Ministry of Agriculture and Forestry

Review and Assessment of Options for Reducing Emissions from Deforestation in Developing Countries

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M-co consulting brings together economic, commercial, regulatory, technical and information systems expertise to focus on carbon and energy issues.

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Executive Summary

Land use change is one of the leading contributors to greenhouse gas emissions, with deforestation accounting for the majority of land use change emissions. Deforestation emissions from developing countries have increased dramatically in the last 50 years and currently account for approximately one-fifth of human-induced carbon dioxide emissions. This has led interested parties to advocate the development of a mechanism which would incentivise developing countries to reduce emissions from deforestation and forest degradation (REDD).

REDD was not included in the Kyoto Protocol first commitment period, but there is a widespread desire to see it incorporated into any post-2012 agreement. REDD is widely seen as a low cost option for dramatically reducing annual greenhouse gas emissions. In addition, encouraging the preservation of tropical forest has social, cultural and environmental benefits.

Given the anticipated low cost of reducing emissions from deforestation and degradation, the high percentage of emissions attributable to deforestation, and the seriousness of climate change, REDD justifiably deserves to be at the top of the agenda. Before moving from concept to reality, two fundamental tasks lie before us. First, the true benefit of REDD must be understood sufficiently to allow an appropriate allocation of resources between REDD and other efforts to mitigate climate change. Second, consideration must be given to the possibility that addressing REDD could involve an unprecedented transfer and distribution of wealth from developed to developing nations.

A key issue with REDD is poor information and a high level of uncertainty relating to actual and potential deforestation emissions. This has led to concerns about the additionality of actions that directly incentivise REDD. In particular, it has led to concern that there is a significant risk that environmentally worthless REDD credits could distract nations from emissions reductions in other sectors.

Therefore, a concerted effort will be required to improve the quality of deforestation data to assure funding nations that emissions reductions are real. Similarly, conservative reference levels and a conservative approach to assessing emission reductions are likely to be necessary to ensure that a REDD scheme does not disrupt international emissions reduction efforts.

Preferred approach

This paper proposes a preferred approach as a starting point for moving forward with a viable REDD regime. It is argued that concerns with the quality of REDD reductions can be addressed effectively through discounting the value of REDD contributions (crediting) relative to more certain mitigation efforts.

The preferred approach consists of a REDD market mechanism, with reference levels established for each participating country, supported by capacity building. In addition,

projects funded outside the market mechanism would be available as an option for countries unable or unwilling to participate in the international REDD market at the outset.

Table 1: Key features of a preferred REDD option

Component	Description	Key Features	Pre-requisites
Capacity building	Directly funded efforts to build capacity in governance, measurement and monitoring	▸ Generates capacity to participate in national-level crediting ▸ Global fund, ODA, or bilateral funding ▸ Nominal emissions reductions	▸ Donor pool ▸ Knowledge of deforestation drivers and target country situation ▸ Clear understanding of national-level crediting requirements
National-level crediting	An international market-based baseline and credit incentive system	▸ Large volume of expected emissions reductions ▸ Managed fungibility with emissions markets drives volume and efficiency of investment ▸ Safeguards against over or under supply of units ▸ "Gearing" of units provides assurance of unit quality ▸ Reference level corridors provide consistent incentives ▸ Nations agree on framework and methodology first and then negotiate reference levels ▸ Dynamic reference levels encourages real reductions ▸ Measurement: currently available technology and techniques: remote sensing imagery to define the spatial extent and stratification; IPCC Tier 1 level approximations to start ▸ Degradation: no initial requirement to report	▸ Additional emission reduction commitments ▸ Agreed framework is a broad international agreement between developed and developing countries to establish REDD's position within the overall UNFCCC climate change efforts ▸ Establishment of a measurement and reporting system
Internationally-funded REDD projects	Projects available for nations unable to participate in national-level crediting	▸ ODA or global fund ▸ Nominal emissions reductions ▸ Projects need to satisfy leakage and non-permanence safeguards	▸ Decision on funding ▸ Clear requirements

We suggest that the targeted timeframe for the establishment of a REDD mechanism would be in the period 2013-2020.

The options

In developing the preferred approach a variety of options were assessed against criteria judged to be critical for a successful international REDD agreement.

The options examined and an overview of the evaluation against the criteria are summarised in the following table. Options were assessed for their suitability as elements of a global REDD framework. Options were not assessed for their suitability as domestic measures. For example, if a national-level market-based mechanism were implemented as the global framework we would still fully expect countries to use projects as domestic implementation tools even if they are not part of the global framework.

Table 2: Summary of option evaluation by criteria

Criteria \ Options		Output Methods				Input Methods			
		Markets		Funds					
		National-level crediting	Project-level crediting	National-level compensation	Funded projects	Compensation for Policies and Measures	Capacity building	Other mechanisms (certification illustrated)	Best Practice
Environmental Effectiveness	Permanence	V	V	V	V	○	○	◔	○
	Leakage	◔	V	◔	V	V	○	◔	○
	Participation	●	V	●	V	V	●	○	●
	Leads to real reductions	V	V	V	V	V	○	◔	V
Economic Efficiency		●	◑	◔	◑	◔	◑	◔	◔
Viability	Acceptability	◔	V	◔	V	○	●	○	●
	Flexibility	◑	◔	◑	◔	●	●	○	●

Degree to which option meets criteria — ● Low — ◔ Medium/ Low — ◑ Medium — ◔ Medium/ High — ● High — V Variable (from low to high) — ○ Not addressed

Structure of report

The next chapter presents the preferred approach to addressing the problem of reducing emissions from deforestation and degradation in developing countries (REDD). Subsequent chapters frame the problem of deforestation and degradation (chapter 2), consider issues with reducing emissions from these sources (chapter 3), identify the options for addressing REDD (chapter 4), develop criteria for assessing these options, and evaluate the options against this criteria (chapter 5). Chapter 6 concludes.

1 Preferred Approach

1.1 Introduction

The preferred approach consists of a REDD market mechanism, with reference levels established for each participating country's deforestation emissions, supported by capacity building.

There would also be provision for projects financed by global funds prior to the introduction of the REDD market mechanism and as an alternative for countries that were not yet in a position to meet that mechanism's eligibility requirements. The key features of the preferred solution are illustrated in Tables 3 and 4.

Table 3 : Preferred REDD Approach

Output management schemes			Input management schemes	
Scale \ Funding	Markets	Funds	International	
National-level	✓ ✓ ✓		National-level	✓
Projects		✓	Projects	

The preferred approach was chosen because of our assessment that:

1. The proposal is one that can feasibly result in an agreement;
2. It is the most efficient combination of options available; and
3. It provides the greatest potential for generating sufficient funds.

Managed integration with markets operating in other sectors will ensure the smooth establishment of the REDD market, while safeguards against under- and over-supply of REDD units will protect the integrity of both the REDD market and markets in other sectors.

Table 4: Key features of a preferred REDD option

Component	Description	Key Features	Pre-requisites
Capacity building	Directly funded efforts to build capacity in governance, measurement and monitoring	▸ Generates capacity to participate in national-level crediting ▸ Global fund, ODA, or bilateral funding ▸ Nominal emissions reductions	▸ Donor pool ▸ Knowledge of deforestation drivers and target country situation ▸ Clear understanding of national-level crediting requirements
National-level crediting	An international market-based baseline and credit incentive system	▸ Large volume of expected emissions reductions ▸ Managed fungibility with emissions markets drives volume and efficiency of investment ▸ Safeguards against over or under supply of units ▸ "Gearing" of units provides assurance of unit quality ▸ Reference level corridors provide consistent incentives ▸ Nations agree on framework and methodology first and then negotiate reference levels ▸ Dynamic reference levels encourages real reductions ▸ Measurement: currently available technology and techniques: remote sensing imagery to define the spatial extent and stratification; IPCC Tier 1 level approximations to start ▸ Degradation: no initial requirement to report	▸ Additional emission reduction commitments ▸ Agreed framework is a broad international agreement between developed and developing countries to establish REDD's position within the overall UNFCCC climate change efforts ▸ Establishment of a measurement and reporting system
Internationally-funded REDD projects	Projects available for nations unable to participate in national-level crediting	▸ ODA or global fund ▸ Nominal emissions reductions ▸ Projects need to satisfy leakage and non-permanence safeguards	▸ Decision on funding ▸ Clear requirements

1.2 Capacity building

The preferred approach supports rapid implementation of capacity building efforts in order to prepare countries to participate in the national-level crediting regime. Global funds and bi-lateral agreements will provide funding for capacity building.

Capacity building efforts would be established to support one of two objectives:

- Enabling measurement and reporting required for national-level crediting; and
- Assisting nations to develop capacities necessary to implement domestic deforestation emissions reduction efforts.

Capacity building programmes would be tailored to national conditions.

1.3 National-level crediting

Framework

The preferred approach would be established by a broad international agreement between both developed and developing countries. This is required to establish REDD's position in the overall UNFCCC efforts to avoid harmful effects of climate change.

The agreement would establish a durable REDD framework to support operation of the REDD regime, including establishment of deforestation measurement and reporting requirements. The reporting requirements would prescribe the information necessary to satisfy the basic reference level and performance measurement data needed to enable the broadest possible participation. Measurement will be discussed further below.

In the interest of obtaining a workable agreement, consensus and ratification of the framework should occur ahead of discussions on specific reference levels and crediting mechanisms for developing countries. Likewise, the approach to integration with markets in other sectors should be decided ahead of any specific discussions of commitment levels and exchange ratios.

All countries would be invited to ratify the framework regardless of their current ability or willingness to elect to begin measurement and crediting. This would help ensure broad agreement to the framework.

Scale

The overall scale of the REDD market would be determined by negotiation. This would include negotiation of the following elements:

- Commitments by Annex I parties[1] above what would have been agreed in the absence of REDD;
    - Annex I parties would have the option to use REDD units to satisfy commitments in a future climate change agreement;
    - Additional commitments are necessary to achieve an overall reduction of emissions. This is because if commitments do not take into account the potential volume of REDD units emission costs are likely to fall significantly;
- Fungiblity mechanisms to allow interflow of investment between the REDD sector and other sectors;[2] and
- REDD-specific bilateral, ODA investments or alternative means such as revenues from auctions of emissions units.

Unit crediting

Under the REDD market mechanism, participating nations would be credited units for emission reductions according to the extent their actual deforestation emissions had reduced relative to the nation's reference corridor, as explained in detail in Figure 2.

[1] In this report, "Annex I" refers to any party with commitments to reduce emissions under a climate change agreement. This report makes no presumption about which parties would or would not be included in Annex I in the future.

[2] Fungibility restrictions act to allow or restrain investment flows from to or from the investments in emissions reductions in other sectors. Without restrictions, at a lower cost, REDD units would attract investment away from other forms of climate change mitigation. Likewise, if REDD credits were costlier than those generated by other mitigation efforts, greater investment would flow to non-REDD projects

As the overall reduction in deforestation resulting from a mechanism is likely to be highly uncertain, one alternative is to include all (participating) developing countries' forests in the overall target and adjusting the level of payment depending on the overall level of emission reduction achieved by all countries.[3] Such an approach would provide incentives for all participating countries to monitor and influence the activities of other countries in order that the payment could be maximised.

Fungibility

REDD units would obtain value through being able to be used by Annex I parties to meet commitments. The mechanism by which this value is realised is by making REDD units fungible with units for other sectors that can be traded under the successor arrangements to International Emissions Trading (Article 17 of the Kyoto Protocol). The decision to expand fungibility to other national or regional markets, such as the NZ ETS or the EU ETS, lies with the operators of those markets. This is in contrast to proposals that establish a completely separate REDD market and obligation to purchase REDD units.[4]

Fungibility is recommended because market interactions between sectors enhance economic efficiency, provided there is true value in the units in each sector. The cross linking of markets provides important price signals to each market.

The caveat "provided there is true value in the units in each sector" is at the heart of the need for managed fungibility. There are two important reasons why fungibility between a REDD market and markets in other sectors needs to be managed:

- REDD units differ from other emissions units:
    - they represent an imperfectly measured reduction; and
    - reductions may be non-permanent; and
- Expected natural variability in the supply of REDD units could significantly impact activities in other markets.

Given the importance of addressing such concerns, we propose several mechanisms to manage the fungibility of REDD units:

- Gearing of REDD units;
- Country-specific redemption limits; and
- Banking of a set portion of units.

Methodologies to establish gearing ratios would be established during negotiation. However, it is anticipated that gearing ratios will incorporate factors to adjust for assumed leakage and degradation, natural effects, measurement uncertainty, and uncertainty around baselines. It is proposed that several gearing ratios would be available to countries, based on the certainty around their measurement systems and inclusion or exclusion of degradation.

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[3] This is, in effect, the approach suggested by Strassburg, et al, though their proposal involves a market mechanism. Strassberg, B., et al, An Empirically-Derived Mechanism of Combined Incentives to Reduce Emissions from Deforestation, Centre for Social and Economic Research on the Global Environment (CSERGE), Norwich.

[4] Ogonowski, M., et al, 2007, *Reducing Emissions from Deforestation and Degradation: The Dual Markets Approach,* Center for Clean Air Policy.

Gearing of REDD units, combined with the effects of the corridor approach (explained below), will limit oversupply of REDD units to the market. To further ensure the market is not overrun by REDD units a cap would be applied to the quantity of units each country can bring to market each year. Units above the cap could be sold in voluntary markets, under bilateral agreements, or could be banked to cover future obligations in other sectors. Alternatively, demand could be restricted by limiting the quantity of units that can be brought into specific markets, such as is the case with the restriction on the use of CDM units in the EU ETS.

Gearing

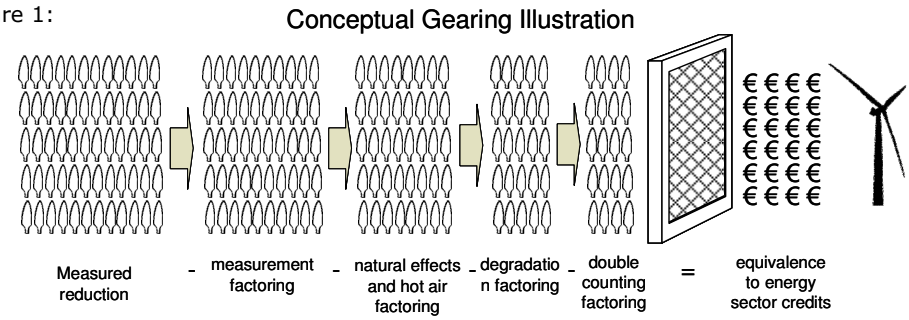
The quantity of units generated by an activity can be tailored to the degree of uncertainty involved, to the level of leakage, or to the level of permanence. As the level of uncertainty is reduced the degree of discounting could be lowered, thus providing incentives for improved measurement accuracy.

For example, a programme with a low degree of accuracy may be eligible for 0.2 REDD units per tonne CO_2-e of emission reductions (or 1 unit per 5 tonnes CO_2-e reductions), while a more accurately measured programme could be eligible for 0.5 REDD units per tonne CO_2-e or (1 unit per 2 tonnes CO_2-e reductions). This approach of adjusting the number of units that can be earned for a given quantity of emissions is here referred to as "gearing" (because more than one tonne of emission reductions must be achieved before a unit is credited) or "factoring" (to denote that a factor is applied to determine the quantity of units that an emission reduction is eligible for).

Gearing can be applied in a number of ways. For example, it could involve:

- the application of a factor to the quantity of emission reductions achieved by an activity;
- establishing "exchange rates" for the conversion of REDD units to other units); or
- establishing a "compliance factor" for determining how many REDD units must be retired per tonne of Annex I emissions for compliance purposes.

Figure 1:



One option is to require supplying countries to bank a set percentage of allocated units as an enforcement mechanism for the "once-in-always-in" nature of the scheme. Such a requirement would further reduce the supply of units available

Treatment of degradation

For the first phase of the REDD regime there should be no compulsory requirement for the monitoring of degradation. While ideally the framework should include degradation, the additional difficulty, cost and time required for establishing a system capable of adequately monitoring emissions from forest degradation is prohibitive at this time. As potential monitoring methodologies are developed, incentives should be provided for countries to elect to incorporate degradation. One method available is to provide improved gearing on units credited as a result of monitoring that incorporates degradation.

As the drivers for deforestation (primarily conversion to pastoral and crop land agriculture) and the drivers of degradation (primarily timber extraction or plantation agriculture), are different, leakage from deforestation to degradation is bounded. The advantages of early establishment of a functional REDD regime outweigh the benefits of waiting until degradation monitoring is feasible.

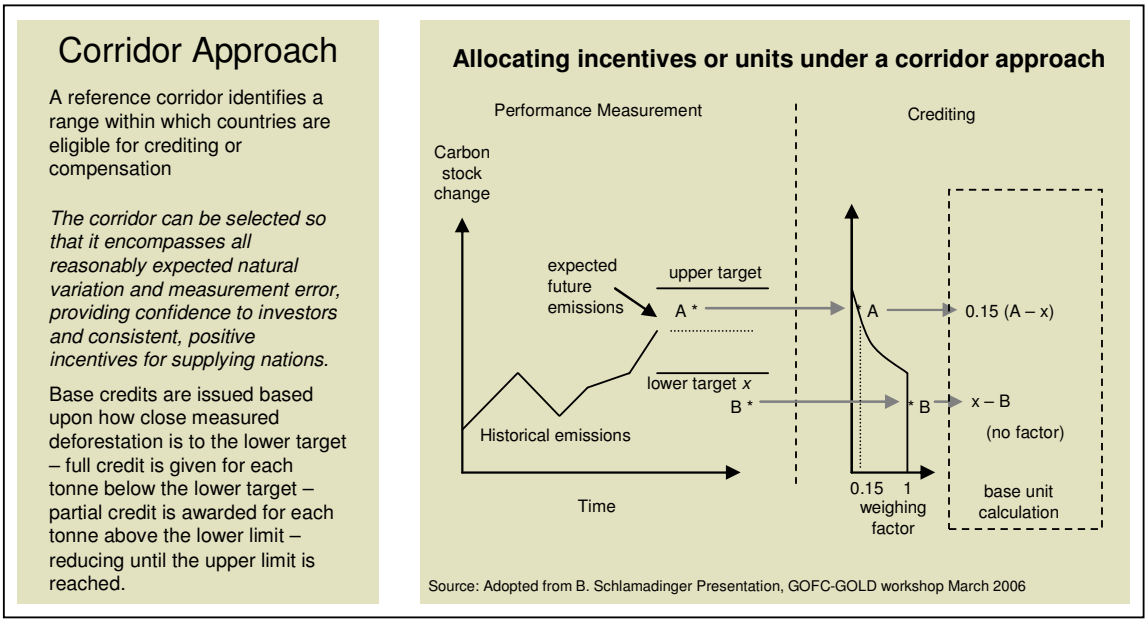
If there is wide concern that degradation should be included from the outset, one option would be to define two classes of forest: intact and non-intact. Indicators, such as the presence of roads, could be used to define non-intact forest. Intact forest would be re-classified as non-intact when indicators pointed to forest degradation. Intact forest that has been degraded prior to being deforested would be counted as having emitted the total carbon stock change between the intact and deforested states.

Reference levels

Reference levels are the heart of a national-level crediting incentive system. Tradable units would be issued for measured performance in reducing emissions from deforestation relative to a reference level. The establishment of a reference level therefore determines how much a participating country will earn for its actions, or how hard it will have to work to achieve a desired emission level.

Reference corridors rather than reference levels should be used, as this will assist in mitigating the risks arising from measurement uncertainty and hot air. Nations will be issued credit for deforestation rates that fall within or below the reference level corridor. Incentives for improvement are greater at the bottom and below the reference level corridor. Incentives will be small but positive above the centreline of the corridor.

Figure 2: Corridor approach



Reference corridors should be negotiated by each country following overall acceptance of a standardised reference level methodology. For example, the reference corridor may be a formula with several variables such as historic deforestation rates and a development adjustment factor. The formula and variables should be agreed upon first, and the variable values should be determined in subsequent negotiations. This will limit the degrees of negotiating freedom and lead to quicker and less costly negotiations. The

preference would be that reference corridors consider the business-as-usual case rather than a strictly historical level.

Reference corridors should be dynamic with reference corridor variables re-negotiated every five years. Such re-adjustment is necessary to account for changes in deforestation drivers.

Measurement

Policy options are limited by what measurement methodologies are available. For example, if measurement and administrative systems allowed, there would be full accounting for degradation.

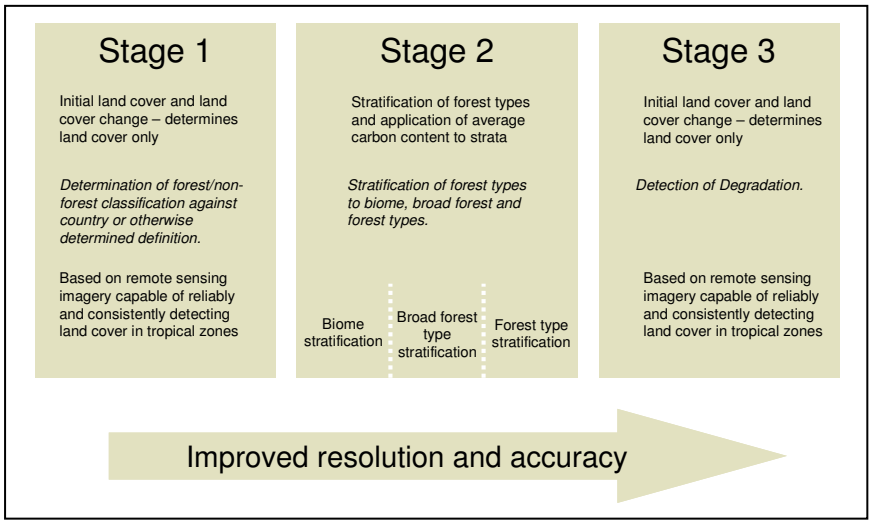
Baseline estimation and monitoring should not rely on unproven technologies and techniques because of the uncertainty as to their success. Policies should be devised based on what is methodologically feasible now or can be confidently relied upon for delivery in the near-term.

Except for calibration purposes, measurement methodologies should not rely on ground-based data, as this will not be a feasible option for developing country tropical forests for the foreseeable future.

REDD methodologies should focus initially on defining the spatial extent of forest lands and stratification of forest areas using remote sensing imagery. REDD participants can then apply IPCC Tier 1 level approximations of carbon stock to those strata while continually enhancing both the level and accuracy of strata and estimation of carbon stock for those strata.

Measurement capacity should be developed in three stages, as shown in Figure 3.

Figure 3: Measurement stages



Stage 1 – Determination of forest/non-forest classification against country or otherwise determined definition. This should be based on remote sensing imagery capable of reliably and consistently detecting land cover in tropical zones, taking into consideration issues of cloud cover and high moisture. This should be reasonably standardised for all countries, and should not rely on country-specific information. Land cover determination should be able to be implemented by the start of an accounting period and used to set land cover base maps.

Stage 2 – Stratification of forest types to biome, broad forest and forest types. The preferred approach is to move directly to stratification of forest types, where feasible. Country or regional information and ground-based validation will be required to establish average carbon content for strata. The cost of data collection and processing, and reliability of data, may vary between countries. By categorising areas into higher or lower carbon content, this approach will limit potential leakage that might result from deforestation shifting from low carbon content areas to higher carbon content areas. Care needs to be taken to ensure average rates of carbon stock estimation has as great a precision as possible, as this will be the greatest source of error. Ideally, this should be implemented by the start of the country's entry into the REDD regime as part of base map setting.

Stage 3 – Detection of degradation. Various options are currently being considered for detection of degradation. These include use of high resolution satellite or airborne platform imagery to classify canopy cover and/or disturbance. However, such an approach has limitations. The use of radar or other techniques may prove more feasible. Detection of degradation should not be required for the start of the REDD regime because of the substantial technological burden, but its inclusion should be encouraged.

Initially, stage 1 or stage 2 can be used for crediting units. Measurement may be provided by a public or private entity on a global basis. Gearing will be established appropriate to the uncertainties involved in each method.

1.4 Projects in the preferred approach

Under the preferred approach, projects can play an important role in generating emissions reductions and building capacity through learning-by-doing. It is anticipated that domestic projects will be broadly utilised by countries to generate emissions reductions in support of their objectives under national-level crediting. In addition, internationally funded projects are recommended under the preferred approach. International funding of projects would provide an early start to REDD activities prior to the inception of national-level crediting as well as providing opportunities for countries that do not yet meet national-level crediting requirements to undertake REDD activities.

International funding for projects would be channelled through global funds or bilateral agreements. While such projects can also seek funding from voluntary markets, projects would not be eligible for crediting of REDD units. The difficulties of accounting for project leakage and ensuring emission reductions are real as well as the burden of creating and agreeing to necessary rules, led to the preference to disallow direct REDD crediting for projects.

Although projects would not be eligible for REDD units, projects still would need to meet additionality and permanence criteria and account for leakage to ensure that funds are being used to promote real emission reductions.

2 Deforestation in Developing Countries

2.1 Deforestation activities as a net source of GHG emissions

Land-use change from deforestation and forest degradation accounts for approximately 20% of current greenhouse gas emissions.[5] Emissions from land-use change are the direct result of human-initiated changes to land management, for example the conversion of forested areas to grazing or crop land for agricultural development. Deforestation is by far the single largest source of land-use change emissions, accounting on a global scale for in excess of 8 $GtC0_2$/yr in 2000.[6] Consequently, addressing emissions from this source is crucial to addressing the wider issue of climate change.

Deforestation emissions arise in a number of ways. The largest source is the carbon dioxide which enters the atmosphere when the carbon stored in trees (and other forms of vegetation) is released as a result of burning or as unburned organic matter decays over time. Deforestation also disrupts soil, causing it to release a proportion of its carbon stores into the atmosphere, particularly for peat forests. The reduction in vegetative cover through deforestation also results in a reduction in carbon dioxide sequestration, allowing more carbon dioxide to remain in the atmosphere.

For the purpose of reducing the net effect of overall carbon dioxide emissions and removals, reforestation and afforestation are not as effective as reducing deforestation. The amount of carbon dioxide released when one tree is cut down is not immediately offset by planting another tree; rather, it can take as long as a hundred years, or more, for a tree to reabsorb the level of carbon dioxide lost.[7]

The level of deforestation occurring worldwide is alarming. The Food and Agricultural Organisation of the United Nations (FAO) estimates that around thirteen million hectares of forest is lost each year, representing a net loss per annum of 7.3 million hectares for the period from the turn of the century to 2005.[8,9] It must be noted however, that measuring the rate of deforestation is a difficult task, subject to much variance depending on the measurement technique used.[10]

The majority of land-use change emissions come from developing and largely tropical countries, in direct contrast to emissions from other sectors which arise predominantly from developed countries. South America is recognised as the region with the highest overall rates of deforestation, with 4.3 million hectares of forest being cleared each year.

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[5] Schlamadinger, B et al , 2007, "A synopsis of land use, land-use change and forestry (LULUCF) under the Kyoto Protocol and Marrakech Accords", *Environmental Science and Policy*, 10, 271-282

[6] Stern, N, 2006, *The Economics of Climate Change- The Stern Review*, Cambridge University Press, Cambridge, www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/Stern_review_report.cfm.

[7] Stern, *op cit.*

[8] Kanninen, M , er al, 2007, *Do Trees Grow on Money? The implications of deforestation research for policies to promote REDD,* Centre for International Forestry Research, Indonesia.

[9] By comparison, the world's total forest area was estimated to be just under 4 billion hectares in 2005. Source: FAO, *Global Forest Resources Assessment 2005,*

[10] Kanninen, *op cit.*

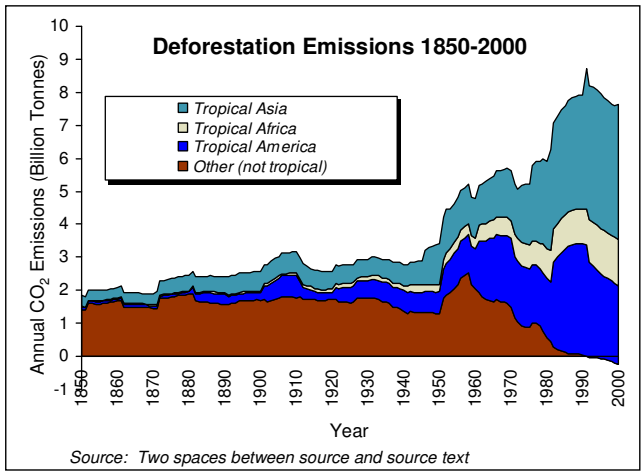
In the first five years of the twenty-first century alone, Brazil lost more than 3.1 million hectares of forest, the majority of which was converted to pastoral land. After South America, the next most affected region is Africa, with four million hectares of land deforested per annum. The proportion of deforestation relative to remaining forest is highest in Central America and Southeast Asia. By contrast, afforestation and reforestation programmes in the United States of America, China, Bangladesh, India and Europe resulted in these countries being net sinks or removers of greenhouse gases. However, the magnitude of this net removal of greenhouse gases is not nearly enough to counter the large level of emissions from deforesting developing countries. [11,12]

Under the Kyoto Protocol, Annex I countries are responsible for emissions from deforestation but are also able to incorporate the benefit (without potential liabilities for the first commitment period) from inclusion of afforestation/reforestation (A/R) activities since 1990. It is optional to account for greenhouse gas emissions and removals from the other land use sub-sectors including forests that meet the definition of a forest in 1990 (Forest Management), cropland management, grazing land management and revegetation. This was mainly due to the cost and complexity of measurement associated with these sub-sectors.

Figure 4, right, shows that while emissions from deforestation in non-tropical countries have stabilised, deforestation in tropical countries has increased roughly fourfold in the last 60 years.

The large scale of greenhouse gases released into the atmosphere from deforestation in developing countries has stimulated interest in developing measures to reduce emissions from these sources. Several different mechanisms and models have been proposed, and will be reviewed in this report.

Figure 4: Deforestation emissions 1850-2000



Source: Two spaces between source and source text

In 2005 Papua New Guinea and Costa Rica[13] presented a submission to the 11th Conference of Parties (COP-11) to the United Nations Framework Convention on Climate Change (UNFCCC) which suggested that developing countries be compensated for reducing emissions from deforestation. The submission marked the beginning of a two year examination period during which various countries and interested parties developed ideas regarding potential compensation mechanisms. The international debate on reducing emissions from deforestation and degradation (REDD) in developing countries culminated at COP-13 in Bali in December 2007 where it was decided to continue working for an inclusion of REDD in the next climate agreement. However, most of the difficult and controversial issues are yet to be resolved, and are currently being discussed in various forums under the UNFCCC.

[11] Stern, *op cit*

[12] Kanninen et al, *op cit*

[13] Costa Rica and Papua New Guinea's submission was supported by the Coalition of Rainforest Nations.

There is now widespread recognition that action needs to be taken to encourage developing countries to reduce deforestation emissions. The challenge we are faced with is how to reduce rates of deforestation without adversely impacting the developmental benefits associated with such land-use change.

For developed countries, accounting for afforestation, reforestation and deforestation under the Kyoto Protocol can represent a cost-effective option for decreasing net emissions, but there is even greater potential to achieve least cost reductions in emissions by undertaking action to reduce the rates of deforestation in developing countries. However, the expectations about large scale transfers from developed to developing countries and the level of this will be among the key issues in future negotiations. Determining a fair and workable REDD agreement will be one of the most significant challenges to overcome as we near the end of the first commitment period of the Kyoto Protocol.

2.2 Drivers

It is known that human induced[14] deforestation and forest degradation rates are affected by proximate and underlying causes. Proximate causes such as land clearing for agricultural expansion and timber extraction are influenced by indirect causes such as subsidies, commodity prices, exchange rates and governance. Farmers, companies and others act as deforestation agents. Table 3 categorises drivers of deforestation. Deforestation drivers vary by country and region so that "one-size-fits-all" solutions are inappropriate. Furthermore, drivers are not static but are dynamic. For example, compared with the situation one or two decades ago, current deforestation is much more driven by large commercial actors than poor, subsistence-oriented farmers.[15]

Despite considerable research into the drivers of deforestation, much remains to be understood. A review of over 150 studies by Kaimowitz and Angelsen (1998) showed a high degree a variation among the effects of drivers between studies. While some factors, such as improvement in rural off-farm wage levels, uniformly indicate reduced deforestation, others such as improved agricultural technologies may increase or decrease pressure on forests, depending on the type of technology and the market context.[16]

[14] Deforestation and forest degradation can result from natural processes but is mainly a consequence of human activity

[15] Rudel, T.K. (2007) Changing agents of deforestation: From state-initiated to enterprise driven processes, 1970–2000. Land Use Policy 24, 35-41.

[16] Kaimowitz, D and Angelsen, A., 1998, *Economic Models of Tropical Deforestation, A Review,* Bogor: Center for International Forestry Research (CIFOR).

Table 5: Drivers of Deforestation[17]

Proximate Causes	
Agricultural expansion	Cultivation
	Cattle ranching
	Colonization, migration
Wood extraction	Commercial
	Fuel wood
	Charcoal
Infrastructure extension	Transport
	Markets
	Public services
	Settlement

Underlying Causes	
Economic factors	Market growth and commercialisation
	Poverty and related factors
	Prices
Policy and institutional factors	Formal policies
	Informal policies
	Property rights
Technological factors	Agricultural sector
	Wood sector
Cultural factors	Public attitudes
Demographic factors	Population, etc

Formal policies such as agricultural subsidies, forest settlement programmes, taxes and logging bans can be prohibited or enacted at the "stroke of a pen". In reality, the informal policies of developing countries (corruption, private interests, mismanagement) often handicap formal policies.

While developed nations and some developing nations such as India and China are experiencing net afforestation, global per-capita consumption continues to grow, contributing to price levels for timber and agricultural products.

Deforestation drivers are also interlinked with other international and environmental policies. Subsidies and policies supporting the large scale use of bio-fuels have been credited with inflating agricultural prices and leading to agricultural expansion, a proximate cause of deforestation. The demand for palm oil has been linked with deforestation and the establishment of palm plantations in Indonesia and Malaysia.[18] International trade agreements can restrict efforts to manage-demand related drivers by preventing restrictions on the sale of unsustainably harvested timber.

[17] Adopted from Geist, H. J and Lambin, E.F., 2001, *What Drives Tropical Deforestation*,, LUCC International Project Office, Belgium.

[18] G. Smith, November 2007, Wren Media, The New Agriculturalist. http://www.new-ag.info/06-6/focuson/focuson6.html

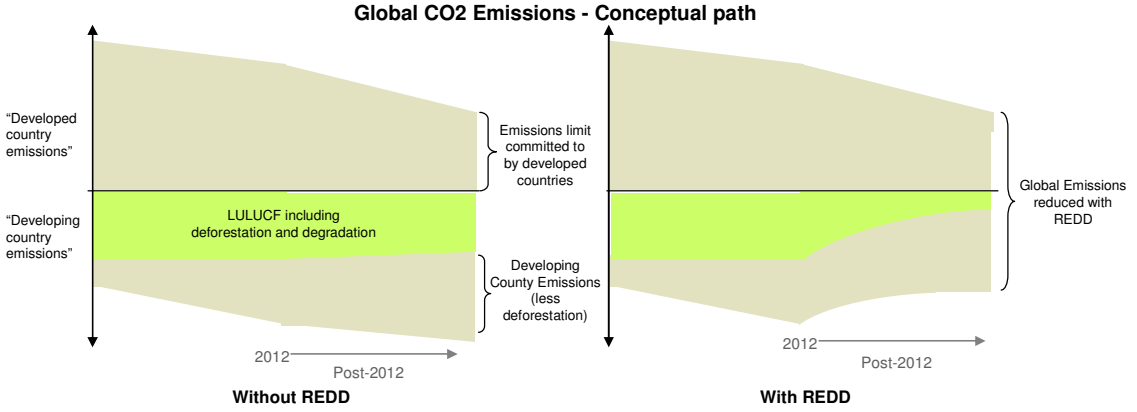
3 REDD

3.1 The value of REDD

Numerous submissions, papers and the Stern report have heralded REDD as a low-cost means to dramatically reduce emissions in support of stabilisation of greenhouse gas levels in the atmosphere. With estimated per tonne CO_2 equivalent mitigation costs starting at close to zero[19] - or even negative when costly subsidies that stimulate deforestation are taken into account - it seems that economic drivers in support of an international REDD regime are sufficient to attract both developing and developed countries.

The ultimate utility of any REDD regime with respect to climate change is to allow deeper global emission reductions in a shorter timeframe and at lower cost than in a regime from which REDD is excluded. It could also provide the opportunity for developing nations to receive some transfer of wealth in compensation for the environmental services provided by REDD and any foregone development from reduced deforestation. This transfer of wealth can also be viewed as a price of incentivising much larger scale and wider developing country participation in actions to reduce net global emissions beyond what will have been achieved by the CDM at the end of the Kyoto Protocol First Commitment Period.

Figure 5: Global CO_2 Emissions - with and without REDD



Conceptual Global CO2 Emissions: As a result of Kyoto, Annex I countries committed to reduce emissions by 2012. It is feasible that in the post-2012 scenario, developed nations will continue to reduce emissions. Without an agreement engaging developing nations, developing nations' emissions will continue to grow with their development, although the intensity of emissions may be reduced as emission efficient technologies are employed. An effective REDD programme, all else being equal, can significantly impact the current rates of LULUCF emissions from developing countries, increasing the probability of avoiding dangerous effects of climate change.

There may be opposition to incentivising deforesting nations to avoid deforestation by payment of funds or units on the basis that deforestation should be treated similarly in developed and developing nations. In particular, forest owners in some developed nations, such as New Zealand, receive no payment from retaining forest they wish to deforest and must buy units if they chose not to retain the forest. The main argument made against engaging in REDD activities is based on the concern that such activities may flood the market with cheap carbon credits, which lower carbon prices and therefore

[19] Strassberg, B., et al, An Empirically-Derived Mechanism of Combined Incentives to Reduce Emissions from Deforestation, Centre for Social and Economic Research on the Global Environment (CSERGE), Norwich.

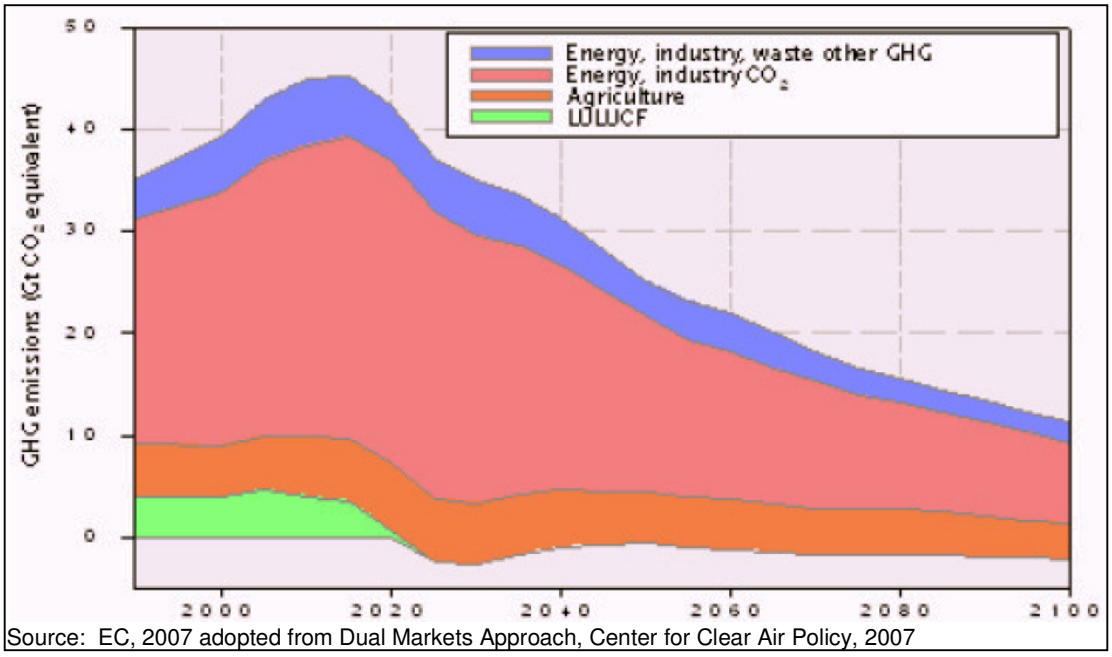
place existing and potential emission mitigation activities at risk. This risk is realised if support of REDD activities results in overstated reductions while diverting resources away from other mitigation activities, such as energy efficiency and renewable energy, that provide more certain emission reductions.[20, 21] One way this risk could be avoided is by commitments to deeper emission reductions by Annex I countries.

However, there are other environmental benefits associated with reducing deforestation that should also be considered, eg avoiding loss of biodiversity, degradation of soil and water, rainfall generation etc. In addition, co-benefits of enhanced economic development in participating countries could accompany the potential unprecedented transfer of wealth to participating nations.

Presented thus with the options of driving deeper reductions of emissions with and without REDD, what are the relative values of the options? REDD can be provided at lower costs but with a higher degree of uncertainty of obtaining reductions. Techniques and technologies currently used and planned for reductions under Kyoto have, for the most part, higher certainty but also higher cost.

The reduction of emissions from the land-use change sector has considerable potential to enable least-cost and, importantly, timely stabilisation of atmospheric concentrations of greenhouse gases and limit global temperature increases to 2°C.[22] Because deforestation activities in developing countries are such a large proportion of total anthropogenic emissions it is vital that REDD is included in future climate change agreements.

Figure 6: Global emissions to limit climate change to 2˚C increase with 50% probability



Source: EC, 2007 adopted from Dual Markets Approach, Center for Clear Air Policy, 2007

While the uncertainty and variability around emissions from deforestation and degradation is considerable, this is unlikely to be addressed unless incentives are

[20] Ogonowski, M., et al, 2007, *op cit.*

[21] See, for example, the European Commission proposal in January 2008 to exclude REDD credits from the EU's emission trading scheme until at least 2020 based on concerns that "easy" REDD credits would undermine the EU's own measures. Butler, R., 2008, *Why Europe torpedoed the REDD forests for carbon credits initiative.*

[22] Ogonowski, *op cit.*

provided to reduce emissions. As has happened when other emissions have been incorporated into climate change regimes, the incentives provided meant that over time the understanding and accuracy of emissions measurement and the capacity to address emissions has improved. New Zealand's own experience in relation to measurement of agricultural and LULUCF emissions and removals provides a good example of this.[23] Delaying the inclusion of REDD in climate change regimes is therefore likely to prolong the period of time before this uncertainty is overcome. This would be at the considerable cost of delay in the substantial benefits that REDD offers.

3.2 REDD and the post-2012 environment

The agreement to the Bali Roadmap confirms that a global consensus has emerged that urgent action is required to address climate change. The IPCC Fourth Assessment Report identified that deep cuts in emissions will be required to limit increases in global temperatures to levels that avoid substantial climate change.[24] All opportunities to reduce emissions should therefore be seriously considered, including REDD. This is reflected in the inclusion of REDD in the Bali Roadmap and the encouragement of demonstration activities and other actions to address REDD.[25] REDD is therefore firmly on the agenda of international discussions on climate change. The question now becomes when and how should REDD be incorporated into a future climate change agreement.

There are five key features of REDD that have implications for how it should be included in any future climate change agreement:

- it represents a large proportion of total global emissions;
- it represents the most significant proportion of total emissions from many developing countries;
- it represents a means of achieving an immediate global reduction of emissions;
- some studies suggest that the costs of reductions are relatively cheap compared with most alternatives;[26] and
- it is difficult to predict with any degree of certainty what the potential amount of REDD abatement might be.

The inclusion of REDD in a global agreement has major implications for both the total emission reductions sought and, potentially, the success of efforts in other areas. The estimated cost efficiency of REDD means that substantial resources might flow into REDD, with implications for the efforts in other sections.

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[23] In particular, at the time of negotiation of the Kyoto Protocol in 1998 and when New Zealand ratified the Kyoto Protocol, New Zealand was projected to have net emissions below 1990 levels in the period 2008-12 principally because of extensive afforestation. However, the New Zealand Government has now indicated that it expects to have a net emissions deficit of around 45.5m t CO2-e for the period 2008-12. Ministry for the Environment 2007, *Projected Balance of Emissions Units During the First Commitment Period of the Kyoto Protocol*.

[24] IPCC, 2007, Climate Change 2007, Fourth Assessment Report.

[25] UNFCCC Decisions 1/CP.13 and 2/CP.13, in FCCC/CP/2007/6/Add.1, 14 March 2008.

[26] See Table 7 for a summary of cost estimates.

For example, if assessments of the cost and potential contribution of reducing deforestation emissions prove correct, the inclusion of REDD in an agreement would enable Annex I parties to agree to deeper emission reductions. However, in order to be in a position to agree to deeper targets, they would need to know the level of emission reductions REDD is likely to deliver, but this is highly uncertain. Equally, parties to such an agreement seeking to reduce deforestation require certainty on the value that can be derived from reducing deforestation before supporting REDD activities. It will be important to either:

- have a reasonable degree of certainty about the amount of REDD abatement that might occur over an accounting period (which will be difficult); or to
- incorporate a mechanism that can 'regulate' for REDD so that the quantity of units generated in any given commitment period does not disrupt the functioning of the market and the ability of countries to meet their targets.

The question then becomes should discussions on the inclusion of REDD in a climate change agreement precede, run in parallel with, or follow discussions on emission reductions in other areas. Because of the implications of REDD for actions in other areas and vice versa it makes sense for discussions to proceed in parallel. This does not mean that REDD must automatically be included in an agreement addressing emissions from other sources. The implications of including REDD will become clearer as negotiations progress. Proceeding in parallel retains flexibility but ensures discussions of within both areas can inform each other. Further, requiring the regime for other sectors to be established before REDD or vice versa could actually impede agreement. REDD is likely to be very important for some participating countries, and their willingness to agree in other areas may well be affected by progress on REDD. Finally, concurrent negotiations are more likely to lead to an efficient outcome.

The question of whether REDD should be addressed under a separate agreement or included in an overarching agreement is likely to be influenced by the option selected to address REDD. However, the potential inter-relationship between REDD and other actions means that in principle it makes most sense for REDD to be part of an over-arching agreement.[27]

3.3 Variability and uncertainty

While the magnitude of emissions from deforestation are large compared the overall human-induced flux of CO_2 into the atmosphere, it is also highly variable from year to year and difficult to measure accurately.

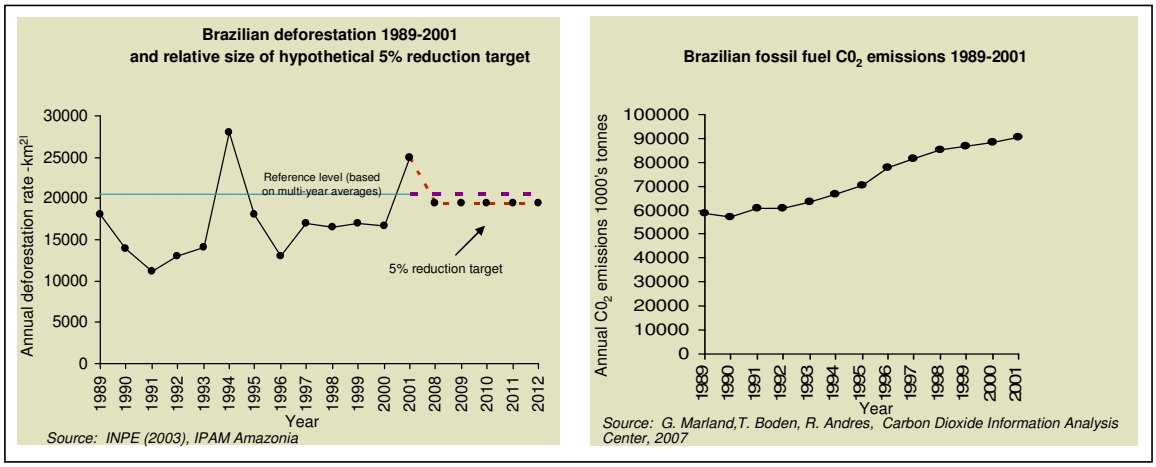
In understanding the variability of deforestation rates, it is helpful to compare the deforestation emissions with emissions from other sectors. Deforestation rates in Brazil, for example, have fluctuated between 10,000 and 30,000 km^2 per year between 1988 and 2005[28]. (See Figure 2) At the same time, Brazil's fossil fuel CO_2 emissions increased roughly 50% but exhibited low inter-annual variability. Growth in sectors such as energy and cement production proceeds at rates which closely track population and economic trends and exhibit low variability.

[27] For example, the fact that "forest" has been defined in relation to Annex I obligations will mean this definition is inevitably considered in the negotiations on REDD.

[28] INPE, 2006 adopted from OECD (Costa Rica and Mexico) p 41

Shifts in commodity prices such as those for soy or cattle may significantly affect motivations to increase or decrease land clearing. The result is high inter-annual variation in deforestation rates. Additionally, it may be hypothesised that regions in which deforestation and forest degradation emissions are closely linked with sustenance agriculture and fuel wood production will have less variability than regions where deforestation agents are commercial entities. The figure below should go beyond 2001, there are more up-to-date graphs of Brazilian deforestation.

Figure 7: Comparison of inter-annual variability of emissions between sectors



n our discussion of variability, Brazil was used as an example due to the relatively high quality and availability of data. In general though, data availability is a significant issue for the study of deforestation in developing countries. While imperfect, measurement of fossil fuel consumption is undertaken as a summation of production, trade, and consumption figures which are generally produced in support of other activities in the economy. Deforestation and certainly forest degradation statistics, however, have rarely been gathered in developing countries. Data that has been gathered is often limited to specific areas of study. The Food and Agriculture Organization of the United Nations (FAO) figures for change in the extent of forest and other wooded land areas are perhaps the most comprehensive figures relating to historical forest resources across nations. The dataset, however, has many gaps and the rates of deforestation listed for numerous countries are extrapolations of estimates from previous decades.[29]

Given the relatively poor quality of historical data, establishing accurate historical rates of deforestation is a challenge. However, recent use of satellite imagery has aided measurement of both current and historical deforestation. One specific proposal suggests the use of historical mid-resolution Landsat satellite imagery for establishment of historical deforestation trends.[30] While using satellite imagery has its limitations[31], it represents a practical way forward for establishing historical trends and monitoring ongoing deforestation activities.

[29] FAO Global Tables accessible at: http://www.fao.org/forestry/site/43035/en/

[30] Brown, S. et al, 2007, *Reducing Greenhouse Gas Emissions from Deforestation and Degradation in Developing Countries: A Sourcebook of Methods and Procedures for Monitoring, Measuring and Reporting*,, GOFC-GOLD.

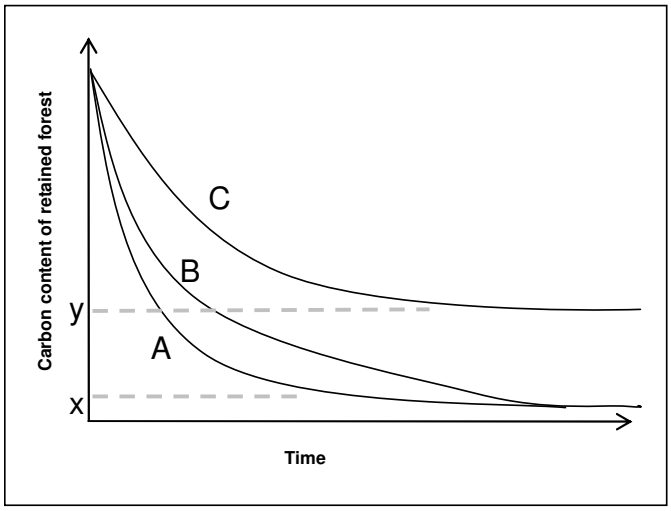
[31] Some limitations include low periodicity of information due to frequent cloud cover over certain areas. This can result in limited availability and high expense of high resolution imagery which could be helpful in detecting some forms of degradation, and masking of land use change due to rapid regeneration of vegetative cover.

3.4 Key issues with REDD

3.4.1 Addressing non-permanence

The potential non-permanence of REDD mitigation efforts (the potential for retained forests to be deforested at a later date) has been raised as an issue with utilising REDD to mitigate climate change. The concern relates to the possibility that nations could defer deforestation activities while they are receiving incentives but resume clearing in subsequent decades.

Figure 8: Conceptual global deforestation pathways



How will REDD affect the retention of the world's forests over time?

The business-as-usual case is represented by curve **A**. Deforestation continues until the globe's net forest cover stabilises at level **x**. Level **x** represents an aggregation of each nations' optimal national forest cover. Such a level will not necessarily involve national internalisation of the global environment value or forest services. Some REDD detractors suggest that REDD efforts simply slow down deforestation, delaying arrival at level **x** as illustrated by curve **B**. Reduction in deforestation rates as illustrated in this case are still beneficial in the effort to limit the effects of climate change as annual emissions are reduced in in the first part of the curve **B** relative to **A**. This can be seen by comparing slopes. Curve **C** represents an ideal scenario where deforestation is slowed and stabilises at level **y**, the global optimal level of forest cover (considering all economic, environmental, and social values).

When considering the issue of non-permanence, it is helpful to view deforestation primarily as an emission. While successful efforts to reduce the flux of carbon into the atmosphere due to deforestation in this decade may ultimately lead to an increased flux in future decades, the *delay* in the release of stored carbon has its own utility in efforts to mitigate climate change. For example, it may buy time to enable the development of new, more emission efficient technologies.

The notion of a forest transition is also useful to understand the issue of non-permanence. A number of developing countries are currently at a stage where their rates of deforestation can be expected to remain high if no preventive measures are taken. However, with economic development the pressure is expected to be reduced over the next few decades. This is exactly what has happened with the historical path of developed nations. In this perspective, REDD can help these countries to jump over the period of high deforestation, after which forest will be retained more easily.[32]

Solutions for addressing non-permanence are available. These include:

- temporary credits for projects, where units used in one compliance period must be replaced with a full credit in the next period. This is the approach used with CDM A/R projects;

[32] Chomitz, K., et al, 2007, At Loggerheads? Agricultural expansion, poverty reduction, and environment in the tropical forests. *Policy Research Report,* Washington D.C., World Bank

- a buffer, where only a portion of total eligible units generated by a project are released each year with the remainder held in a buffer for a period of time, with the possibility that they might be surrendered if the project generates emissions. This is the approach used by the Voluntary Carbon Standard for forestry projects; and

- the national binding commitments of Annex I parties, where if a party obtains a unit through a sequestration activity, it must replace the unit if the activity results in an emission.

3.4.2 Leakage

The concept of leakage is generally applied to the dilution of the merits of a project due to translocation of avoided negative effects to areas outside the project or abatement area. A typical example is that of the establishment of a forest conservation area. Upon establishment of a forest protection area, timber extraction is excluded from the project area. The drivers for timber extraction have been unaffected by the decision to limit utilisation of the forest. Demand for wood increases in the local area leading to intensified extraction in neighbouring areas. Excessive pressure on these neighbouring forests could lead to significant forest degradation. Beyond the local area demand for wood remains unchanged and wood extraction increases in distant markets.

The exact leakage resulting from a project is almost impossible to determine. Studies on project leakage presented in the literature range from 0% to over 95%.[33] Some project designs attempt to compensate for possible leakage by using creative mechanisms. For example, the CARE project in Guatemala involves the introduction of sustainable fuel wood harvesting in an area close to the protected forest in order to prevent uncontrolled leakage into surrounding areas.[34]

Some proposals for the promotion of REDD projects include accounting for project leakage through the use of discounting. One of the most effective means to address leakage is by capturing national leakage through national-level accounting, where both the decrease in emissions from one area and the corresponding increase in another are accounted for.

Leakage in the context of REDD in developing countries may also be addressed through the timely development of robust estimation methodologies. This should aid in the detection of leakage, including through degradation, and reduce barriers to participation. This could increase the proportion of participating countries, thereby reducing the potential for international leakage.

Leakage can travel across borders, however. For example, the Kyoto Protocol does not prevent international leakage to non-Annex I countries. Expansion of carbon intensive production is cost-free in non-Annex I countries while Annex I countries must seek reductions in carbon emissions or purchase compensating units.

The existence and tolerance of international leakage under Kyoto is significant for any proposed REDD framework in two ways. First, the presence of leakage alone does not

[33] Murray, McCarl, Lee. 2004. Estimating Leakage from Forest Carbon Sequestration Programs. Land Econ: 80(1):109-124.

[34] Brown, P., B. Cabarle, and R. Livernash, 1997: Carbon Counts: Estimating Climate Change Mitigation in Forestry Projects. World Resources Institute, Washington, DC, USA, 25 pp.

render a framework unworkable. Second, it may be difficult to insist that developing countries agree to controls and limits aimed at mitigating international leakage when developed nations omitted such controls from their obligations. On the other hand, when Kyoto was negotiated all Annex I countries agreed to being given binding targets. They may argue this meant that they should have no responsibility for leakage of emissions to countries without such targets.

In practice, it would be very hard to estimate the extent of international leakage as it spreads though the global economic system in complicated ways. The possibility of international leakage is a strong argument for including as many countries as possible under a system of national emission targets.

A final type of leakage in the context of REDD is degradation leakage. Of significant concern is that efforts to reduce deforestation could lead directly or indirectly to an increase in forest degradation (or losses of carbon stock in forest areas that continue to meet the definition of a forest). Currently, under Kyoto, deforestation is only considered to occur if the canopy cover falls under the national definition of a forest (between 10% and 30% minimum canopy cover, or below 2-5 metres depending on the country).[35] Historical land use patterns in developing nations have evolved without reference to a canopy threshold. The provision of significant incentives related to the retention of 10-30% canopy cover could lead to emergence of new land-use change behaviours. It is foreseeable that carbon dioxide could continue to be released to the atmosphere at current or accelerating rates but measured forest area (according to the definition of forest) shows a reduction in deforestation. Such a scenario would be an example of degradation leakage. The inclusion of degradation in a REDD framework may limit degradation leakage.

3.4.3 Hot air

"Hot air" and windfall credits refer to benefits for actions that would have occurred anyway under business as usual. The term originates from the situation in Eastern Europe, where the economic collapse in the 1990s reduced emissions by about 40 % (as compared with a zero increase target under Kyoto), giving the countries large amounts of free quotas. Hot air can occur as a result of an overly generous baseline selection, or by compensating parties for activities that were largely a consequence of natural variation or processes.

The existence of hot air could be considered a cost of attracting developing nations and achieving agreement on a REDD framework. On the other hand, hot air would mean environmentally worthless credits would dilute the value of other REDD credits. Also, compensating nations for environmentally worthless credits could displace mitigation efforts in other sectors in some cases.

Within the context of REDD, hot air can occur as a result of selection of an overly generous reference level. It can also develop when parties are compensated for activities that are largely a consequence of natural variation or processes. For example, if a wetter than normal dry season results in the issue of credits because there are fewer natural forest fires, hot air would be generated.

[35] UNFCCC Decision 16/CMP.1, FCCC/KP/CMP/2005/8/Add.3. Note that the definition also says that a forest may consist of either closed forest formations or open forest and includes young trees that have yet to meet the crown cover or tree height criteria, as well as area that is temporarily unstocked because of harvesting or natural causes.

Similarly, if a country's deforestation rates would decrease without direct incentives (such as due to shifts in demographics or commodity prices), a declining reference level would be necessary to avoid hot air.

To compensate for such effects, one option is to factor out indirect and natural effects from carbon stock changes, as included in the principles of the Marrakech Accords.

The process of negotiating reference levels is another mechanism that can limit hot air. Countries interested in realising global emissions reductions will be hesitant to agree to compensate for reductions which contain large amounts of hot air, especially if more robust mitigation alternatives exist. On the other hand, some hot air may be necessary to 'sweeten the pot' sufficiently to achieve agreement. Use of dynamic reference levels, where reference levels are re-negotiated periodically, allow negotiators to correct for hot air as well as deforestation drivers.

4 REDD Options

4.1 Options introduction

Numerous approaches have been proposed for the promotion of REDD at the international level. These proposals have been the subject of submissions to the UNFCCC, papers presented at workshops, academic papers, and numerous discussions. While some proposals represent comprehensive options, others focus on proposing solutions to specific aspects of the REDD issue. Several excellent reviews survey the various proposals[36] but the constantly changing nature of both the science and the debate dictate a periodic review.

Many proposals are complementary and *could* be incorporated in a package of REDD options. For example, a market approach could be aided by a policies and measures approach with nations unable to participate in the market.. However, some options may be incompatible or may be inefficient when used together. For example, depending on their design, the option to internationally fund projects may be not be compatible with country-level market-funded approaches if leakage and double counting are not adequately addressed.

Broadly, an approach to REDD seeks to either manage the drivers which cause deforestation or provide incentives to participants according to the extent deforestation is avoided. Options utilising the first method can be termed input management schemes or cause-oriented approaches, while the second are termed output management schemes or emission-oriented approaches.

Input management options seek to target deforestation drivers. Elimination of a national agricultural subsidy or improving capabilities to detect and fight forest fires are examples. As an option for an international REDD agreement, deforesting nations can be incentivised to adopt input management options without the requirement for direct measurement of deforestation levels, and thus side-step some thorny issues such as reference level selection and measurement accuracy.

Output management options dominate the literature. They provide a financial incentive for avoiding deforestation or degradation. In more direct economic terms, output management options increase the opportunity cost associated with undertaking deforestation.

While both methods can be pursued in parallel care should be taken to avoid 'double compensation' which can occur if recipient counties are compensated for the same activity under both input and output options.[37]

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[36] See for example OECD, 2007, op cit.; Chomitz, K., et al, 2007, At Loggerheads? Agricultural expansion, poverty reduction, and environment in the tropical forests, *Policy Research Report*, Washington D.C., World Bank; Moutinho, P. and Schwartzman, S., eds., 2005, *Tropical Deforestation and Climate Change*, Amazon Institute for Environmental Research, Washington D.C.

[37] Take, for instance, the hypothetical example of a bilateral agreement between a developed country and a deforesting nation establishing an incentive payment in exchange for the adoption of policies and measures (PAM), such as the elimination of an agricultural subsidy. Deforestation rates may decline as a result of the modified economics of land clearing. Subsequently, however, if an output management incentive programme is introduced, the deforestation evaluated for an incentive payment may have been partially caused by the removal of the subsidy. As nations seek to maximise efforts to combat climate change, the potential for such double compensation will affect the value of REDD efforts to developed nations.

It should be noted that a decision against the use of an input management approach at the international level does not mean such methods should not be used by individual nations in their domestic programmes. Regardless of the option(s) chosen at the international level, governments will need to select policies to drive domestic behaviour to obtain desired reductions. Such efforts will likely include input options such as agricultural intensification programmes.

Examples of input and output management approaches are outlined in Table 4.[38]

Table 6: Classifications of REDD options and examples

Output methods

Scale \ Funding	Market	Funds
National-level	Cap and trade (CAT), Reference level and credit (RAC)	Compensated reductions
Projects	CDM expansion to REDD	Conservation projects (ICDP, PES, etc.)

Input methods

International	Best practice development
National-level	Policies and measures (PAM)
Projects	Agricultural intensification

Both output management schemes and input management schemes vary in scale from locally targeted efforts to global approaches. As discussed previously in section 2.3 in relation to leakage, the more globally inclusive the scheme the better, as this assists in ensuring that any leakage is accounted for, providing the opportunity for incentive mechanisms to avoid it. At the same time, locally focussed schemes may better target the needs of local communities that a global approach might overlook. For example, REDD schemes that involve payments to governments could harm the development aspirations of local communities if the communities' only source of income is derived from deforestation, and the funding for avoiding deforestation fails to filter down to them.

It should be noted that some options could be designed to work as either an input or an output management option. For example, countries could be funded to undertake policies and measures, such as removal of deforestation subsidies, by either:

- allowing the country to earn credits dependent on the emission reductions achieved – which would be an output management option; or
- by paying the country a lump sum once the policy had been implemented, with the payment determined by implementation of the policy rather than emission reductions – which would be an input management option.

4.2 Output measures

Output management measures rely on incentivising participants to reduce deforestation by compensating participants on the basis of measured reductions. Under fund approaches, participants are compensated for progress against a target or reference level. Under a market approach, units are credited based upon a reduction in deforestation relative to a reference level. Units can then be sold into an emissions market.

In applying output management measures in the context of an international agreement on REDD, one option is to engage countries (or even regions) as participants. Countries

[38] The left part of Table 6 is based on Angelsen, A, 2008, *Seeing both the forest and the trees in REDD,* unpublished.

would have their deforestation levels compared to national-level reference levels. Another option available is projects where emission reductions are either purchased by international funds or converted into units for sale on international emissions markets.

Estimates of the cost of mitigating tropical deforestation vary widely as shown in the following table.

Table 7: Estimates of funding flows required for REDD – All figures in USD[39]

Study	Cost/t $C0_2$	Annual Flows	Avoided Emissions	Comments
Grieg-Gran (2004) for Stern (2007)		$5 Billion	70% of land use emissions in eight tropical countries	Opportunity cost of forest protection[40]
Obersteiner et al (2006)		$5 Billion	50% reduction in rate by 2025	Targeted funding (Perfect information is $2.9 B, no targeting is $188 B)
Strassburg, et al (2007)	$5.63	$ 30 Billion	94.5% reduction in emissions from top 20 developing countries by forest cover[41]	
IPCC (Nabuurs et al. 2007)[42]	$ 20 $50 $100	*$ 43 Billion* *$162 Billion* *$395 Billion*	2133 $MtCO_2$ ~30% of est. 2000 emissions 3239 $MtCO_2$ ~40% of est. 2000 emissions 3950 $MtCO_2$ ~50% of est. 2000 emissions	*Calculated annual flows are for reference based upon per tonne clearing price shown*
Sohngen and Sedjo (2006)	$27.2		Virtual Elimination	Represents a net cumulative gain of 278,000 Mt CO_2 relative to baseline

It is possible to infer from these studies that funding flows from developed to developing countries in the low tens of billions of dollars per annum have the potential to achieve substantial reductions in emissions from deforestation in developing countries. As deforestation is reduced even further, costs rise, still reductions in excess of 50% are possible for less than $30 per tonne CO_2, and by some estimates, a figure significantly below this.

4.2.1 Measurement

The absence of reliable data on deforestation in developing countries makes it difficult to measure accurately the emission reductions achieved by a REDD activity. Accurate measurement is critical for output management mechanisms that rely on measurement of deforestation reductions for generation of incentives.

Broadly there are two components of REDD output management mechanisms that require estimation. These are:

- establishing a reference level;[43] and
- monitoring and verification of reductions against the selected reference level.

The two core components in estimating carbon stock changes and, hence, emissions and removals of greenhouse gases from forest lands are:

[39] Adapted in part from OECD, 2007, *Financing Mechanisms to Reduce Emissions from Deforestation: Issues in Design and Implementation.*

[40] The opportunity cost is the net present value of returns from land uses that are prevented.

[41] These countries host 77% of total developing country forests

[42] As noted by the OECD 2007, the figures from the IPCC studies are point estimates reported across an averaging of different studies. The OECD notes that use of the bottom-up estimates from forestry modelling studies suggest estimates that are an order of magnitude smaller than these IPCC estimates.

[43] In this report "reference level" refers to the basis against which REDD performance is measured. In some discussions, a reference level is comparable to the concept of a baseline. A reference level is not necessarily equivalent to a historical average.

- spatial delineation and stratification of the forest lands; and
- determination of the deforestation-related carbon stock changes within those strata.

Numerous methodologies exist for estimating these variables.

The most effective means of spatial delineation of forest and non-forest areas at a national level is through remote sensing.

There are two main approaches to remote sensing analysis:

- wall-to-wall mapping, which evaluates all land area in a covered region; versus
- a sampling method, which uses either systematic samples to test deforestation rates and/or focuses on border areas or hotspots.

According to the GOFC-GOLD Sourcebook, determination of forest from non-forest can be achieved with reasonable precision using medium resolution satellite imagery (resolution ~30m).[44]

While accuracy in the determination of forest and non-forest areas and stratification of the forest is important, the application of carbon stock averages to strata[45] is where the greatest sources of error are likely to come from. At the simplest level of carbon stock attribution, allocation of the IPCC Tier 1 approach (default national averages), errors of around 50% are not unexpected. [46]

Understanding the limitations of monitoring emissions from deforestation and forest degradation in developing countries is a critical step in the design and negotiation of a REDD scheme. Recognition of this fact has led to intensive efforts by SBSTA in the last few years. For its part, the FAO has embarked on an ambitious plan to enhance their global monitoring system by around 2010. Some countries, such as Brazil and India, already have credible systems in place for monitoring that may be evaluated with the view to broader application.

4.2.2 Comparison with reference levels

All output management options bestow benefits (tradable units or compensation) based on a comparison of deforestation rates to a reference level. One critical issue which arises is the consequence of performance worsening relative to the reference level. In proposals for an international regime it has been proposed that there be no penalty for emissions above the reference level (and of course no payment).[47] Such a "no-regrets" approach could lead to perverse incentives, as illustrated in the following example. If a nation predicts it will not be eligible for credits in a given time frame because of natural

[44] Brown, 2007, *op, cit.*

[45] Stratification refers to the process of categorising land areas into more homogeneous units. In respect of forest mensuration or inventory, stratification is an efficient means of improving an accuracy outcome.

[46] *Ibid.*

[47] Discussions with B. Schlamadinger February 2008

or human-induced events, it could accelerate land clearing during that time frame and potentially still remain eligible for incentives in future periods.

Alternatively, in order to limit risk for participating nations but maintain continual incentives to reduce deforestation, it has been suggested that deforestation above a reference level might be converted to a reduction from future incentive payments.[48] Other variations include extending eligibility for crediting or compensation to include maintenance and expansion of conservation areas in countries that are no longer deforesting.[49]

The use of a reference "corridor" rather than a reference level also reduces the risk that a participating country may be ineligible for crediting or compensation due to variation in measured deforestation. See Figure 2 in section 1.3.

4.2.3 Market options

Just as the architects of Kyoto established emissions markets in order to improve economic efficiency of efforts to reduce GHG emissions, several proponents of REDD initiatives have suggested similar market mechanisms are ideally suited to generate the large funds required and to enhance economic efficiency.

Most REDD market proposals involve a reference level and credit (RAC) approach.[50] Under a RAC approach deforestation emissions reference level is established and units are credited to participants that achieve emission below that reference level.

An alternative is the cap and trade approach similar to that used for Annex I emissions. Applying a cap and trade (CAT) approach to REDD would involve assigning participating countries with an allowable level of emissions and requiring them to purchase units for any emissions above their allowed level (or "cap"). In economic terms, CAT and RAC approaches are equivalent since both provide incentives to avoid an emission-producing activity by introducing an opportunity cost on the activity.

A cap and trade approach is unlikely to be acceptable to developing countries, as it implies being held economically responsible for a failure to meet the agreed reference level of deforestation. It is, however, likely to be more acceptable to developed countries since it involves broader responsibility for emissions. Whatever model is implemented, there is a need to provide 'incentives on the margin' for all deforesting countries. A BAC approach does not provide such incentives, if emissions are above the baseline and there are no consequences for the deforesting country if this occurs, such as a requirement to purchase the necessary units or an adjustment of future reference levels..

A key design feature of market-based options is the mechanism for establishing a market for REDD units. The value of REDD units may be derived from an independent REDD market or through full or partial fungiblity with carbon markets operating in support of emission reduction efforts in other sectors. An independent REDD market could be established in conjunction with the adoption of REDD commitments by Annex I parties.

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[48] Proposal by Brazil, Op cit.

[49] Proposal by India. UNFCCC/SBSTA/2007/MISC.02

[50] See for example: N24 proposal (Belize *et al*), SBSTA27, FCCC/SBSTA/2007/MISC.14; Pedroni, L and Streck, C, 2007, *The "Nested Approach" A Flexible Approach to Reduce Emissions from Deforestation,* Annex to Submission by Chile, 2007, SBSTA27, FCCC/SBSTA/2007/MISC.14, Proposal by Colombia, SBSTA27, FCCC/SBSTA/2007/MISC.14, COMIFAC proposal (Burundi *et al*) SBSTA27, FCCC/SBSTA/2007/MISC.14, Ognowski, M. et al, 2007, op.cit.

Verified reductions in deforestation would earn credits which could be then be traded to other parties to meet their commitments.

Under a fully fungible mechanism, units generated upon verification of deforestation reductions are fully exchangeable with other units established under climate change agreements. Activities that generate units may include deforestation only, deforestation and degradation, or these two activities along with maintenance and/or enhancement of forested areas.

REDD options which propose partial or full fungibility of REDD units with units in other sectors need to address the relative equality of units. The quantity of units generated by an activity can be tailored to the degree of uncertainty involved. That is, an activity involving a high level of uncertainty may be determined as being eligible for a lower level of units – that is, the quantity of units earned would be "discounted" - relative to an activity with a higher degree of certainty. As the level of uncertainty is reduced the degree of discounting could be lowered, thus providing incentives for improved measurement accuracy. Discounting, which is referred to elsewhere in this paper as "gearing", could be used as an incentive for countries to account for forest degradation, with countries that do not account for degradation eligible for a lower quantity of units than for than those that do. For a full description of how gearing might work in practice see section 1.3.

The main issue with gearing is that it is not applied to concerns about measurement accuracy in relation to activities in the Kyoto Protocol eligible to earn emissions units.[51]

A key concern with the option of a market to drive REDD emission reductions is that an unexpected abundance of REDD units could flood an integrated, cross-sector emissions market. This has led to suggestions for limiting the fungibility of REDD-sourced units. Conversely, an undersupply of REDD units in an integrated market could cause costs of emission reductions to be unexpectedly high. These risks could be addressed by managed fungibility. One example of managed fungibility is the dual markets approach proposed by Ognowski *et al*.[52]

The dual markets approach involves setting a maximum percentage of a country's target that a country could meet with credits from REDD activities, eg a country with an emissions reduction target of 30% could specify that 5% of that reduction would be through purchase of REDD units.[53]

An alternative form of managed fungibility is the approach taken to use of units from CDM afforestation and reforestation projects under the Kyoto Protocol. In particular, Annex I parties are limited to using such units for no more than 5% of their base year emissions to meet their target. Such an approach could also be applied to REDD.

The main problem with either of these approaches is that by limiting the quantity of units that can be used to meet a country's target, and therefore limiting funding flows, REDD activities are also likely to be limited. However, this may be appropriate if such

[51] Note that some countries' domestic programmes that reward emission reducing activities with units do effectively discount the units earned. An example is New Zealand's PRE programme, where the maximum quantity of units that can be earned by a project is determined in a tender, so that the quantity of units earned may be less than the additional emission reductions achieved by the activity. Note that the rules for afforestation projects under the CDM enables the market to effectively discount the value of units.

[52] Ognowski, M., et al, 2007, *op cit*.

[53] *ibid.*

approaches enable an orderly transition to the inclusion of REDD in the international emissions market.

Other options are available to manage the risk to price from an uncertain quantity of REDD units entering emissions markets. These include price floors (to address concerns about an over-supply of units) or price ceilings (to address concerns about under-supply), a "safety valve", and discounting.

Price floors involve setting a minimum price below which the price of a permit would not fall. As noted by the OECD (2007), "if abatement costs are lower than expected, such a system would pay polluters to continue to reduce emissions and hold excess licenses unused in return for subsidy payments, ie governments have to buy back allowances, or confiscate excess allowances".[54] A price floor could be implemented via a minimum bid auction, where a proportion of allowances would be held back and sold above a reserve price. Alternatively, Annex I parties could agree to purchase units at a minimum price but developing country parties would have the option of selling the units at that price or seeking to sell the units at a higher price.[55] Implementation of a price floor in relation to REDD credits is likely to be complicated as the modalities of implementing the price floor would need to be agreed in advance (i.e. agreement would be required on how to restrict the sale of REDD credits to match supply with demand).

A price ceiling would be used in the situation where Annex I parties agreed to deep emissions reductions, in the expectation that sufficient REDD units would be available to enable this at a reasonable cost, but then the expected supply of units failed to materialise. It would involve establishing in advance the maximum price of emissions units (in effect, converting the market mechanism into a tax). This would limit the abatement activity that took place to below that produced by leaving the market unrestricted. Like a price floor, a price ceiling would be complicated to implement. It is likely to be more difficult to get agreement than a price floor because there would be little incentive for parties supplying units to agree to a price ceiling - unless the alternative was the collapse of the market.

A safety valve approach could be used to ensure that the cost of units is neither too low nor too high. To ensure the cost did not fall below a pre-established minimum, the percentage of REDD units allowed into the market could be restricted, eg if the international carbon unit price exceeded \$10/t CO_2-e, allow 5% REDD units into the market, if the price was above \$20, allow 10%, and so on.[56] Similarly, to limit the maximum cost, the quantity of units required by countries for meeting their targets could be adjusted, eg if greater than \$60/t CO_2-e, countries should surrender units equivalent to 95% of their emissions, if greater than \$70, countries should surrender 90%, and so on.

Alternatively, the introduction of REDD could be phased in gradually, with an initial reporting phase to provide more certainty as to the quantity of emissions reductions possible from REDD, followed by an adjustment to Annex I assigned amount dependent on the quantity of REDD units likely to enter the market.

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[54] OECD (2007), *op. cit.*

[55] This is a variation of the 'CER put option' proposed in Müeller, B, July 2007, "Bonn 2007: Russian Proposals, Policy CDM, and 'CER Put Options' (CERPOs), OIES Energy and Environment Comment, http://www.oxfordenergy.org/pdfs/comment_0707-1.pdf

[56] *Ibid.*

In addition to managed fungibility and options that restrict price impacts, it is worth noting that a cap and trade approach to REDD could avoid the problem of REDD units flooding the market. In particular, if the cap is set below countries' existing emissions levels, countries are unlikely have a surplus to sell. This could instead raise the risk of the price of units being too high. However, this risk exists with any deepening of targets if there is uncertainty of supply, such as broadening of commitments in other sectors and including new countries.

4.2.4 National-level compensation/fund options

National-level compensation approaches involve paying deforesting countries a predetermined amount that is dependent on the assessed quantity of emission reductions (or avoided deforestation) that they have achieved against a reference level. Proposals generally leave it to participating countries to determine whether and how communities and actors involved in deforestation activities benefit from the funding.

Contributions to the funding may be voluntary or mandatory contributions from Annex II parties and other sources (see below). If the funding is voluntary, the amount paid may be the proportion of the fund equivalent to the developing country's share of total avoided deforestation in participating developing countries.[57]

Two broad fund approaches have been proposed for generating the quantum of funding required for achieving the emission reductions sought from REDD: voluntary funding and taxes.

Voluntary funding includes the contribution of resources by donor nations either directly to REDD programs or through REDD-related funds. Voluntary funding is the approach used for funding two of the three funds established under the Bonn Agreement, namely the Special Climate Change Fund and the Least Developed Country Fund. The primary source of funding for these funds is contributions from donor countries. However, these funds represent a fraction of the annual amount required to make a significant impact on deforestation in developing countries.

To provide some perspective on the step-change in funding required for REDD, it is worth noting that the total funding pledged by donor nations at the fourth Global Environmental Facility Replenishment in August 2006 was US$3.13 billion.[58] This amount is for funding activities over the period 2006-10 in relation to *four* environmental conventions, including the UNFCCC. In other words, contributions to the GEF would have to double to achieve the level of funding estimated as needed by the most optimistic of the studies surveyed above and increase by more than six times to achieve the level of funding estimated as needed by the Stern review.

REDD funds could also be derived from receipts from taxes. Proposed taxes include tariffs on the sale of fossil fuels such as bunker fuel or aviation fuel used for international transport, the burning of which are currently not covered under Kyoto obligations. Other taxes proposed include assessing a tariff on traded or retired AAU's or similar units, on total emissions or on auctions of units for other sectors.[59] Such a tax would serve as an automatic commitment to REDD programmes linked to other post-2012 commitments.

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[57] Proposal by Brazil. UNFCCC/SBSTA/2007/MISC.2

[58] http://www.gefweb.org/interior.aspx?id=48

[59] For example, see COMIFAC proposal, *op. cit.*

A taxation approach is consistent with the third fund established by the Bonn Agreement, the Kyoto Protocol Adaptation Fund. This is funded by a 2% levy on CERs issued under the CDM. As at 28 March 2008, the fund is worth about €37m but, based on the number of CDM projects in the pipeline, is projected to increase to between US$80-300m in the period 2008-12.[60] Like the UNFCCC ODA-based funds, this is significantly below the level required for significant reductions in tropical deforestation.

One approach is to use the level of funding a country contributes to funding REDD activities as a contribution towards achieving their emissions target.[61] The amount that countries are required to contribute could be mandatory or voluntary. A mandatory level would provide developing countries with some certainty that compensation for avoiding deforestation would be realised. Of course, if the level of contribution was voluntary a country would be likely to determine how much it would contribute according to the cost of alternative means of meeting its target, such as purchasing emission units.

4.2.5 Projects

In sections 4.3.3 and 4.3.4 we considered how market and fund options can provide incentives for avoiding deforestation at the national-level. Similarly derived incentives can be applied on sub-national scales in the form of REDD projects.

REDD projects have limited geographic scope and objectives as compared to national level efforts. As such, they can be tailored to local conditions and deforestation drivers. For example, for a given level of funding, a higher level of incentives can be provided per hectare when targeting a deforestation hotspot at the frontier of a forest than could be provided for the entire forest area.

In order to measure effectiveness, projects have established project boundaries within which the impact of the project on deforestation is measured. A baseline is established against which deforestation or emissions avoided are measured. Other elements may also be specified, including the actions required to reduce emissions, monitoring, reporting, accounting for leakage, consequences of failure to deliver emission reductions, crediting and so on.

Projects may be directly funded by ODA, donor governments, private interests, or through emissions markets. The nested approach, proposed in submissions from Chile, Peru and others, advocates market-based funding for qualifying projects which take place within a national target to reduce deforestation (similar to JI projects in Annex I countries).[62] Project-based REDD efforts may also be funded directly by donors or global funds, as with the national-level approaches.

Participating nations are another source of funding for projects. Countries may elect to enact a basket of policies and measures, which includes projects, with the goal of obtaining reductions in support of participation in a national-level incentive programme.

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[60] http://unfccc.int/files/press/releases/application/pdf/af_board_press_release.pdf

[61] Ognowski, M, *op cit.* This approach of using funding of REDD activities as a means of meeting commitments would of course only make sense if the option of using REDD units to meet commitments was not available.

[62] *Ibid.*

The most well-known example of a project mechanism is the Clean Development Mechanism (CDM). The CDM has not been applied to deforestation because of concerns that include leakage, scale of credits, permanence, and uncertainties. The option of including deforestation in the CDM has been suggested by some submitters.[63]

An example of a REDD project is the Ulu Masen forest in Aceh Province, Indonesia, where the provincial government and local population have committed the 1.9 million-acre forest to a deforestation prevention project. Prevention of both logging and conversion of forest to palm oil plantations is expected to lead to an 85% reduction in deforestation, which would mean an estimated 100 million tonnes of CO_2 will be prevented from entering the atmosphere over 30 years. Local villages will receive payments based on the sale of carbon credits on the voluntary market.[64]

Not all deforestation prevention projects hold prevention of GHG emissions as a primary goal. Some projects seek to limit deforestation in a highly localised manner in order to achieve alternate objectives such as maintenance of habitat or watershed protection. Likewise, REDD projects can positively affect other forms of conservation. From the perspective of REDD, these other objectives can be referred to as co-benefits. Co-benefits of REDD programmes are not limited to project-level activities as national and global co-benefits of deforestation may also be achieved.

REDD projects that provide co-benefits can benefit from greater investment. Marginal projects may become viable with the consideration or monetisation of co-benefits. The forest subject to the Aceh project discussed earlier is home to the Sumatran elephant, Clouded Leopard, Sumatran Tiger, and Sumatran Orangutan.[65] The promise of a co-benefit of preservation of habitat may help Aceh project credits obtain higher prices as they are sold in the voluntary market.

4.3 Input measures

4.3.1 Overview of input options

In order to achieve measurable reductions in deforestation under national-level output management measures, deforestation rates need to be reduced domestically. National goals can be devolved directly to domestic stakeholders, as is proposed for forestry in New Zealand. Alternately, input measures may be used to alter the drivers of domestic deforestation to achieve desired reductions in emissions.

A key reason for the use of input options is that the success of the effort is not directly dependent on estimation of deforestation emission levels. With output options, estimation accuracy is a critical and very likely limiting requirement (consider CDM afforestation and reforestation programmes for example). While continued monitoring of deforestation levels and hotspots are advisable for targeting programmes and checking trends, measurement of compliance or completeness of implementation are all that are necessary for evaluating programme operation with input options. Thus the thorny

[63] Submission by Costa Rice and others

[64] Efstathiou, J. Bloomberg Feb 7, 2008.

[65] Butler, R.; Rainforest-for-carbon-credits deal becomes a reality, mongabay.com, Feb 7 2008

issues of baseline selection and monitoring are avoided. This is likely to flow through to lower administration costs.

Essentially, any activity that reduces the drivers of deforestation is an input measure. For example, in New Zealand the development of a 100% plantation-based wood supply was critical to ceasing deforestation of native forest. Likewise, agricultural efficiency and biofuels may positively or negatively affect deforestation drivers.

4.3.2 International input options

Input options can also be considered at the international level. For example, forest stewardship certification programs operating in developed nations seek to restrain demand for illegally logged timber and incentivise sustainable forest management practices. Alternatively, environmental education programs can work to change public attitudes in deforesting areas. The two above examples could be funded directly by NGOs or donors. Developing nations could also lead such efforts in order to promote optimal use of their forest resources.

4.3.3 Policies and measures

A further variation of input options involves provision of incentives to nations or other organisations for undertaking prescribed policies and measures (PAM). Under PAM, a set of policies or measures are selected with the intent of mitigating specific drivers of deforestation, e.g. removal of land clearance subsidies. The participating government receives an incentive or other benefit upon successful implementation.

4.3.4 Capacity building

Various capacity building measures have been proposed in submissions on the REDD issue. Some measures such as those which lead to improved governance and provide forestry management capabilities classify as input options as they directly affect drivers of deforestation. Other capacity building measures focus on developing the tools, such as measurement and monitoring capabilities, necessary to participate in an international REDD framework. While the main intent of such programmes may be to enable participation in output mechanisms, programmes which improve the availability of information for a national government will also assist in optimising forest management.

5 Evaluation of Options

5.1 Objectives

In assessing options for REDD it is critical to first consider the objectives sought in addressing deforestation in developing countries. As most studies point out,[66] the ultimate objective of the UNFCCC is a useful starting point:

> *"The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."*[67]

The key elements of this relevant to REDD are:

- The stabilisation of greenhouse gas concentrations in the atmosphere;
- That this stabilisation should occur within a timeframe sufficient to enable:
  - ecosystems to adapt naturally; and
  - economic development to proceed in a sustainable manner.

As suggested by the OECD (2007), achieving "sustainable" economic development means "one goal of any REDD mechanism might be to lower the global costs of mitigation".[68]

Schlamadinger et al point out that other Articles 3.3 and 4.1 of the Convention are also relevant in establishing goals for LULUCF activities, and since deforestation is a subset of LULUCF are also relevant to REDD. In particular, Article 3.3 states:

> *"The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost. To achieve this, such policies and measures should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors…."*[69]

This Article reinforces the interpretation of Article 2 above that measures to address climate change "should be at the lowest possible cost". This article also emphasises that policies and measures address climate change should be comprehensive and cover all anthropogenic sources and sinks and all sectors.

Article 4.1(d) states that All Parties shall:

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[66] See, for example, Schlamadinger, B et al, 2007, A synopsis of land use, land-use change and forestry (LULUCF) under the Kyoto Protocol and Marrakech Accords, *Environment Science & Policy*, Vol. 10, Issue 4, Elsevier, Amsterdam, The Netherlands and OECD, 2007 *op. cit.*

[67] UNFCCC, 1992, *United Nations Framework Convention on Climate Change*, Article 2, http://unfccc.int/essential_background/convention/background/items/1349.php

[68] OECD, 2007, *op. cit.*

[69] UNFCCC, *op. cit.*

> *"Promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems…"*[70]

Schlamadinger *et al* (2007) interpret these are Articles of the Convention as saying that with respect to LULUCF activities within a post-2012 agreement, options should create and promote incentives that:

> *"A. Reduce major sources of emissions from LULUCF (reduce deforestation, forest degradation, unsustainable logging, etc).*
> *"B. Enhance and expand major carbon reservoirs.*
> *"C. Promote the sustainable use of biomass in materials and for energy generation.*
> *"D. Link emission reduction and sink enhancement activities with adaptation strategies."*[71]

These objectives are clearly relevant to mechanisms for REDD. The key issue in negotiations will be how to balance these objectives and, in particular, the relative weighting that should be applied to addressing climate change versus reducing poverty.

5.2 Criteria

There have been substantial international efforts to develop a comprehensive set of criteria for assessing options for REDD. Criteria that have been developed range from the comprehensive to the specific. For example, Schlamadinger *et al* (2007)[72] developed a comprehensive set of criteria that addressed the major policy and political considerations that can be taken into account in assessing options for REDD. The OECD (2007) evaluated options according to a narrower set of criteria that emphasised clarity of goals and objectives, adequacy of funding, and environmental performance.[73]

We use the following criteria, which fall somewhat in between these two extremes:

[70] *Ibid.*

[71] Schlamadinger *et al* (2007), *op. cit.*

[72] *Ibid.*

[73] OECD, 2007, *op. cit.*

Table 8: Criteria for assessing options for REDD

Criteria		Description	Topics covered
Environmental Effectiveness	Permanence	Ability to ensure long-term reductions	
	Leakage	Ability to constrain and allow for leakage	• Constrain national leakage • Constrain international leakage • Constrain leakage to degradation
	Participation	Ability to encourage maximum participation	• Extent to which financial return (incentive) to participants is maximised
	Leads to real emissions reductions	Ability to ensure activity would not have happened in absence of intervention	• Methodologies' ability to accurately and fairly determine reference levels and avoid 'hot air'
Economic Efficiency		Ability to ensure developing country forest is retained where benefits of retaining forest exceed the full opportunity cost	• Productive efficiency • Allocative efficiency • Dynamic efficiency
Viability	Acceptability	Ability to be agreed to and financed by participating countries	• Acceptability to developing countries • Acceptability to developed countries • Ability to fairly negotiate reference level • Ability to implement and administer • Ability to meet indigenous and local community needs • Ability to maximise non climate change mitigation benefits • Ability to lead/transition to multi-sectoral caps
	Flexibility	Adaptability to participating nation conditions	• Adaptability of standardized baseline methodology • Ability to meet monitoring and reporting requirements

The criteria we use fall into three broad areas: environmental effectiveness, economic efficiency and viability. The first two of these relate directly to the objectives identified in section 5.1. At a fundamental level these criteria reduce down to: "To what extent does the option being examined reduce emissions and to what degree does it do this at least cost?" The third area, viability, addresses both the practicality of the option and the degree to which the option is acceptable to the various parties involved.

The sub-criteria under environmental effectiveness are all issues that are of concern in relation to initiatives addressing emissions from other sources, and greenhouse gas emissions and removals from LULUCF, in particular. Descriptions of addressing non-permanence and leakage are provided in section 3.4. These criteria address the extent to which an option provides complete coverage of emissions over both space (leakage and also participation) and time (non-permanence).[74] Ensuring an option 'leads to real emissions reductions' addresses the extent to which an option reduces emissions relative to business as usual. As has been widely discussed, a critical aspect to this is estimation accuracy and appropriateness of reference levels.

While the environmental effectiveness criteria are common to all LULUCF activities, the high degree of estimation uncertainty in relation to REDD, the consequent difficulty in setting robust reference levels, and concern about REDD units flooding markets prevented its inclusion under Kyoto. It will therefore be critical that the option selected to promote REDD satisfactorily addresses these issues.

With respect to non-permanence, while it is not an issue that is unique to REDD, the manner in which it is addressed is likely to have an influence over the ultimate success of an option. For example, the temporary credit approach for addressing non-permanence in relation to CDM A/R activities, where Annex I parties are required to replace units in future commitment periods and are responsible for their replacement in the event of any unplanned reversal, has resulted in unattractive units and disincentivised A/R CDM projects. On the other hand, permanence for national-level accounting in Annex I countries was solved by requiring that these countries assumed responsibility for carbon stocks in future (and hopefully contiguous) commitment periods.

[74] Schlamadinger *et al*, 2007, *ibid.*

Participation has significant implications leakage. The wider the participation of the REDD mechanism, the greater the extent to which the problem of leakage can be captured. However, as well as breadth of coverage, the participation criterion also considers depth of coverage, that is, the degree to which an option provides appropriate incentives to all the actors causing the deforestation.

With respect to economic efficiency, as Angelsen (2008) points out, economic efficiency is central to the assessment of options:

> *"The fundamental role of the efficiency criterion is not fully appreciated in the debate. It is not just one among a dozen of desirable features of a climate regime nor some fancy economistic term. It is a prerequisite to minimize global warming from the limited efforts that the global community is willing to spend."*[75]

There are three standard criteria for economic efficiency: allocative, productive, and dynamic efficiency. We first explain each term generally, and then in regard to REDD specifically.

- Allocative efficiency is achieved when consumers allocate their income to each good such that the marginal value they would gain from further consumption of any good is equal to the marginal cost of supply. In regard to reducing emissions, governments are attempting to purchase or regulate (on behalf of consumers) a reduction in adverse climate change. Allocative efficiency is achieved when Government spending and regulation results in the optimal balancing of emission reduction and other goods and services, such as education and health services. It takes into account that there is an opportunity cost of retaining forests in relation to a country's ability to develop as well as that the benefits of retaining forests extend beyond just sequestering emissions.

- Productive efficiency is achieved when the output of a good or service is produced at least cost, or alternatively, when maximum output is achieved for a given cost. In regard to REDD initiatives, this will be achieved when the marginal costs of reduced deforestation are similar across sectors, local areas and countries.

- Dynamic efficiency is achieved when rates of investment and innovation are optimal. In regard to REDD initiatives, dynamic efficiency is most likely to be achieved by policies that facilitate technological and policy innovation for measuring, monitoring, and maintaining optimal forest cover.

The viability criteria consider the degree to which an option meets the needs of the various parties affected by the REDD mechanism (acceptability) and the degree to which the option takes into account the diversity of deforesting countries (adaptability). The acceptability criterion in effect considers whether the option is likely to be viable to propose in negotiations – that is the degree to which it is acceptable at an international level – as well as whether the option is acceptable by parties directly affected by addressing deforestation. The adaptability criterion considers the degree to which an option can take into account the diverse circumstances of the different developing countries that are undertaking deforestation. In effect, the adaptability criterion assesses whether an option can be implemented in some or all of deforesting developing countries or adjusted so that it can.

[75] Angelsen, A., 2008, *Seeing both the forest and the trees in REDD,* Unpublished.

5.3 Evaluation against criteria

This section evaluates the broad options described in section 3 against the criteria described in the previous section.

It should be kept in mind that a combination of options may provide greater flexibility as well as the ability to attack the problem of deforestation on multiple fronts. Many of the proposals by various parties are packages of options, eg the "Nested Approach".[76]

Each option is evaluated from the perspective of its utility in support of an internationally agreed REDD scheme. It should be kept in mind that options that require countries to account for their national emissions at an international level will need to be supported by domestic activities that drive emission reductions. Further, although an option may be assessed as being unsuitable for international application does not necessarily prevent a similar option from being applied successfully within a particular country.

An overview of the evaluation of the options identified is provided in Table 9.

[76] Pedroni, L, and Streck, C, 2007, *op. cit.*

Table 9: Evaluation against criteria of options for elements of a global agreement on REDD.

Criteria \ Options		Output methods				Input methods			
		Markets		Funds					
		National-level crediting	Project-level crediting	National-level compensation	Funded projects	Compensation for Policies and Measures	Capacity Building	Others Non-financial incentive mechanisms (certification illustrated here)	Best Practice
Environmental Effectiveness	Permanence	Variable depending on mechanism. Addressed in short term through aggregation within accounting period. Addressed over longer term provided countries continue to agree to remain within cap	Low to high. Depends on crediting approach applied.	Variable depending on mechanism. Ex-post payments address permanence during accounting period. Future payments may be adjusted or current payments converted into series of payments.	Low to high. Depends on crediting approach applied.	Does not directly address permanence	Does not directly address permanence	Low to medium. Provides limited incentive for addressing permanence as parties that deforest would lose certification.	Does not specifically address permanence.
	Leakage	Medium to high. National aggregation incorporates effects of domestic leakage. International leakage can be mitigated by broad adoption.	Low to high depending on standards. Units integrating with compliance markets must demonstrate low leakage. Units offered in voluntary markets may have high leakage.	As for market funded national-level crediting.	Low to high depending on standards.	May improve capability of detecting leakage Measures such of removal of subsidies, reform of land laws etc may also provide disincentives against leakage	High. Improves capability of detecting leakage.	Low to medium. Depends on adoption rate and scope of certification regime. Low for forest specific scheme, medium for country-level certification with broad international adoption.	Does not address leakage.
	Participation	Potentially high. Depends on expected value—linked to target setting and market expectations. Supply risk, complexity of measurement, and compliance important.	Incentives for participation limited unless provides benefits over and above incentives provided by other alternatives.	Potentially high depending on expected compensation—linked to target setting and funding expectations. Risk, complexity of measurement, and compliance important. Unlikely to mobilise required levels of funding.	As for market-funded projects.	Potentially broad but depends on political acceptability within developing countries of policies and measures. Developing country willingness to undertake actions likely to depend on inducement provided.	High. Incentives are to participate.	Variable. Incentives for participation uncertain as will depend on extent certification is accepted and valued by the market.	High due to voluntary nature and low participation costs.
	Leads to real emission reductions	Depends on targets established. High variability in historical deforestation and high levels of uncertainty with measurement mean ensuring REDD activities achieve real reductions will be difficult initially. Conservative accounting can mitigate such concerns.	Developed country experience suggests it is difficult to separate out activity that would have happened under business as usual versus project instrument.	As for country-level crediting.	As for market-funded projects.	Depends on policies and measures targeted. Assuming key policies targeted likely to result in additional abatement.	Depends on effectiveness of programme and what it targets. An effective programme that improves developing country capability to respond to deforestation likely to enable real emissions abatement	Low to medium. Depends on success of certification in lifting value of sustainable versus non-sustainable forests.	Variable depending on programme.

Criteria \ Options		Output methods				Input methods			
		Markets		Funds					
		National-level crediting	Project-level crediting	National-level compensation	Funded projects	Compensation for Policies and Measures	Capacity Building	Others Non-financial incentive mechanisms (certification illustrated here)	Best Practice
Economic Efficiency		High. Ensures least cost abatement options selected across all sectors, regions and participating countries.	Medium. Less efficient than domestic devolution of policies and programmes under country-level crediting due to high transaction costs and leakage issues.	Medium. Less efficient than market funded approaches as funding flows determined through negotiation rather than by market.	Medium. High transaction costs and leakage issues. Potential to capture difficult-to-monetise benefits such as learning-by-doing.	Medium-High. Seeks to remove distortions that are promoting deforestation, enhancing efficiency. Relatively low cost option but benefits lower compared with more direct measures.	Relatively low cost measure that improves capability to obtain benefits from REDD. While low cost, benefits also limited.	Relatively low cost instrument but benefits also likely to be limited.	Variable. Low cost instrument but benefits probably limited as well. May provide limited informational and capability improvements.
Viability	Acceptability	Medium to high depending on mechanisms and commitments. Selling nations will consider delivery risk, expected compensation, and implications for sharing of burden of climate change actions between developed and developing countries. Local level acceptance depends on national policies and devolution. Buyers of units likely to accept if GHG reductions are credible and comparable to those achieved in other sectors.	Low due to scale of benefits, transaction costs, leakage, and market acceptance issues. High local level acceptance.	Low to medium depending on mechanism and commitments. Selling nations will consider delivery risk and expected compensation. Local level acceptance depends on national policies and devolution. Funding nations of units likely to accept if GHG reductions are credible and comparable to those achieved in other sectors.	Low due to scale of benefits, transaction costs, and leakage issues. High local level acceptance. .	Low to high. Developing country willingness to agree to this option will depend on inducement. Affected developing country communities may be unwilling to accept some measures unless they see offsetting benefits. Likely to be seen as key by many developed countries and developed country industry participants.	High. Most countries likely to support this option as seen as necessary to enable REDD. Financial requirements likely to be at levels acceptable to most developed countries.	Acceptance will depend on market perception. Mixed success of existing certification schemes may mean acceptance will be limited	High. Likely to be acceptable to developing countries because of low participation costs. Likely to be viewed skeptically by Annex I countries because of limited benefits and limited action relative to business as usual.
	Flexibility	Medium. National circumstances can be addressed in target setting process. Compliance, monitoring and measurement requirements may reduce flexibility.	Low to medium flexibility to address local conditions because of need to meet requirements of project programme.	Medium. Can be readily adapted to varied national circumstances. Compliance, monitoring and measurement requirements may reduce flexibility	Low to medium flexibility to address local conditions because of need to meet requirements of project programme	High. Targets issues specific to different countries so therefore flexible to different developing country circumstances.	High. Can be readily adapted to differing circumstances among developing countries.	Success requires consistent application across different countries so unlikely to be flexible to circumstances in different countries.	High. Developing countries to determine extent to which they adopt best practices.

5.3.1 Discussion of evaluation

Table 8 highlights that the problem of ensuring that REDD activities lead to real reductions in emissions is common to all options.[77] High levels of inter-annual variability in deforestation rates combined with high levels of data uncertainty make it difficult to confirm that REDD activities lead to real reductions. This is perhaps less of an issue with capacity building, which focuses more on establishing technical, institutional, and legal capability to address deforestation. Because this option seeks to build capacity and address non-financial barriers to REDD, it could be considered as a necessary precursor to the introduction of options that provide more direct incentives.

The second point to note is that no option or combination of approaches completely addresses the problem of leakage. However, it is unrealistic to address all leakage, as is evident from the Kyoto Protocol, which only addresses leakage within and among participating Annex I countries and, to a lesser extent, in relation to CDM projects. Domestic leakage can, though, be addressed with instruments that have country-level crediting or compensation. Project options directly funded as part of an international REDD agreement will struggle to address leakage. However, a project's domestic leakage can be ignored from the international perspective if it occurs within a country's target – in which case the problem of leakage is assumed by the country.

Permanence is not inherently addressed by any of the options evaluated. However, there are mechanisms available to address permanence. For example it could be addressed by countries taking on full liability for commitments in future commitment periods or by holding a portion of units for use in the event that emission reductions are reversed. Therefore addressing permanence is an additional element that must be considered when designing a REDD regime.

In relation to participation, it is worth noting that options that are likely to result in the widest participation will not necessarily result in the greatest level of abatement of emissions. For example, capacity building is an option where broad participation could be expected but the abatement that would directly result from this approach is likely to be limited. Rather, the option that will generate the greatest abatement is likely to be the one that ensures the largest funding flows and provides greatest incentives for abatement from all sources. This is likely to be the national-level crediting option, as this has the potential to involve action from both developing and developed country private sectors, which the EU ETS has demonstrated can incentivise substantial funding flows. This assessment assumes, however, that the REDD regime agreed results in a demand for REDD units and that there are no additional restrictions placed on flows of REDD units to emissions markets beyond what is agreed at an international level.

Developing country participation may be broad if reference levels are generous but the risk of 'hot air' increases substantially. On the other hand, setting stricter

[77] It should be noted that it has not been required that Annex I targets, if met, lead to real and verifiable reductions in emissions.

reference levels might not preclude participation, but rather give stronger incentives to avoid deforestation and consequently a larger overall reduction.

Options which require estimation of deforestation emission levels to calculate incentives, such as national-level crediting or compensation, subject participating countries to environmental and economic risk, as both natural and man-made drivers contribute to deforestation. This risk may affect the willingness of some countries to participate in such options. Against this though, a country participating in such a mechanism can profit by reducing emissions below its reference level, though it must actually achieve these reductions through a mix of measures it selects. Should these measures fail to generate the desired reductions, incentives may not materialise.

Although financing REDD activities with funds linked to Annex I targets is the fund-based option likely to result in the greatest investment, the magnitude of flows required risk sufficient developed country support and participation.

Of the options evaluated, national-level crediting best satisfies the efficiency criterion. This is because it is the only option that directly seeks to induce the efficient level of abatement across all sectors including REDD. The emissions price provided by this option ensures that emitters consider the full opportunity cost up to that provided by the market price in deciding whether there are net benefits from deforesting. In addition, this option provides incentives and the opportunity for emitters to seek the least cost abatement option across all sectors (assuming some form of fungibility of REDD units with other units). None of the other options achieve this to the same extent.

Note, however, that the option of financing REDD activities with funds linked to Annex I targets could be designed to mimic a market mechanism. In particular, if countries had the option of either purchasing units or direct funding REDD in order to meet their targets then the cost of abatement should equilibrate over all sectors (assuming REDD financing was on a tonne of emissions basis). The key question with this approach is whether the funding flows would reach the levels achieved by markets and therefore whether net benefits would be maximised.

As evidenced by broad support in submissions to date, the option that best meets the viability criterion are the option of funding capacity building activities. Most parties are likely to support initiatives like capacity building, as the funding requirements are low while the potential benefits, in terms of improvements in the quality of information and capability to benefit from other instruments addressing deforestation, are significant.

National-level crediting is likely to be broadly supported with some caveats. These are that parties accept that treatment of deforestation in developed and developing countries needs to be different, and that concerns about the capability of countries to participate and the impact of REDD units on other emissions markets are satisfactorily addressed.

While policies and measures are likely to be elements of any agreement on REDD, the key issue with this option as specified is whether developed countries would be willing to pay developing countries for undertaking actions that "they should already be doing". Of course, if this is treated as "capacity building" then this may be considered as acceptable to developed countries.

The main issue with national-level compensation is whether the significant funding flows required are acceptable to developed countries. National-level compensation does, however, have the key advantage that it would avoid any disruption to existing emissions markets.

Of potential standalone options, the policies and measures option meets the flexibility criterion by targeting the specific conditions of each developing country experiencing deforestation. While the national-level crediting and national-level compensation options can be tailored to the needs of countries with varied capabilities, their requirements are likely to be challenging for many nations.

5.4 Gap analysis

The previous section identified the options that best met each criterion and also discussed problems that were common to all options such as lack of accurate information on deforestation levels. This section discusses the flaws of each of the main approaches identified. It will consider whether there are satisfactory solutions for these problems or whether the lack of solutions means the option should be dismissed. The various output methods will be discussed first followed by input methods. The preferred option is then identified in section 5 below.

5.4.1 Output methods

Many, if not most, developing countries that may seek to participate in a REDD scheme lack the technical, legal and institutional capacity required to demonstrate reductions that merit crediting or compensation. Deficiencies include insufficient capability to measure emissions, establish and enforce property rights, implement required reforms, etc. Unless these issues are addressed, options such as country-level crediting and country-level compensation are not viable. This is why capacity building is likely be a necessary component of any REDD initiative. However, capacity building will take time to address these issues, and it may not fully address them all. Nevertheless, a well-designed capacity-building programme should be sufficient to put countries in a position to start to participate in a REDD mechanism.

To ensure that countries do have the necessary infrastructure in place and that their emissions inventory is reasonable, eligibility requirements similar to those required for Annex I to make full use of the Kyoto mechanism would also be appropriate. The promise of compensation itself can help address lack of capacity as it will attract private sector players who will have an incentive in ensuring, for example, that any credits that they sell are based on good quality information if they wish to realise their full market value. In addition, options such as gearing can address concerns such as the quality of forest inventory by providing, for example, that a country would be eligible for a greater level of credits the more accurate is their inventory.

One issue that needs to be considered with output methods such as country-level crediting and country-level compensation is that while these options provide an opportunity for large flows of resources, such positive flows can have adverse consequences such as increased inflation, corruption, etc.

Market funding

As with all output methods, a key concern in relation to the market mechanisms is that the quality of information on deforestation in developing countries is poor. However, good quality information is particularly critical for establishing a well-functioning market. In particular, high quality information is required to identify whether a country or a project has reduced deforestation below its reference level. Without good quality information, buyers lack certainty as to the quality of units. Poor quality information is likely to flow through to lower prices, which in turn is likely to mean less units flowing on to the market, which in turn will result in a lower impact on deforestation than would be the case if good quality information on deforestation were available. It is therefore critical that steps are taken to address this information gap before any market in REDD credits is established. Under national-level crediting, this could be done by agreeing a pathway for the introduction of REDD, which would involve first collecting information on deforestation, then negotiating and establishing reference levels before the market can commence.

The second key concern with the use of markets to address deforestation is the uncertainty of the impact of REDD credits on existing compliance emissions markets.[78] The primary concern appears to be that there will be an oversupply of REDD credits causing international emissions prices to drop. This is because, as has been discussed earlier in this report, deforestation and degradation in developing countries is the single largest source of emissions not covered by the Kyoto Protocol. Concerns have also been expressed about risk of undersupply of units in the event that developed countries agreed to deeper targets to reflect the large potential for emissions reduction offered by REDD. The problem of concerns about oversupply or undersupply of units is exacerbated by poor quality information about deforestation. However, while the concerns about poor information are significant, the concerns about over- or under-supply are not insurmountable. As discussed in section 4.3.2, there are a range options available for addressing these concerns. These range from simple approaches such as caps on the quantity of units that may enter the market within a trading period, through to much more elaborate approaches such as safety valves or separate REDD markets, such as advocated by Ognowski *et al* (2007).[79] All of these approaches incorporate the flexibility to be reversed in future trading periods, or after a review, if previous concerns have eased or proved unfounded.

Finally, there is a concern that market options that allow utilisation of low cost sources of abatement, such as REDD, will allow developed countries to avoid domestic emission reductions. Ensuring that developed country targets are over and above what they would have been without REDD will maintain pressure for domestic action in developed countries.

[78] Note that this does not appear to be a concern for the voluntary market as standards for this market, such as the Voluntary Carbon Standard, contemplate the inclusion of REDD activities. Voluntary Carbon Standard, 2007, *Voluntary Carbon Standard: Guidance for Agriculture, Forestry and Other Land Use Projects.*

[79] Ogonowski et al, *op. cit.*

Fund supported mechanisms

The key issue with all fund supported options is whether they would be able to mobilise the level of resources required to address deforestation. This is a particular problem with voluntary funding, as current ODA levels suggest it is unlikely that this option can mobilise the resource levels required – Norway's generous contribution notwithstanding.

Funds linked to Annex I targets and levies would be capable of mobilising higher levels of resources. For example, the World Bank (2005) suggests that a $0.20 per gallon levy on aviation fuel would raise $9 billion per annum.[80] This amount represents about 6% of prices at the time of writing,[81] which while a relatively small amount would come on top of substantial price rises for aviation fuel. While this is less than the tens of billions identified from the studies surveyed in Table 6 as necessary to achieve a reduction in deforestation emissions of greater than 50%, a sum of this magnitude would be sufficient to incentivise a sizeable reduction in emissions. Similarly, linking funding to Annex I targets might result in higher funding levels but care should be taken to assess the impact of such a method on other ODA expenditures. The major issue with either of the fund financing alternatives to voluntary funding is whether developed countries would be prepared to agree to them. The example of Norway suggests that some countries might.

With respect to the levy option, concerns arise because most of the levies proposed are, in effect, tied taxes. Tied taxes raise efficiency concerns. In particular, there is no way of knowing that the activity funded by a tied tax is the highest value use of the revenue raised by the tax. Such concerns could be addressed by a mechanism to reveal the highest value use of the revenue – ie an auction – but this would be problematic to design in the international climate change context. In addition, the revenue base of tied taxes is comparatively narrow, causing high deadweight loss. Further, concerns are often raised that the recipients of the revenue risk becoming dependent on the funding. If the tax is on an externality – which would be the case, for example, if airline fuels were the source of funding and were taxed on an emissions basis – then concerns have been raised that funding recipients have incentives to seek to perpetuate the externality. Further, if the tax is on other mechanisms, such as AAUs, or on the proceeds of auctions of units, this would increase the cost of taking on commitments. This is likely to result in countervailing pressure to limit the level of the tax, which would limit the revenue that can be raised.

One concern with national-level compensation is where the funding would ultimately be directed. If it went to governments there would be a risk that this would be seen in the developed at world as further fuel to the fire of corruption. Such concerns would be exacerbated if the funding went to logging companies or other deforesting agents seen by the developed world as the villains of deforestation. The alternative would be for the funding to go direct to forest owners or affected communities. This would face its own challenges because of the unclear property rights in many

[80] World Bank, 2005, Financing the Development Agenda, http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2005/05/19/000160016_20050519162401/Rendered/PDF/32385.pdf

[81] Based on the Singaporean price of around US$3.10 per gallon for kerosene-type jet fuel on 28 March 2008. Source: http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/weekly_petroleum_status_report/current/pdf/table15.pdf

deforesting developing countries. In addition, developing countries may reject attempts at directing how funding they receive should be allocated. Nevertheless, these concerns could perhaps be overcome by requiring that, in order to be eligible for funding, participating countries seeking REDD funding must prepare a plan on the use of the funds according to agreed principles. This is the approach taken with, for example, access to funding from the Adaptation Fund.

Projects

As discussed in section 3.4.2, leakage is a key issue for deforestation projects. When deforestation is halted within a project boundary the incentives on deforestation agents are to shift deforestation to just outside of the project boundary. But even if deforestation in immediately adjacent areas is also accounted for, the incentive remains to deforest just beyond, and so on.

When considering effects over several harvesting cycles, some projects could be expected to create more emissions than were avoided in the first instance. Project leakage can be segregated into two types, primary leakage which is local and observable, and secondary leakage which is dispersed throughout the global economy and propagated by the economic effects of supply and demand.

It may be possible to address leakage by, for example, deducting credits from future allocations to the project in proportion to the leakage outside the project boundary. However, if the leakage is severe this may put the project in jeopardy if it results in so few credits being available in future periods that there are no net benefits to the project developer in continuing with the project.

Project design can be adapted to address leakage in several ways. A project can engage in multiple activities such that project-induced changes in deforestation drivers are neutralised. Ultimately, to the extent leakage cannot be avoided, it can be estimated and factored out of any estimates of emission reductions. The Care/Guatemala project provides an example of leakage mitigation through a planned increase in fuelwood availability and agricultural productivity by promoting agroforestry. Simultaneously the project protected some forests.[82]

The issue of identifying and accounting for project leakage can be sidestepped if it is captured within national accounting, e.g. under national-level crediting. Alternatively, leakage can be taken into account by gearing the quantity of units earned by a project to less than the actual emission reductions achieved within the project boundary. It is helpful to recall at this point that projects, in addition to being proposed as having direct access to international funds or markets, will most likely be one of the varied tools nations use to reduce emissions in support of efforts to profit under national-level accounting. Of course, international project mechanisms have value in terms of providing learning by doing opportunities, encouraging early action, and promoting action when there are informational or other barriers prior to national accounting coming into full effect.

[82] Brown, P., B. Cabarle, and R. Livernash, 1997: Carbon Counts: Estimating Climate Change Mitigation in Forestry Projects. World Resources Institute, Washington, DC, USA, 25 pp.

The other main issue with projects is whether the project results in real emission reductions. Participation may suffer from adverse selection where those not intending to deforest apply for incentive payments. For example, in a Mexican Hydrological services project, only 25% of applicants for funding were approved. Participants received a flat fee for agreeing to protect forests of engage in sustainable forest management for a period of years.[83] A flat fee is necessary to avoid even greater adverse selection issues.

In order to ensure that projects produce real emission reductions projects need much of the infrastructure required by mechanisms that better capture all emissions, such as national-level measures. For example, projects require either similar or higher cost monitoring and reporting infrastructure than for national-level crediting, although monitoring need not be nation-wide. But to address concerns such as leakage and additionality projects often include additional protections, such as is the case with the CDM. These protections add further cost, limiting the benefits that can be captured by projects.

The clearest example of such onerous requirements is CDM afforestation and reforestation projects. Such projects must not only clear the extensive hurdles imposed by the CDM crediting process, which apply to all projects, but must also contend with the crediting method specific to CDM forestry projects and the restrictions on the use of these credits by Annex I parties. All these elements render such projects unattractive from project developer's perspective. The end result is that protections are so extensive that there are few, if any, net benefits from such projects, which is reflected by the single validated project in the A/R sectoral scope and that there is yet to be a single credit issued.

The way around such concerns may be to allow projects to be financed by funds rather than units. Funds avoid the need for extensive rules that seek to limit the impact on markets of units of variable quality.

While imperfect, internationally funded projects can assist with getting countries to a position to begin national-level crediting, as is suggested by the nested approach.[84]

5.4.2 Input methods

The effectiveness of input options is dependent on the effectiveness of the programmes and institutions conducting them. Other factors, such as the extent programmes are culturally appropriate, may also have a significant impact on their effectiveness. Of course, institutions such as the World Bank, the GEF and its implementing organisations have substantial experience in addressing these considerations.

The key disadvantage of using input options is the lack of explicit proof of success. As such, donor countries and participating nations will have a harder time determining if a particular activity is the best use of funds. Moreover, if a country is participating in national-level compensation or crediting regime, the effect of

[83] Karousakis, K Incentives to reduce GHG Emissions from Deforestation: Lessons learned from Cost Rica and Mexico. 2007 p. 19-21

[84] Pedroni, L, and Streck, C, 2007, *op. cit.*

internationally funded input options may be difficult to separate from the nation's total reductions, leading to double counting.

Another issue with input options centres on efficiency. It can be argued that as long as the output mechanisms provide incentives to reduce deforestation, market investors will assist nations to develop the capacities necessary to benefit from those incentives. Directly supporting input measures that pre-empt development that would have occurred in the market, without additional investment, is inefficient. However, it is debateable that developing nations will be able to develop such capacities by relying solely on the market.

There is also a potential adverse selection problem with input options. Whereas in a market-based system determination of the activities which it is most efficient to fund is driven by the market, care must be taken in the selection of input programmes to ensure efficient application of resources. With an input programme, the programmes that are funded are determined by the host country and funding organisations, and there is no guarantee that the most efficient programme is selected.

Such concerns can be countered by enabling a market of programmes. Either donor or participating governments would propose programmes which can then be selected by a counter party. In theory, donor countries will seek to achieve the most impact and optimise their selections.

Policies and measures

PAM approaches focus on activities such as the removal of laws, policies, and institutions that promote deforestation. However, the removal of such policies could be politically challenging in some countries so the countervailing benefits to the country would need to be significant. Such countervailing benefits include significant funding or the opportunity to access significant funding flows such as from REDD credits. Accordingly, one option would be that an eligibility requirement for accessing REDD direct funding or market mechanisms would be that countries had first implemented reforms that removed policies, laws and similar mechanisms that promoted deforestation. However, developing countries may resist this on the basis that the removal of such policies would make sense anyway if they could access REDD funding or credits, and that they may wish to delay implementing such policies to ensure they can access the full income available from these measures.

Capacity building

While capacity building options can improve the capacity of developing countries to address deforestation, their actual impact on deforestation is likely to be relatively limited compared with mechanisms that provide more direct incentives.

Other input method options

Other input method options need to be individually evaluated for their merits and defects. For example, the key issue with certification is whether a regime can be established that buyers of tropical timber value as providing an assurance that the timber is harvested sustainably. In terms of climate change, this means that timber harvesting is done in a manner that reduces net emissions. The degree of tropical

deforestation suggests existing certification schemes have had at best limited success in convincing the market that they deliver value to the degree that buyers should only purchase certified timber. While a UNFCCC sponsored scheme may have more chance of convincing international timber buyers of the additional value of buying sustainably harvested timber because of its international reach, the past record on certification suggests that this option has a low chance of success and will deliver limited benefits. Moreover, like most of the options it requires relatively extensive measurement and reporting infrastructure. The cost of establishing this and the limited chance of success suggest that this is an option that should only be considered when other factors mean more direct options are not available.

Best practice

Best practice is likely to be a limited tool in addressing deforestation. It can affect drivers of deforestation through improving efficiency in agriculture, forestry, or other areas of the economy. This may be important, if not vital, as a supporting programme to help countries achieve reductions in emissions from deforestation and degradation. However, as it is purely voluntary, external incentives for agents to alter their approach is lacking and improved economies that result from the best practice activities must drive all change. While best practice is the lowest cost of the mechanisms examined, it is also likely to have among the most limited benefits as a primary mechanism to address REDD. Other options involving somewhat more expenditure, such as the indirect funding options, are likely to deliver much more significant net benefits.

6 Conclusion

This report began by identifying that deforestation from developing countries represents a substantial portion of global greenhouse gas emissions, and is in fact the largest single source of emissions omitted from the Kyoto Protocol. As Stern and many others following him have identified, this substantial pool of emissions represents an untapped opportunity for low cost emissions reductions. Using this opportunity would make it easier and less expensive to achieve the emission reductions needed to stabilise global temperatures.

Despite this, scepticism remains that REDD may not produce real emission reductions and that REDD will overwhelm emission reduction initiatives, and therefore limit abatement. [85]

This report has identified that such concerns can be managed with careful selection of options to address REDD and careful but innovative design of those options so that any adverse effects of introducing REDD into international markets are mitigated.

There is no doubt, however, that the challenges of including REDD in a future global agreement to address climate change are considerable. There are substantial uncertainties in the level of deforestation and forest degradation in developing countries, and a much more systematic and accurate approach to measuring deforestation and degradation is required. The capacity of developing countries to measure and report their emissions, and to undertake policies and actions to address deforestation, are limited. Substantial effort and resources are required to address these issues in order to put developing countries in a position where they can offer reductions from emissions from deforestation to a REDD market or funds.

Despite these challenges, we believe it is realistic and beneficial to include REDD in an agreement that considers how to address emissions beyond the Kyoto Protocol. Options are available to deal with the uncertainties and ensure that emission reductions are real and do not have an adverse impact on other emissions markets.

This may require developing countries accepting that a conservative approach to measurement and crediting is appropriate. This approach has intrinsic value: for in assuring buyers emissions reductions due to avoided deforestation are real, REDD efforts will be highly valued in both up-front negotiations and subsequent market transactions. The potential financial flows from REDD are substantial but this value will only be realised if the units sold represent real emission reductions.

Including REDD in a future climate change agreement will also require developed countries to accept that they need to devote significant resources to REDD capacity building. This effort is needed to ensure that qualifying developing countries make available this low cost source of emission reductions. Resources are also required to ensure that measurement systems are able to successfully deal with the challenges of measuring deforestation and forest degradation in developing countries. Applying

[85] See, for example, concerns expressed by the European Commission discussed in Tollefson, J, 2008, "Save the trees", *Nature* 452, 6 March 2008.

the resources now will ensure that these substantial opportunities can be obtained quickly.

The measurement problems with deforestation may be used as an argument for delay. However, it must be realised that the longer the delay, the longer before significant incentives exist to address this uncertainty. Developed countries have not got it right first attempt, and Europe's own experience with emissions trading is a good example of this. But by starting emissions trading, incentives were put in place to address the problems, ensuring that Phase II is a success. The same applies to REDD, and the EU ETS experience suggests that starting conservatively with clear rules is an appropriate way to ensure that the inclusion of REDD in a global agreement is also successful.

Failing to address REDD now would mean saying "no" to a substantial opportunity to address one of the world's big environmental problems. REDD offers an opportunity for multiple co-benefits, including enhancing economic development in a large number of poor countries around the world, addressing loss of biodiversity, reducing loss of soil and degradation of land, and so on, in addition to reducing emissions causing climate change. Addressing REDD would mean addressing all of these things as well for a manageable cost.