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

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WestVirginiaUniversity

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

BASICS

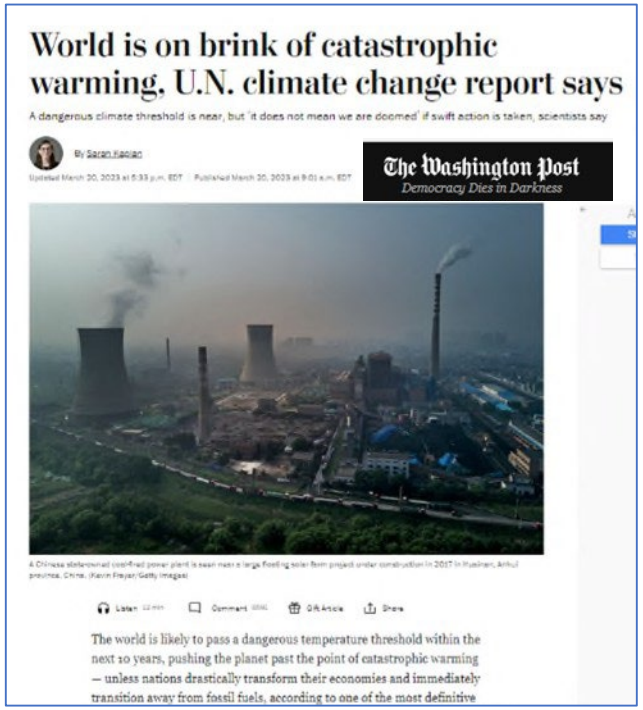
OSAR progress over the decades

- 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*



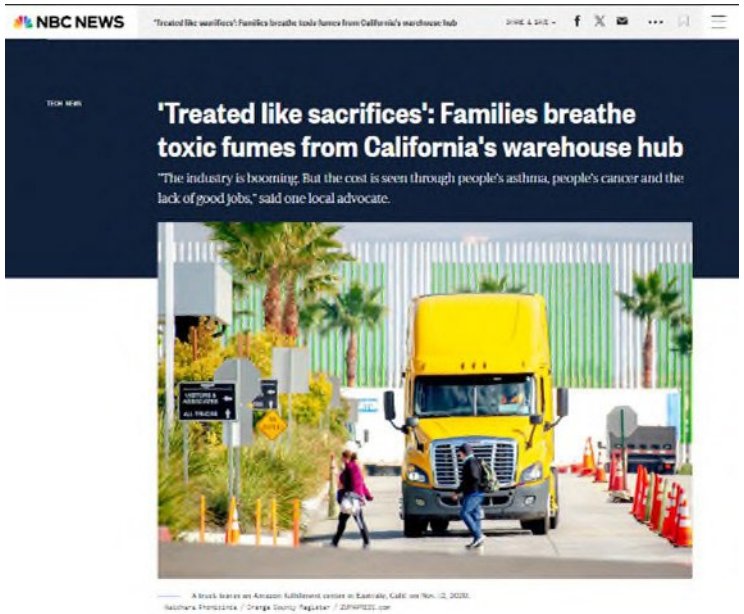
World is on brink of catastrophic warming, U.N. climate change report says

A dangerous climate threshold is near, but 'it does not mean we are doomed' if swift action is taken, scientists say

By Seren Kaplan

The Washington Post
Democracy Dies in Darkness

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



NBC NEWS

'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.

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."

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

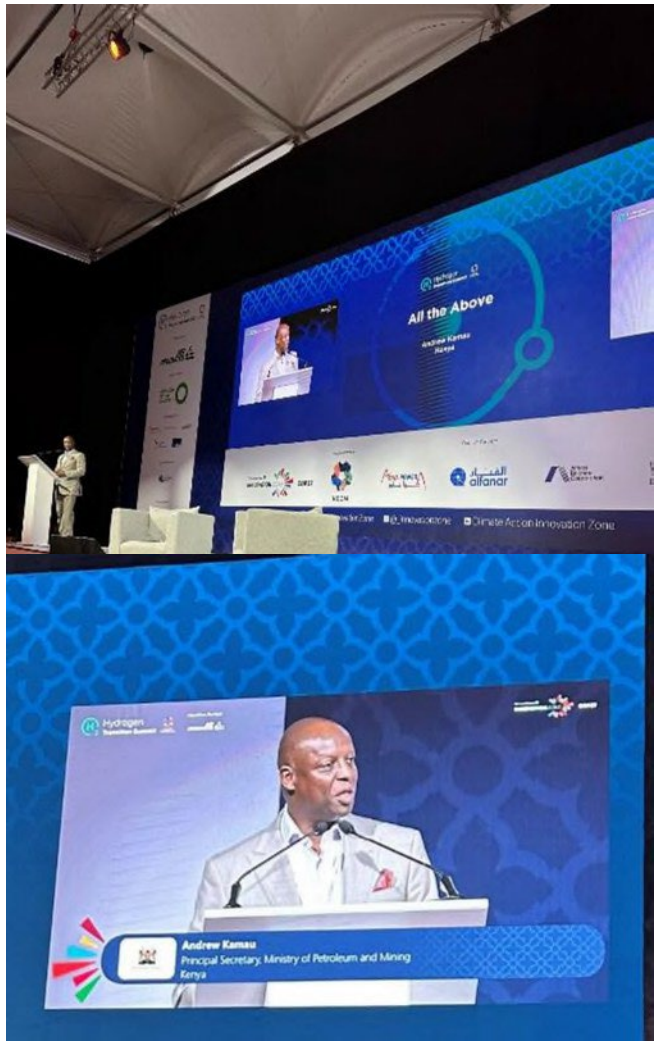
By Laura Paddison, CNN

Antonio Guterres
Secretary-General of the United Nations


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 <u>harmony</u> with cleaner combustion technology (and its fuels)
- Clean combustion necessarily plays a role in transition to zero-carbon future



- Given <u>barriers</u> in low- and middle-income economies, there is <u>skepticism</u> and <u>reluctance</u> 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 <u>incentivize</u> cleaner/affordable/lower carbon vehicles in emerging economies?

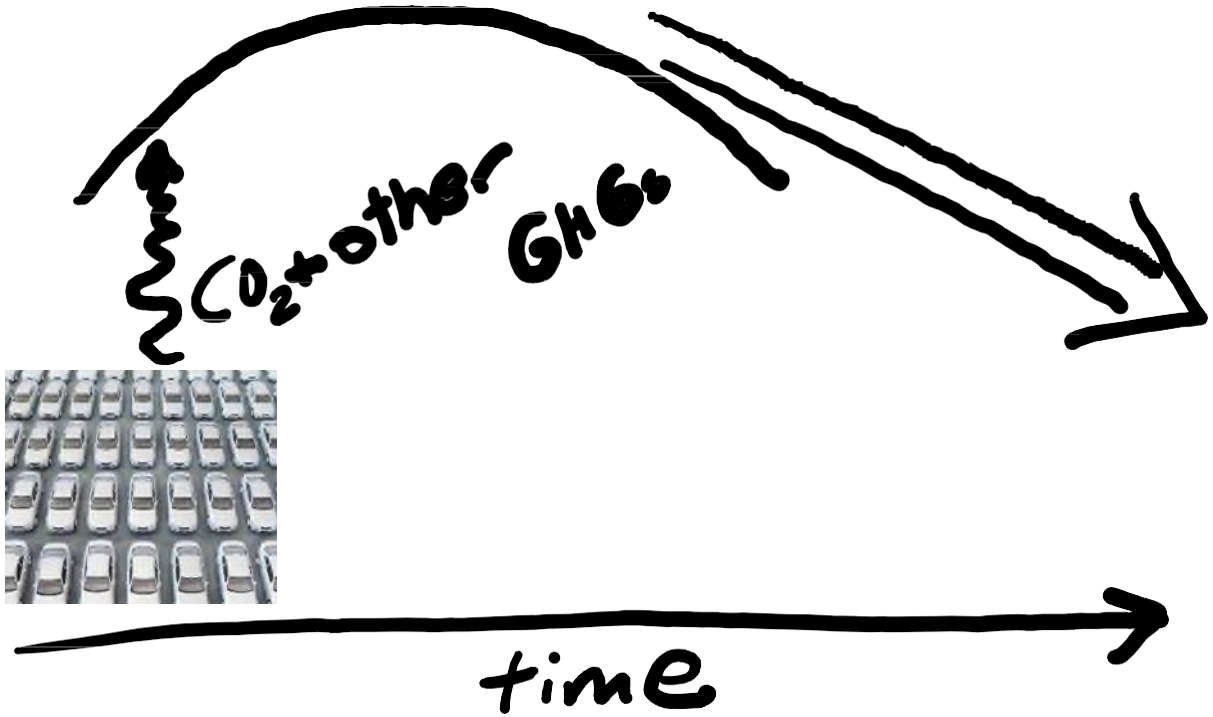

COLUMN

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?

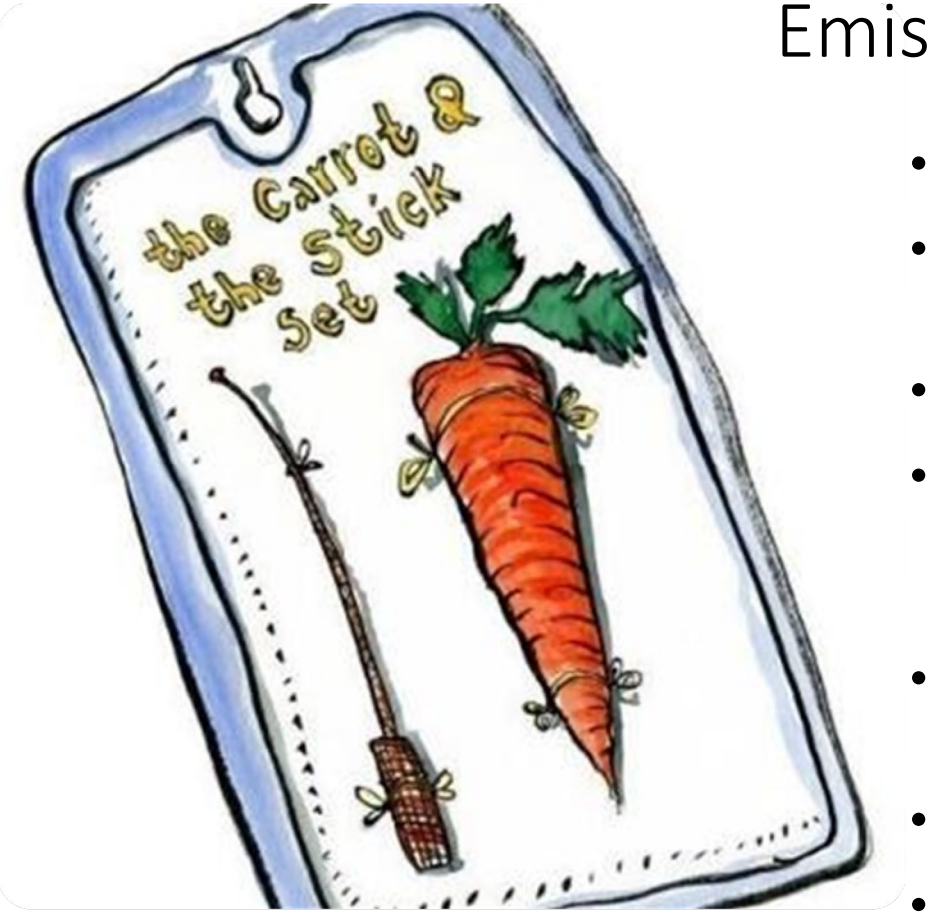
Ref: Ayala, A., Unforced errors in public policy can lead to forced pollution exposures – putting the health of all urban breathers first. *Environment*. Vol.6, No.2, tandfonline.com/env. March/April 2024.



- 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?*


OPTION 1
OPTION 2
OPTION 3
OPTION 4

“The markets” – *carrots balancing sticks*

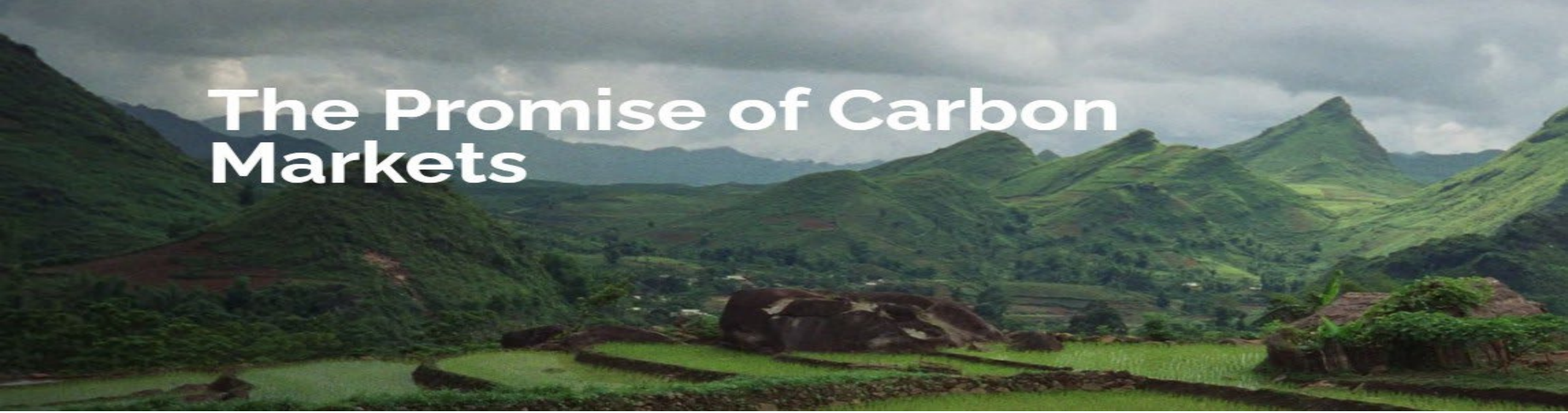


Emission Credits, Banking, and Trading

- 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

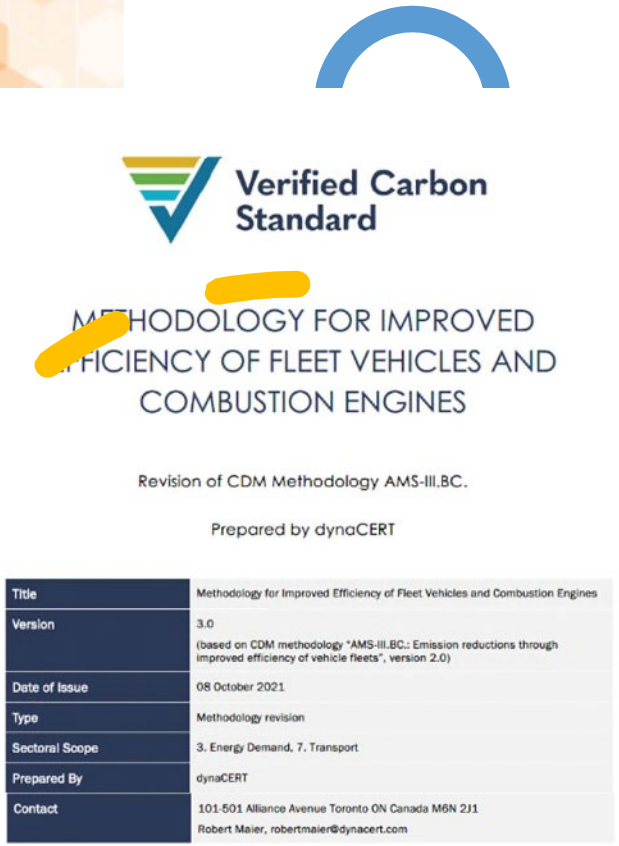
	OSAR	Definition
Real (surplus)		reductions must not already be required by any law, rule, regulation, agreement, or orders
Quantifiable	✓	using actual historical emissions in comparison to proposed post-project
Enforceable	✓	Verifiable and legally binding limitations which are enforceable
Verifiable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



The Promise of Carbon Markets

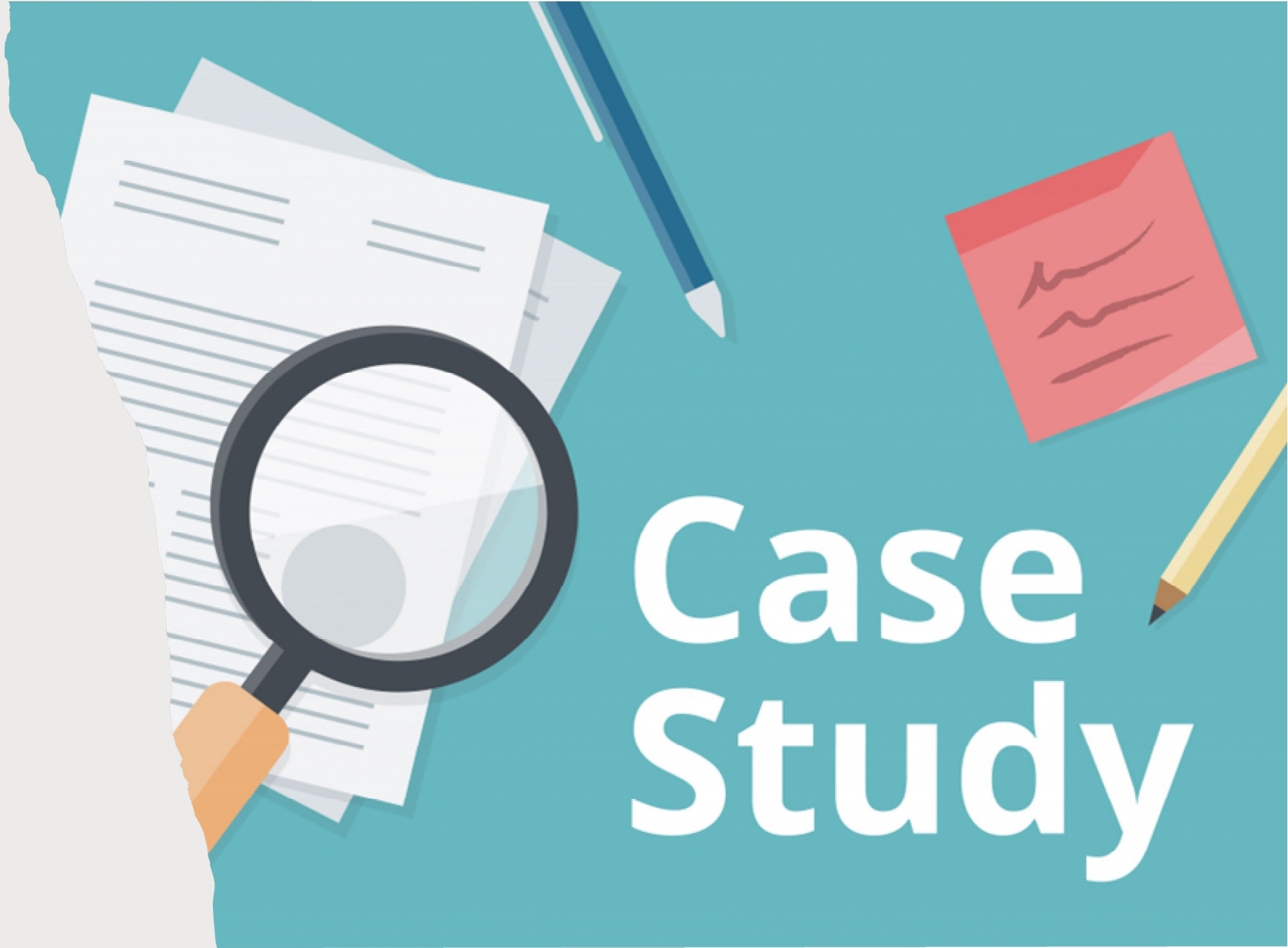
- Compliance and voluntary carbon markets (VCMs) primed for growth
- Due to Paris Agreement and Nationally Determined Contributions (NDCs)
- VCMs driven by demand from companies to meet voluntary climate commitments
- VCMs as bridge as companies make “harder transitions”
- VCMs are short game - play 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*?



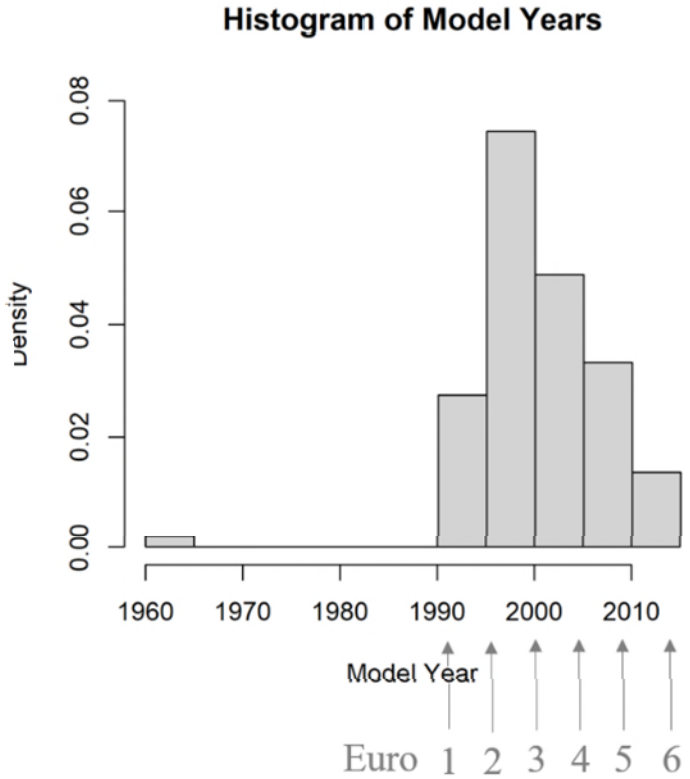
A VERRA STANDARD

- Related methodologies already exist
- We can do better by:
  - Including all related climate forcers : CO_2, 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
- <u>Value based on market rates + other co-benefits</u>


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
- <u>Early Euro models dominate Abuja on-road passenger car fleet</u>



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
[1]Measured values by 3DATX parSYNC ® FLEX
[2]GWP - CO2(100yr), NOx & PM(20yr)
[3](EU)2019/631 target
[4]50% reduction. Assume PM = BC
[5]Euro 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

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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 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

European Carbon Credit Market

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

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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 Attainm

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

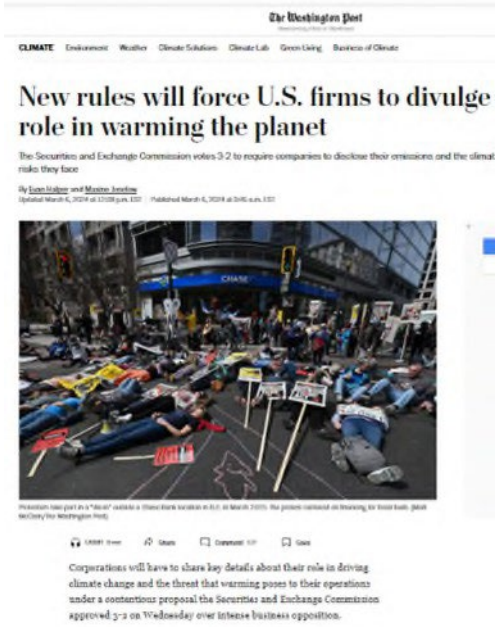
Table H- 4: Community Air Protection Incentives

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)



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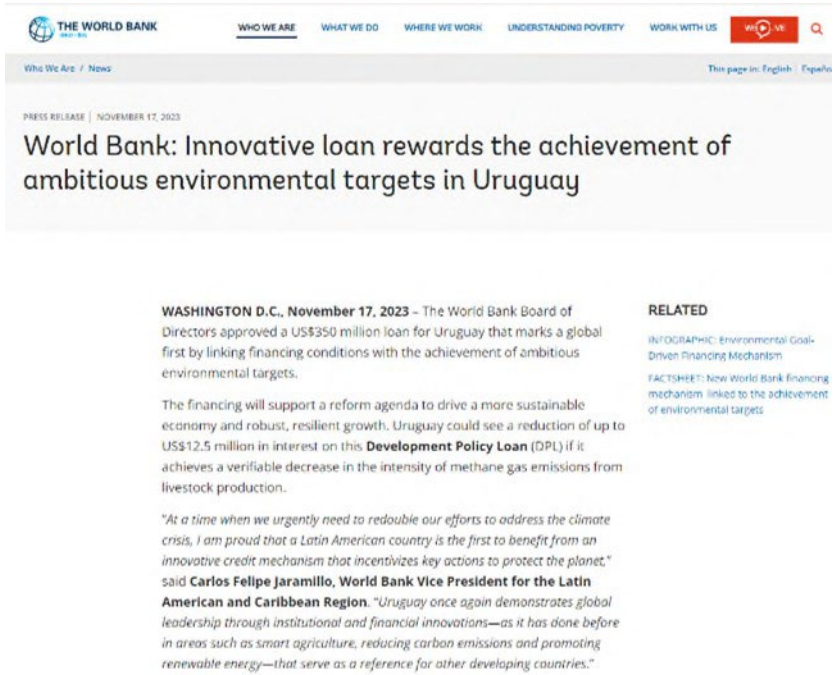
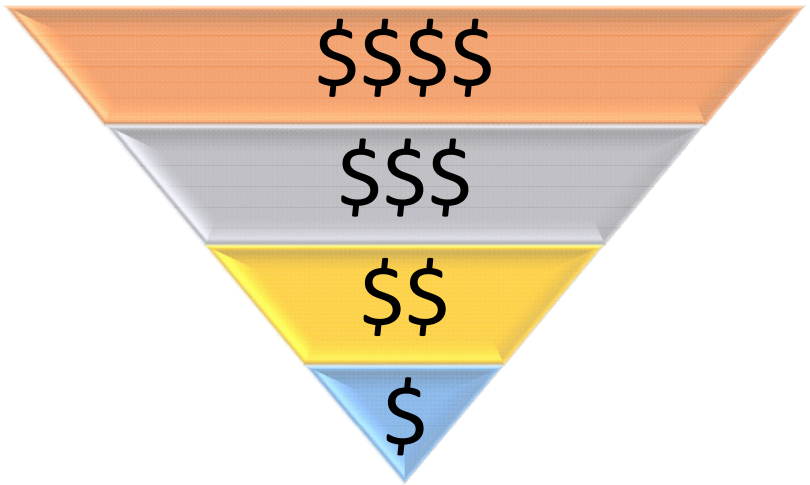
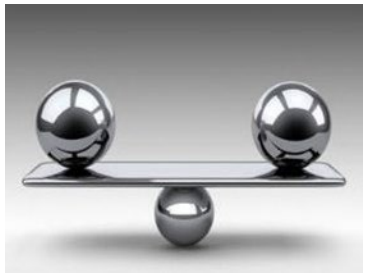
Linking favorable financing with achievement of ambitious environmental targets



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