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Estimated REDD Credit Supply into International Carbon Markets by 2035

Prepared for DFID

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RESOURCES FOR THE FUTURE

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Preface

This report has been prepared for the UK Department for International Development (DFID) to evaluate the potential supply of compliance-grade credits from reduced emissions from deforestation and forest degradation, conservation, sustainable management of forests and enhancement of forest carbon stocks (REDD+) to international carbon markets by 2030. The study reviews the technical mitigation potential of the forest sector, and makes assumptions about the *feasible* quantity of emission reductions convertible into tradable carbon units (either REDD or REDD+ credits based on the model). The potential for market-ready reductions that are measured, reported and verified is relevant for the design of adequate REDD finance mechanisms, particularly to the decision on whether and when markets will play a role in REDD finance.

Constrained by a tight timeframe, scarcity of data, and uncertainty around the rules of an emerging international REDD mechanism, Climate Focus has estimated the timing, costs and quantity of emissions reductions from key forest nations. While we have been as transparent as possible regarding our research methodology and analysis, the challenge of gauging REDD credit supply remains daunting. Any statement on REDD credit supply is qualified by these limitations. We therefore complement our quantitative assessments with qualitative analysis of policy discussions that will define an international mechanism for REDD credits on international carbon markets.

The Climate Focus team has prepared this analysis between October and November 2009. The project team included Michael J. Coren (project leader), Charlotte Streck (overall supervision) and Mattia Fosci (research support). The project would not have been possible without the generous support from many external experts and members of the international REDD research community. We would like to express our special thanks to Erin Myers Madeira (RFF), Jonah Busch (CI), Ruben Lubowski, Pedro Piriscabezas (EDF), Andrea Cattaneo (WHOI), and Nathaniel Keohane (EDF).

Disclaimer

Climate Focus has attempted to obtain and provide true and accurate analysis on REDD credit supply. However, much of the information this report is based upon and has been obtained from sources outside Climate Focus' control. The supplied information is further burdened with insecurities and assumptions subject to judgment and subjectivity. Climate Focus cannot be responsible and waives all liability for the accuracy, completeness, or validity of information or factual statements based on these sources. Additionally, all information such as calculations, projections and forecasts that Climate Focus provides in this report are intended only as an estimate of REDD credit supply and are not intended to be relied upon for specific accuracy or as a guarantee of actual REDD performance. Climate Focus is not responsible for any reliance upon the information provided herein or for any loss or liability incurred as a result of such reliance.

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Glossary

Crediting level: Emissions scenario against which actual emission reductions and enhancements of stocks are measured and eligible to be issued as REDD credits. This is expected negotiated based on agreed upon formulas, and reference or reference emission levels (see below).

Feasible REDD potential: Discounted technical potential to achieve greenhouse gas emission reductions by avoiding or reducing deforestation taking into political and capacity constraints related to weak governance as well as the lack of legal and technical capacities. The feasible REDD potential does not consider credit delivery risks related to project-level implementation or policy failure of REDD.

Forest Carbon Index (FCI): A forest carbon model for REDD produced by Resources for the Future and Climate Advisers that was publically launched in December 2009 examining future volumes and costs of emission reductions.

Forest transition curve: The change in forest cover over time as the value of land uses changes relative to the competing uses, usually resulting in rapidly decreasing forest area during early industrialization and development, followed by slow expansion of forest area to lower than original levels.

GtCO2e GHG: Billion tons (gigatons) of carbon dioxide equivalent greenhouse gas emissions.

Measurement, reporting and verification (MRV): The collection of data and information at a national (or sub-national) level, and performance of the necessary calculations for estimating emission reductions or enhancement of carbon stocks and associated uncertainties against a reference level.

Open Source Impacts of REDD Incentives Spreadsheet (OSIRIS v3.0): Forest carbon model (partial equilibrium economic model) produced by a consortium of researchers released July 2009 designed to compare future volumes and prices of emission reductions from REDD under different reference levels.

Own efforts: The nationally financed effort undertaken by a country to reduce greenhouse gas emissions from the forest sector that will not be issued as REDD credits. A discount factor may be applied to a country's reference level accounting for a country's own efforts. REDD credits will be issued against the crediting level reducing total REDD credits available (e.g. a 20% own efforts discount assumes that 20% of emission reductions must not enter international markets and be accounted as domestic efforts).

Partial equilibrium model: Economic analytical approach that focuses only upon the part of the economy that is affected by the factors being studied

Reference level (RL): The amount of net/gross emissions and removals from the forest sector from a geographical area estimated within a reference time period.

Reference emission level: The amount of gross emissions from the forest sector from a geographical area estimated within a reference time period.

RED: Reduced emissions from deforestation.

REDD: Reduced emissions from deforestation and forest degradation.

REDD+: REDD plus conservation, sustainable management of forests and enhancement of forest carbon stocks.

REDD credits: Emission reductions and enhancements in forest carbon stocks measured in tCO2e that are converted into tradable carbon units.

Technical REDD+ potential: Biophysical potential of the forest sector to remove and store greenhouse gases in biomass and other carbon pools as estimated in academic literature. The technical REDD potential does not include discounts for political and capacity constraints (i.e. feasible REDD potential).

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Executive Summary

Economic models suggest emission reductions from tropical deforestation are central to cost-effective greenhouse gas (GHG) mitigation. To keep global temperature from increasing beyond 2°C compared to pre-industrialized levels, reduced emissions from deforestation and forest degradation (REDD)[1] are essential to lower the cost of global climate change mitigation. The inclusion of forest carbon in GHG markets could reduce the cost of halving global carbon emissions below 1990 levels by 50%, while generating net benefits of USD3.7 trillion over the long term, according to the 2008 Eliasch Review.

The UK Department for International Development (DFID) has asked Climate Focus to evaluate the potential supply of REDD credits to international carbon markets. To assess the realistic potential of generating compliance-grade REDD credits, we tested major assumptions -- exclusion and delayed entry of countries into an international REDD scheme, and discounting credits based on 'own efforts' -- using two global models: Open Source Impacts of REDD Incentives Spreadsheet (OSIRIS v3.0) and the Forest Carbon Index (FCI). The effects of crediting not only deforestation but all REDD+ (reduced deforestation and forest degradation, conservation, sustainable management of forests and enhancement of forest carbon stocks) activities and policy developments such as US climate legislation on the REDD credit supply were also assessed. A comprehensive literature review of more than 22 studies on GHG emissions and mitigation potential from the land use sector between 1999 and 2009 supported this analysis.

The estimated feasible supply of REDD credits is significantly below the technical potential. Nevertheless, the overall opportunity to reduce emissions by implementing a REDD+ mechanism remains significant. All models consulted in this study suggest significant emission reduction from RED(D+) compared to a business-as-usual scenario (Busch 2009; Pacala and Socolow 2004; Stern 2006; Eliasch 2008). The variability of mitigation among various REDD scenarios is much smaller than without REDD at all. While the market effects of REDD credit supply have to be carefully managed, there is clear potential to reduce billions of tons of future GHG emissions through REDD and REDD+. The challenge rests with designing a REDD framework that relies on robust reference levels, ensures a sufficient global price for forest carbon, and appropriate incentives for a diverse set forest nations under different national and ecological conditions.

Global Data

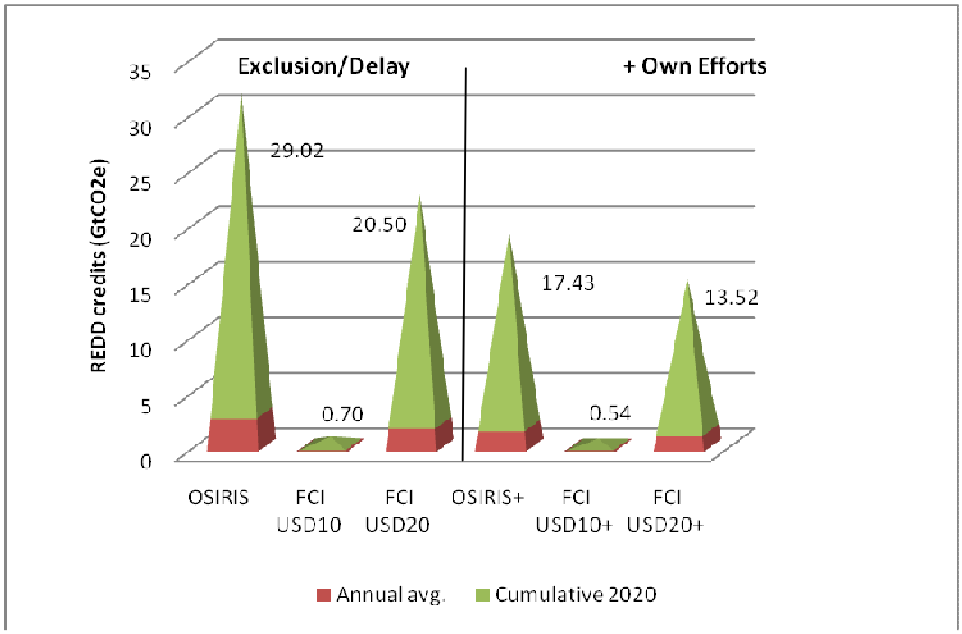
The scenarios modelled in this study indicate a REDD credit supply well below the technical potential from REDD and REDD+. After correcting the models for expected delays of countries in entering a REDD scheme and a discount on fungible credits reflecting national 'own efforts,' OSIRIS credit volumes were 40% lower, and FCI volumes

1 The full reference to REDD in current UNFCCC texts includes enhancement of forest carbon stocks, sustainable forest management and conservation, in total referred to REDDplus or REDD+. The scope of REDD is not subject of this study, but it is understood that references to REDD in the context of the UNFCCC refer to the full set of agreed incentive mechanisms and eligible activities. The models used in this study are limited however to REDD (OSIRIS v3.0) and to REDD and afforestation/reforestation (Forest Carbon Index).

were 70% (USD10) and 46% (USD20) below the technical potential.[2] Delays in entering an international REDD+ scheme were constructed basted on World Bank governance indicators, which serve as a proxy to estimate a country's ability to adopt policies and prepare institutions to support REDD+. The fact that some REDD countries may not be able or willing to convert all GHG reductions from REDD into compliance-grade REDD credits was taking into consideration by applying general discount factors. While the results produced by our analysis are loaded with insecurities, they still suggest that feasible volumes of REDD credits should be discounted heavily from technical potential estimates to reflect achievable and realistic volumes. The literature review identified a REDD emission reduction potential between 1.6 GtCO2e emission reductions per year (USD10) and 2.5GtCO2e emission reductions per year (USD20), ranging as high as 4.3 GtCO2e (USD100). However, we estimate feasible REDD credit to be much lower: 54 million tCO2e (FCI) and 1.74 billion tCO2e (OSIRIS) per year at prices of 5-10USD. In the case of the FCI at USD5, the estimated REDD+ credit supply was as little as 3% of the expected technical potential.

However, this pattern did not hold at higher prices. At USD10-20, both the FCI and OSIRIS models generated comparable annual estimates of feasible emission reduction volumes (1.35 GtCO2e for FCI and 1.74 GtCO2e for OSIRIS), about half the technical potential as mentioned earlier.[3] These results are displayed in the figures below. Ultimately, the actual supply of compliance-grade REDD credits may be even lower since these estimates do not consider delivery risk, the potential for policies and activities to underperform. The effectiveness of various policies, firms, governments and techniques must be tested and it is reasonable to expect that a significant fraction will not succeed, further reducing potential REDD credit supply to international carbon markets.

Figure 1: Annual and cumulative REDD(+) credits in OSIRIS & FCI models (2011-2020)



[2] This assumes that both screens for readiness and own efforts are applied.

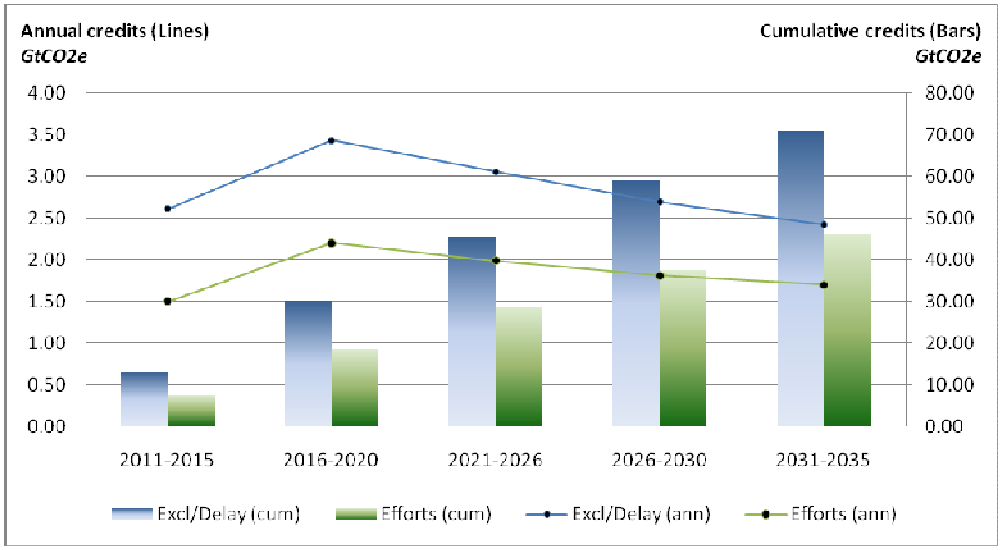
[3] Prices: USD20 (FCI); USD5-USD10 over time for OSIRIS; FCI also includes afforestation/reforestation.

Table 1: Annual and cumulative emission reductions (GtCO2e) under different screens

	Model	Annual avg [4]	Cumulative 2020[5]	Cumulative 2035
OSIRIS	Delay /Elim.	2.90	29.02	67.98
	+ Own Efforts	1.74	17.43	43.11
FCI (USD10)	Delay /Elim.	.70	7.01	--
	+ Own Efforts	.54	5.39	--
FCI (USD20)	Delay /Elim.	2.0	20.50	--
	+ Own Efforts	1.35	13.52	--

1 billion tCO2e (GtCO2e) = 1,000 million tCO2e

Figure 2: REDD credit supply trajectory (OSIRIS; 2011-2035)



While the price of carbon is a dominant variable in estimating feasible emission reductions, the variability appears to be the result of three underlying factors:

1. Differences in the estimated country-level costs to prevent deforestation, especially at low prices. This may be the result of better country-specific data in the FCI; OSIRIS relies on national averages to gauge carbon density and forest cover.
2. Systematic assumptions that entail higher costs to generate REDD credits (e.g. 'built-in' factors such as transaction costs); the FCI may assume that costs are higher per GHG emission reduction which reduces the actual GHG emissions mitigation.
3. Potential correlation between forest carbon density and opportunity cost. For example, if a parcel has more above-ground biomass (trees and vegetation), this could imply higher returns from timber and agriculture – and a higher financial

4 The OSIRIS model includes annual deliveries. Average annual figures are for the 2011-2020 period; averages for Scenarios 1 and 2 are higher during the 2011-2035 period (2,719 and 1,724 tCO2e).

5 2 years of ER added to reflect comparable modelling period with OSIRIS

hurdle to generate credits. OSIRIS' reliance on national averages potentially could obscure a higher opportunity cost with higher biomass areas.[6]

Country-level

About half of feasible modelled emission reductions are projected to be supplied by Brazil and Indonesia, which makes the estimates highly sensitive to the respective policies and their implementation success in these two countries. The table below, and similar data from the FCI, illustrate the distribution of emission reductions among countries. A more elaborate analysis of country-level data was not possible given the time and data constraints.

Table 2: OSIRIS country results: Five largest credit suppliers (annual, million tCO_2e)

Exclusion/Delay screen		Own Efforts screen	
Brazil	1,596	Brazil	798
Indonesia	849	Indonesia	593
Zambia	84	Zambia	84
Cameroon	60	Bolivia	48
Bolivia	58	Cameroon	46
Average annual	448		272
Total (5 countries)	2,240		1,360
Total (All) annual	2,901		1,743

Analysis

The most instructive insights from our study can be summarized as follows:

- Assumptions around political and technical constraints – not biophysical potential – primarily drive the results.[7] Major constraints on market supply relate to countries' entrance into the REDD market according to their capacity and willingness to supply REDD credits, not just the technical potential of forests to reduce emissions. As a result, the estimates produced by this study reflect 'realistic' market supply, not maximum potential forest sector emission reductions.[8]

[6] Preliminary studies show that this is not true in humid rainforests of at least one country – Brazil -- although little empirical evidence exists in other contexts (Cattaneo 2009).

7 The FCI neither calculates annual/periodic credit volumes nor models beyond 2020.

[8] The estimates of 'realistic' credit supply by different countries reflect judgements about countries' future capacity and willingness to supply credits. However, focusing international support on building capacity in countries where capacity is currently weaker could increase the volume of credits supplied from these countries. It is also important to note that estimates relate to credits supplied under a *market-based* REDD financing mechanism; we would expect countries that need longer to build the capacity required to generate market-compliant REDD credits would still benefit from international REDD finance.

- At low price points, perhaps below USD10, there is the risk of significantly reduced supply (53 million credits annually, according to FCI, and 530 million cumulatively up to 2020).[9] Given the inherent uncertainties, it is important to note the clear difference in credit supply associated at low and high prices, rather than the exact price point. The model with the most localized costs and carbon datasets (FCI) suggests higher costs per ton of emission reductions, and a relatively high price threshold (>10USD), to generate credits on a globally-significant scale.

- REDD credit supply will depend on the ability of a country to adopt policies and put in place incentives that lead to forest protection and sustainable forest management. Policy failures will further reduce the volumes of compliance-grade REDD+ credits. Our results do not take into account delivery and policy failure risk; additional discounts may therefore apply.

- Other factors may result into an increase of the supply of REDD credits to international carbon markets, in particular the (i) consideration of emission removals from afforestation/reforestation (A/R) and sustainable forest management (SFM); the (ii) supply of REDD credits to carbon markets by sub-national activities before country reference levels have been adopted. In particular the fact that the models consulted fail to consider broader forestry emission reductions and removals beyond avoided deforestation introduces major insecurities. Project Catalyst estimates REDD potential from all forest sector activities including A/R and SFM may yield up to 1.2 GtCO2e per year (Project Catalyst 2009a). The consideration of REDD credit supply from sub-national schemes could further increase the overall and early supply of credits as it would allow countries to generate offsets while still building institutions to fully participate in the market.

- The feasible REDD credit supply is well below the technical potential from REDD. However, the overall opportunity to reduce emissions by implementing a REDD mechanism is likely a central approach to cost-effective climate mitigation before 2050.

- The absolute figures in this study entail a great deal of uncertainty. As with all models, figures should not be taken as precise estimates but frame the potential values given the technical and political assumptions. As datasets improve and experience with these activities grows, figures will also improve.

[9] The FCI model assumes a starting point of 2013; Two years of additional credit delivery volumes were assumed to make the figures comparable with the OSIRIS model which begins in 2011.