

# Pacific Gas and Electric Company

## Emerging Technologies Program

### Supplement to Application Assessment Report # 0609

#### Efficient Electric Hand Dryers San Francisco, CA

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# Efficient Electric Hand Dryers Evaluation Report

## Table of Contents

0.0	Executive Summary .....	1
1.0	Evaluation Summary .....	2
2.0	Technology Overview.....	3
2.1	Technology Description .....	3
2.2	Where Efficient Electric Hand Dryers are Applicable .....	6
2.3	Market Readiness (Current Status) .....	6
2.4	Comparison to Related Technologies.....	6
3.0	Market Opportunity, Benefits, and Cost Effectiveness .....	8
3.1	Market Opportunity.....	8
3.2	Average System Energy and Demand Savings .....	8
3.3	Other System Benefits .....	10
3.4	Demand Response Capability .....	10
3.5	Cost Effectiveness .....	10
4.0	Design Considerations .....	11
4.1	Implementation Issues .....	11
4.2	System Persistence Risks .....	11
4.3	Codes and Standards.....	11
5.0	Energy Savings Opportunity in PG&E's Territory .....	12
6.0	References.....	13

This evaluation report is a supplement to Report #0609, *Marketable Technologies for the Hospitality Segment*. The full list of supplements follows:

- Occupancy-Based Guestroom Controls
- Hotel Bathroom Lighting Controls
- Laundry Ozone Generators
- Demand Controlled Ventilation
- Card-Key Guestroom Controls
- Efficient Electric Hand Dryers

## List of Tables

Table 1-1: Evaluation Summary .....	2
Table 3-1: Estimated Energy Savings from Calculations .....	9
Table 5-1: Potential Market Impact .....	12

## List of Figures

Figure 2-1: XLERATOR® Hand Dryer (source: <a href="http://www.exceldryer.com">http://www.exceldryer.com</a> ) .....	4
Figure 2-2: Mitsubishi Jet Towel (source: <a href="http://www.mitsubishijettowel.com">http://www.mitsubishijettowel.com</a> ) .....	5
Figure 2-3 : Dyson Airblade (source: <a href="http://www.dysonairblade.com">http://www.dysonairblade.com</a> ).....	6

## **Preface**

The San Francisco office of Architectural Energy Corporation (AEC), an energy and environmental research, development, and design consulting firm headquartered in Boulder, Colorado, prepared this document for PG&E. The report was contributed to by Asim Tahir, and reviewed for technical quality and responsiveness by Erik Kolderup and Donald Frey. Wayne Krill of PG&E provided guidance and input as project manager.

Please note that product and manufacturer names used in this report are proprietary and may be trademarked and copyrighted.

## **Acknowledgements**

This project would not have been possible without the ongoing assistance of Steve Hutchison, PG&E's Hospitality Segment Program Manager and of Sharon Harris, Account Services Manager for major hotels.

## 0.0 Executive Summary

Manufacturers of **various electric hand dryers on the market claim reduced energy consumption and faster drying time compared to traditional electric hand dryers.** The two products available in the United States market that were studied for this report are the XLERATOR Hand Dryer by Excel Hand Dryers and the Jet Towel manufactured by Mitsubishi Electric and distributed in the U.S. by PACARC, LLC.

For both of these products the **payback depends heavily on how often the unit is used per day and whether it is replacing an existing electric hand dryer or replacing paper towels.** If a product is replacing paper towels, there may be overall cost savings but an increase in electric energy consumption and demand.

Both of these products show the **most promise for installations in hotels with meeting spaces and conference facilities where the existing bathroom load is high, or for employee restrooms.**

The XLERATOR costs \$620 per unit and can save 2,372–11,860 kWh annually, depending on frequency of use. **The payback ranges between 0.4 and 2.2 years.**

The Mitsubishi Jet Towel costs \$1,500 per unit and can save 2,646–13,228 kWh annually, depending on frequency of use. **The payback ranges between 0.9 and 4.7 years.**

**No existing PG&E program offers rebates specifically for highly efficient electric hand dryers.** Although they can qualify for incentives under SPC programs, it might be more effective to offer flat rate rebates such as those offered for efficient kitchen appliances. With an assumed rebate of \$200 per unit the payback range for the XLERATOR drops to between 0.3 and 1.5 years; and for the Jet Towel, to between 0.8 and 4.1 years.

## 1.0 Evaluation Summary

There are various electric hand dryers on the market that claim reduced energy consumption and faster drying time compared to traditional hand dryers. The two products available in the United States market are the XLERATOR Hand Dryers by Excel Hand dryers and the Jet Towel manufactured by Mitsubishi Electric and distributed in the U.S. by PACARC, LLC. The paybacks for both products are similar, and depend heavily on how often the units are used per day and whether they are replacing existing hand dryers or replacing paper towels. If an efficient electric hand dryer replaces paper towels, there will be overall cost savings but an increase in electric energy consumption and demand. Both of these products show the most promise for installations in hotels with meeting spaces and conference facilities where the existing bathroom load is high. They also show promise for use in employee restrooms. The XLERATOR was introduced to the market in 2002 and generated much interest. The Jet Towel has been in use in Japan for over 10 years and has recently been introduced to the U.S. market by PACARC LLC. At an estimated retail cost of \$1,765 per unit it is almost three times as expensive as the XLERATOR (\$620); it also generates higher savings.

**Table 1-1: Evaluation Summary**

Criteria	Score (1 = poor, 10 = excellent)	Notes
Speed of Implementation	8	A simple off-the-shelf product that can be easily installed by in-house staff.
Focus on Products	8	Product is well-defined and benefits are readily understood.
Demand Reduction	5	2-3 kW demand reduction per unit if replacing a standard dryer. Demand will increase if existing hand drying method is paper towels.
Cost Effectiveness	5	Significant initial cost with payback dependent upon frequency of use. Retail cost ranges from \$620–\$1,765 for the products with significant discounts available for volume purchase. Payback depends on frequency of use and ranges from 0.4 to 4.7 years for the products
Persistence	7	Savings should persist over product's life.
Customer Satisfaction	6	Potential risk for guest dissatisfaction, as the unit is significantly different from standard dryers
Supply	3	Specific product only offered by one supplier. Other efficient products are available but do not compare favorably with Jet Towel
Market Size	5	Applicable to the majority of hotels. Will be ideal for hotels with high traffic restrooms in common areas. For example, those with event space or conference facilities.
Magnitude of Energy Savings	5	2,000–13,000 kWh annually per unit depending on usage.
PG&E Program	7	Can be offered with simple rebates like other off-the-shelf efficient products.
Existing Installations	3	Numerous installations worldwide. Many existing U.S. installations.

## 2.0 Technology Overview

This report summarizes the status and potential benefits of efficient electric hand dryers that use less energy than standard models and have faster drying time. Conventional electric hand dryers use heated air at moderate velocity to disperse and evaporate water from hands being rubbed together. These dryers require up to 45 seconds to completely dry hands. Many facilities tend to use only paper towels since hand dryers don't provide adequate drying in a reasonable amount of time. Some facilities will have paper towels in addition to hand dryers. Janitorial staff needs to restack paper towels and clear the waste paper bins periodically. Most of the luxury hotels will use high quality towels with more fiber content and a lower percentage of recycled materials. Conventional dryers also blow off the water from the user's hands onto the floor or on to the user's clothing, which may be an unsatisfactory characteristic of their operation.

### 2.1 Technology Description

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Three major products are discussed in this report. As mentioned above, two of them are currently available in the U.S. The third, the Dyson Airblade, is not yet available in the U.S. market but is expected to be offered here in future. All have slightly different positive and negative attributes. The XLERATOR and Jet Towel both report that they are ADA compliant.

#### 2.1.1 XLERATOR Hand Dryer

The XLERATOR Hand Dryers are similar in design to conventional dryers. Three models are offered. The only difference between them is the finish on the cover. Where the XLERATOR differs from conventional dryers is in the way it operates. It blows air at a higher temperature than conventional dryers (135°F) at higher speed (16,000 linear feet per minute), removing some of the water from the user's hands and evaporating the rest. This combined strategy helps to cut down the drying time to about 15 seconds, or less than half the time it takes to dry hands with a conventional dryer. It also draws less power (1,370 Watts) than conventional dryers. The removed water droplets may be blown off the user's hands on to the user's clothes or on to the floor. These are both undesirable aspects of this dryer that are addressed by other models.



**Figure 2-1: XLERATOR® Hand Dryer (source: <http://www.exceldryer.com>)**

### **2.1.2 Jet Towel**

The operation of the Jet Towel is a significant departure from the design of conventional hand dryers. It works with ambient air without any heating, saving significantly on the power required. It requires only 650 Watts to operate. Rather than holding hands stationary in the path of the airflow, hands are inserted flat into the Jet Towel and slowly withdrawn, ensuring that the maximum surface area is dried. The high-speed Jet Towel's strong air current removes water from both sides of the hands with a powerful gust measuring close to 18,000 linear feet per minute. Water blown off the hands is collected in the unit's drain tank, so the floor and the user's clothes stay dry.



**Figure 2-2: Mitsubishi Jet Towel (source: <http://www.mitsubishijettowel.com>)**

The water collection tank needs to be periodically emptied, which can be done at the same time the restroom is being cleaned. A disadvantage is that high velocity ambient air sometimes leaves the hands feeling cold. Feedback from existing installations has been positive. It also generates less noise than the XLERATOR or other conventional dryers.

### **2.1.3 Dyson Airblade**

The Dyson Airblade is not yet available in the U.S. market but is expected to be offered in the near future. Currently it is only being offered in the U.K. and Europe. It is mentioned here for comparison with the Mitsubishi Jet Towel as it appears to be very similar in design and operation. However it is not as efficient as the Jet Towel. The Dyson Airblade forces unheated air through a 0.3mm gap along its entire 9-inch width at over 35,000 linear feet per minute to create a high velocity curtain of air that wipes hands dry in just 10 seconds. Where this differs significantly from the Jet Towel is how the collected water is handled.

Standard hand dryers simply blow the bacteria-laden water from wet hands onto the floor or, worse still, on to users' shoes and clothes.

The Airblade uses an iodine resin micro filter to process the collected waste water from drying hands and removes 99.9% of its bacteria. This disinfected water is then atomized using an oscillating crystal plate and released harmlessly back into the room as an invisible mist. Therefore, no water reservoir has to be emptied each time the bathroom is cleaned.

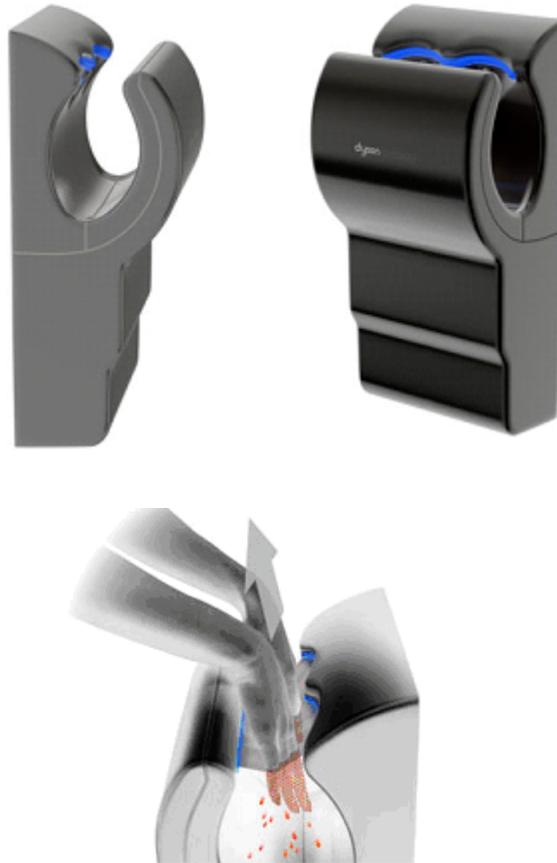


Figure 2-3 : Dyson Airblade (source: <http://www.dysonairblade.com>)

## 2.2 Where Efficient Electric Hand Dryers are Applicable

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Efficient electric hand dryers can be used in lobby restrooms, employee restrooms, and other high traffic restrooms in the hospitality industry. The Jet Towel and Airblade are also applicable for installation in hand washing areas in kitchens due to their sanitizing features. These models have also been used in healthcare and other applications with strict sanitary requirements.

## 2.3 Market Readiness (Current Status)

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Since all the products considered are based on proprietary technologies, the availability of each product will be limited by the lead times and production capacity of the individual suppliers. The Dyson Airblade is not yet available in the U.S.

## 2.4 Comparison to Related Technologies

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The XLERATOR is based on existing technology with improvements in air velocity and temperature. Users have reported it to be noisier than standard hand dryers at about 90 db. The perceived drawback is that it can atomize the water so that the accompanying germs diffuse into

the air where germs can spread farther. Standard hand dryers also have the same perceived drawback.

The Jet Towel is a proven product with 10 years of real-world operation in Japan. The main drawback is the need to empty the water collection reservoir periodically. The manufacturer claims that it needs to be emptied once a week, although a 35-employee restaurant reported that it had to be emptied at least daily. There is a risk of the reservoir overflowing in extremely high traffic restrooms, creating hazards due to slippery, wet floors. At 60 db, it is much quieter than the XLERATOR.

The Airblade filters the air before it blows it on users' hands, and runs the water through a cleansing system before atomizing and releasing it in the space. This may reduce the risk of spreading germs. This product is not yet available in the U.S.

## **3.0 Market Opportunity, Benefits, and Cost Effectiveness**

### **3.1 Market Opportunity**

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These products can be used in lobby restrooms, employee restrooms, and other high traffic restrooms in the hospitality industry. The Jet Towel and Airblade are good choices for installation in hand washing areas in kitchens due to their sanitizing features.

### **3.2 Average System Energy and Demand Savings**

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There are no existing third-party field studies for these products. The energy savings presented in this report are estimated using the power requirements of the unit reported by the manufacturers and assumptions about the frequency of use. The total energy savings are provided by both the reduction in power to operate the dryers and the reduced time required to dry hands. Frequency of use will vary with different installation locations so cost effectiveness is difficult to calculate. To account for this uncertainty, energy savings were calculated for various usage levels for comparison purposes.

It will be beneficial to conduct further field studies of this technology where the different variables can be quantified to generate more accurate estimates of energy and cost savings.

The unit costs used are based on retail prices. Significant discounts are offered by manufacturers for volume purchases. The payback period will be lower if units are ordered in volume.

There are currently no specific PG&E incentives that apply to efficient electric hand dryers. The results in the following table illustrate the economic impact of an incentive of \$200 per unit. The information in Table 3-1 shows that the more a dryer is used, the faster the efficient models will pay back. The paybacks for the less expensive models are less than two years (@ 400 uses per day), even without the rebate.

**Table 3-1: Estimated Energy Savings from Calculations**

	Standard Hand Dryer	XLERATOR® Hand Dryer	Mitsubishi Jet Towel	Dyson Airblade
<b>Total Power Draw (kW)</b>	3.57	1.37	0.65	1.6
<b>Drying time per use (sec)</b>	37.5	12.5	5.5	10
<b>Installation Cost (\$)</b>	\$300	\$620	\$1,500	\$1,100
<b>Incentive / Rebate (\$)</b>		\$200	\$200	\$200
<b>Installation Cost w/ rebate(\$)</b>		\$420	\$1,300	\$900
<b>Number of times used/day</b>	<b>Energy Consumed per Day (kWh)</b>			
200	7.45	0.95	0.20	0.89
400	14.89	1.90	0.40	1.78
600	22.34	2.85	0.60	2.67
800	29.79	3.79	0.79	3.56
1000	37.24	4.74	0.99	4.44
<b>Number of times used/day</b>	<b>Annual Energy Savings (kWh)</b>			
200		2,372	2,646	2,394
400		4,744	5,291	4,787
600		7,116	7,937	7,181
800		9,488	10,583	9,575
1000		11,860	13,228	11,969
<b>Number of times used/day</b>	<b>Annual Cost Savings (Assuming \$0.12/kWh)</b>			
200		\$285	\$317	\$287
400		\$569	\$635	\$574
600		\$854	\$952	\$862
800		\$1,139	\$1,270	\$1,149
1000		\$1,423	\$1,587	\$1,436
<b>Number of times used/day</b>	<b>Payback in Years</b>			
200		2.2	4.7	3.8
400		1.1	2.4	1.9
600		0.7	1.6	1.3
800		0.5	1.2	1.0
1000		0.4	0.9	0.8
<b>Number of times used/day</b>	<b>Payback in Years with Rebate</b>			
200		1.5	4.1	3.1
400		0.7	2.0	1.6
600		0.5	1.4	1.0
800		0.4	1.0	0.8
1000		0.3	0.8	0.6

### **3.3 Other System Benefits**

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The biggest impact will be the reduction in consumption of paper towels. This leads to savings on labor and solid waste disposal costs for the customer. The reduction in paper towel consumption will also lead to other environmental benefits.

The quick drying time will also increase user satisfaction, and may allow a reduced number of dryers to be installed. Reducing the number of dryers in a restroom will reduce the first cost, reducing the payback period.

### **3.4 Demand Response Capability**

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Although efficient electric hand dryers do reduce demand compared with standard hand dryers, it is uncertain how 'demand response' will be achieved in these devices unless they are powered from an electric circuit that can be shut down during peak periods. Powering through such a circuit would not be practical, since restroom users would have no way to dry their hands. Also, as sanitary devices, hand dryers probably need to be available full-time. Some peak demand reduction is likely to occur, but would need to be quantified through field experiments.

### **3.5 Cost Effectiveness**

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Estimated retail cost for the XLERATOR hand dryer is about \$620; for the Jet Towel, about \$1,500. Significant discounts are available for volume purchases, which would reduce the payback period.

#### **3.5.1 Factors Affecting Cost Effectiveness**

Although this measure is cost effective, there are several project-specific factors that will impact energy savings.

- **Best Locations** – The efficient hand dryers can be installed in common area restrooms, and in restrooms and hand washing areas where they will be used by employees.
- **Installation Costs** – The cost to install energy efficient hand dryers will be least when replacing an existing electric hand dryer. The cost will be higher when replacing paper or cloth towels, because electrical wiring will have to be connected to each dryer.
- **Hotel Type** – Hotels with significant traffic in public restrooms will have shorter payback periods. Hotels that host conventions, conferences, and other large gatherings are ideal candidates for efficient hand dryers.

## 4.0 Design Considerations

### 4.1 Implementation Issues

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The Jet Towel needs to be hard wired for 220-volt power. It can be easily wall mounted and for areas where wall mounting is not possible it can be securely affixed to an optional pedestal.

The XLERATOR is available for operation with 110/120 volts, 208 volts, 220/240 volts, and 277 volt power supply. A recess kit is available for installations compliant with the ADA.

For bathrooms without existing hand dryers, an extra cost will be required to provide an electrical connection.

### 4.2 System Persistence Risks

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Some customers dislike the unheated air used in both the Jet Towel and Airblade, though comments from users at existing installations are mostly positive

Customers may not initially recognize the Jet Towel or the Airblade as hand dryers, since they do not look like conventional hand dryers. Clearly posted signs can ameliorate that risk. Though the openings for inserting hands are fairly large for both these products, oversize jewelry or watches may interfere with the operation of the dryers and should be removed prior to use.

Care should be taken to remove unusual chemicals or substances from hands before the Jet Towel is used, as these will shorten the product life.

### 4.3 Codes and Standards

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Efficient electric hand dryers are off-the-shelf products and are designed with the applicable electric codes in mind.

The Americans with Disabilities Act (ADA) requires that hand dryers be installed so that the highest operable part is within the reach of a person who uses a wheelchair.

The XLERATOR is available with an optional recess kit that will allow people with disabilities to use the dryer. The Jet Towel can be installed for disabled persons.

## 5.0 Energy Savings Opportunity in PG&E's Territory

The opportunity for energy savings can be estimated based on average energy savings and estimates of installation costs in new construction and as retrofits. Depending on frequency of use, the dryer can save anywhere from 2,300 kWh to 13,000 kWh/year based on the calculated estimates presented in this report.

Assuming 200 uses per day, the average energy savings for all the products are 2,470 kWh/year. The average demand reduction will be close to 2.3 kW. The demand reduction is not sustained for very long, since these units only operate for 15 seconds or less at a time

A potential market impact is shown in Table 5-1, for an assumed 10% market penetration.

**Table 5-1: Potential Market Impact**

National hotel construction estimate	80,000,000	ft <sup>2</sup> per year	CBECS database, table B9, 1990-2000 <sup>1</sup>
California hotel construction estimate	3,809,524	ft <sup>2</sup> per year	Assumption that PG&E territory per capita construction rate is same as national rate
Guestroom construction estimate	2,857,143	ft <sup>2</sup> per year	Assumption that 75% of floor space is guestrooms
Guestroom size	450	ft <sup>2</sup> per year	Assumption used in PIER evaluation for hotel bathroom lighting control <sup>2</sup>
Annual guestrooms added	6,349	rooms / yr	
Retrofit market	12,698	rooms / yr	Assumption that retrofit market is twice that of new construction
Market penetration	10%		
Incentive program length	2	years	
Market size	2,540	rooms	
Common restrooms	100	restrooms	Assumption based on 1 public restroom for every 25 guest rooms
Per dryer energy savings	2,470	kWh	Assumption of one dryer per restroom
Per dryer demand savings	2,300	W	Instantaneous value, not sustained.
Annual PG&E energy savings	247	MWh	Anticipated energy savings which can be achieved, if 10% market penetration is achieved.
Annual PG&E demand savings	77	kW	Anticipated demand reduction which can be achieved, if 10% market penetration is achieved. Assumes that dryer runs 20 seconds out of each minute during peak periods.

<sup>1</sup> U.S. Energy Information Administration, 1999 Commercial Buildings Energy Consumption Survey: Detailed Tables, table B9.

<sup>2</sup> Siminovitch, M. 2003. Performance Analysis of Hotel Lighting Control System. PIER Lighting Research Program. Deliverable 4.2.1b. Contract 500-01-041. California Energy Commission. Aug. 2003.

## **6.0 References**

“Product Review: XLERATOR – The electric hand dryer reinvented” Environmental Building News, Volume 11, Number 1 · January 2002

“Product Review: Mitsubishi Jet Towel Hand Dryer” Environmental Building News, Volume 15, Number 4 · April 2006