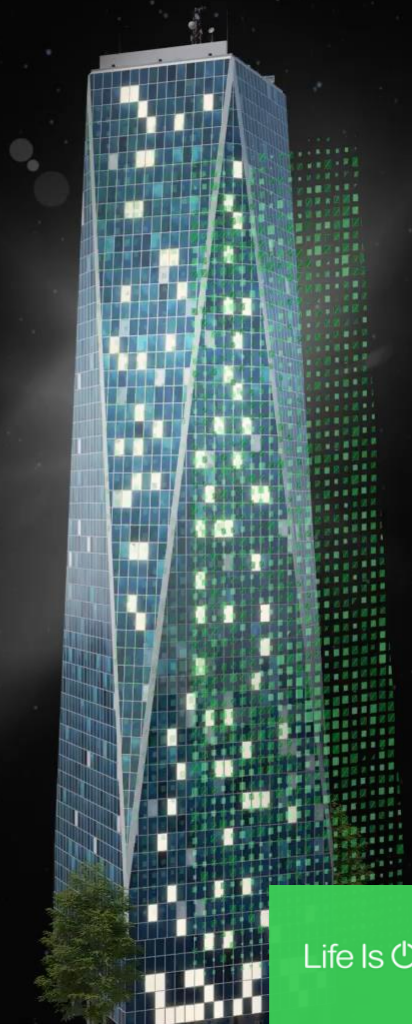
The Path to **Net-Zero Buildings** Post-Occupancy

Efrie Escott, Decarbonization Office



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Why is **existing building decarbonization** a **top priority**?

Climate

We need to save

10-15 Gt CO_2/y

by **2030** to meet the **1.5°C** climate goal

In **2040**, over

67%

of **global building stock** will be buildings that exist today

Financial

90%

of existing buildings will become a **financial risk** if they fail to **decarbonize**

Up to

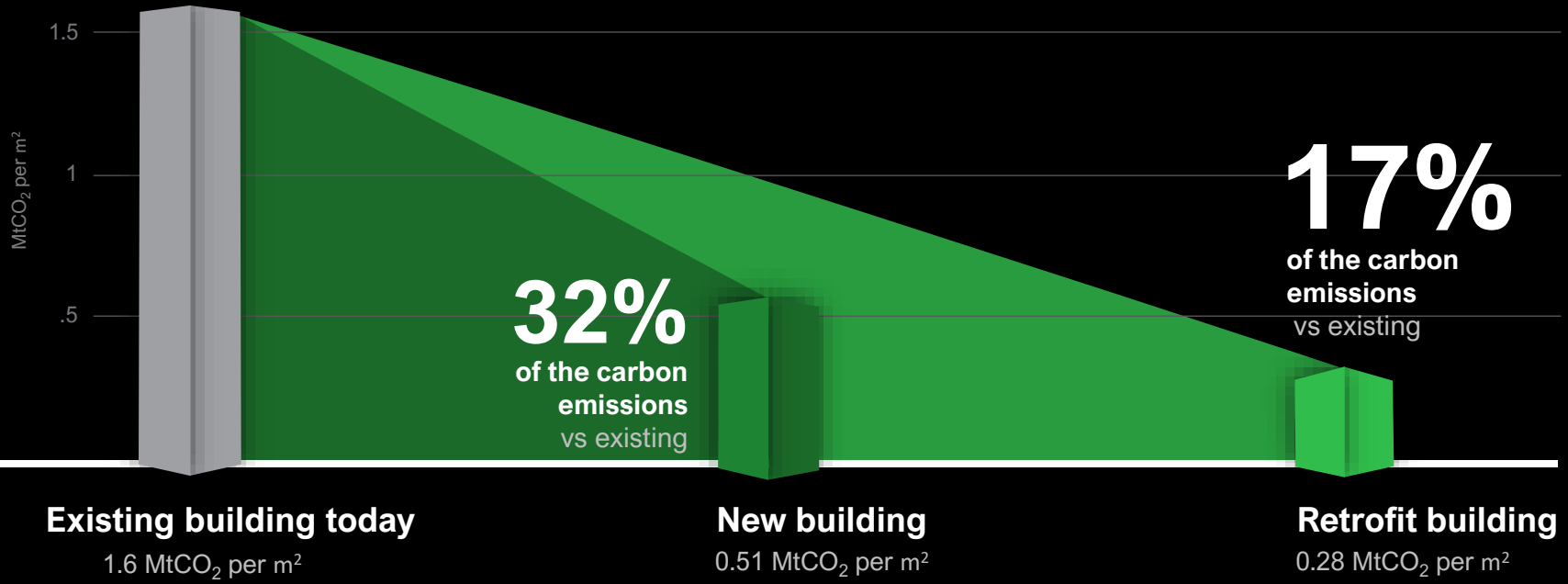
30%

asset value discount for stranded assets

Internal

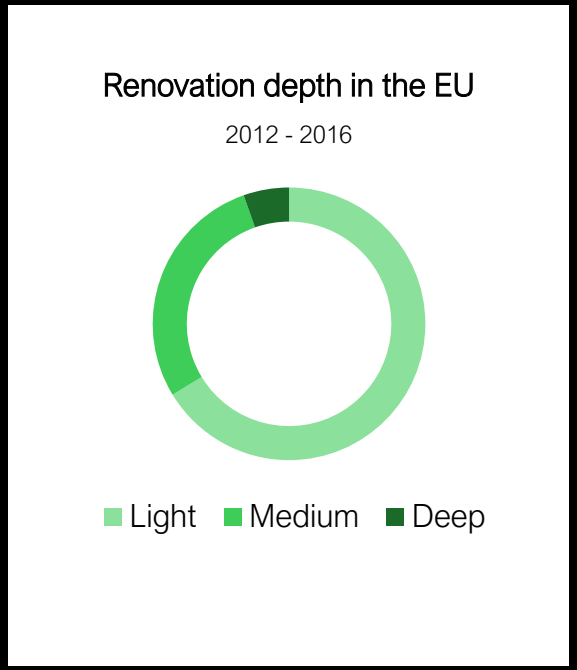
By 2050, 50% of today's buildings will still be in use

Our **biggest opportunity** to make a difference is by **retrofitting existing buildings**



Carbon intensity modelled for representative office building using: *https://caretool.org/*
Assumptions based on CBECS 2018 database

The market needs to boost both the rate and the depth of renovations:



increase in speed

15x

To achieve its **2030 climate target** and climate-neutrality by 2050, the EU must increase the deep renovation rate from 0.2% to **3% per year**, and maintain that rate up to 2050[1]

increase in depth

70%

By 2030, **70% of all renovations** taking place should be **deep renovations** to hit climate targets, which is in stark contrast to current rates of just 5.4%.

This trend must be reversed

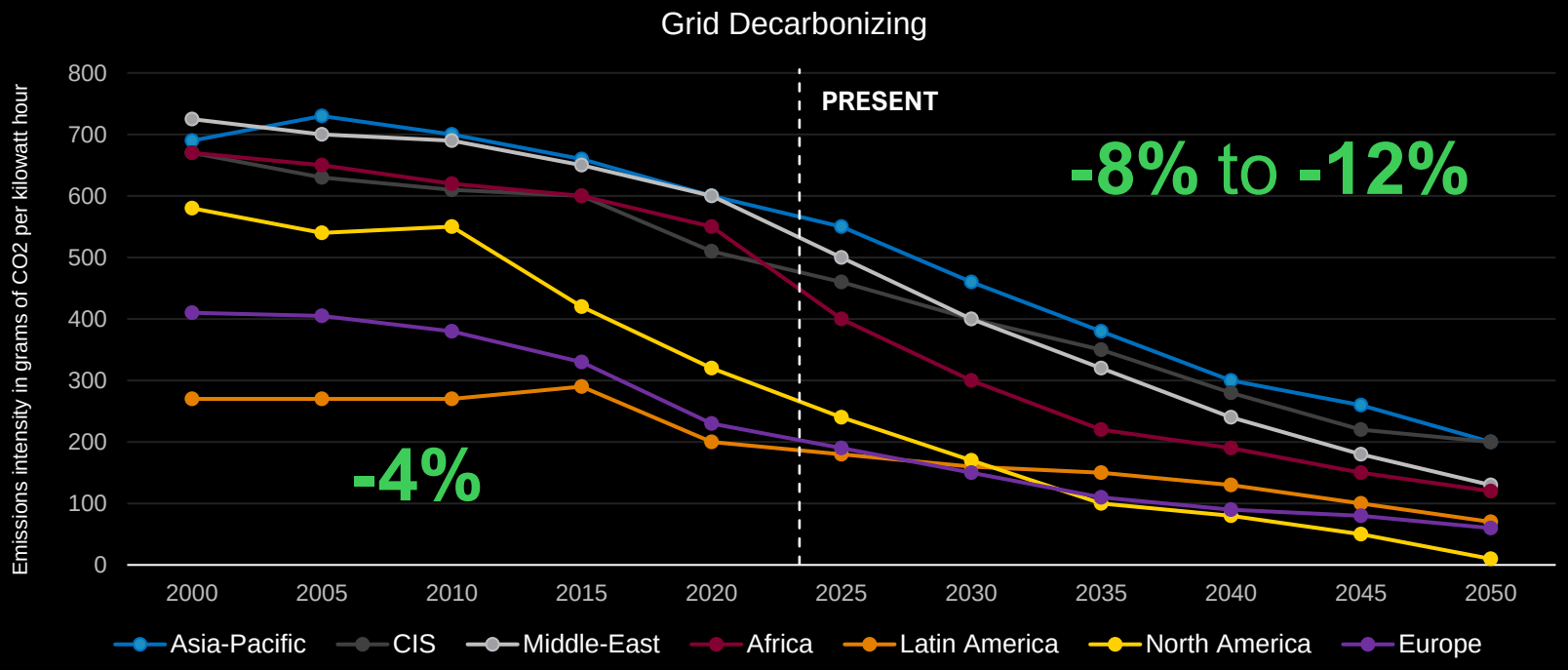
[1] BPIE (Buildings Performance Institute Europe) (2021). Deep Renovation: Shifting from exception to standard practice in EU Policy

Internal

We are at an
inflection point

Internal

The time to act is NOW



Short- and mid-term: implement strategies with the fastest **efficiency impact**

Long-term: as the grid decarbonizes, focus on **electrification**

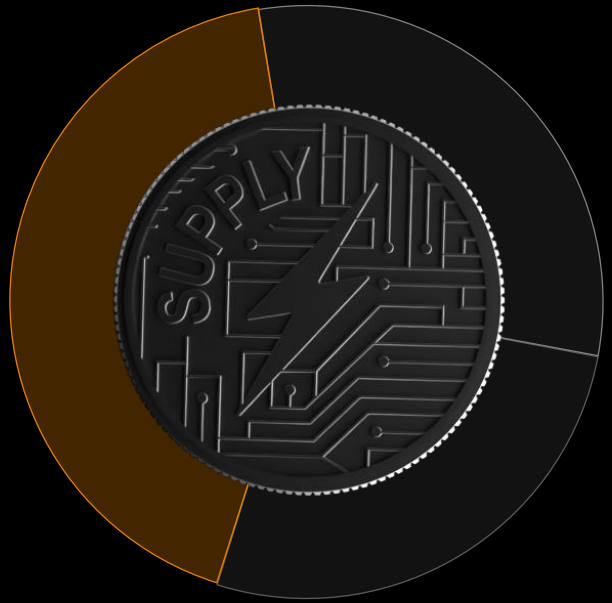
Internal

Decarbonizing supply is just one side of the energy coin…

Replace
energy supply

Offsite renewables purchasing
PPAs

Onsite renewables generation
Solar, microgrid, storage



*Contribution to net-zero energy by 2050

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We need to look at both sides… and tackle **energy demand**

Electrify

processes

Electrify Everywhere

From transport to heat to industrial processes… Reduce fossil fuel demand by transitioning to electric

*Contribution to net-zero energy by 2050

Internal

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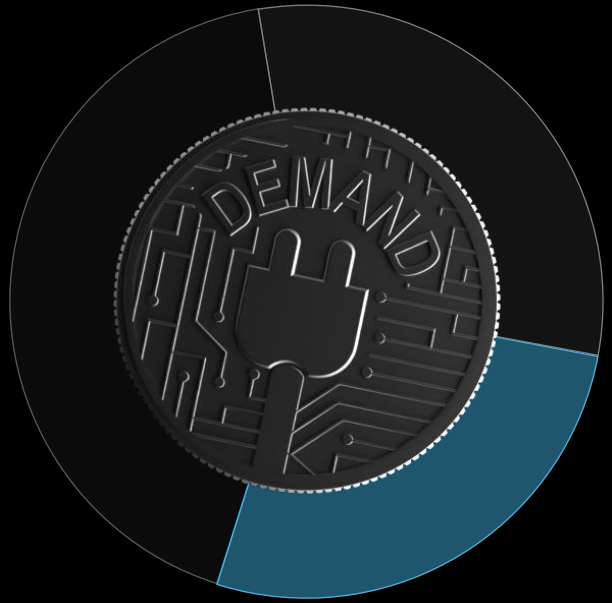
We need to look at both sides… and tackle energy demand



Reduce

for efficiency and circularity

Design & Build for Low Carbon
3D-6D BIM design to reduce embodied carbon

Measure, Monitor & Save
Connected systems and software for real-time data, insights and automation

Circularity for Avoided Emissions
Choose green by design, with extended life, efficient usage & clean disposal options

*Contribution to net-zero energy by 2050

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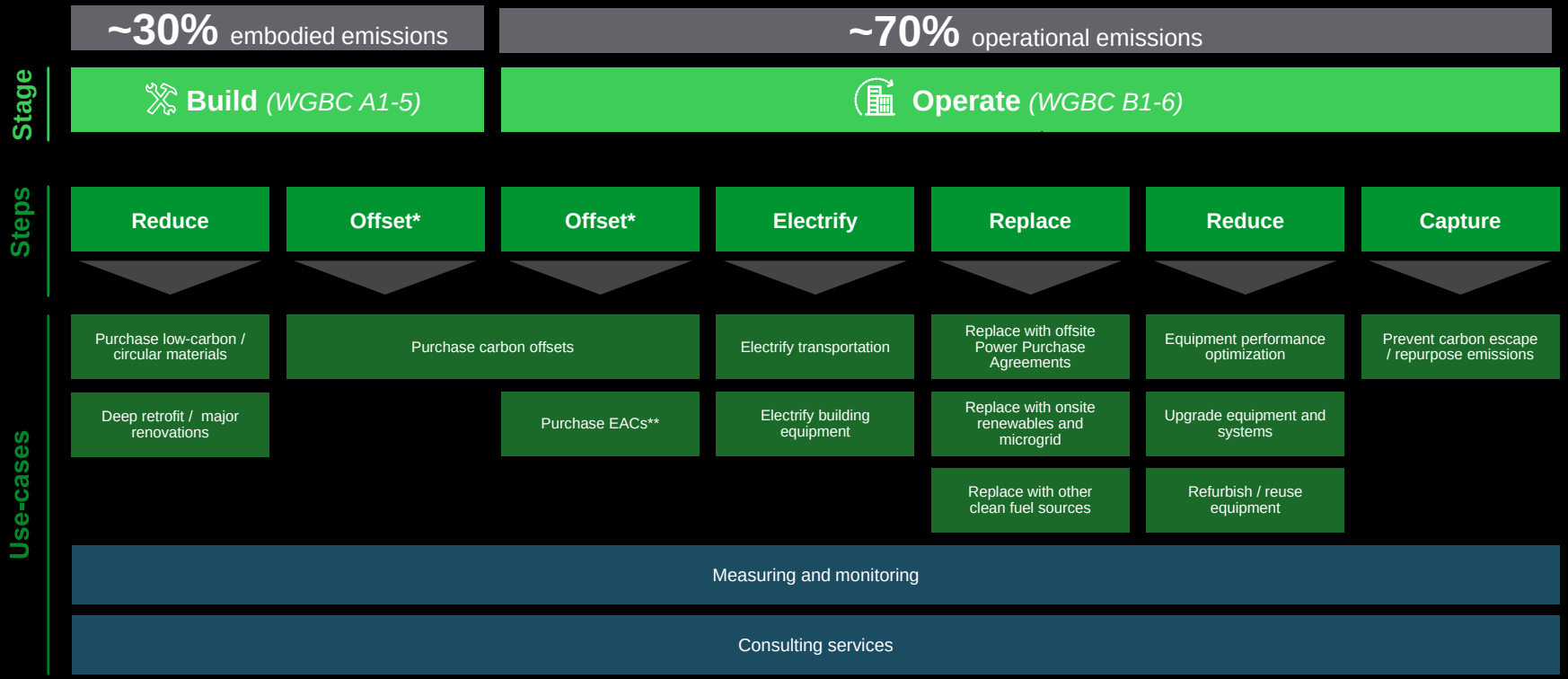
In existing buildings, a key focus is **technology to reduce building energy demand** that has a low upfront carbon impact



Notes: *The "Offset" step maps to the "Other" category of carbon emissions (i.e., emissions that are unavoidable and will require offsets to effectively reduce);
**Energy Attribute Certifications (EACs)- also called Renewable Energy Credits (RECs), and Guarantees of Origin (GOs)
Order steps and use cases as presented do not represent prioritization or sequence of customer journey
Sources: SE experts, WGBC, EN 15978 standard

Internal

The order of application matters because of the time-value of carbon and the rate of the grid decarbonizing

Annual Carbon Emissions by key steps to net-zero*

$kgCO_2E/Year/m^2$

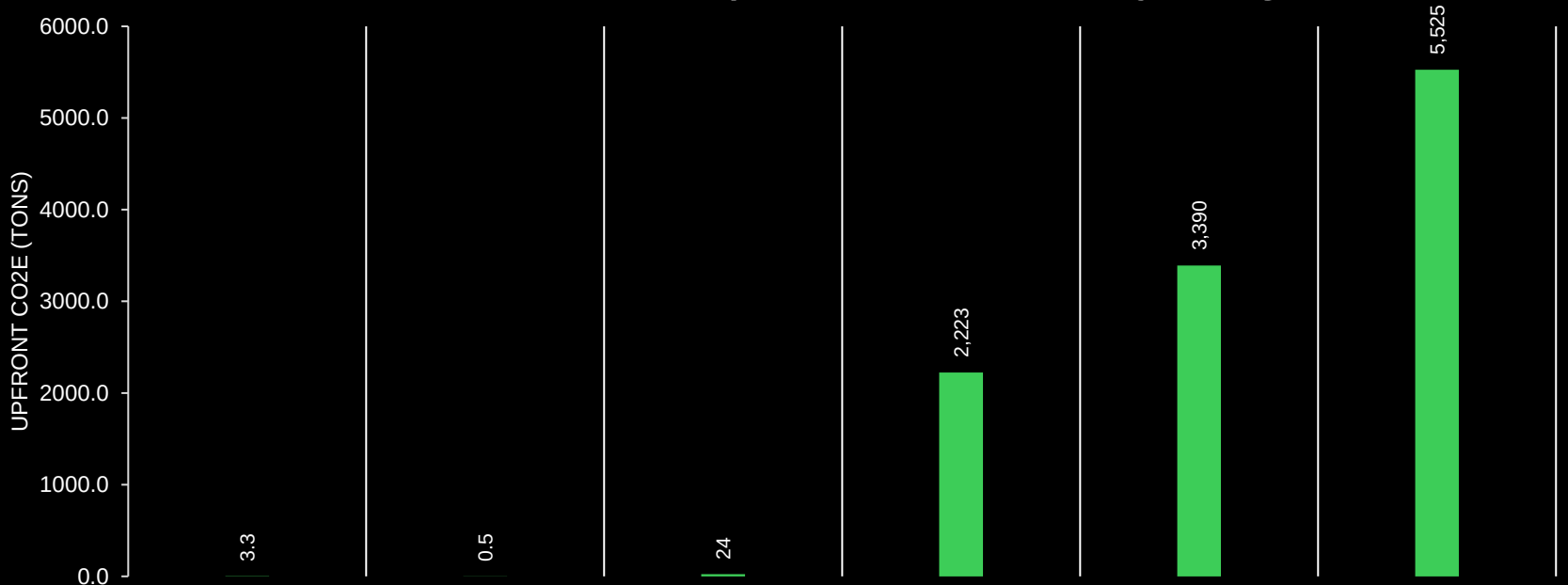
Become a citizen of the grid and **create decarbonization roadmap**

Digital and Power Measures to do NOW

Steps to strategize timing based on financial resources and grid CO2

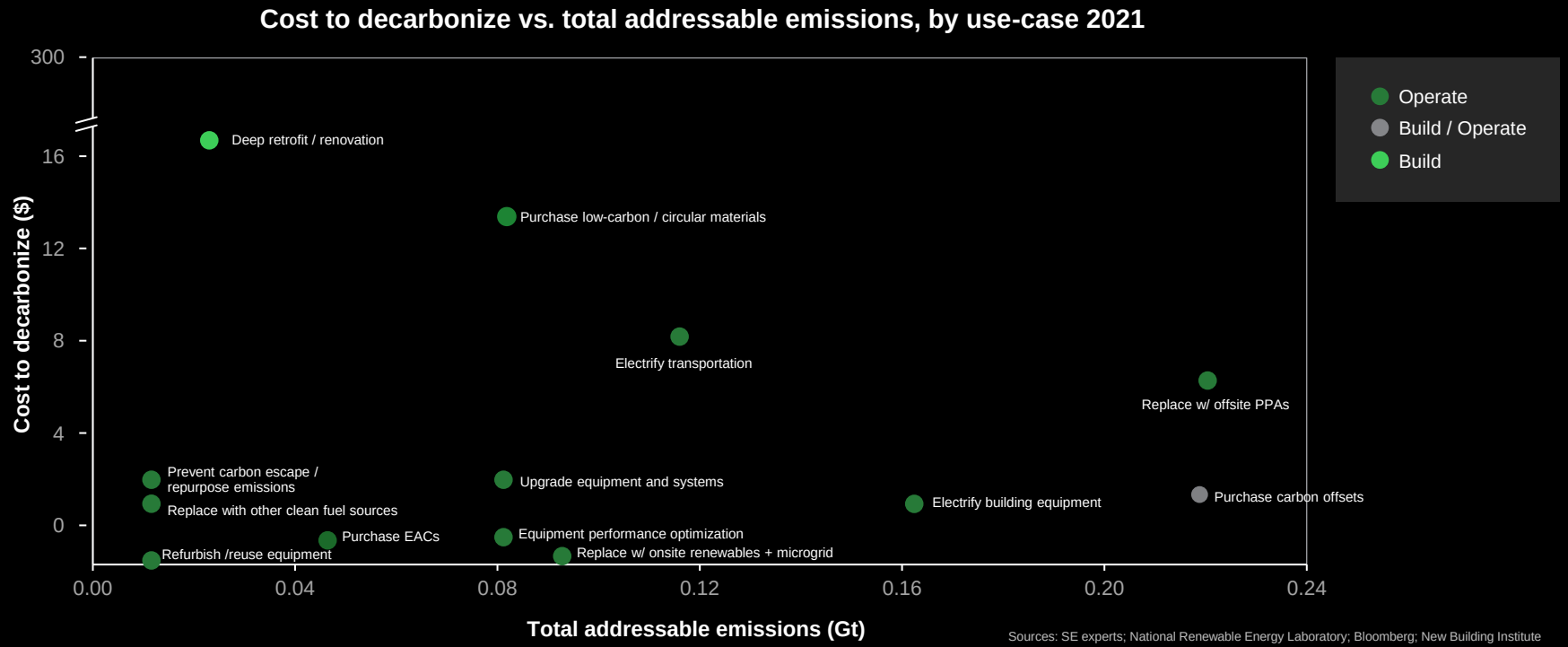
* Baseline uses ASHRAE baseline Large Office [12-stories, 46728 m2] located in Chicago, IL. Modeling based on SE offers include Power Factor Correction, AI-enhanced BMS system for HVAC and lighting control, Connected Room Solutions occupancy-based controls, integrated submetering, PV integrated microgrid (PV capacity at 60% roof coverage), power monitoring and submetering, microgrid and BESS, plug-load shutoff optimization, and offsets.

Energy is not the same as carbon! Time to **carbon payback** (if all solutions are installed in 2024) shows not everything is worth it.



Accelerating retrofits recognizes **variability in the available resources** to decarbonize

Addressing customer financial capacity



Sources: SE experts; National Renewable Energy Laboratory; Bloomberg; New Building Institute

Internal

Start with **an integrated approach**

Strategize

MEASURE enterprise baseline

CREATE decarbonization roadmap

STRUCTURE program & governance

ENGAGE ecosystem

COMMUNICATE commitment

Digitize

MONITOR resource usage & emissions

IDENTIFY saving opportunities

REPORT and benchmark progress

Decarbonize

REDUCE energy use

ELECTRIFY operations

REPLACE energy source

Internal

Top Priorities for **Net-Zero Retrofits**

Strategize

1. **Create** decarbonization roadmap

Digitize

2. **Track** embodied carbon
3. **Measure** and monitor energy and carbon

Decarbonize

4. **Reduce** energy and carbon through automation
5. **Electrify** transportation
6. **Upgrade** power systems and electrical infrastructure
7. **Install** onsite renewables
8. **Limit** embodied carbon
9. **Electrify** building heating systems
10. **Offset** residual carbon emissions

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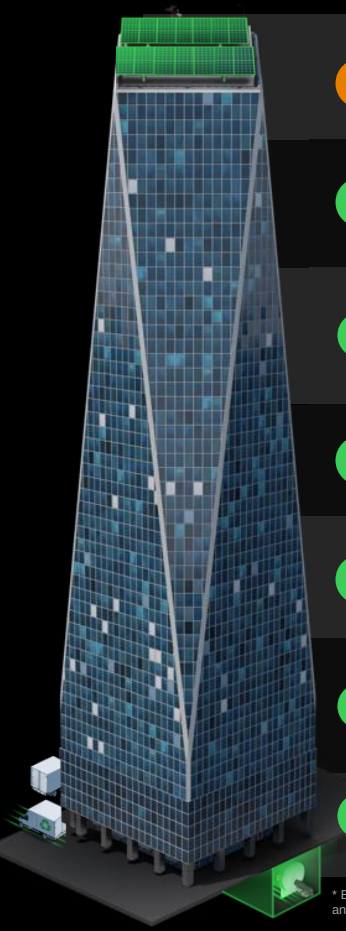
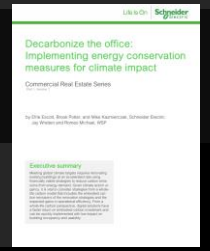
Over **95%** of operational CO_2 can be avoided through digitization and electrification*



3	**Measure** and monitor energy and carbon	**Measure and monitor energy and carbon Submetering** -0.9 kg CO2e per yr per m2 **(1.6%)**		
4	**Reduce** energy and carbon with automation	**Modern Building Management Systems** -5.8 kg CO2e per yr per m2 **(10.7%)**	**Real-time AI-driven HVAC optimization** -7.7 kg CO2e per yr per m2 **(14.2%)**	**Occupancy -based zone control** -4.1 kg CO2e per yr per m2 **(7.5%)**
6	**Upgrade** power systems and infrastructure	**Power factor correction** -5.8 kg CO2e per yr per m2 **(17.6%)**	**Lighting system upgrade to LEDs and daylight optimization** -0.9 kg CO2e per yr per m2 **(10.6%)**	
7	**Install** onsite renewables and microgrids	**Rooftop solar photovoltaic system** -3.2 kg CO2e per yr per m2 **(5.9%)**	**Surface parking solar photovoltaic system** -25.6 kg CO2e per yr per m2 **(47.2%)**	
8	**Track** and limit embodied carbon	**Low-carbon products** -0.5 kg CO2e per yr per m2 **(0.9%)**	**Extended Service Life** -2.1 kg CO2e per yr per m2 **(3.6%)**	
9	**Electrify** building heating	**Air Source Heat Pump** -5.6 kg CO2e per yr per m2 **(10.2%)**		
10	**Purchase** offsite renewables and offsets	**Carbon offsets and/or EACs** -6.7 kg CO2e per yr per m2 **(12.4%)**		



* Baseline uses ASHRAE baseline Large Office [12-stories, 46728 m2] percentages in breakdown are representative of US Climate Zone 5. SE-specific technology modeled to identify the contributions of Power Factor Correction, AI-enhanced BMS system for HVAC and lighting control, Connected Room Solutions occupancy-based controls, integrated submetering, PV integrated microgrid (PV capacity at 60% parking lot and 70% roof coverage), and offsets.

Internal

More content available & deployed

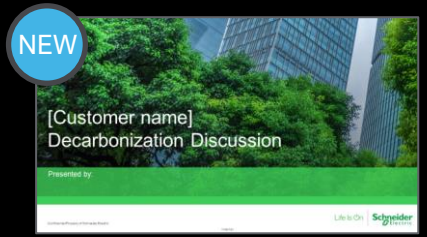
High-level assets

Sustainable Retrofits eGuide

Available: (LINK)

The Path to Net Zero Buildings eGuide

Available: LINK



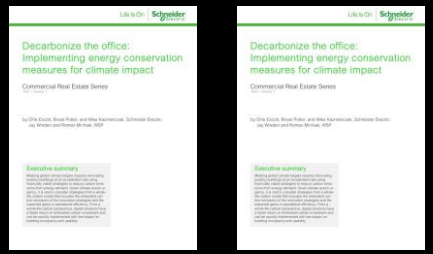
Decarbonizing Buildings – Operational Team Presentation Customer PPT

Links coming soon

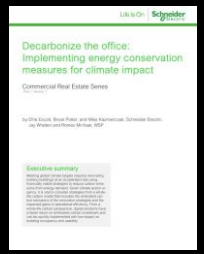
Decarbonizing Buildings – C-level Customer Presentation PPT

Links coming soon

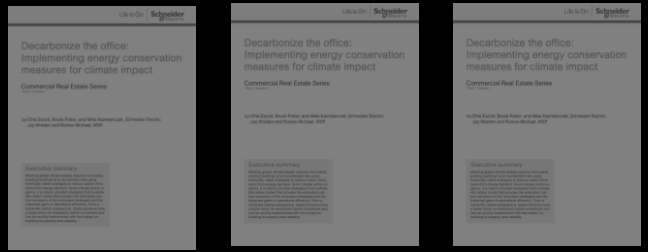
Technical White Papers



Decarbonize the Office: Renovate for Efficiency (#1) and Accelerate with Electrification (#2)
Available now!



Decarbonize Everywhere:
Key Indicators (#3 in series)
Coming soon



Coming in 2024: Decarbonize Retail, Hospitality, and Health Care

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