Benefits, Existing Methods and Key Challenges to Aggregating Greenhouse Gas Emissions Offsets[1]

Background Paper for the EPRI Greenhouse Gas Emissions Offset Policy Dialogue Workshop #12

March 2012

I. Background

This paper has been prepared for a workshop to be hosted by the Electric Power Research Institute (EPRI)[2] on March 15, 2012 in San Francisco, CA. It is the 12th in a series of workshops sponsored by EPRI since 2008 related to greenhouse gas (GHG) emissions offsets.

This paper summarizes information contained in a larger technical report published by EPRI in 2011[3] that examines the business models, offset standards and approaches that have been used to promote aggregation of individual GHG emissions offset projects into larger, unified groups that are capable of achieving larger scale GHG emissions reductions. It discusses lessons learned from the experience of existing aggregation programs, and identifies a set of practices that could be implemented by project aggregators and offset standards to encourage future aggregation. This background paper covers the following topics:

- The need for aggregation;
- Different approaches for aggregating GHG offsets in compliance and voluntary carbon markets;
- Key lessons learned based on case studies of offset aggregation approaches; and,
- Potential next steps.

In addition, five case studies of different offset aggregation projects and programs are presented in the appendices. These case studies include: (i) Cool NRG's Cuidamos Compact Fluorescent Light Bulb (CFL) Programme of Activities (PoA); (ii) Sadia's Brazilian Swine Digester PoA; (iii) North Dakota Farmers Union's Soil Carbon Offset Program; (iv) Ducks Unlimited's Avoided Grassland Conversion Program; and (v) AgCert's CDM Digester Bundling program.

---

[1] This background paper was prepared by Peter Weisberg and Sheldon Zakreski of The Climate Trust, and Adam Diamant of the Electric Power Research Institute. This background paper is for informational purposes only. Please do not cite this paper or the materials in it without prior approval from EPRI.

[2] EPRI is a U.S. based non-profit 501(c)(3) organization created in 1973. EPRI brings together its scientists and engineers, as well as experts from academia and industry, to help address societal challenges in electricity, including reliability, efficiency, health, safety and the environment. Learn more about EPRI online at www.EPRI.com.

[3] *Aggregation of Greenhouse Gas Emissions Offsets: Benefits, Existing Methods and Key Challenges.* EPRI, Palo Alto, CA: October 2011. 1022180. This report also includes an introduction to carbon markets, discussion of barriers to offset aggregation, an overview of sectoral crediting, and analysis of the buyers' perspective on aggregated projects. Significantly more detail also is provided for each case study summarized in the appendices to this paper. The report is available online at: http://my.epri.com/portal/server.pt?Abstract_id=000000000001022180.

II. The Need for Aggregation

There is a clear need to be able to aggregate smaller GHG emission reduction projects into larger groups. Based on market experience, project developers, financiers, policy makers and offset buyers in carbon markets increasingly are realizing it will be very difficult to create GHG emissions offsets on a project-by-project basis that can achieve large scale emissions reductions cost effectively, and provide the large scale offset supplies likely to be needed in the early years of a state or federal GHG cap-and-trade program in the United States.

If most economic sectors are covered under a state or federal "economy-wide" GHG cap-and-trade program, large quantities of emissions offsets likely will need to be created in the *agriculture* and *forestry* sectors. This is so because these sectors are likely to be the only sectors responsible for significant GHG emissions that are expected to remain uncovered under future cap-and-trade programs. While the forestry and agriculture sectors offer large mitigation potential overall, much of this potential is highly fragmented and geographically distributed, so it will be necessary to aggregate many small offset projects together in these sectors to achieve significant emissions reductions. The important role these categories of offsets will likely need to play was highlighted by economic modeling conducted by the U.S. Environmental Protection Agency (EPA) in 2009-2010 when Congress debated comprehensive climate change legislation. This analysis is described below.

Although offsets have the potential to achieve significant cost savings for regulated entities and society, domestic and international offset supplies are expected to be far more limited than the quantities that would have been allowed to be used for compliance in recent federal legislation. For example, while the American Clean Energy and Security Act of 2009 allowed up to one billion metric tons of carbon-dioxide equivalent (tCO_2e) of domestic offsets and one billion tCO_2 of international offsets to be used for compliance annually, EPA's analysis of this legislation showed that only approximately 195 million tCO_2e of domestic offsets[4] could be expected to be available annually at prices less than $\$15/tCO_2e$ beginning in 2012.[5] Moreover, EPA concluded that under this legislation forest management would be expected to account for approximately three-quarters of the total U.S. domestic offset supply in 2015 at prices of $\$11\text{-}14/tCO_2$, and approximately two-thirds of the domestic offset supply in 2020 at prices of $\$14\text{-}18/t\ CO_2$.[6]

[4] "Supplemental EPA Analysis of the American Clean Energy and Security Act of 2009, H.R. 2454 in the 111th Congress: Appendix." Environmental Protection Agency. Washington, DC: January 29, 2010, p. 59. Hereafter cited as "EPA January 2010 appendix." The 195 million ton (Mt) estimate is the average between two estimates for 2015: 174 Mt (from the ADAGE model) and 216 Mt (from the IGEM model. Estimates for 2012 are only available for the IGEM model, which shows a slightly lower estimate than for 2015 (209 Mt). See Data Annex to Supplemental H.R. 2454 analysis; Excel file "Supplemental HR.2454 EPA Data Annex – ADAGE & IGEM v1.0, worksheet "IGEM offsets – Scn09" (domestic offset volumes under low offset supply scenario) http://www.epa.gov/climatechange/economics/downloads/HR2454_SupplementalAnalysis_DataAnnex.zip

[5] EPA estimated annual domestic offsets could increase to 325 million tCO_2 if methane projects are allowed. These methane projects were projected to yield 130 million tCO_2 of emissions reductions from landfills, coal mine methane, and natural gas systems. See "EPA Analysis of the American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress: Appendix," June 23, 2009, p. 27, http://www.epa.gov/climatechange/economics/pdfs/HR2454_Analysis_Appendix.pdf .

[6] EPA Preliminary Analysis of the Waxman-Markey Discussion Draft – Appendix," EPA, April 20, 2009, p. 60 (offset graph), and "EPA Preliminary Analysis of the Waxman-Markey Discussion Draft," EPA, April 20, 2009, p.18 (offset prices).

EPA's analysis also suggested afforestation activities would account for most of the remaining domestic offset supply.

While carbon markets successfully have incentivized the implementation of very-large, low-cost individual offset projects, future offset opportunities are likely to focus more on small-scale, distributed GHG mitigation opportunities in agriculture and forestry which are expected to be the predominate categories of supply in the United States. Unfortunately, existing project-specific methods used by current offset standards in both voluntary and regulatory markets make it difficult to achieve large-scale emission reductions from individual, small-scale projects. The transaction costs associated with the current project-specific method of generating offset credits only can be realistically borne by activities that can reliably deliver more than 10,000 tCO_2e of offsets per year. For example, of the 144 projects issued offset credits by the Climate Action Reserve (CAR) in 2010, 109 (76%) generate more than 10,000 offset credits per year and 78 (54%) generate more than 20,000.[7]

Few forest and agricultural landowners own enough acres of land to implement a stand-alone offset project that can produce 10,000 tCO_2e of emissions reductions annually. In addition, there is increasing pressure internationally for offsets to be generated in the Least Developed Countries where opportunities to reduce GHG emissions generally are focused on house-hold scale activities like installation of efficient lighting and improved cook-stoves. Because few forestry, agricultural or house-hold scale stand-alone projects can reduce 10,000 tCO_2e annually, the large potential for these sectors to reduce GHG emissions may remain untapped as long as carbon markets continue to rely on a project-specific offset paradigm.

Aggregation potentially can help to overcome this critical problem. Aggregation groups *geographically* or *temporally* dispersed activities that reduce GHG emissions in a similar manner to streamline the processes of qualifying and quantifying those activities as offsets. Aggregation is essential to incorporating agricultural, forestry and household-scale projects into the carbon market because it reduces transaction costs, accommodates geographically and temporally dispersed projects, and increases the bankability of carbon revenues. Aggregation also can help make it possible to use quantitative computer simulation models to estimate regional emissions reductions achieved by a group of individual projects, and to use statistical sampling techniques to verify emissions reductions.

A. Reduce Transaction Costs

Aggregation can be used to standardize the assessment of offset additionality and the quantification of individual activities that reduce emissions. Regional assumptions, modeling, standardized crediting rates, and other streamlined approaches to quantification become statistically more accurate with the larger sample size that aggregation allows. In a completely aggregated system, granular quantification of the performance of each individual reduction may not necessarily be paramount, so long as quantification at the aggregated level is conservative and does not overestimate the reductions of the combined activities. This issue is discussed in more detail in section III.C.

[7] Based on authors' analysis of data contained in the Climate Action Reserve offset registry public reports, accessed online at https://thereserve1.apx.com/myModule/rpt/myrpt.asp?r=111 , May 24, 2011.

B. Enable Geographically Dispersed Reductions

Most of the emission reduction opportunities in the forestry and agriculture sector are distributed geographically, and are expected to be relatively small on a per-acre basis. For example, implementing a nitrogen fertilizer efficiency project on the average 420 acre farm in the U.S. can be expected to reduce only 76 tCO_2e per year.[8] At the same time, recent estimates suggest that it is technically feasible to reduce between 18 and 65 million tCO_2e of GHG emissions across the U.S. by reducing nitrogen fertilizer use.[9] As these numbers suggest, it will be essential to aggregate together many farms implementing nitrogen fertilizer efficiency projects to achieve large scale emissions reductions. This logic holds for other agricultural and forestry project types as well. Soil carbon, grassland conservation, and afforestation projects, for example, are all anticipated to sequester less than 10 tCO_2e per acre per year.[10]

C. Enable Temporally Dispersed Reductions

Without the existence of a specific system to aggregate offset projects, a project developer who wants to group projects together will have to ensure that all of the individual projects share a single, coordinated start date and one crediting period in order to integrate these activities into a single "project." Arranging thousands of farmers or households to participate in a project with the same start and end date is impractical. With the creation of an appropriate aggregation program, developers instead can create an aggregated offset program that these individual actors can join over time, and do not need to know the quantity or identity of all the participants before registering the aggregated offsets program.

D. Enable Financing

The large number of participants in an aggregated program allows aggregators and their financiers to mitigate risk through the diversification provided by a portfolio of projects. Aggregation also can decrease regulatory risk. For example, under the Clean Development Mechanism (CDM) Programme of Activities (PoA) system discussed below, once an aggregation program is established and implemented, future activities seeking to be included in the program do not need the approval of the CDM Executive Board. As a result, the regulatory risk that future activities seeking to be included in a program will be delayed, rejected or inappropriately implemented is reduced. These reduced risks may enable banks to lend funds to project developers against future carbon revenues.[11] This issue is discussed in more detail in

---

[8] This estimate assumes nitrogen efficiency projects can reduce 0.18 tCO_2e per acre, as shown in *Greenhouse Gas Mitigation Potential of Agricultural Land Management in the United States: A Synthesis of the Literature*. Second Edition. Nicholas Institute for Environmental Policy Solutions, Durham, NC: March 2011. Report NIR 10-04, page 26. Per-acre value converted from hectares. Other published literature shows potentially rates of avoided N_2O emissions up to 0.5 tCO_2/acre-yr and higher are possible by reducing nitrogen fertilizer usage.

[9] Developing Greenhouse Gas Emissions Offsets by Reducing Nitrous Oxide (N_2O) Emissions in Agricultural Crop Production. Final Project Report. EPRI, Palo Alto, CA: 2009. 1020546.

[10] Nicholas Institute for Environmental Policy Solutions, *op cit*., page 26.

[11] Banks and other lenders also are likely to consider other key factors before lending funds, including the borrower's credit rating, and the existence of a purchase agreement that guarantees the developer can sell the resulting credits to a buyer. Also, aggregation may help developers to convince prospective buyers to enter into such a forward purchase agreement.

section IV, and in Appendix B. Bankable carbon revenues offer a tremendous opportunity to mobilize capital-intensive projects that struggle to raise traditional debt and equity financing.

Beyond carbon finance, aggregators also can seek tradition debt and equity investment at scale. The stand-alone participants in an aggregation program are not large enough on their own to merit the investment of large-scale debt and equity providers. In Sadia's Swine Digester PoA, described in Appendix B, for example, individual projects need to borrow $25,000 to $50,000 to install a methane digester system. By grouping more than 1,000 systems together, Sadia was able to approach the Brazilian development bank and receive a $38 million loan to build digesters and fund the implementation of this large-scale aggregated offset program. By providing investors with large investment opportunities, aggregation can help to increase project developers' access to traditional debt and equity financing.

E. Enable Modeling & Sampling

The GHG emissions of biological systems in agricultural and forestry projects are variable, difficult to predict, and expensive to measure. Some existing and emerging protocols in the agriculture sector rely upon biogeochemical process models to estimate the GHG impact of an offset project rather than requiring on-site measurement or use of regionally-derived, empirically-based crediting rates.[12] The variability that occurs at each individual site is hard to capture in these models, and as a result these models do not typically predict GHG emissions reductions on *one* project site with sufficient accuracy to be used as the basis to issue offset credits. Multiple sites in aggregate help to smooth out this variability, and make it possible for computer simulation models to better represent "average" results. In short, aggregation can help to mitigate the inherent structural uncertainty of biogeochemical process models. The Climate Action Reserve's Rice Protocol and the American Carbon Registry's Nutrient Management Protocol are both examples of methodologies that require aggregation - not to achieve cost savings – but rather to ensure the accuracy of the underlying biogeochemical modeling being used to estimate emissions reductions.

Aggregation also can make it possible to use statistical sampling techniques to verify GHG emission reductions and offset projects. By substituting statistical sampling of a larger aggregate of projects, offset standards can achieve aggregate levels of statistical rigor and desired risk (e.g., 95% confidence interval around the mean), and do so at less economic cost than verifying emissions reductions achieved by each individual project in the aggregate at the same level of stringency.

III. Offset Aggregation Approaches in Compliance and Voluntary Carbon Markets

A. Clean Development Mechanism's Programme of Activities

In 2007, the CDM created a separate set of rules for programs of aggregated projects, called the Programme of Activities (PoA). PoAs allow for the aggregation of temporally dispersed projects that use simple, standardized small-scale CDM methodologies. This separate set of rules for

[12] The use of biogeochemical models like the DeNitrification-DeComposition (DNDC) model to account for GHG emissions reductions achieved by agricultural offset projects is controversial in the scientific community, and may be more appropriate to use for some types of offset projects than others.

creating "programs of projects" also allow new projects to be included in a PoA without additional approval by the CDM, thereby reducing regulatory risks.

The individual projects that reduce GHG emissions within a PoA are called CDM Programme Activities (CPAs). Generally all CPAs in a PoA use the same CDM-approved offsets methodology. CPAs can be included in a PoA any time over a PoA's 28-year crediting period. A CDM project verifier (called a Designated Operating Entity in the CDM program) can include a new CPA in the PoA by verifying that it meets the criteria outlined in the PoA's design document. Once a PoA is registered, CPAs no longer face the regulatory risk that they may be delayed or rejected by the CDM, increasing the certainty that carbon credits will be generated and the bankability of projected carbon revenues. Figure 1 illustrates the structure of a PoA.

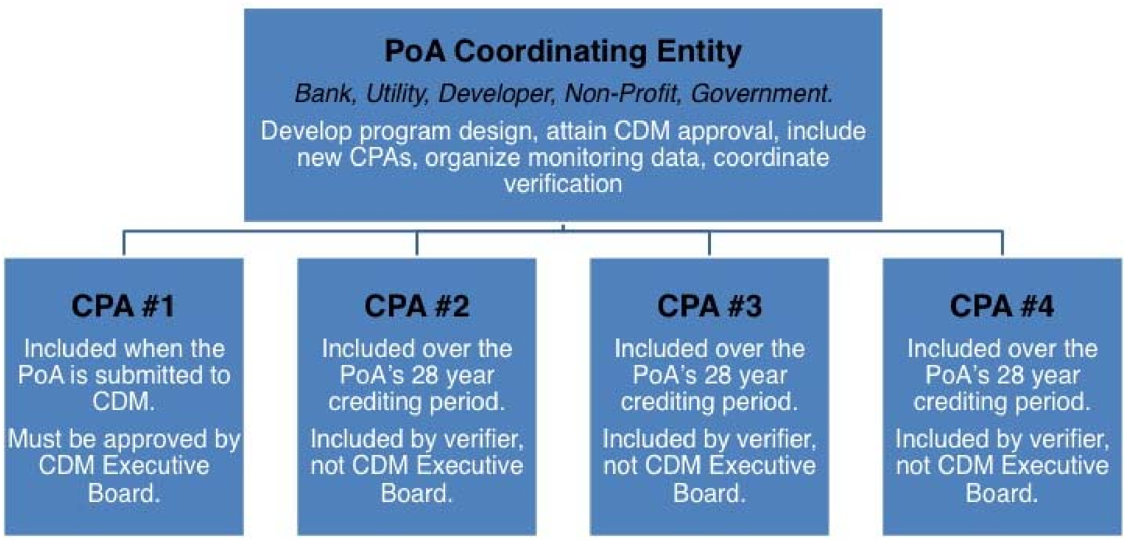

Figure 1
Structure of a PoA. A PoA is made up of groups of project activities called CPAs that can be implemented at different times and reduce GHG emissions using an approved CDM offset methodology. The first CPA is included with the registration of a PoA. Subsequently new CPAs can be included to a PoA for 28 years without the approval of the CDM Executive Board, so long as a verifier attests that the CPAs meet the criteria outlined in the PoA Design Document.

As of January 2012, 16 CDM PoAs had been registered, although none have been issued offset credits (called Certified Emissions Reductions [CERs] in the CDM), and only three have included new CPAs in the larger PoA. About one-third of the PoAs at the project validation stage now are energy efficiency related – either energy efficient lighting or cook stoves projects – and another quarter are renewable energy projects, including a high proportion of solar and solar thermal projects. Point Carbon predicts an estimated 200 PoAs will generate 100 million CERs per year by 2018.[13]

Differences between PoAs and "bundling" under the CDM

Before the CDM created the formal PoA procedures, it allowed project developers to "bundle" together multiple projects using a single protocol. Bundled projects share a common monitoring

[13] Point Carbon. "Programmes of Activities: Status and prospects." Thomson Reuters, 24 January 2012.

plan, and can be validated as a group. Each project must be identified and qualified before the bundle can be registered, so all the projects in the bundle must be implemented at the same time.

Bundling has not been widely used to date. PoAs are considered to be a far a more flexible approach for the following two reasons:

1. *PoAs allow for temporally dispersed projects:* PoAs allow for CPAs with different start dates and implementation schedules to be included over a 28-year crediting period. Bundled projects must have the same start date and crediting period.
2. *CPAs in large PoAs can use small-scale methodologies:* PoAs allow individual projects to use simplified "small-scale" offset protocols, while in most cases bundling does not. For the individual projects included in a CDM bundle to use a small-scale offsets methodology, the bundle *as a whole* must be smaller than CDM's small-scale thresholds. For a CPA to use a small-scale protocol, the CPA needs to be small-scale, but the *overall* PoA can exceed the small-scale threshold. [14]

The growing success of PoAs, in comparison to bundling, demonstrates the effectiveness of creating a separate program of rules and procedures for aggregation. This allowed for a streamlined process for including new projects, extended crediting periods to enable the integration of temporally dispersed projects, and allowed small-scale protocols to create large quantities of offsets.

Yet each CPA in a PoA is monitored and verified according to a CDM protocol that was designed for stand-alone projects. In contrast, new protocols that can be specifically tailored for aggregation could take advantage of statistical sampling, standardized crediting, increased accuracy through modeling, and a variety of other benefits associated with aggregation and produce protocols that have greater environmental integrity and are easier to use.

Reportedly, one key barrier to more widespread development of PoAs has been the assignment of liability for "*erroneous inclusion*" to verification organizations when they approve the inclusion of a new CPA within a PoA. Consequently, if the CDM EB or the Designated National Authority (DNA)[15] retroactively finds a CPA was included that does not meet the criteria outlined in the PoA's design document, the verification organization can be required to purchase replacement offset credits for all CERs issued to the erroneously included CPA. If this occurs, the CDM EB potentially also can review all of other CPAs that the same verifier included in the PoA, extending the potential liability of the verifier to the entire PoA.

Verifier liability for erroneous inclusion gives the CDM EB the power to retroactively enforce the validity of all credits issued under a PoA, even though the EB does not review the inclusion of each CPA. This method of enforcement, however, has become a major barrier to PoA development. Verifiers are hesitant to accept this liability, which is difficult to quantify because the quantity of offset credits to be delivered from a CPA and future carbon prices are unknown. In addition, validation companies may hesitate to take on this financial and reputation risk

[14] To qualify as small-scale each CPA within a PoA, or the entire bundled suite of projects, must have a generating capacity of less than 45 MW, or save less than 60 GWh of electricity or 60,000 tCO_2e annually.

[15] The Designated National Authority is the entity the host country has authorized to approve CDM projects. All CDM projects must obtain a Letter of Approval (LOA) from a host country DNA to request formal project registration in the CDM.

because they may endanger their corporate brand if they are to be found liable for erroneous inclusion. Additionally, the specific actions or omissions that may constitute erroneous inclusion of a CPA are ambiguous and poorly defined.[16] The CDM EB could hold a verifier liable if it disagrees with its additionality assessment, or finds that a project developer has committed fraud. In June 2011, the EB limited the time under which a DOE can be found liable. Liability now is limited to a period of one year after a DOE has included a CPA in a PoA or renews a CPA's crediting period, or for six months after the first time a CPA issues offset credits. Further clarification, however, around the definition of "erroneous inclusion" is needed.

B. Verified Carbon Standard Grouped Projects

The Verified Carbon Standard (VCS) also has adopted an independent set of rules for aggregating individual project activities into a single "grouped project." Unlike the CDM's PoA, the VCS requires all project activities in a group to share a baseline scenario and crediting period. While the PoA's rules facilitate the creation of a program of many independent projects, VCS's rules require many independent projects to work together as one, unified whole.

Like a PoA, project developers can add project activities over time to a project group with the approval of a verifier, but without the approval of the VCS. When an initial project for a group is proposed, the project developer defines a specific geographic area within which all future project activities that will be included in the group must be implemented. All of the projects within this geographic area must share the same relevant regulatory frameworks, common practices, and quantification criteria – such as regional emissions factors or historical deforestation rates – so they share the same baseline scenario. Only project activities within already approved geographical areas can be included in a VCS grouped project.

VCS's methods are temporally restrictive. Any project included in a group falls into the crediting period associated with the first project in the group. VCS projects in a group must share an implementation schedule. Projects that are registered later are only credited for the remainder of the initial project's crediting period.

VCS's requirement that all project activities in a group share *both* a baseline scenario and crediting period makes each grouped project function in many ways like a stand-alone project. While this approach has worked for a small number of renewable energy projects, it may be difficult to integrate temporally distributed agricultural and forestry projects using this framework, as many agricultural and forestry project activities may need to be implemented at different times across a variety regions. Aggregating these temporally distributed activities likely would require using different baselines to accommodate differences in farming practices, data availability, and geographical differences.

C. Climate Action Reserve Forestry Aggregation Guidelines

In August 2010, the CAR finalized its first rules for aggregation. The "Guidelines for Aggregating Forestry Projects" allow projects on parcels of land that are smaller than 5,000 acres

[16] "Erroneous inclusion" of a CPA is defined in CDM EB55 Annex 37. Accessible online at: http://cdm.unfccc.int/filestorage/P/8/J/P8JCEYH6WZBS1R94TQG203KA7UMIFL/eb37_repan37.pdf?t=SUN8bTBqZmo1fDCOTsV-F7syDUf7Mgc8lZ59 .

to join together in an aggregate. The rules enable this aggregate to reduce the costs of verification and inventory development in two ways:

1. *Aggregated projects can inventory their property with fewer inventory plots*. A forest inventory measures tree size, age, volume, and species to determine the amount of carbon sequestered in a forest. CAR requires the inventory for stand-alone projects to contain a sufficient number of individual measurement plots to establish a target sampling error of +/- 5% of the mean at the 90% confidence level. Under the new "Guidelines for Aggregating Forestry Projects," projects are not required individually to sample at this level of stringency. Instead, projects in the aggregation pool calculate the statistical confidence of their *collective* inventories at the aggregated level. By pooling inventories and increasing the size of the statistical sample, individual project inventories can have greater target sampling error, while the aggregated pool as a whole still can achieve a sampling error at +/- 5% of the mean at the 90% confidence level.
2. *Aggregated projects require less frequent verification.* The guidelines reduce verification in two ways: (i) Aggregated projects only need to be verified by a site visit every 12 years, compared with every six years for disaggregated projects; and, (ii) To be issued offset credits between on-site verification, projects must submit a monitoring report for desk verification. Disaggregated projects individually must submit their project for verification any time they want to register offsets with CAR. For aggregated projects, the number of projects equal to the square root of the number of projects in the aggregated pool is selected at random each year for desk verification. If this sample passes the desk review, offset credits are issued for the entire aggregated pool.

To put these transaction cost savings in context, Ecotrust recently estimated that the carbon credits that can be generated by a 3,000 acre property from a project that is not aggregated would have a net present value of $800,000. By aggregating this project with five other 3,000 acre landowners, Ecostrust found the reduction in transaction costs would increase the overall net present value of the project credits to $950,000.[17] In this case, the reduced transaction costs increased the value of the emission reduction project by nearly 20%.

Table 1 provides an example landowner cost savings that can be achieved by aggregating forest carbon projects under the CAR program. As shown, landowner costs to develop a forest carbon offset project can be substantially reduced by participating in an aggregation of similar projects.

[17] Dettman, Steve. "Aggregated price savings of CAR's Forestry Aggregation Guidelines." Ecotrust. Presentation to a small group of landowners and financiers. Portland, OR: May 11, 2010.

Table 1
Cost Savings of CAR's Guidelines for Aggregating Forest Projects. Disaggregated costs assume a 2,000 acre landowner undertakes a stand-alone CAR forestry project. Aggregated costs assume this 2,000 acre landowner joins eight other 2,000 acre landowners in an aggregated pool. Aggregated costs are expressed as costs of the individual landowner in the aggregated pool, NOT the total costs for the pool as a whole. Price assumptions are "best guess" average costs; actual costs are likely to be highly site-specific. Nominal costs are shown for 2016-2070.

Required activities	Landowner costs (disaggregated)	Landowner costs (aggregated)	Rationale	Assumptions
Preparing forest inventory	$27,000	$3,500	Disaggregated: 358 plots. Aggregated: 45 plots.	Each inventory plot costs $75.
Updating forest inventory	$100,000	$30,000	Disaggregated inventory has fewer inventory plots and is cheaper.	A disaggregated update costs $10,000. An aggregated update costs $3,000.
On-site verifications (2016-2070)	$150,000	$75,000	Disaggregated: 10 verifications Aggregated: 5 verifications	On-site verification costs $15,000.
Desk reviews (2016-2070)	$140,000	$53,000	Disaggregated: 55 reviews. Aggregated: 21 reviews.	Desk review costs $2,500 per project per year.
Total Cost	**$417,000**	**$161,500**		

While these savings are significant, the CAR system is still fundamentally project-based. Landowners can leave an aggregation pool at any time. Landowners must sign a Project Implementation Agreement (PIA) with CAR. This agreement commits landowners to monitoring and verifying any offset credits generated from their property remain sequestered for 100 years after the last credit are issued, and holds forest landowners liable for any intentional reversals of sequestered carbon during that period. Figure 2 illustrates the project contractual structure included in CAR's Forestry Aggregation Guidelines.

CAR's aggregation guidelines lower project development and operating costs for groups of stand-alone projects, but the PIA requirement makes it challenging to sign up landowners who will have to bear the risk associated with participating in the carbon market over a very long time period. As such, aggregators that are unable to shield landowners from market risks are not likely to be successful in configuring many small projects into scalable programs.

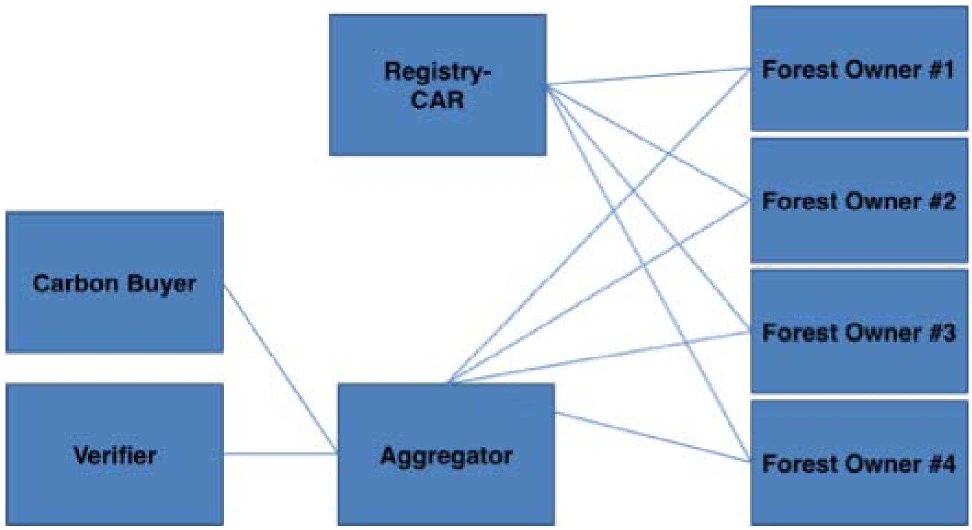

Figure 2
Required Contractual Structure of CAR's Forestry Aggregation Guidelines. CAR's requirement that landowners sign the PIA reduces the impact of aggregation; aggregators are unable to absorb risks on behalf of the landowners because the landowners are ultimately responsible for demonstrating the permanence of their project.

D. American Carbon Registry Forest Carbon Project Standard Guidelines for Aggregated Projects

The American Carbon Registry's (ACR) Forest Carbon Project Standard published in June 2010 outlines specific guidelines for aggregation. ACR's guidelines give aggregators more flexibility to design an aggregation program to make groups of lands work together as one aggregated project. The statistical certainty of the inventory, monitoring, and verification of a group of projects is calculated at the *aggregate* rather than individual project level. While CAR's approach requires each individual parcel of land to have its own project inventory and baseline, under the ACR approach, projects in an aggregate share a common baseline and one aggregate inventory. Offsets are calculated at the aggregate rather than at the individual project level.

The process for completing an inventory, monitoring, and verification is designed by the aggregator, and a verifier must verify that these procedures conform to ACR's requirements for statistical certainty. A verifier determines how and what to sample to ensure credits issued to the entire aggregation pool achieve the necessary level of assurance of accuracy. This must include field visits every five years, but not necessarily to every parcel of land in the aggregated pool.

ACR handles permanence in a fundamentally more flexible way than CAR or VCS. Under the ACR protocol, individual landowners do not have to commit to ACR's permanence requirement that any sequestered carbon sold as an offset credit must remain sequestered for 40 years. Instead, the aggregator guarantees that any credits it sells are permanent. If a landowner experiences a reversal, it is up to the aggregator to find replacement credits. In contrast to CAR, ACR allows aggregators to design mechanisms to mitigate the risks of reversal using diversification, futures contracts, or insurance to allow them to include landowners in a program without each landowner making a 40-year commitment. On the other hand, the ACR appears to be taking on any residual risk that aggregators will not be able to fulfill these commitments over a 40 years time period – a risk CAR avoids by attaching the permanence requirement to the land with the PIA.

This flexibility opens up the possibility for a variety of new aggregation models. ACR's rules allow the aggregator and the individual landowners to negotiate contracts that determine how the pool operates. This allows program participants to design the process for monitoring and verifying projects, allows new projects to enter or leave the aggregation pool, and allows for sharing of costs and profits. ACR also allows aggregators to justify a smaller contribution of credits to a buffer pool to cover unintentional reversals given their unique ability to diversify risks compared to stand-alone projects.

E. Alberta Offset System Tillage Systems Protocol

Alberta launched a comprehensive regulatory system starting on January 1, 2007 that mandates facilities that emit more than 100,000 tCO_2e annually lower their GHG intensity by 12%. Regulated facilities can meet this intensity target in part by purchasing offsets or by paying a C$15 per tCO_2e alternative compliance fee to the government. Eighty-three projects totaling over 14 million tCO_2e are registered in the Alberta offset system. The majority of the projects (50) and substantial portion of offsets (5 million tCO_2e) are registered based on applying the *Tillage Systems Protocol*. All of the tillage projects are aggregated.

Alberta's tillage protocol relies on risk-based discount factors to address permanence, proportional additionality, and the option to use a standardized or customized crediting approach. This streamlined approach to qualification and quantification has enabled aggregation in Alberta, but has caused some observers to question to integrity of its assumptions.

Although the protocol does not address aggregation directly, offset project developers have relied to a large extent on aggregation in practice to design and implement tillage projects in Alberta. These developers have relied on an offset project technical guidance document to ensure they are implementing aggregation business practices consistent with Alberta's offset system. Aggregators generally are project developers in the Alberta system. As such, the individual or company serving as an aggregator originates new projects, register the projects, arrange for verification of the aggregated pool of projects, and commercialize the credits generated.

F. Chicago Climate Exchange's Soil Carbon Protocols

In 2003, the Chicago Climate Exchange (CCX) launched the first voluntary, yet legally binding cap-and-trade program in the United States. This program operated from 2003 until 2010. Participants in the CCX program included energy, industrial, university and governmental entities who agreed to accept binding emissions reduction obligations over the course of the program. CCX had a total emission baseline of 600 million tCO_2, and CCX members achieved their emission reduction goals (e.g., 4% below their 2006 baseline). Although the CCX ended its cap-and-trade program in 2010, the CCX registry continues to host offset project enrollment, and conduct offset issuance and transfer services. Reportedly, many agricultural entities and others continued to hold open their CCX offset registry accounts after 2010, and privately arranged transactions continue to occur across registry accounts.[18]

The proof-of concept elements of CCX included an offsets aggregation and sales system that served 15,000 farmers, ranchers and foresters who implemented specified best management practices on more than 25 million acres of land in the U.S. and Canada. The bulk of CCX trading took place from 2006 to 2008. The average trade price for CCX allowances and offsets over the entire program was $3.10/tCO_2$. Total traded volume was 150 million tCO_2, excluding futures and options related contracts. Some market observers publicly criticized the CCX offset protocols as lacking in rigor and transparency, and asserted that offsets created using CCX's offset protocols lacked environmental integrity.[19]

The bulk of credits registered under the CCX were derived from two protocols that credited landowners for enhancing soil carbon sequestration in cropland, grassland or rangeland. Both are built for aggregation and *required* offset projects that expected to sequester less than 12,500 tCO_2e in a year to submit their projects to the CCX through an aggregator. Despite this reliance upon aggregation, the CCX protocols provided little concrete guidance for how to aggregate. The CCX protocols were standardized and easy to implement on a project-by-project basis through the following procedures:

- *Practice-based crediting.* No on-site monitoring was required under the CCX protocol. Instead, soil scientists established conservative crediting rates[20] for each practice in distinct regions by taking the average sequestration rates published in peer-reviewed literature. All landowners that implemented the approved practice were credited at the standardized rate for their region.
- *Permanence.* CCX rules required landowners to demonstrate the permanence of their practices during the five years that landowners contracted with aggregators to create offsets. CCX set-aside 20 percent of all sequestration offsets as a buffer reserve. This approach combined with automatic offset "take-back" rules made it possible for CCX to cancel sequestration offsets made invalid due to non-performance by an enrolled producer during the five-year contract period. CCX did not enforce long-term maintenance of post-program sequestration.[21]
- *Performance standard for additionality.* A performance standard considered all projects implemented after 2003 to be additional.

[18] See https://www.theice.com/ccx.jhtml .

[19] See, for example, The ENDS Guide to Carbon Offsets. Environmental Data Services, London, England: 2008, or Wall Street Journal, "Pollution Credits Let Dumps Double Dip," October 2008. http://online.wsj.com/article/SB122445473939348323.html. Accessed on April 5, 2011.

[20] According to CCX staff, no-till cropping in parts of the Midwest can be expected to sequester 0.60/tCO_2 per year based on a review of the scientific literature. Under CCX rules, however, crop acreage converted to no-till farming as part of the CCX program were credited with a lower rate of 0.50tCO_2 /year, equal to a 16.6% discount against a crediting rate based on the scientific literature.

[21] CCX forest project commitments eventually were enhanced to require participants to make a contractual commitment of their intent to assure long-term carbon storage, but the in-program rules for maintenance of credited carbon were similar to those for soils.

Once projects were enrolled under the CCX protocol, neither the landowner nor the aggregator faced any project performance risk. So long as the landowner maintained the practice designed to sequester carbon, the project would be credited at the standardized regional rate. This performance guarantee, combined with the simplicity of participation, attracted large-scale participation in the CCX soil carbon programs. A simple, straightforward approach to monitoring and verification (not any specific guidelines from the CCX) facilitated the rapid creation of large aggregation programs.

Several noteworthy aggregators participated in the CCX soil carbon program, including the Iowa Farm Bureau, the North Dakota Farmers Union (NDFUs) and the Delta Institute. Appendix C highlights our case study of NDFU's soil carbon aggregation program, and describes the operation of that program in detail.

G. Potential State and Federal Government Approaches to Aggregation

The systems described above build aggregation into a project-specific framework. They require recruiting individual participants to join an aggregate and analyzing additionality at the project level. As an alternative, a state or federal government agency could create an offsets program across an entire region, commodity group or agriculture and forestry sector. Using this approach, regulators could create one or more programs composed of groups of landowners, stratified by region (e.g., producers in the Corn Belt), commodity (e.g., corn producers) or activity (e.g., afforestation of marginal croplands). These groups of landowners collectively could earn offset credits by reducing their emissions below a baseline established by the regulators for the group as a whole. Protocols could be made as simple as possible, and the agency coordinating the program could oversee monitoring and verification and make adjustments for leakage, permanence, and other criteria at the regional level to ensure environmental integrity. In the agricultural sector, the U.S. Department of Agriculture (USDA) is likely to be in the best position to implement such an approach.

Alternatively, USDA could implement and operate a project-based offset aggregation program. Over the past several decades, USDA has developed considerable knowledge and infrastructure by implementing the Conservation Reserve Program (CRP), and other programs such as the Rural Energy for America Program (REAP). USDA could leverage this experience to develop and implement a large-scale agricultural offsets program that could make practice-based payments to farmers in exchange for them implementing projects or activities to reduce CO_2 emissions. USDA could issue offsets to farmers when they implement emissions reduction or carbon sequestration practices. The agency also could attempt to simplify project accounting by making adjustments related to additionality, leakage, permanence and other criteria at the regional rather than project-specific level. These offsets than could be sold to regulated parties to meet future emissions reduction compliance obligations.

IV. Lessons Learned

This section discusses four key insights that can inform future development of business models, offset protocols, and new programmatic systems to facilitate offset aggregation.

A. Lesson #1 – Programs that reduce individual participants' exposure to carbon market risks can increase participation

Successful aggregation requires grouping together a large number of dispersed activities that reduce GHG emissions in a similar way. Many actors with different appetites for risk must participate in the same program, often using a standardized contract. To encourage large-scale participation, aggregators who have been successful in adding large numbers of participants to their programs have implemented business models that reduce or eliminate carbon market risks for the participants in their program.

Any participant in the carbon market is exposed to the following risks:

- **Regulatory risk.** Will the activity that reduces GHG emissions qualify as an offset under future state, regional, and/or federal regulatory systems such as cap-and-trade? Will its registration be delayed? Will it be considered additional?
- **Project performance risk**. Will the project deliver the number of offset credits it is projected to produce?
- **Carbon price risk**. What will the future value of the delivered credits be?
- **Opportunity cost risk**. What are the opportunity costs associated with participating in the carbon market? For example, if a timber company commits to reducing harvest, what is the foregone timber value? Or, if a farmer commits to a practice that reduces crop yield, what is the foregone crop value?

In our review of existing aggregation programs, we observed two business models that reduce or eliminate carbon market risk for participants. These are described below.

Business Model #1 – Aggregator finances participants' activities

Under this business model, the aggregator provides the technology that reduces GHG emissions at no cost to the program participants. Aggregators arrange for the financing themselves and service debt through the sale of offset credits. Participants are not involved in the financing of the project and so have little or no exposure to financial risk by joining the program.

Under the Cool nrg CFL PoA described in Appendix A, Cool nrg gave four free CFLs to each of 250,000 households. Cool nrg and the lender that provided upfront financing to purchase these CFLs share the regulatory and project performance risk. Cool nrg eliminated the carbon price risk by signing an emission reduction purchase agreement to sell the offsets at a set price.

Sadia uses a similar model for its Brazilian Swine Digester PoA described in Appendix B. Using a loan from the Brazilian Development Bank, Sadia financed the construction of more than 1,000 anaerobic waste digesters to be constructed on swine farms. This loan is serviced by the sale of offset credits. Swine farmers operate the digester equipment, and, in return, receive an improved manure management system.

In both programs, carbon is the only source of revenue. Given this simplified structure, the aggregator can separate the program participants entirely from financing. The aggregator arranges with a lender to finance the equipment and manages the monitoring and verification of the project to ensure the delivery of a carbon revenue stream. Program participants ensure the installed equipment is maintained and operated properly.

Business Model #2 – Aggregator eliminates regulatory, project performance, and carbon price risks

Aggregators can design business models that eliminate project performance risk for program participants. The Ducks Unlimited (DU) Avoided Grassland Conversion Program described in Appendix D is one example. DU pays landowners upfront to place grasslands at risk of conversion to cropland into an easement. In return for this upfront payment, DU receives the rights to any carbon offsets that are generated by the easement.

Under this structure, DU assumed all of the risks associated with participating in the carbon market. This streamlined approach enabled large-scale participation in the program. However, DU is bearing substantial risks, and could see the magnitude of carbon offsets and their future value vary substantially. To be successful, DU and other aggregators need to develop approaches to manage the regulatory, performance and price risks they take on as part of any aggregation.

Like DU, aggregators can eliminate their participants' project performance risk by paying participants to implement specific practices proven to reduce GHG emissions. This upfront payment can be made at practice-based rates (i.e., any farmer that implements conservation tillage in a region is paid at the same rate). Aggregators then measure the performance of the projects themselves, and sell offsets in the market based on the measured GHG performance. By assuming performance risk, aggregators can ensure large-scale participation in their program, while performance-based crediting maintains the environmental integrity of the offsets. If protocols are not practice-based, this may become an essential role for aggregators. Figure 3 illustrates this approach to using practice based payments.

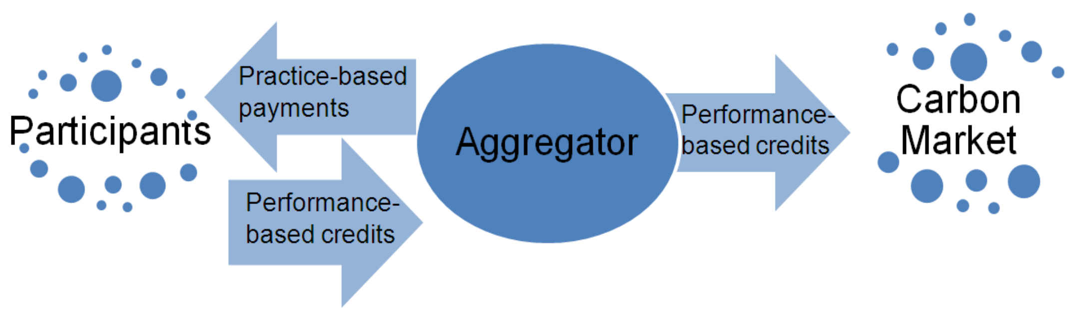

Figure 3
Aggregator makes practice-based payments for performance-based credits. Participants in the aggregation program are paid by the aggregator at standardized rates to implement a practice that reduces GHG emissions. The aggregator is issued offset credits based on the actual performance of this practice. The aggregator sells these performance-based credits to buyers in the carbon market. The risk of the project delivering fewer credits than anticipated is transferred to the aggregator.[22]

[22] Concept originally presented by De Gryze, Steven. "Opportunities for N_2O projects." Coalition on Agricultural Greenhouse Gases (C-AGG). Sacramento, CA: March 29th, 2011.

B. Lesson #2 - Simplified, standardized protocols help to enable large-scale participation in aggregation programs

The offset protocols themselves also can reduce regulatory and project performance risk by creating performance standards to determine the additionality of a project, and/or standardized crediting rates to quantify emission reductions. This is also the case with project-based offset crediting. One challenge to implementing this approach is that it requires regulators to bear much of the cost and risk associated with creating performance standards and developing standardized crediting rates.

A performance standard for additionality defines objective, standardized criteria a project type must meet to be additional.[23] For example, CAR's organic waste digestion protocol performance standard defines specific feedstocks the protocol assumes are disposed of in a manner that generates methane emissions. Any project that digests these feedstocks is considered additional, while any project that digests other feedstocks is not. Protocols that use performance standards, rather than individual assessments of additionality, can help to reduce the regulatory risk a project will be deemed non-additional.

Project performance risk also can be eliminated by creating standardized project crediting rates, as the soil carbon offset protocols developed and used in the CCX program demonstrate. Based on this approach, the NDFU was able to aggregate large numbers of farmers to participate in their aggregation program as described in Appendix C. The CCX's protocols credit farmers using practice-based, regional rates rather than actual measured amounts of carbon sequestered by each project. So long as the farmer is verified to have implemented a specific practice, the rate at which that practice is credited with offsets is guaranteed. In this case, neither the aggregator nor the participant is exposed to project performance risk. So long as the standardized crediting rates are conservative, protocols that eliminate performance risk can produce real, high quality offsets that reduce the risk for all involved, and increase overall participation in carbon markets. However, some market observers have pointed this approach may be difficult to implement in a compliance-based offsets program.

Protocols may be able to adopt a tiered approach to GHG quantification that incorporates the advantages of aggregation. Standardized crediting rates are unlikely to accurately reflect the GHG reductions of one individual project. Stand-alone or small groups of projects require more detailed on-site monitoring and/or modeling and verification. As the size of an aggregation program grows, however, standardized crediting rates are more likely to reflect the overall reductions associated with an aggregation program, because there is a much larger sample size of projects. To account for this, an offset protocol could be designed to require different methods of quantification for different program scales, with small programs or stand-alone projects requiring more site-specific data and larger aggregation programs relying more heavily upon standardized crediting rates.

C. Lesson #3 - Successful aggregation models build upon existing relationships

Aggregators with existing working relationships with potential participants in an aggregation program can rapidly build large aggregation programs. For example, before entering the carbon

[23] *Ensuring Offset Quality.* Offset Quality Initiative. Portland, OR: July 2008. Page 6.

market, Sadia, the Brazilian food company described in Appendix B, already supplied pigs, food, medicine, medical care, transportation, and technical support to more than 3,500 swine producers in Brazil. Financing waste digesters for the producers through carbon markets was a logical additional service Sadia could provide its existing clients. Given these relationships, Sadia built 1,100 swine digesters in 7 years, 44 times the number currently operating in the United States.

The same is true for the NDFU soil carbon aggregation described in Appendix C. NDFU's aggregation program worked through existing state and national farmers unions. Farmers were encouraged to enroll by their local farmers union, with whom they already had existing and trusted relationships. A representative of NDFU mentioned that many farmers considered unknown brokers from New York or San Francisco to be "snake-oil" salesmen. Because farmers trusted their local farmers union, NDFU enrolled 3,900 producers with 5.5 million acres into its CCX soil carbon program over a four-year period.

D. Lesson #4 - Aggregation can make it possible to use new, innovative methods to quantify offsets and assess additionality

Aggregation can change the way protocols are designed to quantify emission reductions and assess additionality. These new methods may be more accurate and cost-effective. Offset methodology developers and standards organizations may want to consider designing offset quantification methods, and approaches to assess additionality, with aggregation prominently in mind, rather than simply treating aggregation as a potential addendum to an offsets accounting protocol primarily designed to be used for stand-alone offset projects.

As discussed in section one of this report, aggregation can help to increase the accuracy of biogeochemical process models if they are used, and so may enable protocols to use these models where appropriate to estimate and validate GHG emissions reductions.

Aggregation also can play an important role in reducing the cost and time to estimate project emissions reductions and to conduct project validation and verification. Aggregations can make it possible to use statistical sampling techniques rather than direct quantification methods to calculated emissions reductions. This can reduce transaction costs while guaranteeing achievement of environmental integrity.

Similarly, aggregation allows for new techniques to be used to determine additionality. Some advocates for increasing offset supplies have suggested using *proportional additionality* to maximize the number of sectors allowed to participate in the carbon market. Proportional additionality discounts the amount of offset credits that can be issued to an offset project according to the general level of penetration of the practice in the marketplace. If 15% of farmers currently use conservation tillage, for example, proportional additionality would deem all conservation tillage additional, but would discount the amount of offsets credited to each project by 15%. However, to accurately represent the portion of additional and non-additional projects, proportional additionality based on regional common practice rates requires *full participation* of a sector in a region.[24] Aggregation potentially could enable this, and therefore enable protocols to use proportional additionality.

[24] The full report includes a more comprehensive discussion of proportional additionality and discusses how it has been implemented in the Alberta Offset System. For a discussion of why proportional

V. Next Steps

Based on this evaluation of existing offset aggregation approaches and programs, two next steps could be taken to broaden the deployment of aggregation and increase the future supply of cost-effective offset credits.

First, it would be helpful if the main offsets standard-setting organizations (in today's voluntary and pre-regulatory markets) and government regulators (in evolving regulatory markets) would craft clear rules and guidelines specifically for aggregating offset projects, similar to the way the CDM created a separate set of rules and procedures designed specifically for use by PoAs. This new set of aggregation rules ideally would address the following key issues:

- **Temporal dispersion –** What is the crediting period for an aggregation program? Does it require developers to define the number of individual projects that will join an aggregation pool before registering the program? Does it allow aggregators to add projects over a long period of time? What steps must aggregators take to add a new project to their program?

- **Geographical dispersion –** What limits will be placed on the ability of aggregators to include projects that are geographically dispersed? Do certain project types need to be aggregated with other projects from similar regions, forest types, or soil classifications, etc?

- **Additionality –** Does each individual project in an aggregation program need to demonstrate additionality, or can the program as a whole establish itself as additional?

- **Risk allocation –** Are procedures designed to minimize risk exposure to landowners and assign it to aggregators with experience navigating the carbon market?

- **Modeling and quantification –** How do aggregation rules reward the increased accuracy that results from modeling emission reductions of a larger sample of projects where modeling or statistical sampling techniques may be used to quantify offsets? Can special standardized crediting rates be allowed for aggregated projects, particularly if regionally-specific, empirical crediting rates have been developed?

- **Sampling –** How can statistically valid sampling procedures be integrated into project monitoring and verification?

- **Enforcement –** What recourse is available to an offsets registry or regulatory body if offset credits are found to have been incorrectly or fraudulently monitored, verified, or registered? Who is liable for errors? How can this liability be shared among program participants?

As a result of the development of a standard set of aggregation rules *upfront* – and separate from individual project protocols – project developers would be able to anticipate how future aggregation systems in sectors currently without protocols may be structured. A separate aggregation system also would force standard-setting organizations to identify and work through aggregation-specific issues, rather than adding aggregation procedures to project-specific methodologies as addendums. Aggregation merits this specialized attention given the importance of scaling up offset supplies and the impact of offset funding, while ensuring – and perhaps even enhancing – the environmental integrity of the resulting offset credits.

---

additionality requires full participation of a sector, see Climate Action Reserve. "Options for Determining the Additionality of Agricultural Projects." September 2010.

Second, it may make sense for state or federal regulatory agencies to consider testing the regional offset aggregation approaches described in section III.G. through pilot programs implemented in different regions of the United States. Agriculture is a good sector to test these approaches because state and federal agencies can leverage their existing experience implementing conservation programs targeting agriculture, agricultural offset protocols are still evolving, and it is difficult to address permanence, leakage, additionality, and offset quantification at the project level for agricultural offset projects.

These two recommendations – one focused on developing programmatic rules for grouping projects, and the other focused on testing a new regional offsets framework in agriculture – could help to realize potential large-scale, distributed mitigation opportunities in agriculture and forestry in the U.S. and household-scale projects in Least Development Countries, and unlock a large and liquid supply of offsets for use in evolving carbon markets.

Appendix A: Cool NRG Cuidamos CFL PoA[25]

Aggregator:	Cool nrg is the Coordinating Entity of the PoA.
Project Description:	Cool nrg exchanges old incandescent bulbs for free compact fluorescents (CFLs). The PoA aims to distribute 30 million CFLs throughout Mexico. The first CPA in the state of Puebla distributed one million CFLs in November 2009. Over the next ten years, these efficient light bulbs will reduce 240,000 tCO_2e emissions. The project was financed, in part, through a large upfront purchase of CERs from Eneco Energy, a utility in the Netherlands. Cool nrg used a small-scale CDM protocol (AMS-II.C), rather than the less-standardized protocol for large-scale CFL projects (AM0046). To qualify as small-scale, CDM efficiency projects must reduce less than 60 gigawatt hours (GWh) of electricity consumption in a year. While Cool nrg's PoA will reduce much more, each CPA will reduce less than 60 GWh.
Start date:	July 2009
Current status:	A regional project under the PoA in the state of Puebla has distributed one million CFLs. First verification is complete, but not yet approved under the CDM. Four other CPAs are in the process of being included. In addition, the Mexican government recently announced plans to buy up to 45 million CFLs that will be distributed by Cool nrg under its PoA. In return, the Mexican government will receive royalties from Cool nrg as it sells the resulting CERs.
Key lessons:	**Simplified methodologies that incorporate streamlined monitoring and standardized crediting rates are helpful to aggregate distributed projects.** Cool nrg developed a PoA rather than a large stand-alone project to enable it to use small-scale protocols in an aggregated manner. Complex methodologies with stringent sampling requirements cannot be cost-effectively implemented on a large scale when individual projects are geographically distributed. **Streamlined inclusion of CPAs within a PoA makes offset revenues bankable.** Cool nrg was able to find banks and buyers to assume registration and delivery risk of its first CPA to finance a project whose sole revenue stream is offset credit sales. By reducing the risk that the registration of future CPAs will be denied or delayed, the creation of the PoA makes it easier to borrow money against the delivery of future credit sales.

[25] The information presented in the case studies shown in these appendixes was developed to prepare the EPRI report *Aggregation of Greenhouse Gas Emissions Offsets: Benefits, Existing Methods and Key Challenges.* EPRI, Palo Alto, CA: October 2011. 1022180. The information associated with these case studies may have changed since publication of this report and may no longer be current. .

Appendix B: Sadia Brazilian Swine Digester PoA

Aggregator:	Sadia Sustainability Institute's Program for Sustainable Swine Production, a non-profit arm of Brazil's largest exporter of meats.
Project Description:	Sadia financed, installed and maintains over 1,000 digesters at swine farms throughout Brazil. The United States, for comparison has 25 swine digesters. Sadia, as the aggregator, arranged for the financing to build these projects from the Brazilian Development Bank. Debt is serviced through the sale of carbon credits. Sadia automated the monitoring required to generate these credits, and commercializes the credits, sharing any additional revenue with the producers. Sadia's technicians maintain the digesters at each farm.
Start date:	The program began in 2004 but was not registered with the CDM until October 2009.
Current status:	1,050 CPAs anticipated to reduce more than 1 million tCO_2e per year have been included in the PoA. This was the first PoA to successfully include new CPAs. No offsets have been verified.
Key lessons:	**Producers have no direct interaction with the carbon market.** Sadia manages the financing, monitoring, verification, and commercialization of offsets. To participate in the program, producers simply operate their digester, which is paid for by offset sales. This is common among successful aggregated programs where the individual projects experience small reductions. Because offsets are worth little to each individual, aggregators must minimize the risk, paperwork, and cost that individual must face to participate in a program. The aggregator instead must assume this risk and cost. **Top-down structure, using "cookie-cutter" technology and monitoring equipment, enabled success.** The top-down processes for identifying its thousands of partner farms already established by Sadia reduced the opportunity for errors, and enabled DNV to accept the liability associated with including new CPAs. This pre-established infrastructure integrated with the monitoring needed to generate carbon credits. **Large-scale participation of the producers was enabled by Sadia's existing relationships with producers**. Sadia's technicians already interact on the ground with producers. Offset credit aggregation is simply another service offered by Sadia to its existing clients.

Appendix C: North Dakota Famers Union CCX Soil Carbon

Aggregator:	North Dakota Farmers Union (NDFU). Given strong response to the program, NDFU began operating the aggregation program for the entire country for the National Farmers Union.
Project Description:	Between 2006 and 2010, the NDFU aggregated 5.5 million acres from 3,900 producers that implemented conservation tillage, converted cropland to grassland, or instituted a grazing management plan. The average participant owned 1,400 acres and generated 700 tCO_2e reductions per year. Landowners enrolled themselves in the program through NDFU's website; no site visit or monitoring was needed because a regional, standard crediting rate was used.
Start date:	In October 2006, NDFU began aggregating projects in North Dakota. They expanded nationally in May 2007.
Current status:	NDFU ended the program and released all farmers from their contracts in 2010 due to low CCX prices. In February 2010, trading on the CCX ended and the market officially closed in November 2010. NDFU was left with six million unsold offsets.
Key lessons:	**The standardized assumptions for permanence, additionality, and practice-based crediting in the CCX protocols enabled large-scale participation in NDFU's program.** Landowners are credited at set rates in exchange for implementing practices rather than for measured performance**.** These assumptions reduced risks to aggregators and landowners alike. This allowed NDFU to quickly bring many dispersed landowners into their program. **Many agricultural producers in the United States lease land on short-term contracts. Long-term commitments to ensure permanence are not possible for these tenants.** Program participation would likely be much lower, especially by farmers that lease their land, if the CCX protocols required participating farmers to demonstrate 100 years of permanence, rather than a five-year permanence threshold, and to implement sophisticated monitoring. **Producers had a long history of working with their local farmers unions and trusted the services they provide**. Many of the producers enrolled in NDFU's program were approached by other aggregators, but doubted the credibility of start-up carbon market companies.

Appendix D: Ducks Unlimited Avoided Grassland Conversion

Aggregator:	Ducks Unlimited (DU). Financing was provided by DU and the Eco Products Fund (jointly managed by New Forests and Equator). Landowners entered easements with the US Fish and Wildlife Service, who also aided in project recruitment.
Project Description:	DU used offset funding to enroll more than 100 landowners and 50,000 acres into the pilot program between 2008 and 2010 in which landowners enter into a permanent conservation easement with the US Fish and Wildlife Service that prohibits the conversion of their grassland into cropland. The participating landowners were insulated from additionality tests and price fluctuations in the carbon market, since they received an upfront payment that was not dependent on offset delivery. Ducks Unlimited assumes this delivery risk. In additional, there is no protocol for avoided grassland conversion projects – though two are under development with the VCS – so DU assumes this risk as well.
Start date:	April 2008
Current status:	According to DU's bio-economic modeling, only 13,000 acres of the 50,000 enrolled acres are additional, and therefore eligible to generate offsets. These 13,000 acres are expected to deliver 384,000 tCO_2e over 10 years. DU currently is not enrolling new landowners. Expansion of the pilot depends upon validation of the protocol under the VCS.
Key lessons:	**Aggregators can turn *practice-based* payments into *performance-based* credits**. DU eliminated their participants' project performance risk by paying participants to implement specific practices proven to reduce GHG emissions at practice-based rates (i.e, any landowner that enters into an easement is paid a set rate, rather than a rate based on the actual amount of carbon sequestered). DU plans to assess additionality and the performance of each of the projects – and sell offsets in the market – based on the actual emission reductions achieved by the projects. By assuming performance risk, DU ensured participation in their program, while performance-based crediting maintains the environmental integrity of the offsets they sell in the market. **Stand-alone avoided grassland conversion projects do not make sense from a landowner or market perspective.** For the majority of landowners, the scale of offsets available is insufficient to justify the upfront and ongoing costs and risks associated with developing a project. Based on the distribution of acreages enrolled by landowners in the program, most would not earn much more than the upfront costs associated with validating the stand-alone project under a certification standard.

Appendix E: AgCert CDM Digester Bundling

Aggregator:	AgCert
Project Description:	AgCert worked with pig farms in Latin America to install manure digesters that capture and destroy methane by combusting it in a flare or an electric generator. AgCert developed a large-scale methodology (AM00016) that was accepted by the CDM in 2004 and used to bundle project activities. Because the program took place before the CDM's PoA, AgCert bundled its projects. Bundled projects are submitted to CDM in a group, but share a crediting period and a project design document.
Start date:	October 2004
Current status:	AgCert bundled 816 sites and registered 92 projects in Brazil and Mexico with the CDM between 2004 and 2008. Forty projects with 599 sites were registered under AM0016, while 52 projects with 217 sites were registered using the small-scale protocol. AgCert's portfolio of bundled projects will produce approximately 3.5 million metric tons of carbon dioxide emission reductions per year. The company faced extreme financial hardship was placed into "examinership" (the Irish equivalent of bankruptcy) in February 2008. AES, a large shareholder in the company, purchased AgCert in May 2008. AgCert stopped registering CDM projects after April 2008.
Key lessons:	**Business models based on aggregating a single offset project type may face particularly high risk due to unanticipated changes to policies, regulations, methodologies, or technologies in that sector.** Revisions and consolidation by the CDM of the offset methodologies used by developers of agricultural waste digester projects caused problems for developers of these projects. Because AgCert's entire project pipeline depended upon these methodologies, delays in the methodology and changes to its sampling requirements made it difficult for AgCert to fulfill its commitments to deliver credits. **It is crucial for standards-setting organizations or regulators to provide aggregators with methodological certainty.** The CDM's decided to retroactively disallow sampling verification procedures resulted in significant operational costs increases to approximately 25 projects AgCert successfully registered based on sampling. Additionally, the decision to consolidate similar animal waste methane destruction protocols had a negative impact on AgCert's business model, as it resulted in reduced crediting.