

Technical Barriers to Decarbonization

Large commercial and residential buildings must overcome various hurdles before implementing deep retrofits or capital projects that help achieve building decarbonization. In this section, we address technical barriers and questions often faced by building owners and retrofit project developers.

Decentralized Systems and Tenant Equipment

Decentralized Systems and Tenant Equipment

1

Access to Occupied Spaces.

2

Lease Concerns.

3

Regulatory Limitations - Rent Stabilized Apartments

1. The building owner is required to provide free heat and hot water.
2. No mechanism to recover investment in new systems is necessary to achieve decarbonization.
3. Buildings are capital constrained

4

Split Incentives (tenants pay for energy).

Infrastructure

Infrastructure

Con Edison Steam: assume district steam system will decarbonize

High temperature renewable resources are limited and face hurdles:

- Deep Bore Geothermal
- Renewable Hydrogen
- Carbon Capture and Sequestration
- Biomethane
- Electric Boilers
- High-temperature thermal storage

- High-temperature industrial heat pumps
- Waste Heat Capture and Reuse
- Fission

Barriers to Electrification:

Utility Capacity Limitations:

- Electric riser capacity
- Switchgear expansion
- New service/vault expansion/point-of-entry space constraints
- Capacity competition with other electrification needs:
 - Space heat and cooling
 - DHW
 - Cooking
 - Pumps and motors
- Excess Distribution Facility Charges (EDF)
- Contributions in Aid of Construction (CIAC)
- Partial Electrification concepts achieve deep decarbonization but do not necessarily achieve peak gas demand reductions (debatable)

Demand reduction strategies do not obviate capacity limitations unless the utility accepts the solution as a permanent demand/load reduction strategy.

- Battery Storage:
 - Fire danger
 - Space constraints
 - Electricity distribution limitations
 - Structural loads
- Building Automation/BMS/Demand Response:
 - Cost
 - Integration limitations; Blackbox software
 - Microgrid development
 1. Cost
 2. Lack of expertise
- On-site Generation:
 - Space constraints
 - Gas use; Zero carbon fuels availability is non-existent
 - Structural loads
 - Pipe infrastructure
- Space constraints
- Structural loads
- Technology limitations:
 - Vacuum insulated storage tanks
 - Phase change material (DHW, space heating)
- Building pipe riser limitations; need additional riser capacity:
 - Building water loops are typically "top down" - cooling capacity is typically located at rooftop

- mechanical penthouses; cooling towers at roof.
 - 1. Some exceptions to this rule
- Space Constraints
- Drilling Difficulty:
 - Outdoor space constraints for geothermal wells
 - Difficult permitting
 - Mud and cuttings disposal
 - 1. Contaminated soil disposal
 - Overhead clearance constraints for drilling in basements /garages
- Shared Loop/Thermal Utility Limitations:
 - Requires entity that may operate in public ROWs and across property lines
 - Utilities are limited by regulations for gas, steam or electric delivery versus shared loop media (ambient temperature water).
 - 1. Only utility entities can provide very long amortization periods
 - 2. Utilities are best suited to work amid crowded underground municipal ROWs.
- Deep Bore Geothermal Limitations:
 - Requires test drilling and geological assessment
 - Seismic risk
 - Drilling equipment is

- very large - more akin to oil and gas development equipment
- Subsurface land rights and DEC restrictions

- Lighting with lighting controls
- High-efficiency electrically commutated motors (ECM)
- Variable Frequency Drives (VFD) on pumps and motors
- Retro-commissioning tasks and maintenance
- Staggered work scheduling
- Telework
- Submetering and billing: potentially creates split incentive between landlord and tenant:
 - Water
 - Electric
 1. Onerous regulatory compliance
 - Heat and Cooling
 1. Rent stabilized buildings prohibit billing for heat

Facade and Windows

Facade and Windows

1

Work must be completed at the end of facade/window useful life; very long useful life

2

Building code

3

Glazing reduction at odds with aesthetic/marketability concerns

4

Difficult installing with occupied spaces

5

Reduce Local Law 11 recurring cost via overcladding

- Aesthetic concerns
- At odds with historic preservation
- Capital intensive
- Lot line limitations

6

Technology Limitations

- Need higher R-value/inch for thinner wall assembly:
 - Vacuum insulated panels
 - Aerogel panels/batts
 - Zero-GWP blowing agents for closed cell spray foam (nitrogen blowing agent needs to be more widely adopted)

Ventilation

1

Energy Recovery Ventilation (ERV)

- Space constraints
- System tie-in point accessibility/feasibility

2

Rooftop Supply Air (Reznor) Unit Alternatives

- Heat pump alternatives to eliminate resistance heat
- Combine with ERV

3

HVAC Load Reduction (HLR) Technology

- Vent or capture exhaust gases
- Space constraints
- System tie-in point accessibility/feasibility

4

Central vs. Decentralized Ventilation Systems

5

Direct Outside Air System (DOAS)

- Modular perimeter ducted air heat pumps:
 - Competition for leasable space
 - Space constraints

6

Ventilation Points-of-Entry

- Aesthetic concerns
- Lot line facades/building setbacks
- Competition with leasable space
- Space constraints

Heat Pump Limitations



1

Variable Refrigerant Flow (VRF)

- Fire and life safety concerns about volume of refrigerant gas located within occupied spaces.

2

Regulatory risk from new refrigerant policies

3

PTAC and VTAC

4

Ducted Supply/Exhaust Air Source Heat Pumps

5

Domestic Hot Water

- Central DHW Systems:
 - Limited domestic production
 - Performance not confirmed by independent third parties
 - More demonstration projects needed
- Decentralized DHW Systems

6

More open-source interconnection between devices/interoperability is needed to achieve energy distribution flexibility and capacity expansion:

- Air source that has a manifold connection to interconnect with water source or refrigerant gas distribution
- Interconnectivity/simplified heat exchange between refrigerants/water/air, etc.
- Other options and add-ons

Crossover Device or “Magic Box” Technology

Crossover Device or “Magic Box” Technology



Multi-purpose technology for heating, cooling, heat exchange and ventilation, filtration, and/or domestic hot water

1

Domestic production and supply chain is limited

2

Small players operating in this space

3

Technology is not tested over long operational periods

- Daikin, Nilan, Zehnder, Drexel und Weiss, Minotair, Build Equinox, Clivet

Zero Carbon Fuels Limitations

Zero Carbon Fuel Limitations

1

Green Hydrogen

2

Renewable Natural Gas

Low-Carbon Fuels

Low-Carbon Fuels

1

Biofuel

2

Biomethane

Renewable Energy Procurement Limitations

Renewable Energy Procurement Limitations

1

REC Purchasing

- NYSERDA monopolizes REC purchasing from renewable energy projects

Pending Carbon Trading Programs Limitations

Pending Carbon Trading Programs Limitations

1

Deployment timeline is highly uncertain

2

Price per ton of carbon is highly uncertain and will likely be volatile/low based on previous emissions trading scheme outcomes

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