

RETROCOMMISSIONING & DECARBONIZATION



A Strategic Approach to Energy Efficiency and Emissions Reduction in Existing Buildings

1. Why This Matters

Building operations account for around 30% of global final energy consumption and 26% of global energy-related emissions (IEA, 2025). Building operations account for around 30% of global final energy consumption and 26% of global energy-related emissions (IEA, 2025).

Retro-commissioning (RCx) is among the fastest and most cost-effective operational decarbonization strategies. Large-scale studies of approximately 1,500 existing buildings show typical whole-building energy savings of 5–14%, with median simple payback periods of ~1.7 years (Crowe et al., 2020; DOE/LBNL, 2018). For building owners facing deferred maintenance, rising energy costs, and expanding regulatory requirements, RCx addresses multiple priorities by simultaneously reducing emissions, controlling expenses, extending equipment life, and ensuring long-term asset value.

2. Definition & Scope

Retro-commissioning, as defined in ASHRAE Guideline 0-2019, is the systematic process of investigating, analyzing, and optimizing the performance of existing building systems to meet current facility requirements and improve operational efficiency. Unlike new construction commissioning, RCx focuses on existing facilities that may have not been commissioned before or have drifted from their original design intent over time.

What RCx Includes:

- Comprehensive system diagnostics and functional performance testing (ASHRAE Guideline 0)
- Identification of operational deficiencies and control sequence issues
- Low-cost/no-cost optimization measures (setpoint adjustments, scheduling, controls tuning)
- Documentation of system performance and recommended improvements
- Training for operations staff on system operation and maintenance

What RCx Does Not Include:

- Major capital equipment replacement (though may identify needs)
- Building envelope upgrades or architectural modifications
- Deep energy retrofits, which typically require significant construction

Distinction from Related Approaches:

- **New Construction Commissioning:** Occurs during design and construction; RCx applies to operating buildings
- **Ongoing Commissioning:** Continuous process after initial RCx; RCx is a discrete investigation and optimization project
- **Energy Audits:** Primarily diagnostic; RCx includes implementation and verification of improvements

3. Value Proposition

ENERGY And EMISSIONS IMPACT	Typical Reduction: 5–14% whole-building energy savings in large-scale studies of existing buildings (Crowe et al., 2020); earlier studies reported savings up to ~16% (LBNL, 2009). Carbon Intensity: Direct impact on Scope 1 (on-site combustion) and Scope 2 (purchased electricity) emissions; enables transition to lower-carbon energy sources through reduced loads
FINANCIAL IMPACT	Payback Period: Typically 0.7-2 years for operational improvements (EPA ENERGY STAR, 2010); 3-5 years with minor capital measures Cost Savings: \$0.13-\$0.45/sq ft annually (Mills et al., 2004); average implementation cost \$0.27/sq ft (EPA, 2010) Asset Value: Improved ENERGY STAR scores, reduced O&M costs, extended equipment life, enhanced tenant satisfaction and marketability
RISK & PERFORMANCE	Reliability: Identifies failing components; improves comfort and reduces complaints; maintains the majority of energy savings several years post-implementation (Gunasingh et al., 2019) Regulatory Alignment: Positions buildings to meet building performance standards mandated by ASHRAE Standard 100-2024 and local regulations (e.g., NYC Local Law 97, Washington HB 1257) Energy Cost Stability: Lower baseline consumption reduces exposure to volatile energy prices

4. Implementation Framework

Following ASHRAE Guideline 0-2019 commissioning principles:

1. **Baseline & Benchmark:** Establish energy consumption baseline using 12+ months of utility data; benchmark against peer buildings using ENERGY STAR Portfolio Manager or ASHRAE Building EQ
2. **Technical Assessment:** Conduct functional performance testing per ASHRAE Guideline 0; review sequences of operation, setpoints, and schedules against current facility requirements
3. **Optimization / Retrofit Measures:** Implement low-cost operational improvements (scheduling, setpoints, economizer repair); evaluate capital measures (lighting upgrades, VFD installations) for phased implementation
4. **Electrification (if applicable):** Assess opportunities for fuel-switching (electric heat pumps, induction cooking) when equipment reaches end-of-life; evaluate electrical infrastructure capacity and alignment with decarbonization roadmap
5. **Measurement & Verification:** Follow ASHRAE Guideline 14-2023 (Measurement of Energy, Demand and Water Savings) or IPMVP protocols; compare post-implementation energy use to baseline, weather-normalized; document savings and persistence
6. **Ongoing Monitoring:** Establish continuous monitoring per ASHRAE Guideline 0; train staff on optimized system operation; develop preventive maintenance plans to sustain improvements

5. Common Barriers & Mitigation Strategies

BARRIER	MITIGATION STRATEGY
Capital Constraints	Prioritize no-cost and low-cost operational improvements; pursue energy savings performance contracts (ESPCs) or utility incentive programs; implement phased upgrades aligned with capital replacement cycles
Data Gaps	Install sub-metering on major end-uses; leverage building automation system (BAS) trend data; use ASHRAE Building EQ or ENERGY STAR Portfolio Manager to identify outliers and focus diagnostic efforts
Operational Disruption	Schedule testing and optimization during off-hours or low-occupancy periods per ASHRAE Guideline 0; implement changes incrementally with continuous monitoring; communicate plans to tenants and stakeholders
Skills Limitations	Engage certified commissioning professionals (CxA per ASHRAE/IES Standard 202); provide training for in-house staff on optimized sequences and system operation; leverage remote monitoring services for ongoing support

6. Case Study

The following represents typical RCx performance based on industry studies (Mills et al., 2004; LBNL, 2009; LBNL, 2020):

Building Profile: 200,000-250,000 sq ft Class B office building, 1980s construction, mixed-humid climate (ASHRAE Climate Zone 4A)

Typical RCx Measures: AHU scheduling and setpoint optimization, economizer repair, demand-controlled ventilation, lighting controls upgrades, chiller sequencing optimization

Expected Results: 10-16% reduction in annual energy use, improved thermal comfort, reduced maintenance calls

Implementation Cost: \$0.27-\$0.30/sq ft (\$54,000-\$75,000 total); median annual savings \$0.27/sq ft (\$54,000-\$68,000)

Typical Payback: 1.1-2.2 years simple payback

Key Success Factors: Economizer faults can represent a significant source of avoidable cooling energy waste; staff training per ASHRAE Guideline 0 principles essential for maintaining savings; continuous monitoring reveals additional optimization opportunities

7. Key References

ASHRAE Standards & Guidelines:

- **ANSI/ASHRAE/IES Standard 100-2024** – Energy and Emissions Building Performance Standard for Existing Buildings
- **ASHRAE Guideline 0-2019** – The Commissioning Process (framework for new and existing buildings)
- **ASHRAE Guideline 14-2023** – Measurement of Energy, Demand and Water Savings
- **ANSI/ASHRAE/IES Standard 202-2024** – The Commissioning Process Requirements for New Buildings and New Systems

Research & Technical Reports:

- International Energy Agency (IEA). Buildings – Energy System. <https://www.iea.org/energy-system/buildings>

- Crowe, E., Mills, E., Poeling, T., Curtin, C., Bjørnskov, D., Fischer, L., & Granderson, J. (2020). Building commissioning costs and savings across three decades and 1,500 North American buildings. *Energy and Buildings*, 227, 110408. <https://doi.org/10.1016/j.enbuild.2020.110408>
- U.S. DOE / Better Buildings (LBNL summary). The Value of Building Commissioning (2018 summary of updated dataset).
- Mills, E. (2009). Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse-gas Emissions. (Technical report record available via OSTI).
- ASHRAE Guideline 14-2023. Measurement of Energy, Demand and Water Savings.
- EPA. ENERGY STAR Building Upgrade Manual (PDF; includes Retrocommissioning chapter).
- Gunasingh, S., Hackel, S., & Zhou, X. (2019). Persistence in Energy Savings from Retro-Commissioning Measures. (ASHRAE Journal feature / excerpt).
- World Green Building Council (WorldGBC). Embodied Carbon / Bringing embodied carbon upfront. (Includes 28% operational + 11% materials & construction framing).
- IPCC (2022). AR6 WGIII, Chapter 9: Buildings. https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter09.pdf
- ASHRAE public policy letter (for the “75–80% by 2030 already exist” statistic).