Sino-German Urbanisation Partnership

Feasibility of positive energy districts in China – research report by the China Academy of Building Research (CABR)

CITIES AND INFRASTRUCTURE TRANSITION

Introduction

China is aiming to achieve climate neutrality by 2060. President Xi Jinping announced this ambitious target at the United Nations General Assembly in September 2020. One of the areas that the country is focusing on as a means of achieving this target is the sustainable transformation of the building sector, in particular promoting energy efficiency in buildings and integrating renewable energy into the construction industry.

The China Academy of Building Research (CABR), a research institute subordinate to China's Ministry of Construction, is investigating the feasibility of positive energy districts in cooperation with the Deutsche Energie-Agentur (German Energy Agency – dena). CABR's research project on positive energy districts began in December 2019 and is expected to be completed in March 2021.

A positive energy building or district (other terms include plus energy or energy-plus) is a building or urban district that generates more energy than it requires for its own needs. The basic premise in such cases is that the energy is obtained from renewable sources.

Research goals

The aim of the research report is to encourage Sino-German cooperation and the exchange of knowledge relating to positive energy districts. As part of this, the results of the Chinese research will be complemented by experience gained in Germany. Innovative technologies and German support schemes and legislation will provide the foundation for further research activities in pilot projects in China.

Research agenda

- Investigation of the technical system for positive energy buildings and districts and exploration of possible technical solutions and cost-effectiveness in China
- Examination of various climate zones and building types (focus on office buildings)
- Analysis of various standards for positive energy districts (positive energy building, zero energy building, nearly zero energy building) and of the principal technical requirements applying to micro energy grids (microgrids) for positive energy districts

Methodology of the research project

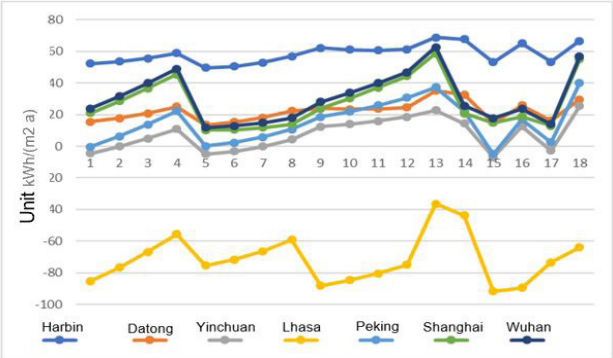
1. Research establishing the current development status of positive energy districts in China and across the world
2. Identification of case studies
3. Analysis of load and energy consumption in buildings
4. Identification of generation-related features and suitability analysis of positive energy buildings
5. Drafting of technology pathways and economic analysis of optimum energy generation
6. Analysis of energy generation, storage and distribution in a positive energy district

Research findings

CABR focused on photovoltaics (PV) as the source of renewable energy in positive energy districts and investigated this in seven Chinese cities and 18 scenario simulations with different

Cities	Zones with solar resources	Climate zones	School buildings/ number of floors	Office buildings/ number of floors	Residential buildings/ number of floors
Harbin	3	severe cold	1	1	1
Datong	2	severe cold	2	2	2
Yinchuan	1	cold	3	2	2
Lhasa	1	cold	10	7	6
Peking	2	cold	3	2	2
Shanghai	3	hot summers and cold winters	3	3	2
Wuhan	4	hot summers and cold winters	3	3	2

uses of the available space. It identified the maximum number of storeys in positive energy buildings with PV in various climate zones.



It also analysed the amount of electricity required per square meter and year in seven Chinese cities, measured as kWh/(m2a).

Two of CABR's findings to emerge in the course of the investigation were that the positive energy district in Harbin had the highest total energy consumption, with demand at 50-69 kWh/(m2a), while the lowest demand was measured in Datong at 14-35 kWh/(m2a). The district in Lhasa produced an energy surplus in all 18 scenarios.

Package of measures

When it examined CABR's research findings, dena identified an additional need for analysis of the energy infrastructure of positive energy districts. Accordingly, it drew up a package of measures for the presentation and selection of suitable technologies that are used in Germany. The package includes recommendations on areas of application, the energy-saving potential of absorption and compression cooling, solar electric cooling, and geothermal and ambient heat.

Political instruments in Germany and recommendations for China

The report also includes an overview of the regulatory framework in Germany and of market incentive programmes and financial subsidies for KfW Efficiency Houses, renewable energy etc., and uses this as a basis for making recommendations for China. These include:

• Introducing market incentive systems for renewable energy technologies, pilot project support schemes and political regulatory measures

• Setting up information points for owners and property developers (advice centres, hotlines, online portals)

• Founding an alliance to build capacity and issue awards for outstanding examples of positive energy buildings and districts

Summary and outlook

• The research is intended to help develop an understanding of the market and increase the acceptance of positive energy buildings in China, and to instigate a technology pathway for demonstration projects.

• The combination of different technologies is particularly relevant to the implementation of positive energy pilot projects.

• Efforts should be made to advance and promote the development of an industry chain for energy-efficient building components and renewable energy systems.

• There is need for more knowledge-sharing platforms such as industry conferences and forums in Sino-German cooperation on positive energy districts. Positive energy pilot projects should also be selected and developed jointly.

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