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ANDRÉ PEROLD

FOREST REINHARDT

MIKELL HYMAN

International Carbon Finance and EcoSecurities

In late 2007, Bruce Usher, Chief Executive Officer of EcoSecurities (AIM: ECO), a leading international supplier of carbon credits, received a call from Peter Ho, ECO's Country Manager in Beijing, China. Ho was calling to pitch Usher on a new project opportunity to destroy methane, a potent greenhouse gas, released from an underground coalmine located in China's Sichuan province. If successful, the Ventilation Air Methane ("VAM") project would be the first of its kind to earn revenues from the sale of carbon credits issued by the United Nations (UN) under the Kyoto Protocol. There would likely also be opportunities to implement VAM projects elsewhere in China and in other countries, and ECO could achieve a first-mover advantage in this untapped project sector. Usher needed to decide whether to give Ho the green light.

The Kyoto Protocol was the first international treaty to address global climate change by directly regulating human-caused greenhouse gas emissions. Humans emitted greenhouse gases primarily by burning fossil fuels (coal, oil, and natural gas) to produce energy, and through land-use change. Industrialized nations that ratified the Kyoto Protocol had to cut their emissions, on average, 5% below 1990 levels between 2008 and 2012. Through the Kyoto Protocol's Clean Development Mechanism ("CDM"), regulated governments and firms could fulfill their emission reduction obligations, in part, by purchasing credits generated by projects that reduced emissions in developing countries. Projects that the UN approved were registered, and could earn carbon credits called Certified Emission Reductions ("CERs"). A CER represented one reduced tonne of carbon dioxide or its equivalent in another greenhouse gas (CO_2e). There were six major greenhouse gases. Emitting one tonne of methane, for example, was comparable to emitting 21 tonnes of CO_2.

Usher expected countries with Kyoto obligations to face a cumulative deficit of 3.3 billion tonnes of CO_2e between 2008 and 2012. In view of that demand, nearly 3,000 CDM projects had been submitted for UN approval, and were slated to deliver 2.4 billion CERs by 2012.[1] Of those projects, the UN had approved 883 to date, of which roughly 10% were sponsored by ECO, more than any other single buyer in the market (see **Exhibits 1** and **2**).

Background on EcoSecurities

Formed the same year (1997) that the Kyoto Protocol was adopted, ECO was one of the oldest firms in the evolving carbon market. Headquartered in Dublin, ECO's mission was to facilitate the acquisition of carbon credits by firms in Europe, Japan, and North America, most of which sought to

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Professors André Perold and Forest Reinhardt and Research Associate Mikell Hyman prepared this case. Some case facts have been disguised to safeguard commercially sensitive and proprietary information belonging to EcoSecurities and third parties. HBS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

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offset their greenhouse gas emissions in compliance with government mandates. To that end, ECO sourced, developed, and secured financing for emission reduction projects. ECO steered projects through the UN approval process, and purchased the resultant carbon credits from project owners.

Usher joined ECO in 2002, after serving in executive roles on Wall Street. He had obtained his MBA from Harvard Business School in 1992. Under Usher's leadership, ECO floated its first shares on The London Stock Exchange's Alternative Investment Market in late 2005. The initial public offering raised $96 million, valuing the company at $244 million.[2] In the summer of 2007, ECO raised $133 million of new equity, of which the bank Credit Suisse contributed nearly $60 million for a 9% stake in the company. At the end of 2007, the firm's equity market capitalization was $345 million. See **Exhibits 3** and **4** for historical share prices, and for EcoSecurities financial data.

By late 2007, ECO had contracted 387 projects, of which 85 had gained UN approval and were expected to deliver 46 million CERs by 2012 (**Exhibit 5**). Another 128 projects were awaiting UN approval, and 174 were in earlier stages of development. In total, ECO expected these projects to deliver 140 million carbon credits by 2012 at an average cost to ECO of $10/CER. ECO had already forward sold 40 million CERs for delivery through 2012 at an average price of $20/CER.

Despite its leading market position, growing delays in the approval process and uncertainty regarding the post–Kyoto regulatory environment prompted ECO to explore new segments of the carbon market. ECO started sourcing credits in the United States and, since 2006, also selectively used its own capital to finance and implement projects (the VAM Project representing one such opportunity).

The Ventilation Air Methane (VAM) Project

Context The proposed project site was the State-owned Duofeng coalmine that had been operating in China's Sichuan Province for nearly 40 years. In 2006, the underground mine had proved reserves of approximately 200 million tonnes of anthracite coal.

Cheap coal was a huge boon to the Chinese economy, but, as one reporter for the China Daily Newspaper described it, coalmining was "the deadliest job in China."[3] Each year, explosions in underground coalmines injured or killed thousands of miners. Explosions occurred when methane gas accumulated in areas where miners worked. The gas was ordinarily stored in and between layers of coal and rock, but leaked into work areas when mining activities agitated the surrounding land. In certain concentrations, the gas became flammable and could easily ignite if a strike against the mine wall formed a hot spot or a spark.[4] To improve safety, mine owners were required to keep methane concentrations low in work areas.[5]

Removing methane from coalmines proved crucial to miner safety, but dumping methane in the air contributed to global climate change. In 2000, coalmines accounted for 8% of all human-caused methane emissions, other sources of which included landfills, natural gas and petroleum production, agricultural activities, combustion, wastewater treatment, and certain industrial processes.[6] See **Exhibit 6** for methane emissions from select countries.

Mine owners controlled methane accumulation with a combination of ventilators and drainage systems. Ventilation units, installed at the mine mouth, introduced fresh air into the mine, flushing stale air out. Drainage systems involved boreholes drilled in the earth surrounding a mine. The boreholes collected methane, which travelled to the surface through pipes. Whereas the concentration of methane in ventilated air was low, typically within 1%, drained methane had concentrations ranging from 30% to 90%, depending on the drainage technique.[7] Ventilated methane, however, usually exited mines in higher volumes than drained methane.

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Methane was the main constituent of natural gas, which accounted for over 20% of global energy consumption.[8] Methane liberated from mines in high concentrations could be used to produce energy, and towns, utilities, and certain industries in China had been using drained methane for this purpose since the 1950s.[9] The concentration of ventilated methane was too low to be combustible.

Only projects that abated drained coalmine methane emissions had thus far been submitted to the UN. Six projects had been registered to date, all located in China, which had quickly emerged as the world's largest exporter of CERs. In keeping with the Chinese government's requirements, the projects all used the gas to produce heat or power. Reductions of CO_2e per year ranged between 41,000 tonnes for the smallest project, and 2.1 million tonnes per year for the largest.[10] No requests for UN approval had yet been made for projects that reduced ventilated methane.

Project Description The VAM Project would use a new abatement technology developed by Tecterra, a leading international producer of industrial machinery. Tecterra was willing to lease ECO a machine called the FOVOC. The FOVOC, which stood for flameless oxidation of a volatile organic compound, was massive; its proportions resembled those of an 18-wheel truck. Three thousand square meters around the coalmine had to be leveled to accommodate the machine, which recovered the gas from the mouth of the ventilator's exhaust pipe.

Five kilometers south of the ventilator's exhaust site, methane was being drained from the earth surrounding the mine, and released into the air. Ho wanted to enrich the ventilation stream with the drained gas. Mixing the drained gas with the ventilated air stream was simple and inexpensive, and would increase the efficiency of the equipment by stabilizing the concentration of the gas.

Ventilated and drained methane exited the mine in about equal quantities, totaling approximately 20,000 tonnes of methane per year. The FOVOC would oxidize the mixed methane stream to convert the gas into CO_2 and water. The environmental damage of one tonne of methane was comparable to 21 tonnes of CO_2, but Usher adjusted the number to 18.05 in order to reflect the 2.95 tonnes of CO_2 that the FOVOC emitted for every tonne of methane it destroyed, including emissions caused as a result of the machine's power consumption. Usher further conservatively estimated that only 50% of the potential emission reductions would be realized: Roughly a quarter of the methane would escape the FOVOC due to a combination of downtime for scheduled maintenance and gas being released from the mine sporadically at concentrations below the range of what the FOVOC could process. And then there was uncertainty relating to the performance of the FOVOC. The machine had proven effective in other industries, cleaning air from odor and certain other pollutants, but its application to VAM was limited to just a few trials. On net, Usher forecast that the project would abate about 10,000 tonnes of methane per year, equivalent to 180,500 tonnes of CO_2e.

Each tonne of avoided CO_2e earned one CER, but 2% of all CERs were drawn into a climate change adaptation fund for communities in countries that were especially vulnerable to climate change risks and that had fewer resources to address anticipated consequences of climate change. The effect would be to reduce expected credits to 176,890 CERs per annum.

Implementation The Project involved a three-way collaboration between ECO, Tecterra, and the coalmine owner. Ho had already begun preliminary negotiations with both parties, each of which had tentatively agreed to a ten-year contract with the possibility of renewal beyond 2018.

ECO's expenses relating to the negotiation as well as the preliminary evaluation of the project site would amount to $45,000. Upon reaching a deal, ECO would place an order for the FOVOC. It would take seven months for the machine to arrive at the project site from a factory in the Czech Republic, and another month to install. See **Exhibit 7** for the Project's timeline.

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In the meantime, ECO would undertake various civil and mechanical works in preparation of the machine's arrival. ECO would pay a local construction company to clear away a small coal processing factory and level the land near the ventilation shaft. There they would build a control room, a janitor's room, a low-voltage distribution room, and a pump room. They would also set up a power and water supply. In addition, gas pipes would be constructed to transport the drained methane to the FOVOC. Upfront costs for these works would amount to roughly $750,000.

As the project site was being prepared, ECO would begin writing the project design document (PDD)—a technical document that described the project activity, ascertained its social and environmental impact, and detailed the implementation plan. It would cost ECO approximately $55,000 to draw up this documentation. After the Chinese government gave its official approval, ECO would pay an independent, UN-accredited organization $15,000 to screen and validate the Project before being submitted to the UN. Once the UN approved and registered the project, it could start earning credits.

Initially, when ECO submitted the project for UN approval, it would have to pay a registration fee based on the expected annual credits. Each subsequent year, ECO would pay the same fee on issued CERs to help cover the UN's administrative costs. The fee was $0.10 per tonne for the first 15,000 tonnes of reduced CO_2e, and $0.20 for each tonne thereafter.

When the equipment became operational, ECO had to ensure that the machinery was properly monitored and that data was accurately collected. Ho estimated that annual operations, maintenance, and electricity costs would amount to $362,500. Although data were recorded electronically, mine managers also had to manually check volumes and methane concentrations of recovered air. A second independent UN approved organization would verify the accuracy of reported emission reductions. Annual costs of monitoring and verification were $50,000.

ECO paid 12.5% corporate income tax on profits, and applied a 15% discount rate when valuing project cash flows. The firm applied 5-year straight-line depreciation to all capital costs.

Risk Usher thought that, in some ways, the VAM Project was simpler than other types of methane reduction projects. Because Chinese law already required that mine owners manage methane concentrations, VAM emission reductions would be easier to measure than others, such as those involving livestock. Further, in keeping with Chinese government requirements, heat generated in the oxidation process would have to be used to produce electricity or to heat water. Supplying power to the Chinese grid would involve costly tariffs associated with a power purchase agreement so Ho was proposing that ECO instead use the recovered heat to supply hot water for free to the coalmine and its employees, most of whom lived on site. He was confident the government would approve the plan.

The major risks related to the UN approval process. Usher thought that the chances of UN approval were high since the Project's only revenues would come from the sale of carbon credits, a testament to the Project's "additionality." Additionality meant that emission reductions would not have occurred in a project's absence. In order to gain UN approval, each project had to be demonstrated additional. One way to do so was to prove that a project was not financially worthwhile in the absence of carbon revenues. Alternatively, a project was considered additional if it overcame other significant barriers to implementation. Beyond being financially additional, the VAM Project overcame technological and common practice barriers by creating access to a new technology that could capture and utilize previously unrecoverable emissions.

The Project's approval, however, could be complicated by its drained methane component. Although the drained methane was not currently being used, it was sufficiently concentrated to be

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combustible. There was a risk that the UN would view the drained gas supply as ineligible for certification if they thought it could be used profitably in the absence of the VAM Project. Based on what they knew, Usher believed there was a 20% chance that the UN would issue credits only for reductions of ventilated emissions and not for reductions of drained emissions, in which case the originally anticipated credits would be cut in half.

The timing of approval was also uncertain, and delays would be costly because emission reductions occurring in the interim would not be recognized. Delays also exposed ECO to the risk that the UN might modify its registration standards before approval was obtained.

Upon approval and registration, the VAM Project would generate credits through 2012. In late 2007, CERs were trading at prices around $26 per tonne of CO_2e (see **Exhibit 8**). Although historical prices for greenhouse gas emission permits had shown considerable volatility, Usher felt he could reasonably forecast CER prices through 2012. There was a forward market in CERs, which, in late 2007, were trading at around $26/tonne for delivery in 2008 through 2012. That said, there was no way of knowing what prices might look like after the Kyoto Protocol expired in 2012. It was unclear what, if any, international regulatory framework would succeed the Kyoto Protocol. If there was a new global pact on climate change, it might not preserve the current market design. Future regulatory developments could undermine the value of emission reductions produced after 2012. These uncertainties complicated the deal at hand.

Finally, Usher was also concerned about financial risk related to cost overruns. He decided ECO would have to set aside another $500,000 as a contingency reserve for miscellaneous unanticipated expenses.

Structuring an Agreement The mine owner would be accountable for the gas supply, and agreement had already been reached that ECO would pay the mine owner $4 per credit, inclusive of a $0.20 tax per CER that the mine owner would pay to the Chinese government for the sale of CERs. Ho thought that future regulatory uncertainty would not deter the mine owner since it would incur little direct cost if the Project ceased to generate CERs after 2012.

Tecterra, on the other hand, would be accountable for the FOVOC's performance, and would be investing heavily in the Project. Ho thought it would cost Tecterra approximately $5 million to manufacture, ship, install, and insure the FOVOC. ECO would lease the equipment from Tecterra, and the lease agreement required negotiation. ECO had to propose a lease fee that met Tecterra's required rate of return while keeping ECO's overall costs of acquiring the CERs below $18 per credit. At that time, $18 was the maximum price ECO would pay for CERs under normal circumstances if it managed the registration process but did not invest directly. Ho believed Tecterra to be risk averse, and that the company required a 20% pre-tax internal rate of return on its investment. He thought Tecterra would require ECO to continue to pay the agreed-upon lease fee through 2018, even if the Kyoto Protocol was not renewed in 2013 and CERs lost value.

The Decision

Despite lingering uncertainty, global demand for carbon credits was growing fast. Irrespective of the future of the Kyoto Protocol, the European Union had already committed to longer-term goals and to the continued use of trading mechanisms to help reach its goals. In addition, the leading candidates for the 2008 U.S. Presidential election had all endorsed binding emission reduction targets and a domestic carbon market.

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For ECO, the prospect of tapping a new sector was appealing as older project sectors were becoming saturated. If the Project succeeded, ECO's relationship with Tecterra would help secure more projects in the future.

Finally, even if ECO could not register the Project's emission reductions as CERs or as other government-issued carbon credits, Usher knew the Project could gain approval in the voluntary market, where credits from the Project would likely sell for somewhere between $4 and $10.[11] On balance, Usher was optimistic about the permanence of the market. He now had to decide whether ECO should pursue the VAM opportunity.

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Exhibit 1 Certified Emission Reduction Supply by Host Nation, as of December 2007, in Thousands of Credits (kCERs)

	All CDM Projects			ECO's CDM Projects		
Country	Registered Projects	kCERs Issued to Date	kCERs Total Expected by 2012	Registered Projects	kCERs Issued to Date	kCERs Expected by 2012
Argentina	10	331	25,794	-	-	-
Armenia	3	0	1,074	-	-	-
Bangladesh	2	0	1,116	-	-	-
Bhutan	1	0.5	4	-	-	-
Bolivia	2	0	2,042	-	-	-
Brazil	108	16,029	118,363	13	727	10,366
Cambodia	1	0	293	-	-	-
Chile	22	2,089	25,675	-	-	-
China	148	36,295	527,663	13	42	9,241
Colombia	7	153	4,774	-	-	-
Costa Rica	5	0	2,071	-	-	-
Cuba	1	0	1,968	-	-	-
Cyprus	2	0	355	-	-	-
Dominican Republic	1	0	299	-	-	-
Ecuador	9	275	2,907	-	-	-
Egypt	3	1,224	10,360	-	-	-
El Salvador	5	135	3,912	-	-	-
Fiji	1	18	164	-	-	-
Georgia	1	0	286	-	-	-
Guatemala	5	198	2,410	-	-	-
Honduras	12	64	1,682	3	14	512
India	296	34,052	200,768	3	187	1,162
Indonesia	12	0	12,685	2	0	256
Israel	7	0	2,897	2	0	769
Jamaica	1	81	456	-	-	-
Laos	1	0	19	-	-	-
Malaysia	26	464	14,102	3	0	960
Mexico	99	2,701	41,481	32	2,152	18,095
Moldova	3	0	278	-	-	-
Mongolia	3	0	393	-	-	-
Morocco	4	26	1,560	-	-	-
Nepal	2	0	697	-	-	-
Nicaragua	3	263	3,497	1	73	1,965
Nigeria	1	0	10,521	-	-	-
Pakistan	1	0	6,300	-	-	-
Panama	5	0	803	1	0	111
Papua New Guinea	1	52	1,836	-	-	-
Peru	8	74	4,457	1	0	353
Philippines	15	28	1,954	9	0	190
Qatar	1	0	13,748	-	-	-
South Africa	12	0	13,421	1	0	380
South Korea	17	18,947	93,027	-	-	-
Sri Lanka	4	173	924	-	-	-
Thailand	5	0	4,160	1	0	1,697
Tunisia	2	0	4,125	-	-	-
Tanzania	1	0	1,112	-	-	-
Uganda	1	0	290	-	-	-
Uruguay	1	0	98	-	-	-
Viet Nam	2	0	6,933	-	-	-
Total	**883**	**113,672**	**1,175,754**	**85**	**3,195**	**46,056**

Source: Jørgen Fenhann, "CDM Pipeline," United Nations Environment Program Risø Centre, February 1, 2008. Accessed February 13, 2008 via http://cdmpipeline.org/.

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Exhibit 2 Top Twenty Buyers in the Market for Certified Emission Reductions, as of December 2007, in Thousands of Credits (kCERs)

Buyer	Projects Submitted for UN Approval[a]	kCERs Expected by 2012 from Submitted Projects[b]	Percent of CERs Expected from HFC Projects[c]	Total Projects Approved to Date	%Submitted Projects Approved	kCERs Issued to Date
ENEL	58	280,280	86%	10	17%	41,881
Mitsubishi	50	234,920	75%	10	20%	24,593
Trading Emissions	50	171,601	70%	9	18%	18,120
EDF Trading	67	143,276	61%	41	61%	32,868
EcoSecurities[d]	213	129,885	11%	85	40%	3,195
Danish Ministry Energy	30	127,761	95%	13	43%	17,802
Noble Carbon	42	113,434	29%	37	89%	25,506
Climate Change Capital	28	106,312	78%	6	21%	9,624
IBRD	60	90,732	56%	28	47%	7,679
CAMCO	37	72,682	0%	4	11%	-
Carbon Asset Mgt. Sweden	98	52,023	0%	25	26%	1,721
RWE	49	43,530	0%	4	8%	1,764
Energy Systems International	32	30,351	0%	14	44%	29
Kommunalkredit	34	28,269	0%	17	50%	1,571
Agrinergy[e]	48	21,665	0%	19	40%	317
Carbon Resource Mgt.	32	15,895	0%	14	44%	24
MGM Carbon Portfolio	31	14,205	0%	1	3%	-
AgCert	50	13,590	0%	49	98%	489
Mitsubishi UFJ Securities	28	9,397	0%	8	29%	-
Cargill International.[f]	41	6,590	0%	30	73%	-

Source: Data from Jørgen Fenhann, "CDM Pipeline," United Nations Environment Program Risø Centre, February 1, 2008. Accessed February 13, 2008 via http://cdmpipeline.org.

Notes: a. In some cases, projects had more than one buyer. Projects with more than one buyer are here counted once for each buyer. Projects were in the following stages: At validation, correction request, registration request, registered, request for review, or under review.
b. Credits issued to projects with multiple buyers are here counted multiple times.
c. HFC projects generated huge amounts of CERs, because HFC-23 was a highly potent greenhouse gas. HFC projects were controversial, and many regarded CERs generated from HFC projects as low-quality. HFC projects often had multiple buyers.
d. Excludes seven projects that were rejected or withdrawn.
e. Excludes three projects that were rejected or withdrawn.
f. Excludes two projects that were rejected or withdrawn.

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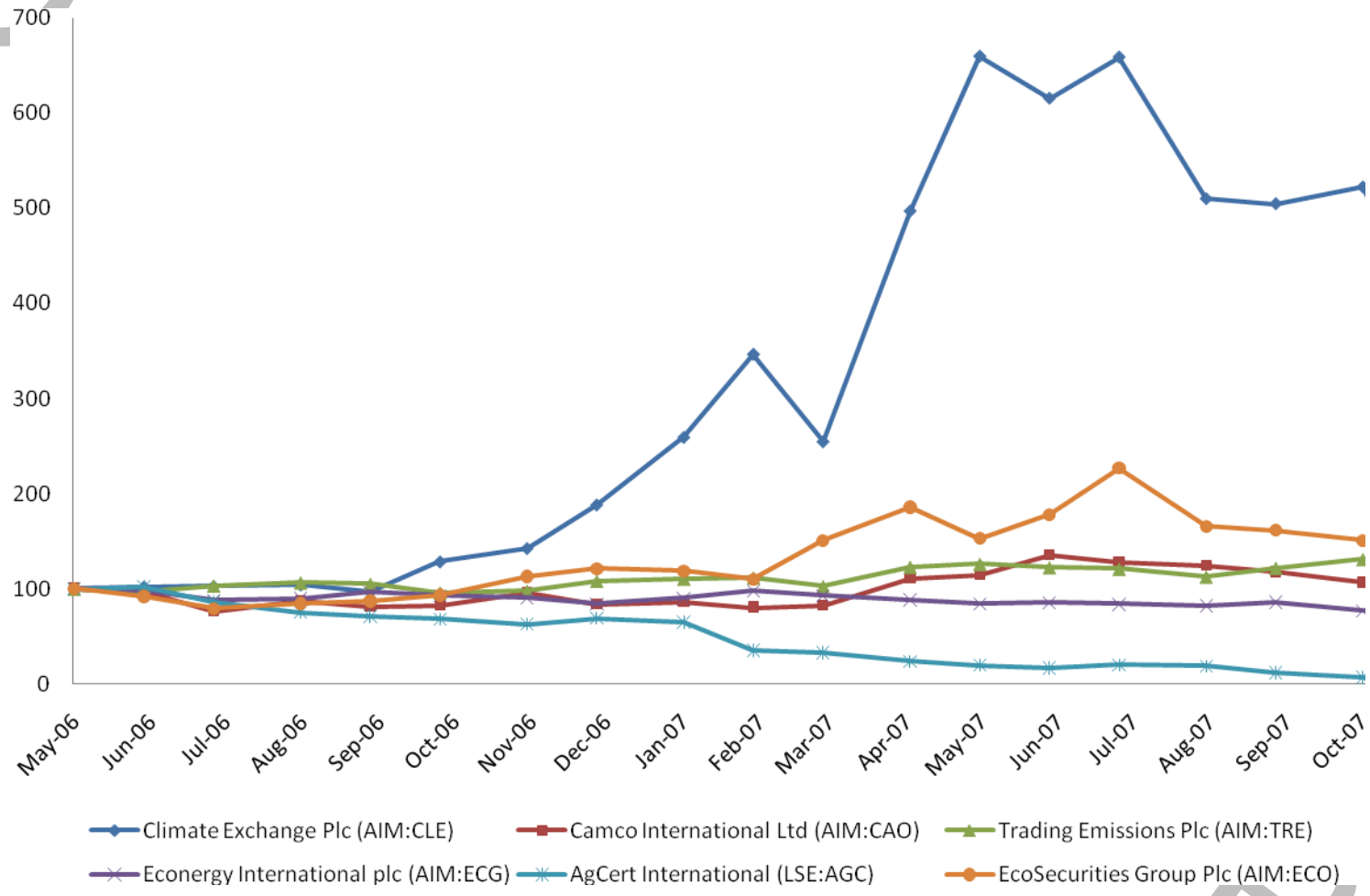
Exhibit 3 EcoSecurities and Competitors Historical Share Price Performance Index (May 2006 = 100)



Source: Data from Standard & Poor's Capital IQ, accessed January, 2008.

Note: Climate Exchange Plc owned market infrastructure such as the Chicago Climate Exchange and the European Climate Exchange, whereas the other firms bought and sold carbon credits.

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Exhibit 4 EcoSecurities Consolidated Financial Statements

Income Statement ($ 1,000)	12/31/2007	12/31/2006	12/31/2005
CER/VER Revenue	8,935	3,004	-
Consulting and Other Revenue	1,711	1,526	3,414
Total Revenue	10,646	4,530	3,414
Cost of Sales	(9,580)	(2,025)	(3,193)
Gross Profit	1,066	2,505	221
Administrative Expenses	(54,002)	(33,494)	(6,100)
Loss Before Financing Costs	(52,937)	(30,990)	(5,879)
Finance Expense	(21,322)	(1,262)	(501)
Finance Income	10,382	3,545	184
Income Tax Expense	(2,577)	(845)	(170)
Loss for Financial Year	(66,453)	(29,551)	(6,365)

Balance Sheet ($ 1,000)	12/31/2007	12/31/2006	12/31/2005
Property Plant & Equipment	6,946	3,631	66
Intangibles	5,954	5,030	4,350
Investment in Subsidiaries	-	-	46,648
Deferred Tax Asset	338	-	-
Trade and Other Receivables	1,229	783	702
Total Non-Current Assets	14,467	9,443	51,766
Inventory	16,092	-	-
Derivative Financial Assets	3,893	-	-
Trade and Other Receivables	30,917	7,400	6,993
Cash and Cash Equivalents	129,837	89,115	85,176
Total Current Assets	180,739	96,515	92,170
Total Assets	195,207	105,959	143,936
Total Equity	152,151	76,193	116,181
Non Current Liabilities	4,756	4,567	4,565
Current Liabilities	38,300	25,199	23,190
Total Equity and Liabilities	195,207	105,959	143,936

Cash Flow Statement ($ 1,000)	12/31/2007	12/31/2006	12/31/2005
Net Cash Out Flow From Operating Activities	(75,360)	(22,403)	(4,588)
Net Cash Used in Investing Activities	(11,750)	(5,882)	(346)
Net Cash Generated/(Used) from Financing Activities	111,359	(12,178)	126,516
Net Increase/(decrease) in Cash & Cash Equivalents	24,248	(40,462)	121,582
Cash and Cash Equivalents at Period Start	79,670	121,713	114
FX on Cash Equivalents	(2,749)	(1,582)	19
Cash and Cash Equivalents at Period End	101,169	79,670	121,713
Restricted Cash	28,668	9,445	859
Total Cash	129,837	89,115	122,572

Source: EcoSecurities Group plc, "2007 Preliminary Results Presentation," March 13, 2008.

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Exhibit 5 EcoSecurities Projects by Region, as of December 2007

	Number of Submitted Projects			Africa and the Middle East			Asia			South and Central America		
	Total	Registered	Pipeline*	Total	Registered	Pipeline	Total	Registered	Pipeline	Total	Registered	Pipeline
Carbon Dioxide	**92**	**25**	**67**	**4**	**2**	**2**	**66**	**12**	**54**	**22**	**11**	**11**
Energy efficiency	7	3	4	2	2	0	3	0	3	2	1	1
Of which:												
Industry	3	3	0	2	2	0	0	0	0	1	1	0
Own generation	3	0	3	0	0	0	3	0	3	0	0	0
Supply side	1	0	1	0	0	0	0	0	0	1	0	1
Fossil fuel switch	5	1	4	2	0	2	2	0	2	1	1	0
Geothermal	2	1	1	0	0	0	0	0	0	2	1	1
Hydro	73	19	54	0	0	0	57	11	46	16	8	8
Wind	5	1	4	0	0	0	4	1	3	1	0	1
Methane	**104**	**59**	**45**	**2**	**0**	**2**	**50**	**21**	**29**	**52**	**38**	**14**
Biogas	53	39	14	0	0	0	20	11	9	33	28	5
Of which:												
Flaring	10	8	2	0	0	0	8	8	0	2	0	2
Power	43	31	12	0	0	0	12	3	9	31	28	3
Biomass	27	11	16	0	0	0	16	7	9	11	4	7
Coalmine	3	0	3	0	0	0	3	0	3	0	0	0
Landfill	21	9	12	2	0	2	11	3	8	8	6	2
Nitrous Oxide	**16**	**0**	**16**	**0**	**0**	**0**	**16**	**0**	**16**	**0**	**0**	**0**
Nitric acid	16	0	16	0	0	0	16	0	16	0	0	0
Hydrofluorocarbons	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**
HFC 23	1	1	0	0	0	0	0	0	0	1	1	0
Total	**213**	**85**	**128**	**6**	**2**	**4**	**132**	**33**	**99**	**75**	**50**	**25**

Source: Data from Jørgen Fenhann, "CDM Pipeline," United Nations Environment Program Risø Centre, February 1, 2008. Accessed February 13, 2008 via http://cdmpipeline.org.

*Note: "Pipeline" projects were those that had been submitted for United Nations approval and were in one of the following stages: At validation, correction request, registration request, request for review, or under review

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Exhibit 6 Select Countries' Methane Emissions in 2000 (million tonnes CO_2e)

		From Coalmines		
Country	**Economy-Wide**	**Ventilated and Drained**	**Percent Ventilated**	**Ventilated 2020 Forecast**
China	788	118	78%	129
United States	546	56	64%	40
India	498	16	25%	5
Russia	307	29	31%	12
Ukraine	148	30	77%	43
Mexico	161	2	100%	2
Australia	125	20	50%	14
Germany	83	17	6%	1
South Africa	53	7	86%	7
United Kingdom	50	7	29%	2
Poland	46	12	50%	5
Kazakhstan	28	10	50%	5
Czech Republic	11	5	20%	1
Other Countries	3,175	147	23%	44
World Total	6,021	476	48%	310

Source: Data compiled from United Stated Environmental Protection Agency, "Assessment of the Worldwide Market Potential for Oxidizing Coal Mine Ventilation Air Methane," July 2003. Accessed via http://www.epa.gov/cmop/docs/ventilation_air_methane.pdf on March 22, 2008; Climate Analysis Indicators Tool (CAIT) Version 5.0. (Washington, DC: World Resources Institute, 2008). Accessed via http://cait.wri.org/cait.php on March 22, 2008; United Stated Environmental Protection Agency, "CMM Global Overview," July 2006. Accessed via http://www.methanetomarkets.org/resources/coalmines/docs/overviewfull.pdf, May 29, 2008.

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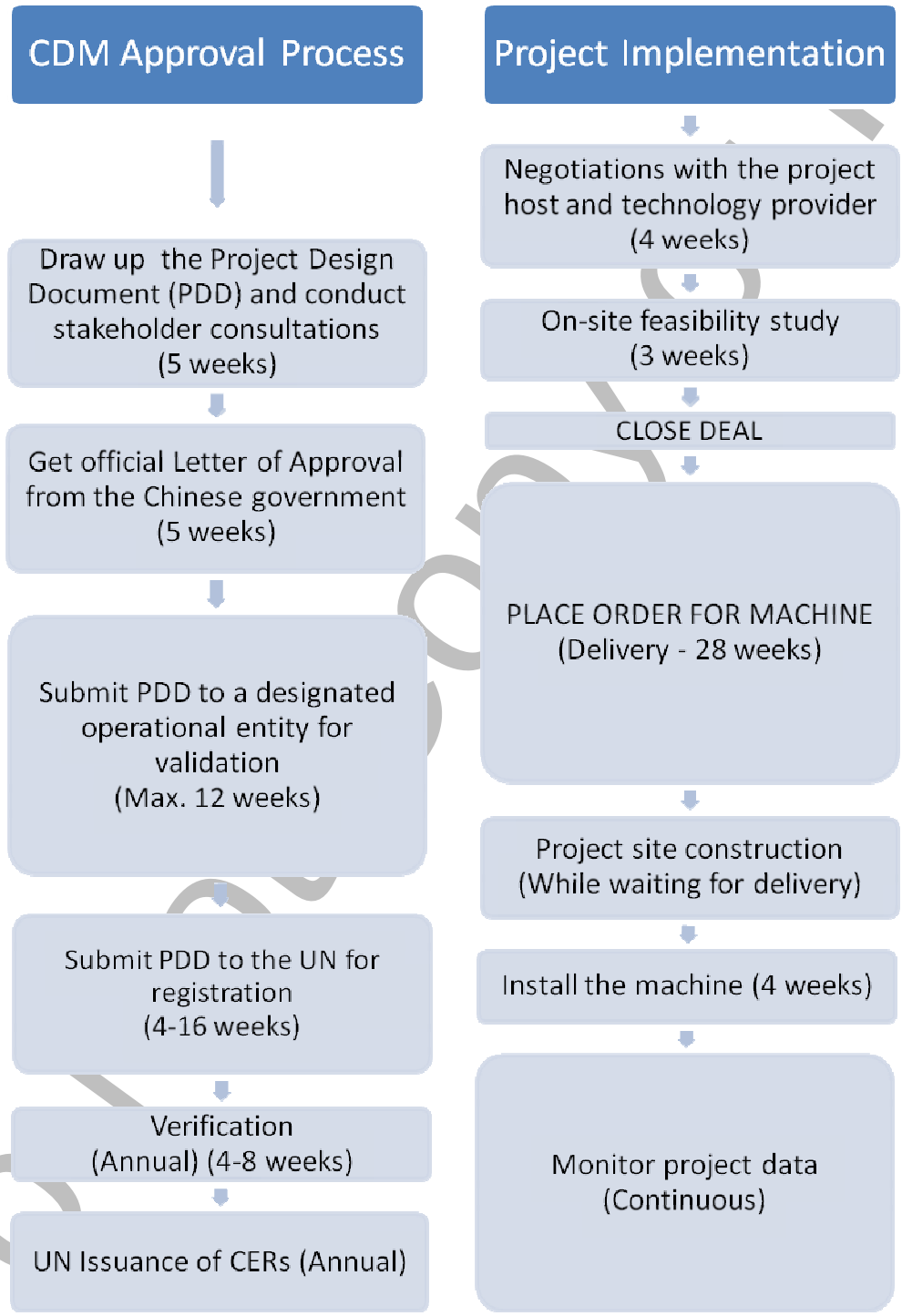
Exhibit 7 Ventilation Air Methane Project Timeline



Source: EcoSecurities.

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Exhibit 8 Historical Exchange Prices for European Union Allowances (EUAs) and Secondary Certified Emission Reductions (USD per tonne CO_2e)

Source: Data from Point Carbon.

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Appendix A Selected EcoSecurities Projects[12]

The following are illustrative of projects undertaken by ECO. In all cases, they were financed by others. ECO managed the projects' approval and registration process, and purchased the credits.

Carbon Dioxide (CO2)

Maoshaping Hydropower Project (China) The Yangbi Heihuijiang Electric Power Development Company built a small hydropower plant in the Yangbi River, which ran through the Yunnan Province. Hydropower was a form of renewable energy that captured energy from natural water flows. With an installed capacity of 7.5 MW, from three 2.5 MW turbines, the plant could displace up to 40,530 MWh per year of conventional coal-fired electricity that would be supplied to local and regional power grids. The Project's upfront costs were high at $6.6 million. The annual operating costs were $5 per MWh. ECO expected the Project to reduce roughly 32,000 tonnes of CO_2e per year, for seven years.

Beijing Building Material Group Project (China) The cement industry contributed 5% of human-caused CO_2 emissions, globally. Half of those emissions resulted from the stage of cement production in which limestone and other ingredients were mixed in a kiln to form "clinker." The BBMG Project recovered waste heat from clinker production at two sites in China, just outside of Beijing. The recovered heat was used to supply the facilities with power. The Project replaced about 20% of the two sites historical consumption of conventional coal-fired power. ECO expected the Project to reduce about 74,000 tonnes of CO_2e a year, for seven years. The Project's upfront costs were estimated to be $6.1 million. Anticipated operating costs were $32 per MWh.

Methane (CH4)

Bandar Baru Serting Biomass Project (Malaysia) Palm fruits grew in bunches on oil palm trees, and were used to make palm oil. In the early stages of processing, palm fruits were stripped from fresh fruit bunches, and the husks were discarded. Typically, palm oil producers burned the husks, but starting in the 1990s, when the Malaysian government began to curb open air burning, many producers started leaving piles of husks to decompose in the fields, and release methane into the air.

The Bandar Baru Serting Biomass Project avoided methane emissions by collecting palm fruit husks that would otherwise have been left to naturally decompose. Once dried, the husks were burned to produce steam and generate electricity, supplied to the local grid. The duration of ECO's contract with the project host and technology provider was 21 years. In its first seven years, ECO expected the Project to reduce an average of 74,000 tonnes of CO_2e per year.

The Ecatepec Project (Mexico) The landfill gas ("LFG") sector was popular because there were many projects that were large and relatively easy to implement. The first project the UN ever registered was a landfill project that ECO had contracted in Brazil. One ECO manager remarked, "Like they say, one man's trash is another man's treasure." By 2008, however, the sector had become largely saturated as most big landfills in developing countries had been tapped.

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About 75 miles Northwest of Mexico City, in Ecatepec de Morelos, the government-owned Santa Maria Chiconautla landfill received 1,600 tonnes of municipal waste a year. ECO contracted to purchase about 200,000 CERs a year, for ten years. The technology provider, UK-based Biogas Technology Ltd., drilled vertical wells into the landfill, where they installed blowers. The blowers drew gas into collection pipes that connected to a larger pipe, which transported the gas to the plant where it was flared. The Project could annually generate between two and five MWh electricity, which would be fed into the regional grid.

Granjas Carrol Mexico Farm Project, Number 16 (Mexico) Swine waste treatment in Mexico promised to be a fruitful project sector for ECO, because Mexico had 5 million farms and over 18 million pigs. Hog production was one of Mexico's most important livestock industries, and was growing by 2% to 3% each year. The drawback of projects that recovered methane from animal waste was that it was difficult to precisely measure emission reductions. The UN, seeking to improve the methods by which such projects were implemented, modified the approved project protocol in such a way that caused AgCert, one of ECO's competitors, to underperform on its projects and eventually go bankrupt.

The Granjas Carrol farm, located near Puebla, Mexico, produced various livestock, but the Project focused exclusively on pig waste. Methane emissions were avoided by exposing pig waste to a process of anaerobic digestion. The Project also displaced conventional coal-fired electricity by using the resultant biogas to produce power. Over the course of the ten year contract, the Project was expected to generate an average of 23,450 CERs per year.

Nitrous Oxide (N2O)

Shijiazhuang Jinshi N_2O Abatement Project (China) Humans unintentionally released significant quantities of N_2O gas when producing Nitric Acid (HNO_3), a key component of chemical fertilizers and of explosives. Emitting one tonne of N_2O had the same impact as emitting 310 tonnes of CO_2.

At a Nitric Acid plant in China's HeiBei Province, the Shijiazhuang Jinshi Chemical Fertilizer Company agreed to reduce its N_2O emissions by fitting new equipment to an existing installation that would break the N_2O into nitrogen (N) and oxygen (O). Excluding monitoring costs and carbon revenues, ECO estimated the Project to cost $0.80 per tonne of reduced CO_2e. The Project's lifetime was 21 years, but the preliminary contract lasted seven years, and anticipated 200,000 tonnes of reduced CO_2e per year.

Synthetic Gases: Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulfur Hexafluoride (SF_6)

Quimobásicos HFC Recovery and Decomposition Project (Mexico) HFC 23 was one of a group of hydrofluorocarbons. It was an exceptionally potent greenhouse gas that was emitted while producing refrigerants. One tonne of HFC 23 trapped 11,700 times as much heat in the atmosphere as a tonne of CO_2. Quimobásicos S.A. de C.V., was jointly owned by Mexican conglomerate Cydsa (51%) and U.S. Honeywell Inc. (49%). The firm produced gases for refrigeration, propellants, foaming agents that were sold in North America, South and Central America, and in Asia. The Project was expected to reduce 1,290 tonnes of HFC 23 emissions over a seven year period, which translated into 2 million tonnes of reduced CO_2e per year.

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