

The background of the slide is a photograph showing water flowing over green, blade-like plants, possibly a wetland or marsh. The water is clear and shows some ripples and reflections of light. The plants are vibrant green and appear to be growing in a shallow, flowing body of water.

Emerging Opportunities for Farmers to Participate in Carbon Markets

Simple in theory, complicated in practice

Goal of Talk: Key Terms & Concepts

Joe Massey
USDA ARS Delta Water Management Research Unit
Arkansas State University, Jonesboro.

GM buys North Dakota grassland emissions credits

David Shepardson, Detroit News Washington Bureau 7:01 a.m. EST November 17, 2014



(Photo: Bill Pugliano, Getty Images)

Washington — General Motors Co. is purchasing carbon credits from North Dakota grasslands aimed at reduce greenhouse gas emissions equivalent to removing 5,000 cars through a new government-backed partnership.

The U.S. Agriculture Department is announcing the program at its headquarters Monday and hoping other businesses take part. A farm bill grant helped value the credits. GM's Chevrolet unit has purchased almost 40,000 carbon dioxide reduction tons generated on working ranch grasslands in the Prairie Pothole region of North Dakota. GM is acquiring credits from around 6,000 acres.

"This announcement is the first-of-its-kind. The amount of carbon dioxide removed from our atmosphere by Chevrolet's purchase of carbon credits equals the amount that would be reduced by taking 5,000 cars off the road," Agriculture Secretary Tom Vilsack said in a statement. "This public-private partnership demonstrates how much can be achieved with a modest federal investment and a strong commitment to cut carbon pollution."

Robert Bonnie, USDA's under secretary for natural resources and environment, is announcing the purchase, joined by Senate Agriculture Committee Chair Debbie Stabenow, D-Lansing; Greg Martin, GM's executive director for global public policy; Sean Penrith, executive director of The Climate Trust; and John Tomke and Paul Schmidt of Ducks Unlimited.

"Along with GM's interest, our hope is there will be additional companies that will be interested in pursuing this," Bonnie said Friday. He thinks many ranchers in North Dakota and other states and many companies will be interested in taking part. Bonnie said it was important that the credits be "real" and that the government's role in creating the methodology for valuing the credits was critical.

Millions of acres in the West could be eligible to take part in the program, USDA said. The Agriculture Department is supporting other carbon offset programs, including one in Illinois for some practices on corn and soybean fields. Bonnie said it was important that the program have "real climate benefits." Farmers and ranchers can reforest land, improve livestock and conservation practices to reduce carbon emissions. "If you look at the broad universe, there's actually a lot of opportunity for agriculture to contribute to mitigating greenhouse gas emissions," Bonnie said.

Key Terms & Concepts

- **Voluntary** carbon emissions reduction market

GM's voluntarily purchased ND grassland emissions credits

- GM voluntarily purchased permanent conservation easements on 2,400 ha marginal, erodible land, preventing its conversion to corn/soy.
- ~ 40,000 metric tons CO₂ not emitted.

Recent land use change in the Western Corn Belt threatens grasslands and wetlands

Christopher K. Wright¹ and Michael C. Wimberly

Geographic Information Science Center of Excellence, South Dakota State University, Brookings, SD 57007

Edited by B. L. Turner, Arizona State University, Tempe, AZ, and approved January 17, 2013 (received for review September 5, 2012)

In the US Corn Belt, a recent doubling in commodity prices has created incentives for landowners to convert grassland to corn and soybean cropping. Here, we use land cover data from the National Agricultural Statistics Service Cropland Data Layer to assess grassland conversion from 2006 to 2011 in the Western Corn Belt (WCB): five states including North Dakota, South Dakota, Nebraska, Minnesota, and Iowa. Our analysis identifies areas with elevated rates of grass-to-corn/soy conversion (1.0–5.4% annually). Across the WCB, we found a net decline in grass-dominated land cover totaling nearly 530,000 ha. With respect to agronomic attributes of lands undergoing grassland conversion, corn/soy production is expanding onto marginal lands characterized by high erosion risk and vulnerability to drought. Grassland conversion is also concentrated in close proximity to wetlands, posing a threat to waterfowl breeding in the Prairie Pothole Region. Longer-term land

conversion of grass-dominated land covers to cultivated cropland (4). Since 2008, however, there has been no regional-scale accounting of grassland conversion in the Corn Belt.

The present study addresses knowledge gaps evident in previous research by assessing very recent grassland conversion (2006–2011) at relatively high spatial resolution (560 m) across the Western Corn Belt (WCB). The WCB encompasses five states—North Dakota, South Dakota, Nebraska, Minnesota, and Iowa—and contains most of the grass-dominated land cover remaining in the Corn Belt (Fig. 1A and Fig. S1). The WCB also intersects much of the Prairie Pothole Region (PPR; Fig. 1B), a wetland landscape of continental significance (14–16).

We analyzed contemporary grassland conversion in the WCB by using the National Agricultural Statistics Service (NASS) Cropland Data Layer (CDL). The NASS CDL is derived from satellite

- Waterfowl and upland game habitat preserved = **“co-benefits”**



Photo credit: North Dakota Tourism

GM buys North Dakota grassland emissions credits

David Shepardson, Detroit News Washington Bureau 7:01 a.m. EST November 17, 2014



(Photo: Bill Pugliano, Getty Images)

Washington — General Motors Co. is purchasing carbon credits from North Dakota grasslands aimed at reduce greenhouse gas emissions equivalent to removing 5,000 cars through a new government-backed partnership.

The U.S. Agriculture Department is announcing the program at its headquarters Monday and hoping other businesses take part. A farm bill grant helped value the credits. GM's Chevrolet unit has purchased almost 40,000 carbon dioxide reduction tons generated on working ranch grasslands in the Prairie Pothole region of North Dakota. GM is acquiring credits from around 6,000 acres.

"This announcement is the first-of-its-kind. The amount of carbon dioxide removed from our atmosphere by Chevrolet's purchase of carbon credits equals the amount that would be reduced by taking 5,000 cars off the road," Agriculture Secretary Tom Vilsack said in a statement. "This public-private partnership demonstrates how much can be achieved with a modest federal investment and a strong commitment to cut carbon pollution."

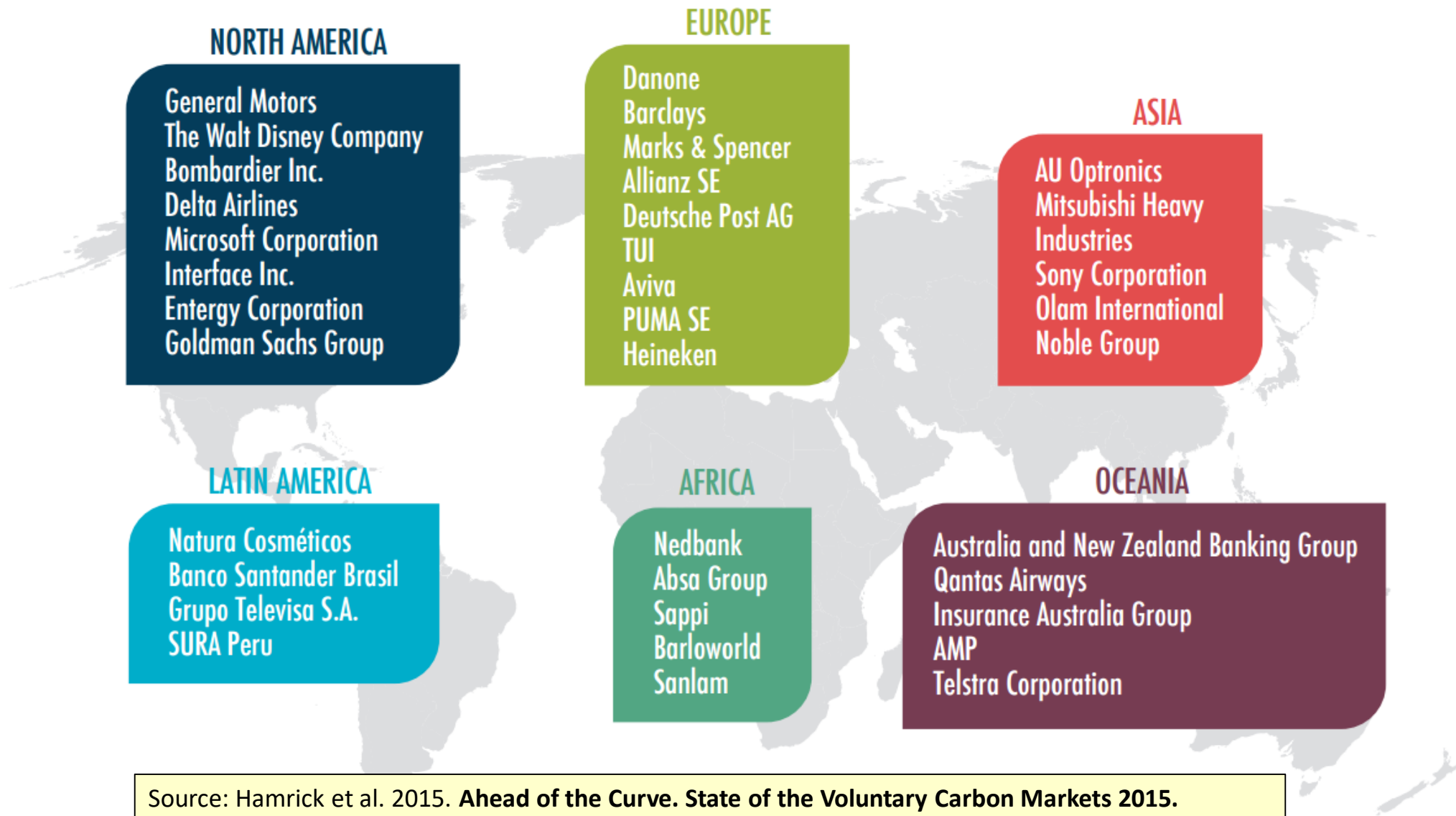
Robert Bonnie, USDA's under secretary for natural resources and environment, is announcing the purchase, joined by Senate Agriculture Committee Chair Debbie Stabenow, D-Lansing; Greg Martin, GM's executive director for global public policy; Sean Penrith, executive director of The Climate Trust; and John Tomke and Paul Schmidt of Ducks Unlimited.

"Along with GM's interest, our hope is there will be additional companies that will be interested in pursuing this," Bonnie said Friday. He thinks many ranchers in North Dakota and other states and many companies will be interested in taking part. Bonnie said it was important that the credits be "real" and that the government's role in creating the methodology for valuing the credits was critical.

Millions of acres in the West could be eligible to take part in the program, USDA said. The Agriculture Department is supporting other carbon offset programs, including one in Illinois for some practices on corn and soybean fields. Bonnie said it was important that the program have "real climate benefits." Farmers and ranchers can reforest land, improve livestock and conservation practices to reduce carbon emissions. "If you look at the broad universe, there's actually a lot of opportunity for agriculture to contribute to mitigating greenhouse gas emissions," Bonnie said.

US Govt. funded Ducks Unlimited to conduct carbon emission reductions estimates, etc.

Figure 15: Examples of Carbon Offset Buyers by Region



Source: Hamrick et al. 2015. **Ahead of the Curve. State of the Voluntary Carbon Markets 2015.**
http://forest-trends.org/releases/uploads/SOVCM2015_FullReport.pdf

Key Terms & Concepts

- **Compliance** (regulated) carbon emissions reduction market

California Environmental Protection Agency
Air Resources Board

Home | Reducing Air Pollution | Air Quality | Business Assistance | Laws & Regulations | Health

Tuesday, January 12, 2016

Assembly Bill 32 Overview

The passage of [AB 32](#), the California Global Warming Solutions Act of 2006, marked a watershed moment in California's history. By requiring in law a sharp reduction of greenhouse gas (GHG) emissions, California set the stage for its transition to a sustainable, low-carbon future. AB 32 was the first program in the country to take a comprehensive, long-term approach to addressing climate change, and does so in a way that aims to improve the environment and natural resources while maintaining a robust economy.

What Does AB 32 Do?

AB 32 requires California to reduce its GHG emissions to 1990 levels by 2020 — a reduction of approximately 15 percent below emissions expected under a "business as usual" scenario.

Pursuant to AB 32, ARB must adopt regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions. The full implementation of AB 32 will help mitigate risks associated with climate change, while improving energy efficiency, expanding the use of renewable energy resources, cleaner transportation, and reducing waste.

Why is AB 32 Needed?

According to leading climate scientists from around the world, anthropogenic climate change (that caused by humans) is a significant and growing problem that must be addressed in order to avoid the worst effects. Climate change is the result of various GHGs that are emitted into the atmosphere, such as carbon dioxide (CO₂) and methane (CH₄), which have a heat forcing effect on the atmosphere. Sharp rises of GHGs over the last century and a half have led to higher overall worldwide temperatures, reduced snowpack in the higher elevations, greater fluctuations of temperature and precipitation, global sea level rise and more frequent and severe extreme weather events, including hurricanes, heatwaves and droughts.



UP LINKS

- ▶ [Reducing Air Pollution - ARB Programs](#)
- ▶ [Climate Change Programs](#)

PROGRAM LINKS

- ▶ [AB 32 Overview](#)
- ▶ [Advanced Clean Cars](#)
- ▶ [Advisory Committees](#)
- ▶ [Cap-and-Trade Program](#)
- ▶ [Carbon Sequestration](#)
- ▶ [Clean Energy Future](#)
- ▶ [Economic Sectors Portal](#)
- ▶ [Fact Sheets / FAQs](#)
- ▶ [GHG Maps](#)
- ▶ [Governor's Pillars](#)
- ▶ [Green Buildings](#)
- ▶ [Highlights](#)
- ▶ [Implementation](#)
- ▶ [Low Carbon Fuel Standard](#)
- ▶ [Reports to Legislature](#)
- ▶ [Public Health Workgroup](#)
- ▶ [Research](#)
- ▶ [SB 375 Regional Targets](#)
- ▶ [Scoping Plan](#)

Key Terms & Concepts

Bayon et al. (2009)

- **Cap-and-Trade system**

A market-based approach used to control pollution by setting a ceiling on total pollutant emissions and providing an economic incentive for achieving emissions reductions. Participants are allowed to trade emissions reduction permits (aka allowances) in order to make profits from unused allowances or to meet requirements.

An example of successful use of an emissions Cap and Trade system to reduce pollution via *market approach* in the US:

SO₂ trading program used to reduce acid rain (1990)

Key Terms & Concepts

Bayon et al. (2009)

- **Carbon Credit**

A financial instrument equivalent to either (a) the right to emit 1 metric ton of CO₂ (i.e., an allowance) or (b) the reduction of 1 metric ton of CO₂ (i.e., an offset).

- **Carbon Offset**

A type of carbon credit representing the reduction or sequestration of 1 metric ton of CO₂ or equivalent amount of other GHG.

Offsetting involves reducing one's net emissions by buying the rights to emissions reductions generated by projects that reduce GHGs. Offsets are project-based emissions reductions and **may be used in voluntary or regulated markets.**

NEWS RELEASE

[Print Release](#)

Release #: 15-35
Date: 06/25/2015

ARB PIO: (916) 322-2990
CONTACT:

Dave Clegern
(916) 322-2990
dave.clegern@arb.ca.gov

Air Resources Board approves rice cultivation carbon offset protocol, expands forestry offset protocol

Rice protocol offers agriculture another opportunity to benefit from cap-and-trade, reduce greenhouse gases

SACRAMENTO - The Air Resources Board today approved a new carbon offset protocol that will allow rice farmers to receive credit for using best practices for rice cultivation. The Rice Offset Protocol joins five other offset protocols developed under California's cap-and-trade program.

"This protocol provides rice growers an opportunity to do something good for the environment as well as save water, and benefit financially from those efforts," said Air Resources Board Chairman Mary D. Nichols. "The protocol is designed to be used not only in California but all rice-growing states, sharing the benefits with growers there while providing another cost-effective way for companies in the program to comply with cap-and-trade."

Carbon offsets come from greenhouse gas emission reductions in sectors that are not regulated by the cap-and-trade program.

Under the protocol, growers who use approved methods for dry seeding, drainage practices, and handling rice straw receive credits based on avoided emissions of methane. The Cap-and-Trade Program evaluates methane as being 21 times more potent than carbon dioxide for trapping heat in the atmosphere.

Each credit a grower receives is the equivalent of a metric ton of carbon dioxide. The grower can sell those credits to companies regulated by the cap-and-trade program.

In California, growers can receive credit through practices such as dry seeding and early drainage of fields in preparation for harvest. These growing practices allow for continued use of flooded fields as winter bird habitat, but reduce the amount of rice straw left to decompose in the water.

The rice protocol has been designed with additional region-specific practices to allow credit generation in other rice growing parts of the country.

The carbon offset protocols used by California and its cap-and-trade partner, Québec, are the most stringent in the world. All projects are subject to annual audits, performed by specially trained, accredited, third-party verifiers and Air Resources Board staff. Each project then undergoes a separate evaluation by Air Resources Board staff before any credits can be issued.

You can find the Rice Offset Protocol and other offset protocols by clicking [here](#).

NEWS RELEASE

Air Resources Board approves rice cultivation carbon offset protocol, expands forestry offset protocol

Rice protocol offers agriculture another opportunity to benefit from cap-and-trade, reduce greenhouse gases

- Effectively, rice growers will be paid by certain CA industries to their reduce carbon emissions.
- Allows rice growers in CA and mid-South to *voluntarily* participate in California's Cap-and-Trade carbon emissions reduction program via carbon offset program.
- Power utilities and other large CO₂ emitters in CA are the group being required to reduce emissions, not rice farmers.
- Voluntary participation by farmers involves (a) growing rice using certain approved practice(s) as per a peer-reviewed protocol, and (b) documenting those practices in specified manner that allows carbon emission reductions to be determined and ultimately verified by a third party.
- The CA ARB's rice protocol is first row crop-based protocol ever accepted into a Cap-and-Trade carbon emissions reduction program. (**co-benefits**)

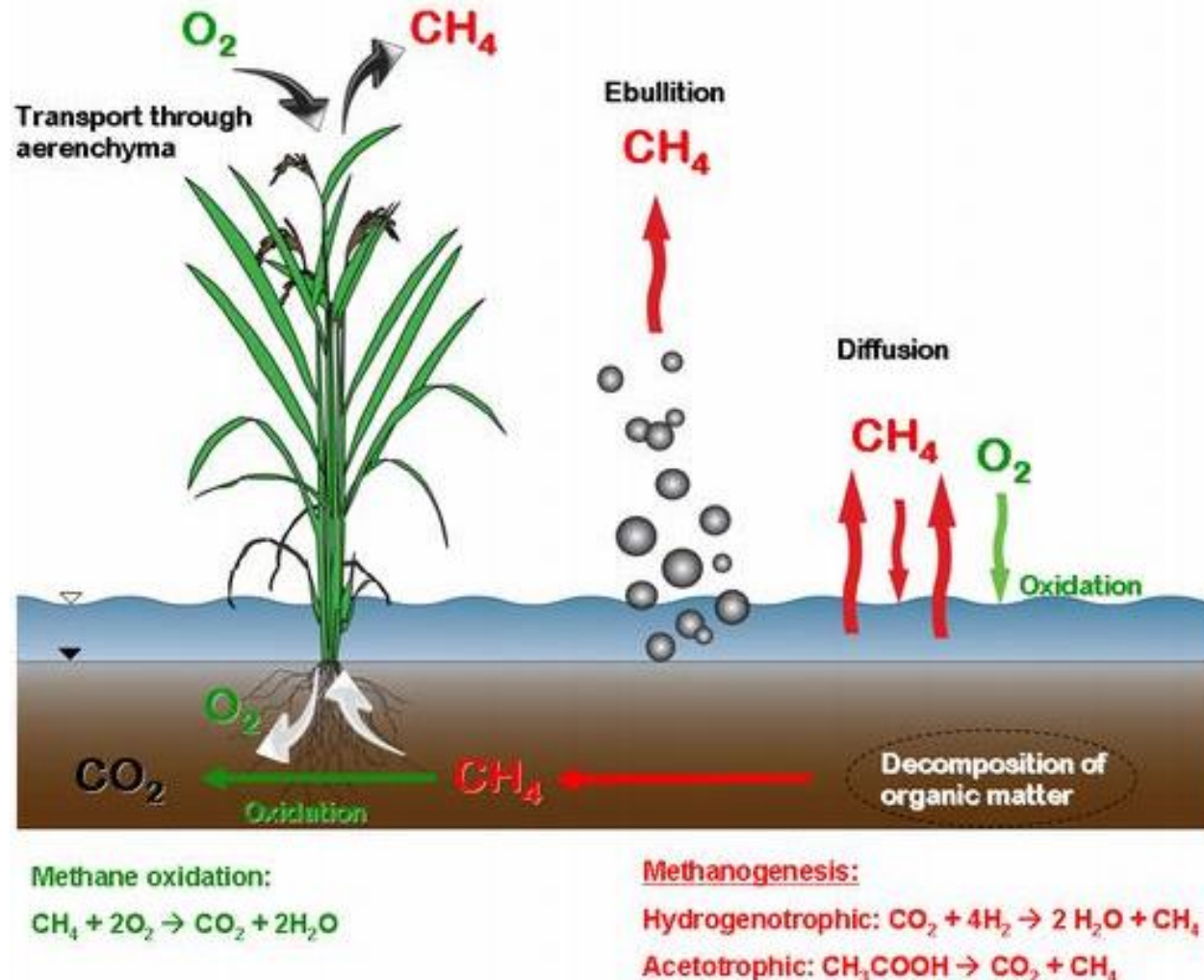
Processes Controlling CH₄ Flux from Flooded Rice Soils

CA-approved ways to reduce CH₄

- Alternating Wet-Dry (AWD) flood management
- Early Drainage
- Straw removal

Also reduce CH₄:

- Sprinkler rice
- Row rice



The CA rice carbon offset program is most interested in reducing CH₄ from rice owing to its warming potential:

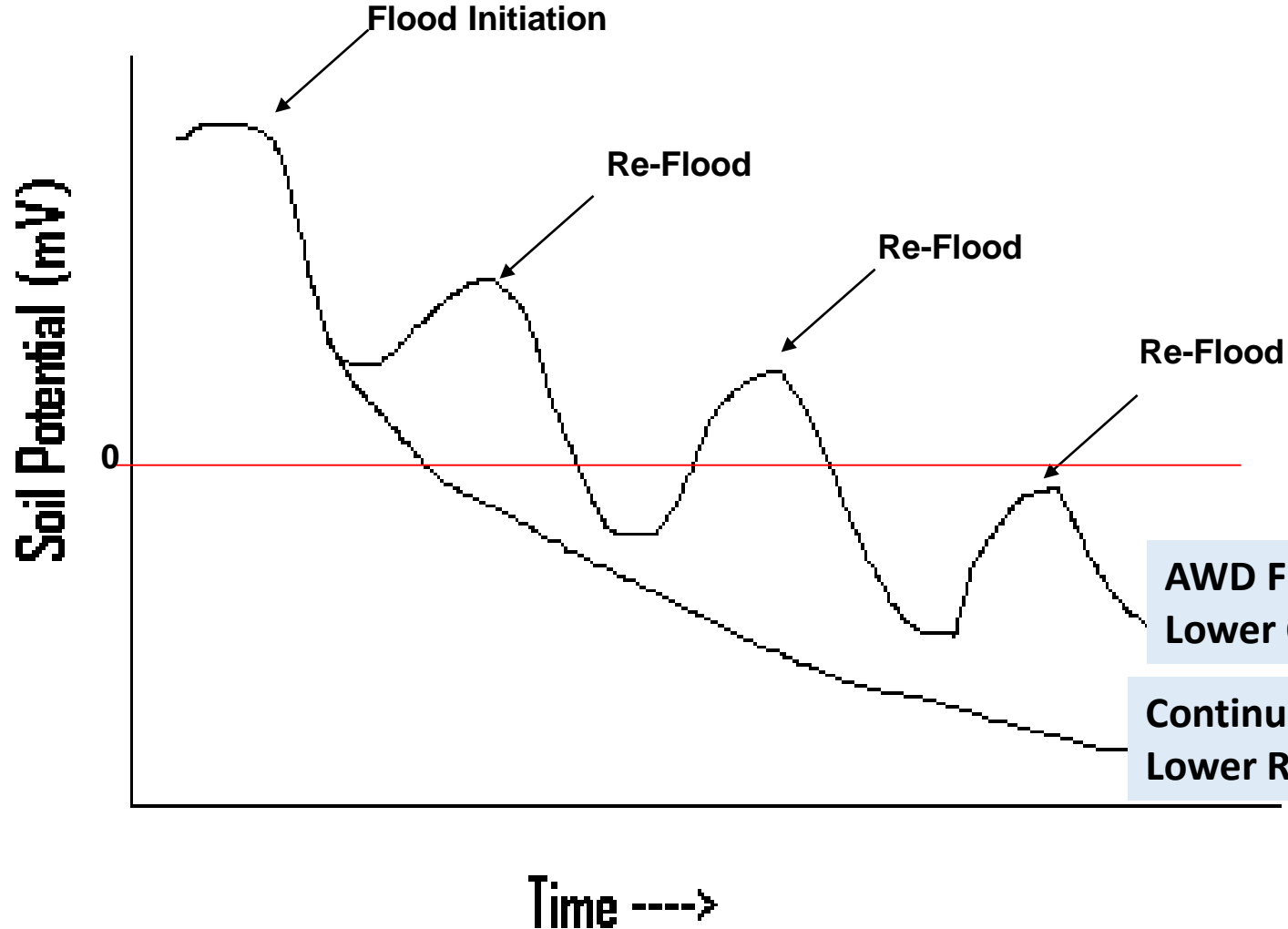
1 CH₄ = 23 x CO₂ (100 yrs)

1 CH₄ = 80 x CO₂ (10 yrs)

Plus, a ton of CH₄ not produced during the growing season will not be produced later, addressing the need for **permanence**.

Continuous Flood vs. AWD Flood Management

Soil redox and CH_4 production



- Challenges with AWD include:
- Does it work?
- How to cheaply, easily document the practice?

AWD Flood = More O_2 = Higher Redox = Lower CH_4

Continuous Flood = Lower O_2 = Lower Redox = More CH_4

The Detroit News

GM buys North Dakota grassland emissions credits

David Shepardson, Detroit News Washington Bureau 7:01 a.m. EST November 17, 2014

Martin said GM's move was one of many examples of GM's commitment to environmental stewardship. Last month, GM announced it would complete by year's end a new 2.2 megawatt ground-mounted solar array at its Lordstown complex in northeast Ohio, where it assembles the Chevrolet Cruze. GM last year installed a 1.8 megawatt solar ray at its Toledo Transmission facility.

"We are looking at making sustainability an integrated part of our business," Martin said.

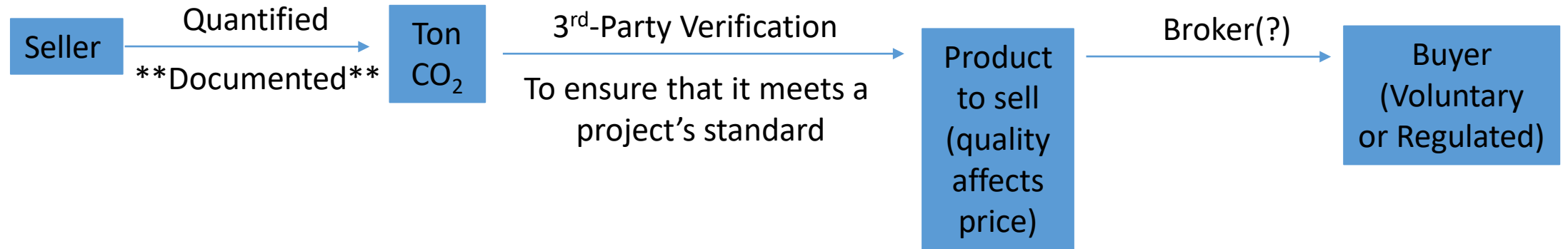
The carbon dioxide tons purchased by GM are equivalent to a year's worth of greenhouse gas emissions generated from more than 5,000 cars — and means the grasslands will be in a permanent conservation easement. Landowners can continue to use the land for grazing and livestock production.

USDA's Natural Resources Conservation Service awarded \$161,000 through a Conservation Innovation Grant to Ducks Unlimited in 2011 to develop the metrics to quantify the carbon stored in the soil by avoiding grassland conversions, resulting in the generation of carbon credits. The program also ensures better water quality and duck habitat.

The way it works is ranchers voluntarily place lands under a perpetual easement but retain rights to work the land, such as raising livestock and growing hay; carbon storage benefits of this avoided conversion of grasslands are quantified, verified and formally registered, resulting in carbon credits. The credits are then made available for sale to those seeking carbon offsets.

Ranchers receive compensation for the carbon credits generated on their lands. USDA notes thriving grasslands provide nesting habitat for wildlife, are more resilient to extreme weather, and help mitigate the impact of climate change.

As with Crops, Market Principles Apply to Carbon Offset Markets



Learning how the CA rice carbon offset market works could serve as gateway to other opportunities in other crops (e.g., ongoing mid-West pilot study for N management in corn).

Simple in theory, complicated in practice...but we're learning.
(Mid-south rice C-offset pilot projects being led by Dennis Carman)

Thank you!

CA Compliance Market Update

- As of 25 June 2015, CA ARB formally adopted offset protocol for rice.
- This means that there is a formal market for certified/verified carbon offsets generated as part of rice protocol.
- This is the First Crop-Based Protocol accepted into Cap-and-Trade system.
- In US, over 21 rice farmers have expressed an interest in participating in formal market with 21,000 rice acres (1%) which reflects “good” interest.
- First rice farmer has successfully made it through Verification process which will lead to this rice farmer’s offsets entering ARB compliance market and will be placed up for sale.
- But like any other market, market fundamentals hold, i.e. must have a Seller and Buyer of the “product”

Measured Diesel Fuel Use for Ground and Surface Water Irrigation Systems per A-in Water Delivered

Source: Dennis Carman, PE, White River Irrigation District (2014)

Groundwater:

Average: **0.7 ± 0.2** gallons diesel used per Acre-inch

Range: 0.48 to 1.03

Total Dynamic Head range: 28 to 57 feet

N= 15 systems measured

Surface Relift:

Average: **0.4 ± 0.2** gallons fuel used per Acre-inch (GPA)

Range: 0.14 to 0.66 GPA

Total Dynamic Head range: 13 to 61 feet

N = 14 systems measured



Measured kWh Use for Ground Water Irrigation Systems per A-in Water Delivered

Source: Yazoo Mississippi Delta Joint Water Management District (YMD)

Groundwater:

Average: **10.9 ± 2.2** kWh used per Acre-inch (kWh/Ac-in)

Range:

