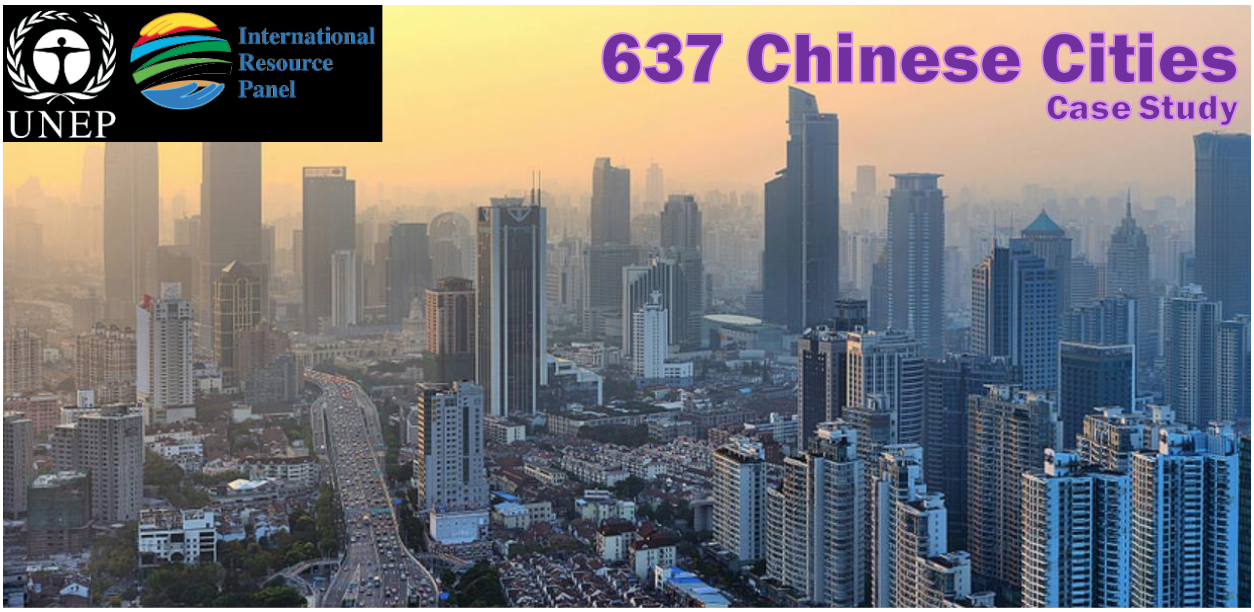


TOWARDS ZERO-POLLUTION CITIES

Circular economy strategies in rapidly industrializing urban areas

Overview

Air pollution is a global killer and predominantly an urban one, responsible for about 7 million premature deaths worldwide each year. Air pollution by particulate matter (PM) in cities can be reduced through system-based approaches focusing on better use of natural resources and better design of urban infrastructures and industries. This case study applies a systems approach to demonstrate the potential economic benefits, resource-savings, reductions in greenhouse gases (GHG) and PM emissions, air quality improvements and associated health co-benefits achievable by implementing key circular economy strategies in all 637 cities in mainland China.

The circular economy strategies focus on material and energy exchange across urban infrastructure and industries, also known as urban-industrial symbiosis. Such strategies are broadly relevant to China and other rapidly urbanizing and industrializing world regions, such as Asia and Africa where future urbanization and industrialization are expected to occur together. China is now the world's largest user of fossil fuels globally, and about 80% of fossil fuel use in China occurs in the industry sector, creating a source of unused waste heat that can displace fossil fuel use in individual stoves and boilers in homes/businesses (which are difficult to regulate and are large contributors of PM pollution). Material use in cement, steel and construction sectors is also high resulting in resource depletion and air pollution. The material footprint of Asian cities, such as Singapore, Tianjin, Xiamen and Shanghai shows the construction sector contributes more than 40% of all material usage on a life cycle basis in final consumption in cities. Reducing demand for new construction materials through material exchange and reuse can reduce resource use and pollution associated with producing these materials. This case study models energy-, resource- and monetary-savings, as well as health and carbon co-benefits of applying key circular economy strategies beyond current practice in all 637 cities of China.

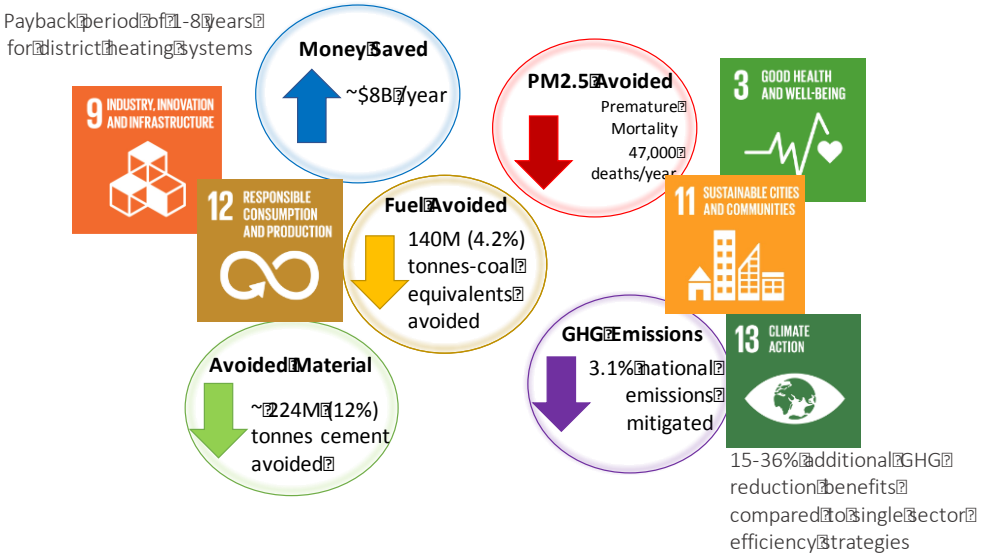
Key Cross-Sector Circular Economy Strategies

Key cross-sector circular economy strategies examined in the case study are noted below:

- Infrastructure design in new cities incorporates high-rise buildings with shared heating-cooling systems that reutilize industrial waste heat in urban district energy systems.
    a. High-grade industrial waste heat is reused for electricity generation.
    b. Medium-grade industrial waste heat is reused in conventional urban district energy systems using steam and hot water, and in other nearby industries co-located in eco-industrial parks.
    c. Low-grade waste heat, not readily reused in industries, is used in advanced 4th generation district energy systems to cost effectively heat/cool buildings.
- Beneficial exchange and reuse of materials occurs across energy and construction sectors focusing on two key material exchanges:
    a. Reuse of fly ash from power plants in lieu of cement (beyond current reuse levels) in the construction sector.
    b. Reutilization of steel slag in a new technology that enables both heat recovery and material substitution of cement.

Co-Benefits of Cross-Sector Efficiencies Achievable in Chinese Cities

These key cross-sectoral material and energy exchange strategies are found to generate significant co-benefits. These co-benefits are compared to the impact of single sector efficiencies (buildings, industries and power plants) noted in China's five-year plan, where cross-sectoral material and energy savings are computed beyond existing levels of implementation in China. Multiple SDGs are benefited with significant economic savings as seen below.



Enabling policies: Eco-industrial parks, urban planning with dense city centers and district energy, along with credits for resource reuse help promote circular economy strategies in China.

The full report can be downloaded at:
http://www.resourcepanel.org/reports/assessing-global-resource-use