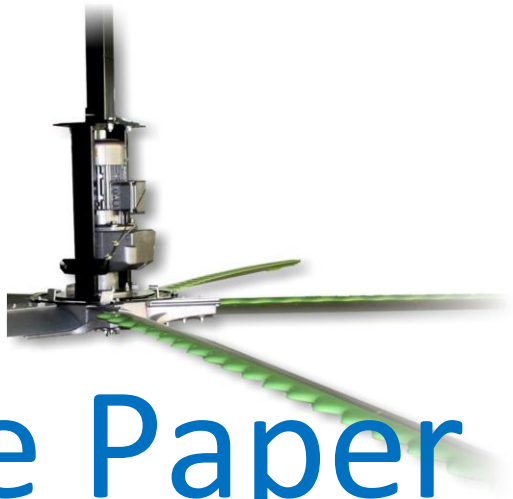
HVLS Fans and Energy Savings

Dubai Case Study



White Paper

This paper is designed to provide insight into a case study of a manufacturing facility in Dubai, UAE. At the 2,500m² air conditioned site, one fan was installed to reduce the energy required to cool employees. This resulted in a 6-month savings of $14,708.00 USD.

Featuring Altra-Air Fans with WhalePower Technology from Envira-North Systems

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The Abstract

In humid and hot climates, building operators struggle with cooling large open spaces. Historically, the space was naturally ventilated and air was circulated to provide some type of comfort to the occupants of the structure. As we have evolved, so have our cooling techniques. These techniques have become very effective in reducing temperatures, but have also become large consumers of electrical power. By utilizing a blend of these new techniques with historically proven methods, a building operator can achieve both effectiveness and efficiency.

The Altra-Air Fan is designed to efficiently circulate large volumes of air in open spaces. The goal is to provide even circulation from wall-to-wall and floor-to-ceiling. In hot climates, by utilizing this technology, the fan produces a column of air which turns at the floor and creates a comfortable non-disruptive breeze for the occupants of the structure. In air conditioned facilities this has proven to reduce energy consumption while maintaining or exceeding previous comfort levels.

This paper is designed to provide insight into a case study of a manufacturing facility in Dubai, UAE. At the 2,500m² air conditioned site, one fan was installed to reduce the energy required to cool employees. This resulted in a 6-month savings of $14,708.00 USD.

Inside TCTI in Dubai after the installation of a 6.1m Altra-Air Fan

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International Sales Manager

April 1, 2013

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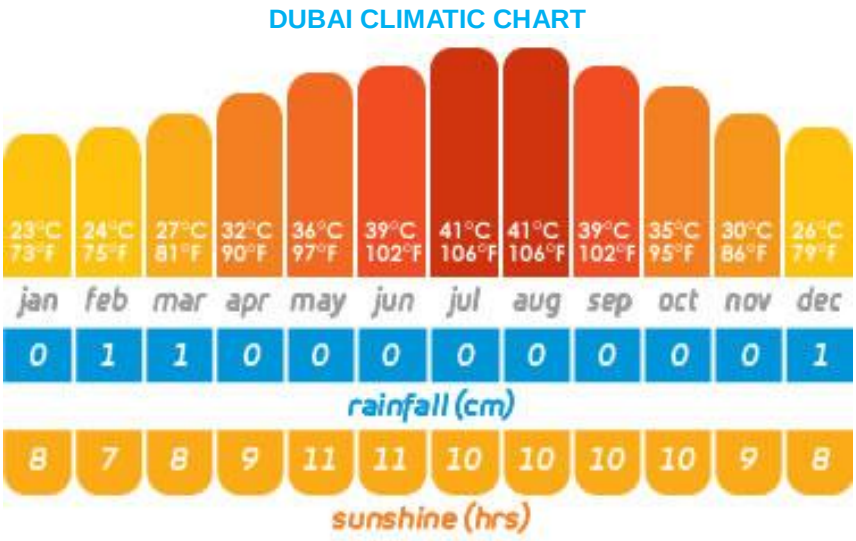
The Challenge

In the Emirate of Dubai climate control companies are thriving. Dubai houses climate specific manufacturing and distribution companies from around the world. Its location provides many advantages to the companies located there. Proximity to major sea and air hubs makes this an ideal centre for many multinational businesses. However, its location also provides unique climatic challenges.



The chart above demonstrates average monthly temperatures in comparison with rainfall and daily sunlight hours.

Due to these climatic challenges, most building owners and operators cool their facilities utilizing large air conditioning units designed to provide relief for occupants while maximizing their productivity. Increasing occupant productivity can generate considerable revenue. However, to improve productivity, energy consumption is increased. These created energy costs can easily offset the additional benefits of increased productivity. Owners and operators are now challenged to provide comfort levels while minimizing costs.

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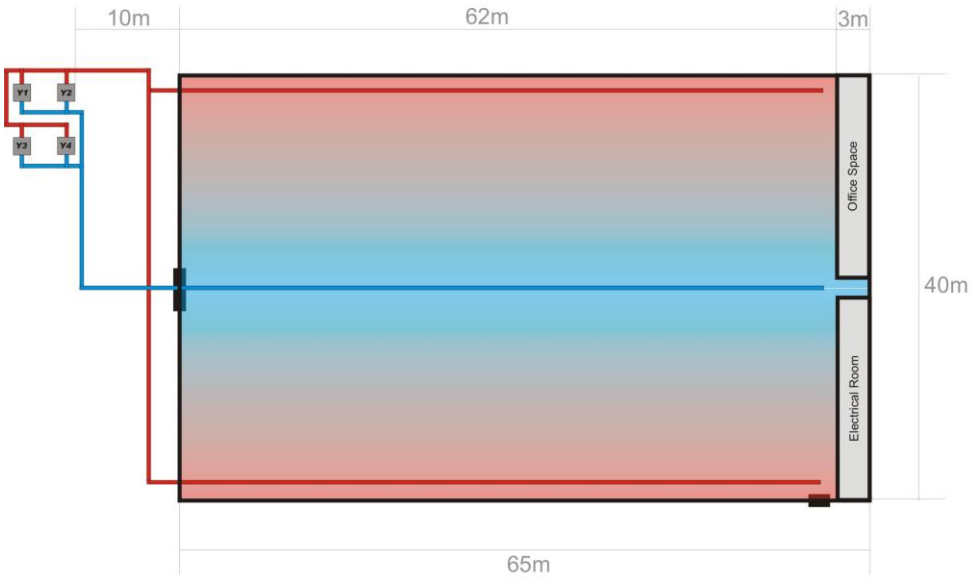
The Situation

Recognizing the climatic challenges in operating a manufacturing facility in Dubai, Trade Circle Technical Industries, a division of Wafi Industrial (TCTI) installed air conditioning in their 2,500m² GRP (glass-reinforced plastic) plant prior to commencement of manufacturing operations. Air conditioning was considered necessary to maintain a consistent temperature for manufacturing purposes and employee comfort.

After identifying high operating costs associated with air conditioning, TCTI was approached by Trimac Inc. (representative of Envira-North Systems in the Middle East) to install a single HVLS fan to increase circulation and minimize air conditioning costs. A decision was made to implement the technology in June of 2012 with the provision that energy consumption be measured and evaluated regularly.

TCTI

Facility Layout



SCHEDULE

Unit No.	Brand	Model	Power
Y1	York Packaged Unit	DMS 480	55kw
Y2	York Packaged Unit	DMS 480	55kw
Y3	York Packaged Unit	DMS 480	55kw
Y4	York Packaged Unit	DMS 480	55kw

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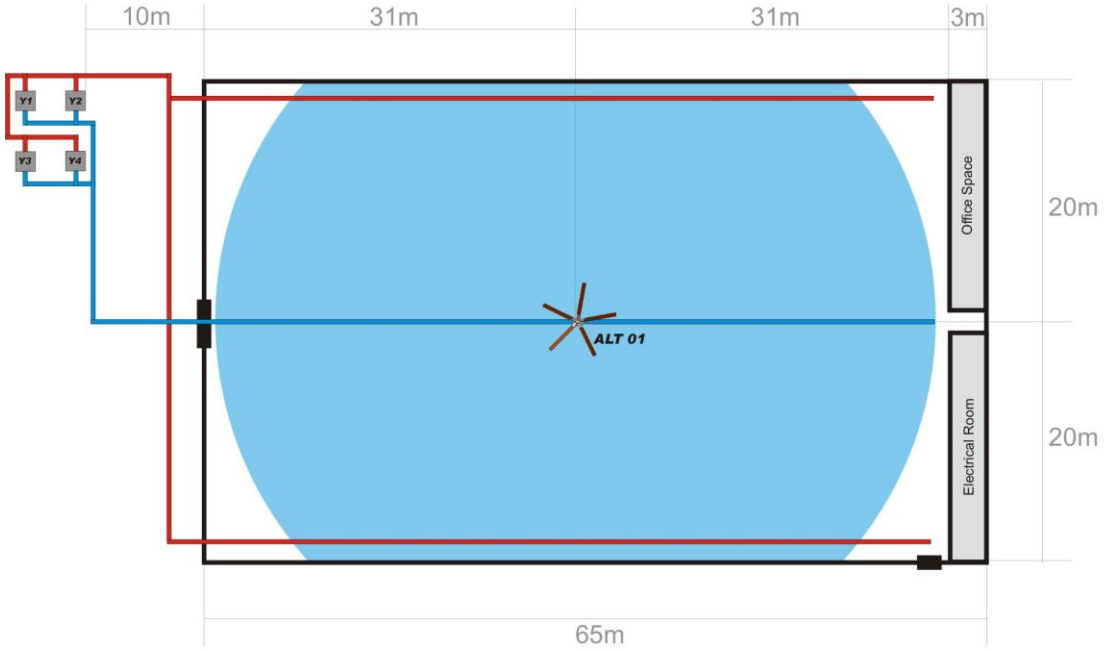
The Solution

Trimac Inc. presented an option to install one 6.1m HVLS ceiling fan to increase distribution of the conditioned air at ground level (where employees are working). The proposal demonstrated the capability of a single 6.1m Altra-Air Fan with WhalePower Technology from Envira-North Systems Limited to increase air flow and create an additional cooling effect of three to four degrees Celsius in the area of influence.

TCTI

Facility Layout



SCHEDULE

Fan No.	Type	Fan Size	Air Movement	Motor Max.	Weight	RPM	dBA
ALT 01	ALTRA-AIR	6.1m (20')	330,030 cfm	1.50kw	140.6 kg	63	63

Coverage Area shown at 60m in diameter

The savings would be created through two avenues; 'Thermostat Settings' and 'Free Cooling'.

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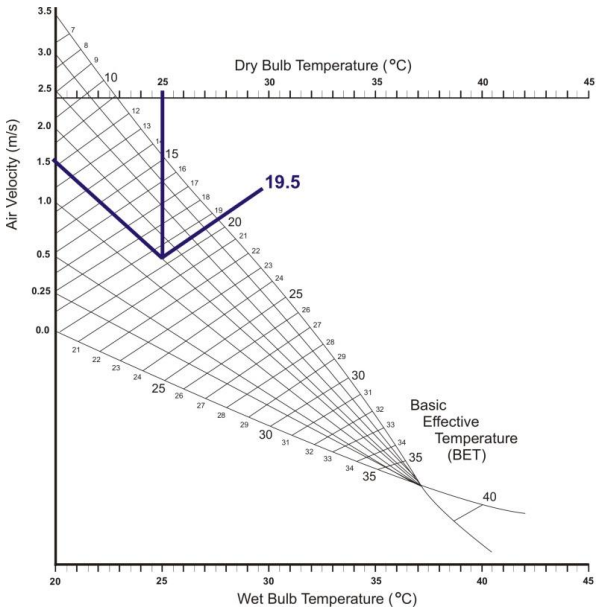
THERMOSTAT SETTINGS

It is commonly accepted that wind chill factor lowers the apparent temperature, making the air feel cooler than it actually is. Thermostat change is achievable by better understanding the 'wind-chill factor' or Basic Effective Temperature (BET) created by HVLS fans.

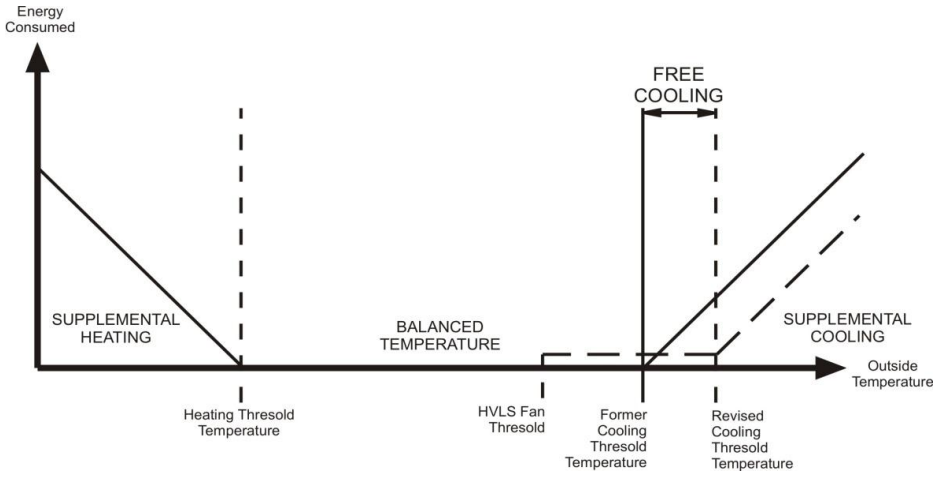


The neighbouring graph examines the relationship between actual air temperature and the velocity at which it is moving. Armed with both these variables, one can successfully determine that a temperature of 25^0C with air moving at a speed of 1.5 meters per second, the BET is less than 20^0C. This creates an environment too cold for occupants, encouraging the operator to increase the temperature set point and create continual savings.

FREE COOLING

Additional savings can be created by adjusting the 'Cooling Threshold' and attaining 'Free Cooling'. Free Cooling is the period of time just before (and after) air conditioning is required. In terms of savings, free cooling is defined by a decrease in annual usage hours created by the capabilities of HVLS fan technology.

The chart below demonstrates how as the temperature increases, energy costs rise. By adjusting your thermostat set point, free cooling is automatically achieved. The cooling threshold is now adjusted to a warmer temperature decreasing usage hours of air conditioning and increasing savings. Free cooling creates even more savings as the temperature decreases from peak summer temperatures. Operating air conditioning units are now required for a shorter period of time.



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The Results

As a standard practice, TCTI tracks electrical consumption via meters. Two meters track electricity consumed by air conditioning and lighting. While examining their consumption, it was noted that a 10% increase in overall production from 2011 to 2012 had occurred. During this increased production, there was no increase in hours of operation and therefore no increase in the lighting load. No other major changes were made during the year (only the additional load from the fan motor was added).

ELECTRICAL COOLING CONSUMPTION – PRIOR TO INSTALLATION									
Month	2011			2012			Differences		
	Temp.	Kwh	Cost	Temp.	Kwh	Cost	Temp.	Kwh	Cost
Jan	21.1	23,047	1,566	20.2 °C	23,503	1,614	- 0.9 °C	455	2 %
Feb	21.6	24,732	1,741	21.1 °C	24,182	1,684	- 0.5 °C	- 550	- 2 %
Mar	23.9	23,571	1,621	24.0 °C	21,116	1,280	+ 0.1 °C	- 2,455	- 10 %
Apr	29.0	25,947	1,867	27.8 °C	29,375	2,090	- 1.2 °C	3,428	13 %
May	33.1	29,142	2,197	33.8 °C	36,379	2,770	+ 0.7 °C	7,237	25 %
TOTAL	**25.7°C ***	**126,439**	**$ 8,992**	**25.4°C ***	**134,554**	**$ 9,438**	**- 0.3°C ***	**8,155**	**+ 6 %**

** indicates average*
- all monetary figures are shown in USD

After completion of the installation, the manufacturer began to evaluate the project by monitoring energy consumption and gauging employee comfort levels. The manufacturer determined that the improvement in air flow produced by the Altra-Air fan gave employees the sensation of a fresh environment and lower overall temperature. The reaction allowed the manufacturer to increase the temperature set point on the air conditioners, thus providing immediate savings. The original set point was increased from 25°C to 27°C.

From January 2012, part of the office staff was moved and vacated the premises. The office was connected with a 12 ton (separate) a/c unit on one of the two meters. To offset this adjustment, the following chart takes into account estimated usage of one 12 ton unit. These figures have been accounted for in all calculations. Example usage of 12 ton unit in June at 12kw x 0.103 USD per KWh x 10 hours per day x 22 days per month x 80% utilization rate. In spite of the reduction in office load, energy consumption increased in April and May (mainly due to the early start of a/c units, caused by higher day time temperatures).

OFFICE CONSUMPTION		
MONTH	KWh	$
Jan	-	-
Feb	-	-
Mar	845	87
Apr	1,267	131
May	1,690	174
Jun	2,112	218
Jul	2,112	218
Aug	2,112	218
Sep	2,112	218
Oct	1,690	174
Nov	1,267	131
Dec	422	44

**all monetary figures shown in USD*

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ELECTRICAL COOLING CONSUMPTION – FOLLOWING INSTALLATION									
Month	2011			2012			Differences		
	Temp.	Kwh	Cost	Temp.	Kwh	Cost	Temp.	Kwh	Cost
Jun	34.6	55,905	4,964	34.4	53,788	4,527	- 0.2	- 2,117	- 4 %
Jul	36.6	78,461	7,296	37.7	57,770	4,939	+ 1.1	- 20,691	- 26 %
Aug	36.4	80,216	7,478	36.6	63,330	5,513	+ 0.2	- 16,885	- 21 %
Sep	34.4	95,716	9,080	34.9	65,546	5,743	+ 0.5	- 30,170	- 32 %
Oct	30.9	85,889	8,064	30.7	50,224	4,202	- 0.2	- 35,666	- 42 %
Nov	26.0	64,111	5,813	26.8	30,636	2,220	+ 0.8	- 33,475	- 52 %
Dec	21.4	25,592	1,830	22.8	25,643	1,792	+ 1.4	51	0 %
TOTAL	**31.5°C ***	**485,889**	**$ 44,525**	**31.9°C ***	**346,938**	**$ 28,936**	**+ 0.4°C ***	**- 138,952**	**- 34 %**

** indicates average*
- all monetary figures are shown in USD

While considering the entire year of electrical consumption for cooling, a savings of $14,708.00 USD was created. However, the fan was not installed until June 1, 2012. Considering this date and the fact that previous electrical consumption was actually higher than the previous year. The increase was due (primarily) to increased production as the temperature remained fairly consistent from the previous year. Following the installation of the fan, electrical consumption was reduced on average 34% per month.

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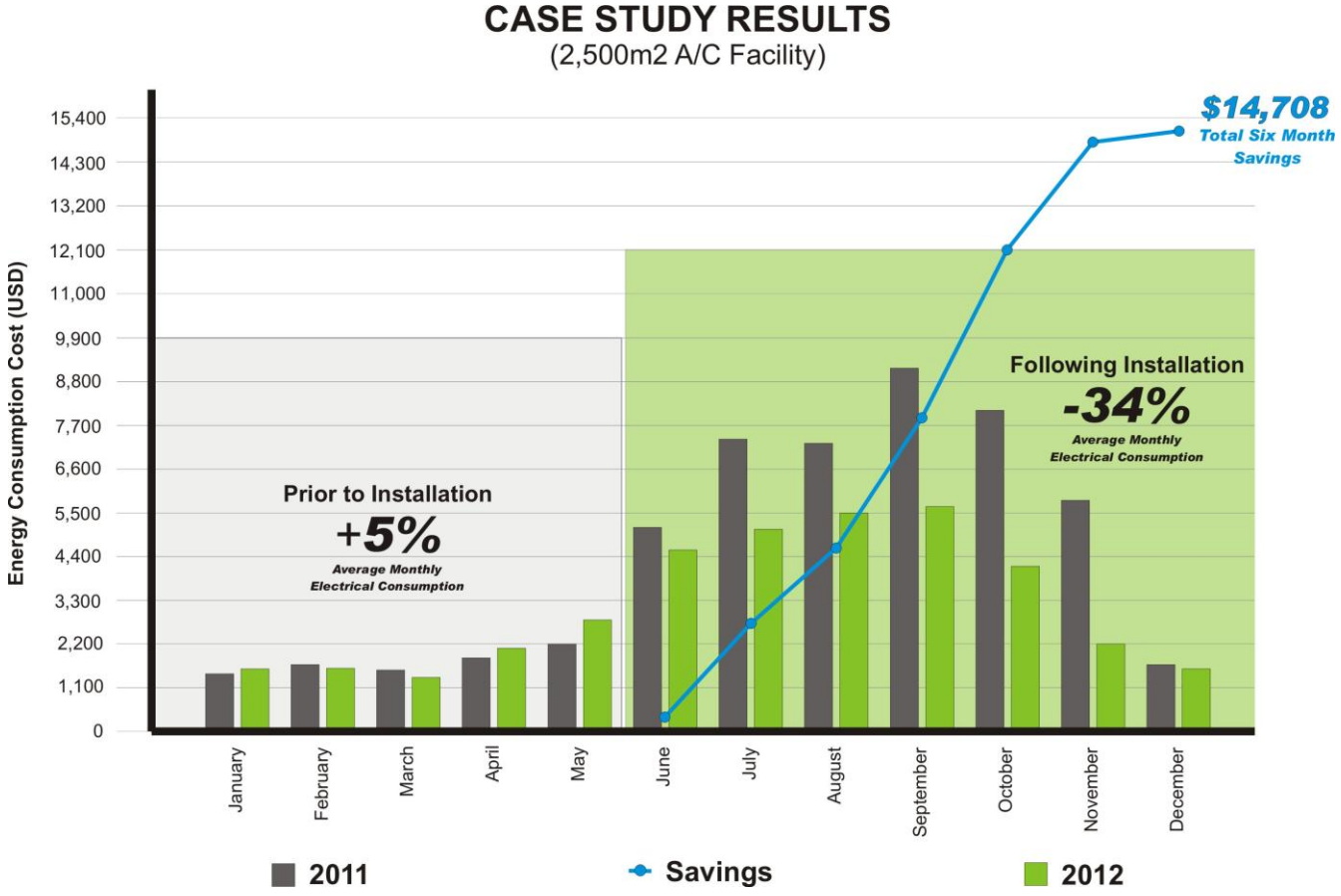
Altra-Air Fan

Air Conditioning Savings



The dramatic difference in savings following the installation of the HVLS fan is better demonstrated using the above graph.

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The Conclusion

Quantifying annual returns becomes difficult based on fluctuating energy prices. For this particular application, the first 10,000 Kwh consumed are based on a price of $0.0626 USD, while the Kwh above 10,000 are charged at a price of $0.1034 USD. These rates and overall increasing energy prices will result in an even greater return on investment.

However, based on the final investment of $5,200 USD (inclusive of product and installation costs), project capital was returned in under 4 months. This was largely due to the timing of the installation as in Dubai, March through November falls within the most suitable time to generate savings.

FINAL NUMBERS		
Investment:	$ 5,200	USD
Savings:	$ 14,708	USD
	138,952	Kwh
Payback:	3.5	Months
IRR:	282	%

A better representation of the impact the project has made is shown in the Internal Rate of Return (IRR) calculation. This performance measure is used to compare the efficiency of a number of different capital investments options. It should be noted that the calculation does not incorporate inflation or fluctuation in external factors (such as; maintenance, electrical costs and consumption).

VALUES	
YEAR (*n*)	**CASH FLOW** (*Cn*)
00	- 5,200
01	14,708
02	14,708
03	14,708
04	14,708
05	14,708
06	14,708
07	14,708
08	14,708
09	14,708
10	14,708

**all monetary figures shown in USD*

INTERNAL RATE OF RETURN

$$NPV = (-5{,}200) + \frac{14{,}708}{(1+r)^1} + \frac{14{,}708}{(1+r)^2} + \frac{14{,}708}{(1+r)^3} + etc.$$

Based upon these values, the internal rate of return for this project is 282.8271% and a total return of $147,080.00 on an small investment of $5,200.00. Using a 10 year life span (conservative estimate) for Altra-Air Fans, this project provides a net cash flow of $141,880.00.

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The References

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Climate – Dubai International Airport (n.d.) *Historical Weather Dubai International Airport.* Retrieved from http://www.tutiempo.net/en/Climate/Dubai_International_Airport/12-2012/411940.htm

The Further Readings

Product Manufacturer, (Canada). *Envira-North Systems Ltd.* - http://www.enviranorth.com
- Facebook: https://www.facebook.com/EnviraNorth
- Twitter: https://twitter.com/EnviraNorth
- Flickr: http://www.flickr.com/photos/envira-north
- YouTube: http://www.youtube.com/user/enviranorth

Middle East Representative of Altra-Air Fans, (Canada). *Trimac Inc.* – http://www.trimacinc.com
- Facebook: https://www.facebook.com/TrimacInc
- Twitter: https://twitter.com/trimacinc

Tubercle Technology, Developer, (Canada). *WhalePower Corporation* – http://www.whalepower.com

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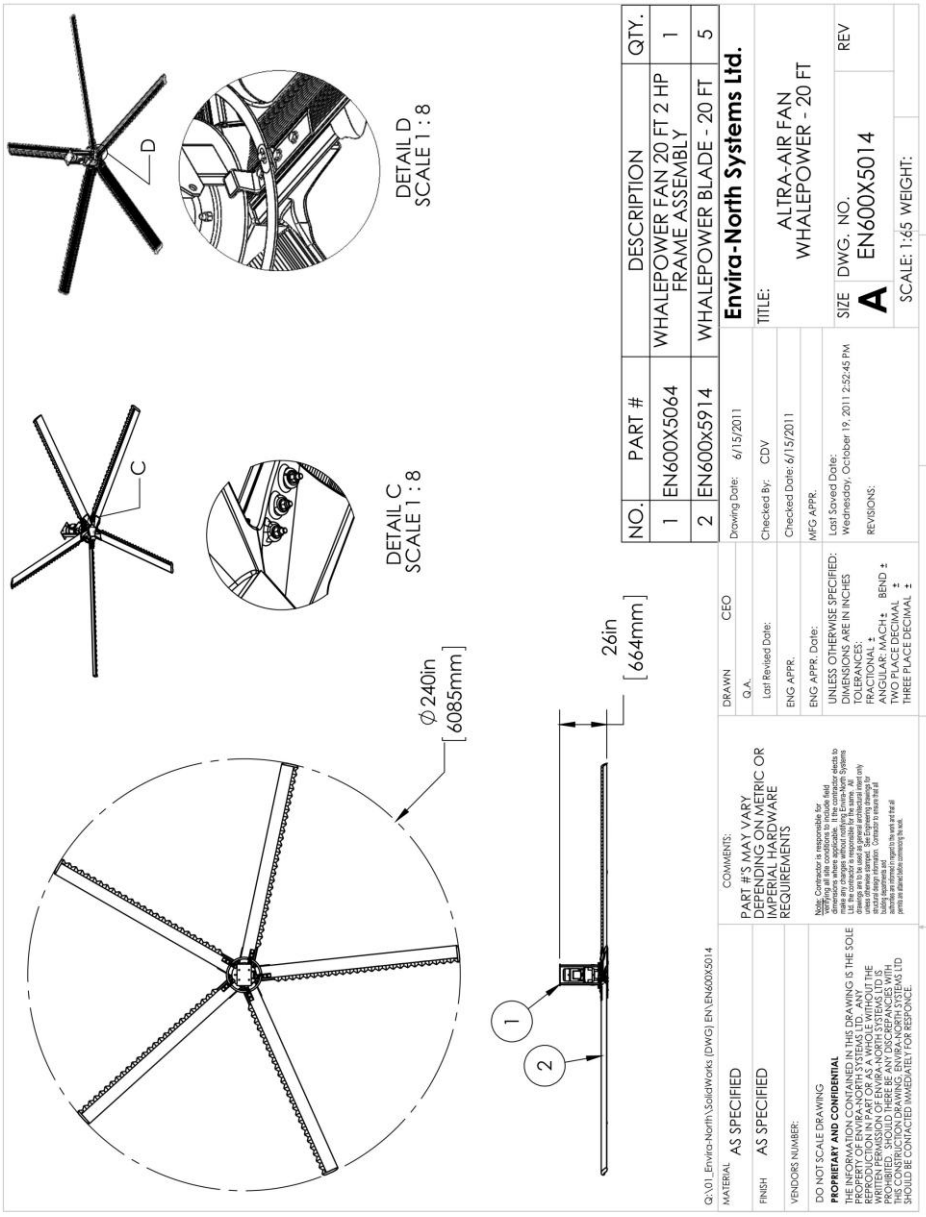
The Appendix



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The Appendix

General

Model Number	EN650X5014
Diameter	6.1 m
Blade	WhalePower Tubercle Technology™
Number of Blades	5
Motor Power	1.5 KW
Noise Level	N/A
Weight (no mount)	140.6 kgs
Packaged Fan (76 cm x 79 cm x 81 cm)	110 kgs*
Packaged Blades (28 cm x 28 cm x 305 cm)	73 kgs

* Mounts, extensions & controls packages separately. Weights may vary.

Performance (at max speed)

Airflow	155,766 l/s
Maximum Speed	63 rpm
Power Usage	1403 W
Maximum Effective Diameter	61.0 m

Construction

Frame	914 mm Gage Steel / Galvanized
Hub	713 Cast Aluminum Alloy
Blades	6063 Extruded Anodized Aluminum
Blade Leading Edge	Plastic Extrusion
Blade End Caps	Plastic Extrusion
Blade Leading Edge Colour	Pantone Green

Safety Components

Safety Ring	6 mm Galvanized Steel
Safety Cables	5 mm Stainless Steel
Guy Wires	3 mm Stainless Steel
Safety Clips	6 mm Galvanized Steel

Mounting Hardware

Standard Mount	Universal I-Beam Clamp w/ Swivel
Drop Extensions (Optional)	300 mm / 600 mm / 1220 mm

Mounting*

Open Web Steel Joist (Optional)	Steel Beam With Brackets
Wood Beam Mount (Optional)	Steel Machined Mount Plates
Concrete Beam Mount (Optional)	Steel Beam with Matching Mount Plates
Purlin "Z" Mount (Optional)	Steel Beam Brackets
Steel Thickness Varies Depending on Beam Span	Consult Factory for Specifics

*Please see Altra-Air Installation Guide for more information regarding mounting hardware.

Gear Motor

Type	Helical Inline Reducer
HP	1.5 KW (50 Hz / 60 Hz)
Ratio	27.24
Volts	230 V / 400 V / 460 V / 575 V
Amps Consumed	6.3 A @ 230 V
Insulation Class	F
Torque	339 Nm
Thrust	928 N

Fan Control

Enclosure	IP65
Operation	Key Pad
Control Options (Not Included)	Low Voltage / Temperature Control
Standard Power	208 V / 230 V / 400 V / 460 V / 575 V
Special Wiring (Thermostats, Fire Alarm Interface, Networking Etc.)(Optional)	Consult Factory

50 / 60 Hz Operation

Warranty*

Motor, Gearbox & Control Panel	3 Years
Blades, Hub & Mounting System	Lifetime

*Please see Altra-Air Installation Guide for warranty specifications and exclusions.

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