Could solar energy help cut high-rise emissions?

By Matthew Stone, NextGen Nano

Huge areas of glass make skyscrapers look impressive, but mean they consume much more energy than other buildings and are responsible for high levels of carbon emissions. Incorporating novel organic solar cells in their design could help.

The skylines of big cities like New York, London and so many others around the world have been shaped by skyscrapers. Despite their aesthetic beauty, these high-rise buildings typically draw their power from the traditional carbon fuel grid and are therefore contributing to ever-increasing carbon emissions and air pollution in major metropolises.

According to the United Nations, the world's urban population will rise from 3.6 billion to 6.3 billion between now and 2050. As more people decide to live in big cities instead of small, rural villages, skyscrapers are not only the symbol of modern cities but are a necessity in order to provide enough space for both living and business purposes.

Since skyscrapers include offices and apartments and need to accommodate a vast number of people, they require more energy than small houses. One study shows that electricity used per square meter of floor area is nearly two and a half times greater in high-rise office buildings than in low ones. The same research shows that the gas consumed for the heating in skyscrapers is 40 percent higher than in normal buildings and total carbon emissions are twice as high.

The problem with glass skyscrapers is related to heat leaks in cold weather, and extreme high temperatures in the summer which increase the need for air conditioning as people are not allowed to open windows. By using air conditioning constantly, carbon emissions from offices are currently 60 percent higher than offices that use natural ventilation.

To reduce carbon emissions and provide enough energy to skyscrapers, one of the best solutions would be to install building-integrated photovoltaics (BIPVs). At the moment, there are four main types of BIPV products: crystalline silicon solar panels for ground-based and rooftop power plants; amorphous crystalline silicon thin-film solar PV modules; copper

indium gallium selenide (CIGS)-based thin-film cells on flexible modules (laminated either to the building envelope element or mounted directly onto the building envelope substrate); and finally double glass solar panels with inside square cells.

Current solar panels use PV cells to generate electricity without requiring carbon fuels or other materials that can produce air pollution. However, there is no guarantee that the panel itself has been produced using environmentally friendly materials, unless it consists of organic PV (OPV) cells.

The challenge in realizing truly green BIPVs is that higher power efficiencies are required to make building-integrated solar practical. OPVs have typically offered lower efficiencies than conventional PVs, but research continues to pave the way for more efficient designs.

At Nextgen Nano, we're working on one solution in the shape of transparent, flexible organic solar cells based on advanced nanotechnology that will support the drive for decentralised energy generation and power consumption. OPVs have the potential to significantly improve the efficiency currently achieved by third-generation solar technologies, and our PolyPower division is exploring the use of Earth-friendly organic materials that can provide a lightweight, flexible, and affordable approach. The results show these have the potential to be applied as a semi-transparent thin layer to the surface of a skyscraper and its windows that would provide power for lighting and temperature control.

Investing in nanotechnologies for solar panels will make it is possible to move forward in the sustainability mission by reducing air pollution in big cities exponentially. OPV cells applied to the glasses of skyscrapers can ensure that as well as being aesthetically attractive they are sustainably and sufficiently powered. Most importantly, aggressive investment in these technologies now can contribute to reducing carbon emissions well ahead of 2050 — allowing us a much-needed breath of fresh air in cities like London and New York.

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