

C-AGG Meeting Summary
 Wednesday-Thursday, March 9-10, 2016
Hyatt Regency
 Sacramento, CA – USA

Meeting Summary Table of Contents

Executive Summary	2
Action Items/ Key Takeaways.....	4
Day 1 - Wednesday, March 9, 2016	
Welcome and Introductions: C-AGG Overview and Background	5
Governor Jerry Brown’s Priorities: Climate Change and Agriculture	6
CA Scoping Plan Update	8
CA Healthy Soils Initiative	9
Monsanto’s Carbon Neutral Commitment.....	10
CA Short-Lived Climate Pollutants Plan Update.....	11
Hydrothermal Carbonization: Converting Manures & Ag Residues into Valuable Products.....	12
Day 2 - Thursday, March 10, 2016	
Rice Offset Projects Underway: Perspectives of Rice Growers, a Certified Crop Advisor & a Scientist Measuring Field Scale Changes in Methane Emissions.....	13
COMET-Farm, Models and Other Tools: Outcomes of a Workshop to Address Reducing Market Transaction Costs.....	15
Identifying & Mitigating Risks in Nitrogen Management Project Development & Implementation: C-AGG Implementation Working Group Paper	16
UNFCCC COP21 Outcomes: The Opportunities for Agriculture & Land Use Created by Paris.....	17

Executive Summary

Debbie Reed, C-AGG's Executive Director, opened the meeting with an overview of C-AGG's mission, operating model, and organization structure followed by a review of the current meeting's objectives. The theme and goals of Wednesday's (Day 1) presentations were to advance dialogues with California's (CA) policymakers on the impacts the state's climate change programs and policies may have on the agriculture sector and to understand how the private sector is reacting to not only CA's policies but those emerging on the national and international front. Presenters from Governor Jerry Brown's office, the CA Air Resources Board (ARB), and the CA Department of Food and Agriculture (CDFA) led these sessions. Monsanto provided the group with an overview of their recent commitment to be net carbon neutral across their operations by 2021, a goal that resulted from internal and external pressure and opportunities. The day culminated with a presentation from a small start-up looking to capitalize on a resurging hydrothermal carbonization technology that could have significant impacts on how the sector handles high moisture agricultural residues and livestock waste. The meeting's second day shifted focus from policy and regulation to project implementation and market development challenges and opportunities. The first panel presentation of the day probed the lessons learned from the development of a first of its kind rice management project for the carbon offset market, which was followed by two presentations that discussed tools and documents that can help reduce the transaction costs associated with these projects. Finally, the meeting concluded with an overview of agriculture's potential role in meeting the global targets set during the 21st Conference of the Parties (COP) in December as part of the Paris Agreement.

Day One. Cliff Rechtshaffen with Governor Jerry Brown's office set the stage for the first day with an overview of the Governor's five pillar climate change strategy to reduce greenhouse gas (GHG) emissions 40% below 1990 levels by 2030. To meet this goal, the ARB and multiple other state agencies are in the process of developing programs and plans that outline GHG reduction roadmaps for all major sectors. The agriculture sector will be required to reduce methane emissions from dairies, reduce emissions from irrigation water, and sequester carbon in terrestrial sinks. These activities are or will be incentivized by allowing producers to generate offsets that can be sold within the state's cap-and-trade market or through the provision of grants using funds from the cap-and-trade revenue. The specific plans behind how the sector will reduce GHG emissions from these activities are outlined in the state's Scoping Plan, which is updated every 5 years. Sara Nichols from the Air Resources Board gave a quick update on the new initiatives that will be included in the next Scoping Plan due out this year which will incorporate the new 40% goal. The specific targets for the agriculture and land use sector are still under development and have presented some challenges due to limited data availability for the sector and the current state of accounting frameworks for land based emissions.

The CA Department of Food and Agriculture (CDFA) has been working with ARB and other CA agencies to develop a statewide Healthy Soils Initiative, a program that will incentivize activities such as cover cropping and compost application that can improve soil health and soil

carbon across the state. Jenny Lester Moffitt and Amrith Gunasekara with CDFA provided an update on the current status of the initiative's pre-funding research and program development and an overview of how the program will move forward if funding is granted. If the effort is approved for funding during the next ARB board meeting, CDFA will have \$20M to distribute to land owners across the state.

Ryan McCarthy with CA ARB provided an update on the status of CA's Short Lived Climate Pollutant (SLCP) plan, concluding the day's updates on efforts underway in CA. The draft SLCP plan was released for public comment in September with reduction goals for black carbon (50% by 2030 from 2013), methane (40% by 2030 by 2013) and hydrofluorocarbons (40% by 2030 from 2013). To reduce methane emissions, those most relevant to the ag sector, the draft SLCP called for an increase in funding for the citing of new anaerobic digesters and a continued focus on adoption of emerging technologies to manage enteric emissions. The SLCP draft released in September also included a requirement for new and emerging dairies to install digesters, however, during the comment period it was pointed out that this would put an end to the generation of carbon credits from digesters, an important source of revenue for current projects. Given this negative impact on the sector, ARB decided to remove the requirement from the current working version. The next version of the plan should be released in April for final comment before going before ARB's board in May.

The programming transitioned from CA to the private sector with a presentation from Monsanto on their recent commitment to become carbon neutral, and the presentation of a resurging technology to handle livestock and other organic waste. Michael Lohuis with Monsanto's sustainability group discussed the driver's behind the company's decision to commit to carbon neutrality by 2021 and the strategies the company will implement to achieve this goal. Monsanto realizes that climate change is negatively impacting their producers and understands that mitigation and adaptation must be undertaken to combat the problem. To achieve their goal, Monsanto will encourage and incentivize domestic producers to adopt precision agriculture and to implement management practices that improve soil carbon sequestration. Internationally the company will focus on ways they can help slow and halt deforestation from agriculture expansion.

The day concluded with a presentation from Bryan Redd on hydrothermal carbonization (HTC) and its beneficial uses in the agricultural sector. HTC uses pressure and high temperatures to create gas, hydrochar (similar to biochar) and process water from manure and other high-moisture content organic wastes. The technology is currently being used in Europe, but there are no full scale units in operation in the US. While the technology is old – discovered in 1913 – it has only recently started to receive the research funding required to fully scale. ThermChem Corporation, Bryan's company, is still raising funds and hopes to have their first unit in place 12-18 months after their final financing needs have been met.

The second day took a deeper dive into carbon offset project development examples, challenges, lessons learned, and the tools and resources needed to continue to build evolving markets. The day began with a presentation from rice producers, a certified crop advisor, and a researcher

working to understand the benefits and challenge associated with implementing alternative wetting and drying (AWD) in mid-south rice production. While both producers and Dr. Reba saw positive environmental results from implementing AWD including a significant decrease in GHG emissions and minor reductions in irrigation water, they all cautioned that AWD does require increased management, has the potential for increased weeds, and can have negative yield impacts. The GHG emission reductions achieved through this practice change are currently in the process of being quantified and verified so that carbon credits can be generated and sold on the voluntary market.

Debbie Reed, C-AGG, Mark Easter, Colorado State University and Adam Chambers, USDA-NRCS, provided an update on the outcomes of a joint workshop convened earlier in the week to discuss how tools, specifically COMET-Farm, can help reduce transaction costs related to carbon offset project development and implementation. Workshop participants identified a host of improvements to COMET-Farm that would reduce transaction costs including the ability to perform batch uploads, to store additional supporting evidence, and to improve uncertainty quantifications. This workshop was the first in a series of three to address the issues of transaction costs for small scale projects, specifically those in the agriculture sector. The next workshop will be held the week of July 11th in Denver.

C-AGG's Project Implementation Working Group presented highlights from their recently published paper that details the inherent risks associated with developing projects using nutrient management protocols. The group hopes the document will be used by project developers to develop business and software controls that verifiers can then audit first for potential risks before developing more detailed site visit plans. If verifiers can begin to feel more comfortable with the results achieved through process audits this could result in a significant decrease in transaction costs, which is much needed to achieve scale in the market.

Finally, C-AGG welcomed Pipa Elias from The Nature Conservancy to provide an update on the outcomes from the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP)21 in Paris that could have implications for the land sector. Representatives from the land sector held numerous side events during the two-week conference that some credit for the inclusion of the land sector in Article 5 of the Paris Agreement. In addition to a focus on conserving and enhancing terrestrial sinks and reservoirs codified in Article 5, over 50 countries included language in their intended nationally determined commitments (INDC) that describe the role of the agriculture sector in achieving pledged reductions. The details of how the agriculture sector will be handled going forward will be worked out in a process to begin later this year through the Subsidiary Body for Scientific and Technological Advice (SBSTA).

Action Items/ Key Takeaways

- California is committed to reducing the state's GHG emissions by 40% from 1990 levels by 2030. Strategies for achieving these reductions are currently being developed as part of the

next iteration of the state's Scoping Plan. More information on the Scoping Plan's schedule of workshops can be found here: <http://www.arb.ca.gov/cc/scopingplan/timeline.htm>

- California's Department of Food and Agriculture (CDFA) is hoping to receive \$20M in funds for the Healthy Soils Initiative and aims to begin implementing the program July 1, 2016. CDFA will be releasing a final version of their agronomic compost application rate white paper in May 2016. C-AGG will circulate the document once it is available.
- Monsanto recently committed to be carbon neutral by 2021. Monsanto will release the research that informed this commitment in April, which C-AGG will circulate once released. For a quick snapshot of their commitment, view the "Give it a Minute: Climate Change" video here: <http://news.monsanto.com/video/give-it-minute-climate-change>.
- California's Air Resources Board (ARB) released their draft Short Lived Climate Pollutant (SLCP) strategy in September, which is currently undergoing revisions based on public comments received. A new version will be released in April or May, but the current version can be found here: <http://www.arb.ca.gov/cc/shortlived/2015draft.pdf>.
- USDA-NRCS released another round of Conservation Innovation Grant funding for projects focused on conservation finance and water quality. They are accepting proposals through May 10, 2016. More information can be found here: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/>.
- C-AGG's Project Implementation Working Group recently published a document identifying the risks inherent in project development and credit generation from nutrient management offset protocols. The document can be found here: http://cagg.org/cm_vault/files/docs/Project_Implementation_WG_N2OProjectRisksControls_FINAL_18JAN2016_v2.pdf
- Article 5 of the UNFCCC Paris Agreement describes how the land use sector will contribute to the agreement's goals. The specific text can be found on page 23 of this document: <https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf>

Meeting Summary

Wednesday, March 9, 2016

Welcome and Introductions: C-AGG Overview and Background

Debbie Reed, C-AGG's Executive Director, kicked off the meeting with an overview of C-AGG, its guiding principles, and current steering committee members. C-AGG focuses on furthering the development of policies, programs, tools and decision support systems that can drive incentive based and market based GHG emissions reductions. C-AGG achieves this mission by building consensus on tools, policies, and decision support systems that allow carbon and environmental markets to scale. Consensus is reached through an open collaboration policy amongst participants during C-AGG's three annual two day meetings. These meetings bring participants working across the agricultural value chain together to discuss key issues facing

the sector and to learn more about the current state of the science, policy, and tool development for quantifying, monitoring and verifying emission reductions from the sector. Between meetings C-AGG hosts intermittent workshops focused on issues requiring a deeper dive; distributes key sector updates via a participant email listserve; and posts regular updates to its website. C-AGG believes that the agriculture sector can provide ecosystem services and environmental solutions to society that complement the sector's current and very important role of feeding the country and the world.

The meeting objectives for the two days in Sacramento included:

- Dialogue with CA policymakers and stakeholders on impacts to the agricultural sector of the state's climate change programs and policies. Probe voluntary, incentive-based opportunities for the sector as part of these policies;
- Share first-hand rice offset project implementation experiences from rice growers, a Certified Crop Advisor, and a USDA scientist. Develop proposed refinements to offset protocols and policies to help replicate and scale project uptake and deliver rigorous offsets to markets;
- Identify concrete steps to reduce environmental market transaction costs and implementation hurdles to help scale and replicate agricultural project solutions; and
- Explore additional ecosystem service opportunities for the agricultural sector.

Governor Jerry Brown's Priorities: Climate Change and Agriculture

Cliff Rechtshaffen from Governor Brown's office provided an overview of the state of California's climate change plan with a focus on how the office sees the agriculture sector contributing to their ambitious GHG emissions reduction goals. CA views itself as a leader in mitigating climate change through the creation of cutting edge regulations and incentives that drive change and protect the state, the planet, and the agriculture sector from the impacts of a changing climate. Four state agencies, the CA Department of Food and Agriculture (CDFA), the Air Resources Board (ARB), the Strategic Growth Council (SGC), and the Department of Conservation, are jointly developing and implementing policies and programs to help the ag sector adapt to and mitigate climate change.

CA's size, unique climate, fertile soils and diverse agriculture sector produces over 400 commodities: 1/3 of all vegetables and 2/3 of all fruits grown in the country are grown in CA. This makes the sector a challenge to fully understand, optimize, and regulate. Given the damaging effects climate change can have on the state, CA is one of the few states that funds climate science and specific vulnerability assessments for the major sectors in the state. In CA's most recent inventory (2012), agriculture accounts for 8% of the state's emissions. This percentage will continue to grow as the state's renewable energy and renewable fuel standards begin to reduce energy's share of the emissions. Cliff indicated that agriculture's growing share of the state's emissions will eventually result in the sector being placed under the cap.

CA has been struggling with the loss of forests and grasslands to urban areas over the past 30 years. The state has permanently lost 1 million acres of farm land and 333,000 acres of rangeland.

To formalize the state's efforts to combat climate change, the governor established a 5 pillar plan to reduce emissions 40% below 1990 by 2030. The pillars include:

- A 50% renewable energy portfolio by 2030;
- Reduction in oil and transportation fuels by 50% by 2030;
- Doubling the efficiency of buildings by 2030;
- Reducing short lived climate forcers in all sectors, which includes the Dairy Digester Program; and
- Converting national and working lands into carbon sinks, including through the state's Healthy Soils Initiative.

The ARB is currently updating the state's Scoping Plan to include the newly created targets and to develop funding priorities for the revenue generated through the state's cap-and-trade system. All revenues from the cap-and-trade system must be invested to further additional GHG reductions. This GHG Reduction Fund has been funding multiple projects including CDFA's dairy research and development program, SGC's sustainable agriculture lands program, and hopefully this year will begin funding the healthy soils initiative. The healthy soils initiative will incentivize management practices that sequester carbon, increase water holding capacity, enhance microbial biodiversity, reduce salinity, improve plant health and yields, and reduce the use of fumigants and synthetic inputs. As a side note to the conversation on the cap-and-trade system, the state is currently being sued by groups that argue the cap-and-trade system is functioning as a tax which is required to be voted on by the legislature to enact, which the system never underwent. The state has been winning in court, so this litigation should have minimal if any impact on the policy. However, there is pressure to decrease the number of offsets used in the state, especially offsets generated outside of the state, so this could impact the timeline for a new agriculture protocol given all of the recent developments and changes in priorities.

To achieve the state's GHG emission reduction goal they are focusing on public-private partnerships, which to date have included the SWEEP program (233 projects funded to date), which funds projects that improve irrigation water use, and the Dairy Digester Research and Development Program (5 projects funded to date), which funds the implementation of new digesters. For the upcoming year, the proposed budget for agriculture includes \$20 M for the SWEEP program and \$55 M for Climate Smart Agriculture. The latter includes \$20 M for the healthy soils initiative and \$35 M for the dairy digester program. In addition to this request for funds, the state is also investing \$40 M in the creation and maintenance of agriculture conservation easements. The funds will be used to establish agriculture land mitigation programs, adoption of urban growth boundaries, agriculture easements and purchasing of strategic properties, upzoning for strategic areas, and agriculture greenbelt buffer and implementation agreements.

The Department of Conservation is also working to modernize the Williamson Act, which allows land owners to enter into contracts to temporarily preserve farmland from conversion by taking it out of production. Land owners are reimbursed for property taxes associated with conserved land as an incentive to take the land out of production. CA understands that to meet food security goals and achieve GHG reductions the state must integrate conservation into their goals and develop a way to calculate and account for these avoided emissions.

CA Scoping Plan Update

Sara Nichols with the ARB's cap-and-trade program presented the agency's plan for updating the Scoping Plan. The state's climate change strategy includes 5 pillars (summarized in Governor's update) guided by a set of principles directed at saving water, creating jobs, transforming the state to a cleaner energy economy, making CA more resilient, giving consumers clean energy choices, and supporting vulnerable communities. The pillars are implemented through initiatives outlined in the the Scoping Plan and legislation passed by the state as a complement to the Scoping Plan's directives. The Scoping Plan uses multiple building blocks including partnerships, research, incentives, grants, voluntary actions, regulations, and local action to achieve the state's climate change goals.

The prior scoping plans established a new paradigm for climate mitigation in the state and developed the first economy-wide climate change plan that dictated how AB32 would be implemented. The plans take a sector-by-sector approach to reductions that include strategies for public outreach and education. The new Scoping Plan will outline strategies for achieving the 2030 GHG target set by the governor. These strategies will likely include collaboration amongst state agencies, engagement with the legislature, coordination with existing initiatives, including the fuel standards and cap-and-trade program, and engagement with the Environmental Justice Advisory Committee. Once the plan is completed it will undergo an environmental analysis and then be open for public comment.

The Scoping Plan will include strategies for each sector, but for the purposes of this meeting only plans for the natural and working lands sector were reviewed. The goals for the natural and working lands sector will be long term and landscape level, but will also include shorter term targets that ensure the sector is directionally on a path to achieving the long-term vision prior to 2030. One of the major challenges ARB has faced with setting and tracking specific goals for the sector has been a lack of scientifically rigorous accounting frameworks that can be applied to the sector's emissions. The Scoping Plan will be accompanied by an economic analysis of the goals and strategies in the report to guarantee that the strategies outlined in the plan do not have significant negative impacts on the state's economy. This will be an iterative process that is initially completed after the release of the first draft of the Scoping Plan. The Scoping Plan team held a kickoff meeting in October 2015 followed by a series of single issue meetings to solicit feedback from the public. The team will host sector specific workshops in spring 2016 (natural lands workshop was held March 23rd), to be followed by the release of a draft document later in the spring, with a final document to be released in the fall.

CA Healthy Soils Initiative

Jenny Lester Moffitt of CDFA provided an overview of the specific programs included in the healthy soils initiative. She was followed by Amrith Gunasekara who summarized the technical and scientific considerations of the Initiative. CA is using the lens of Climate Smart Agriculture -- defined as an integrated approach to achieving GHG reductions while also ensuring food security in the face of a changing climate -- to develop programs and initiatives for the state. In CA, this translates into initiatives that increase soil carbon sequestration, improve manure management, increase water use efficiencies, protect pollinators, conserve agriculture land, and increase renewable energy use on farms.

CA is investing heavily in soils given their importance to the agriculture sector and to the state's ability to continue feeding a growing population. The Healthy Soils Initiative is an integrated plan to reduce GHG emissions and improve drought resiliency by implementing innovative farm and rangeland practices. The state recognizes that the co-benefits provided by healthy soils are just as important if not more important to farmers as the primary goal of sequestering carbon and reducing GHG emissions.

The major actions covered by the initiative include:

- Protecting and restoring soil organic matter in CA by implementing new management practices including managed grazing, field buffers, crop residue, cover cropping, and compost application;
- Identifying sustainable and integrated financing opportunities;
- Investing in research, education and technical support;
- Increasing governmental efficiencies to enhance soil health on public and private lands; and
- Promoting interagency coordination and collaboration.

CDFA and UC-Davis have been working together since 2014 to understand how to build soil organic matter in CA soils and improve plant health and yields through this process. While research is still ongoing, CDFA will use the best available science to provide financial incentives for farmers and ranchers who adopt management practices that have been shown to improve soil health. CDFA is currently working with ARB to develop a methodology for quantifying these improvements, which will be released for public comment once finalized.

To understand the program's potential, CDFA has been using COMET-Planner as an initial screening tool to understand the GHG emission reduction potential from the major activities covered under the initiative. However, compost addition, one of the technologies encouraged under this program, is not yet included in the tool. To better understand the GHG fluxes associated with compost application, CDFA set up a scientific sub-committee to look at agronomic application rates from compost and recently released a final version of their white paper for public comment. The white paper includes a discussion of the optimal application rates characterized by land type, agricultural system, type of compost, and the carbon sequestration potential and available versus unavailable N in compost. The paper establishes

proposed compost rates for the initiative that will result in positive environmental benefits. CDFA is currently reviewing all comments received and will release a final version of the white paper in May.

To meet the increased demand for compost that is anticipated as part of this program, the state will focus attention on increasing composting facilities, increasing organics sent for compost, and managing animal waste more effectively for use on soils. The final technical piece of the initiative will fund research to further the science on soil management. The first round of research funding will be used to investigate:

- Economic potential and climate benefits for carbon sequestration on rangelands and croplands;
- Use of composted food waste and livestock manure to enhance agricultural resilience while reducing GHG emissions; and
- Mapping forest carbon for sequestration and adaptation.

Participants raised some concerns with the knowledge and research gaps that still exist with respect to the CA system. Specifically, most of the studies looking at sequestration potential from additions of compost focused on annual crops, which are not a major part of CA's agricultural sector. Participants encouraged CDFA to be cautious about making broad promises around potential yield and soil improvements across the state and to consider making CA-centric studies a research priority for the next round of funding. Some felt that incentive programs can be more effective than offsets.

Monsanto's Carbon Neutral Commitment

Michael Lohuis from Monsanto's sustainability division joined the group to discuss Monsanto's recent commitment to carbon neutral crop production. After showing a short video that Monsanto produced to promote this commitment, Michael discussed the details of the commitment, the drivers behind it, strategies for achieving the goal, modeling performed to set the goal, and anticipated challenges. Monsanto set a goal to be carbon neutral across all operations by 2021, which equates to a reduction or offsetting of 3.3 M metric tons of CO_{2e}. When they looked at their operations in detail, 66% of their emissions are coming from glyphosate manufacturing, which is hard to produce more efficiently, so that is one challenge they face. Their overarching strategy will be to reduce emissions and achieve efficiencies where they can, to offset the GHG they are unable to reduce with "insets." Monsanto looks to generate insets through the provision of incentives to farmers who adopt carbon neutral crop production methods. To quantify the emission reductions, Monsanto has developed carbon crop models with the help of external experts that they can run internally with data collected from their producers.

Monsanto adopted this goal after realizing that climate change is bad for business, that adaptation plus mitigation is less costly than adaptation alone, and that farmers are already starting to feel some of the effects of a changing climate on their ability to make a profit. Through the World Business Council on Sustainable Development, Monsanto was part of a

team that investigated potential GHG emission reductions from the agriculture and land use sector globally. The team found that 30-50% of the sector's emissions could be reduced by 2030 through avoided deforestation, increased productivity, and soil carbon sequestration. According to the UNFCCC Intergovernmental Panel on Climate Change (IPCC), the agriculture sector has some of the cheapest mitigation opportunities, which Monsanto is hoping to capitalize on.

Monsanto's approach will be three-pronged and focus on conserving resources through precision agriculture; enhancing soil carbon sequestration with decreased tillage, an increase in cover crops, and an increase in genetically modified seed enablement; and slowing or halting deforestation by removing land conversion pressures through improved land productivity and decreased food loss and waste. To ensure that their goal was feasible, Monsanto worked with ICF International and AgSolver to take a cradle-to-field life cycle assessment (LCA) approach to understanding their GHG emissions sources and potential reduction opportunities. The reduction opportunities looked at the potential of ethanol production and use as a blended fuel, cover crops, use of no-till, precision agriculture, and nitrogen inhibitors. They ran over 1 M different scenarios. The results from the Iowa simulations showed significant emissions reduction opportunities by increasing no-till and use of clover as a cover crop. Monsanto realized that if they could achieve 1 ton/acre/year of reductions they would only need 3 M acres to reach their goal. The results are undergoing a peer review and will be available to the public in April.

Monsanto anticipates technical challenges to implementation at the farm level and within the company. On-farm challenges will include the ability to protect yields while practice changes are implemented, working with farmer's cropping windows by not adding additional steps or time to their schedules, providing an easy to use data entry system that also protects the data, and dealing with absentee landowners. From a technical perspective, Monsanto anticipates challenges developing an appropriate protocol, managing uncertainty if models are used, and cost-effectively verifying the reductions. Finally, from a business perspective, Michael's team is working to answer the question, "who will pay for this?," since commodity prices are low, making corporate funding tight. They would like to see additional partners enter this space to share the risks and the rewards of these early stage projects.

CA Short-Lived Climate Pollutants Plan Update

Ryan McCarthy provided an update on CA's draft strategy on short-lived climate pollutants (SLCP), which was released for public comment in September. The SLCP plan covers black carbon, methane, and hydrofluorocarbons (HFCs) that have global warming potentials (GWP) that are tens to thousands of times greater than CO₂ and as a result account for about 40% of current global warming. CA understands that strong, immediate action to cut both CO₂ and SLCP emissions is critical for migrating climate change. Passed in 2014, CA Senate Bill 605 requires ARB to develop a strategy for mitigating SLCP by January 1, 2016 after a thorough review of the research, a completion of the state's inventory, and the identification of existing

and new control measures. While the draft strategy was completed before the initial deadline, the final draft will go before the board in May for final approval a few months after the January deadline.

CA is already a leader in reducing SLCP, having reduced black carbon emissions 90% since 1960, kept methane emissions flat, and already starting to replace high GWP refrigerants with alternatives. More reductions are needed, and the state plans to reduce black carbon by an additional 50% by 2030 from 2013 levels and methane and HFCs by 40% by 2030 from 2013 levels. The 4th IPCC report GWP values and a 20-year horizon are being used to perform calculations, but only for this program given the higher significance of these pollutants over a shorter time horizon. A focus on SLCPs is the only way the world will meet the goals agreed to in Paris.

To reduce black carbon emissions, the plan focuses on improving on-road diesel emissions which are already improving due to past policies, a focus on moving residents to more efficient wood stoves and fireplaces, and an increased focus on implementing and enforcing normal air quality planning standards at ports, rail yards, and on farms. CA agrees that an international agreement would be ideal to reduce HFC, but in lieu of that ARB will be developing regulations this year. To reduce methane emissions, ARB will focus on dairies, eliminating organic waste from landfills, and minimizing or eliminating oil and gas leakage. On dairies, ARB plans to fund and incentivize the use of anaerobic digesters to generate compressed natural gas for use as a fuel on-farm and in trucks. ARB will also continue to monitor the latest scientific developments on enteric emissions reduction opportunities.

In the draft scoping plan, ARB had proposed mandating digesters on new or expanding dairies. However, in the final draft, this language was removed and the agency is instead planning to focus their efforts on developing a strategy for when and how to effectively regulate the sector. ARB will release another proposed strategy and draft environmental analysis in April, present this draft to the board in May with the goal of presenting a final plan to the board in the fall.

Hydrothermal Carbonization: Converting Manures & Ag Residues into Valuable Products

Bryan Redd, the President of ThermChem Corporation, presented an old but reemerging waste management technology that can be used to manage high moisture content agriculture and livestock waste. The world is facing a challenging future characterized by a changing climate, a global food challenge, water shortages, and antibiotic resistant super bacteria. All of these challenges are intertwined and Bryan hoped to find a solution that can help the world address these issues simultaneously. He started to investigate thermochemical conversion technologies and landed on hydrothermal carbonization (HTC) given its lower energy requirements and ability to handle high moisture feedstocks. HTC was originally developed in 1913, but fell out of favor until around 2007 when research again started to emerge, leading to the first full scale HTC operation in Europe in 2010.

HTC functions as an industrial pressure cooker, processing feedstock for 2 hours using steam or heat at a temperature between 180 and 240 °C under pressure (up to 20 atmospheres). Feedstocks can range in moisture content from 1-99%, which is one of the major benefits of this specific technology. Air emissions are minimal since the technology does not involve combustion. In addition to these benefits, HTC can accept a diversity of feedstocks (e.g., manures, ag residues, food and beverage processing waste, food waste, and ethanol residues), produce a diversity of products, and generates numerous co-benefits. These co-benefits include destruction of pathogens, pharmaceuticals and antibiotics, decreased methane emissions, and decreased odors. The outputs or products of the process include hydrochar, process water, and gas.

Bryan provided an example of how the technology works with manure as the feedstock. First, the technology produces gas, both CO₂ and potentially methane, followed by the production of a slurry. The slurry is filtered to produce hydrochar and process water. The hydrochar can be used as a compost amendment and potting media (with a degradation value between 10-40 years), added to an anaerobic digester (AD) to boost biogas production, used as a replacement for coal in power plants, or further processed and stripped of the phosphorus that adheres to it. Finally, given its adsorbent nature, it is a good alternative to activated carbon.

The process water contains nitrogen and potassium, making it a good source of irrigation water. Research is ongoing to determine if the process water could be run through an AD to boost biogas production. Given the complementary technologies, there are some benefits to co-locating ADs with HTCs.

Currently, ThermChem's business model is to design, build, own and operate HTC systems, but they are open to joint ventures with farms and to handing over the technology after installation and training. The technology costs out well (NPV = \$1M) and produces a good internal rate of return (25%) based on a simulation on a 5000 head dairy with 2 onsite modules. They are currently still raising investment capital, but already have a mobile HTC system designed and ready for fabrication 12-18 months from first funding.

Thursday, March 10, 2016

Rice Offset Projects Underway: Perspectives of Rice Growers, a Certified Crop Advisor & a Scientist Measuring Field Scale Changes in Methane Emissions

In 2011 USDA-NRCS awarded 9 Conservation Innovation Grants (CIG) to projects focused on developing GHG offset markets. One of the projects was awarded to the Environmental Defense Fund, the CA Rice Commission, and Terra Global Capital, and focused on the development of a rice management protocol that could generate credits from a pilot project in CA and the mid-south. The project is now on the cusp of generating carbon credits for the voluntary market. Two rice farmers and a certified crop advisor working on the project, and a scientist from USDA's Agricultural Research Service (ARS) who helped support pilot project

implementation presented the challenges and successes of implementing a first-of-its-kind project.

Rice is an important crop to Arkansas (AR), the US, and the world. AR produces 50% of US rice, which makes up 2% of global rice production. Globally rice provides 21% of human calories consumed and is responsible for 11% of global methane emissions, which represents a significant reduction opportunity given methane's higher short-term GWP.

Jim Whitaker and Mark Isbell, rice growers from Arkansas, provided their perspective of the benefits and challenges associated with implementing rice management system changes to generate carbon offset credits. Jim farms over 6,000 acres of long grain rice using sustainable practices, which he defined as methods that do not completely use up or destroy natural resources. He grades and land forms his fields to form a common drainage efficiency and runs tractor straight line guidance to plant his fields. Land forming allows him to use alternate wetting and drying (AWD) technologies during the rice growing season, which not only qualifies the farm for credits due to reductions in methane emissions but also saves the farm 20 acre inches of irrigation water a season. Jim uses water and evaporation gauges to better understand the level of water on his fields at any point in time giving him the insights needed to more precisely manage his irrigation schedule. This technology could result in dramatic water savings if scaled: 45% of global irrigation is used for rice and AWD could save 30% of the water and reduce methane emissions. This represents a significant global opportunity for water and GHG savings.

The farm employs no-till practices, which reduce tractor passes by 5-7 trips and allows for quicker emergence, although it does require extra vigilance with respect to weed management. Jim fertilizes with a variable rate technology applied aerially and to increase income he keeps his fields flooded in the winter to attract water fowl.

Mark Isbell is a 4th generation farmer growing 3,200 acres of continuous rice since the farm's highly clay soil makes it challenging to grow other crops. The farm is zero grade and uses an interconnected canal system with float switches to optimize the use of surface and ground water. This system saves man hours and water and has allowed 56 years of continuous rice to be grown on the land. AR is in the midst of a groundwater crisis, which if not addressed could result in an 80% shortfall in groundwater needed to meet demand in 2050. AWD is one of the technologies rice growers in the state should be considering to help reduce one of the major water uses across the state. As Mark stated, "it is possible to address [water scarcity and increasing GHG emissions] issues with one cost-saving and revenue-positive activity."

In 2015, Mark signed on to a joint research project with the University of AR and USDA-ARS to test the environmental benefits of AWD. The researchers used eddy flow covariance monitors to capture methane emissions while monitoring water levels. Results showed a 75% reduction in methane versus control fields, which is equivalent to 1 ton per acre CO₂e emission reductions with no impact on yield. While this technology may seem like a silver bullet, there are upfront capital requirements and additional risks such as over-drying that make farmers wary of

implementing the technology even with the potential benefits of water savings equivalent to \$20/acre and carbon offsets at \$12/acre.

Dr. Michelle Reba and Greg Simpson rounded out the panel by discussing preliminary results of the joint AWD project on Mark's farm. While there have been studies in Asia documenting the benefits of AWD, this is the first study performed in AR. During the rice cultivation process, fields are flooded at first tiller and held at this level for two weeks after which irrigation is halted and AWD commences. This is followed by a second flood mid-season, followed by drainage. The study focused on a large-scale application of AWD in the lower MI River basin that used side-inlet water management technology, a form of weed control, and had a zero-grade or straight levee. They chose 18 fields on Mark's farm to test AWD versus conventional management.

The study measured irrigation amounts, water depth, soil moisture, water quality (on 4 fields) and GHG emissions (on 2 fields) in addition to collecting yield data, milling quality and arsenic and cadmium levels. Over the season they saw no statistically significant difference in water application even though during the treatment period there was a difference in water levels. Dr. Reba suspects the farm managers were overcompensating after the drainage event which led to no overall difference in water use. The water depth monitoring and soil moisture sensors confirmed that there were differences in how the water was applied and used during the season even through irrigation totals were not significantly different.

GHG emissions were measured on 2 fields using eddy covariance flow monitors and static vented chambers and showed a 20% methane savings during dry down periods and 50% savings in emissions overall. The results showed no difference in yields or milling quality after 2 months in storage. This was the first year of the study, so the team is hoping to see more definitive results in 2016 and will also be releasing the results of their water quality monitoring in the coming months after the data processing is final.

COMET-Farm, Models and Other Tools: Outcomes of a Workshop to Address Reducing Market Transaction Costs

C-AGG, Colorado State University (CSU), and USDA-NRCS co-hosted a workshop on March 8th to identify the opportunities that exist to reduce transaction costs across offset project implementation life cycles. This was the first of three workshops the group will be hosting to answer this question in addition to other questions related to reducing barriers for project implementation. The workshop primarily looked at how COMET-Farm and COMET-Planner, two tools developed by CSU with funding and support from NRCS, could be modified to better meet the needs of project developers in the carbon market space. The COMET tools were designed to give full farm GHG emissions reduction assessments based on changes in management practices, with COMET-Planner taking a broader look and COMET-Farm taking a farm or field specific look. Both tools utilize the methods from the USDA Methods Report released in July 2014 in addition to over 40 empirical and dynamic models.

While the workshop was focused primarily on how tools can help project developers, other larger issues emerged that provided some context for a more nuanced discussion. For example, participants stressed how complicated, difficult and time-consuming designing & building protocols and developing GHG mitigation projects can be. To help make this process more streamlined, the group did identify a list of features that should be added to the COMET tools, which included:

- Adding model flexibility to assess multiple source categories;
- Creating the ability to support multiple spatial scales;
- Batch upload capabilities; and
- Data migration from other management software systems to reduce data entry burdens.

The COMET tools currently include all significant GHG emission source categories and multiple models and methods for calculating them depending on the category. Additionally, an integrated GHG assessment of various practices is possible. The tool can assess the emissions reductions from mitigation practices such as changes in rice management, fertilizer reduction, the use of cover crops, and tillage reductions. Currently, COMET covers 85% of cropland in the US with specialty crops being a major gap that will be addressed this year.

The workshop discussion also addressed how tools can reduce verification and validation costs, which will remain high if field-by-field verifications are required. To reduce these costs, tools can help project developers gather and maintain a repository/archive of documentation, remote sensing data, and other required protocol needs to facilitate a more streamlined risk-based verification. However, registries and regulatory bodies will need to become more comfortable with risk-based and process level audits before verification costs are reduced significantly. One of the biggest costs associated with verification is the site visit, which some feel can be accomplished today through a review of satellite images, pictures, processes and documentation.

Workshop participants also discussed the challenges with project reporting and the role tools can play in streamlining this process. Some suggestions included adding in a capacity to view and print maps to help with boundary and eligibility documentation, allowing more flexible project periods, and making the protocols less prescriptive with regards to the evidence required to prove an activity has occurred. The groups will be hosting the second workshop prior to the July 2016 C-AGG meeting in Denver, CO.

Identifying & Mitigating Risks in Nitrogen Management Project Development & Implementation: C-AGG Implementation Working Group Paper

Monica McBride of C-AGG, Alastair Handley from Carbon Credit Solutions, and Rori Cowan of the American Carbon Registry discussed the recently released C-AGG Implementation Working Group (WG) paper (<http://bit.ly/1pyuPgb>). The group formed after C-AGG's November 2014 meeting to address issues that project developers (PD) continue to face as they attempt to generate carbon offsets in the agriculture sector. The original goals of the group included:

- Investigating ways to move project development forward in the US ag sector;
- Documenting opportunities to minimize transaction costs by fostering collaboration amongst participants along the project development life cycle; and
- Developing an effective strategy for farmer education and outreach.

As a first step in achieving these goals, the WG developed a document to highlight the potential risks a project developer may face when implementing a nutrient management project following one of ACR's protocols. The document was targeted at both PDs and verifiers and was designed to help both parties view the protocol from the same lens, thus minimizing the variability that exists when the methodology is interpreted in isolation. The document includes 30 distinct risks that a PD must develop controls for either before or during the implementation of a project, ranging from field eligibility to regulatory conformance. Alastair walked through an example of how a PD would use this document to develop business and software controls to manage the risk that a field size is being reported and tracked accurately, which Rori complemented with a discussion of how a verifier could use this document to develop their risk ratings and sampling procedures.

While the document was developed for nutrient management protocols, the framework can be applied to any protocol and in fact many of the risks in the document apply to other project types as they are general risks associated with the development of agriculture projects. The collaborative approach and the diverse WG membership provided members the opportunity to engage in constructive debates and discussions on project development challenges. One of the major takeaways from the discussions the working group has had is coming to an agreement that if PDs implement sufficient controls verification can move from substantive to control based resulting in significant transaction cost reductions.

The WG is considering multiple next steps including: development of a PD and verifier training that builds on the document; and creation of a library of protocol supplementary documents to remove barriers to entry faced by PDs new to the agriculture space. Participants agreed that these were worthwhile next steps and encouraged the group to explore partnerships with CSU's GHG Management degree program to look for synergies with their curriculum as well as opportunities at the GHG Management Institute, which develops similar trainings.

UNFCCC COP21 Outcomes: Opportunities for Agriculture & Land Use Created by Paris

Pipa Elias with The Nature Conservancy provided a post-Paris COP21 update, which was a continuation of the discussions started in DC before the negotiations were held. In the final Paris Agreement, Article 5 includes two paragraphs that reference how the land sector should be considered moving forward. The first paragraph states that countries should be taking action to preserve terrestrial carbon sinks within their boundaries, while the second paragraph is primarily focused on the use and expansion of REDD+. Outside of the official text, the conference also had a focus on the importance of maintaining ecosystem integrity in addressing and responding to climate change, which directly relates back to agriculture and land

management. Finally, the small island nations pushed for an aspirational 1.5 °C limit to warming with neutrality reached by 2050, which can only be achieved by reducing emissions and increasing sequestration, meaning the land sector would need to play a significant role. In 2009, countries agreed to commit \$1B to climate financing, which could be used by the land sector to create more effective sinks. There was agreement that countries could cooperate to meet these goals, which would likely entail more bilateral agreements and markets.

To achieve the Paris Agreement goals, countries were required to develop and submit intended nationally determined contributions (INDC) as indicators of the reductions they plan to achieve. While the final INDCs submitted do not get the world to 2°C they do make a dent and many of them include references to agriculture. Over 50 of the INDCs include references to livestock and croplands while more than 40 mention improving or preserving grasslands, rice management systems, manure management, and agricultural residue management. The US's INDC did not mention agriculture specifically since the government did not want to make any specific commitments, but the USDA's 10 Building Blocks for Climate Smart Agriculture came out the same week as the US's INDC making a clear statement that this is how the US will address land sector emissions. Some of the INDCs also included the amount of money they would need to implement these mitigation opportunities.

Beyond the formal negotiations, many groups hosted side events focused on agriculture, which helped drive inclusion of the land sector in the final text. Some of these major initiatives include the 4 per 1000 soil carbon sequestration initiative driven by the French government (<http://bit.ly/1KVIQe8>), a focus on overcoming food insecurity driven by climate change, and an emphasis on reducing food loss and waste.

Coming out of Paris, there is a lot to build off of, but the global conversations on agriculture are lagging behind the forest sector. The topic of markets is still challenging as many NGOs in the community development space are hesitant to support offsets given concerns that the people in the communities where offsets are developed by international groups will not have the ability to make decisions about their land. Additionally, there is a perception that China may come in, buy land, and kick people off to just make money from the land's ecosystem services. One way to safeguard against this is to ensure communities are involved in the planning and implementation processes of offset projects.

The next major steps in the process will take place at meetings of the Subsidiary Body for Scientific and Technological Advice (SBSTA) occurring later this year. Countries have submitted requests for SBSTA to discuss agriculture more directly to work through the technical details.