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How to set energy efficiency requirements for existing buildings

Buildings and Construction

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A major part of the 2050 building stock will be buildings that already exist today. Many of those buildings fall short of today's energy performance standards. Highly inefficient buildings slow down progress toward a zero-carbon-building goal, and can lead to unnecessary investments in renewable energy infrastructure.

To address this, cities can set minimum energy performance requirements for existing buildings, make upgrading an attractive option for building owners, and even ban the rental of highly inefficient buildings. This article sets out the options for cities to raise the energy performance of existing commercial and residential buildings.

Some of these policies require the availability of energy performance information, described in *How to use reporting and disclosure to drive building energy efficiency*. For guidance on municipal building retrofits, also read *How to finance the retrofit of municipal buildings*.

Determine the best zero-carbon-building pathway, finding the appropriate balance between energy efficiency and renewable energy investments

First, focus on improving building energy efficiency, shifting remaining energy needs to clean sources. By prioritising energy efficiency measures cities can improve residents' health and comfort, reduce energy costs and avoid over-spending on renewable infrastructure.

The city will need to conduct or commission analysis to establish the appropriate balance between energy efficiency and clean energy investments (the threshold up to which energy efficiency upgrades are cost-effective). This should be informed by data on current building performance.

Clean energy investments – such as building-scale renewables, decarbonised heating and cooling, and cleaner grid energy – are needed to tackle emissions beyond the threshold if further improvements in energy efficiency are cost-effective.

For example, analysis of the New York City building stock indicated that energy efficiency upgrades for existing buildings are cost-effective until energy savings reach 30 – 50%.[1]

Read our article on developing a net zero carbon building pathway for more details of how to establish the appropriate local balance.

Introduce an energy or greenhouse gas cap

Cities can introduce a cap or quota on the energy use or emissions attributable to individual buildings. This is currently only used in a small number of cities, but a cap can be an effective way to secure declining emissions over time. It incentivises building owners to invest beyond the efficiency required by the measures outlined in the sections below.

A cap can be fixed, such as in Beijing, where an energy intensity limit is set for different building types. Alternatively, alongside a cap, a trading mechanism can be put in place, such as Tokyo's cap and trade scheme (see box). In China, Shenzhen's emissions trading scheme uses the energy quota system used in Beijing as a basis for the initial allocation amounts for each building.

Tokyo's Cap-and-Trade programme

Launched in April 2010, the Tokyo Metropolitan Government's Cap-and-Trade programme is a mandatory emissions trading scheme that covers about 20% of Tokyo's CO_2 emissions.[2]

Large commercial buildings and factories were required to reduce emissions by 6% or 8% in the first stage (2010 – 2014), and must reduce emissions by 15% or 17% in the second stage (2015 – 2019). By 2018, a 27% reduction in emissions had been achieved.

To comply, affected buildings can either reduce their own emissions or purchase offset credits. The market price of credits is very high, creating an incentive to implement energy efficiency measures first.[3] To date, most buildings have opted to meet energy efficiency requirements and little trading has taken place.

Introduce legislation to bring existing buildings up to code

Cities that have the regulatory powers to issue building codes, or strengthen state or national codes, can require existing buildings to comply with the codes and standards applied to new buildings.[4]

Target upgrade policies at major events in a building's lifecycle

Building upgrades are typically more feasible and less disruptive if they coincide with major events in a building's lifecycle, also known as 'triggers.' Many of the mechanisms discussed in this article can be linked to these events.

The main triggers used as opportunities to require upgrades to existing buildings are:

- at the point-of-sale.
- at the point-of-lease, for rented property.
- at a change in the use of a building.
- when a building is refinanced.
- when major equipment is replaced, such has heating, ventilation and air conditioning (HVAC) systems.
- when undertaking maintenance work or renovations.
- when buildings are extended.

Effective ways to do this are to:

- **Expand the scope of mandatory building codes to include major building renovations.** This can apply to all renovations or alterations affecting the building and/or its systems, to renovations over a specified size, or can be targeted at types of upgrade. For countries in the European Union (EU), major renovations (affecting at least 25% of the building, or where the total cost is 25% or more of the value of the building) are required to comply with building codes.[5] In San Francisco in the United States, all alterations and additions, such as new equipment, need to comply with the building code. In Hong Kong, China, any replacement or addition of central building service systems, or service systems covering a floor area of more 500 square metres, must comply with the building code.[6] [7]

- **Require upgrades to code for targeted building types, regardless of renovations.** Cities can use building performance data to inform decisions about which building types have the greatest need and potential for upgrades. For example, Austin, Texas in the United States requires efficiency improvements to be made on low-performing multi-family buildings.[8]

- **Use outcome-based codes.** These assess a building based on actual energy performance. This requires existing buildings to prove compliance through retro-commissioning, as described below.

Cities that don't have the regulatory powers to set and implement their own codes can use other policy measures discussed below.

Use retro-commissioning and 'tune-ups' to make sure that buildings are performing as they should

Retro-commissioning is the periodic testing and maintenance of a building's equipment and operating systems to ensure that the building performs as intended. Retro-commissioning is typically used for commercial buildings and can target priority building types or low-performing buildings. It works best when paired with a policy mandating energy audits to provide data on operational energy performance.[9]

Tune-ups are similar to retro-commissioning. Periodic testing and maintenance are used to identify and implement low-to-no-cost actions relating to building operation that can deliver up to around 10 – 15% in energy savings.

Both need to be done by qualified specialists.

Tune-ups in Seattle

Seattle in the United States requires tune-ups every five years for large commercial buildings (50,000 square feet or larger, excluding parking), under the Building Tune-Ups Ordinance adopted in March 2016.[10] It aims to optimise building energy and water performance.

To support building owners to do tune-ups, compliance deadlines are being phased in by building size: the deadline for buildings of 200,000 square feet or more was 1 March 2019, while the smallest affected buildings (50,000 – 70,000 square feet) have until October 2021 to submit their tune-up summary report. Penalties for missing reporting deadlines range from $2,000 – $20,000. This is a key piece of Seattle's Climate Action Plan, the city's roadmap for achieving carbon neutrality.

Energy audits and retro-commissioning in New York City

In New York City, United States, large public buildings and private buildings are subject to periodic energy auditing and retro-commissioning. Retro-commissioning must be completed within four years of submitting the energy audit report.[11] By 2025, all buildings must upgrade lighting to meet the local code, introduce sub-metres to track energy use per unit (many buildings in New York have only one metre for the whole building), and provide tenants with a monthly statement.

Introduce minimum standards for the highest emitting appliances and equipment

Set minimum energy performance standards (MEPS) for common building technologies. If possible, consider prohibiting the production, import and sale of products that do not meet the minimum requirements.

MEPS are typically set at the national level and cover common appliances such as air conditioners and fridges.[12] However, cities usually have the power to set stricter standards or accelerate their introduction. Many cities set their own standards for lighting in buildings, street lighting and for common building service systems.

Cooling system upgrades in Singapore

In Singapore, building owners replacing or installing new cooling systems have to meet a standard equivalent to the minimum Green Mark level in the local green building rating and certification scheme.[13] This is required under the Existing Building legislation, which was enacted in 2012 as part of Singapore's national target of 'greening' at least 80% of its building stock by 2030. The legislation also requires minimum Green Mark Certified standards for buildings with a floor area of at least 15,000 square metres, and annual submission of building information and energy consumption data.[14]

Use green building rating and certification schemes as an 'off the shelf' minimum standard

There are many well regarded national and international green building rating and certification schemes, many of which are non-governmental. Cities can require buildings to achieve a certain certification level under a relevant local or international scheme.

These schemes can often be used where cities don't have regulatory power to issue or strengthen building codes. Cities can either apply these schemes as standards for buildings under their control, or apply them to public and private buildings that meet certain criteria, such as minimum building size. Read *How to use reporting and disclosure to drive building energy efficiency* for more information and examples of these schemes.

Energy Star rating requirements for large buildings in Washington, D.C.

From 2021 Washington, D.C. in the United States will require all buildings over 50,000 square feet to meet at least median Energy Star scores within a five-year time period, or pay a fine. The requirement will expand to

cover buildings above 10,000 square feet by 2026. This policy is part of D.C.'s December 2018 bill that calls for the city's greenhouse gas emissions to be cut by 50% by 2032. The majority of D.C.'s emissions come from buildings.

LEED certification in Portland

All city-owned existing buildings in Portland, United States must meet the LEED Silver or higher rating under the LEED scheme's Existing Buildings Operation and Maintenance certification track. All interior upgrade projects for city-owned or leased buildings in Portland must either obtain LEED Silver or higher rating under the Commercial Interiors track, or follow the city's Green Tenant Improvement Guide.

Ban the rental of highly inefficient buildings with energy performance certificates and labels

Many cities have introduced mandatory disclosure of buildings' energy performance through the use of energy performance certificates or labels. For guidance on how to implement these schemes, read *How to use reporting and disclosure to drive building energy efficiency*.

Countries, and sometimes cities, can use these schemes to improve the energy efficiency of the lowest performing rental buildings (with the worst label level) by prohibiting owners from renting them to tenants without renovations. This approach is less suitable for non-rental buildings.

The EU's energy efficiency labelling scheme

The EU mandates building classification using labels from A – G, with buildings rated A having the best building energy efficiency. Countries in the EU have used this scheme to ban the rental of the lowest performing buildings. In the UK, since April 2018, landlords of residential and commercial buildings rated F and G have been required to install energy saving measures before they can be rented to new tenants.[15] France requires F and G labelled buildings to be renovated by 2025, and requires energy performance upgrades when improvements are made to external facades and roofs. The Netherlands has proposed a mandatory phase out of rental homes and office buildings labelled less than C by 2023.

Countries and cities can also introduce minimum standards for rental buildings separately from energy performance certificate and labelling schemes. For example, in Belgium rental market buildings must meet minimum insulation requirements.

Colorado's rental energy efficiency standard

In Boulder in the United States, a rental housing energy efficiency standard was identified as a priority in the city's first Climate Action Plan. This became the city's SmartRegs programme, which requires all licensed rental housing to meet a basic energy efficiency standard.

The programme was adopted by the city council in 2010, and all licensed rental properties were required to comply by December 2018. By June 2018, 97% of the city's 23,000 rental buildings had been evaluated and 96% were certified as meeting this required standard.

Of the evaluated buildings, half were compliant at baseline, 32% were compliant following upgrades and 'quick installs' (such as upgraded lightbulbs or programmable thermostats), and 17% were compliant by exemption.[16] In January 2019, all non-compliant rental properties' licenses expired and the buildings can no longer be rented.[17]

Scale-up building retrofits by developing ready-made or 'turn-key' solutions

The main challenges for building owners, managers and occupants to do building retrofits are:

- accessing capital to pay the upfront cost.
- the disturbance to occupants.
- a lack of knowledge about how to upgrade an existing building.

Cities should implement supportive policies and programmes to help overcome these issues. In addition, cities can help to address all of these concerns by supporting standardised and ready-made solutions. These 'turn-key' models typically use prefabricated (factory-made) components that are produced in large volumes in off-site. They enable low-cost and mass retrofit services of consistently high quality.

Ready-made services make building energy efficiency retrofits an attractive proposition for building owners, managers and tenants because they:

- minimise disturbance and hassle.
- remove the need for specialist knowledge.
- can be self-financing, as the cost can be paid back with long-term energy savings.
- give public and private investors return-on-investment confidence, and reduce their transaction costs.

The Energiesprong programme is a successful example (see box below). Energiesprong began in the Netherlands and is already being implemented in the United Kingdom, France, Germany, and Canada. The RetrofitNY programme, in New York is also based on the Energiesprong model.

Net Zero Energy housing

Energiesprong

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The Netherlands' ready-made retrofit solution: Energiesprong

The Energiesprong mission is to make nearly zero energy retrofit (NZER) a market reality on a grand scale. It began when a partnership of social housing associations invited the private sector to develop fully integrated and whole-house refurbishment solutions for net zero energy retrofitting of their own residential buildings. Solutions were required to deliver:

- Scale: delivered at very high volumes.
- Speed: construction completed in two weeks or less, and on-site implementation in under a week.
- Self-financing: they could be paid for via energy savings.
- Desirability: they must be attractive and desirable, so that resident want to participate.

Most solutions offered by developers use prefabricated elements and include detailed assessment and preparation. Retrofits typically include building facades, smart heating and cooling installations, and insulated rooftops equipped with solar panels. They often also include upgrades to bathrooms, kitchens and windows.

The upfront cost of the upgrade is repaid through an 'energy plan' contract with the social housing corporation that replaces tenants' monthly energy bill to the utility company. This financial model, together with a long-term performance guarantee, makes the solution commercially financeable and scalable.[18]

More information and case studies of the policies discussed in this article can be found in:

- *Accelerating building efficiency: eight actions for urban leaders* (Chapter 5).
- *Urban efficiency: a global survey of building energy efficiency policies in cities*.
- *Urban efficiency II - seven innovative city programmes for existing building energy efficiency*.

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