

Klamath Cogeneration Project 2005 Annual Report to the Energy Facility Siting Council



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Revision 1

**Prepared for:
Klamath Cogeneration Project**

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ATTRIBUTION

Data, information and text in this report concerning the years prior to 2004 are taken from “Klamath Cogeneration Project 2003 Annual Report to EFSC” (June 2003) and “Klamath Cogeneration Project Five-Year Report to EFSC” (revised July 2004), both prepared by Trexler Climate + Energy Services, Inc. TRC Global Management Solutions has reviewed the primary data and calculations from those years and has made changes, primarily to report all data in short tons rather than metric tons. We note that in some cases data that were actually short tons were labeled as being metric tons.

REVISION LOG

Revision 1 dated October 3, 2005 is provided to change the column headings in Table 3-3 from “kWh” to “MWh”. All other references in the report to electricity generation have the correct units.

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1.0 EXECUTIVE SUMMARY¹

The Klamath Cogeneration Project (KCP), a 484 megawatt (MW) natural gas-fired combined cycle cogeneration plant and related facilities, was deemed substantially complete on July 28, 2001. PPM Energy, Inc. (PPM) manages KCP on behalf of the City of Klamath Falls (City), while PKE Energy, Inc. (PKE) operates and maintains the plant on the City's behalf.

This report has been prepared pursuant to Section III.F.(2) of the Klamath Cogeneration Project (KCP) Amended Site Certificate. This report grew out of the Oregon Energy Facility Siting Council's (EFSC) 1996 regulatory "exemption from need" proceeding. In that proceeding, the City and two independent power producers sought a 500 MW exemption from the state's need standard. In structuring the proceeding, EFSC determined that it would award the exemption to the applicant demonstrating the least environmental impact based on monetized net air emissions per kilowatt-hour of generation, including carbon dioxide (CO₂). Oregon's 1996 exemption-from-need proceeding marked the first time that CO₂ mitigation was included as a requirement in the United States or throughout the world. The City prevailed in that proceeding based on the proposed implementation of cogeneration at the KCP facility and a portfolio of climate change mitigation projects. The four project activities in the KCP offset portfolio are:

1. Fossil fuel displacement through coalbed methane utilization for power production;
2. Increased carbon sequestration through expansion of the Oregon Forest Resource Trust;
3. Solar rural electrification with photovoltaics in Asia; and
4. Expansion of the City of Klamath Falls' geothermal heating system.

EFSC's final assessment of the KCP portfolio, including cogeneration, credited KCP with approximately 9.4 million short tons (st) of CO₂ reductions from cogeneration and offsets over a 100-year period, equivalent to roughly a quarter of the project's emissions over 30 years. Of these, 8.2 million st of projected reductions were from the offset portfolio, and 2.2 million st of projected reductions (after adjustment for uncertainty) were from cogeneration associated with the provision of steam to the Collins Pine wood-processing facility in Klamath Falls.

EFSC's decision imposed an unprecedented set of site certificate conditions related to the implementation of KCP's climate change mitigation portfolio. These included:

- Mandating implementation of the offset portfolio, with ongoing monitoring and verification;
- KCP to undertake offset monitoring and verification programs at a cost of up to \$50,000 per year, in 1998 dollars;
- Establishing a contingency fund to cover any performance shortfalls in the portfolio;

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- Guaranteeing the estimated benefits of cogeneration, without adjustment (equal to 4,464,395 st over 30 years), with a requirement for implementation of alternative carbon offsets should cogeneration fall short of expectations;
- Guaranteeing the projected facility heat rate, again with provision for implementation of additional carbon offsets to cover any shortfall in actual heat rate;
- Submittal of annual reports providing interim updates on any significant project design changes, the status of implementation activities, and an assessment of the CO₂ offset performance to date; and
- Submittal of five-year reports covering similar topics as the annual reports, but providing more in depth analysis of offset project performance, greenhouse gas (GHG) reductions associated with the overall portfolio, and the lessons the portfolio offers with respect to the EFSC process.

The first report was filed with EFSC in 2002 and comprehensively reviewed the history of the portfolio. The report for calendar year 2002 was filed in June 2003. The five-year report finalized in July 2004 included data for calendar year 2003 and summarized overall portfolio performance as well as projected portfolio performance in the future based on experience to that time. This 2005 annual report provides a review of portfolio developments in calendar year 2004.

In calendar year 2004, KCP expended \$45,000 for monitoring and verification programs.

The mitigation project elements achieved the following results during the year 2004:

Cogeneration: During 2004, the Klamath facility supplied an average of 71,214 pounds per hour (lbs/hr) of steam to the Collins plant. This is well below the 200,000 lbs/hr originally forecast, due to the fact that part of the Collins facility remains shut down. The offset benefit for 2004 was 53,154 st of CO₂ displaced.

Coalbed Methane: Net output for the Nelms 1 site (KFN1) project during 2004 was 1,703 megawatt hours (MWh). Net output from the Federal site (KFFED) was significantly improved at 3,908 MWh, reflecting the improved fuel supply. The Rose Valley site (KFRV) is still in development. Based on an avoided emissions rate of 0.90 st CO₂ per MWh (average emissions factor for Ohio²), electricity generation from the two sites during 2004 was equivalent to 5,220 st of CO₂.

Solar Rural Electrification: The project operator for the solar rural electrification offset project, the Solar Electric Light Co. (SELCO), allocated 1,860 systems to KCP for 2004. This is based on a 28 percent proxy “equity stake” for KCP. The total number of “KCP” systems installed is now 7,377. Based on an estimated CO₂ benefit of 0.35 st per system year (a likely conservative estimate given the installation of systems larger than originally anticipated), the offset benefit during 2004 is calculated to be 2,877 short tons.

² U.S. Department of Energy, Energy Information Administration Average Electricity Emission Factors by State and Region (Updated April 2002). Voluntary Reporting of Greenhouse Gases Program.
<http://www.eia.doe.gov/oiaf/1605/ee-factors.html> (site most recently visited July 7, 2005).

Forestry: The Oregon Forest Resource Trust (FRT) reforested 48 acres during 2004, for a total of 415 acres planted through the end of 2004. The CO₂ sequestration benefits of the FRT remain negligible since no acreage has reached the “free-to-grow” stage. This is expected in 2007.

Geothermal Heating System: The City of Klamath Falls (which is managing the geothermal project) has one additional building owner participating in the district geothermal heating system program. Thus, CO₂ offset benefits from the project remain negligible.

Overall, all four of the CO₂ offset projects are operational. The SELCO and NW Fuel projects are generating offsets. The FRT project has not yet generated measurable offsets due to the growth characteristics of Douglas fir, a slow-growing species. The first acreage planted under the KCP program is expected to reach the free-to-grow stage at the end of 2007. The City’s geothermal project is encountering significant problems in generating interest among building owners. The KCP’s cogeneration element is operating but the intended recipient of the generated steam is operating well below its anticipated capacity.

Table 1-1 provides a review of the annual offsets results:

Table 1-1: Summary of Offsets Performance 2000 – 2004

Project	2000 Offsets (st)^a	2001 Offsets (st)	2002 Offsets (st)	2003 Offsets (st)	2004 Offsets (st)	Total (st)
Cogeneration	0	15,301	50,077	53,324	53,154	171,856
Coalbed Methane	0	3,588	2,987	3,435	5,220	15,230
Forest Resource Trust	0	0	0	0	0	0
Solar Rural Electrification	282	764	1,209	1,855	2,582	6,692
Geothermal Heating System	0	0	0	0	0	0
Total	282	19,653	54,273	58,614	60,956	193,778

^a All data are in short tons (st).

Offsets from the Coalbed Methane and Solar Rural Electrification programs for the years 2000 – 2002 have been formally transferred to the EFSC. As of the date of this report, offsets for the years 2003 and 2004 are in the process of being formally transferred. Cogeneration offsets have not been transferred to the EFSC because title to the offsets is in dispute between KCP and the steam recipient.

Table 1-2 provides a review of the portfolio performance:

Table 1-2: Summary of Portfolio Performance 2000 – 2004

Project	Funds Allocated to Date³ (\$)	CO₂ Offsets to date⁴ (st)^a	Current Projected Lifetime Offsets⁴ (st)	Original Expected Total CO₂ Offsets⁴ (st)
Coalbed Methane	1,000,000 ⁵	15,230	340,000	4,739,668 ⁶
Forest Resource Trust	508,539	0	500,000	3,352,000
Solar Rural Electrification	500,000	6,692	135,000 ⁷	938,332
Geothermal Heating System	7,000 ⁸	0	16,000	141,393
Cogeneration	N/A	171,856	4,464,395 ⁹	4,464,395
Total	2,015,539	193,778	5,455,395	13,635,788

^a All data are in short tons (st).

³ KCP has distributed all of the required offset funds into the respective project trusts. The dollar figures in this column refer to the amount of funds the projects have taken from the trusts for project development and implementation.

⁴ These estimates use the EFSC adjustment factors.

⁵ The coal mine methane project developer has requested a total of approximately \$1.3 million from the Methane Energy Trust (MET). However, some of that funding has been reimbursed back to the MET.

⁶ Originally, \$500,000 was allocated to the coalbed methane program with an expected net CO₂ offset benefit of 2,369,834 st and \$500,000 was allocated to the sewage methane program with an expected CO₂ offset benefit of 357,058 st. Shortly after project inception, the entire allocation was shifted to coalbed methane, so the total expected CO₂ offset benefit was 4,739,668 st.

⁷ A portion of the adjustment for the solar rural electrification results from changes in the methodology used for estimating avoiding CO₂ rather than from project under-performance.

⁸ A total of \$100,000 has been allocated from KCP to the geothermal revolving loan account. Approximately \$7,000 has been spent to hook up one building owner to the heating system.

⁹ This figure accounts for the site certificate requirement that the calculated cogeneration-based offsets without adjustment be guaranteed by KCP.

2.0 MITIGATION COMPONENT #1: KLAMATH COGENERATION PLANT

2.1. PROJECT OVERVIEW

EFSC initially estimated KCP's CO₂ emissions reductions based on the assumed cogeneration of heat and electricity at the 484-MW facility and the associated displacement of fossil fuels in the boilers of the Collins wood-processing facility in Klamath Falls. EFSC included the following assumptions and conditions in the final Site Certificate:

- Steam from the facility would displace Collins' on-site boilers, which are gas fired with the ability to fire on oil (they only fired oil when testing was required). The EFSC Site Certificate requires KCP to supply at least 200,000 pounds of steam per hour on average to the wood-processing plant over a five-year period.
- The City had to guarantee the estimated benefits of cogeneration without adjustment (equal to 4,464,395 short tons over 30 years); if the interim five-year targets are not met, the City is required to secure another steam host, or pursue additional offset programs in the event that another thermal host cannot be found.
- The City had to guarantee the projected facility heat rate, again with provisions for implementation of additional carbon offsets to cover shortfalls in the actual heat rate.

2.2. PROJECT PERFORMANCE ASSESSMENT

2.2.1. PROGRESS THROUGH 2001

The KCP plant began producing steam for off-site industrial use in July 2001. The facility provided approximately 218,300 million British Thermal Units (BTUs) of energy to the Collins plant, which is equivalent to approximately 50,000 pounds of steam per hour. The cogeneration project resulted in 15,301 st of CO₂ emission reductions. Steam production was lower than expected largely due to Collins' decision to shut down the plywood section of its facility before the KCP facility came on line, thus reducing its need for steam.

2.2.2. PROGRESS THROUGH 2002

During 2002, the KCP facility provided approximately 633,853 million BTUs of energy to the Collins plant, equivalent to approximately 62,408 pounds of steam per hour. As in 2001, the output was below the anticipated benchmark of 200,000 pounds per hour due to Collins' reduced need for steam. The cogeneration project resulted in 50,077 st of CO₂ emission reductions in 2002.

2.2.3. PROGRESS THROUGH 2003

During calendar year 2003, the KCP facility provided approximately 701,300 million BTU (871,377 million BTU displaced) of energy to the Collins plant, equivalent to approximately 71,100 pounds of steam per hour. As in 2001 and 2002, the output was below the anticipated benchmark of 200,000 pounds per hour due to Collins's reduced need for steam due to the shutdown of the plywood section of the Collins' plant. To the best of PPM's and PKE's knowledge, this section of the Collins plant will be shut down until further notice. Using the data

format and calculations agreed to between PKE and the Office of Energy, the number of short tons of CO₂ displaced during 2003 was approximately 53,324 st.

2.2.4. PROGRESS IN 2004

During calendar year 2004, the KCP facility provided approximately 759,519 million BTU (868,605 million BTU displaced) of energy to the Collins plant, equivalent to approximately 71,213 pounds of steam per hour. Collins continued to operate at a reduced schedule. To the best of PPM's and PKE's knowledge, this section of the Collins plant will be shut down until further notice. Using the data format and calculations agreed to between PKE and the Office of Energy, the number of tons of CO₂ displaced during 2004 was approximately 53,154 st.

2.3. SUMMARY

Table 2-1 summarizes project performance for 2001 through 2004.

Table 2-1: KCP Facility's Provision of Steam to Collins

Year	Months of Operation	# lbs. Steam sent to Collins	# Hours of Operation (approx.)	Flow rate (lb/hr)	CO₂ Offsets (short tons)
2001	July – December	181,288,984	3,884	46,675	15,301
2002	January – December	533,655,766	8,551	62,408	50,077
2003	January – December	623,281,664	8,758	71,159	53,324
2004	January – December	623,759,744	8,713	71,214	53,154

Source: PPM Energy, Inc. (June 2003, March 2004, and July 2005)

As noted, EFSC gave the KCP facility a five-year true-up period, which will technically not be reached until 2006. If the facility does not meet its steam target by mid-2006, it has until 2007 to identify a method by which to make up the shortfall. Alternatively, the City could purchase additional offsets at a time of its choosing.

2.4. UPDATING THE PROJECTED FOSSIL FUEL DISPLACEMENT FROM KCP COGENERATION OVER THE FACILITY'S LIFETIME

Because of the unexpected shutdown of the plywood section of the Collins plant, steam deliveries from the KCP facility have been significantly below expectations, leading to lower than anticipated fossil fuel and CO₂ displacement. Steam deliveries have averaged around 63,000 lbs per hour since operations began as compared to the anticipated deliveries of 200,000 lbs per hour.

Assuming steam deliveries continue at an average rate of 63,000 lbs per hour, total cogeneration offsets would be approximately 1.2 million tons before applying any uncertainty discount. This compares to the 4.5 million short tons originally estimated before adjustment. EFSC has required the City to make up any shortfall in offsets if the facility does not meet steam delivery targets by mid-2006.

3.0 OFFSET PROJECT #1: FOSSIL FUEL DISPLACEMENT THROUGH COALBED METHANE UTILIZATION FOR POWER PRODUCTION

3.1. PROJECT OVERVIEW

Under the EFSC Site Certificate, the City committed to invest \$1 million (in 1998 dollars) in projects operated by NW Fuel Development, Inc. These projects would extract useful energy for electricity production from two largely untapped sources: methane (CH₄) currently flared at sewage treatment plants around the Pacific Northwest, and CH₄ vented from coalbeds in the eastern United States. Early in 1999, NW Fuel decided to no longer pursue cogeneration opportunities at wastewater treatment plants; it became clear that the treatment plants generally are too small to be cost-competitive, even with carbon funding. As a result, NW Fuel shifted its focus exclusively to coalbed methane utilization projects. Therefore, the total expected CO₂ offset benefit was 4,739,668 st.

Although the capture and destruction of CH₄ generates carbon offsets in and of itself, the City was not allowed to count this stream of emission reductions for the benefit of the KCP facility under the terms of the Site Certificate, and NW Fuel retained control of these reductions. Instead the City will receive CO₂ offsets resulting from the displacement of fossil fuel sources of electricity rather than from methane capture.

3.1.1. PROJECT BACKGROUND AND ASSUMPTIONS

Key EFSC assumptions included:

- The City would commit \$1 million to the Methane Energy Trust (MET) to support NW Fuel's efforts to implement projects that would capture CH₄ from abandoned coalbeds and sewage treatment plants and utilize it as a source of energy.
- The use of methane for power production would result in displacement of grid-based electricity from fossil fuels.
- The life of the methane capture and utilization projects was assumed to be 20 years.
- Project revenues would be returned to the MET to support future project installations, creating a revolving fund that would finance additional methane capture projects over 30 years.
- The revolving fund was expected to result in the installation of a total of 24 megawatts (MW) of capacity utilizing coalbed CH₄ and 7.5 MW of capacity at sewage treatment plants, compared to the initial installation of 2 MW of capacity with \$1 million in upfront funding.
- EFSC applied a 0.6 CO₂ offset adjustment factor to cover project uncertainties.
- EFSC projected approximately 2.73 million short tons of CO₂ offsets from the CH₄ utilization projects over 50 years, 20 years after installation of the last project funded through the revolving fund.

Table 3-1 identifies other project assumptions used for the projects at the time EFSC approved the City’s proposal. As noted, project revenues would be used to fund new projects or additions to existing projects. NW Fuels agreed to return the net revenues from the initial projects to the MET for 10 years from the date of project implementation, after which time net revenues would accrue to NW Fuels. These funds would be invested in additional qualifying projects. The resulting revolving funds, when applied exclusively to coalbed methane projects, were projected to result in approximately 30 MW of coalbed methane recovery projects over 30 years.

Table 3-1: Carbon Quantification Assumptions: Methane Utilization Targets

2,315 short tons	Annual methane intake to support 900 kW system
7,096 MWh	Annual electricity output from a 900 kW system
1.025 short tons CO ₂ per MWh	Net emissions offset from coal bed methane-fired generation
7,273 short tons	Annual CO ₂ emissions reductions for a 900 kW system
27 units	Targeted number of unit installations
30 years	Period over which units will be installed
20 years	Lifetime of each unit
4,544,821 short tons	Projected gross total CO ₂ offset including sewage treatment
0.6	EFSC adjustment factor
2,726,892 short tons	EFSC approved net offset total including sewage treatment
3,949,724 short tons	Projected gross total CO ₂ offset for coalbed methane portion of project only
2,369,834 short tons	Net offset total for coalbed methane portion only
4,739,668 short tons	Calculated net offset total for project with all funds allocated for coalbed methane program

The gross projected magnitude of offsets from the coalbed methane utilization projects (including the sewage treatment projects) was 4.54 million st of CO₂ emissions. This calculation is based on the installation of methane capture and utilization units over 30 years. EFSC applied an adjustment factor of 0.6 to account for project uncertainties. EFSC believed that it was not appropriate to use a time-dependent discount rate to reflect project uncertainty, and simply chose to use an adjustment factor. Application of the adjustment factor resulted in the target total of 2.73 million st of CO₂ emissions offset over 50 years. With all funds allocated to the coalbed methane program, the projected net CO₂ offsets would be 4.74 million short tons.

3.1.2. TERMS OF CITY, MET AND NW FUEL AGREEMENTS

The City and NW Fuel signed the Methane Energy Trust agreement in April 1999; MET and NW Fuel signed an agreement regarding the revolving fund at the same time. The MET

agreement outlines the duties of the trustee, whose role is to manage trust assets for funding the CH₄ utilization projects; the revolving fund agreement governs use of the MET funds for the offset projects. The City advanced approximately \$1 million to the MET in September 1999. Key points of these agreements include:

- On the financial closing date for the KCP facility (April 28, 1999), the City transferred \$1,000,000 (1998 dollars) to an escrow account. The purpose of this account was to transfer funds to the MET, which would direct funding to NW Fuel for installations of its proprietary methane recovery technology.
- NW Fuel agreed to provide the City with CO₂ offsets for the benefit of KCP.
- Beginning on the 60th day after the facility closing date, NW Fuel could request funds from the MET to provide equity funding for projects.
- Each calendar month after a project begins to generate revenue, the project's net proceeds shall be allocated to the MET. This arrangement shall continue for 10 years from the date of initial commercial operation of the project.
- NW Fuel shall operate and maintain project for 20 years.
- NW Fuel shall submit quarterly reports to the MET detailing the electrical generation, CO₂ offsets, revenues, and expenses for funded projects.
- NW Fuel and MET may consider adding other types of CH₄ recapture projects to supplement funded projects, subject to prior written approval of EFSC.

3.2. PROJECT PERFORMANCE ASSESSMENT

3.2.1. PROGRESS THROUGH 2001

The first KCP report covered progress made by NW Fuel through 2001. NW Fuel requested approximately \$540,000 from the MET account during 2000 to begin development efforts on three qualifying projects: KFN1 in Ohio; KFRV in Ohio; and KFFED site in West Virginia. NW Fuel received an additional \$395,000 in MET funding in 2001 to advance implementation of these three projects.

As of December 31, 2001, the KFN1 project was operational; KFRV and KFFED were still in development. The KFN1 project began operating in December 2000. The proposed capacity of the project was 1.2 MW, based on the use of eight NW Fuel generation sets, each with a nominal capacity of 75 kilowatts (kW) for a total of 600 kW and one 600 kW Caterpillar generation engine. However, the project came online with only 600 kW of capacity, as NW Fuel had difficulty in purchasing a 600 kW engine.

Under EFSC assumptions, this project was expected to produce approximately 5,300 short tons of CO₂ offsets in 2001. In actuality, the KFN1 project resulted in 3,588 st of offsets in 2001. Unreliable fuel supplies, in addition to the difficulty in procuring an engine, caused this shortfall. NW Fuel planned to resolve the fuel supply issue by reaching a negotiated settlement with the supplier (Lahd Energy) and by drilling a new well at the KFN1 site to serve the project engines. NW Fuel also planned to continue to search for a 600 kW engine in 2002.

In 2001, an agreement was reached among the MET, NW Fuel, and TransAlta Corporation, a Canadian investor-owned utility. Under this agreement, TransAlta provided investment capital to NW Fuel for qualifying projects in exchange for title to the emission reductions resulting from capture of CH₄, reductions that are not part of the KCP portfolio. The KCP would benefit by receiving CO₂ offsets from additional qualifying projects resulting from accelerated project implementation.

As a result of this agreement, NW Fuel planned to repay 25-50 percent of the KFN1 project cost to the MET in 2002. NW Fuel will receive 50 percent of future net income from the KFN1 project; the MET will continue to receive the same level of offsets. The benefit of early repayment is that more capital became available for qualifying projects; this capital was reallocated to the KFFED project.

3.2.2. PROGRESS THROUGH 2002

As of the end of the third quarter of 2002, MET accounts showed that NW Fuel had requested a total of \$1,062,276 from the MET account: \$210,917 for KFN1, \$273,568 for KFRV (total spent is \$436,168 if one includes NW Fuel funds), and \$577,791 for KFFED (including the reallocated funds).

The original KCP funding was \$1,023,033, plus approximately \$65,000 in accumulated escrow interest through the end of 2001. During 2002, NW Fuel did not request additional funding from the MET for qualifying projects, since MET already had invested the \$1 million seed capital in the initial projects. Project net revenue during 2002 was negative, and the MET continued to incur basic trust administrative expenses. Due to the lack of available funding from the MET, during 2002 NW Fuel paid for operation and maintenance costs at KFN1 (approximately \$46,000) and advanced approximately \$163,000 of its own funds for the KFRV project.

The net output for the KFN1 project during 2002 was 2,074 MWh. Based on an avoided emissions rate of 0.90 st CO₂ per MWh (average emissions factor for Ohio), electricity generation from the site during 2002 was equivalent to 1,867 st CO₂. While all eight of the NW Fuel generation sets operated successfully during 2002, NW Fuel was not able to procure a 600 kW engine for the project. Fuel supply shortages resulted in the NW Fuel generation sets being off-line some of 2002. NW Fuel drilled a new well; however, the well showed a drop in methane quality later in the year. NW Fuel had to reduce the well's production rate, which resulted in less power generation. Other unforeseen circumstances included a lightning strike that destroyed the transformer and main circuit breaker panel box.

During the first half of 2002, NW Fuel reimbursed MET 50 percent of advanced funds for the KFN1 Project (\$193,089). Reimbursement funds for the KFN1 project were made possible by the TransAlta Corporation agreement and largely eliminated the impact of the fuel supply problems on the MET.

For the KFRV project, NW Fuel negotiated an access agreement in 2002 and was able to accomplish installation of the transmission lines interconnect. Generation set fabrication also continued during 2002.

The KFFED project came online in mid-2002; net output was 1,244 MWh. Based on an avoided emissions rate of 0.90 st CO₂ per MWh (average emissions factor for Ohio), electricity

generation from the KFFED site during 2002 was equivalent to 1,120 st CO₂. Problems encountered during 2002 involved fuel supply and weather.

3.2.3. PROGRESS THROUGH 2003

As of the end of the second quarter of 2003 (the last date for which financial data from MET were available as of the writing of this report), MET accounts showed that NW Fuel had requested a total of \$1,258,066 from the MET account: \$211,349 for KFN1; \$468,927 for KFRV, and \$577,791 for KFFED. These amounts are similar or identical to those provided at the end of the third quarter in 2002 for KFN1 and KFFED since those projects are now in operation; only KFRV continues to accumulate significant development charges. There are no current financial statements for the MET. NW Fuel reported that it does not believe that this is a significant issue, since the company has spent more of its own money on the various projects than required and the MET does not have any funds left to invest in new projects. NW Fuel has expended nearly \$300,000 of its own monies in developing and operating the projects in an attempt to get more projects on line and accelerate the program. KCP has written to MET to remind them of their obligation under the Trust Agreement to provide full quarterly financial and performance reports.

The KFN1 and KFFED projects continued operation during 2003. For various reasons including extremely cold weather conditions as well as pipeline disruptions to allow for another connection to the pipeline, the units were offline during some part of the year. Both continued to experience fuel supply problems. The well drilled in 2002 continued to show a drop in methane quality, requiring a reduction in the production rate from the well. NW Fuel did not have alternative fuel sources for the generator.

During 2003, NW Fuel connected two more fuel compressors in series with the original compressor, hoping to increase fuel availability. However, fuel availability continued to be a limiting factor, and the additional compressors were not sufficient to provide all the fuel to run more of the generators.

The Federal mine site operators sealed the area under the power generators in 2003. NW Fuel anticipated that sealing this area would allow more methane to be available in 2004 from a well that was drilled into the “sealed” entries next to this area.

Net output for KFN1 during 2003 was 2,002 MWh. Based on an avoided emissions rate of 0.90 st CO₂ per MWh (average emissions factor for Ohio), electricity generation from the site during 2003 was equivalent to 1,802 st CO₂.

Net output for the KFFED site during 2003 was 1,814 MWh. Based on an avoided emissions rate of 0.90 st CO₂ per MWh (average emissions factor for Ohio), electricity generation from the site during 2003 was equivalent to 1,633 st CO₂.

The KFRV project was still under development throughout 2003. NW Fuel’s financial reporting for 2003 has been delayed and is not available as of the date of this report.

3.2.4. PROGRESS IN 2004

KFN1 output was relatively steady throughout 2004 with the annual total at 1,892 MWh. Based on an avoided emissions rate of 0.90 st CO₂ per MWh (average emissions factor for Ohio), electricity generation from the site during 2004 was equivalent to 1,703 st CO₂.

In 2004, the KFFED site improved significantly, more than doubling its annual output to 3,908 MWh. This occurred as a result of improved fuel supply for the project due to the success of sealing the area under the mine. The new sealed area is providing 60 percent methane to the generating units. Based on an avoided emissions rate of 0.90 st CO₂ per MWh (average emissions factor for Ohio), electricity generation from the site during 2004 was equivalent to 3,517 st CO₂.

The KFRV project was still under development, although it was expected to start operation in 2005. NW Fuel's financial reporting for 2004 has been delayed and is not available as of the date of this report. PPM Energy has written to NW Fuel requesting the financial statements.

3.3. SUMMARY

The monitoring and verification plan originally proposed for the project directed NW Fuel to calculate local grid CO₂ emission factors based on utility fuel consumption and net generation. Given the dynamic nature of electricity grids, it is not possible to identify a utility that reduced its output as a result of the project. Instead, NW Fuels has utilized the Ohio state average emission baseline in its quarterly reports. This factor was selected for use as it is recommended under the U.S. Department of Energy's §1605(b) reporting program when plant-specific data are not applicable. Table 3-2 summarizes the baseline, using this factor and other relevant data.

Table 3-2: CO₂ Emission Offset Performance for Coalbed Methane Projects

	2001	2002	2003	2004
Project Electricity Generation (MWh)	3,987	3,318.5	3,816	5,800
CO ₂ Emission Factor (tons CO ₂ /MWh)	0.90	0.90	0.90	0.90
CO ₂ Offsets (short tons)	3,588	2,987	3,435	5,220

Source: Methane Energy Trust, 2002, 2003, 2004 and July 2005.

The coalbed methane offset project has faced numerous implementation difficulties that have been documented in this report and prior reports. CO₂ offsets generated during the last four years are shown in Table 3-3.

Table 3-3: Coalbed Methane Offsets 2001 – 2004

	KFN1 (Nelms 1)		KFFED (Federal)		Total	
	Electricity Generation (MWh)	Offsets (short tons)	Electricity Generation (MWh)	Offsets (short tons)	Electricity Generation (MWh)	Offsets (short tons)
2001	3,987	3,588	0	0	3,987	3,588
2002	2,074	1,867	1,244	1,120	3,318	2,987
2003	2,002	1,802	1,814	1,633	3,816	3,435
2004	1,892	1,703	3,908	3,517	5,800	5,220
Total	9,955	8,960	6,966	6,270	16,921	15,230

Source: Methane Energy Trust, 2002, 2003, 2004 and July 2005.

4.0 OFFSET PROJECT #2: INCREASED CARBON SEQUESTRATION THROUGH EXPANSION OF THE OREGON FOREST RESOURCES TRUST

4.1. PROJECT OVERVIEW

The Forest Resources Trust (FRT) was established by the Oregon legislature in 1993 with the objective of pursuing reforestation activities on up to 250,000 acres of eligible under-productive lands in western Oregon. This is a portion of the more than 600,000 acres of land (in western Oregon alone) that are believed to need reforestation, restocking, or other intervention. These acres primarily consist of private non-industrial lands whose landowners likely would not reforest them without external support. The Trust was established as a long-term revolving loan fund administered by the Oregon Department of Forestry (ODF). The Oregon legislature designed the Trust to be self-financing, but allocated startup funds from state lottery revenues. The FRT was designed to provide financial support to non-industrial private forest landowners to establish tree stands and improve management of Oregon forestlands for offsetting CO₂ emissions, timber production, wildlife support, water quality, and other environmental purposes.

Though the FRT promised significant environmental and economic benefits, competing budget priorities led the 1995 legislature to withdraw most of the anticipated program funding. As a result, the FRT almost certainly would not be able to meet its planting targets. The KCP carbon offset initiative sought to revitalize the FRT by contributing \$1.5 million to the program.

4.1.1. PROJECT BACKGROUND AND ASSUMPTIONS

Assumptions EFSC adopted in the 1996 proceeding were:

- Commitment by the City of \$1.5 million of funding to the Forest Resources Trust (FRT), which would offset CO₂ emissions through reforesting under-productive lands in western Oregon
- Achievement of a 1:1 matching fund objective, leading to funding of a total of \$3 million
- Program costs of \$480 per acre, covering site preparation and planting costs
- The resulting reforestation of 6,250 acres of Site Class II land, which is defined as cropland
- Sequestration of 670 short tons of CO₂ per acre over a 100-year period, and
- Application of a 0.8 CO₂ offset adjustment factor to cover uncertainties surrounding project performance.

It was assumed that carbon would accumulate on the lands for at least 65 years. At an average age of 65, it was assumed that initial plantings would be harvested, followed by replanting as required by the Oregon Forest Practices Act. Funds paid back to the FRT at the time of harvest would be used to finance planting of additional un-forested acres, ultimately doubling the total planted acreage resulting from the project. Table 4-1 summarizes the carbon quantification factors EFSC accepted in estimating the CO₂ benefits of the project, which led to a projected sequestration of approximately 3.35 million short tons of CO₂.

Table 4-1: FRT Carbon Quantification Assumptions

\$1,500,000	KCP investment in the Program
\$480 per acre	Program cost
6,250 acres	Reforested lands based on 1:1 matching funds – years 1 through 65
12,500 acres	Reforested lands – years 65 through 100
6.0 short tons of CO ₂ /acre	Reference case carbon uptake on reforested lands
670 short tons of CO ₂ /acre	Average net sequestration over 100 years
Year 65	Date of expected harvest and replanting
100 years	Project life
4,190,000 short tons	Total net sequestration after 100 years
0.8	EFSC project risk adjustment factor
3,352,000 short tons	EFSC approved net offset total

As shown in Table 4-1, the projected total sequestration was 4.2 million short tons of CO₂. EFSC applied a 0.8 adjustment factor to adjust for uncertainty. EFSC believed that it was not appropriate to use a time-dependent discount rate to reflect project uncertainty, and simply chose to use an adjustment factor. Application of this adjustment factor resulted in an EFSC-recognized offset total of 3.4 million short tons of CO₂.

4.1.2. TERMS OF THE KCP-FRT AGREEMENT

The City of Klamath Falls and the Oregon Department of Forestry (ODF) signed a memorandum of understanding regarding the FRT carbon offset program in April 1999. Notable features of this agreement included:

- The City agreed to transfer \$1.5 million (1998 dollars) to an escrow account for the FRT program on the financial closing date for the KCP facility. The City disbursed the funds to ODF pursuant to the agreement in July 1999. ODF allocated approximately 20 percent of the funds to administrative and technical assistance costs; the remaining 80 percent was allocated for reforestation activities.
- In exchange for the funding, the Board agreed to provide the City with CO₂ offsets for the benefit of the KCP.
- The Board agreed that the first 6,250 acres planted under the FRT program would be Site Class II lands, although it was agreed that this condition would be met if the average site productivity of the reforested lands was *equivalent* to Site Class II lands.
- The Board agreed that revenues repaid to the FRT at the time of the harvest would be used to plant additional acres for KCP's benefit.

- The Board agreed to create and maintain a “carbon account” to track carbon sequestration associated with activities on FRT lands.
- The Board agreed to provide the City with annual reports reviewing the status of the FRT program. The first of these status reports was in July 2002.

To enhance its ability to generate offsets for the benefit of KCP, the FRT added safeguards into its standard landowner contract. A key element of this contract is that it ties landowner repayment terms to harvest volume – not value. The contract provides that the amount owed to the FRT from harvesting is based on what the clear-cut volume of the stand would be at an age of 55 years. Thus, year 55 is set as the breakeven point and, as the set harvest date increases, so does the potential monetary return to landowners. As a result, landowners face a strong financial disincentive against early harvesting.

4.2. PROJECT PERFORMANCE ASSESSMENT

4.2.1. PROGRESS THROUGH 2001

The FRT began project implementation activities in 1999. As of the end of 2001, 69 acres had been planted and 153 additional acres were enrolled but not yet planted. The FRT had spent a total of \$59,942 of KCP funding. Most of the acres were on Site Class III land. The FRT found from the beginning that landowners with lower-quality lands are more likely to enroll in the program; it concluded that the contract provisions are not attractive enough to owners of higher-quality land capable of commercial timber production. The FRT expected to achieve average sequestration levels equivalent to those projected for Site Class II land through aggressive management techniques, including diligent site preparation, planting of high-quality stock, and regular maintenance of the stands.

Since plantings do not reach the “free-to-grow” stage¹⁰ for five years after planting, carbon sequestration as of the end of 2001 was negligible.

4.2.2. PROGRESS THROUGH 2002

For 2002, its fourth year of operations of the project, the FRT set a target of 250 acres. The ultimate goal was to plant 400-500 acres per year. The FRT hoped to achieve this goal in coming years with expanded outreach program efforts and through “word of mouth” among participating landowners. During 2002, the FRT enrolled (that is, contracted for) 104 acres involving four private landowners. Of this acreage, 94 percent (approximately 98 acres) was on Site Class III land and 6 percent (6 acres) was on Site Class IV lands. Reforestation was accomplished on 189 acres for a total acreage planted as of the end of 2002 of 258 acres.

Obstacles to achievement of the 400-500 acres per year goal included budget cuts and the resulting loss of forester staff. As of the end of 2002, the FRT was unsure whether the original goal would be achievable and revised its annual enrollment estimate to 100-200 acres per year.

¹⁰ “Free-to-grow” is defined as the stage at which trees generally can thrive independently and are no longer threatened by competition with other plants or susceptible to mouse damage.

During 2002, the FRT began to rely on private-sector consultants to conduct project outreach, site qualification, and project plan development. The FRT had one consultant under contract during 2002; at the end of the year, it was in the process of awarding contracts to six other consultants.

The volume of carbon sequestered as a result of the KCP investment in the FRT program continued to be negligible, since none of the reforested acres had reached the free-to-grow-stage. During 2002, FRT and KCP both indicated that there had been no change in the status of matching funds procurement.

4.2.3. PROGRESS THROUGH 2003

For 2003-2004, the FRT set a revised target of 100-200 acres per year. During the year, the FRT enrolled (that is, contracted for) 62 acres (all Site Class III) involving two private landowners. An additional 18 acres of Site Class II land were planted, but lost due to catastrophe. These 18 acres were released from contract. Reforestation was accomplished on 86 acres for a total acreage planted as of the end of 2003 of 344 acres.

During 2003, the FRT relied on private-sector consultants to conduct all project outreach, site qualification, and project plan development. There were 35 “inquiries” during the year regarding the offset program; none of these prospects signed up for the program during the year. As of early 2004, the FRT had six likely prospects involving approximately 120 acres total.

The volume of carbon sequestered as a result of the KCP investment in the FRT program continued to be negligible, since none of the reforested acres had reached the free-to-grow stage.

4.2.4. PROGRESS IN 2004¹¹

In 2004, FRT enrolled 13 acres of Site Class III land (one owner) and reforested 48 acres (one owner). Six landowners applied for the program in 2004. In addition to the one who was enrolled, three are currently being qualified for enrollment (total of 66 acres). Two others (with a total of 54.5 acres) are still considering whether to participate.

A total of 24 landowners inquired about the program, in addition to the six who applied. All were referred to the consultants for more information.

During 2004, there were three consultant foresters under contract to do all the program marketing. Two consultants generated prospects. The ODF would like to contract with additional consultants in other counties if staff time permits.

As noted in prior years, no carbon was sequestered since no acreage reforested with KCP funds has reached the free-to-grow stage. It is anticipated that 339 acres are expected to reach free-to-grow by the end of 2007.

4.3. SUMMARY

Table 4-2 lists FRT progress through the six years of operation. The “monies allocated” category represents the amount the FRT has earmarked for different projects until they reach the free-to-grow stage. The deviation between allocations and expenditures is explained by the fact that planting and subsequent treatments to control competing vegetation and protect seedlings span

¹¹ Email from L. Price, Oregon Department of Forestry, to M. Dubinsky of TRC, July 13, 2005.

several years, so money is not spent in the year it was allocated; consequently, these projects have not yet entered the “subsequent treatments” stage of the implementation timeline. The amount allocated in this category reflects expenditures the FRT expects to make over the next several years. Most planted acres are not expected to reach the free-to-grow stage until 2007.

Table 4-2: Review of Forest Resource Trust Activity

Year	Monies Allocated^a	Monies Spent^a	Acres Enrolled^b	Acres Planted
1 (1999)	\$11,092.50	\$1,768.42	12	0
2 (2000)	\$96,532.20	\$36,560.74	100	38
3 (2001)	\$200,859.00	\$59,942.47	151	30
4 (2002)	\$114,600.00	\$105,952.30	104	195
5 (2003)	\$66,300.00	\$107,026.59	62	104
6 (2004) ¹²	\$19,155.00	\$92,027.32	13	48
TOTAL	\$508,538.70	\$403,277.84	442	415

^a “Monies Allocated” and “Monies Spent” are for enrolled acres only; does not include monies spent for marketing, preliminary site visits by consultants, title policies, recording fees, or administration.

^b Includes 18 acres which were enrolled in 2002, and planted and released from contract in 2003 due to catastrophe.

Source: Forest Resource Trust, April 2003, March 2004 and July 2005.

During 2003, PPM on behalf of the City filed information with the Oregon Department of Energy summarizing the history of the matching funds efforts. In order to improve the success of these efforts, the FRT, with KCP’s support and consultation, began to consider alternative project models. The alternatives were to either seek to attract more Oregon landowners to the FRT program or offer a fundamentally different approach for securing carbon offsets through forestry activities in Oregon. As of the end of 2004, there was no change in the status of procurement of matching funds.

4.4. MONITORING AND VERIFICATION FOR THE FRT

In its original FRT project proposal, the City identified the potential elements of a carbon quantification and tracking strategy that the FRT could use to establish a “carbon account.” The FRT continues to pursue efforts to develop a comprehensive carbon quantification methodology for FRT activities.

Both KCP and ODF initially discussed developing a monitoring and verification program for the FRT. However, based on discussions among the KCP, the Oregon Department of Energy and ODF, it was decided in 2003 that ODF should take the lead on completing the measurement and monitoring plan for FRT projects since ODF had already developed an overall measurement and

¹² Ibid.

monitoring framework for the FRT. The framework was published in the September 2000 issue of the Journal of Forestry. The link to this article is as follows:

http://oregon.gov/ODF/PRIVATE_FORESTS/docs/CarbonSequestration.pdf.

As part of implementing this framework, ODF developed a test version of the “free-to-grow” survey protocol for measuring the degree of forest establishment for FRT projects. As of mid-2005, only a handful of FRT projects have had the “free-to-grow” data collected¹³. Funding limitations have prevented the ODF from completing its work in developing a monitoring and verification plan for the FRT.

¹³ Email from J. Cathcart, Ph.D., Acting Forest Health & Monitoring Manager, Private and Community Forests Program, Oregon Department of Forestry, to M. Dubinsky of TRC, July 7, 2005.

5.0 OFFSET PROJECT #3: SOLAR RURAL ELECTRIFICATION WITH PHOTOVOLTAICS IN ASIA

5.1. PROJECT OVERVIEW

The City provided \$500,000 in funding to support the sale and distribution of household solar photovoltaic (PV) systems in developing countries through the activities of the Solar Electric Light Company (SELCO). SELCO specializes in off-grid solar rural electrification. The project's objective was widespread deployment of small-scale PV systems for individual rural households that have little likelihood of being connected to the electrical transmission grid over the next 20 years.

5.1.1. PROJECT BACKGROUND AND ASSUMPTIONS

EFSC made the following assumptions in reviewing the solar electric offset project:

- The Solar Energy Trust (SET) would be established to disburse funds to SELCO.
- The PV companies would carry out sales of solar home systems (SHS) and installation activities for the KCP over 30 years. The technical life of the SHS, for the purposes of quantifying CO₂ offsets, was assumed to be 20 years.
- It was projected that 182,000 SHS would be installed using a revolving investment fund (RIF), compared to a projected level of 1,300 systems if KCP funding was to be used as an initial investment in SHS.
- The sales mix would include 20 peak-watt (Wp) systems or 35 Wp systems. The 20 Wp systems would offset CO₂ emissions by displacing kerosene use for lighting, while the 35 Wp systems would offset CO₂ by displacing kerosene use for lighting and grid-electricity or diesel-fired generators used for charging batteries to operate household appliances.
- Although monthly kerosene fuel costs are more expensive than SHS repayments, it was assumed that households with PV systems would purchase a small amount of kerosene as an auxiliary measure. Auxiliary use would result in CO₂ emissions of 6.94 short tons per 1,000 systems.
- EFSC applied a CO₂ offset adjustment factor of 0.7 to cover uncertainties surrounding project performance.
- The projected net level of CO₂ offsets from the solar rural electrification projects was projected to be approximately 938,000 short tons over 50 years (20 years after installation of the last SHS).

Table 5-1 outlines the primary assumptions used in calculating net CO₂ offsets from the solar rural electrification project.

Table 5-1: Carbon Quantification Assumptions for Solar Rural Electrification Projects

31.8 gallons kerosene	Annual fuel displacement by a 20 Wp (peak-Watt) solar home system
31.8 gallons kerosene; 30 kWh electricity	Annual fuel and electricity displacement by a 35 Wp solar home system
21.7 lbs CO ₂ /gallon	Carbon emissions factor for kerosene
0.95 tons CO ₂ /MWh	Emissions factor for offset electricity
5.5 hours per day	Average electrical use per household with a 35 Wp system
90% 35 Wp, 10% 20 Wp ¹⁴	Percentages of the types of systems sold through the RIF
182,000 systems	Total number of solar home systems expected to be installed
20 years	Number of years CO ₂ benefits will be credited from the RIF
345 short tons	Annual offsets generated by 1,000 20 Wp home systems
376 short tons	Annual offsets generated by 1,000 35 Wp home systems
1,357,356 short tons	Projected 20-year reduction from the project (note this value includes a 0.6% error relative to the EFSC calculations due to mathematical rounding)
6.94 short tons	Annual emissions from auxiliary kerosene consumption for 1000 units
25,262 short tons	Projected 20-year emissions from the project
1,340,475 short tons	Projected gross total CO ₂ offset (from EFSC calculations)
0.7	EFSC adjustment factor
938,332 short tons	EFSC approved net offset total

The gross projected magnitude of offsets under the PV projects is 1.4 million short tons of CO₂. This calculation is based on the installation of approximately 182,000 20 Wp and 35 Wp systems. To adjust for future project uncertainties, EFSC applied an adjustment factor of 0.7. EFSC believed that it was not appropriate to use a time-dependent discount rate to reflect project uncertainty, and simply chose to use an adjustment factor. When this adjustment factor is applied, the targeted level of offsets from the PV projects is approximately 938,000 short tons of CO₂.

5.1.2. TERMS OF CITY AND SOLAR ENERGY TRUST AGREEMENT

The City signed the Solar Energy Trust (SET) agreement in April 1999; and SET and SELCO signed an agreement regarding the revolving fund at the same time. The City/SET agreement

¹⁴ Although the submission assumed that 20 Wp and 35 Wp SHS would be sold, SELCO's actual sales mix includes systems ranging from 10 Wp to 80 Wp; with 77% of sales between 37 and 60 Wp. The annual CO₂ displacement levels per 1,000 systems are 485 tons for 40 Wp systems and 538 tons for 65 Wp systems.

outlines the duties of the trustee, whose role is to manage trust assets for funding the photovoltaic projects; the SET/SELCO agreement governs use of the SET funds for the PV application projects as well as the scope of activities of SELCO. Key points of these agreements include:

- On the financial closing date for the KCP facility (April 1, 1999), the City transferred \$500,000 (1998 dollars) to an escrow account to be further transferred to the SET along with accumulated interest.
- The intent of this fund was to invest in projects outside the United States. India, Sri Lanka and China were identified as pre-approved locations for projects, but projects located in other countries could be approved and funded with the prior consent of the Beneficiary.
- SELCO agreed to provide the City with CO₂ offsets for the benefit of KCP.
- Beginning on the 60th day after the Offset Project Account is funded, SELCO could request funds from the SET account to provide equity funding for projects.
- A separate option (“Option 2”) to request funds from the SET to provide solar equipment loan installation guarantees would only be available upon a separate EFSC amendment to the Site Certificate allowing the use of Option 2 Funding, or otherwise confirming in writing to the City that the City will be in compliance with the Site Certificate if Option 2 Funding is used.
- If the funding is for an equity investment in SELCO or a local PV company, to enable purchase of PV inventory, SELCO or the local PV company may retain earnings and apply such earnings in accordance with an approved budget for additional Funded Qualifying Projects. If a budget for such additional Funded Qualifying Projects has not been approved by SET, then the portion of such earnings applicable to the equity investment by the Offset Project Account shall be returned to the Offset Project Account on a quarterly basis for reinvestment in additional Qualifying Projects.
- Each calendar month after a project begins to generate revenue, any of the project’s proceeds not retained for additional PV inventory purchases shall be allocated as noted in the bullet immediately above.
- If the funds provided by SET are used for working capital to purchase PV inventory, then to the extent that SELCO or a local PV company has its own funds at risk, or funds of other investors at risk, in a Funded Qualifying Project, distributions of profits may be allocated to the other investors on the basis set forth in the approved budget.
- SET is to provide funding for the installation of PV projects for 30 years.
- SELCO shall submit quarterly reports to the SET regarding the progress of SELCO’s development efforts, and reviewing actual and projected PV generation production at Funded Qualified Projects.

5.2. PROJECT PERFORMANCE ASSESSMENT

5.2.1. PROGRESS THROUGH 2001

SELCO made its first funding request from the KCP of \$200,000 in February 2000 to initiate project activities in Sri Lanka. In September 2000, SELCO requested \$50,000 to build on its existing efforts in Sri Lanka and \$250,000 to begin project activities in India. SELCO decided not to allocate any monies to fund qualifying projects in China due to difficulty in establishing a reliable relationship with an affiliate company.

The first EFSC annual report reflected some fundamental changes to the PV offset project. Instead of assuming that KCP funding would be used as part of a revolving investment fund (due to inapplicability of this model by the time of project implementation), SELCO proposed using KCP funding as the equivalent of equity capital in supporting the activities of its affiliate companies in Sri Lanka and India. KCP accepted this approach. It was agreed that SELCO would allocate SHS and CO₂ benefits to the KCP based on the original portion of the KCP equity contribution. SELCO restated its intent to deliver all of the originally projected CO₂ benefits to KCP on a best-efforts basis.

SELCO installed 4,740 new systems in 2000 and 4,078 new systems in 2001. Based on KCP's equity stake of 34 percent in 2000 and 28 percent in 2001, SELCO allocated 1,612 systems in 2000 and 1,142 systems in 2001 to the KCP for a total KCP allocation through 2001 of 2,754 systems.

5.2.2. PROGRESS THROUGH 2002

During 2002, SELCO installed 4,998 solar home systems in India and Sri Lanka. SELCO allocated 1,400 of these systems to KCP for purposes of determining CO₂ emission reductions associated with the KCP funding, based on a 28 percent equity stake. SELCO reported that through the end of 2002 there had been no reported issues regarding lower performance of the installed PV systems. In many cases, people had increased their system's capacity by buying an extra solar panel.

During 2002, SELCO undertook a market assessment survey in Sri Lanka, which showed that SELCO Sri Lanka had a 22% market share. Local financial institutions told SELCO that recovery rates are highest among SELCO Sri Lanka clients as compared to systems installed by competitors, due to better service and higher-quality systems.

5.2.3. PROGRESS THROUGH 2003

During 2003, SELCO installed 8,191 solar home systems in India and Sri Lanka. SELCO allocated 2,293 of these systems to the KCP for purposes of determining CO₂ emission reductions associated with the KCP funding, based on a 28 percent equity stake. During 2003, the trend toward larger SHS systems continued, including requests from residential schools and other institutions.

SELCO estimates that SELCO Sri Lanka currently has a market share of 21 percent. It appears that the size of the market has grown; moreover, SELCO has additional competitors – 9 as compared to 7 in 2002.

5.2.4. PROGRESS IN 2004

During 2004, SELCO installed 6,643 solar home systems in India and Sri Lanka. SELCO allocated 1,860 of these systems to the KCP for purposes of determining CO₂ emission reductions associated with the KCP funding, based on a 28 percent equity stake. During 2004, the trend was more towards 2-, 4- and 5-light systems, including requests from street vendors. The market in both countries has been affected by Tsunami. The Sri Lankan operations were severely hampered and will take some time to gear up.

The Indian company was responsible for creating innovative financial schemes that have helped the market grow in the poorer sectors of the community. Its innovations in the financial sector have helped the company to create unique niches.

5.3. SUMMARY

Until impacted by bad weather in 2004, there has generally been a steady increase in the number of solar home systems installed in India and Sri Lanka. Table 5-2 shows the distribution of the size of the systems installed.

Table 5-2: Solar Home Systems Installed 2002 - 2004

	Type of System (% of total)										
	10Wp ^a	20Wp	35Wp	37Wp	40Wp	50Wp	60Wp	65Wp	70Wp	75Wp	80Wp
2002	1	4	1	28	25	17	6	9	4	2	3
2003	0	4	1	27	34	10	17	3	2	0	0
2004	6	15	5	35	23	5	2	5	4	0	0

^a Wp = peak-Watt

Source: Solar Electric Light Co., Ltd., June 2003, March 2004 and August 2005.

Table 5-3 summarizes the PV installations allocated to KCP to date and the estimated associated CO₂ emissions reductions. CO₂ savings estimates have not been formally updated since the KCP proceeding. Original estimates of CO₂ savings of approximately 0.32 short tons per system per year were based on an assumed installation mix of only 20 Wp and 35 Wp systems. Table 5-3 uses 0.35 short tons per system per year, which is intended to partially account for the larger systems being installed.

Table 5-3: Summary of KCP Photovoltaic Installations

Year	Systems Installed	Implied KCP Equity %	Systems Allocated to KCP	Cumulative System-Years^a	GHG Benefit Per System	CO₂ Reductions Per Year (short tons)
2000	4,740	34%	1,612	806 (0.5 x 1612)	0.35	282
2001	4,078	28%	1,142	2,183 [1612 + (0.5 x 1142)]	0.35	764
2002	4,998	28%	1,400	3,454 [1612 + 1142 + (0.5 x 1400)]	0.35	1,209
2003	8,191	28%	2,293	5,300 [1612 + 1142 + 1400 + (0.5 x 2293)]	0.35	1,855
2004	6,643	28%	1,860	7,377 [1612 + 1142 + 1400 + 2293 + (0.5 x 1860)]	0.35	2,582

^a First-year systems are assumed to be installed mid-year

6.0 OFFSET PROJECT #4: EXPANSION OF KLAMATH FALLS GEOHERMAL HEATING SYSTEM

6.1. PROJECT OVERVIEW

The geothermal offset project was designed to expand the Klamath Falls geothermal heating system. The City of Klamath Falls manages the largest low-temperature geothermal heating system in the United States. The district-heating loop commenced operation in 1983, pumping water from wells in the Hot Springs area to the injection site at the county museum. This route contains a network of pipes, including a recapture system, which picks up spent effluent from 12 other wells to inject at the museum site.

The City wanted to expand the space-heating system to include more buildings in the downtown area. Although there was significant expansion potential among commercial buildings in the city core, there was no funding available to cover upfront costs associated with hooking up to the geothermal system. The KCP offset project established a \$100,000 revolving fund, managed by the City, to assist in hooking up new buildings to the geothermal heating system.

6.1.1. PROJECT BACKGROUND AND ASSUMPTIONS

Key assumptions EFSC adopted in its decision-making process included:

- The City committed \$100,000 to a revolving credit account, the Geothermal Heating Account, as described below. PPM was to administer this account for the purpose of providing loans to building owners interested in connecting to the City of Klamath Falls' geothermal heating system.
- The City was expected to conduct outreach efforts to attract building owners in the downtown core.
- The City would carry out marketing efforts and enroll interested building owners into the geothermal system over a period of 15 years.
- The projected number of buildings that would be connected to the heating district under the project was 78, with a milestone of 10 buildings during the first year. This target was based on the assumption that it would cost \$10,000 to connect a moderately sized building to the system; that the owner would repay this amount within three years of the hook-up; and that this funding would be available to fund additional hook-ups.
- EFSC applied a CO₂ offset adjustment factor of 0.9 to cover uncertainties surrounding project performance.
- The projected net level of CO₂ offsets from the geothermal hookups was projected to be approximately 141,000 short tons over 45 years; that is, 30 years after connection of the last building to the geothermal system under the project.

The reference case assumed that in the absence of the geothermal heating systems downtown building owners would consume natural gas to meet space heating needs, with emissions of 11.7 pounds of CO₂ resulting from every therm of natural gas used for heating. Under the project

scenario, 78 building owners would sign up for loans to cover the costs of conversion to or installation of geothermal heat. The switch to geothermal energy would displace natural gas use and result in no CO₂ emissions for the hooked-up buildings. Table 6-1 lays out key assumptions as approved by EFSC.

Table 6-1: Geothermal Heating System Carbon Quantification Assumptions

11,430 therms	Amount of natural gas displaced each year per building
11.7 pounds of CO ₂ /therm	Carbon content of natural gas
2,000	Conversion factor pounds per short ton
15 years	Life of revolving loan fund program
78 units	Projected number of connected buildings
30 Years	Life of system hookup
157,104 short tons	Projected gross total CO ₂ offset
0.9	EFSC adjustment factor
141,393 short tons	EFSC approved net offset total

Under the carbon quantification assumptions in Table 6-1, the geothermal project would displace 891,540 therms per year of fossil-fired energy and offset 5,216 short tons of CO₂ per year. CO₂ benefits for the project would accrue through year 45 and total 157,104 short tons. To adjust for future project uncertainties, EFSC applied an adjustment factor of 0.9. EFSC believed that it was not appropriate to use a time-dependent discount rate to reflect project uncertainty, and simply chose to use an adjustment factor. With the adjustment factor, the targeted level of offsets from the geothermal expansion project is approximately 141,000 short tons CO₂.

6.1.2. TERMS OF CITY AND PPM AGREEMENT

The City and PPM signed the Geothermal Heating Account (GHA) agreement on April 1, 1999, and the City used the \$100,000 received to establish a revolving loan fund program to provide eligible applicants a three-year interest-free loan to cover the costs of hooking their building up to the systems. Loan repayments would go back into the revolving fund to support subsequent installations. Key points of this agreement include:

- Within 60 days of the financial closing date for the KCP facility (April 28, 1999), the City shall transfer \$100,000 (1998 dollars) to the GHA, which would provide loans to assist in the hookup of buildings in downtown Klamath Falls to the Geothermal Heating System.
- PPM is to administer the GHA for the benefit of the City. The City shall reimburse PPM for reasonable third party costs incurred by PPM in the administration of the Agreement, as well as PPM's actual costs (including labor overheads) of administering this Agreement in excess of 10 person hours in any calendar month.

- The City owns the CO₂ offset benefits, subject to the rights of the EFSC under the Site Certificate.
- PPM could request funds from the GHA to finance a third party's cost of connecting a building to the Geothermal Heating System; such loan to be for a three year term at an interest rate sufficient to accomplish the objectives contemplated by the Site Certificate.
- The term of the GHA is 30 years.
- PPM shall submit quarterly status reports to the City.

6.2. PROJECT PERFORMANCE ASSESSMENT

6.2.1. PROGRESS THROUGH 2001

The City focused initial implementation efforts on developing a marketing plan for the offset project. It developed marketing materials that described the financial incentives to encourage building owners to join the program. The plan was completed in 2001, and marketing materials have been distributed to a number of businesses. No building owners had joined the program as of the end of 2001; thus, the geothermal project missed its first year milestone of enrolling 10 owners.

6.2.2. PROGRESS THROUGH 2002

As of early 2003, the KCP revolving fund for the geothermal project totaled \$110,000 (interest accrual at 1.5 percent). The fund had not yet been used. The City continued to encounter implementation difficulties with the program and did not finalize any new contracts with building owners during the year.

According to the City, building owners have not been willing to finance the costs of hooking up to the district heating system. Difficulties included errors in the City's communications with the business owners. The City originally had reported to EFSC that it would cost approximately \$10,000 to connect a moderately sized building to the system; however, business owners erroneously had been told that hook-up costs would be approximately \$4,000. Estimated costs (including internal building retrofits) remained close to the original \$10,000 estimate. However, business owners balked at what they perceived as significant increases in cost estimates.

6.2.3. PROGRESS THROUGH 2003

The City signed up two business owners; one of whom completed the retrofit during 2003 and the other was expected to complete its retrofit in 2004. CO₂ benefits attributable to hooking up one building owner to the district energy geothermal system toward the end of the year were negligible.

As of March 2004, the geothermal project revolving fund totaled \$103,737 (interest accrual at 1.5 percent). Estimated costs remained close to the original \$10,000 estimate. The City reimbursed the building owner who completed the one retrofit for 2003 approximately \$7,000; the City absorbed some of the retrofit costs due to the owner having been provided with erroneous information from the City regarding retrofit costs.

6.2.4. PROGRESS IN 2004¹⁵

In 2004, no additional business owners signed up for the program. One of the business owners indicating its intent to sign up in 2003 completed that work but has not yet applied for a loan from the fund. The greenhouse which is attached to the system installed geothermal energy in one-half of another greenhouse, but has also not yet applied for a loan. The revolving fund balance as of the end of 2004 was \$104,994.82.

6.3. SUMMARY

The geothermal energy program has extended geothermal service to three businesses, but only one participant has currently taken advantage of the program funding opportunities. The City is continuing to look for ways to make the program attractive to business owners.

¹⁵ Telephone conversation between Ms. Phyllis Shidler, Finance Director, City of Klamath Falls and M. Dubinsky of TRC on 6 July 2005 and email from P. Shidler to M. Dubinsky dated 21 July 2005.

7.0 SUMMARY

Overall, all four of the CO₂ offset projects are operational. The SELCO and NW Fuel projects are generating offsets. The FRT project has not yet generated measurable offsets due to the growth characteristics of Douglas fir, a slow-growing species. The first acreage planted under the KCP program is expected to reach the free-to-grow stage at the end of 2007. The City's geothermal project is encountering significant problems in generating interest among building owners. The KCP's cogeneration element is operating but the intended recipient of the generated steam is operating well below its anticipated capacity.