"Tapping Into" Commercial Energy Savings: Two Non-Traditional Commercial Sector Energy Users

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ABSTRACT

The paper includes information for two under-examined end uses in the commercial sector – on-premise laundries and dishwashing / ware washing equipment. The paper covers market characterization and assessment information; results of interviews with actors along the "chain" (including manufacturers, vendors, service providers, commercial participants / non-participants and "experts"); and conclusions on decision-makers and influencer attitudes, behaviors and practices, change-out factors, equipment experience, and other information. In particular, the project provided key information on intervention points, barriers, program suggestions, and savings potential. Interviews were conducted with the wide range of users of the equipments, including hospitals, hotels, prisons, and others (OPL), and 7 categories of eating establishments, educational facilities, and others (ware washing).

The largest factor in the decision-making process for both technologies was reported to be financial. However, the research shows that for many facilities, technical issues, implementation, and not least of all, the facility's desire to "do good" for the environment are beginning to play a larger role in installation decisions. The two types of equipment had very different characterizations of initial purchase circumstances (and lifetimes), and the roles of influencers / vendors / suppliers were quite different. Through in-depth evaluation interviews, barriers and the best marketing techniques to overcome barriers were uncovered. The interviews allowed an assessment of specific marketing and rebate techniques to speed market penetration of the technologies. The project looked closely at the current ware-washing and on-premise laundry market saturation and estimated the energy savings (and water savings) potential in the market place.

Introduction

As part of SoCalGas' goal of achieving aggressive CPUC savings targets and California legislation goals related to energy savings, the utility undertook a project to examine the energy efficiency Portfolio of the Future. SoCalGas realized that many of the technologies they had employed in the past to achieve energy savings have been adopted and prior programs are maturing, meaning that additional and future savings may be limited. SoCalGas hired Navigant Consulting to examine an extremely comprehensive list of residential, commercial, and industrial measures and technologies to develop a Portfolio of the Future. As part of this broad scope, SoCalGas and Navigant narrowed 500 measures down to approximately 46 measures, and studied the potential energy savings. SERA Inc. was hired to examine the potential of two commercial measures, on-premise laundry waste water reuse and commercial dishwashers. Combined, SERA conducted 155 separate interviews ranging from 10 to 60 minutes with

participants, non-participants, manufacturers, industry experts, and service providers to uncover the potential savings, barriers, market potential, and opportunities to add the measures to SoCalGas' Portfolio of the Future.

Part 1: On-Premise Laundry

SERA first examined the market for an innovative laundry water reuse technology, identifying opportunities to expand this market. The study focused on a specific waste water reuse technology that filters waste water, uses warm water returns as an input for future loads, and significantly reduces water and energy consumption. It is estimated that overall, commercial laundry systems utilize between 3 to 10 million gallons of water per year and per current estimates each pound of laundry washed uses 3 gallons of water. Wastewater technology researched for this project recycles 100% of the waste water for the first rinse of the next load. The waste water is supplemented with ~15% make-up water to maintain an acceptable level of total dissolved solids. The system is estimated to save somewhere in the range of 40-60% of the total energy costs of the OPL machines. In addition to energy savings, customers utilizing the technology may also realize savings in chemical use costs. At the time of this research only a handful of the OPL systems have been installed in the US.

The research included interviews with "participants" – a variety of businesses with laundry water reuse technologies installed, and "non-participants" – a sample of businesses of generally similar size and business types that did not have the technology installed in their on-premise laundry (OPL) facilities. A total of 30 interviews were conducted, 10 with participants and 20 with non-participants. The goal of the OPL project was to gather information that will help guide program development geared at expanding use of the innovative technology. The interviews covered decision-making, process for capital improvements, barriers, project implementation and finance, expectations and satisfaction, performance, suggestions, and direct and indirect program/project effects, and other topics. The interviews strongly encouraged open-ended or discussion-type responses to allow drilling down on causes and concerns.

Facilities and Laundry Characteristics

Most of the facilities with OPL water recycling technologies installed were in Florida and Georgia, and 9 of the 10 interviews were hotels, with the remaining interview conducted with a hospital. The non-participants were similar, except that they included a higher proportion of hospitals and included some commercial laundries. All facilities used washer extractors, ranging in size from 125 pound – 700 pound washers. A total of 10% of the participants used tunnel washers, while more than 40% of the non-participants used this technology. The volume of laundry processed averaged 10 million pounds per year, with a range of 2.7 million to 26 million pounds per year. The vast majority indicate they operate 7 days a week. All of the participant facilities used the same chemical vendor and over half of the non-participants used the same vendor.

Table 1: Volumes and Staffing of Laundry

Category	Participants	Non-participants
Average volume	9.7 million pounds / year (range 2.7-26 million)	10.3 million pounds / year (range 1.2 – 24 million)
Staffing (full-time equivalents)	42 (range 8-140)	46 (range fewer than 20 – 211)

Purchase Decision-Making

Even though many of the companies interviewed were part of large organizations and stated that many decisions were centralized, laundry seems to be largely a local decision. Only 30% of the participants said laundry decisions were made at a central location (38% for non-participants). The proponents for the system were Chief Engineers, Directors of Engineering, or less frequently, facility owners.

Outright purchase, not shared saving or other acquisition options, was the strong preference. Capital for these investments in hotel facilities did not seem to be a barrier ("no lack of capital"). For some non-participants, particularly hospital and commercial laundry facilities, capital could be a large barrier. Green-lighting an investment generally depends on the return on investment (ROI), and there is little difference for investments that customers/guests see vs. items they do not. When mentioned, the ROI threshold seemed to be about 2 years or less.

Selling Factors

The number one factor in the decision to adopt the water recycling technology was financial (they also reported this was the key element of the selling pitch or approach). Key aspects of the financial considerations related to: energy savings, water / sewer savings, and payback/ROI factors. The number two factor leading to adoption was site visits and credible data on performance. About 75% of the participants had "green" or environmental corporate goals, although some were less formal than others; 31% of non-participants reported similar goals.

Implementation, Payback, and Indirect Benefits

The cost to install the systems ranged from $60K to $270K, with an average of about $167K. The combined consideration / decision-making / implementation time ranged from 17 to 52 weeks (average 28 weeks); however, the physical installation lasted an average of 1.75 weeks. Gaining approval was the longest stage.

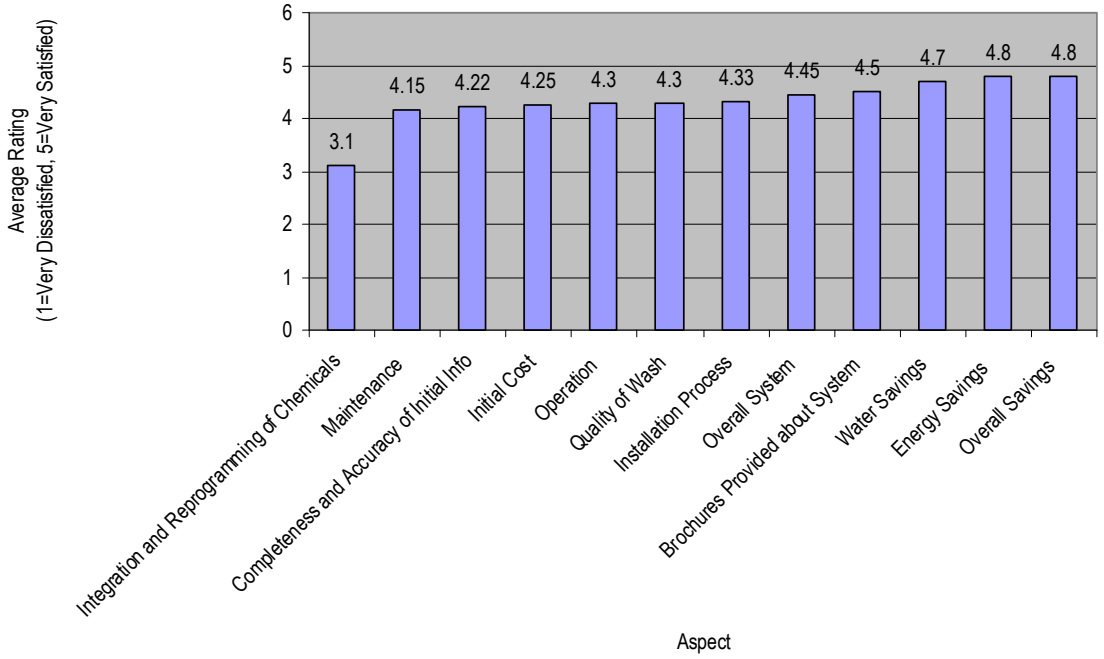
The fiscal performance for the equipment was very close to what participants were led to expect, with none reporting a significant difference in costs vs. expectations. The realized paybacks ranged from 0.5 to 2 years, with an average of 1.2 years payback.

The OPLs also reported that there were significant non-energy benefits (NEBs) associated with the new equipment. Businesses were asked about positive and negative effects they realized above and beyond energy and water savings (the direct fiscal benefits). These factors included changes in chemicals, equipment features, maintenance, system speed and output, safety, texture and cleanliness of laundry, and other factors, including one that was valued quite highly – "ability to do good for the environment". When asked to value these one-time benefits, their total value to the OPLs was about $150K (total lifetime value), or more than 80% of the installation cost. Including NEBs in the equation approximately (factors recognized and valued by the OPL managers) doubles the ROI or halves the payback. The major positive and negative NEBs are discussed in the following section.

Satisfaction / Dissatisfaction and Barriers

Those elements of the system with highest satisfaction (on a scale of 1 to 5, with 5 as very satisfied) are shown in Figure 1. Note that the savings (4.7-4.8), outreach and installation (4.3-4.5), and performance features (4.3) generated high to very high satisfaction. The non-energy benefits most frequently cited as positively valued by participants include the ability of this system to help them "do good for the environment" and meet green goals.

Figure 1: Satisfaction with the System



Barriers / Dissatisfaction Analysis and Action Steps

The major barriers, the way in which the barrier was identified / confirmed in the study, and implications / action steps are summarized in Table 3. Key issue areas include: integration of chemicals, factors related to maintenance / call-backs, installation, and product quality.

Overall, one of the most troublesome areas of concern identified in the study relates to the fact that participants noted the chemical vendor, did not seem to be behind the project. The vendor told some participants the laundry system would not work with recycled water and they should use fresh. One participant seemed to characterize his role as "mediator" between the "enemies" of the chemical representative and the waste water recycling vendor.

Table 2: Detailed Barriers / Issues Associated with OPL Water Reuse System

Barrier / Issue	Indicator of Barrier	Implication / Action
Integration and reprogramming of chemicals	3.1 on 5.0 satisfaction scale (participants); concern from comments, and 40%+ of participants indicated as concern (also concern by non-participants)	Significant problem – worst satisfaction score. Bears significant work with chemical vendor, communication / integration, or other actions to keep client OUT of role of mediator, lessen concerns. The chemical vendor was identified as negative about the program / process; in addition, there was a long process of getting the chemicals readjusted. This needs work on attitudes / cooperation / incentives re: chemical vendor, as well as learning from the experience of existing facilities to do better at the first cut of revised chemical mixes. Concern by non-participants and participants – address in outreach literature also.
Maintenance, by in-house staff, and concerns about number and timeliness of call-backs	More than 50% of participants noted as negative, 4.1 on 5.0 satisfaction scale (participants); Strong fear by non-participants also	In-house staff issue is a large concern – consider training, warranty buy-ups, guarantees of response times when outside help needed. Need up-front information on maintenance guarantees to address the strong concern by non-participants as well.
Operational changes, and operational changes seen by staff (invisibility of system to employees)	40-54% of participants cited as negative effect; even greater concern by non-participants / disconnect.	Some state invisible to staff (preferred), but considerable portion note changes were very visible. If this is chemicals, addressed by improved relationships with chemical firm; if piping or other, may need different actions. Consider making it more invisible (paint?) OR encourage embracing the difference and enhancing pride of staff in environmental process.
Cleanliness of laundry	40-54% cited as negative effect by participants; large negative perception by non-participants; although greater fear than reality (still negative)	This is an important concern; additional testing, consideration of pH effects in rinses, refinements to chemicals to address this should be incorporated up-front (use history on chemical changes to apply earlier / faster to new facilities). Effect on cleanliness is much greater concern than reality, although it remains a significant negative effect.
Physical installation	40-54% cited as negative effect by participants; greater concern by non-participants; although greater fear than reality (still negative)	This varies – some are easier installations than others. Smaller equipment generally easier to install; options for the size / direction / orientation of equipment might help, but there may not be many remedies as laundry facilities are often in cramped, isolated areas not near loading docks.
Texture of the laundry	30-39% cited as negative effect by participants; also significant concern by non-participants although greater fear than reality (still negative)	This is an important concern; additional testing, consideration of pH effects in rinses, refinements to chemicals to address this should be incorporated up-front and learn (chemicals, etc.) from successful sites already in operation.
Completeness and accuracy of initial information	4.2 on 5.0 satisfaction scale (participants)	Update materials based on findings from this evaluation, paybacks, refinements/better match for expectations to reality.
Temperature too hot or too cold for special purposes	Identified during discussions.	Assess the predominance of blood stains at the facility (hospitals) and consider implementing a cooler first step to reduce setting in blood stains; Other adjustments may be needed at other facilities for specialized conditions.

Marketing Opportunities / Positive Factors and Comments

The following factors represent key elements for the additional marketing of these OPL technologies:

- Fiscal performance is a strong element, and fiscal performance promised stands up fairly closely with what is promised in marketing materials. Paybacks of less than 2 years are

standard, with an average of 1.2 years and many installations paying back in less than 1 year.

- There are strong overall indirect effects recognized by participants, which can bring the overall payback to less than a year on average. The most valued of these benefits is "green" or environmental potential from the technology, which fits well with sustainability goals of more and more companies (especially hotels, which are marketing on "green" characteristics).
- Endorsements relate to:
  - strong water/sewer savings;
  - savings in unexpected places (higher water temperature reduces drying time on linens),
  - linens smell better and are whiter
  - maintenance free / "automatic" – just sits there and chugs along running itself
  - vendor fixes and stands behind their product.
- A majority, 68%, of non-participants reported that they were skeptical of the system's ability to deliver on cost savings but 100% of the participants reported that the system did indeed, deliver cost saving to the facility.
- Close to two-thirds of the non-participants reported that they were skeptical that the system could deliver on water quality while 88% of the participants reported that the system did deliver on water quality at least as well as expected, if not better. Only 11% of the participants reported that it wasn't delivering on water quality and this was due to pH issues.

Overall

Overall, the technology has significant advantages, which are highly regarded by the participants, including very strong savings (water and energy), easy process with few changes to procedures for staff, "green" process, and a compact system that installs and integrates relatively easily. While a percentage of the first few installations invariably have a few "kinks", as more data and case studies become available, these issues will be resolved. The adopters are strong proponents of the technology, and within a few months the vast majority of sites had realized the exceptional savings numbers (80% of water) that had been promised, as well as other benefits.

Part 2: Commercial Dishwashers

Commercial dishwashers are considered to be one of the largest energy consumers in the commercial kitchen. The U.S. Environmental Protection Agency (EPA) estimates more than two-thirds of the water consumed in a restaurant is used for dishwashers. The majority of dishwasher energy use is attributed to heating the water required to sanitize the dishes. There are four general categories of machines based on how the dishes are loaded and both standard and high-temp machines (which require a booster heater to heat the water to above 180º in the rinse cycle). Reducing the amount of water required in the rinse cycle is the primary method of increasing efficiency. The rinse water required varies greatly depending on the type of dishwasher used ranging from relatively low in the undercounter models to very high in the continuous conveyor type washers. Technologies are capable of reducing rinse water from 4-5 gallons of water per load to less than half a gallon. Strategies used to increase overall dishwasher

efficiency include waste air heat recovery, drain heat recovery, re-using rinse water, double-walled insulated construction, high efficiency anti-clogging nozzles, continuous filtering, and efficient boost heaters. In the Southern California Gas Company (SCG) service territory, total gas consumption for commercial dishwashing in restaurants, food stores, schools, colleges, hospitals, and hotels is approximately 62 MTh/yr.[1]

Commercial dishwashers are classified according to the method by which dishware is loaded and processed, and each class roughly corresponds to a range of throughputs as measured in racks/hour. Classes of commercial dishwashers include undercounter, stationary rack door type, rack conveyor machines, and flight-type (continuous conveyor) machines. Further variations include number of wash tanks, high temperature or chemical-based sanitation, and other features. However, the majority of energy consumption by commercial dishwashers is attributable to water heating. The study examined an array of business types as part of the market assessment. These include restaurants, schools, hotels, hospitals, prisons, and food stores. Twelve industry experts and actors were also interviewed, including installers / service contractors, manufacturers, and distributors.

End-User Summary Results

Dishwasher usage-hours and gallons. During the interview process all of the interviewees were asked a series of questions to provide the various inputs needed to compute the water usage patterns for each sector. Interviewees were asked to report their peak and non-peak periods of operation, the average hours per day during these periods the dishwashers were operating, and a number of specifications regarding their dishwasher in order to permit the researchers to estimate water usage patterns. However, the large majority of interviewees were unaware of many of the specifications regarding racks per hour, gallons per rack, or overall water usage. To determine these data, the research team instead asked each interviewee to report the make and model of each dishwasher in use in the facility and the corresponding number of hours it was operating. Once the make and model were reported the researchers could determine the gallons per hour used by using the manufacturers published specifications for the make and model.

These data show that restaurants use less water for dishwashing per installation – and are generally much smaller in terms of "covers"[2] – than the institutional buildings interviewed (prisons, hospitals). When the sectors overall are looked at, there are far more restaurants, hotels, and health care facilities located in the state of California when compared to the number of colleges and universities or prisons. The US Economic Census reports that there are 66,568 businesses in the accommodation and food sector in California and 88,249 businesses in the health care sector. Although this does not mean that every business has a kitchen, cafeteria, or dishwasher, the numbers are significantly higher than those for the college and prison sectors. There are approximately 60 prisons and 399 colleges and universities in the state, indicating that there are potentially many more opportunities for increased efficiencies in the restaurant, hotel, or health care sectors. However, when compared one-to-one, one university can provide service to over 40,000 students, while an individual restaurant might have as few as 20 seats. The following table displays the estimated annual water usage per sector based on dishwasher type, hours of operation for the dishwasher, and peak periods of business. Fast food stores, schools,

[2] Industry term defined as number of diners per service period, i.e. a restaurant might report that they typically handle 100 covers for lunch service and 150 covers for dinner service.

and cafeterias are not included in the table below because the majority, if not all, of the interviewees in these sectors reported that they did not use dishwashers but instead hand washed all the dishes at their location.

Decision-making. Dishwashers are critical pieces of equipment in a functioning kitchen. Dishwashers are chosen and installed during the construction/commissioning of a new facility; and replaced when they become too expensive to operate or when they break down. The interviews showed there is no broad sweeping decision-making process for all sectors. In some sectors such as the hotel sector, decisions start locally in either the engineering or dining services department and end at a central location with the approval from an executive board or owner. In the independent restaurant sector, all of the decisions are made on-site and in most cases, the entire decision-making process is completed by one person, the owner. In other sectors, such as prisons and hospitals, the public has a stake in the facility and decisions are made differently.

Interviews with industry experts suggest that for some businesses there are additional parties involved in decision-making – foodservice consultants. These professionals work to establish longstanding relationships with architects, developers, and foodservice businesses, are often called in to consult in the design or remodeling of facilities, and function in a management advisory capacity, looking at the business operations of the restaurant. Their consulting services cover operational aspects, menus, changes in labor, better use of resources, design, and in many cases, specification of warewashing equipment if it is not functioning to needed capacity. It is not yet clear if climate change messages are affecting purchases by all types of restaurants, institutions, and others using warewashing equipment, or whether they are being similarly incorporated into decision-making.

Barriers. The three major barriers to the installation of energy efficient commercial dishwashers are:

- *Cost*- the initial cost of the machine. Small independent businesses and those strapped for capital will tend to select the cheapest machine that will meet throughput requirements. More than half the market (especially small businesses) tends to lease machines, often from the companies that provide chemicals. The purchase decision commonly includes a contractual arrangement for maintenance as well.
- *Maintenance*- both day-to-day and repairs. This includes breakdowns, parts availability (and speed), and the level of training by staff needed to operate the equipment. More sophisticated machines with electronic controls may require more training than is practical with sometimes transient and language-challenged kitchen staff.
- *Performance*- Includes speed and final product. The ability to keep up with warewashing needs (throughput) is critical to restaurant, and reliable performance is essential. Breakdowns, or a poorly suited machine can severely hamper revenue generation. Similarly, the product must be reliably clean and spotless, and provide quality output even if water quality (hard water, minerals, etc.) present challenges.

Manufacturer Summary of Results

The manufacturers as a whole reported that energy efficiency, water savings, and overall "green" attitudes were becoming more prevalent in the market place. As a group, all of the manufacturers are pushing their energy efficient products and many reported that they have been

doing so for years. The market and consumer wants/demands are starting to catch up to the technologies that many of the manufacturers have been touting for years. All of the manufacturers reported that there was an opportunity for substantial and measurable energy savings in the commercial dishwasher sector.

Energy Star and the energy efficient market place. The new Energy Star ratings are supported by the manufacturers as a group despite comments that the labeling needs some refining. Manufacturers reported that the current specifications are a good start but should be re-examined and adjusted in the future to assure customers that the Energy Star labeled machines provide consistent energy savings and end product. Energy Star has had a positive effect in raising consumer awareness but the market is still in its beginning stages.

Energy efficient machines. Manufacturers generally look at decreasing water consumption as the best way to increase overall efficiency. The manufacturers note that water heating is the largest consumer of energy in warewashers and by reducing the amount of water used, the overall energy consumption can be decreased. This also adds savings in water and sewer costs to the end-user. The manufacturers are approaching the technical issue of decreasing water usage in several ways including low-flow nozzles, modified spray valves, rinse water re-use, increased motor horsepower, curtain modifications, timers, and others. One manufacturer reported using a waste air heat recovery system to reduce the energy costs to the consumer.

Sales and distribution. The most important actors in getting the units into the market place are the manufacturers' sales teams, the consultants, and in the case of one manufacturer, the chemical supply company.

Barriers and incentives. In the manufacturers eyes maintenance is a perceived barrier only. Manufacturers note that their customers do express concerns about maintenance with the energy efficient machines but that these concerns are unfounded.

Cost is a real barrier. The manufacturers are using sales tools to try and show customers the return on investment their machines represent but rebates and other incentive programs would help in making up the premium paid for energy efficient machines.

Lack of awareness was also listed as a barrier. Many of the end-users do not know about the potential for energy savings available to them. All of the manufacturers responded that the potential to decrease the demand for energy exists in the commercial warewashing sector and the market is starting to move in that direction.

Service and Distributor Summaries

Servicers report that the amount and type of maintenance service needed for energy efficient machines is not significantly different than that needed for the conventional type of dishwashers. Mostly the smaller size end-users and independent and chain restaurants are the ones that are entering into service agreements with the service providers. Maintenance is seen as a possible barrier to the service providers but extended warranties and service contract could help "push" the product into the market place. Rebates for preferred products could also help to influence end-users to install the technologies.

Energy Star and energy efficient machines. Service providers report that the amount of energy efficient machines in the market place is increasing. To date the influence of the Energy Star labeling program is not very apparent as the program has only been in place for a few months.

Barriers and incentives. The largest barrier to customer installation of energy efficient machines is the lack of awareness. Maintenance was reported as a perceived barrier but not an actual one. There is not an issue with servicing the energy efficient machines when compared to conventional ones despite the fears and trepidation felt and reported by the end-users. Servicers report that the majority of end-users are unaware of the potential energy and monetary savings available.

Non-Energy Benefits, Perceptions, and Marketing / Barriers Analysis

Non-energy benefits (NEBs) represent the array of impacts beyond energy savings that are associated with new, more efficient equipment. Interviewees were asked their perceptions about a variety of factors – positive and negative – associated with new, more efficient dishwashers. NEB results provide input on highly valued marketing messages, "barriers" to the purchase of new equipment, and improved information on the paybacks recognized by dishwasher purchasers based on the "bundle" of features that they associate with new, energy efficient equipment beyond energy savings. Figure 3 shows the NEB results as a percentage of the installed cost of new, energy efficient dishwashing equipment. The results are summarized below:

- Several effects are very commonly perceived as positive, including "doing good" for the environment, lower water costs, reduction in chemical usage, and improved cleanliness.
- When dollar values were assigned, we found that the most important – that is, most highly valued – positive effects included: "doing good" for the environment, cleanliness, and water and chemical savings. These impacts reflect potential marketing messages, especially since, combined, they represent more than half the cost of new, energy efficient dishwashing equipment.
- Negative perceptions were also assigned to some of the features associated with energy efficient equipment, including maintenance and cleanliness, followed by concerns about chemicals and space concerns.
- The key barrier to energy efficient dishwashers (represented by the negative NEB estimate) related to concerns about maintenance of energy efficient equipment relative to standard models.
- The overall value of all NEBs was estimated as about 69% of the cost of new, efficient equipment. [3] Getting these impacts widely recognized by decision-makers could help make the case for energy efficient equipment – especially if concerns about maintenance can be addressed through interventions or other strategies.

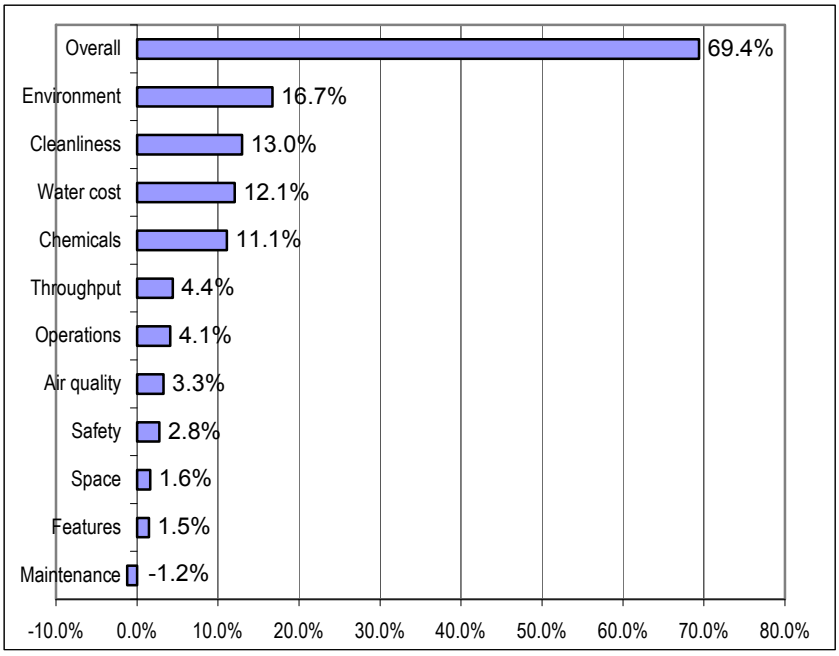
[3] Small sample sizes suggest using these results as indicative, not statistically reliable.

Table 2: Marketing and Intervention Suggestions from Non-Energy Benefits Analysis[4]

Main marketing message	Machines provide benefits beyond energy including: "doing good" for the environment, lower water costs, reduction in chemical usage, and improved cleanliness.
Barriers	Maintenance concerns.
Interventions	Increasing the value of equipment rebates, or perhaps even more appropriate to the source of the concern, "buying up" the value of the machine's warranty, or paying for one (or more) preventive maintenance visit or similar.[5]

Figure 3. Value of Non-Energy Benefits (NEBs) as a Percentage of the Installed Cost of New, Energy Efficient Dishwashing Equipment

(Overall = total of all individual NEBs; NEB values represent expected effects for efficient equipment beyond effects from standard equipment)



Interventions and Recommendations

Based on the results of the interviews and research, there are several suggestions and interventions that may help move the market forward in warewashing equipment efficiencies.

- Financial Incentives: Rebates and economic incentives were of interest. However, rather than set at "deemed" amounts, business-specific rebates based on usage (consumption rebates) will likely be most successful and equitable. Note, however, that the high cost of large volume machines may place significant rebates or financial incentives beyond reasonable costs for a program of this type.
- Identifying effective incentives for leasing companies: The research indicates that businesses that lease warewashing equipment maintain a significant inventory of

[4] Small sample sizes suggest using these results as indicative, not statistically reliable.

[5] The estimates from this small-scale NEB analysis implies that an intervention of these types funded at a level of perhaps 1-2% of the purchase price of the machine, may address some of these maintenance related concerns. A larger interview sample would provide a more reliable estimate of the needed intervention (which might be more conservatively estimated at 5%).

equipment that is frequently refurbished and placed into locations when equipment begins to under perform. Identifying interventions that will work to begin to upgrade efficiencies of this equipment may go a long way to improving efficiency of the stock industry-wide.

- Addressing barriers: The major barrier is concerns about maintenance of energy efficient equipment. Buying up / improving warranties, ensuring parts will be available, and similar interventions will be very helpful in improving market acceptance.
- Education / information / marketing: There are four elements of this recommendation:
  - Targeting consultants and decision-influencers
  - Providing information to firms that lease equipment
  - Targeting visible industry leaders
  - Piggy-backing on the "green" message
- Addressing barriers: Addressing the concerns about maintenance of "new, high tech, efficient" machines (as they are likely perceived) is important. If the concerns are real; that is, if there are maintenance issues, they will need to be addressed through technology improvements, and financial considerations that offset these issues.[6] More likely, it is a perceived problem, and although perception is just as important as reality, the remedy is different. Warranty buy-ups, assurances about availability of parts and knowledgeable repair staff, subsidized scheduled maintenance, data about repair records, and similar strategies will likely be most effective at addressing this issue.[7]

Conclusion

Commercial dishwashers, as reflected by recent EPA standards, represent large potential energy savings for the region. On-primes laundry waste water recycling, although it does not have the potential to be used in as many facilities, is a technology that has significant advantages including very strong savings (water and energy), easy process with few changes to procedures for staff, "green" process, and a compact system that installs and integrates relatively easily. Both of the researched technologies can be relatively easily integrated within the existing market place and supply chains and show promise and positive results among existing participants. Barriers were identified that need to be addressed. For both technologies, cost was both a perceived and real barrier. For OPL systems it is important that all of the stakeholders, including the chemical vendors, can agree on the technology, and it appears that if more systems can be installed a critical mass may be reached in which more and more facilities may adopt the technology. Commercial dishwasher programs need to address, in addition to the initial cost barrier, the perception of increased maintenance costs. Both measures could benefit from the use of non-energy benefits in their marketing message. Cost is the premier concern among measure adopters, however, it may help to "sell" the technologies if other benefits, including "doing good for the environment", reduced chemical usage, and reduce water use. Both OPL waste water recycling and efficient ware washers are measures with large potential to be a significant component of future energy portfolios.

[6] However, if there are quality problems of any kind, it may be worth waiting to spread the equipment into the market. It is notoriously difficult to come back from poor performing early market products, as illustrated by the compact fluorescent lighting example.

[7] The small sample / preliminary information indicates that the positive non-energy effects more than outweigh the negative factors, and if the factors beyond energy efficiency are presented and emphasized (marketed), there should, on average, be a preference for energy efficient models.