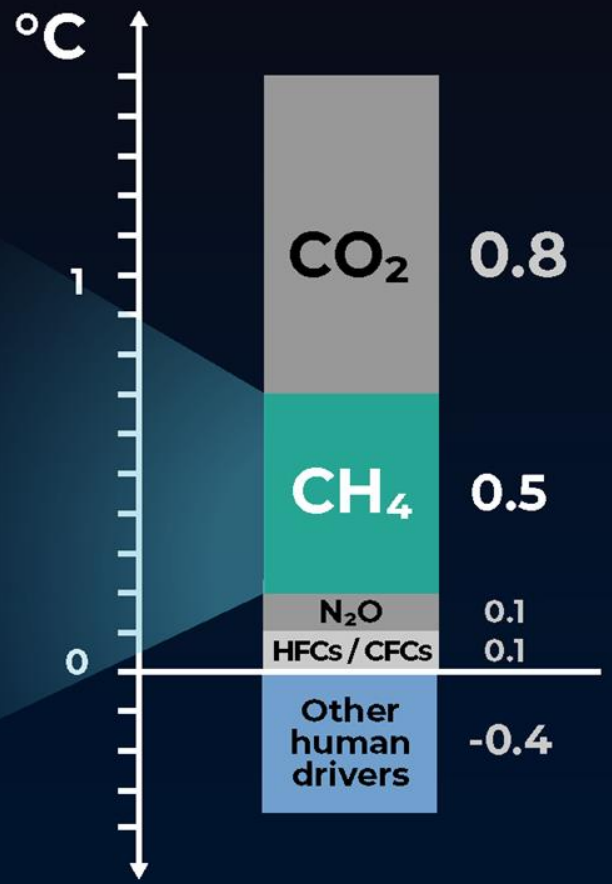
El metano: oportunidades para la ingeniería sanitaria en la era climática

Marcelo Mena CEO

Global Methane Hub

CH_4 has contributed to 45% of recent net warming

IPCC AR6 report.



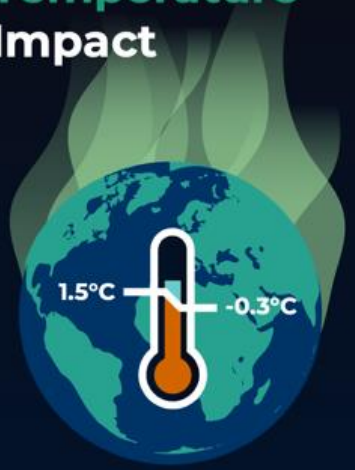
60% of methane comes from

Food production

Food waste

Global Methane Hub

Temperature Impact



Critical to keep **1.5°C** within reach

-0.3°C warming avoid by 2050

Avoided Climate damages

$8.3 trillion avoided damages annually by 2050

Economic & health co-benefits

4.2 million premature deaths avoided

50 million tonnes of crops saved

$370 billion annual savings in health costs & productivity

Different satellites, different opportunities

GOSAT2
GOSAT GW
Sentinel 5P
Sentinel 5

Sensitivity
1+ ton/h

Resolution:
Paris Central

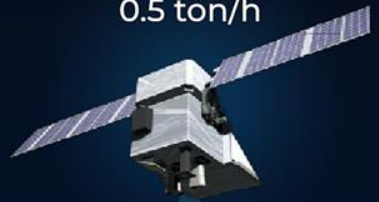
7.5x7.5km

Waste Energy

Aerial emissions &
Very large point sources

Methane SAT

Sensitivity
0.5 ton/h



Resolution:
8 Football fields

140x400m

Agriculture Oil & Gas

Aerial emissions &
Large point sources

CarbonMapper
Tanager
GHGSat

Sensitivity
0.1 ton/h

Resolution:
1 Basketball court

30x30m

Waste Energy

Point sources

Global Methane Hub

WASTEMAP

https://wastemap.earth

- Global Data
- Extensive Reach
- Satellite & Remote Sensing

- Automated Content Generation
- Geospatial Data Enhancement
- Conversational AI

Guatemala

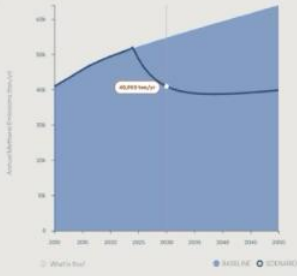
Ecuador

Côte d'Ivoire

Advanced Decision Support Tools

DST

- City Decision Support Tool
- Site Decision Support Tool



Methane reduction potential against BAU

Processing Time (per Country Profile)
16 H (Pre-Intervention) → 1 H (Post-Intervention)

94% Reduction

Unit Cost of Delivery (per Country Profile)
$1.600 (Pre-Intervention) → $100 (Post-Intervention)

Global Methane Hub · RMI · CATF Clean Air Task Force · SRON Netherlands Institute for Space Research · Carbon Mapper · Google.org

UCLA: Spotlight on Top Plumes

Rank	Location	Nearby City / Area Served	Rate (metric tons/hr)	Date Range Observed	Open the Data
1	Algiers, Algeria	Algiers	7.4	Jan 2-Sept 18	Data link
2	Bekasi, West Java, Indonesia	Jakarta	7.1	Feb 15-Sept 13	Data link
3	Penco, Biobío, Chile	Concepcion	5.0	Jan 10-Aug 22	Data link
4	Talagante, Chile	Santiago	5.0	Jan 20-Oct 3	Data link
5	Al Jumum, Saudi Arabia	Jeddah	4.7	Feb 1-Sep 29	Data link
6	Jeram, Malaysia	Kuala Lumpur	4.5	May 7-Jul 9	Data link
7	Rodriguez, Philippines	Manila	4.4	Jan 26-Sept 21	Data link
8	Fazenda Rio Grande, Brazil	Curitiba	4.2	May 9-Sept 14	Data link
9	Mauá, Brazil	São Paulo	4.0	Feb 5-Jun 20	Data link
10	Hong Kong North District	Hong Kong	3.9	April 3-Sept 27	Data link
11	Campo de Mayo, Argentina	Buenos Aires	3.9	Jan 9-Sept 16	Data link

EMISSION INTENSITY RANKING · ALL 20 COUNTRIES

t CH_4 / h per detection unit · Sorted by emission intensity (highest → lowest)

#	COUNTRY	REGION	t/h / UNIT	PLUMES	Σ T/H	MSW MT	INTENSITY BAR
1	**Chile**	South America	**7.4838**	43	67.4	9	
2	**Argentina**	South America	**6.8715**	118	137.4	20	
3	**Peru**	South America	**6.2138**	30	49.7	8	
4	Morocco	Africa	6.1470	33	43.0	7	
5	Brazil	South America	3.4385	198	271.6	79	
6	Algeria	Africa	3.4028	18	44.2	13	
7	Kazakhstan	Asia	3.1970	20	12.8	4	
8	Saudi Arabia	Asia	3.0389	15	48.6	16	
9	Turkey	Europe	2.7158	44	86.9	32	
10	Mexico	North America	2.5390	150	137.1	54	
11	Spain	Europe	2.0956	53	44.0	21	
12	South Africa	Africa	1.4063	35	25.3	18	
13	Pakistan	Asia	1.3064	36	39.2	30	
14	United States	North America	1.2716	363	328.1	258	
15	India	Asia	1.1928	188	221.9	186	
16	Iran	Asia	1.1185	17	19.0	17	
17	Venezuela	South America	1.0094	8	9.1	9	
18	Egypt	Africa	0.9561	12	21.0	22	
19	Australia	Oceania	0.7690	34	15.4	20	
20	Colombia	South America	0.6325	7	8.2	13	

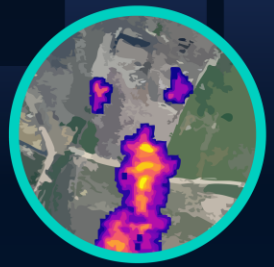
Source: Tanager-1 / TROPOMI · World Bank 2022 MSW · Intensity = t CH_4/h per detection unit

Waste

A major methane source

20%

of methane emissions come from **waste**



1.- Organic Waste Disposal

2.-Size & Open Working Areas

3.-Delays / Poor Pipeline Interconnections

4.-Leaks in biogas capture, flare, and/or energy generation system.

5.-Poor-Quality or Delayed cover/biocover Installation

GMH goal and role in pushing solutions to implementation

Support 30% reduction of waste methane by 2030

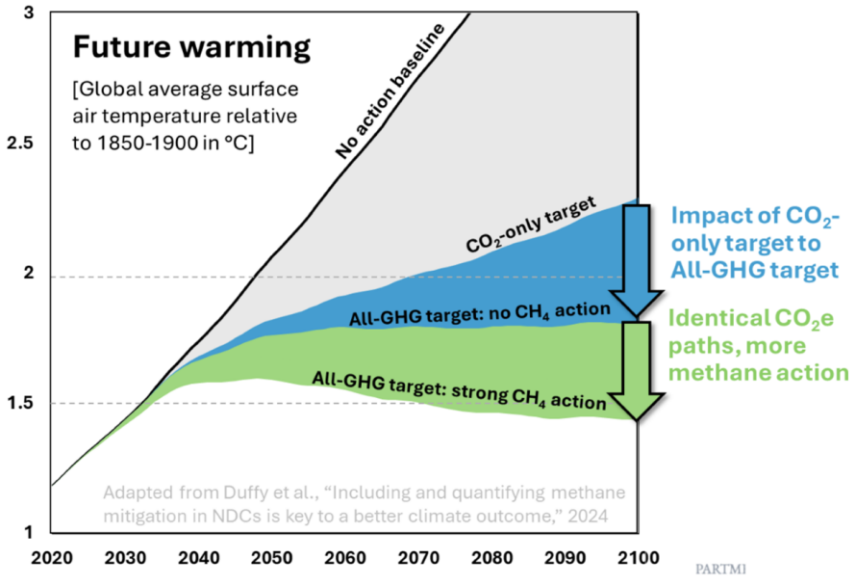
Prioritize prevention
Scale food recovery and change behaviors

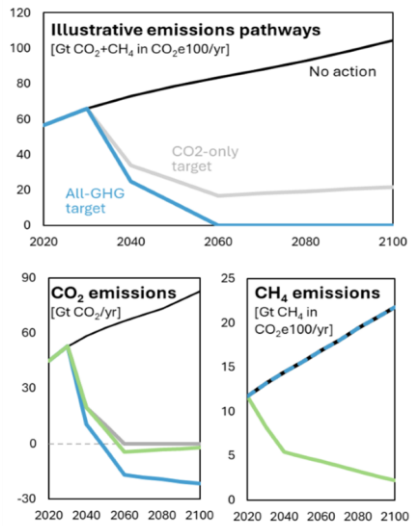
Divert organic waste
Keep organic waste out of landfills

Focus first
Cut landfill methane while we shift upstream

Without targeted measures on methane we have no idea how much we will overshoot.

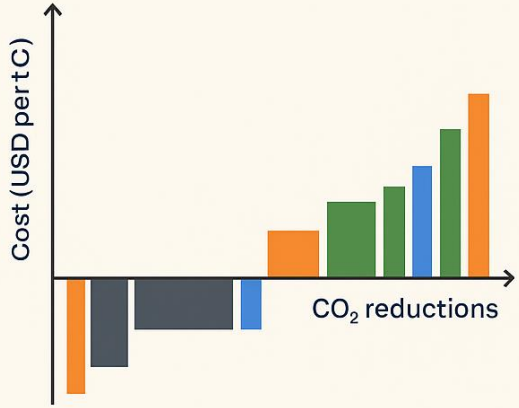
A focus on carbon dioxide without focusing on methane will guarantee no temperature reductions by 2100.



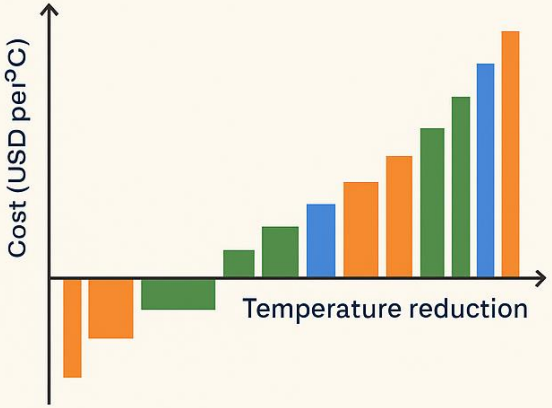


MAAC vs. T-MACC

Global Methane Hub



Marginal Abatement Cost Curve (MACC)



Temperature Marginal Abatement Cost Curve (T-MACC)

Converting emissions into temperature reductions.

E → C → RF → ΔT
Where:
E = Emissions (kg/year)
C = Atmospheric concentration (ppb or ppm)
RF = Radiative forcing (W/m^2)
ΔT = Temperature change (°C)

AGTP

(Absolute Global Temperature Potential)

$\Delta T(t) = \Sigma_i \int_0^t E_i(t') \times AGTP\_i(t-t')\, dt'$

Where:

$\Delta T(t)$ = Temperature change at time t

$E_i(t')$ = Emissions of pollutant i at time t'

AGTP_i = Temperature response per unit emission

$\Delta T\_CH4 = E\_CH4 \times AGTP\_CH4 \times (1 - e^{(-t/\tau\_CH4)})$

$\Delta T\_BC = E\_BC \times AGTP\_BC \times (1 - e^{(-t/\tau\_BC)})$

Comprehensive Benefits Estimation

Methodology

HEALTH BENEFITS

Air quality improvements

Pollutants: PM2.5, ozone, indoor air

Impacts valued:

- Avoided premature deaths
- Reduced respiratory illness
- Avoided hospital visits
- Reduced lost workdays

Valuation: Value of Statistical Life (VSL) adjusted by income

Sources: WHO, IHME GBD, EPA BenMAP

CLIMATE BENEFITS

Avoided warming damages

Pollutants: CO2, CH4, BC, HFCs

Impacts valued:

- Sea level rise damages
- Agricultural yield losses
- Extreme weather events
- Ecosystem services

Valuation: SCC $185/tCO2, SCM $1,600/tCH4

Sources: EPA IWG, Rennert et al. 2022

ECONOMIC BENEFITS

Operational savings

Categories: Energy, agriculture, waste

Savings valued:

- Recovered gas sales (O&G)
- Reduced fuel costs
- Reduced water use
- Avoided crop losses
- Landfill gas revenue

Valuation: Market prices, avoided costs

Sources: IEA, FAO, World Bank

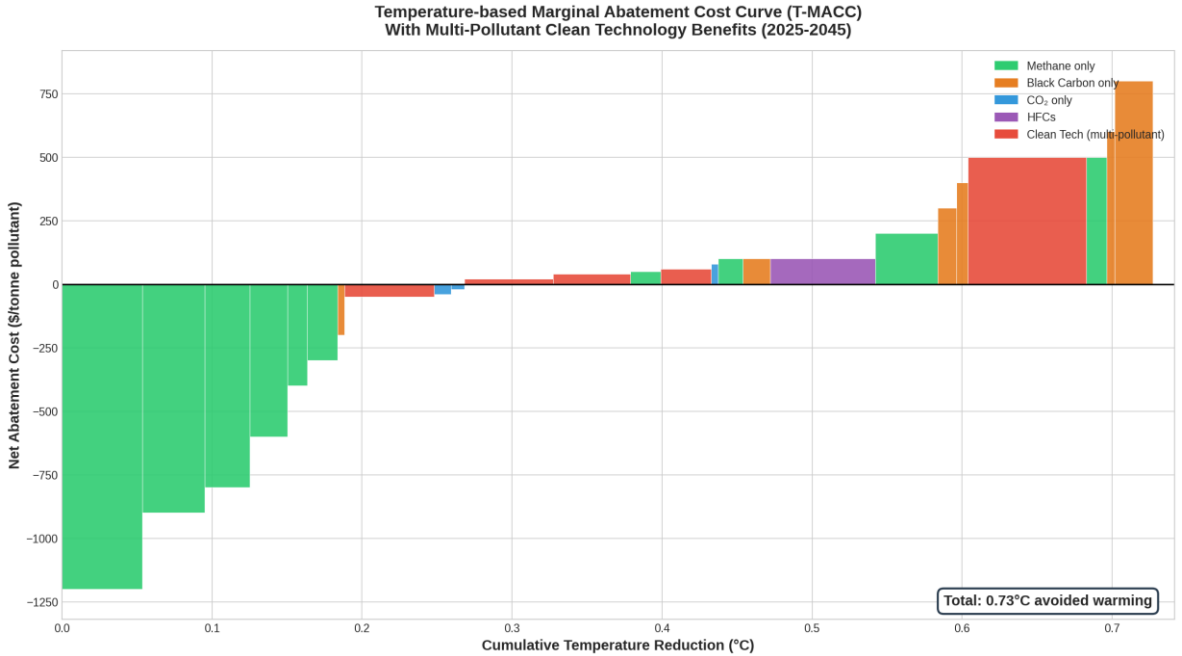
BCR = (Health + Climate + Economic) / Costs

Focusing on promoting synergies between clean tech and SLCP mitigation, deforestation, and targeted SCLP measures can prevent 0.73C by 2045.

Temperature-based Marginal Abatement Cost Curve (T-MACC)

33 Climate Mitigation Measures (2025-2045)

Combined 0.73C avoided warming



Sectoral Reduction (Methane)

Global Methane Hub

Sector	Baseline (Mt/yr)	Technical Potential	2030 Reduction	2045 Reduction
ENERGY SECTOR				
Oil & Gas	80	75%	37.5%	75.0%
Coal Mining	40	50%	15.0%	30.0%
Bioenergy	20	—	0%	0%
AGRICULTURE SECTOR				
Enteric Fermentation	100	30%	15.0%	30.0%
Manure Management	15	50%	25.0%	50.0%
Rice Cultivation	30	50%	25.0%	50.0%
WASTE SECTOR				
Landfills	60	70%	35.0%	70.0%
Wastewater	20	30%	8.3%	16.7%
TOTAL	**365**	**—**	**23.3%**	**46.5%**

Source: IEA Global Methane Tracker 2024/2025, FAO, UNEP

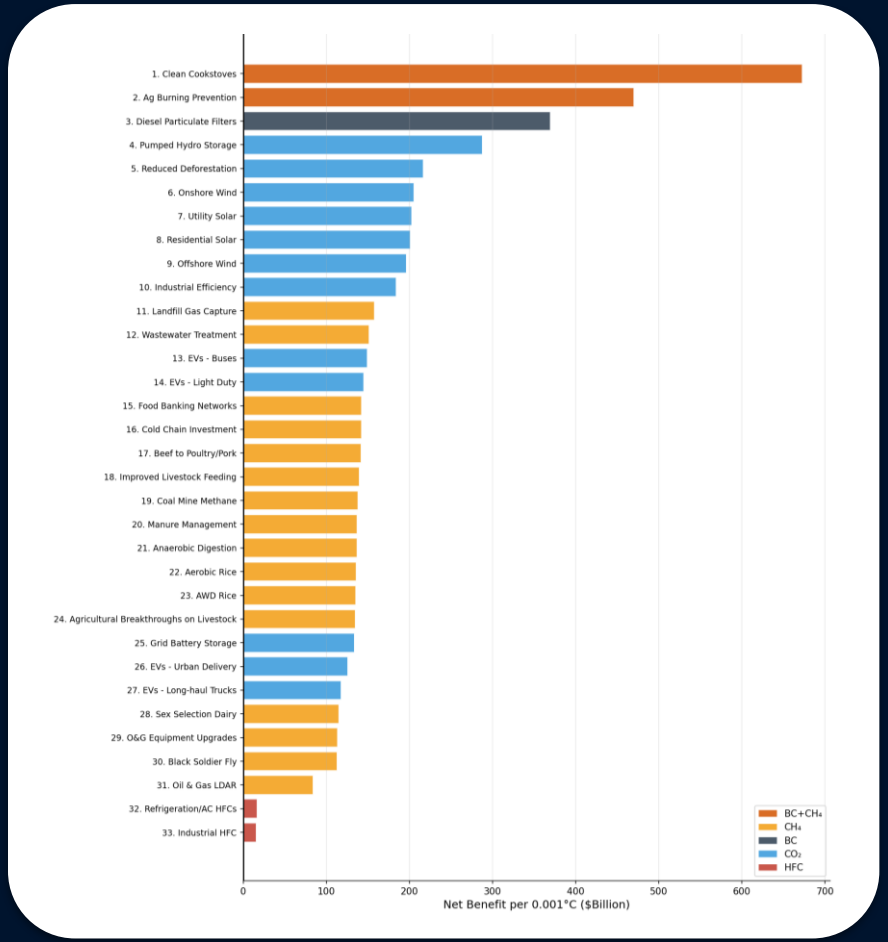
T-MACC Ranking: Mesures by Net Benefit per Millidegree Avoided

(Rank 1 = Most Cost Effective)

- Ranks 33 mitigation measures by net economic benefit per 0.001°C avoided.
- SLCP mitigation (methane + black carbon) dominates highest-impact actions.
- CO_2 measures remain essential for long-term structural decarbonization.

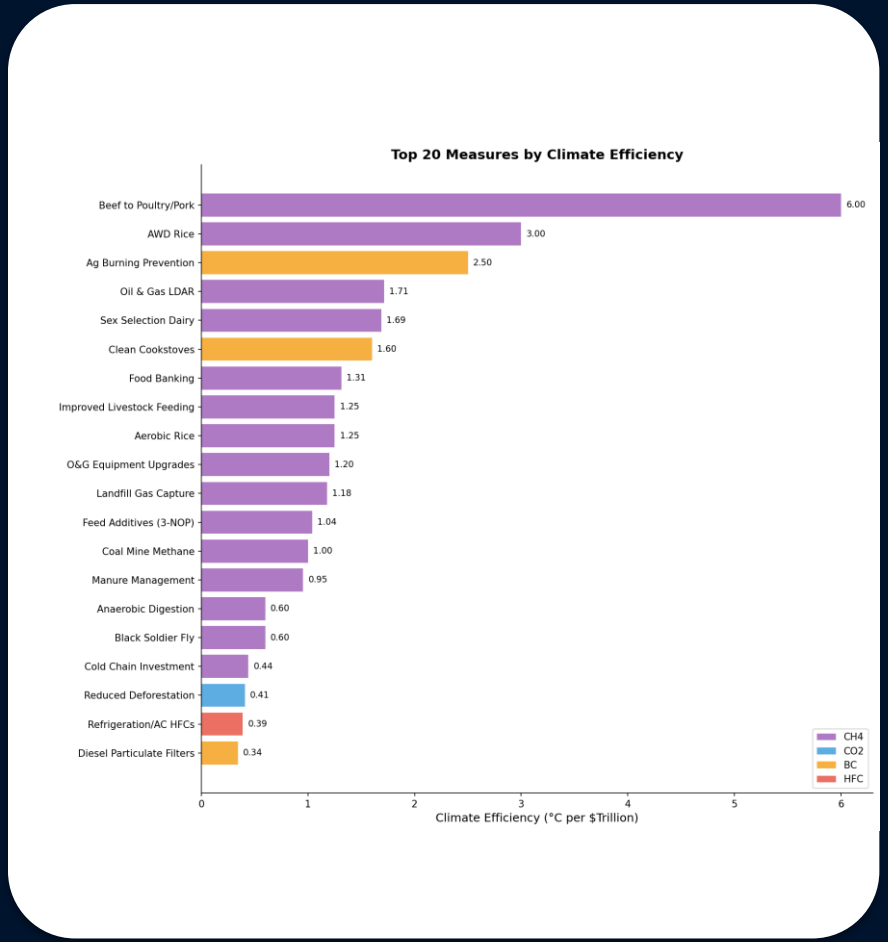
- Clean cookstoves: highest net benefit, major BC + CH_4 reductions.
- Agricultural burning prevention: strong BC mitigation and high returns.

- Wind and solar (utility, residential) rank highly for long-term benefit. Combining SLCP + CO_2 strategies maximizes near- and long-term impact.



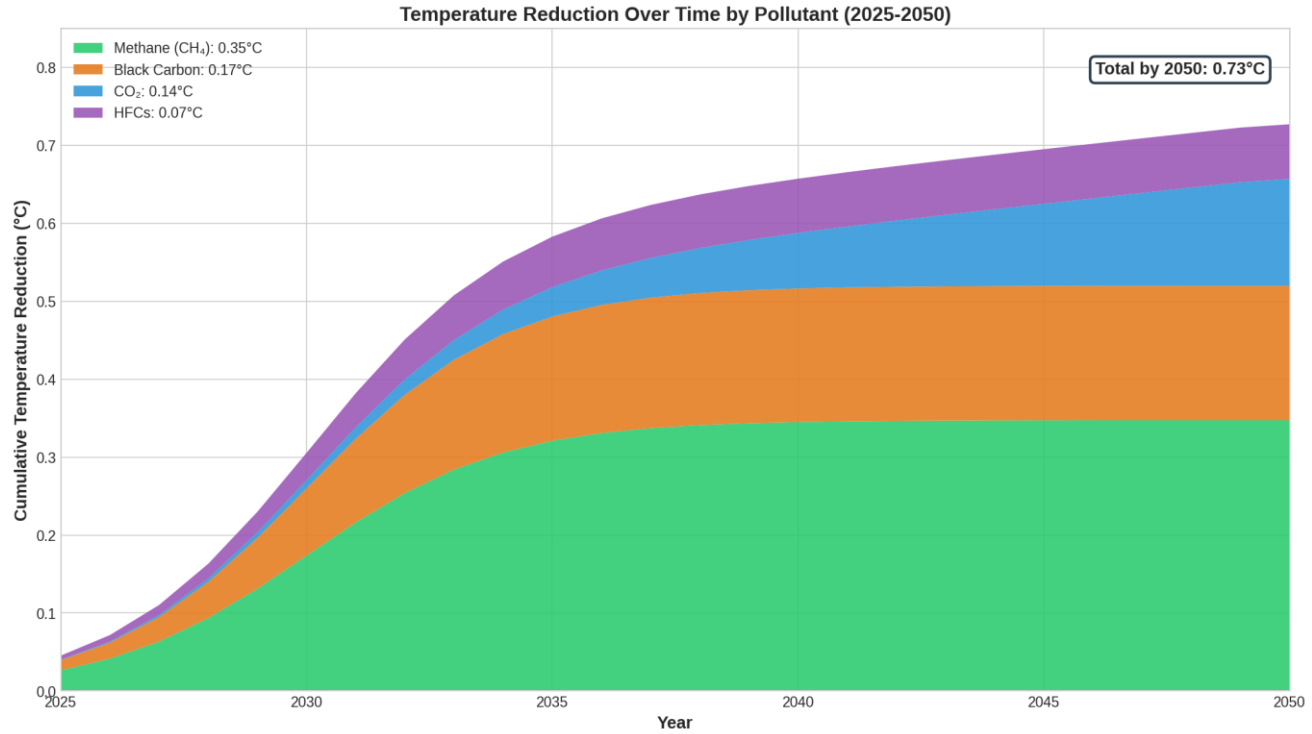
Top 20 Measures
By Climate Efficiency

- The most climate-efficient measures are methane-focused, with Beef-to-Poultry/Pork, AWD Rice, and Ag Burning Prevention delivering the highest °C avoided per dollar invested.
- CH_4 reductions dominate the top of the ranking, reflecting their powerful near-term cooling potential and cost-effectiveness.
- Several agriculture and food-system actions (e.g., improved feeding, food banking, landfill gas capture) offer high returns even at modest investment levels.
- CO_2, BC, and HFC measures appear lower in the ranking, emphasizing that fast methane action outperforms other GHG reductions when the goal is rapid temperature impact per dollar. But this changes when incorporating health benefits.



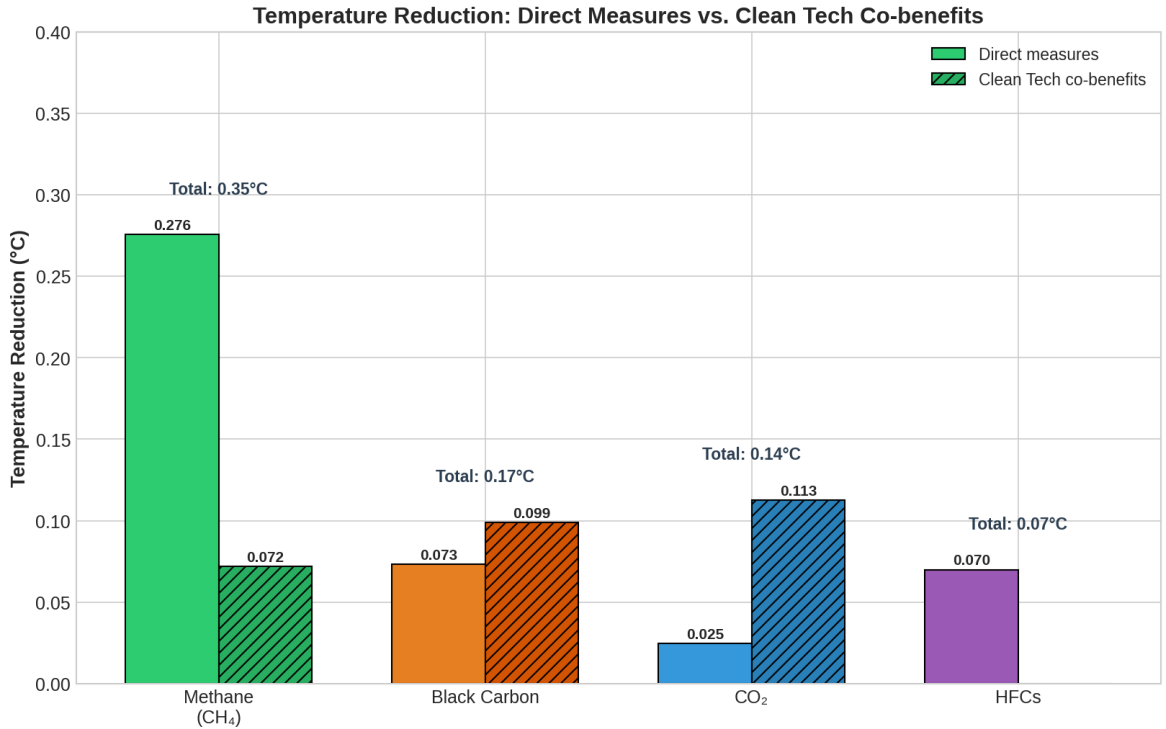
Temperature Reduction Time Series

Deployment 2025-2035, Full Effects by 2050



Temperature Reduction by Compound

Direct Emissions + Indirect Benefits from CO_2 Measures



Fire Risk Projection Analysis Methodology, with pilot projects in Chile and Ghana

Management of operational variables and their effect on fire risk

Implemented by:

Pontificia Universidad Católica de Valparaíso · NBC Núcleo Biotecnología Curauma · Centro de Acción Climática PUCV · ImplementaSur Climate Action · Earth Observation Research & Innovation Centre

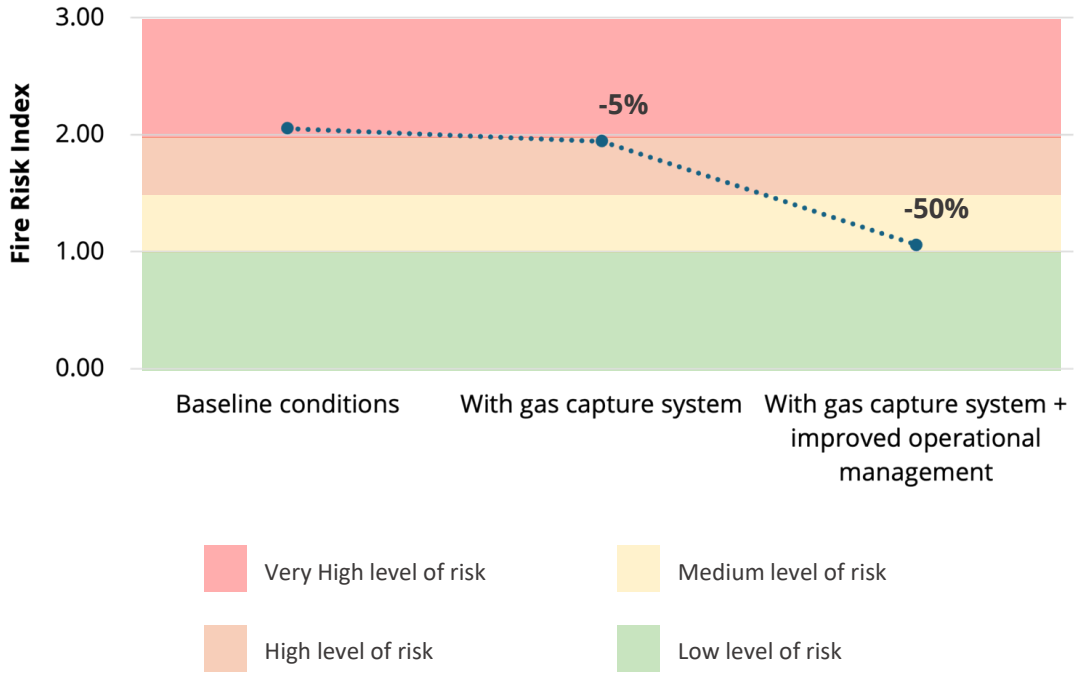
Funded by:

Global Methane Hub · Windward Fund

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment and Climate Change Canada · Environnement et Changement climatique Canada

Fire Risk

Impact of Landfill Operation



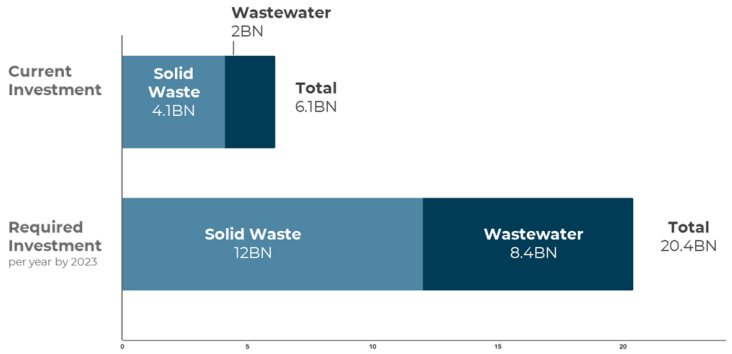
Fire risk can be reduced by 45-50% through improved landfill operation.

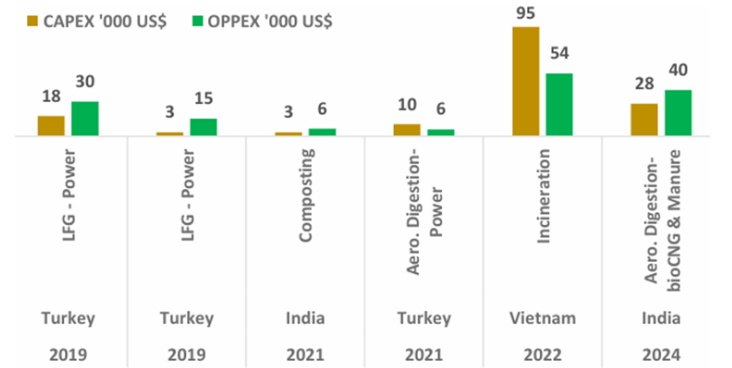
Finance

70% of solid waste services fall to local public authorities.

Investment from the national budget (primarily from MDBs) and the private sector(banks), without a focus on methane mitigation.

WASTE sector: **OPEX** is almost always higher than **CAPEX**





CLIMATE POLICY INITIATIVE
Catalytic cities
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
AGS Carbon Advisory

Finance Mobilization

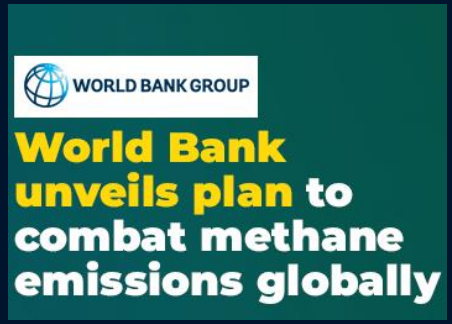
Public and Private finance sector

1. **Inter American Development Bank and World Bank**
   US$5 billion in Investment, >15 countries, potential abatement of 8 million tons CH4. New tools are being developed to measure methane mitigation levels> AfDB.

2. **New Taxonomy**
   Food Value Chain, Waste & Wastewater sub sectors.

3. **Private sector**
   How to address systemic barriers preventing capital deployment

Too Good to Waste



To be Updated by 2026

Reducing organic waste is a highly effective solution for climate change and sustainable development

WE MUST CONSIDER THE CONTEXT OF GLOBAL SOUTH COUNTRIES AND CITIES:

Western Europe vs LAC

- GDP per capita: 65,000 vs 6,500 USD
- % Informal economy: 0.5 vs >60 %
- Waste regulations: Mature vs in development

Collecting and recovering **food and organic waste** has been shown to generate

60% more **GDP** and **4** to **10** times more jobs than disposal.

gaia 25TH ANNIVERSARY

C40 Sustainable Waste Systems Accelerator

Cities committed to 3 targets by 2030:

☑ Providing Citiwide collection services.
☑ Treating at least 30% of organic waste.
☑ Reducing waste disposal emissions by at least 30% (METHANE!).

22 Cities are on track to reduce 1.2 mtCH4 by 2030 by improving their organic waste management.

Removing over **100 million tons of CO2** or taking **22 million** cars off the road.

Chile

(Waste: 48% of methane emissions)

- 2022, Climate Change Framework Law
  - Carbon Neutrality Goal and Carbon Budget per sector
- 2023-24 Mitigation Action Plan (energy, transport, waste, etc)
  - Mitigation Abatement Cost Curve
  - New regulation by 2030 (incremental implementation)
- **2024, Domestic Carbon Market: 50% from the waste sector**
- **2025, Carbon pricing and markets roadmap**

- Clear opportunity for PPP!

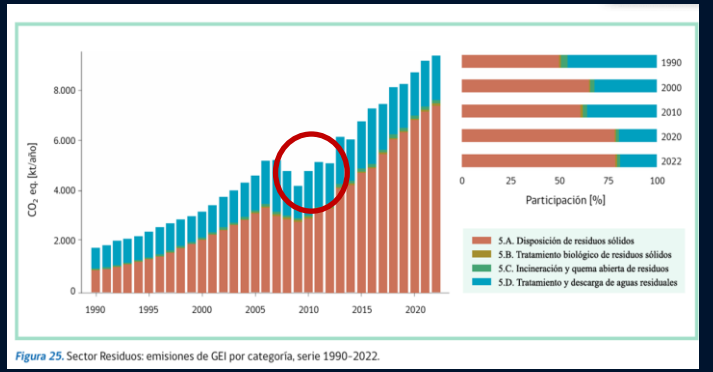


Figura 25. Sector Residuos: emisiones de GEI por categoría, serie 1990-2022.

Chile, GHG Inventory, Waste sector (BTR)

Roadmap launch, COP30, SPS Pavillion

Bilateral Collaboration, art 6.2:

Waste: landfills and more to come

Carolina Urmeneta

Waste & Circular Economy Program Director

Global Methane Hub

General context

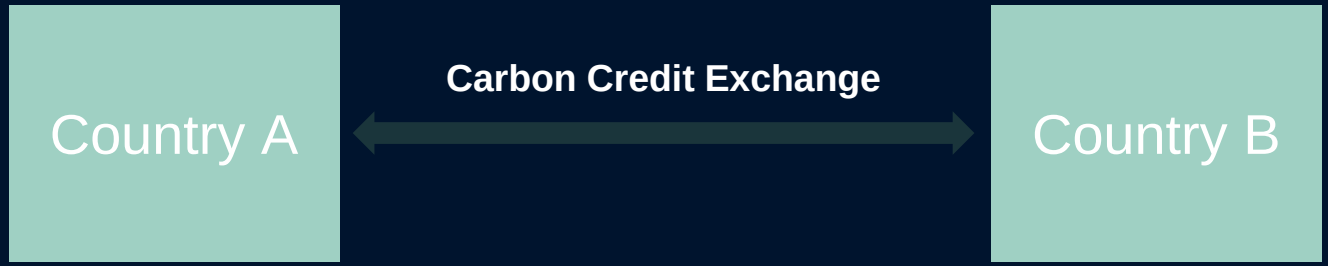
Our ToC: Focus on business models and how to support CAPEX and OPEX for the waste sector

☑ **Carbon markets are one tool among many, not a silver bullet.**

☑ Carbon markets: Domestic, Art 6 (6.2, 6.4 & 6.8), CORSIA, Voluntary.

☑ Art 6.2: Bilateral agreements with clear typologies and periods of time

Bilateral collaboration under 6.2



-Achieve the targets set out in the NDCs of both countries

-Reduce overall costs (global mitigation efficiency)

-ITMOs: Internationally Transferred Mitigation Outcomes

-Corresponding adjustments to maintain environmental integrity

-Authorization by both countries

Switzerland

- KLIK: Foundation for Climate Protection and Carbon Offset
- Private entity mandated under the Swiss CO_2 Act to offset part of the emissions from the transport sector (motor fuel use in Switzerland).
- Acts as a carbon offset mechanism

- Expected to help reduce 20 million tCO_2eq by 2030
- Projects > 250ktonCOeq by 2030

Chile

- 2022, Climate Change Framework Law
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Figura 25. Sector Residuos: emisiones de GEI por categoría, serie 1990-2022.

Chile, GHG Inventory, Waste sector (BTR)

Roadmap launch, COP30, SPS Pavillion

Results

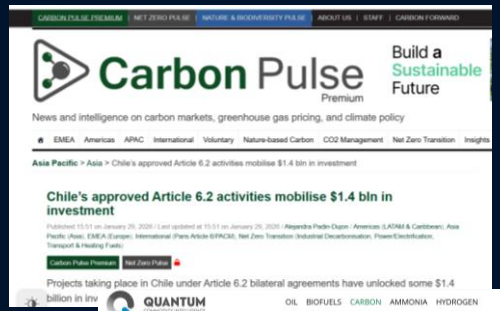
Portafolio

Overview

No	Activity	Status
1	Conversion from Coal to Biomass project	Authorized
2	Electric Mobility Program Chile	Authorized*
3	BESS Project	Authorized*
4	BESS Program Chile	Authorized*
5	Landfill project	Authorized*
6	Electric buses rural and interurban transportation in Chile	In authorization
7	Conversion from Fossil Fuel to Biomass programme	In authorization
8	BESS projects (2)	In authorization

1° - 3.4MM ITMOs = 950MM USD
2° - 2.8MM ITMOs = 860MM USD

20% methane 2027-2030



More to come? YES

Chile has a ROADMAP for Carbon Pricing and Carbon Markets: Mitigation Activities Classification:

- A) **Not included in NDC** measures nor in climate policy instruments supporting NDC implementation. Example: Composting, Anaerobic Digestion, Food Banks.
- B) **Accelerate the implementation** of measures already defined in the NDC and in climate policy instruments. Example: anaerobic digestion large food waste generators
- C) **Included in NDC measures, but facing economic barriers to implementation**. These activities demonstrate that the benefits of using Article 6 mechanisms outweigh the risks, and that international transfer of mitigation outcomes does not compromise Chile's NDC commitments. Example: Landfills with higher efficiency

*** LAC COLLABORATION PROGRAM FOR ORGANIC WASTE AND METHANE MITIGATION**

Organic Waste at COPs

☑ **COP27, first-ever Waste Solutions Pavilion**

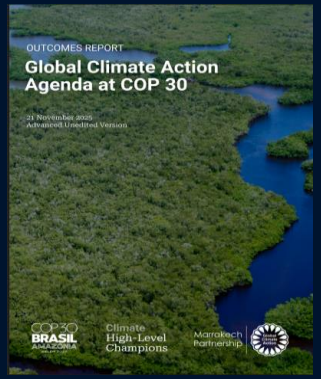
☑ **COP28, LOW Methane, and Too Good to Waste (IDB).** Jurisdictions, at the subnational and national level, to mobilize at least US$10bn and 1 MtonCH4 mitigation well before 2030

☑ **COP29, ROW (reducing organic waste**), endorsed by countries representing more than 50% of methane emissions.

☑ **COP30 Circular Economy NOW**
(Umbrella Initiative)
+50 organizations: Data, Capacity Building, Policies, Finance

☑ GMH (30mUSD): Catalytic Support for methane mitigation.

☑ IKI (15mEUR): Urban value chains through bioenergy use: scalable solutions for sustainable methane reduction



no organic waste

CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS
a UNEP convened initiative

Composting Plant, BELEM

Belem + Catadores + Instituto Polis + GAIA+ MMA + COP30 + GMH, among others:

- Design and operation, Cost-effective, Just Transition, Capacity Building, Job Creation

Partnerships Example

Mobilize finance,

SEBRAE, ABRASEL , Instituto Pólis and the Global Methane Hub

Brazil Leading by the example

National Strategy for Organic Waste
Waste Mitigation Action Plan
National Plan on Super emitters

12 subnational governments committed to Landfill Methane Mitigation
LIR (Lei de Incentivo à Reciclagem a compostagem e a economia circular)

FLW Prevention & Recovery

- **More than 30 NDCs:**
  Cameroon, Cape Verde, Ethiopia, Jordan, China, Gambia, Uruguay, Qatar, Malawi, Sierra Leone, Maldives, Mozambique, Senegal, Indonesia, Uruguay, Sri Lanka, United Kingdom, Vanuatu, Cambodia, Jordan, Chile, Uruguay, Colombia, United Arab Emirates, Indonesia, Nepal, Somalia, Angola, Micronesia (Federated States of), Mauritius, Kyrgyzstan, Nigeria, Eswatini,...

- **Food Waste Breakthrough:**
  UNEP, GEF; GFN, WRAP, REFED, Private Sector, among others

What's next?

- ☑ **COP31,** High Level Champion, Zero Waste Priority

- Action Agenda
- Drive Implementation and Finance Mobilization
- **LAC,** through the Regional Collaboration Programme, can lead by example and mobilize additional funds for implementation.

- **March 30,** Zero Waste Day: Food Waste
- **June 5-7:** Zero Waste Forum
- **Nov:** COP31, Turkey

Reducing **organic waste** is a highly effective, cost-efficient solution for **significantly lowering** methane emissions

Global Methane Hub