BUILDINGENERGY NYC

Engineering Design Considerations for Energy and Carbon Reduction Recommendations

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Speakers

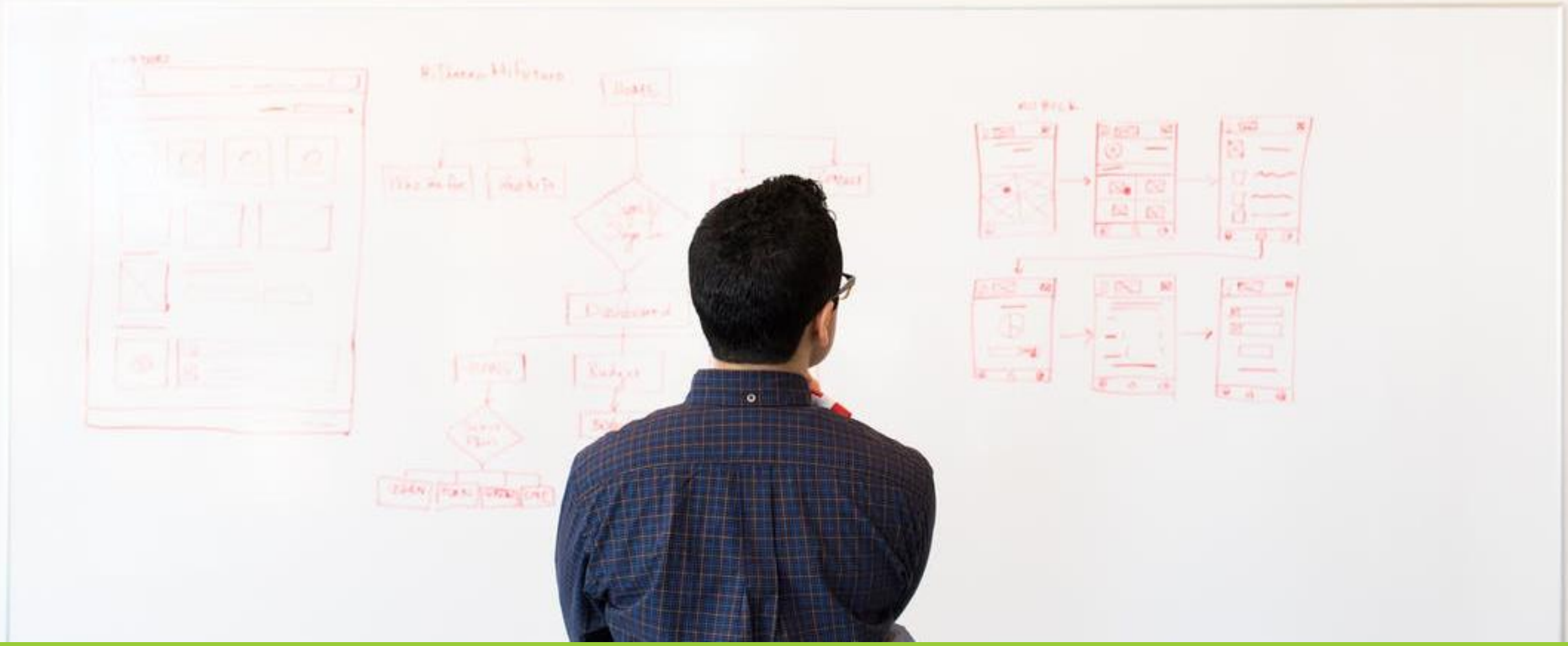
Learning Objectives

Create energy & carbon reduction roadmaps **that better support retrofits**

Close the communication loop between engineers/architects and energy auditors

Be better equipped to facilitate and lead discussions with stakeholders

Make better, **more cost-effective decisions** regarding building measures



Property Management

Property Management

Typical Project Concerns

Will the engineering project(s) reduce carbon emissions and thereby reduce Local Law 97 penalty?

Are building services going to be disrupted?

How long is the process going to take?

Is the estimated project cost accurate?
Will the cost substantially exceed the budget?

Property Management

Desired Project Outcome

Building comfort and performance is improved as planned

- Decrease LL97 penalty
- Increase comfort levels (with respect to odors, noises, temperatures, etc.)

Maximize project returns

- Identify and implement cost-effective measures
- Obtain incentives and/or lost-cost loans

Smooth project implementation

- Minimize interruptions to residents
- Minimize change orders
- Stay in expected budget

Energy & Carbon Auditing

Energy & Carbon Auditing

What is it and why is it important?

What is an energy audit?

Why are preliminary surveys increasingly important?

Why is there sometimes a disconnect between recommendations and design implementation?

What impact does this have on the industry?

Importance of Collaboration Between Design and Audit Teams

Energy & Carbon Auditing

Commonly recommended measures

Variable Frequency Drives (VFDs)

- Size and run time of motors
- Appropriate application
  - Variable load from terminal units
  - Feasibility of parallel pumping

Energy & Carbon Auditing

Commonly recommended measures

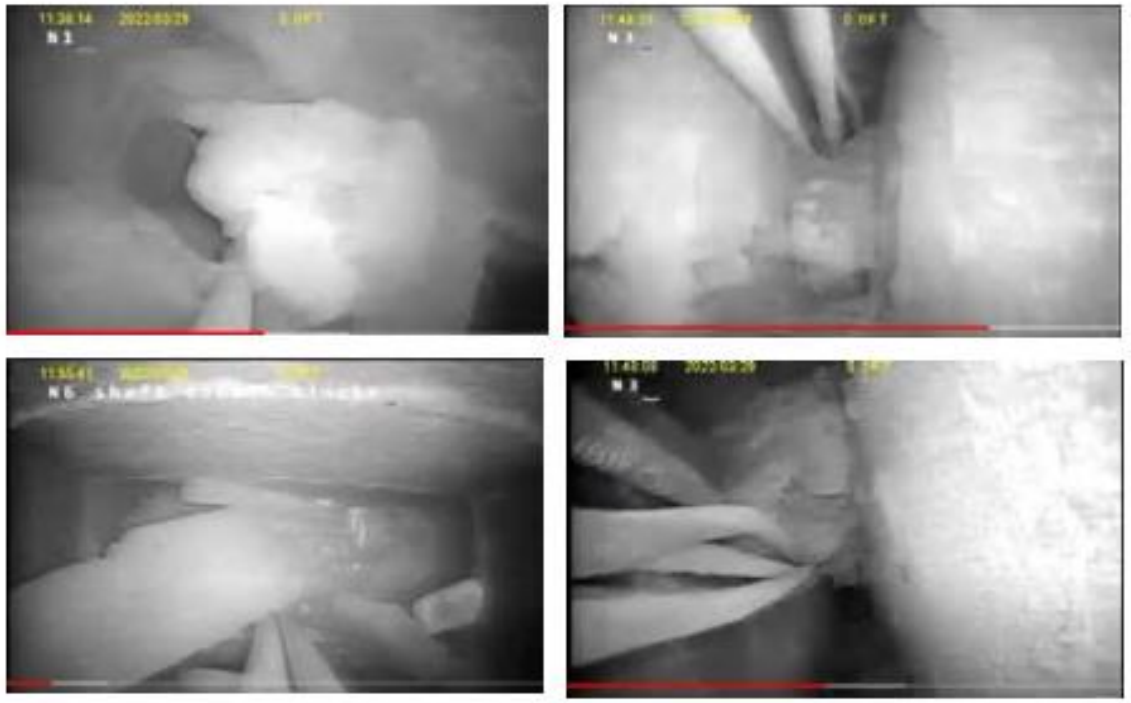
Ventilation

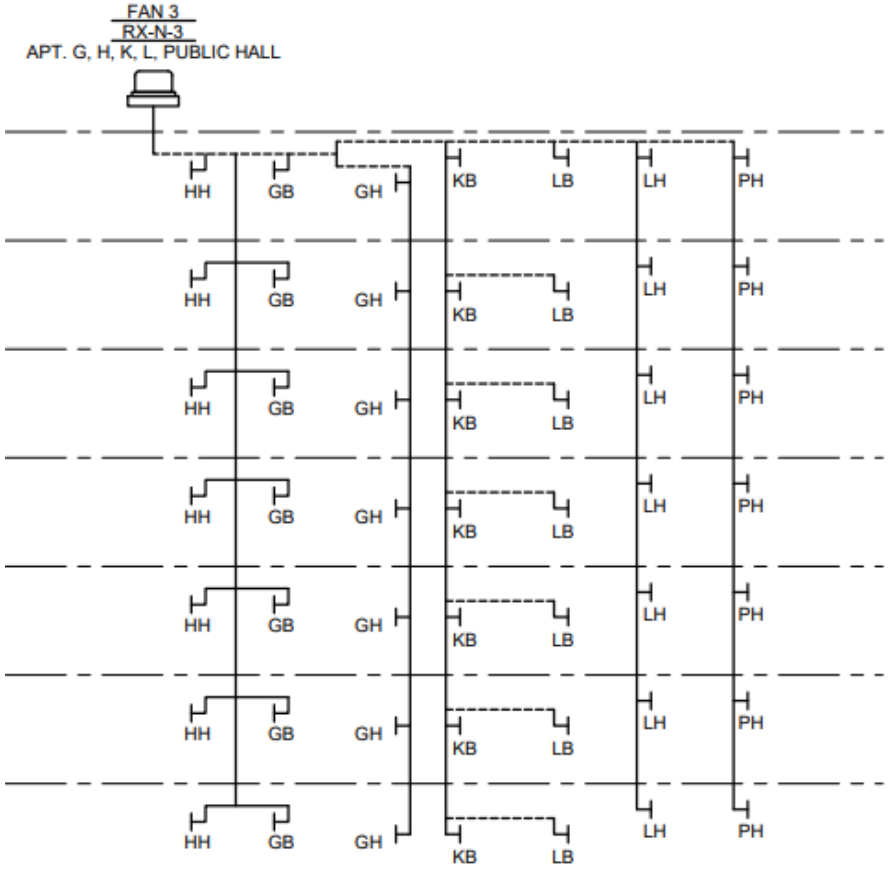
- Duct construction and severity of duct condition
- Fan size and system imbalance
- Fan operation

Energy & Carbon Auditing

Commonly recommended measures

Ventilation





Energy & Carbon Auditing

Commonly recommended measures

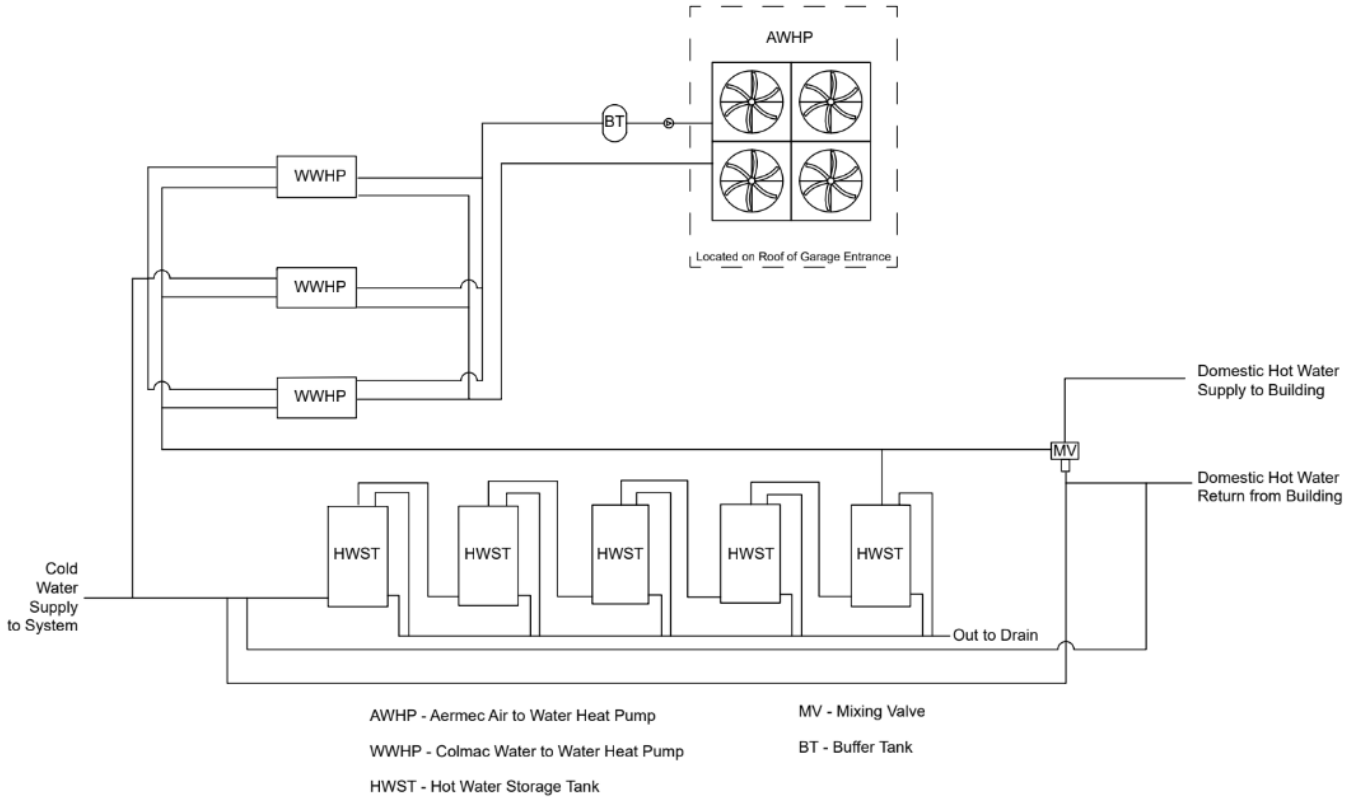
Separate Domestic Hot Water (DHW) Heaters

- Space and piping
- Venting considerations
- Space and rigging
- Natural gas availability
- Electrification of DHW

Energy & Carbon Auditing

Commonly recommended measures

Separate Domestic Hot Water (DHW) Heaters



Energy & Carbon Auditing

Commonly recommended measures

Solar Photovoltaic (PV)

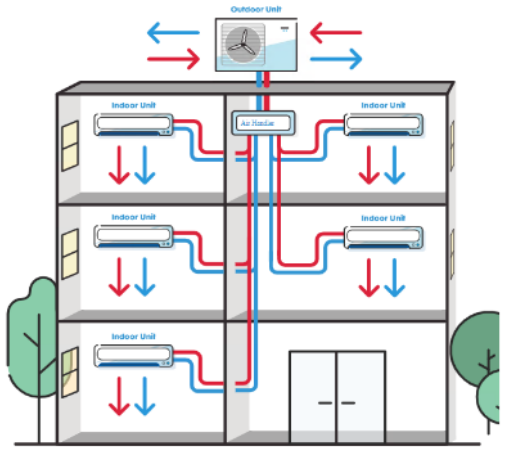
- Roof space (roof edge and equipment)
- Existing electrical load
- Electrical infrastructure challenges
- Roof construction and infrastructure

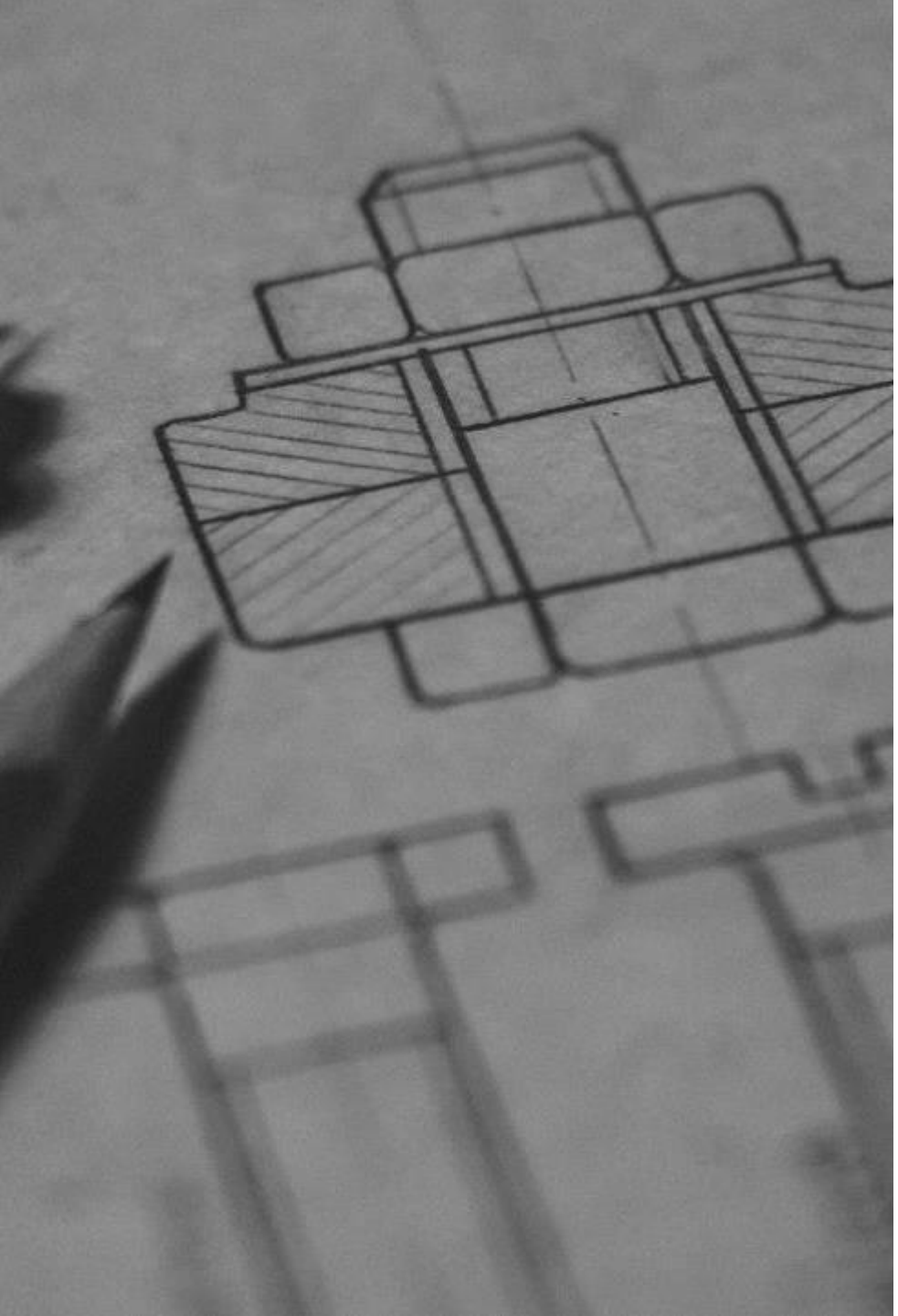
Energy & Carbon Auditing

Commonly recommended measures

Electrification (Heat Pumps / VRFs)

- Sizing requirements
- Electrical upgrade requirements
- Infrastructure requirements
- Envelope improvements





Energy & Carbon Auditing

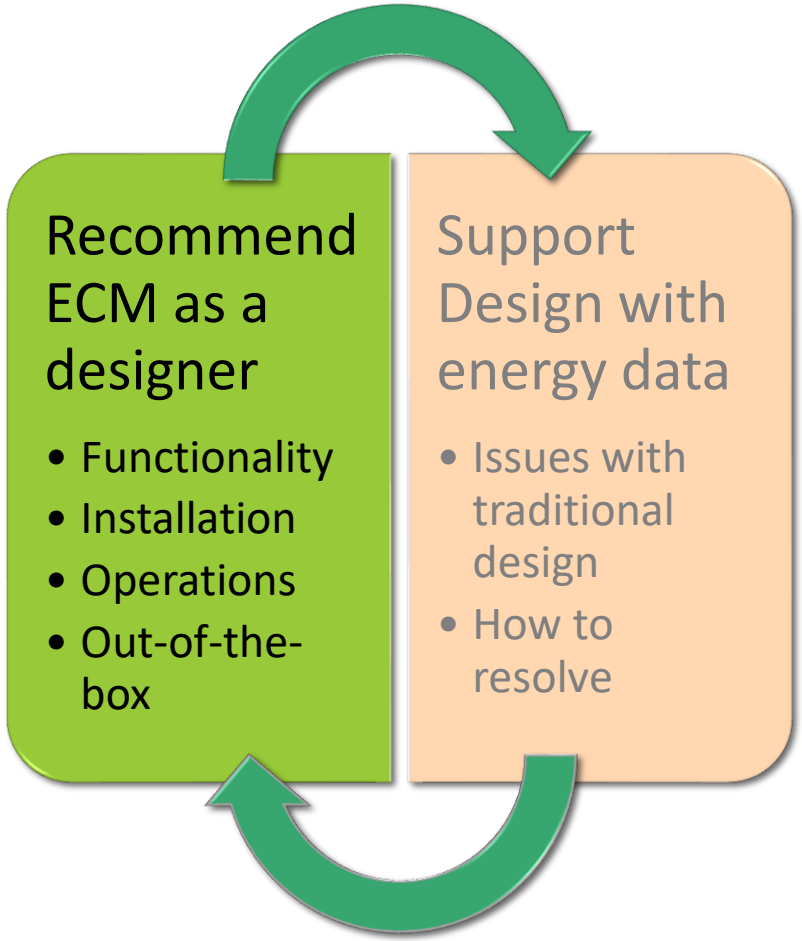
Common issues and observations

While all the mentioned energy conservation measures (ECMs) may seem like good recommendations, they have **hidden design considerations** that cannot always be identified during energy auditing, particularly with limited access and building information.

Potentially unseen costs from the auditing phase make implementation **less attractive**.

Design Considerations

Design Considerations



Design Considerations – Functionality

How would the recommended measures integrate?

- Existing building systems & personality
- Available utility services
- Equipment limitations
- Code limitations

Example: Recommend air source VRF system for high-rise buildings

- VRF piping length capacity
- Limitation of system heating capacity
- ASHRAE 15 requirements

Design Considerations – Installations

How would the recommended measures be installed?

- Space and rigging considerations
- Project staging
- Service interruptions
- DOB inspections
- Utility connections

Examples:

- Recommend VFD: Space constraint for VFD installation
- Recommend boiler / hot water heater: Available rigging path for bringing in large equipment
- Recommend system replacement: How to maintain building utility during installation? Building parallel system? Provide temporary service?
- Boiler upgrade triggers DOB inspections, also backflow preventer (BFP) installations

Design Considerations – Operations

How will the equipment operate?

- Building occupancy type & operation schedule
- Building expectations
- Ability and capacity to manage systems
- Potential impacts to residents / neighbors

Examples:

- What is a good candidate for demand control ventilation?
- Communicate with the building management and residential board members
- Staffing of the building management team
- What will be the noise level of the recommended equipment?

Design Considerations – Out-of-the-Box

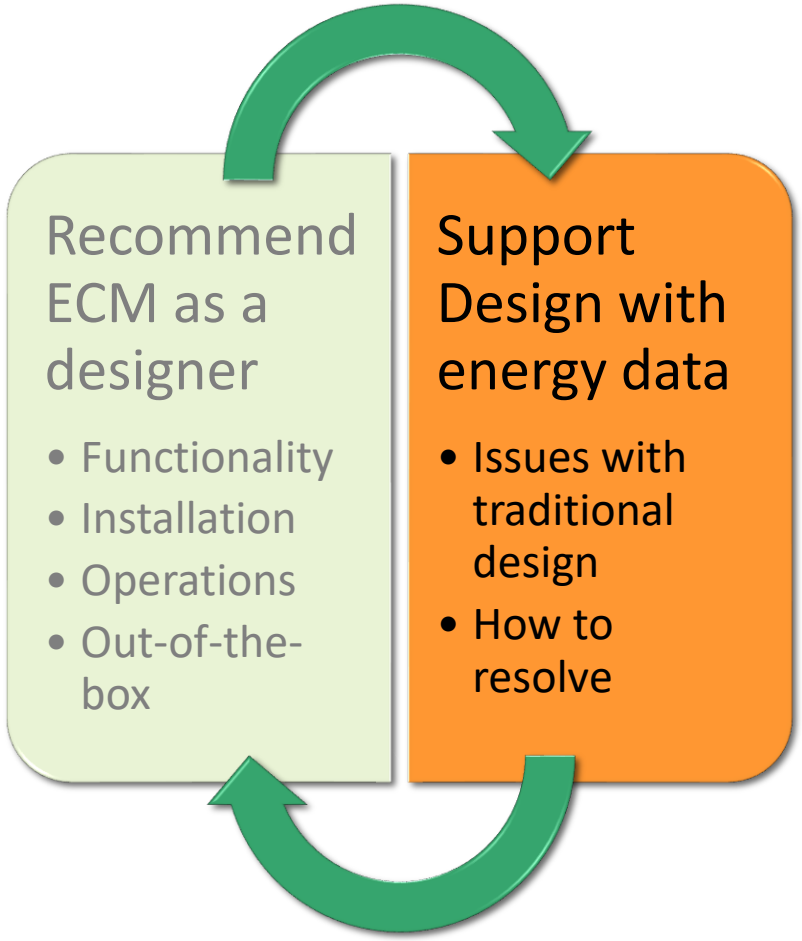
Out-of-the-box recommendations

- Considering building-specific measures
- Utilize building redundant load
- Building with ConEdison steam
- Spot opportunities for heat recovery

Examples:

- Office building operation
- Building with ConEdison steam and cogen (CHP) system
- Wasted condensate return
- Exhaust fan next to intake

Design Considerations



Sufficiency vs. Efficiency

How have we been doing?

How have we been designing historically?

- **"Design condition"** – 89°F DB / 73°F WB cooling; 13°F heating in New York City
- **"Average condition"** – 85°F DB in July; 28°F in January
- **"Safety factors"** in Engineering Calculations
- **"Boiler pickup load"** – What are they and when are they required
- **"User profiles"** – How different occupancy profile affect the load estimation

Effects of oversizing systems

- Higher capital and maintenance costs
- More space requirements
- Higher carbon emissions and Local Law 97 penalties
- Limited turn-down ratios

Sufficiency vs. Efficiency

How can we safely and bravely downsize the existing systems?

- Safely remove the safety factor – energy auditing data
- Equipment arrangement – modulation; turndown ratios and VFDs
- Equipment selection – efficiency and operation point
- Modern building technologies – demand control ventilation; building management system (BMS)

Case Study #1

BOILER UPGRADES IN MULTIFAMILY COMPLEX

Photos from Trulia and Goldbar Real Estate

Property Profile

Year Built: 1952

Square Footage: 934,300

Number of Buildings: 102

Units: 1,072

Property Type: Multifamily complex in Queens, NY with lots of individual buildings

Project Scope: Boiler upgrades

Existing Building System

- Dual-fuel steam boilers
- Above grade oil tanks
- Water heating system
- Boiler DHW coil

Issues:

- Large boilers operating year-round
- Low efficiency
- Low turn down ratio

Designed Building System

- Modular hot water boilers
- Primary / secondary system
- Instantaneous DHW heaters
- VFD pumps

Advantages:

- High efficiency, including higher DHW efficiency
- High turn down ratio

Design Considerations

Example: Design checklist for domestic hot water (DHW) feasibility study

		Y	N
Questions for the Super:			
1	Is there an existing & operational hot water heater at the building?		
2	Is the existing domestic hot water (DHW) supply adequate for the building throughout the year?		
3	Does the building have any issue with the current boiler?		
Observations to make:			
4	Is there available space (at least 3’ x 3’ per unit) for a new hot water heater + storage tank? (Cannot block access area for any equipment / meter / gauges)		
5	Is there a floor drain / sump pump in the boiler room?		
6	Is there a separate boiler gas meter with isolation valves?		

Take photos of (one photo showing the equipment overall condition and connection; one photo showing the equipment tag):		
Existing combustion air intake fan or motorized damper	Existing hot water return pump	Existing mixing valve
Existing chimney interior (to see if chimney lined)	Barometric dampers (If you don’t see one, are there draft regulators installed on the chimney?)	
Measurements to take:		
Diameter of the gas supply	Diameter of the hot water supply pipe	Diameter of the DHW return pipe
Diameter of the cold water piping going into the boiler / joining the return pipe		

Case Study #2

MULTIFAMILY ELECTRIFICATION

Property Profile

Year Built: 1921

Square Footage: 156,700

Number of Buildings: 1

Stories: 13

Units: 177

Property Type: Luxury multifamily in Manhattan, NY

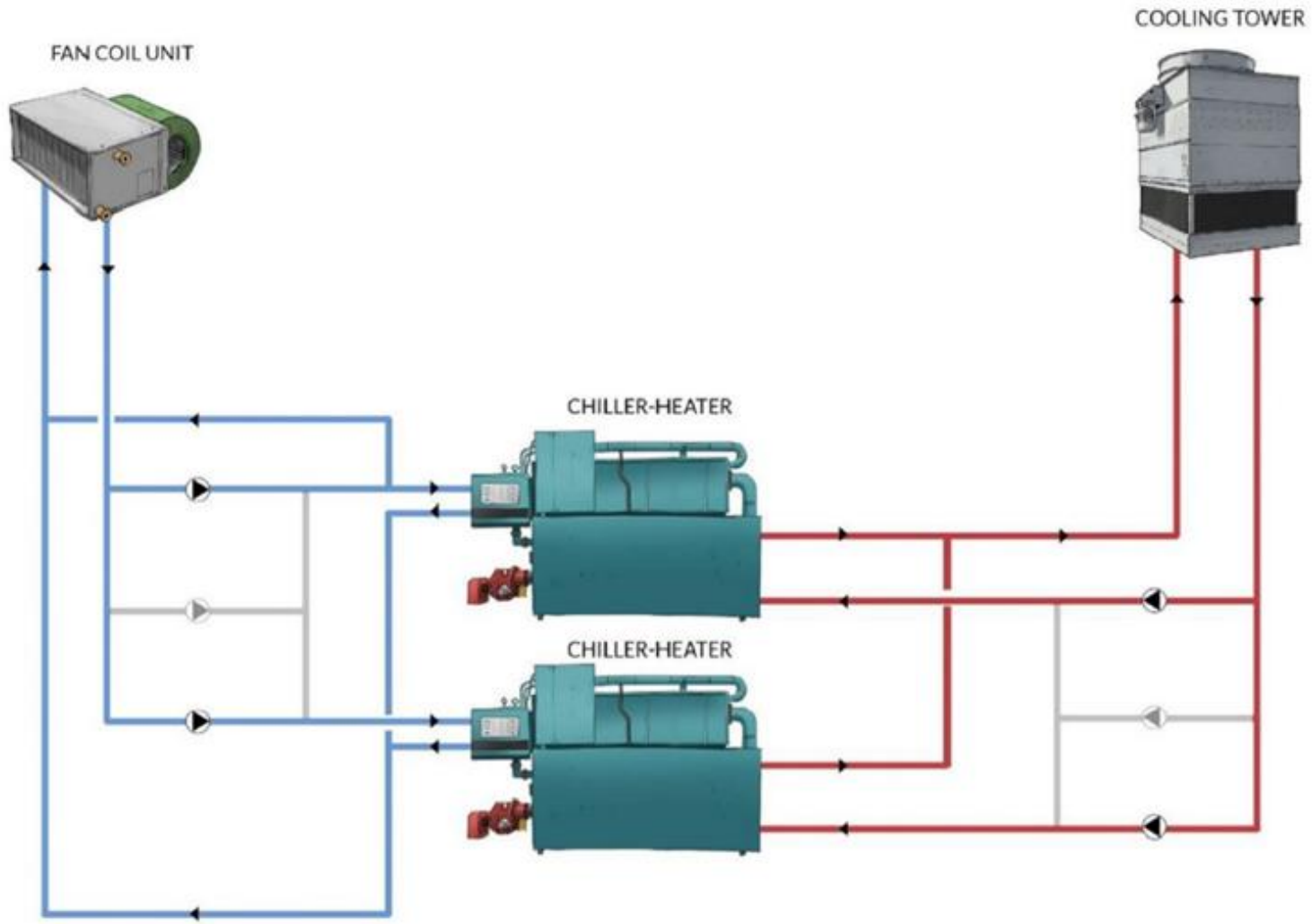
Project Scope: Electrification / heat pump conversion

Existing Building System

Issues:

- Low efficiency
- Low turn down ratio

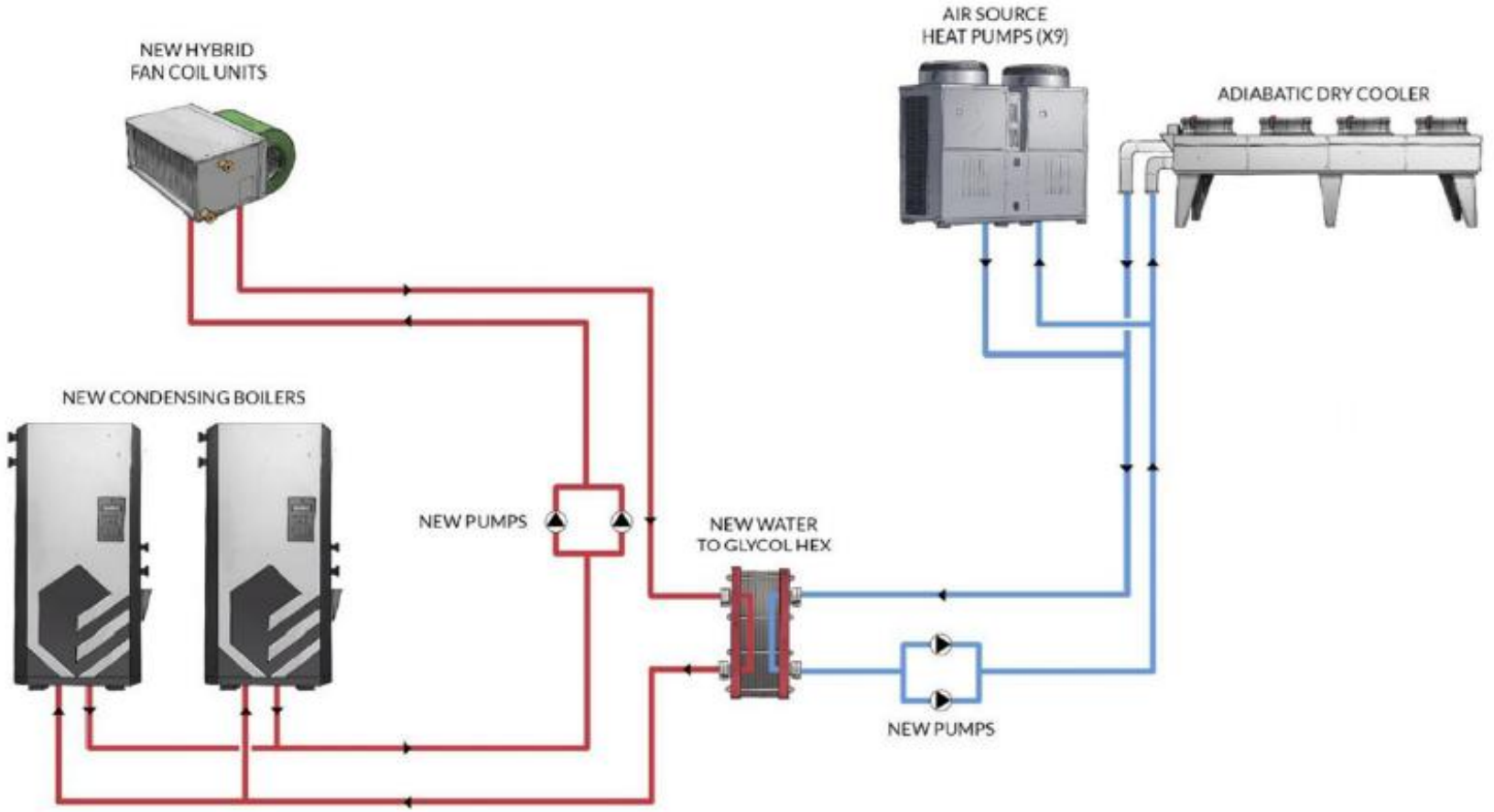
- The building wants to go for electrification



Designed Building System

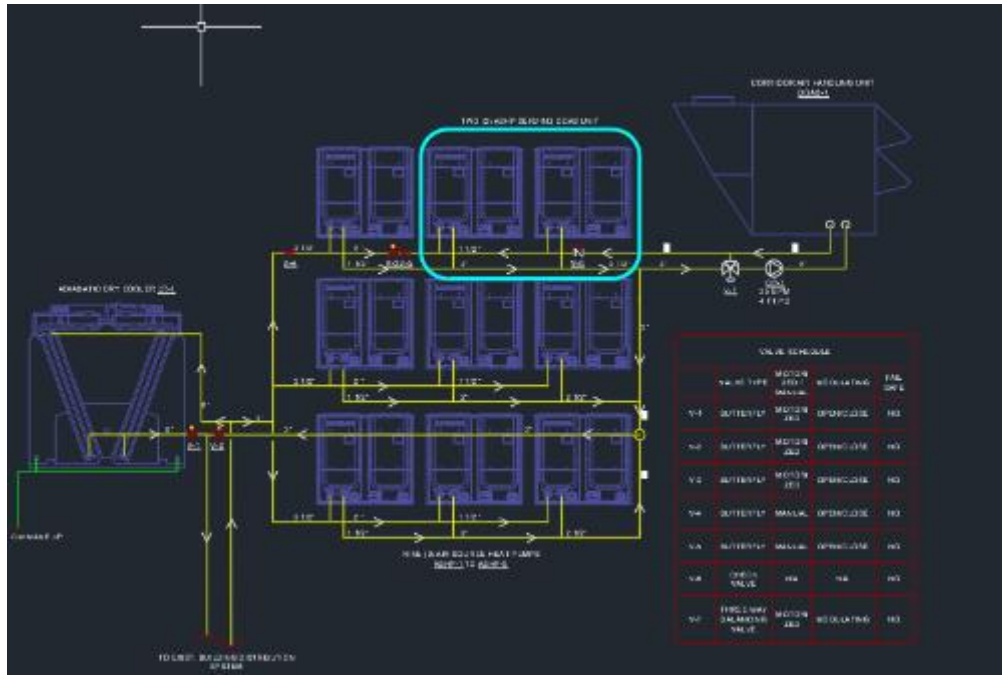
Advantages:

- High-efficiency equipment
- Distributed load to terminal units
- Simultaneous heating/cooling

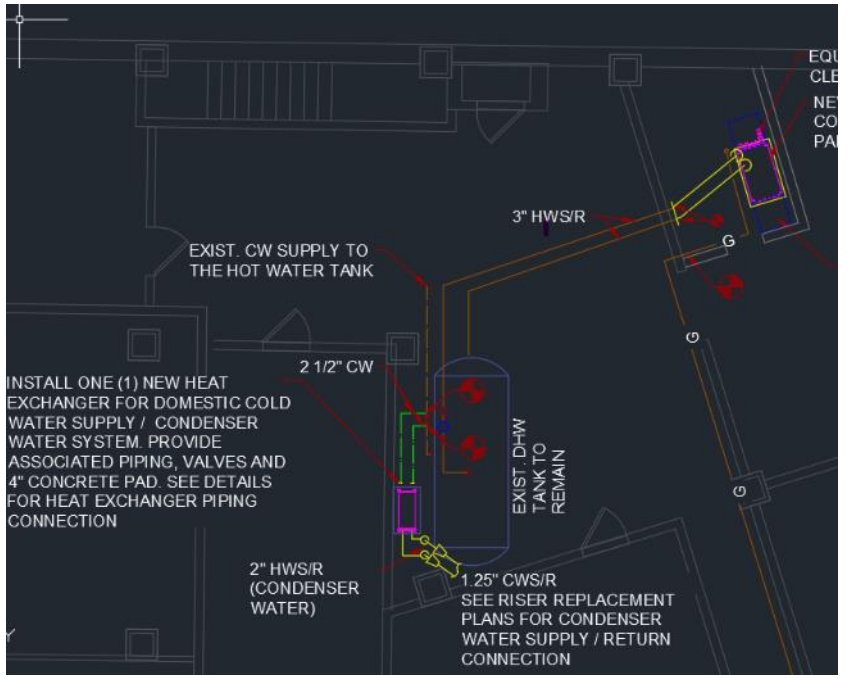


Some out-of-the-box recommendations

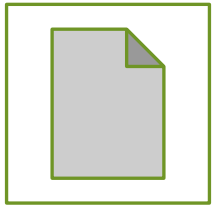
Dedicated outdoor air system (DOAS) unit for corridor ventilation



Domestic hot water (DHW) preheat exchanger



Residential Building Electrification Checklist



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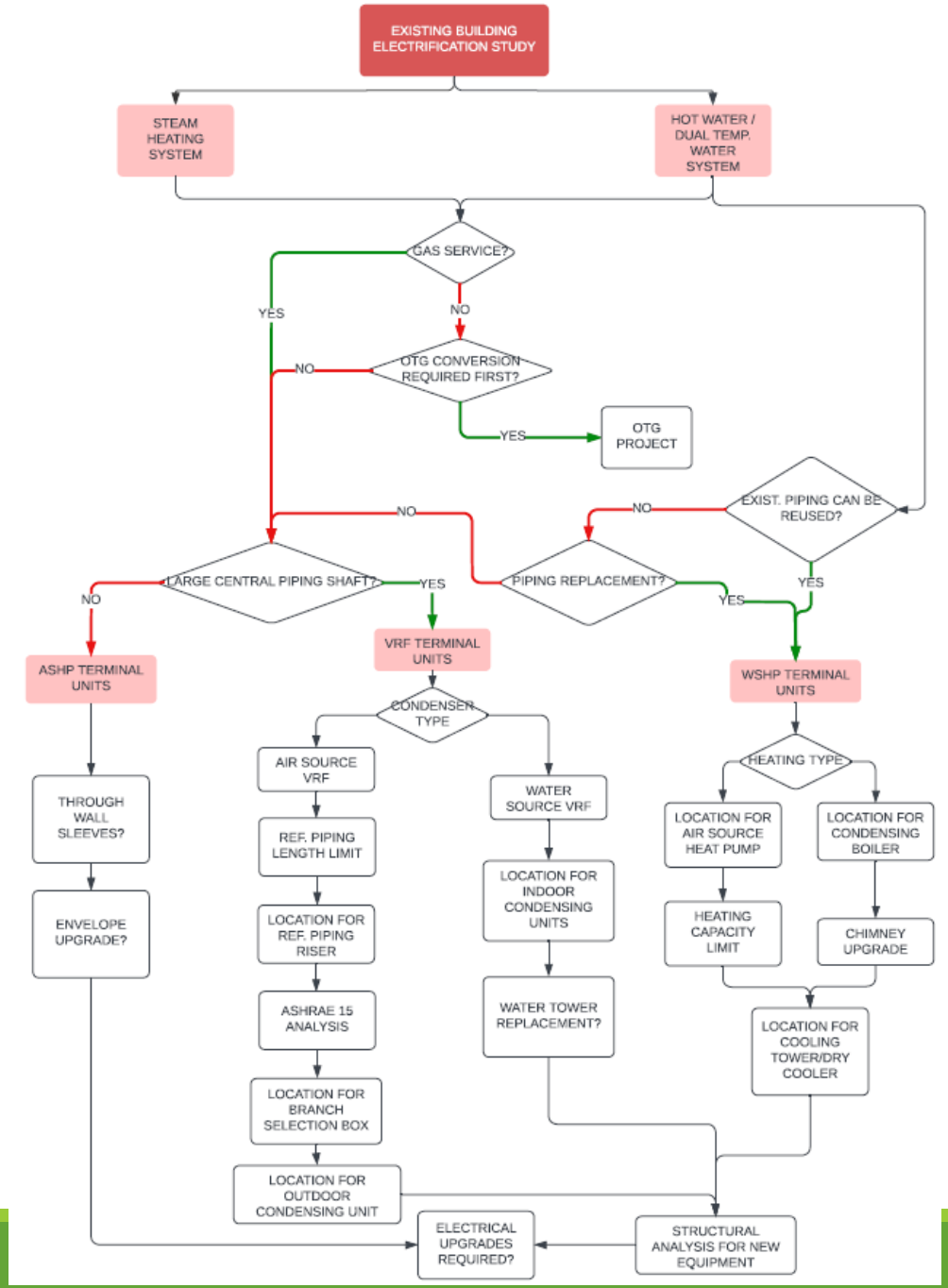
EXISTING BUILDING ELECTRIFICATION STUDY
STEAM HEATING SYSTEM
HOT WATER / DUAL TEMP. WATER SYSTEM
GAS SERVICE?
YES
NO
OTG CONVERSION REQUIRED FIRST?
NO
YES
OTG PROJECT
EXIST. PIPING CAN BE REUSED?
NO
YES
LARGE CENTRAL PIPING SHAFT?
NO
YES
PIPING REPLACEMENT?
NO
YES
ASHP TERMINAL UNITS
VRF TERMINAL UNITS
WSHP TERMINAL UNITS
CONDENSER TYPE
HEATING TYPE
THROUGH WALL SLEEVES?
ENVELOPE UPGRADE?
AIR SOURCE VRF
REF. PIPING LENGTH LIMIT
LOCATION FOR REF. PIPING RISER
ASHRAE 15 ANALYSIS
LOCATION FOR BRANCH SELECTION BOX
LOCATION FOR OUTDOOR CONDENSING UNIT
WATER SOURCE VRF
LOCATION FOR INDOOR CONDENSING UNITS
WATER TOWER REPLACEMENT?
LOCATION FOR AIR SOURCE HEAT PUMP
HEATING CAPACITY LIMIT
LOCATION FOR CONDENSING BOILER
CHIMNEY UPGRADE
LOCATION FOR COOLING TOWER/DRY COOLER
ELECTRICAL UPGRADES REQUIRED?
STRUCTURAL ANALYSIS FOR NEW EQUIPMENT

Key Takeaways

Auditing and design work are **not** separate from each other

Incorporating auditing and design **with one another** can maximize project efficiency and cost-effectiveness

It is important for engineers and design professionals to **collaborate**

Questions?