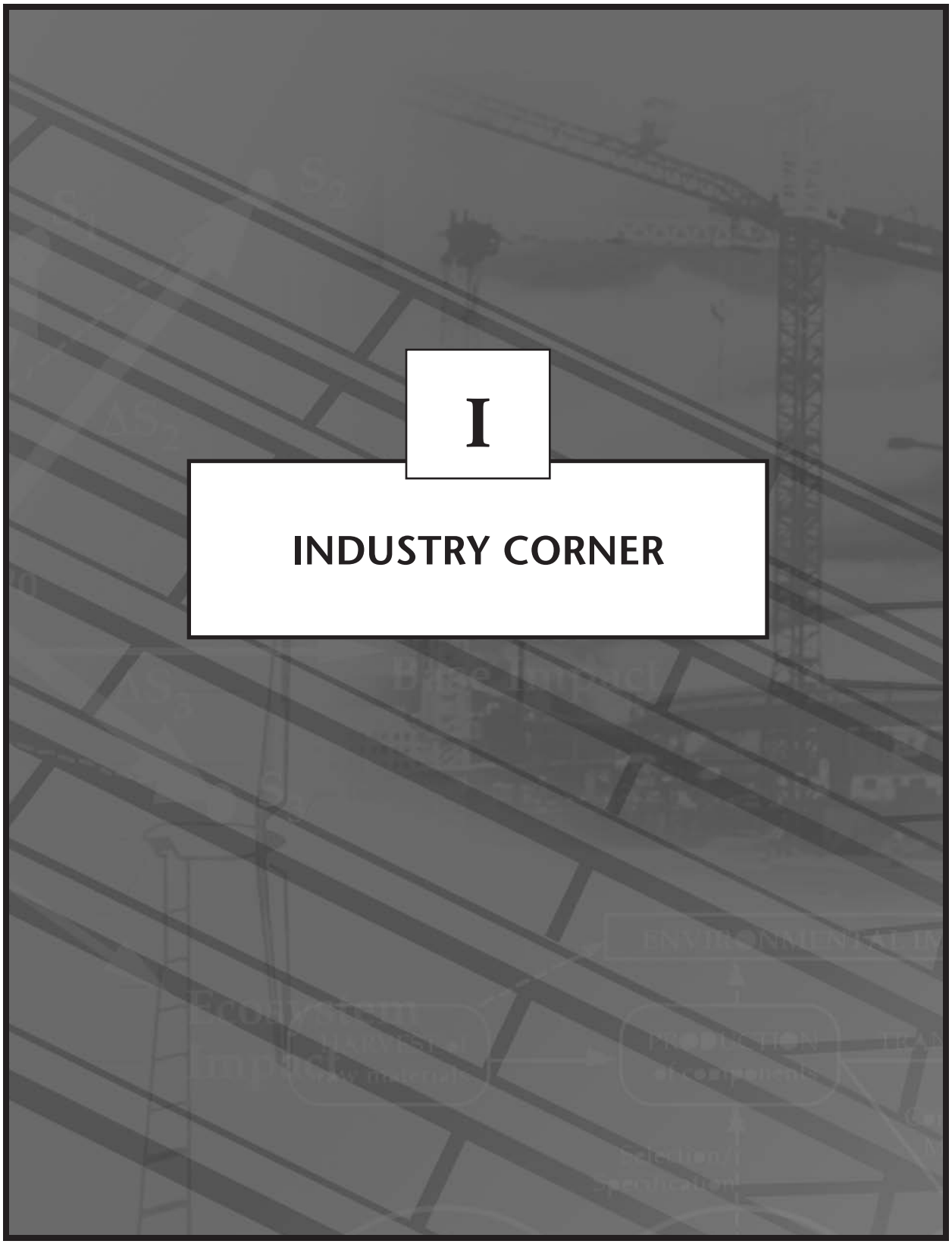

I

INDUSTRY CORNER

HOW CHAPMAN CONSTRUCTION/DESIGN DEEP-GREENED ITS BUSINESS BY CHANGING EMPLOYEE MINDSETS

George A. Dyroff[1]

INTRODUCTION

Chapman Construction/Design, a construction management firm, infused its entire business with green practices and transformed the way its employees think by engaging them in the process with a fuel-efficient vehicle incentive program, the LEED renovation of its office, and a modern-day "barn-raising."

It's no secret that construction workers drive trucks. Big, gas guzzling pick-ups have been the standard of our industry, and they make a certain amount of sense—construction requires heavy tools and equipment that can only fit in a truck.

The practice of driving trucks everywhere was inefficient, so we discouraged it with an electronic scheduling system that has all but eliminated trips to our warehouse and the lumber yard and kept our supervisors on site where they belong. Supervisors place delivery requests through our electronic Field Operations system. The system allows them to choose delivery times and dates, and it automatically distributes their orders on a calendar that identifies potential conflicts and looks like this:

FIGURE 1. Field Operations electronic calendar.

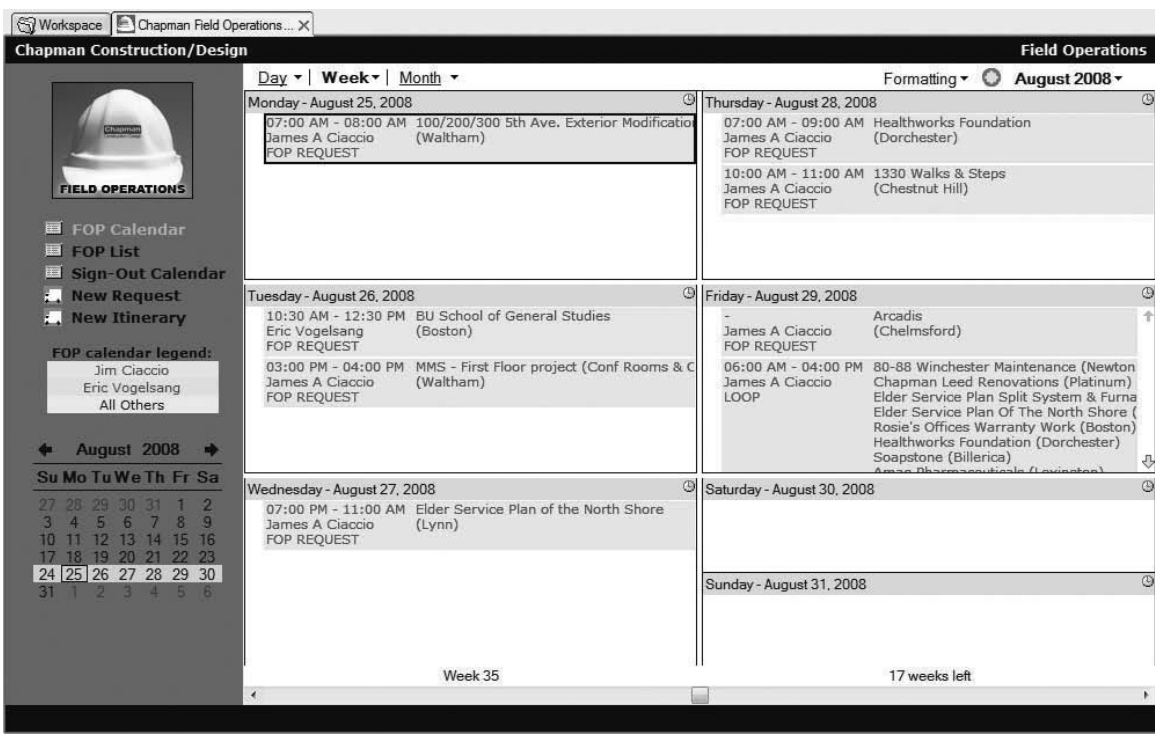

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TABLE 1. Truck vs. Prius calculation.

	miles per year	miles per gallon	gas per gallon	gas per year
Truck for hauling and commuting	25,000	14	$3.84	$6,857.14
Truck for hauling	5,000	14	$3.84	$1,371.43
Prius for commuting	20,000	50	$3.84	$1,536.00
Savings per year				$3,949.71

Most deliveries are made during our warehouse person's Friday "loop" of our job sites, which is plotted in advance to identify the shortest driving distance.

Despite the Field Operations system and the loop, the men in the field continued to drive trucks, even though most of them are site supervisors and have long since given up their hammers and saws for cell phones and laptops.

It just didn't make sense, but our industry has always been slow to change. Slow to change in part because we base proposals for new work on past work. The more closely new work mirrors past work, the more accurate our pricing will be and the more likely we will be to cover our costs and make a profit. We were also slow to give up our trucks because as construction workers we think of ourselves as tough, and trucks—as Ford reminds us during every football game—are "built tough."

To overcome this industry tradition, Chapman mounted a two-pronged campaign that showed the employees how to save serious money and save the planet.

Our vehicle reimbursement program rewards employees for driving hybrid or fuel-efficient vehicles. Employees who drive vehicles that get more that 40 mpg based on EPA standards receive $1,000 yearly; those who drive vehicles that get at least 30 mpg receive $500 yearly; and those who get at least 20 mpg get $250 yearly.

While the rewards program sparked their interest, the tipping point for many of the employees who replaced their trucks with fuel-efficient vehicles came when we showed them that if they used their trucks only for hauling, the gas money they would save plus the company reimbursement would pay for a Prius. The calculation looked something like Tables 1 and 2.

TABLE 2. Monthly cash flow calculation.

Savings per year	$3,950
Company incentive per year	$1,000
Cash flow per year	$4,950
Cash flow per month	$412

A positive cash flow of $412 per month would cover the payments on a $22,500 Prius with $2,500 down and a five-year loan at 6%.

The results of the campaign have been gratifying: Nearly 25 percent of our 50 employees have taken advantage of the incentive program, saving each of those employees an average of $2,000/year in gas money and reducing the weight of their combined carbon footprint by nearly 73 tons and our nation's dependence on foreign oil by 136 barrels. See Table 3.

While the data supports the success of the vehicle incentive program, much of its value lies in changed attitudes that cannot be easily quantified. When men and women accustomed to comparing engine horsepower now compare gas mileage, it seems clear that those changes are very real.

The effort to change the way our employees think has not been limited to the vehicle incentive program. Two years ago we embarked on an effort to introduce all our employees—field and office staff alike—to LEED. That effort began with a day-long seminar and continued with weekly exam prep sessions run by one of the 17 LEED-accredited professionals on our staff. We encouraged all of our employees to become accredited, stressing the importance of knowledge of the LEED prerequisites and credits to the success of a project seeking certification.

Just how important it is to have a site supervisor on a LEED project who knows the LEED rating

TABLE 3. Savings from more fuel efficient vehicles.

Previous	MPG*	Fuel cost**	New Vehicle	MPG*	Fuel cost**	Savings	Carbon*** Footprint reduction in TONS	Reduction in barrels of oil/year
01′ Toyota Highlander	18	$3,200.00	07 Toyota Prius	46	$1,252.17	$1,947.83	6.2	11.6
97′ Honda Accord	22	$2,618.18	07 Toyota Camry Hybrid	34	$1,694.12	$924.06	2.9	5.5
00′ Nissan Quest	18	$3,200.00	07 Toyota Prius	46	$1,252.17	$1,947.83	6.2	11.6
98′ Ford Windstar	18	$3,200.00	07 Toyota Prius	46	$1,252.17	$1,947.83	6.2	11.6
02′ Toyota Tacoma	18	$3,200.00	08 Toyota Prius	46	$1,252.17	$1,947.83	6.2	11.6
02′ Toyota Tundra	15	$3,840.00	08 Toyota Prius	46	$1,252.17	$2,587.83	8.2	15.4
01′ GMC Sierra	14	$4,114.29	08 Honda Civic Hybrid	42	$1,371.43	$2,742.86	8.7	16.3
04′ Chevy Colorado	18	$3,200.00	2009 Toyota Corolla	30	$1,920.00	$1,280.00	4.7	8.7
04′ GMC Sierra	15	$3,840.00	2004 Honda Civic	30	$1,920.00	$1,920.00	6.1	11.4
04′ Chevy Pickup	15	$3,840.00	1998 Jetta	24	$2,400.00	$1,440.00	4.5	8.5
06′ Chevy Silverado	14	$4,114.29	2004 Honda Civic	34	$1,694.12	$2,420.17	7.7	14.4
98′ Jeep Wrangler	17	$3,388.24	2008 Honda FIT	31	$1,858.06	$1,530.17	4.9	9.1
						Total savings/year = $22,636.39	72.5	135.7
						Reimbursement/year = $9,000.00		
						Total = $31,636.39		

*all mpg ratings are combined city and highway per www.fueleconomy.gov

**Per year based on $3.84/ gallon: New England average on 8/11/08 per www.eia.doe.gov

**Average based on 15,000 miles/year: from www.fueleconomy.gov

***Carbon footprint: vehicle impact on climate change in TONS of Carbon Dioxide (CO2) emitted annually (www.fuel economy.gov)
Barrels of oil/year: www.fueleconomy.gov based on 15,000 miles/year

*42 gallons of oil/barrel = reduction of 5,699.4 gallons of oil per year to drive the same distance. www.fueleconomy.gov

*Some of our employees commute between 400–1000 miles per week so the savings is actually much greater.

system became apparent during the Platinum renovation of our own offices when our HVAC subcontractor attempted to use his usual duct sealant. Our supervisor checked the VOC content of the sealant, found that it did not meet the requirements of Indoor Environmental Quality Credit 4.1 Low Emitting Materials, Adhesives and Sealants, and ordered the sub not to use it. Our supervisor subsequently identified a sealant that would pass muster and asked the sub to use it.

Not only has our LEED renovation illustrated the importance of teaching all our employees green construction practices; it also has become a learning lab for our field staff. Over the course of the year-long renovation, we have assigned most of our field employees to work, either in a supervisory capacity or as carpenters and laborers, thus giving them first-hand experience of the green strategies we implemented in pursuit of LEED certification.

That exposure has been invaluable; having seen these strategies once, they are now better able to implement them on their own jobs.

The renovation of our building is expanding our offices into spaces previously occupied by tenants or used for storage.

Our receptionist will relocate to the first floor, as will our accounting and marketing departments. Our second-floor kitchenette, which is much too small for our needs, also will move to the first floor and will grow to include a lunchroom. A second-floor storage room will give way to our Green Library.

Providing daylight and views in these spaces is the hallmark of our renovation. In the first-floor open office area, we dropped the sills and enlarged windows so that seated employees can see outside. Employees in the second-floor open office area already had views to the outside, but the project managers in what we call the "Outback" were bounded by the windowless room that formerly contained old files. With the addition of the east-facing curtain wall in the Green Library and a frameless glass sidelight and door between the work stations and the Green Library, the "Outback" has been transformed into the most desirable piece of real estate in the office (Figures 3 and 4).

In addition to providing a magnificent view of the nearby park, the curtain wall also helps us achieve Indoor Environmental Quality Credit 8.1 Daylight & Views.

Some of the other LEED credits that we pursued were:

- *Sustainable Sites Credit 1E Heat Island Reduction, Roof:* We installed a new white thermo-plastic membrane beneath our photovoltaic array and a white acrylic coating on the rest of the roof to reduce heat island effect.
- *Sustainable Sites Credit 3.2 Alternative Transportation, Bicycle Storage & Changing Rooms:* To encourage bicycle use and reduce pollution from automobile use, we built a shower room, eagerly awaited by one of our assistant project managers, who recently started riding his bike to work, and our director of sustainable practices, who plans to start riding when the shower is finished.
- *Water Efficiency Credit 1.1 Water Use Reduction, 20% Reduction:* Automatic low flow faucets, dual-flush toilets, and waterless urinals that have dramatically reduced our water consumption. We expect to use 25% less water than the U.S. average for the same fixtures (Figure 5).
- *Energy & Atmosphere Prerequisite 1 Minimum Energy Performance:* This prerequisite, probably more than any other prerequisite or credit, forced us out of our comfort zone. As builders, we typically follow the prescriptions of the mechanical documents, confident that the engineers have designed to ASHRAE 90.1, as is required by this prerequisite; but because we acted as designers, as well as builders, on this project, we had to learn the standard and reflect it in our design and construction—no small task. That experience gave us a much deeper understanding of the prerequisite than slavish adherence to an engineer's design ever could have done, and that understanding will inform future work and benefit future clients.
- *Energy & Atmosphere Credit 1.1 Optimize Energy Performance, Lighting Power:* We used a combination of strategies to reduce our lighting power density to 35% below the standard:
    - We replaced 40-watt incandescent bulbs in existing recessed down-lights with 14-watt compact fluorescents.
    - We halved the number of 80-watt 2 × 2 recessed lights in work spaces.
    - We replaced 128-watt 2 × 4 recessed lights in utility spaces with 80-watt 2 × 2s salvaged from work spaces.
    - We halved the number of 64-watt 4'-0" fluorescents in our storeroom.
    - We replaced 120-watt 8'-0" fluorescents in our warehouse, where we added two skylights, with 64-watt fluorescents salvaged from the storeroom.
    - We replaced 64-watt 2 × 2 parabolic fixtures in work spaces with 28-watt 2 × 2 recessed/indirect fixtures.

FIGURE 2. Existing and first-floor plans.

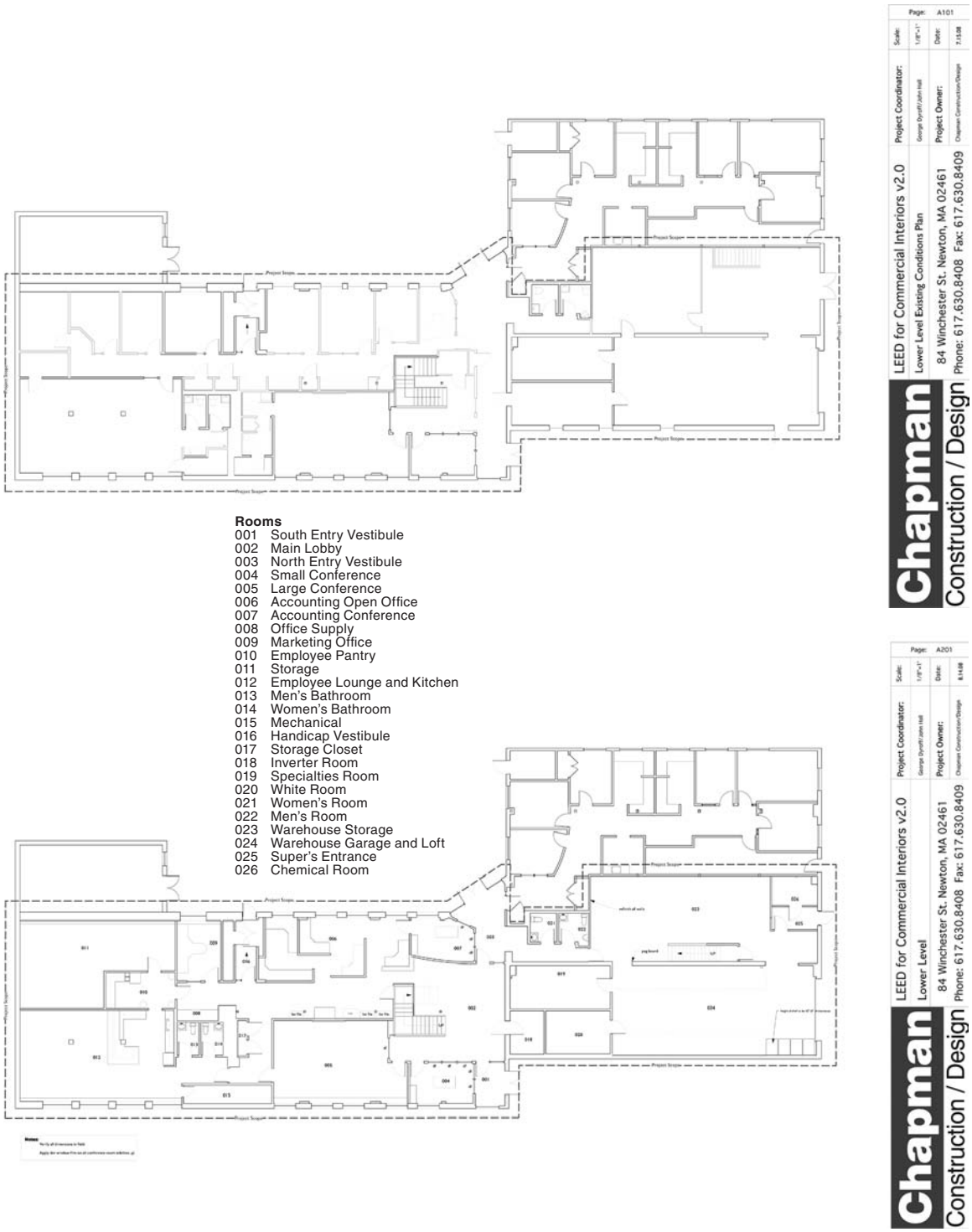


FIGURE 3. Daylighting and views.

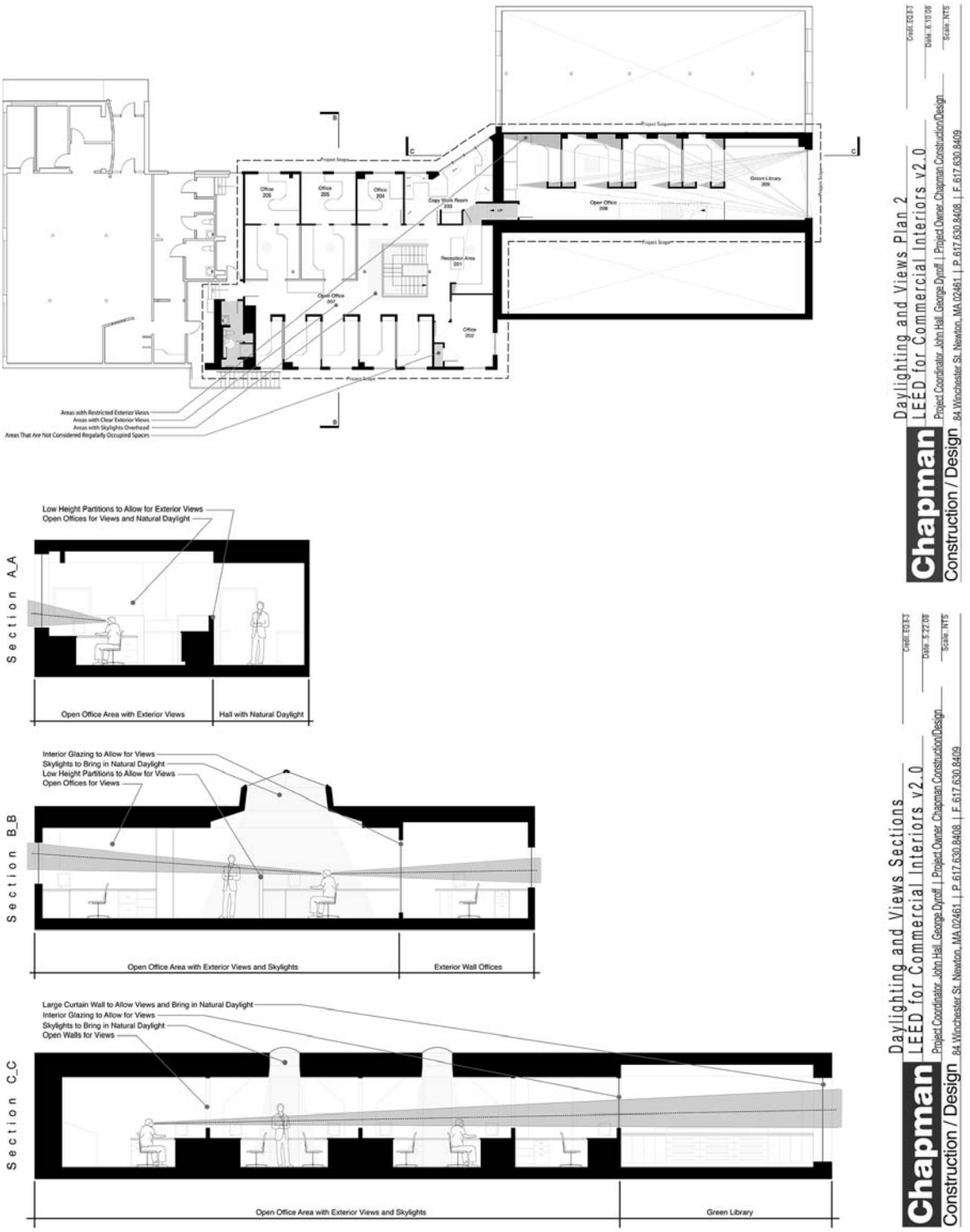


FIGURE 4. Curtain wall as seen through work stations.

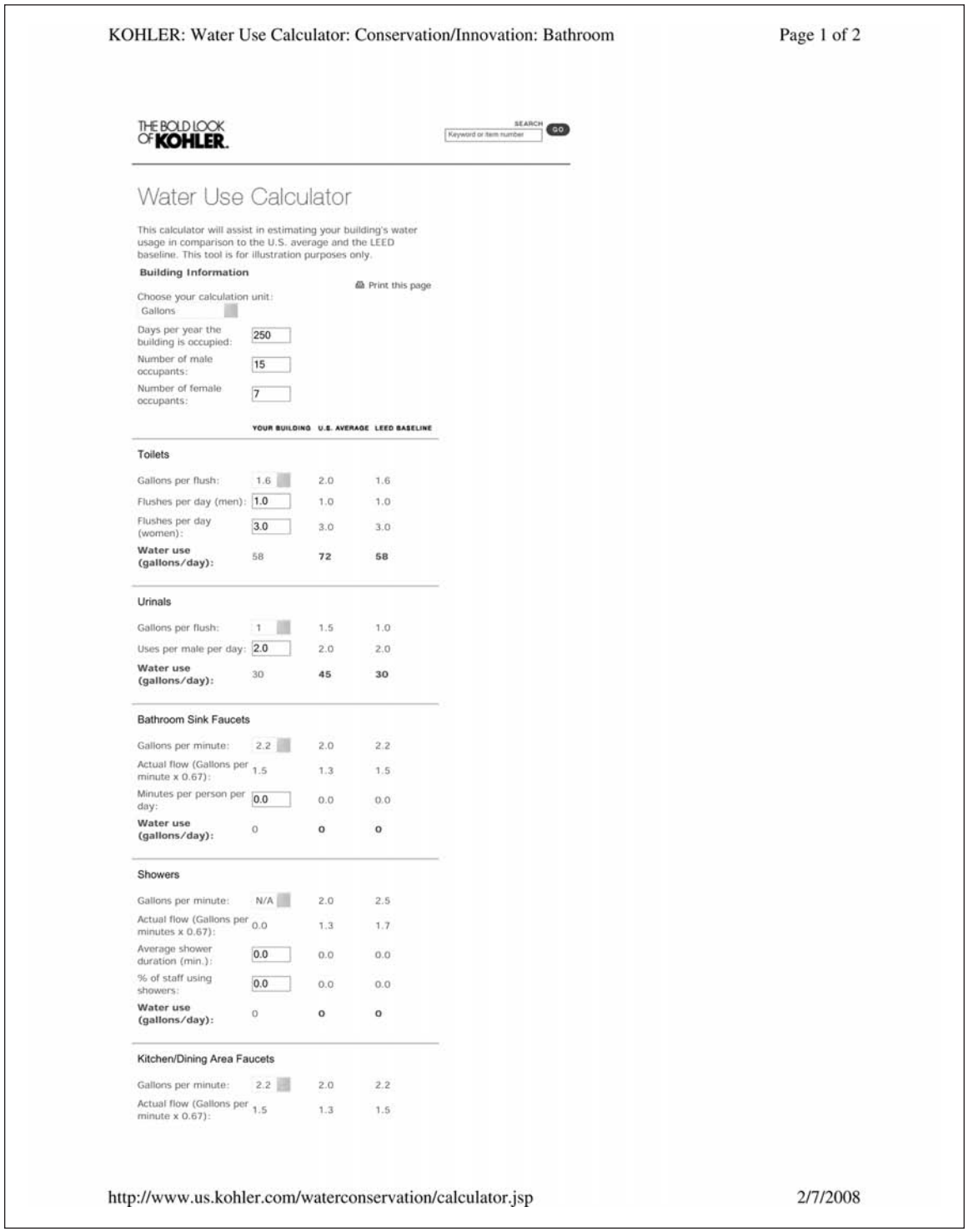
We tested the proposed work space lighting changes before committing to them and found that the additional daylight we brought into these spaces by enlarging windows and adding windows and light tubes more than made up for the reduction in artificial light. In fact it is not unusual for our project managers to work without artificial light because they have plenty of natural light. In calculating the effect these changes had on our lighting power density, we discovered just how important it is to accurately identify the existing conditions. Fortunately, we discovered the mistake we made in our existing conditions survey before we ordered any fixtures based on that survey. The corrected survey required us to completely revamp the fixture schedule to meet the credit.

- *Energy & Atmosphere Credit 1.2 Optimize Energy Performance, Lighting Controls:* We added daylight sensors that turn off the lights in work spaces illuminated by natural light.
- *Materials & Resources Prerequisite 1 Storage and Collection of Recyclables:* Chapman instituted a recycling program four years ago as a first step in its corporate commitment to sustainable practices; our early efforts began in the office with dedicated containers for paper, cardboard, and redeemable and non-redeemable bottles and cans. Aware that we could not claim to be a green construction company without recycling on our job sites, we prepared signage and containers for our site supervisors. With our LEED renovation we now have a dedicated collection center and an alliance with a neighboring city that will allow us to recycle a wider variety of paper products and electronics; that alliance was enabled in large part by our growing reputation as a truly green company and reflects our community outreach.

TABLE 4. Lighting power density calculation.

Space Type	Lighting Power Density [watts]	Area [sf]	Lighting Power Allowance [watts]
Open Office	1.1	2,794	3,073
Enclosed Office	1.1	733	806
Lobby	1.3	1,804	2,345
Lounge/Library	1.2	1,206	1,447
Restrooms	0.9	362	326
Warehouse/Storage	0.9	2,869	2,582
Conference/Multipurpose	1.3	1,062	1,381
Mechanical	1.5	178	267
Total Floor Area [sf] = 11,008			
Total Interior Lighting Power Allowance [watts] = **12,228** Total Installed Interior Lighting Power [watts] = 7,807 Lighting Power Reduction Achieved [watts] = **4,421**			
Lighting Power Reduction Achieved [4,421/12,228] = 36.2%			
36.2% > 35%, 3 points earned			

FIGURE 5. Water use calculator.



KOHLER: Water Use Calculator: Conservation/Innovation: Bathroom Page 1 of 2

THE BOLD LOOK OF KOHLER.

SEARCH Keyword or item number GO

Water Use Calculator

This calculator will assist in estimating your building's water usage in comparison to the U.S. average and the LEED baseline. This tool is for illustration purposes only.

Building Information

Print this page

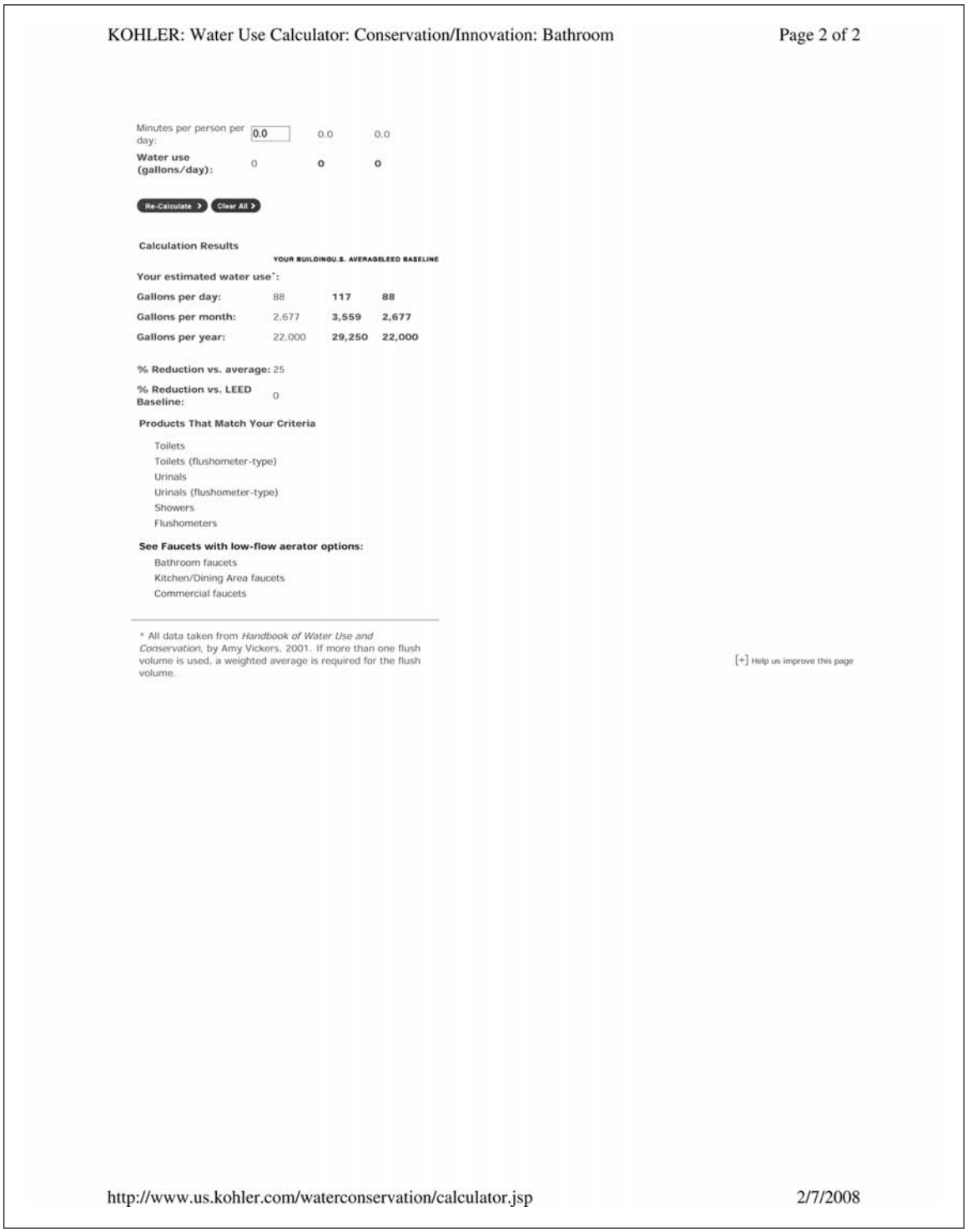
Choose your calculation unit: Gallons

Days per year the building is occupied:	250
Number of male occupants:	15
Number of female occupants:	7

	YOUR BUILDING	U.S. AVERAGE	LEED BASELINE
Toilets			
Gallons per flush:	1.6	2.0	1.6
Flushes per day (men):	1.0	1.0	1.0
Flushes per day (women):	3.0	3.0	3.0
Water use (gallons/day):	58	**72**	**58**
Urinals			
Gallons per flush:	1	1.5	1.0
Uses per male per day:	2.0	2.0	2.0
Water use (gallons/day):	30	**45**	**30**
Bathroom Sink Faucets			
Gallons per minute:	2.2	2.0	2.2
Actual flow (Gallons per minute x 0.67):	1.5	1.3	1.5
Minutes per person per day:	0.0	0.0	0.0
Water use (gallons/day):	0	**0**	**0**
Showers			
Gallons per minute:	N/A	2.0	2.5
Actual flow (Gallons per minutes x 0.67):	0.0	1.3	1.7
Average shower duration (min.):	0.0	0.0	0.0
% of staff using showers:	0.0	0.0	0.0
Water use (gallons/day):	0	**0**	**0**
Kitchen/Dining Area Faucets			
Gallons per minute:	2.2	2.0	2.2
Actual flow (Gallons per minute x 0.67):	1.5	1.3	1.5

http://www.us.kohler.com/waterconservation/calculator.jsp 2/7/2008

FIGURE 5. *(continued)*



KOHLER: Water Use Calculator: Conservation/Innovation: Bathroom Page 2 of 2

Minutes per person per day:	0.0	0.0	0.0
Water use (gallons/day):	0	**0**	**0**

Re-Calculate > Clear All >

Calculation Results

	YOUR BUILDING	U.S. AVERAGE	LEED BASELINE
Your estimated water use*:			
Gallons per day:	88	**117**	**88**
Gallons per month:	2,677	**3,559**	**2,677**
Gallons per year:	22,000	**29,250**	**22,000**

% Reduction vs. average: 25

% Reduction vs. LEED Baseline: 0

Products That Match Your Criteria

Toilets
Toilets (flushometer-type)
Urinals
Urinals (flushometer-type)
Showers
Flushometers

See Faucets with low-flow aerator options:

Bathroom faucets
Kitchen/Dining Area faucets
Commercial faucets

* All data taken from *Handbook of Water Use and Conservation*, by Amy Vickers, 2001. If more than one flush volume is used, a weighted average is required for the flush volume.

[+] Help us improve this page

http://www.us.kohler.com/waterconservation/calculator.jsp 2/7/2008

- *Materials & Resources Credit 1.3 Building Reuse, Maintain 60% of Interior Non-Structural Components:* It is not unusual in the interior fit-out business to preserve and reuse existing non-structural walls, so it was not a big step for us to design our renovation around existing partitions and for our supervisors to carefully delineate the selective demolition.
- *Materials & Resources Credit 2.1 Construction Waste Management, Divert 50% From Landfill:* Just as we formed an alliance to enhance our recycling efforts, we also formed an alliance to streamline our construction waste management program. On a previous LEED project, we site-sorted debris to achieve this credit. That recycling program was labor intensive and required constant policing—despite our signage and education programs, it was not unusual to find mixed debris in dedicated containers. Because of our new alliance with a waste management company that mechanically sorts debris with magnets, sieves, and water we no longer have to separate debris on site. With little effort on our part and no added cost to our clients, more than 70 percent of our construction debris is diverted from the landfill—not just on our LEED projects but on all our jobs (Figure 6). We negotiated a contract with this waste management company that was no more expensive than the agreement with our previous disposal company. In our continuing effort to bring green practices to all our clients—not just those seeking LEED certification—we now offer this service to every one of our clients and provide a report showing how much waste from their project was diverted from the landfill.

We didn't stop there, however. As construction managers, we supply dumpsters for most of our subs but not for our demolition contractors. They are responsible for their own debris. In an attempt to guarantee that they are achieving the same level of landfill diversion, we introduced them to our waste management company and encouraged them to sign contracts similar to ours. Sharing our knowledge with our subcontractors and telling them about the strategies that we have used to green our business is representative of our effort to educate and change the mindsets of not just our employees but also the subcontractors on whom we depend for our success. We have long understood and nurtured this relationship and have long treated our subcontractors as we treat our own employees; given the closeness of that relationship and our corporate commitment to change—one of our mottos is "Force Change!"—it made perfect sense to engage our demolition subs in this dialogue.

FIGURE 6. E. L. Harvey report.

CHAPMAN CONSTRUCTION
1/1/08 thru 7/31/08

Project #	Project Address	Total Tonnage	Concrete Tonnage (Diverted)	Metal Tonnage (Diverted)	Wood Tonnage (Diverted)	Paper and Cardboard Tonnage (Diverted)	Other / Recycled Tonnage (Diverted)	Total Tonnage (Diverted)	Residual or Trash Tonnage	% Recycled / Diverted Material
27309	1700 West Park Dr, Westboro	27.27	0.00	5.39	2.39	4.81	8.08	20.66	6.61	72.90%
28087	1800 West Park Dr, Westboro	23.85	0.00	3.06	2.02	0.79	1.87	7.73	16.12	34.20%
28089	1900 West Park Dr, Westboro	20.28	0.00	5.32	2.57	0.74	2.72	11.36	8.92	58.00%
	2 Highwood Dr, Tewksbury	3.09	0.00	0.93	0.93	0.31	0.00	2.16	0.93	70.00%
	3 Highwood Dr, Tewksbury	4.46	0.00	1.78	1.34	0.00	0.45	3.57	0.89	80.00%
27184	84 Winchester St, Newton	22.50	1.51	4.83	3.67	1.77	3.45	15.23	7.27	67.00%
27383	275 Grove St, Newton	4.54	0.00	0.91	0.91	0.45	1.14	3.41	1.14	75.00%
	73 School St, Chelmsford	5.70	1.14	0.00	3.99	0.00	0.00	5.13	0.57	90.00%
27255	1 Executive Dr, Chelmsford	27.60	0.00	3.70	4.97	3.76	8.77	21.20	6.40	77.50%
28058	3 Allied Dr, Dedham	16.19	0.00	4.56	2.44	1.71	4.40	13.11	3.08	81.30%
27057	450 Washington St, Dorchester	16.33	1.19	5.95	2.85	1.06	2.58	13.63	2.70	83.30%
28002	222 Rosewood Dr, Danvers	10.77	0.00	1.32	2.83	1.36	2.06	7.57	3.20	70.00%
27304	200 Fifth Ave, Waltham	20.13	0.22	3.32	3.41	1.87	5.80	14.62	5.51	72.50%
28021	300 Fifth Ave, Waltham	8.54	0.00	2.21	0.00	1.17	0.25	3.63	4.91	40.00%
27056	37 Friend St, Lynn	18.42	0.63	6.22	3.87	0.92	3.93	15.57	2.85	85.00%
28213	845 Donald Lynch Blvd, Marlboro	2.34	0.47	0.70	0.70	0.12	0.00	1.99	0.35	85.00%
28110	100 Hayden St, Lexington	32.68	0.55	10.29	4.78	3.03	9.45	28.10	4.58	85.80%
28098	1 Federal St, Billerica	28.75	0.44	3.60	2.81	2.11	12.55	21.51	7.24	76.80%
28131	8 Federal St, Billerica	6.01	0.00	2.40	0.60	0.30	0.30	3.61	2.40	60.00%
	TOTAL	**299.45**	**6.15**	**66.49**	**47.08**	**26.28**	**67.80**	**213.79**	**85.67**	**71.39%**

- *Materials & Resources Credit 7 Certified Wood:* This credit, perhaps more than any other credit, required supervisor vigilance. On this project our supervisors, who rotated into the office as they finished their project, were responsible for ordering framing lumber for the reconstruction of the warehouse roof and other interior carpentry. Ever mindful of the FSC requirement, they communicated our needs to suppliers and monitored deliveries to insure that we satisfied this credit.
- *Indoor Environmental Quality Credit 3.1 Construction IAQ Management Plan, During Construction:* While our site supervisors have always been attentive to the well-being and comfort of building occupants during construction, they were even more attentive on this job. With the eyes of 14 project managers on them they sealed HVAC systems and installed filters on active returns, created negative air in work areas to exhaust odors and prevent dust from migrating into occupied spaces, isolated construction areas, and cleaned constantly.
- *Indoor Environmental Quality Credit 4.2 Low Emitting Materials, Paints and Coatings:* If not already specified by the designers, we give all our interior fit-out clients add-alternatives for low VOC paints. This is one among several green options that we offer on every interior fit-out budget.
- *Indoor Environmental Quality Credit 4.4 Low Emitting Materials, Composite Wood and Laminate Adhesive:* Our office renovation has further informed our green budgets. Based on research for this project, we identified subcontractors who already offer formaldehyde-free substrates in their millwork and developed cost-adders for our spreadsheet.
- *Indoor Environmental Quality Credit 6.1 Controllability of Systems, Lighting:* As designers of our renovation, we have come to understand the requirements of this and other credits at a level of detail few builders will ever know. Working closely with our electrical subcontractor, we added switches to work spaces that didn't have them and occupancy/daylight sensors either at the switch or the ceiling.
- *Indoor Environmental Quality Credit 8.1 Daylight & Views, Daylight 75% of Spaces:* Of the several strategies that we employed to satisfy this credit—enlarging existing windows to provide views to the outside for our administrative staff, adding a curtain-wall to our Green Library, and installing light tubes to illuminate interior spaces—the light tubes have generated the most excitement. Our visitors often comment on the light tubes, which have virtually eliminated the use of artificial lighting in our inverter room, shower room, and main office.

While satisfying each of those prerequisites and credits has furthered our understanding of LEED, none has expanded our knowledge of the process and deepened the commitment of our employees to sustainable practices more than our work on Sustainable Sites Credit 1L On-Site Renewable Energy.

As part of our LEED Platinum renovation, we installed a 47.5kW (DC) photovoltaic array (Figure 7) on the roof of our building that produces 90% of the electric power used in our building. With a $130,000 grant from the Massachusetts Technology Collaborative and state and federal tax incentives we have estimated the payback at five years. Our president, four of our project managers, and three of our site supervisors were directly involved in the design of that system, which required significant structural upgrades to our building.

In addition to meeting one of the LEED credits, the array has served several other functions:

- It provides electricity for our office; initially, we planned a 10 kW (DC) array that would shade

FIGURE 7. View of array.

our south-facing windows, reducing air conditioning loads and glare; we increased the size of the array as it became clear that the design and management time required for an array large enough to serve almost all our electrical needs was no greater than the time required for an array that would produce a small fraction of the electricity we use in a year.
- It has furthered our reputation as a truly green company; our building is located on a heavily traveled road; with input from our structural engineer, we designed a galvanized steel frame that positions the panels for maximum visibility as well as maximum solar gain (Figure 8).
- It has become a teaching tool, not only for the eight employees directly involved in the design of the mounting system but also for the employees who prepared the building for the steel reinforcement required for the mounting racks. It has capped the tours of our building that we are giving and will continue to offer to clients, property managers, architects, engineers, and our community to introduce them to sustainable construction practices.
- It has strengthened the family feeling that our company has long enjoyed; thirty-two of our 50 employees, both field and office staff alike, volunteered their time on a Saturday to install the PVs in a modern-day "barn-raising" covered by WCVB-TV (http://www.chap-con.com/people/People1.asp?id=14).
- Our shared enterprise was both a manifestation of the spirit of our company and of our individual support for our corporate commitment to sustainable practices.

FIGURE 8. Array frame.

It would not be possible to overestimate the positive impact that the PV project has had on us as a company and as individuals. We could never have bought the media attention that the project generated: the lengthy piece on Boston Channel 5's Going Green news program, a reference in a business story in The Boston Globe, and the promise of a Globe feature story focused on our success changing mindsets both inside and outside our company. Nor could we have found any better way to further our campaign to change the way our employees think and act.

With their participation in the PV project any lingering resistance to change melted away. Including them in the design, inviting them to help install the panels, and celebrating their contribution with a meal at the end of our PV-raising helped to elevate their awareness of the impact their everyday decisions have on the environment.

While the PVs are, perhaps, the most visible sign of our corporate commitment to sustainable solutions, they are only the most recent in a long line of green initiatives.

Underlying them all is our continuing effort to create a paperless office. As construction managers, we formerly used vast quantities of paper to document and track our projects. To reduce the use of paper and the costs associated with disposal and file storage, we created a customized electronic project management system. That system enables us to create and file electronic project documents including

pre-bid checklists, bid invitations, contracts, purchase orders, change orders, meeting minutes, RFIs, submittal worksheets, invoices, and close-out worksheets. All these documents are stored for instantaneous retrieval in our Lotus Notes-based system.

Lotus Notes (Figure 9) displays multiple icons through which we can access other areas of our electronic database.

There is, for example, our Chapman Knowledgebase, where our project managers and site supervisor share what they've learned on their projects. Instructional programs developed for employee meetings are also stored here.

We fill out weekly timesheets and vacation requests in Lotus Notes and keep the office informed of our whereabouts on our electronic sign-out system. Our unit cost database is located here, as is our wardrobe system, which employees use to order Chapman clothing against their yearly allowance. Our working groups, who develop new concepts for the company, store their ideas here. And it's here that our Free Market can be found.

Our Free Market (Figures 10 and 11) enables project managers to offer items salvaged from their jobs to other jobs and our employees. In the renovation of our office, for example, we saved 10 doors, which another PM claimed for use as temporary construction doors on one of his projects. Employees can also advertise items for free or for sale, and they can request items, either for use on their jobs or at home.

Just as we have developed internal systems that put into practice what we preach, we have also enhanced our services to encourage our clients to incorporate green strategies into their projects.

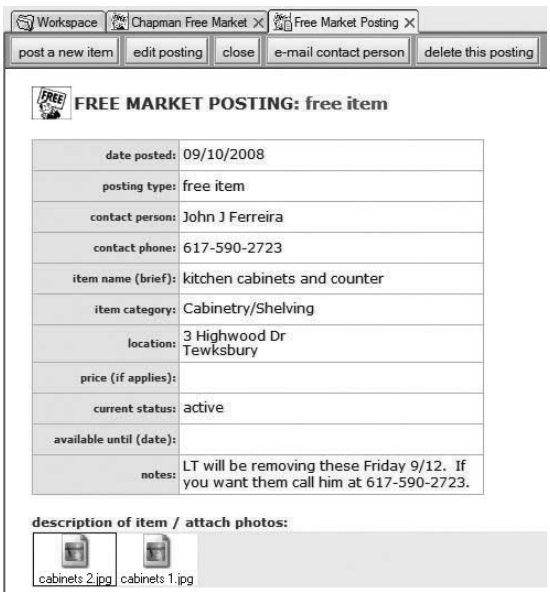
Seventy-five percent of our business is in interior fit-outs for corporate clients. Contracts for that work are often with property managers, who, traditionally, have focused on first costs. To help our property managers understand that there is a range of green strategies we introduced them to our Green Pyramid, which we developed to educate our own employees. The pyramid (Figure 12) places the simplest and least costly strategies at the base of the pyramid. These form the foundation for strategies requiring ever greater corporate and financial commitment from clients. At the top of the pyramid is LEED certification, the gold standard of green construction.

In conjunction with the development of our Green Pyramid we enhanced our budget spreadsheets to include green options. Every budget we produce, whether the project is bid or negotiated, includes a menu (Figure 13) of green options and their

FIGURE 9. Screen shot of Lotus Notes workspace.

FIGURE 10. Free market welcome frame.

FIGURE 11. Free market posting.

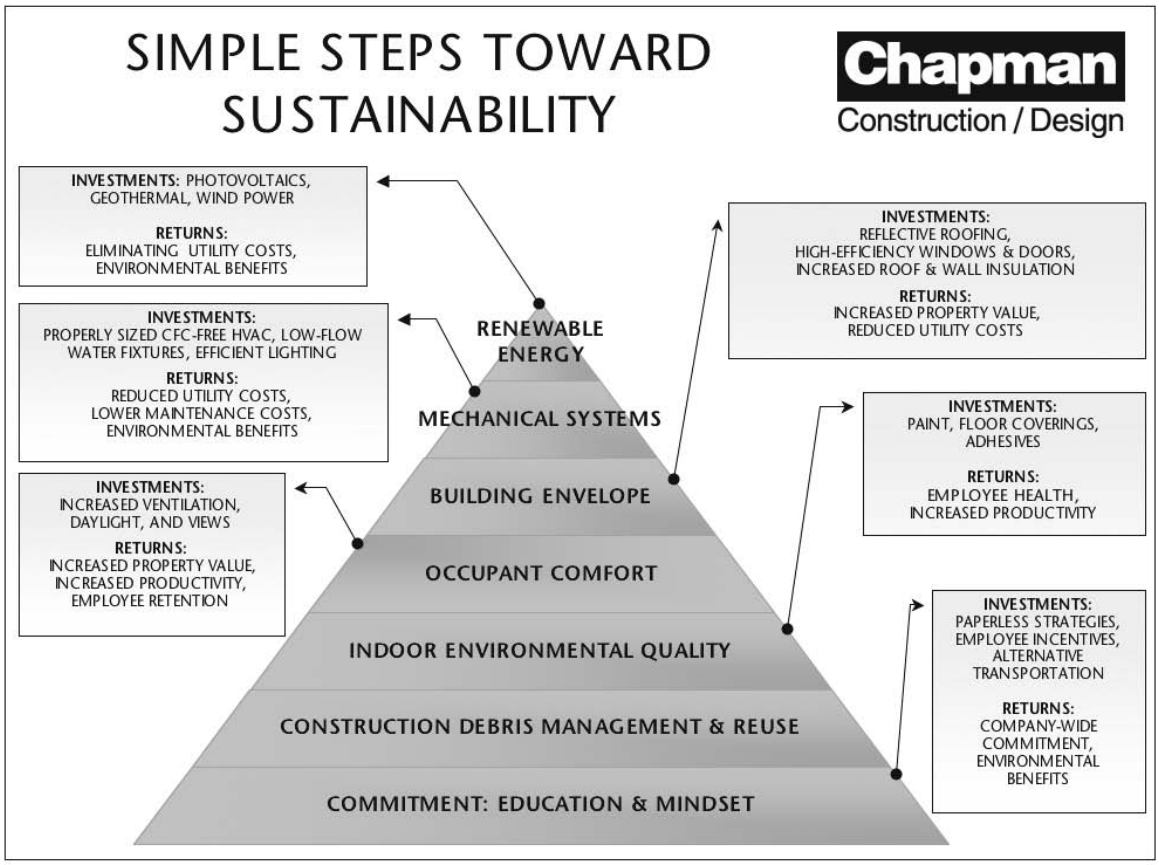


costs. Among the options that a client can choose are 100% recycled drywall, formaldehyde-free door cores and wall insulation, low VOC paints, dual-flush toilets, and flex-head sprinklers.

Also included among the options are utility company rebates. To help us identify those rebates and streamline the rebate process, we have formed an alliance with NSTAR, one of the utilities in our service area. This alliance benefits our clients because we find them rebates and manage the application process; us because it adds value to our service, giving us a competitive edge; and NSTAR because the utility company wants to see its rebate programs used in the interior fit-out market.

In the past construction companies and their interior fit-out clients have been reluctant to participate in utility company rebate programs because the application process was perceived as cumbersome. Neither the builder nor the client wanted to spend the time or the money on an uncertain outcome. NSTAR has taken steps to simplify and streamline

FIGURE 12. Green pyramid.



the process and through our alliance has offered to review plans for rebate opportunities on the tight schedules typical in the interior fit-out market.

While each green option on our budget spreadsheet carries a one-line description of its environmental benefits, allowing the client to weigh costs and benefits, to further educate our clients (and our employees) we have developed green product data sheets (Figure 14) that detail the uses, costs, and benefits.

We know that in sharing information with owners, particularly on bid jobs, we might inadvertently be sharing information with our competitors. It is not unusual for an owner to have a preferred bidder and, very occasionally, we are not that bidder. It also is not unusual for an owner to share the details of a competitor's proposal with a preferred bidder and to ask him to duplicate those services.

That's OK with us. While we are not in the business of giving away what we have worked hard to learn, we also believe that our industry, never particularly known as forward-looking, can only benefit from our knowledge. We would be flattered if a competitor were to imitate us and confident that the clients for whom we want to work will recognize us as industry leaders with a commitment to sustainable solutions that inform every aspect of our business as well as the personal lives of our employees.

We are, as all businesses are, in business to make money. Unlike many businesses, however, we have invested a significant amount of that money in transforming the way we do business. However, no amount of money can effect those changes without the cooperation and commitment of employees. Here's what we did to get our employees to buy into our vision.

FIGURE 13. Green options spreadsheet.

CONSTRUCTION COST PROJECTION

Chapman
Construction / Design

Date	8/8/2008
Project	Green Options Sample
Project #	28000
Contact	Client, Company

Category	Description	Unit of Measure	Quantity	Unit Cost	Total	Category Total	Comments
Green Options						$0	
2000	Sort/Recycle all construction debris (included)	incl.	1	$0.00	$0		Through Harvey, LEED slips provided
	* Minimize impact on landfills, sort, recycle and return all materials back to the manufacturing stream. Reduce impact on natural/virgin resources.						
2000	Recycle all existing ceiling tile through Kamco	ls	0	$1,000.00	$0		palletize, stack, wrap and ship to Kamco
	* Keep ceiling tile out of landfills or non-recycled containers. Goes back for potential reuse or recycling by a qualified organization.						
6400	Formaldehyde free components and fabrication	%	25%	$0.00	$0		boxes, p-lam and adh. formaldehyde free
	* Improved air quality for building occupants. Decreases VOCs and Formaldehyde from being released into the atmosphere.						
8200	Formaldehyde free door cores	ea	25%	$0.00	$0		Only an option if 20 or more pre-fin doors
	* Improved air quality for building occupants. Decreases VOCs and Formaldehyde from being released into the atmosphere.						
9250	100% recycled gypsum wall board (Montreal Board)	%	0%	$0.00	$0		0% on material cost, greater lead time
	* Increase use of recycled material decreasing the need for harvest, manufacture of virgin material. Material used in production stream instead of landfill.						
9250	Formaldehyde free wall insulation	sf	0	$0.15	$0		at all new walls
	* Improved air quality for building occupants. Decreases VOCs and Formaldehyde from being released into the atmosphere.						
9500	Acoustic ceiling tiles (70% recycled material content)	incl.	0	$0.00	$0		included in budget, no upcharge, 70% rec.
	* Purchase and install materials using recycled material in lieu of production processes which use virgin material. Keep material out of landfills, used in bldg material.						
9860	Provide carpet tiles in lieu of broadloom material	sy	0	$10.00	$0		Dep. on grade of tiles $10/yd for mid-grade tile
	* Install flooring materials that contain recycled material. Carpet tiles will be easily recycled at the end of their life, used in the production process and kep out of landfills.						
9900	Provide low VOC paint products	sf	0	$0.15	$0		
	* Improved air quality for building occupants. Decreases VOCs from being released into the atmosphere. Easier/cleaner disposal of remaining product.						
15400	Low Flow Toilets	ea	0	$125.00	$0		change out existing fixtures
15400	Dual Flow Flush Valves	ea	0	$75.00	$0		change out existing valves, spec dual as new
15400	Automatic Faucets	ea	0	$225.00	$0		install in place of standard faucets
	* Reduce water use and reduce the burden on municpal waste water systems and facilities. Ruduce water, utility and disposal fees for tenant/land lord.						
15500	Flex Head sprinkler heads	ea	0	$45.00	$0		in lieu of steel arm over, varies by quantity
	* Saves on future relocation costs. Flex heads are easily adjusted, saves on raw steel material that would be needed for future build-outs.						
15800	Low VOC duct sealant	incl.	1	$0.00	$0		No upcharge for this option
	* Improved air quality for building occupants. Decreases VOCs from being released into the atmosphere. Easier/cleaner disposal of remaining product.						
16100	N-Star rebates for new or upgrade existing fixtures	ea	0	-$10.00	$0		replace 2x2 T-12 with 2x2 T-8
16100	N-star rebates for new light fixtures that meet criteria	ea	0	-$45.00	$0		energy efficient light fixtures
16100	N-star rebates for wall-mount occ. sensors	ea	0	-$25.00	$0		use wall switch sensors
16100	N-star rebates for ceiling-mount occ. sensors	ea	0	-$75.00	$0		use ceiling sensors
16100	N-star rebates for LED exit signs	ea	0	-$10.00	$0		replace existing fluorescent with LED
16100	N-star rebates for compact fluorescent fixtures	ea	0	-$40.00	$0		replace existing halogen cans

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First and foremost, we engaged them in the process. Historically, Chapman employees have worked collaboratively to accomplish our goals. We rely on teams or "working groups" as we prefer to call them rather than on strict hierarchy to develop the ideas that drive our business.

Our Project Management Process working group, for example, which creates and refines the electronic systems we use to conduct our business, is headed by one of our senior project managers but includes our vice president for information technology, our general manager, a recently minted project manager, and a project coordinator. While members originate some of the ideas, many come from non-members invited to contribute ideas during our weekly project management meetings when our working groups describe current work and solicit input from the entire administrative and project management staff.

While the size of our company—50 employees—enables us to directly engage all of our office staff in this process, we cannot include the field staff in these weekly meetings because they must be about their business directing operations and protecting safety on our job sites.

That is why we engage them indirectly by regularly reporting the accomplishments of the working groups to them, oftentimes electronically. All of our site supervisors have company-issued laptops and are electronically linked to our internal systems, sometimes through our company newsletter, and just as

FIGURE 14. Product sheet.

frequently during our monthly employee meetings. Really important developments, such as the green options spreadsheet, are announced in all three venues.

The idea is to keep everybody in the loop, to solicit the participation of all our employees, and thereby earn their support and their buy-in.

While our emphasis has been on maintaining open communication throughout the company, the level of interest in these affairs has outstripped our expectations. For example, one of our site supervisors, who we initially thought an unlikely candidate for LEED accreditation, passed his exam after several attempts and has become one of our staunchest green advocates.

We believe that our corporate philosophy, which encourages the involvement of all our employees in the affairs of the company, is in large part responsible for our successful effort to change the way our employees think about their jobs and their lives. They have adopted new ways of building that reflect their deeper understanding of the impact of their activities on our planet because we engaged them in the process of recreating the way we conduct our business, and many have changed their driving habits, because we showed them how to save money while saving the planet.

While pleased with the changes we have brought about within our own company, we are not yet satisfied. We plan to use our growing reputation as a truly green company and our LEED renovation to change the mindsets of people outside of our company as well.

FIGURE 15. White roof.

We have already begun to do this. We have educated our subs through their work on our renovation. For example, we required our subcontractor to use formaldehyde-free substrates in his millwork, our painting sub to use low-VOC paints, and our plumber to install waterless urinals. And we have shared our knowledge with other building professionals during tours of our renovation, which has become a learning lab for us, a lab that allowed us to experiment with and learn about green strategies at our own expense, not a client's.

For example, we discovered that painting a black membrane roof with a white acrylic coating (Figure 15) is no simple matter. The roof must be prepared with an acidic cleaner that can corrode metal and discolor exterior finishes. Protecting our PVs and the façade of our building from the cleaner was a major undertaking.

Knowing what we now know about this product we would probably advise against using it on a roof without a parapet to corral the runoff and keep it from staining the face of the building. We also would probably recommend against using it on a roof that contains an array like ours.

The tours will continue after we have finished the renovation in an attempt to educate an even broader audience. We will invite community and school groups to visit our inverter room where direct current from our PVs is converted to alternating current to power our building. They will be able to watch an electronic display that will tell them how much clean electricity we are producing and how much less carbon is being released into the atmosphere. We will show them our recyclable carpet tiles, our linoleum flooring, our occupancy and daylight sensors and explain the benefits of each. And we will take them up to our roof on a stairway with transparent risers that allow views to the outside. On the roof we will tell them about the 208 photovoltaic panels that provide electricity for almost all of our needs and the spirit of cooperation and ownership engendered by our PV raising.

And we will tell them that many of these strategies are within their grasp. We will encourage them to start with the strategies at the bottom of the Green Pyramid and to consider the increased benefits of the higher strategies, such as increased property values and lease rates and lower absenteeism and churn.

In short we will share with them all that we have learned in the hope that they will join us in our effort to change mindsets.

CONCLUSION

Creating a truly green company requires changing employee mindsets and behavior, both on the job and at home. Chapman Construction/Design became an agent of change inside and outside of the company by engaging all its employees—from the laborer to vice-president—in the LEED renovation of its building, which included the installation of a 208-panel photovoltaic array that the construction management firm turned into a latter-day "barn raising." Thirty-two of its 50 employees volunteered a Saturday of their time to install those panels in an effort that encouraged employees to adopt the corporate commitment to sustainable construction practices.

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