Constructing Carbon Offsets: The Obstacles to Quantifying Emission Reductions

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Abstract

The existing literature generally ascribes the virtual absence of the transport sector from the Clean Development Mechanism (CDM) to the inherent complexity of quantifying emission reductions from mobile sources. We use archival analysis and interviews with CDM decision-makers and experts to identify two additional groups of explanations. First, we show the significance of aspects of the CDM's historical evolution, such as the order in which methodologies were considered and the assignment of expert desk reviewers. Second, we highlight inconsistencies in the treatment of uncertainty across sectors. In contrast to transport methodologies, other sectors are characterized by a narrow focus on sources of measurement uncertainty and a neglect of economic effects ("market leakages"). We do not argue that the rejection of transport methodologies was unjustified, but rather than many of the same problems are inherent in other sectors. Thus, the case of transport sheds light on fundamental problems in quantifying emission reductions under the CDM. We argue that a key theoretical attraction of the CDM – equalization of marginal abatement costs across all sectors – has been difficult to achieve in practice.

Keywords: carbon offsets, transportation, Clean Development Mechanism

Introduction

Carbon offsets, by definition, do not exist in any tangible form. An offset can neither be measured directly nor observed in reality, because it represents the absence of a certain quantity of emissions that would have been emitted under a counterfactual "without-project" or baseline scenario. Quantifying emission reductions from an offset project thus relies on measuring actual post-project emissions and constructing the unobserved baseline; the size of the offset is the difference between the two. The development of methodologies to estimate these emission reductions is a prerequisite to monetizing a carbon offset.

One function of such methodologies is to provide a way to identify whether an offset is "additional," i.e., it would not have been implemented anyway. Concerns over additionality have fuelled a range of criticism of carbon offset programs (Schneider, 2007, 2009; Wara and Victor, 2008).

This paper explores wider implications of methodologies for quantifying carbon offsets. It argues that, regardless of the additionality of a project, the value of an offset is influenced by not just the technical characteristics of the project itself, but also the historical evolution of the methodology approval process; and the professional training of the decision makers. Given that the baseline is an unobservable counterfactual, the value of an offset is inevitably a fiction, and the precise storyline depends on the institutions and decision-makers writing the story.

We do not argue that this fiction is necessarily undesirable. A carbon offset program may bring wider social benefits even if there are uncertainties in the volume of emission reductions. However, the uncertain nature of an offset can lead to inconsistent outcomes when evaluating different types of projects. Here, we use the example of the Clean Development Mechanism (CDM), the largest carbon offset program to date, to demonstrate that the construction of offset methodologies has been characterized by biases that have virtually excluded the transport sector from CDM funding. The case of transport, meanwhile, illuminates broader problems with the CDM, as the challenges that have hampered approvals of transport methodologies have often been glossed over in other sectors.

Despite accounting for 23% of global energy-related greenhouse gas emissions (International Energy Agency, 2008), transport has been conspicuous by its near absence in the CDM. As of September 1, 2009, just two transport projects had been registered out of a total of 1,792 in the CDM program as a whole (UNEP Risø, 2009). Any project developer may employ an existing approved methodology (if one is available) for quantifying emission reductions, or propose a new methodology in conjunction with a Project Design Document (PDD) for a specific project. If the methodology is approved, the project may proceed to registration and the methodology is available for any similar project in the future. Transport projects have tended to fall at this first hurdle; out of a total of 14 large-scale transport methodologies submitted, just one has been approved by the CDM's decision-making body, the Executive Board.

The paucity of transport projects and methodologies comes despite the professed concern of political leaders and multilateral institutions that transport be represented in the CDM portfolio. At its tenth session, the Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC) explicitly called for the submission of more methodologies for transport, energy efficiency and district heating projects, and for the

Executive Board to prioritize such proposals. The World Bank funded a series of workshops in 2008 to identify a way forward for transport in the CDM (Clean Air Institute, 2008), and both the World Bank and the Japanese government (via its "Future CDM" project) have commissioned several new transport methodologies.

The approval process for any CDM methodology is generally viewed as a highly technical activity. Decisions on methodology approval are nominally taken by the Executive Board, which in practice almost always follows the recommendations of the "Meth Panel," which it appoints. In contrast to the more overtly political forum of the Executive Board, where the national allegiances of members can influence decisions on CDM project registration, there is less evidence that political considerations affect methodology approval (Flues et al., 2008). Indeed, Meth Panel members interviewed for this research took pride in their independence and narrow technical focus, even if their recommendations were sometimes contrary to their personal beliefs about which sectors were appropriate to promote under the CDM. Decisions are almost always taken by consensus, and are informed by two external assessments for each methodology, known as "desk reviews," commissioned from a pre-approved roster of independent experts.

This is not to say that political motivations are absent altogether. Four Executive Board members sit on the Meth Panel, and interactions with and pressure from the Executive Board can be an important factor in methodological decisions and might also explain differences in methodological stringency across sectors, according to one interviewee. Overall, however, the Meth Panel provides a forum that is primarily technical, rather than political.

This paper does not dispute the technical underpinnings of the methodology approval process, nor does it question the motives or professionalism of Meth Panel members. Rather, it demonstrates how the professional background of Meth Panel members and the historical evolution of the CDM have hampered the adoption of transport methodologies. In contrast to the existing CDM literature, which has attributed the lack of transport projects to their complexity and other inherent characteristics, we show that aspects of the approval process also help explain the near absence of transport projects from the CDM.

For the purposes of this paper, transport projects are defined as those involving vehicle efficiency, fuel switching or passenger or freight mode shift. Biofuels are excluded from the discussion, because their specific methodological challenges – largely relating to upstream emissions from land-use change – distinguish them from other fuel-switching possibilities. (For a discussion of biofuels issues in the CDM, see Baatz and Sterk, 2007; Dass et al., 2008.) The paper does not claim that the challenges faced by the transport sector in the CDM are unique. Indeed, they may well be shared by other under-represented sectors such as energy efficiency. However, transport's sheer size and rate of growth make its absence from the CDM particularly important to study.

The paper begins with a review of the literature on barriers to transport in the CDM. It then discusses the methodology employed in this research and the empirical findings. It concludes with observations on the implications for potential CDM reform.

Transport in the CDM

As of September 1, 2009, 14 large-scale transport CDM methodologies had been submitted to the UNFCCC (Table 1).[1] The majority relate to public transport (11 proposed methodologies); the remaining proposals involve fuel switching to LPG, and freight mode shift from road to water. Just one of these 14 transport proposals – that for Bus Rapid Transit (BRT) – had been approved by September 1, 2009, with ten denied, one withdrawn and two decisions still pending. In comparison, the Meth Panel had recommended approval of a total of 128 methodologies from non-transport sectors, corresponding to 47% of those considered (see notes to Figure 2 for calculation method).

The under-representation of transport is even more striking when *projects*, rather than *methodologies*, are considered. Just two transport projects had been registered by September 2009 – the TransMilenio BRT system in Bogotá, Colombia; and regenerative braking on the Delhi Metro (which uses a small-scale methodology, AMS.III.C). As of September 1, 2009, transport accounted for 0.1% of the 1,792 registered CDM projects, and 0.2% of pipeline emission reductions, which include both registered projects and those at earlier stages of the approval process (Figure 1).

The literature to date has highlighted several main reasons for the underrepresentation of transport in the CDM. Prime among them is the complexity of transport methodologies. Specific challenges have included the monitoring of a large number of small, mobile sources; lack of adequate data; difficulties in determining the project boundary; and quantification of "rebound effects" (Baatz and Sterk, 2007; Clean Air Institute, 2008;

[1] This figure excludes small-scale methodologies, and those rejected on pre-assessment by the UNFCCC secretariat. Small-scale methodologies for transport are restricted to projects that reduce emissions by 60,000 metric tons/CO_2-e per year or less, and the approval process is somewhat different from the large-scale methodologies discussed in this paper.

Donoso et al., 2006; Grütter, 2007, 2008; Wittneben et al., 2009). The rebound effect is broadly defined as "the percentage of the technical energy conservation potential that is offset by an increase in the service demand" (Binswanger, 2001: 122), and an example consists of emissions from new auto trips that occur following a reduction in congestion from a BRT system.

The determination of counterfactual baseline emissions has posed particular difficulties, which have been compounded because typical transportation modeling tools may not yield precise enough results for use under the CDM (Baatz and Sterk, 2007; Salon, 2001; Wright and Fulton, 2005; Zegras, 2007). Complexity also tends to increase transaction costs for preparing the methodology and PDD and emissions monitoring (Sandvik, 2005). In addition, many earlier methodologies were criticized for being poorly drafted and conceived (Baatz and Sterk, 2007). These issues are not unique to the CDM; they have arisen in earlier offset programs that have sought to include mobile sources, such as U.S. emission reduction credits for local air pollutants (Electric Power Research Institute, 2006; Nelson, 2004).

The challenges of developing acceptable methodologies are demonstrated in several case studies of potential or proposed CDM transport projects. For example, BRT projects in Jakarta and Bangkok were hindered by problems with baseline identification, data availability and identifying the "zone of influence" of the project (Dass et al., 2008). In the Chinese context, Zegras et al. (2009) discuss the challenges of developing a CDM methodology for transit-efficient land-use development. Difficulties cited include incorporating potential rebound effects, the weaknesses of travel forecasting models, and the selection of comparison sites for a statistical control group.

Another hurdle identified in the literature involves establishing additionality – i.e., demonstrating that a proposed transport project would not have happened in the absence of the CDM (Clean Air Institute, 2008; Dalkmann et al., 2007; Malaczynski and Duane, 2009). While the lack of additionality has been a concern in other CDM sectors, the high cost of many transportation projects and the multitude of policy drivers behind their implementation makes it particularly difficult to demonstrate that CDM funding is critical to their feasibility.

Analysts such as Zegras (2007) have concluded that with a few exceptions, the transport sector is inherently a poor fit for the CDM as it is designed at present. The exceptions are relatively simple and well-defined fuel-switching and other technology-oriented projects, but their scale is likely to be small and co-benefits negligible in comparison to larger, more complex mode shift projects. While some analysts are more upbeat about transport's future prospects, either in the CDM or other offset programs (CURB-AIR, 2008; Grütter, 2007; Malaczynski and Duane, 2009), the more prevalent view is that transport does not mesh with the current project-centered approach of the CDM. Instead, analysts suggest that either a transport-specific mechanism or broader sectoral approaches would be required to bring about major reductions in transport emissions through carbon finance (Clean Air Institute, 2008; Wittneben et al., 2009).

Research Approach

The literature discussed in the previous section provides valuable insights, but tends to consist either of case studies of CDM potential in specific contexts (for example, Dass et al., 2008), or reviews of Meth Panel recommendations (Baatz and Sterk, 2007). In contrast, this paper employs a broader data set derived from archival analysis and a qualitative, interview-based methodology.

Interviews were conducted with 29 Meth Panel members, desk reviewers, project developers and other experts between July and December 2008 (Table 2). Participants were identified from UNFCCC records and referrals from previous interviewees. Interviews followed a semi-structured format and ranged in length from 25 minutes to three hours, with most taking slightly longer than an hour. The interview protocol varied depending on the interviewee's role and area of expertise, but typically involved walking through the review or methodology approval process; discussion of specific issues such as additionality or rebound effects; and review of issues with specific methodologies.

With the exception of one interview conducted mainly in Spanish, all were conducted in English, which is the working language of the UNFCCC. All interviewees were assured anonymity. In addition, the research included a number of background interviews with UNFCCC secretariat staff, other Meth Panel members and independent experts. Interviews were coded using the TAMS Analyzer software for structured analysis of qualitative data. Note that "Meth Panel member" as used in the remainder of this paper may indicate either a current or former member of the Panel. In order to maintain anonymity, we use the term "project developer" loosely to refer to a municipal representative; World Bank employee; or private consultant.

The archival analysis portion of the research consisted of reviews of the Meth Panel recommendation, desk reviews and Project Design Document attached to each transport methodology, as well as the proposed methodology itself.[2]

Transport's Inherent Challenges

The interviews and archival analysis reveal three broad groups of reasons for the difficulties faced by transport methodologies in the CDM. The first echoes the findings of the literature to date, and relates to the inherent challenges of transport. The second group of reasons is historical in nature, and relates to the increasing stringency of Meth Panel recommendations over time. The third and more fundamental group relates to cross-sectoral variation in how the Meth Panel treats uncertainty.

Virtually all interviewees, whether Meth Panel members, desk reviewers or transport sector experts, cite complexity as a barrier to the approval of transport methodologies. Specific issues include the diffuse nature of emission sources; impacts on other modes; rebound effects; and the sheer number of agents taking decisions. "There are just too many parameters, because it's a project related to a system, a transport system. It's not just replacement of technical components," says one desk reviewer.

The unsuccessful proposed methodology for BRT (NM0158[3]) provides a striking example. The methodology is 217 pages long (plus a 199-page PDD), includes 84 formulae, and accounts for an array of "leakages" such as increased emissions resulting from left-turn prohibitions that force vehicles to drive around a block to turn left. The challenges faced by the Meth Panel in examining transport methodologies were amplified by the dubious

[2] All these documents are available at: http://cdm.unfccc.int, last accessed September 10, 2009.
[3] We use UNFCCC identification numbers (listed in Table 1) to refer to specific methodologies. AM (ACM) denotes an approved (consolidated) methodology; NM a rejected or pending methodology.

quality of some early methodologies. Reviewers and the Meth Panel expressed frustration with documents that were "difficult to decipher" (desk review for NM0052), or "very unclear, not logical" (Meth Panel recommendation for NM0083).

These challenges have been exacerbated by the lack of transport expertise in the Meth Panel, whose members tend to be drawn from other sectors such as energy engineering. Six of the 11 Meth Panel members interviewed freely admitted a lack of transport knowledge, either personally or on the part of the Panel as a whole, and several more declined to be interviewed for this reason. "The most problematic has been transportation. We don't feel that the panel has expertise," says one member. Three project developers, meanwhile, complain that Meth Panel members' lack of comprehension of some methodologies leads to unjustified rejections.

Meth Panel members acknowledge these limitations of expertise, but point to their ability to contract with outside experts. Says one member:

> You have a certain reluctance to have new experts [on the Meth Panel], and of course there's an in-built bias against new expertise, and of course that works to the detriment of new methodologies [in underrepresented sectors such as transport]. But having said all of that, I wouldn't agree that the current expertise is the main factor why these methodologies are not covered, because in fact the Meth Panel can and does get outside expertise. There are consultants working on the methodologies on transport that are transport experts.

In practice, however, the UNFCCC has found it difficult to identify transport sector experts with whom to contract, which according to project developers can add to the delays and transaction costs for transport methodologies. "It's been a headache to get good consultants," according to a Meth Panel member.

Ultimately, complexity and lack of expertise only partly explain the paucity of transport methodologies. In all sectors, methodologies have been becoming increasingly complex as project developers exhaust the early simple-to-quantify, cheap abatement opportunities. In the words of a Meth Panel member: "For the CDM, the easy projects are finished. Landfills are gone. Chemical plants are gone. That's an old story. Now, the real problems are coming. More sophisticated issues like transportation, like Liquefied Natural Gas for example." The next section explores how changes over time in the CDM project approval process have influenced the prospects for transport methodologies.

Evolution of CDM Methodologies

Advantages of Early Application

When the Meth Panel met for the first time in June 2002, decisions by the Conference of the Parties provided broad principles but few specific rules. Instead, the process and methodological principles were intended to unfold via a learning-by-doing process, given the inability to anticipate salient issues and the difficulties in agreeing on detailed technical rules through international negotiations. One practical upshot was that approval for early methodologies was easier to gain, and the sophistication demanded by the Meth Panel considerably lower.

Observers and some Meth Panel members themselves point to the increased professionalism of the methodology evaluation process, and, conversely, the shortcomings of earlier decisions. "I don't think they [Panel members] knew what they were doing," says one desk reviewer. "Neither I nor my colleagues had any idea of what we were supposed to do," says a Meth Panel member. According to another:

> The bar increased over time, but for all projects. Over five years, the methodological knowledge has grown. And I think if you look to some of the early approved methodologies, they neglect certain issues, which we consider in later methodologies. And you see that a number of [previously approved] methodologies were withdrawn….because we detected some flaws and we said, a better way of estimating emissions is this way…. And for new methodologies, the bar is going up.

The increasing rigor of CDM standards is also evidenced by declining approval rates over time, which can be observed in econometric studies (Flues et al., 2008) and also in a simple plot. As Figure 2 shows, most decisions on transport methodologies (represented by vertical bars and the right-hand scale in Figure 2) were made well after February 2004, when approval rates had begun to fall.

For transport, the practical upshot was that as a relative latecomer to the CDM, the bar had begun to rise by the time that its initial methodologies were considered. The first two transport methodologies (NM0052 and NM0083) were viewed as poorly conceived and written. Asked to list the strengths of the baseline methodology for NM0083, one reviewer wrote "none" and the other wrote "innovative" before listing a host of problems. The first serious contenders – NM0128 and NM0105 (later approved as AM0031) – did not obtain a Meth Panel recommendation until October 2005 and June 2006, respectively. By then, many of the early methodological principles had already been established, and the methodological bar had risen. For example, the concept of the "combined margin" – a simplified method to estimate baseline emissions from electricity generation – was critical to the feasibility of renewable energy methodologies, as it eliminated the need for ad hoc project-specific methods that would have increased costs and risks to project developers (Kartha et al., 2004). The combined margin method was used in NM0001 and approved in late 2003. Renewable energy now accounts for more than one-third of emission reductions from projects in the CDM pipeline (Figure 1).

Early methodologies were certainly refined in subsequent years, and some were withdrawn as flaws were identified. However, early approval brought a major advantage: in each case when a previously approved methodology was withdrawn, an alternative was made available. For simple reasons of maintaining confidence in the global carbon market, it would be difficult for the Executive Board to withdraw a methodology and exclude a type of project from the CDM altogether once some projects of that type had been approved.

Dependence on Desk Reviewers

In the early stages, the Meth Panel was greatly dependent on desk reviewers for sector-specific expertise in transport. Figure 3 shows the extent to which each Meth Panel recommendation on transport methodologies relies on desk reviewers' comments; with the exception of NM0158 (a special case[4]), the trend is towards less reliance on the reviews. With time, increased staff support and greater Meth Panel experience relegated the desk reviewers to a more supporting role, but early methodologies were highly dependent on the vagaries of the review process.

Given the extent of this reliance on desk reviews, the selection of the reviewers themselves may have influenced the approval of a particular methodology. One reviewer, referred to here as "Reviewer 1," was assigned to review all five methodologies that he did not develop himself (he authored the other eight transport methodologies submitted, excluding one withdrawn methodology for which no desk reviews are available). In almost all five cases, Reviewer 1 was a considerably harsher critic than the second reviewer. For NM0158, Reviewer 1's objections were reflected by the Meth Panel, while the other reviewer's positive assessment was discounted. For NM0128, the other reviewer had some substantive but not necessarily insurmountable concerns related to the development of the baseline scenario, while Reviewer 1 was scathing: "non-transparent…needs a full

[4] Due to the perceived conflicts of interest discussed below, the Mexico City government lodged a formal complaint over the decision on NM0158. The Executive Board referred the methodology back to the Meth Panel; thus, this case received special attention. NM0237 also appears to deviate from the trend, although the reasons for this are less clear.

overhaul…strengths are none." A similar "split verdict" can be observed with NM0205 and also with several biofuel methodologies, including NM0069, NM0109 and NM0223.

Reviewer 1 later stepped into a role as methodology developer, and has authored all the transport methodologies submitted since 2006. Many project developers, World Bank staff and transport experts interviewed raised the issue of conflicts of interest, and the Mexico City government even submitted a formal complaint for this reason over the rejection of NM0158.

A subtle effect of earlier harsh assessments by Reviewer 1 may have been to raise the methodological expectations for transport sector proposals. Some of the issues that he brought up were the first that the Meth Panel had heard of them, and it is plausible that they would never have been considered otherwise. This is not to claim that Reviewer 1's criticisms were erroneous, but rather that under an alternative reviewer they might never have been aired.

Non-Uniform Treatment of Uncertainty

Any offset project is characterized by a degree of uncertainty in quantifying emissions, categorized in Table 3. These uncertainties include the selection of the baseline scenario; the accuracy of monitoring procedures; and the amount of leakage, defined as changes in emissions attributable to the project that occur outside the project boundary. Leakage may be negative (for example, lower gasoline consumption leads to fewer emissions from oil extraction, refining and transport), or positive (for example, emissions from the production of cement used for BRT construction). The net reduction from a CDM project is defined as baseline emissions minus project emissions minus leakage emissions. One particular class of leakage (discussed in detail in this section) is "market leakage," which is transmitted through a CDM project's impact on prices.

In contrast to transport, methodologies for projects in other sectors have been characterized as having little leakage. For example, ACM0002 for renewable electricity is used by more than 1,300 projects in the CDM pipeline, but the methodology does not require the assessment of any sources of leakage despite their potential existence. In this section, we argue this inconsistent treatment across sectors is only partly due to the inherent characteristics of the transport sector itself, and partly to do with the lack of uniformity in Meth Panel recommendations. For example, leakage uncertainties from upstream emissions are typically considered in transport methodologies but neglected elsewhere – even for hydroelectric power projects which use large quantities of cement. The following sections do not discuss each type of uncertainty identified in Table 3, but rather highlight examples of where the methodological bar has differed across sectors.

Treatment of Market Leakage

Leakages through market effects are perhaps the most difficult to identify and quantify in any sector. In many cases, market leakage has simply been ignored by the Meth Panel, desk reviewers and methodology developers, even though this omission will almost always overestimate the emission reductions by either underestimating project emissions or overstating baseline emissions. Figure 4 illustrates the four distinct forms of market leakage listed in Table 3.

The first, the fossil-fuel price effect, is relevant to any project that reduces demand for fossil fuels, and has received some attention in the literature (e.g. Chomitz, 2002). For projects that reduce the demand for crude oil, Vöhringer et al. (2006) estimate that this effect will overstate emission reductions by about 14%. Because the fossil-fuel price effect is typically ignored in *all* CDM sectors, it is not considered further here.

The second form – rebound effects – is a more general case of the fossil-fuel price effect, and may also lead to an underestimate of emissions in the with-project scenario. Lower demand for any emissions-intensive good or "dirty" technology will reduce its price (or time cost) as long as supply is not perfectly elastic, thus leading to a price-induced increase in consumption and emissions that partially offset the initial benefit. The typical transport example is through congestion effects; mode shift away from private autos may reduce congestion, in turn increasing demand for vehicle travel.

The third form – crowding out – arises with projects that increase demand for lower-emission alternatives, and may also lead to an underestimate of emissions in the with-project scenario. Implicitly, ignoring crowding out assumes that supply of the low-emission technology is perfectly elastic, for example that there are no constraints on the supply of wind turbines that would increase the price as demand rises and reduce the feasibility of wind energy projects elsewhere in the world.

A fourth form of market leakage – an outward-shifting supply curve – relates to a potential overestimate in baseline emissions.[5] In some instances, CDM revenue acts as a subsidy for the product, such as renewable energy, and leads to a greater supply being offered at a given price. In other instances, the CDM enables the project to generate revenue from an otherwise worthless co-product such as methane or HFC-23. Unless demand is perfectly inelastic or the entire supply is zero-emission, some of the initial emission reductions will

[5] Note that for the supply curve to shift outwards, the CDM revenue must provide a subsidy at the margin, as is the case with new-build projects such as renewable energy. As discussed below, some methodologies attempt (with mixed success) to ensure that the subsidy is inframarginal (not at the margin), in which case supply would not be affected and the subsidy accrues as rent to the project owner.

be offset. Thus, failure to account for an outward-shifting supply curve leads to the erroneous assumption that demand is the same under the baseline and with-project scenarios, and an overestimate of (unobserved) baseline emissions. It is even possible for emissions to *increase* as a result of the CDM project if demand is sufficiently elastic, and/or the magnitude of the supply shift sufficiently great.

Market Leakages in Transport Methodologies

Market leakages have proven a major barrier to the approval of transport methodologies. In particular, Meth Panel dissatisfaction over the quantification of rebound effects has been a key factor in the rejection of six of the ten disapproved transport methodologies: NM0052, NM0058, NM0083, NM0205, NM0229 and NM0287 (Table 4). Rebound effects were also a stumbling block during the consideration of two pending methodologies, NM0258 and NM0266 (Meth Panel, 2009). More subtly, the need for project developers to respond to Meth Panel concerns over rebound effects has increased the complexity and transaction costs of transport methodologies. And while recent methodologies such as NM0229 have dealt with rebounds such as the response to reduced congestion, they have still been rejected due to the lack of consideration of other types of market leakage such as the impact of transport infrastructure in encouraging higher-density development patterns.

Inadequacies in addressing rebound effects were raised by five of the 11 Meth Panel members interviewed as a partial explanation for rejecting some transport methodologies. Two of them suggest that rebound effects make them skeptical as to whether transport projects reduce emissions at all. Says one Panel member:

> With transport, I don't think that you can always say that [it reduces emissions]. Because of the rebound effect, for example. It might increase mobility.…So if [households] face constraints with living space and distance to work, they might use the increased transport infrastructure to improve that combination. So they might travel more, so they can have a better quality of life, and the net gain for them is a bigger garden… And these rebound

> effects are the key thing to understand. Which is something I think is quite unique to transport, at least it's pronounced.

The third form of market leakage, crowding out, has not been mentioned explicitly in Meth Panel recommendation on transport methodologies, although it may hamper future freight methodologies (Grütter, 2007). However, the fourth form, an outward-shifting supply curve, has been an issue for transport. In its recommendation to reject NM0229, the Meth Panel states that the project would be "basically a capacity addition" and lead to increased passenger travel. In the words of one member interviewed, this issue of expanding supply is the major barrier to transport methodologies in the CDM:

> It's not easy to identify how many people will move from one mode of transportation to bus in this case, how many people would move from their private cars, and how many new people would now begin to use the transportation because before the transportation was so bad…so you have a kind of suppressed demand that is now going to be met… In my view most of the difficulties in transportation methodologies are related to this issue of creating extra demand and isolating the different impacts that are related to it.

Market Leakages in Non-Transport Methodologies

The Meth Panel concern over market leakages in the transport sector is not unfounded. However, these types of leakages are likely to be present in a wide range of CDM project types. While they have been considered in the context of transport, market leakages appear to have been dismissed in other sectors on the basis that they are too difficult to calculate (Boyd et al., 2007), or "unmeasurable or insignificant for individual projects" (Vöhringer et al., 2006: 504) – to the extent that they have been considered at all.

Rebound effects, for example, could be a factor for any CDM project that reduces demand for dirty technology (Figure 4). Examples include reductions in SF_6 demand from magnesium production (AM0065); reductions in demand for limestone for clinker production (ACM0015); and reductions in demand for coal-fired electricity generation technology. The practical significance of the rebound effect is an empirical question.

However, to judge from the desk reviews and Meth Panel recommendations, it was not even considered in the aforementioned non-transport methodologies.

Partly, the lack of consideration of rebound effects outside the transport sector seems to be due to a narrow conception of the phenomenon on the part of some Meth Panel members, or a view that rebound effects are minimal for most non-transport projects. Consider, for example, an energy efficiency example. Says one member:

> We have some methodologies which are to replace non-efficient fridges by energy-efficient ones. I don't see how if I have a more efficient fridge, someone's going to be using the fridge [more], opening [the door] more, which is different again from transportation where…I can think of people driving more on the weekends because the price of fuel is down, or if public transportation is much better, now I can think of people traveling further and further because it's convenient to them.

This restricted view of rebound effects, however, ignores the potential for a competitive response by other manufacturers through cutting the price of energy inefficient refrigerators. It also ignores the potential for energy savings to be offset by increased consumption elsewhere in the household or region (for example, if supply constraints mean that reduced demand helps to alleviate brownouts rather than reduce aggregate consumption).

Another market leakage in Figure 4, crowding out, also applies in theory to a wide range of methodologies. In most non-transport projects, however, it has been ignored, even where it might have been expected to be a particular concern. For example, ACM0002 does not take account of the potential for new wind projects to increase turbine prices or lengthen production backlogs, even though this is a sector where production constraints have been identified and supply may be inelastic (Blanco, 2009). In the long-run, supply may be more elastic and the CDM may help to catalyze technological breakthroughs, but there is no analysis in any renewable energy methodology to support this view.

Where crowding out has been recognized by the Meth Panel as a concern, the methods employed to address it have sometimes been simplistic. For example, ACM0015 (a methodology on substitution of carbonates in cement kilns) obliges the project developer to demonstrate that the regional supply of alternative raw materials to replace carbonates in clinker production is sufficient to meet 1.5 times the existing demand. But the methodology does not define "supply" and says nothing about price; it is possible for the additional supply to be provided only at a high price, thus crowding out usage in otherwise similar non-CDM projects. A similar approach has been applied to biomass generation methodologies such as ACM0006. In both cases, the Meth Panel implicitly sees supply as a physical issue (does it exist?) rather than an economic concept (at what price would additional supply be provided?).

The final form of market leakage in Figure 4, an outward-shifting supply curve or "suppressed demand," is also ignored altogether in many non-transport sectors, including renewable electricity generation. Renewables could be particularly susceptible to this form of market leakage in many developing countries; capacity constraints and brownouts suggest that additional renewable generating capacity would not necessarily substitute for fossil fuels, but would instead alleviate supply shortages or reduce the price of electricity compared to diesel generators. There appears to be little research on the overall emission impacts of improved grid reliability, but even if households do have access to diesel generators, they may reduce overall consumption during power outages. Meth Panel members, however, implicitly see demand as perfectly inelastic. Says one:

> Arguably, the emission factor of the grid is a conservative measure compared to the off-grid diesel generators which people resort to the moment they do it [the grid operator cuts power].

According to the other:

> [Suppose that] people do not have electricity. Now you construct a hydropower plant, and they get electricity. Now, you could also argue that without the project, they would not have refrigerators and would not consume electricity, but I think here the situation is a bit different because you can argue that in the longer-term perspective, sooner or later with the higher income these people will have diesel generators.

A third Meth Panel member argues that in the case of cement production, a reduction in electricity costs, which acts to shift the supply curve for cement outwards, has no impact because demand is fixed (implicitly, it is perfectly inelastic):

> Assume that you need energy to produce one ton of cement. Because electricity now has a lower price, you're not going to produce more than one ton of cement. Because the amount of cement you produce is given by the demand for cement [which is independent of price].

The Meth Panel does not always ignore the emission impacts of outward-shifting supply curves. However, approved methodologies sometimes acknowledge the potential market leakage but disregard it due to the complexities involved. In the case of ACM0008 for coal bed/coal mine methane destruction, the approved methodology states:

> Depending on relative market price of coal and the value of CERs [certified emission reductions] … the new carbon revenue could theoretically eventually induce a decrease in coal prices and, as a result, lead to an increase of coal demand…While this impact is theoretically possible, reliable scientific information is not currently available to assess this risk and check if the phenomenon would be negligible or not. Moreover, it is difficult to assess ex ante the contribution of any particular project given the dynamic nature of local and global coal markets.

Rather pragmatically, the Meth Panel suggests that the Executive Board revisit this issue after two to three years of experience with this methodology.

In other instances, the Meth Panel has recognized and addressed the potential impacts from outward-shifting supply curves. Examples include methodologies for district heating and HFC-23 destruction. Typically, however, a simplistic approach has been used, such as capping emission reductions based on existing installed capacity or historical production. The former approach implicitly assumes that existing capacity would be used in full in the baseline; if production levels were below installed capacity, emission reductions would be overstated. Moreover, both approaches create perverse incentives to inflate existing installed capacity (in the case of district heating) or historical production (in the case of HFC destruction), and can be subject to gaming by CDM project developers. For example, Wara (2006) suggests that HCFC-22 producers have sought to inflate their historical baselines and also maximize the production of the "waste" HFC-23 co-product in order to gain CDM revenue from its destruction.

Perversely, the more likely a proposed project is to be additional due to the positive impact of CDM revenue on a project's Internal Rate of Return (IRR), the greater its vulnerability to leakage through an outward-shifting supply curve that unleashes suppressed demand. This is because the increase in IRR from CDM revenue acts to lower the cost of production and therefore increases the quantity offered at a given price.[6] The main exceptions to this vulnerability may be where a potential outward shift in the supply curve is constrained by the limited availability of inputs, such as in the case of methane destruction from landfills.

Overall, the Meth Panel has struggled with the concept of suppressed demand and how it should be treated in practice. Here is how one Panel member rationalized the Panel's approach:

> Suppressed demand is a very difficult subject. If I as a Meth Panel member or a methodology developer don't have to rely on it, I will not rely on it, because it's ambiguous. You could…go through all 84 methodologies and [try and] find a consistent definition [of suppressed demand], but there isn't. And ultimately what we do, it's a source of frustration for many people. We don't have a top down framework…the ideal of a top-down consistent set of principles worked out across all sectors, and have perfect methodologies for all types of projects and excellent baseline scenarios and all those things.

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[6] The precise impacts on aggregate supply will depend *inter alia* on the structure and competitiveness of the industry. Technically, a shift in the supply curve relates to the impact of CDM revenue on *marginal* costs, while IRR will be affected most by impacts on *inframarginal* costs (i.e., those that do not affect production decisions at the margin). However, IRR and outward shifts in the supply curve will usually be positively correlated as both depend on the relative contribution of CDM revenue to production costs.

> If this is what you want, you can have a lot of criticism of the existing system. But we live with what we've got, and it's a bottom-up approach.

During interviews conducted for this research, Meth Panel members themselves generally rejected the argument that inconsistencies exist in the way that market leakages from rebound effects and outward-shifting supply curves are treated across sectors. But some interviewees agreed that inconsistencies exist. For example, one desk reviewer who has worked on methodologies in a range of sectors, including transport, notes:

> I don't know why, but they've been very picky [in transport]. You see the number of leakages there are in AM0031 [for BRT], there's all types of them, and for so many methodologies [in other sectors] there are no leakages [that are accounted for in the methodology].

A transport project developer adds:

> The problem is that they [the Meth Panel] heard 'rebound effect' from somewhere. Originally, the rebound effect came from the energy sector, in fact…Now, they know about that effect and they heard about induced traffic and things like that, but then they don't know how you can capture it or what you can capture and what you can't capture. So I would say that it's probably a problem that they feel very insecure about, and then they prefer not to take a decision…The difficulty is that they have heard of the term, they relate it to transport and transport only – they don't relate it to energy. And then they ask for something [to account for rebound effects] because they think it's of huge magnitude.

Ultimately, the practical importance of market leakages is an empirical question. In some of the preceding examples, they may not be large, but neither the Meth Panel nor project developers has supported this assertion which is typically implicit. In other examples, particularly an outward shifting supply curve for renewable energy, market leakages may eliminate most or all of the emission reduction benefit.

Baseline Uncertainty and Methodological Shorthand

"Methodological shorthand" is defined here as the process by which the Meth Panel simplifies or disregards complex issues that might otherwise preclude the development of a feasible methodology for a particular class of projects. Ignoring potentially intractable market leakages, as discussed in the previous section, is one example of this methodological shorthand. Another example, discussed here, is the construction of baselines. In both cases, we contend that the Meth Panel has been more amenable to "methodological shorthand" in non-transport sectors.

By definition, counterfactuals used to create baselines are hypothetical, and thus any statement about a baseline is inevitably an unverifiable hypothesis based on professional judgment. A good example about differences in these judgments is provided by comparing public transport to renewable energy methodologies. In the electricity generation sector, baseline emissions depend partly on the marginal generator that is assumed to be displaced, and partly on the impact of the project on the overall mix of generation facilities (e.g. through delay or cancellation of planned alternatives). Take, for example, a proposed CDM wind energy facility. In the absence of the new wind facility, an alternative source of supply such as a coal-fired plant might be built instead; or an existing coal plant might be run more frequently if it is the marginal generator. Or there may be no difference between baseline and project scenario emissions at all, depending on supply constraints, demand patterns and grid dispatch procedures.

In practice, the Meth Panel avoids these complications in baseline construction for renewable energy projects by using a concept known as the "combined margin." This consists of a weighted average emission factor from (i) the existing grid, termed the "operating margin;" and (ii) recently added generation capacity, termed the "build margin." (For a detailed discussion, see Kartha et al., 2004.) The methodology includes options for considering load and dispatch data, but these are not required if unavailable. In essence, the combined margin simplifies away issues such as which plant is the marginal generator, and assumes that were the CDM project not to be built, the same capacity would have been provided in the form of the generation mix constructed in recent years. Moreover, many key parameters, such as the weighting of the operating and build margins, are simplifications based on professional judgment.

The aim here is not to criticize the combined margin approach, which has a number of advantages in terms of reducing data collection and other transaction costs, and the risk of gaming by project developers seeking to inflate baseline emissions (Kartha et al., 2004). Rather, the point is that renewable energy methodologies have been enabled by the adoption of this methodological shorthand, while transport methodologies have been rejected for not addressing a large number of hypothetical occurrences affecting the baseline scenario. Table 4 shows some of these reasons for rejection of transport methodologies, such as urban development or other changes affecting emissions in the project "bubble" (NM0158); or impacts of public transport infrastructure on urban development (NM0229). Any baseline is to some extent a work of fiction, but there is inconsistency in the Meth Panel's recognition of and tolerance for these fictions across sectors.

The use of the build margin explicitly acknowledges that the baseline for the energy sector involves an increase in generating capacity and thus higher baseline emissions than under a "do nothing" scenario. In contrast, the applicability conditions for the approved AM0031 BRT methodology (as well as rejected transport methodologies) restrict the applicable baseline to a "do nothing" scenario. But is the "do nothing" scenario any more likely for transport than for energy? In reality, one might postulate that there is some amount of capital available for investment in transport infrastructure, or that decision-makers respond to complaints about excessive congestion, so that the baseline might involve (for example) new roads or grade separations of congested intersections. Under these circumstances, a required "do nothing" baseline scenario for transport CDM projects may substantially underestimate emission reductions.

Explaining Cross-Sectoral Inconsistencies

The previous sections have identified inconsistencies between transport and some other sectors in the way in which the Meth Panel treats uncertainties over market leakage and baseline construction. This section discusses three possible explanations for these inconsistencies: a deliberate bias against transport; limited pre-CDM experience with ex-post monitoring in the transport sector; and the professional backgrounds and training of Meth Panel members.

The first possibility, a deliberate bias against transport projects, is difficult to sustain empirically. It runs counter to the impressions of outside observers, and the stated positions of many Meth Panel members who appear neutral or even favorably inclined towards transport. Says one Panel member:

> If anything there's a greater interest in trying to fill the holes in the methodology map. So it [the Panel] might give it [transport] if anything a little extra care and feeding relative to the others, because of the recognition that there are so few transportation methodologies.

Indeed, one project developer and one Meth Panel member suggested that the Panel and Executive Board may have acceded to the single large-scale transport methodology that has been approved in spite of some misgivings, in order to ensure that the sector had some representation. "I think there's been a tendency to be a little bit easier on these types of projects, because they are more innovative, they're not supported heavily by the CDM, and they have a lot of development co-benefits," says the Meth Panel member. Thus, even if political rather than technical considerations were dominant in the case of transport, this should work in favor of the approval of transport methodologies.

The second possible explanation relates to the CDM's reliance on ex-post measurement, with which the transport sector has limited experience. Certified emission reductions (the tradable credits generated under the CDM) are only issued following the approval of a monitoring report, which calculates emission reductions from a project using data collected ex-post. Non-transport sectors such as electricity generation have often had long experience with ex-post monitoring outside the CDM, for example with continuous emission monitors for regulatory compliance. In contrast, the transport sector has historically relied on ex-ante simulation techniques, such as travel demand modeling. Thus, in contrast to other sectors, transport had less of a ready-made methodological base to build on for purposes of the CDM. Says one World Bank transport expert:

> What you're trying to do is say, here's what demand will look like if we do an intervention, and here's what it will look like without the improvement. And you could talk about vehicle stock or whatever, but let's face it – CO_2 reductions in the quantity we want are in [reducing vehicle travel] demand [rather than fuel efficiency]. So you've got to have a mechanism that is going to show you what demand is with and…without [the project]. There is no way you can measure that. You have to simulate it. …And the problem is that the CDM Meth Panel has said, 'no simulation models.' So we start out with our hands tied behind our backs. There's nothing we can do – we have to measure… In transport, it doesn't work if you can't simulate.

The point here is not to criticize the Meth Panel's reluctance to accept transport modeling techniques for CDM purposes. Indeed, as one interviewee put it, modelers "often have so many assumptions and free parameters to choose, that virtually any result in terms of emission reductions can be generated." Rather, the issue is the transport sector has little experience with methods for assessing project impacts that may be more acceptable to the Meth Panel.

A third and final explanation for cross-sectoral inconsistencies relates to the professional training of Meth Panel members. Transport project developers have different methodological traditions than Panel members, who are primarily engineers with expertise in energy or industrial processes. The two groups do not share a set of common experiences regarding what is methodologically reasonable and feasible, and the epistemic community built around CDM has little overlap with that of transport planning. This manifests itself partly in the Meth Panel reluctance to accept the ex-ante simulation techniques previously mentioned, which are relied on so extensively by transport planners. More broadly, these differences can be seen in the Meth Panel's focus on measurement uncertainties rather than other sources of uncertainty, particularly those derived from arguments by economists rather than engineers.

"The Meth Panel is a group of engineers," says one member. "We are technicians," says another, pointing to the Panel's role in clarifying detailed technical questions on existing methodologies and mentioning the use of a particular measurement device as an example. Emphasizing the role of measurement, he continues:

> At the end of the day you have in the methodology the uncertainties, for example the heating power of the gasoline, the heating power of the biofuels, the number of people, those parameters. And those are measured following engineering rules. You have a DOE [auditor] who will go to that place to see the monitoring report and will validate the instrumentation, will validate the statistical method, will validate the sampling, will validate the credentials, who is doing this document, who wrote it? And he will see the files, he will see the information of many years. If you are using a Metro, he will see the electricity, what is supplied from the grid. He will request the measurement from an electronic device with an accuracy of 0.2 [percent], maybe. And he also will request the [invoices], the bills paid to the electricity company.

These types of measurements from industrial facilities are relatively straightforward to conduct with a high degree of precision under controlled circumstances. When it comes to sampling and surveys, however, the Panel appears to maintain similar expectations by calling for a rigorous data collection process that goes beyond typical norms for social science research. For example, the approved methodology for energy-efficient lighting (AM0046) is incredibly thorough in its requirements to install measurement equipment in individual households; allocate households to a treatment group (which receives new bulbs) and control group via coin toss; maintain a household-level database including names, addresses and GPS information; and obtain household-level electricity consumption data – all in a developing country setting. Two years after approval in February 2007, no project developer had succeeded in registering a CDM project using this rigorous methodology, casting doubt on its practical feasibility at a reasonable cost.

The Meth Panel clearly has high standards for the precision of measuring emissions in the with-project scenario. However, as previously discussed, these same standards of precision are rarely applied to the construction of baseline scenarios and the measurement of market leakage, particularly in non-transport sectors. Methodological challenges tend to be viewed in engineering terms to the exclusion of economics. One Panel member (albeit perhaps the exception) even expresses skepticism about the contribution of economists towards methodological development:

> [Reviewer 1, an economist] is good but he's not God, it's a simple as that.
>
> [Referring to a member of the UNFCCC's Registration and Issuance Team] He is not an engineer, he is an economist. It's good to be an economist, but this is a technical issue, how to discuss heating values, how to discuss biofuels. I never discuss medicine because I am not a doctor.

The upshot is that methodologies for electricity generation CDM projects, for example, are conceived as "simple," in contrast to a "complex" transport sector. "That one [electricity generation] is so clear. You were burning coal before and now you're burning gas. That's it," says one Meth Panel member. In reality, the simplicity of electricity generation is maintained via a focus on on-site measurement challenges, while the uncertainties associated with predicting market responses and determining baselines are either ignored or simplified via the "methodological shorthand" discussed above.

Overall, the evolution of CDM methodologies has been towards greater complexity and measurement sophistication. There is little evidence, however, that this measurement sophistication has helped reduce methodological bias. Many of the elaborate procedures have been designed to address uncertainties where the expected value of the error is zero and will cancel out in aggregate. In contrast, most of the uncertainties that have been ignored – generally, those that are difficult to measure – would be expected to be biased and overstate emission reductions.

Conclusions

Transport's virtual absence from the CDM has been attributed largely to the complexity of projects in the sector, which have hampered the approval of methodologies. We do not dispute these challenges, nor do we assert that transport is in fact a good fit for the CDM or other carbon offset programs. Rather, we show that the reasons for the paucity of transport projects are more wide-ranging and subtle than previously discussed in the literature.

We identify two new groups of explanations for why transport-sector methodologies have been disproportionately rejected under the CDM. The first group relates to the historical evolution of the CDM program. We find that the order of consideration of methodologies and the assignment of desk reviewers have had an impact on approval decisions. The second group of explanations relates to inconsistencies in the basis for approval decisions between sectors. Difficulties in quantifying market leakages such as rebound effects have been a major hurdle for transport methodologies, but these market leakages have been ignored or treated simplistically in other sectors. Also, in non-transport sectors, the challenges of constructing counterfactual baselines have been made tractable through the adoption of methodological simplifications.

We also find that the Meth Panel has largely construed the challenges of methodology development in engineering terms, and neglected economic issues, with the notable exception of the rebound effects that complicate methodological development in transport. Approved CDM methodologies can be characterized as providing remarkably elaborate procedures to deal with issues of engineering measurement, while neglecting economic phenomena relating to market leakage entirely. Being dominated by engineers, the Meth Panel appears to be far more comfortable dealing with questions of measurement error than the broader uncertainties introduced by the influence of CDM projects on prices. The Meth Panel has raised numerous legitimate concerns over the methodologies submitted for the transport sector, but failed in many cases to apply these insights to other sectors, particularly electricity generation.

This paper reinforces the findings of previous research that the complexity of transport projects introduces a broad range of uncertainties that have hampered methodological development. In exploring these issues, however, we find that complexities in non-transport sectors often exist and may be significant, but have often been ignored because they are less apparent. Indeed, the issues with both transport and non-transport projects that we identified have raised questions about the reality of emission reductions claimed under the CDM in several sectors. The volume of emission reductions depends not only on measured emissions, but also on the unobservable baseline scenario. Yet methodologies rarely account for the unavoidable uncertainties involved in constructing this baseline. Nor do they account for market leakages that will almost invariably overestimate the emission reductions achieved under the CDM. Indeed, efforts to maximize the likelihood of additionality of CDM projects will tend to exacerbate these problems; projects that are more likely to be additional, as evidenced through a higher Internal Rate of Return, tend to be more susceptible to market leakages as the supply curve shifts outward and total production increases.

The lack of consistency between sectors is perhaps unavoidable given the differences in the sources of uncertainty, limited availability of data and complex market effects. A single group of decision-makers may be ill equipped to develop a consistent framework across sectors and incorporate both engineering and economic phenomena. However, in turn this casts doubt over whether a universal CDM can fulfill its fundamental raison d'être, that of maximizing efficiency through equalizing marginal abatement costs across sectors. The case of transport highlights that this universality remains an elusive goal; in practice, the offset "product" has been of a different nature in different sectors.

Sector-specific approaches have been suggested by several analysts as an alternative to project-level CDM.[7] These sector-specific approaches may not have the elegance of a single offset mechanism, but may be a more pragmatic, robust way to take advantage of the full set of emission reduction opportunities. They will not equalize marginal abatement costs across sectors, but then neither has the CDM. And sector-specific approaches may offer a better opportunity to overcome some of the CDM's challenges in ensuring that emission reductions are real, measurable, verifiable and additional.

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[7] For an example calling for a sector-specific mechanism for transport, see Clean Air Institute (2008).

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Table 1 CDM Transport Methodologies Submitted Through September 1, 2009

CDM ID	Official Methodology Title	Project Type	Location	Status*
NM0052	Urban mass transport sector energy efficiency and modal change	Bus Rapid Transit (TransMilenio Phase II)	Bogotá, Colombia	Rejected, Sep. 2004. Subsequent version approved as AM0031
NM0083	Road transport sector in India	Fuel-switching to LPG for automobiles	East and west coasts of India	Rejected, Feb. 2005
NM0105/ AM0031	Methodology for Bus Rapid Transit Projects	Bus Rapid Transit (TransMilenio Phase II)	Bogotá, Colombia	Approved
NM0128	Modal shifting in industry for transport of product/feedstocks	Freight mode shift from road to barge for transport of wood	Espírito Santo, Brazil	Rejected, Nov. 2005
NM0158	GHG emission reductions in urban transportation projects that affect specific routes or bus corridors or fleets of buses including where fuel usage is changed	Bus Rapid Transit and arterial management on Insurgentes corridor	Mexico City, Mexico	Rejected, Oct. 2006. Subsequent version rejected as NM0229
NM0201	Modal shift for the transport of bulk goods within a two node network	Freight mode shift from road to barge for iron ore	State of Pará, Brazil	Withdrawn
NM0205	Improving the fuel efficiency of vehicle fleets	Improved combustion efficiency of diesel in buses	Rosario, Argentina	Rejected, Jun. 2007
NM0229	Mass Rapid Transit Projects	Bus Rapid Transit on Insurgentes corridor	Mexico City, Mexico	Rejected, Nov. 2007. Revised and resubmitted as NM0258
NM0237	GHG Reductions through Improved Occupation Rate of Public Transport Units	Bus dispatch system to increase load factor of buses	Manila, Philippines	Rejected, Nov. 2007. Subsequent version rejected as NM0257
NM0257	GHG Reductions through Supply Optimization Measures of Public Transport	Bus dispatch system to increase load factor of buses	Manila, Philippines	Rejected, Jul. 2007
NM0258	Methodology for Bus Lanes	Bus Rapid Transit on Insurgentes corridor	Mexico City, Mexico	Pending
NM0266	Methodology for Rail Based Urban Mass Rapid Transit Systems (MRTS)	Metro One	Mumbai, India	Pending
NM0279	Methodology for Transport Efficient Development (TED)	Transit-oriented development	Nanchang, China	Rejected, Nov. 2008
NM0287	Methodology for Increasing Rail Based Mass Rapid Transit Ridership	Increase of Metro ridership	Medellin, Colombia	Rejected, Feb. 2009

Source: cdm.unfccc.int, last accessed September 10, 2009.
* Rejection dates refer to date of Executive Board meeting, not the Meth Panel recommendation.

Table 2 Affiliation of Interviewees (Current or Former)

	Number of Interviewees*	
Affiliation	**Face-to-Face**	**Telephone**
Meth Panel	9	2
Desk reviewer	3	2
Multilateral development bank (including World Bank)	3	2
Project owner or developer	2	2
Other transport-sector expert	4	0
Total	**21**	**8**

* Some interviewees fall into more than one category, in which case their most recent affiliation is used.

Table 3 Classification of Methodological Uncertainties

Category	Source of Uncertainty	Example
Leakage Uncertainty (Market)	Fossil fuel price effect	If a CDM project reduces demand for fossil fuels, the price falls and increases consumption elsewhere
	Rebound effects	Reduction in vehicle travel from a CDM project is offset as individuals make more trips in response to lower generalized cost
	Crowding out	If a CDM project shifts freight to barges, these barges may no longer be available for other customers who may then shift back to trucks if supply is not sufficiently elastic
	Outward-shifting supply curve (sometimes termed "suppressed demand" by Meth Panel)	CDM project increases electricity generation or transportation capacity, shifting the supply curve outward and thus increasing demand
Leakage Uncertainty (Non-Market)	Upstream emissions	Emissions from cement or steel production to build the BRT system or hydroelectric facility
	Other leakages	Generally specific to project types, e.g. fugitive emissions from industrial processes
Baseline Uncertainty	Identification of a reasonable counterfactual without-project scenario	Would the local government have built a Metro, expanded roads or done nothing if BRT had not been an option?
	Quantification of emissions under that baseline scenario	What would emissions have been in the presence of the Metro or expanded roads?
Additionality Uncertainty	Additionality (related to identification of baseline)	Would the project have been undertaken in the absence of the CDM?
Monitoring Uncertainty	Ability to measure actual emissions within the project boundary	Measurement of fuel consumption by BRT vehicles
Implementation Uncertainty	DOE* (auditor) competence	Does the DOE have enough time, expertise and incentives to ensure that all the rules and procedures are being followed, and to verify the integrity of data?

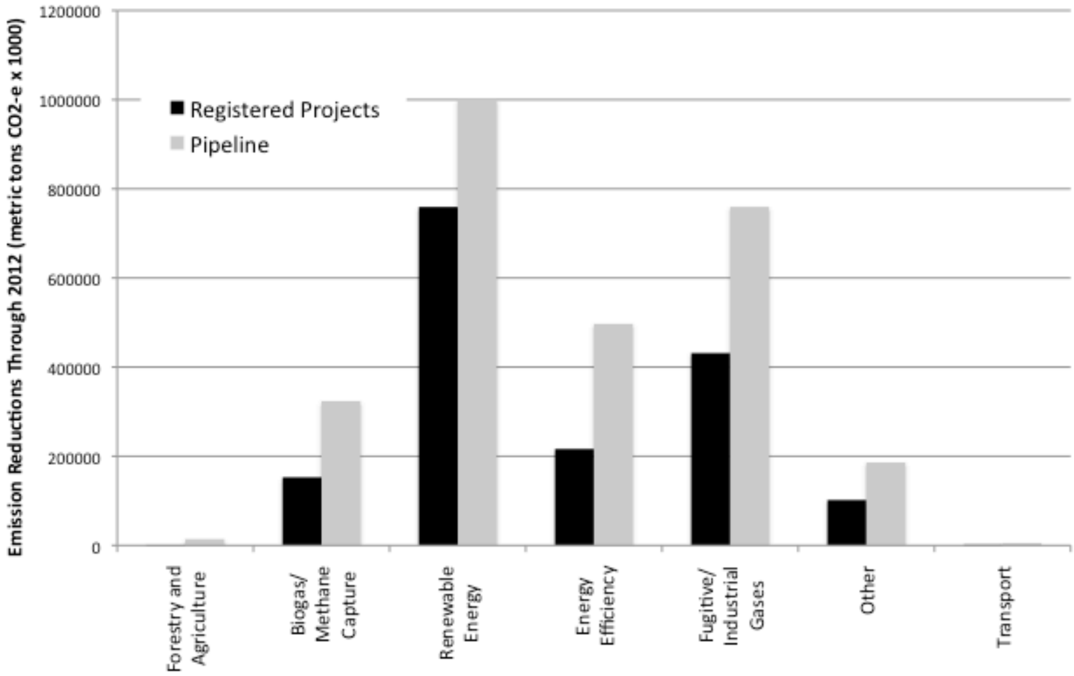
* A Designated Operational Entity (DOE) is accredited by the Executive Board, and contracted by the project owner to validate ex ante the project (certify that CDM requirements and applicability conditions are met) and verify ex post that emission reductions are achieved.

Table 4 Stated Reasons for Rejection of Transport Methodologies

CDM ID	Methodology/ Project Type	Main Stated Reasons for Rejection*
NM0052	Bus Rapid Transit	- No method to determine additionality or select baseline scenario - Too project-specific - Rebound effect not correctly addressed - National/regional policies not fully accounted for - Numerous detailed issues with defaults, formulae, other assumptions and clarity
NM0083	Fuel switching to LPG	- Unclear and not logical - Too project-specific - No justification for selection of baseline scenario - Leakage not adequately assessed, e.g. rebound effects from lower fuel prices - Numerous other technical and data issues and problematic assumptions
NM0128	Freight mode shift from road to barge	- No procedure to determine baseline scenario - No accounting for changes in production - Too project-specific - Inadequate accounting for emissions from (potentially empty) return trips - Lack of quality assurance procedures
NM0158	Bus Rapid Transit and other corridor projects	- "Bubble" drawn around the project corridor could give credit to emission reductions that are not casually related to the project - Leakage not fully accounted for, especially rebound effects - Inadequate procedure to demonstrate additionality - Inadequate accounting for upstream emissions
NM0205	Improved fuel efficiency in diesel bus fleets	- Project would increase combustion efficiency, and may increase fuel efficiency without reducing emissions - Rebound effects not considered - Inadequate monitoring of fuel use and mileage
NM0229	Bus Rapid Transit and other public transport	- "Zone of influence" of the project not clearly defined - Baseline issues as the project would increase total system capacity over that of the baseline system - Inadequate accounting for access trips - Leakages, particularly rebound effects from induced traffic and impacts of new public transport on urban development, not fully considered
NM0237	Bus dispatch to improve load factors	- Demonstrating causality, i.e. problems in isolating emission reductions from the project from wider factors such as urban development - Leakages not fully accounted for, e.g. if drivers and buses shift to other routes
NM0257	Bus dispatch to improve load factors	- Methodology too broad, and applicability ambiguous - Reductions in bus frequencies may cause shift to private car - Leakage not fully accounted for, e.g. if buses shift to other routes - Lack of guidance on monitoring parameters
NM0279	Transit-oriented development	- Control group may not be closely matched with project (treatment) group - Fuller discussion of propensity score matching procedure needed - Inadequate procedure to demonstrate additionality - TOD may be a "policy" not a project and thus not eligible for CDM
NM0287	Increased rail ridership	- Demonstrating causal link between project and changes in ridership - Survey design issues - No accounting for rebound effects from reduced congestion

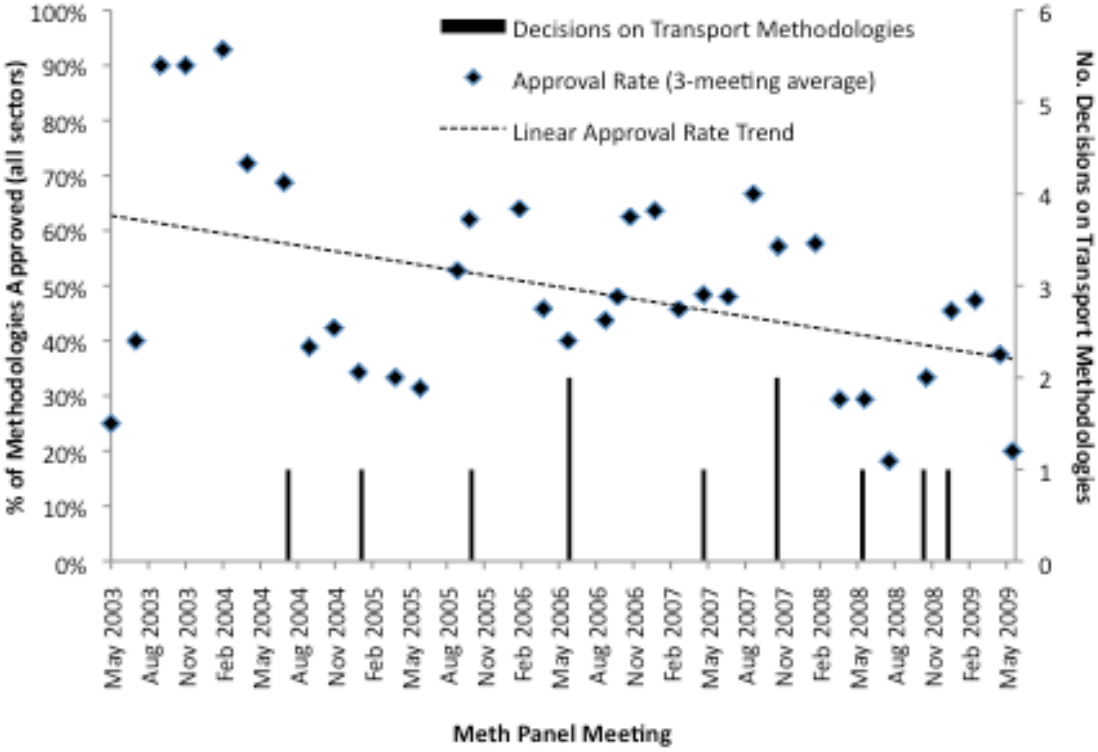
* Reasons for rejection are as stated in the Meth Panel recommendation, last accessed September 10, 2009 at cdm.unfccc.int. Table excludes methodologies that were approved, withdrawn, or where a decision was pending as on September 1, 2009.

Figure 1 Sectoral Representation of CDM Project Pipeline



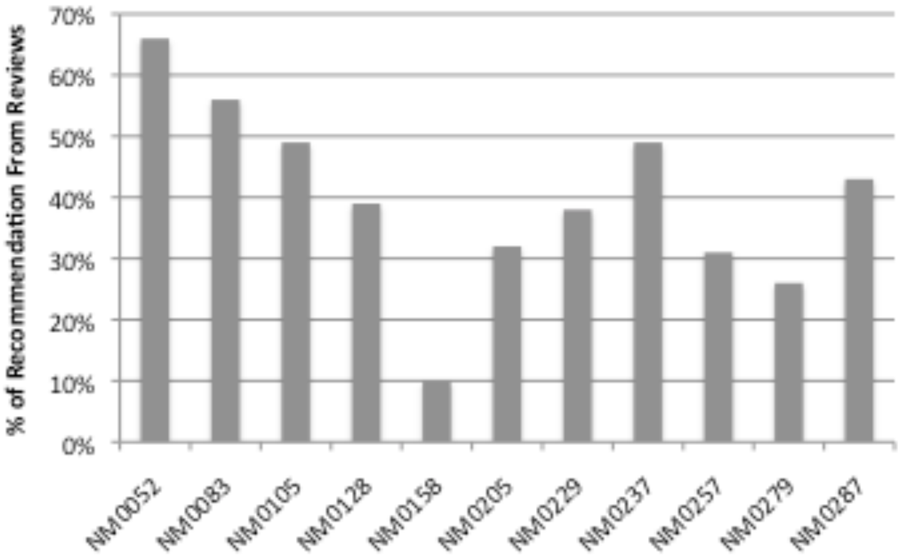
Source: Adapted from UNEP Risø CDM/JI Pipeline Analysis and Database, September 1 2009. "Pipeline" projects include those that have been submitted for validation (i.e., 3rd party assessment of CDM eligibility) as well as those registered by the Executive Board. Only emission reductions through 2012 are shown, but projects may continue to generate emission reductions beyond this date.

Figure 2 **Trends in Methodology Approval Rates**



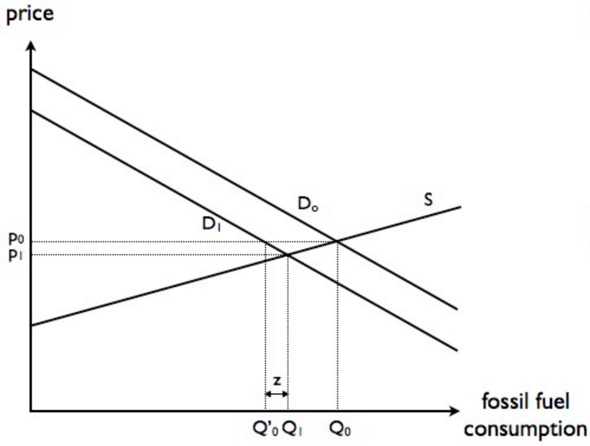
Source: Calculated from Meth Panel meeting reports at cdm.unfccc.int. Approval rate is the number of final approval recommendations divided by the number of final recommendations (to approve plus to reject). A methodology is counted only on the first Meth Panel final recommendation. Neither referrals back from the Executive Board nor “B” recommendations (where the Meth Panel agrees to reconsider a revised version) are included in the calculations. Note that proposed methodologies that are not approved directly but instead have elements incorporated into consolidated methodologies are counted as “approved.”

Figure 3 Meth Panel Reliance on Desk Reviewers

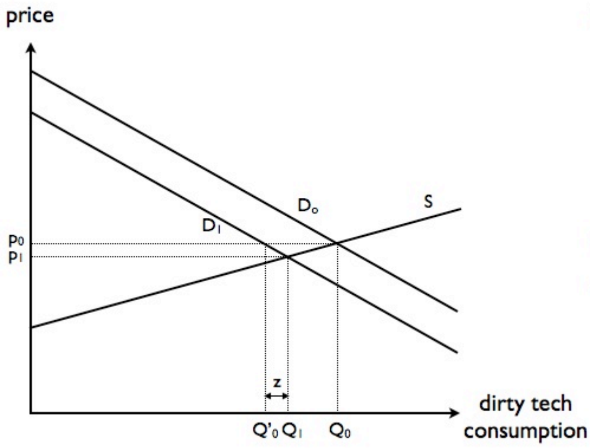


Source: Calculated from review documents and Meth Panel recommendation using WCopyFind v2.6 plagiarism detection software. Figures refer to the perecentage of the Meth Panel recommendation that is drawn verbatim from desk reviews or edited only slightly. Phrases of five words or more are considered in the matching, but some imperfections (e.g. up to 25% non-matching words) are allowed to account for minor editing. Boilerplate text is excluded. For details of the software's matching algorithm, see http://plagiarism.phys.virginia.edu/Wsoftware.html.

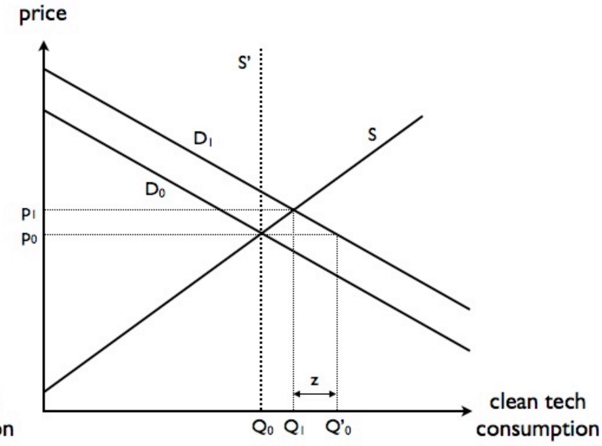
Figure 4 Market Leakage Pathways



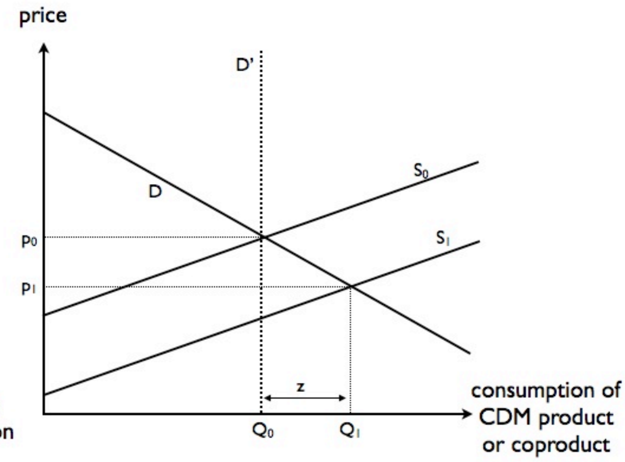
1. Fossil fuel price effects. Reduction in fossil fuel demand from D_0 to D_1 reduces consumption from Q_0 to Q'_0, but it rebounds to Q_1 following the fall in price from p_0 to p_1. Leakage is z.



2. Rebound effects. Reduction in demand for a dirty technology from D_0 to D_1 reduces consumption from Q_0 to Q'_0, but it rebounds to Q_1 following the fall in price from p_0 to p_1. Leakage is z. This is a more general case of (1).



3. Crowding out. Increased demand for a clean technology from D_0 to D_1 increases consumption from Q_0 to Q'_0, but it rebounds to Q_1 following the rise in price from p_0 to p_1. Leakage is z. In the extreme case of perfectly inelastic supply S', there is no emissions benefit.



4. Outward-shifting supply curve. Increased supply of a good (through CDM revenue for the good itself or a coproduct) from S_0 to S_1 increases consumption from Q_0 to Q_1. Leakage is emissions associated with increased consumption z, unless demand D' is perfectly inelastic.