The background of the entire page is a photograph of a modern building's facade. It features a grid of glass windows that reflect the sky and other buildings. Interspersed among the glass panels are vertical sections of orange-colored panels, some of which appear to be part of a larger architectural sculpture or facade element. The lighting suggests a bright, clear day.

ENERGY EFFICIENCY SERIES

**EFFICIENT BUILDING
ENVELOPES TO
REDUCE EMISSIONS**

Better building envelopes for better cities

The construction industry is an advantageous area of focus for cities' climate action plans, as the [sector produces nearly 40% of the world's direct and indirect greenhouse gas \(GHG\) emissions](#). A building's 'envelope' or exterior shell impacts the comfort and quality of the indoor environment as well as its overall energy consumption. City planners, architects, and engineers thus face the challenge of designing optimized building envelopes to decarbonize this sector.

Policy frameworks and the engagement of experts in the field are both important tools to encourage innovative solutions tailored to the needs, opportunities, and climate conditions of individual cities. Properly implemented, innovations to the efficiency of building envelopes promise significant economic savings, increased property values, and improved well-being for citizens. More efficient building envelopes are also crucial to help limit global temperature rise to 1.5°C and increase resiliency in OPCC cities.

Local policies, strategic goals, and programs

CODES AND CERTIFICATIONS

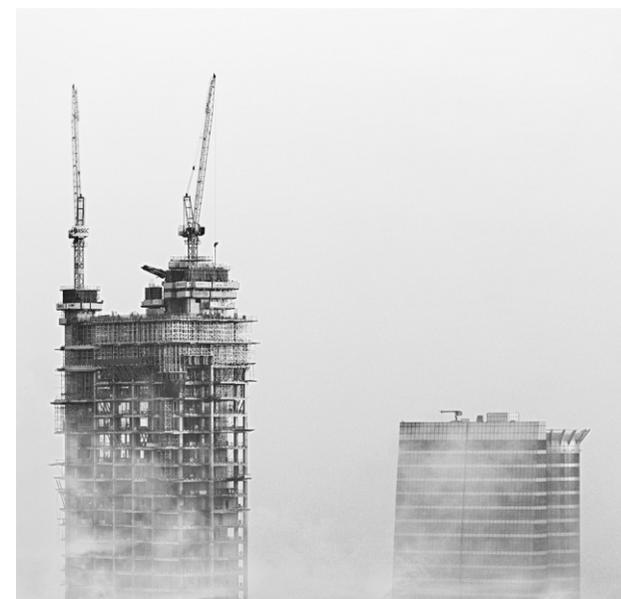
Stringent construction requirements and higher standards in building codes are a first step. For example, all new government buildings in [Zurich, Switzerland](#) must pursue a [Minergie-Eco](#) energy efficiency certification, while in [Durban, South Africa](#) new buildings need to set targets for energy consumption reductions.

INCENTIVES AND FINANCIAL MECHANISMS

Green leases can accelerate efficiency improvements of building envelopes by creating an agreement between landlords and tenants to work together to save money and implement investment actions. Landlords can pass part of the cost of efficiency investments on to tenants who achieve lower operating costs, while landlords enjoy return on investment from building upgrades. Tenants and landlord at [Cherry Street Plaza in Chardon, Ohio, the United States of America](#) share the utility savings of green lease improvements.

40%

of global greenhouse gas emissions are produced by the construction industry.





40,000

micro photovoltaic power plants will be installed in homes through 2020 in Seoul, Korea.

Passive design measures

IMPROVE INSULATION STANDARDS

Adequate insulation improves buildings' thermal regulation – it helps avoid extreme heat gains and losses. Because it achieves these outcomes in a passive manner, improving insulation reduces energy demand both for heating and cooling. In [Morelia, Mexico](#), airtight insulated envelopes ensure a comfortable indoor environment and reduce energy consumption in new city row houses.

LIMIT WINDOW-TO-WALL RATIO

Buildings with fully-glazed façades are HVAC dependent and tend to be highly exposed to solar radiation. Ideally window area should not exceed [30 per cent](#) of a wall façade. [Smart GHAR III](#) housing in [Rajkot, India](#), reduced glazing areas to prevent heat from entering the building.

INTRODUCE SOLAR SHADING

Shading is a passive and inexpensive way to reduce summer heat loads. Examples include vegetation with seasonal variation and envelope elements that reflect natural light.

OPTIMIZE NATURAL VENTILATION

Façade design allows natural ventilation at night to cool the building and reduce peak daytime temperatures in summer. The [Deutsch Schule in Madrid, Spain](#), uses efficient shading and cooling for the building's thermal mass via air flushing around the envelope at night.

IMPLEMENT GREEN ROOFS

Roofs are buildings' main receivers of solar radiation and heat, thus cooling them off is an effective and low-cost envelope strategy. In [New York City, the United States of America](#), the [NYC CoolRoofs](#) initiative applies reflective roof coatings at no or low cost to owners and residents on eligible non-profit and affordable housing buildings.

RENEWABLES IN DESIGN

Photovoltaic (PV) panels and solar collectors can be integrated in the envelope design to produce energy and reduce peak consumption in buildings. In [Seoul, Korea](#), the [Sunlight City project](#) installed photovoltaic panels on about 10,000 buildings increasing the city's renewables capacity to 320 MW with plans to add as many as 40,000 micro PV power plants in homes during the course of 2020.

CASE STUDY RAJKOT, INDIA

The Indo-Swiss Building Energy Efficiency Project (BEEP) developed a green affordable housing project called [Smart GHAR III](#) in **Rajkot, India**. A workshop during the early design phase led to features that reduce peak summer temperatures up to 5°C. Innovations include insulation of the building envelope, external movable shades on windows to reflect heat while letting natural daylight through, and natural ventilation assisted by a fan on top of the central air shaft between flats.

5⁰ Celsius

reduction in peak summer temperatures from features created in the Smart GHAR III project in Rajkot, India.

