Saving Energy with Floating Head Pressure

Presentation to APEC – Southern Illinois

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Agenda

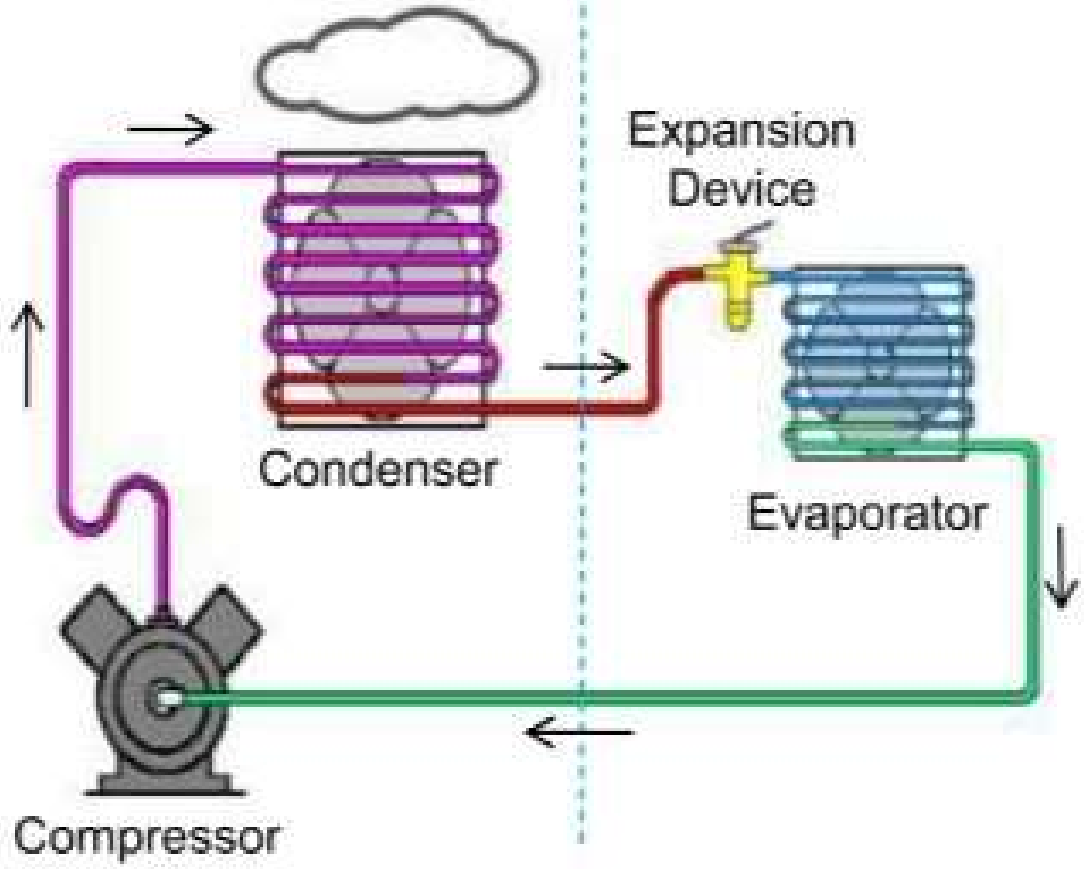
- Basics of Refrigeration Cycle
- Efficiency in Refrigeration Systems
- High Head Pressure – Causes
- Floating Head Pressure – Options

Basics of Refrigeration Cycle

Temperature vs Pressure

- Direct correlation between pressure and temperature
- As pressure increases, temperature increases
- Refrigerants do work by condensing (give off heat) or evaporating (absorb heat)

Basics of Refrigeration Cycle



Basics of Refrigeration Cycle

Where is energy used?

- Compressor *
- Condenser Fans *
- Evaporator Fans
- Defrost Heat

* We will be focusing today primarily on the first 2 items.

Efficiency in Refrigeration Systems

Compressor Efficiency

- Refrigerants must be compressed
- Higher compression ratio= higher power AND lower output
- Compressors vary in efficiency
- Compressors oversized for the load run inefficiently – cycle on/off frequently
- VFD compressors are more efficient – follow loads precisely

Condenser Efficiency

- Under-sized condenser = higher head pressure = higher compression ratio
- Constant-speed, conventional fan motors are inefficient vs VFD ECM motors

Evaporator Efficiency

- Under-sized evaporator = lower suction pressure = higher compression ratio

Efficiency in Refrigeration Systems

Thermostatic Valves (TXVs)

- Why "Thermostatic"?
- TXVs: conventional, balanced-port, or electronic
- Conventional TXVs need a high pressure differential to operate

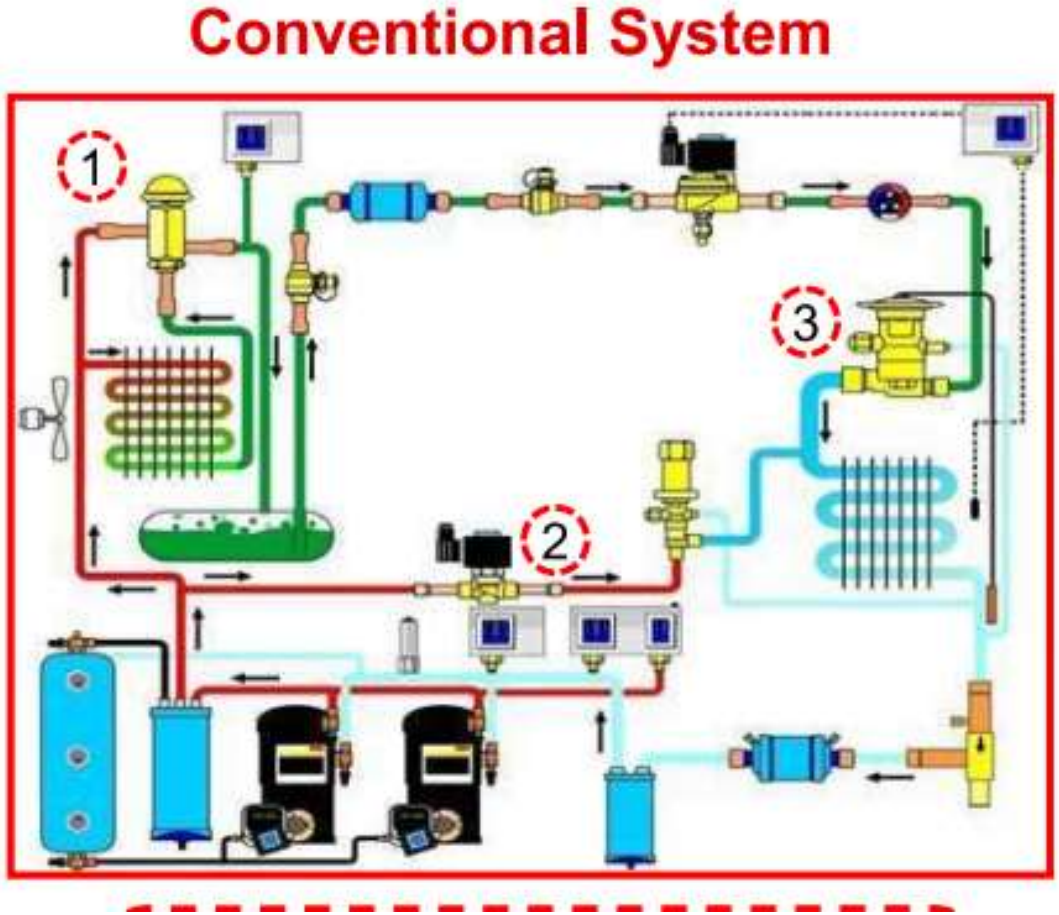
Condenser Design

- May include various devices to maintain high head pressure
  - Hold-back valves
  - Hot gas bypass valves

High Head Pressure – Causes

Elements causing high energy use:

- 1 Hold-Back Valve
- 2 Conventional TXV
- 3 Hot Gas Bypass Valve
- Compressors operate on/off
- Condenser fan constant speed on/off

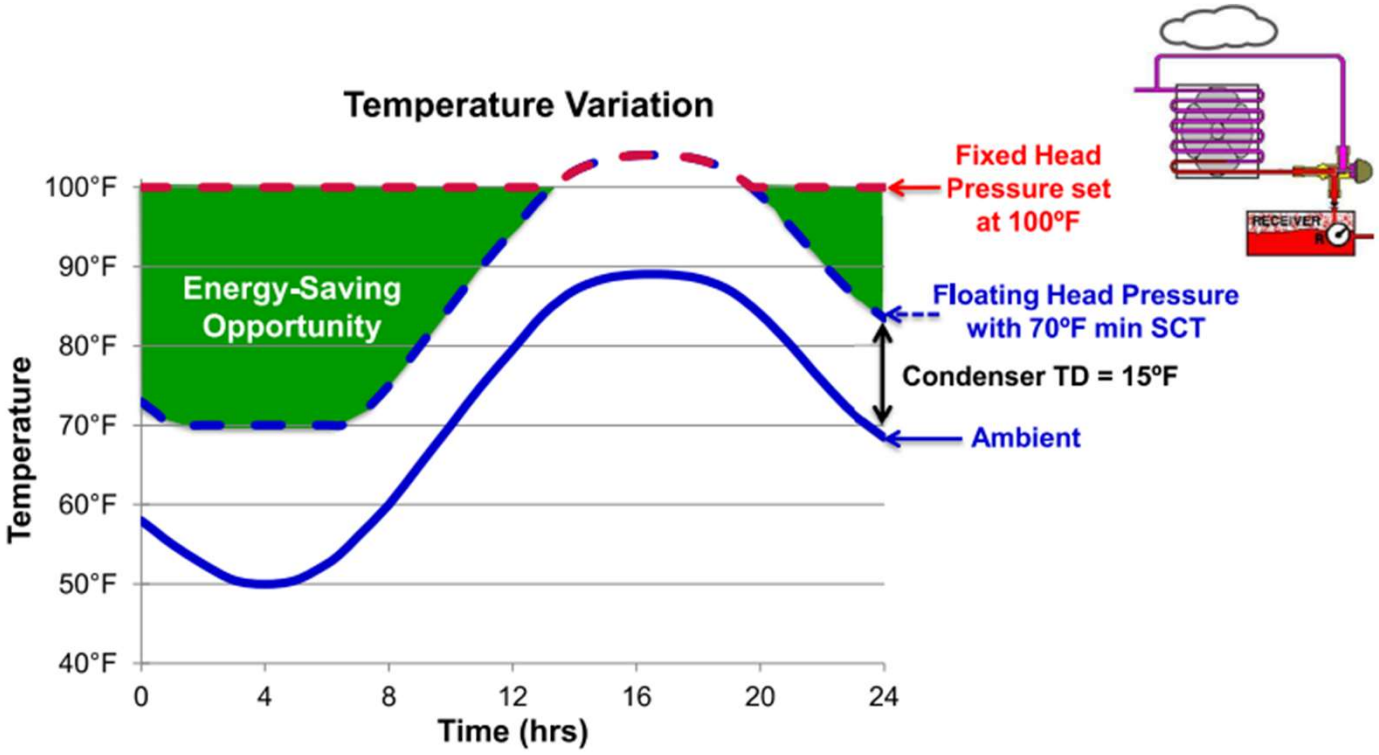


Reducing Energy use: Floating Head Pressure & Efficient Condensing

- Floating head pressure will reduce compression ratio most of the year
- Efficient condensers reduce energy use while providing more stable system operation

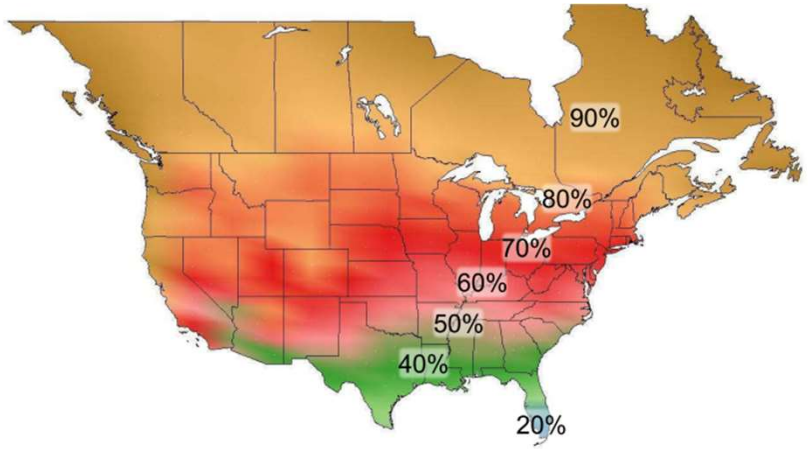
Floating Head Pressure - Theory

- Ambient air fluctuates over year
- Condenser TD adds 10-15F
- Conventional Min HP = 100F = 275 psi
- Optimal Min HP =70F or less = 150 psi
- Green area = savings potential

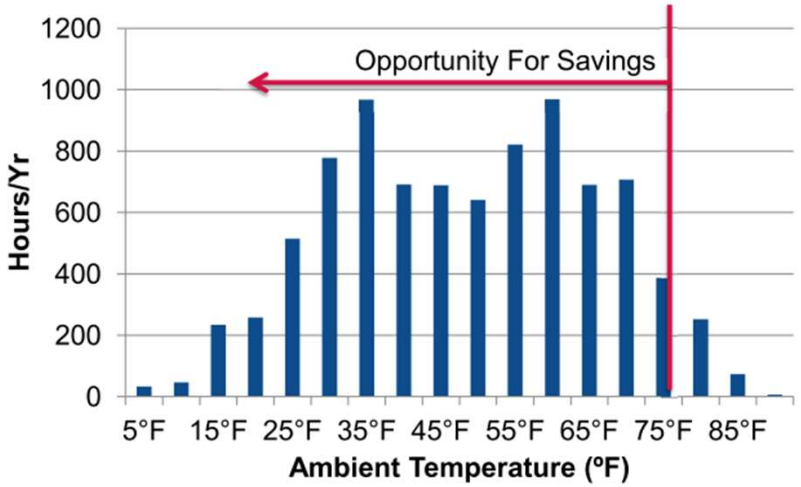


Floating Head Pressure - Theory

- Illinois weather is good for FHP
- 60%% to 70% of year is below 60F

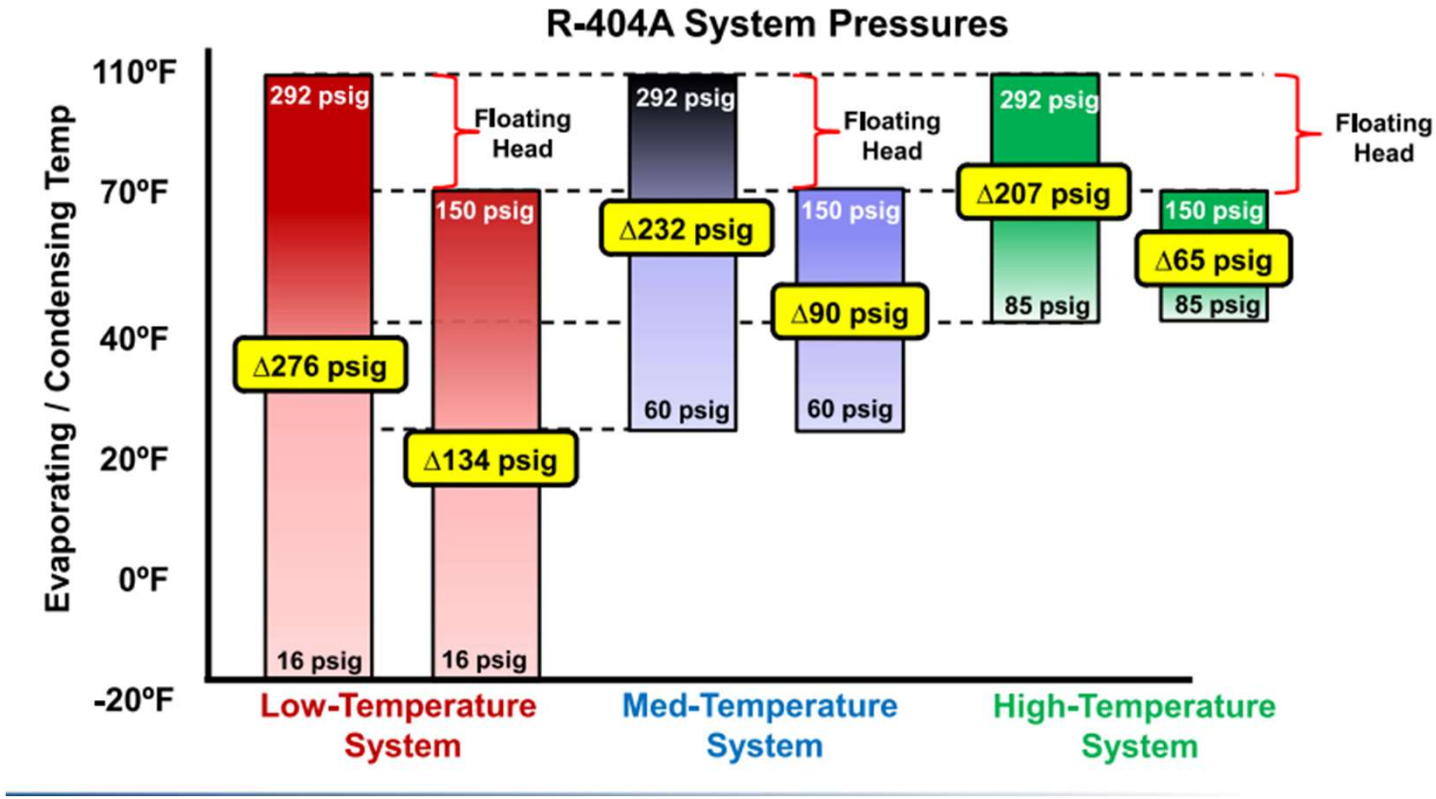


Significant Opportunity for Savings



Floating Head Pressure - Theory

- FHP can make all systems more efficient (R-404A example)



Floating Head Pressure - Options

Simple, Inexpensive Measures

1. Retrofit Balanced-port TXV
2. Manually reduce condenser fan cut-in/cut-out pressure setpoint
3. Manually reduce Hold-Back Valve pressure setpoint
4. Eliminate or adjust setpoint of Hot Gas Bypass Valve

Floating Head Pressure - Options

Moderate Cost Measures

1. Install VFD ECM Condenser fan motors
2. Upgrade to Electronic TXV
3. Retrofit improved DDC controls

Floating Head Pressure - Options

Higher-Cost Measures

1. Install new compressors with VFD
2. Replace entire condensing unit
3. Install new low temperature condenser option with segmented condensers, insulated and heated high-pressure receiver and Limitrol controls

Modified System to Reduce Head Pressure

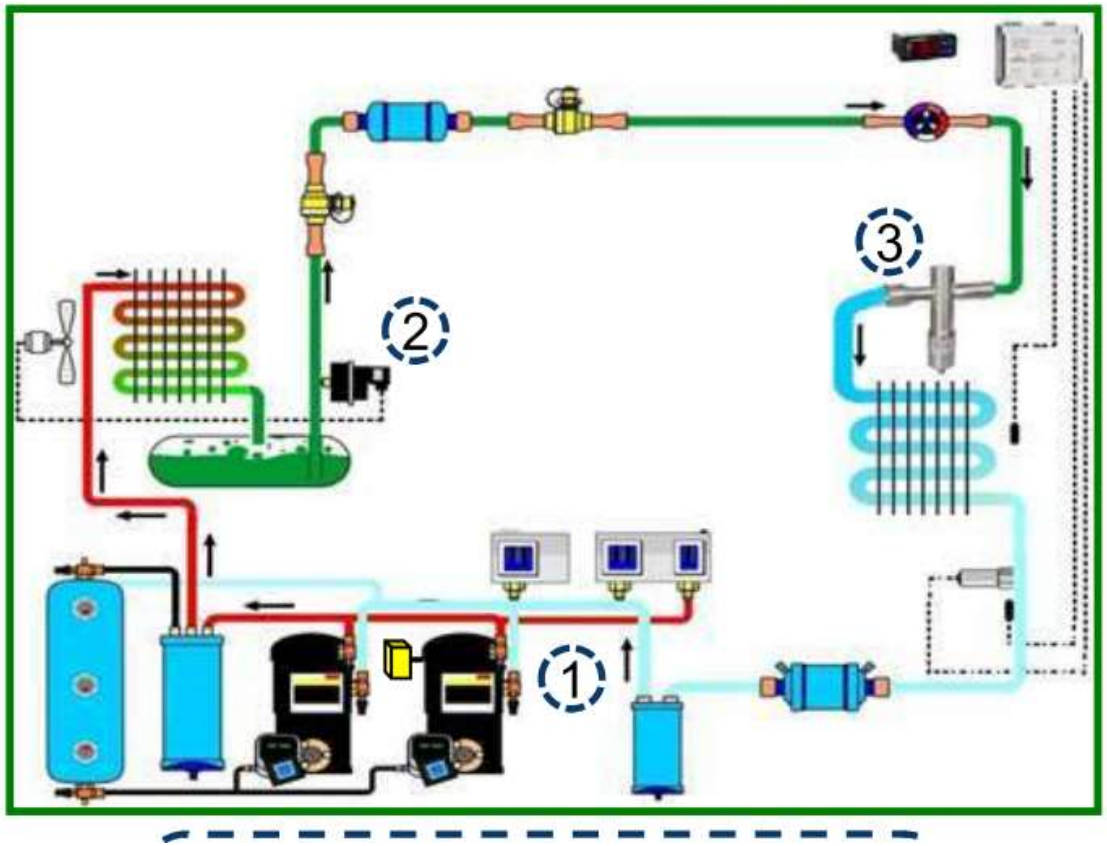
1 Add Modulating Compressor Controls

2 Remove Hold-Back Valve

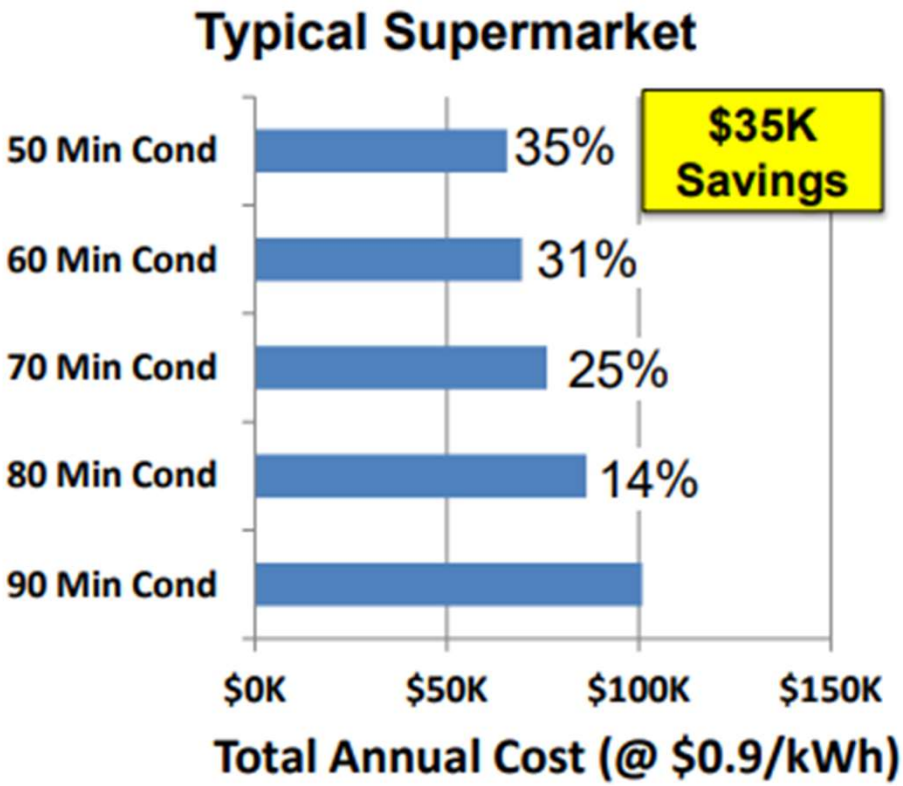
3 Install Electronic TXV

4 Install Condenser Fan VFD Controls

5 Remove Hot Gas Bypass Valve



Typical Savings with FHP



*Based on Boston Installation, 750MBU MT, 235MBU LT

20 HP Condensing Unit

	Min. Cond. Temp	Annual Energy (kWhr)	Annual Energy Cost	Annual Savings
Low Temp	100°	113	$8,450	Base
	70°	82	$6,170	$2,280
	50°	77	$5,794	$2,656
Medium Temp	100°	142	$10,618	Base
	70°	100	$7,461	$3,158
	50°	91	$6,798	$3,820

Savings Multiplied with Additional Load/Systems

*Based on St. Louis Installation

Questions?

Thank you!