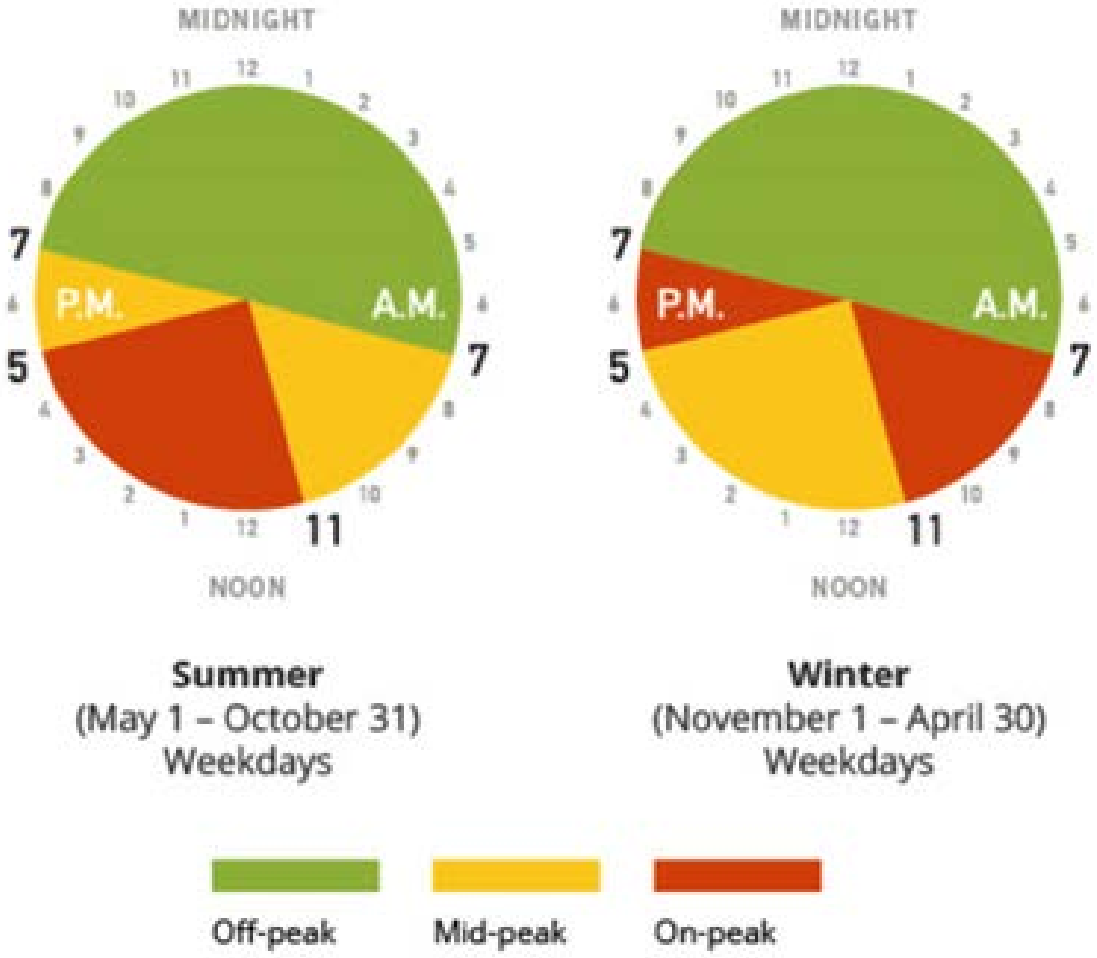
YAZAKI - OFF GRID COOLING SOLUTIONS

In modern times, getting enough power at a reasonable rate cost for your needs from the electrical grid can be troublesome.

- The cost of grid power under time-of-use pricing structures. On-Peak costs can exceed 30 cents per kWh in some markets.
- The cost to bring power to remote sites can be incredibly high – up to $1,000,000 per km!
- Aging infrastructure can limit how much power can be supplied by the grid to your chosen location.



YAZAKI - OFF GRID COOLING SOLUTIONS

For power needs, the solutions are:

- Spend the money to bring sufficient power, assuming there is enough capacity in the first place.
- Make do with what power can be brought or drawn through existing infrastructure.
- Go off-grid with part or all of the power load.

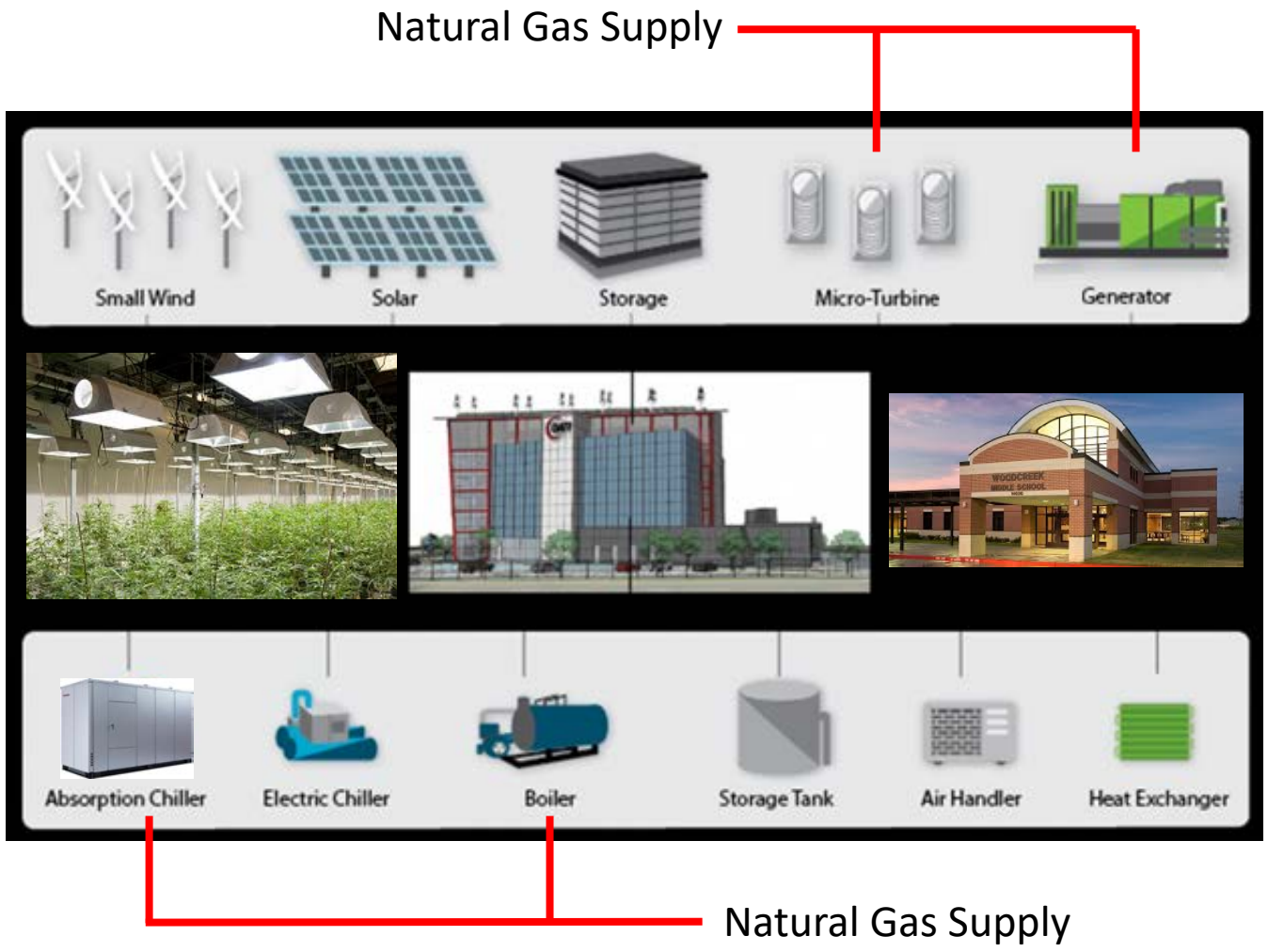
Typical Capital Costs for Electric Transmission Lines, by Voltage	
Transmission Facility	**Typical Capital Cost**
New 345 kilovolt (kV) single circuit line	$915,000 per mile
New 345 kV double circuit line	$1.71 million per mile
New 138 kV single circuit line	$390,000 per mile
New 138 kV double circuit line	$540,000 per mile
New 69 kV single circuit line	$285,000 per mile
New 69 kV double circuit line	$380,000 per mile
Single circuit underground lines	Approximately four times the cost of above-ground single circuit lines.
Rebuild/Upgrade 69 kV line to 138 kV line	$400,000 per mile

Source: American Transmission Company, *10-Year Transmission Assessment*, September 2003.

YAZAKI - OFF GRID COOLING SOLUTIONS

At some point, power will be needed when the sun isn't shining and the wind isn't blowing. Therefore, the only stable method of supplying true off-grid power is through use of onsite fuel-driven power generators. The most common fuel source for these generators is natural gas.

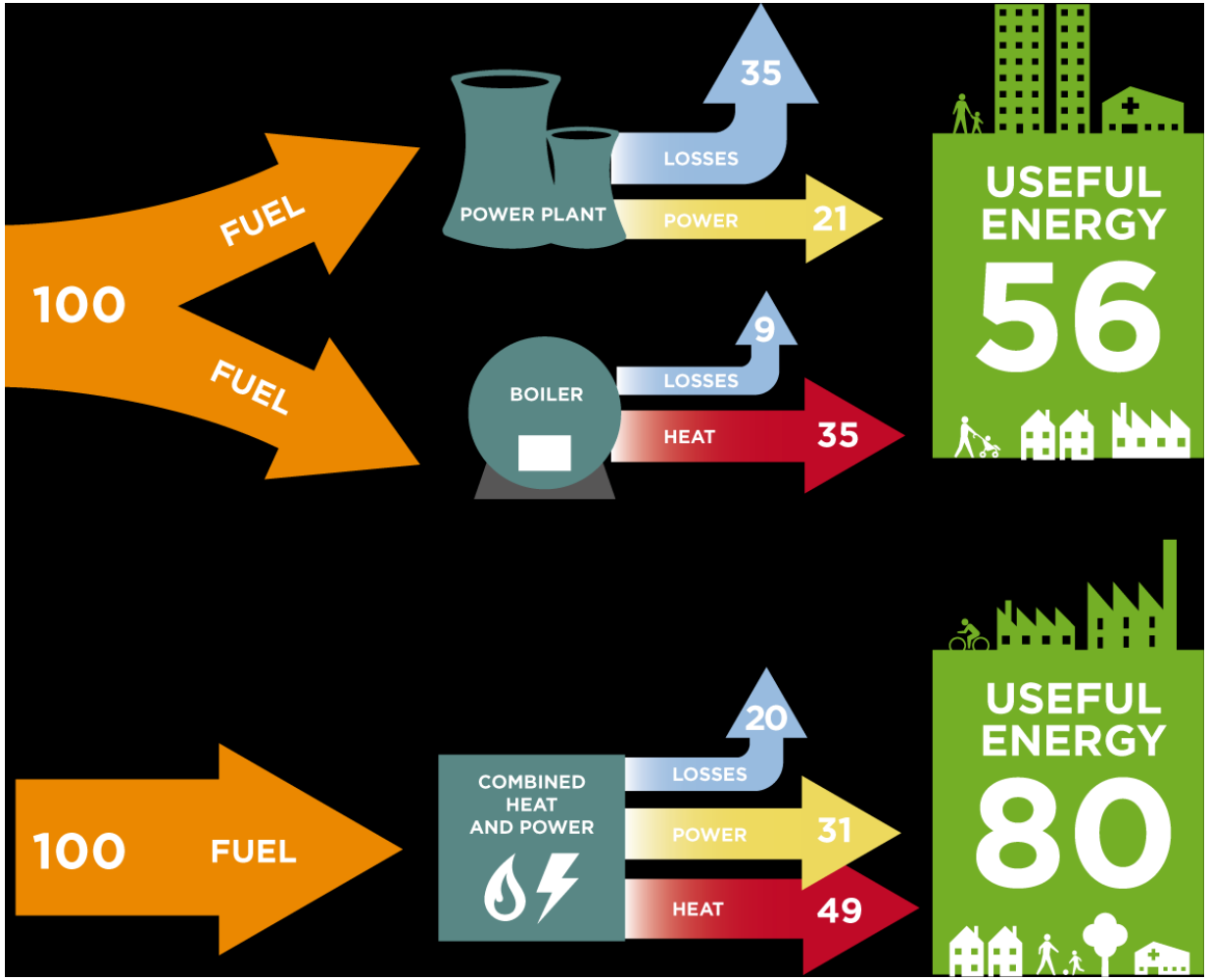
Natural gas is also one of the best fuels to provide heat through either boilers or indirect-to-air.



YAZAKI CHP SOLUTIONS - CCHP

When using onsite fuel-driven power generation, there will always be waste heat, regardless of what fuel source or power generator type is used.

Utilizing the waste heat will raise the overall thermal efficiency of the CHP plant, usually to above 70%. This utilization can be almost anything – domestic hot water heating, space heating, process heating, or powering an absorption chiller so that the waste heat can supply chilled water for space cooling or process use.



YAZAKI CHP SOLUTIONS - CCHP

Since utilizing waste heat can increase the thermal efficiency, then how do you maximize the utilization of the waste heat?

Domestic Hot Water	
Pros	Cons
• More projects need DHW than process heat or cooling	• Typical demand only 2 hours per day
• Typically needed all year	• Only get credit when using the water
• Cheapest utilization (only needs a heat exchanger)	• When hot water not needed, heat is rejected

Process Heating	
Pros	Cons
• Most processes run year round	• Only applies to a process that needs heated water
• High demand, often approximately 20 hours per day	

Process Cooling	
Pros	Cons
• Most processes run year round	• Only applies to a process that needs cooled water
• High demand, often approximately 20 hours per day	

YAZAKI CHP SOLUTIONS - CCHP

Space Heating	
Pros	Cons
• Good demand, typically about 14 hours per day	• Only useful when a space needs heating
	• Heating not typically needed year round

Space Cooling	
Pros	Cons
• Space Cooling more common than Process Cool/Heat	• Only applies to a space that needs cooling
• Cooling loads tend to be longer-lasting than DHW loads	
• Good demand, typically about 14 hours per day	

For year-around high hour waste heat utilization, there is one obvious solution that fits the highest number of potential customers – space cooling with a water-fired absorption chiller. When chilled water demands exceed the available waste heat, direct-fired absorption chillers using natural gas can provide any remaining chilled water needed for the total chill plant. Yazaki has water-fired units from 5 to 100 tons available while direct-fired units come in sizes from 30 to 200 tons.

CHOOSING AN ABSORPTION CHILLER

When first considering using an absorption chiller, the first thing that comes to mind is cost of the chiller. Logical, but a bit misguided since not all chillers are built the same.

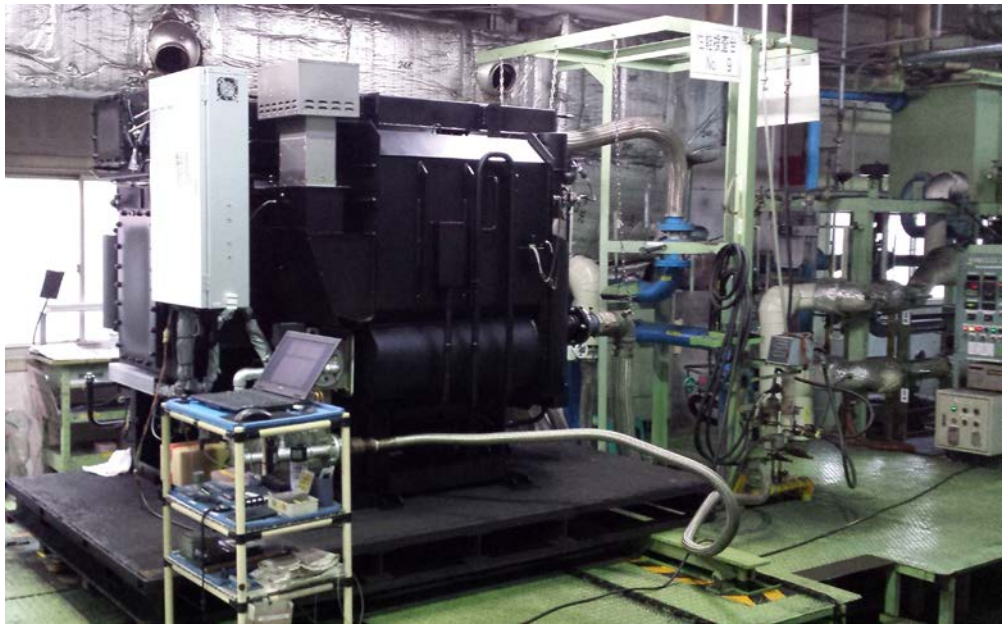
Most of our competitor's absorption chillers are shipped to the site in pieces for field assembly. This subjects the resulting finished product to conditions that are non-standard with inconsistent results.

As a result of this different method of construction, most competitors need weeks on site to assemble and start their equipment, often an entire week just to balance out the solution charge alone. And usually this requires multiple men per day.

Most Yazaki units typically require NO assembly in the field and startup can usually be done in less than half a day by one person. So the Yazaki unit may cost more up front than competitor's units, they save money in the long run with better results, less manpower on site, and quicker startups.

CHOOSING AN ABSORPTION CHILLER

Yazaki products are completed at the factory in Japan where all our chillers are manufactured, run tested at laboratory conditions, and has the solution charge balanced at the factory. The highest welding standards can be maintained, the best leak checking can be done on welds, the best testing standards can be maintained, and the results are consistent every single time.



As a result of our construction methods, Yazaki units are essentially the "self-contained package unit" of the industry. Set it in place, bring water, power, controls, gas (in the case of direct-fired units) and it's ready for startup.

Startup consists of verifying water flow rates, setting a few parameters in the software, setting up the burner (in the case of gas-fired units), and then watching it operate for a while. With the correct tools, startup can be done in a matter of a few hours saving time and money when compared with competitor's requirements.

YAZAKI UNITS – LIFE CYCLE BENEFITS

When the chiller is built completely at the factory, such tight control can be maintained over the construction that vacuum leaks are almost unheard of with Yazaki units. Not so with our competitor's equipment. Field assembly and inconsistent welding results in the need for regular chemical analysis of the solution in the unit as well as use of a purge pump in order to maintain the vacuum level in the unit. **Yazaki units do not need purge pumps.**

In addition, **Yazaki units NEVER need regular chemical analysis.** This saves THOUSANDS of dollars a year on life cycle maintenance costs over most of Yazaki competitor's units.

Yazaki units use a single hermetically sealed solution pump. **This ELIMINATES pump maintenance.** Most competitor's units use multiple pumps and require frequent pump maintenance. Again, this allows Yazaki units to save THOUSANDS of dollars a year on life cycle and maintenance costs over most competitor's units. Lastly, **there are NO spray nozzles in Yazaki units**, eliminating them as a maintenance item when compared to the competition.

Theirs

Yazaki's

No other absorption unit is easier or cheaper than a Yazaki unit for which to provide proper maintenance!

YAZAKI UNITS – LIFE CYCLE BENEFITS

Compare the maintenance requirements between Yazaki and most competitor's units:

	Yazaki Water-Fired Units	Typical Competitor's Units
Regular Chemical Analysis	Never	monthly/quarterly
Chemicals Added	Every 8000 hours	monthly/quarterly
Pump Maintenance	Never	annually
Megaohm Testing	Never	annually
Spray Nozzle Maintenance	Never	annually
Flush and Rodding Tubes	Never on units under 100 tons Every 3-5 years on units 100 tons and up	annually
Purge Pump Maintenance	Never	Monthly (if done right)
Regular Evacuation	Every 1000 hours	Never (if purge pump maintained)

So typical life cycle cost comparison would be:

Materials	**$1000 every 3 years**	**Can be $10,000+/year (Chemicals and Analysis, Pump Oil, Misc. Cleaning)**
Labor	3 days/year in a normal year 6 days/year for the years flushing is done	10+ days per year

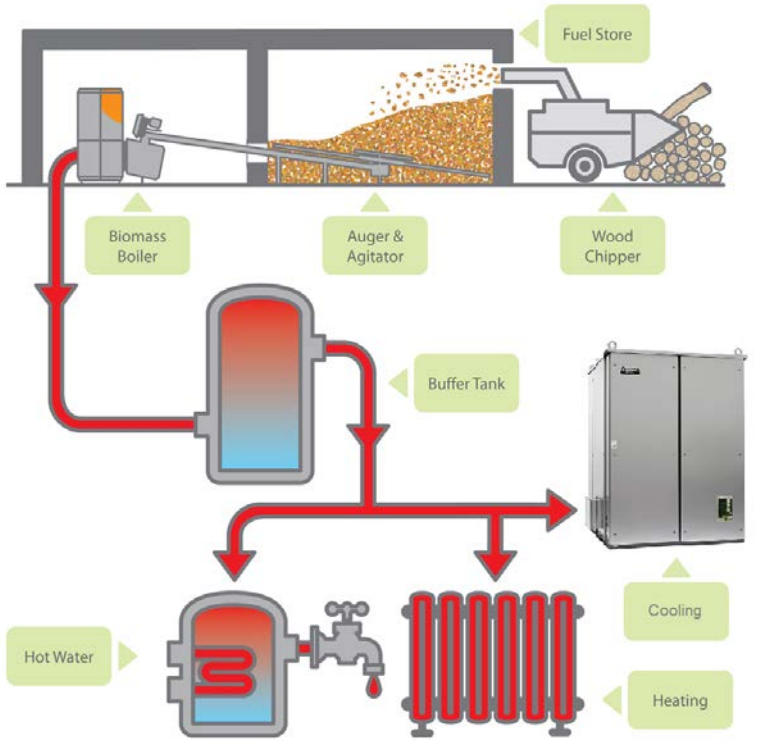
Adding chemicals only takes about a ½ hour and can be done on a regularly scheduled maintenance trip.

YAZAKI UNITS – OTHER APPLICATIONS

CHP isn't the only application for thermally-driven chillers. Yazaki water-fired chillers operate on hot water supplied at 158-203°F (70-95°C). Yazaki's design condition temperature requirement is lower than almost every competitor which allows more of the waste heat to be recovered and used to drive Yazaki units than almost any one else's units of the same tonnage rating. And it doesn't matter how the water got hot, just that is arrives in that temperature range. units. This allows for numerous other applications such as:

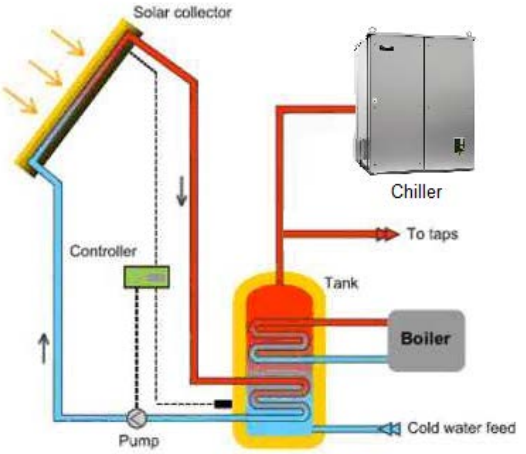
Biomass driven systems. Using a biomass boiler, any sort of biomass fuel can be used to drive a Yazaki water-fired chiller – pellets, wood chips, biodiesel, just about anything that burns.

Many agricultural and greenhouse operations have a need for disposal of excess biomass and also a need for chilled water or cooling. A simple, relatively inexpensive boiler can be coupled to a Yazaki water-fired chiller for a system that can provide both heating and cooling for space comfort or process needs.



YAZAKI UNITS – OTHER APPLICATIONS

Solar Thermal Systems. PV isn't the only way to capture the sun's rays for energy. The sun can also warm water for use in various thermal applications which can include powering a water-fired chiller.



Bakeries. Chilled water is often needed to keep the dough cool enough during the kneading so that it doesn't rise until the desired stage of the baking process. Since ovens are integral to the baking process, the waste heat from the ovens can provide the energy to power a water-fired chiller that can, in turn, provide the chilled water for the kneading process.

Manufacturing. A large number of manufacturing processes require heat at the beginning and cooling at the end. Rather than spend energy on both stages, recovering the heat from the beginning into water would allow that waste heat to power the cooling requirements of the end process.

Low Temperature Heat Recovery

Source	*Temperature ^{0}C*
Process steam condensate	55-88
Bearings	32-88
Welding machines	32-88
Injection molding machines	32-88
Annealing furnaces	66-230
Forming dies	27-88
Pumps	27-88
Internal combustion engines	66-120
Liquid still condensers	32-88
Drying, baking and curing ovens	93-230
Hot processed liquids	32-232
Hot processed solids	93-232