# INTERNATIONAL AVOIDED DEFORESTATION OFFSET PROJECTS:

## INSURING THE RISK OF REVERSAL PENALTIES


by

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## INTRODUCTION

According to the Intergovernmental Panel on Climate Change ("IPCC"), forestry initiatives represent the third-largest source of greenhouse gas ("GHG") emissions by sector, just behind energy production and industry.[1] The IPCC estimates that avoided deforestation ("AD") offers an annual emission mitigation potential of 2,133 MtCO2 by 2030,[2] which amounts to an astounding two billion tons of carbon per year[3]—equivalent to twenty percent of total global emissions.[4] Arguably, AD must be incorporated into a carbon market to stabilize global GHG emissions.[5] Yet to date, international attempts to thwart the carbon crisis have failed, for the most part, to take advantage of the sequestration potential of AD.[6] In contrast, proposed U.S. climate change legislation aims to slow deforestation by allowing international AD projects to receive tradable offset credits for sequestered carbon.[7] This Paper supports such legislation by

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[1] IPCC, CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE TECHNICAL SUMMARY 29 (B. Metz et al. eds. Cambridge Press 2007), http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-ts.pdf.

[2] IPCC. CLIMATE CHANGE 2007: WORKING GROUP III: MITIGATION OF CLIMATE CHANGE, SECTION 9.4.3.2, GLOBAL FOREST SECTORAL MODELING, http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch9-ens9-4-3-2.html.

[3] *Id.* To put this in perspective, two billion tons of carbon approaches total carbon emissions released by the United States annually. ENVIRONMENTAL DEFENSE, REDUCING EMISSIONS FROM DEFORESTATION IN DEVELOPING COUNTRIES: APPROACHES TO STIMULATE ACTION 1 2006, *available at* http://unfccc.int/resource/docs/2006/smsn/ngo/009.pdf As another comparison, this amount is roughly the maximum annual allowance for carbon offsets to demonstrate compliance under the American Clean Energy and Security Act ("ACES"), which was passed by the U.S. House. *See* H.R. 2454, 111th Cong. § 722(d)(1)(A) (2009).

[4] H.R. 2454, 111th Cong. § 752(2) (2009).

[5] *See generally* ENVIRONMENTAL DEFENSE, REDUCING EMISSIONS FROM DEFORESTATION IN DEVELOPING COUNTRIES: APPROACHES TO STIMULATE ACTION 1 (2006), *available at* http://unfccc.int/resource/docs/2006/smsn/ngo/009.pdf; JOANNEUM RESEARCH ET AL, REDUCING EMISSIONS FROM DEFORESTATION IN DEVELOPING COUNTRIES: POTENTIAL POLICY APPROACHES AND POSITIVE INCENTIVES (2007), *available at* http://unfccc.int/resource/docs/2007/smsn/ngo/007.pdf.

[6] ECOSECURITIES CONSULT, SHOULD TEMPORARY CERS BE INCLUDED IN THE EU ETS LINKING DIRECTIVE? AND OTHER QUESTIONS CONCERNING THE POTENTIAL DEMAND FOR CDM FORESTRY CERS, March 2006, http://www.climate-standards.org/images/pdf/EcoSecurities-demand-survey-March06.pdf ("As decided in the Marrakech Accords, avoided deforestation projects are excluded from the CDM in the first commitment period.").

[7] H.R. 2454 § 743; American Power Act (discussion draft) §§ 734–35, 755–59 (2010), http://kerry.senate.gov/americanpoweract/pdf/APAbill.pdf.

addressing one of the challenges[8] associated with including international AD offsets in a U.S. cap-and-trade system—the issue of non-permanence.

Although the American Clean Energy and Security Act ("ACES") will not be the final word regarding a U.S. cap and trade system,[9] it provides a useful foundation upon which future legislation, EPA regulation, and voluntary markets can build. Accordingly, this Paper focuses on ACES, but the analysis, discussion, and conclusions contained herein can apply in other AD offset contexts. ACES allows the Administrator to choose which method or methods to use for addressing reversals[10] and thus for ensuring the permanence of AD projects, though it specifically mentions only two—insurance and a reserve system.[11] The bill provides some structural specifications for a reserve system, including the requirement that project developers pay a "reversal penalty" in the event of a reversal.[12] This reversal penalty requires the project,

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[8] Several factors have contributed to AD's absence from carbon markets, including verification, baseline and uptake measurement, whether to approach deforestation on a national or project level, and how to deal with the natural non-permanence associated with forests. *See generally* Jaime Carlson and Ramon Olivas, *United States Legislative Proposals on Forest Carbon*, *in* FORESTS AND CARBON: A SYNTHESIS OF SCIENCE, MANAGEMENT, AND POLICY FOR CARBON SEQUESTRATION 455–79 (Mary L. Tyrell et al. eds.) (Yale F&ES Series No. 23, 2009), *available at* http://gisf.research.yale.edu/forest_carbon_report/Chapter_17.pdf.

[9] Senators Kerry and Lieberman have recently unveiled a new climate change bill, the American Power Act, which presumably will replace ACES as the frontrunner for climate change policy. Moreover, the American Power Act, in its discussion draft form, includes an offset credit program that not only allows for international AD offsets, but mimics much of the language found in ACES, including language related to reversals. *See* American Power Act (discussion draft) §§ 734-35, 755-59 (2010), http://kerry.senate.gov/americanpoweract/pdf/APAbill.pdf.

[10] Reversal" is an event that causes carbon once stored in an AD asset to be re-emitted into the atmosphere. Susan Subak, *Replacing Carbon Lost from Forests: An Assessment of Insurance, Reserves, and Expiring Credits*, 3 CLIMATE POLICY 107, 108 (2003). ACES defines the term as follows: "an intentional or unintentional loss of sequestered greenhouse gases to the atmosphere." H.R. 2454 § 700(43).

[11] H.R. 2454 § 734(b)(2).

[12] Under ACES, the reversal system would also include a discount or buffer mechanism. This works by granting a developer fewer offset credits than tons of CO2 sequestered in order to provide for the risk of reversal ex ante. Thus, a developer that has sequestered 100 tons of CO2, for example, may receive fewer than 100 offset credits, with the balance being placed into a reserve pool.

upon a reversal, to surrender a certain number of allowances or offset credits depending on whether the reversal is intentional or unintentional.[13]

The bill does not, however, address the concern that project developers suffering from a reversal event may lack the means to satisfy the reversal penalty. Such a failure would undermine the environmental integrity of the offset program, as the number of offset credits on the market would deviate from the amount of actual tons sequestered. In light of this problem, the authors foresee a need for insurance that covers project developers in the event of a reversal, thus assuring payment of reversal penalties. This Paper analyzes the importance of reversal insurance and potential barriers to market entry for insurers.[14] It also provides a financial analysis of the economic feasibility of reversal insurance from the perspective of both insurers and project developers, concluding that without a risk-capping mechanism, premiums for project developers will be cost prohibitive.

Part I of this Paper explains and evaluates various aspects of ACES, including the computation of AD offsets, the two mechanisms—offset reserve and penalty insurance—offered for coping with non-permanence in international AD offsets, and ambiguities in the bill that could affect a potential AD insurance market. It then recommends amending ACES to address

[13] H.R. 2454 § 734(b)(3)(B).

[14] Reversal penalty insurance should not be confused with an insurance mechanism for addressing non-permanence. The insurance mechanism contemplated by ACES, *see* H.R. 2454 § 734(b)(2)(B), uses insurance in lieu of or in conjunction with a reserve mechanism for retiring allowances/offset credits upon reversal. In contrast, reversal penalty insurance would operate in the context of a reserve mechanism using a reversal penalty, and it would insure only the penalty imposed for a reversal. With an insurance only mechanism, there would be nothing reserved. With a reserve mechanism, there is an initial set-aside for the reserve pool and then a penalty upon reversal. It is also possible, and perhaps most desirable, to have a hybrid mechanism that utilizes a reserve in combination with an insurance mechanism.

The viability of an insurance market for an insurance mechanism and the necessity of incentives to overcome associated market barriers are beyond the scope of this Paper. However, the establishment of a reserve penalty insurance market may "prime the pump" for such an insurance market.

non-permanence by requiring (not just allowing) the use of a reserve mechanism as well as explicitly allowing for the purchase of reversal insurance in order to promote environmental and market integrity. Part II explains the benefits of mandating an offset reserve mechanism and of expressly allowing for reversal penalty insurance. It then identifies the limitations of reversal penalty insurance and identifies market barriers that could obstruct insurers from offering such insurance.

Part III provides a financial analysis of reversal penalties for a hypothetical, national-level[15] avoided deforestation project located in Ghana in order to test the viability of a reversal penalty insurance market. This analysis begins by identifying several assumptions and outlining the methodology used to create the financial model. Next, it examines potential costs of reversal penalties and uses the resulting data to assess the profitability of insurance policies covering these reversal penalties. To do this, Model 1 quantitatively analyzes premiums that would be required for insurance companies to break even and then illustrates that such rate levels would deter AD offset developers. Using comparable premiums from the forest timber insurance industry and the commercial property insurance industry, Model 2 illustrates why insurance companies would not be profitable in taking on this risk.

Finally, Part IV discusses policy choices for reducing these premiums to an acceptable level. Options include (1) capping risk for insurers at a given set of absolute dollar figures over a ten

[15] While it appears that ACES gears most of its international offset credits to a sectoral-level approach, *see* H.R. 2454 § 743(c), offsets from international AD efforts appears to be more national in scope. *See* H.R. 2454 § 743(e). Section 743(e) is still silent as to whom the credits are issued, but there is language in the section indicating the nation will be responsible for distribution of profits and revenues related to AD credits. *See* H.R. 2454 § 743(e)(3)(C) (stating profits from credits are to be dispersed to particular groups, such as (indigenous communities and organizations helping drive AD). Even if the nation itself is not the holder of the credits, Section 743(e) makes clear that the preferred measurement for AD offsets is at the national level, and thus this Paper evaluates a national-level project.

year program, (2) limiting insurer liability by capping the price of carbon or by deeming a carbon price cap solely for the purpose of capping the risk exposure held by insurers, (3) placing a cap on the total amount paid by insurers that receive claims involving multiple reversals that impact a single crediting period, and (4) capping penalty payments for multiple payments on a cumulative basis. This Part also discusses the effect of these strategies on environmental integrity.

## I. Avoided Deforestation Offsets in the American Clean Energy and Security Act

The American Clean Energy and Security Act envisions a federal U.S. cap-and-trade system that includes international AD offsets.[16] ACES suggests two potential ex ante mechanisms to deal with non-permanence—an offset reserve and insurance[17]—while authorizing the Administrator to decide which mechanisms ultimately will be employed.[18] This Part explains and evaluates the computation of AD offsets, the two suggested mechanisms for coping with non-permanence in international AD offsets, and the ambiguities in ACES that could affect an AD insurance market for reversal penalties. Finally, for purposes of both environmental integrity and market creation and stability, it recommends that ACES be amended to require usage of a reserve mechanism to account for non-permanence risk as well as to explicitly allow for the purchase of reversal insurance.

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[16] H.R. 2454 § 734(e). ACES also would create an international deforestation reduction program for countries not participating in the carbon market through AD offsets. H.R. 2454 §§ 751-56. This section of ACES is beyond the scope of this paper, however, and therefore is not discussed.
[17] *See* H.R. 2454 §§ 734, 743. ACES also authorizes the Administrator to require additional mechanisms. H.R. 2454 § 734.
[18] H.R. 2454 § 734.

## A. *Computation of AD Offset Credits under ACES*

ACES provides that the Administrator may issue AD offset credits for activities reducing GHG emissions in developing countries with bilateral or multilateral agreements.[19] The bill authorizes the Administrator to issue credits on a national, subnational, or project basis.[20] On the national scale, "[t]he quantity of the [AD offset credits] is determined by comparing the national emissions from deforestation relative to a national deforestation baseline for that country."[21] Under ACES, the national deforestation baseline shall "[take] into consideration the average annual historical deforestation rates of the country during a period of at least five years, the applicable drivers of deforestation, and other factors to ensure that only reductions that are in addition to such commitments or actions will generate offsets."[22] As such, once this baseline is established, offset credits will be issued only for the reduction in emissions realized against that computed baseline, as opposed to the total carbon stock present in a forest at the end of the applicable verification period. Interestingly, ACES is silent as to whom credits are issued, although there is some suggestion it could be the nation itself.[23]

## B. *Mechanisms Available under ACES to Counter Non-permanence: Offset Reserve Mechanism, Reversal "Penalties," and Insurance*

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[19] H.R. 2454 § 743(b)(2).

[20] *See generally* H.R. 2454 § 743 (creating the requirements for national-, subnational-, and project-level offset credits while also creating a phase-out of subnational- and project-level credits). Such a national-based approach has become the preferred approach after COP-15 in Copenhagen. *See* UNION OF CONCERNED SCIENTISTS, TROPICAL FORESTS AFTER COPENHAGEN: CLIMATE POLICY IN 2010 AND BEYOND 1–2, http://www.ucsusa.org/assets/documents/global_warming/tropical-forests-after.pdf ("In the months leading up to Copenhagen, REDD-plus negotiations had focused on reducing the area of forest lost to deforestation, but the final framework document addresses deforestation in terms of emissions.").

[21] H.R. 2454 § 743(e)(1).

[22] H.R. 2454 § 743(e)(4) (providing the relevant requirements in creating a baseline, such as consideration to the applicable drivers of deforestation and zero net twenty year trajectory for each baseline).

[23] *See supra* note 15 and accompanying text.

ACES requires the Administrator to "prescribe mechanisms to ensure that any sequestration with respect to which an offset credit [corresponds] . . . results in a permanent net increase in sequestration."[24] While ACES leaves the ultimate choice to the Administrator, it specifically lists an offset reserve mechanism (combined with reversal penalties) and an insurance mechanism as two possibilities.[25] The bill's suggested offsets reserve mechanism establishes a pool of offset credits ("the offset reserve pool," "the reserve," or "offset reserve") from which credits are retired in the event of a reversal episode at an amount sufficient "to fully account for the tons of carbon dioxide equivalent" released.[26] In order to build and preserve this offset reserve, the Administrator forces AD projects to pay what this Paper calls a "reserve requirement" or "discount," meaning the Administrator discounts the total AD credits issued based on the risk of reversal,[27] thus issuing fewer credits to an offset project than it has actually sequestered.[28]

In addition to this reserve requirement, ACES requires an offset project developer, in the case of intentional and unintentional reversals, to pay a reversal penalty to help replenish the offset reserve.[29] For intentional reversals, an offset project developer must place credits or allowances

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[24] H.R. 2454 § 734(b)(2). These requirements apply to AD offset projects. *See* H.R. 2454 § 743(2)(c)(i) (stating "all of the requirements of this part apply to the issuance of international offset credits under this section").

[25] *Id.* Additional options the Administrator could utilize include temporary credits and land reserves. Subak, *supra* note 10, at 107–08.

[26] H.R. 2454 § 734(b)(3)(B)(i).

[27] ACES neither establishes the level of the discount rate nor requires the Administrator to apply the same rate to all projects. Though CCX, for example, applies a uniform discount rate of twenty percent to all projects, CHICAGO CLIMATE EXCHANGE OFFSET PROJECT PROTOCOL, FORESTRY CARBON SEQUESTRATION PROJECTS, § 8 (2009) [hereinafter CCX PROTOCOL], http://www.chicagoclimatex.com/docs/offsets/CCX_Forestry_Sequestration_Protocol_Final.pdf, the vast geographic and political variables affecting AD offset projects world wide warrants giving the Administrator the discretion to set rates on a project by project basis. For instance, a new project by a first-time project developer may have a higher risk of reversal and thus a higher reserve rate than a project that is fifteen years old, operated by a seasoned developer with a low historical reversal rate, and located in a politically- and climate-stable country. As such, ACES provides the Administrator with flexibility in setting the discount rate. *See* H.R. 2454 § 743(e)(1)(D).

[28] H.R. 2454 § 734(b)(3)(A).

[29] H.R. 2454 § 734(b)(3)(B).

into the reserve "equal in number to the number of reserve offset credits that were canceled due to the reversal."[30] For unintentional reversals, the project developer must replenish the offset reserve with either half the number of credits canceled due to the reversal or half the number of credits already placed into the reserve for that project, whichever is less.[31]

This reversal penalty is key to maintaining environmental integrity, as the Administrator, in the event of a depleted reserve pool, would not be able to retire offset credits equal to the amount of CO2 released in a reversal. Such a scenario would create a gap between AD offset credits on the market and the putative corresponding amount of tons sequestered. Beyond reversal penalties, the offset reserve mechanism protects environmental integrity by ensuring that the number of offset credits introduced into the market does not exceed the requisite amount of CO2 sequestered by the offset project.

The other mechanism suggested by ACES is an insurance mechanism, which would provide "for purchase and provision to the Administrator for retirement of an amount of offset credits or emission allowances equal to the tons of carbon dioxide equivalents of greenhouse gas emissions released due to reversal."[32] ACES does not elaborate as to the form or means of such an insurance policy, presumptively leaving it to the Administrator's consideration. However, an

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[30] H.R. 2454 § 734(b)(3)(B)(ii).

[31] To illustrate this provision, consider a hypothetical project that offsets one-hundred tons of carbon dioxide ("CO2") in one vintage year. Under ACES, if the Administrator applied a twenty percent discount, it would issue the project developer eighty offset credits and place twenty credits into the offset reserve at the end of the vintage year. Now assume that this project experiences an unintentional reversal (e.g., a forest fire initiated by lightening) releasing forty tons of sequestered CO2. Under ACES, at the time of reversal, the Administrator would retire a quantity of offset credits equivalent to forty tons of CO2 from the offset reserve to account for the credits lost due to the unintentional reversal. The Administrator would then require the project developer to place ten offset credits into the reserve (half the number already reserved for that project), rather than twenty credits (half the number of credits retired by the Administrator).

[32] H.R. 2454 § 734(b)(2)(B).

insurance-only approach (one operating without a reserve mechanism) could prevent market entry for otherwise viable AD offset projects that are uninsurable due to a high risk of reversal, political uncertainty, or other discouraging factors to potential insurers. A reserve system may be able to accommodate nascent projects by exacting a high reserve requirement and requiring reversal penalty insurance, thereby resulting in higher global sequestration. Such a model may be more attractive to insurers as they would only be required to cover a portion of the actual reversal,[33] as opposed to the entire reversal.[34]

### *C. Ambiguities in and Possible Changes to ACES*

In its current form, ACES contains ambiguities that may discourage market entry for potential reversal penalty insurers. By altering some of this language it is possible to bolster market confidence and improve the chances of successfully developing a viable AD offset reversal penalty insurance market. Because of this Paper's focus, not every ambiguity or issue in the offset sections of the bill is addressed here, and only those having a direct affect on an AD insurance market are described.[35]

#### 1. Ambiguities

[33] *See* H.R. 2454 § 734(b)(3)(B) (holding project developers only partially liable for unintentional reversals).
[34] *See* H.R. 2454 § 734(b)(2)(B) (requiring projects developers to hold insurance to cover all CO2 released in a reversal); *see also* Part II.B.
[35] For instance, while not having a direct bearing on AD market creation, ACES should require the Administrator to hold enough offset credits or emission allowances in the reserve to fully compensate for GHG emissions attributable to reversals. Currently, the bill requires the Administrator to "retire offset credits or emission allowances [in the case of reversal] from the offsets reserve to fully account for the tons of carbon dioxide equivalent that are not longer sequestered.[35] However, the bill does not require the Administrator to ensure that sufficient offset credits or emission allowances reside in the reserve. While this section apparently intends to convey this requirement, the omission of offset credits means that only emissions allowances must be withheld. To fix this, section 734(b)(1)(B) should require the Administrator to "require emission allowances *or offset credits* to be held in amounts to fully compensate for greenhouse gas emissions attributable to reversals . . . ."

ACES leaves several open questions that are critical to the creation of an AD offset market. First, ACES states that with an offset reserve, the Administrator shall discount the quantity of offset credits to be issued to a project depending on the risk of reversal.[36] The bill, however, is silent on how this reserve requirement would be calculated and does not give any market signal as to what factors would impact the rate. Second, the bill does not indicate for how long AD offset developers would be liable for reversals. Presumably liability would endure, at minimum, for the length of a project's accreditation period, but in order to protect environmental integrity it may be necessary to require insurance coverage for even longer periods.[37] Specifically, the concern is that if the project developer's liability ends before the accreditation period is complete, after which time a reversal occurs, the developer would have benefitted for only short-term sequestration without any penalty.

Third, ACES does not indicate whether an AD project developer who suffers from multiple reversals in the same crediting period will have to pay a penalty for each reversal. The legislation merely states that for unintentional reversals, the project developer must replenish the offsets reserve with either half the number of offsets (or allowances) canceled due to the reversal or half the number of offsets already placed into the reserve for that project, whichever is less. While an insurance company's model will likely account for the possibility of multiple reversals, without further clarification, companies may assume a higher potential maximum loss, resulting in higher—and potentially unaffordable—premiums for project developers. Although the financial

[36] H.R. 2454 § 734(b)(3)(A).
[37] Insurance could be required for the duration of the project, for the duration or the certification period, for a certain number of years beyond the certification period, or for a set number of years (twenty years, thirty years, etc.). HWWA HAMBURG, CAN PERMANENCE BE INSURED? 2 (2006) [hereinafter HWWA REPORT], www.econstor.eu/bitstream/10419/19207/1/235.pdf.

analysis in Part III does not illustrate a multiple reversal scenario, the feasibility analysis and recommendations would remain the same.[38]

Fourth, the bill leaves open the issue of which mechanism will be used to address the risk of non-permanence in AD offset projects. While legislators appear comfortable leaving the ultimate determination to the discretion of the Administrator, such delegation is unnecessary and leaves potential AD project developers without clear guidance as to the risks involved within this market. This uncertainty presents a risk that may scare potential market participants away and delay the development of the AD offset market. In addition, permitting the Administrator to choose any mechanism meeting the goals of the bill[39] leaves open the possibility that it will eschew the reserve and insurance mechanisms altogether and instead choose a model of temporary credits similar to those used in other systems.[40]

2. Suggested Changes

This Paper addresses the fourth ambiguity listed above—which mechanism will be used to address the risk of non-permanence in AD offset projects—and recommends that the bill both mandate a reserve mechanism and expressly allow for reversal penalty insurance. Part II explains these recommendations in detail, but it is first helpful to briefly suggest other changes to the bill associated with this recommendation. Due to the important role of insurance companies in managing AD risk, requiring the appropriate body to promulgate regulations for insurers of

[38] *See infra* Part IV.B for a discussion of strategies for addressing this issue.
[39] H.R. 2454 § 734(b)(2)(C).
[40] Temporary Certified Emissions Reductions (tCERs) convey a "temporary license to emit." Subak, *supra* note 10, at 114. They give "investing countries the option of bundling a temporary sequestration project with a commitment to eventually undertake a follow-on action that will ensure a permanent emissions reduction." *Id.*

international forestry offset projects and to review those regulations periodically would help protect the financial and environmental integrity of the offset system. In other words, the unique nature of this type of insurance may warrant unique oversight mechanisms to ensure that insurance pools are sufficiently large, liquid, and diversified. Also, the legislation should require that all insurers involved with AD offsets (whether they only insure reversal penalties or insure against the actual reversal) be certified, and it should require the Administrator to establish guidelines for accrediting and supervising insurers.[41] Further, ACES should instruct the oversight body to consider any insurance requirements used by other offset systems in order to promote a sufficiently large pool of insured projects and to encourage linkage between systems.

## II. MANDATING A RESERVE MECHANISM AND EXPRESSLY ALLOWING FOR REVERSAL PENALTY INSURANCE

While ACES provides the Administrator with some direction in regard to the issue of non-permanence by mentioning reserve and insurance mechanisms, the bill falls short in safeguarding environmental integrity and strengthening the market confidence necessary for startup projects. For these reasons, this Paper argues that ACES should require the Administrator to use an offset reserve mechanism and that the bill should expressly permit reversal penalty insurance.

### *A. Why Require an Offset Reserve Mechanism?*

An offset reserve mechanism, which includes reversal penalties, is necessary to provide for the environmental integrity of an AD offset market and the ACES bill as a whole. The offset

[41] Such a requirement is standard in relation to many insurance markets. *See, e.g.*, North Carolina Department of Insurance, http://www.ncdoi.com/main.asp ("Any insurance business in this state first must be approved by the Commissioner, and companies and agents must meet rigorous standards before they receive a license to do that business.").

reserve mechanism establishes a means to bank credits to help deflate the environmental cost of a reversal. AD projects are prone to experience non-permanence issues, whereby reversals cause a release of GHGs into the atmosphere. In order to ensure that ACES creates a carbon market based on actual reductions on CO2 released, some mechanism must be in place to counter these reversals. Without a mechanism in place to bank credits in lieu of such reversals and to spread the risk stemming from the natural non-permanence risks of AD projects, project developers may find the risk associated with AD projects too onerous. Assuming no offset reserve is in place, in the instance of reversal, a project developer may have to account for the entire carbon release—thereby facing what could be a catastrophic economic loss that may either bankrupt the developer or render the developer unable to pay the reversal penalty, thereby undermining the market's environmental integrity.

As indicated in ACES, an insurance mechanism could be used instead of or in conjunction with a reserve mechanism to address the risk of reversals.[42] Because reversals are caused by events that are difficult or cost prohibitive to insure against—intentional reversals, erosion, lack of property right enforcement, etc.—insurance may be nonviable for some projects or cost prohibitive for others. As ACES is written, reversal penalties (for unintentional reversals) calculated under a reserve mechanism require project developers to pay for only a portion of the overall release. Because of the reserve's banking, it helps protect the overall environmental integrity of an AD offset market while at the same time reducing the cost potentially borne by an AD developer suffering from a reversal.

[42] H.R. 2454 § 734(b)(2).

Compared to an AD insurance mechanism, the offset reserve establishes a constant by which insurers can actuarially determine product and service costs and reduce their exposure to risk. In ACES, the offset reserve mechanism's penalty structure also provides a ceiling against which insurance companies could model or forecast cost-benefit analyses for insuring AD projects. Further, the hybrid nature of the offset reserve mechanism—requiring both a reserve requirement to bank credits on the front end and reversal penalties on the back end—allows insurance companies easier access into the marketplace, as they are not required to bear the full risk associated with non-permanence. In this way, the offset reserve serves as a market incentive by creating a set guideline for risk calculation and diluting the risk associated with insuring AD projects.

*B. The Value of Reversal Penalty Insurance*

In combination with the offset reserve mechanism, reversal penalty insurance offers many benefits, especially when it comes to providing economic stability for project developers and environmental integrity of the offset system. First, the availability of insurance may encourage AD offset project development by providing a project developer economic security in the event of reversal. This security would come from the knowledge that the financial risk of an unintentional reversal event could be shifted to an insurer. Second, greater systemic confidence that reversal penalties will be paid reduces the number of credits needed to be set aside for the reserve at the outset. In other words, penalty insurance may allow offset projects to generate and trade a larger portion of offset credits in light of the reduced risk-management burden the reserve system would shoulder. The future potential revenue from these additional credits would function as an economic incentive to the development of an AD offset market. Thus, by assuring that reversal penalties will be paid by the project developer, the presence of reversal penalty insurance reduces a project's reserve discount rate and increases the amount of tradable credits allocated for a project.

A third benefit of reversal penalty insurance is that it protects against judgment proof project developers. Large out-of-pocket expenses could bankrupt a project developer, rendering him unable to replenish the reserve pool. If this occurred, the Administrator might have little recourse against a judgment-proof developer at the national level—though international pressure may be sufficient to prevent a sovereign-based developer from defaulting. Although the default of one developer is unlikely to lead to systemic economic or environmental instability, insurance-based protection can provide integral support, both to the developer and the system as a whole.

Fourth, supplementing the reserve requirement with reversal penalty insurance increases the viability of AD offset projects that experience a reversal by limiting the outlay required from a project developer's coffers. Depending on the price of offset credits and allowances, the size of the reversal, and the depth of a developer's pockets, a reversal could financially overwhelm the project developer.[43] Either undercapitalization or a catastrophic reversal could economically destabilize the project in the event of such a reversal and subsequent penalty, hindering future sequestration.

[43] *See* explanation of the reversal penalty structure in ACES *supra* notes 29–31 and accompanying text.

Finally, reducing the likelihood of default on the part of a developer required to pay a reversal penalty helps to maintain a healthy reserve pool, from which credits are retired in proportion to the amount of CO2 release. ACES recognizes that "someone must bear the risk of default,"[44] and since insurance providers are able to spread risk among policyholders, they—compared with individual developers—are less likely to default or delay in the case of a reversal. As such, penalty insurance not only provides for economic security to the project developer, but also provides environmental integrity of the offset system by increasing the probability that reversal penalties will be paid.

### C. *Challenges for Reversal Penalty Insurance*

#### 1. Limits to Reversal Penalty Insurance

While there is a need for reversal penalty insurance, this type of insurance comes with limitations. Reversal penalty insurance would not account for certain predictable carbon sequestration loss, such as CO2 released from erosion.[45] In addition, the presence of insurance may create a moral hazard, whereby project developers become less careful about vigilantly protecting against carbon releases that would be covered by the insurer.[46] Moreover, insurance may not fully compensate for the economic limitations of a developer suffering from a reversal. The developer may be unable to pay the deductible or co-payment when the insurer does pay out,

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[44] Robert N. Stavins, *A Meaningful U.S. Cap-and-Trade System to Address Climate Change*, 32 HARV. ENVTL. L. REV. 293, 322–23 (2008).
[45] HWWA REPORT, *supra* note 37, at 7.
[46] *Id.* at 8. Deductibles or co-insurance are ways to avoid moral hazard and make developers pay in case of reversal. *Id.* at 5.

or the insurer may refuse to cover the entire loss due to an uninsured cause of reversal, leaving the developer responsible for the balance.[47]

Another limit to reversal penalty insurance is that insurers may be unwilling to insure projects for an extended credit period. While insurers typically operate on an annual cycle, forest offsets may be required to remain in place for decades.[48] Reversals also may result from a variety of factors, including some that are uninsurable. For example, insurance may not cover an intentional reversal, such as an efficient breach by the developer to take advantage of "changes in opportunity costs of land."[49] In other words, a developer may intentionally remove or degrade the forest in order to realize economic gain above that awarded by maintaining it as forest. Finally, political risk is difficult to insure, as a countrywide avoided deforestation program may suffer from "non-enforcement, non-compliance, expropriation, uncertain property rights, [and] policy changes."[50]

2. Barriers to Market Entry for Potential Reversal Penalty Insurers

In addition to the limitations of reversal penalty insurance, a potential high level of risk uncertainty may present barriers for insurers interested in entering this market. During early stages of an AD market, insurers may not be attracted to the market due to a limited number of AD projects[51] and the short average time interval between loss occurrences.[52] As a result,

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[47] *Id.* at 11.
[48] *Id.* at 14; *see also* Subak, *supra* note 10, at 109 (explaining that AD offset projects could be required to be certified from between a few decades and a century).
[49] *Id.* at 7.
[50] *Id.* at 3.
[51] *Cf.* HWWA REPORT, *supra* note 37, at 7 (identifying this is a risk for using insurance with afforestation and reforestation offset projects).

without government incentives, insurers may require high premiums that in turn bar project developers from entering the market,[53] and insurers may have difficulty setting deductibles in light of a lack of history of damages.[54] Small numbers of insured projects also may lead to an insurance pool insufficiently diverse and large enough to insure a sizeable correlated loss event.[55]

Another hurdle to penalty insurance is that ACES and AD offset credits in particular focus on national-level project development. Presumably, this issue constitutes a growing concern in light of the trend to nationalize measurement of AD projects after COP 15 in Copenhagen.[56] National-level projects could present too large a risk to insure, either in terms of the potential reversal size or the potential reversal rate. It is conceivable, however, that countries would contract with private third parties to manage and oversee AD offset projects in that country. Nevertheless, such contractual arrangements do not fully mitigate the issues presented by the national-level approach to avoided deforestation. For example, developing countries with political unrest or instability could equate to uninsurable risks, thereby thwarting AD offset development if penalty insurance became a requirement. Furthermore, as ACES is silent as to whom credits are issued for AD projects,[57] it is conceivable that insurance companies could be insuring a sovereign government, which could create difficulty if the need for legal recourse arose. In the event of

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[52] *Id.*
[53] *Id.* at 7–8.
[54] *Id.* at 8.
[55] Insurers of many forest offset projects in the same region are susceptible to correlated losses, which can strain payment pools. Among other things, this could come in the form of successive dry seasons resulting in a surge of large forest fires or of a pest infestation that eviscerates forests. Both of these occurrences become more likely as the global climate increases.
[56] *See* United Nations, Ad Hoc Group on Long Term Cooperative Action Under the Convention, Draft Decision/-CP.15, at 2 (2009), *available at* http://unfccc.int/resource/docs/2009/awglca8/eng/l07a06.pdf. ACES needs to address these concerns head-on, potentially by requiring insurers of international AD credits to submit to jurisdiction in the United States.
[57] *See supra* note 15.

contract disputes that require litigation, the insurer may find itself seeking redress in the court in that sovereign country, which may not render an impartial decision.[58]

In sum, after considering the benefits and limitations of reversal penalty insurance, an insurance mechanism could alleviate many risks associated with reversal penalties—even if it does not account for all of them. An offset reserve coupled with reversal penalties permits risk-spreading, which reduces capitalization costs for developers and insurers and makes the credit retirement mechanism safer. Once a project begins, reserve penalty insurance also potentially allows projects to receive a larger portion of offset credits by reducing the risk-management burden shouldered by the reserve system. The availability of this insurance also reduces the risk that a reversal will bankrupt a project and increases the likelihood that a project will continue after a reversal event. Finally, allowing for insurance promotes environmental integrity by helping to assure that reversal penalties will be paid and the offset reserve will be replenished to some extent upon a reversal. For these reasons, it is important that U.S. climate legislation expressly allow for penalty insurance, thus removing the ambiguities that prevent market entry by potential reversal penalty insurers.

## III. Financial Analysis: Insuring Reversal Penalties

Having determined that reversal penalty insurance is both critical to preserving environmental integrity in a reserve-based system and having identified market barriers in Part I,

[58] A related issue is what recourse the Administrator would have against a project where the developer is a sovereign nation that has secured reversal penalty insurance, received and sold offset credits, and then ceases to pay insurance premiums. The result would be an uninsured project. Also, it is unclear that the Administrator could enforce against a sovereign nation that flatly refuses to pay a reversal penalty.

this Part assesses whether reversal penalty insurance is viable for insurers and AD customers and whether market incentives are necessary to facilitate market entry. In the end, this Part finds that such incentives, risk-capping in particular, are necessary. While investment and production tax credits are often used to encourage business development (i.e. assisting the burden of funding for new ventures) and other tax credits are sometimes used successfully to promote conservation and preservation, these tools do not squarely address the primary concern with reversal penalty insurance—unknown risk.

This Part provides a financial analysis regarding reversal penalties for a hypothetical, national-level avoided deforestation project located in Ghana. The analysis begins by identifying several assumptions used to create the financial model. Next, it examines potential costs of reversal penalties and then uses the resulting data to assess the profitability of an insurer covering reversal penalties for a given AD asset. This profitability analysis then compares two methods for calculating premiums. The first uses an expected maximum loss figure and focuses on whether insurance premiums that allow firms to break even will be cost prohibitive for AD project customers. The second uses historical averages and asks whether historical premiums in forestry will allow for a viable insurance business. This Part concludes that strategies will be needed to reduce insurance premiums, and then Part IV discusses policy options for reducing these premiums to an acceptable level.

*A. Assumptions and Statistics*

By focusing on a hypothetical avoided deforestation project in Ghana, this case study explores the economic feasibility of insuring AD assets from the financial risk of large reversal penalty payments. To do so, this study explores the viability of insurance, using two different economic models. The first model calculates an expected maximum loss ("EML")[59] and determines a premium charge to yield a break-even loss ratio[60] of 1.0. It then qualitatively considers whether a rational, risk-averse project developer would be willing to pay the premium fees given the amount of risk that the premium averts. The second model assumes insurance premiums will be charged based on a certain percentage of the coverage and calculates a loss ratio given the premium revenue generated. The second model then qualitatively analyzes this loss ratio and compares it to common loss ratios in the primary insurance industry to see if the business opportunity would be viable. After exploring these financial models, the analysis discusses the benefits and detriments of each and concludes with a business recommendation.

To conduct this analysis, it is necessary to adopt several assumptions. First, the "carbon stock" contained in one hectare of forest (in West Africa) consists of 155 tons.[61] Second, the "carbon uptake in a given forest area" for one hectare of forest (in West Africa) is approximately three tons of carbon per year.[62] Third, a twenty percent reserve requirement will be applied to the

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[59] "[E]stimated maximum loss (EML) Used in fire, explosion and material damage insurance policies, it is an estimate of the monetary loss that could be sustained on a single risk as a result of a single peril, which is considered by the underwriter to be possible." JOHN CLARK, INTERNATIONAL DICTIONARY OF INSURANCE AND FINANCE 130 (1999).

[60] For an explanation of loss ratio, see *infra* Part III.C.1.

[61] FORESTRY DEP'T, FOOD AND AGRIC. ORG. OF THE UNITED NATIONS, GLOBAL FOREST RES. ASSESSMENT 34 (2005), ftp://ftp.fao.org/docrep/fao/008/A0400E/A0400E03.pdf.

[62] Subak, *supra* note 10, at 110 (according to the Forestry Agriculture Organization).

AD offset project.[63] Fourth, the unintentional reversal penalty will be the lesser of half the number of credits that were reserved for that offset project, or half the number of offset credits that were canceled due to reversal.[64] Also, this case study is limited to unintentional reversals and thus any intentional reversals will be outside of this Paper's scope.

Fifth, interviews with insurance professionals revealed that reversals range from four percent (usually when the underlying asset has relatively low risk and has proper forest management) to ten percent (where the portfolio includes riskier assets).[65] These figures are further supported in Susan Subak's forest fire loss analysis, which recorded the cumulative area of loss from fire as a percentage of forest area at between 0.03% (New Zealand) and 13.4% (Argentina).[66] Taking these figures into account, this Paper uses a twenty percent probability of loss as a conservative estimate. Sixth, it accepts that Ghana's average annual "Rate of Deforestation" is 2.0% annually.[67] Seventh, the "Reduced Annual Rate of Deforestation" is 1.5%. Lastly, it is necessary to address "Avoided Deforestation (calculated)." This rate is the difference between the annual rate of deforestation (baseline) and the reduced annual rate of deforestation (new amount). Table 1 lists these assumptions.

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[63] *See supra* notes 27, 35 and accompanying text. ACES does not set a reserve requirement, though some cap-and-trade systems do. CCX, for instance, sets its rate at twenty percent and RGGI, if a developer chooses the "reserve" system, requires a ten percent discount. CCX PROTOCOL, *supra* note 27, at § 8; REGIONAL GREENHOUSE GAS INITIATIVE MODEL RULE § XX-10.5(c)(4) (2008), *available at* http://www.rggi.org/docs/Model%20Rule%20Revised%2012.31.08.pdf.

[64] H.R. 2454, 111th Cong. § 734(b)(3)(B)(ii) (2009).

[65] Telephone Interview with Peter Welten, Vice President of Insurance & Specialty, Swiss Reinsurance Company Ltd. (Apr. 28, 2010); Telephone Interview with James Bryant, Employee, Federated Mutual Insurance Company (Apr. 27, 2010); Telephone Interview with Tomas Arias, Senior Underwriter, Liberty Mutual (Apr. 19, 2010).

[66] Subak, *supra* note 10, at 112.

[67] FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, STATE OF THE WORLD'S FORESTS 110 (2009), *available at* ftp://ftp.fao.org/docrep/fao/011/i0350e/i0350e04b.pdf.

*Table 1: Assumptions and Statistics*

| | **Unit of Measure** | **Units** |
|---|---|---|
| Credit Equivalent (carbon stock) | Carbon tons / hectare | 155 |
| Annual Carbon Uptake | carbon tons / year | 3 |
| Assumed Reserve Set-aside Requirement[68] | Portion of credits | 20% |
| Unintentional Reversal Penalty (paid in credits) | Portion of set-aside | 50% |
| Annual Rate of Deforestation (5 yr avg)[69] | Percent lost | 2.0% |
| Reduced Annual Rate of Deforestation (5 yr avg) | Percent lost | 1.5% |
| Avoided Deforestation (calculated) | Percent avoided | 0.5% |

### *B. Avoided Deforestation Asset Data (Ghana)*

It is necessary to estimate a total area of deforestation to determine the number of AD Forest hectares that will generate carbon credits. By subtracting a calculated reduced rate of deforestation from a baseline deforestation rate or business as usual approach, it is possible to generate an estimated avoided deforestation percentage (0.5%).[70] Multiplying this percentage by the total forested area of a country then yields the total amount of avoided deforestation in hectares (28,000 ha).[71] Using this information in conjunction with the total carbon stock present in forests in West Africa and estimated carbon uptake estimates (Table 1), it is then possible to arrive at the amount of carbon credits generated over a particular time period (22,120,000 tons of CO2).[72] In this case, the time period is based on language in ACES and is assumed to be five years.[73] Based on this information, it is possible to calculate the maximum potential credits that

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[68] "Set-aside" refers to the individual contribution of each AD project to the reserve pool.
[69] Calculated by an average at the end of 5 years, or longer) Section 743(e)(4)(B).
[70] *See supra* Table 1.
[71] *See infra* Table 2.
[72] *Id.*
[73] *See* H.R. 2454, 111th Cong. § 743(e)(4)(B) (2009).

could be forfeited for a reversal penalty (2,212,000 credits).[74] Thus, because this Paper has assumed a reserve requirement of twenty percent, the reversal penalty will never be greater than ten percent of the total asset value, or one-half the credits in the reserve.

*Table 2: Avoided Deforestation Asset Data (Ghana)*

| | **1 year** | **at 5 years** |
|---|---|---|
| Total Hectares of Forest (Baseline) | 5,600,000 | 5,600,000 |
| *Amount deforested per year (business as usual)* | *112,000* | *560,000* |
| *Reduced amount deforested per year (ha)* | *84,000* | *420,000* |
| Avoided Deforestation (ha) | 28,000 | 140,000 |
| Credits Generated (AD ha * 155 tons carbon stock) | 4,340,000 | 21,700,000 |
| Assumed Uptake (AD * 3 tons/yr) | 84,000 | 420,000 |
| Total Credits Generated (credits + uptake)[75] | 4,424,000 | 22,120,000 |
| Credits in Reserve (20% of total credits) | 884,800 | 4,424,000 |
| Maximum Credits Paid upon Reversal (=1/2 of set-aside) | 442,400 | 2,212,000 |

Table 3 takes this analysis a step further and shows possible values that would have to be paid for the maximum penalty of reversal based on a range of offset prices, ranging from $5 to $50 (listed in US$ per ton of CO2). The end value shown in Table 3 of $22,120,000—the expected maximum loss from a reversal penalty—is a key figure that will be used later in the analysis.

By assuming a maximum reversal penalty and a given range of carbon prices listed in Table 3, it is possible to derive the upper and lower bounds of the Ghana project's potential liability. For the purposes of this case study, this Paper accepts that the price of carbon can reasonably be expected to range between $5 a ton and $50 a ton, though it is possible that the

[74] *See infra* Table 2.
[75] "Total Credits Generated" refers to the sum of the credits that will be granted to the offset project and the credits that will be set-aside for the reserve.

carbon market price could fall outside of this range. Accordingly, the expected maximum loss is not the highest possible loss, but rather the highest reasonably expected loss. Although these figures involve a degree of subjectivity, they provide reference points with which to analyze the potential financial consequences of a large-scale reversal.

These high- and low-risk variables are multiplied by a conservative, estimated actuarial risk of loss, which is twenty percent.[76] Using this actuarial figure, the following profitability analysis calculates the expected maximum loss at carbon's assumed low and high price points of $5 and $50 per ton. Furthermore, it is assumed that insurance firms, operating in a new market with numerous unknowns will consider a high price of carbon as a reference point when calculating the EML and will require premiums to cover these high expected losses. Throughout the analysis, it is assumed that insurance companies will only consider a high carbon reference price ($50) and ignore the low ($5).

[76] *See* discussion of assumption five *supra* notes 65–66 and accompanying text.

*Table 3: Potential Reversal Penalties*

| Offset Price (per ton CO2) | 5 yr AD Offset Asset Value (minus reserve)[77] | Cost of Paying Reversal |
|---|---|---|
| $5 | 88,480,000 | 11,060,000 |
| $10 | 176,960,000 | 22,120,000 |
| $15 | 265,440,000 | 33,180,000 |
| $20 | 353,920,000 | 44,240,000 |
| $25 | 442,400,000 | 55,300,000 |
| $30 | 530,880,000 | 66,360,000 |
| $35 | 619,360,000 | 77,420,000 |
| $40 | 707,840,000 | 88,480,000 |
| $45 | 796,320,000 | 99,540,000 |
| $50 | 884,800,000 | 110,600,000 |

| **Cost of Paying Reversal (Financial Liability)** | |
|---|---|
| Low Risk Liability—risk of Reversal Penalty | 11,060,000 |
| High Risk Liability—risk of Reversal Penalty | 110,600,000 |
| Assumed Risk of Maximum Reversal Penalty | 20%[78] |
| *(reversal penalties paid in credits)* | |

| | Low Carbon Value Scenario | High Carbon Value Scenario |
|---|---|---|
| EML | 2,212,000 | 22,120,000 |

## C. *Insurance Profitability Analysis*

The key figure mentioned above—the maximum likely amount of reversal penalty the AD owner faces—is the cost that developers will seek to insure.[79] Assuming that project developers have a reasonable level of risk aversion, they will explore options to mitigate the financial risk associated with potential reversals.

[77] The AD offset value is the total value, minus a reserve portion.
[78] Twenty percent represents the probability of a maximum payment for insurance providers—a conservative assumption of actuarial risk.
[79] *See supra* Table 2.

To determine whether insurance companies will enter this market, it is necessary to examine the logistics of insuring forestry assets, and, more importantly, the expected profitability of these ventures. This Paper assumes that new AD penalty insurance policies can be offered by existing insurance companies.[80] Therefore, this section will focus specifically on whether or not this market could be profitable and assumes that if profitable, it will attract new entrants.

Profitability is comprised of two main factors: revenues, in the form of premiums paid by customers, and costs, estimated in the form of EML. As is standard practice in the insurance industry, companies calculate a loss ratio. Firms use this fraction as a key determination of success and future viability in financial reports. The loss ratio is calculated as the EML divided by the premiums generated by a particular line of business, or individual asset.

$$\text{Loss Ratio} = \frac{\text{EML}}{\text{Premiums Generated}}$$

Following this methodology, this analysis measures the economic viability of AD insurance using the same loss ratio figure.

Referencing the annual reports of Zurich Financial Services Group (a global insurance company), recent loss ratios range close to seventy percent. For example, Zurich shows loss ratios of 70.1%, 70.5%, and 72.6% for 2006, 2007, and 2008 respectively, and each year the firm

[80] Companies that provide coverage for forestry assets in the logging industry (standing timber) are commonplace. *See* Subak, *supra* note 10, at 109 (stating that there are a "handful of countries with extensive experience with forest insurance . . . [including] Portugal, where forest insurance is compulsory for private forestry owners.").

generated large operating profits.[81] Overhead expenses are also included to find a combined ratio. However, as this analysis will show, including overhead expenses is unnecessary since they do not affect the findings of the model.[82]

The analysis next presents two models for calculating the feasibility of reversal penalty payment insurance. This approach addresses the question of viability from both a supply (insurance provider) and demand (developer) perspective.

### 1. Model 1

Model 1 uses the EML (from Table 3) as a loss baseline,[83] and then adds an additional fifteen percent to account for expected overhead costs.[84] The sum of the EML and estimated overhead costs forms an updated EML figure. This new figure becomes the numerator of the loss ratio calculation. The model then determines a premium charge—the denominator—to yield a break-even loss ratio of 1.0 (where premiums received are equal to the expected maximum losses, plus overhead costs). By considering the premium values that would be required to simply earn the break-even loss ratio of 1.0, the model makes a conservative estimate of profitability.

Given the results of the Ghana example, it is important to qualitatively consider whether a rational, risk-adverse individual (i.e. the developer or the country) would be willing to pay the premium fees given the amount of risk that the premium averts in this simplistic model. Keeping

[81] ZURICH FINANCIAL SERVICES GROUP, FINANCIAL REPORT 2007, at 75, *available at* http://zdownload.zurich.com/main/reports/financial_report_2007_en.pdf; ZURICH FINANCIAL SERVICES GROUP, FINANCIAL REPORT 2008, at 70; *available at* http://zdownload.zurich.com/main/reports/financial_report_2008_en.pdf; ZURICH FINANCIAL SERVICES GROUP, FINANCIAL REPORT 2009, at 77, *available at* http://zdownload.zurich.com/main/reports/financial_report_2009_en.pdf.

[82] *See infra* Table 4a and accompanying text.

[83] Presumably, insurance providers will need premiums to cover maximum expected losses, and a reasonably high carbon price scenario is used

[84] Insurance industry contacts referenced overhead charges of five to eight percent for a reinsurance firm, such as SwissRE, and larger for primary insurance firms—in the range of fifteen to twenty percent. *See supra* note 65 and accompanying text.

in mind that the EML is the price of paying a reversal penalty (at a carbon price of $50 per ton of CO2) times the actuarial risk of reversal (at a conservative twenty percent), the insurance company, with obligations to reduce risk for their shareholders, will likely charge premiums based on a higher than expected price of carbon. Therefore insurance companies would eschew the $5 low value of carbon and consider only a $50 price of carbon.[85] Based on this high cost of carbon, the customer (i.e. the developer or nation) would have to pay an insurance company approximately $25.4 million annually in premiums to cover their risk of reversal.[86] As Table 3 illustrates, the maximum reversal penalty would equal $110.6 million. Therefore, the Ghana project would pay approximately one-fourth the cost of the risk that it is trying to avoid each year, and in roughly four years, it will pay enough in premiums to equal the entire cost of a maximum reversal penalty. From the developer's perspective, as it is well above similar premium to risk comparisons in commercial property[87] and standing timber industries,[88] this insurance premium is cost prohibitive. Table 4a walks through this premium to risk comparison.

If developers find it unlikely that carbon prices will spike to $50 immediately—meaning developers would face a potential maximum reversal penalty less than the $110.6 million associated with a $50 carbon price—it becomes even less likely that developers would purchase insurance.

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[85] Due to insurance companies' risk averseness and unfamiliarity with the carbon market, they will likely choose a high carbon price. Insurance companies would most likely revisit these models on a yearly basis, but at the early stages of a U.S. carbon market that accepts international offset credits, a $50 price of carbon is a reasonably high value assumption for a sample year one. However, as these companies become more familiar with this market and get better at forecasting, it is assumed that they will lower pricing structures resulting in a net reduction to the cost of premiums.
[86] *See infra* Table 4a.
[87] *See infra* note 98.
[88] *See infra* note 97.

*Table 4a: Premium Calculation Method 1—Premiums to result in break-even loss ratios*

**Example with 15% Overhead**
Overhead Costs (as a % of premiums): 15%
Discount Rate: 8%
*No profit included - break even*

| | Low Cost Carbon ($5) | High Cost Carbon ($50) |
|---|---|---|
| EML | 2,212,000 | 22,120,000 |
| Overhead Charges (SG&A, agent salaries, IT, etc.) | 331,800 | 3,318,000 |
| Operating Profit | 0 | 0 |
| Premiums required to break even | 2,543,800 | 25,438,000 |

| | Low Cost Carbon ($5) | High Cost Carbon ($50) |
|---|---|---|
| **Loss Ratio:** (EML/Premiums) | 0.87 | 0.87 |
| **Combined Ratio:** (EML + Expenses)/Premiums | 1.00 | 1.00 |

| | |
|---|---|
| Risk being Averted (for the developer) | 110,600,000 |
| Insurance Premiums that must be paid to avoid this risk | 25,438,000 |
| Premium Cost as a Percentage of Risk Averted | 23.00% |
| Years Until Total Premium Payments Equal Payment Risk | 4.35 |

Interestingly, the overhead is of little consequence in the calculations within this model. Table 4b calculates premiums with zero overhead costs included and comes to the same conclusion as shown in Table 4a above. Even with zero overhead costs and zero profit included above a break-even loss ratio, the value of premiums paid is still a large enough fraction (one fifth) of the total risk being insured that prospective buyers would have little incentive to pay these high costs.

*Table 4b: Premium Calculation Method 1—With Zero Overhead*

**Example with Zero Overhead**
Overhead Costs (as a % of premiums): 0%
*No profit included - break even*

| | Low Cost Carbon ($5) | High Cost Carbon ($50) |
|---|---|---|
| EML / PML | 2,212,000 | 22,120,000 |
| Overhead Charges (SG&A, agent salaries, IT, etc.) | 0 | 0 |
| Operating Profit | 0 | 0 |
| Premiums required to break even | 2,212,000 | 22,120,000 |

| | Low Cost Carbon ($5) | High Cost Carbon ($50) |
|---|---|---|
| **Loss Ratio:** (EML/Premiums) | 1.00 | 1.00 |
| **Combined Ratio:** (EML + Expenses)/Premiums | 1.00 | 1.00 |

| | |
|---|---|
| Risk being Averted (for the developer) | 110,600,000 |
| Insurance Premiums that must be paid to avoid this risk | 22,120,000 |
| Years of Payments when Premiums paid will equal the payment risk | 5.00 |

Taking this analysis a step further, one can perform a net present value ("NPV") calculation. Such an analysis calculates the annual premium payments[89] starting at time zero (the first day the AD project is certified), which are to be paid annually for the next four years,[90] in order to calculate the total cost (at time zero) to the developer of all the future payments for insurance (see Table 4c below for an NPV calculation with a high carbon price of $50). This allows a comparison of the total current cost of insurance payments to the price of a reversal penalty. In almost every scenario (from $5 to $50), there is no economic incentive to pay for the insurance, because the present value cost of premiums is higher than the potential cost for a reversal penalty. There is only one carbon price scenario where the developer may have even just a slight

[89] This is assumed to be annual, but based on when or how often the insurance companies would have to pay, it might change to be a term for however often it is verified / reported—"5 year premium" If it is only every five years, more uncertainty would exist for the insurance company and even higher premiums might be charged.
[90] Payments made annually for four years, starting at time zero and covering one year of insurance with each payment will insure a total period of five years.

incentive to pay for insurance, and that is at a carbon price reference point of $50 a ton. Even in this $50 carbon price scenario, the developer will face a present value cost of the premium payments roughly equal to the total financial risk exposure over time, as the NPV of $109,691,883[91] is roughly equal to the $110,600,000 of risk averted.[92] The developer will be, for the most part, economically indifferent—even in this unique price scenario.[93] The present value of payments, and therefore the premiums, would need to be much lower than the total risk averted for the developer to be incented to purchase this insurance.

*Table 4c: Premium Calculation Method 1—Net Present Value Analysis*

| | Years | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | Sum |
| Annual Premium | 25,438,000 | 25,438,000 | 25,438,000 | 25,438,000 | 25,438,000 | |
| PV of Payments *(discounted at 8%)* | 25,438,000 | 23,553,704 | 21,808,985 | 20,193,505 | 18,697,689 | 109,691,883 |

NPV = 109,691,883

Arguably, if the developer expected carbon prices to spike to even higher price levels (e.g., well above $50/ton), he might still desire to hedge this risk with the high-cost insurance. However, in the scope of these sample prices, a developer would not have an economic incentive to purchase reversal penalty insurance. Along with the situation of developers expecting extremely high carbon prices, another possibility is that the developer could purchase carbon future contracts in order to hedge the risk of future carbon price volatility. However, not all developers will have the business infrastructure, economic sophistication, or desire to enter into

91 *See infra* Table 4c.
92 *See supra* Table 4b.
93 *See infra* Table 4c.

these transactions on their own. Overall, the NPV analysis shows that AD reversal penalty insurance is cost prohibitive based on premiums calculated under this model.

### 2. Model 2

The second model analyzes the same problem—the viability for insurance companies to insure reversal penalties for international AD assets—but uses a different approach. Unlike Model 1, which starts by asking what premiums would cover the maximum expected losses for an insurance company, Model 2 assumes that insurance premiums will be charged at a rate comparable to industry averages and as a certain percentage of the coverage. The model then calculates a loss ratio given the premium revenues that these comparable percentage values generate. While Model 1 qualitatively analyzes the viability of insurance from the question of whether developers are willing to pay the premiums that insurance companies would charge to cover expected losses, Model 2 shows reasonable premiums and asks whether insurance companies will be willing to take on this level of risk.

From interviews with insurance industry contacts,[94] a sample premium charge for simple (low risk) property insurance (guarding against risk of loss from fires, theft, etc.) in the United States is approximately fifteen cents per $100 of coverage. However, in using a similar percentage (0.15%) in the profitability analysis, the premiums generated from this extremely low-risk percentage and the high value EML would result in a loss ratio that is exceedingly large (133.33)—well beyond the risk tolerance of an insurance firm.[95] As typical premium charges for

[94] *See supra* note 65 and accompanying text.
[95] *See infra* Table 5a.

insuring forest assets in developing nations range below one percent,[96] consider the loss ratio in the Ghana AD example for a one percent premium charge. At one percent, the loss ratio drops to a 20.00, but this ratio is still over nineteen points greater than anything reasonable for insurance firms. Table 5a displays all of the loss ratios for a given set of premium percentage charges.

*Table 5a: Premium Calculation Method 2–Premium Revenues at Various Rates of Coverage*

| **Annual Premiums** | | | | **Loss Ratios** | |
|---|---|---|---|---|---|
| **Low Cost of Carbon ($5)** | **High Cost of Carbon ($50)** | **Dollars per $100 coverage** | **% of coverage** | **Low Cost of Carbon ($5)** | **High Cost of Carbon ($50)** |
| 16,590 | 165,900 | 0.15 | 0.15% | 133.33 | 133.33 |
| 22,120 | 221,200 | 0.20 | 0.20% | 100.00 | 100.00 |
| 27,650 | 276,500 | 0.25 | 0.25% | 80.00 | 80.00 |
| 33,180 | 331,800 | 0.30 | 0.30% | 66.67 | 66.67 |
| 38,710 | 387,100 | 0.35 | 0.35% | 57.14 | 57.14 |
| 44,240 | 442,400 | 0.40 | 0.40% | 50.00 | 50.00 |
| 49,770 | 497,700 | 0.45 | 0.45% | 44.44 | 44.44 |
| 55,300 | 553,000 | 0.50 | 0.50% | 40.00 | 40.00 |
| 60,830 | 608,300 | 0.55 | 0.55% | 36.36 | 36.36 |
| 66,360 | 663,600 | 0.60 | 0.60% | 33.33 | 33.33 |
| 71,890 | 718,900 | 0.65 | 0.65%[97] | 30.77 | 30.77 |
| 77,420 | 774,200 | 0.70 | 0.70% | 28.57 | 28.57 |
| 82,950 | 829,500 | 0.75 | 0.75% | 26.67 | 26.67 |
| 88,480 | 884,800 | 0.80 | 0.80% | 25.00 | 25.00 |
| 94,010 | 940,100 | 0.85 | 0.85% | 23.53 | 23.53 |
| 99,540 | 995,400 | 0.90 | 0.90% | 22.22 | 22.22 |
| 105,070 | 1,050,700 | 0.95 | 0.95% | 21.05 | 21.05 |
| 110,600 | 1,106,000 | 1.00 | 1.00%[98] | 20.00 | 20.00 |
| 116,130 | 1,161,300 | 1.05 | 1.05% | 19.05 | 19.05 |
| 121,660 | 1,216,600 | 1.10 | 1.10% | 18.18 | 18.18 |
| 127,190 | 1,271,900 | 1.15 | 1.15% | 17.39 | 17.39 |
| 132,720 | 1,327,200 | 1.20 | 1.20% | 16.67 | 16.67 |

[96] Subak, *supra* note 10, at 110.
[97] The Davis-Garvin Agency, of Columbia South Carolina lists rates ranging from 0.65% to 1.25% as reasonable insurance premium rates for standing timber insurance that covers southern yellow pine against fire, lightning, explosion, wind, flood, ice, and theft. Alabama Forest Owners Association, Standing Timber Insurance is Now Available, http://www.afoa.org/CILive/CI050316_b.htm (last visited May 18, 2010).
[98] Charging premiums based on one percent of the asset is a common heuristic for re-insurance providers. Telephone Interview with Peter Welten, Vice President of Insurance & Specialty, Swiss Reinsurance Company Ltd. (Apr. 28, 2010).

| | | | | | |
|---|---|---|---|---|---|
| 138,250 | 1,382,500 | 1.25 | 1.25%[99] | 16.00 | 16.00 |
| 143,780 | 1,437,800 | 1.30 | 1.30% | 16.05 | 16.05 |
| 149,310 | 1,493,100 | 1.35 | 1.35% | 16.10 | 16.10 |
| 154,840 | 1,548,400 | 1.40 | 1.40% | 16.15 | 16.15 |
| 160,370 | 1,603,700 | 1.45 | 1.45% | 16.20 | 16.20 |
| 165,900 | 1,659,000 | 1.50 | 1.50% | 16.25 | 16.25 |

According to the Davis-Garvin Agency, of Columbia, South Carolina, a high estimate for premiums on standing timber insurance would be 1.25%.[100] Yet Table 5b shows that given this relatively high yet reasonable premium calculation, the loss ratios would still be too large to provide incentives for insurance firms to engage in these business opportunities.

*Table 5b: Premium Calculation Method 2 and Corresponding Loss Ratios*

**Loss Ratios Given a premium charge of 1.25 %**

| | **High Carbon Scenario ($50)** |
|---|---|
| **EML** (See Table 3) | 22,120,000 |
| **Premiums** (See Table 5.a) | 1,382,500 |
| **Loss Ratio** (EML/Premiums) | 16.00 |

| | **Low Carbon Scenario ($5)** |
|---|---|
| **EML** (See Table 3) | 2,212,000 |
| **Premiums** (See Table 5.a) | 138,250 |
| **Loss Ratio** (EML/Premiums) | 16.00 |

Though these historical premiums result in extremely large loss ratios for insurance firms, developers will be highly incented to purchase insurance under these more reasonable rates. Table 5c illustrates the different number of years when premium payments will roughly equal the

99 *See supra* note 100 and accompanying text.

100 Alabama Forest Owners Association, Standing Timber Insurance is Now Available, http://www.afoa.org/CILive/CI050316_b.htm (last visited May 18, 2010); Telephone Interview with Peter Welten, Vice President of Insurance & Specialty, Swiss Reinsurance Company Ltd. (Apr. 28, 2010).

total risk of penalty payment for a developer considering this insurance. The Table shows that a developer would have a significantly greater economic incentive to purchase insurance under a 1.25% premium rate plan, rather than the premiums calculated in Model 1.

*Table 5c: Comparison of Premiums from Methods 1 and 2 for a Developer's Willingness to Purchase Insurance*

| Method 1: (Premiums to achieve break-even loss ratios) | | | |
|---|---|---|---|
| | **Max Penalty Payment** | **Annual Premium** | **Years when premium payments equal risk of penalty payment** |
| Low Carbon Value Scenario | 11,060,000 | 2,543,800 | 4 |
| High Carbon Value Scenario | 110,600,000 | 25,438,000 | 4 |
| | | | (Not helpful in hedging financial risk) |

| Method 2: Historical Rate Premium Method (at 1.25%) | | | |
|---|---|---|---|
| | **Max Penalty Payment** | **Annual Premium** | **Years when premium payments equal risk of penalty payment** |
| $5 Carbon Scenario | 11,060,000 | 138,250 | 80 |
| $50 Carbon Scenario | 110,600,000 | 1,382,500 | 80 |
| | | | (Extremely helpful in hedging financial risk) |

Despite the large incentives for developers to purchase the insurance, resulting loss ratios for insurance firms in Method 2 are not economically viable. A review of the loss ratios for insurance firms in Tables 5a and 5b, reveals that insurance companies will not be incentivized to enter the market. The loss ratio is simply well beyond their means to ensure a profitable return for shareholders.

Presumably, insurance firms could disaggregate the risk of high carbon prices from AD insurance opportunities by procuring carbon derivatives—such as futures contracts or call options—for emissions credits. Insurance firms wanting to hedge the risk of AD penalty insurance would buy the exact amount of carbon credits to match the potential obligation they would have to meet with an expected maximum reversal penalty. By engaging in these market transactions, insurance firms could effectively disaggregate any risk from future carbon price spikes from the underlying insurance opportunity. Insurance companies will most likely want to hedge this risk and give themselves a known "price ceiling" with futures contracts. However, as the Table 6b will show later in Part IV, futures contracts can help reduce risk associated with carbon price volatility, but associated loss ratios would still not be profitable.

## IV. Controlling Insurer Risk and Reducing Insurance Premiums

Building on the finding in Part III that insurers will need to charge prohibitively high premiums in order to earn a reasonable return in the initial years of a reversal penalty insurance market, this Part first discusses two potential strategies for capping the risk to insurers, which will allow insurance companies to charge reduced project premiums and still be profitable. Next, it explains problems presented by the potential for multiple reversal events impacting a single term[101] for which offset credits have been issued, and it discusses strategies for capping this risk.

### A. *Capping the Price of Carbon*

Before discussing three options for capping insurer risk, it is worth mentioning that the reversal penalty section of ACES already includes a risk-limiting mechanism. Upon an unintentional reversal in a reserve mechanism, the offset project is not required to compensate the reserve for the total amount of CO2 released. It is only responsible for either one-half of the

[101] This Paper assumes a five-year term.

tons released or one-half of the amount of credits surrendered, whichever is less.[102] Thus, from the outset, the project will not have to secure insurance for an entire reversal, only a maximum of one-half of the credits surrendered to the reserve under the reserve requirement.

1. $1 Million Price Cap

As found in Part III, insurers will insure against the potential expected maximum loss imposed by a covered AD offset project, which, in this Paper's Ghana example, would rise to approximately $110,600,000 given a $50 market price for carbon.[103] As a result, insurers would need to charge approximately $25,438,000 in premiums per year to cover a calculated expected maximum loss and break even. Thus, risk-capping may be needed to make insurance profitable for insurers to enter the market and create insurance that is not cost prohibitive for countries to purchase. Table 6a shows that a price cap of $1 million would be required for an insurance company to charge developers affordable premiums that would result in reasonable loss ratios given historical industry figures.[104] Though a $1.3 million risk cap would result in a 0.94 loss ratio, which would be considered profitable,[105] a $1 million cap and resulting loss ratio of 0.72 allows for additional overhead costs and a reasonable profit margin.[106] The graph that follows Table 6a shows the relationship between various risk caps and resulting loss ratios.

[102] H.R. 2454, 111th Cong. § 734(b)(3)(B) (2009).
[103] *See* Table 3.
[104] *See supra* note 81 (indicating 0.72 to be a reasonable loss ratio for an insurance company).
[105] *See supra* Part III.C.
[106] *See supra* note 81 and accompanying text.

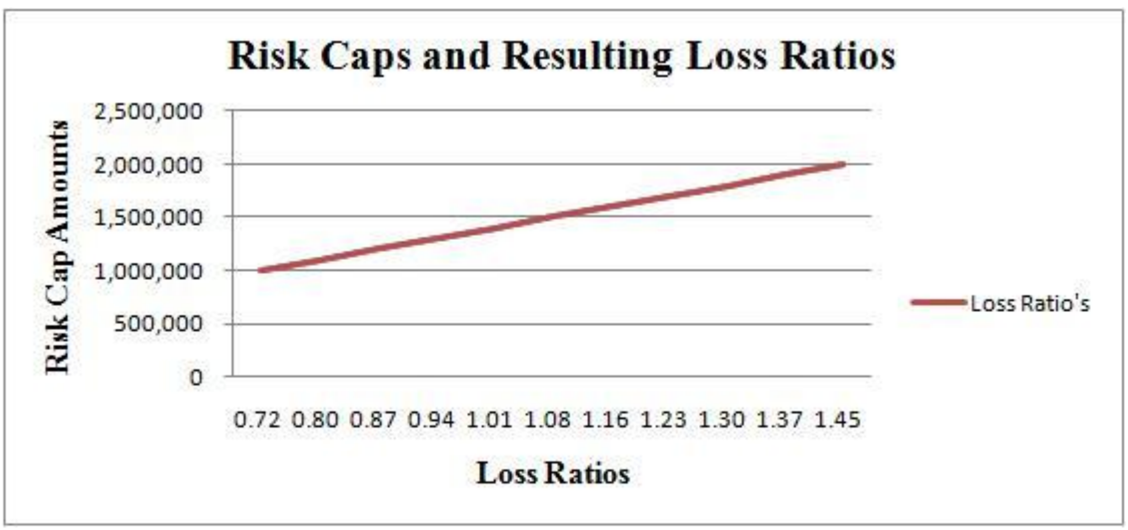
*Table 6a: Premium Calculation Method 2—Loss Ratios with Risk-Capping*

Loss Ratios given the following: a risk cap (to reduce the EML), and premiums charged at 1.25%

| | Low Cost Carbon ($5) | High Cost Carbon ($50) |
|---|---|---|
| **Risk Cap** | 1,000,000 | 1,000,000 |
| **EML** | 1,000,000 | 1,000,000 |
| **Premiums** | 138,250 | 1,382,500 |
| **Loss Ratio** (EML/Premiums) | 7.23 | 0.72 |

Effect of various Risk Caps on Loss Ratios (premium charge of 1.25%)

| Risk Caps | Loss Ratios[107] |
|---|---|
| 1,000,000 | 0.72 |
| 1,100,000 | 0.80 |
| 1,200,000 | 0.87 |
| 1,300,000 | 0.94 |
| 1,400,000 | 1.01 |
| 1,500,000 | 1.08 |
| 1,600,000 | 1.16 |
| 1,700,000 | 1.23 |
| 1,800,000 | 1.30 |
| 1,900,000 | 1.37 |
| 2,000,000 | 1.45 |



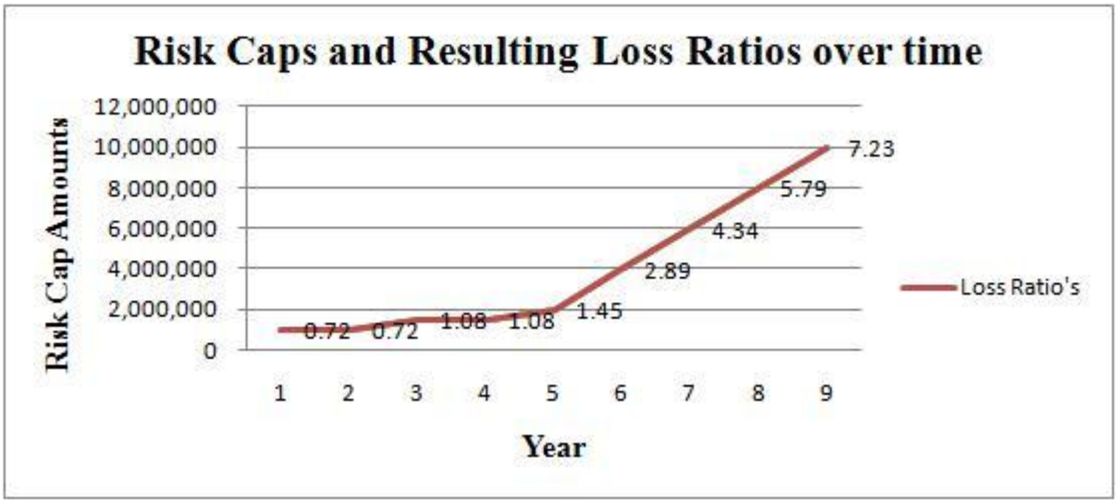

[107] Loss Ratios below 1.00 are assumed to be allows an insurance company to break even.

The graph only shows initial loss ratios and does not account for insurance firms becoming more adept at operating in the AD insurance market. Creating a "phase in" period of risk-capping would allow insurance companies to gain valuable experience in the market, build economies of scale (with agents in the field, operational support activities, etc.), and use the first few years in the market to create more accurate analytical models and develop better risk calculations.[108] Table 6b illustrates the effect of a sample risk-capping program.

*Table 6b: Proposed Risk-Capping Program with Resulting Loss Ratios over Time*

| **Risk Caps** | **Year** | **Loss Ratios** |
|---|---|---|
| 1,000,000 | 1 | 0.72 |
| 1,000,000 | 2 | 0.72 |
| 1,500,000 | 3 | 1.08 |
| 1,500,000 | 4 | 1.08 |
| 2,000,000 | 5 | 1.45 |
| 4,000,000 | 6 | 2.89 |
| 6,000,000 | 7 | 4.34 |
| 8,000,000 | 8 | 5.79 |
| 10,000,000 | 9 | 7.23 |
| End Program | 10 | |

[108] While risk capping may bring insurers into the market, it is possible that insurance companies calculate exorbitant premiums because they are pricing reversal risk correctly. In these situations where the risk of a reversal episode is exceedingly high, then neither the developer nor the insurer's risk should be capped, as not all AD offset projects ideas will be viable.




As shown in Table 6b, the risk-capping is extreme in the beginning to truly incent insurance companies to enter the market in the first five years; then the cap sharply increases from year six onward to protect environmental integrity and gradually phase out government interaction in the marketplace. The graphs in Table 6b illustrate this phase out and the resulting increase in loss ratios. Still, the loss ratios in the graph following Table 6b represent insurance trends without any gains in market awareness or risk modeling accuracy. Despite the increased loss ratios, over time, the risk caps will become less applicable as insurance companies find it increasingly more profitable to insure AD assets with more extensive experience in the market and better knowledge of inherent market risks. Furthermore, risks are expected to decrease as forest management improves.[109]

With regard to Ghana, by establishing a risk cap of $1 million, insurance companies can provide a more reasonable premium charge of 1.25% of the total liability or coverage provided, a

[109] Subak, *supra* note 10, at 110.

cost more in line with standing timber insurance in developed nations. At the same time, by minimizing losses, the loss ratios of an insurance provider will still be competitive. In order to incentivize insurance firms, the cap should be equal to or less than $2 million, though a cap of $1 million may be required to incentivize insurance firms.[110] While Ghana's cap appears low, all risk caps depend on the amount of forest assets a country has in place. In other words, there is a direct relationship between available forest assets and the risk cap. For example, insurance providers covering AD in Indonesia or Brazil could maintain profitable loss ratios with much higher risk caps. Therefore, it is important that the Administrator set risks caps in each country after a careful examination to ensure that caps are set high enough to ensure environmental integrity.

One may assert that insurance firms can use carbon derivatives (such as futures contracts) to hedge the risk of future carbon price spikes. But even with hedging, loss ratios are still too large to be profitable. Considering the components of the loss ratio, hedging will effectively put a price ceiling on the EML, while keeping the premiums the same. The numerator in the new loss ratio calculation changes from the cost of paying for a reversal penalty at a $50 price of carbon, to the cost of paying for a reversal penalty at a $30 price for carbon, or $13,272,000 annually.[111] The denominator in the loss ratio stays the same and is based on premiums generated from charging 1.25% of the coverage provided at an expected $50 price of carbon (resulting in total premiums of $1,382,500[112]). Thus, with future carbon prices locked in at the lower rates ($30)

[110] See Table 6a for a recommended ten-year risk-capping program.
[111] *See supra* Table 3.
[112] *See supra* Table 5a.

and considering premiums at 1.25%, loss ratios will decrease from 16.00 to 9.60. If the insurance firm were to lock in carbon prices of $20, the resulting loss ratios would decrease even further to 6.40. As a result, locking in a $30 price for carbon decreases loss ratios by 40%, and locking in a $20 price for carbon decreases loss ratios by 60%. Yet, despite these decreases, the resulting loss ratios are still exceedingly high—well above the break even 1.0.[113] Consequently, despite the fact that hedging with futures contracts could benefit insurance firms (and they will most likely have an incentive to pursue such hedging strategies), firms will still not be economically incented to enter the AD penalty insurance market without additional risk control measures that are beyond market derivatives. Providing a $1 million risk cap as shown in Table 6a will provide a greater economic incentive.

*Table 6c: Premium Calculation Method 2—Loss Ratios with Hedging Through Derivatives*

Loss Ratios Given the following:
Premium charges of 1.25% of coverage
Carbon price estimate of $50
C*arbon price guarantee of **$30/ton** (hedging with futures)*

| | |
|---|---|
| **EML:** Cost of Reversal at $30 (see Table 3) * Actuarial Risk of Reversal (20%) | 13,272,000 |
| **Premiums:** charged on $50 price estimate and 1.25% coverage (see Table 5a) | 1,382,500 |
| **Loss Ratio:** (EML/Premiums) | **9.60** |

Loss Ratios Given the following:
Premium charges of 1.25% of coverage
Carbon price estimate of $50
*Carbon price guarantee of **$20/ton** (hedging with futures)*

| | |
|---|---|
| **EML:** Cost of Reversal at $30 (see Table 3) * Actuarial Risk of Reversal (20%) | 8,848,000 |
| **Premiums:** charged on $50 price estimate and 1.25% coverage (see Table 5) | 1,382,500 |
| **Loss Ratio:** (EML/Premiums) | **6.40** |

[113] *See infra* Table 6c.

### 2. Carbon Market Price Collar

A second option for controlling insurance risk associated with reversal penalties is to set a price collar on carbon. While the prudence of imposing a price collar on carbon is contentious and has broad implications for environmental and business integrity, a price collar would provide a risk ceiling for insurers. For example, if the price collar were set at $40, the maximum potential cost of a reversal in the model would fall by over $22 million.[114] However, even if this would reduce the overall risk for insurers, consequently reducing premiums, project developers would not have any additional incentive to purchase insurance because the relationship between premiums and their loss exposure would remain constant and still be cost prohibitive.[115]

### 3. Carbon Reversal Penalty Price Collar

Even without an actual price collar on carbon, the Administrator could deem a price ceiling on carbon solely for the purpose of calculating a reversal penalty insurance payout. For instance, consider a project required to pay a reversal penalty of 10,000 tons of carbon at a time when the market price for offset credits is $45. In such a "forgiveness method," the Administrator could deem carbon to be priced at $40, resulting in a cost to the project insurer of only $400,000 (a capped price of $40 * 10,000 tons), as opposed to $450,000 (the true market price), toward the purchase of market offset credits to supply the reserve. In essence, the project developer and the insurer would only have to purchase $400,000 worth of offset credits to contribute to the reserve, which results in 8,888 credits (400,000 / 45).

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[114] *See supra* Table 3 and subtract the cost of paying reversal at a $40 carbon price ($88,480,000) from a $50 carbon price ($110,600,000).
[115] *See supra* Tables 4a and 4b for an illustration of the proportional nature of premiums to the risk avoided.

Another variation would be to continue requiring the project to supply 10,000 credits and require the insurer to apply only $400,000 towards the purchase of those credits. The remaining $50,000 could come from a universal emergency reserve fund established for this purpose. Such a fund could be funded by charging insurers a fee on each ton of carbon insured. This second option would better preserve environmental integrity compared to setting an artificial carbon price ceiling as more offset credits would be retired. Yet there is the possibility that an insufficient number of insurance providers would exist to fully supply this fund. In such a situation, the system could revert back to the artificial ceiling and forgiveness method.

#### 4. Preserving Environmental Integrity

Environmental integrity likely will be adversely affected by each of the three price caps suggested above. However, further analysis is required to determine whether the environmental cost outweighs the environmental gains achieved through encouraging the creation of offset projects through cost controls. For instance, it is possible that these risk-capping measures will serve only to limit risk on the actuarial tables and balance sheets of insurance companies. If the price of carbon never reaches the cap (which was set at $40 in the example above), then these risk-capping mechanisms would reduce an insurer's risk and project premiums without negative environmental impacts. Increasing price caps also preserves environmental integrity, by setting a price cap (whether it be an absolute risk of loss cap proposed in Part IV.A, a real market-price cap in carbon, or a deemed price-cap on offsets) low enough to encourage a nascent market and then "stepping up" the cap over time.[116] As carbon markets mature, insurers may be able to tolerate a higher price cap since if the size of the AD offset project pool increases and actuarial reversal risk models improve.

### *B. Multiple Reversal Liability Cap*

While the analysis in Part III only accounts for one reversal per project per term, AD projects may experience multiple reversal events requiring multiple payouts. Consider a project that, after five years, receives 800 offset credits after a reserve requirement of 200 credits (1,000 total tons sequestered and a twenty percent reserve requirement rate). Then, an unintentional reversal occurs on year six, totaling 100 tons. The project pays a reversal penalty of 50 offset credits. Six months later, there is another reversal of 100 tons, requiring the retirement of another 50 offset credits. At year seven comes a third such reversal, and in year eight a fourth such reversal. This would result in a total cumulative reversal penalty of 200 credits. However, if there had been just one 400-ton reversal, the reversal penalty would have only 100 credits.[117] As there is no cap on the number of potential reversals, insurance companies would calculate maximum risk when estimating the risk of multiple reversals, which, again, could lead to higher premiums. To address this situation, the Administrator could set the maximum amount of reversal penalty payments to be cumulatively no more than half the credits set-aside under the reserve requirement for the affected project, which parallels ACES's provisions for a single reversal.

[116] *See supra* Part IV.A.1.
[117] In the event of a 400 ton reversal, ACES requires the project to retire either one-half of the amount of the reversal (200 tons) or one-half the amount of credits placed into the reserve initially, which would be 100 credits (200÷2=100), which ever is less. Thus, a project that set aside 200 credits and experiences a 400 tons reversal only incurs a reversal penalty of only 100 credits.

This may sacrifice environmental integrity for market stability as it limits the total number of credits to be retired, unless the reserve pool was always sufficiently populated to cover projected incidental risks of loss. While the efficacy of each price cap discussed in this Part requires further research, some strategy or combination of strategies will need to be employed in order to spur a reversal penalty insurance market for AD offset projects.

## CONCLUSION

In light of the emissions mitigation potential of AD offsets by 2030—roughly twenty percent of total global emissions today,[118] U.S. climate change legislation should encourage AD offset projects. While ACES takes steps toward encouraging these offsets, ambiguities in the bill create uncertainty for project developers and insurers considering market entry. Revising the legislation to require the Administrator to utilize a reserve mechanism and to expressly allow reversal penalty insurance would be a strong step towards encouraging market development, thereby increasing the environmental impact of the bill.

After conducting a financial analysis that examines the potential costs of reversal penalties and assessing the probability of insurance policies covering these penalties (for a hypothetical, national-level avoided deforestation project located in Ghana), this Paper finds that some strategy or combination of strategies will be required to encourage insurers to offer reversal penalty insurance with reasonable premium levels. It may be that these decisions are made in the administrative rule-making process rather than in the legislative process. In either case, environmental integrity concerns lead to inclusion of a reversal penalty, and AD offset project

[118] *See supra* notes 2–4 and accompanying text.

developers could benefit from some form of affordable insurance mechanism to offset the risks associated with such penalties.