Estimation of Transaction Costs and the Impact of Barriers in Forestry

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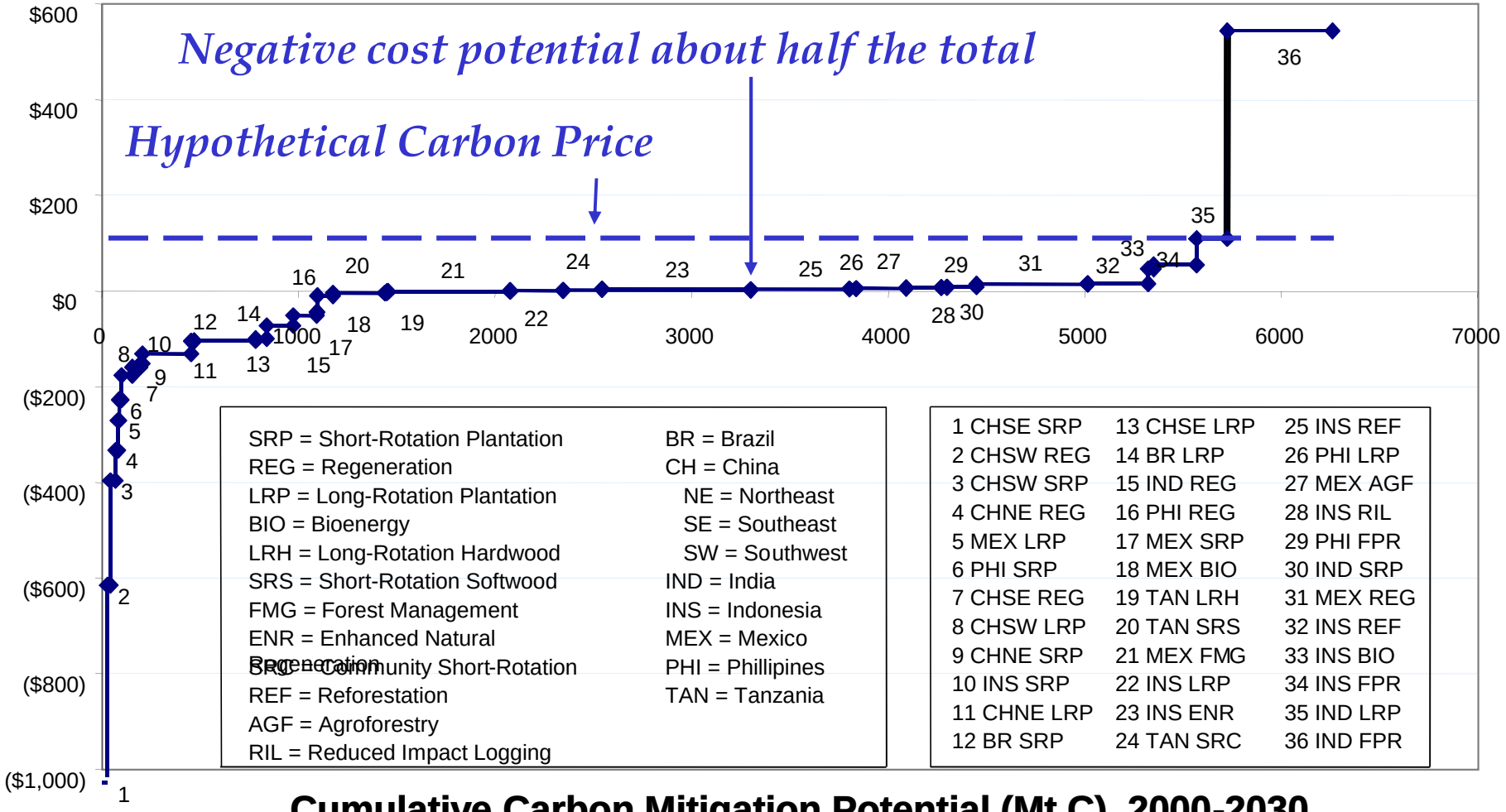
COMAP: Forestry Mitigation Potential

(Brazil, China, India, Indonesia, Mexico, Philippines and Tanzania)

Cost ($/ t C) DR = 8-12%



Cumulative Carbon Mitigation Potential (Mt C), 2000-2030

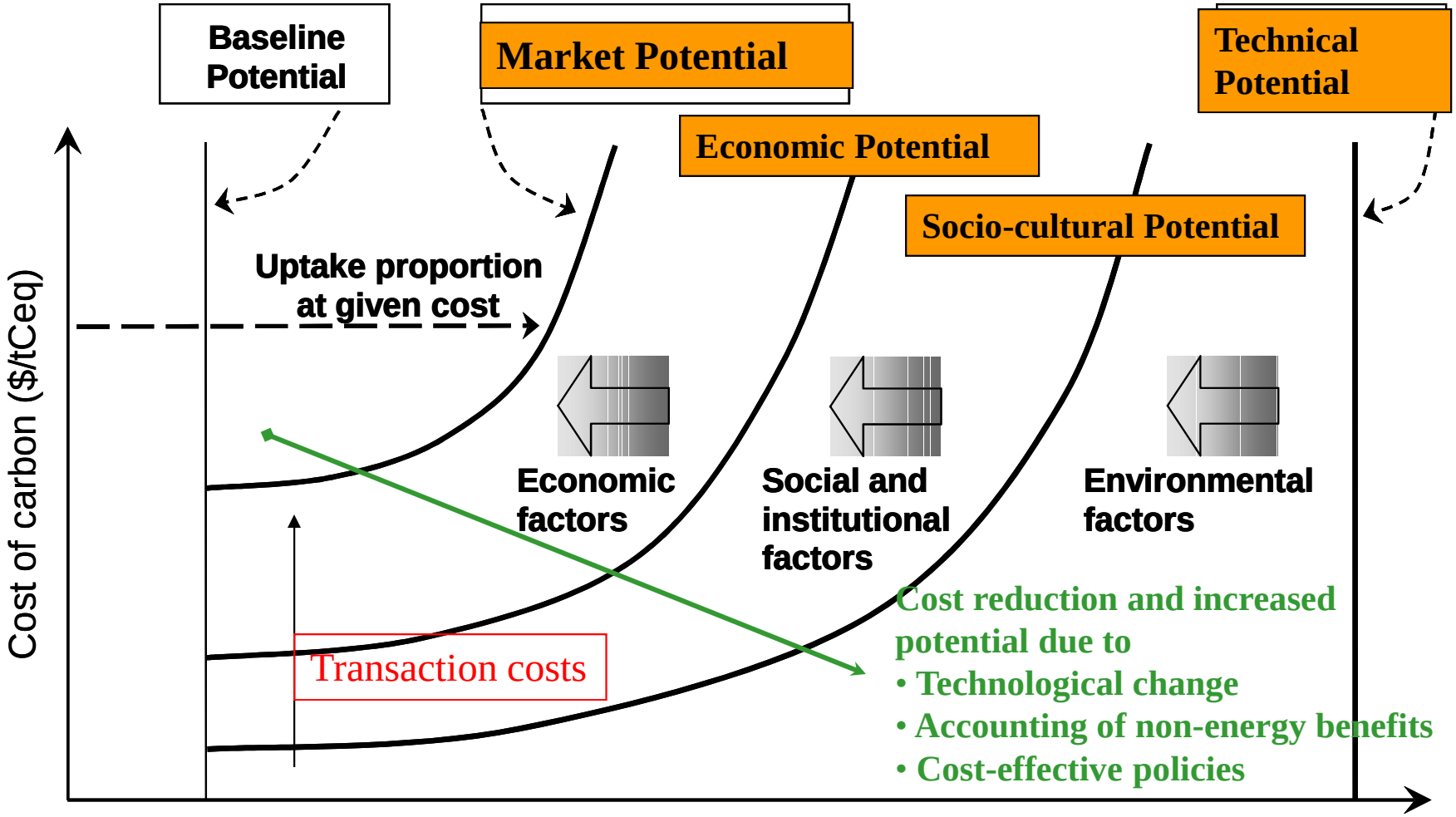
Source: 1. Sathaye J. Makundi W., Andrasko K. Boer R., Ravindranath N.H., Sudha P., Rao S., Lasco R., Pulhin F., Masera O., Cerón A., Ordonez J., Deying X., Zhang X., and Zuomin S. 2001. Carbon mitigation potential and costs of forestry options in Brazil, China, India, Indonesia, Mexico, the Philippines, and Tanzania. *Mitigation and Adaptation Strategies for Global Change,* Vol. 6. Nos. 3-4, pp. 185-211.

Bottom-up Models: How to explain negative cost results?

- Factors that could increase costs:
  - Transaction costs
  - Hidden costs, such as the risks of using a new technology
  - Rebound effect
  - Real preferences of consumers
- Factors that could reduce costs:
  - Technological change over time
  - Complete accounting of benefits
  - Policies that remove costlier barriers

Effects of economic, environmental and social-institutional factors on mitigation costs and potential

(based on IPCC TAR WGIII, Sathaye and Bouille et al., 2001, and Sathaye, Makundi, Andrasko et al., 2001)



Mitigation Potential = Carbon Sequestered or GHG emissions avoided, as a fraction of technical potential mitigation

Cost of Carbon Benefit (CCB): Accounting for Changes in Costs and Increased Carbon Benefit

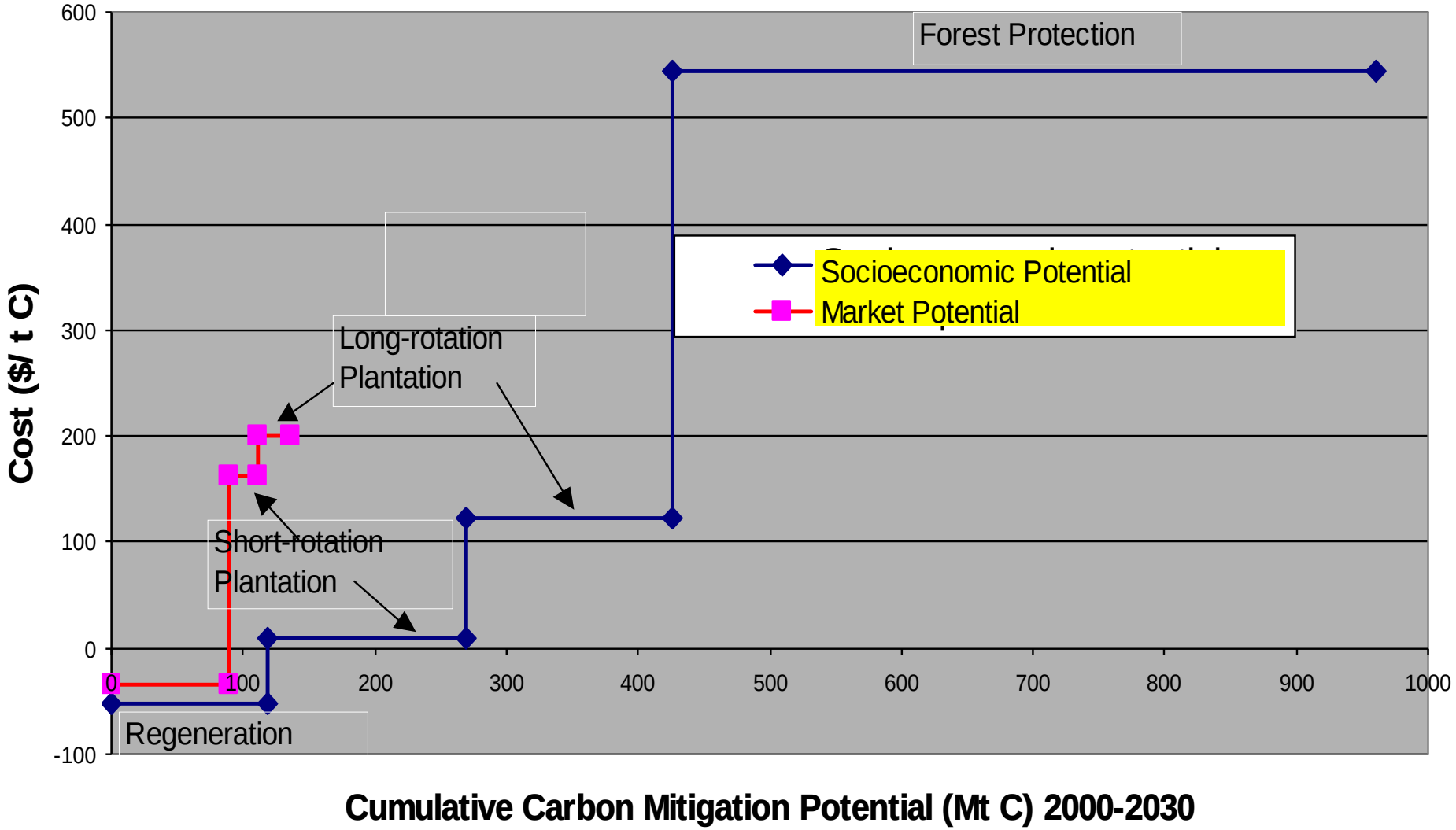
$$CCB = \frac{I \cdot q + M}{CB}$$

$$q = \frac{d}{(1-(1+d)^{-n})}$$

where:

***CCB* = Cost of carbon benefits for a forestry option, in $/t C**
***I* = Capital cost ($)**
***q* = Capital recovery factor**
***M* = Annual change in labor, material and other costs, and monetizable benefits ($)**
CB = Annual carbon benefit (t C)
***d* = discount rate**
***n* = lifetime of the forestry option (years)**

Forestry Mitigation Options With and Without Barriers, India: Preliminary COMAP Results



Key Barriers: Absence of organized markets, long distance to market, lack of access to credit, lack of information about seed quality, and new technologies, bounded rationality, cultural traits and habits, etc.

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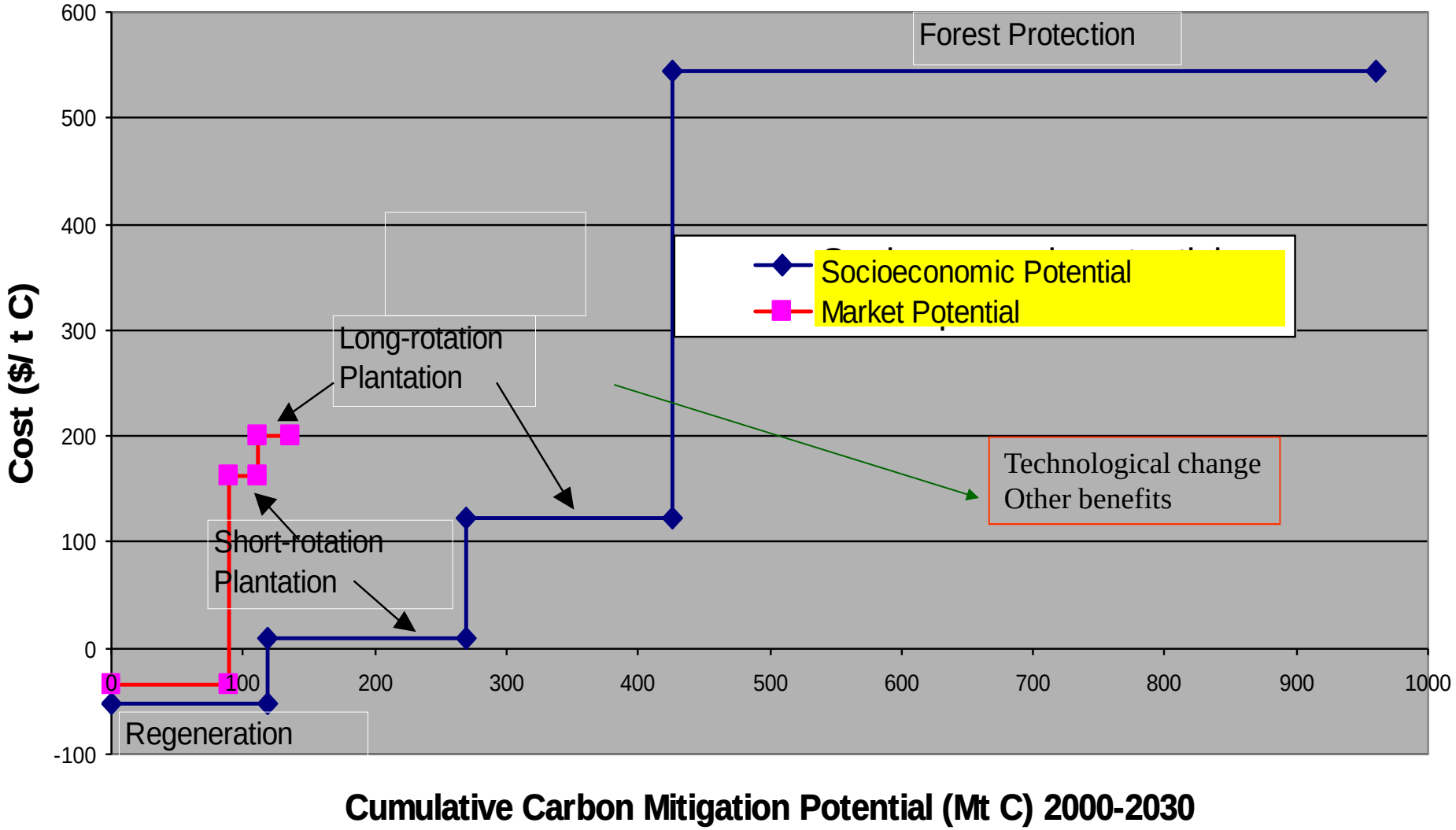

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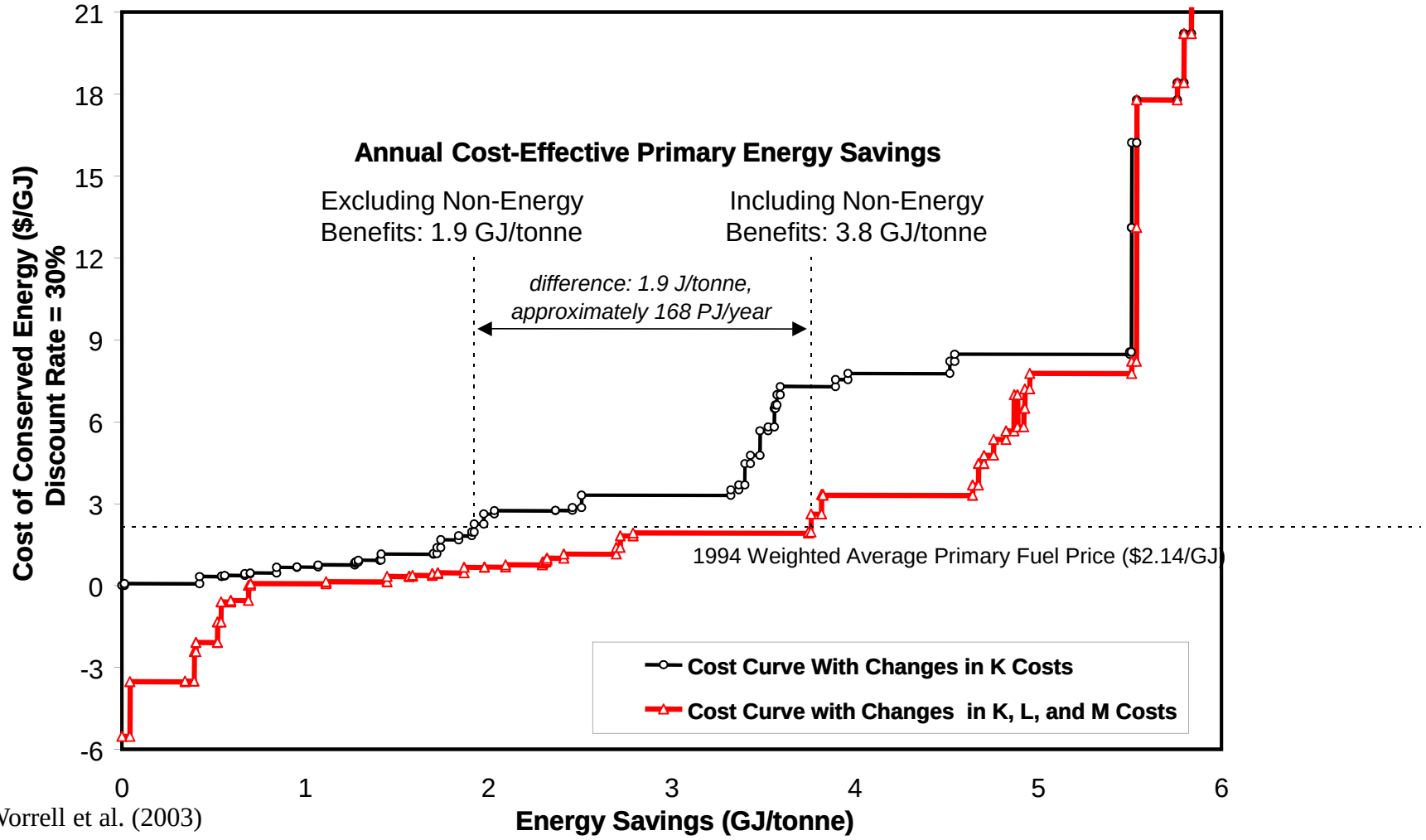
US Steel Industry Supply Curves: Accounting for Changes in Capital, Labor, and Material Costs

Benefits double cost effective energy efficiency potential to 19%



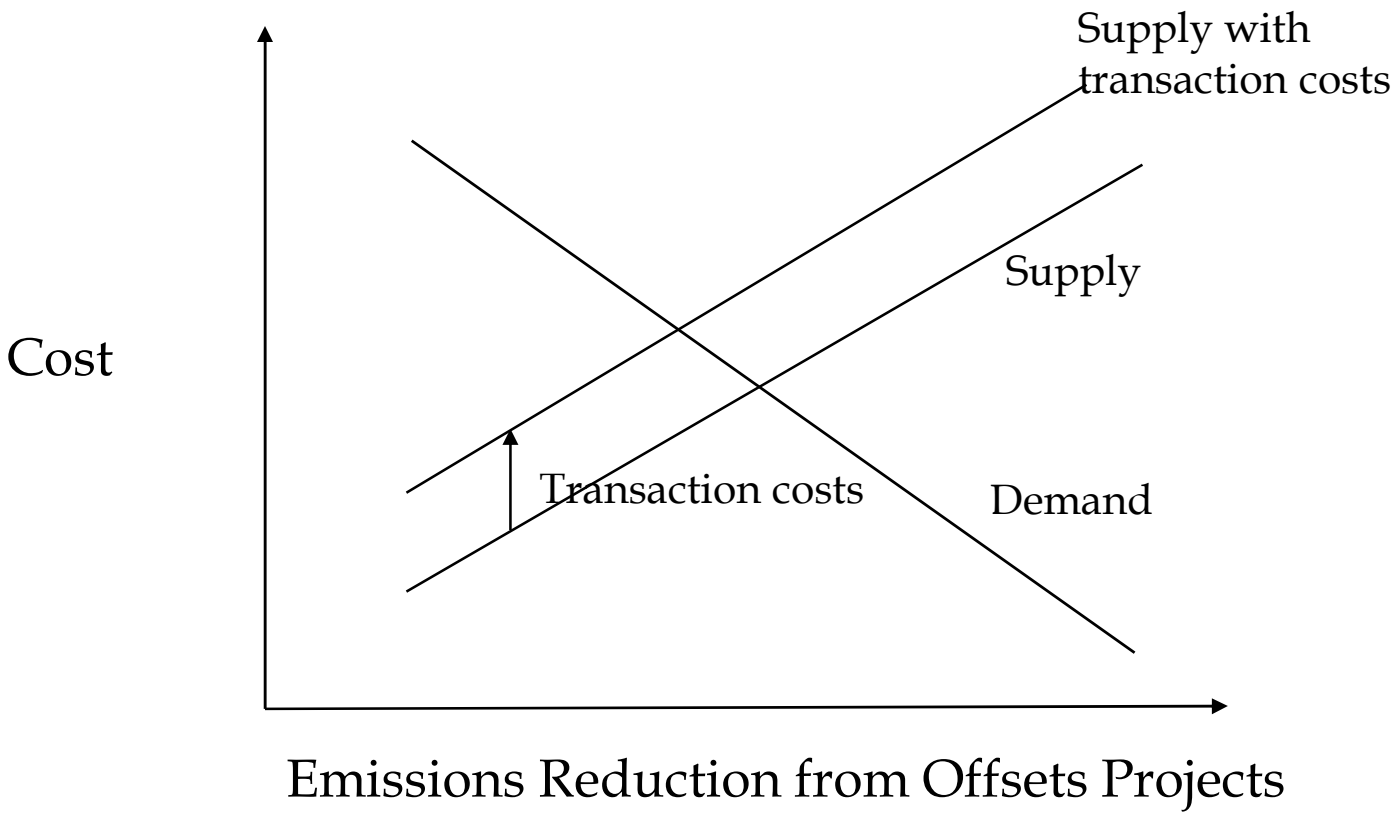
Source: Worrell et al. (2003)

Effect of Accounting for Changes in L and M Costs on Cost-Effectiveness and Ranking of Measures

	With Energy (E) Benefit Only			*With E and Other* Benefits		
Measure	**CCE**	**Rank**	**Cost-**	**CCE**	**Rank**	**Cost-**
	($/GJ)	**(of 47)**	**Effective?**	**($/GJ)**	**(of 47)**	**Effective?**
Inj. of NG – 140	3.1	19	NO	-0.5	8	YES
Coal inj. – 225	3.9	22	NO	1	23	YES
Coal inj. – 130	4.4	23	NO	0.1	11	YES
DC-Arc furnace	5	26	NO	-1.3	6	YES
Process control	5.6	27	NO	-2.1	5	YES
Scrap preheating	6.7	31	NO	-0.6	7	YES
Thin slab casting	8.5	35	NO	1.9	27	YES
Hot charging	8.9	36	NO	5.3	35	NO
FUCHS furnace	12.7	37	NO	-3.5	3	YES
Adopt cont. cast	14.3	39	NO	-3.5	2	YES
Twin shell	16.6	40	NO	3.3	30	NO
Oxy-fuel burners	17.4	41	NO	-5.5	1	YES
Bottom stirring	20.5	45	NO	-2.4	4	YES
Foamy slag	30.1	46	NO	7.2	40	NO

NOTE: These cost of conserved energy (CCE) and cost-effectiveness calculations are based on a discount rate of 30% and an average primary energy price of $2.14/GJ.

Transaction Costs Influence Supply of Offsets Emissions Credits



Transaction Cost Components

- Project search costs – Identification and stakeholder consultation
  - May be spread over many projects
- Feasibility studies costs – engineering, economic, and environmental assessments
  - GHG Baseline estimation and establishing additionality
- Negotiations costs – obtaining permits, negotiating and enforcing contracts for fuel supply, arranging financing
  - Marketing GHG credits, carbon contracting and enforcement
- Insurance costs – project risk insurance
  - GHG credit insurance (Difficult to get or too expensive today)
- Regulatory approval costs (GHG)
  - Project validation and government review (May include both domestic and international validation costs)
- Monitoring and verification costs (GHG) – During project implementation
  - Monitoring including equipment cost, verification and certification (Spread over many years of project life)

Transaction Costs: Data Sources

- Data Set 1: (11 forestry projects out of 26 total)
  - The Nature Conservancy -- Bolivia, and Brazil
  - Indian Institute of Science
  - Oregon Climate Trust
  - Natural Resources Canada (Forestry)
- Three other data sets on energy projects (

Descriptions of Belize, Bolivia and Brazil Projects

Project Name	Rio Bravo	Noel Kempff Climate Action Project	Guaraquecaba Climate Action Project	Atlantic Rainforest Restoration Project	Antonina Pilot Reforestation Project
Project type (AIJ Category)	Forest preservation	Forest preservation	Forest restoration	Forest restoration	Forest restoration
Host Country	Belize	Bolivia	Brazil	Brazil	Brazil
Project developer	TNC, PfB*	TNC, FAN, GOB*	TNC, SPVS*	TNC, SPVS*	TNC, SPVS*
Carbon credit buyers	US utility companies	AEP, Pacificorp, BP Amoco	AEP	GM	Texaco
Project Size	50,328 ha	634,286 ha	8,100 ha	12,000 ha	1,000 ha
Funding identified for Non-GHG goals	No	Yes	No	No	No
Project lifetime (years)	40	30	40	40	40
Initial Start Date	1996	1997	2000	2001	2001
Est. total carbon benefit — low tons (C)	2.4 million	6 million	339,600	660,000	106,000
Est. total carbon benefit — high (tons C)	2.4 million	8 million	566,000	1.1 million	162,000
Frequency of monitoring/ verification	3 years	Annual	5 years	5 years	5 years

*Abbreviations:
PfB: Programme for Belize
FAN: Fundacion de Amigos de la Naturaleza
SPVS: Sociedade de Pesquisa em Vida Selvagem e Educacao Ambiental (Society for Wildlife Research and Environmental Education)
GOB: Government of Brazil

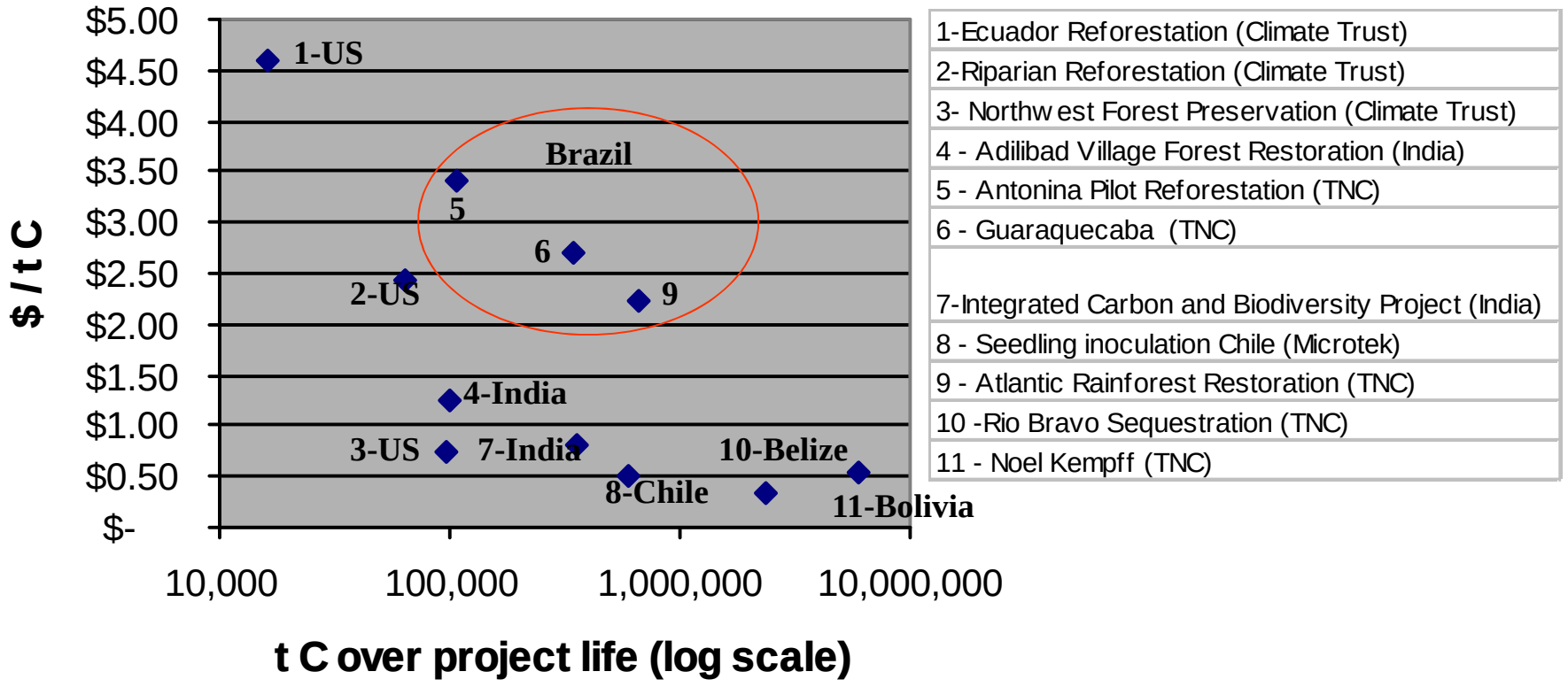
Data and information for the above projects is based on Henderson et al. 2003.

Descriptions of India, Chile and US Projects

Project Name	Village Based Forest Restoration Study	Integrated Carbon Sink Enhancement & Biodiversity Conservation Study	Seedling Inoculation	Rainforest Reforestation Project	Pacific Northwest Forest Preservation Project	Riparian Zone Reforestation Project
Project type (AIJ Category)	Forest restoration	Forest restoration	Afforestation	Forest restoration	Forest preservation	Forest restoration
Host Country	India	India	Chile	Ecuador	USA	USA
Project developer	Canadian Government	Karnataka Forest Department	Mikro-Tek, Instituto Forestal (Chile)	Climate Trust	Climate Trust	Climate Trust
Carbon credit buyers	Open market	Open market	Open market	Climate Trust partners	Climate Trust partners	Climate Trust partners
Carbon sellers	Local residents	Local residents	Local landowners	Jatun Sacha Foundation, Conservation International	Lummi Indian tribe	Private landowners
Institutional status	None	None	Canada's Voluntary Challenge & Registry	Oregon CO_2 program	Oregon CO_2 program	Oregon CO_2 program
Project Size	2000 ha	13,000 ha	5000 ha	275 ha	700 ha	830 ha
Funding for Non-GHG goals	Yes	Yes	Yes	Yes	Yes	Yes
Project lifetime (years)	10	5	12	99	100	52
Initial Start Date	2002	2002	1999	2002	2002	2001
Est. total carbon benefit — low tons (C)	100,000	358,800	600,000	16059	95446	63631
Est. total carbon benefit — high (tons C)	Same	Same	1,440,000	16059	95446	63631
Frequency of monitoring/ verification	Annual	Annual	Annual			

Data and information for US projects is based on Henderson et al. 2004.

Transaction Cost - Forestry Projects



Transaction costs: Work in progress on

- Statistical analysis of each data set with forestry combined with other projects to
  - Determine influence on cost components – search, feasibility, insurance, negotiation, regulatory, and monitoring and verification costs

- Factors being assessed:
  - Project Size
  - Multiple benefits – technology demonstration, social development, other environmental benefits
  - Forestry, energy efficiency, and renewable energy dummies
  - Regional dummies – Asia and Latin America
  - Mature vs. nascent markets
  - Smaller size projects

Conclusions

- Bottom-up curves of net carbon sequestration show low costs of carbon sequestration that
  - May increase with the inclusion of barriers, but
  - May decrease when other benefits and technological change are included
- Transaction costs of forestry projects
  - Range from less than $ 0.50 to almost $5 per t C
  - Vary significantly with project size
  - Decreased in Brazil with learning by doing