GAS COOLING
VS.
ELECTRIC COOLING

COMPARING THE COSTS

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Introduction

Not so long ago when someone needed to purchase a chiller for their facility, in all likelihood, it was taken for granted that the chiller would be an electrically-powered, compressor-driven unit. Today, a growing number of manufacturers are offering chillers that are powered by natural gas. Many claim natural gas chillers can have lower operating costs than electric chillers and may therefore be more economical. The main point supporting this argument is that, per unit of energy, natural gas costs less than electricity.

In many parts of the world electricity is so expensive that gas cooling is without question more economical. In these regions, favourable economics for natural gas has made gas cooling more prevalent. In Japan, for example, gas cooling accounts for about 70% of total installed cooling tonnage. In North America, where electricity is still relatively cheap, gas cooling currently accounts for only about 8% of the space cooling market. However, energy prices are rising rapidly, prompting more and more people to look at alternative technologies, such as gas cooling, for their space cooling needs. The purpose of this study is to provide people who are considering a natural gas powered chiller for a commercial or industrial facility with the information to help them make an informed decision.

Comparison Overview

In our study we compare three chillers: an *electric chiller*, a *gas engine chiller* and a *gas absorption chiller*. The comparison is based on primary *energy costs*, *maintenance costs* and *equipment costs*. Since the operating conditions are exactly the same for each chiller in our comparison, the energy costs depend on two factors: the cost of the energy used (electricity or natural gas) and the efficiency of each chiller.

In order to truly understand the cost of electricity or natural gas, we must understand exactly what we are paying for. To that end we take a fairly detailed look at the rates for electricity and natural gas and review the various charges that comprise an electric bill or a gas bill. The electricity rates we used come from Toronto Hydro. The rates took effect on December 1, 2000. The natural gas rates come from Enbridge Consumers Gas, and took effect on January 1, 2001.

The efficiency ratings for each chiller are based on figures taken from manufacturers published data. The maintenance costs come from a study conducted by the Georgia Institute of Technology. Equipment costs are derived from the average cost per ton of cooling for each type of chiller.

Operating Conditions

The chillers in our comparison are used for cooling a commercial building of approximately 400,000 square feet. The chillers operate 24 hours per day for the months of April through October. The cooling loads used in our calculations are the maximum average and minimum average cooling loads for each month and were calculated using weather data for the city of Toronto.

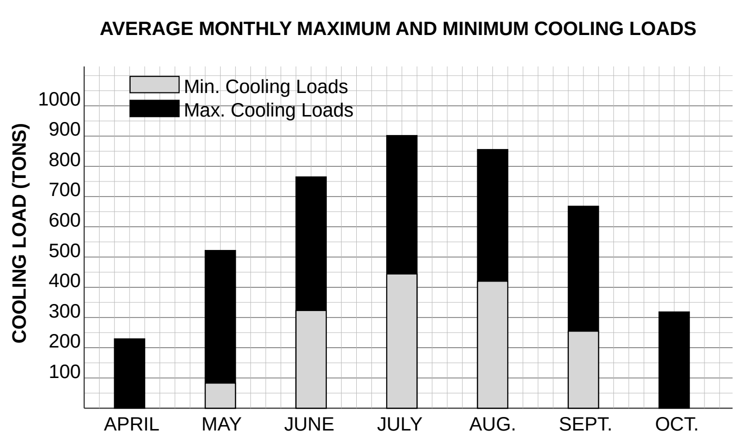


Figure 1: Average maximum and minimum cooling loads for the months of April through October. Note: Average minimum temperatures for April and October resulted in no average minimum cooling loads for those months.

The Chillers

The electric chiller and the gas engine chiller are essentially the same type of centrifugal chiller, which operate on the *vapour compression process*. The electric chiller employs an electric motor to drive the compressor while the gas engine chiller employs a natural gas-powered internal combustion engine to drive the compressor. Both chillers use an HFC (Hydrofluorocarbon) refrigerant.

The absorption chiller is unique among the chillers in this comparison. Rather than using a compressor, the absorption chiller uses the heat from natural gas combustion to drive a thermal-effect refrigeration process called the *absorption cycle*, in which water is the refrigerant. All three chillers have a maximum design load of 1000 tons of cooling, which is equivalent to 12 million BTU/h (British Thermal Units/hour) or 3,514kW (kilowatts).

Chiller Particulars

Electric Chiller

The electric chiller is equipped with a *variable frequency drive* (VFD). A VFD adjusts the speed of the electric motor in proportion to changes to the cooling load, making the chiller more efficient at part loads than a chiller that is not equipped with a VFD. An electric chiller without a VFD is most efficient when operating at or near full load capacity (in this case, 1000 tons). However, chillers rarely operate at full loads; they typically spend most of their operating time between 50% and 75% (500 to 750 tons) of full load capacity. The VFD raises average efficiency of the chiller by almost 19%. It also increases the equipment cost of the chiller by about 22%.

The efficiency of an electric chiller is also directly effected by its *power factor*. Power factor is a measure of how efficiently an electric motor utilizes electricity. Not all of the power drawn by an electric motor is used to produce actual work (i.e. turn the motor shaft). Some power, called *reactive power*, is needed just to maintain the necessary magnetic field inside the motor. Power factor is the ratio of the actual power used to turn the motor shaft to the total power the motor draws. The electric chiller in our comparison has a power factor of .95. This means that 95% of the electricity supplied to the motor is turned into useful work.

Gas Engine Chiller and Heat Recovery

Of all the energy generated by the engine of our gas engine chiller, about 30% actually goes to driving the compressor. The rest remains as waste heat. A portion of the waste heat generated by the engine can be recovered and used for other purposes. In our comparison, the recovered heat is used to supplement the heat generated by a boiler that supplies the building's hot water. By applying the energy savings gained through heat recovery against the energy used by the chiller we can effectively lower the chiller's energy costs.

Coefficient of Performance (COP)

COP is an overall measure of a chiller's cooling efficiency and is expressed as the ratio of output energy in cooling (heat removal) to input energy. In other words, COP measures how much energy the chiller requires to remove a given amount of heat. The more units of heat energy a chiller can remove for every unit of energy put in, the higher the COP and therefore the higher the efficiency. The electric chiller has a COP of 6.0 at full load. This means that the energy removal (the output) is 6 times greater than the energy input from the electric motor. The full load COP for the gas engine chiller is 1.94. The COP for the absorption chiller-heater is 1.0. As you can see, the electric chiller is about three times more efficient than the gas engine chiller and six times more efficient than the absorption chiller at full (design) load.

Although COP is typically measured at full load, COP values can vary at part loads. All of the chillers in our comparison have higher COPs at part loads (see Figure 2). The electric chiller is up to 50% more efficient at part loads than at full load. The gas engine chiller is up to 13% more efficient, and the absorption chiller is up to 17% more efficient.

CHILLER	COEFFICIENT OF PERFORMANCE (@TONS / kW)			
	1,000 / 3,514	750 / 2,635	500 / 1,757	250 / 879
Electric	6.0	7.2	8.8	9.0
Gas Engine	1.94	2.19	1.97	1.20
Absorption	1.0	1.097	1.167	1.089

Figure 2: Coefficient of performance figures for the three chillers.

The Cost of Energy

One of the main arguments for gas cooling is that electricity rate structures make the cost of electricity very high for commercial customers with high electrical demands. In order to understand how much a chiller will cost to operate, one must know what they are being charged for. In the following section we will take a close look at both electricity rates and natural gas rates to understand why each one costs what it does and how the costs for electricity compare to the costs for natural gas.

Understanding Electricity Rates

For our comparison, we used the rates from Toronto Hydro. It must be noted that rates and rate structures can vary from utility to utility, and region to region. Let's take a look at the various charges that make up an electric bill.

Customer Charge

The Customer Charge is what the utility charges in order to pay for fixed costs, such as the costs of maintaining generators, power lines, transformers, and for customer services such as billing, metering and 24-hour emergency service.

Distribution Charge and Transmission Charge

Customers whose demand exceeds 50kW are charged for maximum demand. Maximum demand is the fastest rate at which electricity is consumed at any time during the billing period.

The reason that customers are charged for maximum demand is that electricity is an on-demand service. Utilities cannot store electricity; it must be generated the minute it is needed. However, a customer's maximum demand typically occurs for only very short periods during each day (for example, at the beginning of the day when equipment is started up). Having the capacity to meet short periods of high demand puts extra burden and cost on the utility, which the utility passes on to those customers responsible for it.

TORONTO HYDRO ELECTRICITY RATES

Time-of-use rates for customers with monthly demnads of 50–1000kW

(Effective December 1, 2000)

	Winter	Summer
Customer Charge	$23.06	$23.06
Distribution Charge (per max kVA)	$3.91	$3.91
Transmission Charge (per peak kW)	$3.29	$3.24
Energy Charge		
Peak/Shoulder (per kWh)	$0.0882	$0.0732
Off-peak (per kWh)	$0.0346	$0.0238
Transformer Allowance (per max kVA)	$0.6300	$0.6300

Peak: 0900 to 2000 Monday through Friday, except public holidays
Shoulders: 0700 to 9000 and 2000 to 2300
Off-Peak: All other times

Figure 3: Electricity rate schedule.

Under Toronto Hydro's latest rate structure, the demand charge is broken up into a Distribution Charge and a Transmission Charge. The Distribution Charge is what Toronto Hydro charges to get the electricity, which is measured in kVA (kilovolt-amperes), from a distribution centre to the customer. The Transmission Charge is the charge for transmitting the electricity, which is measured in kW, from Ontario Power Generation's generating plants to a Toronto Hydro distribution centre. Under the old Demand Charge the utility charged for either 100% of the kW or for 90% of the kVA, which ever was greater. This scheme was based on the idea that a good power factor was at least 0.9; that is, at least 90% of the supplied kVA was turned into useful kW.

Energy Charge

The Energy Charge is what you pay for the actual amount of electrical energy used during the billing period, and is measured in kilowatt-hours (kWh). For example, a 1 kW motor operating for 1 hour will consume 1kWh of electricity.

Transformer Allowance

Some customers choose to buy their own transformers. Since this reduces the cost burden on the utility, Toronto Hydro compensates these customers with a pay-back in the form of a transformer allowance. For our study, a Transformer Allowance is not applicable.

Time-of-Use Rates

Customers with demands between 50kW and 1000kW can opt for time of use billing which has different rates for peak and off-peak times. This could be very beneficial if the customer runs equipment during the off-peak hours when energy charges are lower. Customers with demands greater than 1000kW are automatically placed on a time-of-use schedule.

The electric chiller in our comparison falls within the 50 to 1000kW rate schedule. Since the chiller is running 24 hours per day, we will use the time-of-use rate schedule and calculate the electricity costs using a combination of peak and off-peak rates. Opting for the time-of-use schedule should result in slightly lower electricity costs than if we chose the standard schedule.

Understanding Natural Gas Rates

The rate structures for natural gas are much simpler than the rate structures for electricity. The main reason for this is that, unlike electricity, the energy from natural gas does not have to be generated on demand by the utility. Rather, the energy from natural gas is stored in the natural gas, which itself is stored inside pipelines until it is burned by customers' equipment. Gas utilities also maintain reserves of natural gas, so short-term fluctuations in natural gas consumption is less of an issue for gas utilities. Natural gas prices are made up of several components, which are described below.

ENBRIDGE CONSUMERS GAS COMMERCIAL & INDUSTRIAL RATES

For the months of April through November inclusive

(Effective January 1, 2001)

Customer Charge per month (per meter)	$18.00	
Delivery Charge (for m³ per month)	**Price (per m³)**	**Price (per kWh)†**
For the first 30 m³	14.3779 ¢	1.3693 ¢
For the next 55 m³	13.8554 ¢	1.3195 ¢
For the next 1,315 m³	13.2805 ¢	1.2648 ¢
For the next 1,400 m³	12.6554 ¢	1.2053 ¢
For the next 2,800 m³	12.0304 ¢	1.1458 ¢
For all over 5,600 m³	11.0909 ¢	1.0563 ¢
System Sales Gas Supply Charge (if applicable*)	24.4445 ¢	2.3280 ¢
Buy/Sell Sales Gas Supply Charge (if applicable*)	24.4267 ¢	2.3263 ¢

*The System Sales Gas Supply Charge is applicable if the customer purchases its natural gas requirement from Enbridge (system sales). The Buy/Sell Gas Supply Charge is applicable if the customer is under a buy/sell program.

† One m³ of natural gas has an energy content of 37.8 MJ (Mega-joules), which equals 10.5kWh , or 35,842.5 Btu.

Figure 4: Natural gas rates.

Customer Charge
Similarly to the electricity Customer Charge, this charge is for fixed costs (such as meters) and administration.

Delivery Charge
The Delivery Charge covers the costs associated with getting the natural gas to your facility (via the pipelines).

Supply Charge
The Supply Charge is the cost for the natural gas itself. It is analogous to the Energy Charge on your electric bill.

Comparing the Costs of Electricity to Natural Gas

In order to have a direct comparison between the energy costs of natural gas and electricity we must first use the same unit of energy with which to measure them. In this comparison we will use kWh. Normally the energy content of natural gas is measured in Btu (British Thermal Units). One cubic meter of Canadian natural gas has an energy content of about 36,000 Btu which equates to 10.5 kWh.

To calculate the per kWh cost of natural gas we added the average Delivery Charge and the Supply Charge. We then factored in the Customer Charge, which had a negligible affect. The result: natural gas costs 3.40¢/kWh.

Calculating the per kWh cost of electricity is more complex due to the more complex rate structure. To calculate the per kWh cost, we must take into account the demand charges, which vary depending on the demand. Therefore the per kWh cost calculation of electricity is specific to the electric chiller in our study.

To calculate the per kWh cost of electricity, we took the total of all the associated costs: Energy Charges, Distribution Charges, Transmission Charges, and Customer Charges. We then divided that figure into the total number of kWhs used. The per kWh cost of electricity for the electric chiller was 7.96¢. Therefore, kWh for kWh, electricity costs about 2.3 times more than natural gas.

Why is natural gas a cheaper source of energy than electricity?

The answer to that question has to do with a concept called the *fuel cycle*. The fuel cycle examines the costs (in terms of energy efficiency) associated with getting the energy from natural gas or electricity from the source to the end user. Invariably, it is impossible to capitalize on 100% of the available energy content because energy must be expended to extract, refine, generate, transport and distribute the energy or energy source. Natural gas must be extracted from the ground, compressed, transported through pipelines, and distributed to the end user. To generate electricity, fuels such as oil, coal and natural gas must be extracted, processed and transported. When electricity is generated using nuclear power or the kinetic energy in flowing water (hydroelectricity) it must be converted from one source of energy (nuclear or kinetic) into electricity.

According to the U.S. Department of Energy, the conversion efficiency of natural gas from source to end user is about 91%. Which means 91% of the total available energy reaches the end user. The conversion efficiency of electricity is between 29% and 40%, depending on what energy source was used to generate the electricity, which means that no more than 40% of the available energy actually reaches the end user. Of course it is the end user who pays for all the costs associated with the fuel cycle.

Chiller Cost Comparison

We have seen that electricity costs much more than natural gas per unit of energy. Does this necessarily mean that an electric chiller is more expensive to operate than a chiller powered by natural gas? Let's factor in the other costs and find out. It should be noted that the energy cost calculations take into account only the energy used to drive the compressors (in the case of the electric chiller and the gas engine chiller) and the heat supplied by the gas burners (in the case of the absorption chiller). In the case of all three chillers, some electricity is also needed to power equipment such as pumps and control systems. All cost figures were rounded to the nearest dollar.

Electric Chiller Cost Calculations

Distribution Charges
The Distribution Charge is for the maximum power draw, measured in kVA for each month. Because the maximum average cooling load varies from month to month, the maximum kVA also varied from a high of 556 kVA in July to a low of 93 kVA in April. The total amount paid in distribution charges for the seven month period is $8,416.

Transmission Charges
The transmission charge is for the maximum power draw in kW for each month. This varies in direct proportion to the the kVA draw. The total amount of transmission charges is $6,626.

Energy Charges
The total amount of energy used by the chiller over the seven month period is 956,265 kWh. The maximum monthly energy consumption was in July (258,577 kWh). The minimum energy consumption occurred in April (32,296 kWh). The total cost of the energy used is $60,917. ($4,366 in off-peak charges and $56,551 in peak charges). The lower off-peak cost reflects the lower price of electricity during off-peak (night-time) hours and the lower cooling load placed on the chiller during those hours.

Customer Charge:
The total in Customer Charges is $161.

Electric Chiller Electricity Cost Summary
Distribution Charge.........................$8,416
Transmission Charge........................$6,626
Energy charge...............................$60,917
Customer Charge..............................$161
Total Electricity Costs...................$76,120

Gas Engine Chiller Cost Calculation

The total amount of natural gas consumed by the chiller was 385,233 m^3. The month with the highest consumption of course was July (84,047 m^3) and the lowest was April (26,948 m^3). When we calculate the various charges we get the following.

Delivery Charge................................$43,282
Supply Charge..................................$94,168
Customer Charge..................................$126
Total Gas Cost...............................$137,576 (without heat recovery)

The Heat Recovery Factor
We are able to recover 65% of the waste heat generated by the gas engine which supplements the heat generated by a boiler. After factoring in the boiler's efficiency of 90%, the total volume of natural gas saved works out to 159,005 m^3. The savings is $57,059. When we apply this savings against the cost of the gas consumed by the chiller we get a total energy cost of $137,576 - $57,059 = **$80,517**

Absorption Chiller Cost Calculation

The total amount of natural gas consumed by the absorption chiller is 640,137 m^3. The month with the highest consumption of course was July (156,101 m^3) and the lowest was April (29,695 m^3). When we calculate the various charges we get the following.

Delivery Charge................................$71,949
Supply Charge................................$156,478
Customer Charge..................................$126
Total Gas Cost...............................$228,553

Maintenance Costs

The annual maintenance cost for a 1000 ton electric chiller is estimated to be $22,320. The estimate for the 1000 ton gas engine chiller is $34,550. The higher cost for the gas engine chiller is due to the complexity of a gas engine which has more moving parts that an electric motor. The absorption chiller-heater which has very few moving parts has maintenance costs equal to the electric chiller at $22,320.

Equipment Costs

Based on operating costs alone it is clear that the electric chiller has the lowest operating costs of the three chillers. The closest competitor is the gas engine chiller with heat recovery, which cost $16,628 more to operate. However to get the whole picture we need to consider at least one other cost: the cost of the equipment. Here is where the picture gets blown totally out of proportion.

Equipment costs were calculated based on the average cost per ton of cooling. An electric centrifugal chiller costs about $275 per ton. So a 1000 ton electric centrifugal chiller will cost $275,000. The electric chiller in our comparison was equipped with a variable frequency drive which adds about $60,000 to the cost. So the electric chiller costs approximately $335,000. A gas engine chiller will cost —are you ready—$900 per ton! You do the math. That's right, a 1000 ton gas engine centrifugal chiller will cost you a whopping $900,000! The difference in cost between a 1000 ton electric centrifugal chiller and a 1000 ton gas engine centrifugal chiller is $565,000. An absorption chiller costs around $750 per ton which works out to $750,000 for a 1000 ton unit.

CHILLER	ANNUAL ENERGY COSTS	ANNUAL MAINTENANCE	TOTAL ANNUAL OPERATING COSTS	EQUIPMENT COST
Electric	**$76,120**	**$22,320**	**$ 98,440**	**$335,000**
Gas Engine	**$137,576**	**$34,551**	**$172,127**	**$900,000**
with HR	**$80,517**		**$115,068**	
Absorption	**$228,553**	**$22,320**	**$250,873**	**$750,000**

Figure 5: Operating costs and equipment costs of the three chillers.

Conclusion

We started out by comparing the unit for unit energy costs of natural gas and electricity; we found that currently, natural gas costs less than half what electricity costs. This suggested a clear advantage, at first, for the gas chillers. Then we applied the rate information to calculate the actual operating costs of the three chillers. Due to the superior efficiency of the electric chiller, the price advantage of natural gas was not great enough to translate into lower operating costs. In short, at current electricity and natural gas prices, electric cooling is more economical.

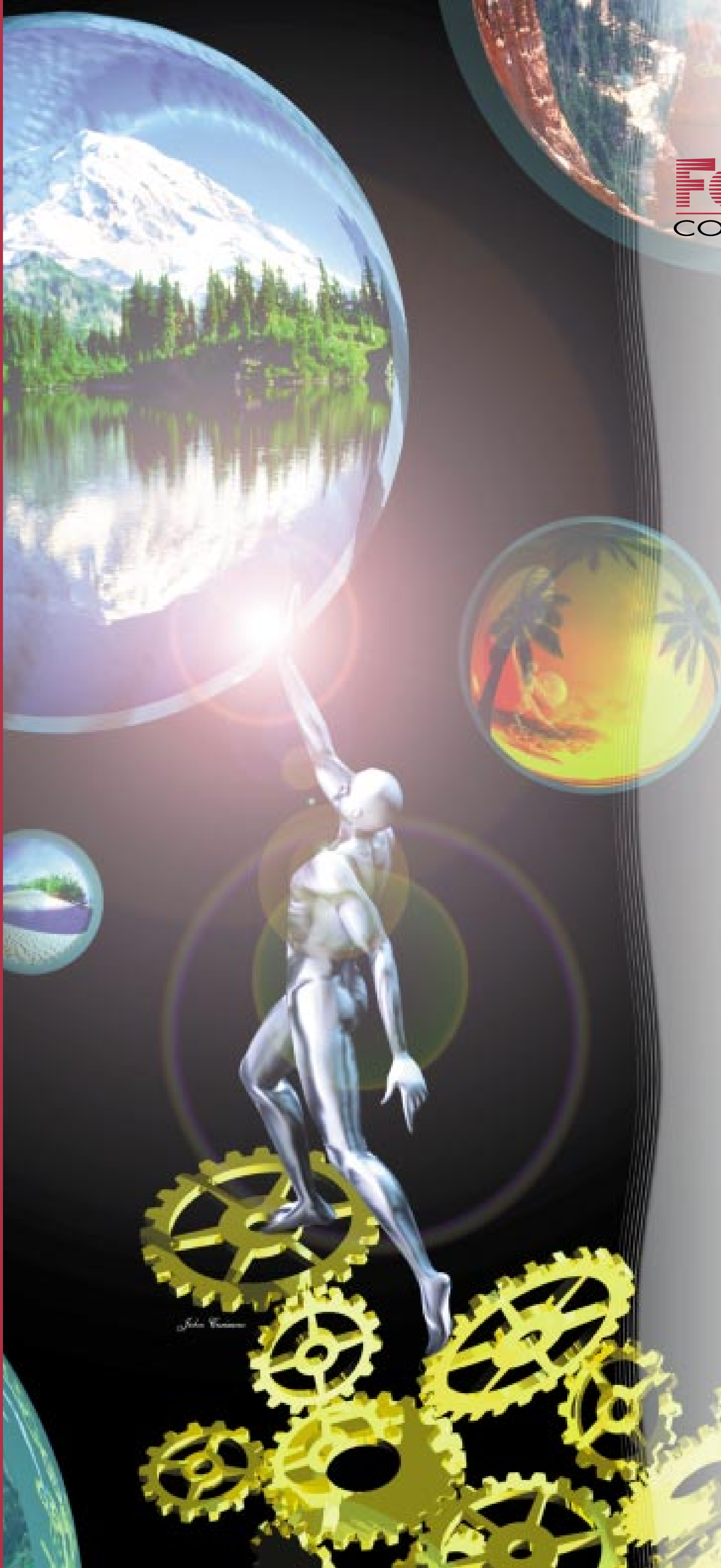
It may surprise some to learn that gas cooling costs more than electric cooling, given the common knowledge that gas heating is so much more economical than electric heating. As we have just proved, this is not the case. Why is this so?

Heating using natural gas is very efficient because the primary energy derived from natural gas is heat. Transferring the heat energy from the natural gas to the water or air being heated is a very straight-forward, and therefore, inherently efficient process. When you factor in the superior fuel cycle conversion efficiency of natural gas over electricity, we can easily see why gas heating is more economical than electric heating.

However, converting heat into other forms of energy is intrinsically inefficient. In a gas engine chiller for example, the process of converting the heat from the combustion of natural gas into kinetic energy to turn the compressor is only about 30% efficient. In an electric chiller the process of converting electricity to kinetic energy is 95% efficient.

Can gas cooling ever compete with electric cooling on an economic basis? Let's say that a person was willing to install a more expensive gas engine chiller over an electric chiller if the pay-back period was reasonable, say five years. In order to achieve a five-year pay-back, the overall cost of electricity would have to be about five times the overall cost of natural gas. As electricity is currently about 2.3 time more expensive than natural gas, that means the cost of electricity would have to increase by more than 200% while the cost of natural gas remained static. The likelihood of this happening is low, especially given the fact that natural gas prices *are* increasing, and at a much faster rate than electricity prices.

One caveat: energy prices are currently very unstable. All of our main sources of energy—oil, natural gas, electricity—are becoming more expensive. Deregulation of electricity markets, which is being considered in many regions, adds an element of unpredictability to the future prices of electricity. Furthermore, given the uncertain future of nuclear power as a means to generate electricity very cost effectively, it is not unreasonable to predict that we may see increases in the prices of electricity on a similar scale as we are currently seeing in the prices of oil and natural gas. So, if you have gathered fact sheets and brochures on gas chillers, it might make sense to keep them in your filing cabinet, if not on your desk.



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CONTROLLED CLIMATES LTD.

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Ventilation
Refrigeration
Process Heating
Process Cooling
Heating
Sheet Metal
Energy Management
Controls
Humidity Control

Industrial
Commercial
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Trust us to do it right.
Every time.

We help businesses succeed

We all have the same concerns when we need someone's services: Will they do a good job? Do they really care about my needs or are they only interested in making a sale? Do they stand behind their work? Will they be there when I need them? **Can I trust them?**

Having these same concerns ourselves, we created a company made up of honest people, dedicated to serving *the best interests of our customers*. We take personal interest in helping people solve their problems and improve their everyday operations. In short, **we help businesses succeed**.

We do this in 4 main ways:

1) We lower operating costs by reducing the number of equipment breakdowns, optimizing performance, maximizing efficiency and extending equipment life.

2) We lower production costs by improving the productivity, efficiency and safety of production lines; minimizing costly down time, and; improving building comfort for higher employee productivity.

3) We solve problems. We offer cost-effective solutions for indoor environmental problems and production problems.

4) We expand capabilities with custom-designed, special equipment that can improve an existing operation or perform a new function.

Hundreds of businesses, large and small, have trusted Four Seasons Controlled Climates to lower their costs while improving their operations. Allow us the opportunity to help *your* business succeed.

Why Four Seasons Controlled Climates is better for your business…

We look after your best interests
At Four Seasons Controlled Climates our best interests are your best interests. Our goal is to help you improve your business, not just make a sale. We carefully consider your specific needs and offer the solutions that will best look after them.

A higher standard of service
We judge our level of service in a very simple way: We ask ourselves if we were the customer how we would like to be served and then try to serve our customers even better. Furthermore, we continually look for ways to improve our service in order to maximize the benefits of dealing with us.

A higher standard of workmanship
The operation of your business depends on the quality of our work. We take this very seriously, so we continually strive for higher quality workmanship that is above industry standards.

A higher standard for employees
The main way we achieve a higher standard in our service and workmanship is with a higher caliber of people. All Four Seasons Controlled Climates employees, from the technicians to the office staff, are carefully selected for their professionalism, integrity, skills and dedication to serving our customers. We provide our employees a comfortable work environment, the latest technology, and on-going training so they are equipped to look after your needs.

A greater variety of services
With expertise in so many types of mechanical systems we are able to offer a variety of services that most of our competitors can't touch.

Respect for the environment
Feel comfortable knowing you're dealing with a company that cares for the environment. We conduct **proper recycling, reclamation and disposal of materials and chemicals**. We keep our service vehicles tuned and running well to reduce emissions. We recommend the most efficient equipment and options, and we offer solutions for energy management and energy recovery. It's our part to help ensure a cleaner future for us all.

Your Installation

The quality of your mechanical system starts with the quality of its installation.

Four Seasons Controlled Climates has the expertise, the people and the technology to provide superior-quality installations of all types of building mechanical systems, from rooftop units to entire production lines.

When planning an installation we take into account environmental conditions, site conditions, structural concerns, future considerations, and ease of maintenance. We then engineer the system, select the most appropriate equipment, fabricate the necessary parts and make the necessary preparations. The efforts of all people involved, from technicians to suppliers, are carefully coordinated to ensure a smooth, efficient installation from start to finish.

Quality. Installed.

Engineering Services
Using the latest CAD software, we can properly design/engineer installations to achieve optimum system performance, greater equipment reliability, and maximum energy efficiency. With engineering done in-house, getting projects from paper to metal is faster and costs less.

Complete Fabrication Services
We make **custom components**, build **specialized equipment** and **refurbish older equipment.** Our fabrication facilities are equipped with the latest technology and are well-stocked with quality parts and materials. We perform as much installation prep work as possible in-house for tighter quality control and for smoother, more efficient work on site.

Fleet of Mobile Shops
We handle on-site work with fully-equipped and stocked mobile shops. We keep our mobile shops clean, organized and running well to help us do our work well and efficiently.

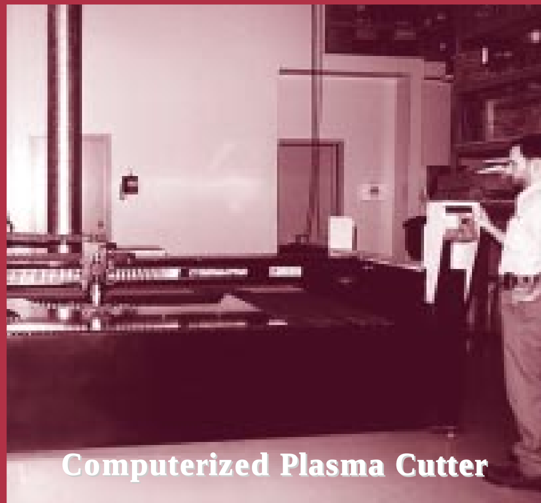
Complete Installation Services
Our complete range of installation services include **structural work**, **crane service**, **roofing**, **electrical**, **control work**, **piping** (gas, steam, air, water, refrigeration, etc) and **sheet metal work** (duct work).

Team of Skilled Technicians
All installations are performed by **licensed technicians** who work as a team under the supervision of a highly experienced Foreman. Our technicians are **specially-trained** for the type of equipment they install, and they take great pride in the work they do.

Suppliers of Quality Equipment
Four Seasons Controlled Climates has well-established relationships with reputable suppliers who offer fast, dependable delivery. When available, we prefer to use equipment from local manufacturers to help support the local economy. Whichever suppliers we use, the **equipment must meet our high standards** for durability, reliability, performance and efficiency.

The Most For Your Investment
With a properly engineered system, quality components and unbeatable workmanship, you can rely on a Four Seasons Controlled Climates installation to give you the most return on your investment. It's one of the ways we can help your business succeed.


In-House Engineering

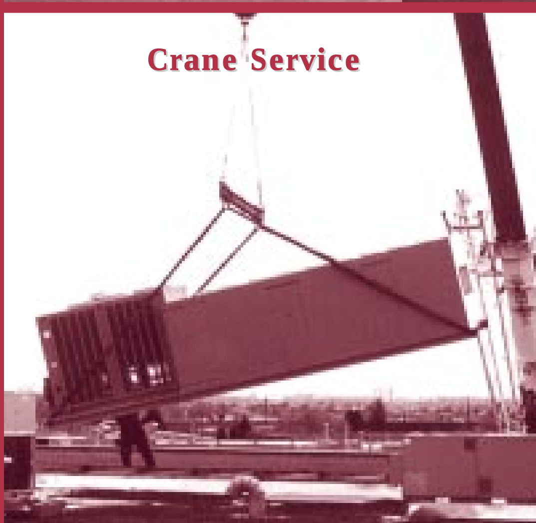

Computerized Plasma Cutter


Sheet Metal Shop


Machine Shop


Welding Shop

Mobile Shop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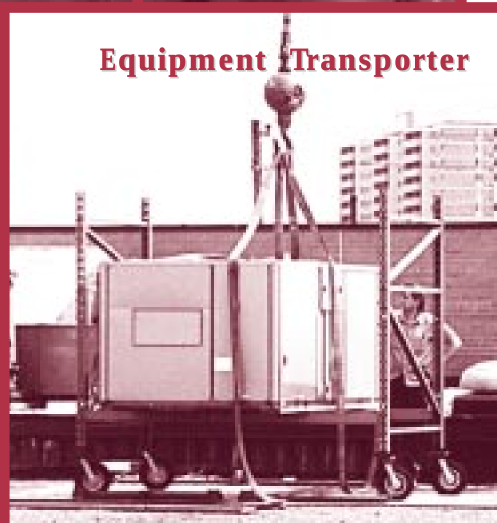
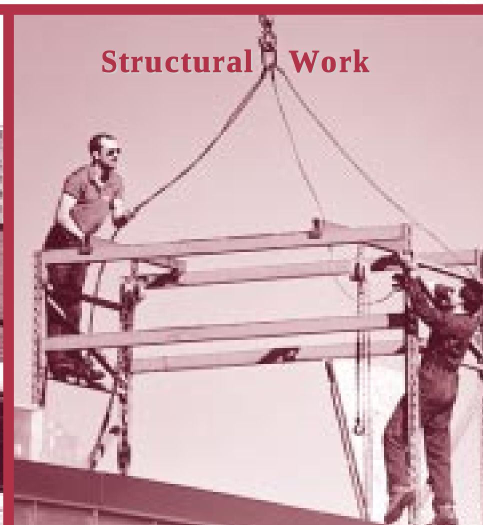
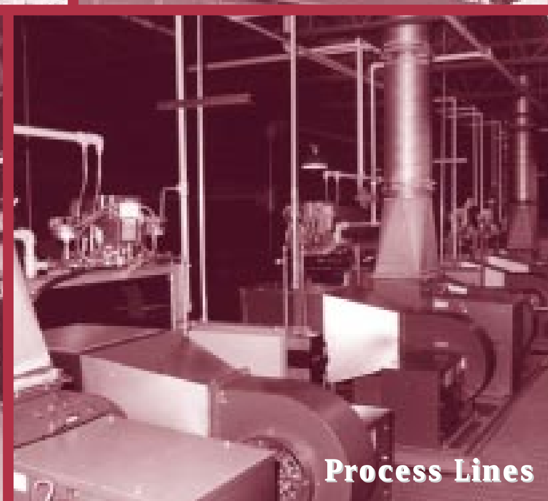

Equipment Transporter


Structural Work


Rooftop Systems


Heavy Equipment


Process Lines

Protect your investment:

Certified Service Plan

To get the most for your investment in your mechanical systems you need to keep them operating properly at minimum cost for as long as possible. To do that, you need proper maintenance.

The problem is, a good maintenance program is hard to find. Service companies are offering cheaper and cheaper programs in order to compete for your business. As a result, you may end up with inadequate maintenance that actually increases your operating costs because you're not paying any less in repairs, plus you have to pay for the program.

We believe that a maintenance program should save you money, not cost you extra. That's why we created the Certified Service Plan.

The Certified Service Plan is a customized, worry-free program, carefully designed to keep your equipment running properly and efficiently. We don't cut corners, omit steps, or set loss leader prices and then try to find ways to recover the loss. Furthermore, we record all maintenance, so you'll know your equipment is receiving the care it needs.

With lower operating costs and maximized equipment life, a Certified Service Plan gives you the most for your investment.

Service so good it's Certified

Custom-Tailored Maintenance
We create an optimized schedule that provides **the right maintenance at the right time** based on your specific equipment and operating conditions.

Your Technician for the Duration
A licensed, specially-trained technician is assigned to your equipment. Your technician offers **on-going recommendations** to improve the performance of your systems and **reduce operating costs**. Two backup technicians are assigned to ensure you are always covered.

Taking the Time to do it Right
We allow technicians the correct amount of time to properly perform **documented, step-by-step maintenance procedures** that are specifically designed for each piece of equipment you may have.

ISO/QAS Service Reports
After each visit from your technician you receive a **complete report** that lists the equipment serviced, the work performed and any recommendations from your technician. Reports are documented according to **ISO/QAS standards** so registered businesses can maintain the required records.

Computerized Records
We use specially-developed software to create your customized service schedule, update information on your equipment, and track service history.

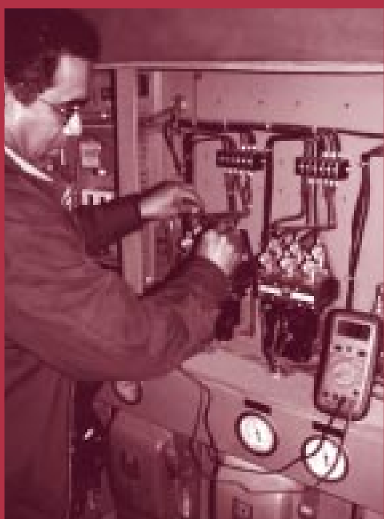
If Repairs or Upgrades are Needed
You may choose to give approval for repairs while your technician is at your site, or your technician or Technical Sales Advisor can present an **action plan** complete with costs and risk analysis.

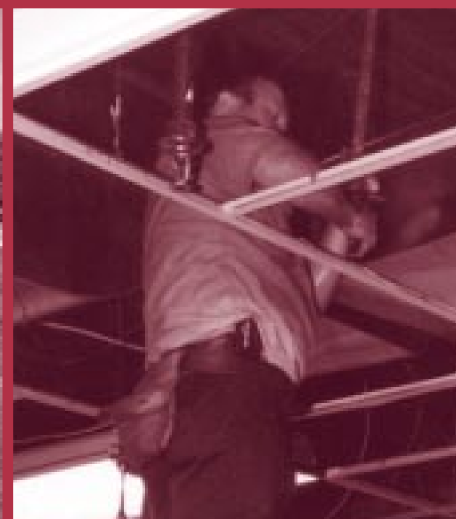
24/7 Emergency Service
A technician is available to respond to your needs any time of the day or night. After-hours emergency calls are handled by our **automated attendant** which will dispatch a technician to your site within minutes.

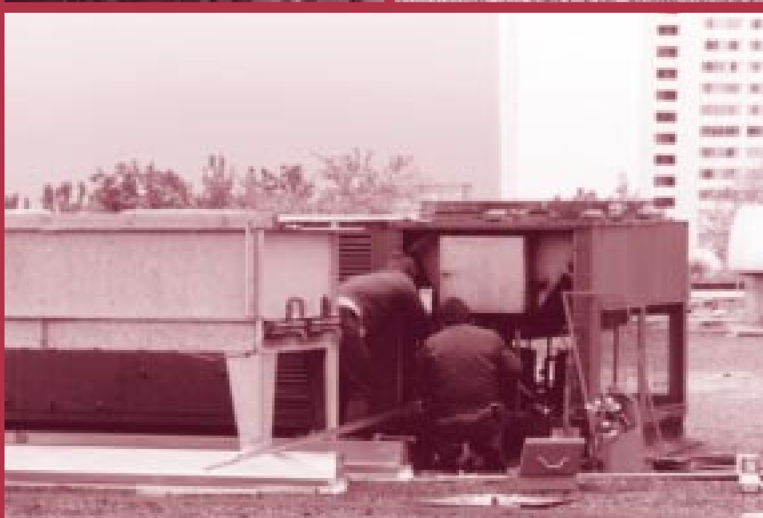
Helping Maintain Your Cash Flow
The cost of investing in the Plan is spread throughout the term.

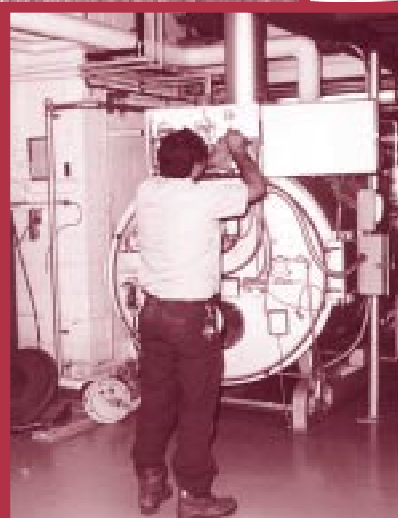
Return on Investment
With lower energy costs, fewer breakdowns and less down time, your Certified Service Plan will not only pay for itself but it will also **pay big dividends**.

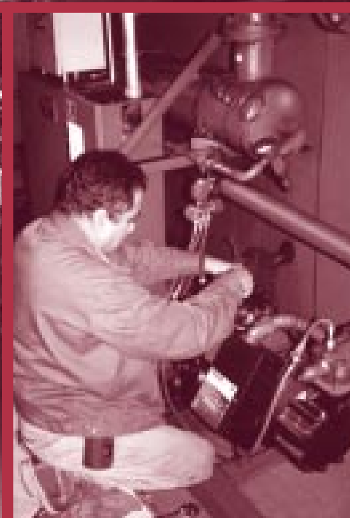
Our large team of dedicated licensed technicians are specially trained for each type of equipment they service. Trust them to do it right.











CERTIFIED® SERVICE