Including High Forest, Low Deforestation Countries in a UNFCCC REDD Mechanism

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HFLD Side Event

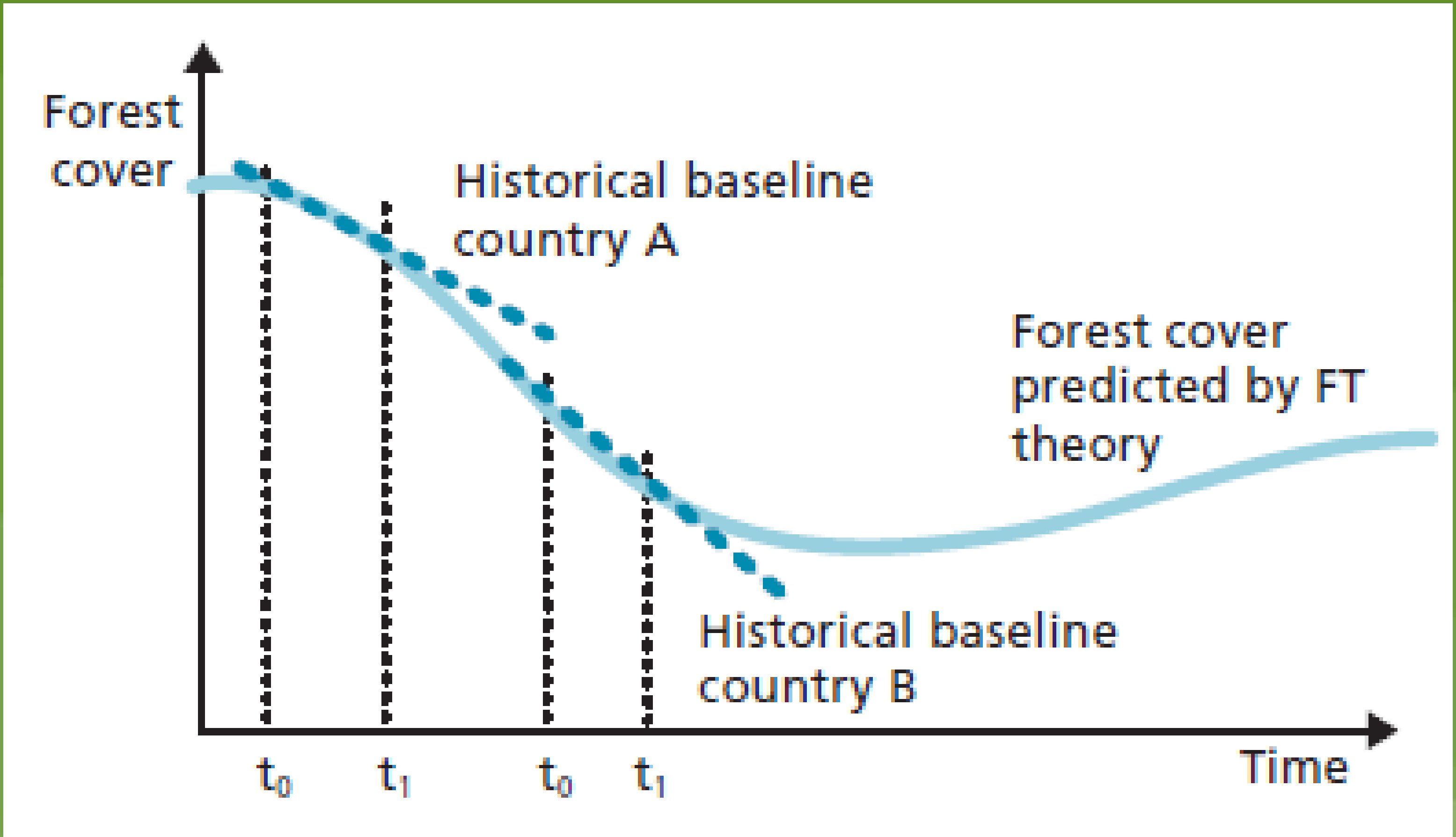
AWG-LCA, Barcelona, Spain, November 3, 2009

HFLD: High Forest Low Deforestation

No Forest Left Behind ***PLoS Biology*** **(da Fonseca et al., 2007)**	**Norway Options Assessment Report** **(Angelsen et al., 2009)**	**Nature Conservancy / TerraCarbon** **(Griscom et al., 2009)**
>50% Forest; <0.22% Deforestation	>50% Forest; <0.50% Deforestation	>85% Forest <0.10 Deforestation
13% of REDD-eligible forest carbon	27% of REDD-eligible forest carbon	8% of REDD-eligible forest carbon
Belize	Belize	Belize
Bhutan	Bhutan	
	Bolivia	
Colombia	Colombia	
Congo	Congo	
	D.R. Congo	
Gabon	Gabon	Gabon
	Guinea-Bissau	
Guyana	Guyana	Guyana
	Laos	
Panama	Panama	
	Papua New Guinea	
Peru	Peru	Peru
Republic of Korea	Republic of Korea	
Suriname	Suriname	Suriname

Forest Transition Curve

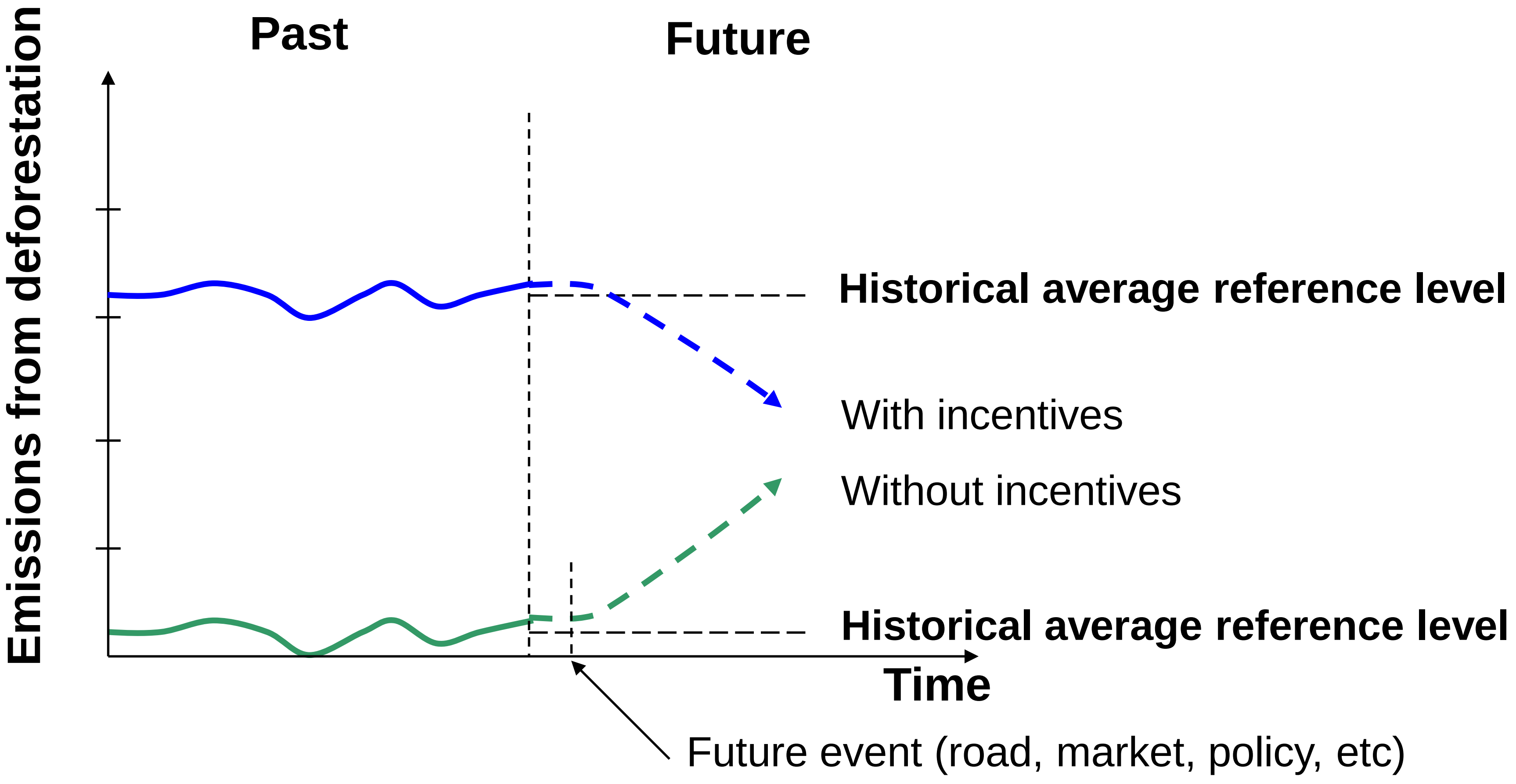
Source: Angelsen et al, 2009



- **Historical baselines underpredict BAU in high forest countries (A)**
- **Historical baselines overpredict BAU in low forest countries (B)**

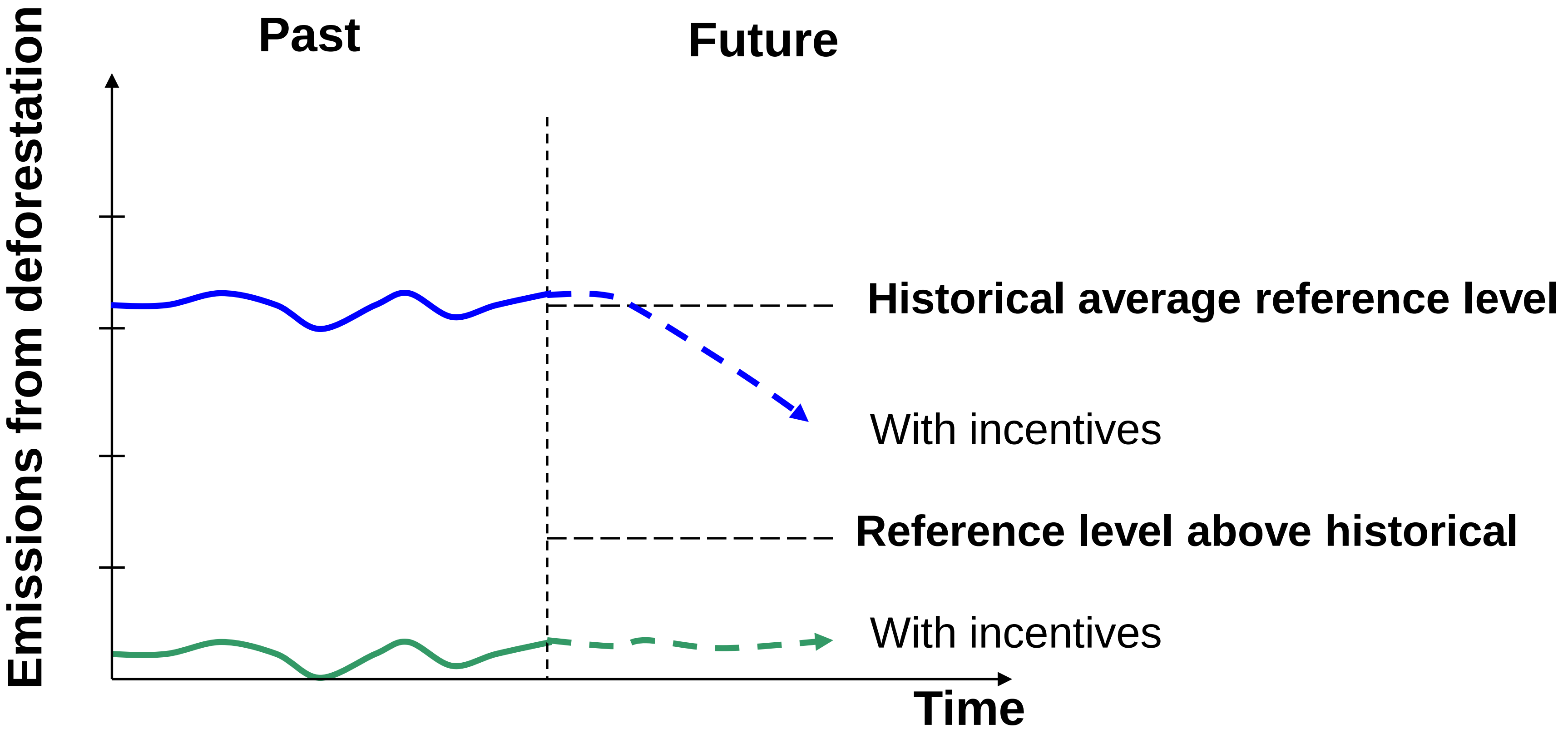
Mather, A.S. (1992). The forest transition. *Area*, 24(4):367-379.

Historical average reference levels provide no incentive to maintain low deforestation emissions



Higher than historical reference levels provide incentives to keep emissions low

(Santilli *et al*, 2005; Mollicone *et al*, 2007)



REDD design proposals

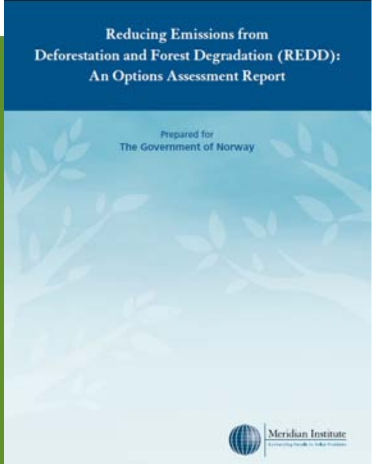
Design	Citation	Description
Without REDD	FAO FRA (2005)	Counterfactual business as usual scenario
National historical reference levels	Santilli *et al* (2005)	Reduction credits only
Elevated reference levels for countries with low deforestation rates	Mollicone *et al* (2007); da Fonseca *et al* (2007)	Stabilization credits in addition to reduction credits
Reference level is weighted average of national and global rate	Strassburg *et al* (2008)	Stabilization credits funded by fewer reduction credits
Flow withholding and stock payment	Cattaneo *et al* (2008)	Stabilization credits funded by withholding reduction credits
Annualized fraction of forest stock at risk of emission	Ashton *et al* (2008)	Credits for reduction below forward-looking reference level
Cap and trade for REDD	Eliasch (2008)	Countries above cap must purchase credits; countries below cap may sell credits

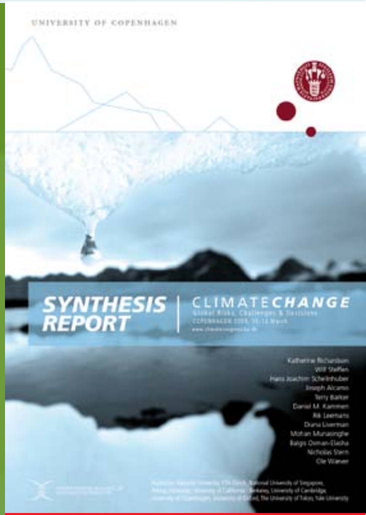
Open Source Impacts of REDD Incentives Spreadsheet (OSIRIS)

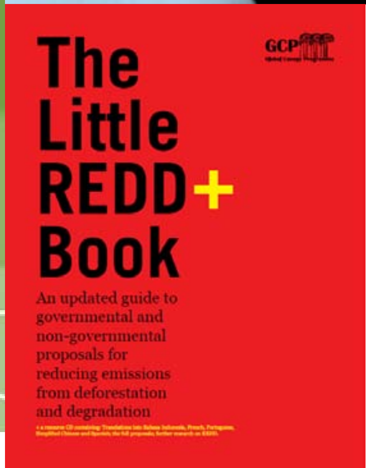
Busch, J., Strassburg, B., Cattaneo, A., Lubowski, R., Bruner, A., Rice, R., Creed, A., Ashton, R., Boltz, F. (2009). Comparing climate and cost impacts of reference levels for reducing emissions from deforestation. *Environmental Research Letters*, 4:044006

- **84-country partial equilibrium model for agriculture and one-time timber produced on one hectare of tropical frontier land ("frontier agriculture")**
- **Incorporates national incentives to reduce deforestation emissions, and international leakage**
- **National supply curves calibrated using best available global data on agricultural and timber returns, carbon density, forest cover and forest cover change**
- **Outputs: country-by-country deforestation (Ha/yr), emissions (ton CO_2e/yr), revenue ($/yr), cost-efficiency of emissions reductions ($/ton CO_2e)**

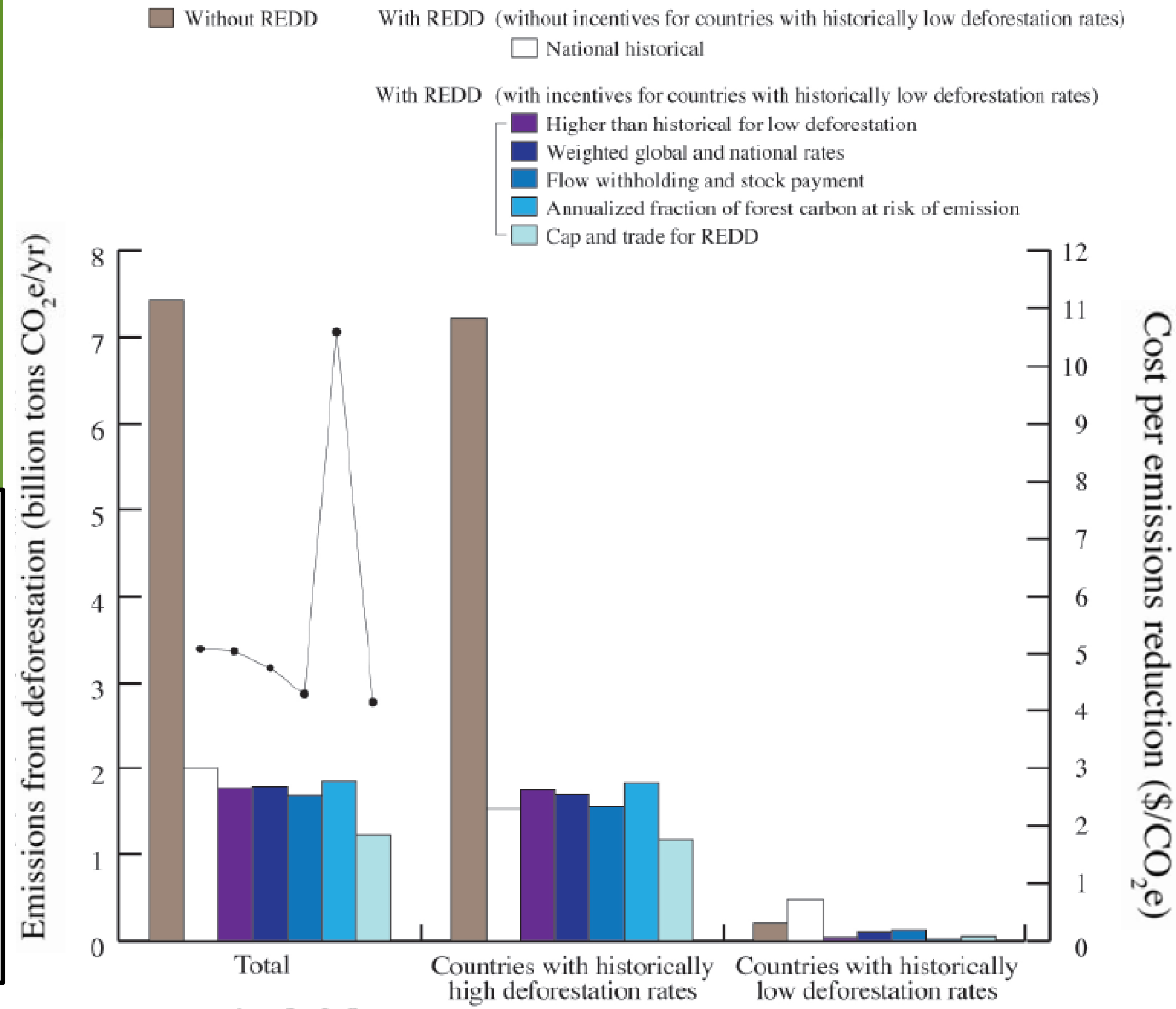
- **Caveat: Model designed to compare climate and cost impacts across REDD+ designs, rather than to predict absolute magnitude of impacts**







The most effective REDD designs balance incentives for reducing high deforestation, maintaining low deforestation



OSIRIS v2.6 Parameter values: CO_2 price=$5/ton CO_2; Permanence scale=1.00; Elasticity of demand=1.0; Social preference for REDD surplus = 1.00; Mgmt cost=$3.50/Ha/yr; Soil carbon eligible=0.25; Baseline for low defor=0.0015; Weight on historical=0.85; Stock-flow withholding=0.15; Low defor emitted by: 2100; High defor emitted by: 2050

REDD finance for Suriname

(GDP = $2.2 billion/year, World Bank, 2007)

Design	Estimated REDD payment ($million/year)
Without REDD	$0
National historical reference levels	$0
Elevated reference levels for countries with low deforestation rates	$72
Reference level is weighted average of national and global rate	$42
Flow withholding and stock payment	$37
Annualized fraction of forest stock at risk of emission	$482
Cap and trade for REDD	$0

OSIRIS v2.6 Parameter values: $C0_2$ price=$5/ton CO_2; Permanence scale=1.00; Elasticity of demand=1.0; Social preference for REDD surplus = 1.00; Mgmt cost=$3.50/Ha/yr; Soil carbon eligible=0.25; Baseline for low defor=0.0015; Weight on historical=0.85; Stock-flow withholding=0.15; Low defor emitted by: 2100; High defor emitted by: 2050

AWG-LCA Non-Paper No. 18

Option 1: include [reducing emissions from deforestation and forest degradation [, maintaining existing carbon stocks and enhancing removals] [or increasing forest cover through afforestation and reforestation], [while promoting] [enhancement of carbon stocks through [sustainable forest [and land] management] [sustainable management of forests].]

FCCC/SBSTA/2009/L.9

[Recognizes that [developing countries, when establishing] [methodologies to establish] [national] reference emission levels and reference levels [should] take into account, [inter alia,] national circumstances; respective national capabilities and capacities; historical data; [if necessary adjustments for expected future emission trends]; relevant socio-economic factors; drivers of deforestation; and existing domestic legislation, policies and measures [, or those under development], as appropriate;]

Key Messages

- 8-27% of forest carbon is in HFLD countries
- Continued low deforestation emissions by HFLD countries is not guaranteed in the absence of financial incentives
- A REDD mechanism provides greatest climate mitigation benefits by balancing incentives to reduce high rates of deforestation emissions with incentives to stabilize low rates of deforestation emissions
- A balanced REDD mechanism with adequate, sustainable finance would enable HFLD countries like Suriname to pursue low carbon development pathways

Thank you!

www.conservation.org/osiris

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The case for REDD

- Deforestation causes ~17% of global GHG emissions (IPCC AR4)
- Can't meet +2.0 °C target without REDD (Eliasch, 2008; Warren *et al*; Sawin *et al*)
- Low cost mitigation from REDD (Naucler and Enkvist, 2009) means world can meet stronger targets at lower cost with REDD than without REDD+ (Boucher, 2008)
- REDD is one "stabilization wedge" (Pacala and Socolow, 2004) which is available now, but won't be available later

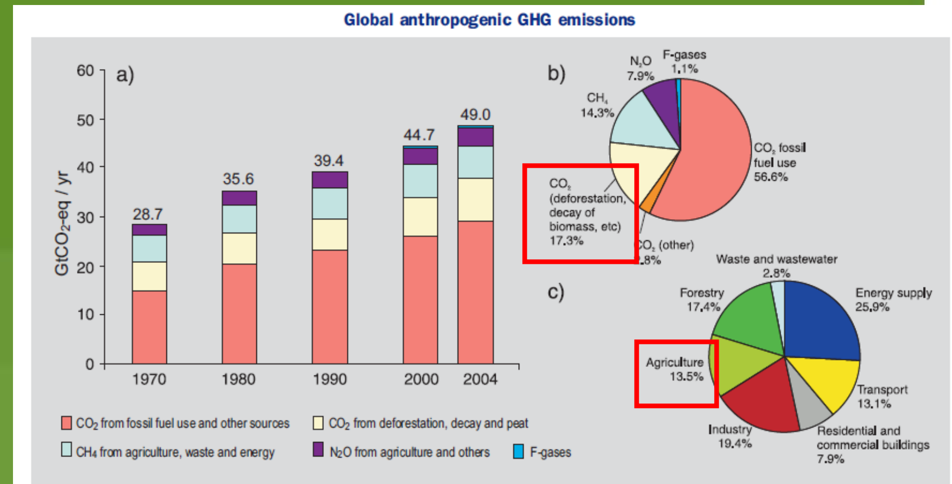
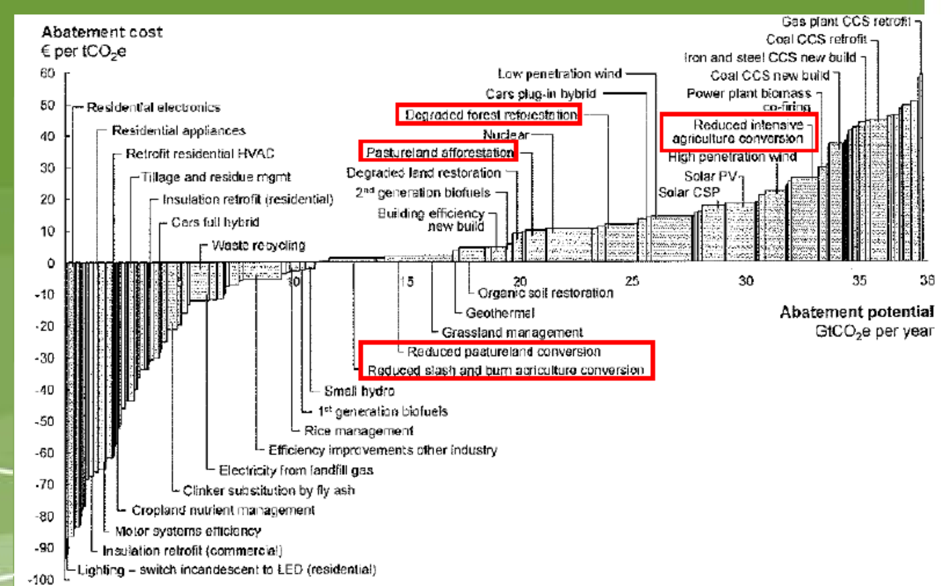


Figure SPM.3. (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004.[5] (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of carbon dioxide equivalents (CO_2-eq). (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO_2-eq. (Forestry includes deforestation.) {Figure 2.1}

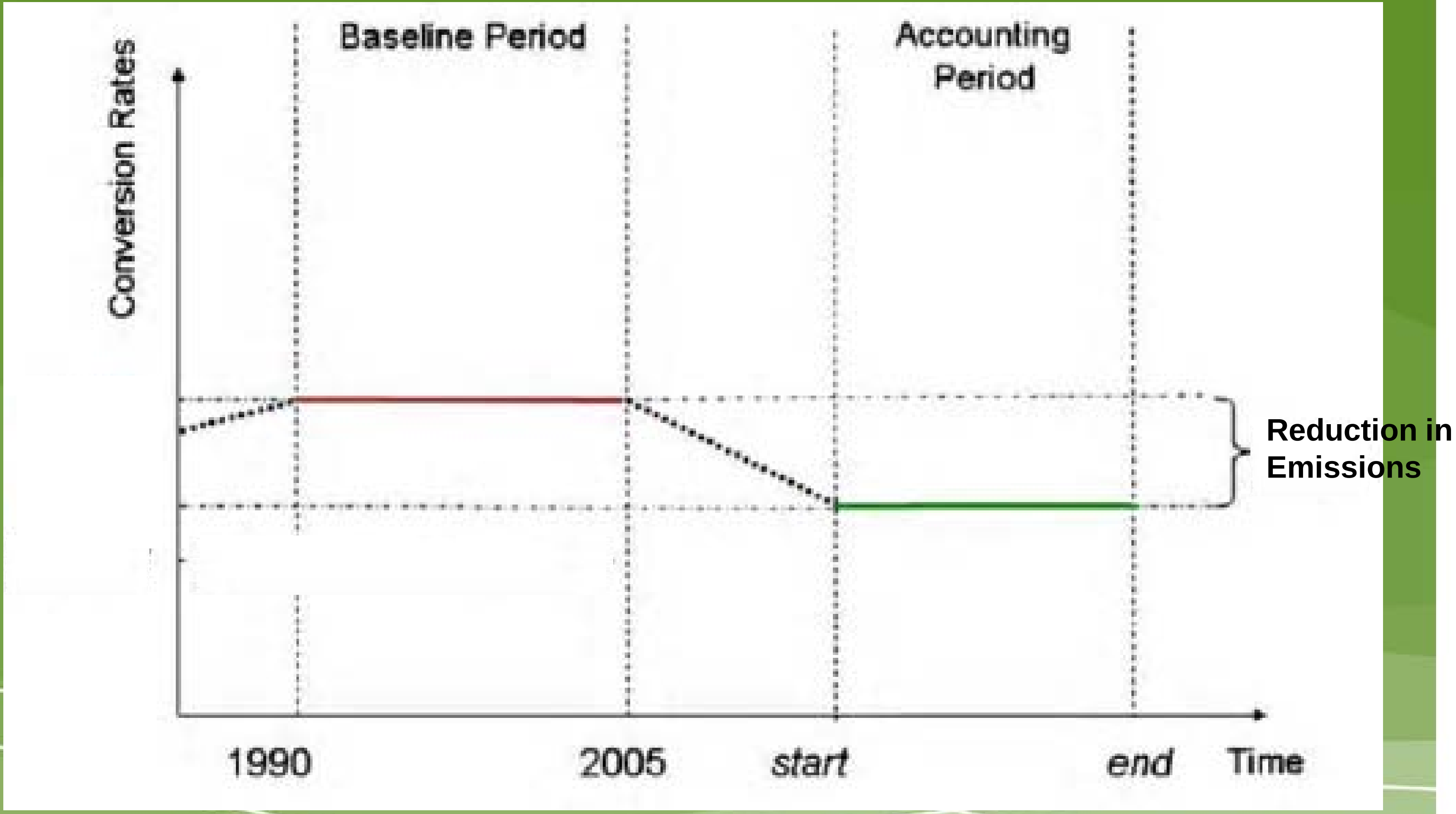


Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO_2e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.
Source: Global GHG Abatement Cost Curve v2.0

REDD+ design issues

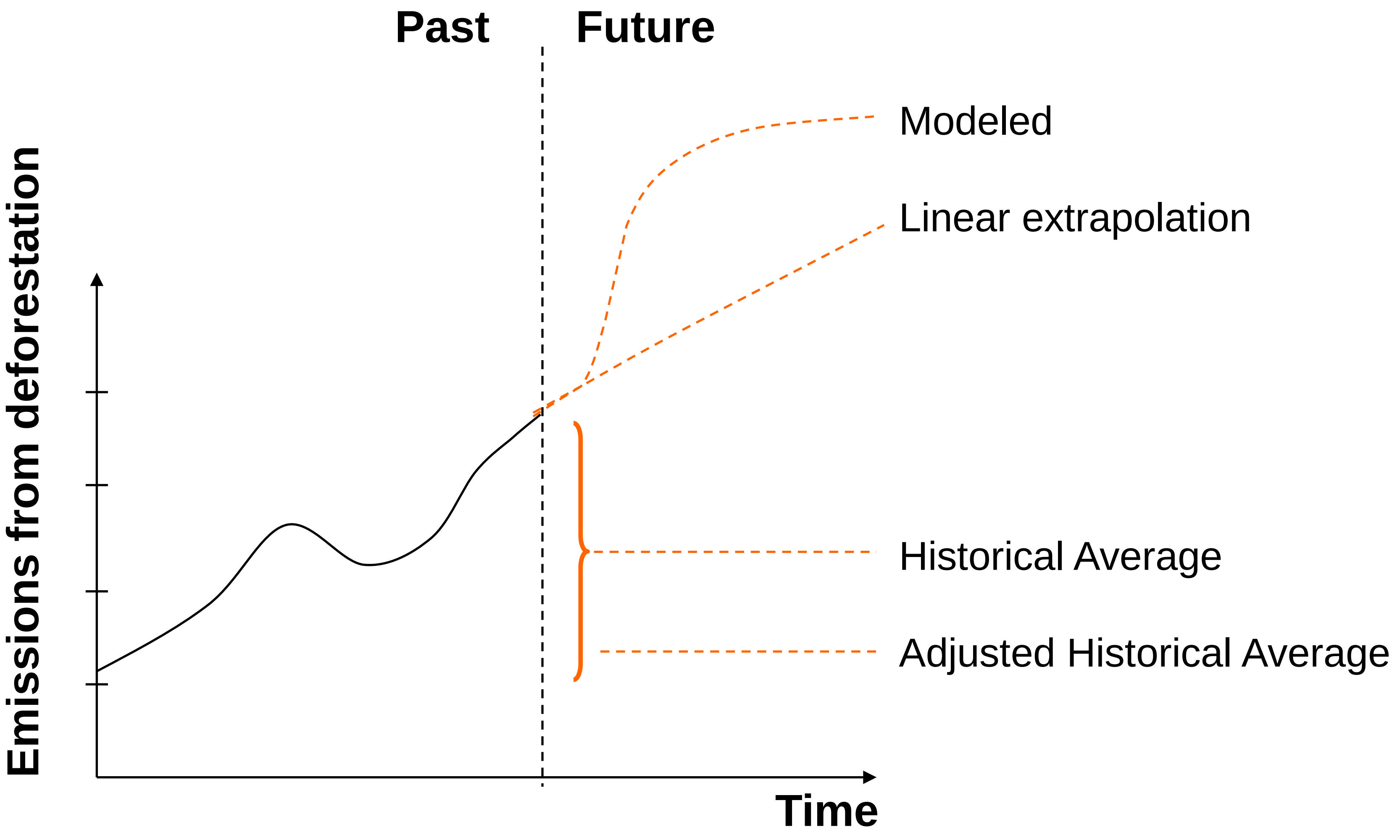
- Monitoring, reporting and verification
- Permanence and liability
- Inclusion of indigenous peoples and local communities
- Reference levels

Reference levels: Positive incentives only; *not* cap-and-trade!

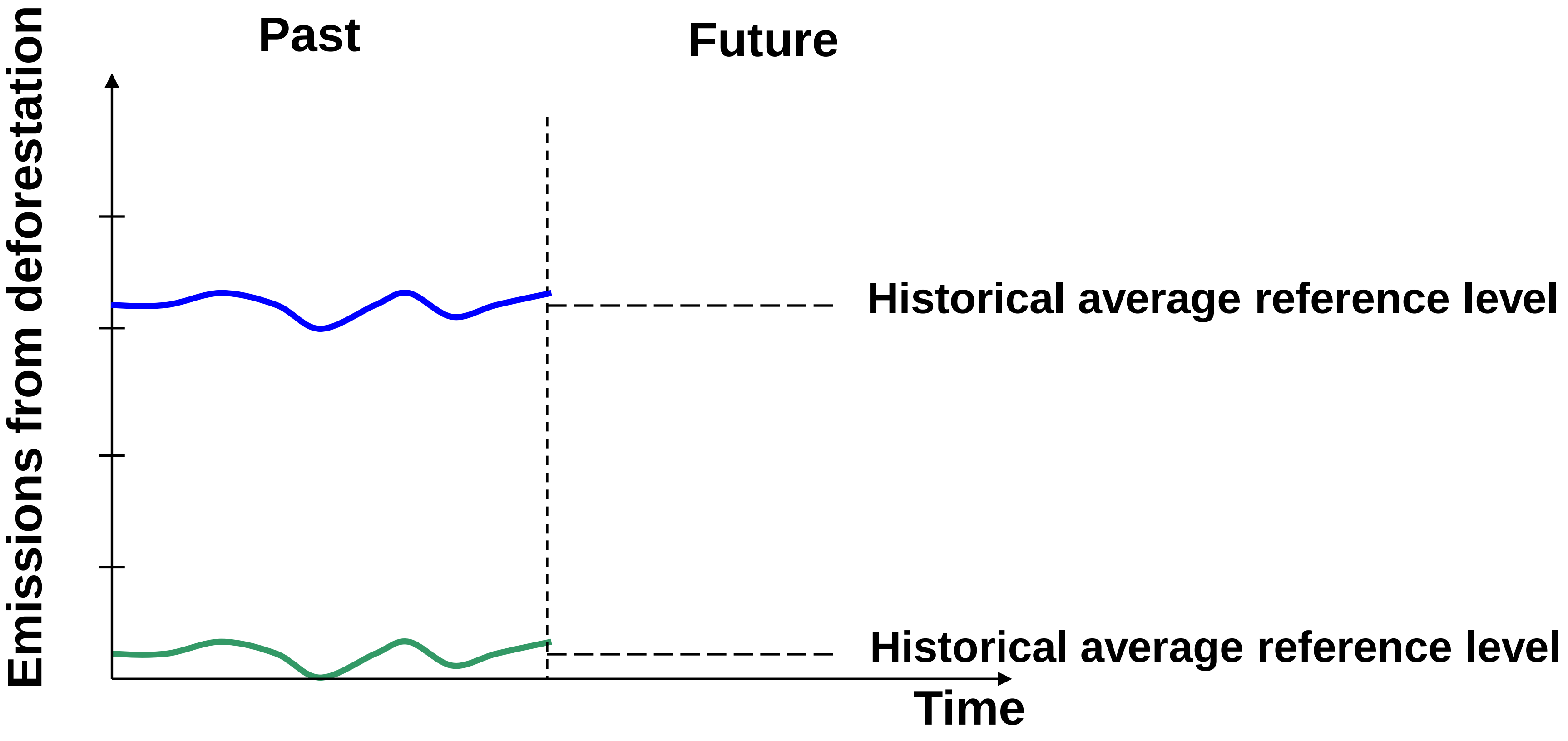


Source: Mollicone *et al*, 2007

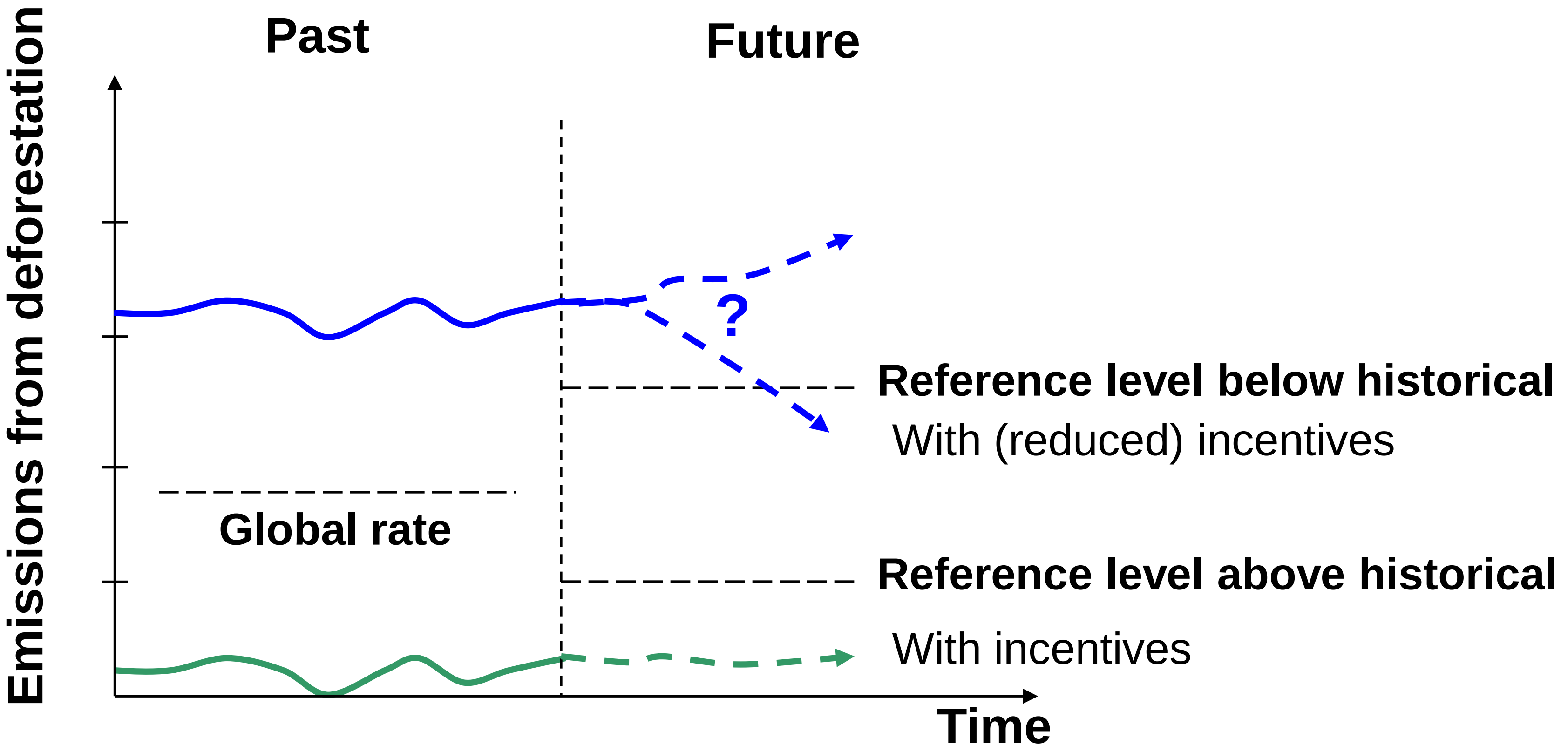
How to determine reference level?



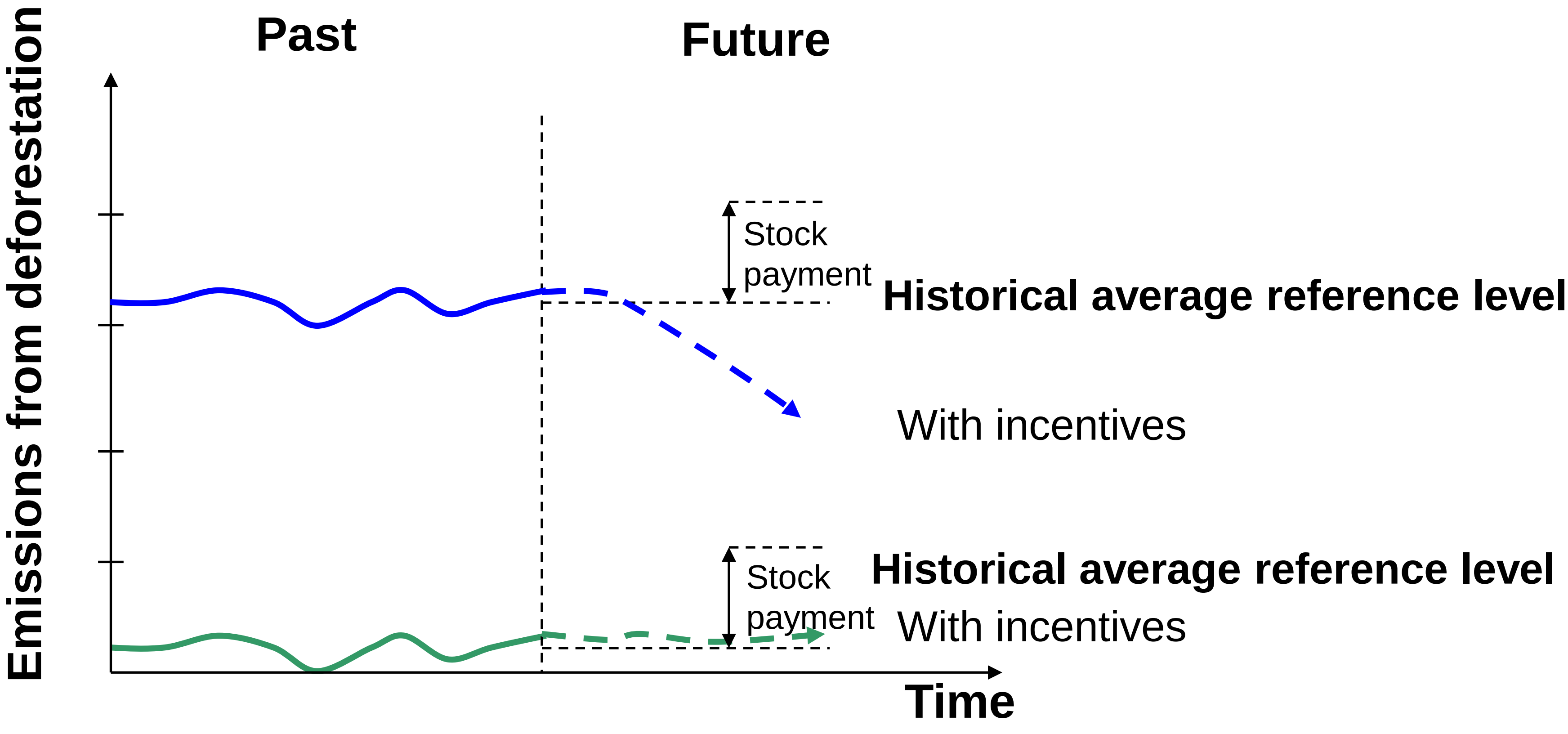
National historical reference levels (Santilli *et al*, 2005)



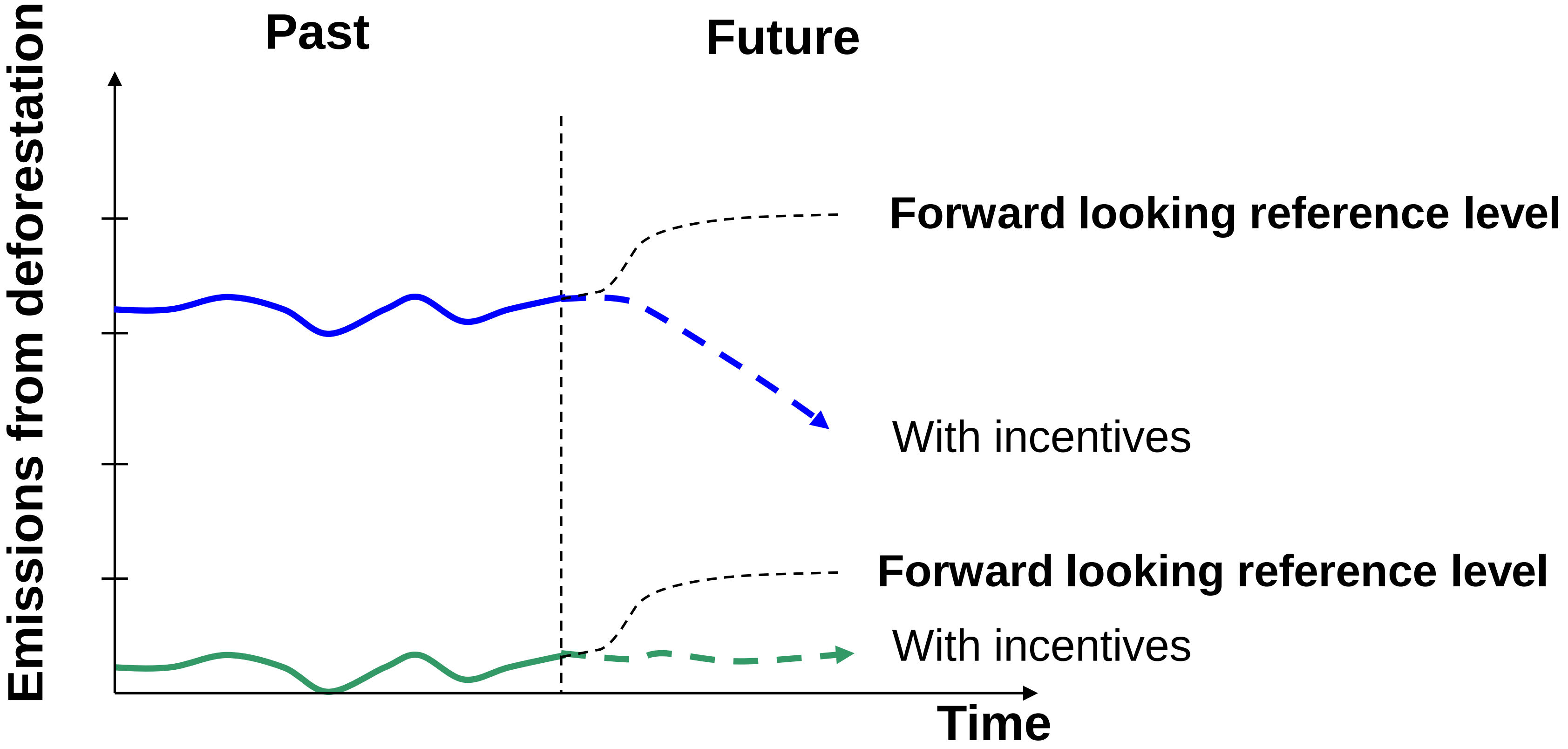
Reference levels that weight national and global historical rates (Strassburg *et al*, 2009): Less incentive to reduce high deforestation rates



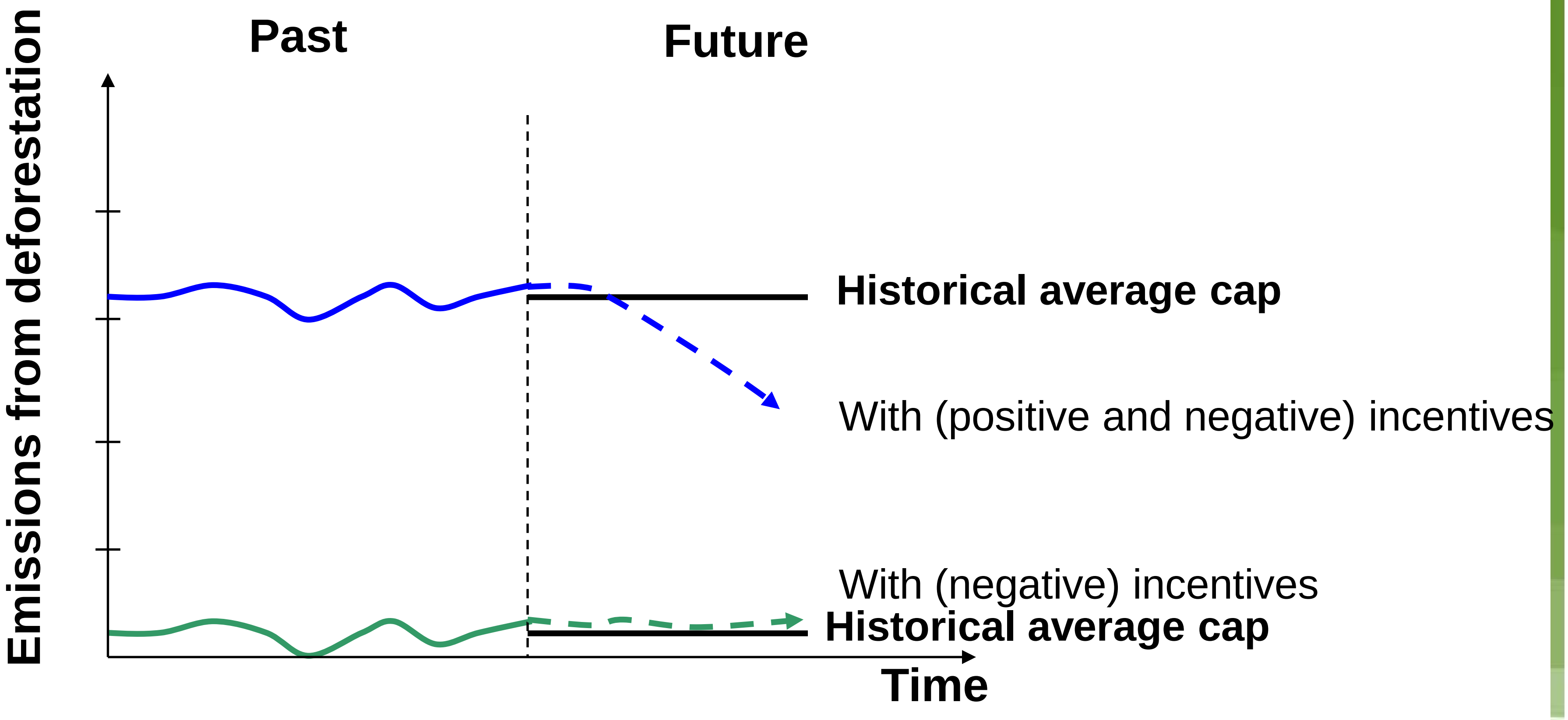
Flow withholding and stock payment (Cattaneo, 2009)



Reference level is uniform fraction of at-risk stock (Ashton *et al*, 2008)



Cap and trade for REDD (Eliasch, 2008)

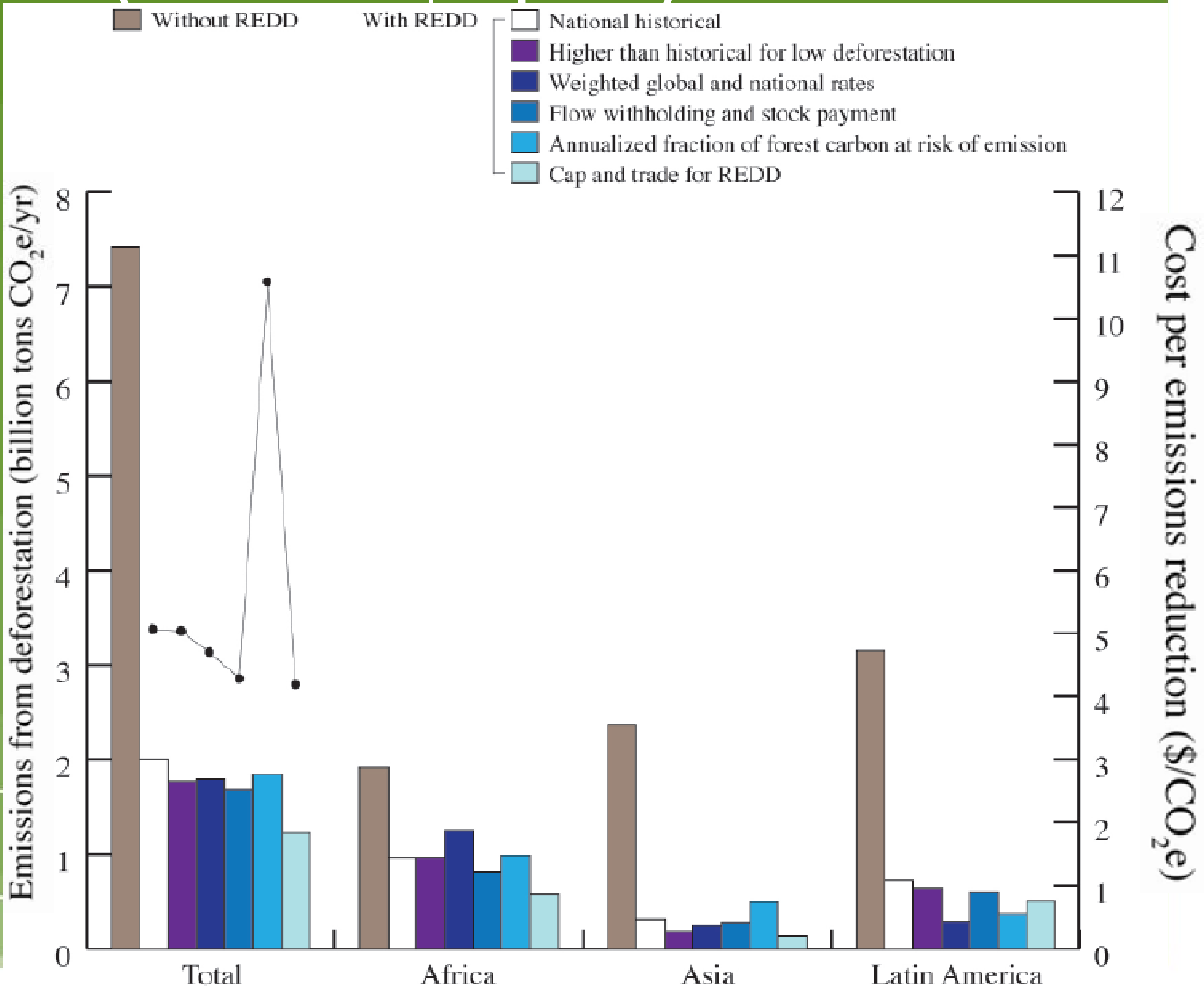


OSIRIS flexible inputs

- Reference level design
- Carbon price ($/ton CO_2)
- Management cost and transaction cost ($/Ha or $/ton CO_2)
- Fraction of soil carbon eligible for REDD+
- Market, fund, or quota
- Timing of payment
- Suite of countries participating in REDD+
- Base period ('90-'00 or '00-'05)
- Responsiveness of price of frontier land agricultural output to changes in extent of deforestation ("price elasticity of demand")
- Weight of countries' preference for REDD+ surplus vs. agricultural surplus
- Design-specific parameters

REDD+ can be an effective, efficient source of emissions reductions under a broad range of designs (Busch et al, in press)

OSIRIS v2.6 Parameter values: CO_2 price=$5/ton CO_2; Permanence scale=1.00; Elasticity of demand=1.0; Social preference for REDD surplus = 1.00; Mgmt cost=$3.50/Ha/yr; Soil carbon eligible=0.25; Baseline for low defor=0.0015; Weight on historical=0.85; Stock-flow withholding=0.15; Low defor emitted by: 2100; High defor emitted by: 2050



Policy Messages

- REDD can provide effective, cost-efficient climate change mitigation under a a broad range of reference level designs
- The most effective, cost-efficient REDD designs balance incentives for reducing historically high rates of deforestation with incentives for maintaining historically low rates of deforestation
- The overall effectiveness of REDD can be increased by supplying agricultural needs off the tropical forest frontier

- OSIRIS is a free, transparent, accessible open-source decision support spreadsheet tool designed to support UNFCCC negotiations on REDD:

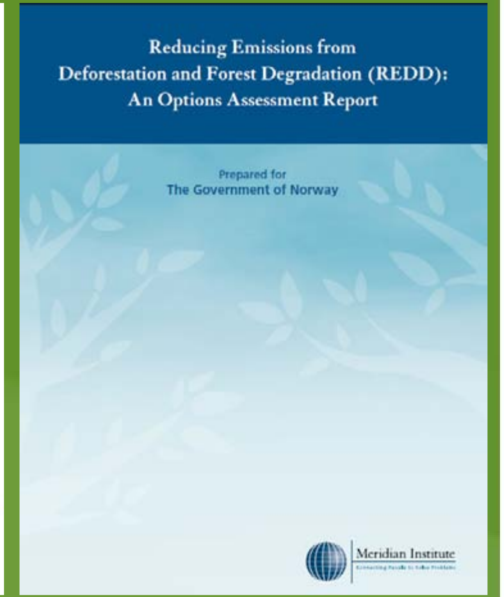
http://www.conservation.org/osiris

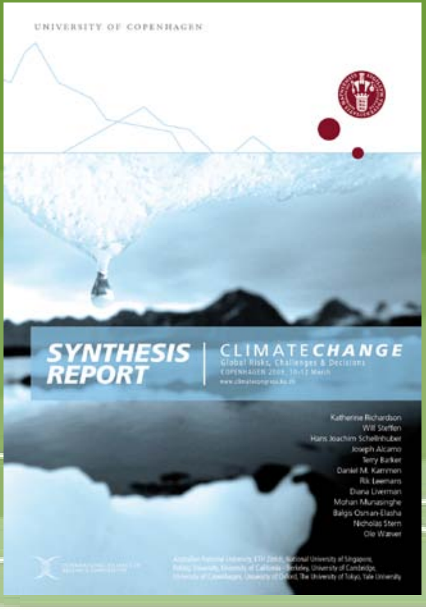
Selected Policy Engagement

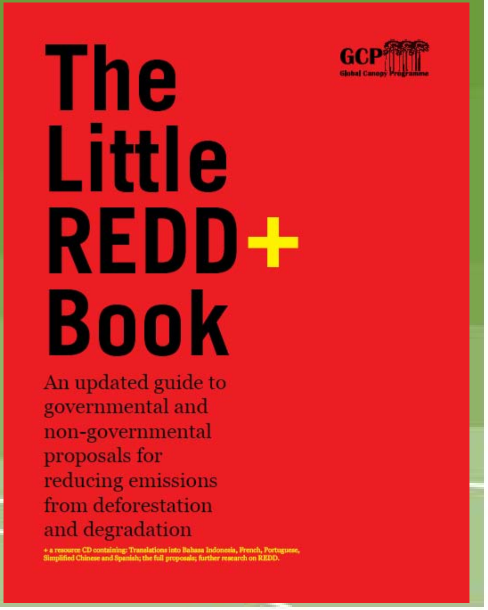
- UNFCCC
- U.S. State Department
- U.S. EPA
- Government of Denmark
- Government of Guyana
- Government of Indonesia
- Government of Norway
- Government of Peru
- Central African Governments
- Informal Working Group on Interim Finance for REDD
- Global Environment Facility
- IARU Synthesis Report
- Little REDD+ Book

Comparing climate and cost impacts of reference levels for reducing emissions from deforestation

Jonah Busch, Bernardo Strassburg, Andrea Cattaneo, Ruben Lubowski, Frederick Boltz, Ralph Ashton, Aaron Bruner, Richard Rice and Anna Creed







Next steps for reference level research

- REDD designs of interest to parties
- Equity
- Impacts to 2050
- Phased readiness
- Co-benefits of REDD: Poverty alleviation, biodiversity, clean water
- Leveraging REDD for biodiversity
- Downscale to Brazil, Indonesia, Madagascar…

CI’s vision and mission

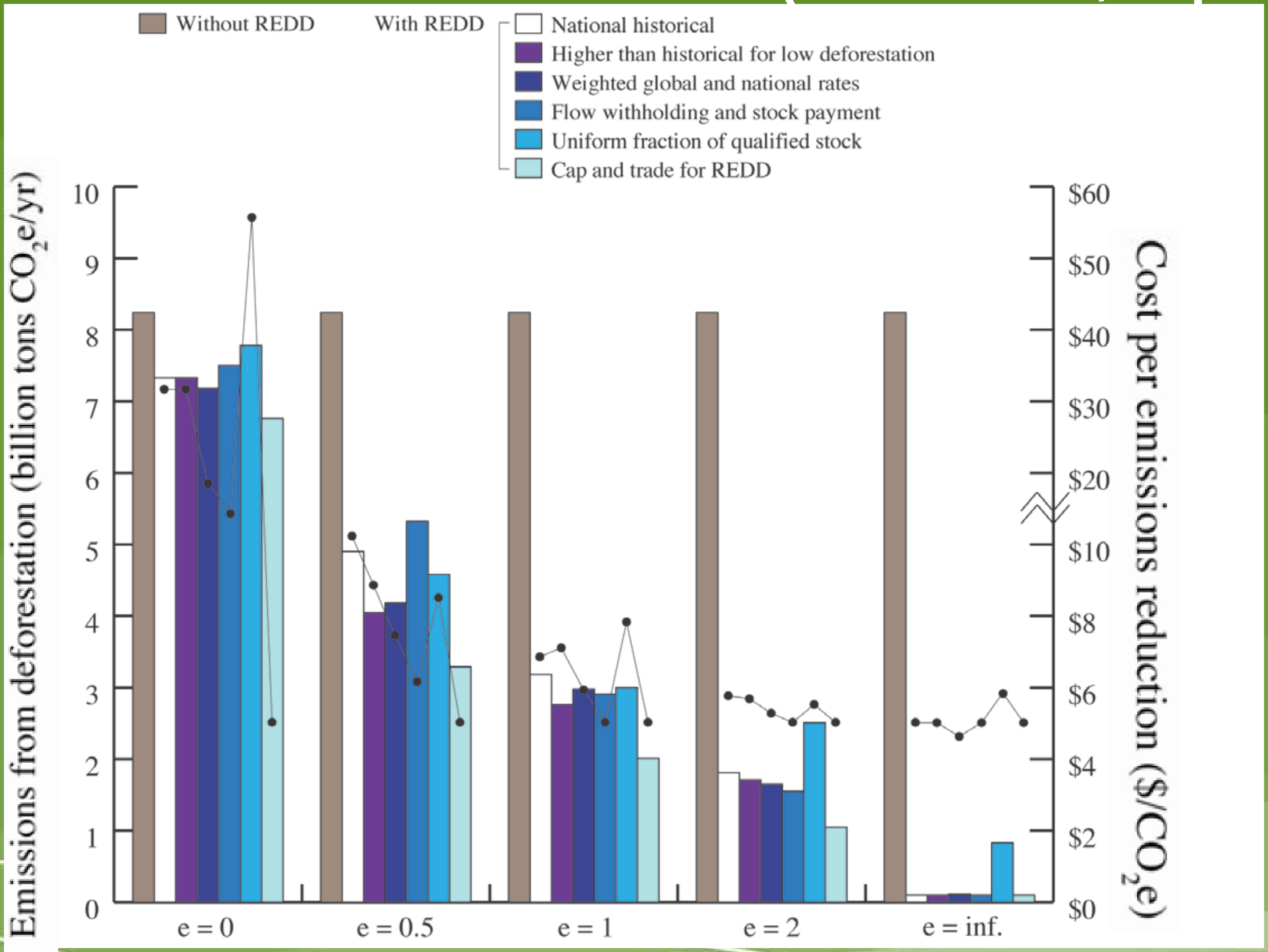
- **CI’s Vision**

  We imagine a healthy prosperous world in which societies are forever committed to caring for and valuing nature for the long-term benefit of people and all life on Earth.

- **CI’s mission**

  Building upon a strong foundation of science, partnership and field demonstration, CI empowers societies to responsibly and sustainably care for nature for the well-being of humanity.

REDD+ effectiveness can be increased by meeting agricultural needs off the frontier (Busch et al, in press)



OSIRIS v2.0 Parameter values: CO_2 price=$5/ton CO_2; Permanence scale=1.00; Elasticity of demand=1.0; Social preference for REDD surplus = 1.00; Mgmt cost=$3.50/Ha/yr; Soil carbon eligible=0.25; Baseline for low defor=0.003; Weight on historical=0.40; Stock-flow withholding=0.40; At-risk land=0.80; Baseline as % of at-risk land=0.10

Distribution of payments to countries depends on reference levels

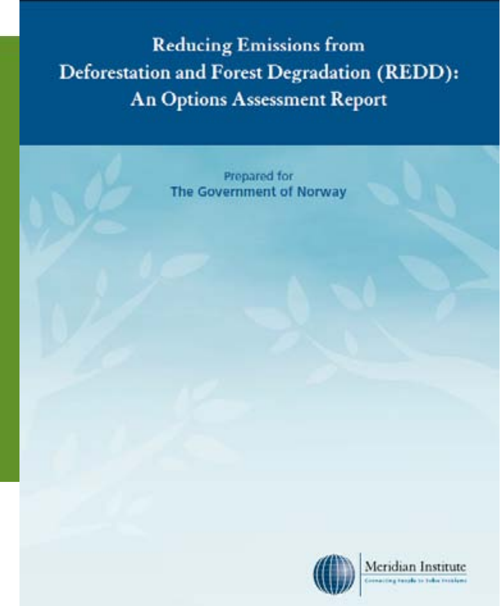
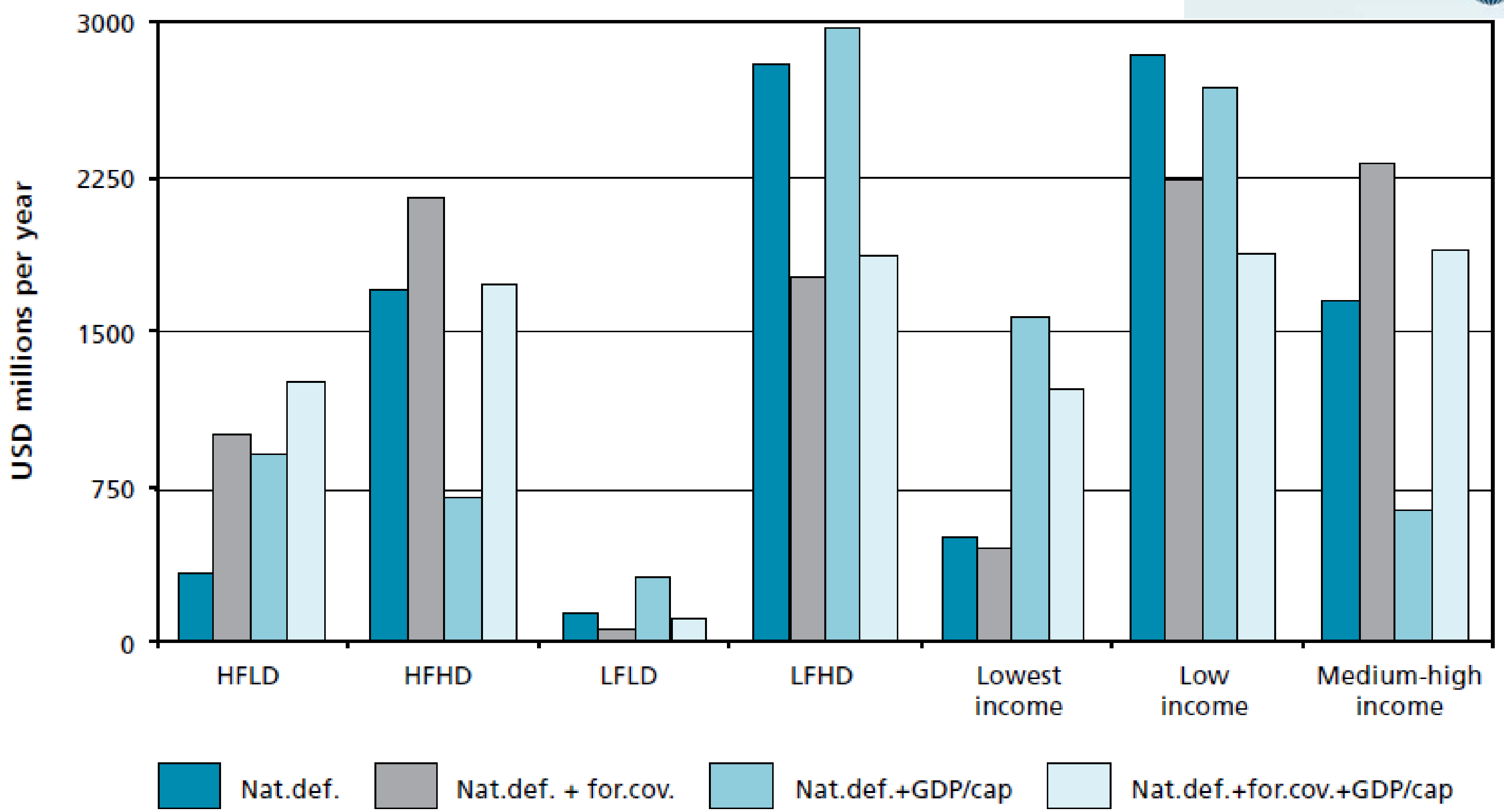
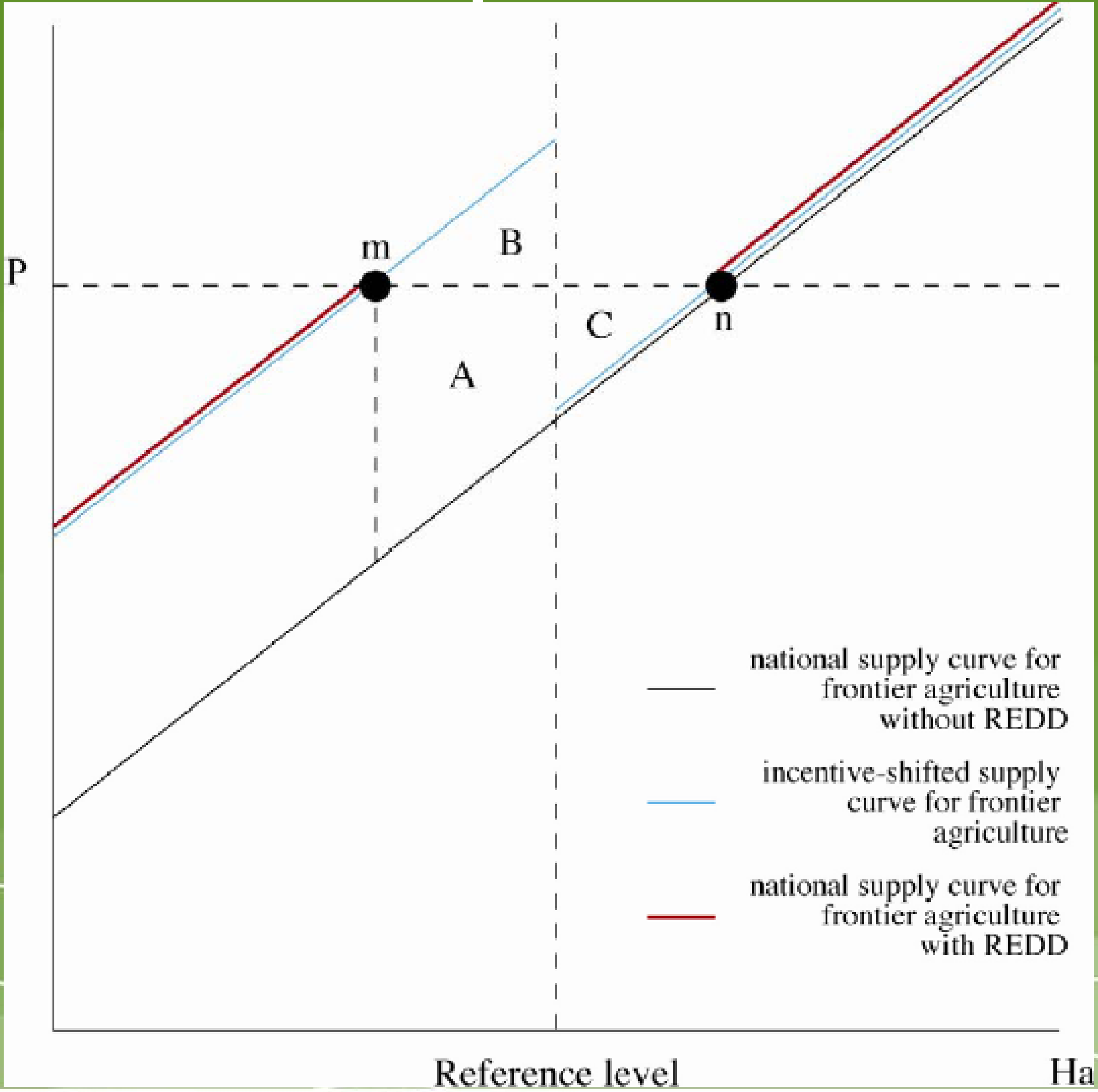


Figure 3.2 REDD transfers to groups of countries under different RL options



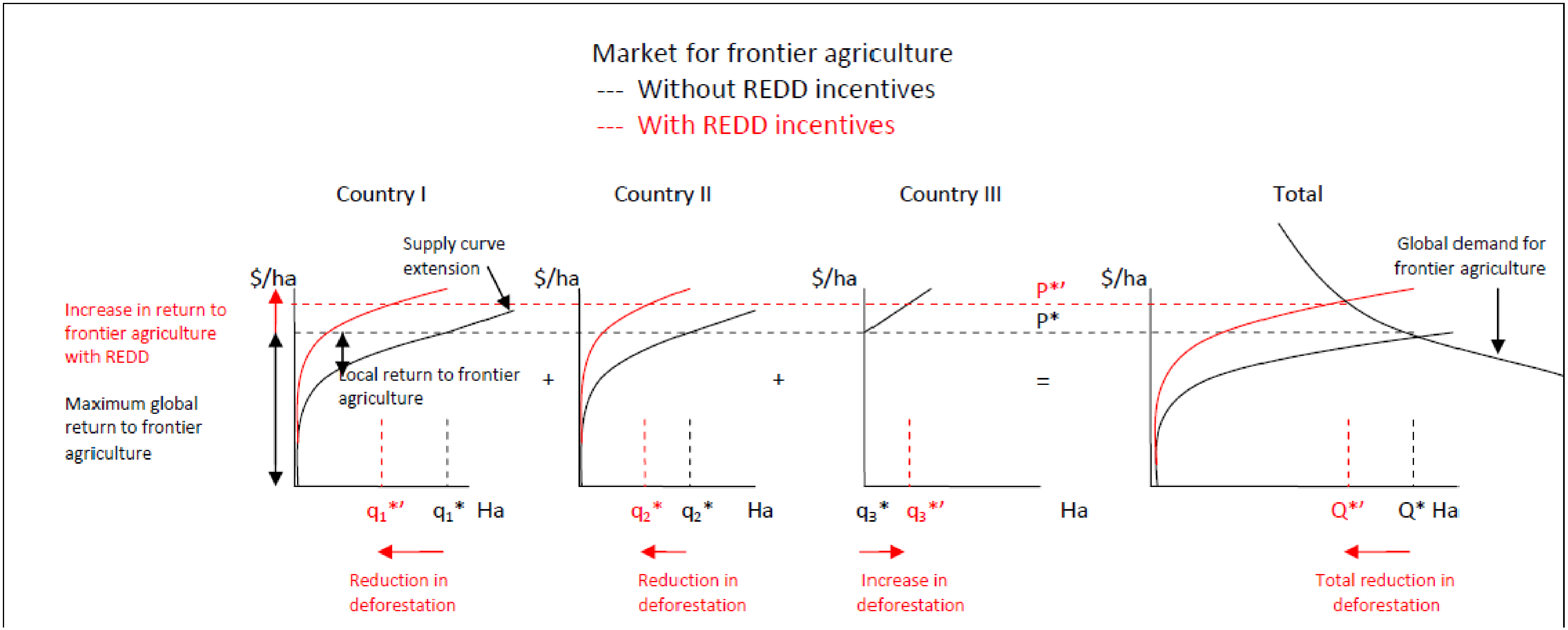
Shift in national supply of frontier agriculture depends on carbon price and reference level



Ongoing research leading to UNFCCC COP 15

- REDD+ designs of interest to parties
- Impacts of REDD+ incentives to 2050 (with IIASA)
- Market vs. fund vs. quota
- Distribution and equity
- Co-benefits of REDD+ (development, water, biodiversity)
- Phased implementation of REDD+ by countries
- Downscaled analyses in key countries (Indonesia, Peru, Madagascar, Liberia, Guyana, Suriname, Brazil)

Market for frontier agriculture: Supply and demand without REDD



Best available global data

- Forest cover, 2005 (FAO FRA, 2005)
- Forest cover loss rates, 2000-2005 (FAO FRA, 2005)
- Forest carbon density (Ruesch and Gibbs, 2008)
- Soil carbon density (GSDTG, 2001)
- Gross agricultural returns (Fischer *et al*, 2000; Naidoo and Iwamura, 2007; Strassburg *et al*, 2008; Schmitt *et al*, 2008)
- Timber returns (Sohngen and Tennity, 2004)
- Management costs (James *et al*, 2001)

Supply curves for frontier land agricultural and timber output

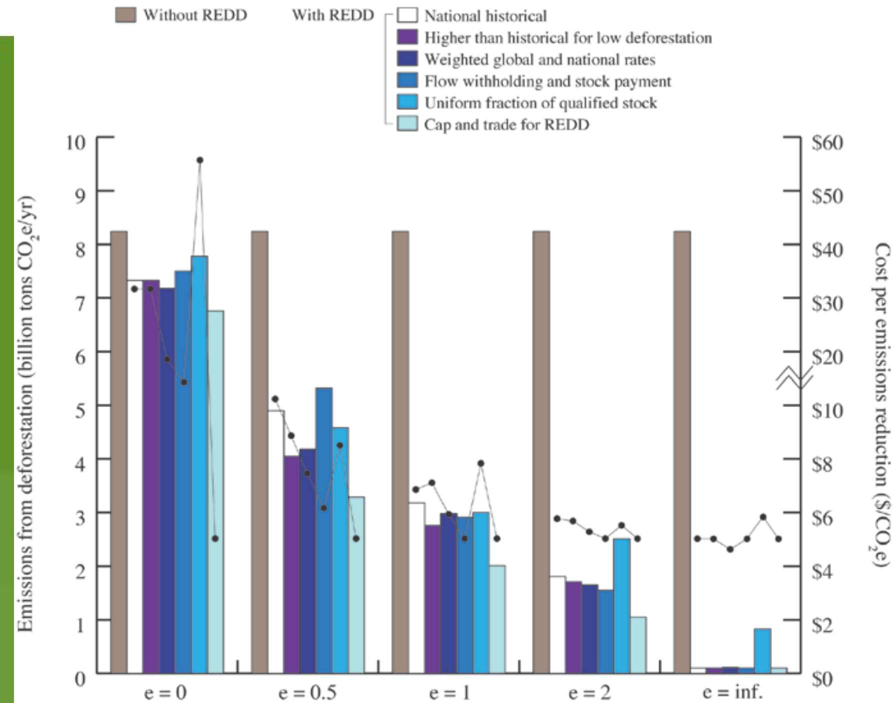
$$p_j = (\pi \sum_{n=1}^{N} r_{ij}^{(1-\delta)^n}) + t_i$$

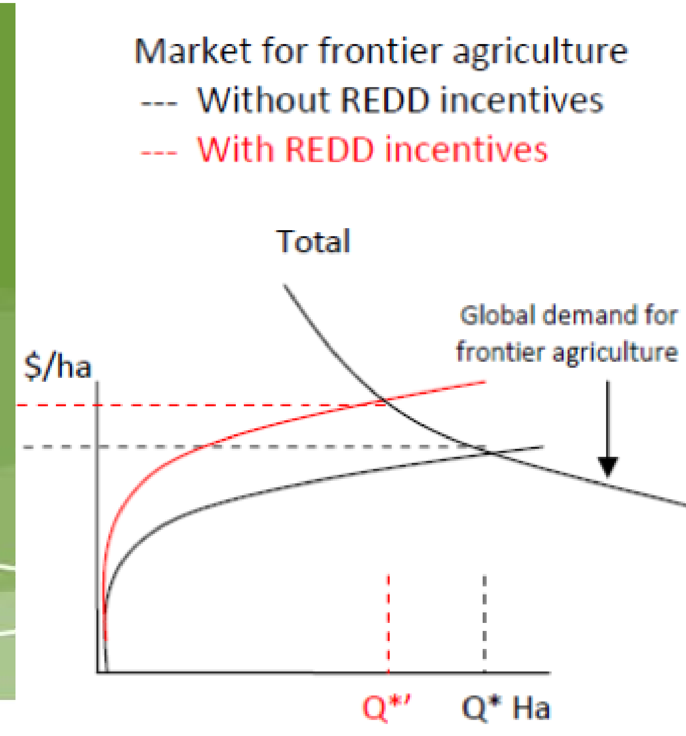
- p_{ij} = net present value of agriculture and timber in country *i* on hectare *j*
- r_{ij} = maximum gross annual return to agriculture in country *i* on hectare *j* (Fischer et al, 2000; Naidoo and Iwamura, 2007; Strassburg et al, 2009)
- π = profit margin = 0.15 (net return = 0.15 * gross return) (following Stern, 2007)
- *N* = 30 year time horizon (following Stern, 2007)
- δ = discount rate = 0.10 (following Stern, 2007)
- t_i = once-off value of timber in country *i* (Sohngen and Tennity, 2004)

- NPVs calculated across all forest area in country (spatial), then scaled to FAO net forest cover loss area (non-spatial)

“Finger snap” improvement: elasticity

- Price elasticity of demand for food calories can not be distinguished from perfectly inelastic (Roberts and Schlenker, 2009)
- Price elasticity of demand for food crops (Seale, Regmi, and Bernstein, 2003):
  - Developed: -0.1 to -0.5
  - Developing: -0.3 to -0.8
- But, market share of frontier agriculture is small, with great potential for substitution





Costs of REDD

- Marginal costs (included in OSIRIS):
  - Opportunity cost of agriculture and timber ($0.20-$8/ton CO_2)
  - Management cost (~$4.20 / ha / yr; James *et al*, 2004)
  - Transaction cost ($/ton CO_2; not included)

- Project, program and policy costs (not included)

- National start up costs (added to OSIRIS) ($14-92 million per country; Chatham House, 2009):
  - National REDD strategy development ($1-5 million)
  - Baseline and inventory ($1-7 million)
  - Land reform ($7.5-40 million)
  - Legal reform ($0.6-3 million)
  - Enforcement ($2-13 million)
  - Institutional reform ($1-19 million)
  - Finance and banking ($0.1-5 million)

- Co-benefits of forests and institutional reforms (not included)

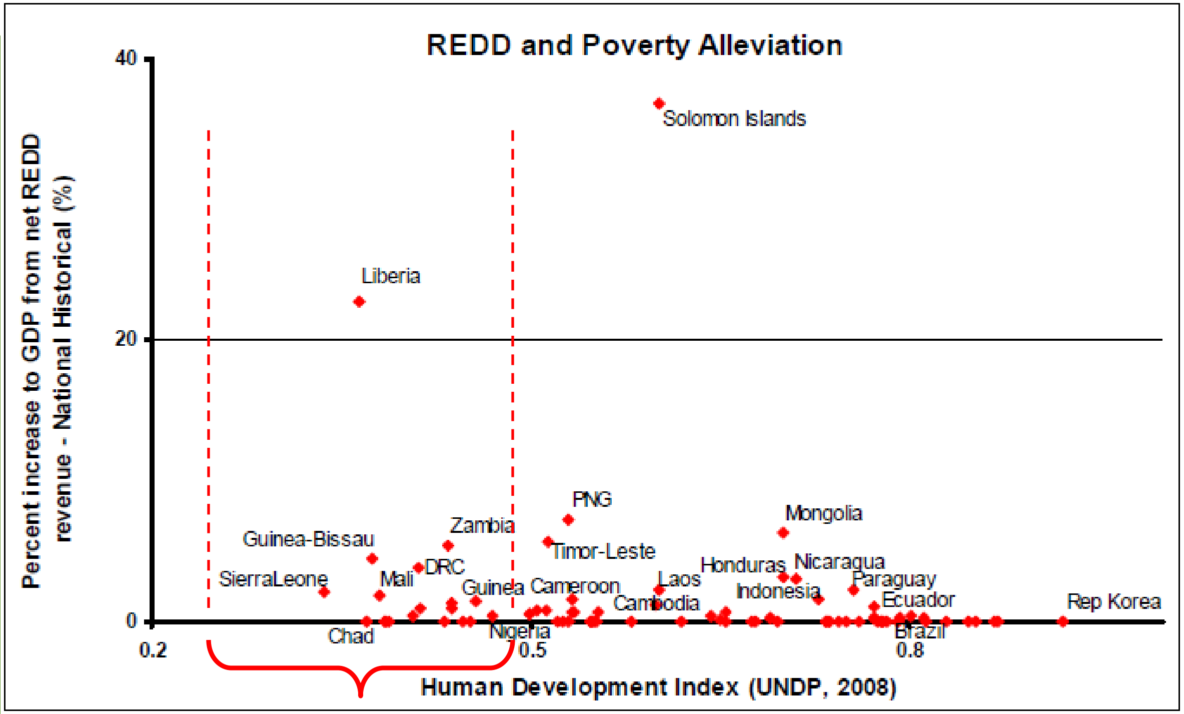
Scope of analysis

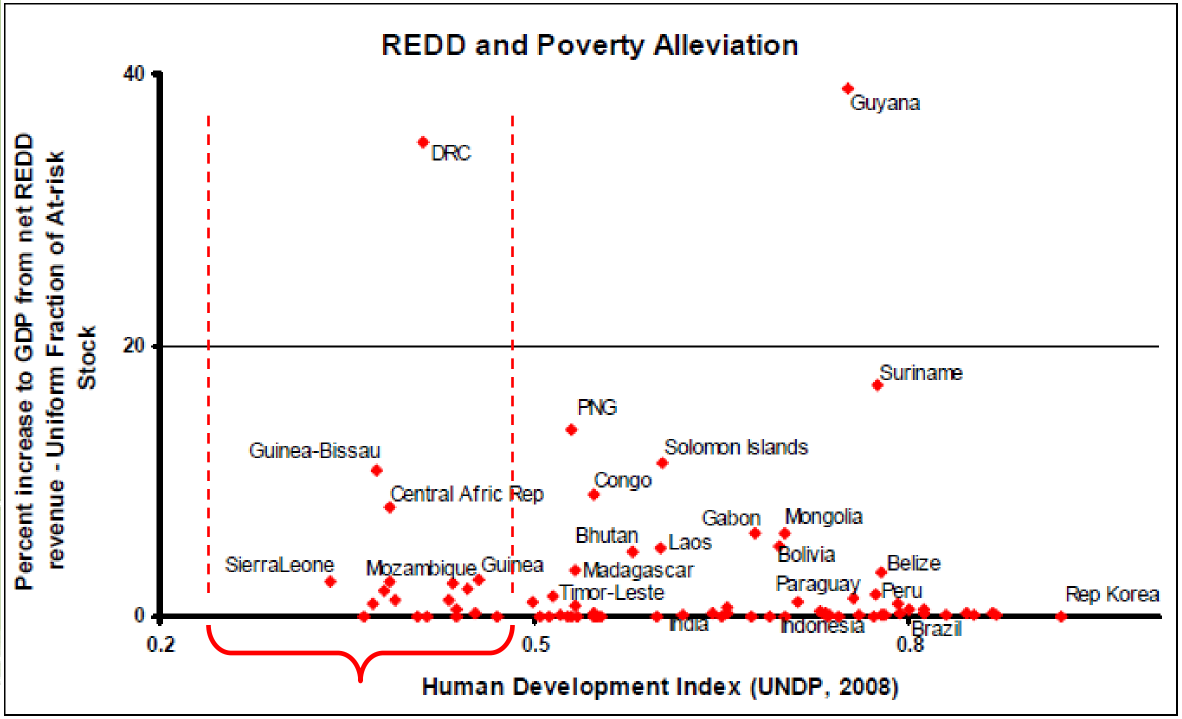
- Single period model only—dynamic effects not included
- Agriculture and timber only—mining not included
- Forests and soil only—other carbon pools not included
- Deforestation only—degradation, A/R, SFM not included
- Historical, rather than projected, business as usual

- Caveat: Model designed to compare impacts across REDD reference level designs, not to predict absolute magnitude of impacts

Co-benefits of REDD: Poverty alleviation

Is REDD projected to contribute to poverty alleviation by increasing income in the least developed countries?

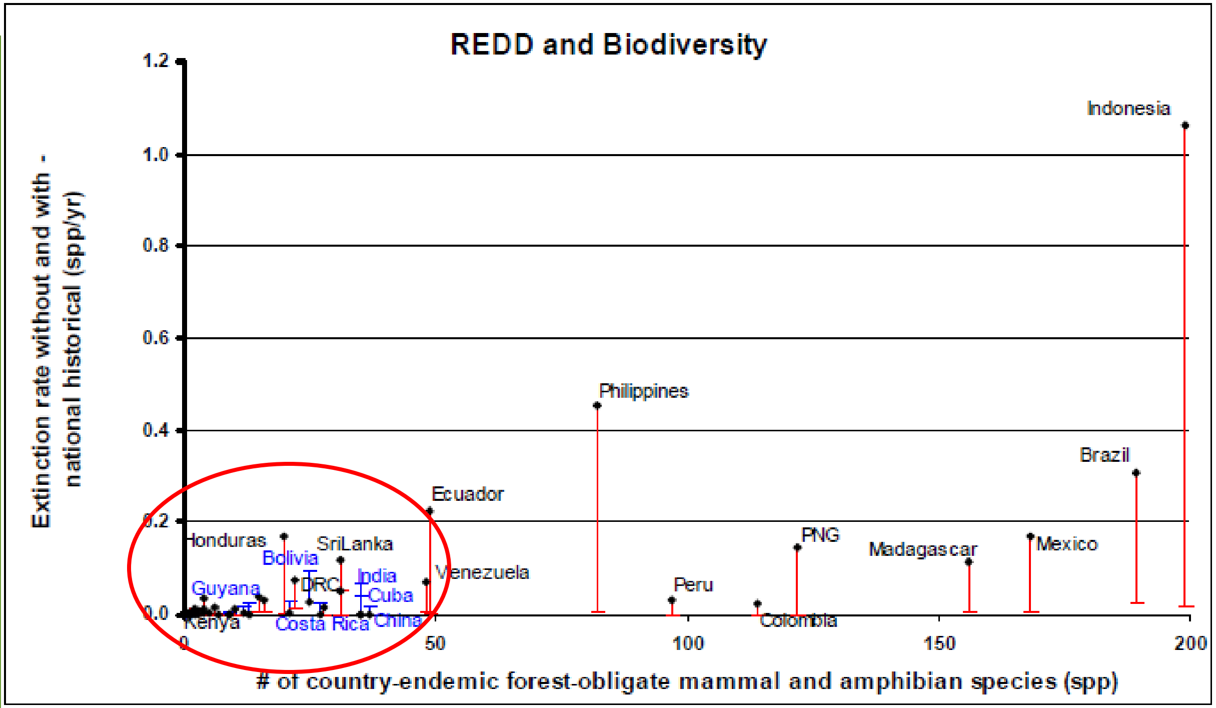


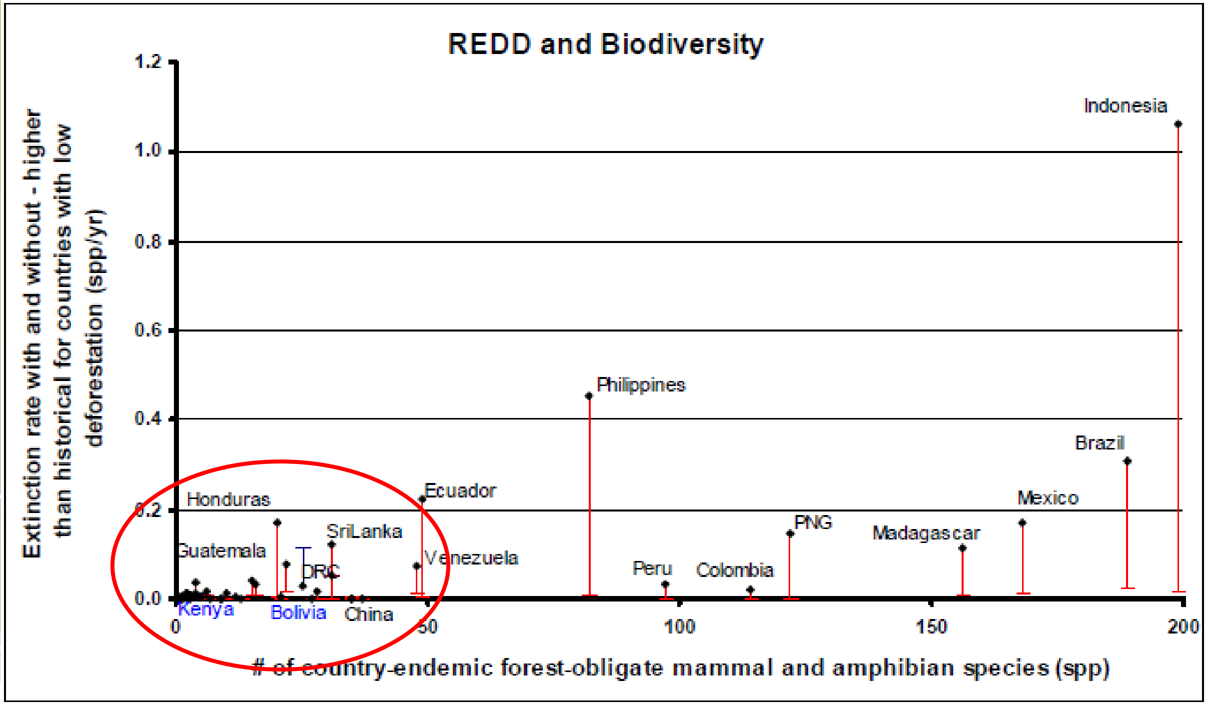


OSIRIS v2.3 Parameter values: CO_2 price=\$5/ton CO_2; Permanence scale=1.00; Elasticity of demand=1.0; Social preference for REDD surplus = 1.00; Mgmt cost=\$3.50/Ha/yr; Soil carbon eligible=0.25; At-risk land=0.80; Baseline as % of at-risk land=0.10

Co-benefits of REDD: Biodiversity

Is REDD projected to incentivize reduction of forest habitat loss in the most biodiverse countries?

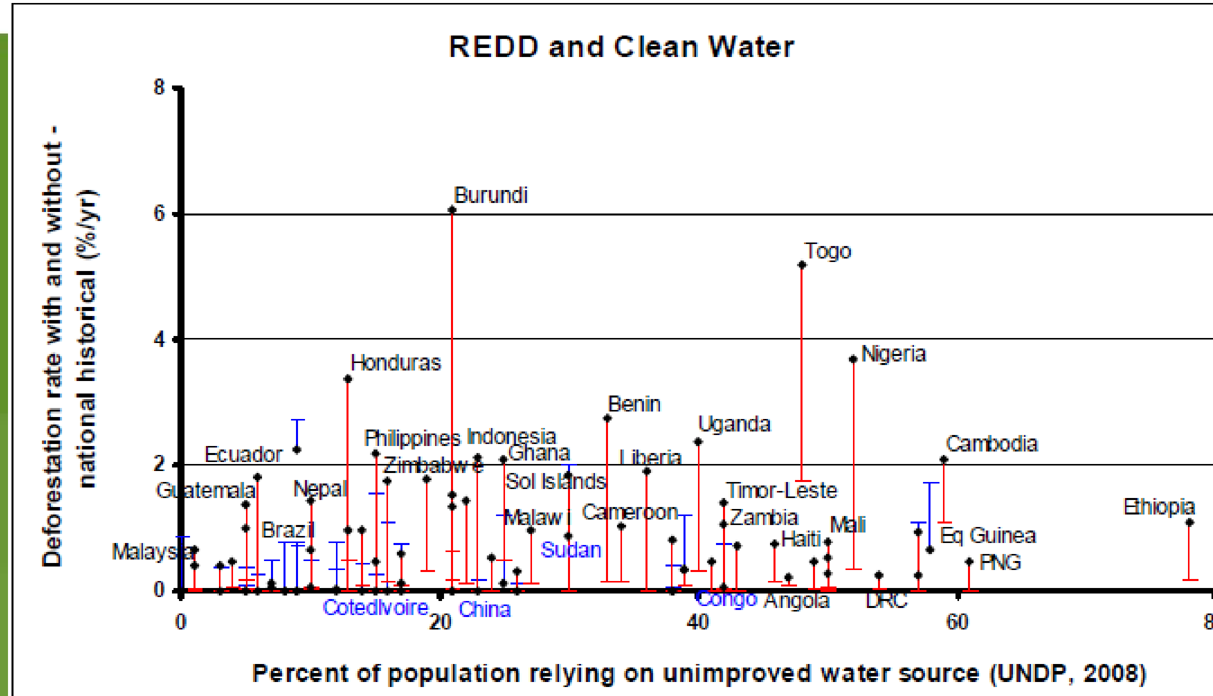


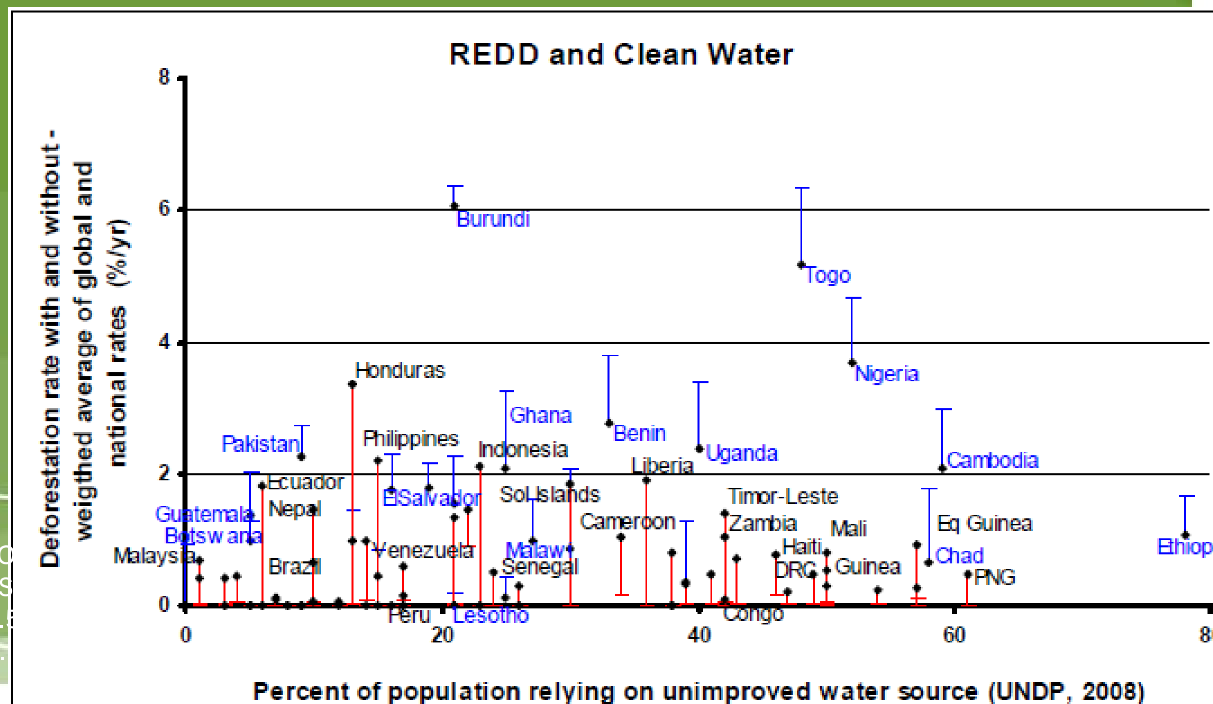


OSIRIS v2.3 Parameter values: $C0_2$ price=$5/ton CO_2; Permanence scale=1.00; Elasticity of demand=1.0; Social preference for REDD surplus = 1.00; Mgmt cost=$3.50/Ha/yr; Soil carbon eligible=0.25; Baseline for low defor=0.003

Co-benefits of REDD: Clean water

Is REDD projected to incentivize reduction of forest loss in countries most reliant on unimproved water?





OSIRIS v2.3 Parameter values: CO_2 price=$5/ton CO
Permanence scale=1.00; Elasticity of demand=1.0; S
preference for REDD surplus = 1.00; Mgmt cost=$3.5
Soil carbon eligible=0.25; Weight on historical=0.40.

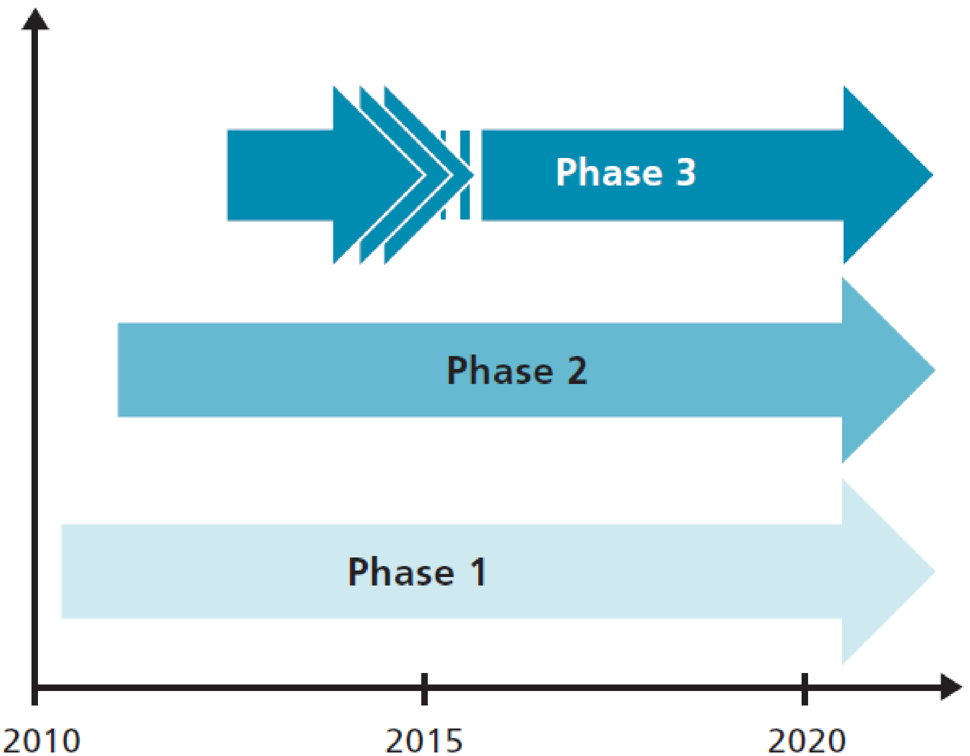
A phased approach to REDD
(Angelsen et al, 2009)

Phase 1: Funds for MRV and capacity building

Phase 2: Fund-based demonstration activities

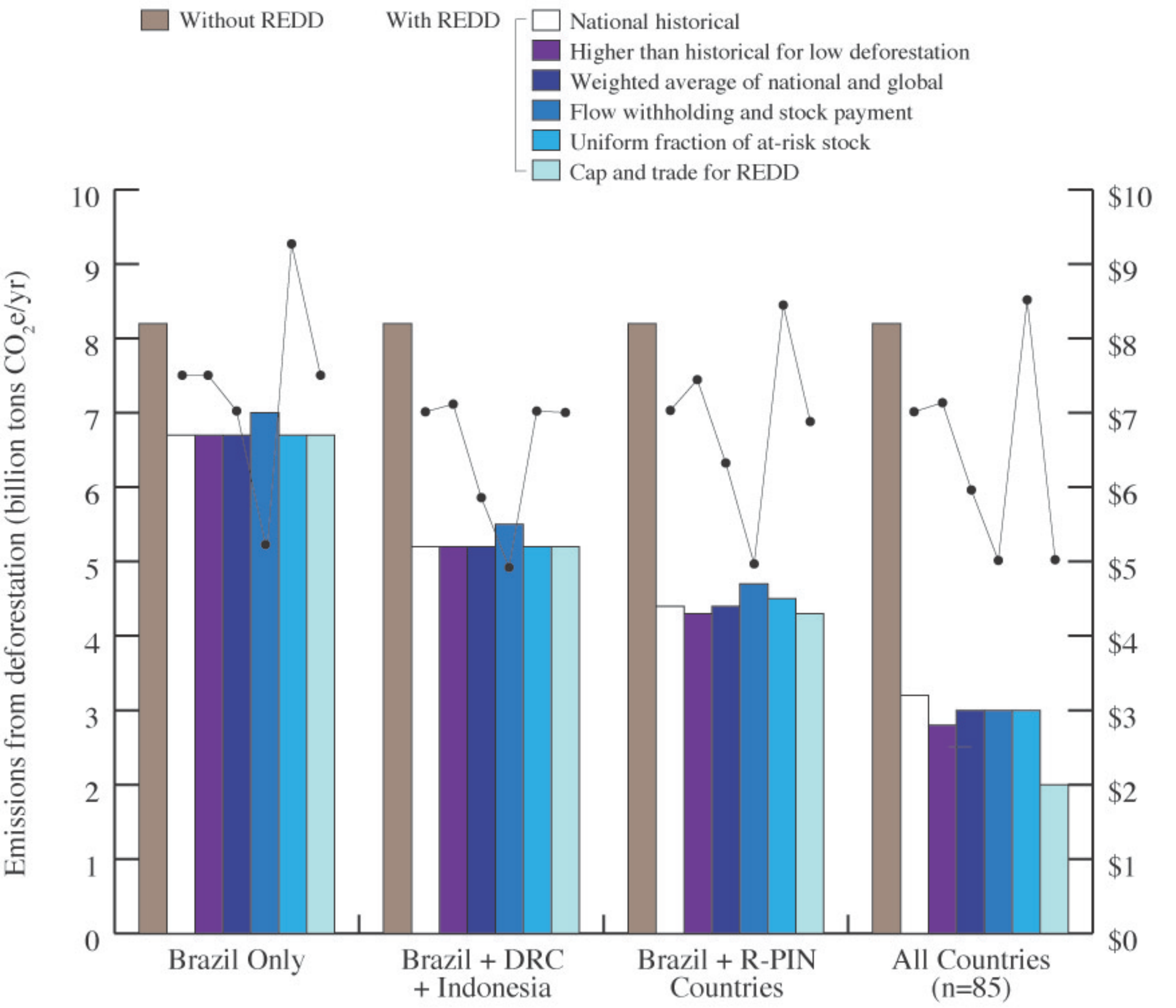
Phase 3: Market compensation for reductions below reference levels

Figure 2.1: Suggested timing for phasing in support mechanism for REDD action



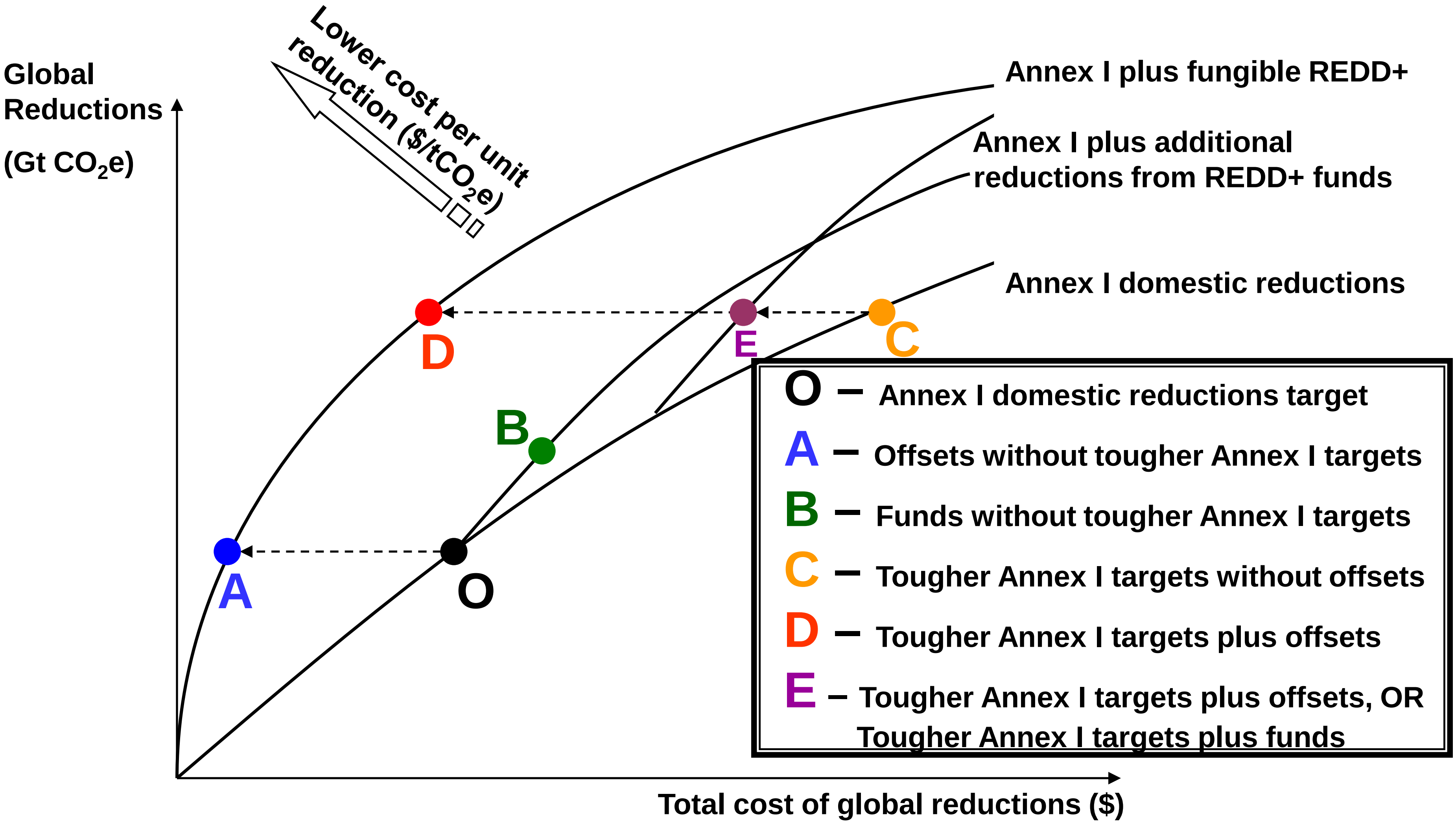
Phased implementation

- Greater participation leads to greater reductions
- Cost-efficiency at any level of participation
- Full participation increases cost-efficiency in cap-and-trade



OSIRIS v2.3 Parameter values: CO_2 price=$5/ton CO_2; Permanence scale=1.00; Elasticity of demand=1.0; Social preference for REDD surplus = 1.00; Mgmt cost=$3.50/Ha/yr; Soil carbon eligible=0.25; Baseline for low defor=0.003; Weight on historical=0.40; Stock-flow withholding=0.40; At-risk land=0.80; Baseline as % of at-risk land=0.10

Achieving greater global reductions with REDD+



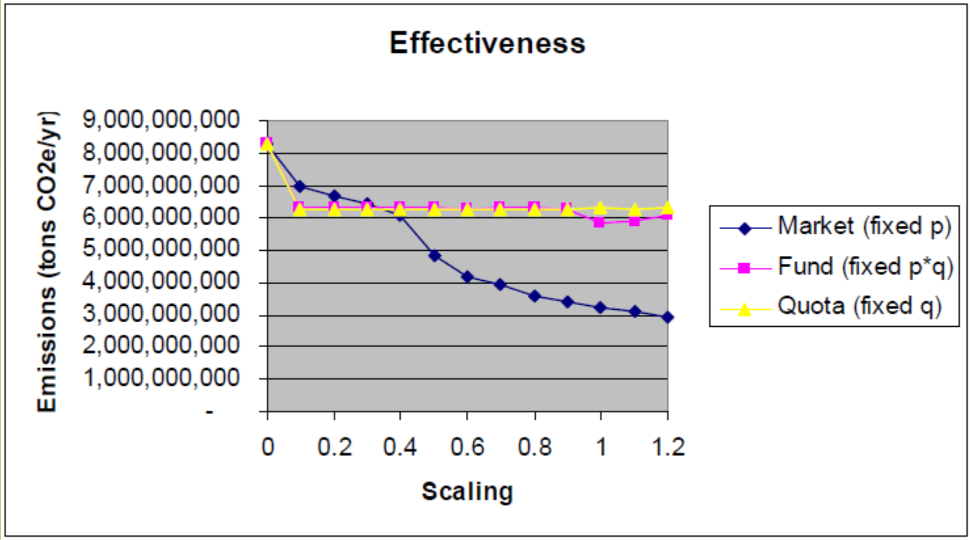
Reference Levels in a Market vs. a Fund
(Busch, Angelsen, and Cattaneo; in preparation)

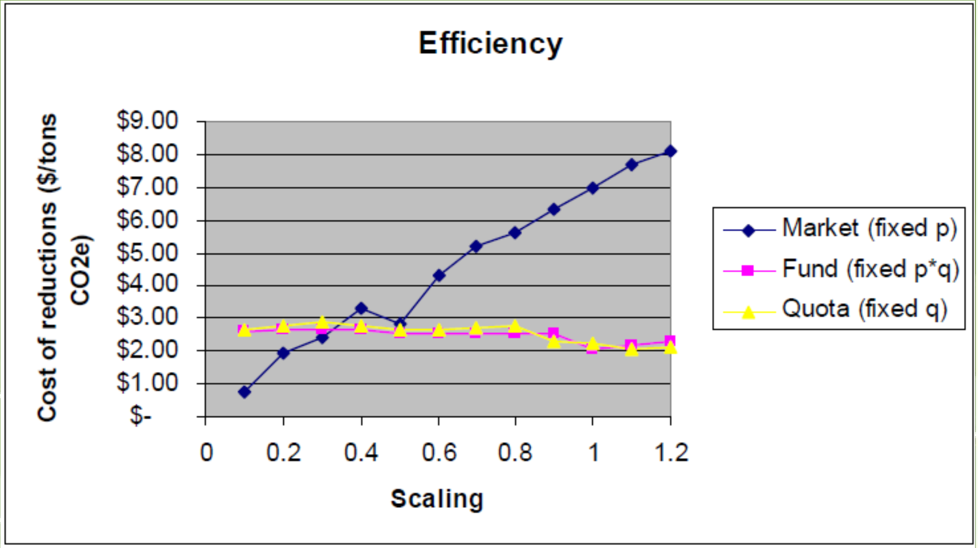
Market (fixed price, no restriction on quantity):

- Decreasing national RLs decreases participation, decreases effectiveness and increases cost-efficiency

Fund (fixed price * quantity):

- Decreasing national RLs decreases participation, increases credit price, has ambiguous/neutral impact on effectiveness and cost-efficiency

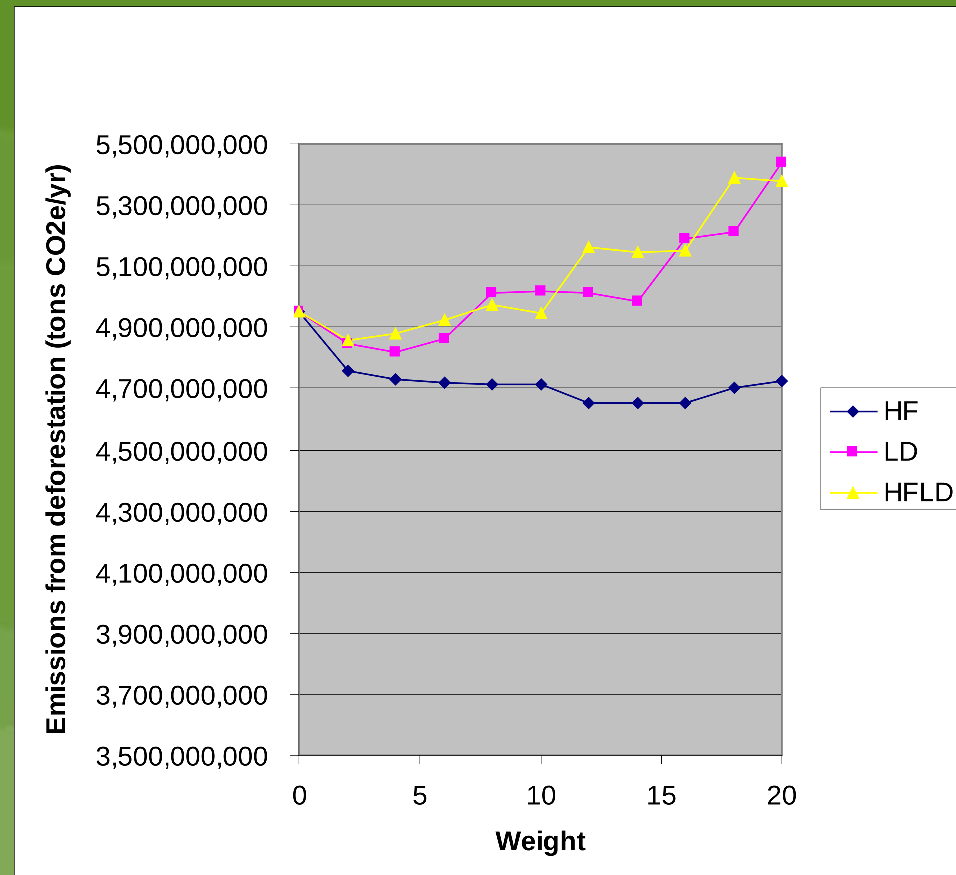


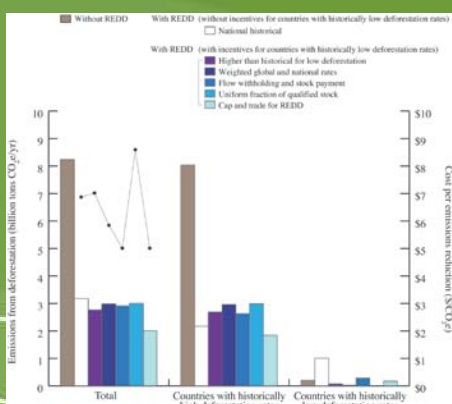


Reference Levels in a Market vs. a Fund
(Produced for Norway REDD OAR; unpublished)

- Global REDD financing set at $10 billion per year

- In a fund as in a market, greater overall reductions can be achieved through higher weight on reference levels for countries with low deforestation.



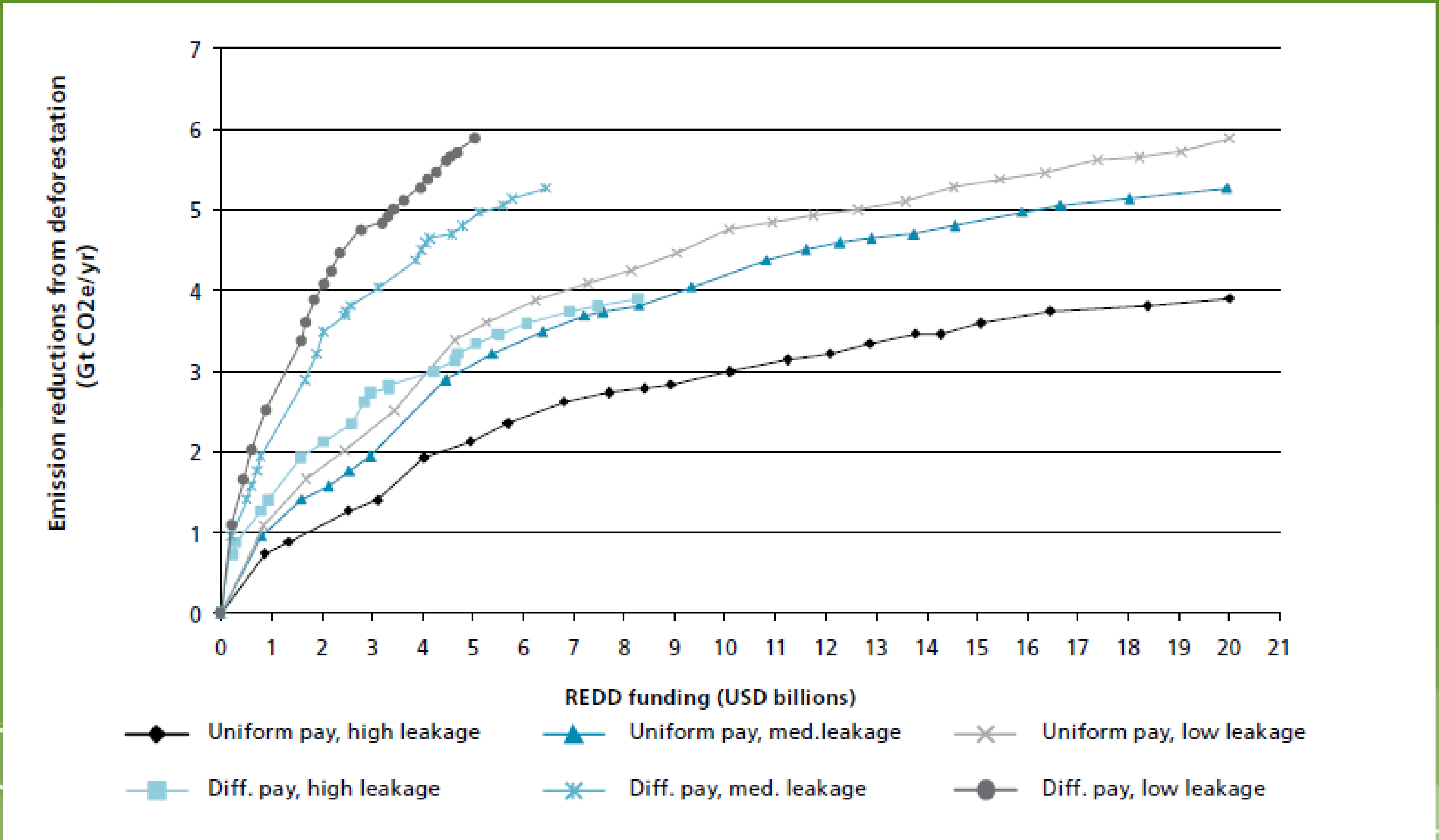


OSIRIS Norway parameter values: Fund size=$10 billion/yr; Permanence scale=1.00; Elasticity of demand=1.0; Social preference for REDD surplus = 1.00; Mgmt cost=$3.50/Ha/yr; Soil carbon eligible=0.10

Key Messages

- Poverty alleviation, biodiversity, and clean water co-benefits of REDD+ can be substantial, in countries where they are needed most
- Greater participation in REDD+ leads to more mitigation
- REDD+ mitigation is cost-effective at any level of participation
- In both a fund and a market, greater reductions can be achieved with higher reference levels for countries with low deforestation.
- Greatest global emission reductions and cost-efficiency of reductions can be achieved by combining tougher Annex I targets with REDD+

Quantity of emissions reductions available from REDD at given levels of funding (Angelsen et al, 2009)



OSIRIS vOAR Parameter values: Social preference for REDD surplus = 1.00; Mgmt cost=$3.50/Ha/yr; Soil carbon eligible=0.10

Cost to half global emissions from deforestation

Design option	Reference	Cost to half emissions (2008 US$billion/yr)
“National historical”	Santilli *et al* (2005)	18.1
“Higher than historical for countries with low deforestation rates”	Mollicone *et al* (2007); da Fonseca *et al* (2007)	14.7
“Weighted average of national and global”	Strassburg *et al* (2008)	15.6
“Flow withholding and stock payment”	Cattaneo *et al* (2008)	11.0
“Uniform fraction of qualified stock”	Ashton *et al* (2008)	25.6
“Cap and trade for REDD”	Eliasch (2008); For comparison only	8.1
“Pure stock approach”	For comparison only	2716.9

OSIRIS v2.2 Parameter values: Permanence scale=1.00; Elasticity of demand=1.0; Social preference for REDD surplus = 1.00; Mgmt cost=$3.50/Ha/yr; Soil carbon eligible=0.25; Baseline for low defor=0.003; Weight on historical=0.40; Stock-flow withholding=0.40; At-risk land=0.80; Baseline as % of at-risk land=0.10

Deforestation causes ~17% of global greenhouse gas emissions

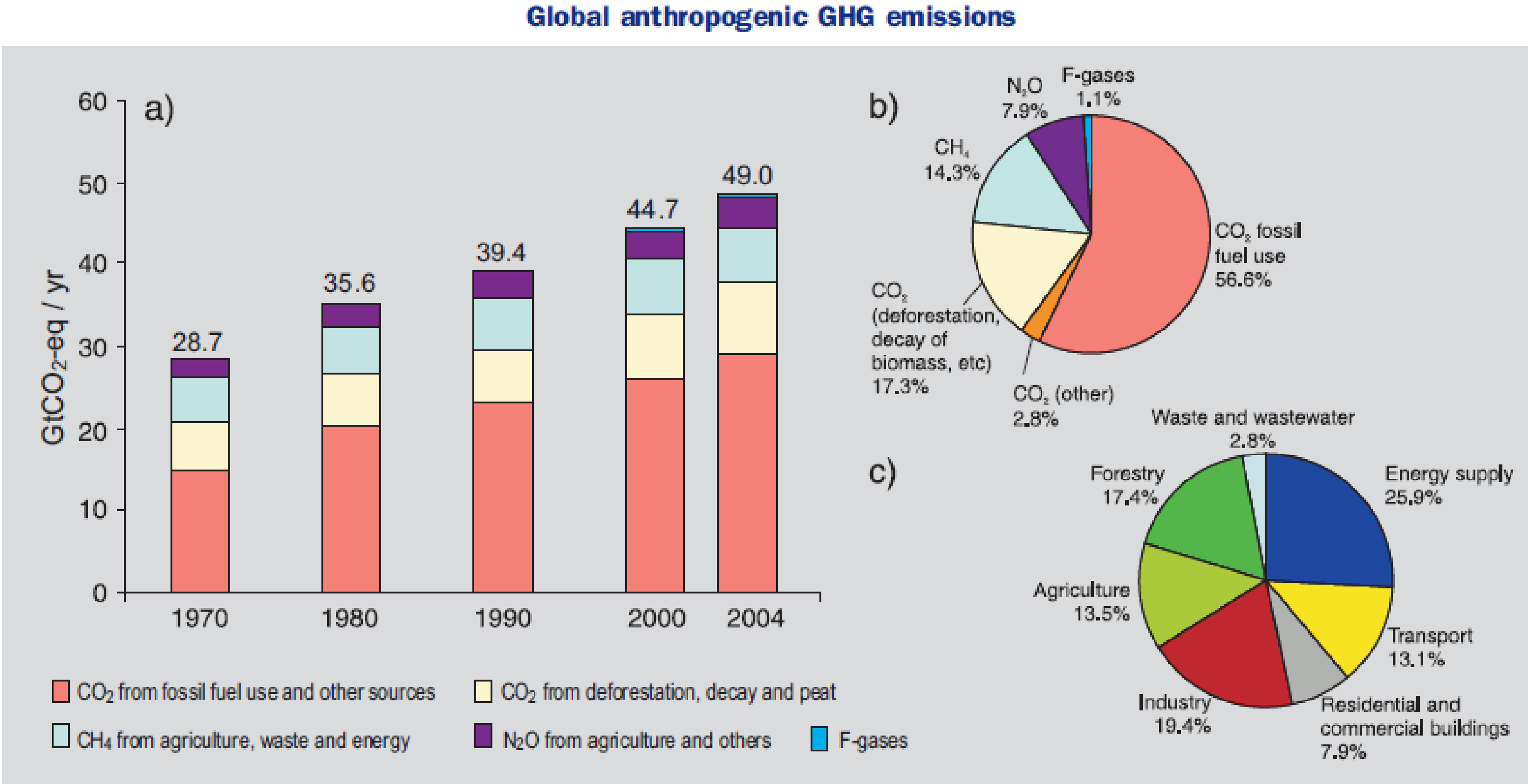
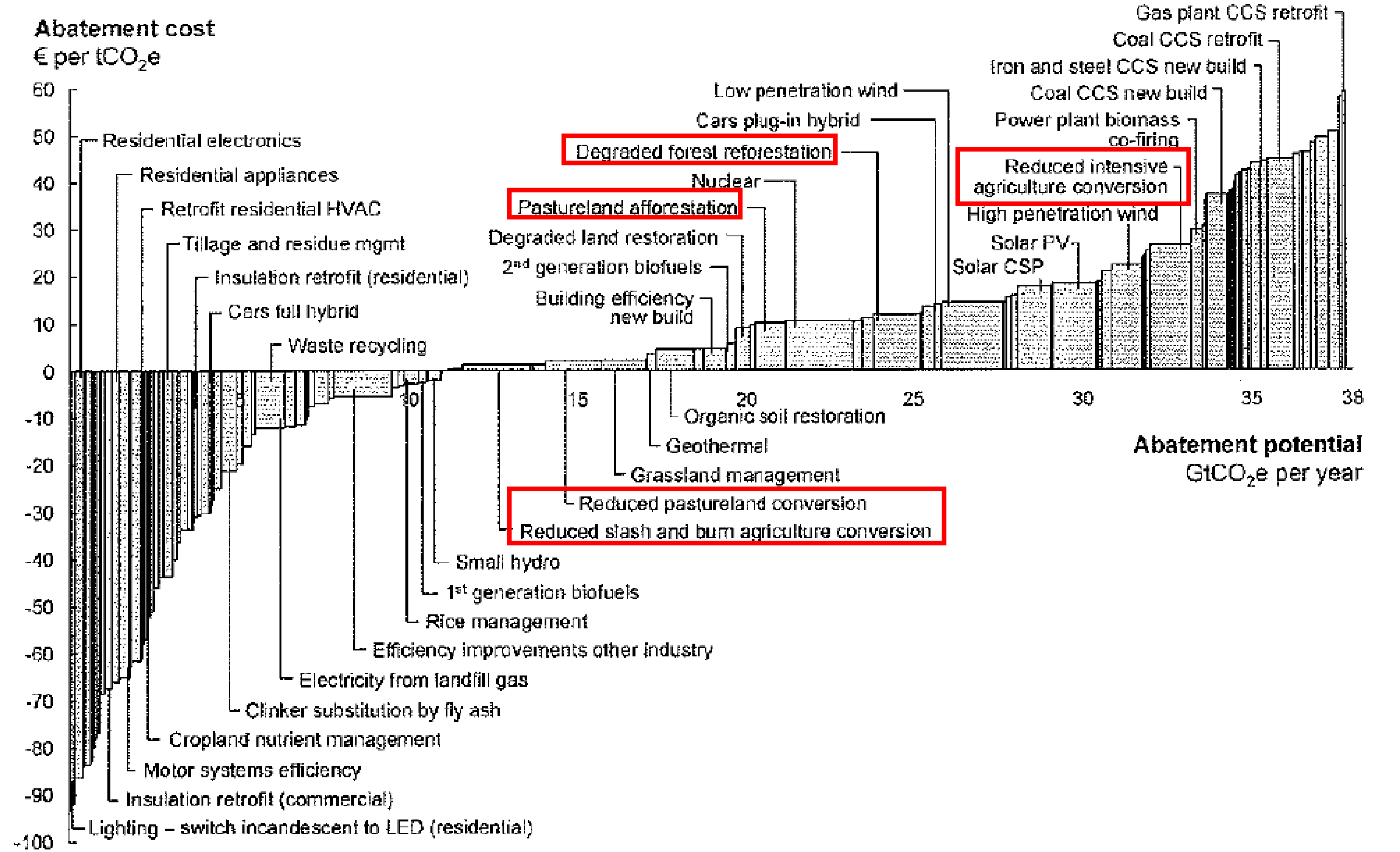


Figure SPM.3. *(a) Global annual emissions of anthropogenic GHGs from 1970 to 2004.[5] (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of carbon dioxide equivalents (CO_2-eq). (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO_2-eq. (Forestry includes deforestation.) {Figure 2.1}*

Source: IPCC 4AR, Executive Summary, Figure SPM.3

McKinsey GHG Abatement Cost Curve



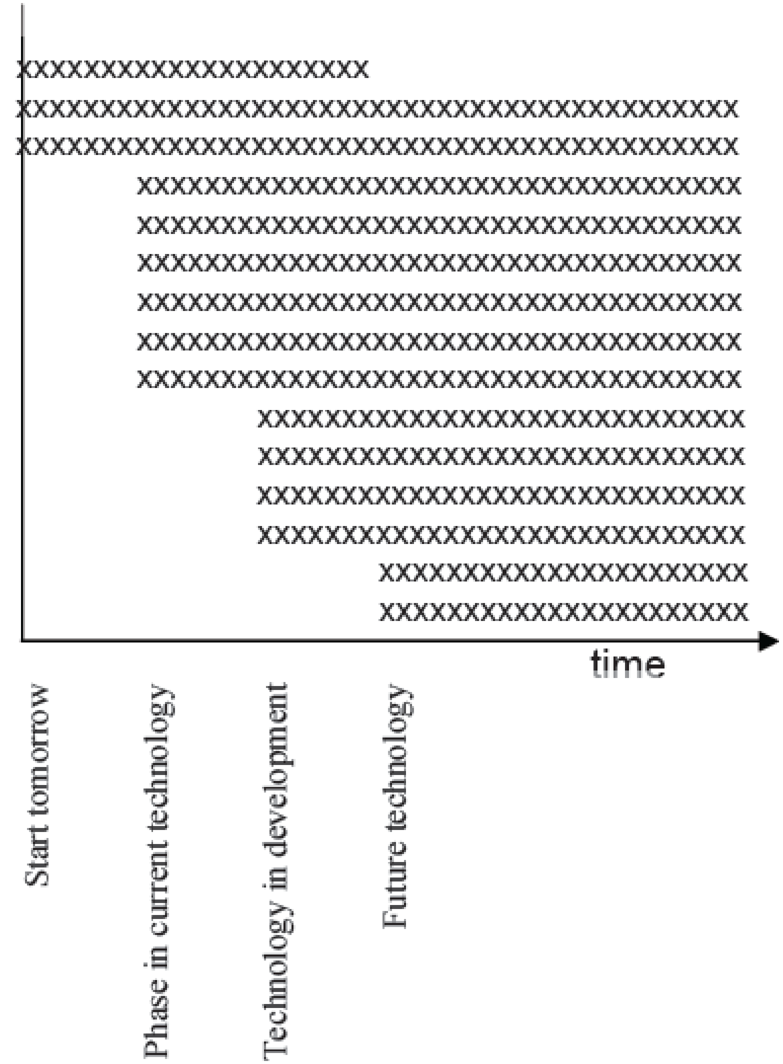
Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO_2e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.0

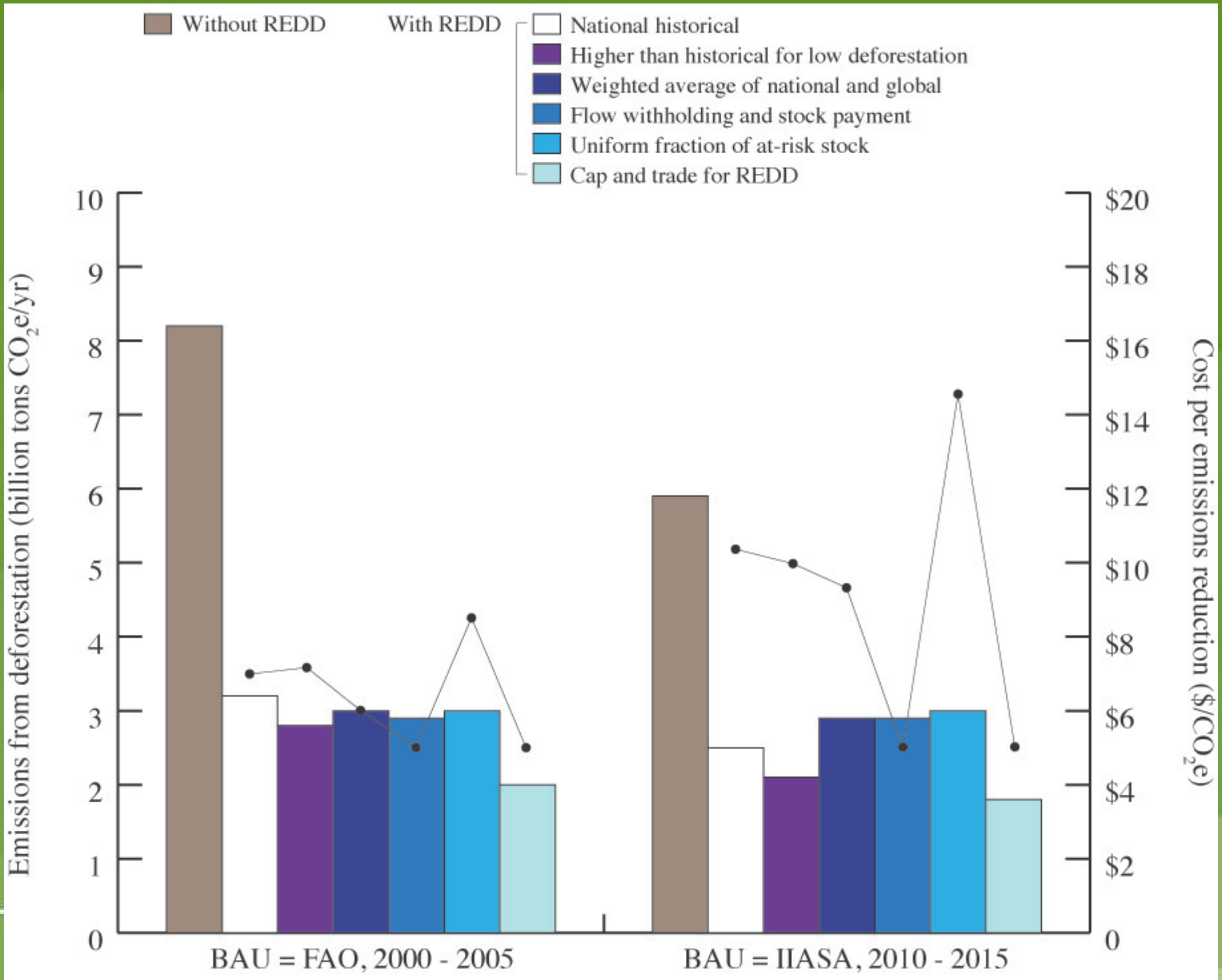
Source: Naucler and Enkvist, 2009

Timing of potential deployment of mitigation wedges
(preliminary; adapted from Pacala and Socolow, 2004)

1. REDD+
2. Reduced use of vehicles
3. Conservation tillage
4. Efficient vehicles
5. Efficient buildings
6. Efficient baseload coal plants
7. Gas baseload power for coal baseload power
8. Nuclear power for coal power
9. Wind power for coal power
10. Capture CO2 at baseload power plant
11. PV power for coal power
12. Wind H2 in fuel-cell car for gasoline in hybrid car
13. Biomass fuel for fossil fuel
14. Capture CO2 at H2 plant
15. Capture CO2 at coal-to-synfuels plant+geological storage



Impacts of REDD designs, to 2050
(preliminary results of CMI-IIASA collaboration)



OSIRIS v2.3 Parameter values: CO_2 price=$5/ton CO_2; Permanence scale=1.00; Elasticity of demand=1.0; Social preference for REDD surplus = 1.00; Mgmt cost=$3.50/Ha/yr; Soil carbon eligible=0.25; Baseline for low defor=0.003; Weight on historical=0.40; Stock-flow withholding=0.40; At-risk land=0.80; Baseline as % of at-risk land=0.10