REHAU

Unlimited Polymer Solutions

DESIGNING CAMPUS PIPING SYSTEMS

THAT ARE EFFECTIVE AND BUILT TO LAST

BENEFITS OF USING PEX PIPE RATHER THAN METALLIC PIPE

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Construction
Automotive
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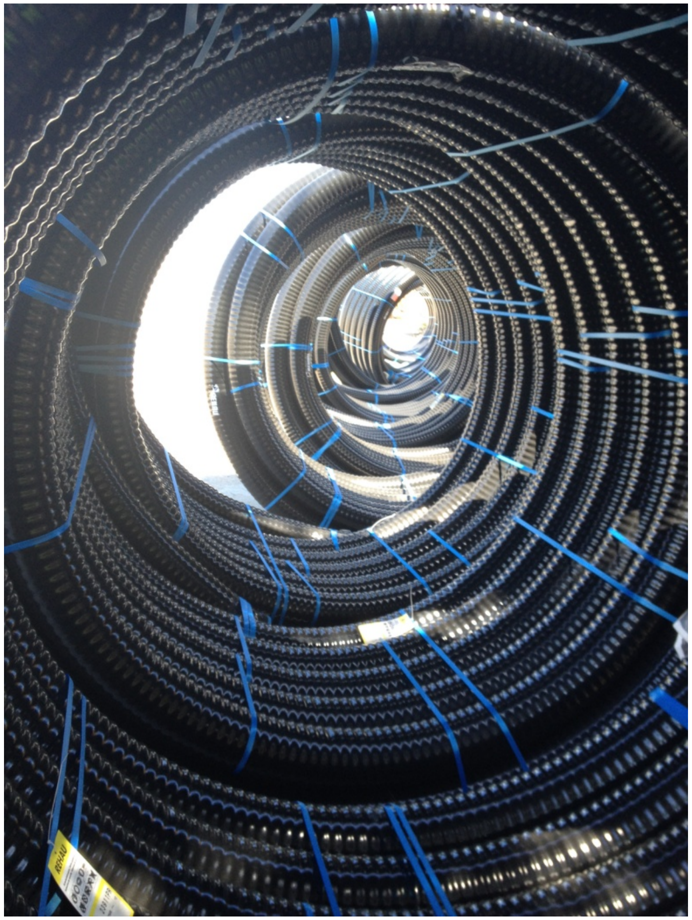
PRESENTATION OUTLINE

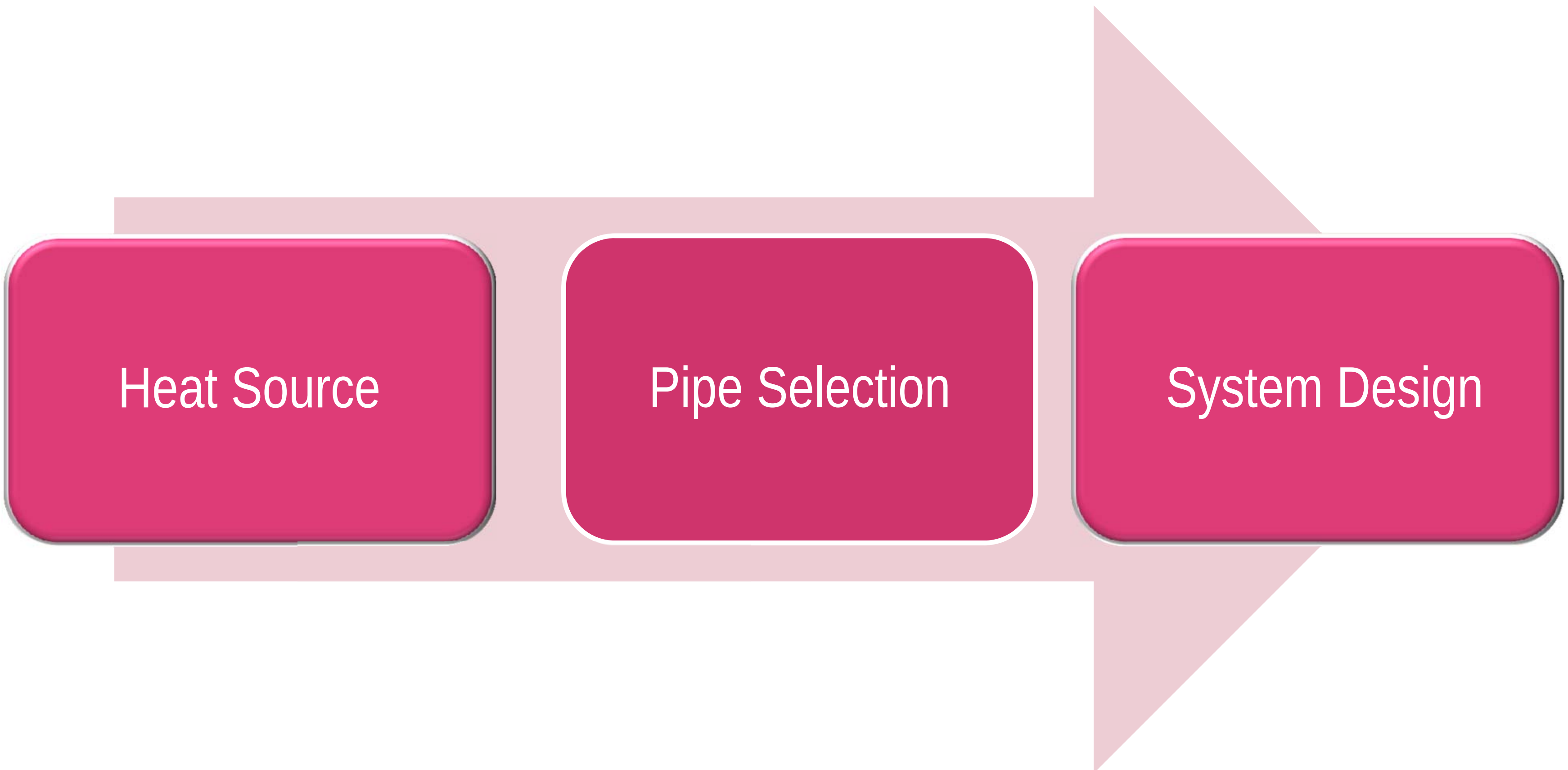
Considerations when designing a campus piping system:

- Establish potential heat sources
  What options are available?
- Determine correct pipe materials and properties (steel vs. polymer)
  Which is the most appropriate pipe material for the project?
- Evaluate design and installation
  What key data is needed to size a pre-insulated piping system?
- Case study review of campus piping projects



HEAT SOURCES

OVERVIEW



HEAT SOURCES

OPTIONS AVAILABLE

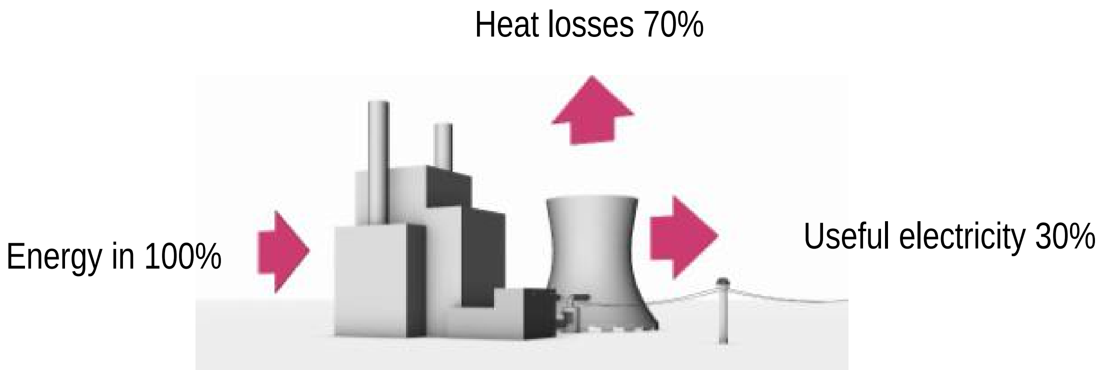
- Biogas (wood chip, pellet)
- Gas boiler
- Gas-fired CHP
- Biomass CHP
- Anaerobic digestion CHP
- Geothermal
- Waste heat from power stations
- Energy from waste
- Industrial waste heat
- Solar thermal

HEAT SOURCES

COMBINED HEAT AND POWER (CHP)

BASIC PRINCIPLE

TRADITIONAL POWER PLANT

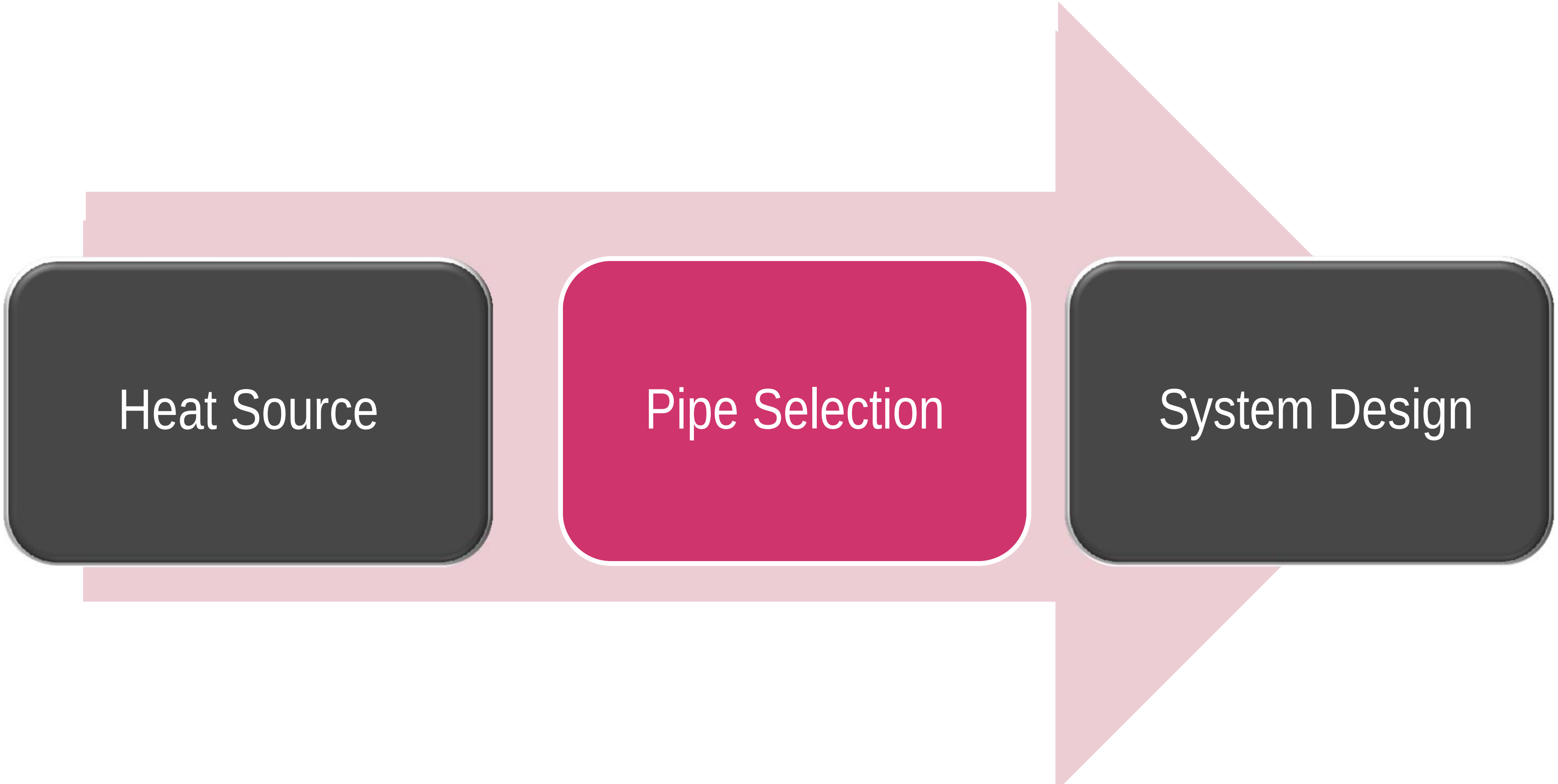


COMBINED HEAT AND POWER PLANT (CHP)

Not fuel source dependent – powered either using fossil fuels or renewable sources (such as biomass or biogas)

DESIGN AND INSTALLATION

OVERVIEW



PIPING MATERIALS

OPTIONS FOR PIPING MATERIALS

STEEL PIPE WITH PU FOAM

- ASTM A53 Steel
- Closed-cell
- Bonded

POLYMER PIPE WITH PU FOAM

- ASTM F876 Polymer
- Closed-cell
- Bonded

PIPING MATERIALS

STEEL PIPES

ADVANTAGES

- Very large diameter pipe sizes available
- Capable of withstanding higher operating temperatures/pressures
- Offered as conduit systems for high temperature steam

DISADVANTAGES

- Only straight lengths possible so joints are required ever 20 to 40 ft
  - 75% of steel pipe failures come from on-site welding (district heating damage study in Germany)
- Corrosion problems resulting in need for warning systems

PIPING MATERIALS

POLYMER PIPES

ADVANTAGES

- Polymer pipes do not corrode, and therefore do not require corrosion protection
- Long coil lengths reduce need for buried joints
- Do not require on-site field welding (simple compression-sleeve technology)
- Can be designed in a way that does not require expansion loops or compensators

DISADVANTAGES

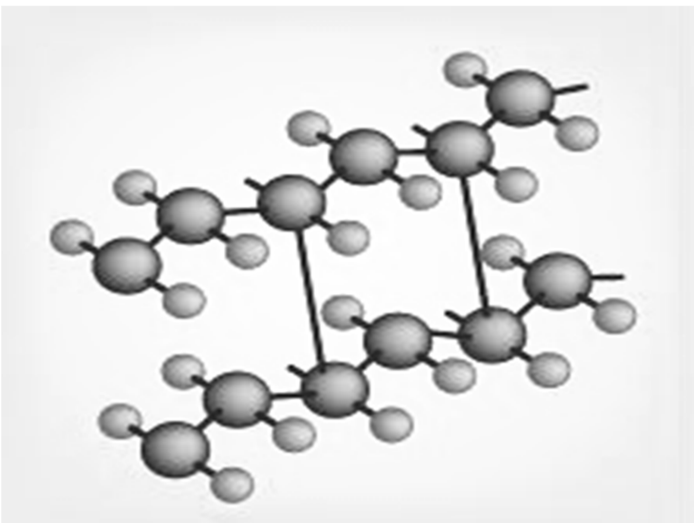
- Limitations on size
- Limitations on temperatures/pressures

PIPING MATERIALS

CROSSLINKED POLYETHYLENE (PEX) PIPES

Definition

- PEX stands for **P**oly**E**thylene which is crosslinked (**X**)
- **Crosslinking** is a permanent change that bonds HDPE molecule chains together
  - PEX is a high-performance flexible thermoset polymer material
- **Crosslinking** improves the properties of polyethylene, especially in terms of high temperature strength, resistance to slow crack growth, improved chemical resistance and higher flexibility

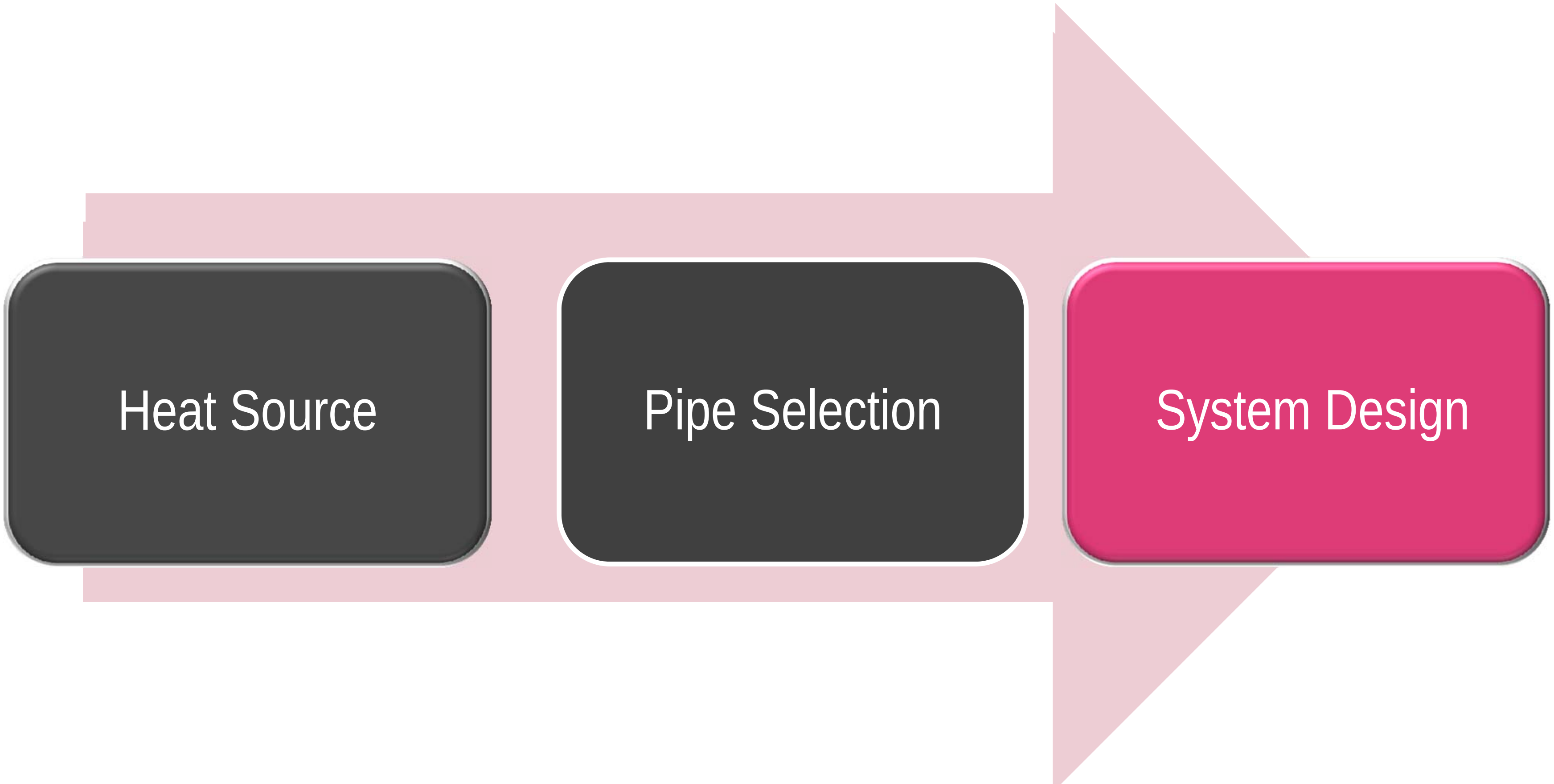


Crosslinked polyethylene matrix…

...Similar to a chain link fence

DESIGN AND INSTALLATION

OVERVIEW



DESIGN AND INSTALLATION

OPTIMIZING SYSTEM DESIGN

3 FOCUS AREAS

1. Increase life expectancy of system
2. Reduce maintenance and installation costs
3. Optimize pipe materials

DESIGN AND INSTALLATION

REDUCING INSTALLATION COSTS

TEMPERATURE AND PRESSURE LIMITS FOR POLYMER PIPE

The service life of PEX pipes is a minimum of 25 years under the following conditions:

- Continuous operating temperature and pressure up to 180°F at 100 psi (for SDR9 pipes) or 80 psi (for SDR11 pipes or combined SDR systems)

DESIGN AND INSTALLATION

USING SMALLER PIPE DIAMETERS

IMPORTANCE OF OPTIMIZING SUPPLY AND RETURN TEMPERATURES

Modern systems should use fluid temperatures below 180°F:

- Extends pipe lifespan
- Makes for a safer network (no steam)

Fluid Temperatures	Heat load	Pressure loss	Pipe size required
supply 180°F, ΔT 20°F	1.5 million Btu/hr	.51 psi per 100 ft	125 mm SDR11
supply 180°F, ΔT 30°F	1.5 million Btu/hr	.45 psi per 100 ft	110 mm SDR11
supply 180°F, ΔT 50°F	1.5 million Btu/hr	.48 psi per 100 ft	90 mm SDR11

Ensure return temperature is as low as possible (high ΔT)

- Reduced pipe size = reduced capital costs
- Ensures low-temperature hot water can be used (e.g., waste heat from CHP)

DESIGN AND INSTALLATION

USING SMALLER PIPE DIAMETERS

IMPORTANCE OF OPTIMIZING SUPPLY AND RETURN TEMPERATURES

Supply / return temperatures	Pipe size	Flow rate	Heat loss thru pre-insulated PEX pipe wall
180°F / 160°F	125 mm SDR11	158 USGPM	3000 Btu/hr per 100ft
180°F / 150°F	110 mm SDR 11	105 USGPM	2800 Btu/hr per 100ft
180°F / 130°F	90 mm SDR11	63 USGPM	1800 Btu/hr per 100ft

Increased ΔT = reduced heat losses = operational cost savings

DESIGN AND INSTALLATION

USING SMALLER PIPE DIAMETERS

IMPORTANCE OF OPTIMIZING SUPPLY AND RETURN TEMPERATURES

Losses

- Reducing the supply temperature has a significant effect on the system losses.
- Typically, a district heating network with a supply / return of 158/131°F has losses of 6-7%
- Reducing the system conditions to 131/86°F can reduce district heating network heat losses to 3 to 4%.

Pipeline Materials

- Systems operating at lower temperatures can make use of polymer PEX pipes that last longer, are lower cost, more flexible and quicker to connect than conventional steel pipes.

Extracted from GLA Report on London's Zero Carbon Energy Resource (July 2013)

DESIGN AND INSTALLATION

LONGEVITY AND REDUCED MAINTENANCE

HYDRONIC PEX SYSTEMS PROVIDE LONG LASTING RELIABILITY

- With proper design and installation, hydronic distribution systems provide long-term performance and reliability, thanks to durable components such as PEX pipes
- PEX pipes are maintenance-free and do not corrode
- PEX pipes require no flushing or treatment

CASE STUDY

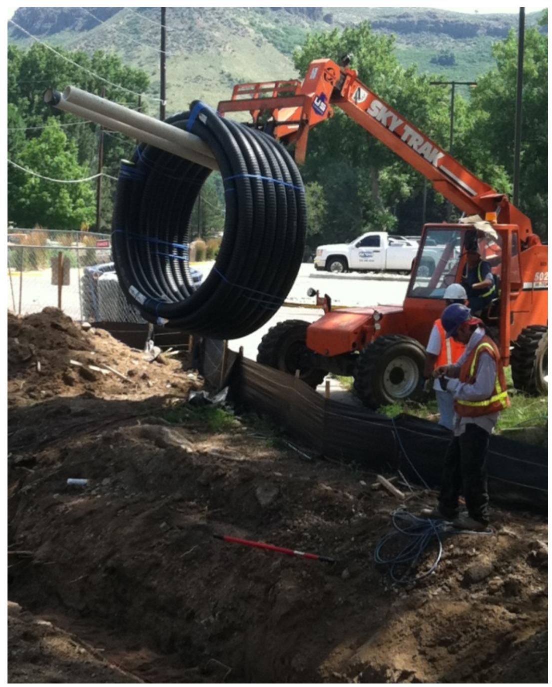
ADDITION OF COLLEGE ADMINISTRATION BUILDING
MIRAMAR COLLEGE, SAN DIEGO, CALIFORNIA

- 4-pipe heating and chilled water distribution system
- Engineered to eliminate expansion loops and thrust blocks for heating hot water

CASE STUDY

CAMPUS CHILLED WATER PIPING FOR STUDENT DORMATORIES
COLORADO SCHOOL OF MINES, GOLDEN, COLORADO

- Chilled water supply and return piping run from central plant to underground chase
- Utilized 110 mm (4 in) pipe
- Did not require any field joints over 600 linear feet

CASE STUDY

HEATING DISTRIBUTION RE-PIPE
FORT LEWIS COLLEGE, DURANGO, COLORADO

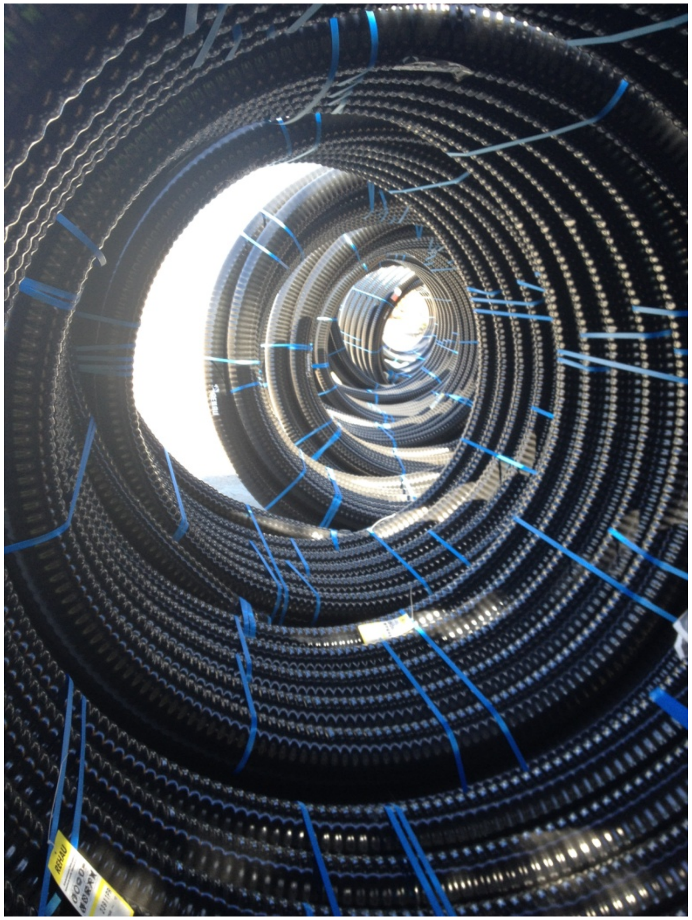
The school's heating distribution system was overhauled using polymer PEX pipe.

- 4,500 ft of pre-insulated pipe installed
- Required 4 buried joints
- Installed in less than 2 weeks

PRESENTATION REVIEW

Considerations when designing a campus piping system:

- Established potential heat sources
- Determined correct pipe materials and properties (steel vs. polymer)
- Evaluated design and installation
- Reviewed campus piping systems where modern design was implemented



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CONCLUSION AND QUESTIONS

This concludes the presentation

- Feel free to ask any questions related to today's topic

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