The Empire Building Challenge

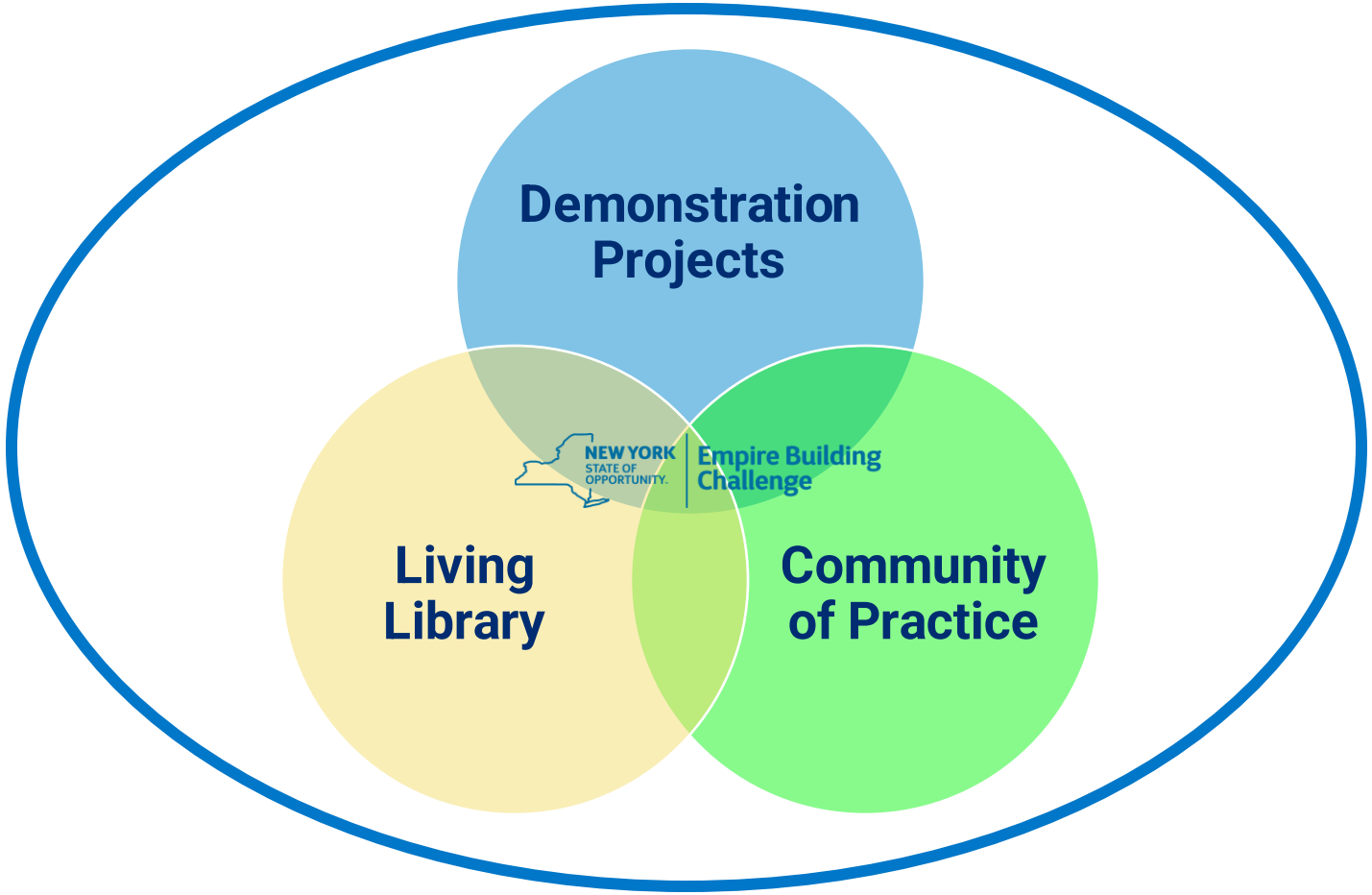
Orientation Workshop, EBC Cohort 2

Strategies and methods to achieve deep decarbonization.

NEW YORK STATE | NYSERDA

July 28, 2022

The EBC manifests in four different ways



Strategic Influence

The EBC Process Drives Toward A Strategic Decarbonization Plan

Strategic Decarbonization Plan (SDP): a comprehensive, financially and technically integrated roadmap for decarbonization

- Elements of the SDP will be assessed by NYSERDA and considered for funding
- Project funding decisions will be made based on NYSERDA criteria
- The goal is for every team to create a realistic, comprehensive and actionable SDP regardless of funding award

EBC Team Presenting Today

Michael Reed, NYSERDA
Team Lead

Sophie Cardona, NYSERDA
Program Management

Michel Beguin, NYSERDA
Project Management

Molly Kiick, NYSERDA
Project Management

Jared Rodriguez, Emergent
Urban Concepts
Advisor

Jon Walton, Reos Partners
Facilitator

Gerardo Marquez, Reos Partners
Facilitator

Lane Burt, Ember Strategies
Technical Consultant

Brett Bridgeland, RMI
Technical Consultant

AGENDA

- **Program Details and Key Activities**
- **Decarbonization Roadmap**
  - Condition Assessment and Engineering Strategies
  - Capital Planning and Business Case

Goal: Prepare to implement NYSERDA's process for Strategic Decarbonization Planning while developing a competitive EBC submission.

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PROGRAM DETAILS & KEY ACTIVITIES

Time: 20 Minutes

Presenters: Molly Kiick

Michel Beguin

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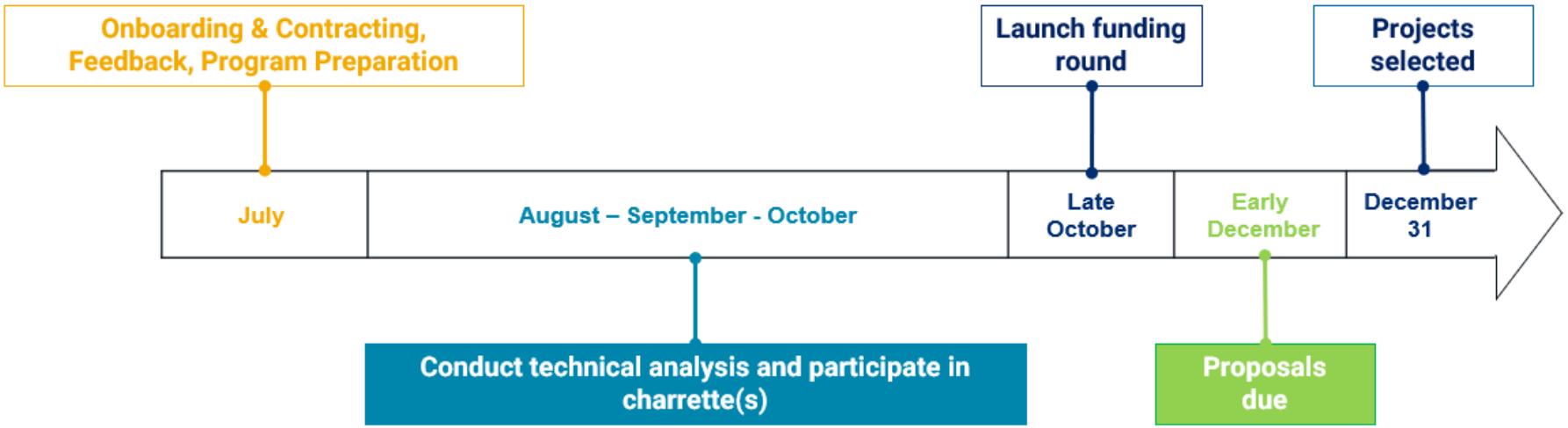
What to Expect

- $100,000 in technical assistance funds.
- Decarbonization process and roadmap for your buildings.
- Tools, resources and support network.
- Compete for $3M in implementation funding.
- Promotion of EBC partners as sustainability leaders.

Empire Building Challenge
PARTNER
Reimagining Low-carbon Buildings



EBC Tools and Resources

Tools and resources are available to support a Carbon Neutrality Roadmap and Strategic Decarbonization Plan

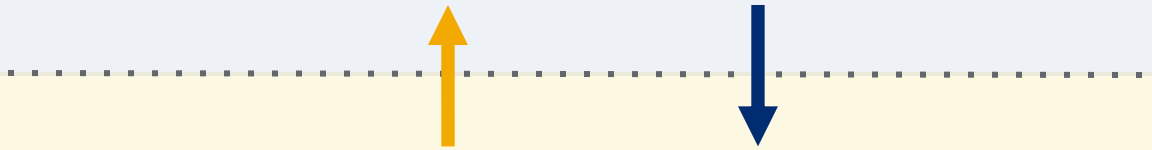
- EBC Knowledge Base
- Empire Building Playbook
- EBC Technology Database
- Strategic Decarbonization Assessment (SDA) Tool

Promote Knowledge Share Between Technical and Real Estate Roles

- Successful decarb planning requires **information flow between technical focused team members and real estate focused team members** throughout the process.
- If your team is missing input needed for the development of an *integrated* Strategic Decarb Plan, please consider adding people who can fill in technical or implementation gaps within or outside your organization

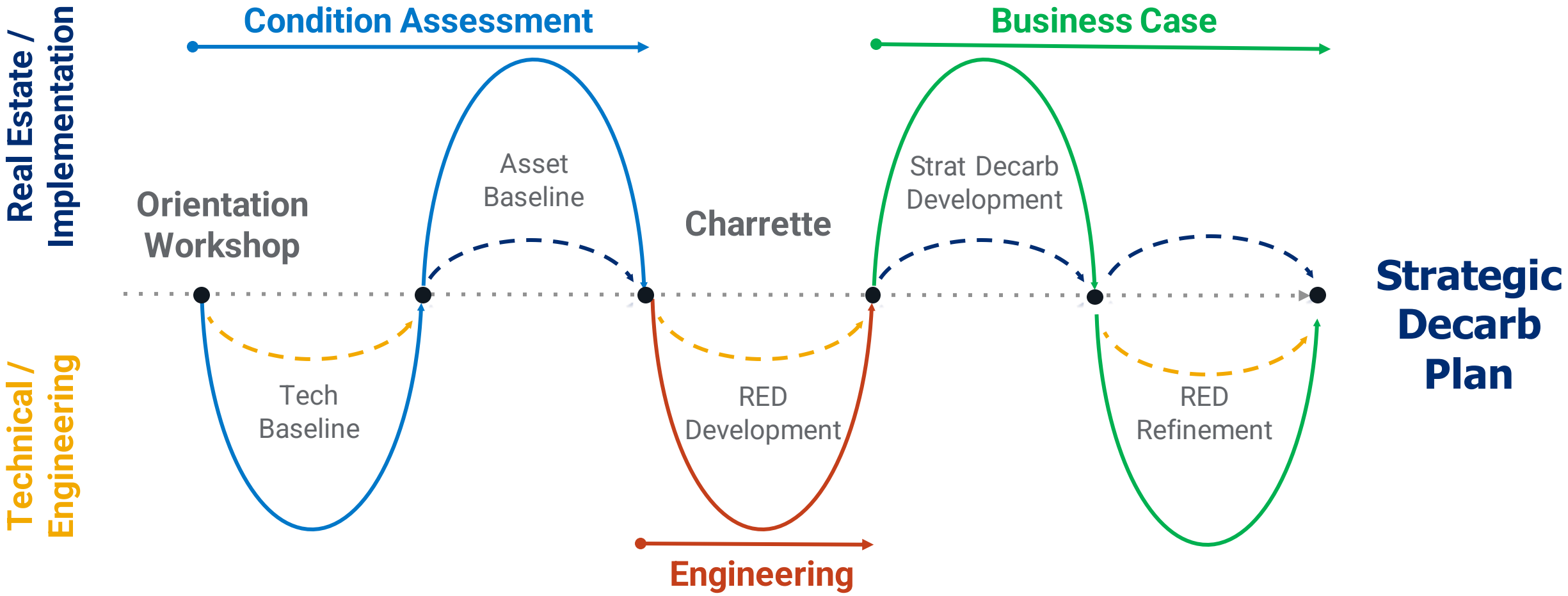
Real Estate / Implementation

- What is in the existing capital plan?
- Upcoming major events:
  Leases? Transactions? Regulatory compliance? Pandemic Repositioning?
- Investor goals/ESG requirements?



Technical / Engineering

- What types of technical solutions work for this building? HPWH? Enclosure upgrades?
- What building systems are nearing their end of useful life?
- What keystone equipment drives the order of ECMs?



EBC Cohort 2 Roadmap

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Next Steps: Take advantage of the NYSERDA team and charrette sessions

Charrettes

- **What?** A working session with the NYSERDA team and its consultants to review your decarbonization roadmap and proposed low carbon retrofit projects, and explore technical and financial solutions to critical decarbonization issues
- **When?** Throughout the summer, by October 1st. We encourage scheduling more than one charrette to maximize feedback and enable design iteration.
- **Why?** Ensure alignment with funding evaluation criteria

Your Pitch:

The narrative of your strategic decarb plan to NYSERDA

Draft Funding Evaluation Criteria:

- Total reduction of on-site fossil fuel and/or district steam
- Site EUI reduction
- Ratio of NYSERDA subsidy to owner cost-share for proposed measures
- **Replicability** within portfolio and broader market
- Level of **innovation** – how novel is this project for NY retrofits?

Q&A
PROGRAM DETAILS & ACTIVITIES

Time: 10 Minutes

DECARBONIZATION ROADMAP: BEST PRACTICES

- Condition Assessment & Engineering Strategies
- Capital Planning & Business Case

CONDITION ASSESSMENT & ENGINEERING STRATEGIES

Time: 15 Minutes

Presenters: Jared Rodriguez

Brett Bridgeland

Condition Assessment has two distinct parts

Tech Baseline:

Engineering considerations, constraints and opportunities

Equipment and performance audit info that will be operationalized to achieve decarbonization

- Replacement costs
- ECMs
- Budget constraints
- Stranding Assets

Asset Baseline :

Real estate and capital markets considerations, obligations, constraints and opportunities

Pro Forma info that will be leveraged to justify Strategic Decarb Plan

Taxonomy of Implementation Triggers

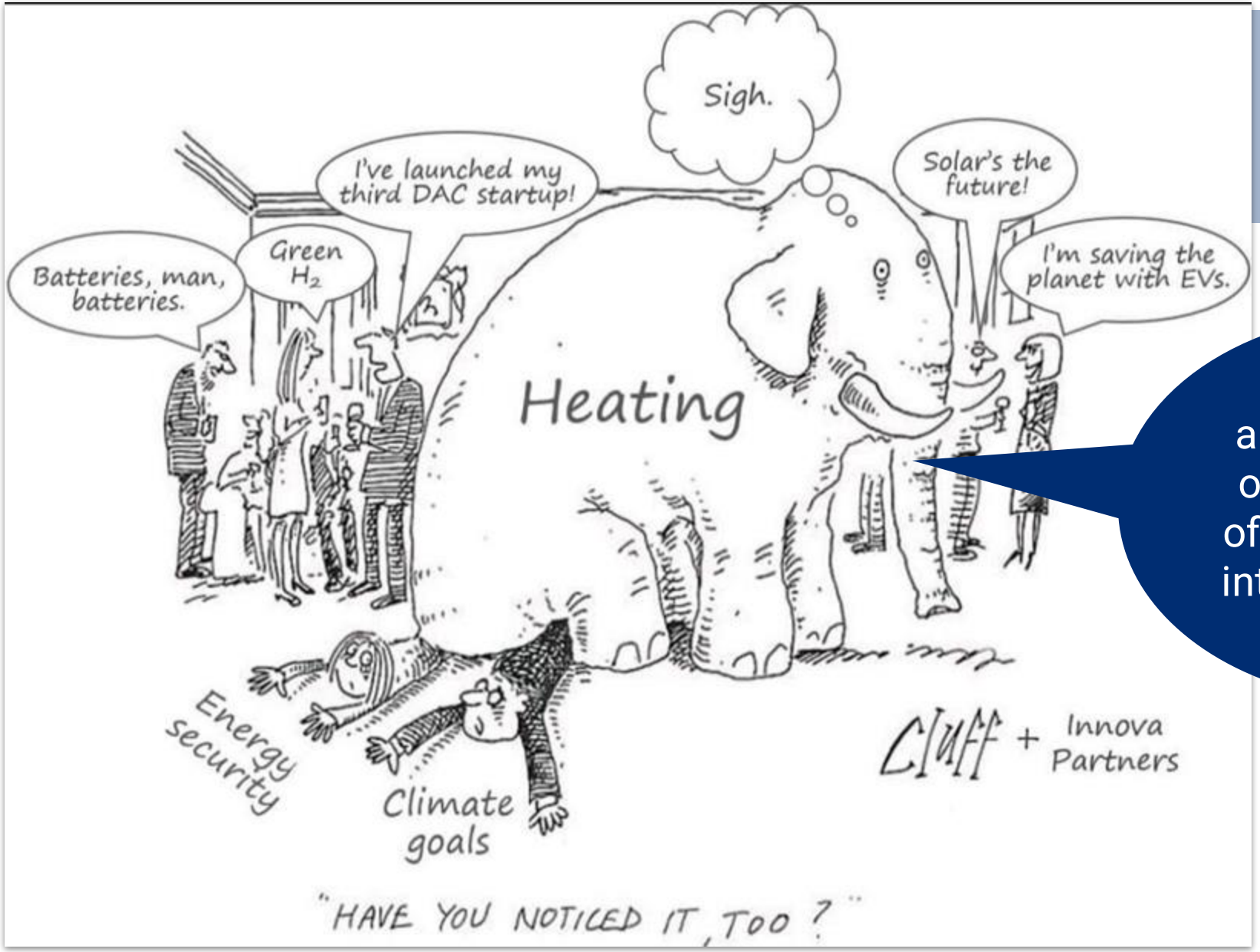
Conditions, requirements or events at your building or real estate company that trigger a decarbonization effort spurring the development of a carbon neutrality roadmap prompting Strategic Decarbonization Assessment (SDA).

Asset triggers:

- Repositioning
- Recapitalization
- Capital event cycles
- Tenant turnover/vacancy
- Facade compliance
- Carbon emission limits
- Tenant/investor ESG goals
- Building codes
- Utility bills

Technology triggers:

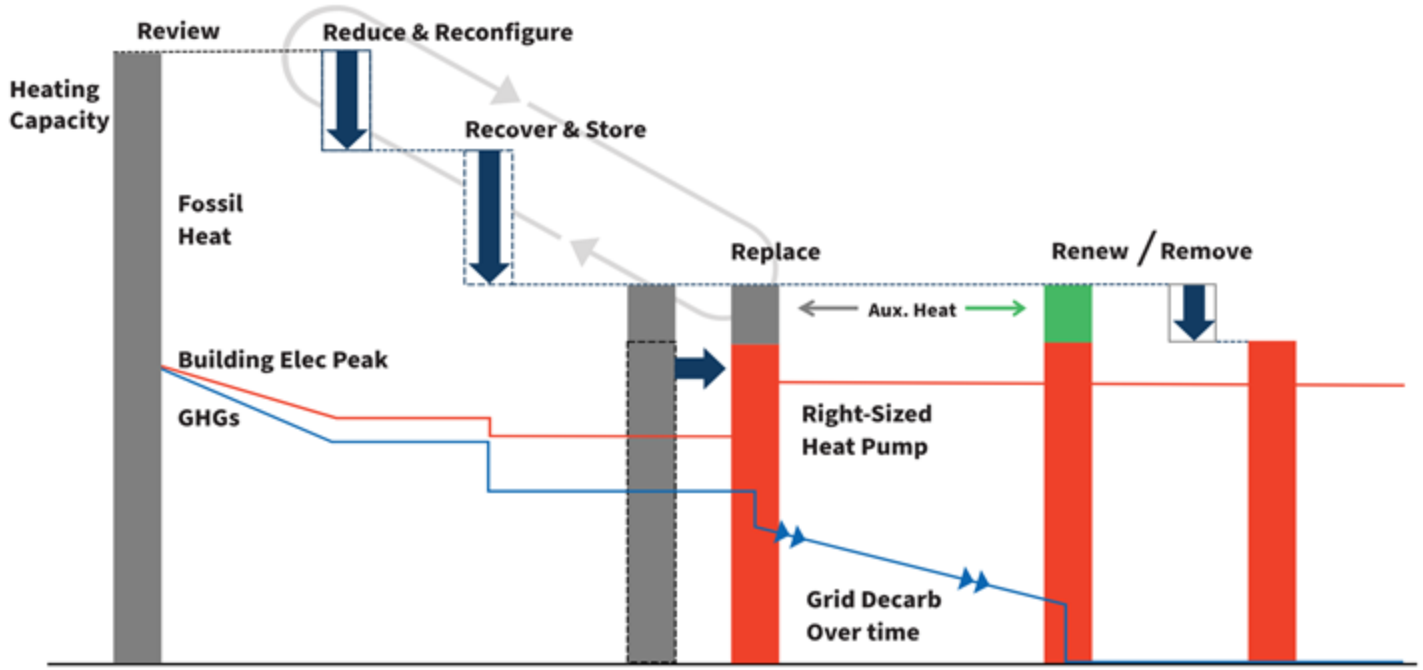
- System failure
- Damage from an event
- Approaching equipment end-of-life
- Waste heat (steam condensate return, cooling tower, wastewater, etc.)
- 100% fresh air with no recovery
- Tenant loads
- Indoor Air Quality



and there are lots of different kinds of heat pumps and integrations, too. . .

Engineering begins qualitative and becomes more quantitative

Resource Efficient Decarbonization (RED): an incremental methodology and integrated design process combined with strategic capital planning creates a path to delivering carbon neutral buildings.

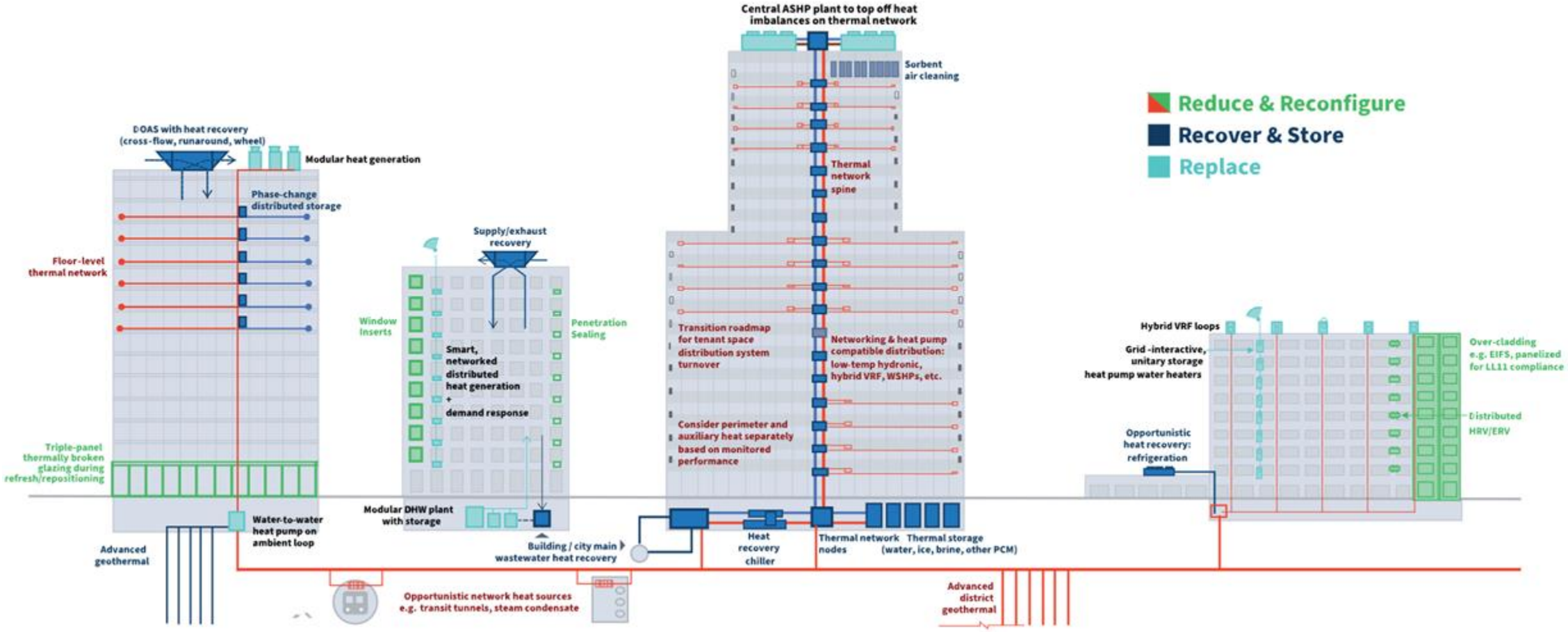


Go Beyond Simple Electrification

A decarb plan that is unlikely to obtain project funding might:

- Have heat pumps everywhere but operating independently;
- Replace fossil fuel kBTUs with electrons but maintain single use pathways through the building (ignore storage, heat recovery, EE, network effects);
- Do everything all at once to show the biggest possible financial burden (ignore business cycles, tenant disruption, opportunity to leverage necessary investment);
- Be optimized around “simple payback” only (ignore marginal cost differences, BAU cost and cost of inaction);
- Fail to integrate other requirements, e.g. envelope requirements, gas safety rules, etc.;
- Fail to optimize for remaining useful life and ignore stranded asset risk;
- Use unrealistic assumptions about utility and offset costs.

Partial Decarb and Thermal Energy Networks



Take enabling steps now: Omni's "Thought Journey"

As part of a major property recapitalization, Whitney Young Manor will undergo a $22 million renovation, with nearly $12 million allocated to the decarbonization effort.

During their planning journey, **Omni** first considered converting the resistance heating system to PTAC or PTHP, trying to take advantage of the balcony space. However, after further analysis, Bright Power and Omni decided to switch their design to a central hydronic loop feeding hot water or chilled water to fan coil units in the apartments. As an affordable housing developer, Omni is used to converting resistance heating units in its portfolio to hydronic piping with gas powered boilers. This design is pushed further by integrating a central ASHP system with an existing gas boiler as back up, and integrating waste heat recovery in the summer to preheat DHW.

This is in addition to load reduction measures, i.e. façade overclad and DOAS with ERV.

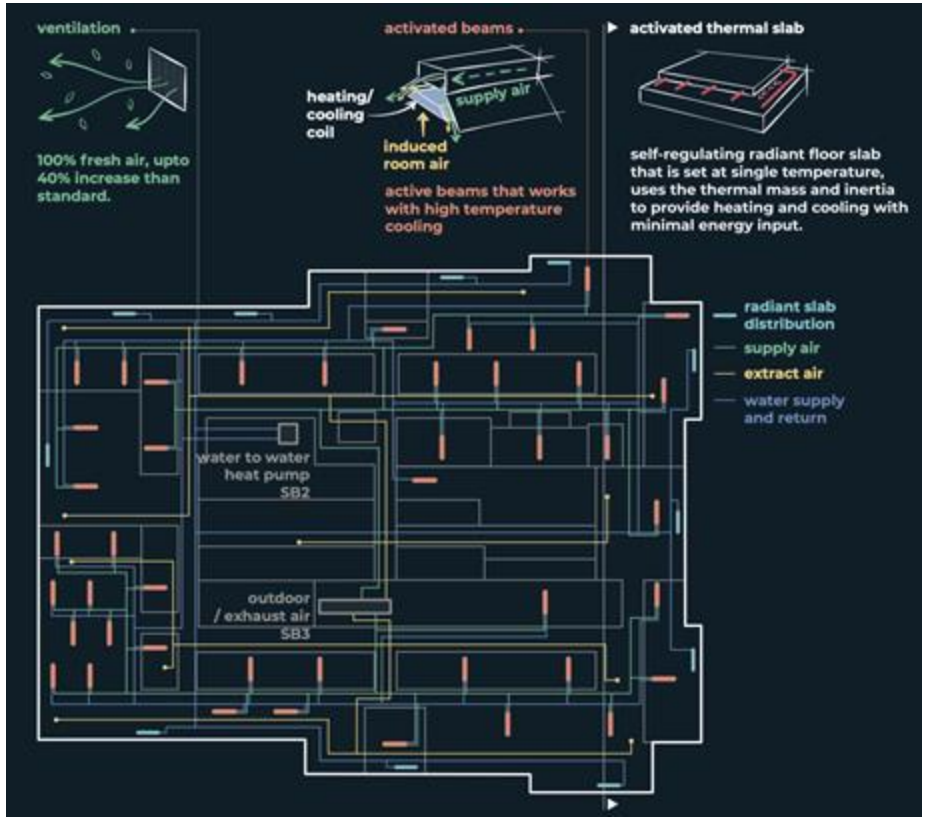
Design a Tenant fit-out menu enabled by a hydronic thermal network (Hines)

Hudson Square's three alternatives hinged on their new tenants' system decisions, as the system selections significantly influenced the decarbonization timeline and financial outcome.

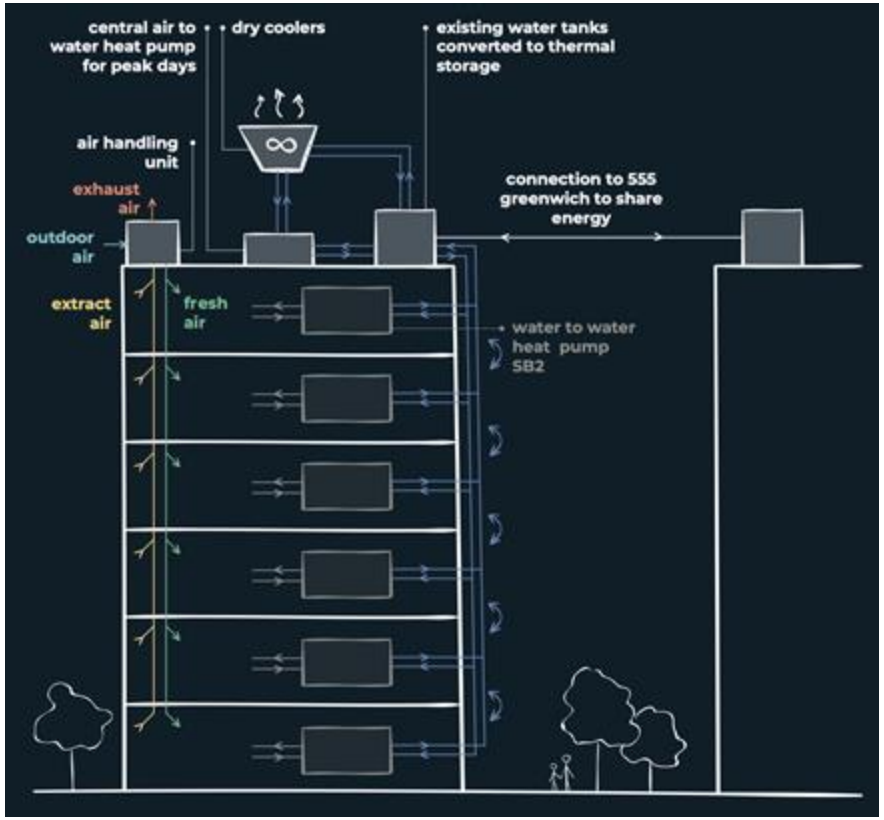
- Tenants will choose from a "good, better, best" menu featuring chilled beams, radiant floors, and radiators, airside systems, and a performance insurance product is offered to encourage selection of the highest performance system.
- All tenant options ride on a technology neutral, hydronic core platform enabling flexible, phased interconnection to a variety of thermal systems including heat pumps, heat recovery, storage, etc.
- Retrofits on tenant floors are split to account for tenant turnover and phased install

Design a Tenant fit-out menu enabled by a hydronic thermal network (Hines)

Tenant Menu 1: Unlocking the full potential



Ambient Loop: The Energy Arbitrage



Peer Discussion (20 Minutes)

Topic: Condition Assessment and Engineering Challenges

CAPITAL PLANNING & BUSINESS CASE

Time: 15 Minutes

Presenters: Lane Burt

Capital Planning and Business Case

What To Do

Start with the ideal plan from an engineering perspective, absent any constraint. In what order would you do things?

- Symptoms of success - reduced heat rejection, minimum heat pumps, grid/prosumer opportunities

When To Do It

Bring in the constraints and opportunities from the Asset Baseline.

- Sensitivity analysis
  - How reliant is model on predictions about the future?
  - What has to go right? What can't go wrong?
- NPV evaluation
- Value of accelerated Decarb

Stress test the plan.

In what future does this plan work?

Think sensitivity and materiality. Be aware of blind spots.

- **The future cost of gas/steam, compared to electricity.**
  - Will gas and steam remain cheaper, despite the carbon implications?
- **The future cost of carbon offsets, especially high-quality offsets.**
  - Will low quality offsets be allowed?
  - Will increasing demand for high quality offsets impact the cost?
- **Time of electricity use and the carbon implications.**
  - Will we be locked into electricity use at peak times, or do we have options?
  - How much might those options be worth if rate structures change?
- **Future availability of replacement equipment**
  - What if I can't buy another boiler?
- **Short term bias in a long-term model; high discount rates**
  - Are we discounting the costs of BAU and the benefits of action?
  - How does the discount rate combine with the assumptions above?

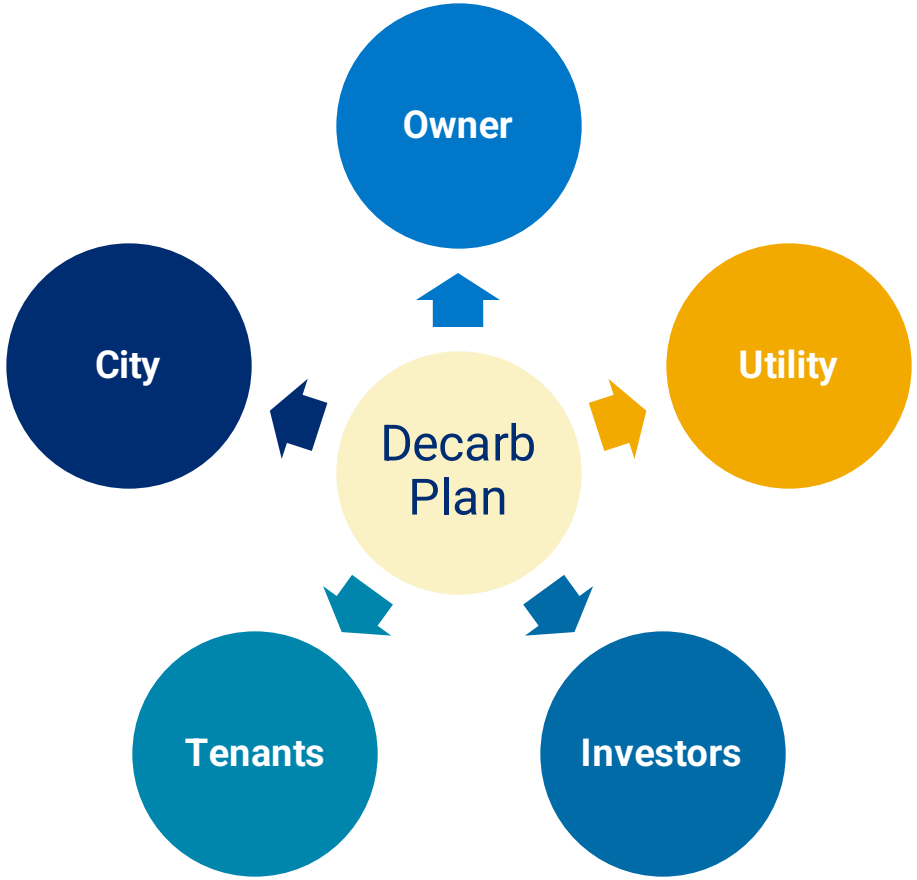
There is no zero cost future

Think beyond simple payback

Key Strategic Decarbonization Assessment (SDA) Methods:

- Take time to develop an appropriately accurate BAU cost scenario. This forecast will incorporate equipment inventory (EUL/RUL), fines, cost of offsets and reasonable and consistent assumptions about the future cost of carbon/fossil fuels.
- The Net Present Value (or Net Present Cost) of decarb pathways should be assessed alongside the BAU cost scenario to find the lowest marginal cost of decarb.
- Grid decarbonization (cleaner electricity) may mean no fines are incurred for 10+ years in high performing office buildings in NYC. Confirm this for your building.

How will you communicate the plan?



Our plan is based on:

___ technology
___ phasing
___ approach

Articulate Clear Narratives for Each Alternative (L+M)

L+M's Heritage project team considered two alternatives, and the primary driver for both is building façade regulatory compliance lifecycle cost reduction (Local Law 11): nearly 80% of overclad project cost savings for the facade work came from avoided O&M due to LL11 compliance.

- In one alternative, the façade upgrade (windows plus exterior insulation and air sealing) coupled with roof insulation reduced loads in the residential units and the electric resistance heater were replaced with centrally controlled packaged terminal heat pumps (PTHPs) for both heating and cooling in one of the three towers.
- In the advanced plan, the gas fired domestic hot water in one tower was upgraded to heat pumps.
- The baseline alternative did not include the PTHPs or gas DHW upgrades. These were add-on/add. alt. measures to move further down the decarb pathway.

Articulate Clear Narratives for Each Alternative (ESRT)

ESRT developed high-reduction, mid-reduction and light-reduction decarbonization plans. The plans are most significantly distinguished from each other based on the degree to which they rely on the existing steam system for heating. ESRT took advantage of planned tenant turnover to create a steam to electric heating phase-in plan that will leverage temporary vacancies that limit operating income disruption.

- The high-reduction plan calls for transitioning the existing steam-based heating system to a fully hydronic, heat pump-based heating system. This steam to heat pump transition is enabled by the execution of a variety of load reduction ECMs which decrease the required perimeter heating temperatures.
- The mid-reduction and light-reduction plans have decreasing levels of load reduction ECMs which limit the technical feasibility of transitioning the existing steam system to a water-based system (particularly at the perimeter) and in the case of the light-reduction plan, no heating electrification is proposed at all.

Peer Discussion (20 Minutes)

Topic: Condition Assessment and Engineering Challenges

Key Takeaways

- Work together to develop a comprehensive techno-economic analysis of options
- Condition assessments comprise technology **and** asset baselining
- Engineering starts qualitative and becomes more quantitative
- **Resource Efficient Decarbonization:** Review, Reduce, Reconfigure, Recover, Store
- Take enabling steps now
- Strategic capital planning > Simple payback
- Compare alternatives with business-as-usual
- Plan your pitch for each stakeholder

Next step: schedule charrette sessions and get feedback from the NYSERDA team

Appendix

EBC Team

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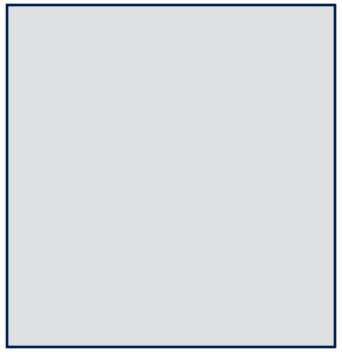

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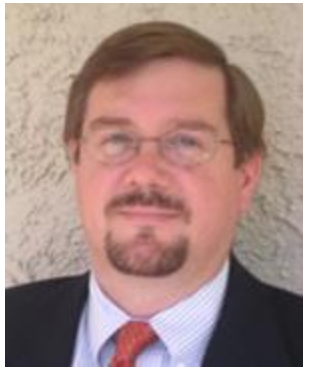

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Technical and capital planning support

Lane Burt, P.E
Ember Strategies

Specialty: Scenario planning, risk assessment, and decision framing focusing on district infrastructure, green building, and energy efficiency.

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Brendan Owens, P.E.
Black Vest Strategy

Specialty: Strategic decarbonization capital planning, net zero and grid interactive buildings, market transformation, system interactions.

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RMI

Specialty: Multi-disciplinary experience across architecture and energy engineering, deep expertise in integrative design, deep retrofits and decarbonization of building mechanical systems.

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Ben Milbank, CEM
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Specialty: Net Zero master planning, Life Cycle Costs Analysis, existing building efficiency retrofits, low temperature hydronic re-engineering and hybrid electrification, leveraging asset renewal needs for decarbonization.

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Whole Systems Energy Consulting

Specialty: Technical consulting in support of the design of net zero buildings and districts, deep retrofits, as well as the development and application of emerging, potential break-through technologies.

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Go Beyond Simple Electrification

EBC aims to support projects that are part of a holistic, integrated plan that:

- ✓ Drastically reduce or eliminate combustion;
- ✓ Are highly efficient at low design temperatures;
- ✓ Remain resilient during extreme weather;
- ✓ Are demand conscious, and energy grid-interactive (enabling the grid to decarbonize faster);
- ✓ Capture and recycle on-site or nearby thermal flows to reduce thermal waste;
- ✓ Incorporate realistic and flexible implementation strategies by optimizing and scheduling phase-in of low carbon retrofits competing with business-as-usual;
- ✓ Rapidly decarbonize;
- ✓ Are transparent to tenants and regulators.

The Tech Baseline will be (mostly) familiar

Familiar
(all from audits, models)

- Building characteristics
  - Plant/system overview
  - Equipment inventory
  - 80/20 energy use / “Keystone” systems
  - Utility Bills

Less familiar to some
(from audits, but with a twist)

- End of/ Remaining Useful Life Assessments
  - Required to estimate BAU replacement cost; move away from payback to lowest cost decarbonization
- Building heat profile
  - Where is heat lost/ gained?
  - What are the energy flows?
  - What do heating/ cooling requirements look like under varied outdoor conditions?
- Known electrification opportunities
- Known problems - comfort considerations, system performance problems, warranty

What's wrong with energy audits?

Nothing; but we need the right tool for this job.

Distinction	ASHRAE Standard 211; Level 2 Audit	Strategic Decarbonization Assessment
Question answered	How can this building perform better, **today**?	How should we **re-engineer** this building to perform **in the future**?
Financial significance	**Small**	**Big**
Primary audience	Facilities/Ops, Engineering	Asset Management
Time horizon	**Short**; payback constrained	**Long**; full capital cycle, 10+ yrs
Downside avoided	Wasted utility spend	Stranded asset, degraded value/NOI, increased CapEx/TCO

The Asset Baseline is not always provided to the engineers.

- Existing capital plan
  - Capital streams for the building are known
  - Budgets exist for things that are known replacement obligations
  - Utility and other O&M costs
- Leasing plan/state, TI budget and other major opportunities –
  Is the owner planning to spend money on this building, and to what end?
- When a space will be redone with a new tenant, can TI budget can be leveraged?
- Does an upcoming transaction present opportunities?
- Landlord initiated, tenant win-win decisions
  - Upcoming transactions/change in approach
    - A sale, repositioning, tenant lease turnover
    - Future regulatory compliance (LL11, or others)
    - Timing opportunities, can decarb save money elsewhere?
- Investor goals and ESG requirements
  - Key dates/metrics for internal priorities
  - Emerging requirements - TCFD, SEC disclosures

Asset inputs are crucial to an integrated decarb plan to avoid disruption to tenants and work within normal business cycles

Review	• Disaggregate time-of-use profiles to identify heat waste and recovery opportunities and to right-size equipment.
Reduce	• Repair, upgrade and refresh envelopes. • Optimize controls.
Reconfigure	• Eliminate or reduce inefficient steam and forced air distribution. • Create thermal networks and enable heat recovery. • Lower supply temperatures to ranges of optimal heat pump performance. • Segregate and cascade supply temperatures based on end-use.
Recover	• Simultaneous heating & cooling in different zones of building • Eliminate “free cooling” economizer modes • Exhaust heat recovery; sorbent air cleaning • Building wastewater heat recovery • Municipal wastewater heat recovery • Steam condensate • Refrigeration heat rejection. • Other opportunistic heat recovery and heat networking.
Store	• Store rejected heat from daytime cooling, for overnight heating. • Store generated heat— centrally, distributed, or in the building’s thermal inertia. • Deploy advanced urban geothermal and other district thermal networking solutions.

Enabling steps can overcome heat pump size and cost barriers.

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Central Plants

- Air-to-air
- Air-to-water
- Air source domestic hot water (e.g. CO2 refrigerant)
- Ground source
- Storage-source, wastewater-source
- Heat Recovery Chiller (water-to-water)

Distribution System

- Water-to-Air
- Water-to-Water
- Variable refrigerant flow (VRF)
- Hybrid VRF (water distribution)
- Other Hybrids/Integrations

Distributed Standalone

- Packaged terminal heat pumps
- Mini-split single-zone/multi-zone heat pumps
- Unitary domestic hot water heat pumps
- Split domestic hot water heat pumps

Heat pump taxonomy to Replace/ Remove fossil heat capacity

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Rough Order-of-Magnitude (ROM) costs to find the right direction, before detailed work is done

- BAU Replacement cost estimates
- ECM cost estimates
- ECM sequencing based on asset baseline/RE major opportunities
- Cost of advanced ECM - BAU replacement + cost to study

AACE Class	ANSI Classification	Typical Use	Project Definition	Expected Range of Accuracy: Low Expected Actual Cost	Expected Range of Accuracy: High Expected Actual Cost	Other Terms
Class 5	Order-of-Magnitude	Strategic Planning; Concept Screening	0% to 2%	-50% to -20%	+30% to +100%	ROM; Ballpark; Blue Sky; Ratio
Class 4		Feasibility Study	1% to 15%	-30% to -15%	+20% to +50%	Feasibility; Top-down; Screening; Pre-design
Class 3	Budgetary	Budgeting	10% to 40%	-20% to -10%	+10% to +30%	Budget; Basic Engineering Phase; Semi-detailed
Class 2	Definitive	Bidding; Project Controls; Change Management	30% to 75%	-15% to -5%	+5% to +20%	Engineering; Bid; Detailed Control; Forced Detail
Class 1		Bidding; Project Controls; Change Management	65% to 100%	-10% to -3%	+3% to +15%	Bottoms Up; Full Detail; Firm Price

Source: ProcessEngineer.com

Cost Estimates: "Probable Cost" + Budget to Study

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Articulate the narratives within alternatives

- **Rapid Deep Electrification Retrofit.**

  This building has an old steam HX for heating and gas boiler for domestic hot water, both of which will be replaced immediately with all-electric alternatives. This will be accompanied by other equipment replacements in the building to most-efficient alternatives. The building will also implement comprehensive RCx to ensure peak performance of all equipment. Carbon offsets, if needed, will make up the difference to achieve LL97 compliance.

- **Phased Compliance.**

  This building will start with low-cost and no-cost RCx, controls measures, and proven energy savings measures (such as LEDs) to achieve energy and carbon savings early at low cost. The building will replace gas- and steam-using equipment at the end of useful life with more efficient all-electric alternatives.

- **Efficiency Only (offsets)**

  This building will start with low-cost and no-cost RCx, controls measures, and proven energy savings measures (such as LEDs) to achieve energy and carbon savings early at low cost. Equipment will be replaced at end of useful life with efficient alternatives, but no proactive effort will be made for fuel-switching to electrification. Carbon offsets will be used to make up the difference to achieve LL97 compliance.

Showcase Projects

Initial retrofit decarbonization projects under contract with EBC

Empire State Realty Trust – Empire State Building, NYC

- Maximize energy recovery, minimize steam consumption, reduce/ eliminate simultaneous heating and cooling.
- Private invest.= $40M+

Hudson Square Properties – 345 Hudson, NYC

- Comprehensive water source heat pump system to recycle heat from different spaces in the building
- DOAS + heat recovery
- Private invest.= $30M+

L&M Fund Management – The Heritage Towers, NYC

- Building envelope upgrade with EIFS and new windows
- Complete electrification of 1660 Madison Ave.
- Private invest.= ~$14M

Omni NY LLC – Whitney Young Manor, Yonkers, NY

- Recapitalization to retrofit systems, modernize affordable housing.
- Upgrade envelope; all heating, DHW w/ heat pumps
- Private invest.= $12M