Duke
NICHOLAS INSTITUTE
FOR ENVIRONMENTAL POLICY SOLUTIONS

Working Paper
NI WP 16-09

September 2016

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A Review of the Use of Early-Action Incentives in U.S. Environmental Markets

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Citation
Galik, Christopher S., and Lydia P. Olander. 2016. "A Review of the Use of Early-Action Incentives in U.S. Environmental Markets." NI WP 16-09. Durham, NC: Duke University. http://nicholasinstitute.duke.edu/publications.

SUMMARY

Early action can refer to activities undertaken prior to a regulatory program or the generation of a particular service before its use to mitigate an impact elsewhere. In U.S. environmental markets, early action can result in multiple benefits. One benefit is facilitation of market function by helping to generate a sufficient supply of viable, low-cost credits to buyers and gain momentum in new markets. Another benefit is providing advance mitigation, which can speed the delivery of ecosystem services. As markets emerge and mature, early action can help reduce lags in environmental performance, improve outcomes, and encourage innovation in mitigation approaches.

Multiple tools have been proposed for encouraging early action in ecosystem services markets. To varying extents, these tools have also been deployed, providing valuable experience and insight into their functioning. This paper presents several case studies of how these tools have been used in wetland and stream mitigation, species and habitat banking, greenhouse gas emissions reduction and sequestration, and water quality trading. It finds that early action incentives necessary to motivate sellers differ from those necessary to motivate buyers and that interventions should account for this reality. The tool or approach best suited to encourage early action may also vary as conditions change and new barriers arise. Anecdotal evidence suggests the potential for benefits to accrue from early action, but additional data on the costs and benefits of early action are needed to inform the selection and implementation of specific tools.

WHAT IS EARLY ACTION?

Early action can mean different things, depending on the particular context in which it is used. In some situations, early action refers to activities undertaken prior to implementation of a particular regulatory program, for example, prior to set compliance periods under greenhouse gas (GHG) reduction regimes (IISD 2002; DiMascio 2007; Kelly and Bianco 2009) or prior to implementation of total maximum daily load (TMDL) requirements to improve water quality (Willamette Partnership et al. 2015). In other situations, early action refers simply to the generation of a particular ecosystem or environmental outcome through protection, restoration, or both prior to the need to mitigate an impact elsewhere (e.g., Hahn and Noll 1990; Woodward 2003; USFWS 2011; The White House 2015).

This paper discusses both types of early action as well as the policies and incentives used to facilitate early action in practice. It describes the policy tools to encourage early action, and it reviews those that have been used in four markets: wetland and stream mitigation, species and habitat conservation, GHG reduction and carbon sequestration, and water quality trading. It concludes with a brief review of the lessons provided by this implementation experience and recommendations for future research.[1]

Purposes of Early Action: Claims of Benefits and Concerns

In the specific case of U.S. environmental markets, early action can result in two distinct benefits. The first is market function. Early action can help to generate sufficient credit supply to provide a viable, low-cost option to buyers and to help new markets gain momentum. The second benefit is facilitation of advance mitigation. As markets emerge and mature, early action can increase environmental and other benefits by producing benefits before impacts occur, resulting in accumulated early benefits (more carbon stored earlier) or reduced lags in outcomes (wetland functions partially restored before others are impacted).

Much of the literature on early action policies and incentives focuses on the theoretical potential to achieve these claimed market and environmental benefits. The literature also addresses areas of concern and critical policy design choices that could limit the effectiveness of early action programs. To assess whether early action mechanisms have performed as desired, this paper reviews their recent use in more established environmental markets in the United States. In new or emerging markets, the lack of implementation experience necessitates greater reliance on the published literature for insight into potential effect.

As argued by Landry et al. (2005, 20), "one of the major impediments to the success of trading programs is the lack of supply of and demand for mitigation offsets, or 'thin' markets." A thin market is "a market with few buying or selling offers" and one "characterized by low trading volume, high volatility and high bid-ask spreads" (Rostek and Weretka 2008). Thin markets may lead to higher transaction costs and price volatility (Adjemian et al. 2016; Herberling and Nietch 2015). Thin markets can also reduce transparency and make it difficult for small parties and outside entities to know the true prices being paid, thus complicating their efforts to fairly participate in or adequately support market activity (Adjemian et al. 2016).

[1] Importantly, this paper does not review the broader economic literature on transaction costs (e.g., Coggin 2015; McCann et al. 2005; Antle et al. 2003), the influence of risk aversion or price certainty on program outcome (e.g., Murray et al. 2009; Baldursson et al. 2004), or the influence of different assumptions about policy changes on preferred policy design (e.g., Pizer and Prest 2016). Instead, it focuses on the general mechanism used in each early action tool and the observed outcomes in existing markets. But, as one reviewer points out, further evaluation of early action in the context of theoretical constructs present in the economics literature could allow for both greater generalizability beyond what is possible here and allow for greater prediction of expected effects.

Early action mechanisms are often designed to address thin markets. External market support can help to reduce investor risk and thus encourage participation (Moura Costa 2010). By fostering a more favorable trading environment and seeding emerging markets, early action policies and incentives may also provide important learning opportunities for market participants and help to improve long-term business decision making while reducing economic risks (IISD 2002; Streck et al. 2010). If properly designed, early action policies and incentives theoretically could reduce the long-term costs of program compliance (Parry and Toman 2000). If not designed properly, however, early action programs could give rise to activities that undercut market and environmental objectives (Kelly and Bianco 2009; Streck et al. 2010).

Early action policies and incentives can also speed the delivery of environmental services to market, contributing to early achievement of environmental objectives. Depending on the mechanism used to facilitate early action, early contributions could be retained for longer periods of time before being used to mitigate impacts elsewhere, resulting in further environmental uplift. Mitigaiton in advance of impacts may also reduce permitting time, further reducing costs (Institute for Water Resources 2015).[2]

Alternatively, poorly designed early action programs could undercut market or environmental objectives if they foster low-quality activities or fail to provide long-term assurances that a particular service will continue to be provided (e.g., Streck et al. 2010). Environmental objectives could also be undercut if early action policies and incentives serve only to award early adopters for activities that would have been provided regardless of the presence of a market (i.e., credits that are non-additional).

Tools to Facilitate Early Action

Multiple policy tools and incentives can be used to encourage or reduce barriers to early action (IISD 2002). Specifically reviewed are buyer banking, seller banking, purchase guarantees, advance sales, early action credits, phased-in or ratcheting baselines, and general financial, regulatory, and administrative incentives. Apart from having important functional differences, the tools vary in the market actors they affect (e.g., seller versus buyer) and the timing of effect (initial or short term versus long term or continuous). These differences translate into a variety of possible advantages, drawbacks, and distributional effects that, collectively, can influence the decision of when and where to deploy each tool for maximum benefit.

Buyer Banking

Buyer banking is defined here as authorization for a buyer of an environmental credit to hold that credit for use against future compliance obligations or for resale at a later date (e.g., Whitesell and Davis 2008). Buyer banking facilitates early action on a continuing or long-term basis by providing an incentive for buyers to invest ahead of anticipated needs, thus increasing planning flexibility and decreasing price and supply risk (Valderrama et al. 2013; Olander 2016). Buyer banking can be particularly helpful in nascent markets by creating demand for early (and presumably lower-cost) reductions, thus providing upward pressure on prices and encouraging increased supply (Whitesell and Davis 2008). A potential drawback to buyer banking is that allowing entities to purchase and hold credits can exacerbate speculative behavior and market manipulation, intensifying market power disparities and reinforcing price feedbacks and the possibility of market bubbles. The risk of these outcomes may necessitate limits on banking, as was the case in many early carbon markets. However, the decision to impose limits could also undermine incentives for early action (Whitesell and Davis 2008).

Seller Banking

Seller banking is defined here as authorization for a producer or seller of an environmental credit to offer that credit for sale at some date following generation of the credit. The most straightforward example of

[2] IISD (2002) also notes that the effects of early action policies and incentives can be different for those willing or able to participate in early action activities than for those unwilling or unable to participate, with non-participants facing potential disadvantages in later compliance periods.

seller banking is the establishment of physical banks, which produce tangible benefits for a particular resource (e.g., wetlands, species).[3] If deployed correctly, seller banking can help seed the available stock of credits and act as a price-hedging tool to maximize profitability over the long run—an important benefit because credits may be held for sale until conditions are most favorable. To encourage seller banking, there must be adequate demand from potential buyers who will need these credits; even if the demand is from the seller (for future self-mitigation, for example).

Purchase Guarantees

Purchase guarantees are defined here as formal contractual relationships that detail the fixed price that is to be paid by a buyer for some quantity supplied by a producer (Lowder et al. 2011). Purchase guarantees involve a reallocation and sharing of market risk (Olander et al. 2016). The costs of supplying the credit are borne by the producer; the buyer agrees to purchase what is delivered at a particular price, presumably up to some negotiated amount (Lowder et al. 2011). By providing contractual certainty, purchase guarantees provide both volume and price certainty to credit sellers, reducing barriers to early action.

One specific type of purchase guarantee is government purchase of an established volume of credits. This type of guarantee can support market development by providing certainty to sellers that their credits will be purchased regardless of the eventual market. If poorly designed, government purchases can also lead to abuse because potential sellers might pursue otherwise unprofitable actions if they believe that the government will purchase all unsold credits (Walker and Selman 2014). The potential for abuse can be tempered by ensuring that credits meet established standards (see, e.g., Valderrama et al. 2013).

Advance Sale of Credits

The advance sale of credits can provide financing for development of new offset projects (e.g., restoration or management). These projects could generate an early supply of credits and help jumpstart a new market. Advance sales are different from purchase guarantees in that purchase guarantees establish a contract for the sale of credits at some later date, usually upon completion of the activity that generates the credit. Advance sales allow for the sale of a credit before completion of the activity that generates the credit. Allowing advance sales against future credits can improve the financial viability of banks by providing an early influx of capital to support bank implementation and management, but it requires that significant financial and other assurances safeguard against future credit failure (Landry et al. 2005). Advance sales must also be compatible with the regulatory requirements governing the ultimate end use of any generated credits.[4]

Like advance credit sales, pre-program certification allows prospective sellers to seek pre-certification of their contributions and then to market them as "contingent." This approach allows sellers to gauge market conditions without actually having to invest in credit-generating activities, and it allows buyers to gauge potential supply (Walker and Selman 2014). To be effective in encouraging early action, both advance sale and pre-program certification approaches must be accompanied by demand-side pull.

Early Action Crediting

Early action credits are given in exchange for activities that are undertaken prior to the regulatory requirement to do so. As such, they are a formal recognition of the validity of early action as a compliance strategy. They provide certainty to credit sellers and help to support activities in the short run by clearly delineating the requirements for what is eligible or allowable to be used in future market transactions.

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[3] Other types of activities can also be considered a form of seller banking, such as the assembly of portfolios of credits by aggregators. When serving as a third-party intermediary, aggregation could also be considered a form of buyer banking, as well.

[4] For example, a reviewer notes that advance credits are unlikely to meet the regulatory requirements for issuance of an incidental take permit or authorization under the Endangered Species Act unless the bank is completed and approved prior to use of the credit.

Grandfathering

Another approach for providing regulatory certainty is "grandfathering," or the blanket allowance of a certain set of activities or of activities undertaken by a certain date. An important consideration in either approach is the ratio of the volume of early action credits and that expected under the compliance portion of the market. Environmental objectives can be impeded if the standards for early action credits are too lenient and the ratio of early action credits to regulated market credits is high (Marshall and Weinberg 2012).

Phased-In or Ratcheting Baselines

Phased-in or ratcheting baselines encourage early action by easing compliance obligations for early activities relative to later ones. Although effective in encouraging early action among some actors, the approach can put some potential sellers at a competitive disadvantage by virtue of either their current practice (average rather than above average) or their unique site conditions. As with any baseline determination, there is also the risk that a ratcheting baseline set too low at the outset could reward non-additional activities. The existence of these non-additional credits could reduce the incentive to bring other (additional) contributions on line, possibly affecting attainment of environmental objectives.

Other Financial, Regulatory, and Administrative Tools

Financial incentives or direct payments or other forms of support can be deployed to lower project or management costs (e.g., IISD 2002). These tools support buyers and sellers, foster both market function and advance mitigation objectives, and are deployable over both short- and long-term timeframes. These tools could include incentives such as loan guarantees, tax incentives and direct grants as well as other payment or cost-reduction mechanisms.

It is also possible to facilitate early action through regulatory provisions or administrative support. For example, the 2008 Final Rule on Compensatory Mitigation for Losses of Aquatic Resources established a mitigation preference hierarchy that increased incentives to deploy banks and in-lieu fee programs. The establishment of requirements to guide the development and trade of early action activities is also necessary to support market development and to promote advance mitigation. Standards and measurement protocols for early action activities are necessary to establish regulatory certainty for users. Such protocols could also help credits from early action activities survive regulatory or market scrutiny (IISD 2002). Multiple analyses also note the importance of a centralized infrastructure to support early activities and facilitate transactions (e.g., IISD 2002; Moura Costa 2010). Examples include a centralized trading registry, formalized reporting or auditing procedures, and staff or other resources to help guide early action activities and investment.

Summary of Available Policy Tools

As Table 1 shows, tools to facilitate early action vary by party (buyer or seller) and objective (market function or advance mitigation). They also vary by targeted portion of the market (demand or supply side) and their intended duration of effect (short-term startup mechanism or long-term market support). Tools to encourage early action may more directly affect one party to a transaction than the other, or they may affect both equally. Tools may also be better suited to address one objective than the other (e.g., market function versus advance mitigation), or they may affect both.

Table 1 also reviews the mechanism of effect for each tool. Supply-side effects are those that influence behavior by potential credit suppliers and, in doing so, help to support an increased volume of credits being brought to market. Conversely, demand-side effects are those that influence the willingness of potential buyers to acquire credits. Short-term policies are those that support early action for a limited or defined period of time, for example, initiation of a specific project or market. As the name implies, long-term or continuing policies can buoy early action or advanced mitigation indefinitely.

This analysis considers effects of early action policy on the particular market or resource for which it is targeted. However, early action policy in one market may influence the provision of services relevant to another market (e.g., wetland preservation could generate species habitat benefits). These interactions could have important implications for stacking or double counting (e.g., Cooley and Olander 2011) beyond the individual market effects summarized in Table 1.

Table 1. Summary of existing mechanisms to encourage early action

Tool	Target	Timing	Advantages					Disadvantages				
			Description	*Party/objective affected* [a]				*Description*	*Party/objective affected* [a]			
				B	*S*	*M*	*A*		*B*	*S*	*M*	*A*
Buyer banking	Demand-side	Long-term, continuing	Price stability	X	X	X		Encourages speculative behavior	X		X	
			Early-year price support	X	X	X		Potential mismatch in service timing			X	X
Seller banking	Supply-side	Long-term, continuing	Price hedging		X	X		Potential mismatch in service timing			X	X
			Supply certainty	X		X						
			Holds mitigation before use	X	X	X	X					
Purchase guarantees	Demand- and supply side	Short-term	Risk sharing	X	X	X	X	Could encourage poor quality credits if not properly designed	X		X	X
Advance sale of credits	Supply-side	Short-term, Long-term	Provides early influx of capital		X	X		Credits may not materialize		X	X	X
Early action credits	Supply-side	Short-term	Regulatory certainty	X	X	X		Could depress compliance credits		X	X	X
Grandfathering	Supply-side	Short-term	Regulatory certainty		X	X		Could depress compliance credits		X	X	X
Phased-in ratcheting baseline	Demand- and supply side	Short-term, Long-term	Eased compliance or production requirements	X	X	X		Could encourage poor quality or non-additional credits; potential inequitable treatment of early- and late-actors	X	X	X X	X
Financial and other incentives	Demand- and supply side	Short-term, Long-term	Can be efficiently targeted	X	X	X	X	Potential for unintended consequences and market distortion	X	X	X	X

[a] "B" = buyer; "S" = seller; "M" = market function; "A" = advance mitigation.

EARLY ACTION MECHANISMS IN PRACTICE: A CASE STUDY OF EXISTING MARKETS

To a varying extent, the early action tools described above have been deployed in environmental markets, lending valuable insight into how they function in the real world. This experience is reviewed below, citing examples from wetland and stream mitigation, species and habitat banking, GHG emissions reduction and sequestration, and water quality trading. For each market, both the tools and lessons from their implementation are discussed.

Wetland and Stream Mitigation

Pursuant to the Final Rule on Compensatory Mitigation for Losses of Aquatic Resources (2008), three mechanisms have been established for the mitigation of unavoidable impacts to wetlands and streams in the United States: permittee-responsible (or "self") mitigation, mitigation banking, and in-lieu fee mitigation. When available, the latter two are to be given preference over self-mitigation approaches. Banking and in-lieu fee (ILF) approaches are also most relevant to the early action considerations explored in this paper. Banks are a form of seller banking and implicitly provide advance mitigation. ILF programs may provide for advance sale of credits so long as sufficient assurances are provided to account for any residual risk that benefits would not accrue in the future.

In addition to the use of these banks and ILF programs as a mitigation approach for wetlands and streams, advance mitigation is receiving particular attention by the transportation sector as a general compliance strategy to lower costs and increase environmental benefits (e.g., Sciara et al. 2015). Though multiple resources can be affected, wetlands and streams are often the primary emphasis of advance mitigation efforts. In practice, these transportation-led advance mitigation initiatives often make use of mechanisms similar to banks or ILF programs, but they employ unique funding and implementation models.

Overview of Tools

Emphasis in wetland and stream mitigation is on two mechanisms: advance sale of credits, largely achieved through presales and ILF programs, and seller banking.[5] Both are given preference in regulation (33 CFR 332.3(b)) and have been extensively used. As is evident in the discussion below, the 2008 final rule strongly influenced activities in the wetland and stream mitigation arena. Although the entirety of mitigation research and practice is relevant to understanding the general performance of early action tools in a market setting, specific lessons vary as the market evolved in response to these regulatory developments.

Advance Sale of Credits

Advance sale of credits in wetland and stream mitigation takes many forms. Estimates made before major revisions to the compensatory mitigation regulations in 2008 suggested that 92% of established banks were releasing credits prior to all performance standards being met and 90%, before any performance standards were met (Bean et al. 2008; ELI 2002). The advance sale of credits is an important part of financing banking operations; absent marketing of credits ahead of full performance-standard compliance, fewer commercial banks were likely to be established (ELI 2002). However, given the documented low rates of standards being met at time of sale, there was a risk that this financial security came at the risk of environmental performance (though limitations on the use of advance credits were later established by the 2008 Final Rule).

Advance payment for mitigation is also achievable through ILF programs active in many states—45 as of the end of 2014—many of which are small in scale and targeted to a specific watershed or region (Institute for Water Resources 2015). When realized mitigation is not available at the time of impact, many ILF programs allow for the impact to occur so long as the promised resource benefits are achieved

[5] A reviewer notes that anecdotal evidence may also exist for the use of purchase guarantees, but these tools are not tracked by the U.S. EPA or the Army Corps of Engineers.

within a short time period (e.g., three or fewer growing seasons as in the case of Vermont and Virginia as noted by ELI 2013). This flexibility can help ILF program managers obtain additional financial resources to implement mitigation. It also allows aggregation of many small impacts into a larger offset or mitigation project. Although acknowledging the potential of ILF programs, pre-and post-final rule analysis by the Environmental Law Institute identified concerns with existing programs, in particular with managers' ability to identify specific compensation ratios, to address time lags between impact and mitigation, to align public and private objectives, and to incorporate a watershed planning approach in program implementation (Wilkinson 2009; Wilkinson, Thomas, and Thompson 2006).

Advance wetland and stream mitigation is receiving increased interest from the transportation sector. Anecdotal cost savings have been reported from programs in Oregon ($72 million due to planning efficiencies), Michigan (a cost reduction from $75,000–$150,000 to $25,000–$35,000 per acre due to adoption of standards and statewide wetland mapping initiatives), and Washington (30%–80% cost savings due to centralized mitigation and economies of scale accompanying restoration of a single large site) (Sciara et al. 2015). One program that is often cited as an innovative example of advance mitigation is the North Carolina Ecosystem Enhancement Program (EEP) (renamed the Division of Mitigation Services in 2015). In that program, bids are accepted for credits in areas where future mitigation needs are anticipated. By establishing a set demand for credits, the program encourages private supplier competition to provide high-quality credits on a set schedule and at the lowest possible price, thus helping to address many problems traditionally associated with a thin market (Landry et al. 2005). The program also allows mitigation to be established before it is actually needed to compensate for loss elsewhere, resulting in additional environmental benefits.

Similarly, state Department of Transportation-affiliated programs in California, Florida, and Washington State have sought to facilitate advance mitigation. The programs' scope of mitigation planning efforts, funding mechanisms, and implementation experience vary. In particular, Caltrans experience has been characterized as "ad-hoc" and "opportunistic" and as achieving "uneven success" (Sciara et al. 2015, 5). Experience in California also points to the advantages of other planning processes (e.g., habitat conservation plans) in facilitating advance mitigation, largely by allowing costs to be spread among multiple projects in a planning area and by avoiding project-by-project planning.

Seller Banking

One of the primary examples of early action in wetland and stream mitigation is advance mitigation through seller banking, allowing for functional credits to come on line before they are used to offset impacts elsewhere (Landry et al. 2005). As of 2014, approved banks were spread throughout the United States, but the majority are found in the Midwest, Mid-Atlantic, and Southeast (Institute for Water Resources 2015).

Previous analyses have attempted to understand the factors impeding bank development. These reports point to problems integrating state and federal agencies and laws, the time-consuming nature of bank approval, land value, and uncertainty regarding the governance of established banks (ELI 2002; Landry et al. 2005). Before release of the final rule on compensatory mitigation, uncertainty was noted as a primary supply- and demand-side barrier in wetland credit trading (Landry et al. 2005). Reports from that time also cited public perception, a lack of political support for bank use, and a limited service area for which to supply credits (ELI 2002; Landry et al. 2005). More recent analysis suggests that banks need to be supported by predictable wetland and stream impacts in areas where regulators will go beyond avoidance and minimization to require mitigation (Hook and Shadle 2013). Specifically, banks need development to be concentrated enough so as to generate sufficient demand within service area requirements while avoiding areas where ILF programs or permittee-responsible mitigation options could undercut sales. Regulatory uncertainty, particularly the timing and extent of both credit supply and demand, is another potential barrier to the establishment and operation of mitigation banks (Hook and Shadle 2013).

Financial assurance mechanisms are also required as part of the 2008 final rule. These mechanisms, including performance bonds, escrow accounts, letters of credit, irrevocable trusts, and casualty insurance, are largely intended to ensure that banks remained financially viable and capable of satisfying long-term environmental objectives. Although these mechanisms may have enabled early action by virtue of enhancing the financial security of banks, they were not necessarily designed to directly facilitate early action (Landry et al. 2005; Olander 2016).

Summary of Early Action Experience

Banks and ILF programs have been deployed in large numbers, primarily driven by the 2008 final rule on compensatory mitigation. They provide significant opportunity for advance mitigation through seller banking. Early credit sales (presales) are likewise an important tool, helping to provide upfront resources to support mitigation efforts for both banks and ILF programs. An important consideration in the use of ILF programs continues to be the potential for time lags between credit sales and the subsequent deployment of resources for preservation or restoration work. Owing to the size of impact, the availability of resources, and the long-term planning timelines under which they operate, transportation initiatives play a unique role in advance mitigation, particularly as it pertains to wetlands and streams. These initiatives often make use of banking or ILF program mechanisms, but they invest more in upfront planning and coordination with regulators.

Species and Habitat Conservation

Species and habitat conservation trading includes both traditional conservation banks and more recent recovery credit trading, habitat exchanges, and pre-listing conservation crediting approaches.[6] Conservation banks have a substantial history of both policy development and implementation, and accordingly tend to dominate the available literature. Other market-based species conservation tools have received greater attention in recent years, though they largely remain in planning or development stages. Nonetheless, a few case studies provide insight into the potential to foster early action in future instances.

Seller Banking

Conservation baking is the most common form of seller banking used in species and habitat trading. As of June 15, 2016, RIBITS publicly listed 156 conservation banks, the majority of which are in California.[7] Several approved banks are also in Texas and Florida, and to a lesser extent in Utah, Oklahoma, Oregon, Washington, and other states. In 2005, Fox and Nino-Murcia (2005) reported that a majority of conservation banks active at that time preserved habitat but that only 2 of the 32 banks surveyed were restoring or creating new habitat. Notable exceptions were projects such as International Paper's bank for the red cockaded woodpecker and Utah's School and Institutional Trust Lands Administration bank for prairie dogs, both of which required evidence of species improvement prior to the release of credits (Bean, Kihslinger, and Wilkinson 2008). As discussed below, this early emphasis on preservation may be shifting in some aspects of bank and credit implementation.

The decision to implement a conservation bank is complicated and is dependent on real estate market conditions, species needs, and preservation or restoration opportunities. Previous analyses of conservation banks have noted the importance of sufficient demand-side support in fostering conservation banks. Fox and Nino-Murcia (2005) specifically cite high demand stemming from regulatory stringency and enforcement in California as well as the high prices paid for qualified credits, in supporting the

[6] A reviewer also notes the use of ILF programs in species habitat conservation. Though these programs go by a variety of names and are not centrally tracked by the U.S. Fish and Wildlife Service, they can be expected to share many of the strengths and weaknesses characteristic of ILF programs used in stream and wetland mitigation, reviewed above.

[7] The U.S. Army Corps of Engineers, with support from other federal agencies, created and maintains a web-based tool called the Regulatory In lieu fee and Bank Information Tracking System, or RIBITS (https://ribits.usace.army.mil/). RIBITS allows users to access information on banks and ILF sites nationwide and at multiple stages of the approval process. Reviewers note, however, that additional banks may be under development but not visible to the public through the portal.

development of banks in that state. Banking may also be encouraged directly or indirectly through other regulatory processes under the Endangered Speciaes Act (ESA). For example, mitigation required as part of activities under an approved habitat conservation plan (HCP) may be accomplished by the purchase of credits from outside conservation banks (Baldino, Olander, and Galik 2016). Alternatively, banks may be established by communities to facilitate private landowner mitigation (e.g., the gopher tortoise in Mobile County, Alabama).

Variations on banking are habitat credits and affiliated habitat exchanges. Habitat credits are earned by preserving or restoring habitat for at-risk species. The Western Association of Fish and Wildlife Agencies' (WAFWA) range-wide plan for the lesser prairie-chicken, for example, weights credits by quality, providing an incentive for proactive management (Van Pelt et al. 2013). Payments for restoration activities occur only after activities are undertaken; payments for maintenance practices are on an annual basis. According to WAFWA's first year annual report, contracts for approximately 96,000 acres have been issued (WAFWA 2015). A vast majority of offsets have been for conservation activities (i.e., preservation of existing habitat), though credit issuance for restoration on approximately 8,300 acres is expected soon (Van Pelt et al. 2016; WAFWA 2015). Unavoidable impacts have also been tallied, resulting in more than $42 million in fees paid into a fund to help support conservation plan implementation (WAFWA 2015).

The example of habitat crediting also introduces aspects of early action crediting, in that it has been applied to unlisted species as a possible pre-compliance strategy. A blurred boundary between early action crediting and seller banking is also noticeable in the draft Policy Regarding Voluntary Prelisting Conservation Actions (2014). Though still a draft as of the date of this analysis, the prelisting policy would define the terms for generating credits for conservation actions taken in advance of a species listing. These credits could be held and later used to mitigate for an individual's own post-listing impact or traded to another user. Reliance on state frameworks to oversee the creation and operation of these markets may limit the reach of any eventual market. Research also suggests that linking the value of the credit to an eventual listing decision may further limit the number of species likely to benefit from any such conservation efforts as well as the incentives to undertake conservation activities well in advance of a listing decision (Galik and McAdams under review).

Recovery credits are conceptually similar to conservation banks and private-to-private stakeholder habitat credit trades. The key difference is that recovery credits involve trades between federal and non-federal entities and that they provide for a net conservation benefit to the species of concern. Under the recovery credit system, a federal agency contracts with a non-federal entity to help mitigate for temporary or permanent impacts to species habitat. Regardless of the duration of the credit, conservation benefits must be achieved prior to any credit being used to mitigate for impacts (Draft Recovery Crediting Guidance 2007). Recovery crediting has been applied at the Fort Hood Military Reservation in Texas, where it has resulted in net habitat acreage benefits in a manner that is efficient and conducive to landowner participation. The net species benefit of the Fort Hood program remains unclear, largely due to the absence of clear criteria and monitoring data (Wolfe et al. 2012). Analysis also suggests that recovery crediting could be more expensive than other compliance mechanisms available to the military (Canes and Rohr 2008).

Summary of Early Action Experience

Seller banking is the predominant mechanism employed in species and habitat trading, but early action crediting mechanisms are being developed to expand to at-risk (but not yet listed) species. Traditional conservation banks remain a complex undertaking and are not evenly distributed geographically. A strong regulatory driver has traditionally been associated with advance mitigation efforts, but market-based

efforts must also compete with other, traditional regulatory means of compliance.[8] Development of regional recovery credit or habitat credit trading platforms is expanding conservation and mitigation options. Because these approaches are relatively new, little is known about their long-term conservation or economic effectiveness.

GHG Reduction and Carbon Sequestration

The benefits of early action policies in a GHG regulatory context include improved market integration and price stability (Kelly and Bianco 2009). The prospect of emerging state, national, and global GHG reduction initiatives in recent years prompted a great deal of discussion of the role that early action can play in seeding early compliance markets and achieving reductions ahead of regulatory targets. The discussion of early action tools below is drawn from the literature, policy initiatives at multiple levels of government, and compliance and voluntary offset markets. This last category—offset markets—is arguably the source of the most extensive implementation experience with market-based mechanisms for reducing GHG emissions and increasing GHG sequestration. Most of the examples reviewed below are drawn from these markets.

Buyer Banking

Buyer banking of GHG credits is allowable under California's AB32, though individual entities are bound by holding limits that cap the amount of allowances that may be banked. As of April 2015, holding accounts had approximately 14 million credits, which can be traded or banked for future compliance needs (Dahan et al. 2015). But as Whitesell and Davis (2008) recall, banking in the context of the sulfer dioxide (SO_2) trading program contributed to dramatic near-term price swings in response to changes in long-term policy expectations, raising the possibility of a similar phenomenon in the case of GHG markets.

Seller Banking

An inherent quality of offsets is that the GHG benefit must be realized and credits must be verified before they can be marketed. In this way, offsets are a form of seller banking, with the tons held for sale (either by the producer or by an intermediary) until market conditions are favorable or until a buyer is found. This flexibility is particularly advantageous in early voluntary and compliance markets, as sellers await better terms in what is currently viewed as a buyer's market characterized by low prices (Hamrick and Goldstein 2015). At the same time, recent market data suggest that the share of pre-issuance investment, which includes forward purchasing—a form of purchase guarantee—is declining (Hamrick and Goldstein 2015). This trend implies that an increased share of buyers are looking for registered tons—credits that have already been produced and banked by a seller.

Early Action Credits

As Hamrick and Goldstein (2015) note, "[p]re-compliance, in particular, incentivizes buyers and thus suppliers to seek market advantages by acting ahead of regulations – and quickly" (35). Much of the discussion on early action under a GHG regulatory regime has focused on how to award early action so as to maximize market and environmental benefit. In the specific context of encouraging early action from potentially regulated sources, for example, Kelly and Bianco (2009) discuss the tradeoffs between awarding credit for early action under or over an emissions cap, suggesting that crediting early action from under the cap is perhaps more effective at rewarding actors while otherwise maintaining GHG reductions.

Early action credits have received a great deal of attention in offset markets. Policy is an important driver of early action in this context. For example, Hamrick and Goldstein (2015) suggest that policy is "the

[8] In addition to the Section 7 consultation option suggested by Canes and Rohr (2008), other regulatory tools such as Safe Harbor Agreements and Candidate Conservation Agreements with Assurances provide measures of regulatory certainty in exchange for activities that may benefit listed or candidate species, respectively.

single most impactful determinant of market performance, driving or diminishing both supply and demand" (Hamrick and Goldstein 2015, 35). Indeed, as Congress considered comprehensive climate legislation in the late 2000s, the value of Chicago Climate Exchange (CCX) credits rose markedly, ostensibly as potentially regulated sectors increasingly looked to the market as a source of pre-compliance credits. Early action was likewise an important aspect of the early California market, particularly as the market (and its related projects) transitioned from voluntary- to compliance-grade credits. The push for pre-compliance credits in the California market was viewed as a particularly strong driver of improved forest management (IFM) offsets (Hamrick and Goldstein 2015).

Summary of Early Action Experience

Use of early action credits in GHG emissions reduction programs is increasingly reflected in the literature (e.g., DiMascio 2007; Parry and Toman 2000). What emerges from these analyses is both the specific terms necessary for policy makers to define (e.g., IISD 2002) and the interaction between early action credits and other mechanisms to facilitate early action. For example, Parry and Toman (2000) demonstrate the potential economic benefits of allowing early action credits under the Kyoto Protocol if entities are allowed to bank them for later use.

With specific regard to early action, offsets can achieve mitigation in advance of their use and retirement so long as permanence is maintained. Buyer banking is commonly used in contemporary GHG markets, as are early action credits. Use of these tools occurs against a backdrop of declining caps and shifting baselines that take into account regional conditions or previous management activities. Although these accounting approaches share some similarities with ratcheting baselines (upward pressure on prices and a shifting basis for calculation of net project benefits, respectively), the mechanism of effect is less direct than that of a targeted ratcheting baseline.

Recent data suggest that, in practice, investment patterns have generally shifted away from pre-project finance to purchase of issued credits (Hamrick and Goldstein 2015). Though this trend signals a maturation of the market, it also represents a reduction in resources for initiation of new projects. At the same time, policy uncertainty is factoring into supplier decisions to hold onto existing credits. This uncertainty is prompting some suppliers to develop so-called dual-use credits for potential sale in either voluntary or compliance markets (Hamrick and Goldstein 2015). It is difficult to say at this point what the effect of these changes will be, whether they will chill project development or whether they will increase advance mitigation as sellers hold onto generated credits for longer periods of time.

Water Quality Trading

Water quality markets primarily target pollutant or stormwater loads. Effluent trading markets have been in place for some time, but actual trades have been sparse (Woodward 2003). As recently as 2013, analysis suggested that "nearly all active trading programs…have been characterized by low trading volumes and voluntary over-compliance" (Suter et al. 2013, 36–7). Not surprisingly, the available literature often speaks to the difficulties encountered in water quality trading markets and to the challenges that these markets present for early action. Water quality markets are inherently thin due to the narrow watershed reach of many programs (Roberts et al. 2008; Heberling and Nietch 2015). The small number of potential buyers in some potential water quality trading markets fundamentally limits trading opportunities (e.g., Roberts et al. 2008). Experience in these markets could shed light on how early action tools can address these challenges and facilitate early credit production and purchase decisions.

Buyer Banking

Buyer banking has received a great deal of attention in both literature and practice. Indefinite banking of stormwater retention credits under Washington, D.C.'s stormwater reduction program is allowable, though no differentiation between buyer and seller banking is apparent in the program's authorizing

rules.[9] As of 2005, some form of buyer banking was also allowed in the Chesapeake Bay, Michigan, Virginia, and West Virginia. As of that same year, buyer banking was undetermined in some states (Colorado, Maryland, Pennsylvania, and Wisconsin) and expressly prohibited in others (Idaho and Oregon) (Morgan and Wolverton 2005).

In practice, research shows that banking may have unintended consequences. For example, Woodward (2003) notes that fewer net reductions would have been achieved in Dillon, Colorado, had banking of early reductions been a possibility. This is because regulated entities were already reducing pollution in the years leading up to the trading program. If regulated entities had been allowed to bank any of these reductions as early action credits, the incentive to achieve later (and much greater) reductions would have been reduced because entities could simply have tapped into their store of banked credits rather than engage in new non-point reduction partnerships.

Grandfathering

Grandfathering, another tool used in water quality trading programs, provides long-term certainty for sellers who undertake early reductions. As deployed in Maryland's water quality trading program, it permits certified credits to be valid for the life of a contract, regardless of whether TMDL or modeled loads change in the meantime (Walker and Selman 2014). If deployed correctly, grandfathering can both encourage early action and provide market certainty. Too lax a standard, however, can compromise water quality objectives by allowing a large number of under-performing activities (Willamette Partnership et al. 2015).

Purchase Guarantee: Government Purchase

Under Washington, D.C.'s, stormwater reduction program, stormwater retention credits (SRC) may be purchased directly by the district and retired, hastening both market maturation and stormwater reduction goals (Water Environment Federation 2014; DOEE 2016). In particular, the recently announced SRC Purchase Agreement Program is making available $11.5 million to purchase SRCs from nonprofit organizations, universities, and the private sector (DOEE 2016). Applicants may elect to sell SRCs to the district or to trade them to a regulated party, providing market participation opportunities and the certainty that comes with both an established price floor and a guaranteed buyer.

Advance Sale of Credits

Different forms of advance sales have been used to facilitate early action in water quality trading programs. In the Washington, D.C., stormwater program, for example, the online program database maintained by the Department of Energy and Environment includes a list of expected SRC supplies and potential suppliers as well as expected needs for SRCs based on project stormwater plans. Though this informational service does not constitute an advance sale, it does provide insight into the potential pipeline of credits. Similarly, pre-certification and contingent sales have been used in water quality trading programs in Maryland, where sellers were allowed to market their credits to regulated buyers prior to creation of the credits (Walker and Selman 2014). These sales allow the seller to test prospective markets and seek potential buyers prior to investment in credit-generating activities. In the Great Miami program in Ohio, a market was established before implementation of a final TMDL—a market that largely funded advance mitigation by farmers through a fund seeded by point sources and government grants (Ribaudo and Gottlieb 2011; Willamette Partnership et al. 2015). In this program, a distinction between "predicted" and "final" credits provided incentives for early action. "Predicted" credits require matching amounts to be held in escrow until activities can be confirmed. "Final" credits do not require the same protections and are thus favored (accelerating the implementation of activities) (Breetz et al. 2004). The program is estimated to be economically beneficial, particularly to waste water treatment plants and BMP-implementing farmers, though this success cannot wholly be attributed to early action.

[9] The 2013 Washington, D.C., Final Rule on Stormwater Management and Soil Erosion and Sediment Control does not explicitly distinguish between buyer and seller banking (DOEE 2013).

Ratcheting Baseline

Baselines define the minimum performance necessary to achieve a creditable reduction and can therefore influence the timing and extent of activities undertaken in a water quality trading market. In Wisconsin, for example, credits may be awarded as either interim or long-term reductions. Reductions to an approved TMDL generate interim credits (valid for five years), whereas reductions below the TMDL generate long-term credits (valid after five years) (Wisconsin Department of Natural Resources 2013). The credit differential created by these two types of activities can help to reward early adopters of activities and thus encourage early action.

Other Financial, Regulatory, and Administrative Tools

Administrative actions are a critical step in facilitating active water quality trading markets, particularly establishment of binding caps (Ribaudo and Gottlieb 2011). Complementing establishment of those caps is establishment of compliance certainty programs. Certainty programs can facilitate early action by clearly defining how activities or implementation practices will be considered in trading programs, thus reducing uncertainty (Walker and Selman 2014). To date, regulatory certainty provisions have been outlined at the federal level for the consideration of BMPs against TMDL load allocations and at the state level in Maryland's nutrient trading program. Like certainty provisions, standard setting reduces uncertainty by establishing clear expectations of what would be expected in an eventual market. For example, Walker and Selman (2014) note that providing insufficient information on trading in the 2003 EPA guidance document on water quality policy resulted in creation of widely varying programs.

Elsewhere, exchange mechanisms, termed "trading banks" by Greenhalgh and Selman (2012), have been used to facilitate trading by serving as an intermediary between buyers and sellers (a sort of quasi-public aggregator). In the case of North Carolina's Tar-Pamlico program, Breetz et al. (2004) note that targets were met without trading despite a stepped-down baseline over time. Credits were funded through cost-share programs and banked ahead of expected needs. Despite the lack of trades, significant cost savings were reported relative to a purely regulatory approach. Virginia and Pennsylvania have taken a different approach, establishing provisions that seek to protect regulated entities acting in good faith, either by providing a centrally managed reserve to guard against individual credit supplier defaults (Pennsylvania) or through the use of a centralized bank of affordable credits in the event that credits prove otherwise too scarce or costly (Virginia) (Selman et al. 2009).

Finally, incentives can be applied to early credit-generating activities to increase their relative value and encourage their deployment. For example, trading incentives can provide advantages to the sellers of early credits by increasing the ratio of credits provided per unit of activity. Newburn and Woodward (2012) cite the existence of favorable trading ratios for early trades in Ohio's Great Miami Water Quality Trading Program and the role of those ratios in driving early trading activity.

Summary of Early Action Experience

Despite the lack of robust trading activity, early action has received a great deal of attention in an attempt to address regulatory and market risks while enhancing the environmental benefits of water quality trading. Activities to encourage early action in water quality trading markets include various forms of banking, grandfathering, pre-certification programs, standard establishment, purchase guarantees, favorable baseline establishment and flexible compliance windows, and trading ratio incentives (e.g., Walker and Selman 2014; Newburn and Woodward 2012; Willamette Partnership et al. 2015). Often, incentives are combined or layered to provide added flexibility or incentives for early action. The Ohio River Project, for example, includes provisions for early action for buyers who volunteer to purchase credits during the pilot phase of trading. These provisions include preferred access to credits, favorable trading terms such as decreased fees and uncertainty factors, and flexible compliance schedules (EPRI 2013). But regardless of efforts to facilitate credit supply in water quality trading markets, the watershed-based nature of many programs may present limited opportunities for trading.

MECHANISMS, THEIR USE, AND EFFECT

The above-described tools not only have different effects on market function and advance mitigation objectives but also affect buyers and sellers differently (Table 2). In wetland and stream mitigation, seller banking and advance sale of credits have received the most attention. Buyer banking and early action credit approaches are not as common, perhaps because of the relative maturity of the market and the preference for mitigation at the time of impact (and therefore a reduced incentive to purchase credits early and hold them for later use). Buyer banking is also not as often discussed as seller banking in species and habitat trading. Purchase guarantees may factor into the contracting affiliated with the bidding process in recovery credit operations, but they do not appear to be commonly used independent of these other approaches. Advance sale of credits is likewise not often seen, presumably due to the risk of species decline in the absence of upfront conservation. The ESA has mechanisms to provide some certainty for activities taking place prior to a species listing (such as 4(d) rules and the aforementioned safe harbor agreements and candidate conservation agreements with assurances) as well as other tools that could be used in an early action context (e.g., habitat credit trading), but the draft prelisting policy is perhaps the first instance in which a market mechanism is specifically being targeted to facilitate early action under the ESA.

In GHG markets, the above review highlights the use of buyer banking, seller banking, and early action credits, but other tools are also used in combination in early GHG trading markets. For example, aggregation and purchase guarantees are often employed as mechanisms to bring offsets to market (though as discussed above, early investment and forward purchases may be declining). The wide array of mechanisms used is a function of both the complexity of the present market as well as the nascent condition of many programs and initiatives.

In water quality markets, a consistent finding in the literature and experience is that adequate demand prompted by a threat of future regulation is necessary to drive water quality trading markets (e.g., Greenhalgh and Selman 2012). As in GHG markets, a number of tools are used in combination and in interesting ways that complicate formal classification. The wide array of tools is likely the result of both the site- and user-specific needs of particular programs and the still-nascent nature of many markets.

Returning to the two primary early action objectives reviewed at the paper's outset, these effects can be further organized by their general effect, either facilitating market function or facilitating advance mitigation. As shown in this review, certain tools are primarily used to help facilitate early market transactions (e.g., purchase guarantees, grandfathering, phased-in or ratcheting baselines, early action crediting). Other tools are designed to facilitate advance mitigation, the primary example being seller banking. Other tools can be deployed to achieve multiple objectives, such as the advanced sale of credits and buyer banking. Though these distinctions are not always clear, they nonetheless provide a general sense of where the strengths of each tool may lie.

Facilitating Market Function

Experience in early environmental markets demonstrates the importance of clear regulatory expectations to drive demand for and guide production of credits. Regulatory expectations have a strong influence on all the market programs reviewed. GHG markets are also buoyed by opportunities in voluntary markets.

Among the tools used in these markets, the literature and market experience suggest that buyer banking can help to drive demand for credits early in a market's operation. Over time, buyer banking can be used to provide a hedge against price swings but can also expose markets to manipulation. Observing the use of buyer banking across the four markets explored here suggests that the tool may be more applicable to spatially fungible assets (GHGs) than to place-based assets (e.g., species habitat, wetlands), where future trading or use opportunities could be further constrained. Seller banking meanwhile emerges as a useful tool as a hedge against price volatility for the producer over the long run. As is the case with buyer

banking, the price-hedging capacity of seller banking may be inversely related to the spatial fungibility of the asset, because place-based asset sellers may be trading in inherently thinner markets.

Experience also shows that advance sales can provide liquidity to otherwise thin markets and can help fund development of centralized mitigation projects. But protections are necessary to ensure that the required environmental benefit is acheived. Combinations of early action tools have been used with some degree of success (e.g., purchase guarantees and seller banking in GHG markets). These tools are also used in multiple ways, at times spanning the multiple categories used here to define the various options (e.g., early action crediting and seller banking in species and habitat markets).

Table 2. Summary of tool use and experience in established and emerging environmental markets.

Tool	Objective		Affected party		Markets used[a]			
	Market function	*Advance mitigation*	*Buyer*	*Seller*	*WTL*	*SPP*	*GHG*	*WQT*
Buyer banking	Provides liquidity by bringing additional options on line; can reduce price volatility	Encourages early mitigation services, providing benefits if credits are held by the buyer before retiring	Provides hedge against costs; can link prices to policy expectations	Facilitates early demand for credits; can link prices to policy expectations			X	X
Seller banking	Provides liquidity, bringing additional options on line	Generates advance mitigation so long as banks achieve restoration success	Provides purchase options, eased transactions, liability transfer	Provides market-response capability; requires upfront financing	X	X	X	
Purchase guarantees	Provides certainty, experience in use/ production of credits	Set schedule can encourage investment ahead of time to meet delivery obligations	Provides predictable supply of credits at set price	Provides predictable demand for credits at set price	(X)		(X)	X
Advance sale of credits	Provides liquidity, bringing additional options on line; reduces risk, price volatility	Allows centralized restoration; encourages early production with timely deployment of revenue	Provides options, liability transfer, cost savings, eased transactions	Provides resources for acquisition and management	X			X
Early action credits	Provides liquidity by bringing additional options on line	Can drive advance mitigation if appropriate standards are set	Provides additional purchase options	Provides certainty; facilitates early credit production		(X)	X	X
Phased-in ratcheting baseline	Can decrease supply/ increase cost of credits while encouraging earlier delivery	Can drive early action in advance of declining baseline and increase environmental performance	Ensures quality credits; can decrease supply/ increase costs	Provides incentive to act in advance; decreases options/ increases costs			(X)	X
Administrative incentives	Provides liquidity by bringing options on line; provides certainty	Can drive advance mitigation if appropriate standards are set	Provides additional purchase options, regulatory certainty	Facilitates early credit production, regulatory certainty				X

[a] WTL = wetland/stream mitigation; SPP = species and habitat conservation; GHG = GHG and carbon sequestration; WQT = water quality trading. Parentheses indicate a market in which a variation of a tool has been used or in which anecdotal information on the tool's use is available.

Facilitating Advance Mitigation

The literature and market experience reviewed here suggests that fewer tools are used to achieve advance mitigation than to achieve market function. Wetland and stream mitigation markets are an important outlier in this respect, and they use a variety of tools to address long lag times and slow recovery times. Advance mitigation is also used in species habitat and GHG markets, which rely on generation of a credit or offset prior to sale.

Of the tools that are used to achieve advance mitigation, seller banking is among the most common, particularly in relatively mature markets. Early action credits have also generated advance mitigation in nascent or emerging markets even if that was not the express purpose of the tool. Purchase guarantees have also been used to facilitate advance mitigation. Experience in GHG offset market points to a possible decline in forward purchases as the market matures, suggesting that the tool may be more relevant to newly emerging markets. Other incentives, such as favorable trading ratios, have been helpful in speeding the delivery of mitigation, particularly when used in combination with other tools such as the regulatory certainty or early action credits.

CONCLUSION

This review of early action literature and market experience suggests that the incentives needed to drive early action will differ between parties, and interventions will need to be responsive to and balance these differences. As Streck et al. (2010) argue, the private sector may predominantly be looking for financial returns or regulatory certainty, while the public sector is looking to secure a broader suite of economic, social, and environmental benefits. The tool or approach best suited to encourage early action may also change as conditions change and new barriers arise.

Though certain lessons emerge from the review above, further research is necessary as markets continue to evolve and additional lessons are garnered from that experience. In particular, greater data on the costs and benefits of early action are needed to inform the selection and implementation of specific tools. Anecdotal evidence from a few transportation-related initiatives and a handful of water quality trading markets suggests that substantial economic benefits could accrue from early action. The mere presence of wetland and stream mitigation banks and the influence of pre-compliance credit demand on offset project implementation in nascent GHG markets further suggests that individual market actors are seeing potential benefits for early action. What is missing, however, is comprehensive data on the use and long-term economic and environmental effects of efforts to facilitate early action both within and across individual ecosystem markets. The acquisition of such data is likely to be difficult owing to a series of valuation, monitoring, and accounting challenges but is nonetheless critically important to future efforts to facilitate environmental markets.

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Acknowledgments
Development of this paper was supported by the U.S. Department of Agriculture's Office of Environmental Markets under Cooperative Agreement 8-0111-15-005. The authors thank Chris Hartley and several anonymous reviewers for their helpful comments on earlier drafts. All statements are the authors' alone and do not represent the position of the funding agency.

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