

The logo for UCR CE-CERT, featuring the letters "UCR" in white on a blue square background, followed by "CE-CERT" in white text to its right.

UCR CE-CERT

2023 OSAR Conference

**Welcome to the 12th Annual
International OSAR Conference
Thank You for Joining Us**

OSAR Technology, Mobile Source Carbon Offsets, and the Role of Cleaner Combustion in the Orderly Transition to a Decarbonized Transportation Future

Alberto Ayala - Sacramento Metro AQMD, Kent Johnson - UCR CE-CERT,
Andrew Burnette - MeasureMission, Gurdas Sandhu and David Miller - 3DATX

Bourns College of Engineering-Center for Environmental Research and
Technology, University of California, Riverside, CA



Why are mobile carbon offsets needed?

- Transition to electrification of transportation has begun
- Not everyone can afford EVs
- Cleaner combustion engines and cleaner fuels can help transition
- Carbon offsets - a new tradeable commodity to enable projects by financially-constrained businesses or in cash-strapped economies
- OSAR can ensure transparency and permanence of GHG reductions

- Transition is underway – 6.7 Million EVs sold in 2021; 16 Million overall (279 Million US vehicles)
- Transportation exceeds 30% of global greenhouse gases and is fastest rising sector & second to electric power
- Global Transportation Markets for cars, trucks, ships, trains, airplanes & buses are NOT covered by ANY of the 68 mandatory Greenhouse Gas control programs
- According to the Wood Mackenzie, Global Carbon markets will reach \$22 TRILLION by 2050 vs. \$84 Billion in 2021 (Source: World Bank)*
- California & EU are 2 largest carbon credit markets – and EXCLUDE tailpipe emissions



Carbon credits markets (CCM) provides significant upside potential

Live Carbon Prices Today

CarbonCredits.com Live Carbon Prices	Last	Change	YTD
Compliance Markets			
European Union	€94.20	-4.99 %	+17.75 %
California	\$29.14	-	+0.24 %
Australia (AUD)	\$37.00	+0.68 %	+9.47 %
New Zealand (NZD)	\$68.00	+4.21 %	-11.02 %
South Korea	\$10.23	+3.07 %	-15.94 %
China	\$8.11	-3.45 %	-3.11 %
Voluntary Markets			
Aviation Industry Offset	\$2.34	+0.43 %	-39.06 %
Nature Based Offset	\$3.08	-10.20 %	-33.04 %
Tech Based Offset	\$0.81	+1.25 %	-28.95 %

CarbonCredits.com Real-time Pricing (Updates Every 5 Mins)

[Click here](#) to learn how carbon credits are priced.

Mandatory and Voluntary prices continue to rise globally

Mandatory Compliance Market Carbon Pricing

Mandatory (Compliance) Market: Mandatory (compliance) markets are governed by national, regional, or provincial law and compel emission sources to meet GHG emission reduction targets. Because compliance program offset credits are generated and traded for regulatory compliance, they typically act like other commodity pricing. Data below could be delayed by as much as 24hrs.

European Carbon Credit Market



EU ETS – is the European carbon credit contract which is exchange traded. It is a Futures contract for the purposes of trading and delivering EUAs (European Union Allowance – the official name for the region’s emission allowances). One EUA allows the holder to emit one ton of CO₂ or CO₂ equivalent greenhouse gas.

California Carbon Credit Market

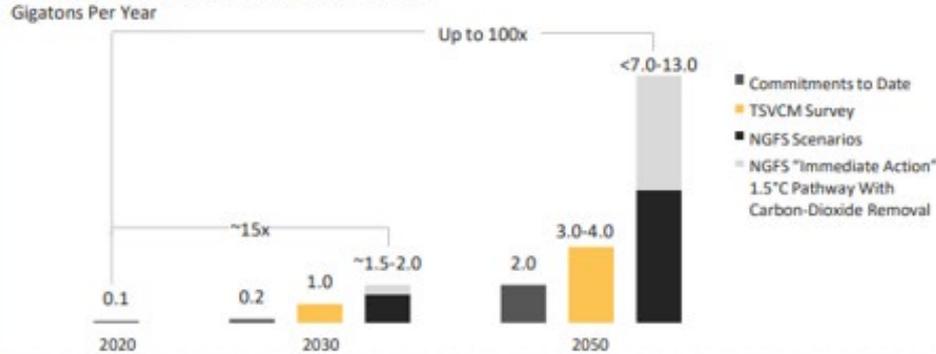


Known simply as the “California Cap and Trade Program”, CCA Futures is the physically delivered greenhouse gas emissions allowances for the California Carbon Allowance (CCA) program. One CCA credit represents one metric ton of CO₂ equivalent under California Assembly Bill 32 “California Global Warming Solutions Act of 2006”.

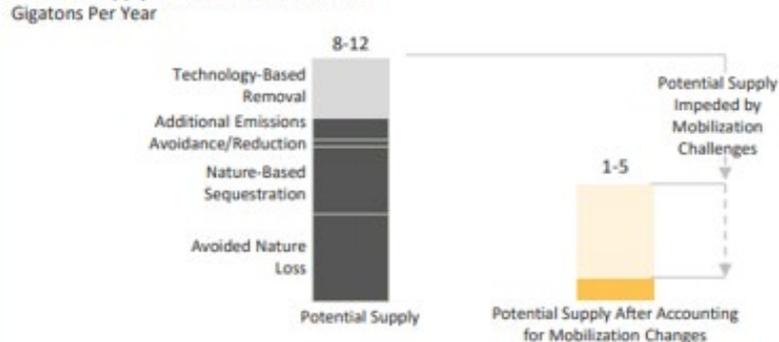
Carbon credits markets (CCM) are projected to grow rapidly

Market Tailwinds Support Robust Carbon Credit Demand⁽¹⁾...

Voluntary Demand Scenarios for Carbon Gigatons



Potential Supply of Carbon Credits in 2030



1. McKinsey & Co.

...Driving an Increase in Carbon Credit Prices

Carbon offsets price may rise 3,000% by 2029 under tighter rules – Bloomberg

Voluntary carbon market (VCM) started to increase due to increasing pressure of competitors

5x-10x⁽³⁾

Over next 10 years

8x-20x⁽³⁾

By 2040

10x-30x⁽³⁾

By 2050

3. Trove Research

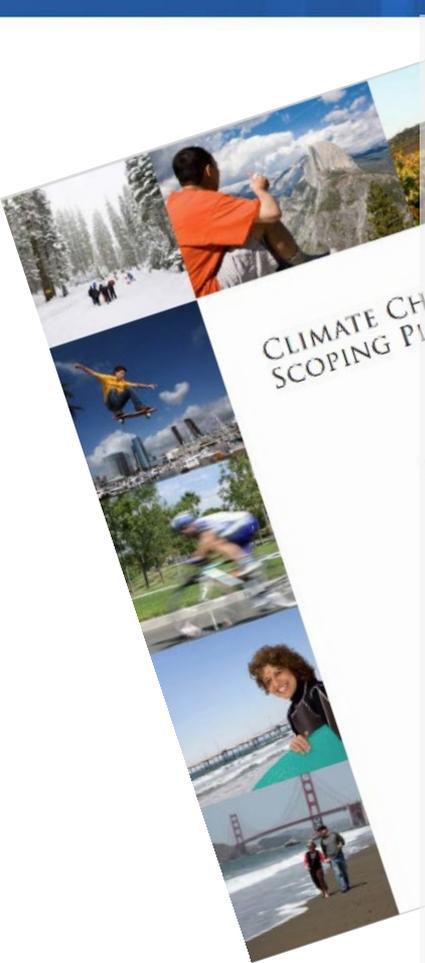
Worldwide desire to reduce carbon emissions.



A credit system rewards surplus emission reductions

- Banking and trading of emission reduction credits (ERC) are integral parts of air quality management practices in US and other jurisdictions
- Banking and trading of ERCs are not new concepts, they've been around for a long time
- Typically, ERCs refer to “conventional” air pollutants
- ERCs meet established criteria and are used for compliance
- Voluntary public incentive programs like CA's Carl Moyer Program “buy” and “retire” emission reductions

The California climate program

- 
- California climate program includes various categories of policies to achieve GHG reductions
- Traditional vehicle and engine emission standards (e.g., ACF, ACC2)
 - Traditional clean fuel standards (e.g., CA Renewable Portfolio Standard, LCFS)
 - Other strategies (e.g., solar roofs, ship electrification)
- Market-based mechanisms (e.g., Cap&Trade, carbon offsets)
- Cap limits emissions, puts a price on carbon, and declines over time
 - Regulated entities buy and trade carbon allowances to emit
 - Carbon offsets or carbon credits are functionally like ERCs or any other emission reduction

Two Types of Markets, Regulatory and Voluntary

The regulatory market is our common market we frequently use

Accelerate the shift toward zero emissions

What is a voluntary market?

SCAQMD – Clean Fuels Program - BEV Beachhead
EMG eConsulting / 2.2.2023

FREIGHTLINER
Run Smart™

Examples of regulatory compliance markets

- Europe's Emission Trading System (EU ETS)
- United Nation's Clean Development Mechanism (CDM)
- California's Cap&Trade Program
- Northeast's Regional Greenhouse Gas Initiative (RGGI) – Cap&Invest
- Washington State Cap&Invest
- Massachusetts cap and trade

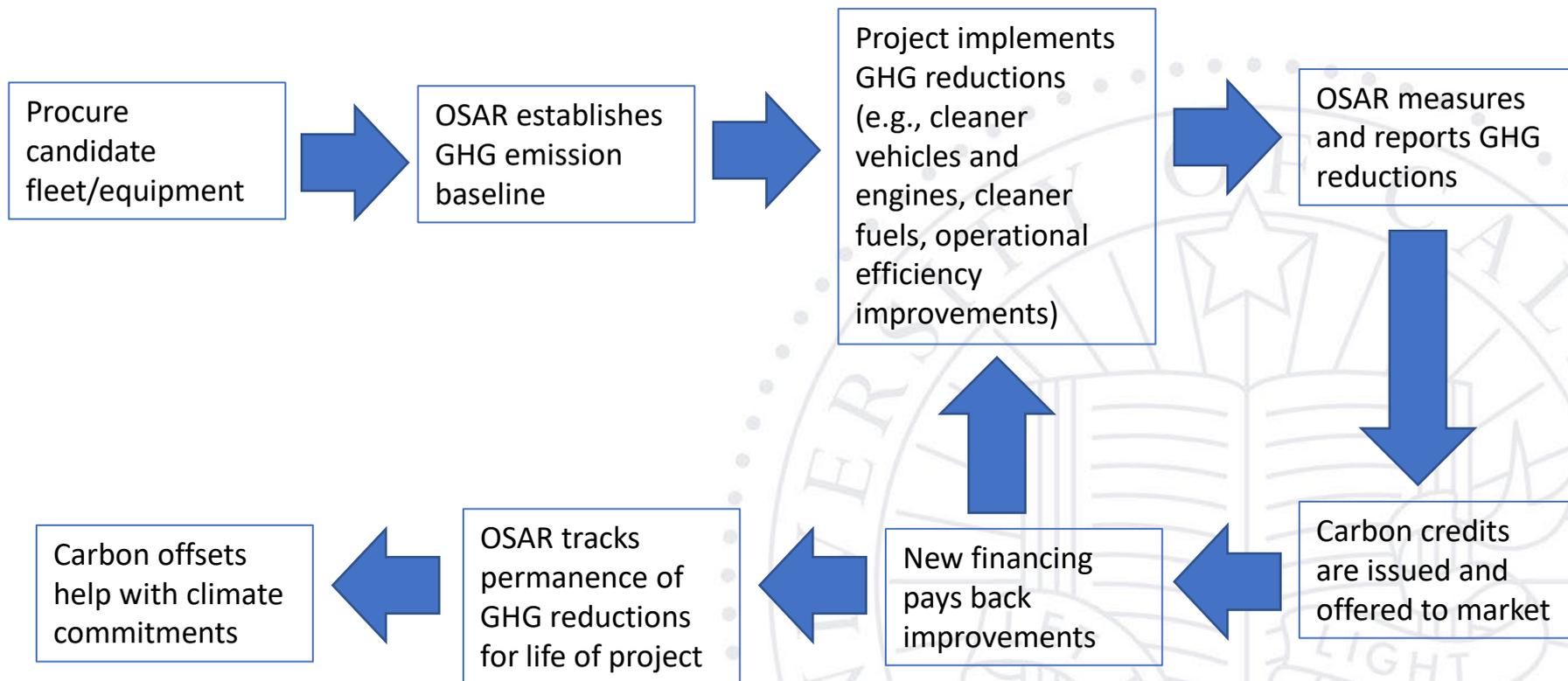
Why a voluntary carbon market exists

- Compliance GHG reductions are not sufficient to arrest climate crisis
- Growing demand from corporate sustainability commitments
- Growing public and private consumer demand
- Various recognized registries certify reductions/commodities
 - Climate Action Reserve (CAR),
 - American Carbon Registry (ACR),
 - VERRA, Gold Standard (GS)
- Can be controversial and flawed
- Improvements can be made

- Popular types of carbon offsets include
 - Renewable energy projects
 - Improving energy efficiency
 - Carbon and methane capture and sequestration
 - Land use and reforestation
- Why not mobile source carbon offsets?
- Regulators are creatures of habit – *“don’t fix if it ain’t broken”*
- Regulators prefer traditional regulatory approach (e.g., emission standards)

- In theory, mobile GHG reductions that meet criteria can generate tradeable offsets
- A new tradeable commodity is created if GHG reductions are demonstrated and certified to be surplus, quantifiable, enforceable, and permanent
- Help financially constrained businesses generated new revenue
- Assist low-income economies with new funding to clean up fleets and equipment
- OSAR can be a key enabling tool

Elements of a new mobile source carbon offset protocol



- Study after study says “the [data] is dependent on the [method]”

- A
- t
- An



Draft Final Report
In-Use Emissions Testing and Fuel Usage Profile of
On-Road Heavy-Duty Engines
 Contract #11612



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Report #1

Onboard Sensing, Analysis, and Reporting
(OSAR): Phase 1 Sensor Evaluation on Heavy
Duty Trucks

Contract No. 20158

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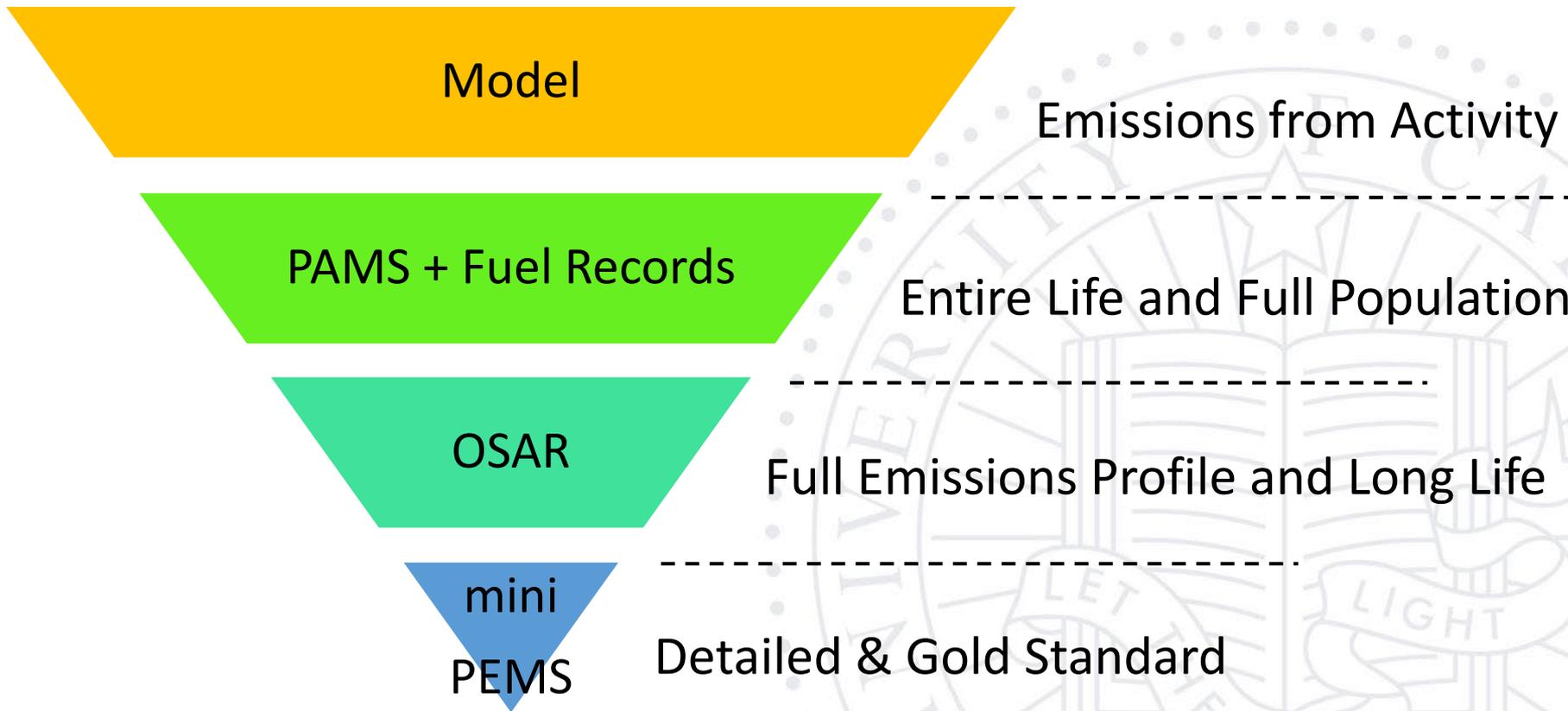
February 2023

Submitted by:

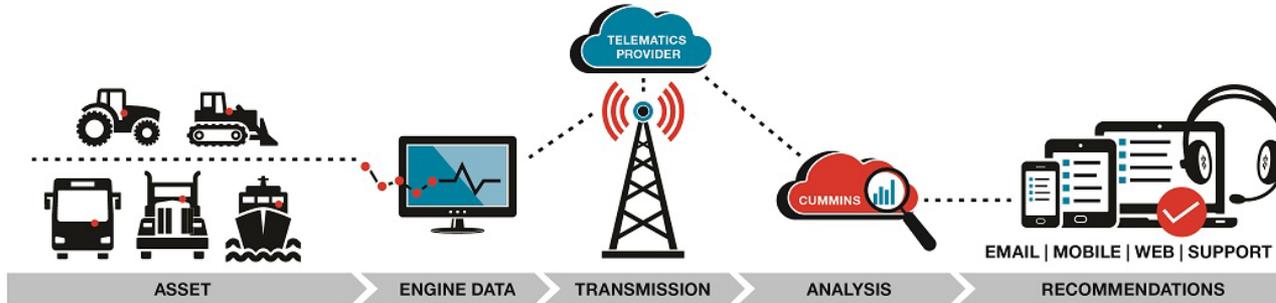
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Four tiered approach to quantification and verification



Telematic data may exist for some technologies



Available method for retrofits and revised technologies

➤ OSAR includes

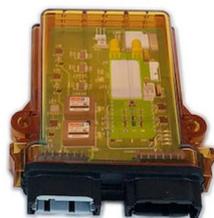
- CO₂, NO_x, PM, GPS, CAN, and other sensors
- Auto starting and shutdown to capture cold starts and all truck operation



NO_x/O₂ Module



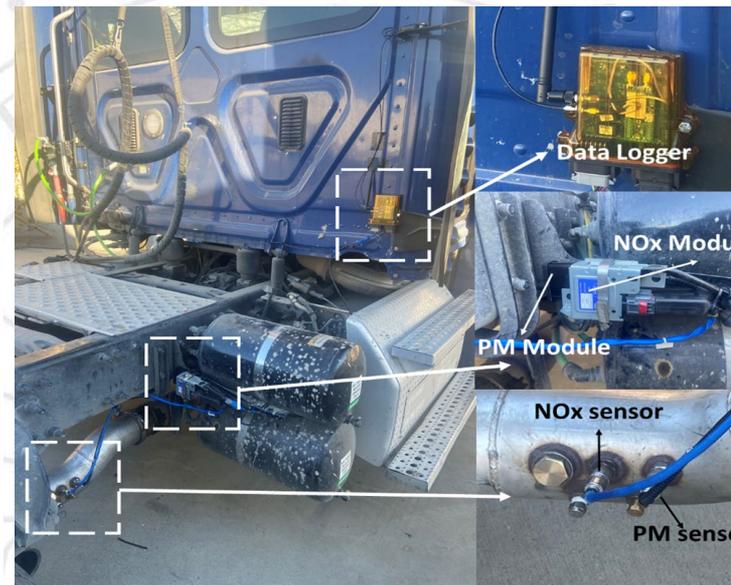
PM Module



Data Logger
(CAN, GPS, LTE)



GPS & LTE
Antennas



- A new idea creates additional opportunities for GHG reductions (i.e., carbon offsets) from mobile sources
- Carbon offsets can be registered and traded in voluntary carbon market
- New financing can assist more action and air quality improvements, especially in cash-strapped economies
- OSAR is key enabling factor
- The value is too high and the opportunities are too wide
- We need to provide options or the rapidly growing voluntary market will miss a key new opportunity
- It is up to groups like us to provide a recommended framework and then execute that framework

Acknowledgement

- ❑ We acknowledge that this is a partnership between entities for the solution of a free market place carbon trading platform. The partnerships is called Data Carbon Partners (DCP)

