Retro-commissioning

Overall review and future development

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Carbon Reduction
Retro-Commissioning
New Normal for COVID-19
Smart City

RCx Background in the world
Commissioning Tools for Improved Building Energy Performance – IEA ANNEX 40

1. Initial Commissioning (I-Cx)

2. Retro-Commissioning
   - Re-Commissioning (Re-Cx)
   - Ongoing-Commissioning (On-going Cx)

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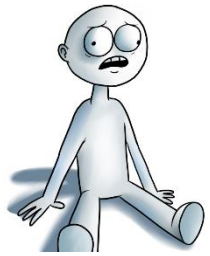
1. Testing & Commissioning (T&C)

Scope:

Testing, adjusting & balancing (TAB)

2. Functional Performance Test (FPT)
   - Measurement & Verification (M&V)

How?



System Manual

1. O&M Manual
   By Contractor

Where?

2. System Control & Operation Manual
   By Designer

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Not only:

Drawing & Specification

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Building Operation & RCx Characteristics

- >97% of time air-conditioning are operated at **part load**
- >90% of time lifts, escalators and lighting can operated at **part load**

How can we manage building facilities as operated **per demand**?
How can we know the building facilities as operated at **optimized efficiency** range?
How can we know the **operational improvement opportunities** in existing buildings?
Is there any **guidelines, standards and practices** provided for the industry?

RCx characteristics

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RCx Journey in HK

Government

4Ts partnership engagement meeting

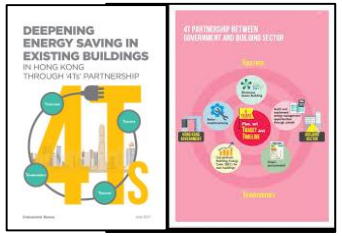
Energy Saving Plan for HK, Built Environment 2015~2025+

Draft Technical Guidelines

Paris Agreement

機電工程署 EMSD

Government Buildings (6 RCx pilot projects)



4Ts partnership

Energy Saving Charter Hong Kong's Climate Action Plan 2030+

Technical Guidelines on Retro-commissioning (1st Edition)

2015 | 2016 | 2017

(Con't)

Industry

ACT-SHOP

(24 Commercial Buildings)

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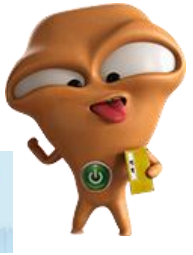
RCx Journey in HK

Government

Launched RCx Resource Centre website

Technical Guidelines on Retro-commissioning (Updated Version)

Signing of the MOC



Energy Saving For All- Energy Saving Championship 2019

Green School 2.0

(Con't)

2018 | 2019 | 2020

Eco-Building Fund (CLP) incl'd RCx

Charity Buildings (6 Buildings)

Smart Power Building Fund (HKE) incl'd RCx

RCx Training

Hospital (2 buildings)

RCx Registration Scheme on Individual and Services Provider

Industry

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How to make Retro-Commissioning (RCx) as one of the successful drivers to sustain the reduction of Energy Intensity

(Low cost & short payback)

- To further securing the reduction of energy intensity for existing buildings, EMSD published the 1st edition of **Retro-Commissioning (RCx) Technical Guide** in 2017
- Using existing building as a living laboratory to demonstrate RCx can save energy through checking the building's performance for identifying **operational improvements**.

(5-10% Saving)

- Environment Bureau (EnB) to organize RCx Competition under the **Energy Saving Championship Scheme** in 2019 for RCx.

(Over 80 commercial applications)

What's Next

- RCx process can also facilitate the **deepening of retrofitting works** and encouraging the movement of **green and innovation technology development** in building sector.

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"Smart" & Energy Saving for All 2019 - RCx

Over 80 applications and over 10 finalists were engaged in the Energy Saving Championship Scheme 2019 and most of them:

* Using significant amount of operating data and **conduct data analysis / measurement & verification** process to verify the RCx improvement works
* Using **smart technologies** to sustain the RCx process (on-going RCx) and developing the portfolio of RCx technologies
* **Bundling RCx** works together and **integrating RCx** with major retrofitting works to create synergy effect for increasing the amount of energy reduction.

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Which is better?

Integrate ALL of them….

On-going Cx
Re-balancing
Repairing
Re-adjusting
Fine Tuning

- 5 - <10% Saving
- No capital investment

Smart
IoT

- % Saving?
- Convenience
- Expandable
- Informative

Major Renovation
Modification
Retrofitting

- >10% Saving
- With significant capital investment
- Require in-depth investigation

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Site-based VS Cloud-based RCx Process (Smart & RCx)

Stage	Site based	Cloud based
Planning	• On-site Operating Data and Information Collection • Site Inspection / On-Site Measurement setup • Understanding ***Current Facility requirement,*** *Key Deliverable:* ***RCx Plan***	• ***Cloud Data*** *and* ***E-information (incl'd current facility requirement)*** • ***Remote*** *site* ***inspection*** */* ***IoT sensor*** *for On-site measurement (cloud-base data transmission & visualisation)* • ***"ZOOM meeting"*** *interview with operation team / services provider* *Key deliverable:* ***RCx Plan***
Investigation	**Desktop services** which can deliver online • Data Analysis and Diagnostic • ESO identification *Key Deliverable:* ***Investigation Report***	Recover from COVID-19
Implementation	• Implement ESO by manual / advance control logic • Conduct M&V Process on-site *Key Deliverable:* ***RCx Final Report***	• Implement ESO through **demo video / Online sharing** / advance control logic • Conduct M&V Process ***remotely through screen capture, IoT sensor*** *Key Deliverable:* ***RCx Final Report,*** ***proposed current facility requirement (e.g. control logic / control setting schedule)***
Ongoing Commissioning	• RCx Review *Key Deliverable:* ***Ongoing Commissioning (Cx) Plan***	• RCx Review remotely through screen capture / IoT sensor *Key Deliverable:* ***Ongoing Commissioning (Cx) Plan***

Site-based VS Cloud-based Tools

Data/Information capture & Storage	Logsheet / services report O&M Manual (paper/pdf) Site Meeting Face-to-face Sharing	**Cloud** operating **data** **E**-System **Manual** (database) → **BIM ?** **Online Meeting** **Screen sharing / video capture & Online Sharing**
Data Analytic and Diagnostic	**Microsoft Excel** (Semi-auto)	• **Dashboard** (Auto) • **Advance Control logic** (proactive)
Implementation	Through:- 1. Skill transfer 2. Operating schedule	Through:- 1. Advance control logic development 2. M&V Dashboard and condition-based auto-adjustment
On-going Cx	Through manual process and KPI review	3. Predictive and proactive control strategy Through automation & process review

Integrated RCx & Smart

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Integration of Retrofitting (replacement) and Retro-commissioning

Integration
[40% of total CH plant energy saved]

Whole facility analysis and consideration
(i.e. synergy effect)

Retrofitting at / beyond BEC
(15-20% of total CH plant energy saved)

- Replacement of Chillers
- Redesign the combination of chiller types and chiller capacities

Retro-commissioning (CH plant)
[5-10% of total CH plant energy saved]

- Development of optimize control logic for **chiller sequencing**
- Development of **setpoint reset**, ON/OFF, shifting & shedding (N+1/N+1), etc. **operation strategy** for chiller (CH) plant operating
- Evaluate the impact of ***airside system*** due to saving measures for CH plant

Retrofitting / retro-commissioning for airside system

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Deep Energy Retrofit (DER)
(IEA ANNEX 61 – Subtask D)

Significantly reduce energy use (by more than 50%)

Integrated Approach

Super Low Energy

- Develop **deep energy renovation** as part of normal building renovation activity
- **Conduct retro-commissioning** before issuing an Energy Performance Certificate every 10 years
- A life cycle **cost-neutral approach**, with quantitative energy and non-energy related (e.g. health, productivity) benefits
- **Avoid Staging** and "Cream-Skimming" in Building Refurbishments
- Incentives can access to **public subsidies**
- Reliable **data** must be collected and distributed (M&V become more significant)

Advancing Net Zero

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Deep Energy Retrofit (DER) Requirement

1. A "DER" requires a **whole-building analysis** approach along with an integrative design & development process
2. Typical energy efficiency improvement are planned as:
   * A part of major and minor building renovation (**Integration approach**)
   * global carbon and indoor quality enhancement (i.e. **Utilities modernization**)
   * Mechanical and electrical equipment/systems replacement (**Retrofitting**)
   * **System / whole building retro-commissioning**

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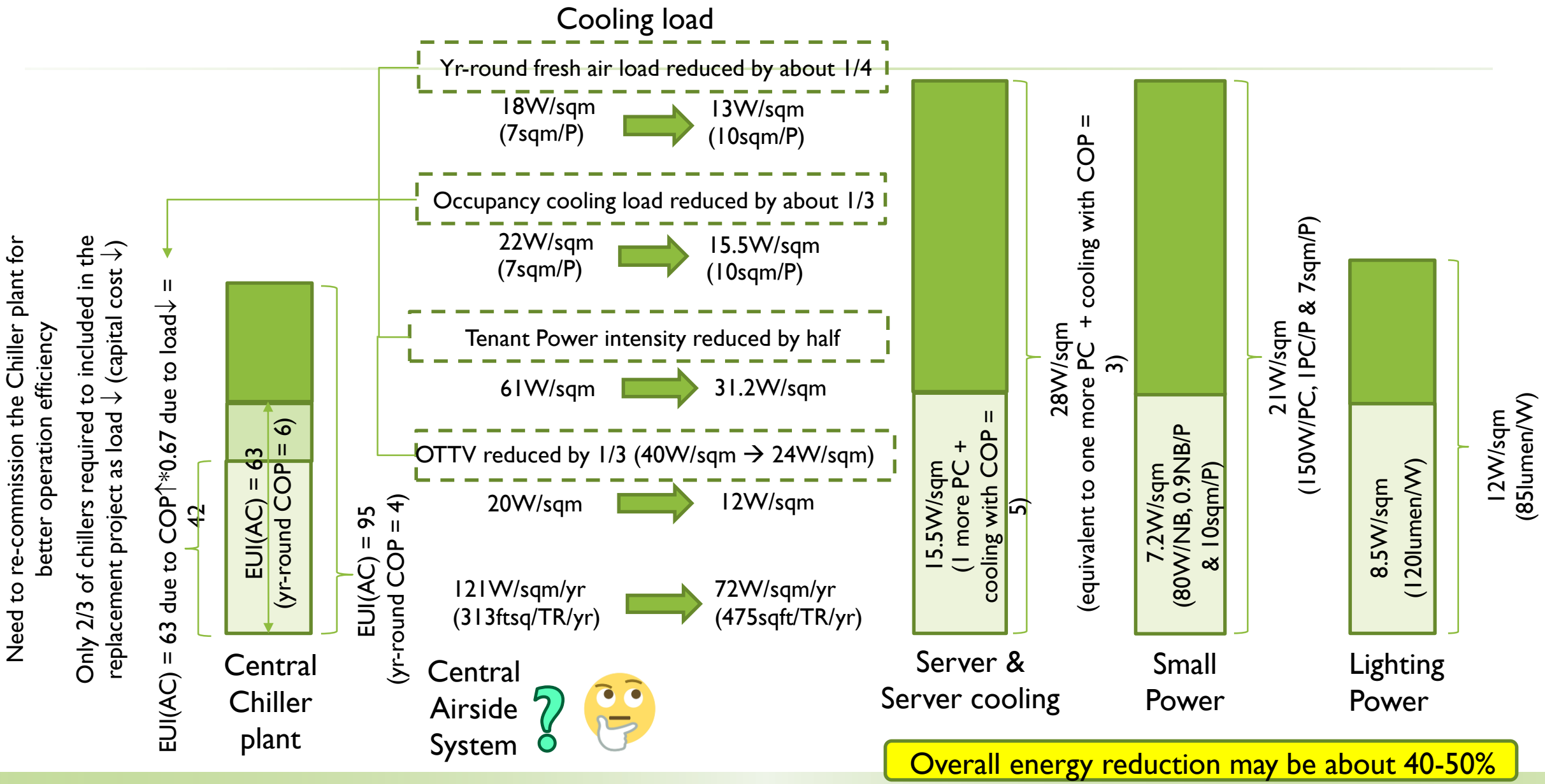
Deep Energy Retrofit (DER) – A case sharing



Deep Energy Retrofit (DER) Process

Reduce loads: Reduce the amount of energy needed to heat, cool and light the building

Integrated Approach

Identify integrative **bundles** of measures

Select appropriate and efficient **technologies**

Trend of
1. Practical New Technologies
2. Energy Code, Guideline & Standard Development

Optimize operations

Explore recovery & renewable energy

Net zero approach

1. Bldg Facilities Retrofit + retro-commissioning

2. Bldg envelop

Whole Building Envelope Upgrade
- Passive + Active System
- Tightness but naturally ventilated
- Insulated but transparent

Whole Building Facilities Upgrade
- Whole range System Efficiency
- Decentralization but proactive control
- Recovery + Renewable

Whole building Analysis

Analysis + Diagnostic + M&V

Table 2-1. Core technologies bundles for DER.

Category	Name
Building Envelope (Envelope)	Roof insulation
	Wall insulation
	Slab insulation
	Windows
	Doors
	Thermal bridges remediation
	Airtightness
	Vapor barrier
	Building envelope quality assurance (QA)
Lighting and Electrical Systems	Lighting design based on LED technologies, daylight and motion controls
HVAC (Facilities)	High performance motors, fans, furnaces, chillers, boilers, etc.
	Dedicated outdoor air system (DOAS)
	Heat recovery (HR) (dry and wet) with efficiency >70%
	Duct insulation
	Duct airtightness
	Pipe insulation

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Objective of Deep Energy Retrofit (DER)

- To reduce GHG emissions and support the Climate Action Plan
- To replace aging infrastructure and improve a building system's reliability
- To reduce operating costs and hedge against risks such as rising energy costs
- To improve occupant satisfaction, wellness, and productivity
- To maintain access to additional cost-effective upgrades and infrastructure renewal in the future

IF you know the interactive and synergy effects between retrofit, retro-commissioning, renovation and trend of technologies, it definitively increase the opportunities to success

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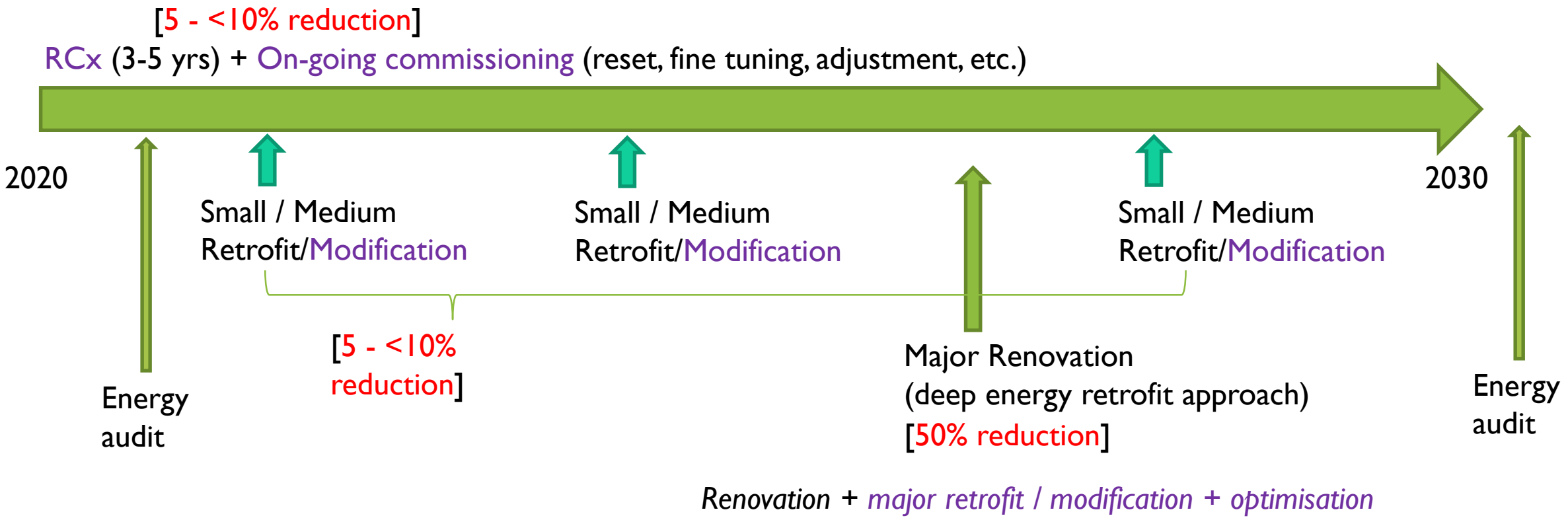
Integration RCx with retrofit & major renovation



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