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WHAT IS ADDITIONALITY PART I

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Part 1: A long standing problem

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What is Additionality?
Part 1: A long standing problem

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ABSTRACT

This article is the first in a three-part series whose overall aim is to more precisely define the terms "additionality" and "baseline" in the context of environmental policy and propose a conceptual framework for applying these concepts within offset programs. The elaboration of precise and theoretically well-grounded definitions of these terms is a necessary precursor to their application in real world offset programs in a way that allows programs to operate with both greater credibility and effectiveness. Through a historical analysis and literature review, it is shown that the current language employed to define additionality and baseline in greenhouse gas emissions offset policy is imprecise and that major offset programs and standards are built upon circular definitions. The root of these problems is a failure to explicitly recognize and specify a policy intervention. A failure that has abandoned additionality and baseline assessments to politics and *ad hoc* justifications. Definitions of additionality and baseline are proposed that are intended to be broadly applicable to offset policies and programs addressing any public goods issue at any scale, from traditional project-based initiatives to new scales transcending traditional offset projects.

KEYWORDS
additionality, offsets, standardized approaches, baseline scenario, environmental markets

1 Introduction

Emissions trading programs and other environmental markets have grown in number and size over the last several decades, and, the former at least, are generally seen as being a cost-effective and efficacious policy mechanism. One form of environmental market, however, has been subject to repeated criticism: offsets. At the heart of these critiques is often implicitly or explicitly the concept of additionality, the defining characteristic of an offset, as it justifies the creation of a tradable environmental instrument that represents a real benefit that can compensate for harm occurring elsewhere.

This article is the first in a three-part series whose overall aim is to more precisely define the terms "additionality" and "baseline" in the context of environmental policy and propose a conceptual framework for discussion and application within offset policies and programs. The elaboration of more precise and theoretically well-grounded definitions for these terms is desperately needed to enable real-world offset programs to improve their credibility and effectiveness.

The intended audience for these articles includes policy makers, environmental market practitioners, and social scientists. Significant attention is given to greenhouse gas (GHG) emission offsets as a case study; however, the findings and framework presented are intended to be applicable to any type of environmental as well as non-environmental offset policy.

This article first discusses the purpose of additionality and the challenges in its application. It then provides brief historical and literature reviews, focusing on the problems with the terminology and language that has been used to define additionality and baseline. I show that many current offset standards and programs are based upon definitions of additionality and baseline that are circular. I find that the literature on additionality and baselines commonly fails to clearly and consistently define the policy intervention created and recognized by offset programs. I then propose a definition of additionality and baseline that is part of a broader framework for applying these concepts with less ambiguity, thereby better enabling the development of more standardized approaches. This framework is explored in the second article in this series, while the third article focuses on the issue of stacking that can occur when a single activity generates multiple potentially creditable environmental benefits (e.g., ecosystem services).

Unfortunately, and despite years of debate within the environmental policy community, there is no commonly held precise understanding of what additionality means or how to best implement it. This lack of progress is surely inhibiting consensus on environmental policy design issues as well as the development of environmental markets by reducing stakeholder confidence in the claims that tradable environmental commodities are intended to represent. A key reason for taking this seemingly conceptual issue seriously is this: if the additionality concept is perceived by policy makers and the public as inherently dubious and/or problematic, then political support for emission offset policies, and potentially environmental markets more generally, could further erode.[1]

Several authors have examined problems with offset programs—often focusing on the Clean Development Mechanism (CDM), the world's largest GHG emissions offset scheme—and have cited the "additionality" of offset projects as a leading source of concern (Gillenwater, Broekhoff et al. 2007; Schneider 2007; Wara 2007; OQI 2008; Wara and Victor 2008; Haya 2009; OQI 2009a; Hayashi, Müller et al. 2010; Bushnell 2011). For example, the most common reason for the rejection of proposed CDM emission reduction projects has been the inability of project proponents to demonstrate additionality using the CDM process for doing so (WB 2009; Gillenwater and Seres 2011).

But before exploring the topic further, let us first discuss a prerequisite: what is an offset? The relevant dictionary definition of "offset" refers to something that counterbalances or compensates for something else with some measure of equivalence (Webster 1986). It is a concept that is not unique to environmental markets. However, it is within GHG emission markets that the issues related to offsets and additionality have received the most attention.

How do we offset the harm caused by someone or something else? In the simple terms, one does something that results in extra good that is equivalent—in magnitude, approximate timing, and recipient

[1] An added challenge is that some policy makers may resist more precise definitions of additionality and baseline for strategic reasons (e.g., to maintain regulatory discretion).

population—to the original harm done. The key questions are: how do we define what is "extra" and to what is this "extra" measured against? These are just another way of asking about additionality and the baseline against which additionality is assessed.[2] One cannot examine the topic of offsets without understanding additionality.

Conceptually, additionality is a determination of whether a proposed activity will produce some "extra good" in the future relative to a reference scenario, which we refer to as a baseline. In other words, additionality is the process of determining whether a proposed activity is better than a specified baseline.

In the context of offsets, a baseline is a quantified amount of good or harm produced by the behavior of the actors proposing and affected by the proposed activity in the absence of one or more policy interventions, holding all other factors constant (*ceteris paribus*). In other words, the concept of a baseline is defined by the absence of the specified policy intervention that is created by the offset policy or program. Explicit and careful identification of policy interventions has been a key missing element in reaching consensus on more precise definitions of additionality and baseline.

Overall, additionality is about assessing causation. It is about deciding if a proposed activity is being caused to happen by a policy intervention.[3] We perform this assessment by deciding if a proposal is different than its baseline, which is defined as the scenario absent the same policy intervention. The concept of additionality is further grounded in an assumption that policy interventions can cause behavior change.

Although techniques for assessing additionality and baselines have been developed, implemented, and debated for years, especially within the climate change policy community, insufficient attention has been given to defining and specifying policy interventions as well as cause and effect relationships. These issues are at the core of these articles.

2 What is the role of additionality?

First, what is the purpose of an offset program? Primarily, it is to "capture"[4] certain public benefits, such as GHG emission reductions (or removal enhancements), in a way that is more cost-effective than would be possible using other policy mechanisms. In part, offset programs achieve increased cost-effectiveness by using a market-based mechanism that incentivizes private actors to search for and locate low cost opportunities that policy makers either cannot access or lack information on. Typically, an offset program is thought of as issuing tradable credits that can be used in lieu of some other mandatory (or voluntarily imposed) compliance obligation, such as substitution for an emission allowance under an emissions cap-and-trade system. Offset credits are generally issued by a governing offset program, either governmental or non-governmental, and are targeted to activities not easily identified or incorporated into other policy mechanisms (Bushnell 2010; Gillenwater and Seres 2011).

Although, the demand for offset credits is typically thought of as coming from a quota-based market (e.g., cap-and-trade), demand for offset credits can derive from a variety of sources.[5] For the purposes of this

[2] Additionality has at times also been referred to as "surplus," meaning public good benefits that are surplus to what would have been provided under baseline conditions (ELI 2002).
[3] I will discuss in Part 2 of this series the implications of thinking of additionality (i.e., causation) as a binary condition or a probabilistic one.
[4] By capture, I mean to identify and implement activities that will produce public goods.
[5] Offset programs require some source of demand for their credits. Examples of such a mechanism include, but are not limited to: direct government purchases, government mandated purchases and retirements, voluntary purchases, or linkage to quota-based trading systems. For example, voluntary offset markets can be thought of as individual parties imposing compliance quotas on themselves, which they then satisfy in part or in whole with offset credits.

article, though, the concept of additionality can be considered independent of the source of demand for credits.

Additionality is not only an essential quality criterion for offset credits (Trexler, Broekhoff et al. 2006; OQI 2008; OQI 2009a); it is fundamental to the very definition of an offset. Additionality and baselines are also used to constrain the supply of credits in a market. In an environmental commodity market, a mechanism is needed to create a scarcity, since the underlying commodity is typically a public good. In the case of offset programs, scarcity is created by separating the activities eligible to receive credits from those that are not, and then only issuing credits for demonstrated performance improvements to the former group (OECD/IEA 2000).

Additionality also distinguishes offsets from another policy mechanism: economic subsidies.[6] Subsidies can be used to influence behavior and produce extra public goods. But unlike offset credits, subsidy programs rarely involve rigorous procedures to determine whether a recipient of a subsidy would have engaged in the desired behavior even in the absence of the subsidy. If true, then the purpose of assessing additionality is to exclude that receipt[7] from the program (Bernow, Kartha et al. 2001; OQI 2008).[8]

The lack of a reliable process for determining additionality and baselines within an offset program not only subverts potential public benefits from the mechanism, it can also harm those who might appear to benefit from laxness. Asuka and Takeuchi (2004) showed that a lax additionality process under the CDM could actually cost recipient countries (in the form of a lower market price for credits) more than the lax process would benefit them (in the form of greater credit sales volume). Ultimately, errors in additionality and baseline determinations will reduce both the environmental and economic gains of the mechanism, for example, though increased pollution and a less efficient allocation of investment resources relative to an error-free offset program (Fischer 2005).

The additionality and baseline of a proposed activity are grounded on a prediction of behavior under conditions different than those in which the proposal was made. The ability of offset program administrators to make these predictions will, in most cases, be imperfect (Trexler, Broekhoff et al. 2006; Murray, Sohngen et al. 2007). But, does this lack of perfection mean that additionality is impractical to implement, as has been suggested (Haya 2009; Schneider 2009b)?[9] Given that additionality is fundamental to the definition of an offset, if it is impractical to apply in real-world offset programs, then policy makers should abandon offsets as a viable policy option.

For policy making, this question should be reframed as: Do we have sufficient confidence in our ability to predict behavior within the classes of activities included in an offset program to meet our policy objectives? It is known that there are at least some classes of activities where we have high confidence in our predictive abilities. These classes include activities in which the only benefits to those proposing them, and therefore only reason for engaging in them, come from the recognized policy intervention. For example, in the context of GHG emissions, capturing and flaring methane from abandoned and isolated coal mines constitutes such a class. If it is not legally mandated, there are no benefits to a private actor that implements this type of activity other than offset credits (Greiner and Michaelowa 2003; Trexler,

The origins of demand in a voluntary market are the psychological and/or marketing (e.g., public relations) value to buyers (unless driven by pre-compliance interests).

[6] Similarly, additionality differentiates offsets from certificate-based schemes such as Renewable Energy Certificates (RECs) (Gillenwater 2008a; Gillenwater 2008b; OQI 2009b).

[7] Also referred to as a "free rider" (Chandra, Gulati et al. 2010).

[8] Additionality can also be thought of as a type of inverse price discrimination that intends to screen out inframarginal suppliers under the pre-subsidy demand curve.

[9] "There is no practical way to assess in a reliable manner whether a project is implemented as a result of the CDM incentive" (Schneider 2009b).

Broekhoff et al. 2006; WB 2009). Although such obvious examples are limited, the point is that the application of additionality is not inherently impractical in all cases, and therefore we can dismiss those that reject offsets as an inherently impractical policy option for all classes of activities.

The primary advantage of an offset mechanism relate to the use of a market-based mechanism that identifies and implements activities that would be missed, or captured at greater cost, by other policy mechanisms. By incentivizing the private sector, it would seem reasonable to expect that an offset mechanism has the potential to perform with greater cost-effectiveness than alternative policy mechanisms for addressing some classes of activities.

However, offset programs, relative to other policies, have the potential to entail greater implementation costs associated with the assessment of additionality of and baselines for proposed activities.[10] Offset programs will involve errors in the assessment of additionality and baselines. These errors can include false positives (Type I errors), in which non-additional activities are incorrectly recognized as additional; false negatives (Type II errors) in which truly additional activities are incorrectly rejected (Chomitz 1998; Trexler, Broekhoff et al. 2006); as well as errors in the quantification of baseline performance.

A better question for policy makers is then: For each specific class of activities, can additionality be assessed and baselines predicted with sufficient accuracy so that the incremental benefits of an offset mechanism outweigh the incremental costs relative to the policy alternatives? In other words, the objective is to design offset programs that are better than the alternative policy options, which is done by minimizing errors in additionality and baseline assessments while controlling transaction costs. Additionality assessments and baseline predictions do not have to be perfect for an offset mechanism to be a practical policy option; they only have to be accurate enough so that, for a given class of activities, an offset program is as good as or better than the competing policy alternatives.

3 Why is additionality challenging to apply?

In assessing additionality and predicting baselines, offset program administrators face a number of challenges, although none of these challenges are unique to offset policies.

Comparison to an unobserved scenario. For a given proposed activity or class of similar activities, additionality is assessed relative to an unobserved baseline, which represents a scenario under identical conditions except for the absence of a recognized policy intervention.[11] Although, it may be possible to observe the behavior of an actor under the influence of a policy intervention and another similar actor under near identical circumstances where the policy intervention is absent, it is rarely possible to simultaneously observe the behavior of the same actor under the same conditions both with and without the policy intervention present.

[10] The costs referred to involve all actors involved in the offset program, including participants and administrators. There are also other costs such as monitoring (or measurement), reporting, validation, and verification as well as methodology development. It is important to remember that other policy mechanisms will have their own problems, errors, and transaction costs. Any comparison of an offset program with alternatives should not fall into the classic trap of comparing a realistic option with an idealized alternative.

[11] Although common in the literature (e.g., Millard-Ball and Ortolano (2010)), the term "counterfactual" can be misconstrued when discussing baselines or additionality. Counterfactual is defined as something that is contrary to the facts or not reflecting or considering relevant facts. Models of behavior based on proper causal inference are not best described as being contrary to relevant facts, although the term counterfactual is often used in social science. Observations (i.e., facts) from related cases or experiments can be used to develop models that predict behaviors in similar or identical situations. These models are unlikely to be perfect representations of the original case, but, unless conducted with no consideration of good causal inference methodologies, they can be based on observed facts. Therefore, the term "unobserved" is used here instead.

Asymmetric information and misaligned incentives. Offset program administrators require information from actors proposing activities to assess additionality and predict baselines. Like other situations where regulators face the challenge of asymmetric information (Akerlof 1970), actors proposing activities have an incentive to provide biased information (Rentz 1998; Meyers 1999; Gustavsson, Karjalainen et al. 2000; Ferraro 2008; Bushnell 2011). More specifically, actors have an incentive to provide biased information that will increase the likelihood that program administrators will deem their proposed activity additional and assign them a more favorable baseline.[12] Aggravating this challenge are two other problems. First, both the seller and buyer of offset credits tend to benefit from the approval of a non-additional activity; therefore, a third party is needed to assure offset quality (Michaelowa 2009a).[13] Second, the most cost-effective activities—because only a small incentive is needed to cause their implementation—are also the activities that are more likely to result in false negative additionality determinations (Meyers 1999; Greiner and Michaelowa 2003; Bushnell 2011).

Multiple factors influencing behavior. The actual behavior of actors is likely to be a function of multiple variables (i.e., factors), including, but not limited to, variables affected by the recognized policy intervention, as well as random noise inherent in natural and social systems. Actors can also vary in their objective functions (e.g., minimum acceptable profit for an investment) and their expectations of future performance and risks (Greiner and Michaelowa 2003).

Subjectivity. Due to the challenges listed above, there is inherently some subjectivity in the assessment of additionality and prediction of baselines, which has been critically noted by some researchers and program participants (Schneider 2007; Wara and Victor 2008; IETA 2009). Although standardized approaches can enable more objective assessments there will inevitably be some subjective judgments in the setting of standards.

Addressing these challenges entails administrative and other transaction costs associated with measurement, reporting, and verification (MRV) and investigations to support standard setting. In the case of CDM, research on the transaction costs suggests that they are unlikely to exceed the economic gains from the use of an offset mechanism for many types of projects (Michaelowa and Jotzo 2005; Antinori and Sathaye 2007; Wetzelaer, van der Linden et al. 2007). The application of more standardized approaches to additionality and baselines under the CDM and other offset programs should reduce some transaction costs (e.g., related to proposal development and validation) while increasing others (e.g., related to upfront research and development of evidence-based predictive models for building standardized approaches).

4 Additionality as a broadly applicable concept

Although, air and water pollution are common applications for offset mechanisms, the concept of additionality is not unique to environmental policy. It is relevant to other fields of public policy and public finance (Pearce and Martin 1996; Brown, Bird et al. 2010) as well as being fundamental to social

[12] One could also make an argument that in some circumstances actors may not be aware of how they would actually behave under a policy intervention-free scenario. They also would have no incentive to collect data that might question the additionality of their proposal.

[13] Within an offset credit trading market there will typically be three roles involved: program administrators (i.e., regulators and their designated auditors), actors proposing activities, and buyers of any resulting offset credits. Unlike transactions of tangible goods and services where buyers can directly confirm the quality of goods and services delivered, offsets represent public goods (e.g., GHG emissions), are intangible, and therefore lack this incentive because the public, instead of the buyer, suffers the losses resulting from acknowledged poor quality. Program administrators (with the support of auditors or verifiers) represent the interests of the public with respect to offset quality.

science (King, Keohane et al. 1994) and program evaluation (Khandker, Koolwal et al. 2010). It is especially relevant to any policy mechanism where credit is given for supplying a public good if those credits are used to offset (i.e., compensate for) a harm caused elsewhere (Valatin 2009). Potential applications include water or energy consumption and conservation, biodiversity, land development and preservation (e.g., wetlands), and other natural resources (Bennett 2010). The discussion and conclusions presented in this series are intended to have broad applicability. However, to elaborate some points and provide a useful case study, I focus on experience with GHG emission offset policy.

Additionality and baselines are relevant at a variety of scales—such as individual project activities, multi-project bundles (e.g., program of activities under CDM), products, technologies, organizations, economic sectors, or political jurisdictions (e.g., province)—where credit is awarded for performance improvements. The generic term "activity" is used in this article to refer to all of these scales. Readers more familiar with GHG emission offset discussions can mentally substitute the word "project" for "activity" as they read.

5 Literature review

This section provides a brief literature review on additionality primarily within the context of climate change policy. Readers not interested in a literature survey may choose to skip this section without limiting their ability to follow the remainder of the article.

Although much of the environmental policy literature on additionality and baselines focuses on issues related to CDM, Chomitz (1998) and Rolfe (1998) provide earlier discussions as well as an early literature review. Baumert (1999) and Baumert (2000) provide a snapshot of the conceptual framing that came out of the Kyoto Protocol negotiations. And Michaelowa and Fages (1999) and Gustavsson, Karjalainen et al. (2000) discuss various approaches to selecting a baseline scenario and provide an early literature review on baselines.

Sugiyama and Michaelowa (2001) provide a literature review on additionality as well as examples of similar additionality and baseline issues faced by: i) energy Demand Side Management (DSM) programs in the United States, ii) the multilateral fund for the Montreal Protocol, and iii) GEF funding processes. Chomitz (1998) also provides a useful, and more in-depth, discussion of lessons learned from U.S. DSM programs.[14]

Asuka and Takeuchi (2004) provide an updated literature review on additionality with an insightful chronological analysis of the debate over additionality within the CDM Methodology Panel and Executive Board. The result of this debate was the use of the ambiguously defined term "project additionality" and a process that focused on tests for additionality. A fault with the Meth Panel's well-intentioned effort was that it did not clearly define what was being tested for. Greiner and Michaelowa (2003) discuss the need for a more rigorous foundation to additionality and evaluate the use of investment (i.e., financial) analysis approaches. Bode and Michaelowa (2003) analyze the question of additionality in terms of a single economically rational investor who is trying to maximize his or her profit. Further literature reviews have been provided by Shrestha and Timilsina (2002) and Paulson (2009). Valatin (2009) focuses on approaches for assessing additionality for forestry projects.

[14] A critical distinction between offset crediting of individual project activities and DSM programs implemented at the utility level is that the latter adjusts for free riders in aggregate. In other words, with DSM programs it has not been necessary to make determinations on the additionality of individual proposed activities because all activities are viewed to have been implemented by a single actor (the utility) and credit awarded to the utility as a whole can be statistically adjusted.

Vermont (2008) and Menges (2003) suggest, due to the challenges related to assessing additionality, that its assessment simply be left unregulated. They instead suggest that regulators let the market and offset credit consumers' preferences for the appearance of additionality to govern offset quality. Similarly, Sugiyama and Michaelowa (2001) propose that reputation effects could govern international offset markets by transparently labeling offset credits with the identities of their project developers and host countries.

Schneider (2007) and Schneider (2009a) focus on critiquing the application of additionality under CDM and JI. Specifically, Schneider (2009a) concluded, based on a detailed study of 93 projects, that CDM's tools for demonstrating additionality resulted in highly subjective results that were difficult to validate due to lack of transparency (i.e., poor documentation) as well as a lack of evidence to justify additionality claims. For example, he found that CDM projects that would be expected to use similar hurdle rates for their investment analysis (e.g., similar projects from the same host country) do not and often fail to support their asserted hurdle rate with evidence. He further critiqued the CDM additionality process as lacking a detailed reporting framework and standardized guidelines for validating additionality claims. Schneider's findings demonstrate the problems created from a failure to establish a sound definition for additionality. Similar conclusions were reached by Michaelowa and Purohit (2007) and Haya (2009). The former analyzed the additionality assessments for a sample of 52 CDM projects and found a lack of documentation and variability in the thoroughness of proposal reviews.

Au Yong (2009) also analyzed CDM based on a sample of 222 projects and a calculation of the change in internal rate of return (IRR) due to the expected revenue from CDM offset credits (i.e., Certified Emission Reductions or CERs) found in each project proposal. She found that the median change in the IRR for the projects sampled was 2.7 percentage points, with clear differences between project types. Biomass projects, including landfills, showed the largest IRR change, while wind and hydropower projects showed the least, with fossil fuel switching projects being intermediate. As an example, she applied a threshold of two percentage points change in IRR, which she treated an indicator of questionable additionality and found that 26% of projects sampled fell below this threshold. Similarly, Sutter and Parreño (2007) and Alexeew, Bergset et al. (2010) used the change in the reported IRR of CDM projects and found that some project types appeared to be more likely to be additional than others based on a financial analysis.

More recently, Bennett (2010) provided an insightful discussion of the issues and options for applying additionality within the context of broader ecosystem services markets. She highlights the limited application of the concept of additionality in payment for ecosystem services programs.

6 A demonstration of imprecise language

The language used for describing and defining additionality and baselines in the literature and by GHG emission offset programs is, with few exceptions, imprecise, varied, and internally inconsistent, thereby leading to confusion when program administrators and other stakeholders attempt to interpret and apply the concept. This definitional ambiguity has caused problems for investors and the ability of programs, such as CDM, to achieve greater scale (IETA 2009). It has also exposed emission offset programs to criticism (Wara and Victor 2008) and claims that offset policies are inherently flawed because of additionality assessment issues (IR 2008; FOE 2009).

Typical examples of language used to define additionality and baselines include the following, which illustrates both diversity in terminology and a general lack of precision:

- beyond "business-as-usual" (OECD/IEA 2000);[15]

[15] Business as usual (BAU) is ambiguous term because it implies current or historical conditions should be the baseline. This problem can be solved by viewing the concept of BAU as forward looking.

- “without project scenario," "no action case," and "no-project scenario" (OECD/IEA 2000);
- "would the project have happened anyway?" (CRS 2007; Wara and Victor 2008);
- "the emissions that would have occurred without the project" (CRS 2007);
- "what would have happened otherwise" or "what would have occurred otherwise" (OECD/IEA 2000; WB 2009);
- emissions "in the absence of credits" (Bernow, Kartha et al. 2001); and
- "emissions in the absence of an offset" (Bushnell 2010).[16]

Paulson (2009) provides a typical illustration of the type of language used to define additionality and baseline: "The baseline is a counterfactual scenario describing the amount of GHGs that would be emitted if the project was not implemented, that is, under business-as-usual circumstances."

A review of the climate change policy literature shows that the language used for describing and defining additionality and baseline is largely silent on the policy intervention recognized to cause an activity to be additional. It is not possible to define additionality without referring to the concept of a baseline. And it is not possible to define baseline without first defining the policy intervention(s) that differentiate it from the conditions under which activities are proposed. The literature often refers to baselines as what would have happened otherwise, but then fails to answer the question *otherwise except for what*?

HM Treasury's *The Green Book*—which provides guidance for the evaluation of national policies, programs and projects—states that an "impact arising from an intervention is *additional* if it would not have occurred in the absence of the intervention"(HMT 2007).[17] In further technical guidance, the UK government elaborates on its definition of additionality as the "extent to which an activity is undertaken on a larger scale, takes place at all, or earlier, or within a given geographical area as a result of the policy intervention. Thus, an impact arising from a policy intervention is additional if it would not have occurred in the absence of the intervention" (EP 2008).

The climate change policy literature is not universally silent on the concept of a policy intervention (although the term "intervention" is almost never used). But where a policy intervention is mentioned, it is typically ambiguous. More importantly, there is a lack of consensus on the precise policy intervention recognized by GHG emission offset programs. Representative examples of policy intervention descriptions from the literature on CDM include:

- "the CDM activity" (Shrestha and Timilsina 2002);
- "emission mitigation projects" (Dutschke and Michaelowa 2006);
- "carbon policies or projects" (Murray, Sohngen et al. 2007);
- "CDM incentive" (Schneider 2007), "market incentive" (Bennett 2010), or "incentive provided by the credit-trading program" (Kartha, Lazarus et al. 2004);
- "CDM and associated financing" (Rosendahl and Strand 2009);
- "climate change issue *and* CDM" (Asuka and Takeuchi 2004) [*emphasis* added].

Although rare, some authors have been more precise in their definition of the recognized policy intervention. Meyers (1999) refers to additionality as the question: "Without the revenue of carbon credits made possible by CDM, would the investment occur anyway?" But he also refers to the policy

[16] CBO (2009) offers a rare example of more precise language with: "[emission] reductions that would not have occurred in the absence of the program that grants credit for offsets".
[17] Emphasis added. *The Green Book* also uses the term "deadweight" to refer to outcomes that could have happened without the policy intervention (i.e., in the baseline case). In this article, "deadweight" is referred to as free riders, false positives, or Type I errors.

intervention as "the CDM", "CDM activity", and "the project". Such inconsistent terminology within a single publication is common.

Trexler, Broekhoff et al. (2006) provide one of the least ambiguous definitions, referring to the recognized policy intervention as: "the question is whether the availability of offset credits is a decisive reason (although not necessarily the only reason) for pursuing the emissions reduction project." They thereby identify the potential to earn revenue through offset credits as the policy intervention. However, in the next sentence they shift and indicate that the creation of the broader offset market or offset program is the policy intervention, saying "holding everything else constant, would a project have happened in the absence of the offset crediting mechanism (i.e., if it and all other projects were not eligible for offset credits)?" Both definitions of the policy intervention could be argued are reasonable, but they are not exactly equivalent, as will be discussed later.[18] Is the policy intervention the expected value of offset credits that a proposed activity anticipates earning (i.e., a price signal) or is it the historical creation of the offset credit policy? Each has different implications for how we think about baseline scenarios. The first would define a baseline scenario as behavior in the absence of the offset credit price signal, while the latter could recognize a scenario where the offset policy had never been implemented.

This section provides a brief history of how the concept of additionality has developed within the context of climate change policy. It then shows how the dominant definitions of additionality and baseline in major offset standards and programs are circular and/or ambiguous. Lastly, a detailed tabular analysis of this messy linguistic landscape within the GHG emission offset policy community is presented.

6.1 A brief history of additionality

The history of a concept matters, as it identifies the issues that have and have not been considered in the development of the concept as well as how and whether those issues were resolved. Offsetting did not originate within the context of climate change policy. Offsets credits were actually one of the earliest forms of emissions trading (Tietenberg 2006). Specifically, one of the first applications of a tradable emission offset mechanism was under the 1977 Clean Air Act in the United States (Hahn and Hester 1989; ELI 2002), which allowed a permitted facility to increase its emissions of a local air quality pollutant if it paid another company to reduce, by a greater amount, its emissions of the same pollutant at one or more of its facilities. Here, additionality and baselines were assessed relative to restrictive emissions permit standards. Since then, offsetting has also been used for various types of water pollution, biodiversity, and air pollution (King and Kuch 2003; Fischer 2005) and additionality has been applied in the evaluation of energy efficiency program performance, especially for electric utility DSM programs (Vine and Sathaye 2000; Vine, Kats et al. 2003).

At the international level, starting in the early 1990s, the Multilateral Fund of the Montreal Protocol and the Global Environment Facility (GEF) used an assessment process, analogous to additionality, to establish the incremental cost of a proposed activity, relative to a baseline. They would then fund only this incremental cost (Chomitz 1998; Sugiyama and Michaelowa 2001; Asuka and Takeuchi 2004; Figueres and Streck 2008).[19]

Within the context of climate change policy, experience with assessing additionality began with the development and implementation of a pilot program started after the first Conference of Parties (COP-1) to the United Nations Framework Convention on Climate Change (UNFCCC) in 1995. This pilot program

[18] The authors also provide a more generalizable definition of additionality by asking: "would a project have occurred regardless of the existence of drivers created by the trading system, or not?" (Trexler, Broekhoff et al. 2006). These drivers are referred to as policy interventions here.
[19] GEF funding was explicitly recognized as the policy intervention for the definition of baseline.

was referred to as Activities Implemented Jointly (AIJ) and was a predecessor to Joint Implementation and CDM under the Kyoto Protocol (Rentz 1998). AIJ's objective was to gain experience with methodologies and implementation of a global GHG emission offsetting mechanism, although it did not allow the actual creation or transfer of emission reduction credits. It was during the period immediately following the establishment of the UNFCCC at the 1992 Rio Earth Summit that debate on additionality and baselines began in earnest.

Because it was anticipated that the funding for AIJ projects would come from international aid sources, the focus of this debate was about the desire of developing countries for project funding not to be a renaming of existing international development assistance, GEF, or other UNFCCC funding (Rentz 1998).[20] Specifically, the Berlin Mandate at COP-1 defined additionality as "environmental benefits related to the mitigation of climate change that would not have occurred in the absence of such activities", going on to state "the financing of activities implemented jointly shall be additional to the financial obligations of Parties included in Annex II to the Convention within the framework of the financial mechanism as well as to current official development assistance (ODA) flows."[21]

Unfortunately, during the AIJ pilot in the 1990s—including its largest component, the U.S. Initiative on Joint Implementation (IJI)—only vague guidance was provided on how to assess the additionality of and baselines for project proposals, and the topic continued to be problematic for policy makers (Michaelowa 1998; Trexler and Kosloff 1998; Meyers 1999).[22] The Kyoto Protocol text outlining its CDM and JI mechanisms did little to build upon the Berlin Mandate language on additionality. The Kyoto Protocol refers to the additionality of CDM projects as "reductions in emissions that are additional to any that would occur in the absence of the certified project activity"[23] and to the additionality of JI projects as "a reduction in emissions by sources, or an enhancement of removals by sinks, that is additional to any that would otherwise occur."[24] There appears to be no technical reason for why the language on additionality in these two articles of the Kyoto Protocol differs.

It is important to highlight two critical omissions in the language of the Kyoto Protocol, as this language still governs today. First, the language defining additionality under CDM places enormous weight on the term "certified," yet provides no guidance on the requirements of the certification process with respect to additionality. Secondly, and more importantly, no guidance was provided on what program administrators should recognize as the policy intervention created by CDM and JI.

The Parties to the UNFCCC recognized that both the CDM and JI required further elaboration prior to implementation, which was the focus of COP-7. However, negotiators at this meeting were unable to reach consensus on a more precise definition of additionality (Michaelowa 2009b).[25] This round of negotiations produced the Marrakesh Accords, which defined a project as additional "if anthropogenic emissions of GHGs by sources are reduced below those that would have occurred in the absence of the

[20] This debate occurred prior to any consideration of the Clean Development Mechanism. At the time, AIJ under the UNFCCC was seen as the mechanism in which developed countries, versus private parties, would invest in emission reduction projects in developing countries and receive credit towards their national commitments.
[21] See FCCC/CP1995/ADD.1, Decision 5/CP.1, paragraphs 1(d) & (e)
[22] The U.S. Department of Energy in its guidance for the U.S. IJI program used the following language when referring to additionality: "Projects accepted into the [USIJI] Program demonstrate that it was developed for or realized because of the USIJI Program" (Asuka and Takeuchi 2004).
[23] See Kyoto Protocol Article 12, paragraph 5(c)
[24] See Kyoto Protocol Article 6, paragraph 1(b)
[25] Michaelowa (2009b) points to several reasons for negotiators failure to elaborate a definition of additionality, including: differences in views among parties, a lack of understanding of the issues (especially by developing countries), and a sense that it was a technical and not a negotiations issue.

registered CDM project activity" (UNFCCC 2001).[26] This language is little changed from the original Kyoto language and simply substitutes "registered" for "certified."

Recognizing the lack of guidance on additionality and baselines provided by the negotiating process, the newly constituted CDM Methodologies Panel (the Meth Panel) attempted to address the issue soon after it was constituted in 2002. In its first draft of the form used to submit CDM project proposals (i.e., the Project Design Document template) in 2002, the Meth Panel included language requesting that project proponents "provide affirmation that the project activity does not occur in the absence of the CDM" (Asuka and Takeuchi 2004), thereby defining the existence of the offset program as the recognized policy intervention for assessments of additionality.

Two months later, in response to stakeholder claims that it was neither necessary nor appropriate for the Meth Panel to clarify the definition of additionality provided in negotiated decisions, a second draft for the project proposal form was circulated.[27] This second draft used the following language: "why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances" (Asuka and Takeuchi 2004). This second draft reverted to the earlier language, which left the recognized policy intervention unspecified. It mentioned the need to consider existing and future policies but did not clarify how these were to be treated with respect to predicting baselines. Were policies, existing or new, to be considered as part of the baseline or not?

At its eighth meeting in 2003, the Panel added parenthetical language to the project proposal form asking project proponents to explain "how and why this project is additional and therefore not the baseline scenario" (Asuka and Takeuchi 2004; Michaelowa 2009a). This new language provided some conceptual clarity by highlighting a key characteristic of additionality; that it is about distinguishing a proposed activity from a reference baseline. However, by continuing to not provide guidance on what factors define a baseline scenario (i.e., the absence of a recognized policy intervention).[28] The first CDM projects were then registered in 2004 after largely subjective and *ad hoc* assessments of additionality and baselines by independent validators.[29]

In practice, CDM administrators have implicitly interpreted the potential to earn revenue in the form of tradable offset credits as the recognized policy intervention for assessing additionality and baselines. However, for political and other reasons, language codifying this treatment has not been adopted. As a result the *de facto* CDM process for assessing additionality (i.e., additionality tool) relies on several largely subjective tests (i.e., regulatory, investment, barrier, and common practice),[30] although increasingly detailed guidance has been developed over time (CDM 2009; Haya 2009).

To be fair, when predicting behavior, subjectivity can rarely be completely avoided. Expert judgment is not inherently problematic if judgment biases are carefully managed. However, because the CDM and most other GHG emission offset programs are imprecise about how additionality and baselines are

[26] See Decision 3/CMP.1

[27] Note the problem here. Negotiators assumed that additionality was a technical issue, yet when technical staff attempted to address it, they were rebuffed by stakeholders claiming it was a political issue. The result is that the issue was not addressed.

[28] Since 2003, the wording in the CDM PDD form (version 7) has been revised to read: " Explanation of how and why this project activity is additional and therefore not the baseline scenario *in accordance with the selected baseline methodology*" (emphasis added).

[29] See Michaelowa (2009a) for a detailed history of additionality within the development of the CDM.

[30] See Michaelowa (2009a) for a detailed discussion of the CDM additionality assessment process and additionality tool. See Trexler, Broekhoff et al. (2006) and Gillenwater (2008a) for a general discussion of various additionality tests.

defined and assessed, subjective biases in the process cannot be effectively managed. Under these offset programs each expert is consciously or unconsciously making private assumptions about the factors that will cause behavior to change. A key objective of offset programs should be to eliminate as much of this subjectivity as practical.

In sum, the climate change policy community has debated the issue of additionality for over a decade (Rentz 1998; Trexler and Kosloff 1998; Gustavsson, Karjalainen et al. 2000). Nonetheless, there has been little discussion on the underlying theoretical and logical foundation of additionality and baselines.[31]

6.2 Talking in circles

Beyond a lack of precision, the existing language on additionality and baselines exhibits another problem. It is based on circular definitions. This problem is exemplified by the definitions in the Kyoto Protocol, which identifies the "project" as the policy intervention that causes the implementation of the project activity. Remember that, by the definition used here, a proposed activity is additional if it is different than its baseline.[32] A baseline scenario is then the behavior that occurs when that policy intervention is absent, while holding all other factors constant. Therefore, *the lexicon of the Kyoto Protocol and similar programs are examples of circular definitions because "the project" has been specified as both the cause and the effect for the assessment of additionality and baselines.*

A key source of confusion in many additionality debates is the failure to distinguish between two separate offset-related cause and effect relationships. Figure 1 illustrates this problem more clearly, since circular definitions can be stealthy. To explain: the correct "cause" for the assessment of additionality and the definition of a baseline is the policy intervention recognized by the governing offset program. A classic example of a policy intervention is an economic payment for some behavior, in the form of a government subsidy.[33] The "effect" of a change in behavior, assuming it occurs, is then the implementation of an *additional* activity. This cause and effect relationship is illustrated in the boxed question on the left in Figure 1. The fundamental question of additionality is whether the behavior of a given actor really did change as a result of a policy intervention or whether the intervention had no effect. If a proposed activity would be implemented even in the absence of the intervention then there is no change in behavior and the proposal is actually the baseline scenario.

Once a proposal is deemed additional, then the implemented activity (e.g., project) is the cause in a second relationship, with its effect being some measured performance improvement relative to the same baseline previously used in assessing the proposal's additionality.[34] This second cause and effect

[31] A cynical interpretation of this history would be that CDM administrators and policy makers intentionally preserved ambiguity with respect to additionality and baselines so as to increase their regulatory discretion. The CDM Executive Board utilized discretion in the early days of CDM when the additionality of few project proposals was questioned (Flues, Michaelowa et al. 2010; Gillenwater and Seres 2011). The approval of methodologies by the CDM Executive Board appears to be subject to less political influence than the approval of projects (Flues, Michaelowa et al. 2010).

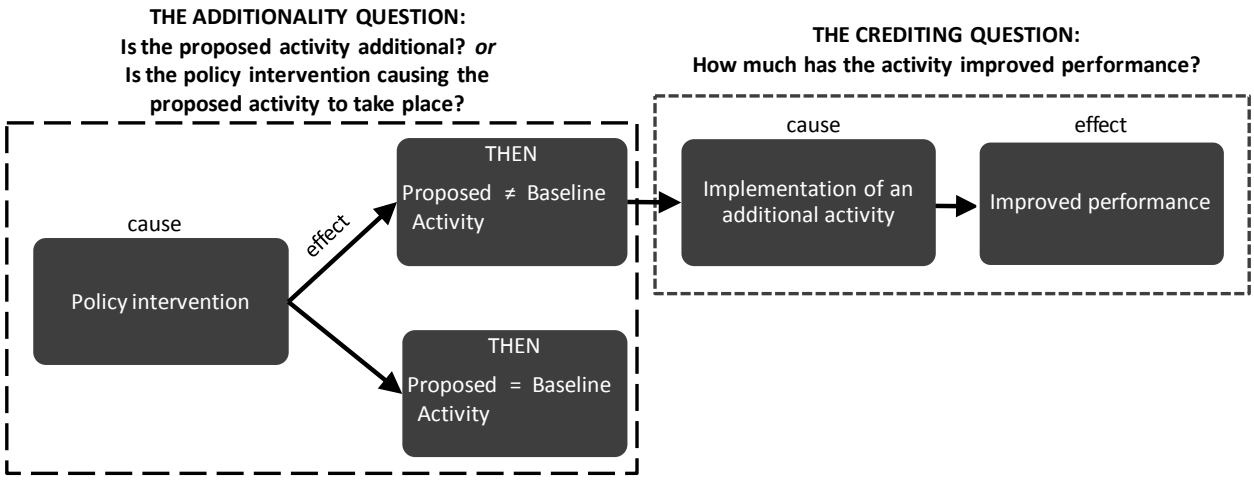
[32] There are some who argue that additionality is simply a determination of the eligibility for a proposed activity, and that setting a baseline is then a separate process related to the calculation of credits for issuance. If this position is accepted, though, it is not clear what the basis for additionality is. If the concept of additionality is decoupled from the associated baseline then the program will inherently entail some combination of higher false negative (positive) error rates in additionality determinations and under (over) crediting.

[33] Part 2 of this series will explore in detail the options for what can constitute a policy intervention in the context of offset policy.

[34] The quantification of baseline performance, although based on the same baseline scenario, may vary based on ongoing performance monitoring of the activity. For example, for a wind power project, the quantification of the baseline will be a function of how much energy the wind turbines actually generate (versus how much they were predicted to generate in the project proposal).

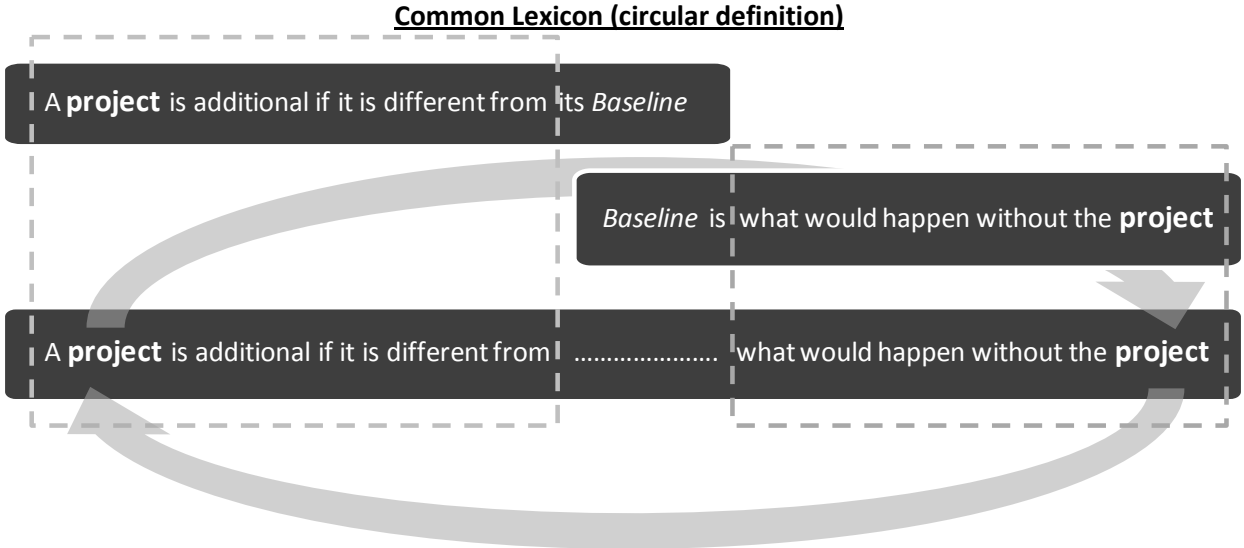
relationship is illustrated in the boxed question on the right in Figure 1—it is often confused with additionality.

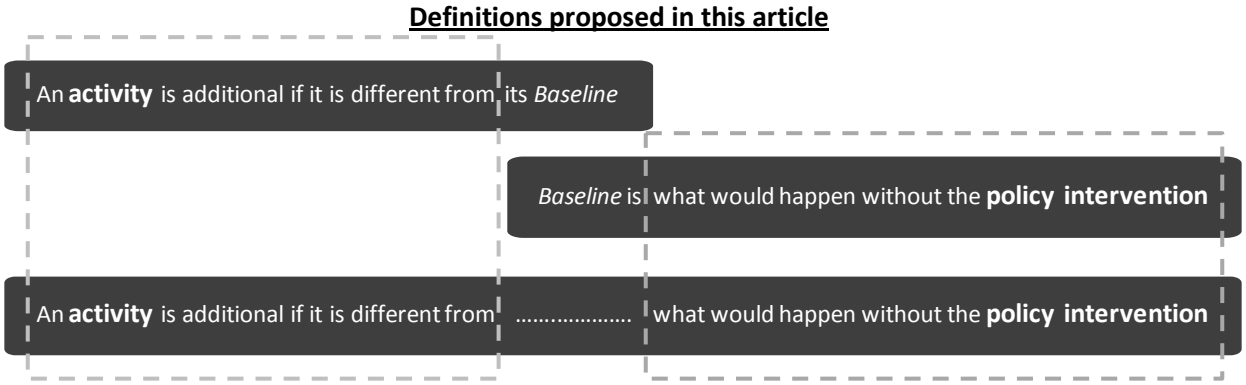
Figure 1. The two cause and effect relationships involved in assessing offset activities



Definitions of additionality and baseline are hopelessly circular when they are founded on a question that asks whether a proposed activity caused itself to occur. Figure 2 outlines this circular aspect and contrasts it with language that references a policy intervention as the proper causal factor, and thereby avoids the trap of circularity.

Figure 2. Circular and non-circular definitions of additionality





As shown in Table 1, the major GHG emission offset standards and programs are built upon circular definitions of additionality and baseline. For the debate on additionality to advance, policy makers, researchers, and other stakeholders must take greater care with their language.

Table 1. Additionality and baseline definitions from select offset standards, programs, and references[35]

Reference	Additionality	Baseline	Comments
GHG Protocol (WRI/WBCSD 2005)	"A criterion often applied to GHG projects, stipulating that project-based GHG reductions should only be quantified if the project activity 'would not have happened anyway'—i.e., that the project activity (or the same technologies or practices it employs) would not have been implemented in its baseline scenario and/or that project activity emissions are lower than baseline emissions."	"A hypothetical description of what would have most likely occurred in the absence of any considerations about climate change mitigation."	Identifies the relevant policy intervention as the emergence of climate change as an issue for policy or decision making consideration[36]
ISO 14064-2 (ISO 2006)	"[ISO 14064-2] deals with the concept of additionality by requiring that the GHG project has resulted in GHG emission reductions or removal enhancements in addition to what would have happened in the absence of that project. It does not use the term 'additionality', prescribe baseline procedures or specify additionality criteria."	A "hypothetical reference case that best represents the conditions most likely to occur in the absence of a proposed greenhouse gas project."	Circular definitions because they refer to the project as the policy intervention

[35] This table is, in part, based on the work of Derik Broekhoff, who generously allowed the author to adapt for use in this article.
[36] The problem with defining a policy intervention this way is discussed in Part 2.

CDM (UNFCCC 2001)	"A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity."	"the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity."[37]	Circular definitions because they refer to the project as the policy intervention
U.S. EPA Climate Leaders (USEPA 2009)	"The GHG reductions must be surplus to regulation and beyond what would have happened in the absence of the project or in a business-as-usual scenario based on a performance standard methodology."	"The baseline reflects the emissions or removals that would have occurred in the absence of the project activity."	Circular definitions because they refer to the project as the policy intervention
Handbook of Carbon Offset Programs (Kollmuss, Lazarus et al. 2010)	"Would the activity have occurred, holding all else constant, if the activity were not implemented as an offset project."	"a hypothetical scenario of emissions that would have occurred had the activity not been implemented as an offset project."	Circular definitions because they refer to the project as the policy intervention
H.R. 2454 [111th Congress]: American Clean Energy and Security Act of 2009 (i.e., the "Waxman-Markey" bill")[38]	"…reductions, avoidance, or sequestration that result in a lower level of net greenhouse gas emissions or atmospheric concentrations than would occur in the absence of an offset project."	"A standardized methodology for establishing activity baselines for offset projects…[that]…reflect a conservative estimate of business-as-usual performance or practices …such that the baseline provides an adequate margin of safety to ensure the environmental integrity of offsets calculated in reference to such baseline."	Additionality definition does not reference the concept of a baseline. Baseline definition self-references and is thereby internally circular.[39]

Note: Although they do elaborate processes for assessing additionality and baselines, neither the Verified Carbon Standard nor the Climate Action Reserve provides explicit definitions of either term.

6.3 Additionality terms, tests and further definitional chaos

Adding to the confusion, an elaborate lexicon of additionality types has emerged in the climate change policy literature. Some of these terms are meant to explain or define additionality, while others are intended to advocate for or against a particular approach to assessing additionality. In practice, they are often framed as tests that, by themself, or in combination, should be used for assessing proposed activities.

Table 2 presents this range in terminology. The descriptions for each term presented in Table 2 are not intended to be exhaustive or definitive, as in most cases there is no precise or unambiguous definition of the term available in the literature.

Stepping back, the profusion of types of additionality in the literature could be seen as a process of searching for policy consensus. However, no consensus has emerged and offset policy makers continue to lack a sound theoretical basis for applying the concepts of additionality and baselines. Offset policy

[37] See UNFCCC Decision 4/CMP.1, Annex II, paragraph 27.
[38] §700 at http://thomas.loc.gov/cgi-bin/bdquery/z?d111:h.r.02454:
[39] A superior definition of baseline is provided in §743(c)(3)(B) in the context of sectoral approaches rather than offset policy.

would be better served by a single definition of additionality rather than a proliferation of types and tests, as a test is not meaningful without clarity on what is being tested for. Definitions of additionality and baseline, as proposed at the end of this article, would be a first step in achieving consensus and resolving questions over additionality and baseline assessment techniques.

Table 2. Variation in terminology used to describe the concept of additionality in climate policy literature

Terminology[40]	**Description of usage of term**	**References**[41]
Financial Additionality	The original use was in reference to projects being additional to official development assistance (ODA),[42] meaning international development funding.[43] The concern was that offset projects, such as those under AIJ, that were funded by developed country governments (rather than the private sector) would simply be a reallocation of existing ODA (Bode and Michaelowa 2003; Dutschke and Michaelowa 2006). Under the U.S. Initiative on Joint Implementation (USIJI), financial additionality was defined as the requirement that a project be independent of existing foreign or multilateral aid funds and programs (Gustavsson, Karjalainen et al. 2000). The Intergovernmental Panel on Climate Change (IPCC) has defined the term as "the project activity funding is additional to existing Global Environment Facility, other financial commitments of parties included in Annex I, Official Development Assistance, and other systems of cooperation" (IPCC 2007). The term is often confused with the term "investment additionality" and used interchangeably by some, in conflict with its original meaning.	(Trexler and Kosloff 1998; Baumert 1999; Vine and Sathaye 1999; Baumert 2000; Greiner and Michaelowa 2003; Asuka and Takeuchi 2004; Dutschke and Michaelowa 2006; IPCC 2007; Sirohi and Michaelowa 2008; Paulson 2009; Valatin 2009; Achterman and Mauger 2010)
Investment Additionality	Typically refers to a focus on the expected behavior of a rational investor influenced by the potential to earn extra revenue from offset credits. Often assessed by testing whether predicted offset credit revenue will push the internal rate of return (IRR) of a proposed project over some specified investment hurdle rate. The IPCC has defined it as "the value of the Emissions Reduction Unit/Certified Emission Reduction Unit shall significantly improve the financial or commercial viability of the project activity" (IPCC 2007). Referred to as "financial additionality" (above) by some authors, for example (Meyers 1999; Baumert 2000). See Greiner and Michaelowa (2003) for a discussion of various investment additionality evaluation metrics.	(Bode and Michaelowa 2003; Greiner and Michaelowa 2003; Asuka and Takeuchi 2004; IPCC 2007; Au Yong 2009; Valatin 2009)
Regulatory Additionality	Refers to the behavior of project investors in contexts where government regulations mandate certain behaviors or performance and considers performance that exceeds mandated levels as additional or potentially additional.	(Greiner and Michaelowa 2003; Trexler, Broekhoff et al. 2006)
Program Additionality	Generally refers to the offset crediting program and/or trading system enabling the implementation of an activity. The USIJI defined the term as meaning that an activity was caused by the USIJI program. Where used, the specific recognized policy interventions are typically not identified.	(Rolfe 1998; Baumert 1999; Michaelowa, Begg et al. 1999; Gustavsson, Karjalainen et al. 2000)
Project Additionality	There is no unambiguous or consensus definition in the literature and is often used without being defined. Typically refers to an assessment process that considers the additionality of individual proposed projects. Often used in similar ways as "program additionality" (above).	(Rolfe 1998; Asuka and Takeuchi 2004; Waldegren 2006; Valatin 2009)

[40] Terms are generally ordered by usage, from most to least common.
[41] Representative citations that use the term. Cited authors may argue for or against each term, or simply mention them. Therefore, references do not imply support for the use of the term or the description provided in table.
[42] Referred to in some references as Overseas Direct Assistance.
[43] See Dutschke and Michaelowa (2006) for a discussion of the effect of CDM on ODA and how it relates to financial additionality (original definition).

Terminology[40]	Description of usage of term	References[41]
Environmental Additionality	No unambiguous or consensus definition in the literature. Is often used without being defined and used similarly to "emissions additionality" (below). Generally, is discussed in context with reductions in emissions relative to a baseline without an explanation of how it is distinct from plain "additionality." The CDM Methodology Panel, at its sixth meeting, defined it as asking the question whether a less environmental friendly activity would have been initiated or continued instead of the proposed project. The IPCC has defined the term as "the environmental integrity of the claimed amount by which greenhouse gas emissions are reduced due to a project relative to its baseline" (IPCC 2007). Where used, the specific policy interventions are typically not elaborated.	(Baumert 1999; Baumert 2000; Asuka and Takeuchi 2004; Trexler, Broekhoff et al. 2006; Waldegren 2006; IPCC 2007; Paulson 2009)
Emissions Additionality	No unambiguous or consensus definition in the literature and is often used without being defined. See “environmental additionality” (above). For example, "A project results in 'emissions additional' reductions if it reduces emissions from what they would have been in the absence of the project" (Rolfe 1998). The USIJI defined the term as the requirement that a project must reduce emissions below those of the baseline.	(Rolfe 1998; Vine and Sathaye 1999; Gustavsson, Karjalainen et al. 2000; Sirohi and Michaelowa 2008; Paulson 2009)
Economic Additionality	Used similarly to "investment additionality," but seems to imply a broader set of relevant economic factors involved. No unambiguous or consensus definition in the literature.	(Shrestha and Timilsina 2002)
Technology (ical) Additionality	No unambiguous or consensus definition in the literature and is often used without being defined. Typically, refers to predefined technologies or best practices being inherently additional in some or all contexts. The IPCC has defined it as "the technology used for the project activity shall be the best available for the circumstances of the host party" (IPCC 2007).	(Greiner and Michaelowa 2003; IPCC 2007; Sirohi and Michaelowa 2008; Valatin 2009)
ODA Additionality	See financial additionality.	(Asuka and Takeuchi 2004)
Barrier Additionality	Not widely used; synonymous with barriers analysis or tests such as the one used in the CDM additionality tool. The IPCC also includes the following text in its definition of additionality (although it does not use the term "barrier additionality"): "A project activity is further additional, if the incentive from the sale of emission allowances helps to overcome barriers to its implementation" (IPCC 2007).[44]	(Valatin 2009)[45]
Practice Additionality	Not widely used; synonymous with common practice test/analysis or market penetration analysis such as used in the CDM additionality tool.[46]	(Valatin 2009)
Performance-based Additionality	Refers to assessments relative to some pre-determined and quantified performance metric.	(Vermont 2008)

[44] This sentence in the IPCC definition is interesting because it suggests that the IPCC has endorsed the position that additionality is a continuous variable rather than a binary classifier variable. In other words, additionality is not a yes/no question but instead an activity can be more or less additional, which has implications for how crediting occurs. It is unclear if IPCC Working Group III consciously intended to recommend a policy on this issue. See Part 2 of this series for a discussion on dependent variables.

[45] Valatin (2009) mixes discussion of how to define additionality with discussion on specific techniques to assess additionality. Again, it is common in the literature for authors to fail to distinguish between a definition of additionality and a discussion of the techniques for assessment.

[46] See Kartha, Lazarus et al. (2005) for a discussion of issues related to the estimation and use of market penetration rates.

Terminology[40]	Description of usage of term	References[41]
Reporting Additionality	Not widely used; no unambiguous definition available.	(Valatin 2009)
Institutional Additionality	Not widely used; no unambiguous definition available.	(Valatin 2009)
Date Additionality	Not widely used. Refers to the calendar date upon which an activity was initiated as a relevant factor.	(Valatin 2009)
Jurisdiction Additionality	Not widely used. Refers to the jurisdictional boundaries in which an activity occurs as a relevant factor.	(Valatin 2009)
Sales Additionality	Not widely used. Refers to whether offset credit revenues were considered by investors in their decision making process.	(Valatin 2009)
GHG Additionality	See "emissions additionality."	(Valatin 2009)
Unit Additionality	See "performance-based additionality."	(Valatin 2009)
Compliance Additionality	See "regulatory additionality."	(Valatin 2009)
Incentive Additionality	Not widely used. Similar to "regulatory additionality," but focused on government incentives rather than mandates.	(Valatin 2009)
Behavioral Additionality	Not widely used. See "investment" and "economic" additionality.	(Meyers 1999)

7 Discussion and conclusion

Offset policy making and program administration has been hindered by definitions of additionality and baseline that are ambiguous and circular. Standards and programs that define a baseline in reference to the absence of an activity or project are specifying this activity as both the cause and the effect for their assessment of additionality. They have failed to precisely specify the policy intervention that is the correct causal factor. The definition of a baseline is contingent on the specification of a policy intervention, and the assessment of additionality is contingent on an established baseline (or set of equally likely baselines).

Additionality is about what is being caused by a policy intervention. But because we are only able to observe behavior (e.g., performance) with the policy intervention present, the assessment of additionality is actually about predicting what would happen without the policy intervention and then comparing a proposal to that prediction. In other words, an assessment of additionality is done relative to a prediction of future behavior under baseline conditions and then comparing a proposed activity—either a single case[47] or a set of similar cases as a class of activities[48]—to this baseline to decide if they are different. If a proposal is different than its baseline then it is deemed additional, otherwise it is not.

To address the problems outlined in this article, the following generalized definitions of additionality and baseline are proposed:

Additionality is the property of an activity being *additional*. A proposed activity is *additional* if the recognized policy interventions are deemed to be causing the activity to take place. The occurrence of additionality is determined by assessing whether a proposed activity is distinct from its baseline (see below).

A **baseline** is a prediction of the quantified amount of an input to or output from an activity resulting from the expected future behavior of the actors proposing, and affected by, the proposed activity in the absence of one or more policy interventions, holding all other factors constant (*ceteris paribus*). The conditions of a baseline are described in a baseline scenario.

These definitions are intended to be broadly applicable to offset policies and programs addressing any public goods issue at any scale, from traditional project-based initiatives to new scales. such as an economic sector. Baselines are ideally based on metrics directly related to an environmental good or harm, such as GHG emissions. However, in some cases it may be necessary to use well-correlated proxies in the form of other activity outputs or inputs (e.g., fossil fuel consumption).

Because additionality is fundamentally about assessing whether one, or a combination of, policy interventions is changing behavior, the entire concept of offsets must be built upon a careful understanding of the policy interventions recognized by offset program administrators as well their assumptions about how behavior is affected by these interventions. With this understanding, the definitions above can then be tailored to address specific environmental issues, such as GHG emission offset policy, specific policy interventions, and assumed theories of behavior. A methodical exploration of policy interventions and their causal relationships to behavior is the subject of the second article of this three part series.

[47] For example, under a project-specific approach (WRI/WBCSD 2005).
[48] For example, under a standardized approach (WRI/WBCSD 2005).

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