Opportunities With Gas Engine-Driven Cooling Systems

DOE - Chiller System Optimization
TECOGEN Markets
Gas Cooling Market Is One of the Fastest Growing Segment in HVAC Industry

- Rising Cost of Electric Cooling
- Refrigerant Issues
- Available Incentives
- Increasing Acceptance of Gas Cooling

Chiller Decision Is No Longer an Automatic Choice for Electric
Market Drivers - Strongest in Company History

- Unprecedented Attention to Energy
  - Front Page National Press
  - National Priority

- Efficiency
  - No Longer About Being a Good Citizen...
  - It's About Staying in Business
Peak Seasons for Gas and Electricity Sales

% Of Peak

Electricity Sales
Natural Gas Sales

Cooling Season
Electric Chiller

- **ELECTRIC MOTOR**
- **COMPRESSOR**
- **CONDENSER**
  - Hot Refrigerant Vapor
  - Warm Refrigerant Liquid
- **EXPANSION VALVE**
  - Cold Refrigerant Vapor
  - Cold Refrigerant Liquid
- **EVAPORATOR**
  - Cold Refrigerant Vapor
  - Cold Refrigerant Liquid
- **COOLING COILS IN BUILDING**
Natural Gas Engine Driven Chiller

- Condenser
  - Hot Refrigerant Vapor
  - Warm Refrigerant Liquid

- Compressor
  - Cold Refrigerant Vapor

- Expansion Valve
  - Cold Refrigerant Liquid

- Evaporator
  - Cold Refrigerant Liquid

- Cooling Coils in Building

- Gas Engine
TECOCHILL RT Series

Air-Cooled Water Chiller or Condensing Unit
TECOCHILL RT Series

Air-Cooled Water Chiller or Condensing Unit
TECOCHILL DT Series

Water Chiller
TECOCHILL CH-400x
TECOCHILL Hybrid Installation
Engine Driven Chillers

**Benefits:**

- Lowest Operating Cost/Lowest Life Cycle Cost
- Most Efficient Technology Available
  - High-Efficiency Screw Compressor
  - Variable Speed Engine Drive
  - Very High Part Load Efficiency
  - Continuous Load-Following Capability
Engine Driven Chillers Benefits

- Heat Recovery Capability
- Environmentally Friendly
  - Non-CFC Refrigerant
  - Reduced Global Warming
  - Reduced Fossil Fuel Use
  - Reduced CO$_2$ Emissions
Engine Driven Chillers

- Engine Driven vs. Electric
  - Significantly Lower Operating Costs
  - Peak Electric Demand Reduction
  - Heat Recovery Capability
  - Superior Part Load Efficiency
  - Stand-by Generator Size Reduction
  - Back-up Cooling During Power Outages
  - Avoid Electric Service Capacity Upgrades
Understanding Your Electric Bill

80% Demand Ratchet

[Graph showing Billed Demand vs. Actual Demand with a peak demand and the cost of ratchet highlighted.]
Engine Driven Chillers

- Engine Driven vs. Absorption
  - Lower Operating Costs
    - High COP; Much Higher at Part Load
    - Low Parasitics
  - Easy Retrofits
    - Smaller Footprint
    - Can Use Existing Tower, Pumps, Piping
  - Familiar Vapor Compression Technology
  - Low Temperature Capability
Economic Analysis Is Critical In Chiller Decision-Making
Typical Building Load Profile

- 25% Load: 610 hours per year
- 50% Load: 1472 hours per year
- 75% Load: 1212 hours per year
- Full Load: 155 hours per year
Importance of Part Load Efficiency

- **TECOCHILL** IPLV = 2.6
- **DF Absorber** IPLV = 1.1

![Graph showing COP vs. % Full Load for TECOCHILL and DF Absorber](image)
Factors Affecting Chiller Economics

- Equipment Operating Efficiency (IPLV)
- Gas and Electric Rates (Including Demand)
- Use of Heat Recovery
- Utility Rebates
- Equipment and Installation Costs
- Electric Power Requirements (Transformer, Switchgear)
- Standby Generator Requirements
Savings Example: (1) TECOCHILL CH-400x

Operating Information

- Peak Load: 400 tons
- Annual Hours of Operation: 3,000 hours/yr
- Equivalent Full Load Hours (EFLH): 1,500 hours/yr
- Cooling Season Length: 6 months/yr
# TECOCHILL Gas Cooling Energy Cost Analysis - Boston Area Project

## Electric Utility Rates

| Summer Demand: | $22.52/kW |
| Winter Demand | $11.25/kW |
| Energy Rate:   | $0.068/kWh |

## Natural Gas Utility Rates

| Cooling Rate:  | $0.60/therm |
| Boiler Rate:   | $0.60/therm |

## Chiller Efficiencies

<table>
<thead>
<tr>
<th>Electric:</th>
<th>IPLV</th>
<th>Full Load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.62 kW/ton</td>
<td>0.6 kW/ton</td>
</tr>
<tr>
<td>Absorption:</td>
<td>1.00 COP</td>
<td>1.00 COP</td>
</tr>
<tr>
<td>TECOCHILL:</td>
<td>2.50 COP</td>
<td>1.60 COP</td>
</tr>
</tbody>
</table>
Annual Energy Costs - Boston Area

TECOCHILL vs. Other Chillers

- Electric Chiller: $52,315
- Absorption Chiller: $55,230
- TECOCHILL without heat recovery: $20,446
- TECOCHILL with heat recovery: $8,926
Characteristics of Good Gas Engine Chiller Applications

- Owner-Occupied
- High Electric Demand Rates
- Insufficient Electric Power
- Cooling Necessary During Power Outages
- Hot Water Needed
- Process Applications
- Eligible for Utility Rebates
Typical Gas Engine Driven Chiller Applications

- Hospitals
- Nursing Homes
- Colleges/Schools
- Hotels
- Industrial/Process
- Multi-Family Residential
- Department Stores
- Ice Rinks
U. S. Installations: TECOCHILL/TECOGEN/TecoFROST
TECOCHILL CH-50ACP
TECOCHILL CH-50ACP
TECOCHILL CH-50ACP
TECOCHILL CH-400x
TECOCHILL CH-400x
TECOCHILL CH-200x
The Future of Gas Engine-Driven Cooling is NOW!!!