By **MONICA SHAW,** Editor

Stepping toward energy savings

Stora Enso's midwestern mills get a head start on accelerating energy costs with projects that balance energy consumption with financial and environmental concerns

While it's impossible to predict natural disasters and other external factors that have influenced the acceleration of oil and gas prices since late 2005, a three-year series of energy projects have positioned Stora Enso's U.S. mills to better offset those increases.

To encourage the mills to consider energy-related projects as often as production-related ones, a group was formed in 2002 to solicit corporate capital for energy conservation and emission reduction projects that would not tap into mill budgets.

"Our corporate power and energy department, headed by Thomas Scharff in Wisconsin Rapids, recognized that energy projects often have a high ROI, so we needed to create the incentive for our mills to make them a higher priority," says Thomas Wroblewski, P.E., energy engineer with the power and energy department. "At the same time, we also wanted to reduce our emission of greenhouse gases, especially CO_2, on a voluntary basis as part of our commitment to the Chicago Climate Exchange."

To accomplish these goals, capital was requested of the North American investment committee (IC), a group of mill managers, vice presidents, and others responsible for funding decisions. From 2003-2005, the IC dedicated corporate funds specifically for the energy projects, while the mills submitted project proposals.

To evaluate the 113 proposals received, a multi-functional internal project review team was formed. The team created a special methodology for evaluating and scoring the projects. Twenty projects were eventually funded, with an internal rate of return (IRR) ranging from 41% to 400% and annual cost savings that exceeded investment. Greenhouse gases were also reduced, helping Stora Enso with its goals as founding member of the Chicago Climate Exchange (see sidebar, p. 23).

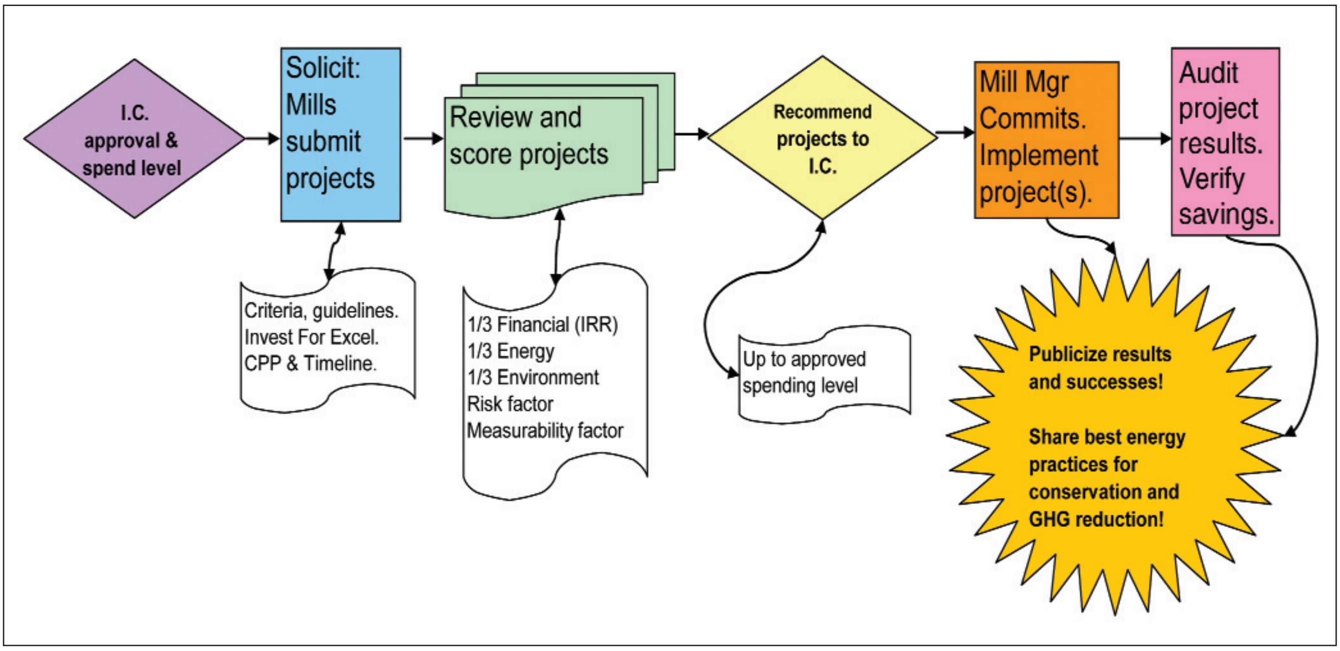
Evaluating project proposals

To evaluate the projects, a specific method for scoring proposals was developed by Stora Enso's internal review team. In addition to Wroblewski, other team members were Clay Williams (corporate engineering), Annabeth Reitter (corporate environmental), Samir Marwah (business development and strategic planning), Dale Bikowski (corporate finance/accounting), and Thomas Scharff (power and energy).

Reflecting the multi-disciplinary team, the scoring was balanced between energy, environmental, and financial performance, with each comprising one-third of the score. According to Wroblewski, the key issue here was to compare apples with apples. For example, all interested mills and support groups were given Invest for Excel software to

FIGURE 1.

Process flow Stora Enso developed for submission and implementation of energy conservation and greenhouse emission reduction projects in North America



calculate financial benefit on an IRR basis for each project.

Also, when evaluating the projected energy savings, the team always converted the energy units to million Btus. That way, the team could take the predicted energy savings in terms of million Btus for a given project and divide it by the capital needed to determine a raw score for how much energy each invested dollar could save. "This allowed us to somewhat level the playing field for projects that were very high capital versus very low capital," Wroblewski describes.

Wroblewski says it is also important to factor in the price of marginal fuel when predicting energy savings because it varies from facility to facility.

"If you lower your mill's steam consumption, you should theoretically lower the marginal fuel usage, which is where your cost savings are," explains Wroblewski. "But you still must bear in mind that if you lower steam out of the boiler turbine generator system, steam turbine generation will also go down and you could end up spending an equal amount if not more for the replacement power from your utility, depending on self-sufficiency and the market price of power."

In assessing environmental benefits from a project, a similar approach was taken, albeit "a little more subjective," according to Wroblewski. A separate numerical score was given for projects that reduced coal, for projects that reduced residual or distilled fuel oil, and then finally for projects that reduced natural gas – a kind of a "pecking order" for where the fuel stood with regard to greenhouse gas contributions.

A risk factor was also applied to designate whether a project had a low, medium, or high risk for success. Finally, a measurability factor was applied to the decision making process. "We had to be able to measure the before and after conditions of a given system or situation and then apply the cost of energy; those submitting projects knew that they would be post-project audited going into the program," Wroblewski explains.

Submission and implementation

Figure 1 shows the process flow Stora Enso developed for submission and implementation of energy and emissions reduction projects. Once funding was released each year from 2003-2005, the internal review team would visit the mills and mill support groups, soliciting ideas for projects.

Next, the team evaluated the projects based on the methodology it had developed. After scoring the projects, the internal review team made recommendations to the IC. If approved by the IC, the team would go to the mill manager and ask for a commitment in writing that the project would be completed within a set timeline.

Also, the team performed a pre-implementation audit to set the stage for what to specifically look for once the job was done. Upon completion, the project was assessed with another audit.

Lastly, the team publicized the results from the projects to all the mills to provide recognition of the success, as well as valuable information and replication where possible.

"By doing these projects, we hoped to create ideas that got the mills excited and to share best practices so they might be implemented elsewhere," Wroblewski describes.

2003 projects exceed expectations

While the internal review team did not receive all the money it requested for the first year of the corporate-funded energy and emissions projects, it did receive enough to fund three. These projects had a simple payback of 10 months, according to Wroblewski.

IRR ranged from 86% to 211% among the three projects described in this section. Combined, the projects reduced Stora Enso's direct CO_2 emissions by more than 4,000 mtpy as a result of natural gas savings, and there was also a reduction in electricity use.

Atmospheric tank vent condenser system: At the Kimberly, Wis., mill's No. 97 paper machine complex, a condensate tank was vent-

emissions trading

Stora Enso pioneers North American climate exchange

Stora Enso is a founding member of the Chicago Climate Exchange (CCX), a voluntary, but legally binding rules-based program for reducing and trading greenhouse gas (GHG) emissions in North America. Phase 1 of the CCX program requires a 1% reduction per year for the years 2003 through 2006 relative to a 1998 to 2001 baseline. Phase 2 will extend the CCX program through 2010, and will require existing members to reduce to a total of 6%.

Members that reduce their emissions below the required level or generate offsets through registered offset projects can sell the emission allowances or bank them. This creates a market-based program in North America similar to market-based programs available in other parts of the world.

Some of the energy conservation and emission reduction projects have played a role in Stora Enso meeting its CCX GHG reduction goals.

"We have easily met our CCX reduction goals for the years 2003, 2004, and 2005," describes Tom Scharff, director of power and energy for Stora Enso. "Being a member of CCX gives us the opportunity to participate in a market-based GHG reduction program and to be proactive in addressing the climate change issue."

ing to the atmosphere. Flash steam significantly increased in winter when condensate drained to it from the glycol heating system, and a large plume went up the roof stack, creating condensate and/or frozen ice on nearby streets.

This project recovered the heat using a shell and tube heat exchanger in the vent line to heat process water on a continual basis for the No. 97 paper machine, sending the water to the economizer tank or excess whitewater tank. This system saved filtered water by displacing recovered non-contact cooling water and reduced 200-psig steam consumption at the retention aid post dilution tanks.

Variable speed drives for air make up units: Variable speed drives were installed for seven fans on make up air systems throughout the Stevens Point, Wis., mill. The savings came from running these fans at lower speeds and heating less make up air when unnecessary. This reduced steam consumption by 110-psig, having a direct impact on boiler natural gas fuel consumption, as well as some savings in electrical power.

Boiler blowdown reduction: Continuous boiler blowdown in the power and recovery department of the Wisconsin Rapids, Wis., pulp mill was set manually and represented a significant loss of operating efficiency. The project required the purchase and installation of flow transmitters and control valves for installation on each continuous boiler blowdown (CBD) line.

Due to the extremely high pressure drop of 1,200-psig, a sacrificial pressure reducing orifice plate was installed between the flow transmitter and control valve to minimize cavitation across each valve. Control loops were built such that the CBD flow is remotely controlled to remain at 2% of the boiler feed water flow. This set point operates the boilers at 50 cycles, the maximum recommended per ASME guidelines.

Bias capabilities were made available such that compensation was achieved for testing of CBD silica, conductivity, or other boiler water specifications. An instrumentation/automation overview page was installed on the Foxboro DCS for each of the six faceplates.

Success brings more funds for 2004

With the success of the projects in 2003, the

TABLE 1.

Summary of projected impacts from the 11 energy emissions projects implemented in 2004

Mill	Project Description	Energy & Other Savings Manifest	Coal Savings mm Btu/yr	Gas Savings mm Btu/yr	Power Savings kWh/yr	Water Savings million gal/yr	CO_2 Savings tpy
Duluth	Improved retention aid injection	PRB Coal & Water	41,481		0	95	4,412
Duluth	Office air handling unit	Electricity & Water	0		185,654	47	139
Duluth	Hot process water heating	PRB Coal	33,600		0		3,574
Kimberly	Optimize 13 fans	Gas & Electricity	0	10,004	523,918		979
Kimberly	Vent condenser for No. 96 paper machine	Gas & Water	0	30,326	0	4	2,012
Niagara	No. 44 paper machine joints and stationary syphons	Coal	19,354				1,987
Port Hawkesbury	No. 1 paper machine fiber recovery	Power & Fiber			3,910,000		2,933
Stevens Point	Yankee exhaust humidity	Gas		35,000			2,049
Whiting	Groundwood silo pump variable frequency drive	Power & Sewer Loss			438,648		329
Wisconsin Rapids	Lime kiln gas gun	Gas		56,452			3,305
Water Quality Center	Aeration paddle replacement	Electricity			3,724,927		2,794
Totals - English Units			**94,435**	**131,782**	**8,783,147**	**146**	**24,512**
Average Wisconsin homes that could be heated & powered			1,049	1,464	1,162	N.A.	N.A.
Totals - SI Units			**99,634**	**139,038**	**8,783,147**	**552,363**	**22,237**
	SI Units for above totals		**GJ**	**GJ**	**kWh/a**	**m3/a**	**t/a**

IC provided double the funds for the energy conservation and emissions projects in 2004. The second year, Stora Enso provided money to fund 11 projects in North America.

The 11 projects were divided among seven mills and yielded an IRR from between 41% and 400%, which exceeded expectations, says Wroblewski. Energy savings were more than 2.2 million therms/yr and 8.8 mm kWh/yr of power. On the environmental side, CO_2 emissions were reduced by more than 22,000 mtpy and fresh water consumption dropped by 146 mm gal/yr.

Table 1 summarizes impacts from the following 11 projects:

- Improved retention aid injection: Duluth, Minn., mill
- Office area air handling unit modification: Duluth mill
- Hot process water heating: Duluth recycled mill
- Optimization of 13 fans in Buildings 23 and 79: Kimberly mill
- Steam joints and stationary siphons: Equipment was installed in the No. 44 paper machine's fourth dryer section at the Niagara, Wis., mill.
- Fiber recovery: Improvements were made on the No. 1 paper machine at the Port Hawkesbury, N.S., mill.
- Paper machine yankee exhaust humidity control: Stevens Point mill
- Lightning aerator paddle replacement: Water Quality Center, Wisconsin Rapids
- Variable frequency drive for groundwood 85-ton silo pump: Whiting, Wis., mill
- Lime kiln gas gun replacement: With installation of this equipment at the Wisconsin Rapids, Wis., pulp mill, natural gas savings of about 10% were estimated at the kiln, but due to equipment procurement lead times, the installation occurred in summer of 2005.
- Atmospheric tank vent condenser system: This equipment was installed on the No. 96 paper machine at the Kimberly mill due to deferment of the Wisconsin Rapids' pulp mill air compressor sequencing project.

2005 yields six project awards

Six energy conservation and greenhouse gas emissions reduction projects shared implementation funds at five mills, and IRR ranged from 77% to 235%. Energy savings were more than 3.6 million therms/yr and 1.0 mmkWh/yr of power. Environmentally, CO_2 emissions were lowered more than 34,000 mtpy, and fresh water consumption dropped by 276 mm gal/yr.

Natural gas main coming into the Stevens Point, Wis., mill

Vacuum pump seal water reconfiguration: At the Duluth mill, cold fresh water was replaced by warmer recycled water to five low vacuum pumps, and one high-volume pump was piped to receive cold fresh water. The cold fresh seal water has warmer recycled water added to it to increase its temperature, further reducing fresh water use.

Fresh water use was reduced by 300 gpm, and 300 gpm of warm water that was previously sewered is now reused, conserving steam. This results in a 151.5 million gal/yr fresh water reduction and 140 million gal/yr effluent reduction.

Treated effluent recovery: This project enables the Kimberly mill to recycle wastewater treatment plant effluent for fresh water influent, which is then used in the papermaking process, conserving steam produced in a natural gas-fired boiler.

This saves about 24,582 mm Btu/yr (natural gas consumption) and a corresponding quantity of CO_2.

Kraft whitewater dilution supply: Installation of a new pump and motor with a variable speed drive at the Niagara, Wis., mill replaced a dilution water supply system that required heating of cold filtered fresh water for use in the wet end of the paper machines. This conserved steam produced from eastern bituminous coal. A 33,250 mm Btu and greenhouse gas savings resulted from the changes.

Bark-burning optimization: A new, more efficient bark-shredding system at the Whiting mill can process all wood room bark and additional bark transported from other of Stora Enso's North American mills or from external sources for steam generation in the boiler, reducing reliance on coal by approximately 11,000 tpy and a corresponding quantity of CO_2.

Preheating of fresh water: New equipment at the Whiting mill allows an exchange of heat from the Chest 25 filtrate (130 °F) to the mill fresh water (55 °F), cutting back on the steam required to heat the water on the paper machines. Savings were 117,500 mm Btu/yr and 22.9K mtpy of CO_2.

Precipitator energy management modifications: At the Wisconsin Rapids pulp mill, an energy management system for power boiler precipitators has provided an automatic voltage control that allows the system to respond to opacity variances in a more effective manner, decreasing energy use and improving control of opacity. Control of emissions and opacity drive the benefits, as well as a small energy savings.

Combined results and future plans

Annual cost savings for all projects are calculated at better than 100% IRR on the investment, but Wroblewski points out that all estimates were made at project year dollars and energy prices. "So, with the effects of Katrina and other global events, the savings are even greater than that given in project year energy prices," he comments.

The net effect of all the projects has contributed to a drop in energy consumption per ton of 12%, well above the aggressive goals set for the 2003-2005 period. "Not all of it is due to these 20 projects, but they have been a major factor," Wroblewski notes.

Also, with 113 project submittals and 20 funded, 93 good ideas were left hanging. Many Stora Enso mill managers and their staffs went after these projects with their own in-mill replacement budget funds, because the projects "made sense," says Wroblewski.

"I think that creating awareness is part of a program like this," he adds. "People get excited about having access to additional capital and then see the merit of such projects, so they're more apt to do it."

In late 2005, after requesting funds for 2006, Stora Enso's organizational structure changed such that mills and other business areas report to business unit leadership in Europe on a grade-oriented basis. Energy and emissions projects for 2006 were then segregated for appeal to the various business units, meaning that the North American mills are competing with other projects in Europe for capital. Wroblewski doesn't see this as a problem, as "energy efficiency is ingrained in our corporate culture."

"The success rates for funding these projects will be the same or even better," he says. "Funds are already starting to roll in; they just had to be shifted and realigned with the business units." P&P