Sacramento Municipal Utility District
Professional Wet Cleaning Demonstration Project

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Disclaimer

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Abstract

This report, "Sacramento Municipal Utility District Professional Wet Cleaning Demonstration Project" is one in a series of reports by the Pollution Prevention Center at Occidental College designed to address the significant environmental and health impacts associated with the use of perchloroethylene (PCE), the chemical cleaning solvent used by the vast majority of dry cleaners in the United States. To help jump-start the diffusion of professional wet cleaning, a non-toxic alternative to dry cleaning, study authors administered a grant program to provide financial and technical assistance to two cleaners in Sacramento interested in switching from dry cleaning to professional wet cleaning, and serving as demonstration sites. A successful outreach campaign to recruit applicants to the grant program included: information articles in the regional trade press, direct mail flyers sent to Sacramento cleaners describing the grant program and announcing workshops and seminars, individual site visits to Sacramento cleaners, and workshops and seminars hosted by demonstration site cleaners. As a result of these outreach efforts, three Sacramento cleaners applied to the demonstration program. The two cleaners selected as demonstration site grantees were converted over a two-year period. Technical evaluation was conducted at both facilities operating a PCE dry cleaning immediately prior to converting to professional wet cleaning. Both demonstration cleaners showed that they were able to maintain their level of service and customer base after switching to professional wet cleaning. In regards to owner satisfaction, each of the demonstration site cleaners considered their decision to switch to professional wet cleaning to be a good business decision and would recommend professional wet cleaning to other dry cleaners needing to replace their existing cleaning equipment. A resource evaluation showed substantial reduction in electricity use, electricity demand, natural gas use, and water use. The study concludes with a summary of the successes of the Sacramento program and offers recommendations to further promote the diffusion of professional wet cleaning. These recommendations include developing a SMUD rebate program, an ongoing demonstration program, and a utility-based equipment loan program.

Executive Summary

Background

This report, "Sacramento Municipal Utility District Professional Wet Cleaning Demonstration Project" is one in a series of reports by the Pollution Prevention Center at Occidental College evaluating the prospects for pollution prevention in the garment care industry.

Since the 1950s, the vast majority of dry cleaners have relied on perchloroethylene (PCE) as "the" solvent used to clean clothes as part of the dry cleaning process. However, a wide array of scientific studies and federal, state, and local regulatory actions have focused on PCE's health and environmental risks. Costly regulatory and liability actions have created significant economic burdens for cleaners, most of whom are small businesses. These pressures have prompted a search for alternative cleaning processes.

Over the past few years, a number of alternatives to PCE dry cleaning have emerged including professional wet cleaning. Professional wet cleaning is the process of cleaning delicate garments in water using computer-controlled washers and dryers, specially-formulated detergents, and specialized finishing equipment. CO_2 dry cleaning compresses CO_2 into a liquid solvent for cleaning delicate garments.

The diffusion of professional wet cleaning and CO_2 dry cleaning as substitutes for dry cleaning has been slow. For professional wet cleaning, barriers to diffusion include a lack of awareness by garment care professionals about the technology, cleaners' concerns about technical feasibility and customer reaction, lack of sufficient training and technical support to cleaners converting, lack of sufficient knowledge about professional wet cleaning among other industry stakeholders, care labeling laws, and apparel manufacturing practices that favor dry cleaning. For CO_2 dry cleaning, the biggest barrier is the cost of equipment. CO_2 machines cost twice that of comparably sized PCE dry clean systems.

Since 1995, the Pollution Prevention Center at Occidental College, has been administering a successful commercialization for professional wet cleaning in the greater Los Angeles region. This current report is the first study to evaluate a project designed to jump-start professional wet cleaning in Sacramento by recruiting cleaners to operate dedicated professional wet cleaning facilities. The study describes the process of recruiting cleaners interested in making a transition from PCE-based dry cleaning and evaluates the success of these transitions. By initiating the first dedicated professional wet cleaners in Sacramento, the Project sought to create a positive model for the garment care industry as well as to establish the infrastructure necessary to begin a larger self-sustaining transition towards environmental garment care methods in these two regions.

Project Goals

To jump-start the diffusion of professional wet cleaning in Sacramento, the primary goals of this project were as follows:

- Develop a grant program to provide financial and technical assistance for two cleaners to switch from dry cleaning to professional wet cleaning and to serve as demonstration sites.
- Conduct an educational outreach campaign to educate dry cleaners about the viability of professional wet cleaning and identify qualified applicants for the grant program.
- Expand educational outreach through tours hosted at the newly created professional wet clean demonstration sites.
- Evaluate the overall viability of demonstration site cleaners before and after their switch to professional wet cleaning with respect to technical performance, customer satisfaction, and energy use.
- Develop recommendations to further commercialization of professional wet cleaning.

Project Development

At the beginning of this commercialization project, a great deal of effort went into planning each major component of the project including: structure of the grant program, educational outreach strategies, providing technical assistance, and project evaluation methods.

Outreach to Cleaners

A general outreach strategy was developed to inform cleaners in Sacramento about the program including publicity in fabricare trade journals, publicity in the general press, direct mail campaigns, and individual visits to cleaners. Outreach materials were designed to raise cleaners' awareness about the viability of professional wet cleaning, publicize and bring cleaners to demonstration workshops, and recruit cleaners into the grant program.

As a consequence of the outreach campaign, a total of seven cleaners contacted project staff expressing an interest in learning more about professional wet cleaning and the grant program.

Demonstration of Professional Wet Cleaning Technology

First-hand observation of professional wet cleaning at dedicated professional wet cleaning facilities was seen as essential for dry cleaners to effectively evaluate the technology and to provide sufficient information for them to make a decision to apply to the grant program. To this end, at the beginning of the project, a number of workshops

and individual tours were organized at existing professional wet cleaning facilities in the Bay Area where these technologies were already established.

These initial activities proved to be instrumental in identifying the first set of cleaners interested in applying to the Sacramento grant program and switching to professional wet cleaning.

Grant Application Process

A total of four applications were received for the grant program. A number of issues were identified that led to two cleaners not being accepted as demo sites. The main issues involved were their inability to obtain loan financing for new equipment, and their inability to pay for the remaining cost of equipment.

The two cleaners selected to become demonstration sites were similar in regards to geographic location, household income level of local community, and size of cleaning operation.

Demonstration Site Conversion Process

Each grant recipient received technical assistance during the conversion process in order to facilitate a smooth transition to professional wet cleaning. This technical assistance included: equipment selection, plant redesign, identification of qualified installers, consultation during the installation process, and coordination and assistance in technical training.

Both demonstration site cleaners chose similar configuration of equipment. Equipment installation proved to be relatively manageable for the cleaners selected to be demo sites. Successful training was enhanced by having grantees observe the professional wet cleaning process at another dedicated facility prior to having equipment installed at their facility.

Evaluation of Viability of Professional Wet Cleaning

An evaluation of each demonstration site cleaner revealed that both were able to successfully wet clean their customer garments, experienced a high rate of customer satisfaction, would recommend the process to fellow dry cleaners, and experienced lower rates of energy use.

A resource use evaluation included an in-depth sub-metering assessment of the first demonstration site and an evaluation of monthly billing resource to characterize energy use before and after the cleaners converted.

The sub-metering analysis showed electricity use, electricity demand, and water use in processing garments in dry cleaning to be over two times higher than in wet cleaning. Electricity use in dry cleaning was 25 kWh/100 lbs of garments cleaned in dry cleaning compared to 11 kWh/100 lbs of garments cleaned. Electricity demand was

9 kW in dry cleaning versus 3 kW in wet cleaning. Water use was 1,063 gallons/100 lbs of garments cleaned in dry cleaning versus 308 gallons/ 100 lbs. of garments cleaned in wet cleaning. Wet cleaning also used less natural gas: 2,500 cubic feet/100 lbs. of garments cleaned in dry cleaning vs. 1,750 cubic feet/100 lbs. of garments cleaned in wet cleaning.

Analysis of monthly billing record data supported the sub-meter analysis, showing reduction in electricity use, electricity demand, and natural gas use after the cleaners switched from PCE dry cleaning to professional wet cleaning.

Conclusions and Recommendations

The project successfully introduced professional wet cleaning to the Sacramento market by establishing the first two professional wet cleaners in the region.

Barriers to the diffusion of professional wet cleaning include the dominance of petroleum dry cleaning as the preferred alternatives to PCE dry cleaning. The issuance of the new state fire code requiring using of sprinklers when installing petroleum dry cleaning machines, due to its combustibility, will likely dissuade cleaners from the more polluting and more energy-intensive option.

The results from this study support the establishment of a SMUD rebate for professional wet cleaning. A relatively large rebate, based on the lifetime electricity saving, was recommended to accelerate professional wet cleaning's diffusion in the region. In addition, expanded the demonstration program, based on the two established demonstration sites, was seen as complementary to the rebate program. Finally, given problems with access to capital, a utility-based equipment loan program was recommended to assist cleaners in switching to this pollution prevention energy-efficient technology.

1. Introduction

1.1 Background of PCE-Based Dry Cleaning

Since the 1950's, perchloroethylene (or PCE) has been the dominant cleaning agent in the garment care industry -- a solvent that is currently used by 85 percent of the more than 30,000 dry cleaners operating throughout the United States. Due to its low flammability and effective cleaning properties, PCE was largely able to displace previous non-aqueous based solvents used in garment care, notably carbon tetrachloride (which was banned due to significant health risks) and petroleum (which suffered from concerns about potential fire hazards in garment care facilities). During this period, the dry cleaning industry also achieved its name and recognition, in part by widely promoting its ability to substitute a cleaning solvent such as PCE for water. In turn, the "dry clean only" garment care label was established by actions of the Federal Trade Commission for garments that required professional cleaning as opposed to home laundry cleaning or cleaning in water. This care labeling process in particular and the evolution of the dry cleaning business in general occurred in the context of dry cleaning's ability to clean clothes that broadly met various industry expectations in such areas as dimensional change (shrinkage or stretching), colorfastness (dye bleed), and overall cleaning ability.

Just as dry cleaners became ubiquitous in cities and even small towns, evidence began to emerge in the 1970's of the adverse health and environmental impacts associated with PCE use in dry cleaning.[1] Effects of chronic exposure to PCE include dizziness, impaired judgment and perception, damage to the liver and kidneys, and respiratory disease.[2] Other risks include neurotoxicity and reproductive and developmental toxicity as well as various forms of cancer such as bladder, stomach, esophageal, intestinal, and pancreatic.[3] PCE has been classified as a probable human carcinogen (a Group 2A carcinogen) by the International Agency for Research on Cancer and as a potential human carcinogen by the National Institute of Occupational Safety & Health (NIOSH).[4]

Knowledge of the adverse effects of PCE came precisely at a time when significant new national environmental and occupational regulations were being developed. Workplace exposure limits were first placed on PCE in 1970 by the Occupational Safety and Health Administration. In the 1980s, the EPA as well as state and regional agencies began establishing standards to regulate PCE as a water, land, and

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[1] *Bioassay of Tetrachloroethylene for Possible Carcinogenicity*, Carcinogenesis Technical Report Series No. 13; National Cancer Institute, 1977; Smith, E. B. *Job, Safety, and Health* 1978, 25-28; Blair, A.; Decoufle, P.; Grauman, D. *American Journal of Public Health* 1979, *69*, 508-511.

[2] Solet, D.; Robins, T. G.; Sampaio, C. *American Industrial Hygiene Association Journal* 1990, *51*, 566-574.

[3] Ruder, A. M.; Ward, E. M.; Brown, D. P. *Journal of Industrial Medicine* 2001, *39*, 121-132.

[4] *Tetrachloroethylene (Group 2A) - Summary of Data Reported and Evaluation*, IARC Monograph 63; International Agency for Research on Cancer, 1995.

air contaminant.[5] Following their actions, solid waste and discharge water contaminated with PCE must now be disposed of as hazardous waste. Soil and groundwater contaminated with PCE is subject to Superfund designation and clean-up requirements. Regulatory oversight of PCE as an air contaminant increased substantially with the passage and implementation of the 1990 Clean Air Act Amendments.

The 1990 Amendments classified 189 chemicals (including PCE) as hazardous air pollutants (HAPs), and developed administrative procedures to establish emissions standards, or NESHAPs (National Emissions Standard for Hazardous Air Pollutants), for each classified chemical.[6] PCE dry cleaning was the first NESHAP promulgated by the EPA after the 1990 legislation took effect. Issued in 1993, the rule focused on the use of pollution control ("add on" or "end-of-pipe") equipment to achieve emissions reductions as well as operator monitoring requirements to assure compliance with emission reduction goals.[7] All new dry clean machines were required to install PCE vapor recovery systems (refrigerated condenser or carbon adsorber), with large facilities required to install vapor recovery for existing machines. Good housekeeping requirements included monitoring, record keeping, reporting, and leak detection and repair.

Initially, implementation of these pollution control regulations appeared to create a relative degree of certainty within the garment care industry that PCE use could remain viable for years to come. But recent revelations concerning lack of regulatory compliance as well as questions regarding population exposure to PCE from dry cleaning (even when facilities are in compliance) have created a crisis both within the regulatory community as well as within the garment care industry. Enforcement evaluation audits in the late 1990s revealed that few cleaners were in compliance with federal, state, or regional rules. [8]

1.2 A Pollution Prevention Approach

The traditional approach to environmental regulation, as discussed above, is costly for government and businesses alike, and often simply transfers pollution from one environmental medium to another.[9] Pollution prevention is an alternative approach that prevents pollution at the source by minimizing or even preemptively eliminating the

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[5] *Cleaner Technologies Substitutes Assessment for Professional Fabricare Processes*, EPA 744-B-98-001; United States Environmental Protection Agency, Design for the Environment, 1998.
[6] *Clean Air Act*; 1990, 101-549, 112.
[7] *National Perchloroethylene Air Emissions Standards for Dry Cleaning Facilities*; 1993, 40 CFR Part 63, Subpart M.
[8] An Evaluation of the Sacramento Metropolitan Air Quality Management District's Air Pollution Control Program, California Air Resources Board, 1997; Fact Sheet: Findings from Dry Cleaner Inspections in South Coast AQMD. California Air Resources Board, An Evaluation of the Bay Area Air Quality Management District's Air Pollution Control Program, California Air Resources Board, 1998; An Evaluation of the Bay Area Air Quality Management District's Air Pollution Control Program, California Air Resources Board, 1998; Drycleaners News 1998, 47; Drycleaners News 1999, 48.
[9] U.S. Congress, Office of Technology Assessment. 1994. *Industry, Technology, and the Environment: Competitive Challenges and Business Opportunities* (OTA-ITE-586). Washington, D.C.

creation of pollution.[10] One form of pollution prevention is the use of "clean technology," defined as a technology or process that generates less waste or emissions than the norm.[11] The adoption of a clean technology requires at least two steps: the development of the initial technological innovation followed by the diffusion of the new technology across the relevant industry sector or sectors. [12]

The potential to integrate a pollution prevention approach into regulation is not only feasible, but also has been written into a number of environmental statutes. For example, the 1990 Clean Air Act Amendments, instruct the USEPA to develop a technology standard for hazardous air pollutants, such as PCE, based on the maximum degree of reduction, including prohibition of such emissions when technologically achievable.[13]

By 2000, taking a pollution prevention approach in the garment care industry had become feasible. This was because as regulation of PCE dry cleaning intensified in the 1990s, so did interest in the development of alternatives to PCE including reformulated petroleum solvents, silicone-based solvents, liquid carbon dioxide, and professional wet cleaning.

As a consequence of the commercial availability of a number of these alternative technologies to PCE dry cleaning, as well as the low level of compliance with existing rules, and ongoing risks associated with emissions, the South Coast Air Quality Management District in California ruled in December 2002 to phase out PCE dry cleaning for Los Angeles, Orange, Riverside, and San Bernardino Counties.[14] In January 2007, the California Air Resource Board ruled to phase out PCE dry cleaning in California.[15]

In October 2003, California enacted a law (AB998) to provide financial incentives to cleaners in the state switching from PCE dry cleaning to non-toxic and non-smog forming technologies, including professional wet cleaning and liquid carbon dioxide.[16] A fee imposed on the sale of PCE to dry cleaners funds the incentive program.

1.2.1 Alternatives to PCE Dry Cleaning

A number of alternatives to PCE dry cleaning have emerged since the 1980s in response to increasingly stringent regulations. These technologies present the opportunity to reduce environmental risks while maintaining performance standards and financial viability.

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[10] Gottlieb, Robert, et al. 1995. New Approaches to Toxics: Production Design, Right-to-Know, and Definition Debates. In *Reducing Toxics*. Washington, D.C.: Island Press.
[11] Allen, David. 1995. The Chemical Industry: Process Changes and the Search for Cleaner Technologies. In *Reducing Toxics.* Washington, D.C.: Island Press.
[12] Stewart, Richard B. 1981. Regulation, Innovation, and Administrative Law. *Cal. L. Rev.* 69:1256-1377.
[13] *Clean Air Act*; 1990, 101-549, 112; Ashford, Nicholas A., Ayers, Christine, and Stone, Robert F. 1985. Using Regulation to Change the Market for Innovation, *Harvard Envt'l L. Rev.* 9:359-466.
[14] SCAQMD, Rule 1421, December 6, 2002.
[15] CARB, Perchloroethylene Dry Cleaning ATCM, December 27, 2007.
[16] www.arb.ca.gov/toxics/dryclean/ab998.

Petroleum Dry Cleaning: Petroleum solvent (also referred to as 'hydrocarbon') is the most widely used alternative to PCE. Equipment costs are slightly higher than PCE dry cleaning machines. Although petroleum solvents are not currently classified as hazardous air pollutants, they do emit smog and greenhouse gas-producing volatile organic compounds (VOC's) and generate hazardous waste. Government regulations require that petroleum dry clean machines be equipped with solvent-recovering pollution control devices similar to those found on PCE equipment. Petroleum solvents also face regulations regarding flammability. They are classified as Class III-A solvents, meaning they have a flash point between 140 and 170 degrees Fahrenheit. Fire codes often require an automatic sprinkler system throughout the plant as well as the construction of firewalls between the machine and the rest of the facility.

Silicone Dry Cleaning: Silicone solvent has become increasingly popular over the past few years, and has been aggressively marketed as a non-toxic alternative to PCE by GreenEarth Cleaning, L.L.C. Equipment costs are slightly higher than PCE dry cleaning machines. The Green Earth solvent, also known as D-5 or decamethylepentacyclosiloxane, is similar to the silicone substance formerly used in breast implants (D-6). Silicone dry clean machines are equipped with solvent recovery devices similar to those found on PCE equipment, and some machines are designed to handle either petroleum or silicone solvents. Although D-5 has been marketed as non-toxic, toxicity testing has not been completed and a recent inhalation study of rats by Dow Corning has raised questions about its safety. [17] Like petroleum solvents, D-5 is a Class III-A solvent and has a flash point of 170 degrees Fahrenheit. Although it has a higher flash point than petroleum solvents, it is subject to the same fire codes and regulations.

Professional Wet Cleaning: Professional wet cleaning is a water-based process that uses computer-controlled washers and dryers, specially designed biodegradable detergents to clean sensitive and delicate garments, and specialized tensioning finishing equipment to restore shape and form. Both equipment and operating costs are lower in wet cleaning compared to PCE dry cleaning, and cleaners who have switched to professional wet cleaning have been able to process the full range garments they had previously dry cleaned.[18]

CO_2 Dry Cleaning: Liquid CO_2 solvent used in dry cleaning is pressurized carbon dioxide gas, and is non-toxic and non-flammable. Equipment costs of a CO_2 dry cleaning system is substantially higher than a PCE dry clean machine due to the additional steel required to maintain the pressure inside the cleaning vessel during the wash process.

Professional wet cleaning and CO_2 dry cleaning have emerged as the leading pollution prevention alternatives to PCE dry cleaning.

[17] Dow Corning. OPPT Public Docket #42071-A, February 4, 2003

[18] Sinsheimer, P; Grout, C; Namkoong, A; Gottlieb, R. Commercialization of Professional Wet Cleaning. Occidental College, October 28, 2002.

1.3 Project Goals: Commercialization of Professional Wet Cleaning

To overcome a number of market barriers, an Environmental Garment Care Demonstration Project was designed to help "jump-start" the diffusion of professional wet cleaning by providing financial and technical assistance to cleaners in Sacramento willing to operate dedicated professional wet cleaning facilities and to serve as demonstration sites.

These new demonstration sites were intended to provide the marketplace experience that is essential for commercial development as well as to expand the education of dry cleaners about the viability of professional wet cleaning. An extensive educational outreach campaign to the garment care industry in Sacramento was organized to identify these new demonstration sites. These new demonstration sites would in turn, serve as new venues for educational outreach.

The specific goals of the project were as follows:

- Develop a grant program to provide financial and technical assistance to cleaners in Sacramento to operate dedicated professional wet cleaning facilities and to serve as demonstration sites.
- Conduct an educational outreach campaign to educate dry cleaners about the viability of each technology and identify qualified applicants for the grant program.
- Expand educational outreach through tours hosted at the new demonstration sites.
- Evaluate the overall viability of demonstration site cleaners before and after facilities switched.
- Evaluate the viability of each demonstration site and the success of the project as a whole.
- Develop recommendations for the further commercialization professional wet cleaning.

2. Project Development

2.1 Professional Wet Cleaning Grant Program

The core of the Commercialization Project was the development of a grant program to provide financial and technical assistance to two cleaners in Sacramento willing to switch to professional wet cleaning become demonstration sites. Site grantees were provided the following:

- $10,000 to be put towards the purchase of professional wet cleaning equipment from the State of California.
- $10,000 research grant from the Sacramento Municipal Utility District (SMUD).
- Free technical assistance including: selection of specific equipment; obtaining financing; and identifying qualified installers to remove existing dry clean equipment and install professional wet clean equipment.
- Free comprehensive technical training in operating as a dedicated wet cleaning facility.

2.2 Development of Application Form

An application form was created to assess the qualifications of cleaners interested in receiving demonstration grant funding. The application form, available in both English and Korean, was designed to elicit the following information about the applicant: the experience of the cleaner, the current volume of garments cleaned at the facility, the age of dry clean equipment, an explanation for why the cleaner is interested in becoming a professional wet cleaner, the kind of wet clean equipment the cleaner wants to purchase, the cleaner's interest in marketing his or her business as a professional wet cleaner (e.g. interest in changing name, interest in advertising), and the financial solvency of the business.

In addition to soliciting information about the cleaner, the application form explained the responsibilities of the cleaner as a grant recipient. These responsibilities included: the willingness of the cleaner to remove all dry clean equipment from the shop before the installation of wet clean equipment, and the willingness to serve as a demonstration site (e.g., to host periodic tours of the facility and to provide information on the performance and financial capacity of the business before and after switching).

2.3 Criteria for Selection of Grant Applicants

A series of criteria were developed to help select cleaners to serve as demonstration facilities. These criteria included the following: (1) Willingness of the cleaner to operate as a dedicated professional wet cleaning facility -- for an existing

cleaner, this would require replacing all dry clean equipment with wet clean; (2) Experience of the operator as a professional cleaner – at least three years of experience was preferred, demonstrating that the cleaner had developed substantial knowledge in operating as a professional cleaner; (3) Agreement of cleaner to serve as a demonstration site for the length of the project; (4) Demonstration facilities would be geographically distributed throughout the region in order maximize the cleaners' access to demonstration sites.

A site visit would be conducted at each qualified applicant's facility to develop a ranking of the most qualified applicants. Only facilities that were determined to be likely to make a successful transition to professional wet cleaning would be selected. A Cleaner Contract Agreement would subsequently be drawn up for each grantee specifying the exact grant award as well as the responsibilities of the grant recipient.

2.4 Development of Technical Information Packet

A technical information packet was developed to provide information through brochures, flyers, advertisements, and articles on professional wet cleaning.

In addition, a number of aspects of the Technical Information Packet were revised. Specifically, an Equipment Report was updated to provide more detailed information on wet cleaning machine models currently available from manufacturers. For wet clean washers, information on each model included the load capacity of the washer, extraction speed, whether it was soft or hard mount, whether it included a detergent injection system, and the retail price. For wet clean dryers, information on each model included load capacity for drying wet cleaned garments, information on the moisture sensing technology, and the retail price. Information on tensioning finishing equipment included the retail price and any specific features that differentiated one set of finishing equipment from another.

3. Outreach to Sacramento Cleaners

3.1 Direct Mail Campaigns

A direct mail campaign targeting all PCE dry cleaners in Sacramento was developed. An informational mailer that described the grant program and advertised upcoming workshops was sent out to dry cleaners. Mailers were sent out a few weeks prior to four sets of workshop dates.

3.2 Site Visits

During the two-year program period, extensive efforts were made to visit various sites in the Sacramento area to educate cleaners about wet cleaning. Between June 2008 and March 2009, Gabrielle Saveri, PPC's Northern California Program Coordinator, made one separate trip to Sacramento alone, and another two with Hans Kim, visiting over 30 dry cleaners and dropping off outreach materials and applications to the program. Ms. Saveri also helped connect dry cleaners to established wet cleaners in the Bay Area and Southern California to educate them more about the wet cleaning process. Because of the outreach efforts, four cleaners visited by Ms. Saveri attended Sacramento workshops at a later time.

3.3 Workshops for Sacramento Cleaners

Between August 2008 and March 2009, a series of four professional wet cleaning workshops were held in the Sacramento area that targeted Sacramento cleaners (Table 3.1).

Because most cleaners process clothes Monday through Friday, workshops were held on a Sunday, generally in the afternoon. Each workshop was publicized through direct mailers sent to dry cleaners in the Northern California region and articles published in the regional trade press (see Section 3).

Each workshop was free of charge and included a demonstration of the wet cleaning process. Performance, financial, and environmental issues were discussed, as well as the parameters of the grant program. Each dry cleaner attending a workshop was provided a technical information packet on professional wet cleaning including an application form for the grant program.

During the course of the workshop, the cleaning process was demonstrated by the host cleaner. Loads of garments labeled "dry clean" or "dry clean only" were pre-spotted, washed, dried, and finished. The host cleaner provided background as to why they decided to switch, the impact on their business, how customers have responded, and the difficulty and/or ease in making the transition. Information packets were distributed to each cleaner attending workshops. Information in the packet was discussed by project

staff including the different types of equipment on the market as well as the different amounts of incentive funding available.

Table 3.1: Workshops for the Sacramento Cleaners

Date	Day of Week	Location	Number of Attendees
8/16/08	Sunday	Cleaner #1	5
09/21/08	Sunday	Cleaner #1	3
10/19/08	Sunday	Cleaner #1	3
03/22/09	Sunday	Cleaner #2	2

4. Grant Application and Selection Process

4.1 Overview

A total of four applications were received. After receiving each grant application, the applicant was contacted by telephone to set up a site visit to his or her facility. The site visit was designed to verify the information provided by the cleaner in the application form, evaluate the location of the facility, and assess the capability of the facility to serve as an effective demonstration site.

In the selection of grant recipients, it was a goal to achieve a balanced coverage of demonstration sites in the Sacramento area with respect to facility size, brands of wet cleaning equipment used, geography, and affluence of the surrounding community.

Two applicants viewed as highly qualified for the program were immediately selected, both situated in central Sacramento.

Cleaner #1 processes approximately 220 garments per day and operates with three employees. Cleaner #2 processes 500 garments per day and is operated by one owner with four additional workers. The owners of both cleaners had over fifteen years experience as professional cleaners prior to their conversion.

Two of cleaners who applied for the grants were unable to qualify for the program because they could not obtain financing for new wet cleaning systems. If SMUD had a program to lend money to potential wet cleaners, both grant applicants would happily have participated in the program.

5. Demonstration Site Conversion Process

5.1 Equipment Selection

Each professional wet cleaning demonstration site grantee was required to install a set of equipment that included a wet clean washer, a wet clean dryer, a detergent dispensing system, a tensioning form finisher, and a tensioning pants topper. The range of available equipment options was discussed with each grantee prior to purchase. An equipment report developed for the project was used to review equipment manufacturers, specifications, and pricing options.

Cleaner #1 purchased a Miele wet clean washer and dryer system, and Veit tensioning finishing equipment. Cleaner #2 chose a Wascomat wet clean washer and dryer, and opted instead for Hi-Steam tensioning finishing equipment.

5.2 Equipment Installation

Few mechanics in Sacramento had experience installing professional wet cleaning equipment. Cleaner #1 used Mike Holder, their local mechanic, for the full plant installation. Cleaner #2 used Antioch-based Taylor Houseman, for their equipment installation. In both cases, installation was relatively easy given the prior dry cleaning experience of the installers.

5.3 Coordination and Assistance in Technical Training

Project staff coordinated the implementation of a technical training program for each grant recipient. A number of options and opportunities for technical training were available to each grantee.

- *Observational Training*: Prior to the installation of equipment, grantees were encouraged to visit established professional wet cleaning facilities for an observation session. At these sessions, grantees were able to do the following: Observe the structure of work at a professional wet cleaning facility; learn spotting, washing, and drying techniques; Learn about the operation of specialized finishing equipment; Observe how staff interacts with customers in regards to the use of wet clean technology. These sessions were strongly encouraged for both the cleaner (typically the owner) as well as the pressing staff, and were usually scheduled at the facility owned and operated by the trainer.
- *On-Site Training*: After the equipment was installed, a minimum of a one-day training session was scheduled at each grantee's facility.
- *Follow-Up Training*: A follow-up training session at each grantee's facility was recommended within the first month after installation was completed.

- *Telephone Consultation*: Telephone consultation with the trainer was available to each grantee for one year after equipment was installed.

The owners of the two Sacramento demonstration sites each visited at least one other dedicated professional wet cleaning plant before making the switch. The owner of Cleaner #1 trained with Miele Representative Hans Kim and trainer Mrs. Park. The owner of Cleaner #2 had no additional training after the first eight hours with Roland Dobbins of Seitz.

6. Case Studies of Two Demonstration Sites

Structured interviews with the owners of the two demonstration site were conducted to evaluate the experience of these two sites in making the transition to professional wet cleaning.

6.1 Cleaner #1 Case Study

Cleaner #1	
Sacramento, CA	Switch Date: 07/13/08
Wet Clean Washer	Miele N-NR6010200
Wet Clean Dryer	Miele 6068340
Tensioning Pants Topper	Veit
Tensioning Form Finisher	Veit
Detergent	Lanadol
Daily Volume	220 pieces
Staff	1 presser 1 counterperson/operator (owner) 1 presser/spotter (husband)

Background

Cleaner #1 is owned and operated by a first-generation Korean couple. The owner runs the store and has two employees (including her husband) to help her in her business. She has been in the dry cleaning business for 19 years. She bought her shop approximately 19 years ago after leaving her job in the technical support area at Hewlett Packard. The shop is located next to a bowling alley in a relatively "middle-class" area of central Sacramento.

The owner first heard about wet cleaning through an article she read in the Korean Dry Cleaners' Magazine. After reading the article, she was curious and started looking into workshops in different areas. In 2006, she attended workshops in the Bay Area (at Hesperian Cleaners and Taylor Houseman), and in Los Angeles (LA Edison).

The owner knew she had to phase out her perc machine -- that machine had started giving her problems. She looked into hydrocarbons briefly but figured that since they were still using petroleum-based solvents, they would eventually be regulated and phased out too. She decided wet cleaning was the best solution. Before purchasing a wet cleaning system, she was very skeptical about wet cleaning and did everything she could to make certain wet cleaning was the right decision. During the time that her perc machine was giving her problems, she went to garage sales and bought clothes and tested them out in her shop's laundry machine, and realized that many garments could be

washed in soap and water. She started bringing her own fine garments to workshops and made sure they turned out well. She attended Miele and Wascomat workshops, but decided on Miele because she felt the quality was "excellent."

In the summer of 2008, the owner bought a Miele wet cleaning system. Mrs. Park came up to Sacramento over a two-week period of time and trained the owners on the system. The owners found that the new system was "not too hard at all." She had already tried out all kinds of clothes in wet cleaning machines and she was confident that she could do wet cleaning.

Transition Process Evaluation

The owner originally thought it was going to be "somewhat difficult" to transition to professional wet cleaning. Her main concerns were quality of cleaning -- she wanted to make sure the wet cleaning process worked and that there would be no shrinkage of garments due to the use of water, and no harm to silk garments.

Now that she is actively doing wet cleaning, she says that adapting to wet cleaning was "not too difficult." She says shrinkage ended up not being a problem at all. The biggest problem she found had to do with removing grease from garments. She believes degreasing is still a problem and that the wet cleaning equipment companies need to work on that.

The owner of Cleaner #1 believes the training she received was excellent, and that there is nothing that needs to be changed in the training process. She found the whole switchover process to be easy and stress-free.

Performance Analysis

Cleaner #1 currently cleans approximately 220 pounds of garments per day, including a full range of delicate garments. According to the owner, the volume of garments cleaned has remained the same since her switch.

The owner is extremely happy that she opted for wet cleaning and says she would make the same decision again if she had to. She says the clothes come out cleaner and she doesn't have to worry about exposing her customers to chemicals. She loves the fact the process is "environmentally safe."

Customer Response to Wet Cleaning

The owner of Cleaner #1 has told 80% of her customers that she is doing wet cleaning. She has also advertised in a local newspaper called "Inside Arden." She says that many of her customers have noticed that something has changed. She says some of her clients tell her "their clothes smell different, feel different." Some customers don't really seem to care one way or another, as long as they get their clothes cleaned. She has not lost any customers because of the switch to wet cleaning. She says word is traveling around that there is a "green" cleaner in the area. Some customers who complained about skin problems with perc now tell the owner that their condition has improved. They tell their friends, and the owner believes she is getting new customers because of the strong recommendations from her customers.

Owner Satisfaction Evaluation

The owner believes that the decision to switch to wet cleaning was a good business decision, and given the opportunity, she would make the same decision over again. She would "strongly recommend" wet cleaning to other cleaners who need to replace their dry cleaning machines, and she believes anybody with experience in the dry cleaning industry can do wet cleaning. She does believe, however, that training is essential for doing the process well.

6.2 Cleaner #2 Case Study

Cleaner #2	
Sacramento, CA	Switch Date: 12/15/08
Wet Clean Washer	Wascomat EX655CL
Wet Clean Dryer	Wascomat RMC
Tensioning Pants Topper	Hi-Steam
Tensioning Form Finisher	Hi-Steam
Detergent	Seitz
Daily Volume	500 pieces
Staff	1 counterperson (owner) 1 operator 1 assistant counter-person/assembling (son) 2 Pressers

Background

Cleaner #2 is owned and operated by a second-generation Korean woman. She runs the store with the help of her son, an operator, and two pressers. The owner has been in the dry cleaning business for 31 years. Her parents originally owned the store and she began working there when she was 18 years old. She eventually took over and runs the business from the same location. Her shop is located in a strip-mall in central Sacramento that recently received an unexpected face-lift when Whole Foods moved in.

The owner first heard about wet cleaning from Gabrielle Saveri of the Pollution Prevention Center. She was skeptical, and almost hung up the phone when Ms. Saveri called, but since Ms Saveri was so enthusiastic, the owner decided to hear her out. The owner then told her operator to go look into wet cleaning at an upcoming workshop at Cleaner #1. Her operator was so impressed he told her she had to see wet cleaning in action. Consequently, the owner made an appointment to spend a day at Cleaner #1 to observe wet cleaning. She "really watched" and "saw the results." She was so impressed by the quality of wet cleaning and the easiness of the process that she decided to switch over to wet cleaning. Ms. Saveri had mentioned to her that there was a less expensive system than Miele, and after some research, the owner decided to purchase a Wascomat system with Hi-Steam tensioning equipment.

The owner attended no workshops and received no virtually no training, other than some introductory help from Roland Dobbins of Seitz laundry detergents. She believes that for someone like her, with over 30 years of experience in the garment cleaning business, wet cleaning is easy.

Transition Process Evaluation

The owner originally thought it was going to be "not at all difficult" to transition to professional wet cleaning. Her main concerns were shrinkage – especially that wools would never go back to their original shape. She was also concerned about color bleeding. She was not worried about having to learn a new process.

Now that she has made the switch to wet cleaning, the owner says that switching over to wet cleaning has been "not at all difficult." She says that the spotting and pressing take longer, and that her pressers now work three hours more per day, but overall, the transition has been very easy.

The owner believes training is "very important" in helping make a successful transition to wet cleaning, although she did not receive much of it. She is happy that she has not had to receive extensive training, primarily due to the fact that she knows the garment cleaning business so well.

Performance Analysis

Cleaner #2 currently has a booming business, processing approximately 500 pounds of garments per day, including a full range of delicate garments.

The owner reports that her business has increased steadily since December 2008, when she was processing approximately 325 pounds of garments per day. She believes the increase is due to the fact that a neighboring cleaner recently went out of business, and also, that word is traveling around her area that she is doing "chemical-free" cleaning.

The owner rates the overall quality of her cleaning service as a wet cleaner to be "higher" than that as a dry cleaner. She believes the switch to professional cleaning was a good decision because it is "stress-free" and she no longer has to be around toxic chemicals. She is extremely happy that she no longer has to deal with the air quality regulations or attend safety clean-up courses. And she is thrilled that she no longer has to worry about maintenance issues. After going through a recent divorce, the owner did not know how she was going to repair the machines when they broke down, as her husband always used to take care of that. With the new wet cleaning system, the owner says she can now fix the problems on her own and not have to worry about hazardous waste.

According to the owner, the only drawback to wet cleaning is spot removal takes much longer than perc dry cleaning. She believes that the clothes come out much cleaner in wet cleaning, but removing grease spots and tensioning takes four times as long as dry cleaning.

Despite the increased length of time, the owner says it was "absolutely" worth it to switch over to wet cleaning. She would "strongly recommend" the process to other cleaners. In fact, she has now convinced two of her cleaner friends to look into purchasing wet cleaning systems. The owner says there is much less stress, and the

cleaning is better than before. She believes that anybody who has worked in the dry cleaning industry before can do wet cleaning.

Customer Response to Wet Cleaning

The owner says her customers are generally "very happy" with wet cleaning, although she has only told 30 percent of them that she is doing it. She is afraid to tell people she is doing wet cleaning because she fears they will just think it is the same as using soap and water. Customers have asked her if she has changed her cleaning method, because the clothes smell better, but she only tells them that she is now using a "new environmentally-correct method." The people she has told are extremely happy with the "new" method.

One customer of seven years was going to leave for another shop because she wanted chemical-free cleaning, but when she noticed the clothes smelled different, she asked about it. The owner told her that she had just switched over to a chemical-free system, so the customer did not end up finding a new cleaner. Word is traveling fast that the owner is using chemical-free cleaning and she is getting new customers every day.

The owner says the other 70 percent of her customers don't really care what method she uses, as long as the clothes come out clean.

Owner Satisfaction Evaluation

The owner believes that the decision to switch to wet cleaning was a good business decision, and given the opportunity, she would "absolutely" make the same decision over again. She would "strongly recommend" wet cleaning to other cleaners who need to replace their dry cleaning machines, and she believes anybody with experience in the dry cleaning industry can do wet cleaning. The owner does not believe that training is essential to do the process well if the cleaner has extensive prior dry cleaning experience. If not, then training is extremely important.

The owner rates her level of satisfaction as a wet cleaner to be "higher" compared to when she was a dry cleaner because she feels it's easier and faster to do (except for spotting), and the clothes come out cleaner. She no longer has to feel afraid that regulators are going to come through her front door.

7. Resource Use Evaluation

At professional cleaners, electricity runs a number of pieces of equipment including: washers, dryers, air compressors and vacuum pump, and pressing equipment. A dry clean machine requires additional electricity to operate pollution control devices including: refrigerated condensers, distillation units, and wastewater evaporators. A dry clean machine requires natural gas to generate steam for drying garments and distilling solvent. A wet cleaning system using electricity to run motors and uses natural gas to dry garments.

7.1 Energy Demands of Cleaning Equipment

7.1.1 PCE, Petroleum, and Silicone Dry Clean Process

Figure 7.1 shows the key energy demands associated with advanced PCE, petroleum, and silicone dry cleaning process. The process includes washing, drying, and pressing.

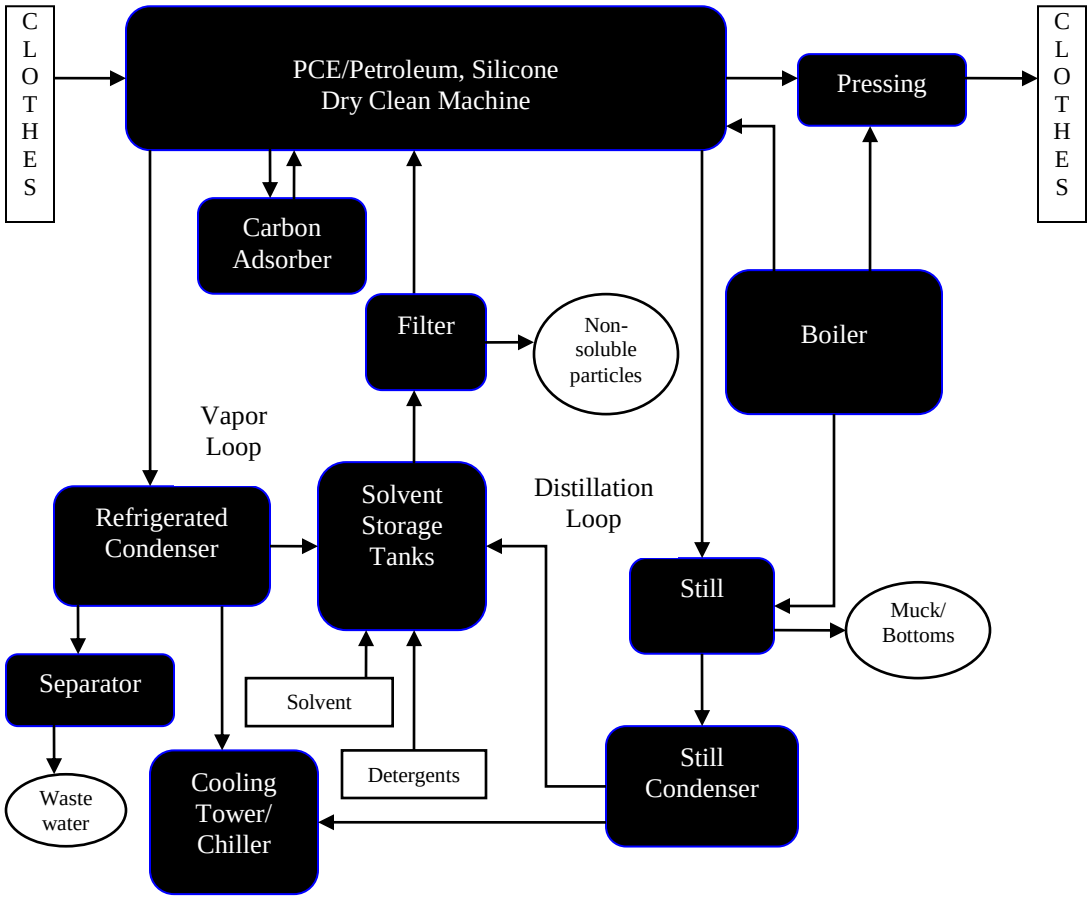
Electricity: A dry clean machine uses electricity to pump solvent and detergent to the cleaning cylinder, for mechanical action during the wash process, for refrigeration to cool evaporated solvent during the dry cycle and distillation cycle, and for a pump and fan to operate the cooling tower or chiller, as well as for mechanical action of the pressing equipment.[19]

Natural Gas: Dry clean machines are never directly heated by natural gas because of safety hazards associated with the exposure of solvent to open flames. Dry clean machines instead use steam from a boiler as a source of heat.[20] For PCE, petroleum, and silicone dry cleaning, steam heat is used during the dry cycle, distillation, cleaning carbon filters, and pressing.

Water: Dry clean machines rely on cooling towers to transfer heat away from the machine via evaporation of water. Water cycling through cooling towers and boilers is usually recycled, but should be periodically bled and replaced to prevent scaling.

[19] Some petroleum and silicone dry cleaning machines also use a vacuum pump to eliminate oxygen from the cleaning system as a fire protection process.
[20] Models that use an electrical heat source are also available, but are less common.

Figure 7.1 Process Flow Diagram for PCE, Petroleum, and Silicone Dry Clean Machine[21]



7.1.2 Professional Wet Clean Equipment

Wet cleaning, a process of hand-laundering delicate garments, has long been practiced by cleaners.[22] *Professional* wet cleaning industrializes this practice by using computer-controlled washers and dryers, specially formulated detergents, and specialized finishing equipment to create a cost-effective alternative to dry cleaning. A number of features enhance the efficiency of professional wet clean systems (See Figure 7.2). These features include:

- A horizontally mounted cleaning drum enables the use of low water levels.
- Minimal agitation is used during the wash cycle.

[21] Adopted from USEPA. Cleaner Technology Substitutes Assessment, EPA 744-B-98-001, June 1998, p. 2-4.
[22] Encyclopedia Americana, 1970; Vol. 9.

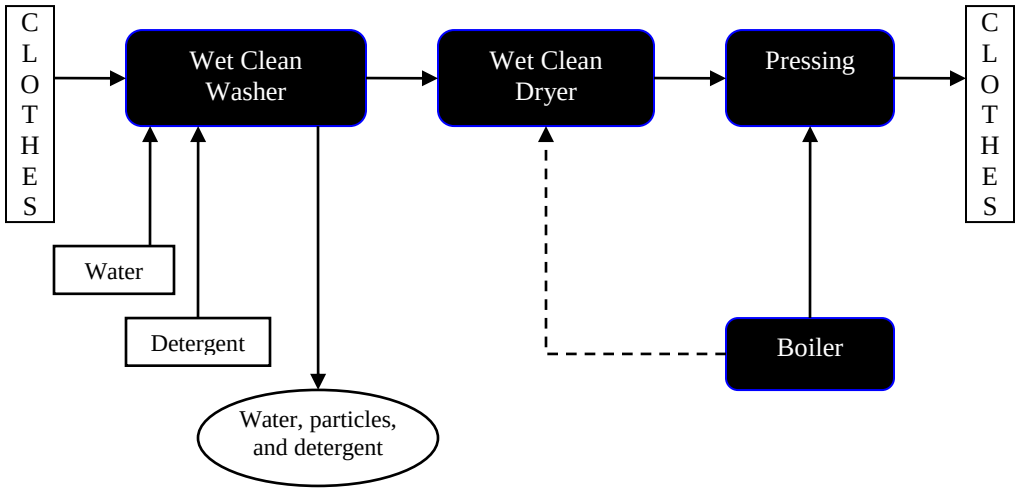
- High-speed extraction removes moisture from garments and shortens dry times.
- Precision garment-sensitive moisture sensors in the dryer prevent over-drying.
- Tensioning finishing equipment maximizes the use of steam and lowers pressing times.

Electricity: Professional wet clean washers and dryers use electricity for mechanical action and the operation of computers, sensor systems, and detergent pumps. Tensioning equipment uses electricity to operate fans and computer systems.

Natural Gas: Some wet clean washers use natural gas directly or in the form of steam to heat water used in the wash cycle. Wet clean dryers use natural gas as a direct source of heat or in the form of steam heat from the boiler. Tensioning equipment uses steam from the boiler.

Water: Professional wet cleaning uses water as a solvent. Recycling systems that reuse rinse water in wash cycles are available, but are not widely used.

Figure 7.2 Process Flow Diagram for Professional Wet Clean System[23]



[23] Adopted from USEPA. Cleaner Technology Substitutes Assessment, EPA 744-B-98-001, June 1998, p.2-5.

7.2 Sub-Meter Evaluation of Cleaner #1

7.2.1 Data Collection

Cleaner #1 agreed to have sub-meters placed on equipment to measure electricity, natural gas, and water use both prior to and after their converted to professional wet cleaning. ADM Associates, Inc. was selected to install and collect data from sub-meters. In April 2008, an on-site meeting was held with Dan Mort from ADM, Dave Bisbee from SMUD, and Peter Sinsheimer from Occidental College to determine sub-metering and data collection procedures. Sub-meters were installed in May 2008. Electricity sub-meters were installed on the dry clean machine, the boiler and boiler pump, the vacuum, and the air compressor. Natural gas used by the boiler was sub-meter by placing a logger on the burner valve to record time and duration of burner valve "on" and one-time measurements of gas flow rate when only the boiler burner was on. Water meters were placed on the dry clean machine and boiler. When the dry clean machine was removed, an additional electric sub-meter was added on the wet clean washer and dryer system. Because the wet clean washer was unable to be sub-metered for water, water used by the wet cleaning machine was estimated, based on the number of wash loads used on test days, the programs used for each wash load, and the maximum number of gallons used per load.

To standardize energy, water use, and pounds of garments cleaned at Cleaner #1, data was collected on a number of days both prior to and after conversion. Table 7.1 shows the days the cleaner collected data on the pounds of garments cleaned. For each day volume of clothes was collected, the amount of resources used that day and divided by the volume of garments cleaned and multiplied by 100 to derive standardize measure of resource use per 100 pounds of garments cleaned. An average standardized resource use number was then generated. The average standardized resource values were compared both before and after the cleaner converted to professional wet cleaning.

Table 7.1 Days Data Collected of Garments Cleaned at Cleaner #1

Before Switch				**After Switch**			
Date	Lbs Dry Clean	Lbs Shirts	Lbs Total	Date	Lbs Wet Clean	Lbs Shirts	Lbs Total
5/29/2008	103	30	133	10/14/2008	52	35	87
5/30/2008	92	85	177	10/16/2008	85	30	115
6/2/2008	102	105	207	10/17/2008	90	35	125
6/3/2008	41	53	94	10/20/2008	63	55	118
6/4/2008	58	30	88	10/21/2008	90	60	150
6/5/2008	49	20	69	10/22/2008	63	30	93
6/6/2008	33	20	53	10/23/2008	57	25	82
6/9/2008	70	65	135	10/24/2008	38	25	63
6/10/2008	83	35	118	10/27/2008	98	45	143
				10/28/2008	60	20	80
				10/29/2008	78	45	123

7.2.2 Electricity Use Comparison

Figure 7.3 shows the standardized electricity use of professional cleaning equipment at Cleaner #1 before and after switching to professional wet cleaning.[24] Electricity used to operate professional cleaning equipment was substantially lower after switching to professional wet cleaning.

Figure 7.3 Standardized Electricity Use

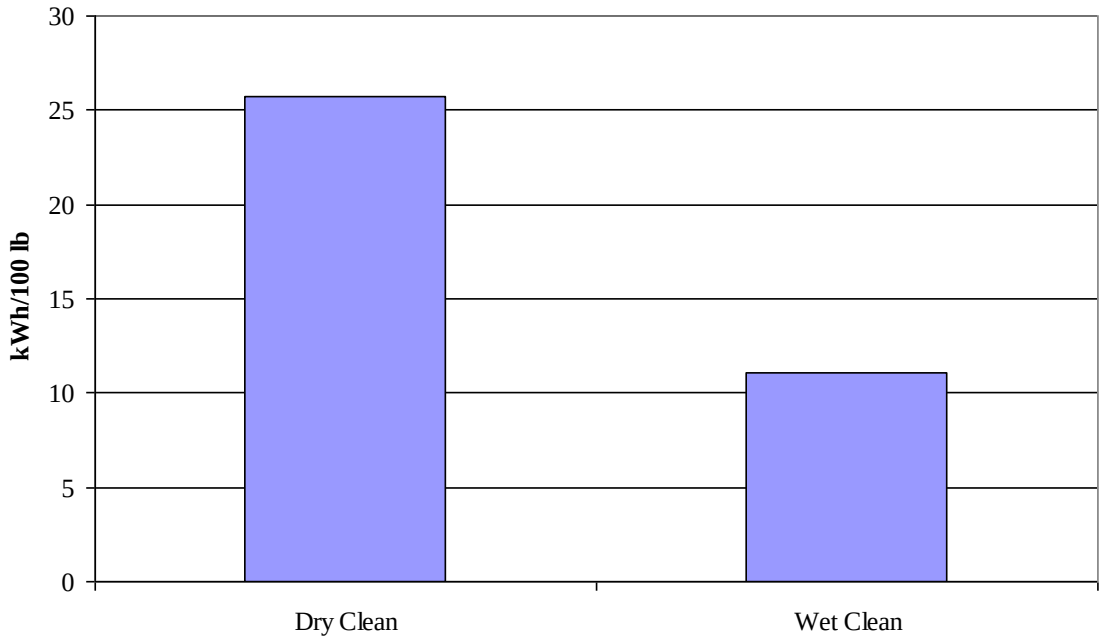
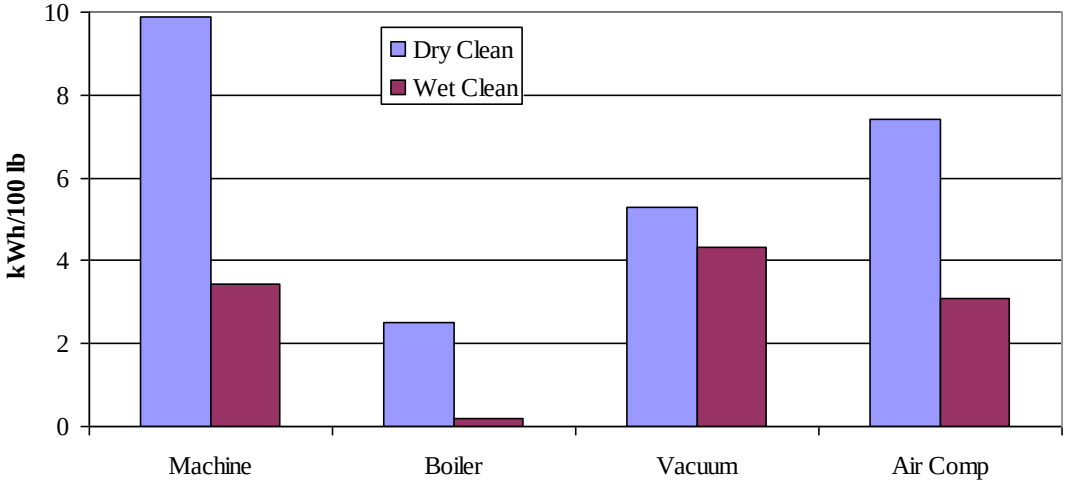


Figure 7.4 breaks down electricity use before and after the conversion by specific equipment. Electricity used savings from the cleaning machine accounted for the greatest amount of savings, followed by the air compressor, and the boiler. The reduction of electricity use of the vacuum was relatively small.

[24] See Appendix A for raw data for all sub-meter and billing record data.

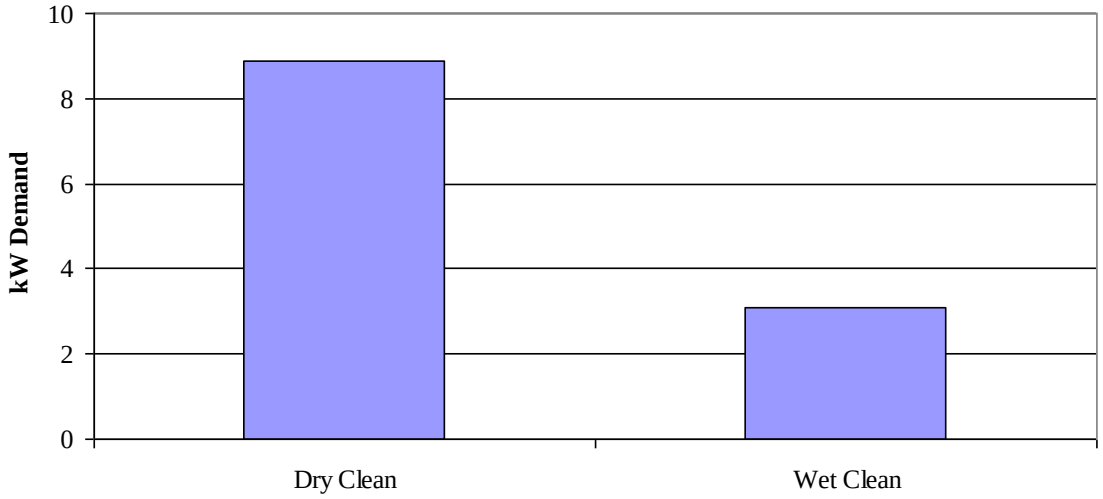
Figure 7.4 Comparison of Standardized Electricity Use by Equipment Type



7.2.3 Electricity Demand Comparison

Many utilities structure billing rates based on the highest average 15 minute demand during a billing period. Figure 7.5 shows the fifteen minute peak kW demand before and after the switch to professional wet cleaning. Average 15 minute peak demand was almost three times higher in professional dry cleaning compared to professional wet cleaning.

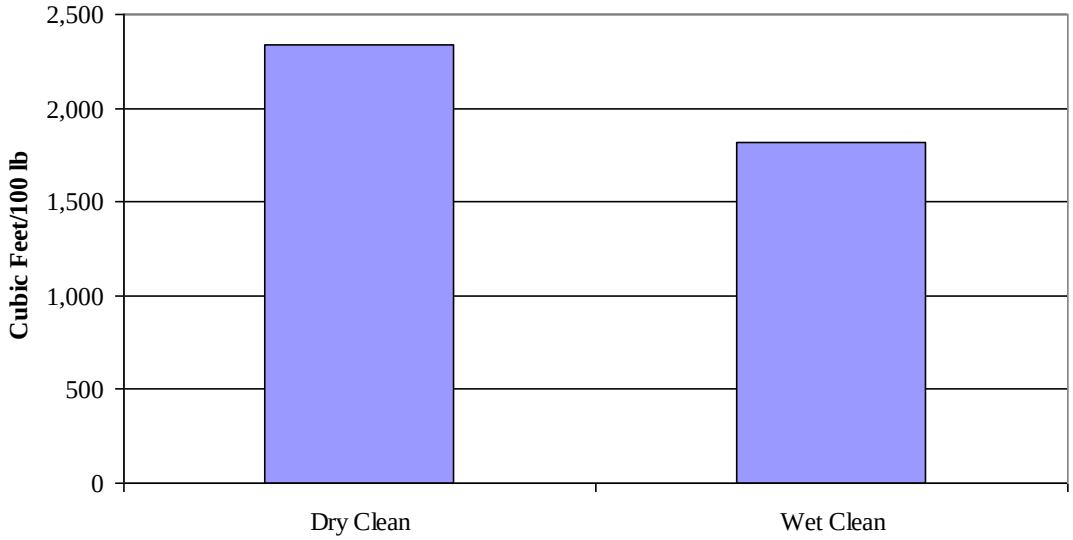
Figure 7.5 kW Demand, Sub-Meter



7.2.4 Natural Gas Consumption

Figure 7.6 shows the natural gas use at Cleaner #1 standardized per 100 pounds of garments cleaned. As with electricity, natural gas use associated with the cleaning process was lower after switching to professional wet cleaning, albeit by a smaller degree.

Figure 7.6 Natural Gas Use (cu ft per 100 pounds)



7.2.5 Water Use Consumption

Figure 7.7 shows total water use at Cleaner #1 associated with the cleaning process standardized per 100 pounds of garments cleaned. Total water use was three times higher in dry cleaning compared to professional wet cleaning.

Figure 7.7 Total Water Use

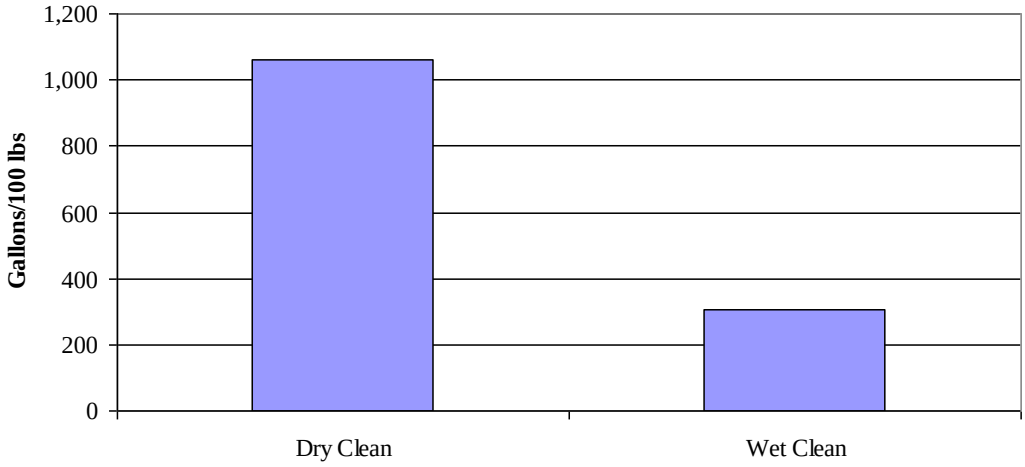


Figure 7.8 shows that the water use associated with the cleaning machine accounted for most of the savings in professional wet cleaning. The saving in machine water use in professional wet cleaning was attributed to the fact that cold water was pumped through the machine to cool down the condenser during vapor recovery. After exiting the machine, the warmed water was drained directly to the sewer.

Figure 7.8 Machine Water Use

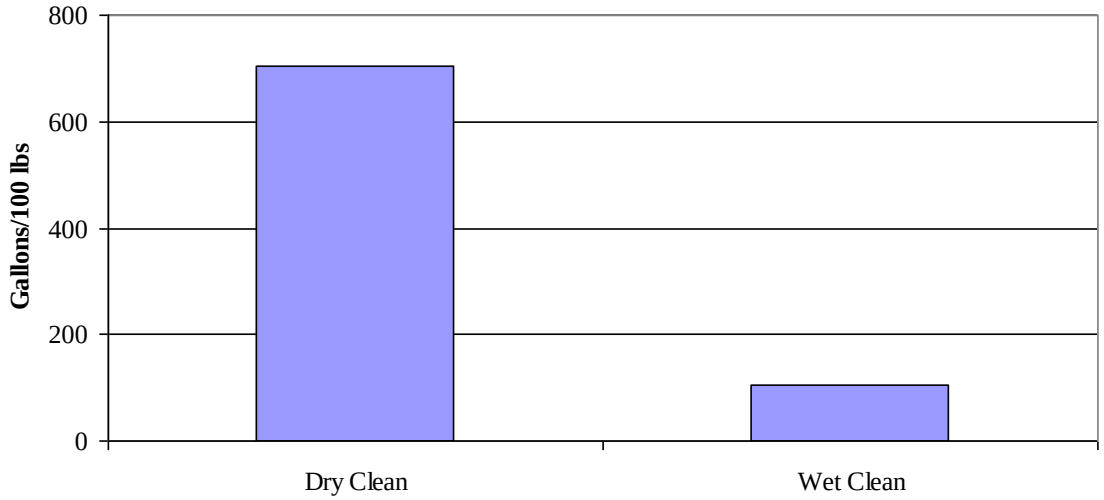
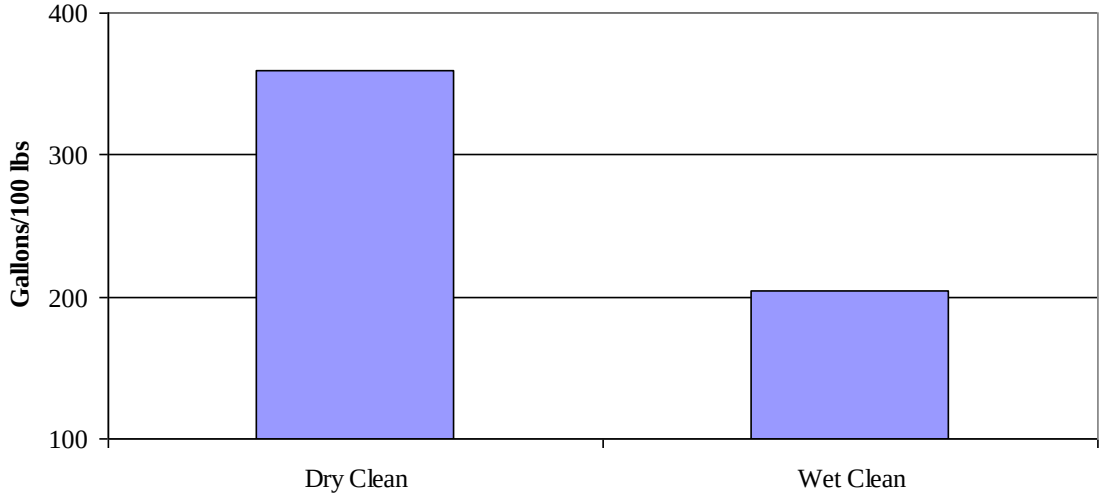


Figure 7.9 shows that the water use associated with the boiler was cut almost in half after the cleaner switched to professional wet cleaning. The greater water use in dry cleaning from the boiler was likely due to the greater steam demand associated with the drying process as well as distillation. The wet clean machine did not use hot water.

Figure 7.9 Boilers Water Use



7.3 Energy Use Based on Monthly Billing Reports

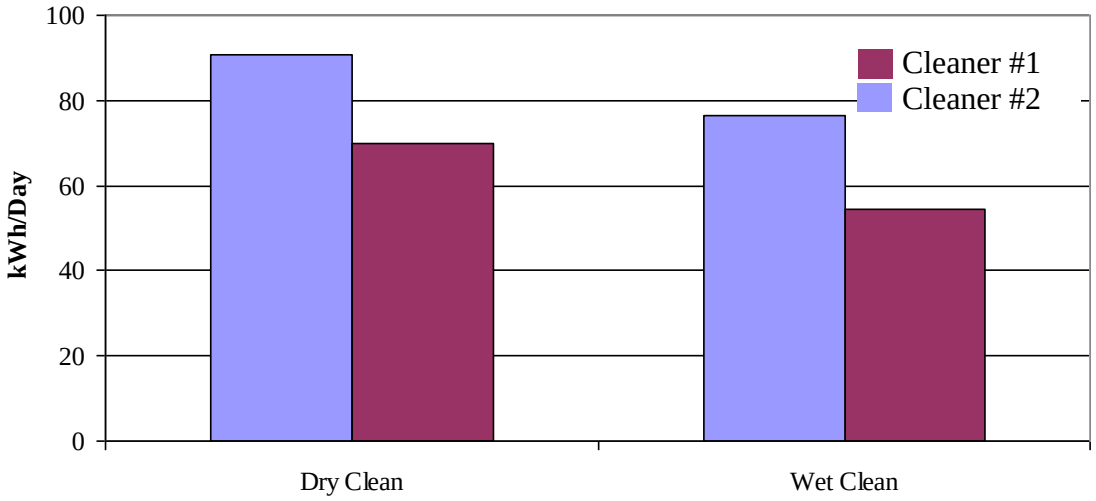
7.3.1 Data Collection

Monthly billing records for the two demonstration sites were collected to evaluate other electricity use and natural gas use. Electricity records were provided by the Sacramento Municipal Utility District and natural gas records were provided by Pacific Gas and Electric. Monthly billing records reported total energy use within each month as well as average daily use. Energy use was also standardized by the average volume of garments cleaned per day.

7.3.2 Electricity Use

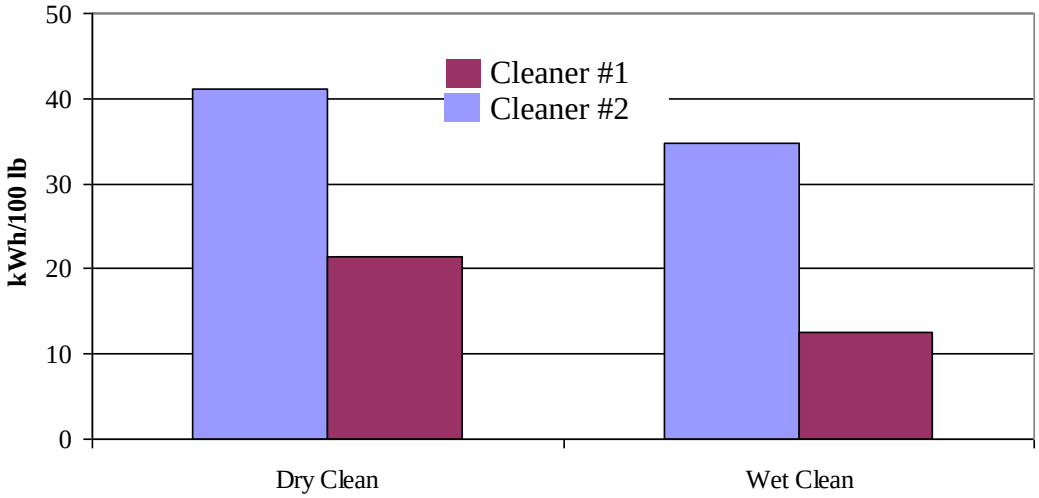
Based on monthly billing record, Figure 7.10 shows that at both cleaners, average daily electricity use dropped after switching to professional wet cleaning -- 16.5% at Cleaner #1 and 21.8% at Cleaner #2.

Figure 7.10 Electricity Use Per Day, Based Monthly Billing Reports



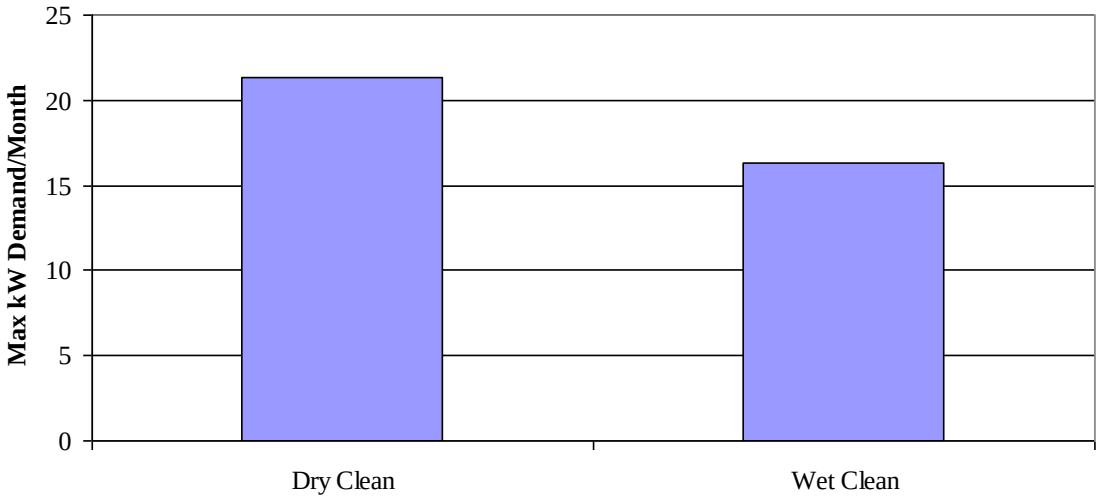
Adjusting for volume of garments cleaned, Figure 7.11 shows a greater reduction at Cleaner #2 because the pounds of garments cleaned increased after converting to professional wet cleaning while volume remained constant at Cleaner #1. The reduction at Cleaner #1 was 16.5%. Cleaner #2 experienced a reduction of 41.1%.

Figure 7.11 Electricity Use Per 100 lb– Based Monthly Billing Reports



The billing meter at Cleaner #1 calculated the maximum 15-minute kW demand every month. Cleaner #2 was not equipped with a similar meter. Based on their monthly billing records, peak kW demand at Cleaner #1 dropped by 23.4% after switching to professional wet cleaning (See Figure 7.12).

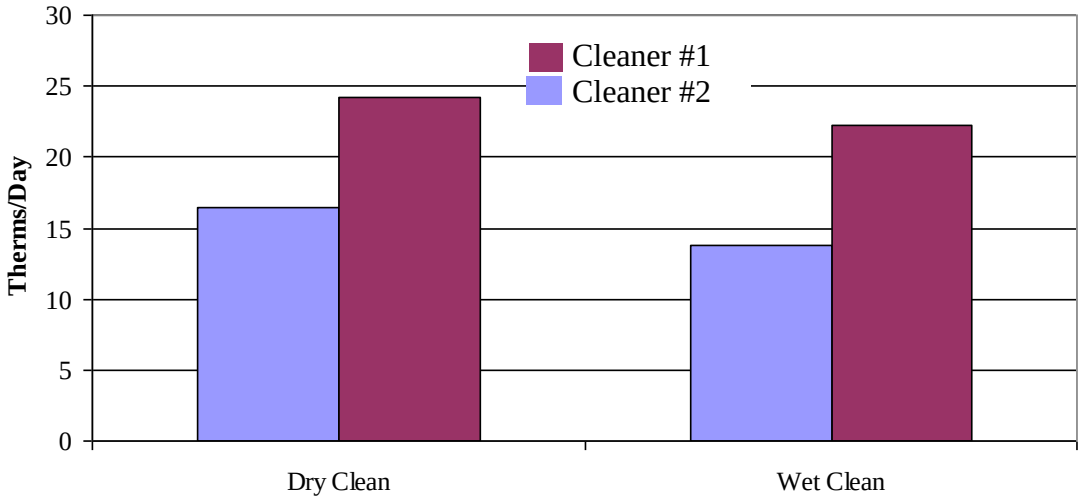
Figure 7.12 Electricity Use Per 100 lb, Cleaner #1 – Based Monthly Billing Reports



7.3.3 Natural Gas Use

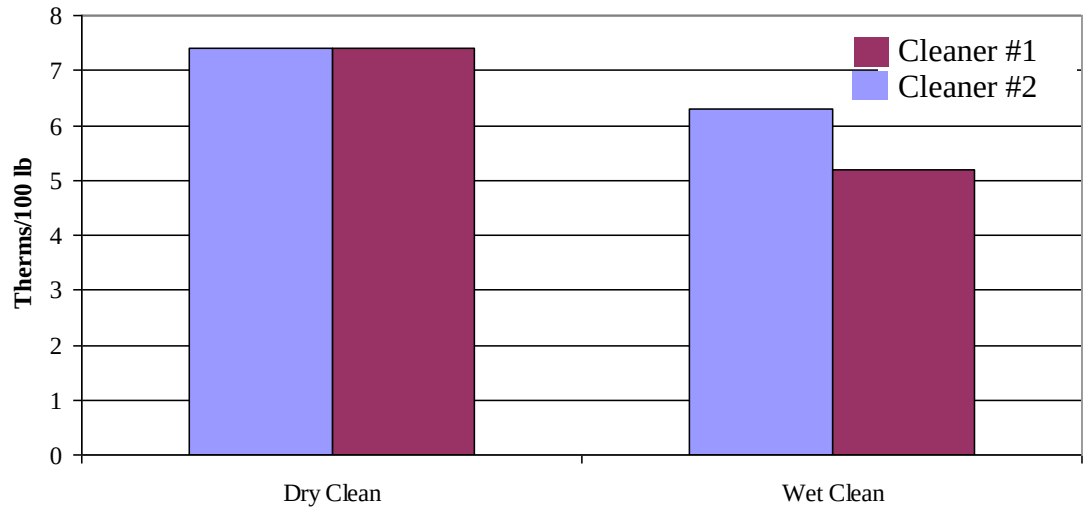
Natural gas use, based on monthly billing records, was lower at both test sites after switching to professional wet cleaning -- Cleaner #1 showing a 15.9% reduction and Cleaner #2 showing an 8.2% reduction. (See Figure 7.13).

Figure 7.13 Natural Gas Use Per Day, Based Monthly Billing Reports



Standardized natural gas use shows a substantially larger reduction in natural gas used after switching to professional wet cleaning at Cleaner #2 due to the increased volume of garments cleaned after their conversion – 15.9% at Cleaner #1 and 29.7% at Cleaner #2 (see Figure 7.14).

Figure 7.14 Natural Gas Use Per 100 lb, Based Monthly Billing Reports



7.4 Resource Use Evaluation Conclusion

Results from the resource use evaluation confirmed prior research showing that cleaners switching from PCE dry cleaning to professional wet cleaning experience a substantial reduction in electricity use, electricity demand, and natural gas use. In addition, water use was substantially lower in professional wet cleaning. This coincides well with the findings found in other case studies.

8. Success of Program and Recommendations

8.1 Summary of Results

This section summarizes the activities and findings of a project designed to jump-start the commercialization of professional wet cleaning through the establishment of a grant program that created the first professional wet cleaning sites in Sacramento.

Sacramento cleaners were educated about the demonstration grant program through a direct mail campaign and individual site visits to cleaners. In addition, a total of three workshops were held for Sacramento cleaners.

A total of four applications to the grant program were received. The two cleaners selected to become demonstration sites through this program were diverse in regard to size of cleaning operation and type of equipment used.

Each cleaner selected as a demonstration site received technical assistance throughout the conversion process. Grantees received guidance in regards to selection of equipment, plant redesign, equipment installation, and technical training.

Each demonstration site cleaners chose a different configuration of professional wet cleaning equipment. Training was enhanced by having grantees intensively observe the professional wet cleaning process at another dedicated facilities prior to having equipment installed at their own facilities.

8.2 Viability of Technology

Demonstrations sites were evaluated in terms of performance capacity, owner satisfaction, and resource use. Both cleaners stated that they were able to successfully process the full range of garments brought in by customers.

In regard to owner satisfaction, the evaluation indicated that each of the demonstration sites considered their decision to switch to professional wet cleaning as a good business decision and recommended professional wet cleaning to other cleaners. This evaluation also revealed that availability of demonstration sites at which the technology can be observed first hand are primary factors that can facilitate a more rapid transition to this new technology.

The resource evaluation showed that standardized electricity and natural gas use at both cleaners was substantially lower after switching to professional wet cleaning. In addition, electricity demand and water use measured only at Cleaner #1, were both substantially lower in professional wet cleaning.

8.3 Conclusion and Recommendations

This project successfully completed the primary goals set forth at the beginning, specifically, establishing professional wet cleaning demonstration sites, providing educational opportunities for Sacramento dry cleaners to learn about the viability of professional wet cleaning, and confirming the viability of professional wet cleaning as an energy-efficient alternative to dry cleaning.

The biggest barrier to large-scale diffusion of professional wet cleaning in Sacramento is the establishment of petroleum dry cleaning as the dominant alternative to PCE dry cleaning. Because petroleum dry cleaning creates smog-forming and greenhouse gas emissions, and is more energy-intensive than PCE dry cleaning, it is not considered a pollution prevention technology. Yet, recent changes to the state fire code for petroleum dry cleaning, which requires cleaners switching to this technology to install automatic sprinkler systems, is likely to substantially increase the cost of the petroleum dry cleaning option, making professional wet cleaning a more attractive alternative. Informing Sacramento cleaners, as well as their property owners, about the state fire code requirements is strongly recommended.

Based on the resource use savings associated with professional wet cleaning – including electricity use, electricity demand, natural gas use, and water use – the results of this study supports establishing a SMUD rebate for professional wet cleaning. A rebate based on the lifetime energy savings associated with professional wet cleaning would help jump-start the diffusion of this technology. This rebate program should be coupled with an expansion of the demonstration program, bring cleaners into the two established professional wet cleaners and adding additional regional demonstration sites.

Access to capital also appears to be a problem with cleaners converting to professional wet cleaning. A number of cleaners who expressed interest in applying for the third SMUD incentive where not able to make the conversion because they were unable to obtain a bank loan or lease for the equipment. Along with a rebate program and demonstration program, SMUD may also wish to consider establishing a loan program for cleaners to pay from the remaining cost of converting to this energy-efficient pollution prevention technology.

Appendix A

Resource Use Data

Sub-Metering Data: Cleaner #1
Electricity Use Per 100 lbs

PCE Dry Cleaning							
Date	Dry Clean Machine	Boiler & Pump	Vacuum	Air Compressor	Total	Average Volume	kWh/ 100 lb
5/29/2008	18.222	4.093	7.805	9.965	40.085	133	30.139
5/30/2008	15.251	3.754	6.873	9.605	35.483	177	20.047
6/2/2008	14.470	4.258	7.647	10.710	37.085	207	17.916
6/3/2008	12.745	3.114	5.899	7.579	29.338	94	31.210
6/4/2008	7.049	2.833	5.078	6.850	21.810	88	24.784
6/5/2008	7.260	2.252	4.263	6.591	20.365	69	29.515
6/6/2008	9.446	2.888	4.143	6.745	23.221	53	43.813
6/9/2008	7.312	0.526	6.097	8.338	22.274	135	16.499
6/10/2008	7.576	0.458	5.834	7.349	21.217	118	17.981
Total							231.905
Average							25.767
Professional Wet Cleaning							
Date	Wet Washer / Dryer	Boiler & Pump	Vacuum	Air Compressor	Total	Volume	kWh/ 100 lb
10/14/2008	3.025	0.209	4.585	3.309	11.129	87	12.791
10/16/2008	2.773	0.229	5.049	3.381	11.431	115	9.940
10/17/2008	4.059	0.264	5.592	4.035	13.950	125	11.160
10/20/2008	3.164	0.213	4.376	3.311	11.064	118	9.376
10/21/2008	3.479	0.274	5.720	4.093	13.566	150	9.044
10/22/2008	3.093	0.167	3.887	2.654	9.801	93	10.539
10/23/2008	3.426	0.182	3.436	2.638	9.682	82	11.808
10/24/2008	3.465	0.148	2.879	2.345	8.837	63	14.027
10/27/2008	3.687	0.285	6.107	3.885	13.963	143	9.765
10/28/2008	3.540	0.186	3.938	2.719	10.383	80	12.979
10/29/2008	4.549	0.243	4.838	3.333	12.962	123	10.538
Total							121.966
Average							11.0878

Sub-Metering Data: Cleaner #1
Total Water Use Per 100 lbs

PCE Dry Cleaning			
Date	Boiler Water Use/100 lb	Machine Use/100 lbs	Total Water Use per 100 lbs
6/2/2008	361.520	539.21	900.733
6/3/2008	411.583	1257.69	1669.276
6/4/2008	419.164	488.27	907.429
6/5/2008	284.718	281.24	565.957
6/6/2008	729.927	1616.70	2346.624
6/9/2008	176.079	386.96	563.037
6/10/2008	136.694	353.15	489.843
Total			7442.901
Average			1063.272
Professional Wet Cleaning			
Date	Boiler Water Use/100 lb	Machine Use/100 lbs	Total Water Use per 100 lbs
10/14/2008	261.821	126.92	388.744
10/16/2008	170.487	77.65	248.134
10/17/2008	187.244	106.67	293.911
10/20/2008	217.713	104.76	322.475
10/21/2008	185.230	73.33	258.563
10/22/2008	186.941	104.76	291.703
10/23/2008	204.240	115.79	320.030
10/24/2008	269.166	173.68	442.850
10/27/2008	172.806	67.35	240.153
10/28/2008	201.012	110.00	311.012
10/29/2008	187.647	84.62	272.263
Total			3389.838
Average			308.167

Sub-Metering Data: Cleaner #1
Boiler Water Use Per 100 lbs

PCE Dry Cleaning			
Date	Boiler Water, gallons	Volume	Gallons/100 lb
6/2/2008	368.750	102	361.520
6/3/2008	271.645	41	411.583
6/4/2008	243.115	58	419.164
6/5/2008	139.512	49	284.718
6/6/2008	240.876	33	729.927
6/9/2008	123.255	70	176.079
6/10/2008	113.456	83	136.694
Total	1500.609		2519.685
Average	214.373		359.955
Professional Wet Cleaning		Volume	
Date	Boiler Water, gallons		Gallons/100 lb
10/14/2008	136.147	52	261.821
10/16/2008	144.914	85	170.487
10/17/2008	168.52	90	187.244
10/20/2008	137.159	63	217.713
10/21/2008	166.707	90	185.230
10/22/2008	117.773	63	186.941
10/23/2008	116.417	57	204.240
10/24/2008	102.283	38	269.166
10/27/2008	169.35	98	172.806
10/28/2008	120.607	60	201.012
10/29/2008	146.365	78	187.647
Total			2244.308
Average			204.028

Sub-Metering Data: Cleaner #1
Machine Water Use Per 100 lbs

PCE Dry Cleaning			
Date	Dry Clean Water Use, gallons	Volume	Gallons/100 lbs
6/2/2008	549.998	102	539.21
6/3/2008	515.654	41	1257.69
6/4/2008	283.194	58	488.27
6/5/2008	137.807	49	281.24
6/6/2008	533.510	33	1616.70
6/9/2008	270.871	70	386.96
6/10/2008	293.114	83	353.15
Total			4923.22
Average			703.32
Professional Wet Cleaning			
Date	Total	Volume	Gallons/100 lbs
10/14/2008	66	52	126.92
10/16/2008	66	85	77.65
10/17/2008	96	90	106.67
10/20/2008	66	63	104.76
10/21/2008	66	90	73.33
10/22/2008	66	63	104.76
10/23/2008	66	57	115.79
10/24/2008	66	38	173.68
10/27/2008	66	98	67.35
10/28/2008	66	60	110.00
10/29/2008	66	78	84.62
Total			1145.53
Average			104.14

Monthly Billing Data: Cleaner #1
Electricity Use Per Day and Per 100 lbs

Period	Month	kWh/Day	Volume	kWh/100 lb
Dry Cleaning				
04/27/07-05/25/07	May-07	95.52	220	43.42
05/26/07-06/25/07	Jun-07	93.61	220	42.55
06/26/07-07/26/07	Jul-07	100.97	220	45.90
07/27/07-08/23/07	Aug-07	74.61	220	33.91
08/24/07-09/25/07	Sep-07	95.33	220	43.33
09/26/07-10/24/07	Oct-07	97	220	44.09
10/25/07-11/21/07	Nov-07	95.29	220	43.31
11/22/07-12/24/07	Dec-07	79.64	220	36.20
12/25/07-01/25/08	Jan-08	88.38	220	40.17
01/26/08-02/26/08	Feb-08	81.81	220	37.19
02/27/08-03/26/08	Mar-08	87.9	220	39.95
03/27/08-04/25/08	Apr-08	92.47	220	42.03
04/26/08-05/23/08	May-08	94.18	220	42.81
05/24/08-06/24/08	Jun-08	87.72	220	39.87
06/25/08-07/24/08	Jul-08	96.70	220	43.95
		1361.13		618.70
Average		90.74		41.25
Wet Cleaning				
08/23/08-09/23/08	Sep-08	84.31	220	38.32
09/24/08-10/22/08	Oct-08	83.83	220	38.10
10/23/08-11/21/08	Nov-08	73.87	220	33.58
11/22/08-12/23/08	Dec-08	72.44	220	32.93
12/24/08-01/26/09	Jan-09	69.91	220	31.78
01/27/09-02/25/09	Feb-09	80.17	220	36.44
02/26/09-03/26/09	Mar-09	75.38	220	34.26
03/27/09-04/24/09	Apr-09	74.93	220	34.06
04/25/09-05/26/09	May-09	73.00	220	33.18
		687.84		312.65
Average		76.43		34.74

Monthly Billing Data: Cleaner #2
Electricity Use Per Day and Per 100 lbs

Period	Month	KWH/Day	Volume	kWh/100 lb
Dry Cleaning				
04/29/07-05/29/07	May-07	65.97	325	20.30
06/28/07-07/28/07	Jun-07	80.06	325	24.63
07/29/07-08/28/07	Jul-07	83.16	325	25.59
08/29/07-09/27/07	Aug-07	78.53	325	24.16
09/28/07-10/25/07	Sep-07	69.75	325	21.46
10/26/07-11/27/07	Oct-07	63.36	325	19.50
11/28/07-12/27/07	Nov-07	63.7	325	19.60
12/28/07-01/29/08	Dec-07	61.97	325	19.07
01/30/08-02/29/08	Jan-08	64.48	325	19.84
03/01/08-03/29/08	Feb-08	63.28	325	19.47
03/30/08-04/28/08	Mar-08	61.17	325	18.82
04/29/08-05/29/08	Apr-08	71.55	325	22.02
05/30/08-06/26/08	May-08	77.25	325	23.77
06/27/08-07/29/08	Jun-08	76.36	325	23.50
07/30/08-08/26/08	Jul-08	77.57	325	23.87
08/27/08-09/25/08	Aug-08	73.83	325	22.72
09/26/08-10/24/08	Sep-08	69.48	325	21.38
10/25/08-11/24/08	Oct-08	63.65	325	19.58
11/25/08-12/26/08	Nov-08	58.72	325	18.07
		1323.84		407.34
Average		69.68		21.44
Wet Cleaning				
01/29/09-03/02/09	Jan-09	50.76	369	13.76
03/03/09-03/30/09	Feb-09	52.57	413	12.73
03/31/09-04/28/09	Mar-09	54.59	457	11.95
04/29/09-05/28/09	Apr-09	60.2	500	12.04
		218.12		50.47
Average		54.53		12.62

Monthly Billing Data: Cleaner #1
Natural Gas Use Per Day and Per 100 lbs

Read Date	Days	Therms Delivered	Therms/Day	Volume	Therms/ 100 lb
Dry Cleaning					
1/11/07	31	474	15.3	220.0	6.95
2/10/07	30	493	16.4	220.0	7.47
3/13/07	31	489	15.8	220.0	7.17
4/12/07	30	519	17.3	220.0	7.86
5/15/07	33	573	17.4	220.0	7.89
6/12/07	28	487	17.4	220.0	7.91
7/13/07	31	549	17.7	220.0	8.05
8/11/07	29	355	12.2	220.0	5.56
9/12/07	32	425	13.3	220.0	6.04
10/11/07	29	533	18.4	220.0	8.35
11/9/07	29	542	18.7	220.0	8.50
12/11/07	32	500	15.6	220.0	7.10
1/10/08	30	487	16.2	220.0	7.38
2/8/08	29	489	16.9	220.0	7.66
3/10/08	31	480	15.5	220.0	7.04
4/8/08	29	484	16.7	220.0	7.59
5/8/08	30	452	15.1	220.0	6.85
6/10/08	33	665	20.2	220.0	9.16
7/9/08	29	433	14.9	220.0	6.79
			310.9		141.32
Average			16.4		7.44
Wet Cleaning					
9/8/08	30	399	13.3	220.0	6.05
10/8/08	30	508	16.9	220.0	7.70
11/6/08	29	395	13.6	220.0	6.19
12/9/08	33	380	11.5	220.0	5.23
1/7/09	29	345	11.9	220.0	5.41
2/7/09	31	433	14.0	220.0	6.35
3/11/09	32	492	15.4	220.0	6.99
4/10/09	30	426	14.2	220.0	6.45
5/9/09	29	398	13.7	220.0	6.24
			124.53		56.61
Average			13.84		6.29

Monthly Billing Data: Cleaner #2
Natural Gas Use Per Day and Per 100 lbs

Read Date	Days	Therms Delivered	Therms per Day	Volume	Therms/ 100 lb
Dry Cleaning					
1/22/07	33	771	23.4	325.0	7.19
2/21/07	30	714	23.8	325.0	7.32
3/24/07	31	742	23.9	325.0	7.36
4/23/07	30	712	23.7	325.0	7.30
5/22/07	29	719	24.8	325.0	7.63
6/22/07	31	782	25.2	325.0	7.76
7/24/07	32	710	22.2	325.0	6.83
8/21/07	28	734	26.2	325.0	8.07
9/21/07	31	779	25.1	325.0	7.73
10/19/07	28	738	26.4	325.0	8.11
11/19/07	31	728	23.5	325.0	7.23
12/19/07	30	739	24.6	325.0	7.58
1/18/08	30	651	21.7	325.0	6.68
2/19/08	32	720	22.5	325.0	6.92
3/19/08	29	692	23.9	325.0	7.34
4/18/08	30	707	23.6	325.0	7.25
5/19/08	31	718	23.2	325.0	7.13
6/18/08	30	736	24.5	325.0	7.55
7/18/08	30	731	24.4	325.0	7.50
8/18/08	31	673	21.7	325.0	6.68
9/17/08	30	738	24.6	325.0	7.57
10/16/08	29	774	26.7	325.0	8.21
11/17/08	32	845	26.4	325.0	8.13
			556.0		171.06
Average			24.2		7.44
Wet Cleaning					
2/18/09	33	711	21.5	369	5.84
3/19/09	29	649	22.4	413	5.42
4/19/09	31	682	22.0	457	4.81
5/19/09	30	720	24.0	500	4.80
			111.1		20.87
Average			22.2		5.22