SCHOOL AND MUNICIPAL BUILDINGS

140 Projects
8-year Period

Reasons for All-Electric Trend
- Improvement in heat pump technology
  - Air source heat pump operation down to zero degrees
  - Water source heat pump providing 130-degree water at 5 degrees
- EUI 25 to 35
- Efforts for decarbonization
- Rising natural gas prices

Electrical Distribution Considerations
- 50% increase in Service Size
- 100% increase in the Emergency Generator Size
GEOTHERMAL WELL FIELD

**Pros:**
- High energy efficiency
- Reduced carbon footprint for environmental considerations
- Low noise levels inside and outside of building as no exterior mounted equipment with condensers or fans are required
- Potential for heat recovery; simultaneous heating and cooling

**Cons:**
- Increased capital investment for geothermal plant
- Requires increased site coordination for well locations
- Higher automatic temperature controls for geothermal plant equipment
- Requires increased maintenance for geothermal plant equipment (filters, additional pumps, etc.)

**Options:**
- Traditional U-bends: HDPE (2 Pipe)
- Quad Loop: Double U-Bend (4 Pipe)
- Coaxial Rygan Well
TRADITIONAL U-BENDS: HDPE (2 PIPE)

Pros:

• Easiest to install.
• 6” diameter bore required (smaller than other options)
• Installed universally by most contractors.
• Heat-exchanger available with short notice.

Cons:

• Requires more drilling than the other options provided.
• Requires the most excavation.
• Least Heat Transfer of the three heat exchangers.
  ➢ Up to 3.25-tons per bore
  ➢ The comparison assumes 500-foot bores
• Installed universally by most contractors.
• Heat-exchanger available with short notice.
**Pros:**
- Provides up to 25% more Thermal capacity than a single u-bend
- Requires Less drilling than the traditional u-bend
- Less excavation than the traditional U-bends
- Can be installed to depths of 900-feet
- Up to 5-tons for a 600’ bore or 8-tons per 900-foot bore

**Cons:**
- May require a larger diameter bore than a traditional U-bends
- Limited contractors who install this heat-exchanger
- Heat exchanger requires a 4–6-week lead time to procure

Website: www.Versaprofiles.com
The HPGX system is a coaxal heat exchanger comprised of a composite material that provides the most efficient heat transfer of the three options.

Pros:
- Requires less drilling. Fewer bores required to achieve the desired transfer.
- Less impact to the site, reduced space needed.
- Less excavation than quad & traditional u-bend systems.
- Can be installed to depths of 1500-feet.
- Up to 10-tons per 1000-foot bore

Cons:
- Most costly to install-per foot cost.
- May require a larger diameter bore for exchanger at deeper depths.
- Limited certified installers
- Long lead times to procure product

Website: www.Rygancorp.com
### MECHANICAL SYSTEM PAYBACK SUMMARY

#### SCHOOL EXAMPLE

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<tbody>
<tr>
<td></td>
<td>1. Hot water coil heating/chilled water coil cooling VAV AHU system with energy recovery and terminal VAV boxes with hot water radiant coils</td>
<td>$7,085,144</td>
<td>542,150</td>
<td>1,704.8</td>
<td>$108,430</td>
<td>$32,459</td>
<td>$150,910</td>
<td>$1.10</td>
<td>$52.1</td>
<td>$152,704</td>
<td>$1,450,500</td>
<td>$203,031</td>
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#### Base Design

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<tbody>
<tr>
<td></td>
<td>1. Dehumidification displacement ventilation diffusers with radiant heating panels</td>
<td>$6,025,903</td>
<td>511,760</td>
<td>1,551.7</td>
<td>$102,930</td>
<td>$11,676</td>
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<td>2. Gas-fired heating/cooling VAV ventilating units with energy recovery with terminal VAV boxes with CO2 controls</td>
<td>$7,998,654</td>
<td>897,380</td>
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<td>$-953,002</td>
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<td>3. High efficiency water-cooled chiller plant with dry cooler</td>
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<td>4. Supplemental electric boiler plant</td>
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#### Tier 1

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<td>1. Dehumidification displacement diffusers with radiant heating panels</td>
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<td>2. Hot water coil heating/chilled water cooling VAV ventilating units with energy recovery with terminal VAV boxes with CO2 controls</td>
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<td>3. Geothermal wells with high-efficiency water-to-water source heat pump chillers</td>
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<td>1. Dehumidification displacement diffusers with radiant heating panels</td>
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<td>$150,823</td>
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<td>$273,002</td>
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#### Tier 3

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* Gross Capital Investment: The initial cost of implementing the system.
** Combined Expense Savings: Savings from energy usage over the life cycle.
*** Total Life-Cycle Savings: Total savings with discounting.
**** Discounted Payback: Time it takes to recover the initial investment with discounting.
## Mechanical System Payback Summary

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<tbody>
<tr>
<td>1</td>
<td>Full air-conditioning displacement ventilation diffusers with passive heating radiation.</td>
<td>$7,818,915</td>
<td>$1,122,100</td>
<td>$177,175</td>
<td>$1.14</td>
<td>24.7</td>
<td>600,050.0</td>
<td>185,018.3</td>
<td>$23,150</td>
<td>$200,326</td>
<td>$50,547</td>
<td>$1,102,845</td>
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<tr>
<td>2</td>
<td>Variable refrigerant flow (VRF) terminal evaporator units with air-cooled condensing units serving the administration, classroom media center, and support areas.</td>
<td>$9,354,430</td>
<td>$1,220,000</td>
<td>$192,959</td>
<td>$1.24</td>
<td>26.9</td>
<td>752,082.2</td>
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<td>$50,750</td>
<td>$243,709</td>
<td>$13,164</td>
<td>$1,746,335</td>
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<td>3</td>
<td>Full air-conditioning displacement ventilation diffusers with passive heating radiation.</td>
<td>$10,044,815</td>
<td>$149,500</td>
<td>$149,807</td>
<td>$0.97</td>
<td>20.9</td>
<td>593,291.3</td>
<td>235,307.6</td>
<td>$18,150</td>
<td>$148,037</td>
<td>$98,836</td>
<td>$1,922,366</td>
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<td>4</td>
<td>Full air-conditioning displacement ventilation diffusers with passive heating radiation.</td>
<td>$9,745,335</td>
<td>$1,435,000</td>
<td>$228,588</td>
<td>$1.46</td>
<td>31.8</td>
<td>853,682.0</td>
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<td>$33,125</td>
<td>$299,713</td>
<td>$42,840</td>
<td>$1,010,599</td>
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</tbody>
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**School Example**

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375 Faunce Corner Road, Suite D
Dartmouth, MA 02747
P (508) 998-5700  F (508) 998-4083