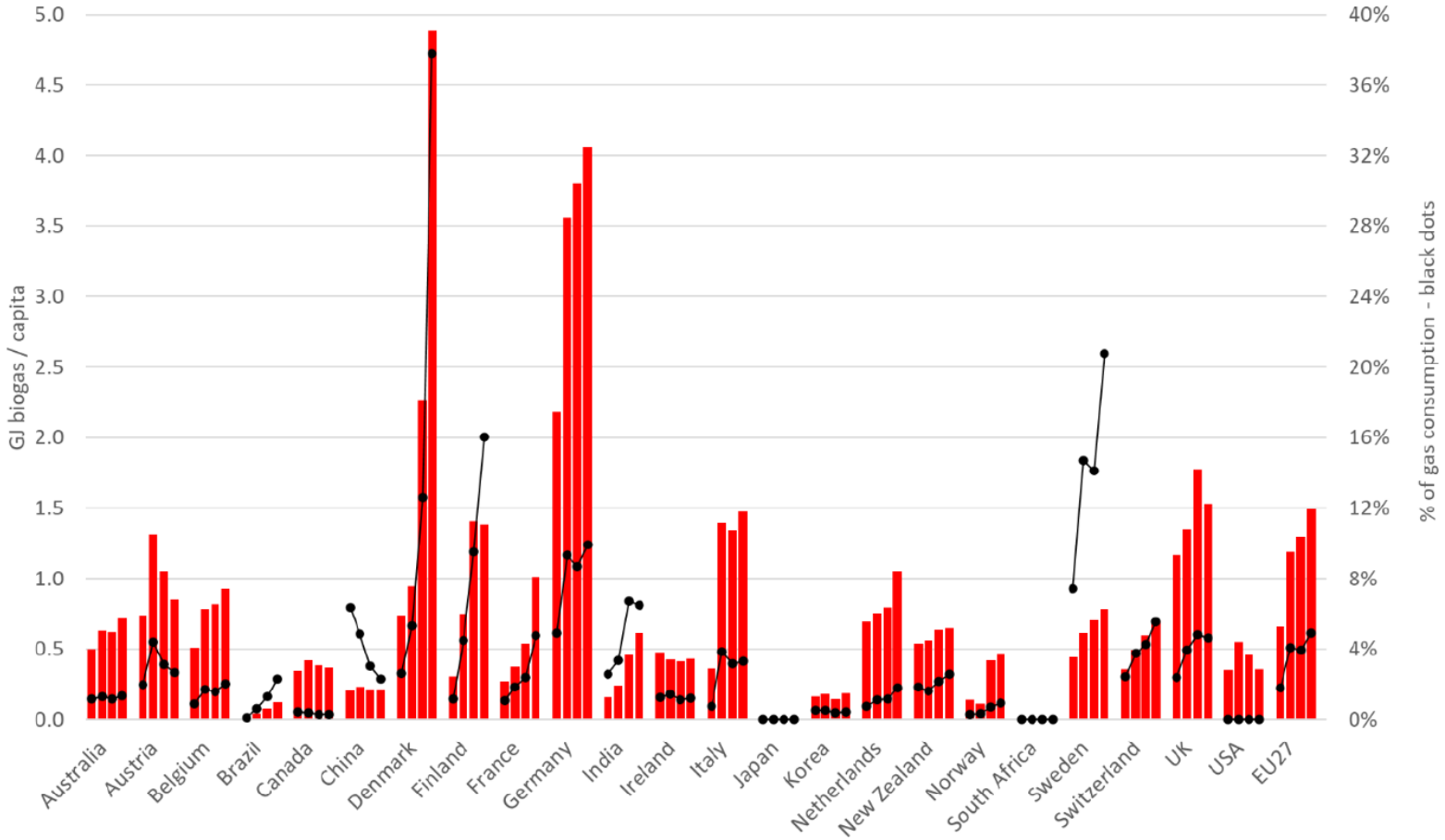
Geographic distribution of potential for biogases



IEA – International Energy Agency (2025) Outlook for Biogas and Biomethane - A global geospatial assessment
https://www.iea.org/reports/outlook-for-biogas-and-biomethane

Biogas use in the IEA Bioenergy member countries





IEA Bioenergy: Countries' Report – update 2024 - Implementation of bioenergy in the IEA Bioenergy member countries (2024) https://www.ieabioenergy.com/wp-content/uploads/2025/01/CountriesReport2024_final.pdf

The role of biogas and biomethane in pathway to net zero



- The pathway to net zero requires far more than provision of renewable electricity
- Biomethane as replacement for natural gas – can be fed into existing gas infrastructure
- Biogas and biomethane systems are mature and multi-functional
- Biogas systems can contribute to energy security since the whole production chain can be set up and operated locally
- Biogas production can utilize a wide variety of organic feedstocks

https://task37.ieabioenergy.com/wp-content/uploads/sites/32/2023/05/2022_12_12-IEA_Bioenergy_position-paper_Final2.pdf

The role of biogas and biomethane in pathway to net zero II

- Often the driver for biogas solution is reduction in fugitive emissions from waste
- Biogas systems provide the by-products digestate and carbon dioxide
- A detailed region-specific analysis of availability, costs and impact of specific feedstock utilization is recommended in order to ensure an effective and sustainable biogas sector
- Biomethane is cheaper than green hydrogen and is expected to remain so for some time in future
- Biogas and biomethane are sustainable flexible systems that play essential roles in circular economy, energ and environmental systems

https://task37.ieabioenergy.com/wp-content/uploads/sites/32/2023/05/2022_12_12-IEA_Bioenergy_position-paper_Final2.pdf

Sustainability effects associated with biogas solutions



"It is of utmost importance that decision-makers, including planners, developers and policymakers, and the public develop a comprehensive understanding of the broad system effects of biogas solutions and their highly cross-sectoral nature involving waste management, energy, industry and agriculture.

Unlike mono-functional systems which are easier to understand and manage, biogas solutions contribute to multiple sectors and sustainability goals, and require a great deal of cross-sectoral collaboration to create industrial-urban-rural symbiosis."

Ammenberg J., Baier, U., Lyng, K-A., Nägele, H-J., Thual, J., Wellisch, M. (2025). Identification and assessment of sustainability effects related to biogas solutions - Literature review and perspectives from five countries. Ammenberg, J; Wellisch, M, Liebetrau, J. (Ed.) IEA Bioenergy Task 37, March 2025. ISBN 979-12-80907-62-2 https://task37.ieabioenergy.com/technical-reports/identification-and-assessment-of-sustainability-effects-associated-with-biogas-solutions/

Key externalities

Environment

- GHG impact (+/-)
- Change in soil health
- Impact on N pollution of water

Economy, society

- Improved energy security
- Organic waste processing costs
- Provision of biogenic CO2
- Job Creation
- Contribution to resilience of agriculture

Agriculture

- Reduction in use of synthetic fertilizer
- Impact of intermediate crops

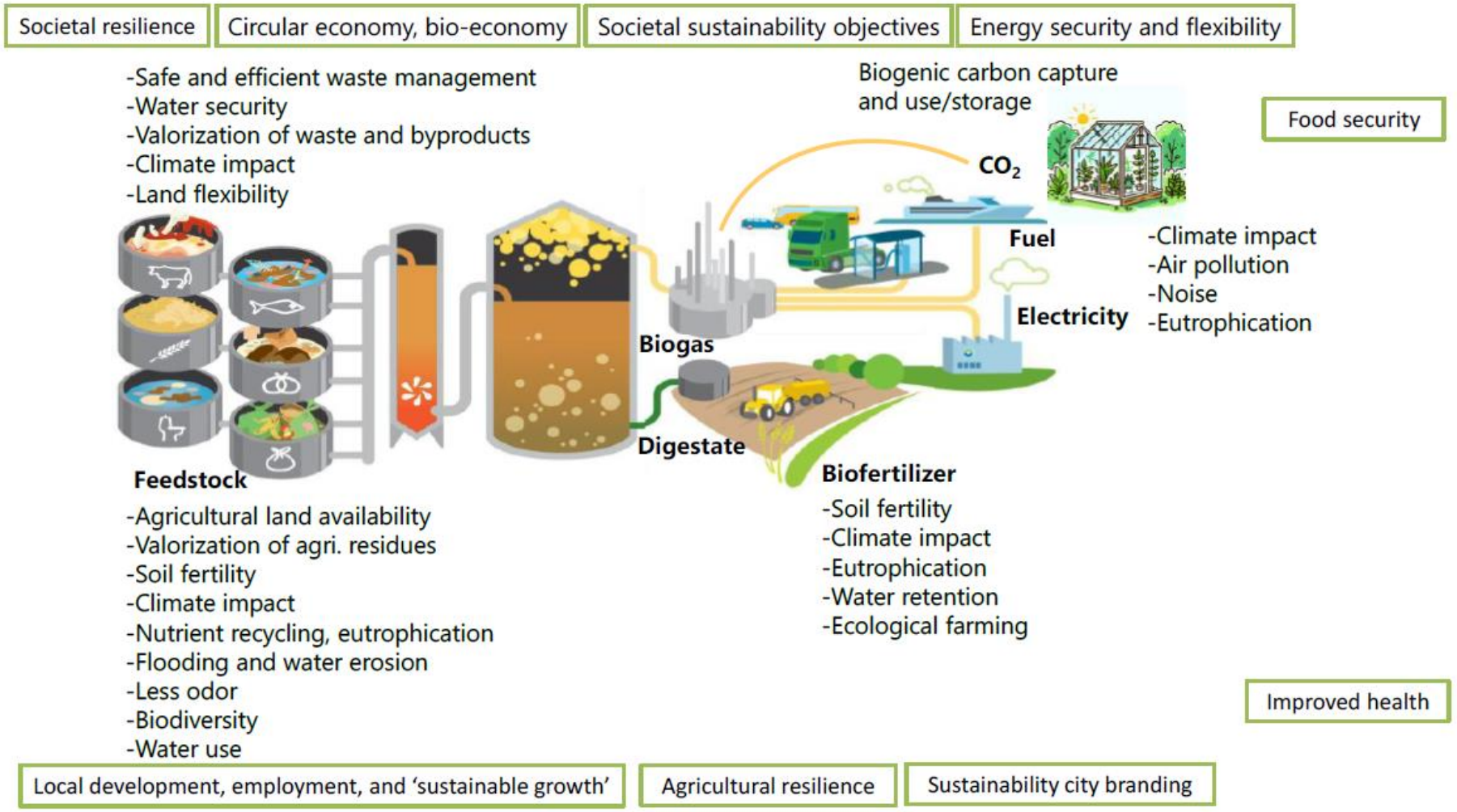
Energy

- Use of exisiting gas infrastructure
- Production of renewable energy – stable and storable
- Contribution to energy transition and regional circular economies
- Elimination of fossil fuel energy

The report highlights 53 sustainability effects of biogas solutions.

https://task37.ieabioenergy.com/technical-reports/identification-and-assessment-of-sustainability-effects-associated-with-biogas-solutions/

Valorising sustainability effects / co-benefits of biogas



https://task37.ieabioenergy.com/technical-reports/identification-and-assessment-of-sustainability-effects-associated-with-biogas-solutions/

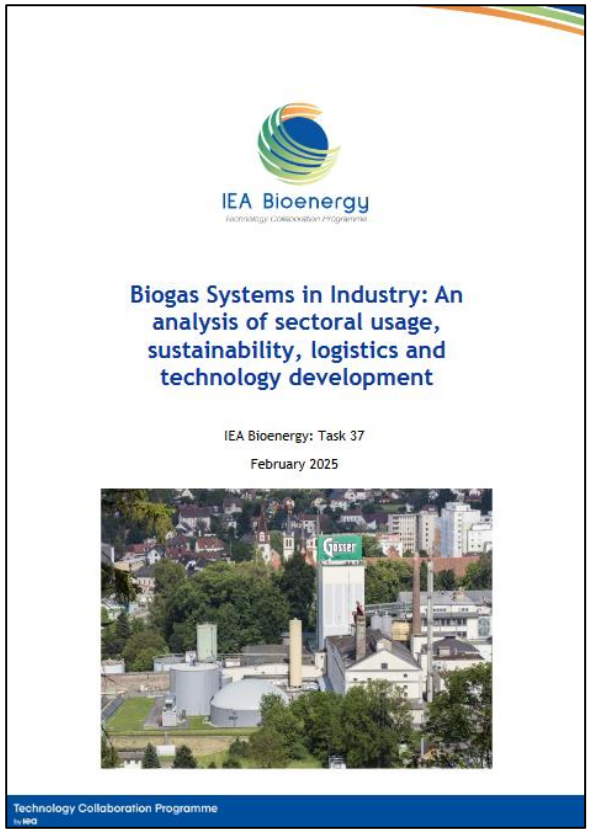
Promote More Holistic Understanding and Perspectives

- Use science-based, multi-criteria sustainability assessments to inform decisions on technical alternatives.
- Recognize the cross-sectoral benefits of biogas solutions in waste, wastewater, agriculture, energy, transport, and various industrial sectors.
- Encourage greater cross-sector collaboration, shared decision-making and support solutions that contribute to a circular economy. Include different sized solutions and solutions that are co-created with local communities.
- Shift the focus toward integrated strategies that combine multiple renewable technologies to deliver desired functions while addressing urgent sustainability challenges.

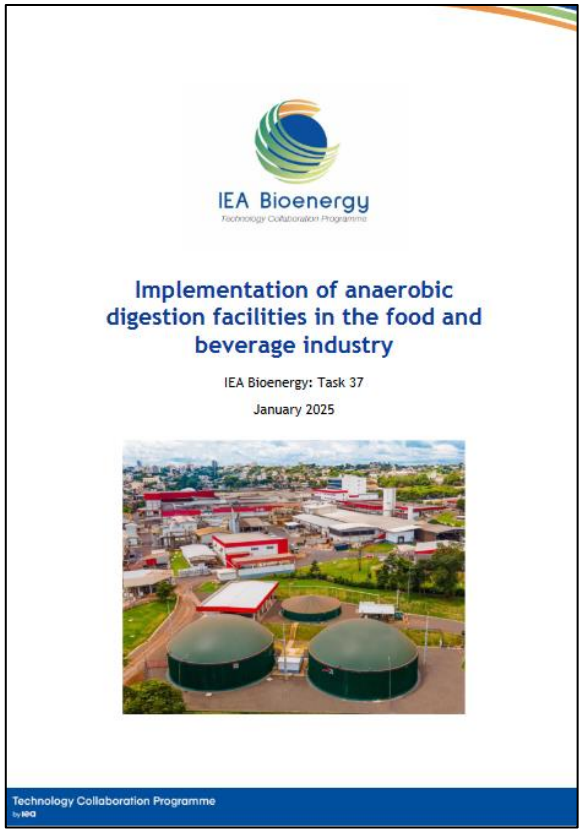
Adopt Coherent and Effective Policy Frameworks

- Harmonize lifecycle and value chain perspectives across relevant policies.
- Enable biogas value chain actors to capture the full societal value of their contributions.
- Remove regulatory and administrative barriers, such as restrictions on sustainable crop-based biogas and lengthy approval processes for mature technologies.
- Set clear targets for the production and use of biogas, biomethane, digestate/biofertilizers, and biogenic CO_2, and ensure the development of supporting infrastructure and access to land to make these targets achievable.
- Balance top-down strategies with local adaptability to facilitate effective and implementation.

Biogas and the producing industries



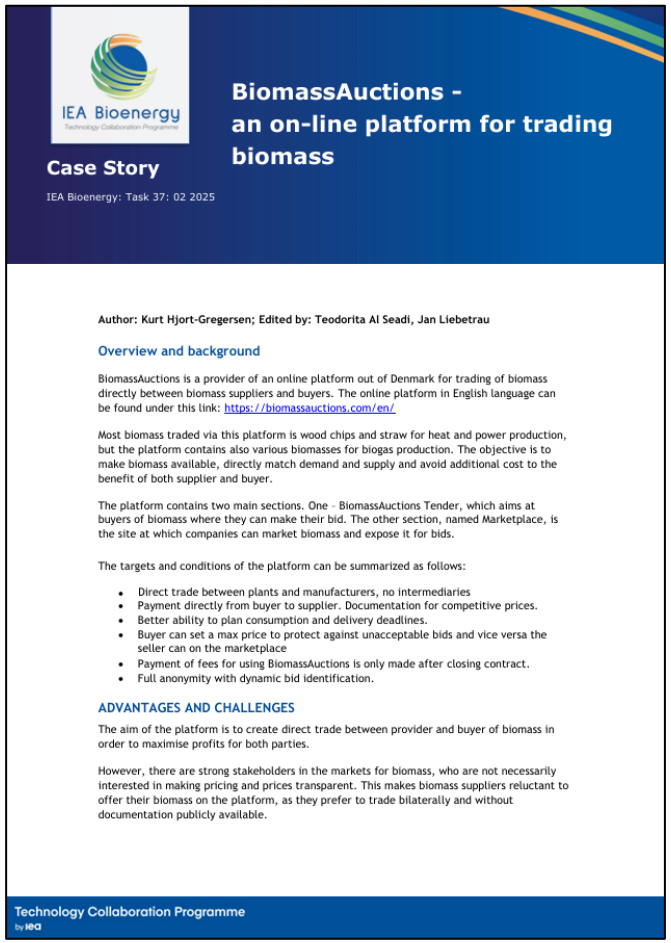
- Producing industries can address their Scope 1 and Scope 2 emissions by biogas / biomethane.
- The food and beverage industries have a vast range of byproducts and wastes which can be used as feedstocks onsite.



Wall, D.M., O'Shea, R. (2025) Biogas Systems in Industry: An analysis of sectoral usage, sustainability, logistics and technology development, Murphy, J.D. (Ed.) IEA Bioenergy Task 37, 2025:1.

Pesta G., Hansemann E., Bochmann G., Drosg B., Gabauer W. (2025) Implementation of Anaerobic Digestion facilities in the Food and Beverage Industry. Liebetrau, J (Ed.) IEA Bioenergy Task 37, 2025, ISBN 979-12-80907-60-8

Case story – a Danish online platform for trading biomass



IEA Bioenergy
Technology Collaboration Programme

BiomassAuctions - an on-line platform for trading biomass

Case Story

IEA Bioenergy: Task 37: 02 2025

Author: Kurt Hjort-Gregersen; Edited by: Teodorita Al Seadi, Jan Liebetrau

Overview and background

BiomassAuctions is a provider of an online platform out of Denmark for trading of biomass directly between biomass suppliers and buyers. The online platform in English language can be found under this link: https://biomassauctions.com/en/

Most biomass traded via this platform is wood chips and straw for heat and power production, but the platform contains also various biomasses for biogas production. The objective is to make biomass available, directly match demand and supply and avoid additional cost to the benefit of both supplier and buyer.

The platform contains two main sections. One - BiomassAuctions Tender, which aims at buyers of biomass where they can make their bid. The other section, named Marketplace, is the site at which companies can market biomass and expose it for bids.

The targets and conditions of the platform can be summarized as follows:

- Direct trade between plants and manufacturers, no intermediaries
- Payment directly from buyer to supplier. Documentation for competitive prices.
- Better ability to plan consumption and delivery deadlines.
- Buyer can set a max price to protect against unacceptable bids and vice versa the seller can on the marketplace
- Payment of fees for using BiomassAuctions is only made after closing contract.
- Full anonymity with dynamic bid identification.

ADVANTAGES AND CHALLENGES

The aim of the platform is to create direct trade between provider and buyer of biomass in order to maximise profits for both parties.

However, there are strong stakeholders in the markets for biomass, who are not necessarily interested in making pricing and prices transparent. This makes biomass suppliers reluctant to offer their biomass on the platform, as they prefer to trade bilaterally and without documentation publicly available.

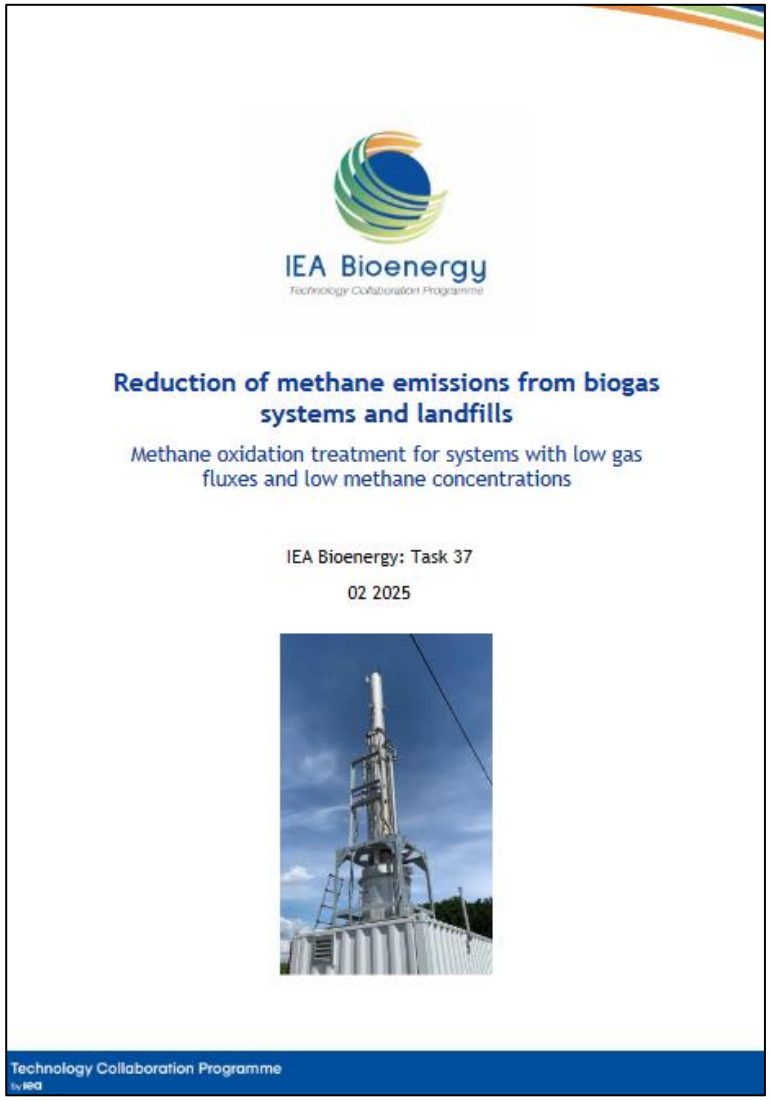
Technology Collaboration Programme
by IEA

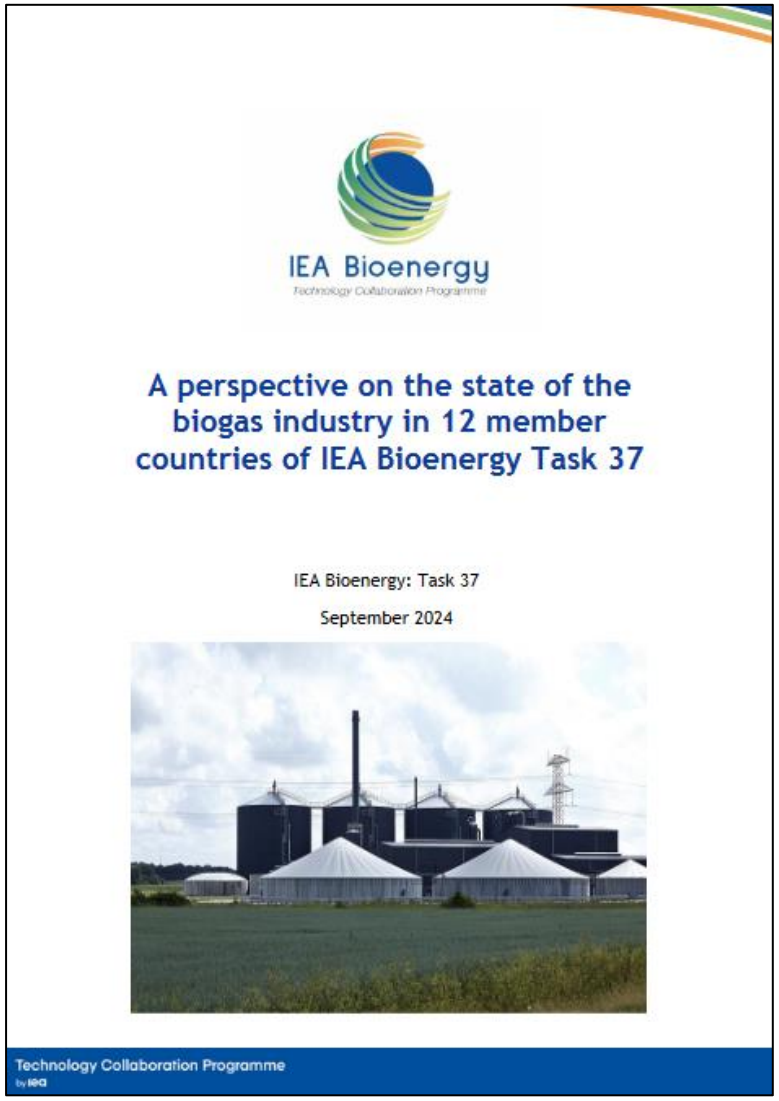
The targets and conditions of the platform:

- Direct trade between plants and manufacturers, no intermediaries
- Payment directly from buyer to supplier. documentation for competitive prices
- Better ability to plan consumption and delivery deadlines.
- Buyer can set a max price to protect against unacceptable bids and vice versa the seller can on the marketplace
- Payment of fees for using the platform is only made after closing contract
- Full anonymity with dynamic bid identification.

https://task37.ieabioenergy.com/wp-content/uploads/sites/32/2025/03/IEA-Bioenergy-case-story-BiomassAuctions_2025.pdf

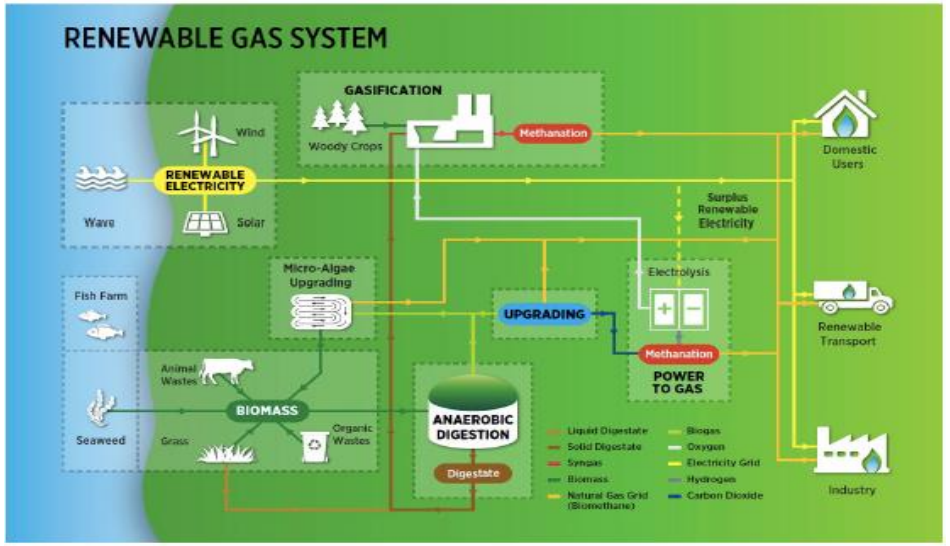
Task 37 Energy from Biogas - Other reports





Topics of ongoing work programme 2025-2027

- Assessment of sustainability effects of biogas in a circular economy system
- Field application of digestates in agricultural production: standards, regulations, policies, best practices and challenges
- Monitoring microbial cultures in biogas plants
- Economics and GHG marginal abatement costs
- Small scale biogas systems - Home Biogas Systems
- Biogas systems and synergies with E-fuel production
- Case stories (2-4 pagers)
- Country report summary
- Intertask: BECCU/S, Synergies of bioenergy
- Newsletter



All information is available under: https://task37.ieabioenergy.com/

Task 37 Energy from Biogas

- Newsletter - https://task37.ieabioenergy.com/newsletter.html
- Country Reports - https://task37.ieabioenergy.com/country-reports.html
- Case Stories - https://task37.ieabioenergy.com/case-stories.html
- Webinars and Workshops - https://task37.ieabioenergy.com/events/
- Technical Reports - https://task37.ieabioenergy.com/technical-brochures.html

Thank you for your attention!

Contact IEA Bioenergy Task 37

Bernhard Drosg
Task Leader - IEA Bioenergy Task 37
Tel. +43 (0) 664 8878 3186
Email: bernhard.drosg@boku.ac.at

IEA Bioenergy
Technology Collaboration Programme

www.ieabioenergy.com

Mr. Paul Greene

North America's RNG Ecosystem Case Studies and Best Practices

Paul Greene

June 2025

GreeneTec Introduction

- First founding member of American Biogas Council in 2010 and first elected chair
- See:
  - www.greene-tec.com
  - www.biogas.tv
- Biogas RNG Advisory business since 2022

Biogas Markets

- Agriculture
  - Manures
  - Processing Waste (DAF Float, etc)
- Food Manufacturing Waste
- Landfill Gas
- Food Waste – Preconsumer, Grocery Store, Restaurants
- Municipal Wastewater Treatment
- Post Consumer Food Waste

Drivers

- A few USA states have landfill ban directives to keep organic waste out of landfills
  - Connecticut, Massachusetts, California, New York City
- Low Carbon Fuel Standards for Transportation
- SAF – Several states are creating tax credits
- Section 48 Investment Tax Credit created a big wave of projects in late 2024.
- Canadian Clean Fuel Regulation (CFR) is very good for both Canadian and American RNG.

Policy

- National Policy
  - RFS – RINS
- State Policy
  - CA LCFS
- Canada
  - CFR (Clean Fuel Regulation)



The future

- All eyes are on the upcoming 45Z Production Tax Credit
- People now building the projects that were registered in 2024 deploying the ITC
- Looking at new fuels like aviation fuels and Maritime

Renewable Fuel Standard

- Rewards RIN credits for food waste, manures, biosolids and landfill gas
  - D3 RINs (Cellulosic Biofuels) are trading at about $33 per mmbtu
  - D5 RINs (Advanced Biofuels) are trading at about $14 per mmbtu

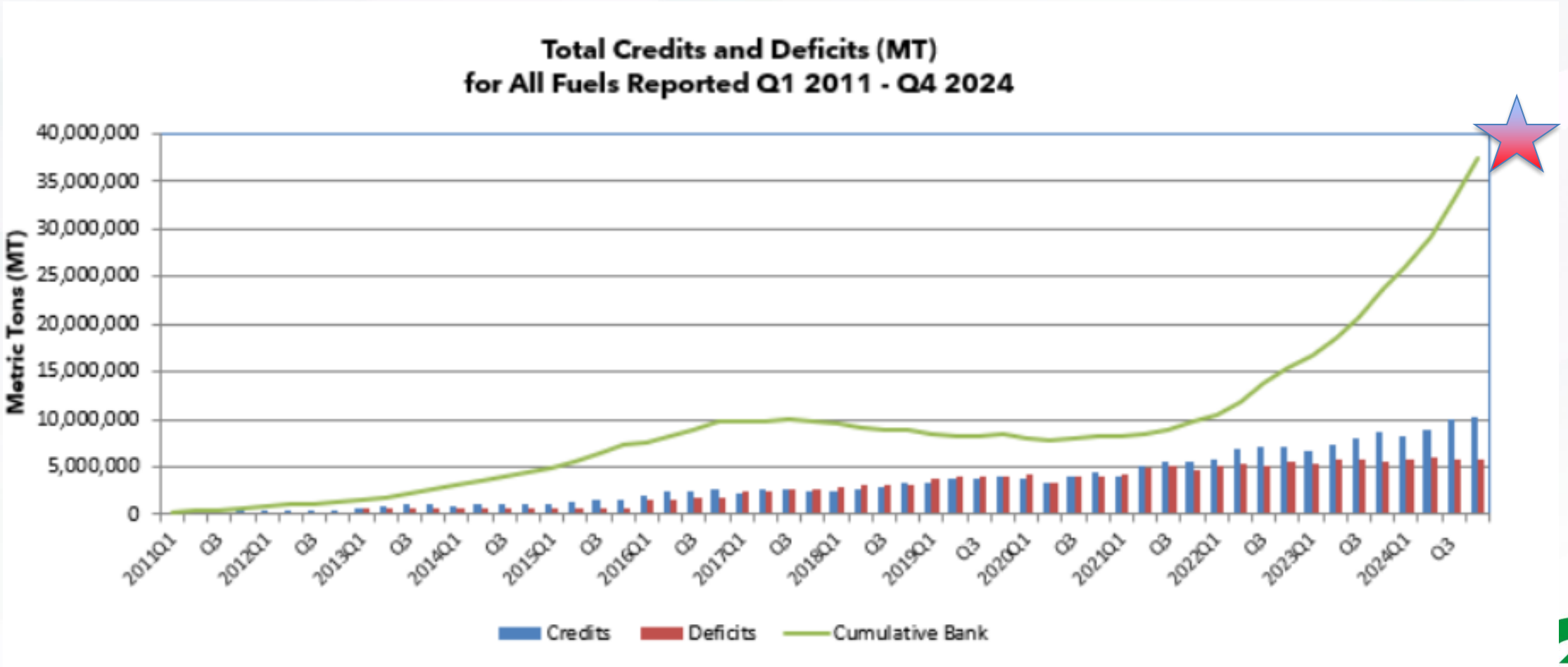
The 2025 Budget Battle

- The “Big Beautiful Bill”.
- Terminates
  - Section 45V for Hydrogen
- Section 45Z is a low carbon fuels tax credit.
  - Unclear if negative carbon intensity scoring will be allowed
  - A production tax credit now good until 2027 but looks like it will be extended to 2031
- Investment Tax Credit – Section 48 expired

Trends

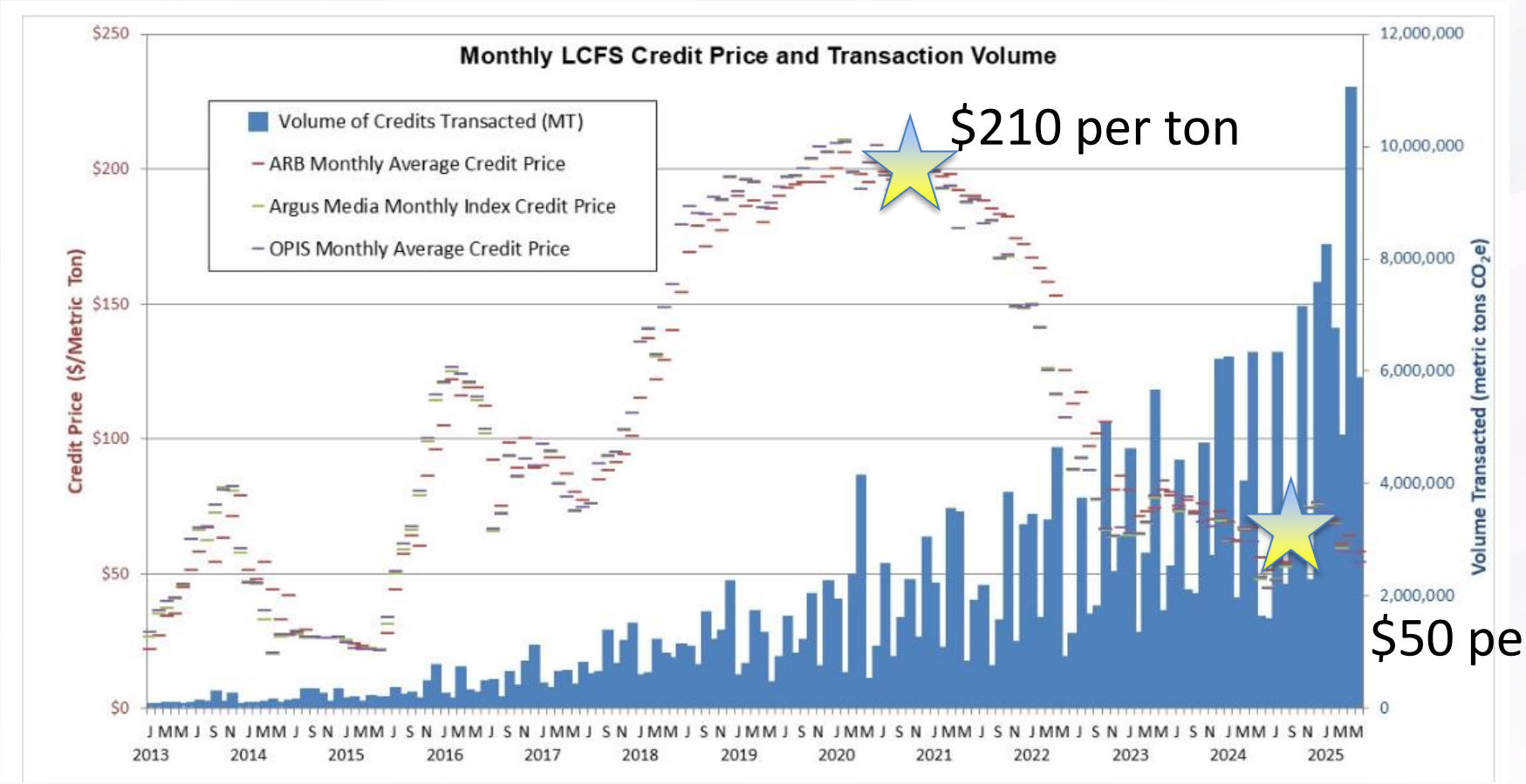
- California LCFS Prices – softened from $100+ to $45 per ton
  - CA LCFS was the catalyst for the USA boom in the RNG business from 2020 to 2023
- D3 RIN prices have softened to $2.50 each
- Regulatory uncertainty

California carbon bank is full of credits the program is very popular



California LCFS Prices

have reached a new normal



$210 per ton

$50 per ton

Tax Code

- Section 48 ITC – Need to have “safe harbored” the project before 1/1/2025

The U.S. Biogas Market

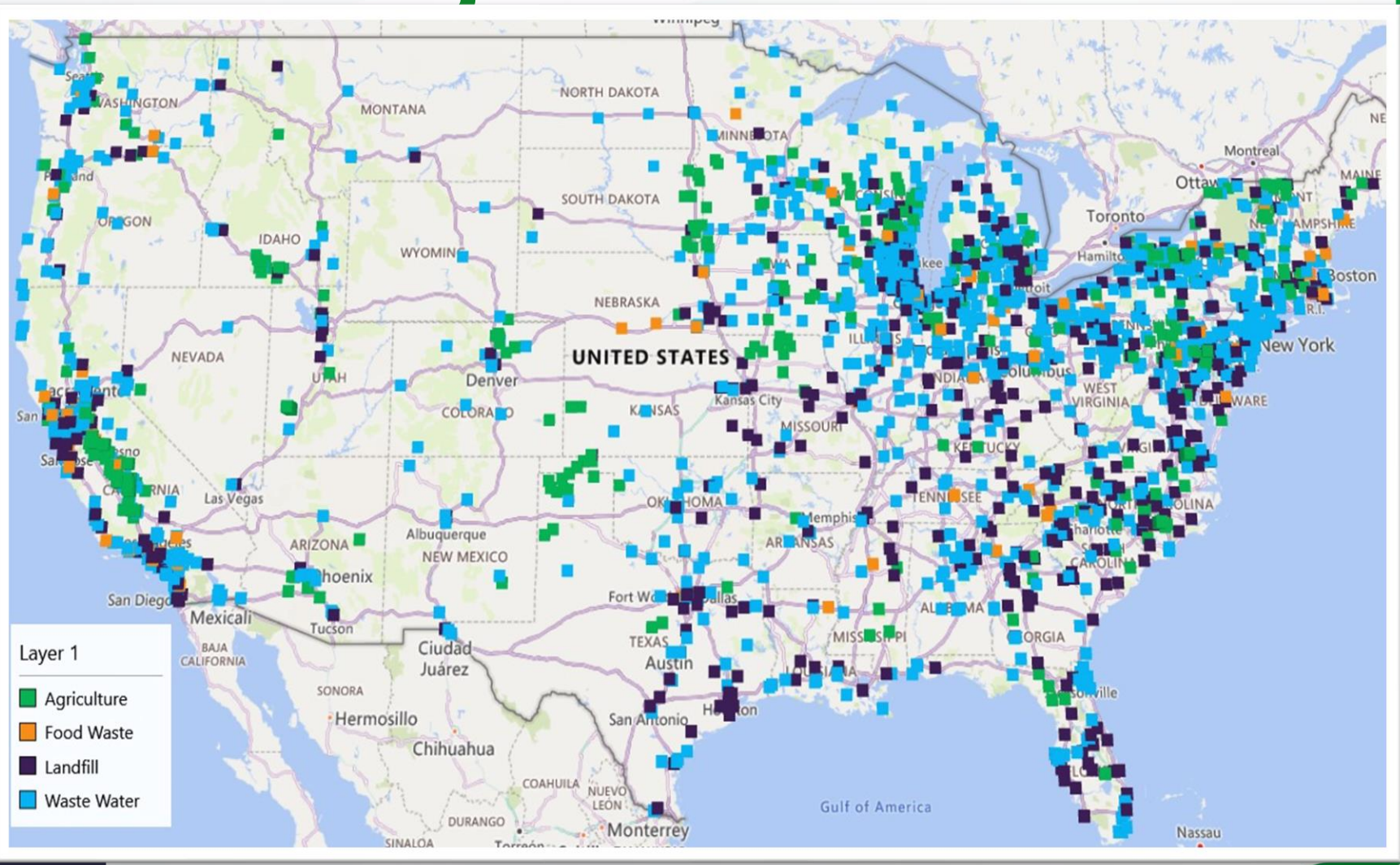
Operational Biogas Systems: 2,494

- 576 RNG
- 1,400 Electricity

- 609 on Farm
- 1,189 Wastewater
- 113 Food Scrap
- 583 at Landfills

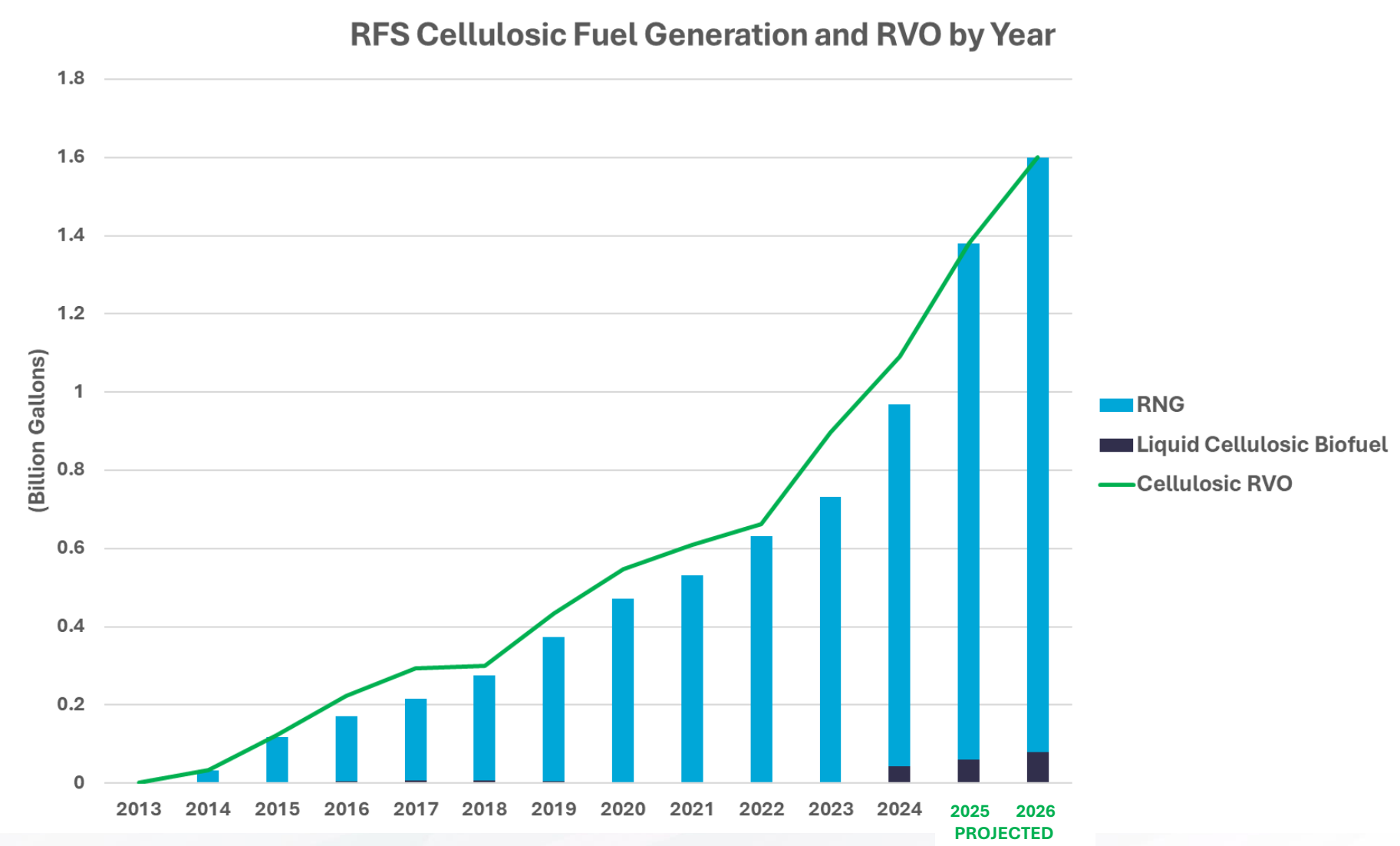
Potential New Biogas Systems: 17,000

- 11,200 on Farms
- 3,750 Wastewater
- 1,370 Food Scrap
- 730 at Landfills



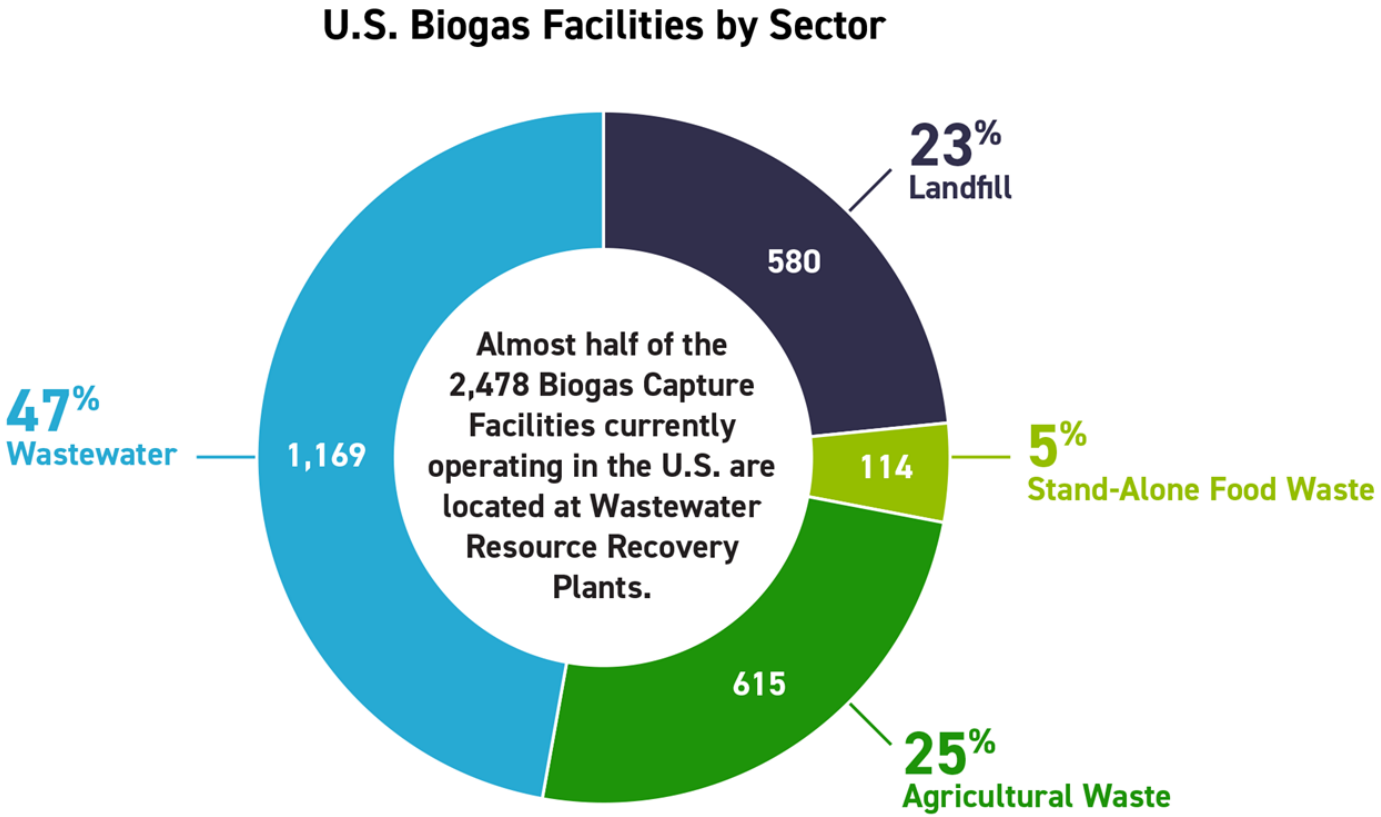
April 2025

Growth of US Biogas Use in Transportation



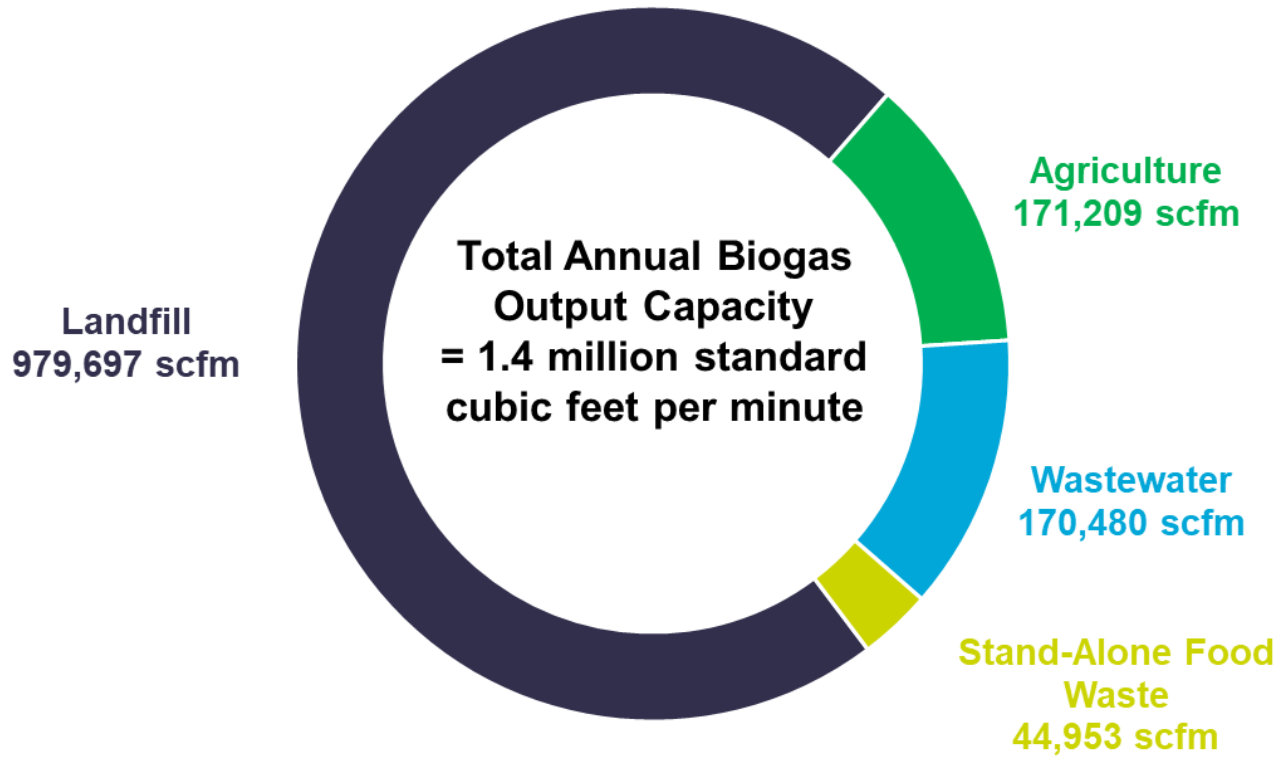
April 2025

Biogas Systems In The U.S. By Feedstock Source, 2024



2024 Growth: 5.4%	
Landfill	+4.3%
Agriculture	+18.0%
Wastewater	+0.4%
Food Waste	+2.7%

U.S. Biogas Production Capacity (scfm)



2024 Growth: 10.6%	
Landfill	+12.3%
Agriculture	+13.9%
Wastewater	+0.9%
Food Waste	+2.4%

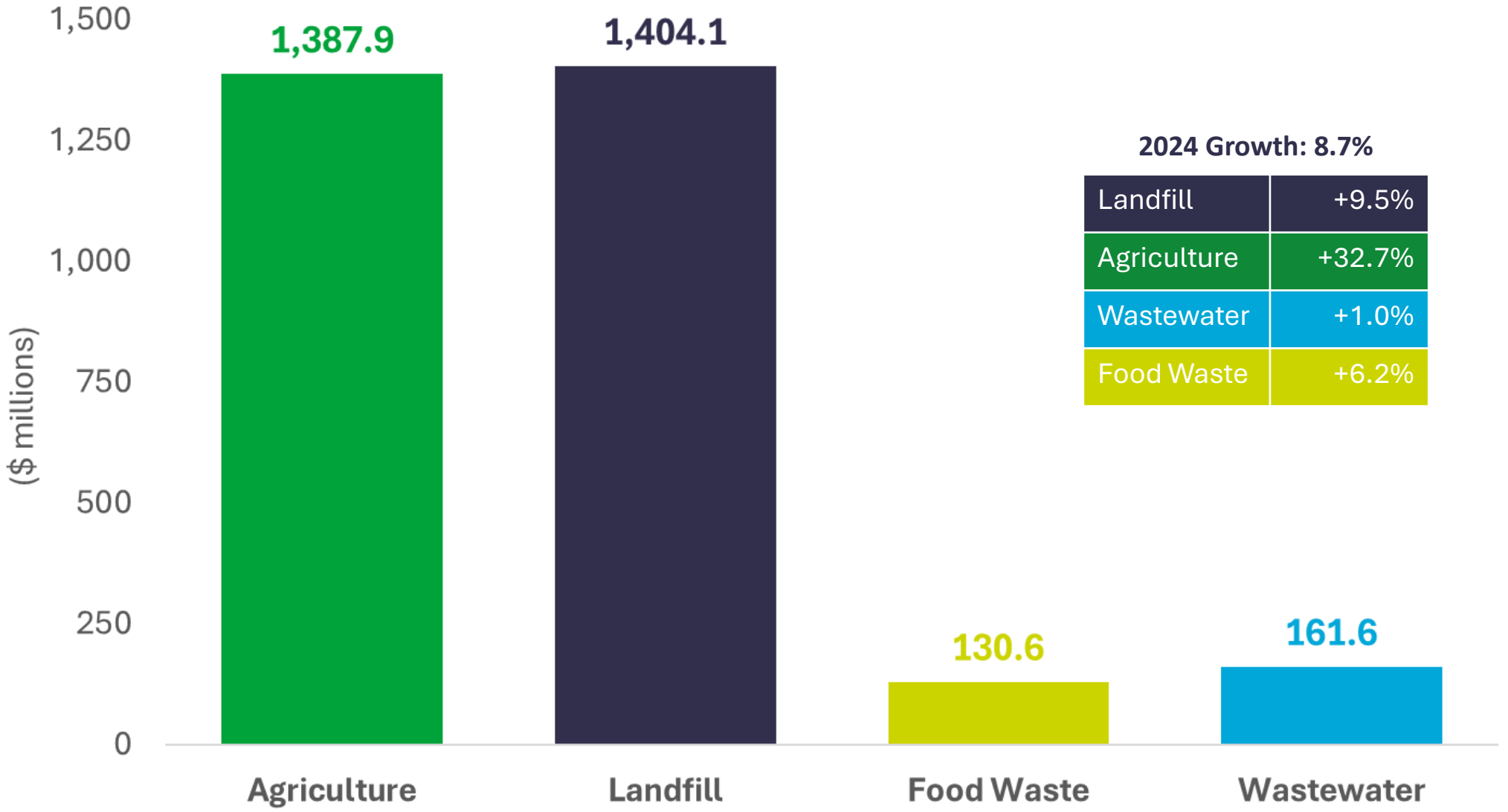
Total U.S. Biogas Production Capacity, 2015-2024



NOTE: Production is attributed to the year system went into operation.

January 2025

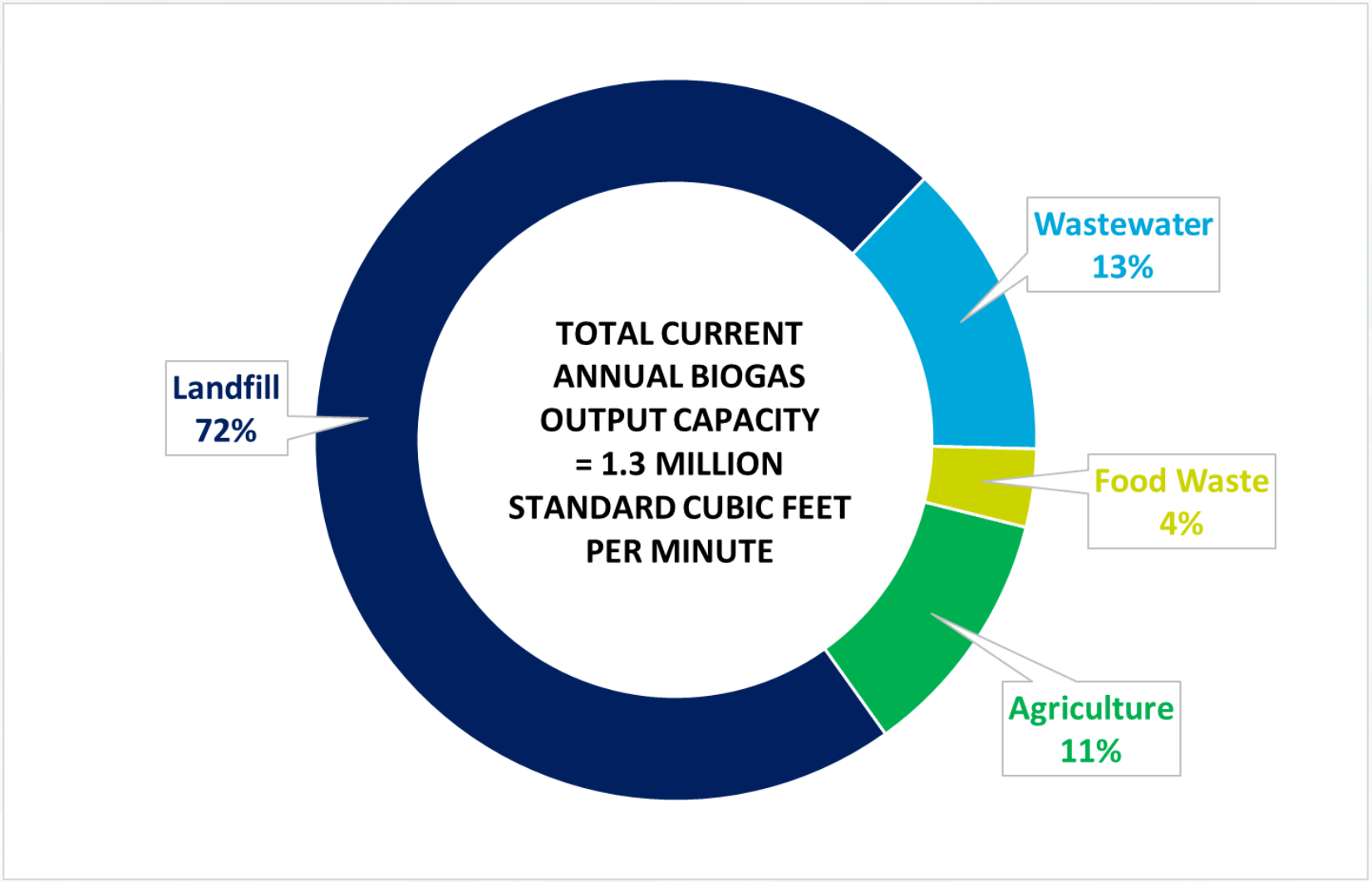
$3B of Capital Came Online in 2024



2024 Growth: 8.7%

Landfill	+9.5%
Agriculture	+32.7%
Wastewater	+1.0%
Food Waste	+6.2%

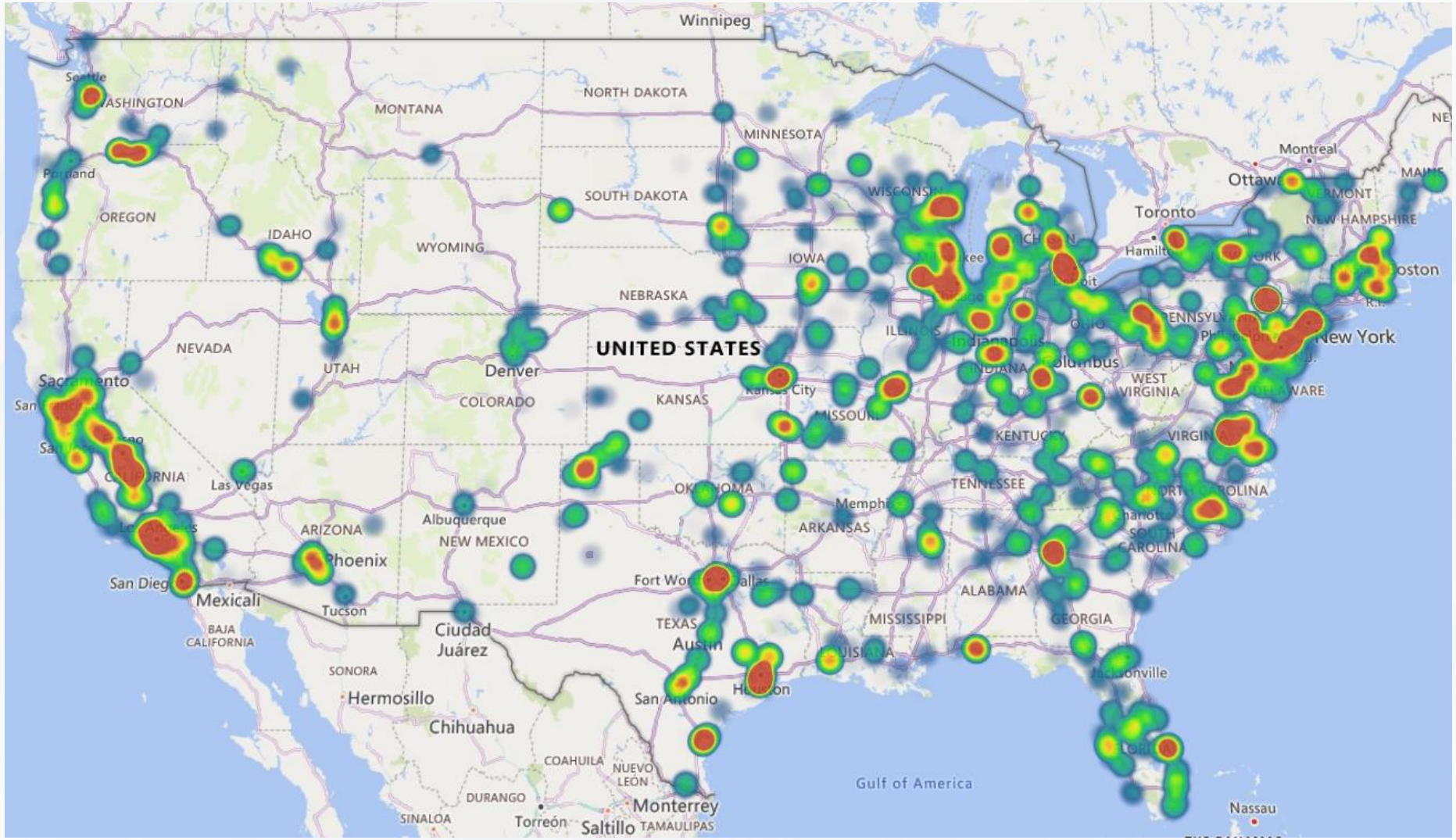
Total U.S. Biogas Production Capacity



US Biogas Output, 2014-2023 (scfm)

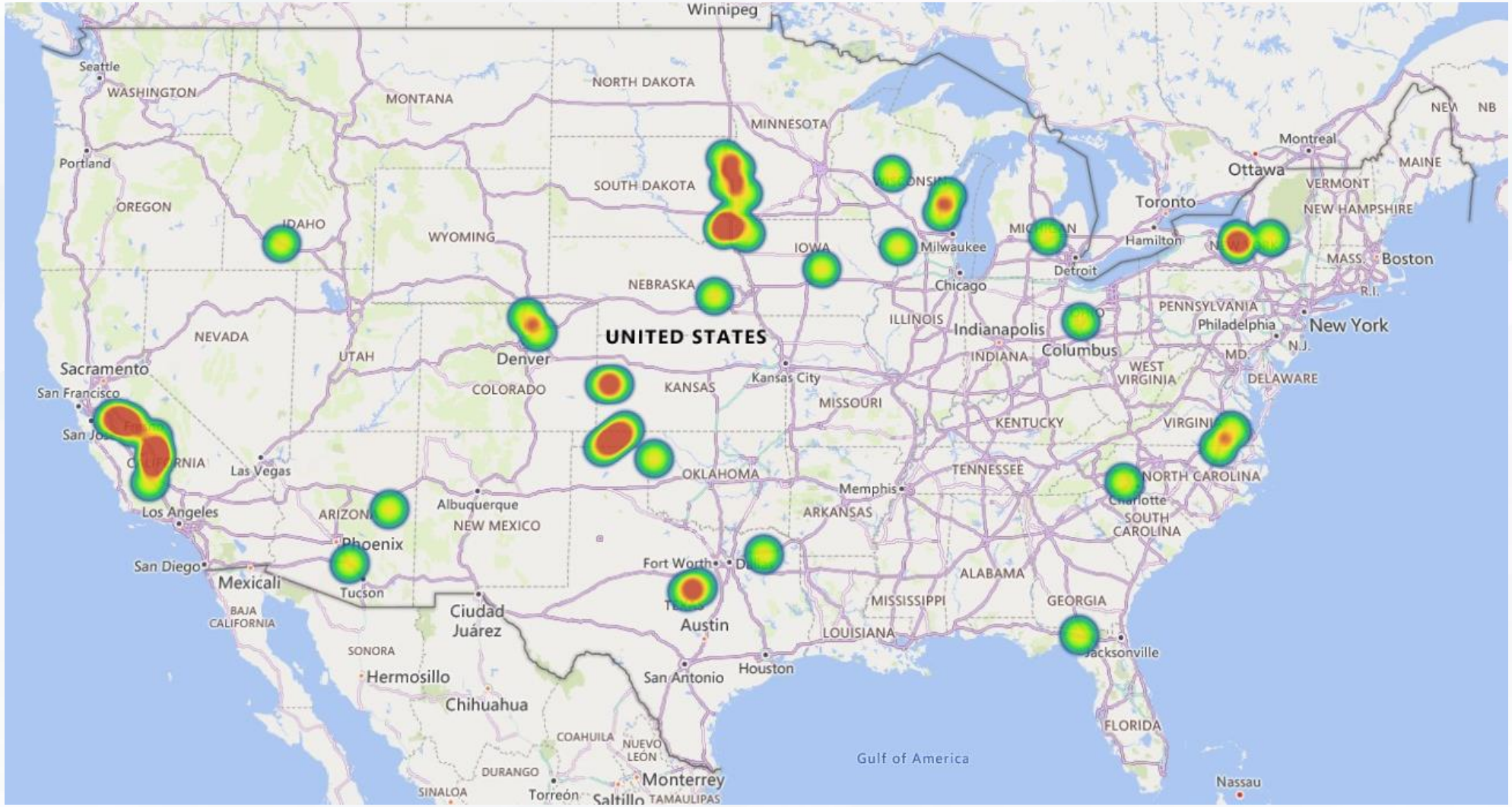


U.S. Biogas Production



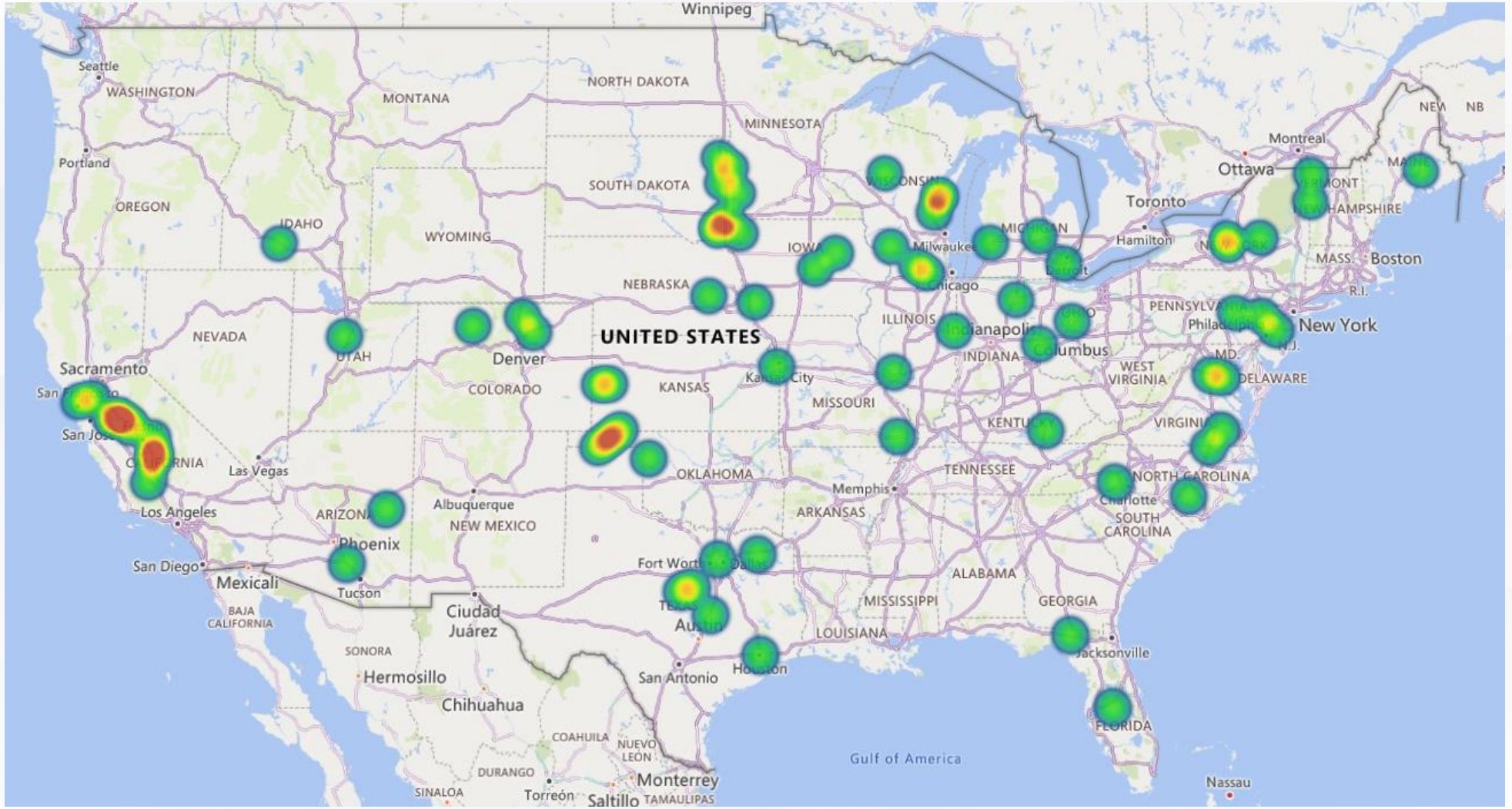
March 2025

Main Centers of U.S. Biogas Production on Farms



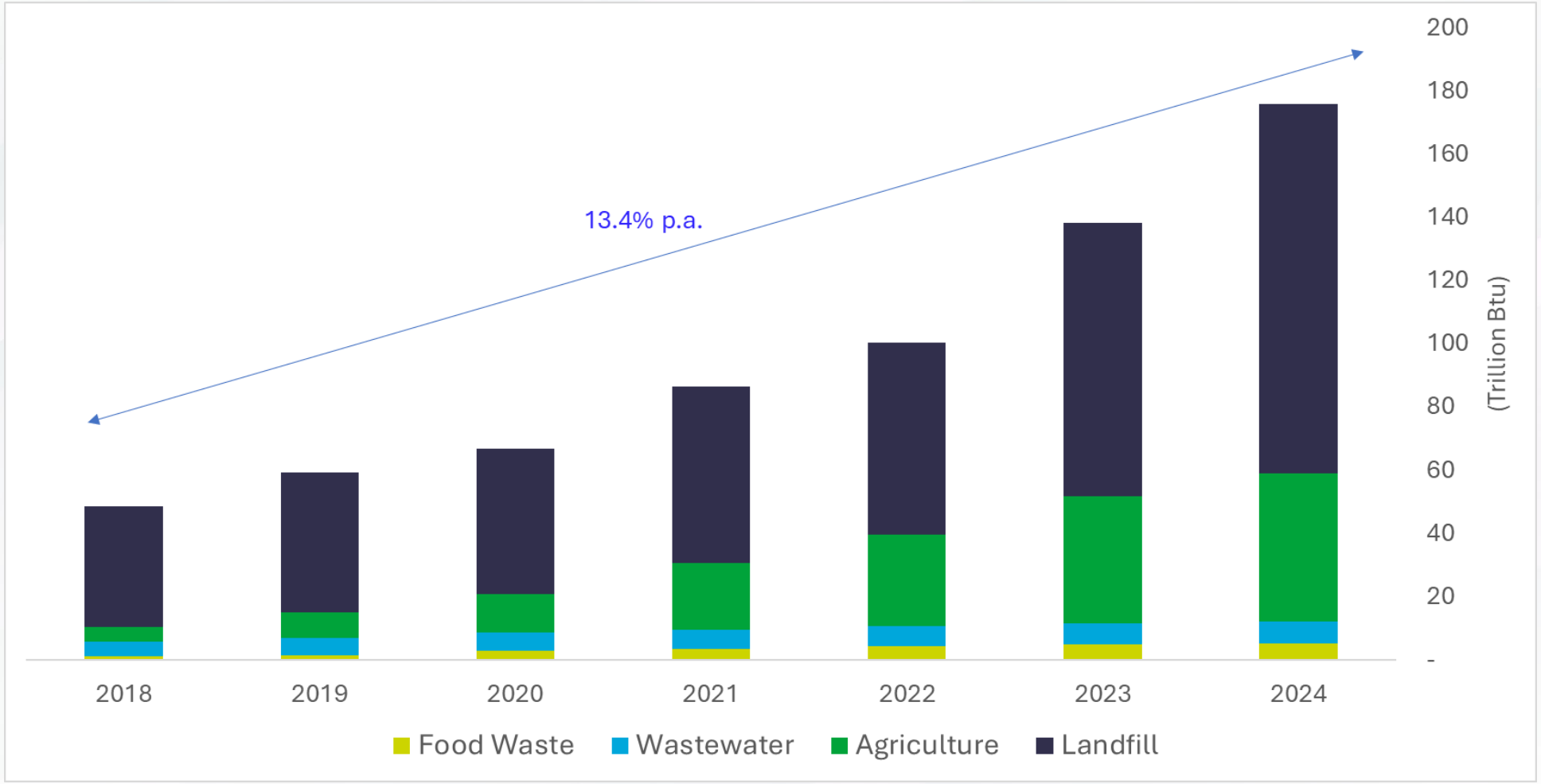
March 2025

New Biogas Production Capacity Added in 2024



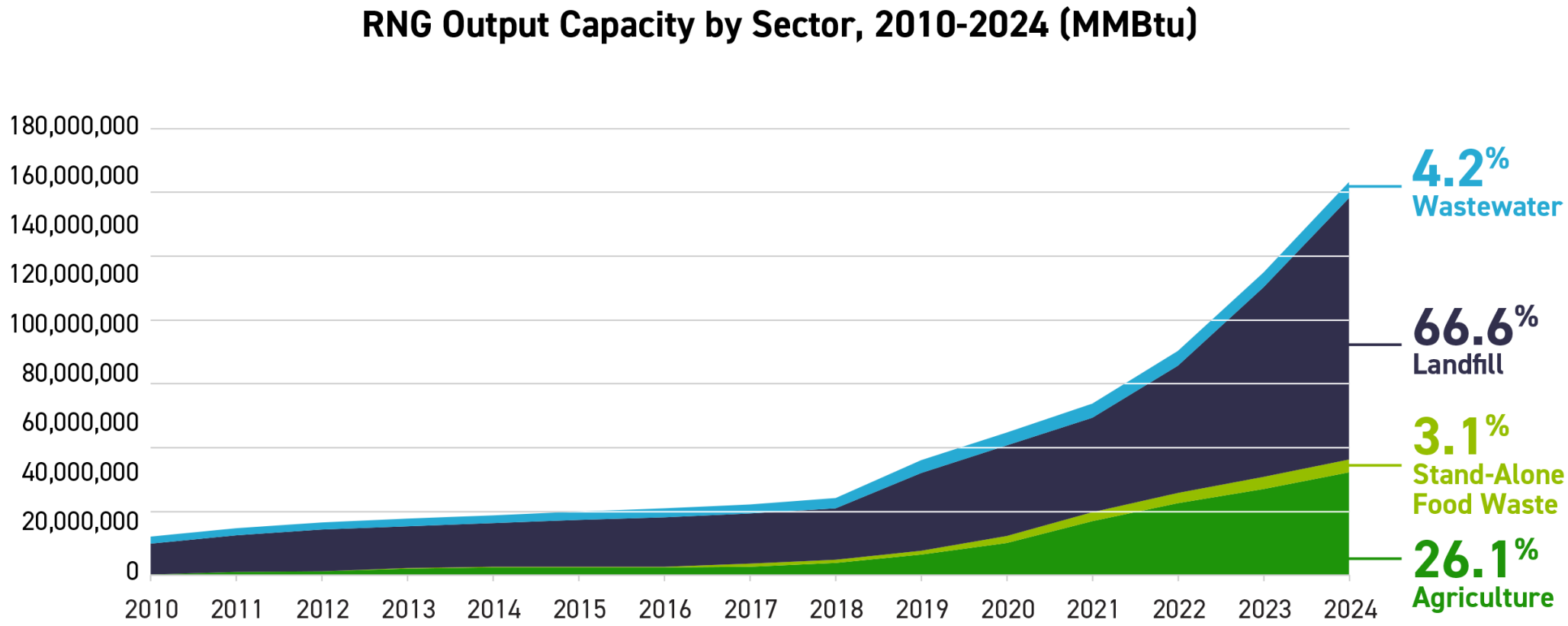
March 2025

U.S. RNG Production by Feedstock, 2018-2024 (Trillion Btu)



March 2025

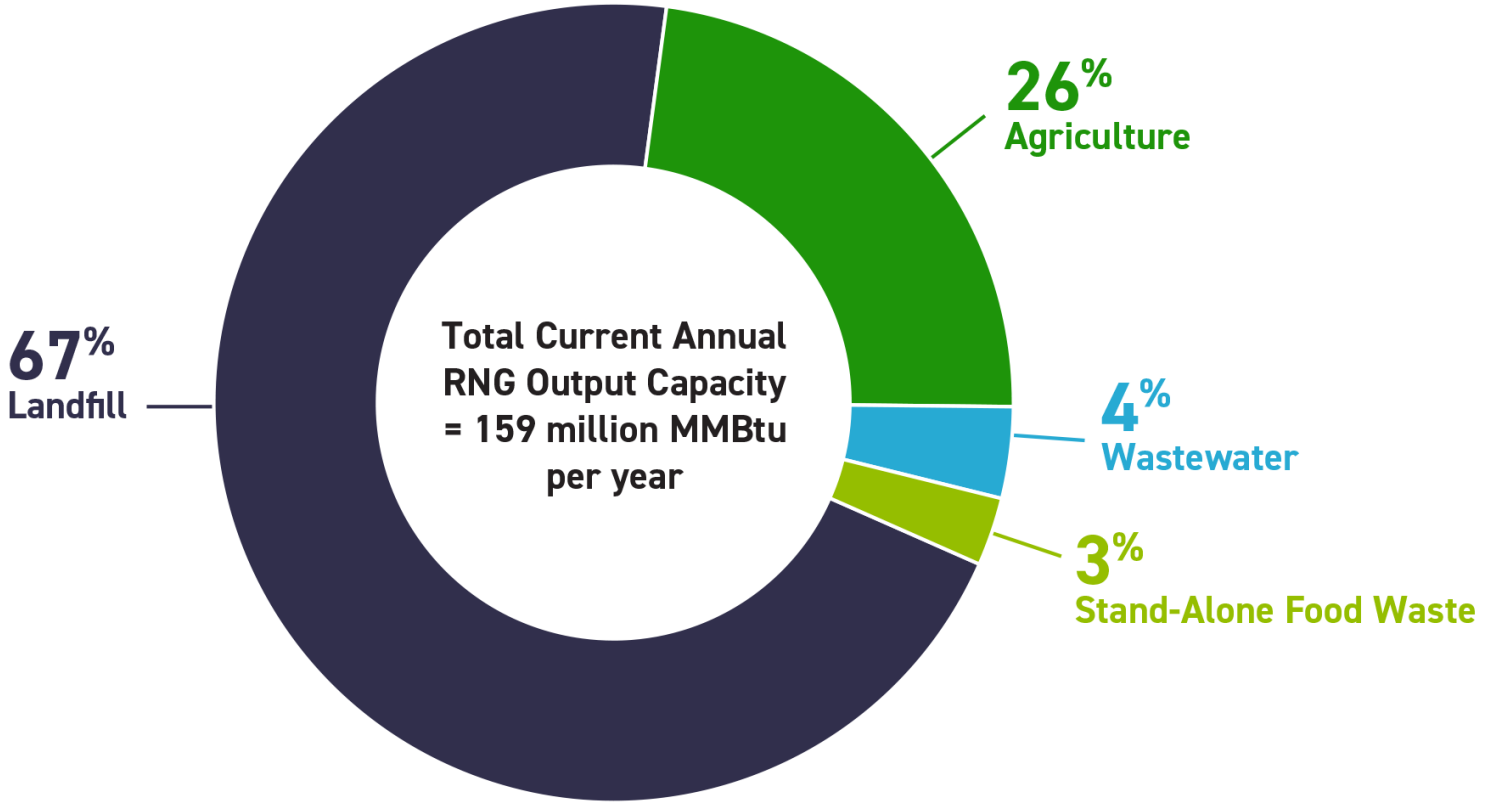
RNG Capacity 2010-2024



January 2025

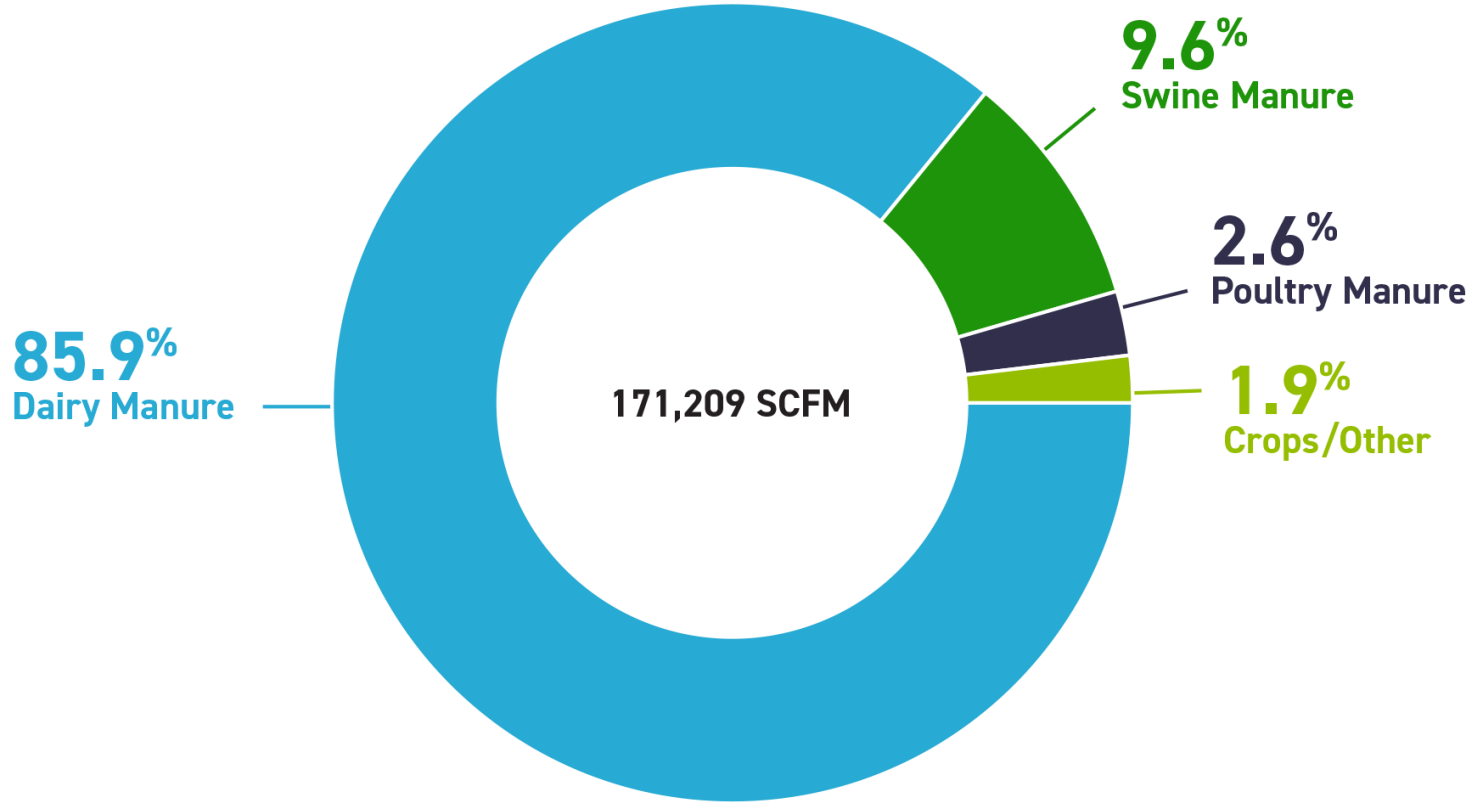
RNG Capacity by Sector

RNG Production Capacity at end of 2024, (MMBtu)



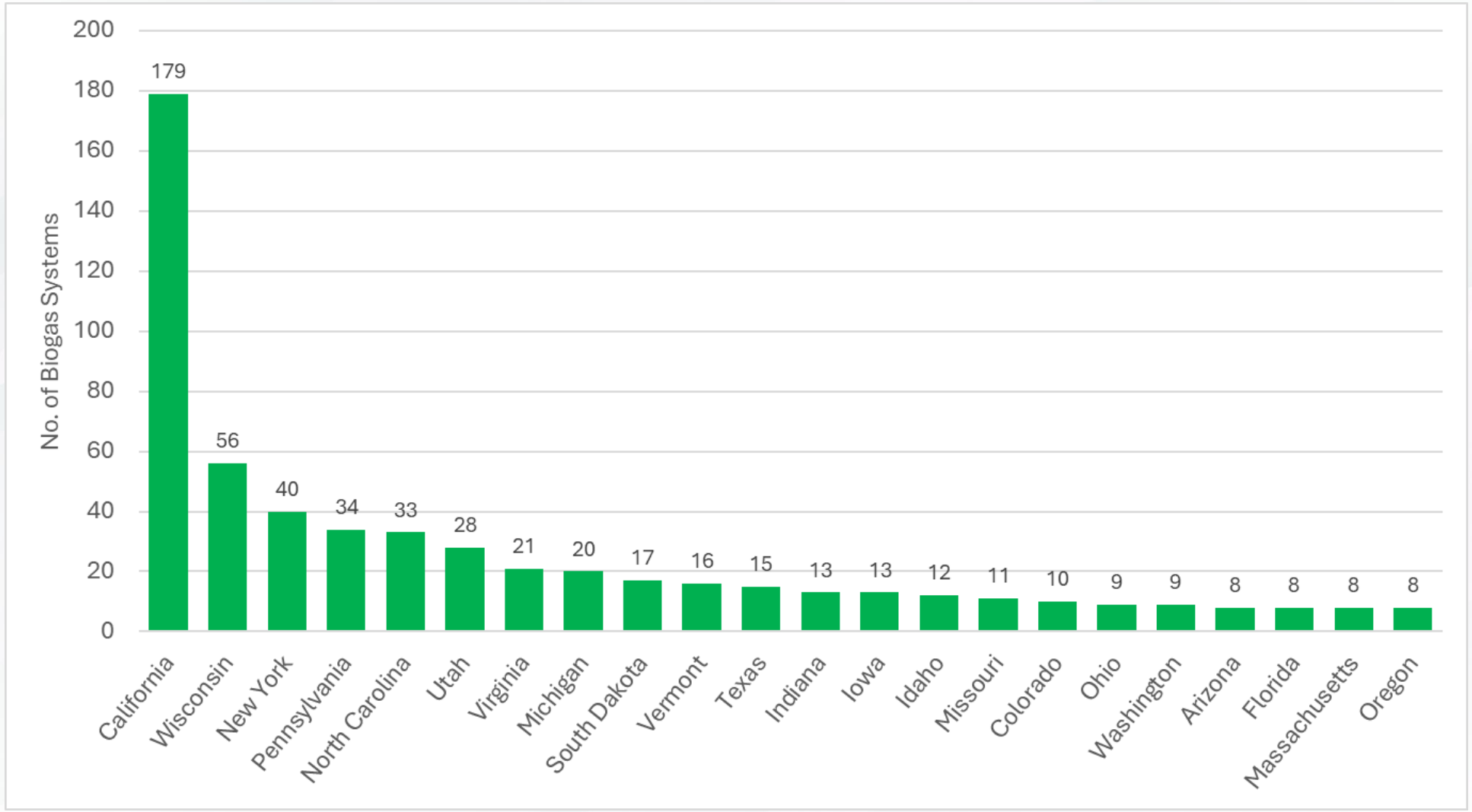
Farm-Based Biogas Capacity

Farm-Based Biogas Production Capacity by Primary Feedstock at end of 2024



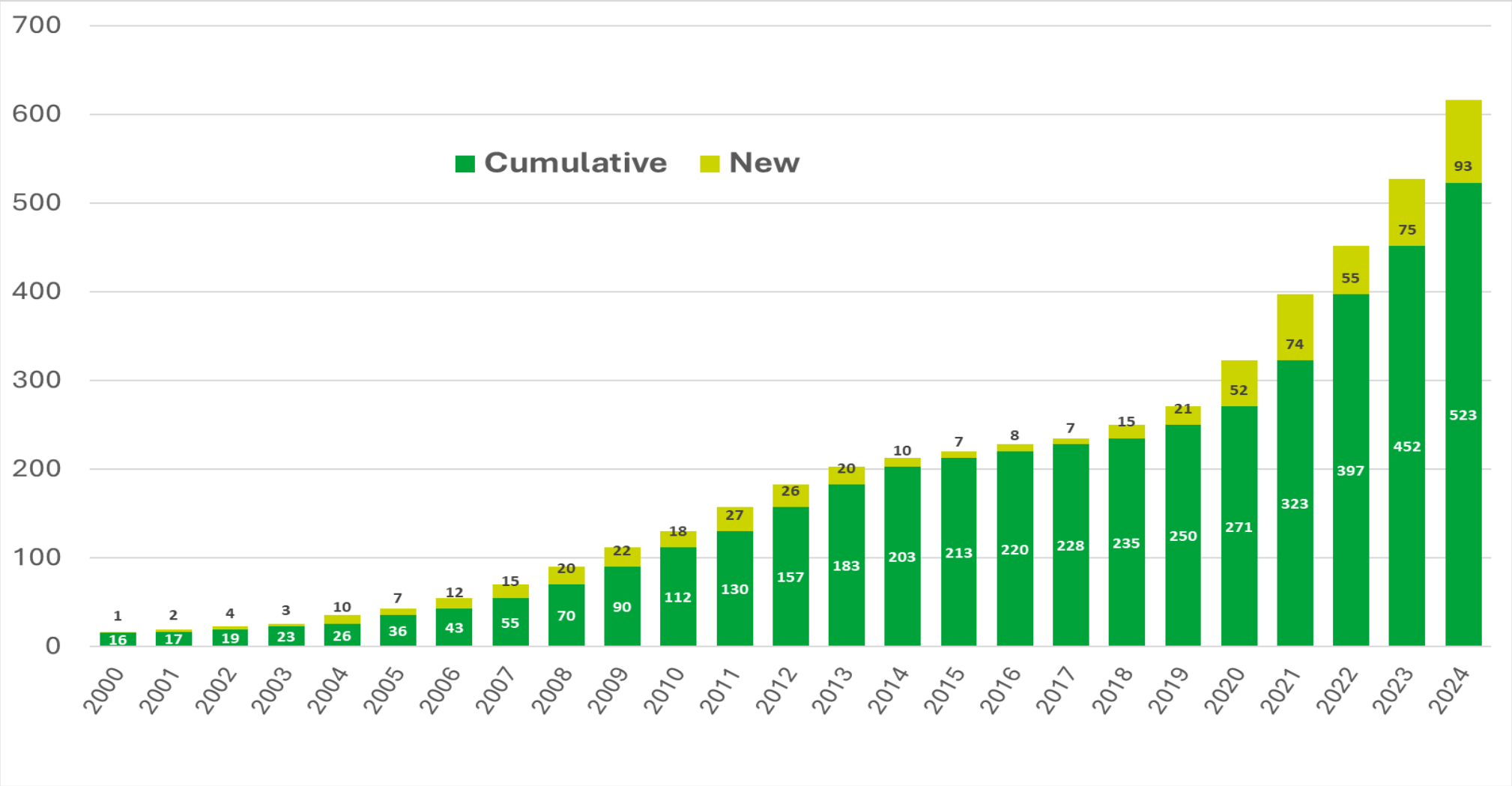
January 2025

Operational On-Farm Biogas Systems by State, 2024



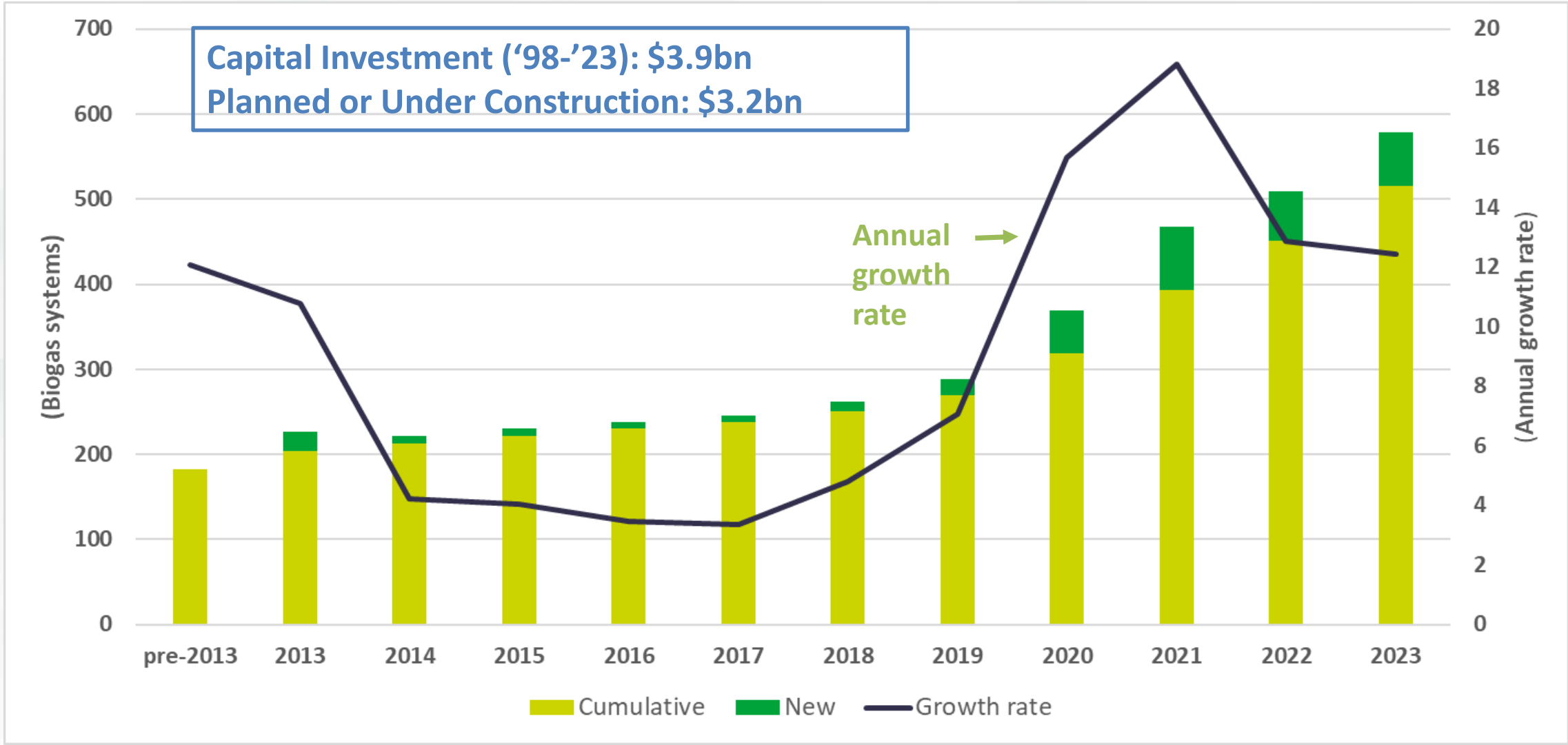
February 2025

US Farm-based Biogas Systems, 2000-2024

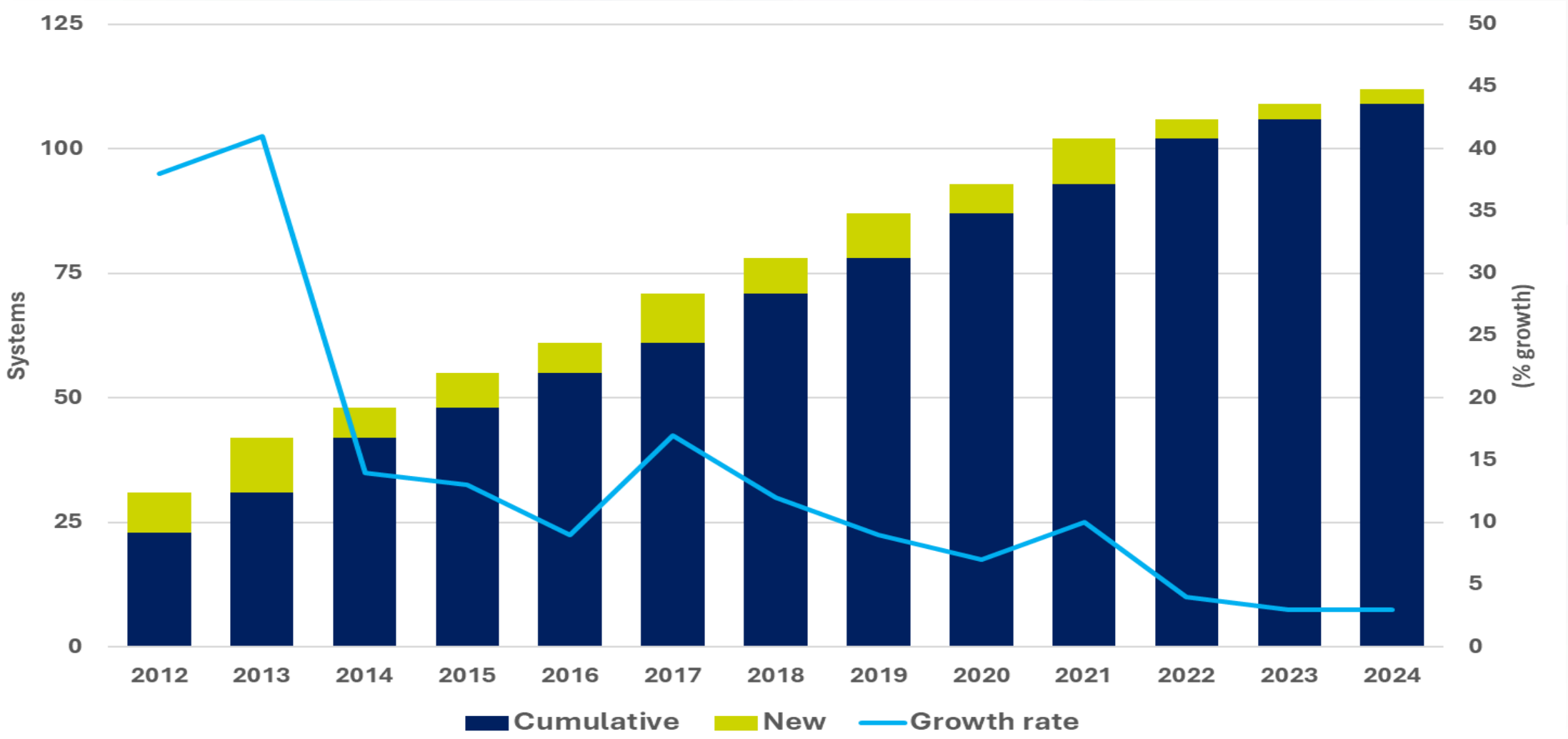


616 operational farm-based biogas systems in 2024

Farm-based Biogas Systems in the US

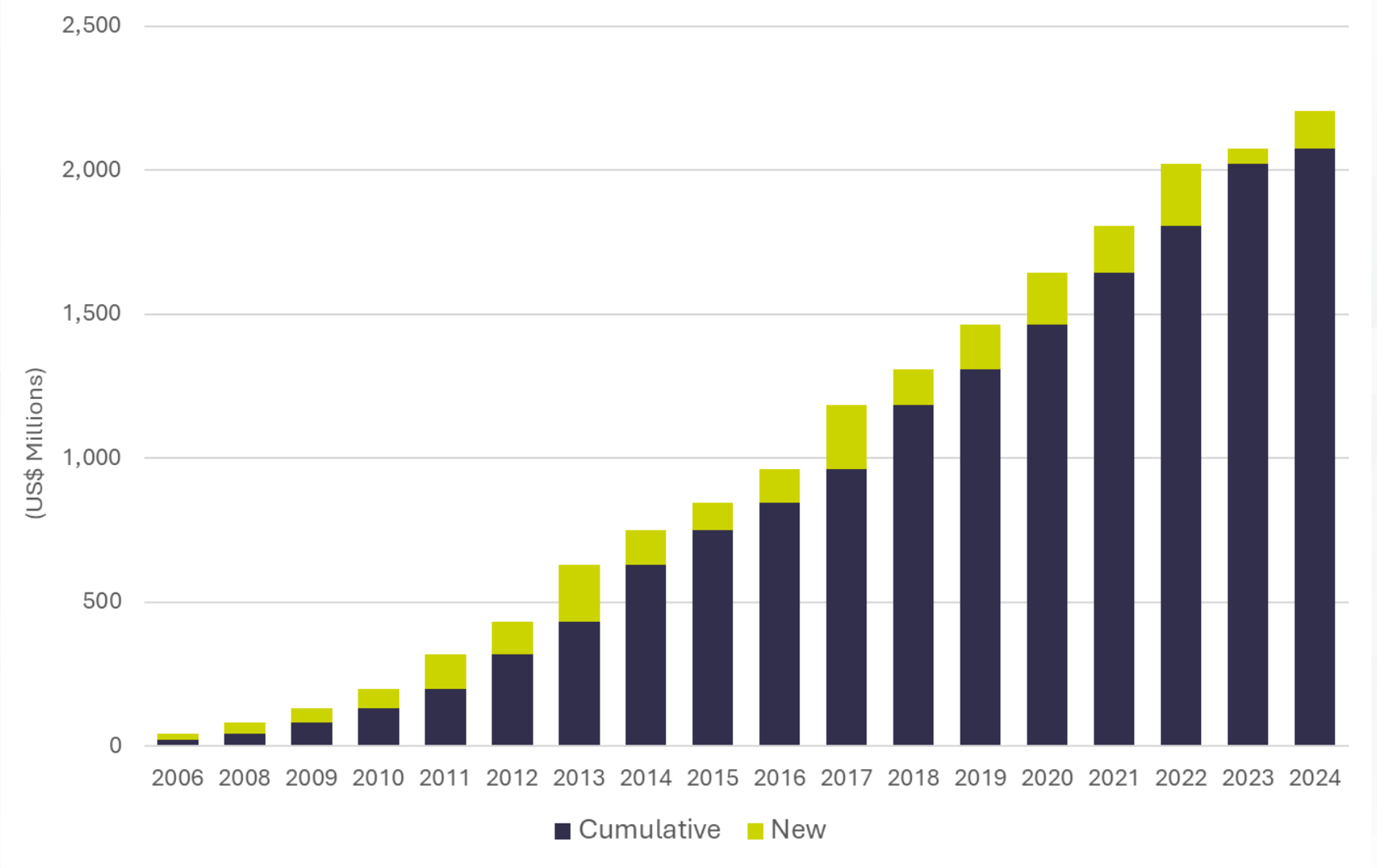


Stand-Alone Food Waste Biogas Systems, 2012-2024



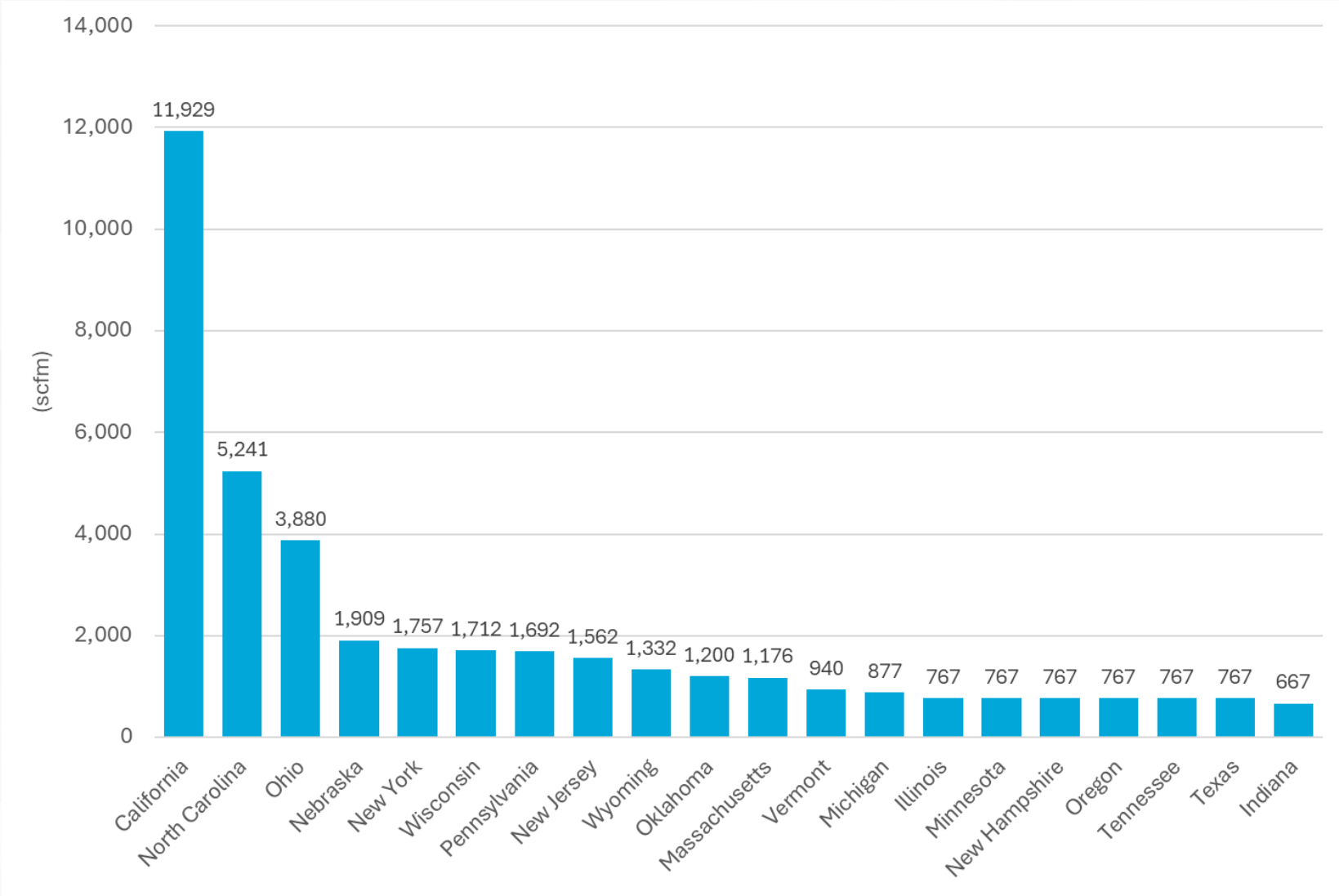
April 2025

Capital Investment in Standalone Food Waste Biogas Systems

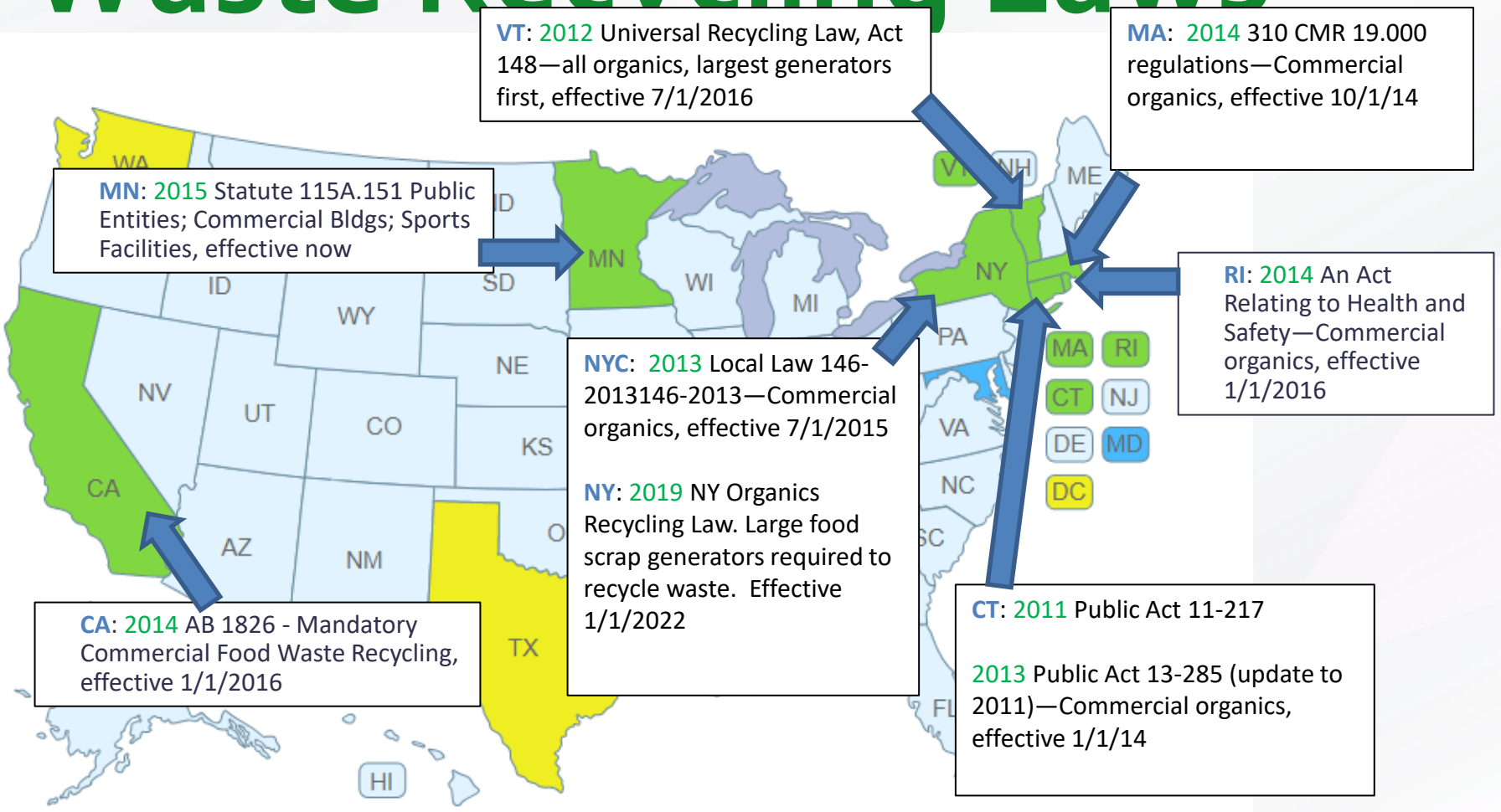


April 2025

Total Biogas Production Capacity at Standalone Food Waste Facilities by Leading States, 2024



10 States Have Food Waste Recycling Laws



VT: 2012 Universal Recycling Law, Act 148—all organics, largest generators first, effective 7/1/2016

MA: 2014 310 CMR 19.000 regulations—Commercial organics, effective 10/1/14

MN: 2015 Statute 115A.151 Public Entities; Commercial Bldgs; Sports Facilities, effective now

RI: 2014 An Act Relating to Health and Safety—Commercial organics, effective 1/1/2016

NYC: 2013 Local Law 146-2013146-2013—Commercial organics, effective 7/1/2015

NY: 2019 NY Organics Recycling Law. Large food scrap generators required to recycle waste. Effective 1/1/2022

CA: 2014 AB 1826 - Mandatory Commercial Food Waste Recycling, effective 1/1/2016

CT: 2011 Public Act 11-217

2013 Public Act 13-285 (update to 2011)—Commercial organics, effective 1/1/14

PROJECTS - USA

Green Era – Chicago, IL

100,000 tons per year
Of food waste from
Food manufacturing

200,000 mmbtu per year
Of RNG

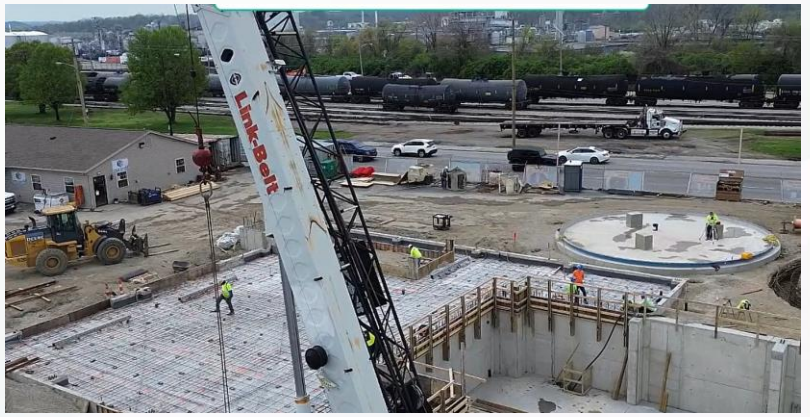
Solids depackaging system



Synthica – Cincinnatti Ohio

- 190,000 tons of food waste per year
- RNG into the natural gas pipeline







Dairy Farms, Iowa

USA – BIOSTREAM DEPLOYMENTS 11 SITES 19 UNITS









- Our Goal is to be the most Reliable Upgrading Partner for the Industry
  - Technology
  - Relationship
- lamram@ivysads.com
- prao@ivysads.com



Warsaw, North Carolina

Food Waste Digesters

Creation of RNG

45,000 m3 of digesters

Waste from processing of Proteins (Hogs, chickens)





Jessup, Maryland

100,000 tons of food waste
Per year

190,000 mmbtu of RNG per year

Food waste from local food
Manufacturing

BTS Bioenergy



Gila Bend, Arizona

Dairy Manure Digesters

Creation of RNG

10,000 milking cows



San Bernardino, California

100,000 tons of food waste/ year

Creation of electricity from biogas

Extensive digestate treatment with Reverse osmosis water filters



THANK YOU

PAUL GREENE

PAUL@GREENE-TEC.COM

01 518 951 5766

Mr. Alessandro Gardeman

ABiogás

Associação Brasileira do Biogás



Global Biofuels Alliance (GBA) Webinar on Biomethane

Alessandro Gardemann

Chairman of the Board

25/06/2025

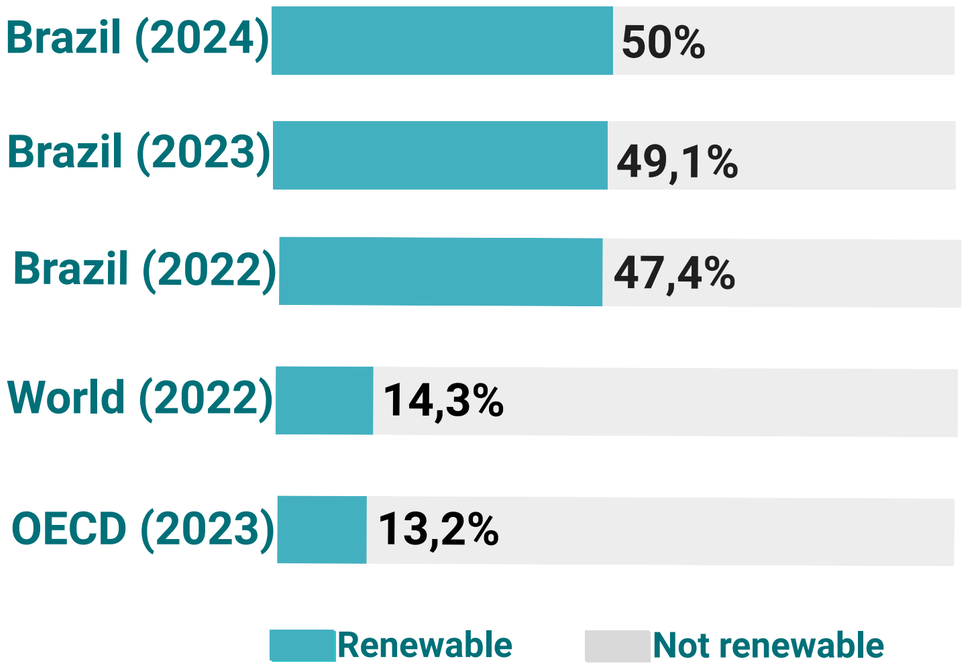


ASSOCIATED COMPANIES

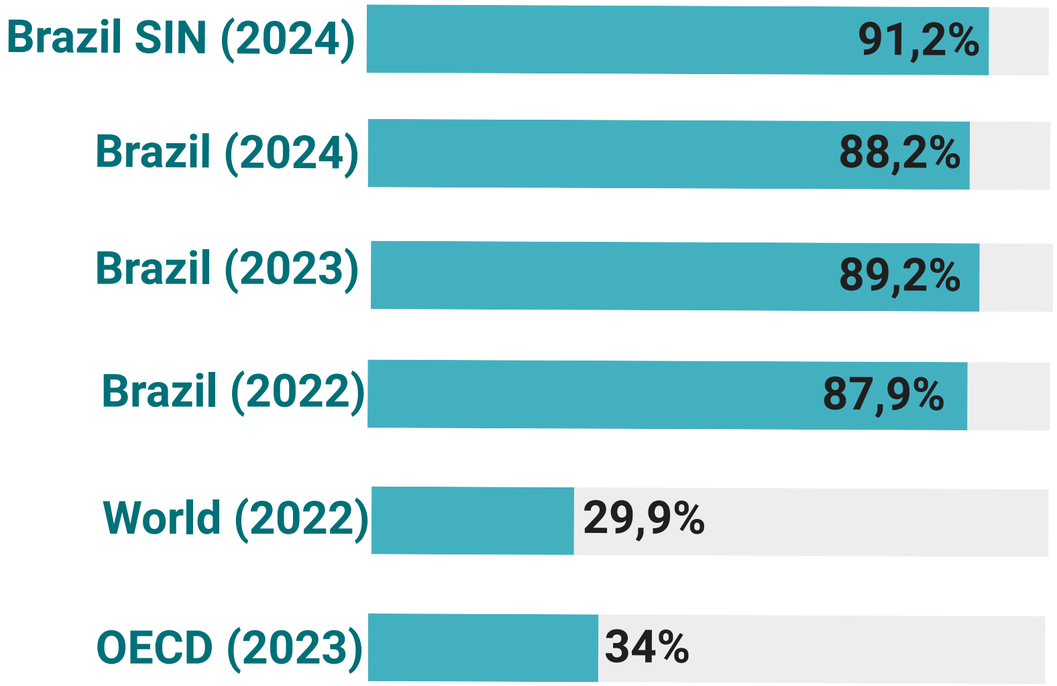
2G
acciona
adecoagro
ADEKOM Kompressoren
adicomp
AERZEN
AFBEL
aggreko
AIR PRODUCTS
altaz
Âmbar Energia
AMPLUM BIOGÁS
ANDERSEN BALLÃO
APOLO ENERGIA
asja
ASVO TEC Since 1965
Atlas Copco
atvos
AUMA
Awite
Barral Parente Pinheiro
BAUER COMPRESSORS
BAUR
Beng
BENU ENGENHARIA
BiogasLab
BioMovement
bp bunge bioenergia
Braskem
brasuma
Burckhardt Compression
camfil
CM
CSTR
GRUPO CETRIC
CIBiogas
Clean
cocal
comerc gás
comgas
GASMIG
COMPAGAS
LEÃO
GERANDO ENERGIA A SERVIÇO DO FUTURO
contil
COPA energia
Copergás
COPERSUCAR
DELMAR ANALYTICAL DO BRASIL
ecometano
ecotec
EDGE
EUROPEAN ENERGY
EKIUM
elera RENOVÁVEIS
energisa
ENERGY COOP
COOPERATIVA DE ENERGIAS RENOVÁVEIS
ENERMAC
estre
URCA
EVONIK
Faveret
FIGENER
FLUXO
GAIATEC SISTEMAS
GALILEO
GasBrasiliano
CRE
GAS FUTURO
GásOrgânico
gás verde
ZEG BIOGÁS
GASPROM
geo Biogas & Tech
GREENLANE BIOGÁS
Gruen
gss
H2A
INSTITUTO SENAI
INSTITUTO TOTUM
Ivri
JPX
GRUPO LARA
LEWA
ogas
safe
luming
MARQUISE AMBIENTAL
MAT
MATTOS FILHO
MAYEKAWA MYCOM
MC
METALPLAN
MITSUI GÁS
MultiFlow
MWM
Naturgy
newGas
nitrotec
nts
OMA
ON BIOGÁS
IVECO GROUP
onPower
ORIZON
ÓXIDO DE FERRO RIO ACIMA
PAQUES
PAULMICHL
Pietro Fiorentini
PlanET
PRODEVAL
PURE
raízen
REITER
RENU
RESOLVE BIOGAS
ROESLEIN
sabesp
Sanetran
São Martinho
SCHULZ
SCANIA
SEBIGAS
SERVARE
SINERGAS
TOYOTA TSUSHO BRASIL
SOENERGY
solvi
Statled Brasil
STOCCHE FORBES
suzano
SUPERGASBRAS
SWEP
sysadvance
TBG
TPI
TERAWATT
Tereos
thymos
TIETJEN DAS ORIGINAL
TORMENE GROUP
TotalEnergies
TR4NSFORM ENERGY
TAG
ultragaz
Unilever
UVBMARCA
VAISALA
VEIRANO
VEOLIA
verve
VIBRA
VILLEMOR AMARAL
GBio ENERGIA
WAGA ENERGY
WHITE MARTINS
YARA
zilor

BRAZILIAN MATRIX

ENERGY MATRIX



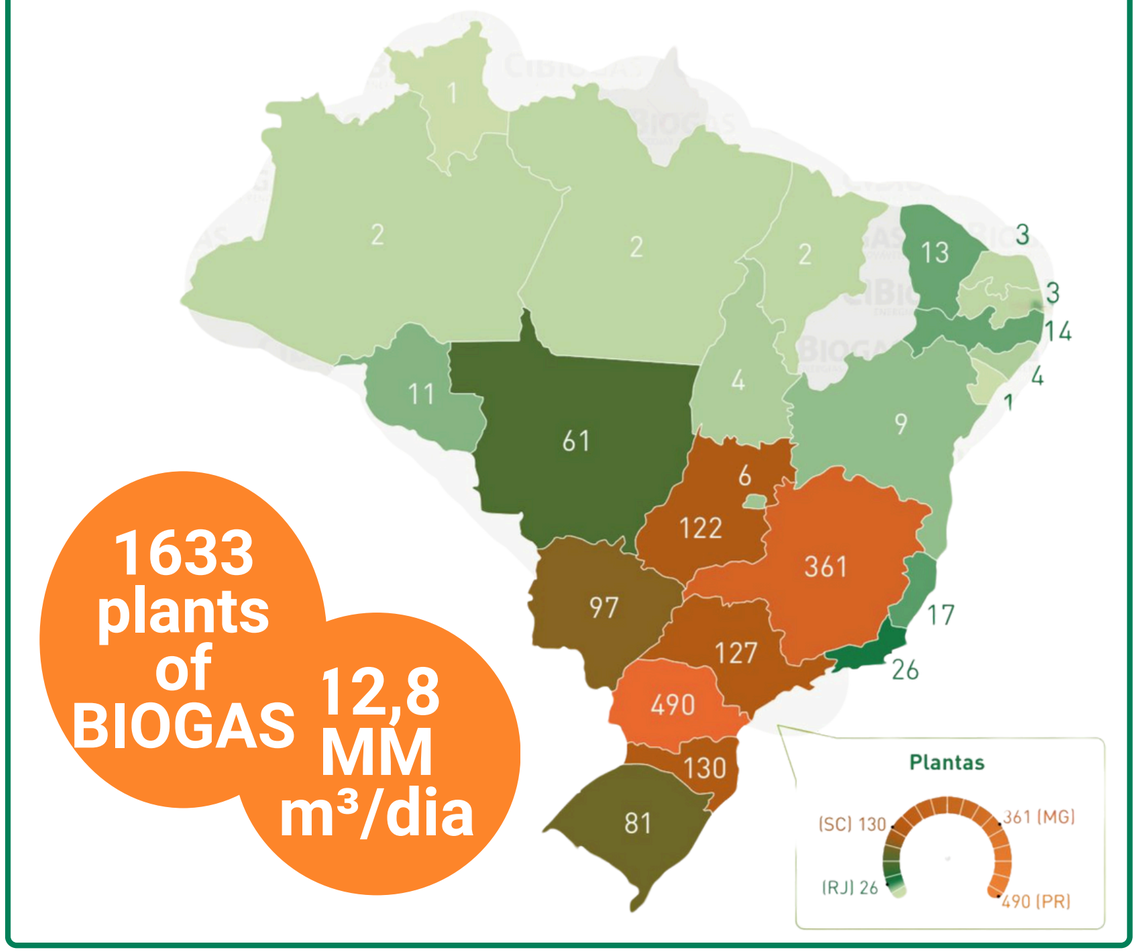
POWER MATRIX



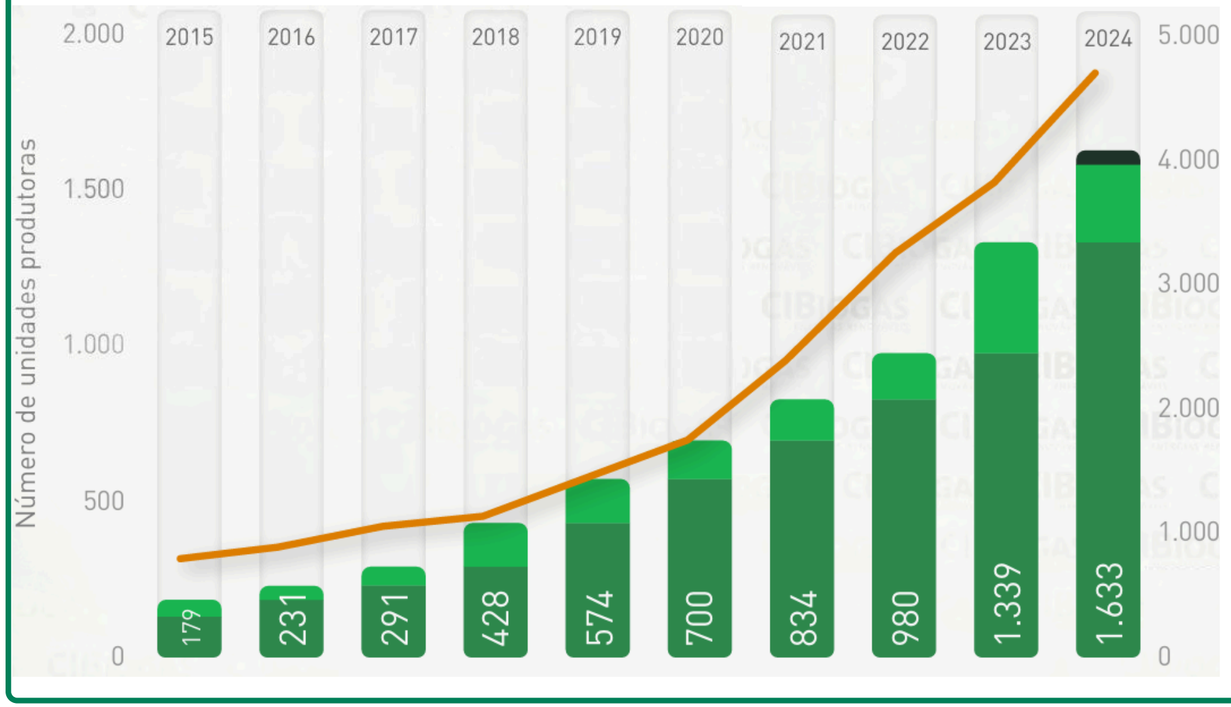
Source: National Energy Balance (BEN) 2024 - EPE

BIOGAS OVERVIEW

BIOGAS



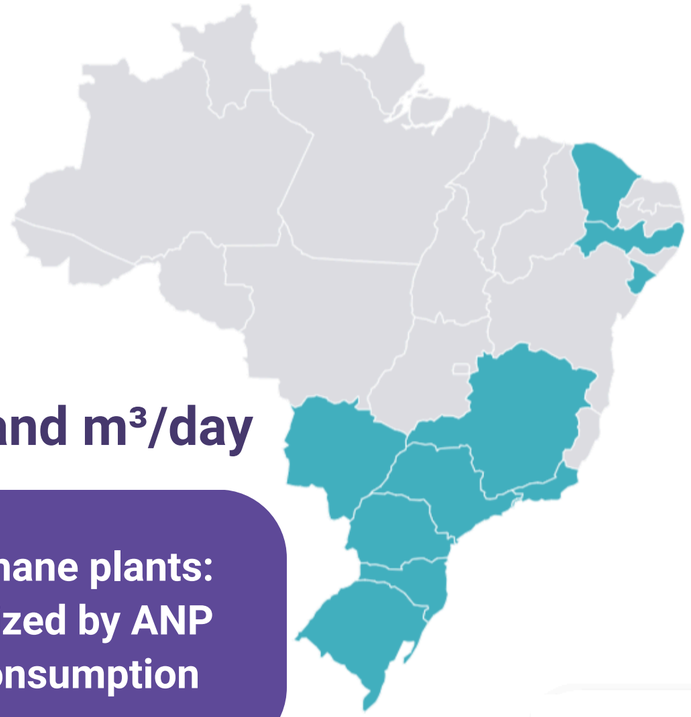
SECTOR GROWTH BETWEEN 2015 AND 2024



Source: Biogas Panorama - CIBiogás, 2025.

BIOMETHANE OVERVIEW

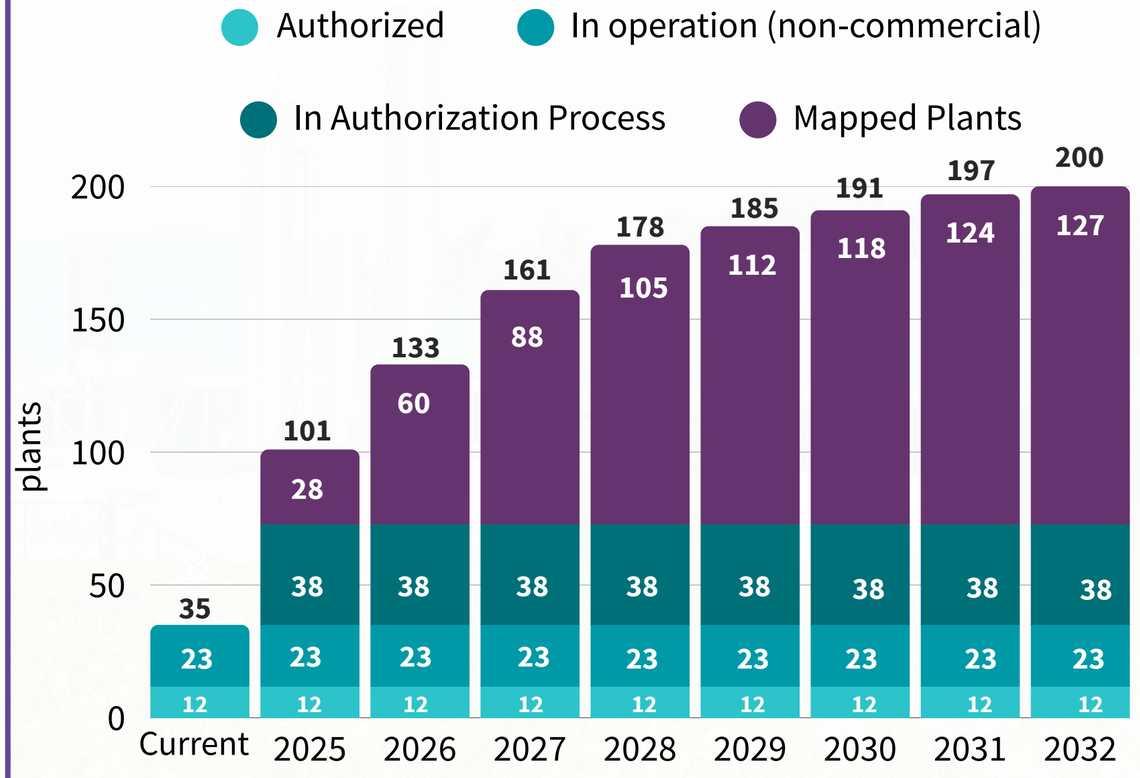
BIOMETHANE



874 thousand m³/day

35 biomethane plants:
12 authorized by ANP
23 self-consumption

ESTIMATED GROWTH OF BIOMETHANE UNTIL 2032



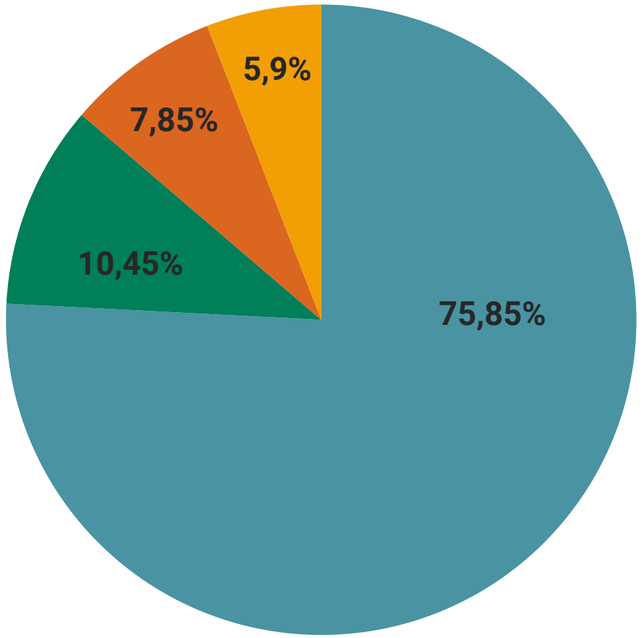
32	7,92 MM³/D
31	7,60 MM³/D
30	7,34 MM³/D
29	7,07 MM³/D
28	6,73 MM³/D
27	5,89 MM³/D
26	4,41 MM³/D
25	1,75 MM³/D

In Authorization Process → 1 509 973 m³/day

Source: ABiogás, ANP and CIBiogás, 2024.

SHORT-TERM POTENTIAL OF ABIOGAS

- Sugar-energy **26.48 million m³/day**
- Animal protein **3.65 million m³/day**
- Urban Solid Waste (MSW) **2.74 million m³/day**
- Sanitary sewage **2.06 million m³/day**



By 2030, biomethane production could reach

34.9 million

m³/day

Source: ABiogás based on the Study for the Development of the Potential for Biogas and Biomethane in the State of São Paulo by FIESP, 2024.

Long-term

Biomethane potential

120 million m³/day

Brazil produces biogas exclusively from waste

Anaerobic digestion is a natural and sustainable process that transforms organic waste into renewable energy, using only waste materials and not relying on any energy crops.



SUGAR CANE INDUSTRY



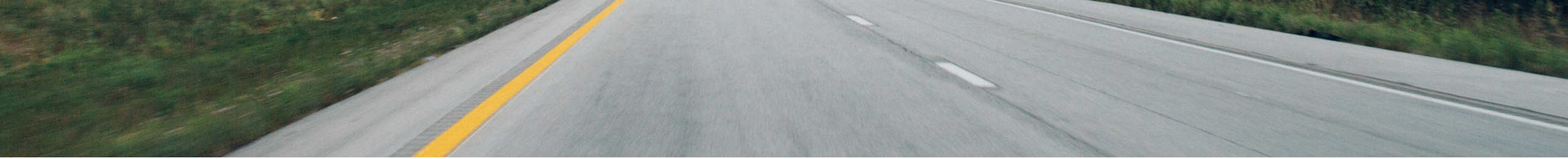
AGRICULTURE



ANIMAL MANURE



SANITATION



TRANSPORT

GÁS VERDE - URCA ENERGIA

Seropédica, RJ - Brazil



Substrate:
Landfill

Biomethane Volume:
120,000 m³/day

COMPANIES THAT USE BIOMETHANE IN THEIR FLEETS













TransMaroni chega a 50 caminhões











INDUSTRY

GEO BIO GAS&CARBON

Tamboara, PR - Brazil

INDUSTRIAL USE: FURNACES AND FORGES FOR METALLURGICAL PRODUCTION AT AESA AUTOMOLAS



Substrate:
Agroindustry

Biogas Volume:
86,880 m³/day

ZEG BIOGÁS

São José dos Campos, SP - Brazil

INDUSTRIAL USE: INDUSTRIAL CONSUMERS IN THE CHEMICAL AND GLASS SEGMENT



Substrate:
Sanitation

Biogas Volume:
30,000 m³/day

CIRCULAR ECONOMY

BLEY ENERGIAS

Londrina, PR - Brasil

CIRCULAR ECONOMY: TRANSPORT OF MILK AND ANIMAL FEED



Substrate:
Animal Manure

Biomehane Volume:
200 m³/day

ADECOAGRO

Ivinhema, MS - Brazil

CIRCULAR ECONOMY: POWER GENERATION AND TRANSPORTATION FUEL



Substrate:
Sugar cane industry

Biomethane Volume:
6,600 m³/day

YARA FERTILIZANTES

Cubatão, SP - Brazil

CIRCULAR ECONOMY: 5 THOUSAND TONS/YEAR OF RENEWABLE AMMONIA



Substrate:
Sugar cane industry

Biomethane Volume:
20,000 m³/day

FEDERAL REGULATORY INCENTIVES

FUELS OF THE FUTURE:
Creates of a decarbonization target that will be met through the mandatory purchase of biomethane by producers and importers of natural gas and creation of a certificate of guarantee of origin of biomethane. Decarbonization target of SAF.

MOVER:
Establishes that all government incentives must consider life cycle energy analysis when making policies to incentivize green mobility.

NATIONAL BIOFUELS POLICY - RENOVABIO:
Program that sets decarbonization goals for liquid fuel distributors, who need to acquire decarbonization credits(CBIOs) from biofuel producers.

PATEN:
Its objective is to facilitate access to credit for sustainable development projects. The program uses corporate tax credits with the federal government to finance initiatives related to the energy transition, including biogas and biomethane projects among its priority sectors.

HYDROGEN LEGAL FRAMEWORK AND INCENTIVES TO GREEN AND RENEWABLE HYDROGEN:
Regulates the production of hydrogen considered low-carbon and establishes a voluntary certification.

NEW GAS LAW:
Brought measures to opening the gas market in Brazil and establishes that biomethane that complies with ANP standardization must have equal regulatory treatment of natural gas.

NATIONAL POLICY FOR SOLID WASTE:
Established targets for improving the management of urban solid waste, including biogas production.

CARBON MARKET:
Established a regulated carbon market, creating mechanisms for the trading of carbon credits. This initiative aims to encourage the reduction of greenhouse gas emissions and promote investments in clean technologies, such as biogas and biomethane.

LAW No. 14,993/2024

Promotion of sustainable low-carbon mobility and the capture and geological storage of carbon dioxide.

National Program for Decarbonization of Natural Gas Producers and Importers and Incentive to Biomethane

GUIDELINES

I

Recognition of the use of biogas and biomethane to meet decarbonization goals.

II

Recognition of LCA as the best methodology for measuring the reduction of GHG emissions and the environmental benefits of technological routes.

GOALS

I

Stimulate the production and consumption of biomethane and biogas with projects in the production chain.

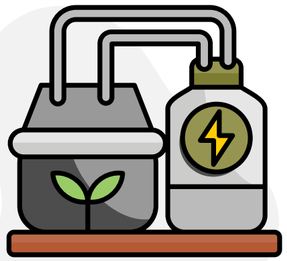
II

Encourage heavy vehicles, agricultural machinery and engine conversion to methane.

III

Promote infrastructure to connect biomethane plants to natural gas networks, with economic viability.

NATIONAL PROGRAM FOR DECARBONIZATION OF NATURAL GAS PRODUCERS AND IMPORTERS AND INCENTIVE OF BIOMETHANE



1

DECARBONIZATION GOAL

CNPE defines the mandatory decarbonization target, from 1 to 10% from 2026.

DEFINITION OF THE VOLUME OF BIOMETHANE TO BE ACQUIRED

2

The ANP will define the volume of biomethane according to the percentage of the mandatory annual target for reducing greenhouse gas emissions in the natural gas market.

BIOMETHANE OR CGOB

3

Natural gas producers and importers must prove decarbonization through the purchase or use of a minimum volume of biomethane or the acquisition of a Biomethane Origin Guarantee Certificate - CGOB.





CGOB MARKETING

4

The CGOB and biomethane acquired may be freely traded until their retirement by those who are interested in effectively decarbonizing, but may only be used to achieve objectives once.

CGOB NEGOTIATION

5

The Biomethane Origin Guarantee Certificate may be traded in organized markets, including at auctions.





CGOB REGULATION

6

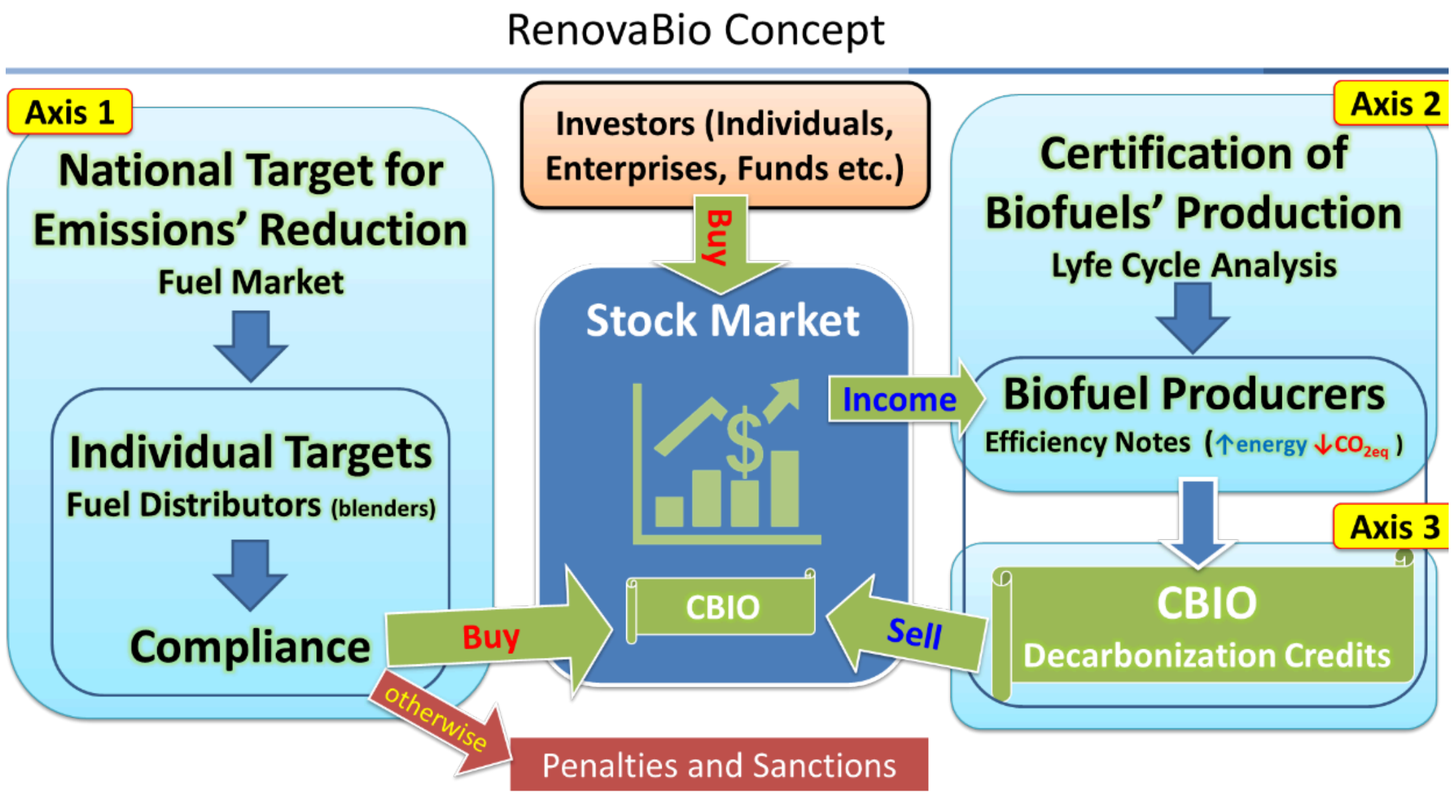
The regulation will provide for the issuance, maturity, intermediation, custody, bookkeeping, negotiation and other aspects related to the CGOB.

REGULATORY INCENTIVES

NATIONAL BIOFUELS POLICY - RENOVABIO: Program that sets decarbonization goals for liquid fuel distributors, who need to acquire decarbonization credits(CBIOs) from biofuel producers.

US$ 19,30 (average value on April 12, 2024)

Since the beginning of RenovaBio, the prices of credits have ranged from US$ 2,89 to US$ 40,31



STATE REGULATORY INCENTIVES

GREEN SUPPLY CONTRACT:

Natural Gas distribution companies in the State of São Paulo may sign with consumers a contract that will provide biomethane to consumers, by charging an additional price.

PARANÁ RENEWABLE RURAL ENERGY - RENOVAPR:

Special financing conditions for renewable energy generation, including biogas and biomethane production.

SIMPLIFICATION OF ENVIRONMENT LICENSING BUREAUCRACY:

State of Paraná establishes different environmental licensing process according to the environment risk presented by different sizes and kinds of residues used in plants.

THE SUSTAINABLE CORRIDORS PROGRAM:

State incentives to adapt fuel stations to supply trucks with natural gas and biomethane and federal incentives for the substitution of diesel truck fleet to CNG and LNG motors.

BIOMETHANE MANDATORY MIXTURE:

State of Rio de Janeiro obliges natural gas distribution companies to have a 10% mixture of biomethane, but it sets a very low cap price for the acquisition of biomethane.

PUBLIC CALLS FOR BIOMETHANE PROCUREMENT:

In 2024, eight public calls for biomethane highlighted the sector's growth and its role in energy diversification. Initiatives in states like Alagoas, Bahia, Pernambuco, Paraná, São Paulo, and Mato Grosso do Sul are driving investment and regional integration.

TAX INCENTIVES

CONSTITUTIONAL AMENDMENT Nº 123/2022

Established that taxation of biofuels and renewable hydrogen must be lower than the taxation of fossil fuels, to guarantee competitiveness.

SPECIAL REGIME OF INCENTIVES FOR INFRASTRUCTURE DEVELOPMENT (REIDI)

Reidi's tax incentive consists of suspending the incidence of contributions to PIS (1.65%) and COFINS (7.6%) on revenues arising from the acquisitions of good necessary to the construction of biogas and biomethane plants

REDUCTION OF ICMS (IVA) RATE FOR BIOGAS AND BIOMETHANE

Reduces tax rate on biogas and biomethane transactions to 12% in some states.

TAX REFORM

It simplifies taxes and strengthens the competitive advantage of biofuels, setting IBS and CBS rates at up to 60%, in relation to fossil fuels.

INCENTIVATED DEBENTURES AND BONDS

Tax reduction for renewable energy infrastructure companies that issue bons and debentures.

ABiogás

Associação Brasileira do Biogás

Alessandro Gardemann

Chairman of the Board

Mr. Tim Hamers

Global Biofuels Alliance knowledge webinar



Renewable Gas Certificate for biomethane

25 June 2025

Visit Our Website
www.ergar.org

Introducing ERGaR

- ERGaR is the **European Renewable Gas Registry**

- What do we do?
  - Facilitate the cross-border transfers of renewable gas certificates (Certificates/Guarantees of Origin)

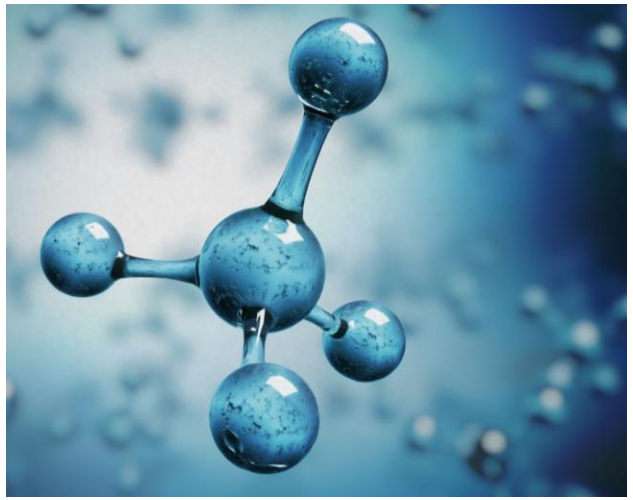
  - Provide a forum for the collaboration of renewable gas registries and market participants in Europe



ergar
European Renewable Gas Registry

Why certification?

Non-renewable methane from grid



Biomethane from grid



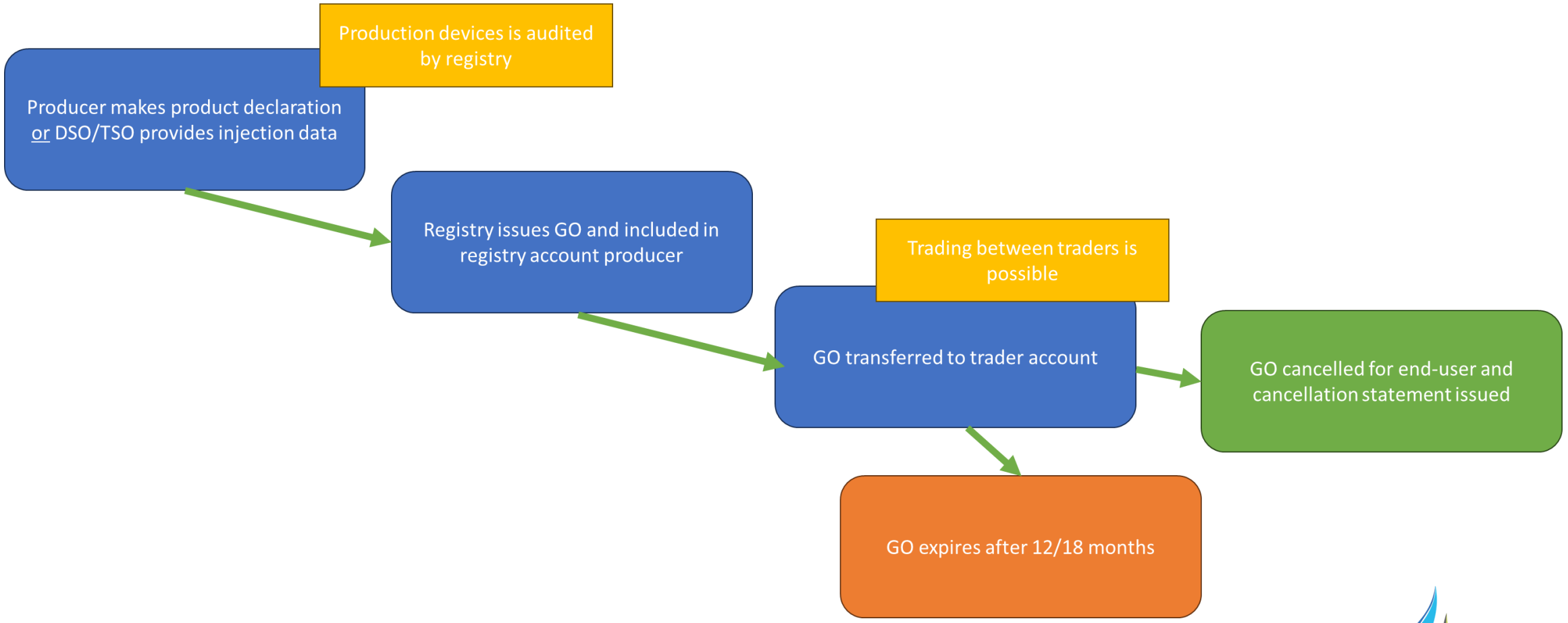
ergar
European Renewable Gas Registry

Types of certificates

Key characteristics			
Certificates	Guarantee of Origin (GO)	Proof of Sustainability	Others (e.g. Certificate of Origin)
Legal basis	Art. 19 RED II	Art. 25-31 RED II	None, national legislation
Purpose	Consumer disclosure	Target counting	Renewable obligations, disclosure
Verification	EN 16325	Recognised voluntary schemes	National legislation
Issuing body	Government appointed	Sometimes national databases, none	Differs (e.g. dena)
System	Book & claim	Mass balancing	(Generally) book & claim

ergar
European Renewable Gas Registry

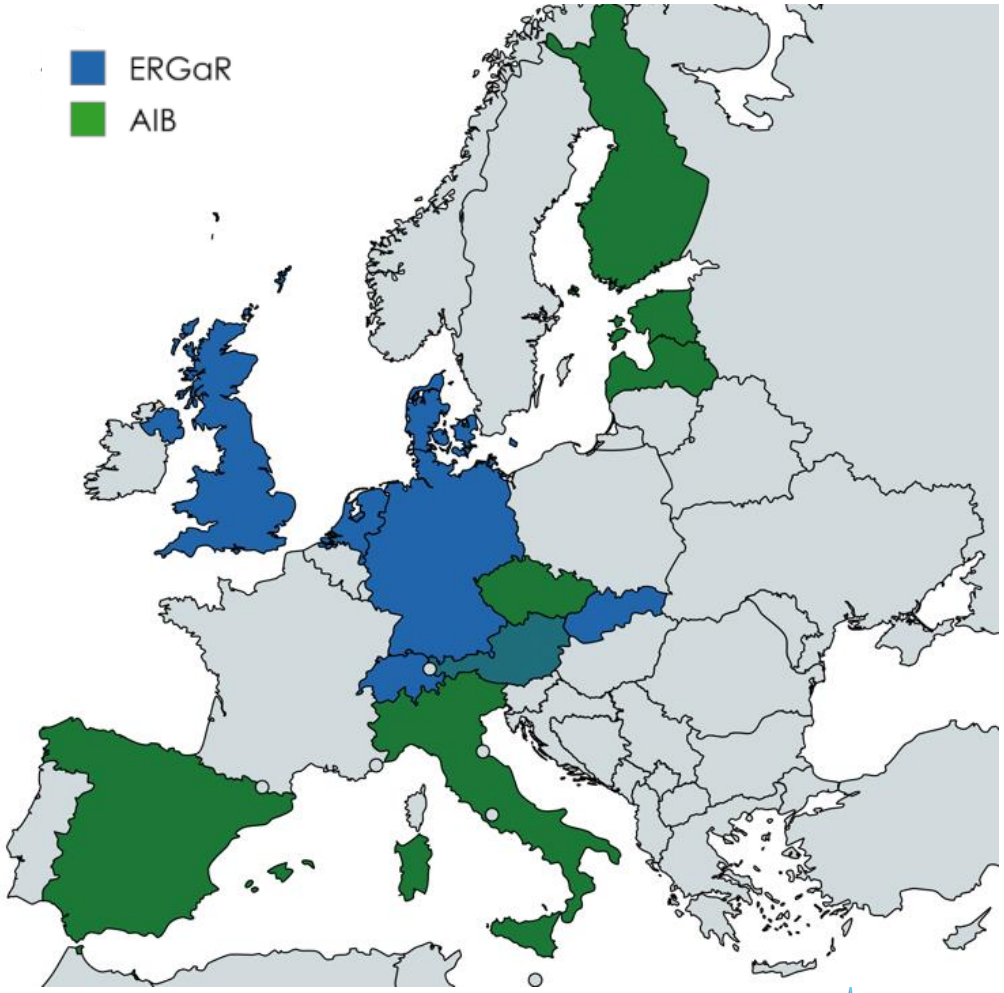
Guarantee of Origin – in practice



ergar
European Renewable Gas Registry

ERGaR CoO Scheme

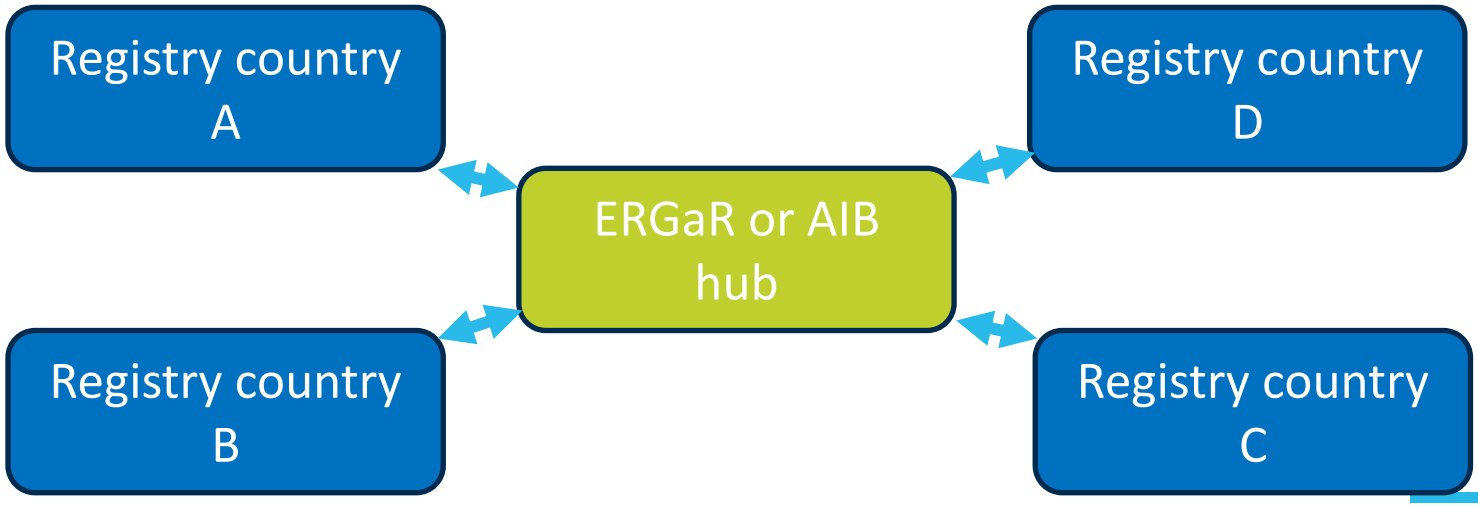
- Launched in Q1 2021
- 7 system participants at the moment
  - Sometimes government approved (e.g. NL, DK, SK, CH) with a GO, sometimes not (e.g. DE, UK, AT) with a CoO



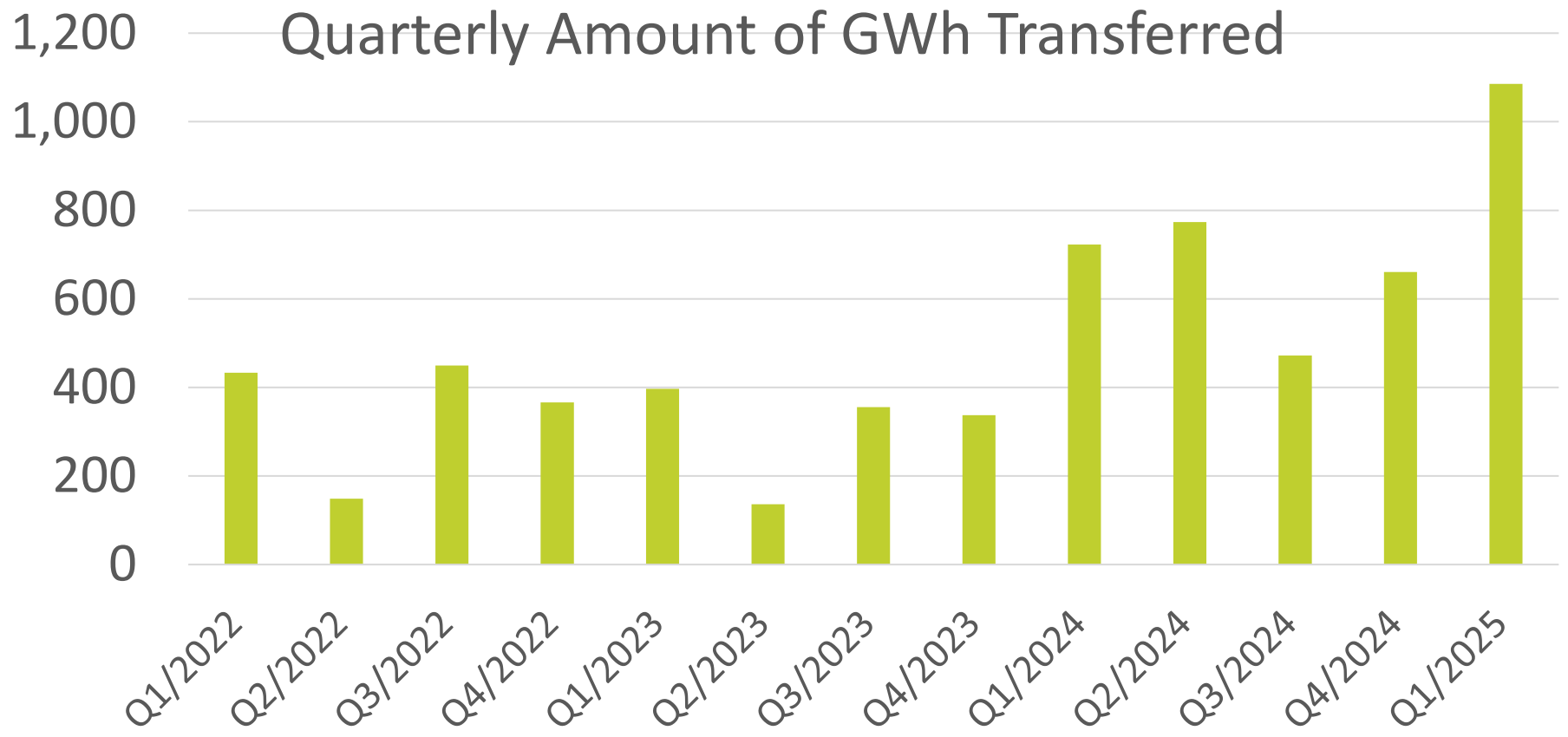
ergar
European Renewable Gas Registry

Cross-border trading GOs/COs

- Cross border trade via ERGaR or AIB for member countries
  - Easier with one centralised hub than bilateral agreements between all countries
  - Ongoing discussions on cooperation with AIB
  - AIB Gas Scheme members: Spain, Italy, Austria, Czech Republic, Latvia, Brussels & Finland



Statistics



ergar
European Renewable Gas Registry

Challenges cross-border GO trading

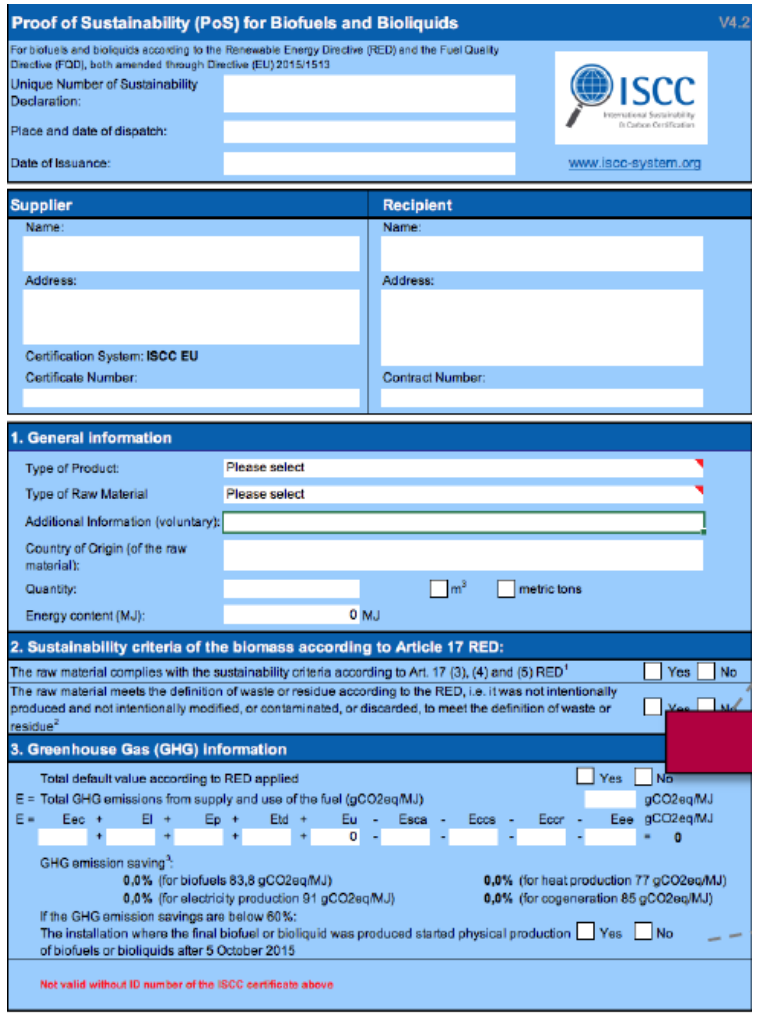
- No GO registry in each country
- Not all GO registries connected to same Hub
- Requires account in various GO registries

ergar
European Renewable Gas Registry

Proof of sustainability

- Document that confirms the production is sustainable according to RED II rules

- PDF document can be sent by email across all borders
  - No capacity bookings required on EU gas grid



Proof of Sustainability (PoS) for Biofuels and Bioliquids V4.2

For biofuels and bioliquids according to the Renewable Energy Directive (RED) and the Fuel Quality Directive (FQD), both amended through Directive (EU) 2015/1513

Unique Number of Sustainability Declaration:

Place and date of dispatch:

Date of Issuance:

ISCC

www.iscc-system.org

Supplier	Recipient
Name:	Name:
Address:	Address:
Certification System: **ISCC EU**	
Certificate Number:	Contract Number:

1. General information

Type of Product: Please select

Type of Raw Material: Please select

Additional Information (voluntary):

Country of Origin (of the raw material):

Quantity: ☐ m³ ☐ metric tons

Energy content (MJ): 0 MJ

2. Sustainability criteria of the biomass according to Article 17 RED:

The raw material complies with the sustainability criteria according to Art. 17 (3), (4) and (5) RED[1] ☐ Yes ☐ No

The raw material meets the definition of waste or residue according to the RED, i.e. it was not intentionally produced and not intentionally modified, or contaminated, or discarded, to meet the definition of waste or residue[2]

3. Greenhouse Gas (GHG) Information

Total default value according to RED applied ☐ Yes ☐ No

E = Total GHG emissions from supply and use of the fuel (gCO2eq/MJ) gCO2eq/MJ

E = Eec + El + Ep + Etd + Eu - Esca - Eccs - Eccr - Eee gCO2eq/MJ

0 = 0

GHG emission saving[3]:

0,0% (for biofuels 83,8 gCO2eq/MJ) 0,0% (for heat production 77 gCO2eq/MJ)

0,0% (for electricity production 91 gCO2eq/MJ) 0,0% (for cogeneration 85 gCO2eq/MJ)

If the GHG emission savings are below 60%:

The installation where the final biofuel or bioliquid was produced started physical production of biofuels or bioliquids after 5 October 2015 ☐ Yes ☐ No

Not valid without ID number of the ISCC certificate above

ergar

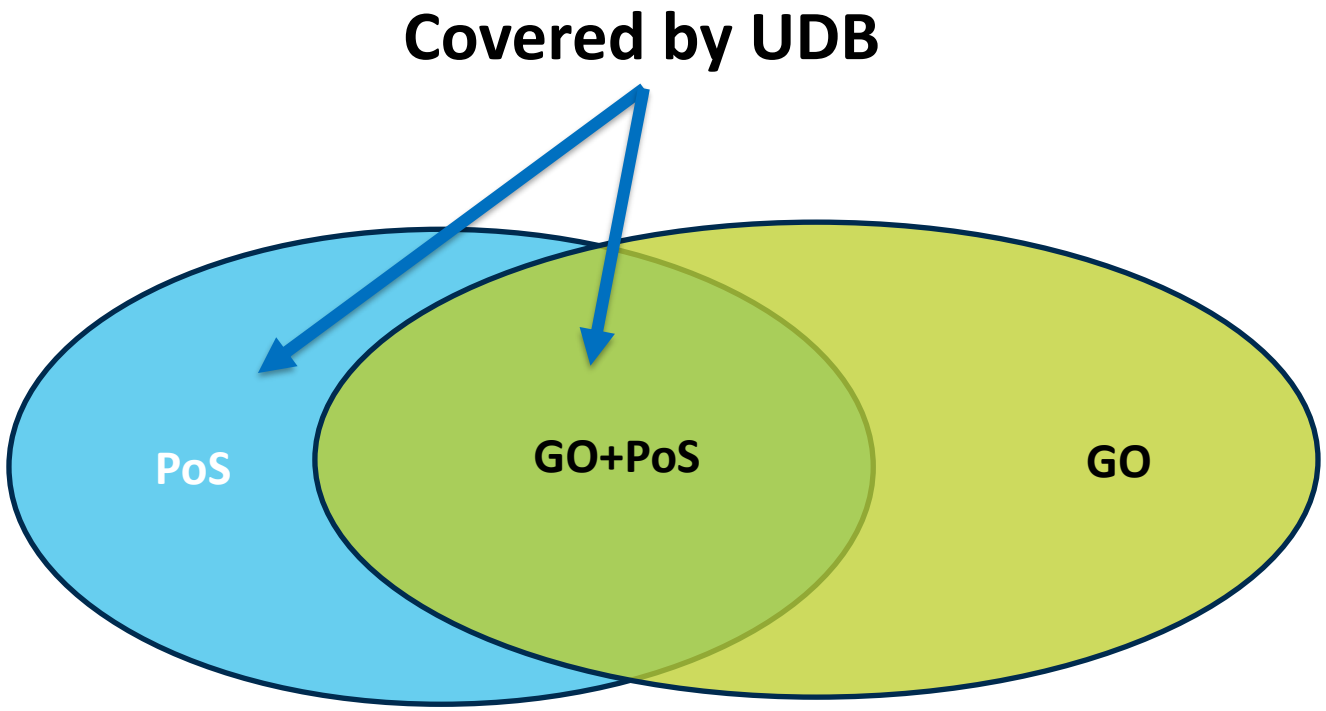
European Renewable Gas Registry

Union Database

- New Union Database will replace current system of tracking and tracing ownership of PoS
  - Based on article 31a Renewable Energy Directive
  - Not a trading platform
  - Many questions still open **-> i.e. major disclaimer on presentation**

ergar
European Renewable Gas Registry

UDB scope



Impact UDB on cross-border trade

- More harmonized market for GO + PoS
- More clarity
- Problems with imports from 3rd countries

ergar
European Renewable Gas Registry

Biomethane markets

- Different use cases for biomethane (certificates)
  - Compliance markets
  - European Emission Trading Scheme (ETS)
  - Voluntary market

ergar
European Renewable Gas Registry

Biomethane compliance market

- Compliance markets (with PoS)
  - Transport sector
    - In each country based on EU Renewable Energy Directive
  - Blending obligations (e.g. Netherlands or France)
    - Certain percentage of methane/gas used needs to be biomethane
    - Starting to be implemented
    - Limits on using biomethane from abroad
  - German quotas (EEG, BeHG, etc)
    - Several types of quotas in Germany
    - Most commonly used is EEG to claim renewable energy production and increase expected for renewable heating

Biomethane ETS markets

- European Emission Trading Scheme allows use of sustainable biomethane
  - Biomethane with PoS considered zero-rated
  - According to EU guidance (MRR) PoS and GO should be used jointly to claim according to ETS
  - Differences in implementation in countries on where to send certificates or how to use subsidized biomethane
  - UDB should make this simpler

ergar
European Renewable Gas Registry

Biomethane voluntary markets

- Uncertainty on how biomethane can be used for voluntary market
  - Main guidance should come from GHG Protocol, but no clarity on how biomethane certificates can be used
  - Companies follow the GHG Protocol due to EU legislation or programme setting within SBTi
  - GHG Protocol guidance documents are currently being revised
    - Timeline: standard ready by end of 2028 with first document end of 2025
    - Depending on results GO and/or PoS can be used to reduce scope 1 and/or scope 3 emissions
      - Will have big impact on biomethane market

Biomethane support

- Biomethane market support mechanisms are different between European countries

- Support mostly needed and different in countries:
  - Investment support (e.g. Ireland)
  - Production support (e.g. France)
  - Quotas (e.g. Germany and soon Netherlands)

- Will impact price in each market with small differences in approach

Biomethane price drivers

- Carbon intensity score (i.e. GHG emissions)
  - CI-score can be minimum threshold (e.g. German transport) or be part of total calculations (e.g. Dutch blending obligations)
    - Manure and other waste has lower CI score than crops
- Subsidised/unsubsidized biomethane
  - Depending on national rules subsidized biomethane cannot be used for transport market and/or ETS
- Guarantee of Origin – Proof of Sustainability
  - Biomethane that is considered susbtainable with a PoS is higher in price
- Feedstock
  - Waste often higher price due to limitations on crop use to quality for subsidies or quotas in certain countries

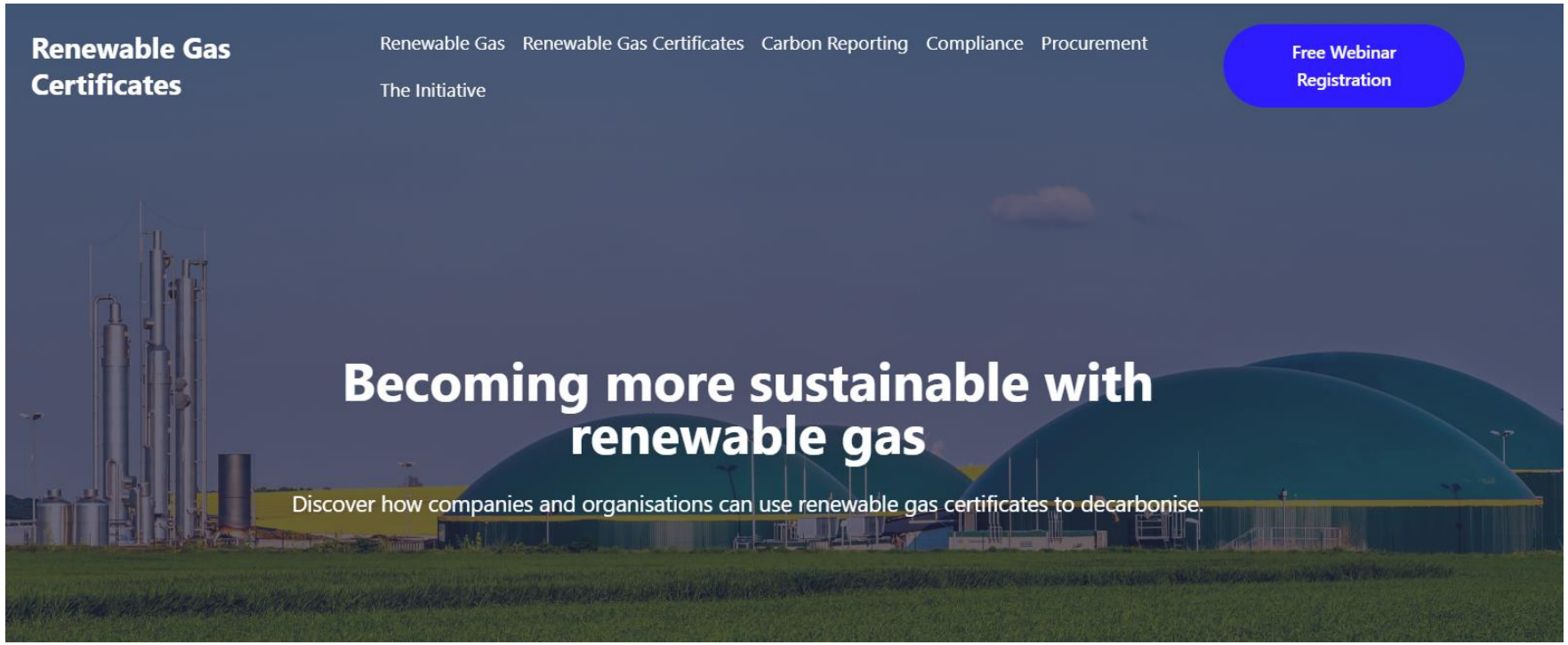
ergar
European Renewable Gas Registry

Key developments expected coming years

- Continue trend of stable and significant growth
- Movement towards single European market
  - EU Union Database will create more harmonization and trust in system
  - More certificate registries connected
- Expected more voluntary demand
  - Revision GHG Protocol guides (hopefully) with more clarity on role biomethane
  - Increased interest from corporates
- Continued support systems with more attention to quotas and blending obligations

ergar
European Renewable Gas Registry

More information



www.renewablegascertificates.org

ergar
European Renewable Gas Registry

THANK YOU & STAY IN TOUCH WITH US!

https://www.ergar.org/

Avenue de Cortenbergh 100
B-1000 Brussels

Follow us on LinkedIn
ERGaR European Renewable Gas Registry aisbl

ergar
European Renewable Gas Registry

Dr. Archishman Bose & Dr. Richard O'Shea

MaREI
Energy · Climate · Marine

Taighde Éireann
Research Ireland

Innovations in Biomethane: Insights from Recent Research Projects

Presenters: Dr Archishman Bose, Dr Richard O'Shea

The Biomethane Webinar
25th June 2025

HOST INSTITUTION

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

PARTNER INSTITUTIONS

DCU Ollscoil Chathair Bhaile Átha Cliath Dublin City University
DIAS
Dundalk Institute of Technology Institiúid Teicneolaíochta Dhún Dealgan
ESRI An Institiúid um Thaighde Eacnamaíochta agus Sóisialta Economic & Social Research Institute
MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University
Maynooth University National University of Ireland Maynooth
Trinity College Dublin Coláiste na Tríonóide, Baile Átha Cliath The University of Dublin
DUBLIN
Tyndall National Institute
UCD University College Dublin An Coláiste Ollscoile, Baile Átha Cliath
Ollscoil na Gaillimhe University of Galway
University of Limerick Ollscoil Luimnigh

Dr Richard O'Shea



Dr Richard O'Shea

- Lecturer in Sustainability in Enterprise, School of Engineering, UCC (2021- Present)
- PhD in Energy Engineering "Pathways to a biomethane industry in Ireland" (UCC, 2018)
- BE (Hons) in Energy Engineering (UCC, 2014)
- *Multiple Criteria Decision Analysis*
- *Decarbonization of industry, technoeconomic analysis*

EcoAD
Developing Economic solutions for on-farm Anaerobic Digestion technologies under Irish conditions

CABBBIE
Developing Cascading Biomethane Biochemicals and Biofertiliser Systems for a Circular Bioeconomy in Ireland

ShipFuel-IE

eagasc
Agriculture and Food Development Authority

REVEIRE
Regenerative Value Systems for Irish Grown Wool in Ireland

ENTYRE
Mapping the Role of End-of-Life Tyres for a Sustainable Circular Economy in Ireland

seai Sustainable Energy Authority of Ireland

Gas Networks Ireland

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

An Roinn Iompair
Department of Transport

Walsh Scholars Programme

epaResearch

Circular Economy, Energy & Environmental Systems

MaREI Energy · Climate · Marine



Prof Jerry Murphy

Director: MaREI

Professor of Civil Engineering



Dr Archishman Bose

Bioenergy & Biorefinery

Eli Lily Lecturer in Process Engineering



Dr David Wall

Advanced Fuels & Circular Economy

Senior Lecturer in Transportation Engineering



Dr Richard O Shea

Industrial Ecology

Lecturer in Sustainability in Enterprise

Interreg North-West Europe BIOWILL

eagasc Agriculture and Food Development Authority

Gas Networks Ireland

An Roinn Talmhaíochta, Bia agus Mara Department of Agriculture, Food and the Marine

Irish Distillers Pernod Ricard

epaResearch Climate · Water · Sustainability

Taighde Éireann Research Ireland

seai Sustainable Energy Authority of Ireland

Irish Research Council An Chomhairle um Thaighde in Éirinn

An Roinn Iompair Department of Transport

AbInBev



Dr Xue Ning



Dr Nathan Gray



Dr Deepa Sachan



Dr Soumitra Pati



Dr Yunfei Li



Dr Abdul Haq



Derek Casey



Rajas Shinde



Nikita Verma



M. Nabeel Haider



Mohammadali Babanejadi



Asif Tanvir Bhuiya



Niloufar Hasanpour



Rohan Solanki



Hongkun Zhu



Shaghayegh Mojoodi



Jun Ni



Matthew Carrol



Dr Gaia Crestani

e-Fuels & e-Refineries



Hydrogen

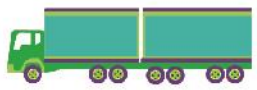
Methanol

Ammonia

Methane

Fuels





Sustainable Technologies

Experimental Analysis

Systems Modelling

Waste Valorisation

ces3

Circular Economy, Energy & Environmental Systems

Refinery

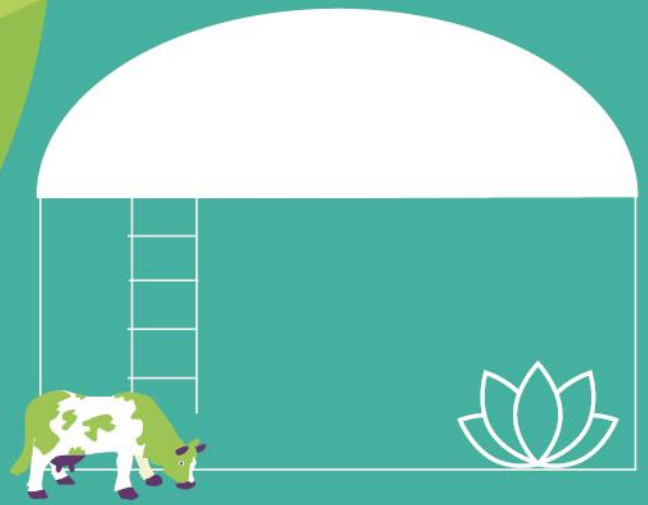
Micro-algae

Biochar

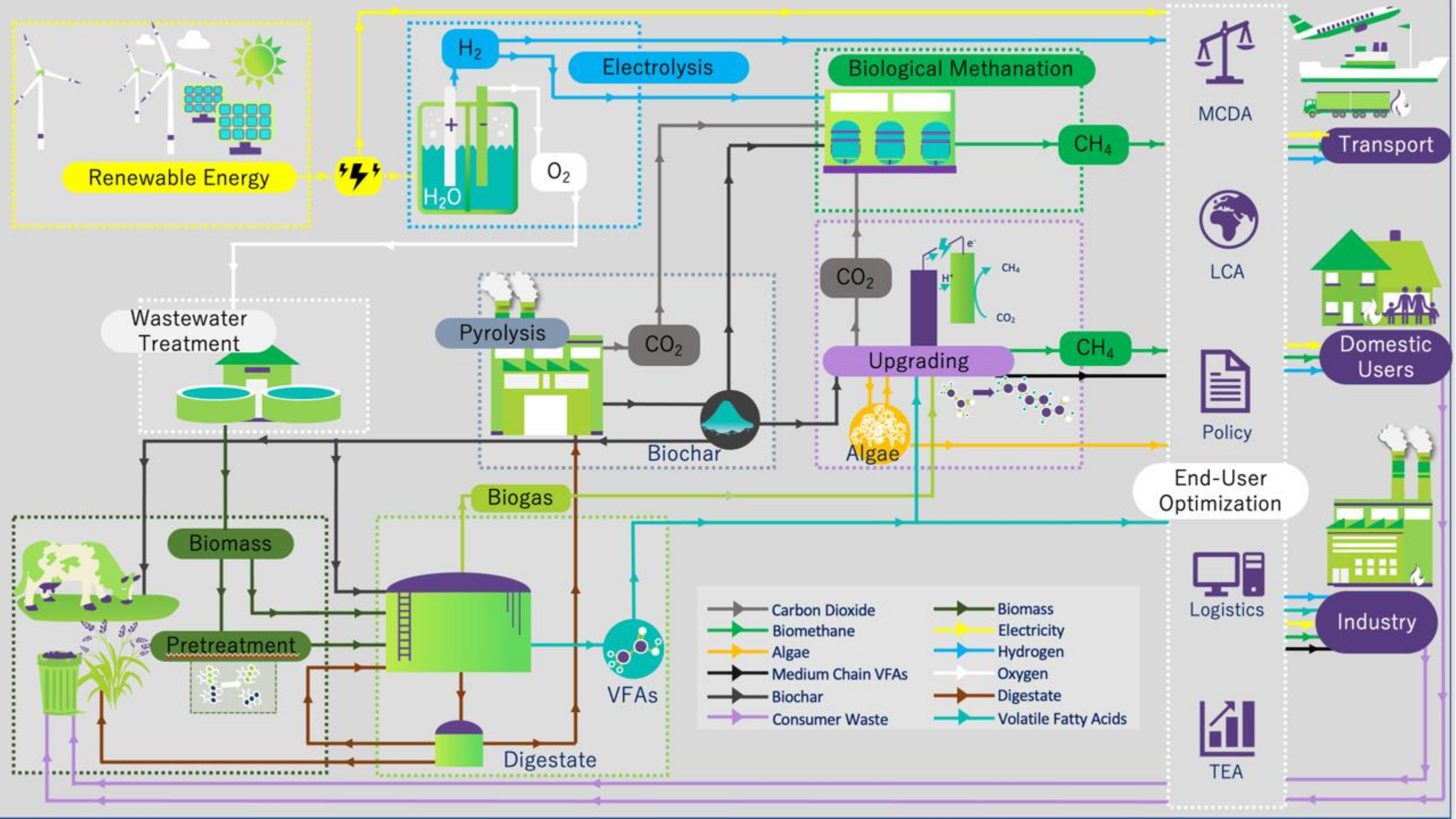
Biofertilisers

Carboxylic Acids

Carbon Dioxide



Biofuels & Biorefineries


Renewable Energy
H_2
Electrolysis
O_2
H_2O
Biological Methanation
CH_4
MCDA
Transport
LCA
CO_2
CH_4
Wastewater Treatment
Pyrolysis
CO_2
Upgrading
CH_4
Domestic Users
Policy
Biochar
Algae
End-User Optimization
Biogas
Biomass
Pretreatment
VFAs
Digestate
Logistics
Industry
TEA
Carbon Dioxide
Biomethane
Algae
Medium Chain VFAs
Biochar
Consumer Waste
Biomass
Electricity
Hydrogen
Oxygen
Digestate
Volatile Fatty Acids

EcoAD


Prof Jerry Murphy


Dr David Wall


Dr Richen Lin


Dr Richard O Shea


Dr Xue Ning


Dr Donal O Ceileachair


Dr Jorge Diaz Huerta

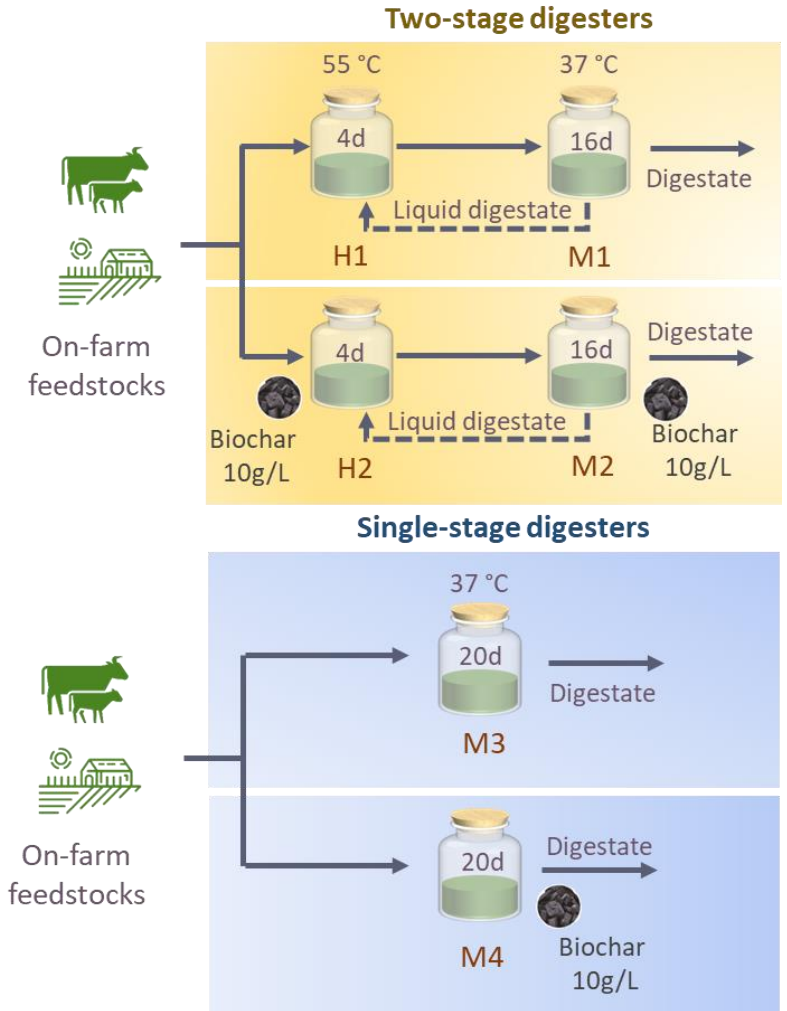
WP1: Enhance on-farm digestion efficiency through novel pre-treatments

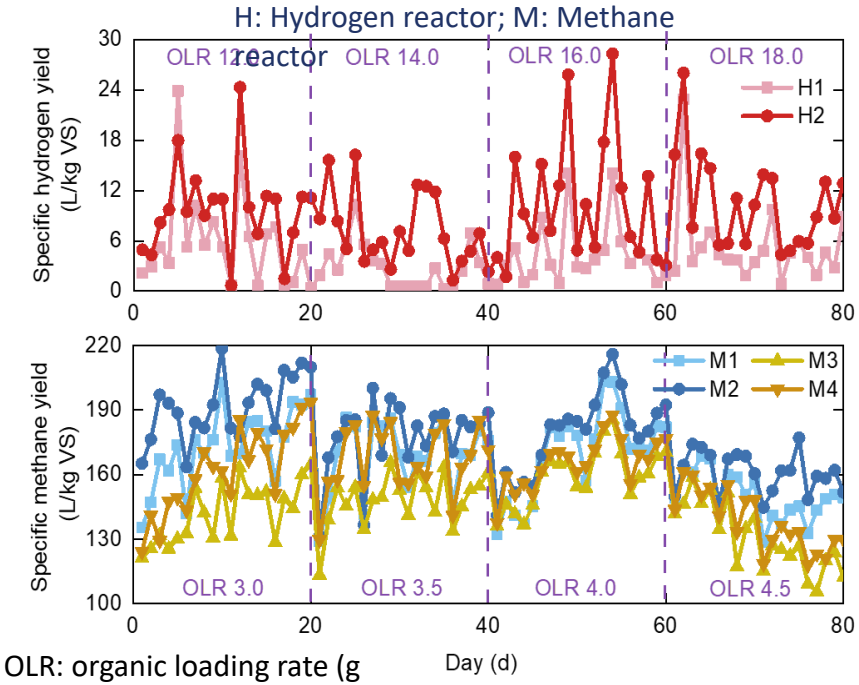
WP2: Integration of electro-methanogenesis with anaerobic digestion to increase overall biomethane conversion

WP3: Optimising the logistics of on farm anaerobic digestion in Ireland

WP4: Techno-economic analysis of potential on-farm anaerobic digestion pathways

WP5: Management, communication, and dissemination

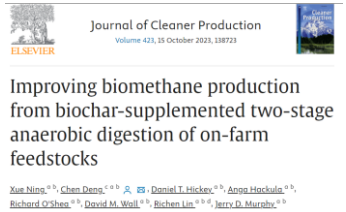




OLR: organic loading rate (g VS/L/day)

Biochar increased bio-hydrogen yield by 62% - 139% in two stage continuous digestion

Biochar increased biomethane yield by 3% in single stage continuous digestion, and 7% in two stage continuous digestion (OLR 4 kg VS/m^3/day)


Journal of Cleaner Production

Improving biomethane production from biochar-supplemented two-stage anaerobic digestion of on-farm feedstocks

EcoAD


Prof Jerry Murphy


Dr David Wall


Dr Richen Lin


Dr Richard O Shea


Dr Xue Ning


Dr Donal O Ceileachair


Dr Jorge Diaz Huerta

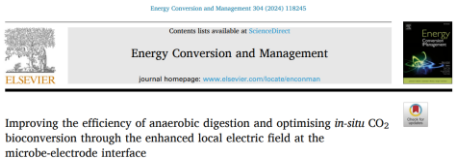
WP1: Enhance on-farm digestion efficiency through novel pre-treatments

WP2: Integration of electro-methanogenesis with anaerobic digestion to increase overall biomethane conversion

WP3: Optimising the logistics of on farm anaerobic digestion in Ireland

WP4: Techno-economic analysis of potential on-farm anaerobic digestion pathways

WP5: Management, communication, and dissemination

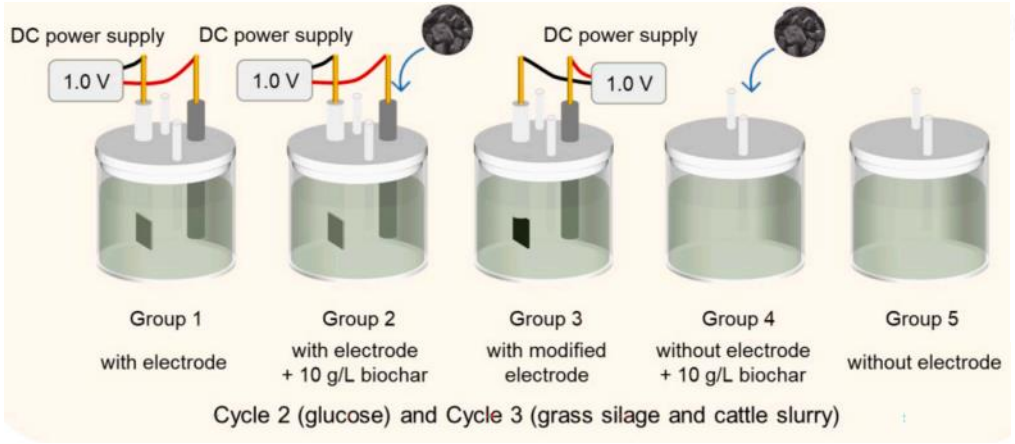

Energy Conversion and Management 304 (2024) 118245

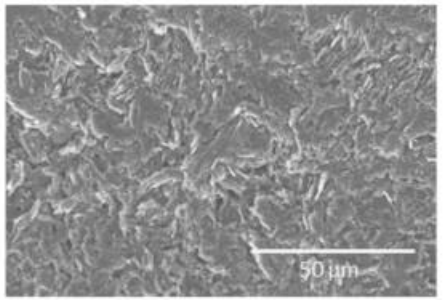
Contents lists available at ScienceDirect

Energy Conversion and Management

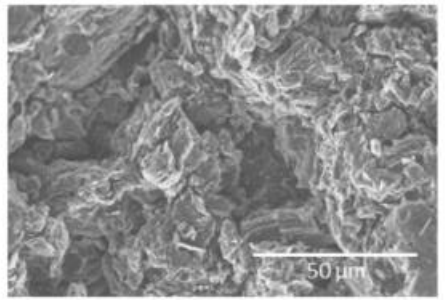
journal homepage: www.elsevier.com/locate/enconman

Improving the efficiency of anaerobic digestion and optimising *in-situ* CO_2 bioconversion through the enhanced local electric field at the microbe-electrode interface

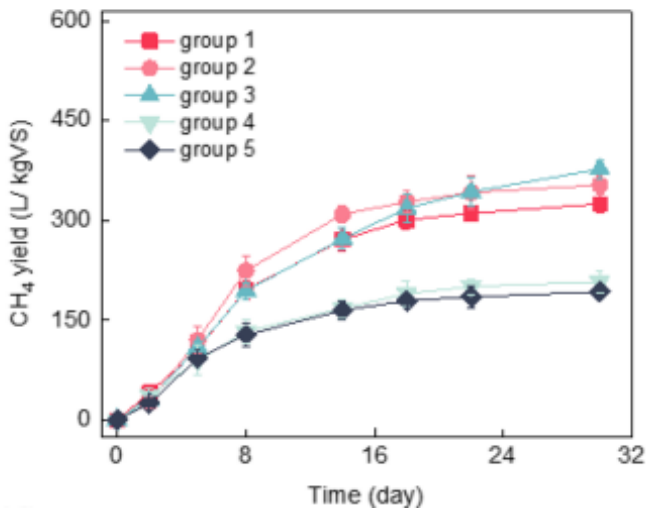




Pristine Electrode



Modified Electrode



Biochar increased biomethane yield by 7.9%

MEC-AD system increased methane yield by 96.8% and methane content by 32.5%

Proposed underlying cause: Increased VFA degradation on the anode and in-situ carbon conversion from CO_2 to CH_4 on the cathode

6.5 fold return on electrical energy input

EcoAD


Prof Jerry Murphy


Dr David Wall


Dr Richen Lin


Dr Richard O Shea


Dr Xue Ning


Dr Donal O Ceileachair


Dr Jorge Diaz Huerta

WP1: Enhance on-farm digestion efficiency through novel pre-treatments

WP2: Integration of electro-methanogenesis with anaerobic digestion to increase overall biomethane conversion

WP3: Optimising the logistics of on farm anaerobic digestion in Ireland

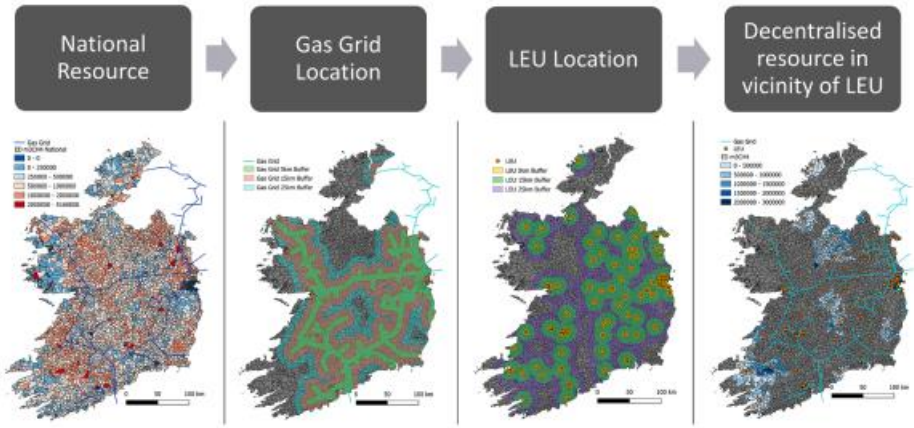
WP4: Techno-economic analysis of potential on-farm anaerobic digestion pathways

WP5: Management, communication, and dissemination

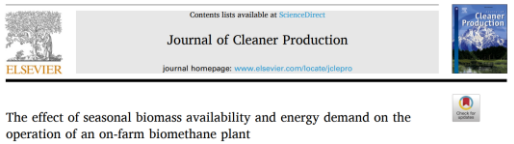

Applied Energy

Alternative energy management strategies for large industry in non-gas-grid regions using on-farm biomethane

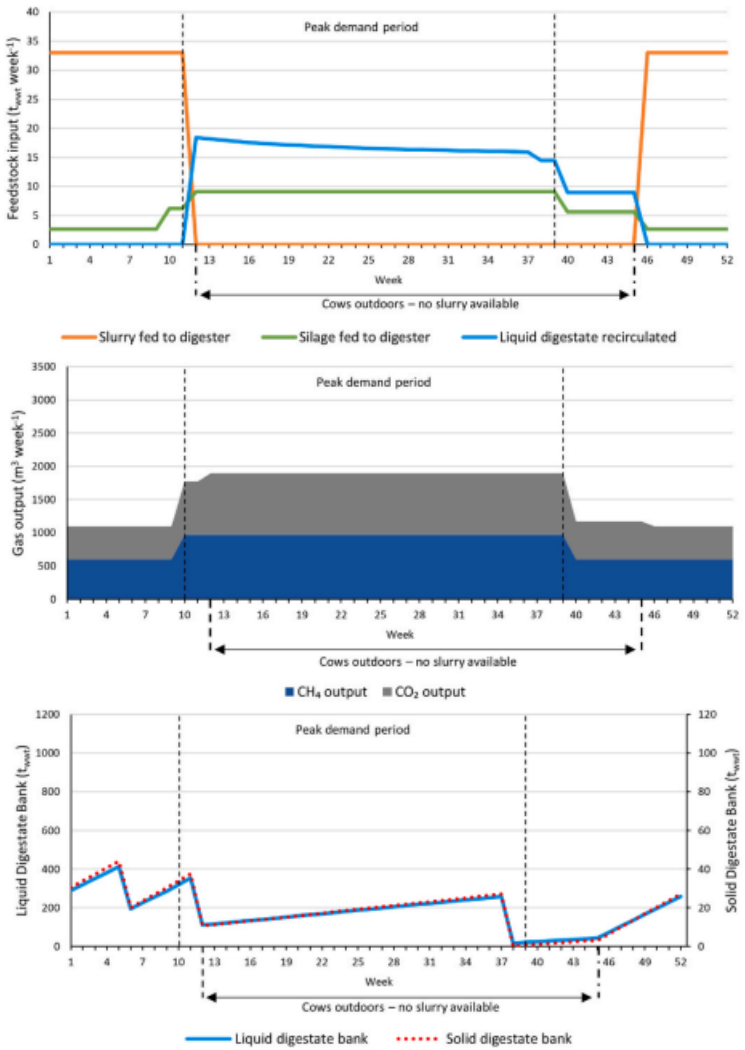
Total biomethane resource: ~67 PJ



Share of Total Resource (%)		Distance from Gas Grid (km)				
		5	10	15	20	25
Distance from Large Energy User (km)	25					11.19
	20				14.40	9.56
	15			17.31	12.28	7.87
	10		16.06	12.25	8.61	5.16
	5	9.72	7.42	5.69	3.91	2.42


Journal of Cleaner Production

The effect of seasonal biomass availability and energy demand on the operation of an on-farm biomethane plant



Supply: Zero-grazing, pasture based

Demand: Constant, Winter, Summer

- Seasonal manure availability may reduce output by 21%.
- Can reduce digester size by 6- 17%.
- If extra silage is used meeting the RED-III criteria becomes more difficult.
- Digestate recirculation is required if liquid manure is unavailable
- Seasonal gas demand may increase digester size by up to 30% compared to constant demand.

EXPECT



Dr David Wall

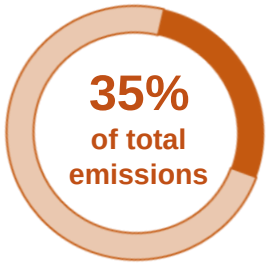


Dr Richard O Shea

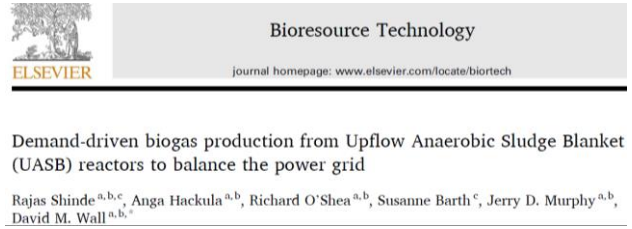


Rajas Shinde





"A Dynamic Anaerobic Digestion-based Biorefinery Model to Enhance the Alternative Uses of Grass"



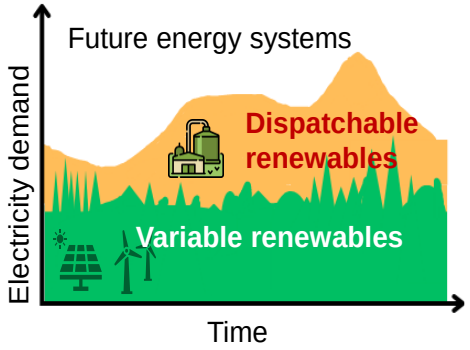
Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

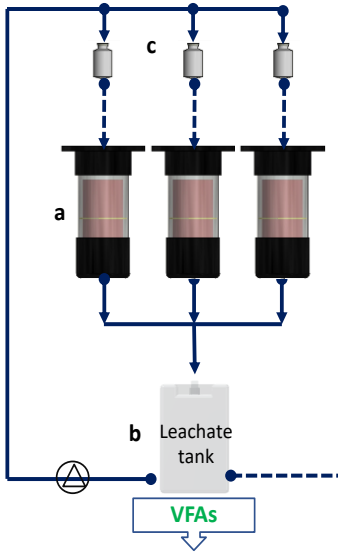
Demand-driven biogas production from Upflow Anaerobic Sludge Blanket (UASB) reactors to balance the power grid

Rajas Shinde [a,b,c], Anga Hackula [a,b], Richard O'Shea [a,b], Susanne Barth [c], Jerry D. Murphy [a,b], David M. Wall [a,b,*]

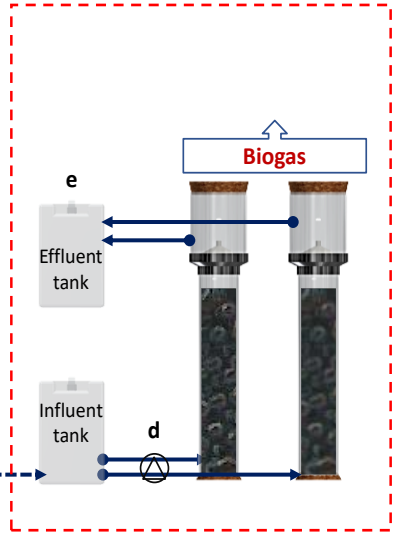
Peak OLR 2 hours before peak demand
20 %/hr ramp up
18 %/hr ramp down
123 %bandwidth
Biogas production aligned with peak electricity demand

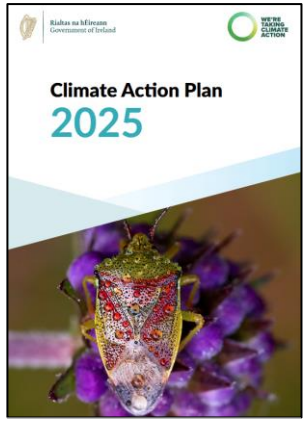


Leach Bed Reactor (LBRs)

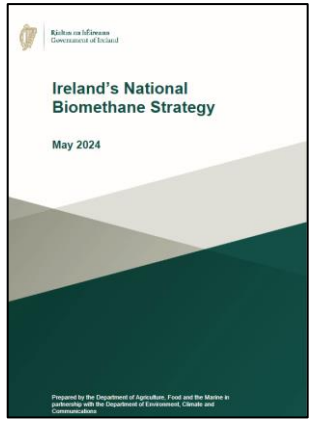


Upflow Anaerobic Sludge Blanket (UASB)reactor

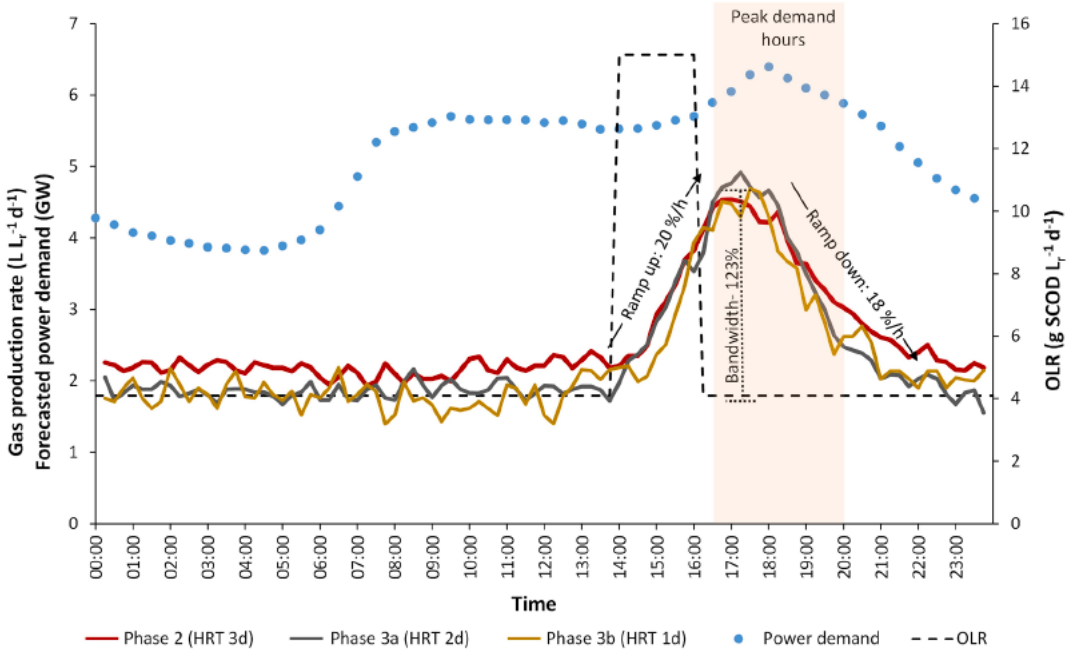




25% reduction in agricultural emissions by 2030



5.7 TWh of biomethane by 2030





Decarbonisation of Whiskey Distilleries in a Circular Economy


Prof Jerry Murphy


Dr David Wall


Dr Richard O Shea


Dr Anga Hackula

By-products: 10.3 kg per Original Litre Of Alcohol (OLA)



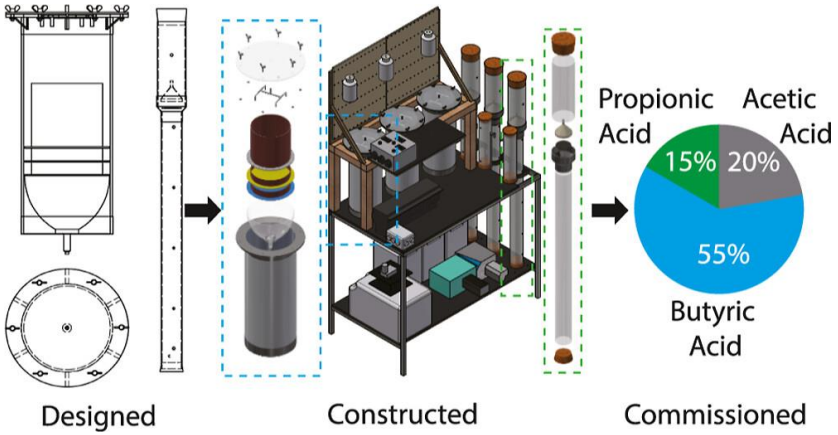
ACS ENGINEERING Au
AN OPEN ACCESS JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

pubs.acs.org/engineeringau Article

Design, Construction, and Concept Validation of a Laboratory-Scale Two-phase Reactor to Valorize Whiskey Distillery By-products

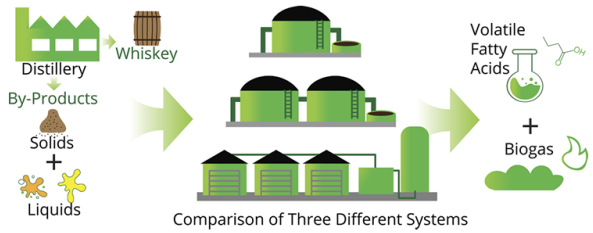
Anga Hackula, Richard O'Shea, Jerry D. Murphy, and David M. Wall*

Cite This: *ACS Eng. Au* 2023, 3, 224–234 Read Online





~60% of theoretical biogas output
~75%vol. methane content
~55% butyric acid
~20% acetic acid



ELSEVIER

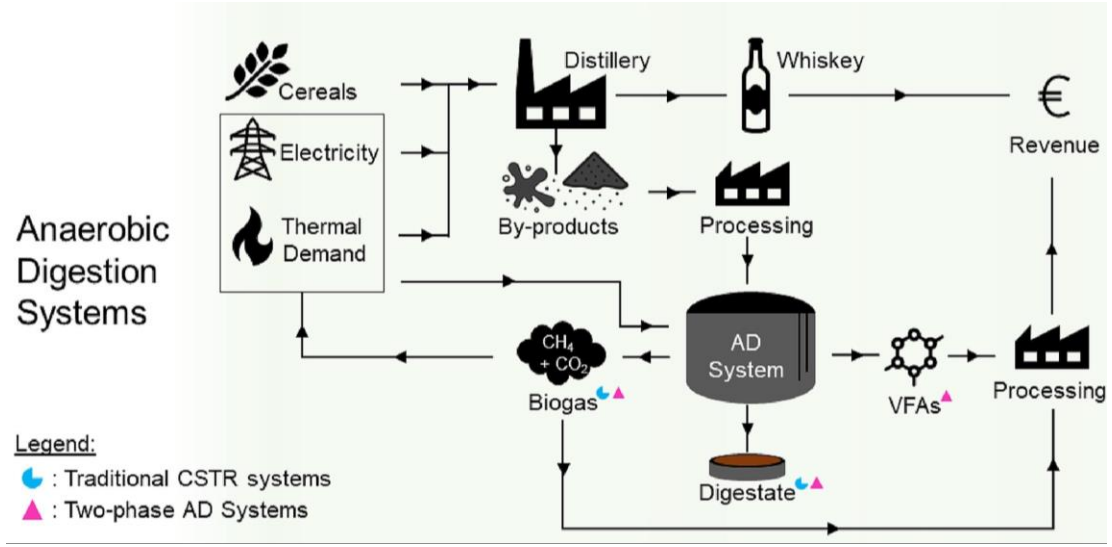
Contents lists available at ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Two-phase anaerobic digestion for enhanced valorisation of whiskey distillery by-products

Anga Hackula[a,b], Rajas Shinde[a,b,c], Daniel Hickey[a,b], Richard O'Shea[a,b], Jerry D. Murphy[a,b], David M. Wall[a,b,*]



Similar methane yields between 3 systems assessed
Ability to replace 44% of distillery gas demand
Additional 0.14€/OLA

Decarbonising whiskey production



Prof Jerry Murphy



Dr Stephen Jackson



Dr Richard O Shea



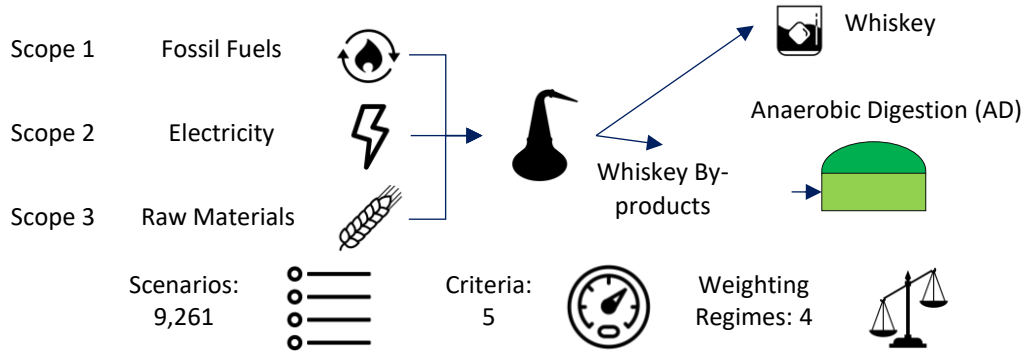
Dr Xihui Kang

Biofuel Research Journal 31 (2021) 1417-1432

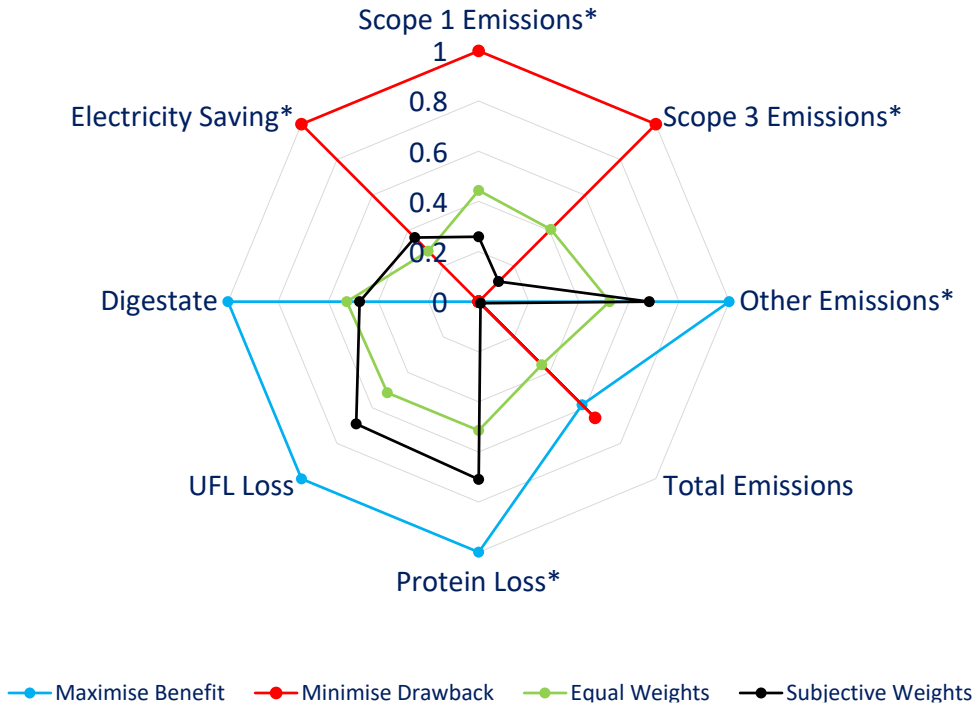


Original Research Paper

Distillery decarbonisation and anaerobic digestion: balancing benefits and drawbacks using a compromise programming approach



	Max benefit	Min drawback	Equal weights	Subjective weights
Draff (%)	100	0	50	100
Thick Stillage (%)	100	0	50	100
Thin Stillage (%)	100	0	55	0
Scope 1 Saving (%)	60	0	33	45
Scope 3 Saving (tCO_2eq)	11,389	0	6,748	10,105
Other emissions ($ktCO_2eq$)	38,641	0	20,165	26,315
Protein Loss (t)	13,554	0	6,974	9,618
Electricity Saving (MWh)	8,514	0	6,086	5,442



Decarbonizing whiskey production



Prof Jerry Murphy



Dr Stephen Jackson



Dr Richard O Shea



Dr Xihui Kang

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Assessing decarbonisation pathways in the food and beverage sector: A multi-criteria decision analysis approach

Richard O'Shea [a,b,*], Richen Lin [c], David M. Wall [a,b], Jerry D. Murphy [a,b]

Technologies: 5

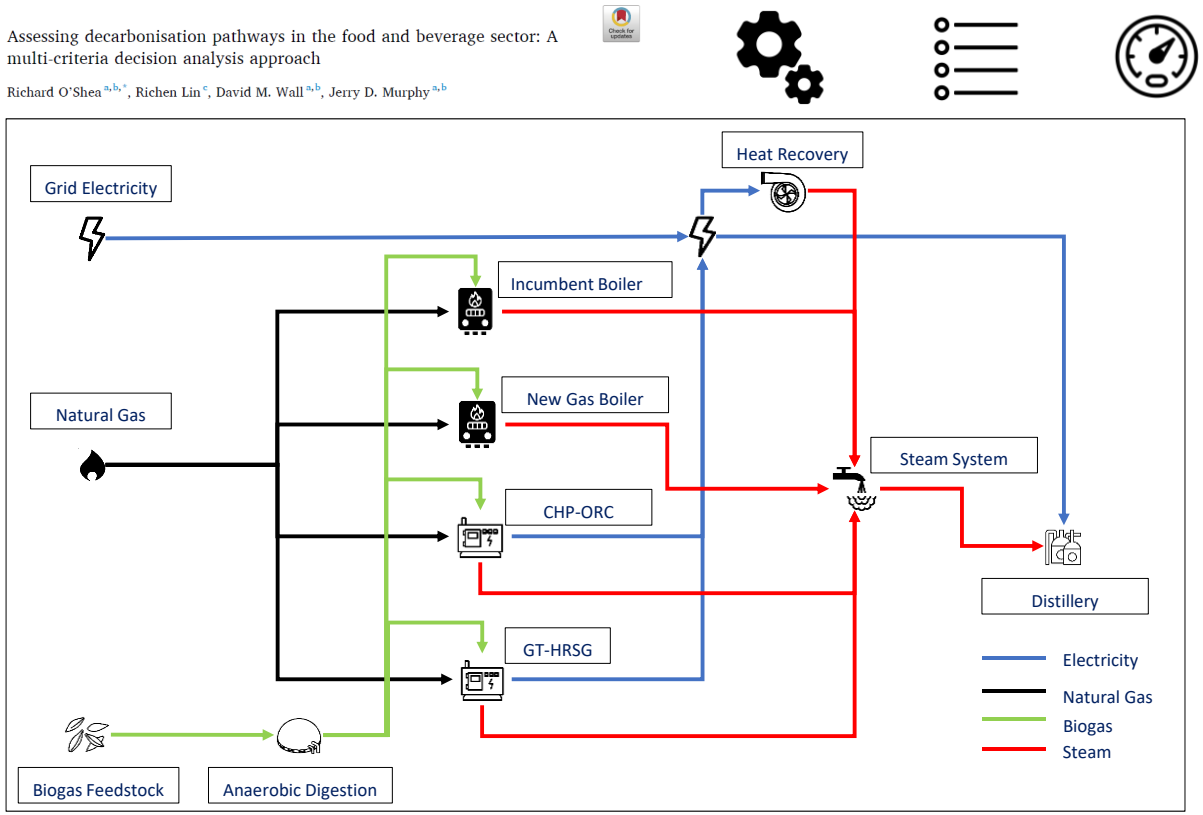
Pathways: 21

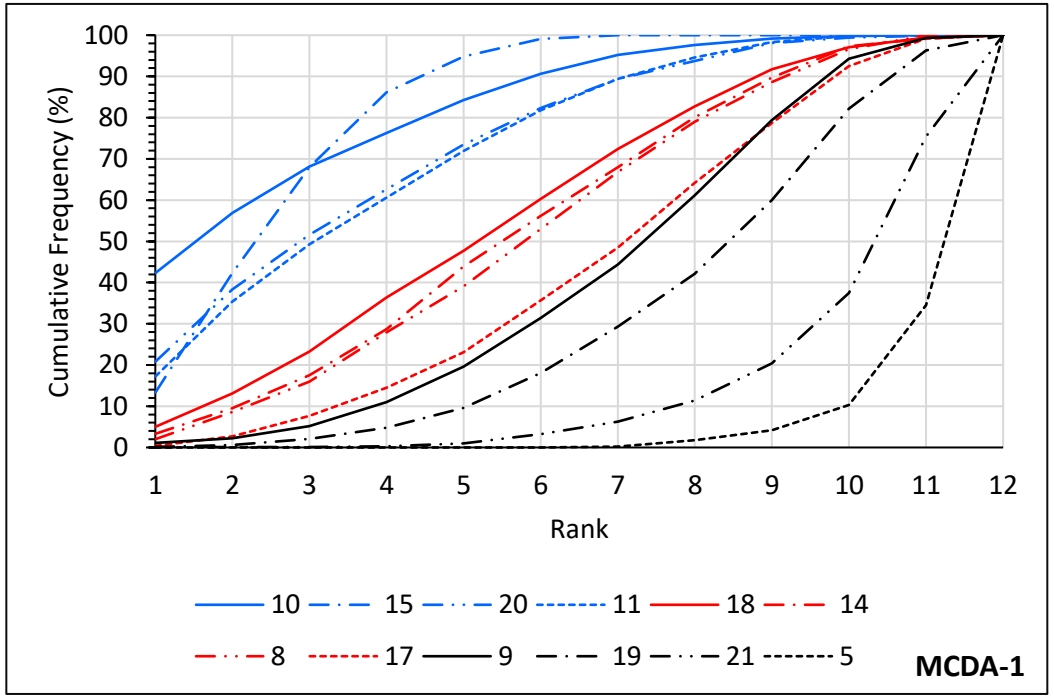
Criteria: 5

Weighting Regimes:4

MCDA Methods: 5

Monte Carlo Simulations: 1,000





	Equal Weighting (MCDA-1)	Economic Only (MCDA-2)	Environment Only (MCDA-3)	Environment and Economy (MCDA-4)
Pathway	New Boiler & CHP-ORC & Heat Recovery	New Boiler & CHP-ORC & Heat Recovery	38kV & Heat Recovery & Biogas	New Boiler & CHP – ORC & Heat Recovery & Biogas
NPV (M€)	11.232	11.232	-15.398	-6.016
Project carbon saved (tCO_2eq)	342,383	342,383	780,365	765,188
LCOA (€/tCO_2eq)	-32.80	-32.80	19.73	7.86
Discounted payback (yr)	12.75	12.75	>20	>20
CAPEX/tCO_2	1,524	1,524	480	932
Scope 1 emission reduction (%)	43	43	100	100

Dr Archishman Bose



Dr Archishman Bose

- Eli Lilly Lecturer in Process and Chemical Engineering, UCC (2022)
- PhD in Engineering, focusing on Photosynthetic Biogas Upgrading, UCC (2022)
- MSc (Mechanical/Energy Engineering), KTH Royal Institute of Technology, Sweden and Politecnico di Torino, Italy (2018)
- BEng (Mechanical), Jadavpur University, Kolkata (2014)
- Program Director, MEngSc Pharmaceutical & Biopharmaceutical Engineering, UCC (2023)
- *Circular Bioeconomy* and *Industrial Symbiosis*
- *Process design and feasibility analyses* (technoeconomic analysis, life cycle assessment) with focus on biorefining

CABBBIE
Developing Cascading Biomethane Biochemicals and Biofertiliser Systems for a Circular Bioeconomy in Ireland

seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Engineered Organic Carbon-based EMERGE Functional Materials for Energy and Water

Taighde Éireann Research Ireland
Energy Innovation Challenge

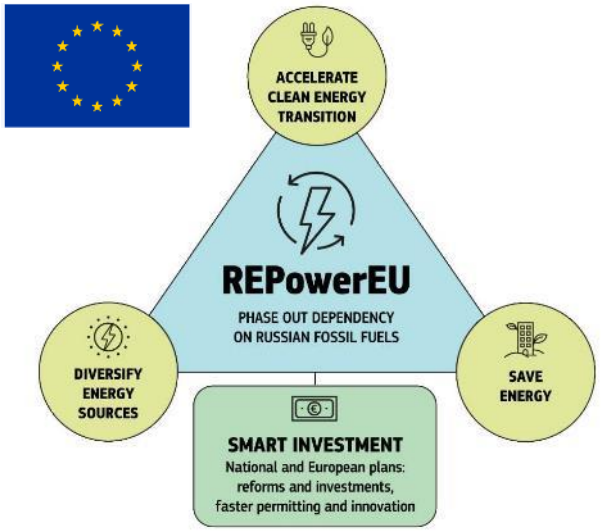
ENTYRE
Mapping the Role of End-of-Life Tyres for a Sustainable Circular Economy in Ireland

epaResearch

REVEIRE
Regenerative Value Systems for Irish Grown Wool in Ireland

epaResearch

Sustainable Biomethane for a Renewable Future



37.6 TWh

2021

380 TWh

2030

Target 2030

CLIMATE ACTION PLAN 2023
Changing Ireland for the Better



0.5 TWh

2021

5.7 TWh

2030

?

What is **Sustainable** Biomethane

- 80% Emission Reduction in Heat
- 65% Emission Reduction in Transport
- Competitive prices

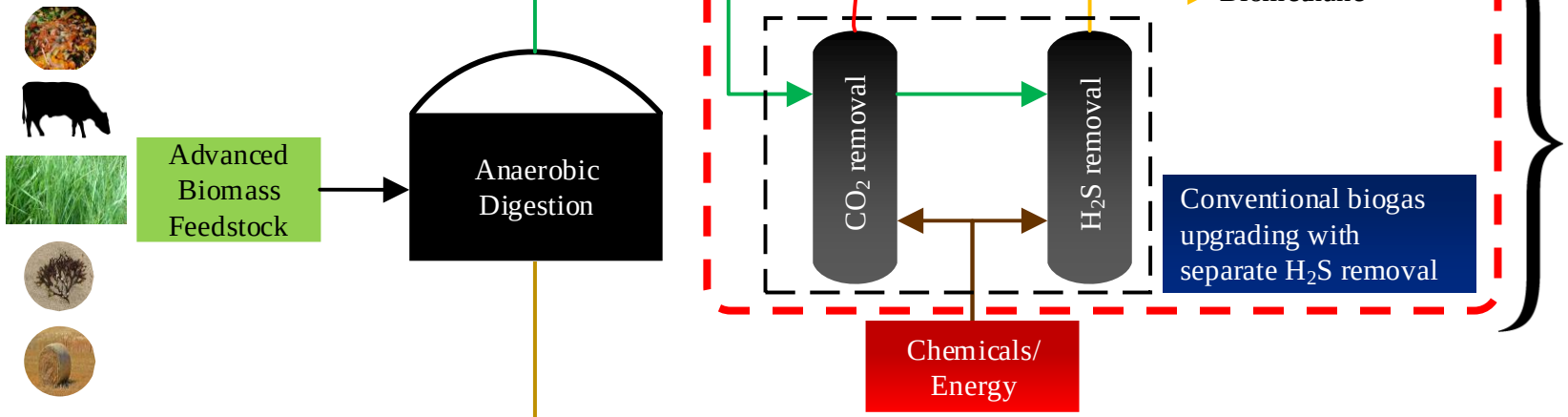
L 328/82 EN Official Journal of the European Union 21.12.2018

DIRECTIVES

DIRECTIVE (EU) 2018/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 11 December 2018
on the promotion of the use of energy from renewable sources
(recast)
(Text with EEA relevance)

Need for Sustainable Biomethane

Advanced Anaerobic Digestion



- Higher Cost & Energy
- Problems of Scaling
- Higher Marginal Abatement Costs
- CO_2 released back into atmosphere

Digestate management and Land availability remains technological bottlenecks



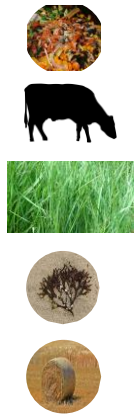
Novel AD-Biorefineries

Need for more Sustainable Biogas Upgrading

Need for alternative use of digestate

Photosynthetic Biogas Upgrading

Conventional Biomethane



Advanced Biomass Feedstock

Anaerobic Digestion

Biogas (CH_4, CO_2, H_2S)

CO_2

CO_2 removal

H_2S removal

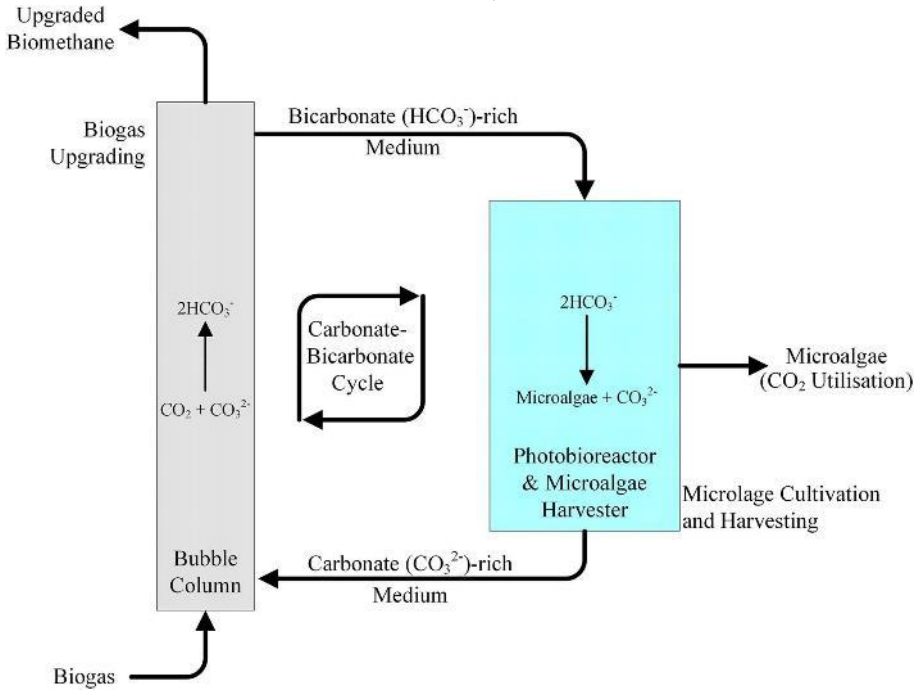
Biomethane

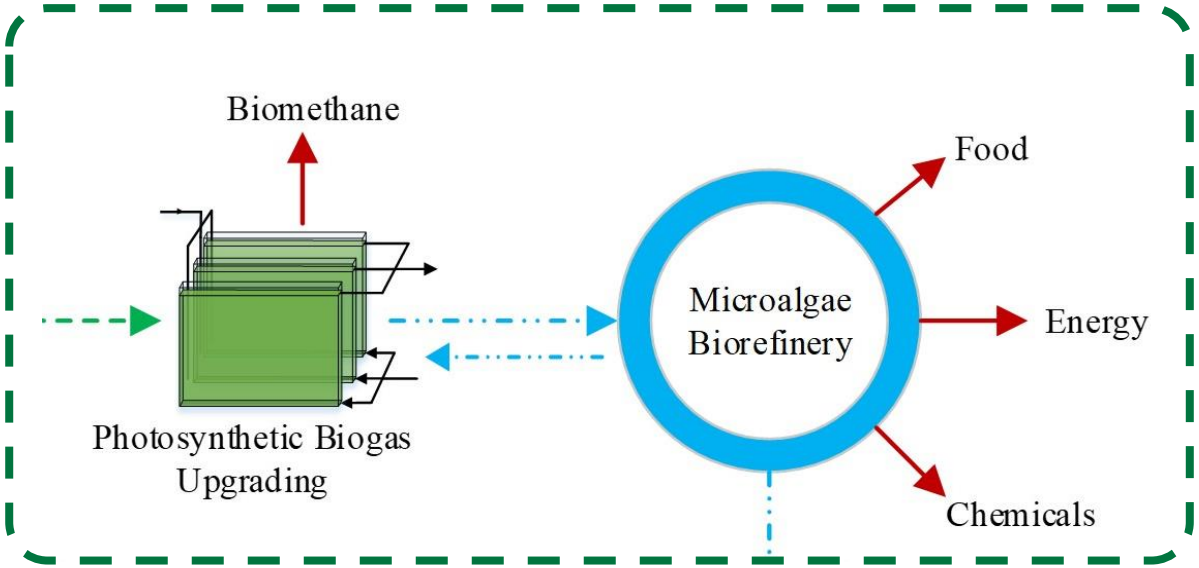
Conventional biogas upgrading with separate H_2S removal

Chemicals/ Energy

- Higher Cost
- Higher Energy
- Higher Marginal Abatement Costs
- CO_2 released back into atmosphere

Photosynthetic Biogas Upgrading





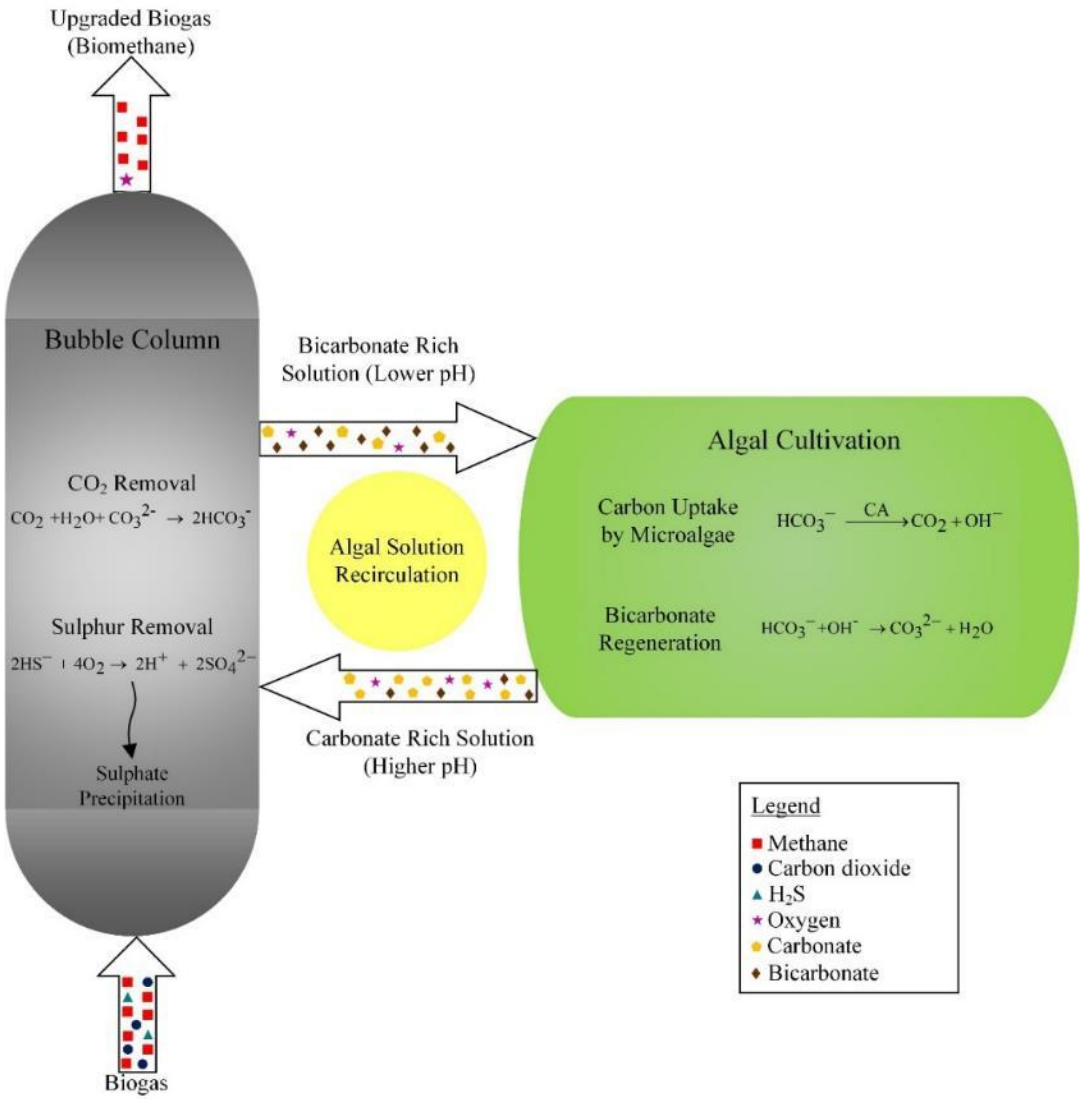
Novel Biogas Upgrading

Understanding the Process

Understanding the Process and its Opportunities

Gas Networks Ireland

Fondúireacht Eolaíochta Éireann
Dá bhfuil romhainn
Science Foundation Ireland
For what's next



Biotechnology Advances 37 (2019) 107444

Contents lists available at ScienceDirect

Biotechnology Advances

journal homepage: www.elsevier.com/locate/biotechadv

Research review paper

How to optimise photosynthetic biogas upgrading: a perspective on system design and microalgae selection

Archishman Bose[a,b], Richen Lin[a,b,*], Karthik Rajendran[c,*], Richard O'Shea[a,b], Ao Xia[d], Jerry D. Murphy[a,b,*]

[a] Environmental Research Institute, MaREI Centre, University College Cork, Cork, T23 XE10, Ireland
[b] School of Engineering, University College Cork, Cork, Ireland
[c] Department of Environmental Science, SRM University-AP, Amaravati, Andhra Pradesh 522 502, India
[d] Key Laboratory of Low-grade Energy Utilisation Technologies and Systems, Chongqing University, Chongqing 400044, China

Bioresource Technology
Volume 304, May 2020, 123027

Review

A perspective on novel cascading algal biomethane biorefinery systems

Archishman Bose [a, b], Richard O'Shea [a, b], Richen Lin [a, b], Jerry D. Murphy [a, b]

Show more

https://doi.org/10.1016/j.biortech.2020.123027

Get rights and content

Chemical Engineering Journal
Volume 437, Part 1, 1 June 2022, 134988

Optimisation and performance prediction of photosynthetic biogas upgrading using a bubble column

Archishman Bose [a b c], Richard O'Shea [a b d], Richen Lin [a b d], Jerry D. Murphy [a b d]

Show more

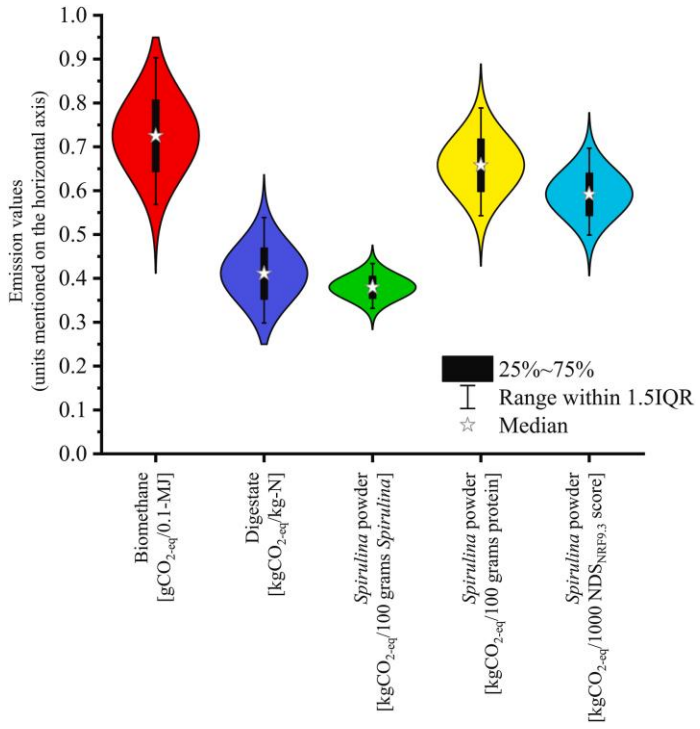
Feasibility Study – Bringing up to Technology Readiness Level (TRL) 3

Initial Feasibility Assessment

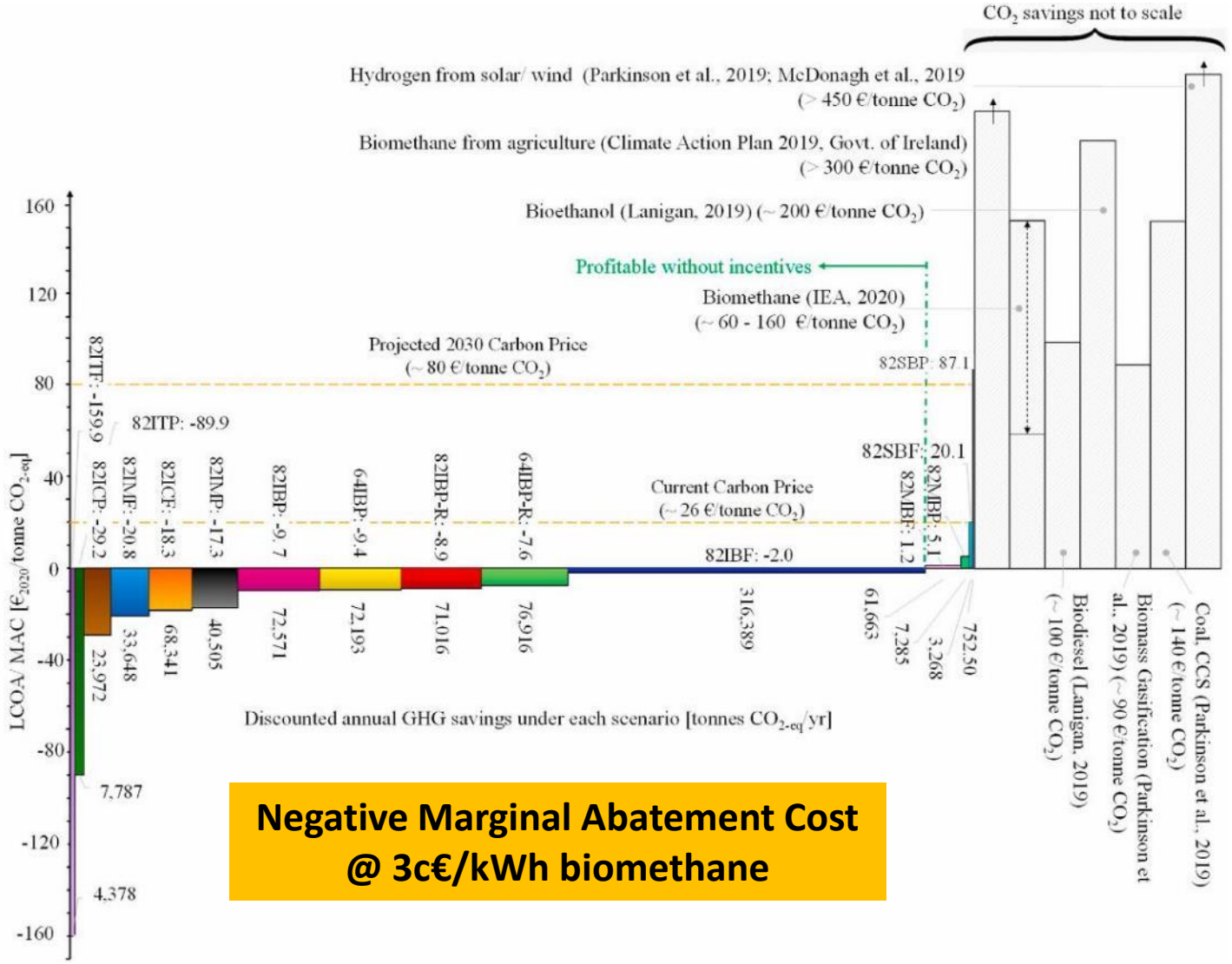
CH_4 (Biomethane)

Protein (Spirulina)

Biofertiliser (Digestate)



Biomethane @
< 10 gCO_2/MJ
(c. 90% emission reductio)



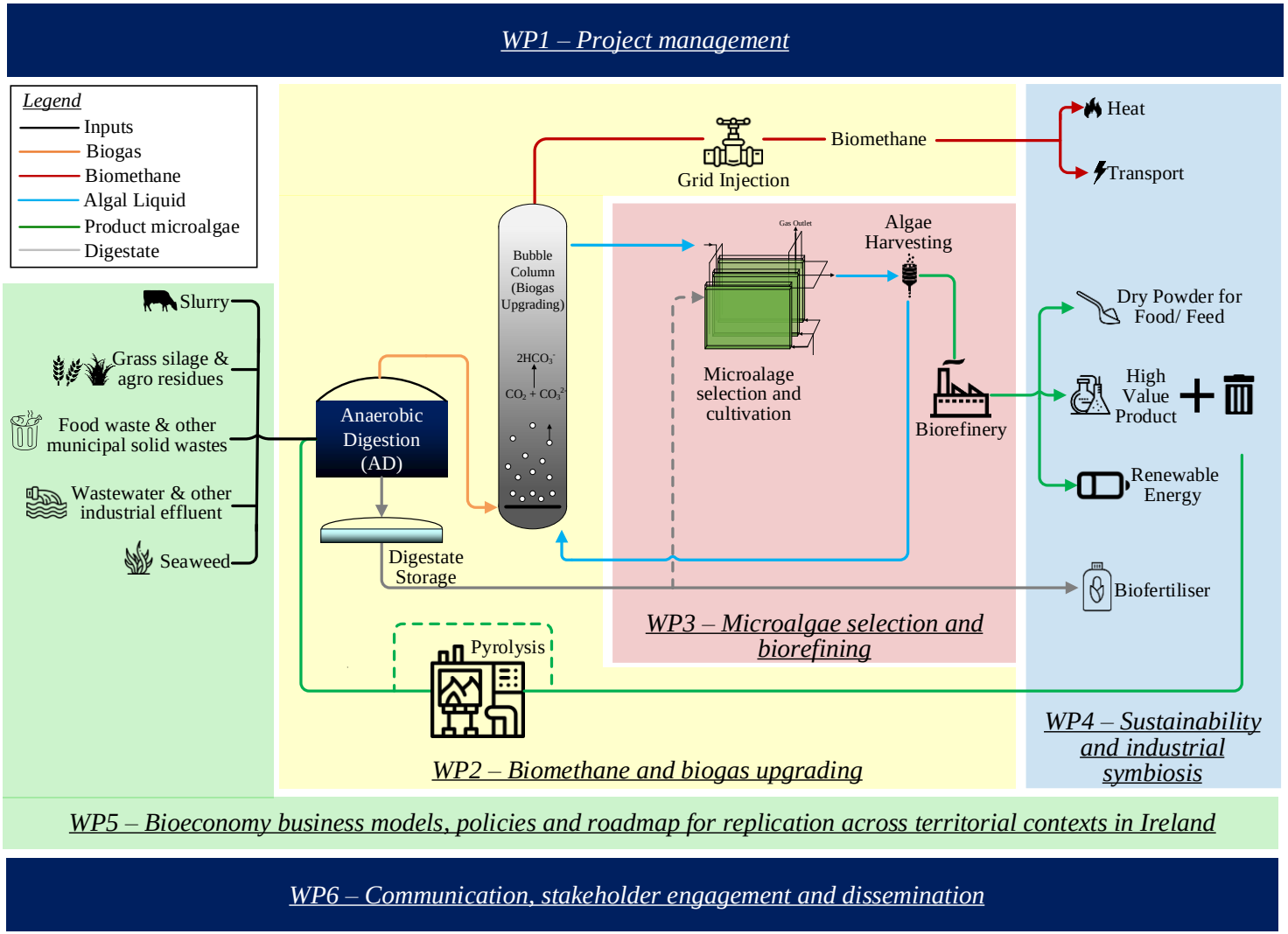
Negative Marginal Abatement Cost
@ 3c€/kWh biomethane

CABBBIE (2023-26): Key Questions to be answered

4 Key Questions

- **How to optimise and scale-up** the Bubble Column Reactor
- **Which** local **microalgae species** is ideal in Ireland
- **What** product/ process **configuration is optimal**?
- **How to develop business models** around this cascading process

Developing Cascading Biomethane Biochemicals and Biofertiliser Systems for a Circular Bioeconomy in Ireland (CABBBIE)



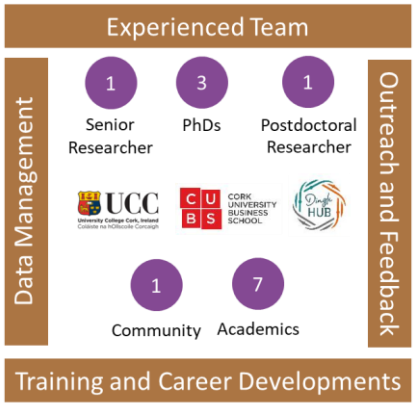
CABBBIE Work Overview

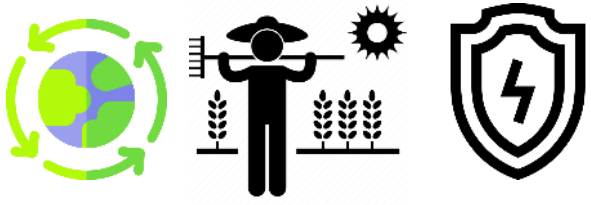
In practice (feasibility, acceptance, business models and scaleup)

Sustainability Assessments	Multi Criteria Decision Analyses	Business Model Development		Scale-up via Piloting	Dissemination and Capacity Building	Policy and Roadmaps
NPV, IRR, E-ROI thinkstep GaBi shdb social hotspots database	X @RISK	**Demand Analysis** **Financing Model** **Ownership Model**			Dingle HUB	

In the lab (deep science)

Microalgae species selection	Lab-scale optimsation





ELSEVIER

Biotechnology Advances
Volume 82, September 2025, 108581

Selecting optimal algal strains for robust photosynthetic upgrading of biogas under temperate oceanic climates

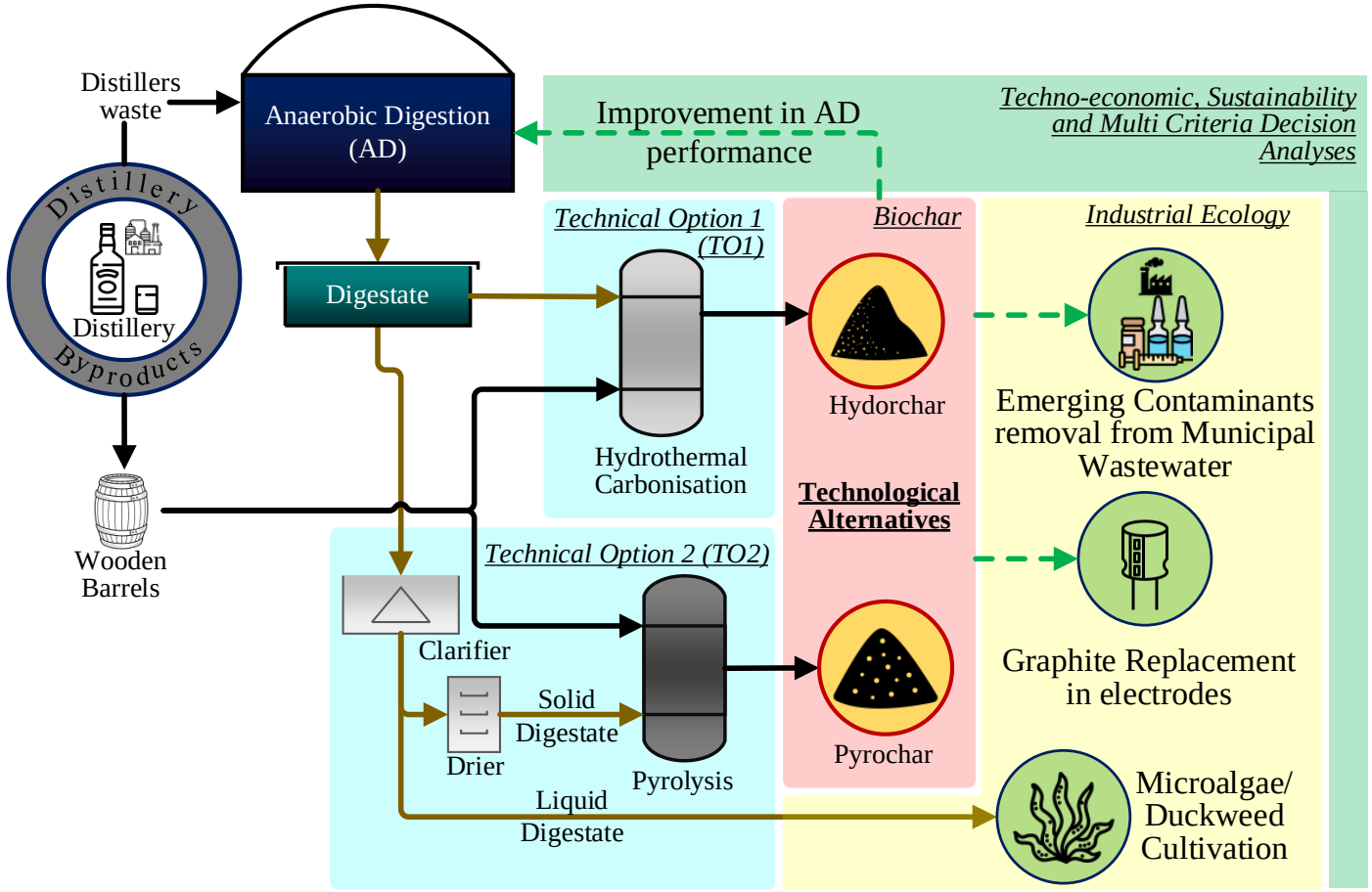
Muhammad Nabeel Haider [a b], Linda O'Higgins [a], Richard O'Shea [a b], Lorraine Archer [c], David M. Wall [a b], Nikita Verma [a b], María del Rosario Rodero [d], Muhammad Aamer Mehmood [e], Jerry D. Murphy [a b], Archishman Bose [a b]

Novel Digestate Valorisation: EMERGE (2023-2025)

Digestate to **Biochar**

Engineered Organic Carbon-based EMERGE Functional Materials for Energy and Water

Engineered Organic Carbon-based Functional Materials for Energy and Water (EMERGE)



Distillery by-products
(consistent feedstock)

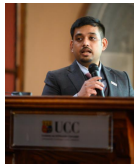
Anaerobic digestate ?

Biochar

Novel Adsorbent

Graphite Replacement

Engineered Biochar from Anaerobic Digestate



Dr Archishman Bose



Dr Xue Ning



Dr Deepa Sachan



Prof Jerry Murphy (mentor)



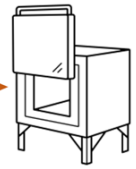
Distillery byproducts



Lab-Scale Anaerobic Digester

Digestate separation

Dried Willow



Muffle Furnace



Biochar characterisation

300 – 700 °C

4 – 10 °C/min

30 – 90 min

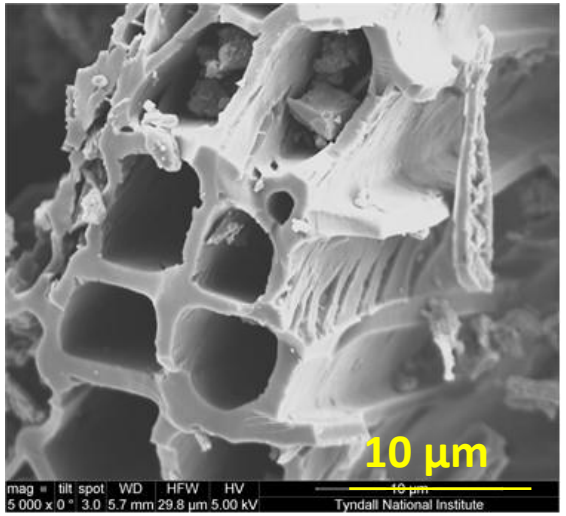


Biochar



€16 for 12g = €1.333 M /t

Biochar at 700 °C, 90 mins



- BET surface area **54.4m²/g**
- High Conductivity **23.6 µS/cm**
- Surface Morphology & Functional Groups
- **Large Variation within batches!**

Acid-Treated Biochar

- BET Surface Area **391.5 m²/g (7-fold increase)**
- Conductivity **44.5 µS/cm g (2-fold increase)**
- Improved Consistency

Biochar Production and Characterisation Techniques



Tube Furnace



Muffle Furnace



Microwave Digester

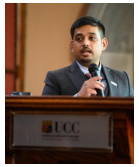
Lab-scale experiments	Characterisation of biochar
Optimisation of operations	Mapping Pathways for Scale-up



Surface Area Analyser

- **BET Surface Area and Pore Volume Analyser**
- **FTIR**
- **Scanning Electron Microscopy**
- **Xray Diffractometry**
- **Raman Spectroscopy**
- **EDX (Energy-Dispersive X-ray analysis)**

Can Biochar Remove Emerging Contaminants?


Dr Archishman Bose


Dr Xue Ning

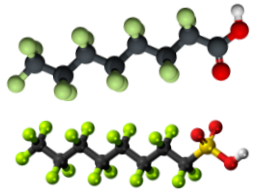

Dr Deepa Sachan


Prof Jerry Murphy (mentor)

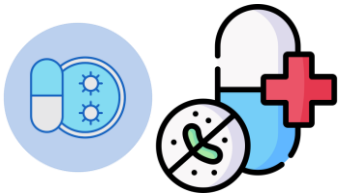
Pristine Biochar



Acid-Treated Biochar



Per- and Polyfluoroalkyl Substances (PFAS)

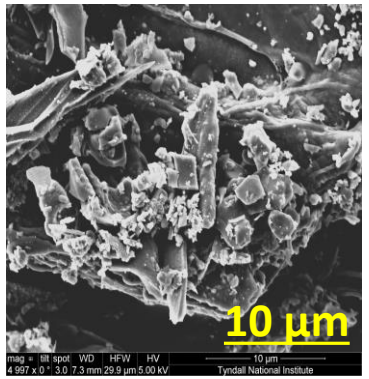


Pharmaceuticals and Antibiotics

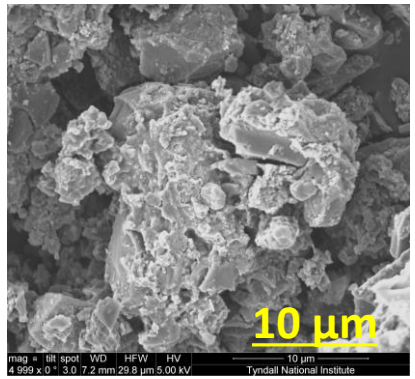
DoE

- Dosage
- pH
- Concentration
- Time

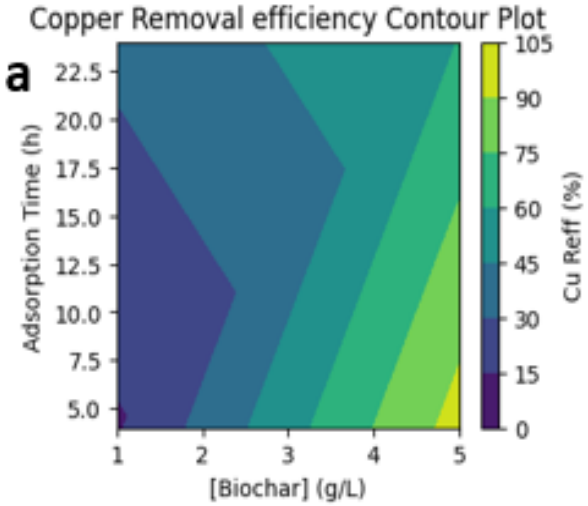
Ibuprofen Removal using Pristine Biochar

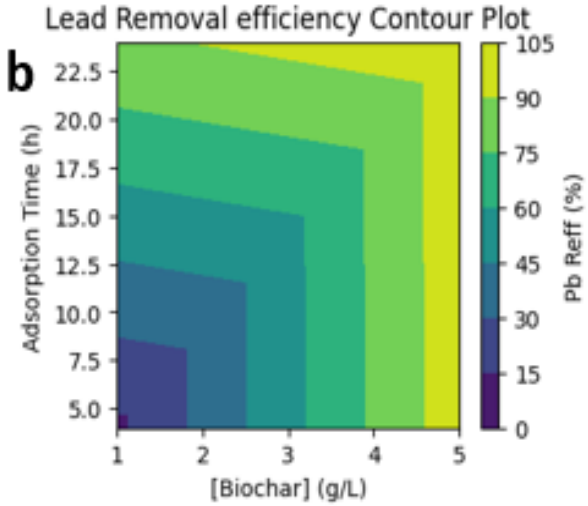


Before



After



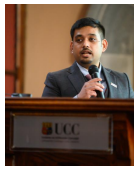


Energy Innovation Challenge →

Biochar Electrodes to Enhance AD



Dr Xue Ning



Dr Archishman Bose



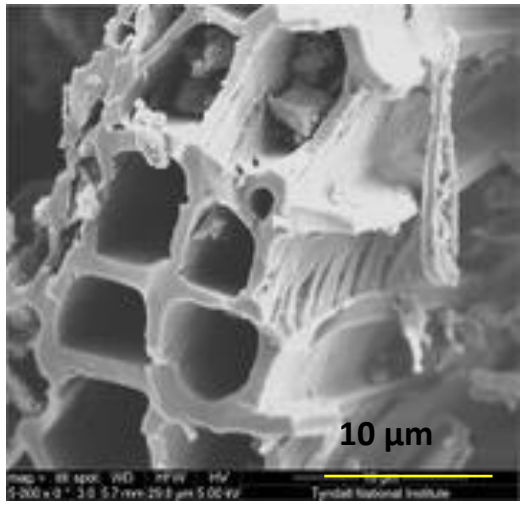
Prof Jerry Murphy (mentor)

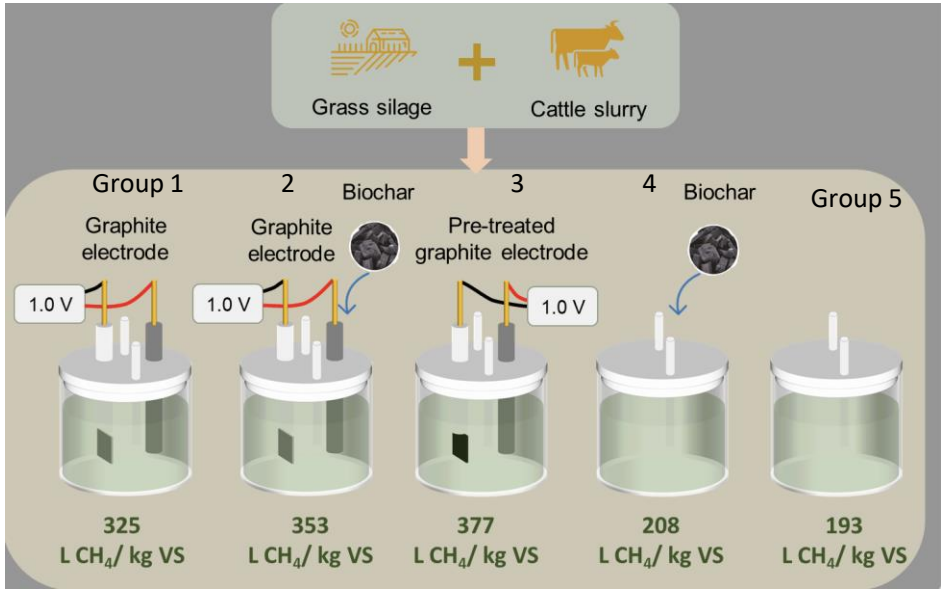
Description: Minimising feedstocks to facilitate RePowerEU target of 35 bcm of biomethane by 2030

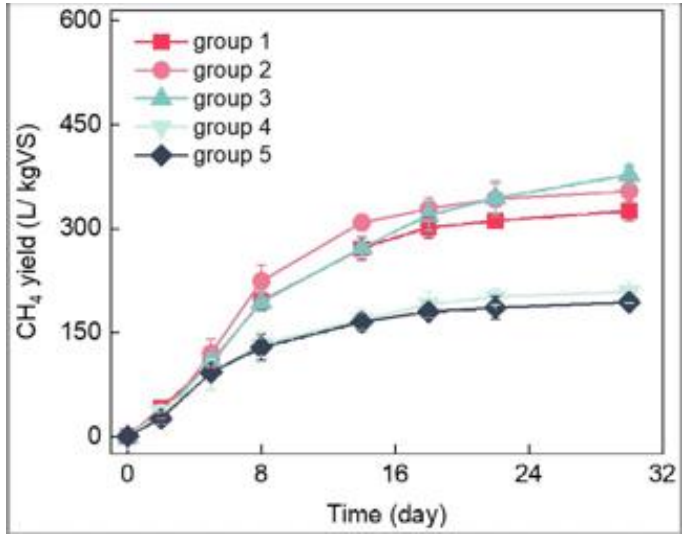
(1) Two phase digestion with biochar electrodes to improve biomethane production.

(2) Replacing graphite electrodes with biochar-based electrodes could improve sustainability of adding electrodes to AD.

(3) The concept could be extended to microbial electrosynthesis for CO_2 valorisation

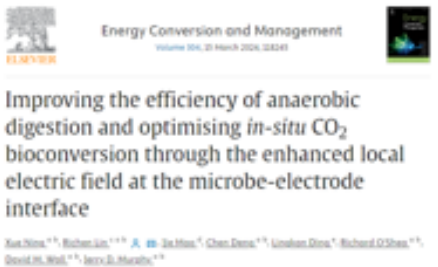


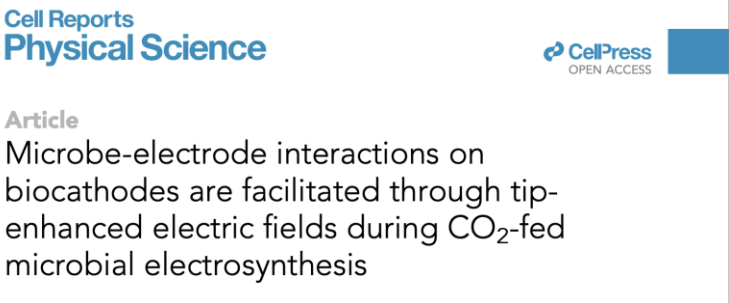








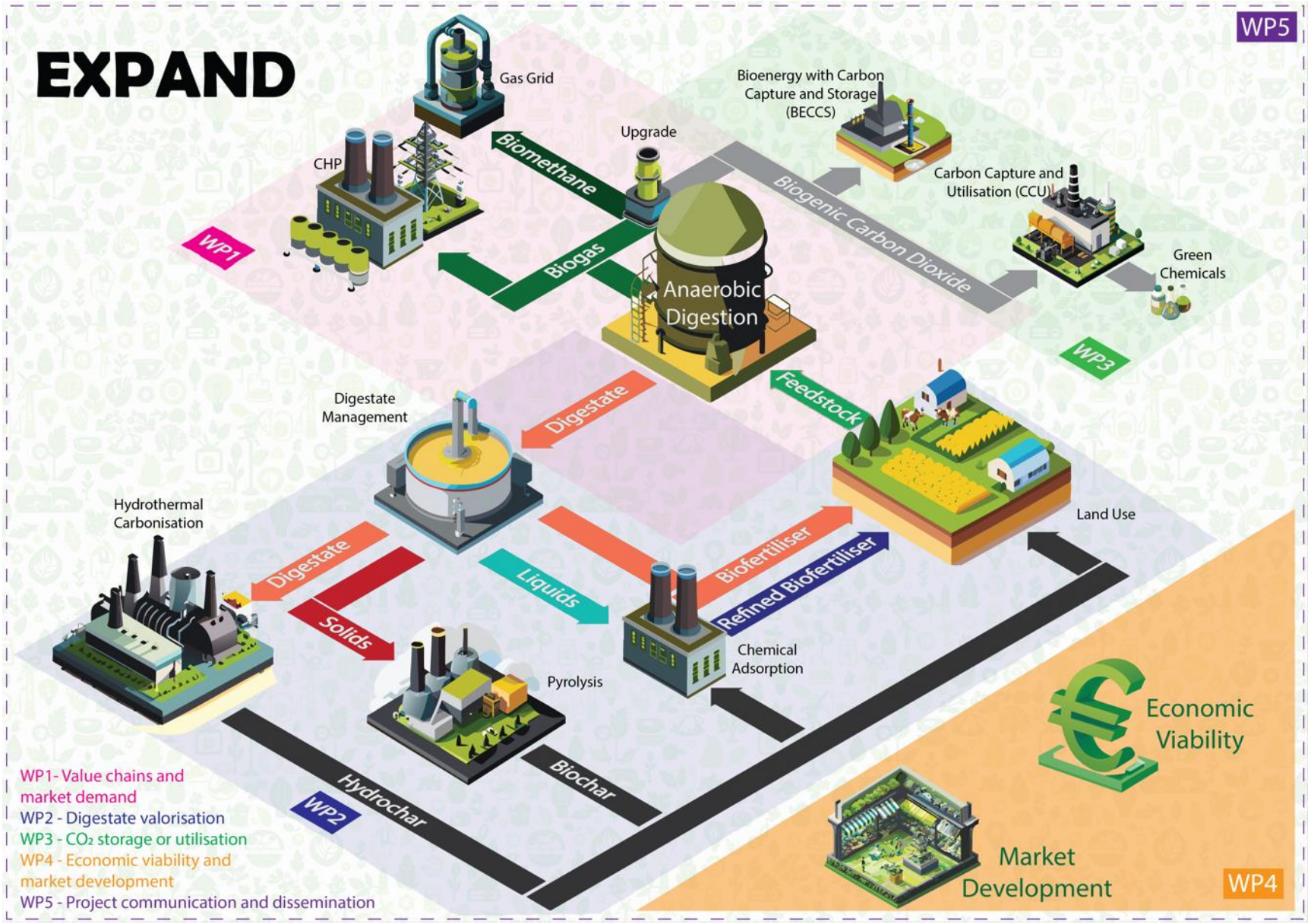




EXPAND (2025-2028)

EXPAND
Exploring Economic Viability and Market Development of Products from Anaerobic Digestion

Exploring Economic Viability and Market Development of Products from Anaerobic Digestion



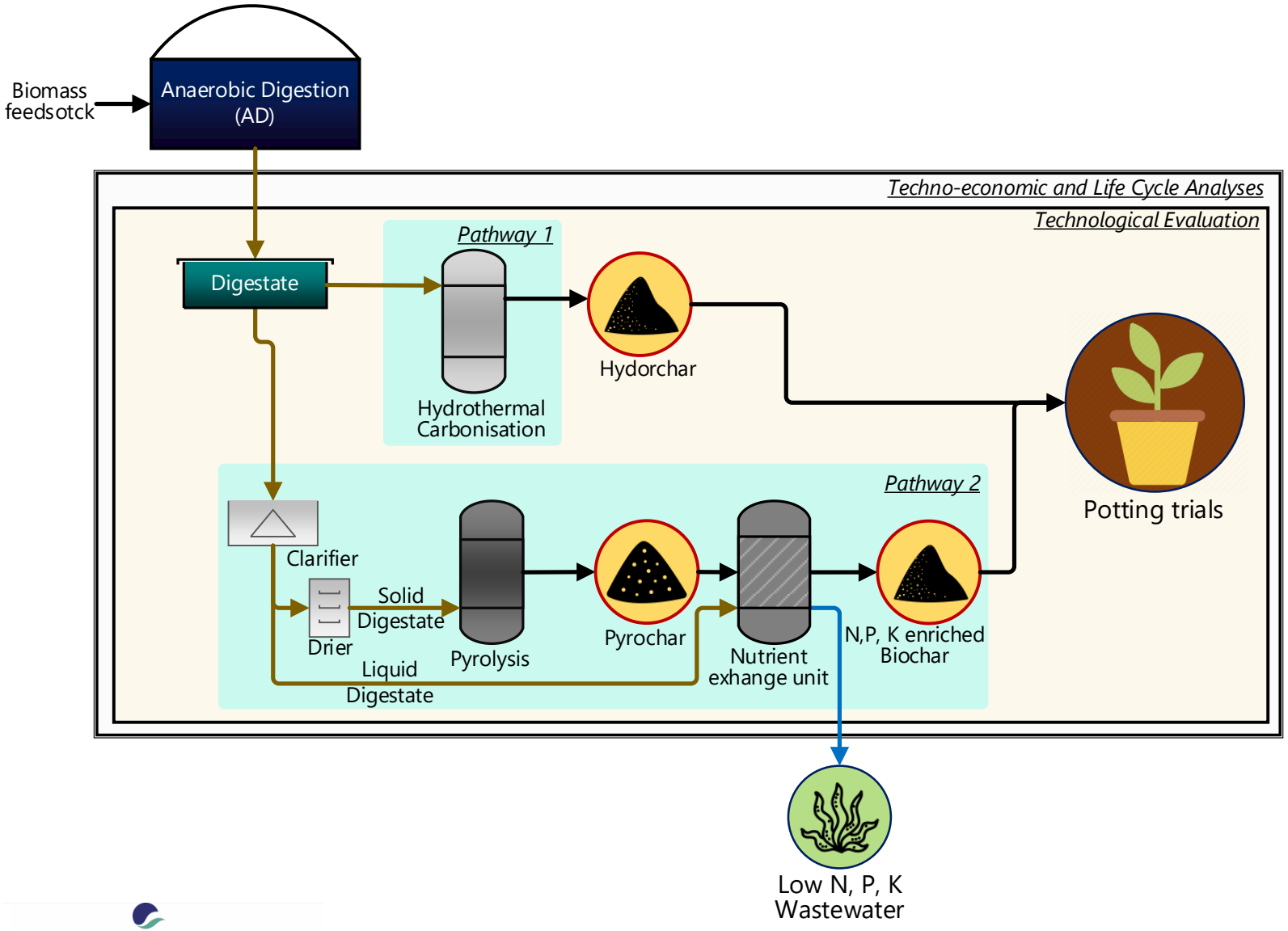
SEAI SUSTAINABLE ENERGY AUTHORITY OF IRELAND

CUBS CORK UNIVERSITY BUSINESS SCHOOL

teagasc AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

MaREI Energy · Climate · Marine

EXAPND - Optimal pathways for valorisation of digestate

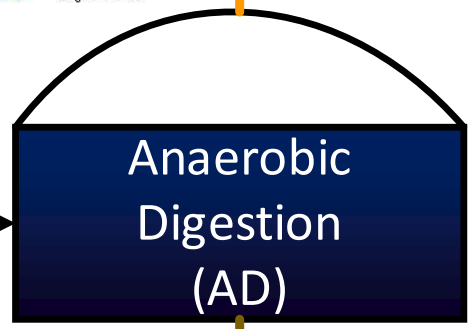


1. Assessment of **conventional digestate management options focusing** on digestate as a biofertiliser.
2. **Production of pyrochar and hydrochar** from digestate as a **soil amendment** and a **biofertiliser**.
3. **Nutrient adsorption capacity of pyrochar from liquid digestate.**
4. **Pot trials to assess grass growth yield** from different biochars.
5. **Techno-economic and lifecycle assessment** of biochar fertilisers v. direct land spreading of digestate

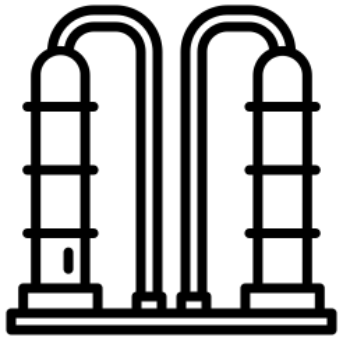
Our Contribution towards Sustainable Biomethane



Feedstock







Biogas
Upgrading



Biomethane

Digestate







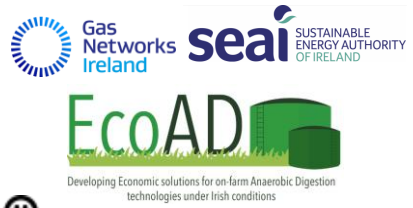
















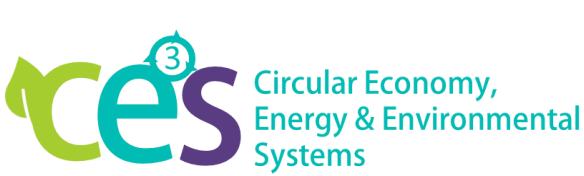
















MaREI
Energy · Climate · Marine

Taighde Éireann
Research Ireland

Thank you

Dr Richard O'Shea (Richard.oshea@ucc.ie)

Dr Archishman Bose (archishman.bose@ucc.ie)

HOST INSTITUTION

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

PARTNER INSTITUTIONS

DCU Ollscoil Chathair Bhaile Átha Cliath Dublin City University
DIAS
Dundalk Institute of Technology Dhún Dealgan
ESRI An Institiúid um Thaighde Eacnamaíochta agus Sóisialta Economic & Social Research Institute
MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University
Maynooth University National University of Ireland Maynooth
Trinity College Dublin Coláiste na Tríonóide, Baile Átha Cliath The University of Dublin
DUBLIN
Tyndall National Institute
UCD University College Dublin An Coláiste Ollscoile, Baile Átha Cliath
Ollscoil na Gaillimhe University of Galway
University of Limerick Ollscoil Luimnigh

Dr. Pradeep Monga



WORLD BIOGAS ASSOCIATION

#MakingBiogasHappen

Programme

Webinar 26 June 2025

Dr Pradeep Monga

Senior Advisor and Policy Director

World Biogas Association

- Founded in 2016 by associations from the United Kingdom, the United States of America and Italy, together with 20 founding companies.
- It currently represents more than 100 organisations, including national associations, from around the world.
- WBA is an accredited member of the UNFCCC and REN21, an official partner of the CCAC (secretariat of the Global Methane Pledge) and the GMI, a founding member of the Global Biofuels Alliance (GBA), and an associate of the Global Bioenergy Partnership and the CTCN.
- WBA works closely with the IEA, UNIDO, FAO, the European Commission and C40 Cities, among others.
- Global association for the biogas, landfill gas and anaerobic digestion (AD) sectors, dedicated to facilitating the adoption of biogas globally.

WBA Vision and Mission

Our Evolving Vision

"A world where sustainable biogas is integral to climate, energy, agriculture, and waste solutions, with WBA as a definitive global voice in circular economy, member champion, and indispensable enabler"

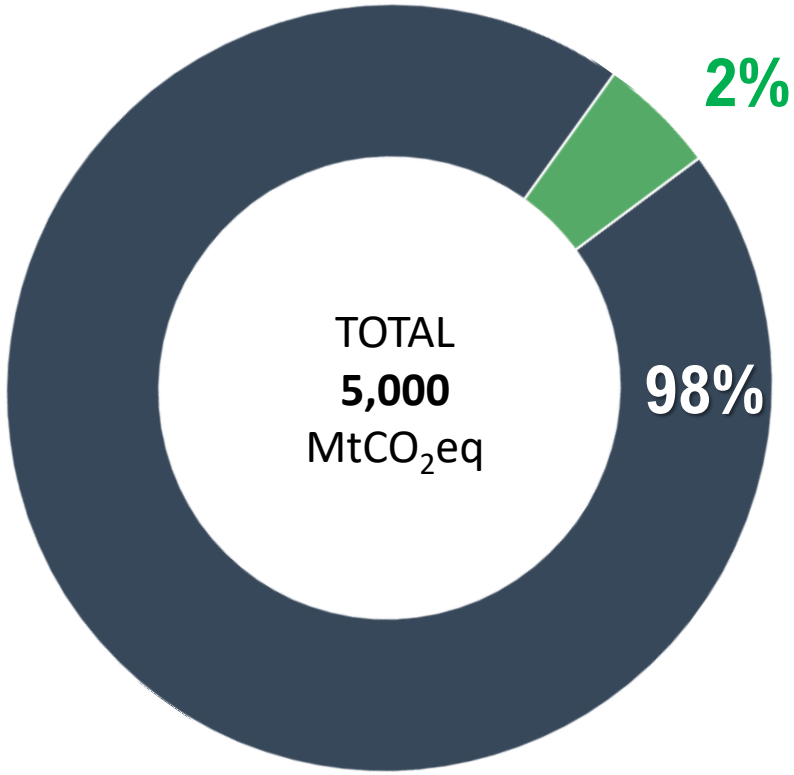
Our Mission

"WBA empowers the global biogas ecosystem, uniting members, nations, and industries to unlock biogas's full potential for a decarbonised, circular, and sustainable future"

Biogas, a circular economy waste to energy solution

- More than 105 billion tons of organic waste are produced worldwide annually. Not being recycled, they emit methane and other greenhouse gases – 98% are not recycled.
- Anaerobic digestion (AD) and biogas upgrading are recognised as one of the fastest, most cost-effective ways to reach net-zero.
- AD recycles organic waste, converting an environmental problem into a valuable solution, such as biogas, biomethane, bio-CO2 and biofertilisers.
- By recycling available organic waste, it is possible to meet 50% of the Global Methane Pledge and reduce GHG emissions by 11% by 2030.
- Reduction of 5 billion tons of CO2 equivalent

Organic Waste Emissions



Actually recycled
250 $MtCO_2eq$

Household waste
304 $MtCO_2eq$

Food waste
447 $MtCO_2eq$

Energy crops
1182 $MtCO_2eq$

Agricultural residues
1222 $MtCO_2eq$

Animal waste
1870 $MtCO_2eq$

Global Biogas Market

- **40 billion cubic metres of natural gas equivalent (bcme) of Biogas is produced annually,** primarily for electricity and heat generation – IEA 2025
- **Upgrading Biogas to Biomethane for Transport Sector** is increasingly common, driven by efforts to decarbonise transport and ambitions for energy independence
- **10 billion cubic meters of Biomethane is produced globally**, equivalent to 0.2% of natural gas demand
- **Technological advancements** are increasing methane yields and recovery at biogas plants
- **Biogas, Biomethane and Bio-CO2** are now seen as raw materials for producing hydrocarbons, sustainable aviation fuel (SAF), e-methane, e-methanol, bio-LPG and Renewable Dimethyl Ether (rDME)

Global Biogas Market

- **Investment in Biogas** is expected to surge, rising from the current USD 2 billion per year to U**SD 15 billion annually by 2050**, underscoring the sector's increasing importance in the global energy transition.
- **Demand for Biogas and Biomethane** is projected to double between 2023 and 2035 under the IEA's Stated Policies Scenario.
- **Emissions-intensive industries**, gas networks, and big oil companies are turning to biogas and biomethane production as drop-in alternatives that require minimal changes to existing infrastructure, are reliable and mature technologies, and are attractive for rapid decarbonization at relatively low transition costs.
- **Governments and industry** are developing cooperative models, collection hubs and digital platforms to coordinate logistics for reliable feedstock availability for biogas projects.

Measures to scale up the Biomethane Market Globally

- **National Biomethane Production Targets:** Strategic instruments to guide the development of the sector, attract investment, and integrate biomethane into the energy matrix and fuel markets in a planned and sustainable manner.

1. **The European Commission's RePowerEU plan aims to generate 35 billion cubic metres of Biomethane per year by 2030, reducing imports and increasing the European Union's energy storage capacity, while mobilising €37 billion in loans and subsidies.**
2. **India has set a mandate of 5% Biomethane in compressed and channelled natural gas by 2030.**
3. **As of 2026 in Brazil, at least 1% of the carbon dioxide (CO_2) emissions from fossil gas producers and importers must be abated through direct commercialisation or biomethane credits (CGOB).**

Measures to scale up the Biomethane Market Globally

- **Linking to Emissions Trading System (ETS):** Market policies designed to control and reduce greenhouse gas (GHG) emissions cost-effectively.
  - The ETS is regulated by law and is compulsory for specific sectors (e.g., energy, industry, aviation, agriculture), unlike the voluntary system.
- **Providing initial Financial Assistance (CAPEX) to this fast-growing sector to have a level playing field like other renewables**

Examples

1. **Ireland: *National Biomethane Strategy* (2024) provides subsidies of 20% of the CAPEX up to a maximum of € 5 million.**
2. **Italy: offers a subsidy of up to 40 % of the investment cost from the European Union's National Recovery and Resilience Plan (RRP).**

Measures to scale up the Biomethane Market Globally

- **Recognise Anaerobic Digestion as a priority technology pathway for Waste Management.**

Examples

1. The Food Policy of the Municipality of Milan, which aims to reduce food waste, identifies anaerobic digestion and composting as priority methods for waste treatment.
2. The Swedish city of Malmö has set among the objectives of its 2014 food policy the reduction of waste and the valorisation of organic waste to produce electricity and biomethane from biogas.
3. Countries in Latin America (including Brazil) and the Caribbean have developed a joint roadmap for closing open dumps. Preventing landfills from forming reduces greenhouse gas emissions that enter the atmosphere and lowers risks to human health.



The Biogas Sector still faces major challenges

- Technical, operational and maintenance challenges
  - Plants with low yield and environmental performance
  - Lack of information and qualification of operators
  - Lack of safety and standardisation
- Policy, Regulatory, Standards, and Certification challenges for the market:
  - Variations in regulations between councils and provinces,
  - Fragmented policies, agencies and ministries,
  - Delays in obtaining licences.
- High CAPEX and limited financing options

How can we construct hundreds of thousands of high-performance and reliable biogas plants, along with all the necessary infrastructure, within five years (by 2030)?

World Biogas Association
MakingBiogasHappen (#MBH) Programme

Phase 1

Global Biogas Regulatory Framework (GBRF) and Anaerobic Digestion Certification Scheme International (ADCS)

- **GBRF: 9 Pillars -** Recommendations for local and national governments to encourage regulatory harmonisation and investment in the use of best practices, policies, and technologies from around the world.
- **Certification and Standards: 11 Modules -** Best practices and safety measures for biogas plants through an international certification scheme and a biogas-tailored Life Cycle Assessment (LCA) methodology.

#MakingBiogasHappen - Phase 1
Global Biogas Regulatory Framework

Now available at:

🔗 www.globalbiogasframework.org

GLOBAL BIOGAS REGULATORY FRAMEWORK

Nine Pillars:

1. International and National Policy
2. Feedstock Policy
3. Biogas Utilisation
4. Digestate Policy
5. Gas Quality Regulations
6. Technical and Operational Quality Standards
7. Permitting Regulations
8. Planning Policy
9. Health, Safety and Environmental Protection

#MakingBiogasHappen - Phase 1
AD Certification Scheme International

Now available at:

🔗 www.adcsinternational.org

ADCS INTERNATIONAL

Eleven modules:

1. Site information and understanding
2. Managing health and safety risk
3. Staff training
4. Process monitoring
5. Maintenance of the plant, kit and infrastructure
6. Procuring services
7. Managing environmental risks
8. Cross-contamination regulations compliance
9. Digestate management
10. Biomethane process
11. Life cycle assessment (LCA)







#MakingBiogasHappen

Phase 2

- **Dissemination & Outreach**
- **Adaptation & Integration**

Global Methane Hub

WORLD BIOGAS ASSOCIATION

World Biogas Association
#MakingBiogasHappen Programme

Phase 2

Roll out at the national and sub-national levels

- **Outreach and Dissemination** of #MBH findings at national and subnational levels. Participation in bilateral events and meetings.
- **Adaptation:** Preparation of Biogas Action and Implementation Plans at the national, state or city level as required, by customising key elements of GBRF and ADCS International to the local biogas ecosystem.
- **Capacity Building**: Training and resources to develop local expertise in the biogas value chain. Dissemination of the best practice regulatory framework.
- **Standardisation:** Technology Benchmarking, Standards, ADCS Certification, and LCA adapted for biogas.

#MakingBiogasHappen - Phase 2
Way Forward

- WBA presence at Global Events for MBH dissemination and outreach
- Establishing partnerships with national, state, and local agencies to roll out MBH phase 2
- Finalizing MoUs with national and state governments: Focus on Brazil and India
- Customise key elements of GBRF and ADCS International to the national policies and programmes, aligning with climate targets and energy security, building upon ongoing activities
- Workshops on GBRF and ADCS International for policymakers and regulators, operators, and entrepreneurs.
- Present the key elements of the #MBH Phase 2 at the global events: COP 30







Signing of MoU on 5 June with the State Government of São Paulo on the Roll-out of #MBH Phase 2

#MakingBiogasHappen Programme

Key Deliverables

1. Rapid and adaptive growth of the Biogas Industry and Supply Chain
2. Alignment with climate targets and ensuring business models
3. National policies adapted to promote high Performing Biogas / Biomethane plants
4. Standards and Certification with guarantees that regulations and safety measures are implemented
5. Life Cycle Analysis methodology dedicated to Biogas Plants, with links to the carbon market
6. Social acceptance and economic empowerment
7. Fast, efficient and dedicated licensing processes for biogas/biomethane.
8. Quality standards for the biogas industry
9. Global linkages, identification of pioneering technologies, and correct design
10. Linking Global Conventions, Protocols, and Alliances (GBA, GMH)

WORLD BIOGAS ASSOCIATION

Mission Biogas

Mission Possible

WORLD BIOGAS ASSOCIATION

Thank you!

pmonga@worldbiogasassocation.org