Pollution Prevention Program
for
Dry Cleaning and Laundry Services

Prepared for Toronto Public Health
by
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1.0 BACKGROUND INFORMATION

1.1 ChemTRAC Facilities

In the Metropolitan Toronto area[1], 844 facilities[2] have self-identified as belonging to NAICS code 8123, which corresponds to Personal and Laundry Services. In the 2013 reporting year, 100 unique facilities reported to ChemTRAC that they met or are exceeding the reporting thresholds, representing approximately 12% of the facilities implicated in the sector. It is anticipated that the facilities that met the reporting criteria used solvent based cleaning such as perchloroethylene, or operated large natural gas fired drying machines. Four contaminants were reported from this sector, NO_x, $PM_{2.5}$, tetrachloroethylene (perchloroethylene), and VOCs.

1.2 Sector Releases

In the 2013 reporting year, the sector reported releases of four (4) contaminants: $PM_{2.5}$, NO_x, tetrachloroethylene (perchloroethylene), and VOCs. Ten (10) facilities reported meeting or exceeding the air release thresholds of NO_x, eight (8) for $PM_{2.5}$, thirty-nine (39) for tetrachloroethylene (perchloroethylene), and twelve (12) for VOCs, respectively. In total, only one (1) facilities reported meeting or exceeding the thresholds for all 4 contaminants.

The Personal and Laundry Services sector – NAICS code 8123 – has been divided into two divisions based on services provided – commercial or personal laundering. The commercial laundering segment consists of facilities that generally employ more than 10 people and launders a significant quantity of garments, generally uniforms and linens from commercial service industries. These facilities are often equipped with commercial dryers, which provide heat by use of electricity or natural gas. The personal laundering segment consists of facilities that generally employ less than 10 people and provide laundry service to individual customers, resulting in a lower quantity of garments laundered. Based on the 2013 ChemTRAC data set, this segment is the primary user of tetrachloroethylene through personal dry cleaning services.

1.2.1 Nitrogen Oxides (NO_x)

Total release to air of NO_x were reported at 13,924 kg by 29 facilities in the 2013 reporting year. Releases of NO_x are expected to be primarily from natural gas combustion sources related to heating

[1] Toronto's Metropolitan Area refers to those within a postal code starting with M, to align with the ChemTRAC reporting region
[2] Source: Composite of Scott's Directory (Accessed October 2015), Industry Canada, and the 2013 ChemTRAC reporting year data set.

water or air for washing, drying or steam (pressing purposes). Combustion equipment is typically integral to the water or air handling equipment, and is often referred to as packaged burner/boiler equipment. One of the facilities, KBRO Linen, released 3,103 kg of NO_x, which represents 22% of NO_x emissions from the sector. Emissions from the largest 5 emitters in this sector accounted for 73% of releases, all of which were commercial launderers. From the ChemTRAC data, the top 10 facilities with the highest air releases for NO_x are provided below in Table 1.

1.2.2 Particulate Matter 2.5 ($PM_{2.5}$)

Total releases to air of $PM_{2.5}$ were reported at 2,064 kg by 19 facilities in the 2013 reporting year. Releases to air of $PM_{2.5}$ are expected to be primarily from the drying operation and as a by-product of combustion. Discharges to air from the facility are both controlled (via filter "lint filter"), and direct (uncontrolled). Other ancillary operations such as spot cleaning and folding operations are not expected to emit comparably significant emissions. The top three emitters of NO_x are from commercial launderers, as would be anticipated. Commercial launderers represent approximately 85% of total $PM_{2.5}$ emissions from the sector. From the ChemTRAC data, the top 10 facilities with the highest air releases for $PM_{2.5}$ are provided below in Table 1.

1.2.3 Tetrachloroethylene (Perchloroethylene)

Total releases to air of perchloroethylene were reported to be 13,208 kg by 69 facilities in the 2013 reporting year. Releases of perchloroethylene are exclusively from the solvents used as a cleaning agent in the dry cleaning process. Sixty six (66) facilities reported air releases of perchloroethylene, accounting for 69% of facilities that report to ChemTRAC. The release of perchloroethylene is well distributed across the sector with no more than 9% of total perchloroethylene releases to air emitted from any single facility. In 2006, it was estimated that 360 dry cleaning facilities in Toronto were using perchloroethylene[3], the number of dry cleaning facilities has increased since then, it is not currently known if the number of facilities still using perchloroethylene has increased or decreased since this time. In general, it is anticipated that the demand from perchloroethylene in the dry cleaning industry is decreasing annually.[4] From the ChemTRAC data, the top 10 facilities with the highest air releases for perchloroethylene are provided below in Table 1.

1.2.4 Volatile Organic Compounds (VOCs)

Total releases to air of VOCs were reported at 37,164 kg by 32 facilities in the 2013 reporting year. VOCs emitted are expected to be various hydrocarbons and volatile methyl siloxane-based solvents[5].

[3] Dr. David McKeown, *Reducing Health Impacts of Perchloroethylene from Dry Cleaning in Toronto,* 2007.
[4] http://www.partneresi.com/resources/chemicals-used-in-drycleaning-operations.pdf
[5] Findings of Operation Green Clean. Environment Canada. 2002.

Releases to air from the sector are primarily from solvents used in cleaning activities, including normal use, delivery, and spills. From the ChemTRAC data, GK Services Canada Toronto East released 85% of the total emissions. The top 10 facilities with the highest air releases is shown in Table 1.

Table 1 - Top 10 Contaminant Emitting Facilities from 2013 ChemTRAC Data Set for the Dry Cleaning and Laundry Sector

Pollutant	% Contribution in Sector	Air Release (kg)	Type of Facility
Nitrogen Oxides (NOx) (11104-93-1)		**13924**	**Commercial/Personal**
KBRO Linen Systems	22.29%	3103	Commercial
MOH Holdings Inc Faster Linen Service Ltd	14.57%	2029	Commercial
Cintas Corporation Loc 882	13.87%	1931	Commercial
Canadian Linen And Uniform Service Co	11.59%	1614	Commercial
Canadian Linen Uniform Service Co	10.17%	1416	Commercial
GK Services Canada Toronto East	6.25%	870	Commercial
Cintas Corporation 881	6.13%	853	Commercial
Cintas Canada Limited	3.66%	510	Commercial
Gibson's Cleaners Company Limited	3.53%	491	Commercial
Topper Linen Supply Limited	3.22%	449	Commercial
Particulate Matter 2.5 (PM2.5)		**2064**	**Commercial/Personal**
GK Services Canada Toronto East	30.62%	632	Commercial
Canadian Linen And Uniform Service Co	29.46%	608	Commercial
Canadian Linen Uniform Service Co	24.76%	511	Commercial
Evergreen Dry Cleaners	4.84%	100	Personal
KBRO Linen Systems	3.73%	77	Commercial
MOH Holdings Inc Faster Linen Service Ltd	1.84%	38	Commercial
Cintas Corporation Loc 882	1.79%	37	Commercial
Cintas Corporation 881	1.55%	32	Commercial
Cintas Canada Limited	0.48%	10	Commercial
Parkers Custom Clothing Care	0.29%	6	Personal
Tetrachloroethylene (Perchloroethylene) (127-18-4)		**13208**	**Commercial/Personal**
Sketchley Cleaners	8.67%	1145	Personal
GTA Cleaners	7.28%	962	Personal
Tip Top Cleaner Son	6.47%	855	Personal
Suedemaster Leather Cleaners	6.09%	805	Personal
Abra Dry Cleaners	5.20%	687	Personal
Cleanrite Cleaners	3.52%	465	Personal
Ashford Cleaners	3.43%	453	Personal
Better Way Dry Cleaners	3.01%	398	Personal
Sparkle Discount Cleaners	2.83%	374	Personal
Blue Bonnet Cleaners	2.83%	374	Personal
Volatile Organic Compounds (VOCs) Total		**37164**	**Commercial/Personal**

Pollutant	% Contribution in Sector	Air Release (kg)	Type of Facility
GK Services Canada Toronto East	84.99%	31586	Commercial
Aramark Uniform Services Canada Ltd	3.96%	1472	Commercial
Etobicoke Laundry & Dry Cleaners Ltd.	2.96%	1100	Personal
Custom Colour Labs Inc	1.82%	675	Personal
GTA Cleaners	1.35%	501	Personal
Canadian Linen Uniform Service Co	1.28%	474	Commercial
KBRO Linen Systems	0.71%	263	Commercial
Ashford Cleaners	0.40%	149	Personal
Canadian Linen And Uniform Service Co	0.31%	117	Commercial
New Way Cleaners	0.31%	116	Personal

1.3 Description of Sector Processes and Operations

Within the Dry Cleaning and Laundry Services sector facilities receive soiled/stained linens, fabrics, or garments that require cleaning. The industry group comprises establishments primarily engaged in providing self-service laundry and dry-cleaning facilities for public use; providing dry cleaning and laundering services; laundering and supplying laundered uniforms, linens and other fabric items; and providing other laundry services such as clothing repair and alteration services.

There are two predominant forms of cleaning: dry cleaning, and wet cleaning. Dry cleaning activities account for the majority of the industry revenue at an estimated 68.1% of the total[6]. The distinction between the two methods is that dry cleaning is any cleaning process for clothing and textiles that uses a chemical solvent other than water. In the dry cleaning process, a dry-cleaning machine is used where garments are placed in the washing or "extraction chamber". Similar to a domestic washing machine, the washing chamber contains a horizontal, perforated drum that rotates within an outer shell. The shell holds the solvent while the rotating drum holds the garment load. Typically a dry cleaning machine can handle between 10 – 50 kg per load[7]. As the technology has evolved, dry cleaning machines are classified into one of five generations[8]:

- 1st Generation – Transfer machines. Used predominantly pre-1960s, these machines require manual transfer of solvent-laden clothing between a separate washer and dryer
- 2nd Generation – Dry-to-Dry (vented). These machines are non-refrigerated, dry-to-dry machines, using a one-step process that eliminates clothing transfer. Clothes enter and exit the machine dry.

[6] IBISWORLD, *"Dry Cleaners in Canada: Market Research Report"*, March 2015
[7] Dalex Canada Inc. http://www.dalex.ca/page.cfm?id=2CB549B9-8C25-4F25-8ADF-02DA4ABD41DD&catid=103
[8] http://www.cdc.gov/niosh/pdfs/hc18.pdf

Second generation machines vent residual solvent vapours directly to the atmosphere or through a form of vapour recovery system during the aeration process.

- 3rd Generation: Dry-to-Dry (unvented). Dry-to-dry machines with refrigerated condensers were introduced in the late 1970s, and early 1980s. These non-vented machines are essentially closed systems, which are only open to the atmosphere when the machine door is opened. They recirculate the heated drying air through a vapour recovery system and back to the drying drum. These machines provide considerable solvent savings and reductions in PERC emissions over their predecessors.
- 4th Generation: dry-to-dry (non-vented with secondary vapor control) "Fourth Generation" dry cleaning machines are essentially "third generation" machines with controls to reduce residual PERC in the machine cylinder at the end of the dry cycle. These machines rely on both a refrigerated condenser and carbon absorber to reduce the PERC concentration at the cylinder outlet below 300 ppm at the end of the dry cycle. These machines are much more effective at recovering solvent vapours than machines equipped with a carbon adsorber or refrigerated condenser alone.
- 5th Generation: dry-to-dry (non-vented with secondary vapour control and drum monitor) "Fifth Generation" machines, have the same features as "fourth generation" machines. However, they also have a monitor inside the machine drum and an interlocking system to ensure that the concentration is below approximately 300 ppm before the loading door can be opened.

Wet cleaning is a similar process to the domestic cleaning where a water based cleaning agents such as bio-degradable soaps and conditioners are used to wash the garments. The wet garments are then transferred to a drying machine (either manually or automatically), where they are air dried.

The process that Toronto launderers use vary, and so a general process flow diagram was developed to visualize the processes and sources of emissions.

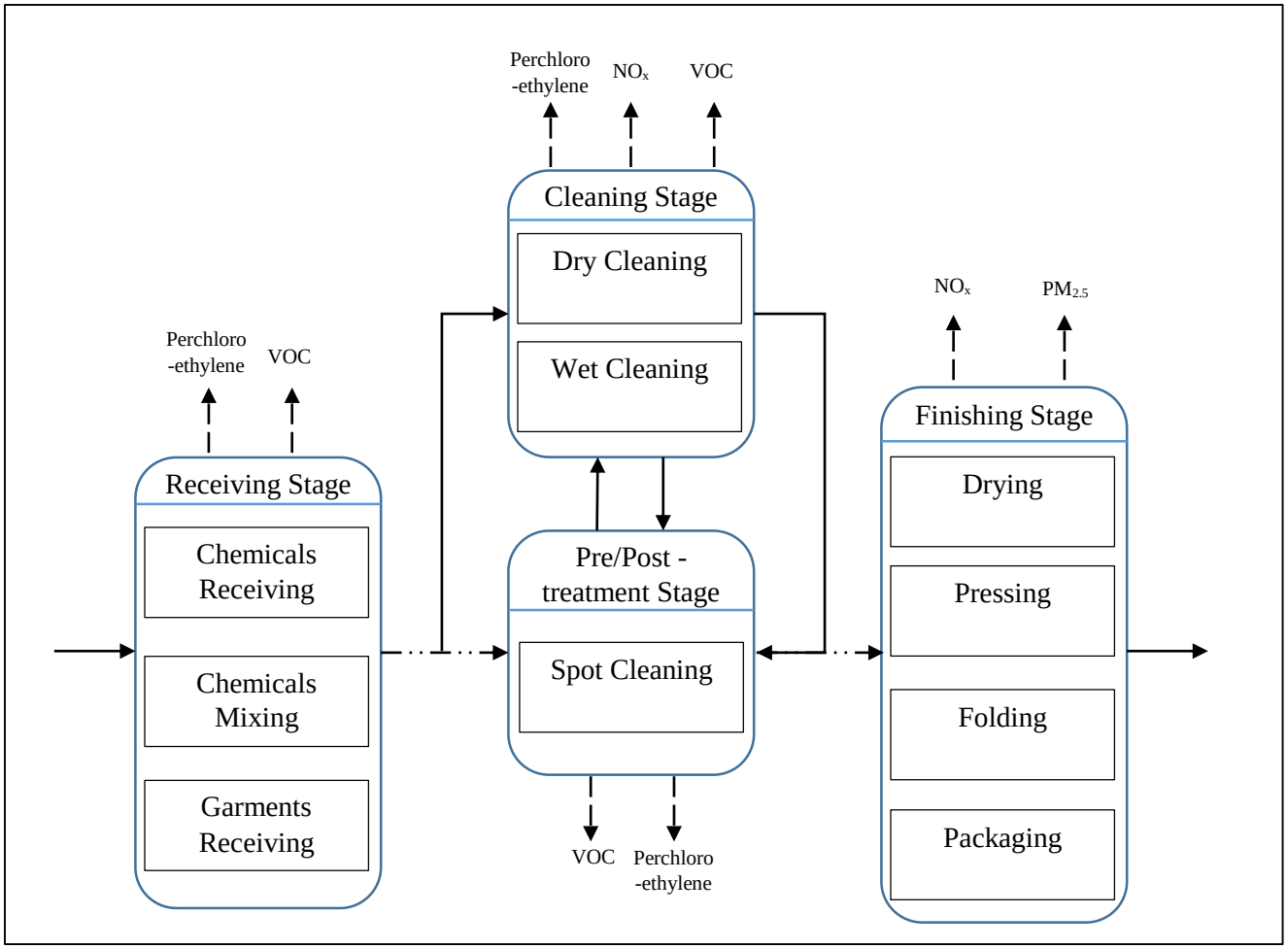

Figure 1 - Process Flow Diagram of a Generalized Laundry Services Facility

2.0 BARRIERS IDENTIFIED

2.1 Sector Breakdown

The barriers preventing the Dry Cleaning and Laundry Services industry from implementing P2 initiatives vary significantly depending on the type of services that the facilities offer: commercial or personal. As identified in Section 1.2, the commercial laundering segment consists of facilities that generally employ more than 10 people and launders bulk quantities of garments, generally uniforms and linens from commercial service industries. The personal laundering segment consists of facilities that generally employ less than 10 people and provide laundry service to individual customers, resulting in a lower quantity of garments laundered. The barriers are dependent on the decision maker of pollution prevention programs. For commercial facilities, this is likely to be someone in management, whereas for personal facilities, it is likely to be the owner/operator or the landlord.

2.2 Motivation

The motivational barriers vary between personal and commercial segments because of the demographics of each. In the personal laundering segment, most businesses are owner operated, and so only one person, the owner operator, needs to be motivated to begin pollution prevention practices. In the commercial laundering segment, a chain of operators, maintenance people, and management need to be motivated to begin pollution prevention practices. These differences result in inherently different motivational barriers. These barriers include:

- The concept of pollution prevention was overlooked for years without any perceived negative attributes while proving that current systems and management practices work well.[9]
- Different types of workers needing to be motivated to use pollution prevention practices, including line workers, maintenance people, and management
    - Present only in the commercial segment
- Lack of financial incentives
- Lack of pressure from customers (In the personal laundering market segment, specifically, dry cleaning, customer awareness is beginning as a result of consumer education. Services have sprouted up to help customers locate "Eco-cleaners" in Toronto[10]. In the commercial market, the cleaning practices are driven by the customer. Some organizations such as hotels have sustainability policies which mandate toxic-free cleaning for their linens.[11]

[9] Wilts, H., Dehoust, G., Jepsen, D., & Knappe, F. (2013). Eco-innovations for waste prevention - Best practices, drivers and barriers. *Science of the Total Environment*, 823-829.
[10] http://www.blogto.com/fashion_style/2015/02/the_top_10_eco_friendly_dry_cleaners_in_toronto/
[11] http://www.torontocentre.intercontinental.com/environmental-fact-sheet.aspx

- Savings are hard to predict[12]
- Lack of regulatory requirements

2.3 Knowledge

Within this sector, employees are predominantly responsible for equipment operation, customer intake, equipment repair and maintenance. Facilities are unlikely to employ technical specialists able to identify pollution prevention activities. Typically, facilities receive technical information from equipment or chemical suppliers, service technicians, and industry associations. Facilities are likely to learn from equipment vendors, and business-to-business discussions about the successes/failures of equipment and cleaning agents.

Within the sector, the following knowledge barriers have been identified:

- Limited or no technical resources in-house
- Business owners are not aware of alternative technologies[13]
- Fear of altered, lower quality performance of alternative technologies[14]
- Desire external expertise to validate potential opportunities[15]

Assisting facilities to understand the business case (increased business, cost savings, etc.) will be necessary to overcome the barrier.

2.4 Financial Resources

Financial investment is one of the major barriers identified that prevent facilities from implementing P2 initiatives. The owner-operated facilities are focused on day-to-day survival in a competitive market. As a result, new expenditures of money have to be well defined, targeted, and the risks well understood. Statistics Canada reported that a notable 27.9% of dry cleaners operated at a loss in 2010. Consequently, the number of industry establishments is expected to fall at an average annual rate of 0.7% nationally[16]. Based on our experience in the sector for options to be viable, the payback period will need to be less than 1 year.

[12] Ochsner, M. (1998). Pollution Prevention: An Overview of Regulatory Incentives and Barriers. *New York University Environmental Law Journal*, 586-617.
[13] Malloy, T. F. (2001, October 22). Pollution Prevention as a Regulatory Tool in California: Breaking Barriers and Building Bridges. *Evan Frankel Envrionmental Law and Policy Program*. Los Angelas, California, United States of America: University of California Los Angeles.
[14] Malloy, T. F. (2001, October 22). Pollution Prevention as a Regulatory Tool in California: Breaking Barriers and Building Bridges. *Evan Frankel Envrionmental Law and Policy Program*. Los Angelas, California, United States of America: University of California Los Angeles.
[15] ChemTRAC Business Panel, 2012
[16] http://www.prweb.com/releases/2014/06/prweb11908482.htm

The following financial barriers have been identified within the personal laundering sector:

- Alternative technologies require too large of a capital investment[17]
- Pollution prevention cannot be justified in terms of short-term benefits[18]
- Cumulatively, business owners do not understand the financial risk they are taking, and so they do not pursue pollution prevention

While still subject to the same barriers as smaller facilities, commercial laundering companies are more likely to have strategic financial plans as a result of increasing operating costs (water rates, electricity, natural gas), and maintenance (equipment maintenance costs generally rise equipment ages). It is anticipated that these facilities because of higher laundering rates, upgrade equipment more frequently. It is estimated that 10-20% of this segment leases washing equipment[19]. Increased energy efficiency, reduced detergent uses, and high quality laundering are the main drivers for replacement of laundering equipment, often occurring before the natural end of life of the equipment.[20]

2.5 Time/Human Resources

The majority[21] of the sector employs less than 5 people, and most are expected to be owner-operated. As a result, the owners are heavily time-invested in their day-to-day survival, and general management of the company. Resources available to investigate pollution prevention are little to none.

The following time/human resources have been identified within the sector:

- Owner-operators have very little time to research pollution prevention opportunities.
- Facilities employ a small workforce,[22] and so committing employees to learn a new skill relating to new cleaning technologies or best management practices can result in an inability to complete jobs
- Transitional challenges, learning new equipment programming, improper installation of equipment[23]

[17] Oregon Department of Environmental Quality. (2015, October 19). *Impediments Affecting Dry Cleaner Statute Implementations*. Retrieved from Oregon Department of Air Quality Website: http://www.deq.state.or.us/lq/cu/drycleaner/impediments.htm
[18] Ochsner, M. (1998). Pollution Prevention: An Overview of Regulatory Incentives and Barriers. *New York University Environmental Law Journal*, 586-617.
[19] Discussions with Bruce Miller, VP, CSC ServiceWorks Canada. October 2015.
[20] http://unimac.com/Products/why-replace-with-unimac/
[21] From the 2013 reporting year ChemTRAC data, more than 90% of facilities in the sector employ 5 people or less.

[22] Ibid.
[23] Sinshiemer, et al. *Viability of Professional Cleaning as Pollution Prevention Alternative to Perchloroethylene Dry Cleaning.* 2007

Commercial laundering facilities are subject to the small barriers, although are better positioned as a result of their increased workforce, and sub-specialization to have potential resources to allocate to studying P2 initiatives. As labour costs can account for 50% of the operational costs of commercial laundering operations, it is anticipated that viable businesses are operated lean[24].

2.6 Organizational

The organizational barriers differ greatly between the personal and commercial laundry segments. The personal laundry segment is represented by a diverse group of owner/operators. As a result, many languages are spoken, and communication across these language barriers can be difficult, especially for technical topics that are not traditionally covered in language schools. A notable association with the dry cleaning industry in Toronto is the Korean Dry Cleaning Association. The commercial laundry segment is not anticipated to have significant language barriers, but rather organizational barriers exist between various layers of management from operations to corporate management

The following organizational barriers have been identified within the sector:

- Communication can be difficult within the industry because of the cultural diversity represented[25]
    - Personal cleaners
- Changing the cleaning process can require a long chain of approvals, and getting buy-in at all required levels to implement P2 initiatives can be difficult[26]
    - Commercial launderers

2.7 Market

Within the personal laundry segment, the dry cleaning industry has consistently declined over the past five years, with an annual decline of 0.7%, as dry cleaning services are highly discretionary and consumers held off on dry cleaning services. However, the economic recovery has slowed declines in recent years. Nevertheless, the growing popularity of casual clothing and dry cleaning alternatives have siphoned industry demand and will continue to do so in the next five years.[27] Within the personal laundry segment, convenience is listed as the main consideration for customers when selecting a business.[28]

[24] http://unimac.com/Products/why-replace-with-unimac/
[25] One of the major industry associations is the Korean Dry Cleaning Association, communicating mostly and sometimes exclusively in Korean
[26] Ochsner, M. (1998). Pollution Prevention: An Overview of Regulatory Incentives and Barriers. *New York University Environmental Law Journal*, 586-617.
[27] IBISWORD, "*Dry Cleaners in Canada: Market Research Report"*, March 2015
[28] Ibid

Considerations such as proximity to place of residence, work, and turnaround time are considered the primary drivers along with cost in influencing a customer's decision.

There is also confusion by both the industry, and consumers over what constitutes "green cleaning". Around Toronto, the use of terms such as "organic", "natural", "eco", and GreenEarth Solvent have been seen in numerous dry cleaning shops.[29] Neither of which is guaranteed to be non-toxic. GreenEarth Solvent, which was originally promoted as a green alternative to perchloroethylene has now been listed as a potential carcinogen from a joint Environment Canada / Health Canada study.[30]

Further adding to customer confusion is garment labels which list "Dry Clean" or "Dry Clean Only".

The owner/operator of dry cleaning facilities does not receive extensive training to build a knowledge of the cleaning machines, and as a result, they become dependent on the manufacturers of these machines for information, or service companies which repair them on an as needed basis.

The following market barriers have been identified in the sector:

- Manufacturers of dry cleaning systems do not offer alternative technologies. As a result, business owners do not want to end dealer relationships or do not know who to contact.[31]
- Manufacturers are the main source of technical information for small business owners, and do not make information about alternative technologies as readily available as for dry cleaning.[32]
- The use of terms like "organic", and "natural" confuse both industry and the customer into what is truly a "green solution".
- Customers prioritizing convenience, and price in selection of service provider. Not willing to pay for more environmental friendly technologies.

2.8 **Technological**

As mentioned in the market barriers, operators of personal laundry facilities do not receive extensive training, with their roles limited to operating purchased equipment, and dispensing approved chemicals. As a result, a fundamental understanding of the cleaning process and opportunities for improvement by pollution prevention are missed. Additionally, learning how to use new, alternative technologies as part of

[29] https://nowtoronto.com/lifestyle/ecoholic/busting-organic-dry-cleaners-and-getting-your-boss-off-suvs/
[30] Screening Assessment for Decamethycyclopentasiloxne. Environment Canada, Health Canada. 2008
[31] Malloy, T. F. (2001, October 22). Pollution Prevention as a Regulatory Tool in California: Breaking Barriers and Building Bridges. *Evan Frankel Envrionmental Law and Policy Program*. Los Angelas, California, United States of America: University of California Los Angeles.
[32] Ibid.

a pollution prevention approach can have a steep learning curve, and operators will not feel confident using these technologies, especially if additional techniques are required for pre-treating, and finishing.

Personal laundry service facilities are also located in small outlets where real estate can be expensive. Pollution prevention technologies such as wet cleaning, requiring the use of both a washer and dryer, as well as wastewater treatment equipment, which require space which is not unavailable in the facility.

The following barriers have been identified in the sector:

- Operators are not confident in operating alternative technologies[33]
- Lack of physical space in the facility to implement P2 initiatives
- Pollution prevention technologies are not compatible with existing equipment, or the owner/operators do not understand how to make them compatible

2.9 **Regulatory**

The personal laundry services industry is heavily regulated. Federally, Environment Canada has SOR/2003-79: Tetrachloroethylene (Use in Dry Cleaning and Reporting Requirements) which sets limitations on the use of Tetrachloroethylene, as well as the sale of tetrachloroethylene unless the dry cleaning machine:[34]

(*a*) uses the same drum for the washing, extraction, drying and aeration cycles;

(*b*) has an integral refrigerated condenser that recovers tetrachloroethylene vapour in the recirculated air from the drum of the machine;

(*c*) prevents tetrachloroethylene vapour in the drum from being vented into the atmosphere during the washing, extraction, drying and aeration cycles;

(*d*) has an integral tetrachloroethylene-water separator that recovers tetrachloroethylene from waste water;

(*e*) has a manufacturer's design rating for tetrachloroethylene consumption equal to or less than 10 kg or 6.2 L of tetrachloroethylene per 1000 kg of clothing cleaned or, alternatively, was installed or in use prior to August 1, 2003; and

[33] Malloy, T. F. (2001, October 22). Pollution Prevention as a Regulatory Tool in California: Breaking Barriers and Building Bridges. *Evan Frankel Envrionmental Law and Policy Program*. Los Angelas, California, United States of America: University of California Los Angeles.
[34] http://laws-lois.justice.gc.ca/eng/regulations/SOR-2003-79/page-1.html#h-3

(*f*) is operated within a dry-cleaning facility that is equipped with

(i) a tetrachloroethylene-impermeable secondary containment system encompassing at least the entire surface under each dry-cleaning machine, tank or other container containing tetrachloroethylene, waste water or residue and capable of containing at least 110% of the capacity of the largest tank or container within the containment system, and

(ii) tetrachloroethylene-resistant drain plugs that are readily available to seal all floor drains into which tetrachloroethylene, waste water or residue may flow in the event of a spill

Owners of dry cleaning establishments in Ontario are subject to O. Reg 323/94 – The Dry Cleaners Regulation, which requires dry cleaning establishments to have at least one employee on staff certified in the Ministry of Environment and Climate Change (MOECC) sanctioned course. Certification is good for 5 years, at which time re-certification is required. The course is currently taught at Seneca College[35]. The program outcomes listed on Seneca's website include:

- Meet the requirements of Ontario Regulation 323/94 by operating dry cleaning equipment in ways to manage contaminants and wastes related to dry cleaning operations and to minimize their discharge into the natural environment
- Implement procedures that meet the requirements of other federal, provincial and municipal regulations pertaining to the environment
- Monitor and identify opportunities to improve the efficiency of water, energy and solvent use in the operations of your establishment
- Explore alternative techniques for improved environmental performance
- Implement good environmental management practices

It should be noted that this course also covers the City of Toronto Municipal Code Chapter 423: Environmental Reporting and Disclosure by-law.

Other jurisdictions have reported negative impacts of increased regulations, which can create the following barriers:

- Regulations requiring specific reporting requirements can discourage looking beyond compliance to multi-media solutions. This can be due to a set amount of time or human resources allotted to

[35] http://www.senecacollege.ca/ce/environment/environ-sustain/dry-cleaners-environmental-management.html

environmental management, and current regulations that are not focused on investigating new pollution prevention practices consume this time.[36]

- Regulations requiring pollution control equipment can consume the budget for environmental projects, causing pollution prevention to be overlooked.[37]

3.0 POLLUTION PREVENTION OPPORTUNITIES

The followings have been identified as potential P2 options for facilities:

3.1 Wet Cleaning

The wet cleaning process eliminates the use of perchloroethylene, and other VOC's as the washing solvent, and replaces it with water combined with detergent. The technology is highly effective as there are no persistent or toxic impacts known to the environment involved with wet cleaning[38]. The only major difference in operating processes between wet cleaning and dry cleaning is the selection of detergents and cycles dependent on stains and garment type.[39]

The cost of wet cleaning machines vary greatly depending on desired performance. In estimating the cost, it is important to include the cost of detergents, spot cleaners, wet cleaning machines, tensioning equipment, and drying equipment. Tensioning equipment is used to maintain the structure of garments such as jackets. Typical cost ranges of the components of these machines are stated in Table 2.

Table 2 - Cost of Wet Cleaning[40]

	Detergent Dispensing	**Wet Clean Washer**	**Wet Clean Dryer**	**Tensioning Equipment**	**Total**
Cost (USD)	$50 - $1,500	$10,000 – $22,000	$5,000 - $20,000	$7,500 - $20,000	$22,550 - $63,500

Professional wet cleaning uses considerably less electricity, costs less, and can operate a lesser cost per pound cleaned that conventional perchloroethylene dry cleaning. A comparison of costs is provided in Table 3. The average cost is calculated based on the average of all options on the market.

[36] Ochsner, M. (1998). Pollution Prevention: An Overview of Regulatory Incentives and Barriers. *New York University Environmental Law Journal*, 586-617.
[37] Ibid.
[38] New York Pollution Prevention Institute. (2013). *Professional Wet Cleaning Implementation Guide.* Rochester: Rochester Institute of Technology.
[39] Ibid.
[40] Sustainable Technology & Policy Program. (2013). *Equipment Report: Professional Wet Cleaning.* Los Angeles: University of California Los Angeles.

Table 3 - Cost Comparison of Perchloroethylene Dry Cleaning to Professional Wet Cleaning[41]

Cleaning Option	Average Installed System Cost	Average Cost for first 5 years of Dry Cleaning Facility	Cost per pound Cleaner	Average Natural Gas Usage per 100 pounds cleaned (therms)	Average Electricity Usage per 100 pounds cleaned (kWh)
Perchloroethylene Dry Cleaning	$52,000	$27,376	$0.63-$1.94 (avg. $1.02)	12	26.6
Professional Wet Cleaning	$47,000	$20,926	$0.57-$1.32 (avg. $1.10)	9	9.3

(*it should be noted that Table 6 of Environment Canada's Operation GreenClean identified that wet cleaning resulted in operating costs that were approximately 50% than that of dry cleaning)

The US EPA developed a detailed workbook to assist dry cleaning facilities to determine the costs associated with conversion from dry cleaning to wet cleaning, and a partial conversion to wet cleaning (one dry cleaning plus one wet cleaning machine, and dryer).[42]

3.2 Cleaning Chemical Substitution

Alternative chemicals to perchloroethylene can be used to reduce the toxicity of emissions from a dry cleaning facility. Common substitutes raise new dangers such as high flammability and health effects similar and different to those of perchloroethylene, although the toxicity of the chemicals presented is thought to be less. The environmental and health impacts of common perchloroethylene substitutes are presented in Table 4.

Table 4 - Impacts to the Environment and Human Health of Chemical Substitution[43]

Cleaning Option	Environmental Impacts	Potential Human Health Impacts
Perchloroethylene Dry Cleaning	Persistent in water, soil, air; very persistent in sediment, unknown aquatic toxicity	Affects central nervous system, irritates eyes, skin, respiratory tract
Acetal (Solvon K4)	Persistent in sediment, toxic to the aquatic environment	No known impacts
Glycol Ether (Rynex®)	May be toxic to the aquatic environment	Causes serious eye damage
Hydrocarbon[44]	Varies dependent on type used	Affects central nervous system, irritates eyes, skin, respiratory tract

[41] New York Pollution Prevention Institute. (2013). *Professional Wet Cleaning Implementation Guide.* Rochester: Rochester Institute of Technology.
[42] Making the Most of Your Cleaning Business. Dry Cleaning/Wet Cleaning Case Study, and Financial Analysis Workbook. US EPA, 1997.
[43] New York Pollution Prevention Institute. (2013). *Professional Wet Cleaning Implementation Guide.* Rochester: Rochester Institute of Technology.
[44] Includes DF-2000 Fluid, Sasol LPA I42, Pure Dry, Eco Solv, Shell Sol I40 HT, Stoddard Solvent

Cleaning Option	Environmental Impacts	Potential Human Health Impacts
Liquid Carbon Dioxide	Not persistent or toxic to the aquatic environment	Persistent in air, irritates skin, eyes; causes frostbite
n-Propyl Bromide (DrySolv®)	Persistent in sediment, very persistent in air, toxic to the aquatic environment	Irritates eyes, skin, respiratory tract; affects central nervous, reproductive, & respiratory systems, kidney, & liver
Siloxane D5 (GreenEarth®)	Persistent in soil and air, very persistent in sediment, toxic to the aquatic environment	Mild eye irritation

Dry cleaning systems are unique based on the cleaning agent used. Some perchloroethylene systems can be retrofitted for use of a new chemical, reducing cost significantly. The cost of these systems, as well as the usage of natural gas and electricity are presented in Table 5.

Table 5 - Cost Comparison of Perchloroethylene Dry Cleaning to Various Alternative Chemicals Dry Cleaning[45]

Cleaning Option	Average Installed System Cost	Average Cost for first 5 years of Dry Cleaning Facility	Cost per pound Cleaner	Average Natural Gas Usage per 100 pounds cleaned (therms)	Average Electricity Usage per 100 pounds cleaned (kWh)
Perchloroethylene Dry Cleaning	$52,000	$27,376	$0.63-$1.94 (avg. $1.02)	12	26.6
Acetal (Solvon K4)	$50,000 -$100,000	Unavailable	Unavailable	Less than perc	Less than perc
Glycol Ether (Rynex®)	$56,000	$26,220	$1.14	Unavailable	Unavailable
Hydrocarbon[46]	$59,000	$28,000 avg.	$0.73 - $1.02 (avg. $0.88)	13.1	35.5
Liquid Carbon Dioxide	$140,000	$58,881	$1.40	7.3-14.2	30.9
n-Propyl Bromide (DrySolv®)	$40,000 - $60,000[47]	Unavailable	Unavailable	Unavailable	Unavailable
Siloxane D5 (GreenEarth®)	$61,000	$32,718	$1.08-$2.33 (avg. $1.71)	13.4	54.2

3.3 Spill Containment and Prevention

While regulated by Environment Canada, dry cleaners compliance with spill containment requirements are anticipated to be low[48]. Many jurisdictions in North America have also identified spill containment

[45] New York Pollution Prevention Institute. (2013). *Professional Wet Cleaning Implementation Guide.* Rochester: Rochester Institute of Technology.
[46] Includes DF-2000 Fluid, Sasol LPA I42, Pure Dry, Eco Solv, Shell Sol I40 HT, Stoddard Solvent
[47] Costs vary greatly depending if a new system is installed or an existing system is retrofitted
[48] Discussions with P. Payne of Environment Canada, 2015.

and prevention as a pollution prevention opportunity because it is relatively inexpensive to implement while reducing avoidable discharge of perchloroethylene, and other toxic chemicals.

A number of methods can be used to prevent spills or the ability of contaminants to volatilize while exposed to air, including:

- Closed loop, controlled delivery of cleaning chemicals
- Ensuring tight lids are used in chemicals storage
- Using spigots and pumps to dispense chemicals instead of pouring
- Having a chemical spills cleanup kit onsite, and located in a visible location
- Conduct a regular maintenance program including record keeping of chemical levels to ensure that leaks are found, fixed, or avoided

3.4 Electrical Dryers

Conversion from natural gas to electric dryers and water heaters would eliminate 100% of the NO_x emissions associated with those operations at the facility. Electric heating equipment generally has a slower response time when heating up, and is less attractive from a financial perspective because of the prevailing market prices of natural gas versus electricity. Given a weak business case, this option has not been promoted by other jurisdictions.

3.5 Dryer Exhaust Filtration

The use of inline lint filters can reduce particulate matter emissions between 80-99.5% of particulate from commercial laundry dryers. Because of risk of fire hazards associated with lint build-up, the vast majority of commercial dryers supply systems come with integral lint filters. Installation of further filtration technologies does not provide any further cost savings to the facility, as such, has not been advocated as an element of pollution prevention or control programs in other jurisdictions.