



Leveraging voluntary carbon offsets, evolving global markets, and OSAR technology for incentivizing fleet modernization/cleaner internal combustion in emerging economies

Alberto Ayala, PhD, MSE

Executive Director, Sacramento Metropolitan Air Quality Management District

Adjunct Professor, Mechanical, Materials, and Aerospace Engineering, West Virginia University

Former Deputy Executive Officer, California Air Resources Board



acknowledgments

David Miller and Dr. Gurdas Sandhu



Dr. Kent Johnson



Andrew Burnett



Dr. Carl Desouza



Dr. Alberto Ayala



Thank you CE-CERT for a decade+ of advancing PEMS knowledge

Who Should Attend:

- Air quality scientists
- Regulators
- Policy makers
- Equipment manufacturers

Many researchers are engaging in complicated testing projects either to learn the inventory contribution to a community or to provide assurance that the diesel engines meet the standards. Special knowledge is essential to accurately measure in-use emissions.

Researchers considering in-use testing programs that involve hybrid, aerodynamic vehicles, aftertreatment, deterioration factors, and other in-use measurement approaches should attend this conference to learn about the latest tools and “lessons learned” from experienced measurement experts.



To Register visit:

www.cert.ucr.edu/events/pemsworkshop.html

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(951) 781-5682
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PEMS: The Latest Tools and Techniques for In-Use Measurements

Thursday, March 24, 2011



A workshop to explore comprehensive issues for testing programs in on-road, off-road, marine, and agricultural applications.

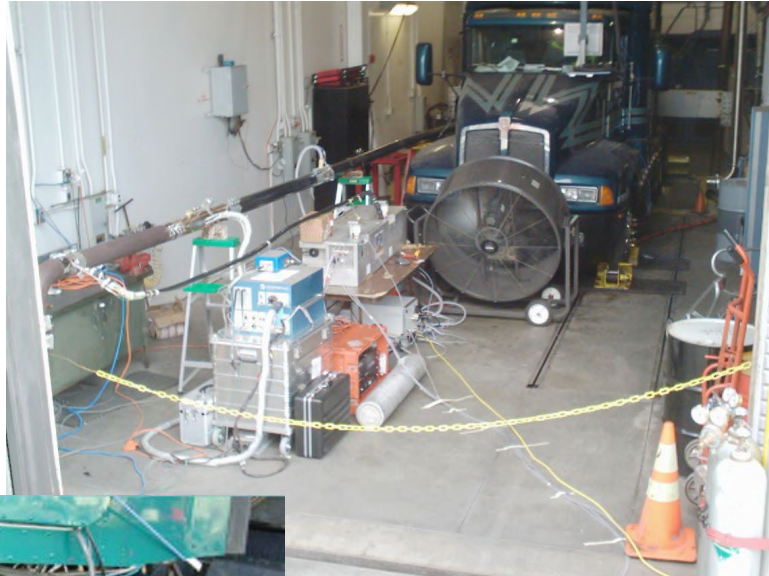


A desk setup featuring a spiral-bound notebook on a wooden easel. The notebook's cover is white and prominently displays the word "BASICS" in large, bold, black, sans-serif capital letters. To the left of the easel, a pair of gold-rimmed glasses rests on the desk. In the foreground, a silver and black ballpoint pen lies horizontally. To the right, a clipboard with a black clip is positioned over a document with a grid pattern. The background is a plain, light-colored wall.

BASICS

OSAR progress over the decades

- We've come a long way...
- And learned a lot
- From early days of SPOT and RAVEN
- To EPA/ARB/EMA measurement allowance program
- To today's PEMS and OSAR



ARB lab @ LA MTA



Early 2000s



Today



- Expanding global policy drivers for climate action
- More/faster - air and climate pollution reductions sorely needed
- *“Burning fossil fuels is threatening human well-being and stability of much of life on Earth, and our chance to avoid most severe impacts is fast moving out of reach.” IPCC*

World is on brink of catastrophic warming, U.N. climate change report says
 A dangerous climate threshold is near, but 'it does not mean we are doomed' if swift action is taken, scientists say

By Sarah Kaplan
 Updated March 20, 2023 at 5:55 p.m. EDT | Published March 20, 2023 at 9:03 a.m. EDT

The Washington Post
Democracy Dies in Darkness




A Chinese state-owned coal-fired power plant is seen next to a large flooding water from project under construction in 2017 in Huadian, Anhui province, China. (Marin Fajen/Getty Images)

Like Comment QR Code Share

The world is likely to pass a dangerous temperature threshold within the next 10 years, pushing the planet past the point of catastrophic warming — unless nations drastically transform their economies and immediately transition away from fossil fuels, according to one of the most definitive

UN: Warming above 1.5C likely unless world acts now



ASIM HAFEEZ BLOOMBERG

A woman carries a pot to fill drinking water in Sindh province, Pakistan, on Sept. 10, 2022. Floods triggered by torrential rains have inundated a third of Pakistan, displacing more than half a million people and destroying cash-crops and communication infrastructure.

BY ERIC ROSTON BLOOMBERG

The report published Monday by the world's leading climate science body, the U.N. Intergovernmental Panel on Climate Change, summarizes the panel's output over the past five years, amounting to some 10,000 pages of dense scientific prose. This synthesis is succinct at 37 pages, and its message is blunt: Burning fossil fuels is threatening human well-being and the stability of much of life on Earth, and our chance to avoid the most severe impacts is fast moving out of reach.


"This report is a clarion call to massively fast-track climate efforts by every country and every sector and on every timeframe," U.N. Secretary General António Guterres said in a statement on the report's release. "In short, our world needs climate action on all fronts - everything, everywhere, all at once."

NBC NEWS "Treated like sacrifices": Families breathe toxic fumes from California's warehouse hub

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'Treated like sacrifices': Families breathe toxic fumes from California's warehouse hub

"The industry is booming. But the cost is seen through people's asthma, people's cancer and the lack of good jobs," said one local advocate.



A truck leaves an Amazon fulfillment center in Eastvale, Calif. on Nov. 12, 2020. Southern Transportation / Orange County Register / ZUMA Press

CNN World Africa Americas Asia Australia China Europe India Middle East United Kingdom

'The climate time-bomb is ticking': The world is running out of time to avoid catastrophe, new UN report warns

By Laura Paddison, CNN
 Updated 10:12 AM EDT, Mon March 20, 2023

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Antonio Guterres
 Secretary-General of the United Nations

© Video Not Feedback

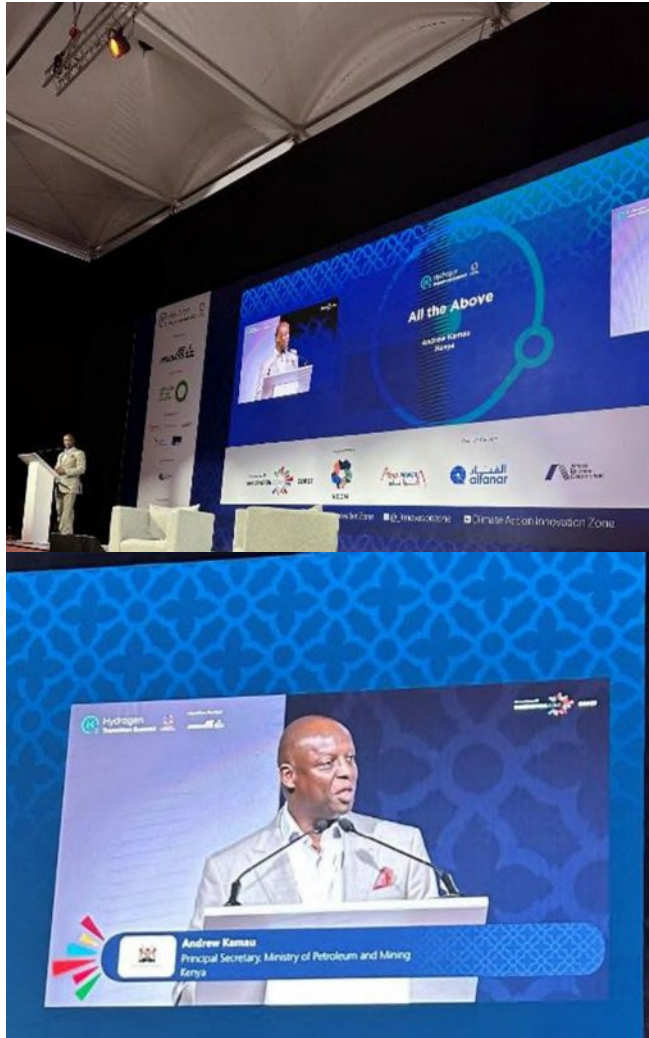
A green rectangular sign with rounded corners and a white border is mounted on two wooden posts. The sign features the word "Reality" in a large, bold, white sans-serif font, with "Just Ahead" in a smaller, white sans-serif font directly below it. The background of the image is a bright blue sky filled with fluffy white clouds. The entire scene is presented as if it were a cutout from a white background, with a jagged white edge on the left side.

Reality
Just Ahead

Transition to zero has begun

- Private sector bringing to market growing number of EVs, low-carbon fuels, and other mobility solutions
- But, globally, a bumpy road ahead for EVs
- Electrified technologies (and their e-fuels) too costly and unproven for many end-uses
- Lack of a sufficient and readily available charging/fueling infrastructure
- And supply/distribution/storage of renewable energy
- Decades are likely needed to reach scale and lower costs
- We need harmony with cleaner combustion technology (and its fuels)
- Clean combustion necessarily plays a role in transition to zero-carbon future





- Given barriers in low- and middle-income economies, there is skepticism and reluctance about EV transition
- “Air pollution is a threat to health in all countries, but it hits people in low- and middle-income countries the hardest” WHO Director-General Dr. Ghebreyesus.
- Might there be another way to incentivize cleaner/affordable/lower carbon vehicles in emerging economies?

COLUMN

Unforced Errors in Public Policy Can Lead to Forced Pollution Exposures—Putting the Health of All Urban Breathers First

by Alberto Ayala

Why Is Clean Air Such a Rare Commodity These Days in Many Places?

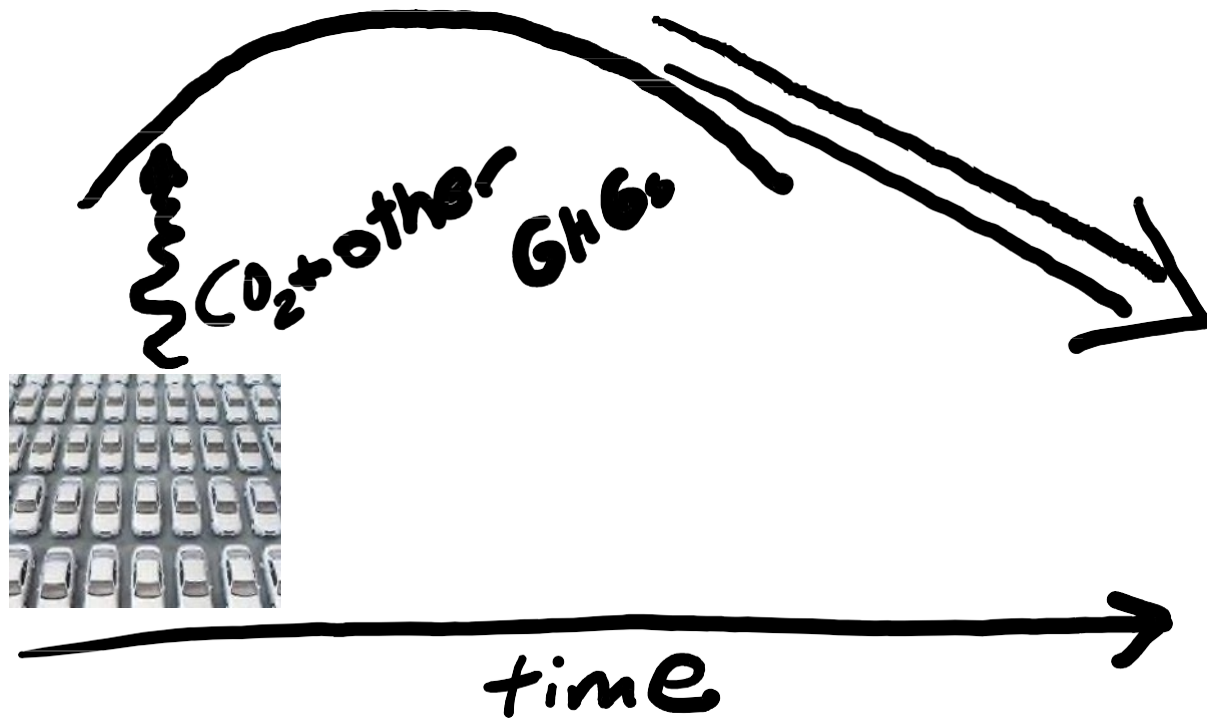
It is difficult not to have a visceral reaction to the September 15, 2023 edition of the U.S. Climate Change Cast. The levels of pollution, ozone exposures, a public measure of the danger, and various technological and administrative health outcomes in Metropolitan Mexico City (MMXC) are disturbing. But the real story is not ozone, emissions, or outcomes. Climate, in rich and emerging economies, is not pollution and air quality or local food systems is not pollution exposure that produce 7 to 10 million premature deaths annually, according to recent academic studies and the World Health Organization, which ranks air pollution as the top five factors of the global burden of disease (see Figure 1).



View of Mexico City in the morning, with air pollution and buildings popping out of the fog and smog. SOURCE: TANDFONLINE.COM/ENV

ENVIRONMENT SOURCE: TANDFONLINE.COM/ENV VOLUME 6 NUMBER 2

Ref: Ayala, A., Unforced errors in public policy can lead to forced pollution exposures – putting the health of all urban breathers first. *Environment*. Vol.6, No.2, tandfonline.com/env. March/April 2024.



- Command and control is preferred rich world approach
- Increasingly stringent emission standards are traditional regulatory intervention
- A declining cap on mobile source emissions
- Costly, complicated, and lengthy
- *Is there another option?*



“The markets” – *carrots balancing sticks*



Emission Credits, Banking, and Trading

- Not a new “*thing*” in the US
- Acid rain program was first “market-based” mechanism (1990, aka cap and trade)
- Then came NO_x budget trading program and others
- Today we have: Europe Emission Trading System (ETS), New Zealand ETS, California/Quebec ETS, US Northeast RGGI, Korea ETS, China ETS, Washington Cap-and-Invest, etc.
- Long-standing option in most regulatory policies tackling conventional pollution
- We call it “flexibility” for regulated entities
- Examples: ERCs, California Carl Moyer (30 year program) and other incentive programs

OSAR and integrity of credits/offsets

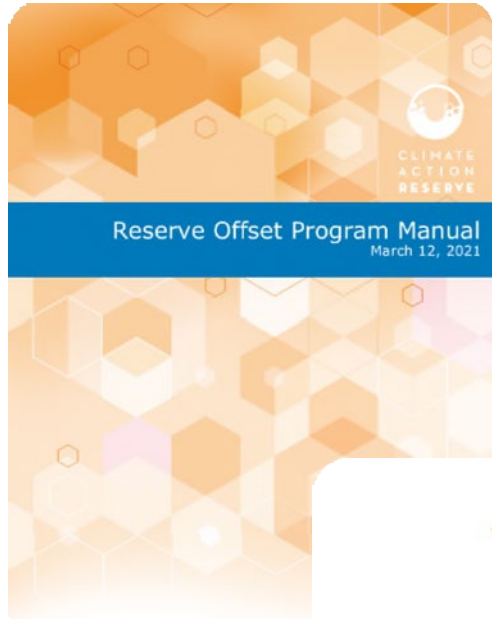
	OSAR	Definition
Real (surplus)		reductions must not already be required by any law, rule, regulation, agreement, or orders
Quantifiable	✓	using actual historical emissions in comparison to proposed post-project
Enforceable	✓	Verifiable and legally binding limitations which are enforceable
Verifiable	✓	
Permanent	✓	continuing without change for life of ERC



The Promise of Carbon Markets

- Compliance and voluntary carbon markets (VCMs) primed for growth
- Due to Paris Agreement and Nationally Determined Contributions (NDCs)
- VCMs driven by demand from companies to meet voluntary climate commitments
- VCMs as bridge as companies make “harder transitions”
- VCMs are short game - play more immediate role in unlocking climate finance
- Compliance markets are long game – key to meeting longer term goals
- Today, many countries lack institutional capacity and infrastructure to participate in compliance markets, and it will take time to establish these systems
- In the interim, VCMs can build capacity and deliver results

Carbon offsets for fleet modernization – *how would it work?*



METHODOLOGY FOR IMPROVED EFFICIENCY OF FLEET VEHICLES AND COMBUSTION ENGINES

Revision of CDM Methodology AMS-III.BC.

Prepared by dynaCERT

Title	Methodology for Improved Efficiency of Fleet Vehicles and Combustion Engines
Version	3.0 (based on CDM methodology "AMS-III.BC.: Emission reductions through improved efficiency of vehicle fleets", version 2.0)
Date of Issue	08 October 2021
Type	Methodology revision
Sectoral Scope	3. Energy Demand, 7. Transport
Prepared By	dynaCERT
Contact	101-501 Alliance Avenue Toronto ON Canada M6N 2J1 Robert Maier, robertmaier@dyncert.com

A VERRA STANDARD

- Related methodologies already exist
- We can do better by:
 - Including all related climate forcers : CO₂, PM/BC, NO_x
 - Direct emission measurements:
 - OSAR to quantify baseline project emissions
 - OSAR for verification and monitoring
- GHG Assessment Boundary and Baseline GHG emissions for a candidate fleet (i.e., project)
- Implement fleet modernization intervention (no EVs)
- Incentivizing vehicle scrap and replacement
- GHG reductions = baseline – project
- Realistic carbon reductions in emerging economies
- Value based on market rates + other co-benefits

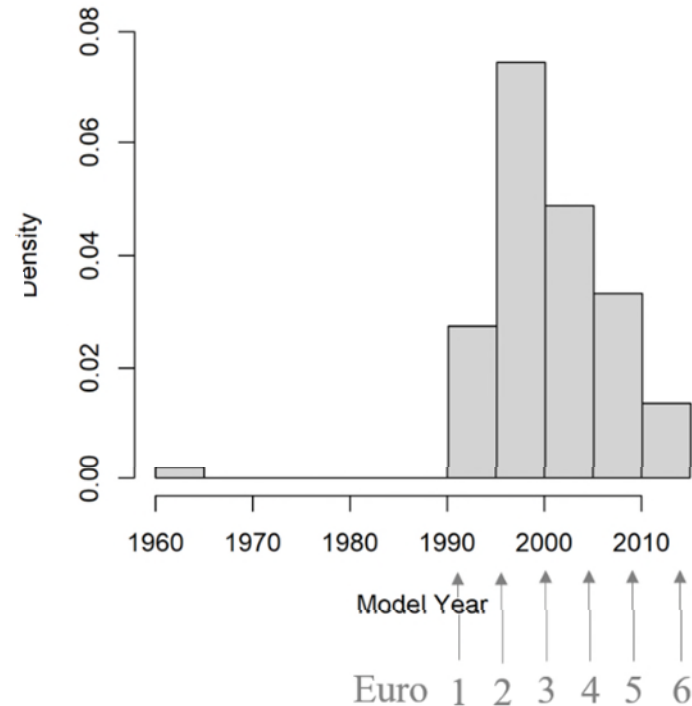


Case Study

Case study – 3DATX Abuja pilot project

- Nigeria has stated climate agenda
- NDC, desire for ETS, no fuel subsidy, and other climate commitments
- Prominent economy in African continent
- Facing challenges typical of emerging economies (i.e., poor fuel quality, resources/capacity to develop/implement policy interventions)
- Promise of access to global climate finance
- Early Euro models dominate Abuja on-road passenger car fleet

Histogram of Model Years



Let's do the math...

Pollutant	Baseline emission ¹ (mg/km)	Project emission (mg/km)	Global Warming Potential ²	Reduction	CO2e (mg-e reduction/km/vehicle)
CO2	140,000	95,000 ³	1	45,000	45,000
BC (PM)	3	1.5 ⁴	4400	1.5	6,600
NOx	2,500	150 ⁵	30	2,350	70,500

Definitions & assumptions:

Reduction = baseline – project

¹Measured values by 3DATX parSYNC[®] FLEX

²GWP - CO2(100yr), NOx & PM(20yr)

³(EU)2019/631 target

⁴50% reduction. Assume PM = BC

⁵Euro 3 standard or better

30,000 km/year/vehicle

10 yr project life

Carbon offset	units
122,100	Total mg CO2e reductions/km/vehicle
36.63	Total project metric tons/vehicle⁺

VOLUNTARY CARBON OFFSET CREDIT MARKET INDICATIVE PRICING - INTERNATIONAL

PRODUCT TYPE	REGISTRY	INDICATIVE SPOT PRICE
International Forest Carbon - Asia & South America	VERRA	\$1.00 - \$35.00
India - Wind/Hydro/Solar	VERRA	\$1.85 - \$6.25
International Forestry - Mangroves	VERRA	\$25.00 - \$35.00
Waste Handling & Disposal	VERRA	\$2.00 - \$9.50
Africa - Cookstoves	GS	\$3.00 - \$6.00
India - Cookstoves	GS	\$4.70 - \$8.00
Turkey - Wind/Hydro	GS	\$1.60 - \$5.75
Biochar	VERRA	\$110.00 - \$165.00
Plugging Orphaned Oil and Gas Wells	ACR	\$20.00 - \$30.00

Nature Based Carbon Offset



carboncredits.com



VOLUNTARY CARBON STANDARDS



Verified Carbon Standard
A VERRA STANDARD



Gold Standard



American Carbon Registry

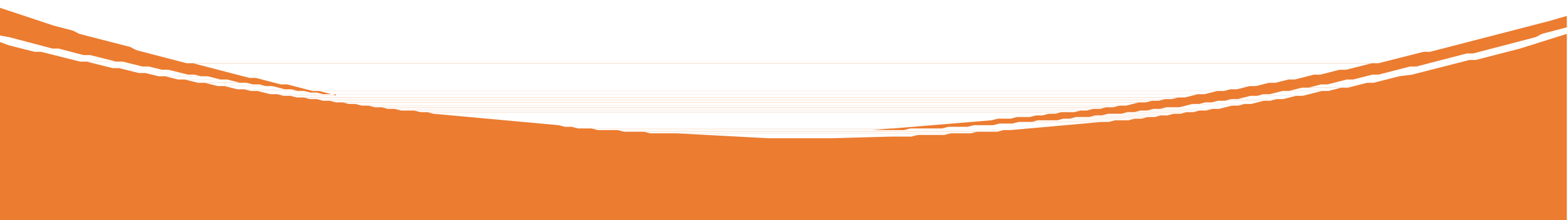


CLIMATE ACTION RESERVE

Does it pencil out with carbon offsets?

- Not likely
- Carbon offsets alone not enough revenue at current prices
- Offsets/vehicle too small (\$36 to ~\$5,000 per vehicle?)
- VCM is just one tool
- What if prices go up because of global pressures?
- Or might there be other incentives?

OPPORTUNITY



CALIFORNIA CAP & TRADE PRODUCTS

PRODUCT	BROKER SPOT OFFER
CCA	\$41.90
CCO ₃	\$16.17
CCO ₈	\$16.08
GCCO	\$18.00 - \$19.00
GCCO DEBs	\$35.00 - \$36.00



European Carbon Credit Market



CALIFORNIA ERC MARKETS

Current bid-offer pricing is as follows:

South Coast ERCs

POLLUTANT	ZONE	BID/lb/day	ASK/lb/day
ROG	BOTH	\$4,000	\$5,500
PM10	BOTH	\$60,000	\$75,000
NOx	BOTH	\$65,000	\$80,000
SOx	BOTH	\$45,000	\$60,000

San Joaquin Valley ERCs

POLLUTANT	BID /TPY	ASK /TPY
SURPLUS VOC	\$50,000	\$315,000
NON-SURPLUS VOC	\$4,000	\$6,000
SURPLUS NOx	\$45,000	\$65,000
NON-SURPLUS NOx	\$9,000	\$12,000
PM10	\$8,000	\$12,000
SOx	\$8,000	\$12,000

Mojave Desert ERCs

POLLUTANT	BID /TPY	ASK /TPY
VOC	\$35,000	\$50,000
NOx	\$25,000	\$40,000
PM10	\$15,000	\$25,000

Bay Area ERCs

POLLUTANT	BID /TPY	ASK /TPY
POC	\$8,500	\$12,500
SOx	\$6,000	\$15,000
NOx	\$20,000	\$30,000

San Diego ERCs

POLLUTANT	BID /TPY	ASK /TPY
VOC	\$35,000	\$60,000
NOx	\$80,000	\$110,000

Yolo-Solano ERCs

POLLUTANT	BID /TPY	ASK /TPY
VOC	\$30,000	\$50,000
NOx	\$30,000	\$50,000
SOx	\$10,000	\$20,000
PM10	\$10,000	\$20,000

Santa Barbara ERCs

POLLUTANT	BID /TPY	ASK /TPY
ROC	\$100,000	\$125,000
NOx	\$100,000	\$125,000

LOW CARBON FUEL STANDARD CREDITS

DELIVERY DATE	\$/LCFS CREDIT
CURRENT	\$60.00
DECEMBER 2023	\$63.31

What about compliance market for new regulatory interventions in Africa? In Nigeria?

California low carbon transportation program

Proposed Project	Average GHG Cost-Effectiveness per Project (\$/weighted ton GHG)	Average Cost-Effectiveness per Project (\$/weighted ton)
Vehicle Purchase Incentives		
CVRP (Standard)	\$711	\$258,705
CVRP (Increased)	\$1,739	\$581,936
CC4A	\$2,000	\$463,187
Financing Assistance for Low-Income Consumers	\$2,700	\$912,243
Clean Mobility Incentives		
Clean Mobility Options	\$6,000	\$6,043,789
Clean Mobility in Schools	\$698	\$1,283,000
Agricultural Worker Vanpools	\$1,164	\$714,020
Rural School Bus Pilot	\$1,202	\$78,234
Heavy-Duty Vehicle and Off-Road Equipment Incentives		
Heavy-Duty Demos and Pilots	\$2,997	\$760,000
HVIP	\$277	\$213,776
CORE	\$1,472	\$222,458
Truck Loan Assistance Program	Not applicable	\$16,093

Table H- 3: Carl Moyer Memorial Air Quality Standards Attainment

Project/Source Category	Average GHG Cost-Effectiveness per Project (\$/weighted ton GHG)	Average Cost-Effectiveness per Project (\$/weighted ton (NOx+ROG+20*PM))
Infrastructure	Not applicable	Not applicable
Locomotives	Not applicable	\$12,000
Marine Vessels	Not applicable	\$14,000
Off-Road Agricultural	Not applicable	\$12,000
Off-Road Other	Not applicable	\$18,000
On-Road	Not applicable	\$39,000
Car Scrap	Not applicable	\$12,000

Table H- 4: Community Air Protection Incentives

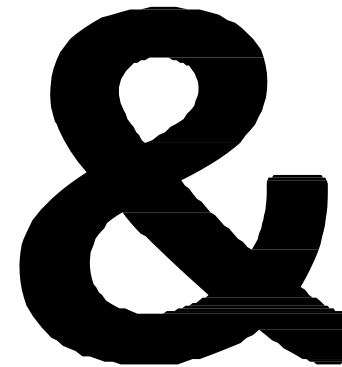
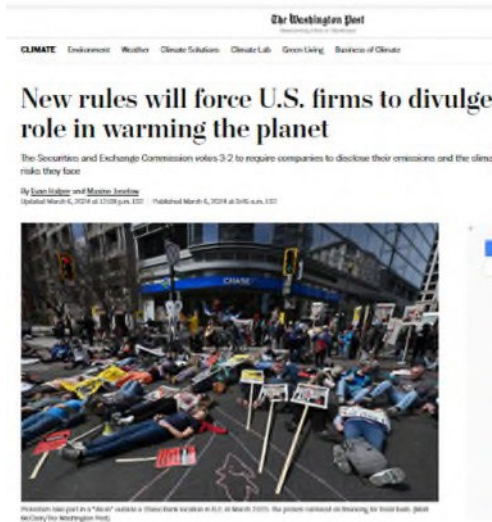
Project/Source Category	Average GHG Cost-Effectiveness per Project (\$/weighted ton GHG)	Average Cost-Effectiveness per Project (\$/weighted ton (NOx+ROG+20*PM))
Infrastructure	Not applicable	Not applicable
Locomotives	\$6,402	\$18,000
Marine Vessels	Not applicable	\$23,000
Off-Road Agricultural	\$2,050	\$8,000
Off-Road Other	\$1,520	\$24,358
On-Road	\$783	\$101,000

What about a premium for health co-benefits from air pollution reductions?

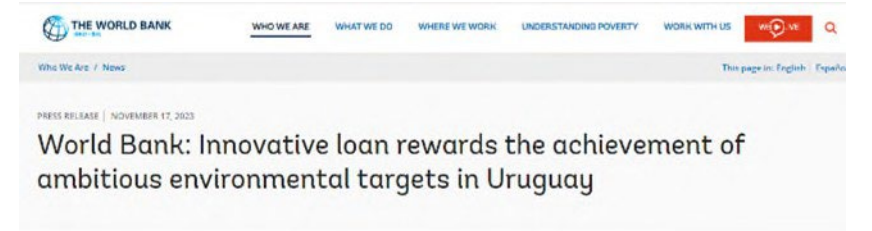


The writing is on the wall...

New regulatory requirements for corporate disclosure of GHG emissions (Scope 1, 2, 3)



Linking favorable financing with achievement of ambitious environmental targets



WASHINGTON D.C., November 17, 2023 – The World Bank Board of Directors approved a US\$350 million loan for Uruguay that marks a global first by linking financing conditions with the achievement of ambitious environmental targets.

The financing will support a reform agenda to drive a more sustainable economy and robust, resilient growth. Uruguay could see a reduction of up to US\$12.5 million in interest on this **Development Policy Loan (DPL)** if it achieves a verifiable decrease in the intensity of methane gas emissions from livestock production.

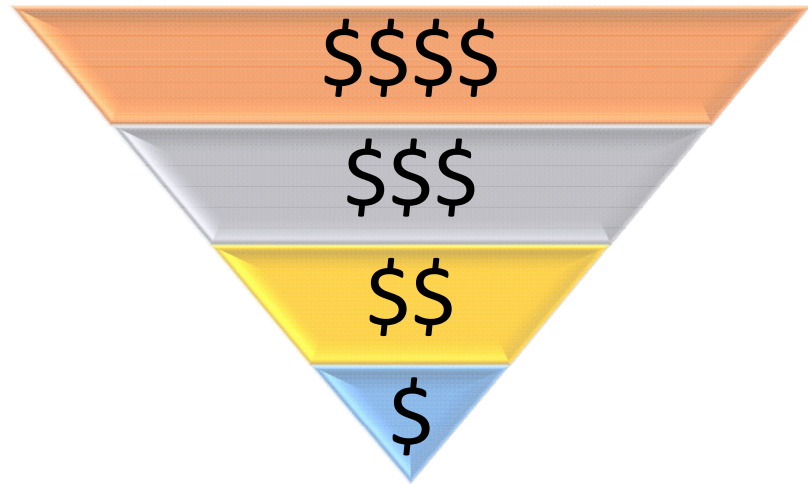
"At a time when we urgently need to redouble our efforts to address the climate crisis, I am proud that a Latin American country is the first to benefit from an innovative credit mechanism that incentivizes key actions to protect the planet," said Carlos Felipe Jaramillo, World Bank Vice President for the Latin American and Caribbean Region. "Uruguay once again demonstrates global leadership through institutional and financial innovations—as it has done before in areas such as smart agriculture, reducing carbon emissions and promoting renewable energy—that serve as a reference for other developing countries."

RELATED

INFOGRAPHIC: Environmental Goal-Driven Financing Mechanism

FACTSHEET: New World Bank Financing Mechanism Links to the Achievement of Environmental Targets

An opportunity for Nigeria/Abuja – a modified VCM offset from stackable incentives



Domestic compliance for global commitments



Air quality premium



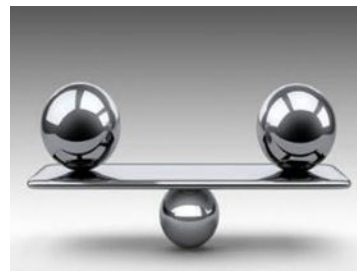
Corporate ESG goals and mandated disclosure



Favorable financing with achievement of environmental targets



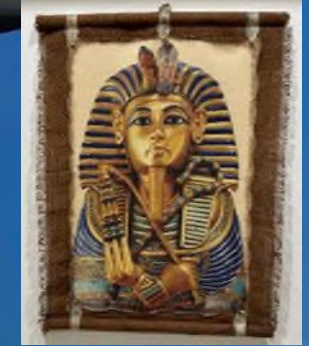
Carbon offsets





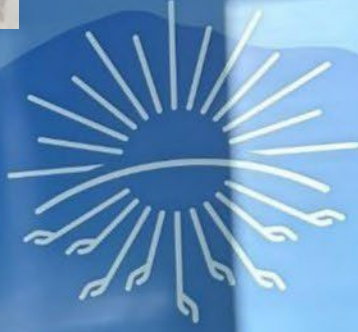
Loss and damage...and the possibilities of negotiation

REPARATIONS
LOSS



United Nations
Climate Change

COP27
SHARM EL-SHEIKH
EGYPT 2022



COP27
SHARM EL-SHEIKH
EGYPT 2022

SOLUTIONS

CLIMATE FINANCE
BILLING STATEMENT

\$100 billion a year

OVERDUE

FOR THE VULNERABLE NATIONS